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ANNUAL FISH POPULATION AND ANGLER USE, HARVEST AND PREFERENCE SURVEYS ON LAKE OAHE, SOUTH DAKOTA 2005

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ANNUAL FISH POPULATION
AND
ANGLER USE, HARVEST AND PREFERENCE SURVEYS
ON
LAKE OAHE, SOUTH DAKOTA, 2005

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PREFACE

Information collected during 2005 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, Kit Bramblee, Robert Hanten, Harrold Hoffman, Walt Hohle, Dan Jost, Jason Jungwirth, Joseph Kean, Darla Kusser, Karli Larsen, Jared Lorensen, Brad Richards, Joe Riis, Jim Riis, Justin Sarvis, Sylvester Schied, Robert Schunot, Jason Sorensen, and Jason Stahl.

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EXECUTIVE SUMMARY

This report includes results of angler use and harvest and fish population surveys conducted during 2005 on Lake Oahe, SD and references information collected during previous years. Discussion focuses on species that may be important from a sport perspective or as prey.

Species composition in coolwater survey gill net catches in 2005 was similar to 2004, with 21 species sampled both years. The proportion of the annual gill net catch comprised of white bass decreased from over 20% in 2004 to less than 2% in 2005. Channel catfish and walleye were the most abundant species in gill net catches in 2005, with mean catch-per-unit-effort (CPUE) values of 20.5 and 18.2 fish/net-night, respectively.

Age-0 gizzard shad CPUE in the standard seining survey decreased from 500 fish/haul in 2004 to 84 fish/haul in 2005. 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.

Walleye CPUE in the standard gill net survey was significantly higher in upper Oahe than in middle and lower Oahe during 2005. Walleye gill net CPUE, for the entire reservoir in 2005, was similar to other years in the 2000-2005 period and significantly lower than for 1997 to 1999.

Walleye proportional stock density (PSD) for the total Oahe sample in 2005, at 70, exceeded the desired range of 30-60, signifying a lack of recruitment. However, lower Oahe, with a PSD value of 97 for 2005, is the main area of the reservoir where recruitment is lacking. The lack of recruitment in lower Oahe resulted in only 4% of walleye in the 2005 gill net sample being less than 380-mm TL. The relative stock density of preferred-length walleye (RSD-P) for the total Oahe gill net sample in 2005, at six, was below the Lake Oahe Strategic Plan (LOSP) objective of 10. While the objective was attained for lower Lake Oahe in 2005, the RSD-P objective for the entire lake has not been met since 1997.

Mean length at capture, for age-2 through age-4 walleye in 2005, was higher than for the 2002-2004 surveys. Incremental growth of walleye has increased for younger, smaller walleye, from the 2002-2003 growth period to the 2004-2005 period. However, by an initial length of 450 mm TL at the beginning of the growth period, no difference in growth added existed among the three growth periods for which incremental growth was documented.

Walleye production in 2005 appeared to be low, based on an age-0 CPUE of 0.3 fish/net-night. Approximately 53% of walleye captured during the 2005 gill net survey were from the 2001 and 2002 year classes.

Estimated fishing pressure for the South Dakota portion of Lake Oahe in 2005, at 460,334 h, was the lowest estimated for all years in which surveys have been conducted. Approximately 69% of the estimated fishing pressure during the 2005 April-October survey period occurred during June and July. Angling pressure was the highest in the middle zone of Oahe in 2005 at 52% of the total for the reservoir, followed by the upper and lower zones at 25% and 23%, respectively.

Of the estimated 210,953 fish harvested from Oahe in 2005, 164,428 (78%) were walleye, similar to 2004. The estimated walleye harvest during June and July 2005, at 142,986 fish, comprised 87% of the total walleye harvest during the April-October 2005 period.

Approximately 21% of angling parties averaged four or more walleye harvested per angler in 2005. However, only 7% of angling parties during both 2004 and 2005 harvested a daily limit of six walleye per angler. For the April-October 2005 daytime period, the Lake Oahe fishery had a direct economic impact of 5.3 million dollars based on a value of $61.00 per trip. The LOSP objective of at least 70% of angling parties expressing some degree of satisfaction was last met in 2000, though the 2005 value of 62% is approaching that objective.

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ANNUAL FISH POPULATION AND ANGLER USE, HARVEST AND PREFERENCE SURVEYS ON LAKE OAHE, SOUTH DAKOTA, 2004

INTRODUCTION

Lake Oahe is an extremely important fisheries resource for the State of South Dakota, annually supporting between 110,000 and 339,000 angler trips during the 1991-2004 period (Lott et al. 2006). The Lake Oahe fishery had an estimated direct economic input of over $25 million for the April-October 1998 daylight period, based on information provided by the United States Census Bureau (1998). Approximately 132,726 trips occurred during the April-October 2004 daylight period on Lake Oahe (Lott et al. 2006), for an estimated economic input of $8.1 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.

MANAGEMENT OBJECTIVES

Reservoir-wide Objectives

- Maintain the annual number of angler days within 25% of the past five-year average with a 70% angler trip satisfaction rating.
- Provide 1,000,000 angling hours of fishing recreation
- Continually work to preserve or enhance and protect the existing fish community structure, diversity and aquatic habitats of Lake Oahe.
- Annually conduct information and education efforts to disseminate information and document user input

Species Specific Objectives

<u>Walleye</u>

- Maintain a walleye population that can annually support a harvest of 250,000 walleye, one million angler hours of pressure and a walleye harvest rate of 0.25 fish/angler-h.
- Maintain a lake survey walleye gill net CPUE within 25% of the five-year average.
- Maintain a balanced walleye population with a gill net PSD between 40 and 60 and RSD-P of at least 10.

SAMPLING STRATEGIES

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:	2.9×10^3 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 $\leq 15^{o}$C in August.

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.

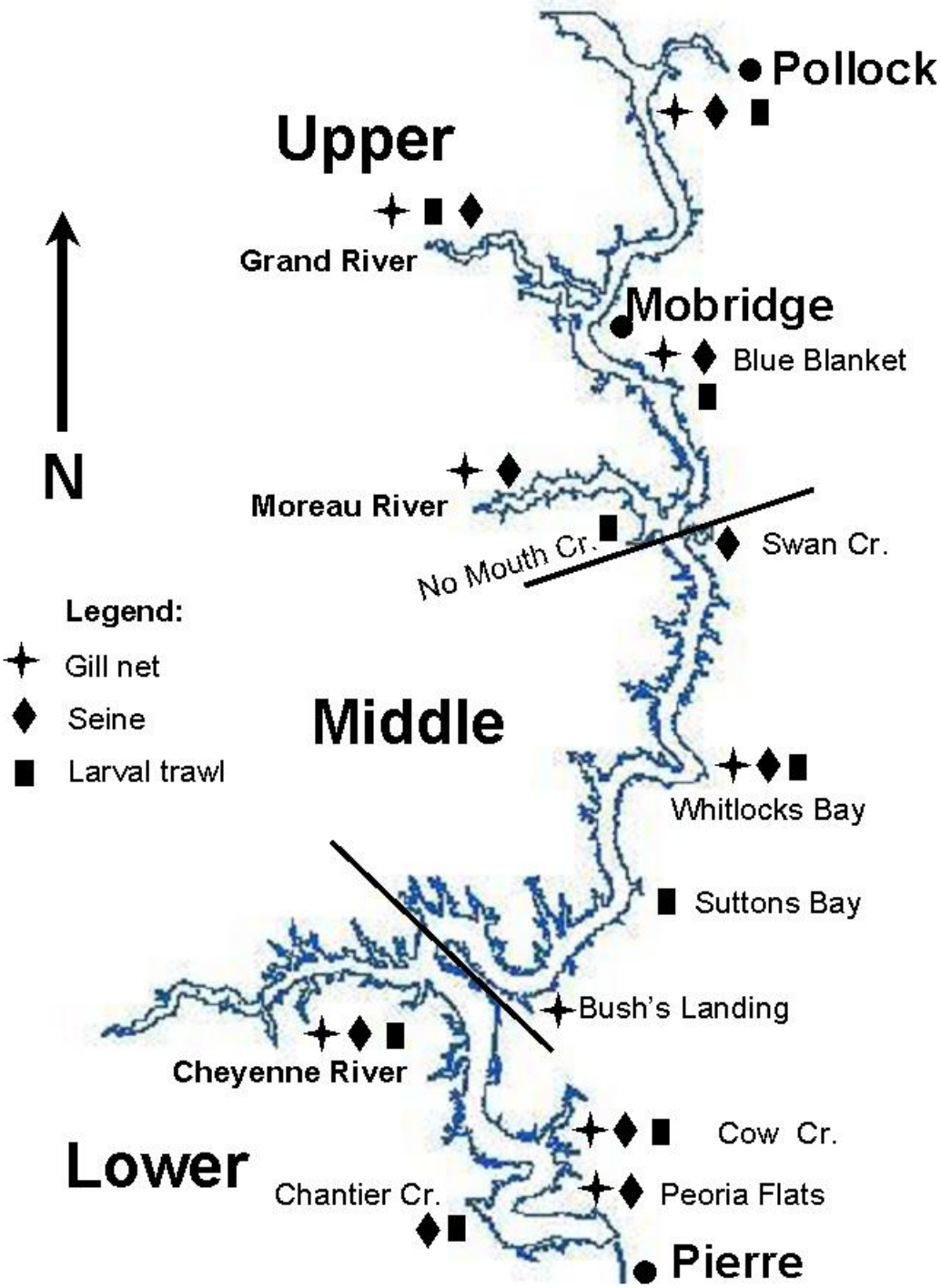

Figure 1. Reservoir zones for fish population and angler use and harvest surveys on Lake Oahe, South Dakota, for 2005. Specific fish population sampling stations are also listed.

Table 2. History of harvest regulations for walleye on Lake Oahe, South Dakota, 1968 through 2005.

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

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, 2006).

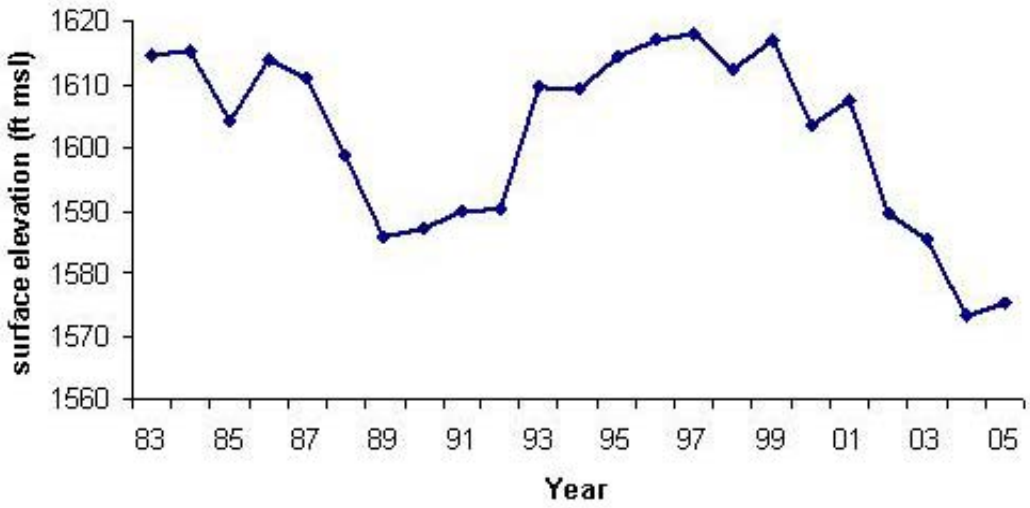

Figure 2. Average August elevation of Lake Oahe for the 1983-2005 period, as determined by the U.S. Army Corps of Engineers.

SAMPLING METHODS

FISH POPULATION SURVEYS

Data Collection

Gill nets, seines, and larval trawls were used to sample fish populations in Lake Oahe in 2005. 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

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), 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 2002 because of concerns about the decreasing efficiency of seining at Peoria Flats, in association with low water levels (Figure 2).

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 2005. Pollock was not sampled in 2005 due to low water conditions. All samples were preserved in 10% formalin and later identified and enumerated. Mean densities from peak sampling times for important prey fish species were reported expressed as mean number per 100 cubic meters.

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. . Length and CPUE data were $\log_{10}$ N+1 transformed prior to analyses to better meet the assumption of normality. 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 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.

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, 2005 through October 31, 2005, 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 2005. Besides asking anglers how satisfied they were with their fishing trip, considering all factors, anglers were asked if they were on a guided trip. A complete list of satisfaction, attitude and preference questions asked in association with the 2005 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 95% 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 1575.3 FT MSL in 2005. The corresponding decreases in surface area and volume of Lake Oahe from 2000 to 2005 were approximately 37,018 ha and 8,549,517,195 m^3, respectively. Percent decreases in surface area and volume were approximately 31% and 39%, 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 34% and 30% of the fish caught in the 2005 coolwater gill net survey, respectively (Table 5), while gizzard shad was third in terms of percent of total catch, at 18%. Species composition in coolwater survey gill net catches in 2005 was similar to 2004, with 21 species being sampled both years. Burbot were collected in the survey in 2004 but not 2005, while lake herring were collected in 2005 but not 2004 (Table 6). The proportion of the annual gill net catch comprised of white bass and white bass CPUE in the coolwater gill net survey decreased significantly during the 2001-2005 period (Table 5 and Table 6). White bass went from comprising over 20% of gill net catches in 2001 to less than 2% in 2005.
Channel catfish and walleye were the most abundant species in gill net catches, with mean CPUE values of 20.5 and 18.2 fish/net-night, respectively.

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 2001 through 2005. Trace (T) for values < 0.5 %.

Species	Year				
	2001	2002	2003	2004	2005
Channel catfish	32.0	37.3	35.1	41.8	33.5
Walleye	28.8	35.8	31.0	32.1	29.9
Gizzard shad	1.9	T	3.7	5.5	18.0
Freshwater drum	2.5	2.0	3.5	4.2	3.6
River carpsucker	2.5	2.5	2.9	3.4	3.5
Yellow perch	2.8	4.3	5.5	3.3	2.9
Common carp	1.9	2.1	2.4	2.4	2.3
Goldeye	2.5	2.1	4.7	2.3	2.2
White bass	20.6	6.0	6.7	1.7	0.7
*Others	4.5	7.7	4.4	3.4	3.6

*Others includes bigmouth buffalo, burbot, black bullhead, Chinook salmon, lake herring, northern pike, rainbow smelt, sauger, shorthead redhorse, shortnose gar, shovelnose sturgeon, smallmouth bass, smallmouth buffalo, spottail shiner, white crappie, and white sucker.

Channel catfish CPUE, for the 2001-2005 period, was similar among years. Other species commonly captured in gill nets in 2005 included gizzard shad, freshwater drum, river carpsucker, yellow perch, common carp, and goldeye, listed in order of decreasing mean CPUE (Table 6). Mean CPUE for all species collected in 2005 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, 1996, 1997, Lott et al. 2000, 2004, 2006).

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, 2001-2005. Trace (T) indicates values less that 0.05.

Species	Year									
	2001		2002		2003		2004		2005	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Bigmouth buffalo	T	T	0.1	T	0.1	0.1	0.2	0.1	0.1	0.1
Burbot	0.0	---	0.0	---	0.0	---	T	T	0.0	---
Black bullhead	0.0	---	0.0	---	T	---	0.1	0.1	T	---
Channel catfish	16.5	1.5	19.1	2.3	15.6	1.4	20.7	1.7	20.5	1.8
Chinook salmon	T	T	0.0	---	0.0	---	0.0	---	0.0	---
Common carp	1.0	0.2	1.1	0.2	1.1	0.2	1.2	0.2	1.4	0.2
Freshwater drum	1.3	0.3	1.0	0.2	1.6	0.3	2.1	0.3	2.2	0.5
Gizzard shad	1.0	0.8	0.2	0.1	1.6	0.5	1.7	0.6	11.0	2.5
Goldeye	1.3	0.3	1.1	0.5	2.1	0.5	0.9	0.2	1.3	0.3
Lake herring	0.0	---	0.1	T	0.0	---	0.0	---	0.1	0.1
Northern pike	0.1	T	0.2	0.1	0.2	0.1	0.1	T	T	---
Rainbow smelt	0.1	0.1	0.1	0.1	T	---	T	T	T	---
River carpsucker	1.3	0.4	1.3	0.3	1.3	0.2	1.1	0.2	2.1	0.6
Sauger	0.1	0.1	0.2	0.1	0.1	T	0.3	0.1	0.3	0.1
Shorthead redhorse	0.5	0.2	1.7	0.5	0.7	0.2	0.4	0.1	0.3	0.1
Shortnose gar	0.0	---	0.1	0.1	T	---	0.1	T	T	---
Shovelnose sturgeon	T	T	T	T	0.0	---	0.0	---	0.0	---
Smallmouth bass	0.4	0.2T	0.5	0.1	0.3	0.1	0.1	T	0.9	0.4
Smallmouth buffalo	0.2	0.1	0.2	0.1	0.1	T	T	T	0.1	---
Spottail shiner	0.1	T	0.2	0.1	0.1	0.1	0.2	0.1	0.1	---
Walleye	14.9	2.0	18.3	2.4	13.8	1.5	15.9	1.5	18.2	2.1
White bass	10.6	2.3	3.1	0.7	3.0	0.8	1.6	0.3	0.4	0.1
White crappie	0.6	0.3	0.2	0.1	0.1	T	0.1	0.1	0.1	0.1
White sucker	0.1	0.1	0.4	0.1	T	---	0.1	T	T	--
Yellow perch	1.4	0.3	2.2	0.5	2.4	0.7	2.7	0.7	1.7	0.4

However, age-0 gizzard shad CPUE decreased from 2004 to 2005. 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 2005 seining survey included emerald shiners, freshwater drum, river carpsucker, white bass, and yellow perch, 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									
	2001		2002		2003		2004		2005	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Bigmouth buffalo	0.1	0.1	0.0	---	0.0	---	0.0	---	0.0	---
Black crappie	0.0	---	0.1	0.1	0.0	---	0.0	---	0.0	---
Bluntnose minnow	0.0	---	0.0	---	0.0	---	1.1	0.7	0.0	---
Brassy minnow*	0.3	0.2	0.0	---	0.0	---	0.5	0.3	T	T
Channel catfish	T	T	0.1	0.1	0.1	T	0.1	0.1	2.0	1.2
Common carp	2.1	0.9	1.9	1.9	0.1	T	0.0	--	1.6	0.6
Emerald shiner*	83.3	47.1	50.0	20.8	35.0	3.6	43.8	22.1	23.3	15.3
Fathead minnow*	0.7	0.5	0.0	---	1.2	0.3	0.0	---	0.2	0.1
Flathead chub	0.0	---	0.1	0.1	0.0	---	0.0	---	0.0	---
Freshwater drum	1.6	0.9	21.6	14.1	2.9	0.5	2.7	1.0	5.1	1.4
Gizzard shad	2.9	2.9	46.2	27.3	322.2	41.1	500.0	173.0	83.8	33.6
Golden shiner	0.1	0.1	0.0	---	0.0	---	0.0	---	0.0	---
Goldeye	0.0	---	0.0	---	T	T	0.3	0.2	1.0	0.9
Johnny darter*	0.4	0.3	0.1	T	0.5	0.1	0.3	0.1	0.1	T
Lake herring	1.2	0.8	0.0	---	0.0	---	0.1	T	0.0	---
Largemouth bass	0.7	0.5	0.0	---	0.0	---	0.0	---	0.0	---
River carpsucker	1.1	0.7	0.1	0.1	0.2	T	0.2	0.2	4.2	3.0
Shorthead redhorse	0.1	0.1	0.0	---	0.1	T	0.0	---	0.0	---
Silvery minnow	0.2	0.2	2.1	1.9	0.0	---	0.0	---	0.0	---
Smallmouth bass	3.9	1.6	0.9	0.3	0.2	T	1.6	0.7	2.7	0.6
Spottail shiner*	15.2	7.9	14.5	5.9	24.5	2.5	9.3	4.2	1.8	0.6
Walleye	0.2	0.1	T	T	0.1	T	0.2	0.1	0.2	0.2
White bass	66.4	38.9	21.0	7.3	46.3	7.9	15.2	5.1	4.1	0.9
White crappie	0.6	0.3	0.1	0.1	0.1	T	T	T	0.0	---
White sucker	1.4	0.7	0.0	---	0.5	0.1	0.1	T	0.1	0.1
Yellow perch	37.4	22.8	0.5	0.3	4.2	0.8	1.4	0.7	2.1	0.9

* Includes all ages.

Northern pike, red shiner, smallmouth buffalo, and suckermouth minnow, though previously collected in the standard seining survey, were absent in seine catches during all years in the 2001-2005 period.

Population Parameters for Walleye

Walleye CPUE in the standard gill net survey was significantly higher in upper Lake Oahe than in middle and lower Lake Oahe during 2005 (Table 8). The only year during the 1997-2004 period when this was not the case was 2003, when CPUE for upper and middle Lake Oahe were similar.

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, 1997-2005. 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	25.2
1998	23.4a	19.3a	21.1a	20.3
1999	17.4a	17.9a	29.3b	21.4
2000	13.1a	17.6a	27.4b	19.3
2001	8.9a	9.1a	26.6b	14.8
2002	9.7a	12.5a	32.8b	18.3
2003	9.7a	16.6b	14.9b	13.8
2004	11.7a	11.7a	24.2b	15.9
2005	12.5a	15.9a	26.3b	18.2

Walleye gill net CPUE for the entire reservoir in 2005 was similar to other years in the 2000-2005 period and significantly lower than from 1997 to 1999 (Table 9). While overall CPUE of walleye has been similar the last six years, differences in CPUE of the various incremental length groups exist. Substock walleye CPUE was significantly lower in 2004 and 2005 than during any year from 1997-2003, while CPUE of quality-to-preferred walleye, in 2005, was significantly higher than any year in the 1997-2004 period (Table 9).

Walleye population size structure, as quantified with stock density indices, differed significantly among years in the 1997-2005 period (Table 10). Proportional stock density values for all zones of Lake Oahe increased from 2004 to 2005, while RSD-P values only increased for lower and upper Oahe (Table 10). Higher PSD and RSD-P values for lower Lake Oahe than the other two zones is partially related to lower recruitment in that zone (Lott et al. 2006). Walleye PSD for the total Oahe sample in 2005, at 70, exceeded the desired range of 30-60, signifying a lack of recruitment (Anderson and Weithman 1978). However, lower Lake Oahe, with a PSD value of 97 for 2005, is the main area of the reservoir where recruitment is lacking, as the PSD values for middle and upper Oahe are near the upper end of the 30-60 range for balanced populations. The RSD-P value for the total Oahe gill net sample in 2005, at 6, was below the LOSP objective of ≥10, while the objective was attained for lower Lake Oahe (Table 10). The RSD-P objective for the entire lake has not been met 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 1997-2005, 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	12.1ab	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	9.9ad	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

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, 1997-2005

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

Walleye *Wr* values for the total Oahe sample were similar in 2004 and 2005 (Table 11). While *Wr* values differed significantly among some zones and length groups from 2004 to 2005, changes appear to be statistically significant but not biologically significant. The objective range for mean *Wr* values for Lake Oahe walleye is 90-100. 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, 1997-2005. 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	85ce	18	85e	150
2004	85bcdef	70	87ae	112	89ae	27	87ef	209
2005	81bef	7	90b	176	87ae	41	89a	224
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	81cd	129
2002	82ed	104	81bc	75	83ac	6	82d	185
2003	82ed	148	85c	69	79a	9	83e	226
2004	88ef	130	90d	55	84ac	4	89f	189
2005	86f	105	88d	108	82ab	6	87f	220
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	79d	217	78a	196	--	--	79d	413
2003	79d	132	75ce	70	68c	2	78de	204
2004	87c	325	85bd	78	82ab	3	87c	406
2005	88c	162	88f	286	84a	8	88f	456
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	78b	11	85e	675
2002	81c	382	80c	352	83abd	8	80f	742
2003	81ad	344	82d	207	82ab	29	82g	580
2004	87g	525	87e	245	88d	34	87h	804
2005	87g	274	88f	570	86d	55	88h	900

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 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 2002-2005 are presented in Table 12. Mean length at capture for age-2 through age-4 walleye, in 2005, was significantly higher than for the 2002-2004 surveys (Table 12). Higher mean lengths at age-2 through age-4 in 2005 may be a result of faster growth during 2004 and 2005, as indicated by higher condition (Wr) values during those years (Table 11).

Table 12. Mean length-at age time of capture (mm) for walleye collected in the standard August coolwater gill net survey, 2002-2005, 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	--
Mean of means		233	319	377	408	429	456	458	470	501	524	528	508

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 through age-5 walleye in the 2005 gill net survey was significantly higher for walleye collected from lower Oahe than walleye collected from upper Oahe (Table 13). Lengths of age-4 and age-8 walleye in the 2005 gill net sample, for fish in lower and middle Lake Oahe, were similar and significantly higher than lengths for these age groups in upper Lake Oahe.

Table 13. Mean length (TL; mm) at time of capture, by reservoir zone, for walleye collected in the coolwater gill net survey from 2003 through 2005, in Lake Oahe, South Dakota. N is sample size and SE is standard error.

Zone	Age	2003			2004			2005		
		Length	N	SE	Length	N	SE	Length	N	SE
Lower	**1**	244	27	2.8	281	13	4.5	--	--	--
	2	314	50	3.2	359	42	3.7	391	12	3.8
	3	389	14	8.5	401	71	3.8	438	21	3.8
	4	438	19	5.5	437	11	12.9	463	58	3.2
	5	446	7	10.9	484	13	6.7	493	10	11.7
	6	444	10	13.2	481	6	29.3	531	13	11.2
	7	485	13	11.0	477	10	12.1	478	5	8.9
	8	503	21	8.8	509	19	11.7	512	1	--
	9	579	3	40.6	521	14	16.8	511	2	45.5
	10	515	1	---	544	7	21.1	553	7	15.5
	11				605	2	24.5	520	1	--
	12									
	13									
	14	570	1	---						
Middle	**1**	226	30	3.5	232	22	5.8	224	68	2.5
	2	288	146	2.4	309	59	4.4	341	83	2.6
	3	389	17	7.0	367	90	2.5	403	44	3.4
	4	425	31	6.9	426	12	12.3	425	67	3.6
	5	438	9	14.1	461	5	10.6	445	1	--
	6	479	8	13.8	471	5	22.1	502	5	11.6
	7	458	11	14.4	478	6	17.2	544	3	53.1
	8	483	14	12.9	448	2	7.5	520	1	--
	9				484	7	13.7	500	4	19.2
	10				516	3	56.5	504	3	13.4
	11	573	1	---						
	12				580	1	---			
Upper	**1**	213	20	3.1	233	26	3.0	262	23	3.3
	2	263	99	2.2	296	43	4.0	348	90	3.0
	3	359	24	10.2	340	186	1.7	388	50	3.6
	4	381	37	5.6	389	34	5.8	415	274	2.2
	5	396	10	9.1	420	33	5.3	427	37	4.4
	6	435	10	16.1	447	4	29.6	470	25	11.3
	7	403	20	8.3	449	6	20.9	475	16	11.2
	8	411	34	7.3	431	7	10.6	476	3	19.5
	9	434	4	29.9	447	8	19.4	524	6	26.5
	10				488	4	18.6	516	15	17.7
	11							415	2	8.0
	12							435	1	--

Growth increments of walleye going from age 1 to age 2 and from age 2 to age 3 were higher during the 2003-2004 and 2004-2005 periods than during the 2002-2003 period (Table 14). Growth increments for

fish going from age 3 to age 4 were higher for the 2004-2005 period than for the 2002-2003 and 2003-2004 periods. It must be remembered though that an accurate assessment of changes in incremental growth among years must involve looking at new growth added as a function of initial length at the beginning of the growth period and this information is provided in Figure 3. As in Table 14, Figure 3 illustrates the fact that incremental growth of walleye has increased for younger, smaller walleye, from the 2002-2003 growth period to the 2004-2005 period. However, by an initial length of 450 mm TL at the beginning of the growth period, no difference in growth added exists among the three growth periods illustrated.

Relative weight generally has the highest correlation with growth rate during the period of the year of fastest growth (Anderson and Neumann 1996). Therefore, increases in walleye condition since 2002 may have resulted in increased incremental growth rates for age-1 and age-2 walleye but not for walleye longer than 450 mm. Relative weight values may need to be within the objective range of 90 to 100, for incremental growth of walleye longer than 450 mm to increase from levels documented for the 2002-2003 to 2004-2005 growth periods.

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, and 2004-2005 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

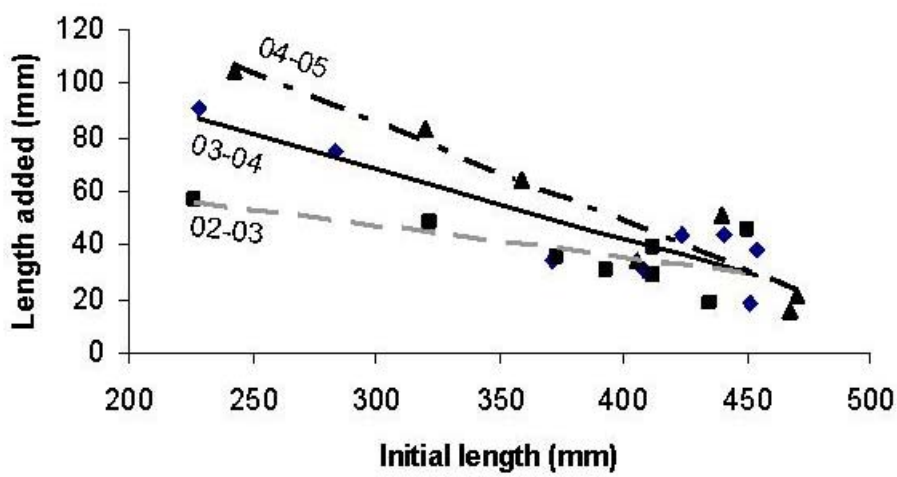

Figure 3. Mean length added by walleye in an age group during a growth period plotted against mean initial-length-at-age-values for the beginning of the growth period, for walleye collected from Lake Oahe, South Dakota during annual August gill net surveys. Trendlines for the 02-03, 03-04, and 04-05 growth periods are included.

Age frequency distributions in Table 15 illustrate the continued presence of year classes produced in 1995, 1996, 1999 and 2001 in the 2005 Lake Oahe walleye population. Walleye production in 2005 appears to be low, based on an age-0 CPUE of 0.3 fish/net-night (Table 15).

Approximately 53% of walleye captured during the 2005 gill net survey were from the 2001 and 2002 year classes.

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**

For Lake Oahe, CPUE of age-1 walleye in the standard coolwater gill net survey has been established as an index of recruitment (Lott et al. 2006). Definitions of low, medium, and high recruitment were based on mean age-1 gill net CPUE. Mean CPUE values of > 5 for age-1 fish

are considered “high“ recruitment, values between 2 and 5 are considered ”moderate” recruitment, and values < 2 are considered “low” recruitment.

With this in mind, high levels of walleye recruitment occurred from 1989 through 1991 and in 1994 and 1995 (Figure 4), while recruitment in 1996, 1997, 1999, and 2001 was moderate. The majority of preferred-length walleye in the 2005 population (Table 12) would have been produced during the period of moderate-to-high walleye recruitment from 1994 through 1997 (Table 15 and Figure 4). Walleye recruitment during the 2002-2004 period can be classified as low.

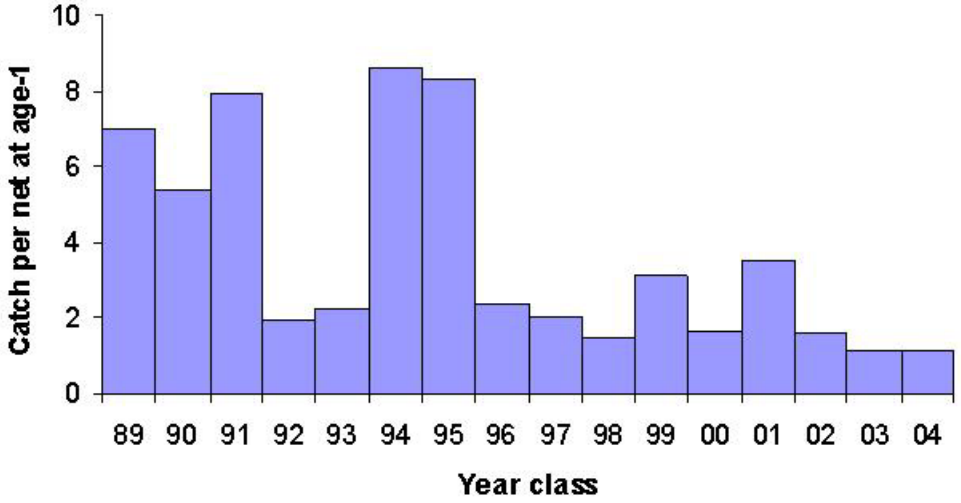

Figure 4. Mean catch per unit effort (CPUE; No./net-night) of age-1 walleye for the 1989-2004 standard coolwater gill net surveys conducted during August on Lake Oahe, South Dakota.

Walleye population CPUE by incremental length group is presented in Figure 5. 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 4) and growth has increased (Table 12; Lott et al. 2004a), resulting in higher PSD and RSD-P values since 2000 and 2003, respectively (Table 10).

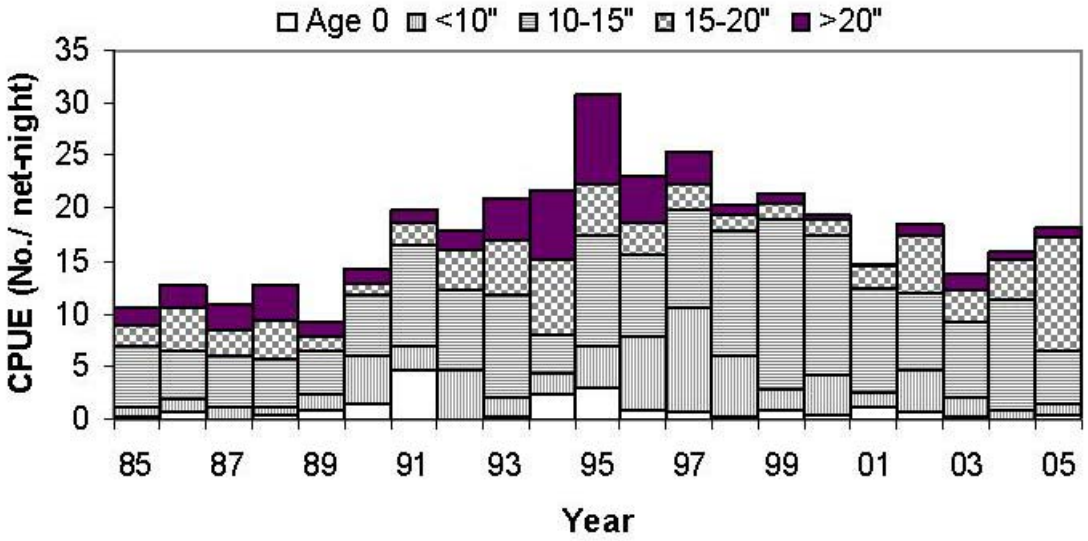

Figure 5. Length structure, in terms of catch per unit effort (CPUE), of Lake Oahe walleye sampled in the standard coolwater gill net survey, 1985-2005.

Length frequency distributions for gill net catches in 2005, in terms of CPUE, illustrate the current status of the Lake Oahe walleye population (Figure 6). The walleye abundance index (CPUE) increased from lower to upper Lake Oahe in 2005 and age-0 fish (fish < 180 mm TL) were absent from gill net samples in the lower zone of the reservoir. Low recruitment of the 2003 and 2004 year classes is evident from the lack of fish < 340 mm TL in lower and upper Lake Oahe. (Figure 6). 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). Peaks in length frequency distributions for upper and middle Lake Oahe, from approximately 380 mm to 420 mm TL, represent fish from the 2001 and 2002 year classes. The peak in the length frequency histogram for lower Lake Oahe, at 460 mm also represents fish from the 2001 year class, but these fish have experienced faster growth than fish of the same year class in middle and upper Oahe (Table 13).

Changes in walleye population structure for the 2002-2005 period are evident from examination of Figure 7 through Figure 10. During the 2002-2005 period, recruitment was higher in upper and middle Oahe than lower Oahe. The lack of recruitment in lower Oahe has resulted in only 4% of walleye in the 2005 gill net sample being less than 380-mm TL in length (Figure 8). For 2005, the walleye gill net sample from middle Oahe is the best balanced, with a PSD of 52 (Figure 9).

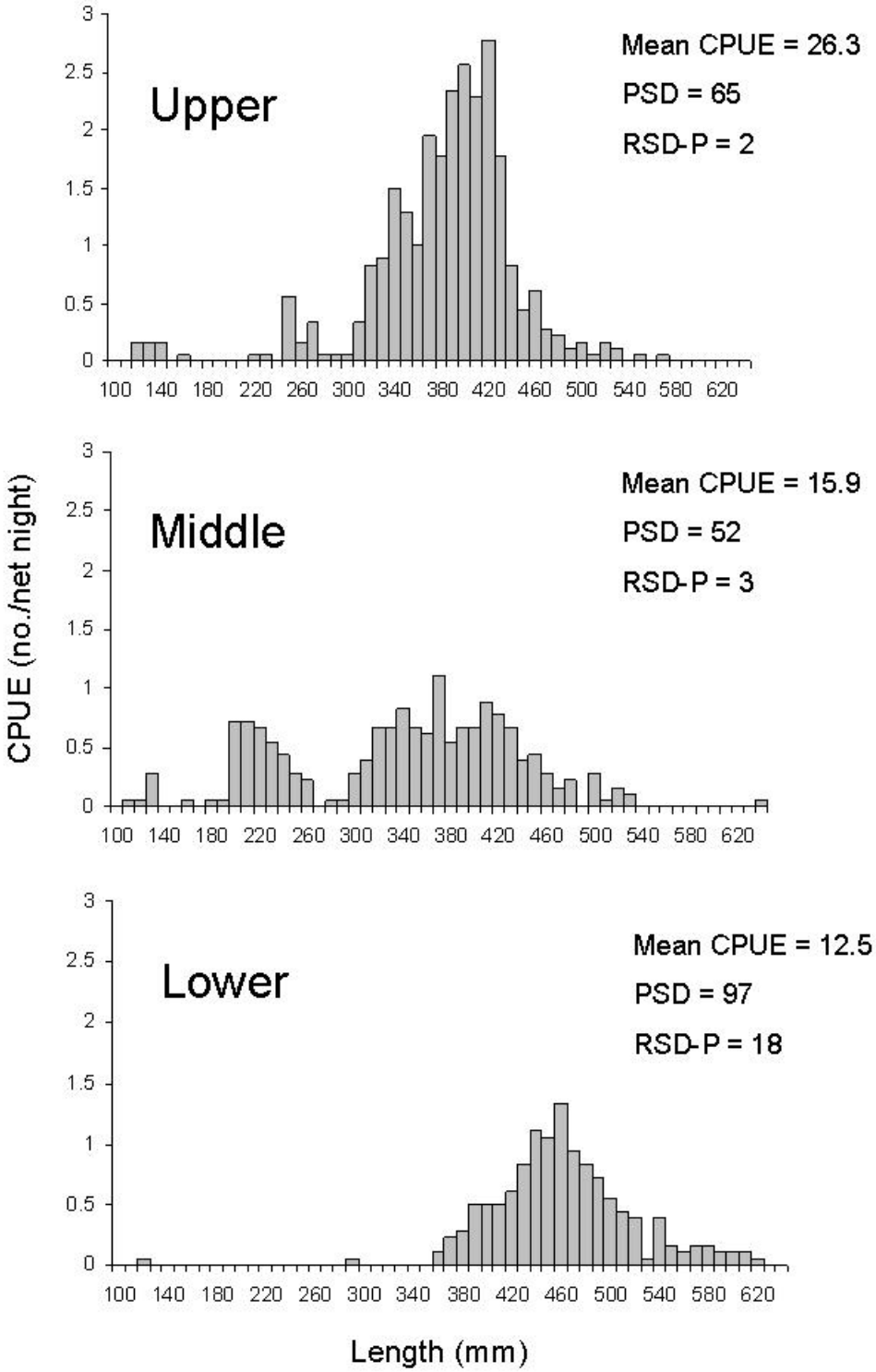

Figure 6. Length frequencies of walleye collected, in terms of catch per unit effort (CPUE), by zone, for fish collected during the standard coolwater gill net survey in 2005.

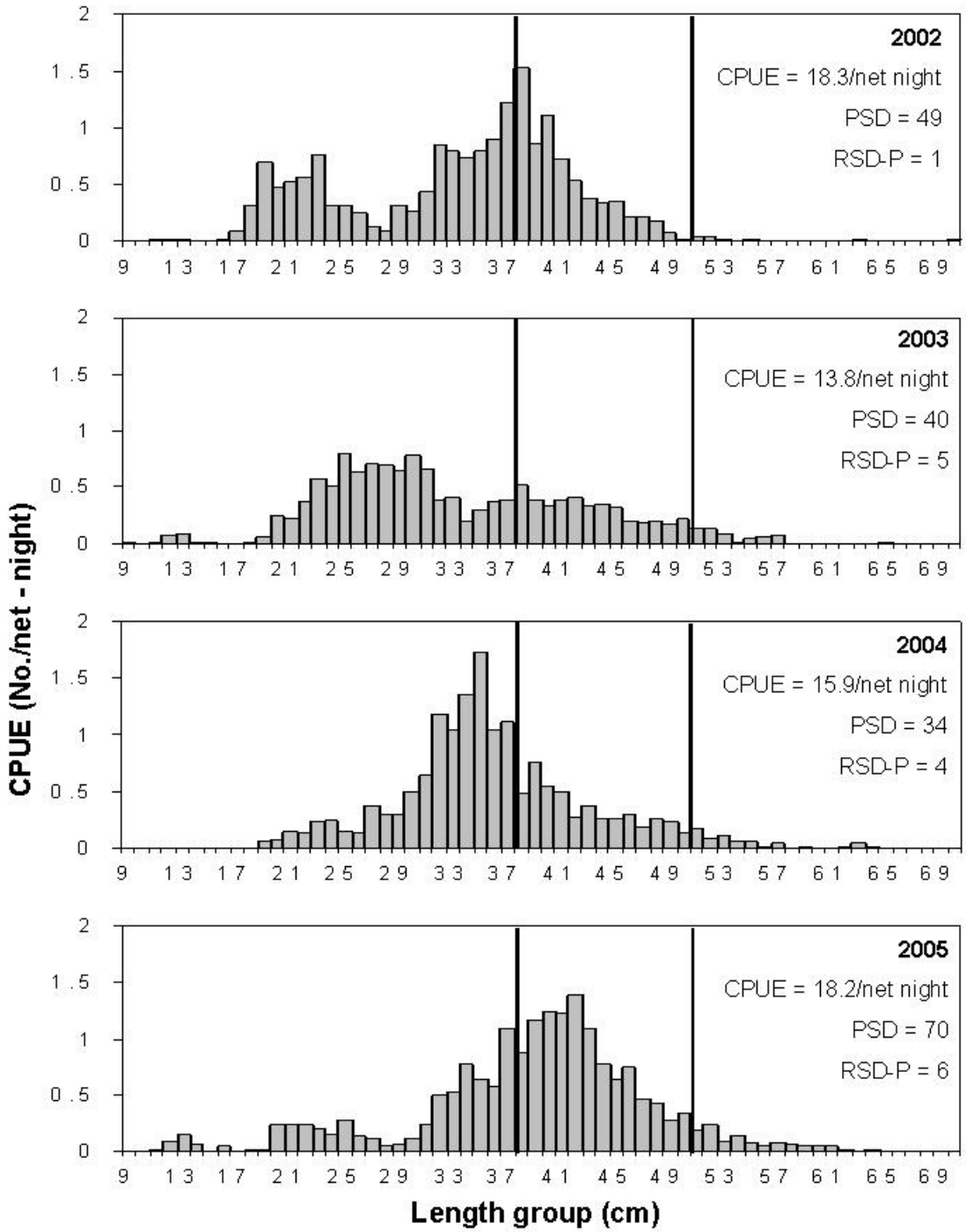

Figure 7. Overall Length frequency, by catch per unit effort, of walleye collected in standard gill-net sets in Lake Oahe, South Dakota, during August 2002 through 2005. Vertical lines represent the 15-inch and 20-inch classifications. Catch per unit effort (CPUE), PSD and RSD-P are presented for each year.

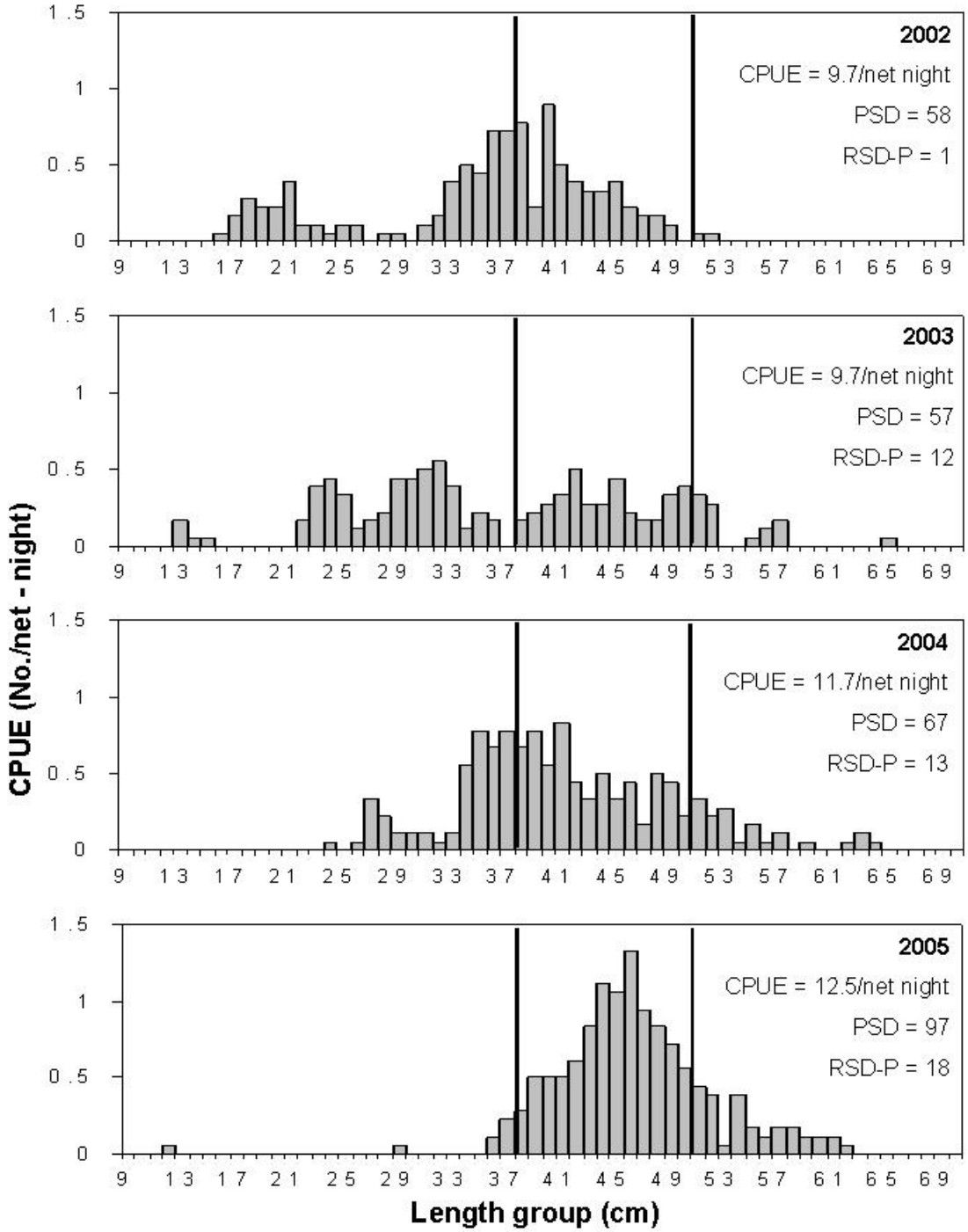

Figure 8. Lower zone of Lake Oahe, South Dakota, length frequency by catch per unit effort, of walleye collected in standard gill-net sets during August 2002 through 2005. Vertical lines represent the 15-inch and 20-inch classifications. Catch per unit effort (CPUE), PSD and RSD-P are presented for each year.

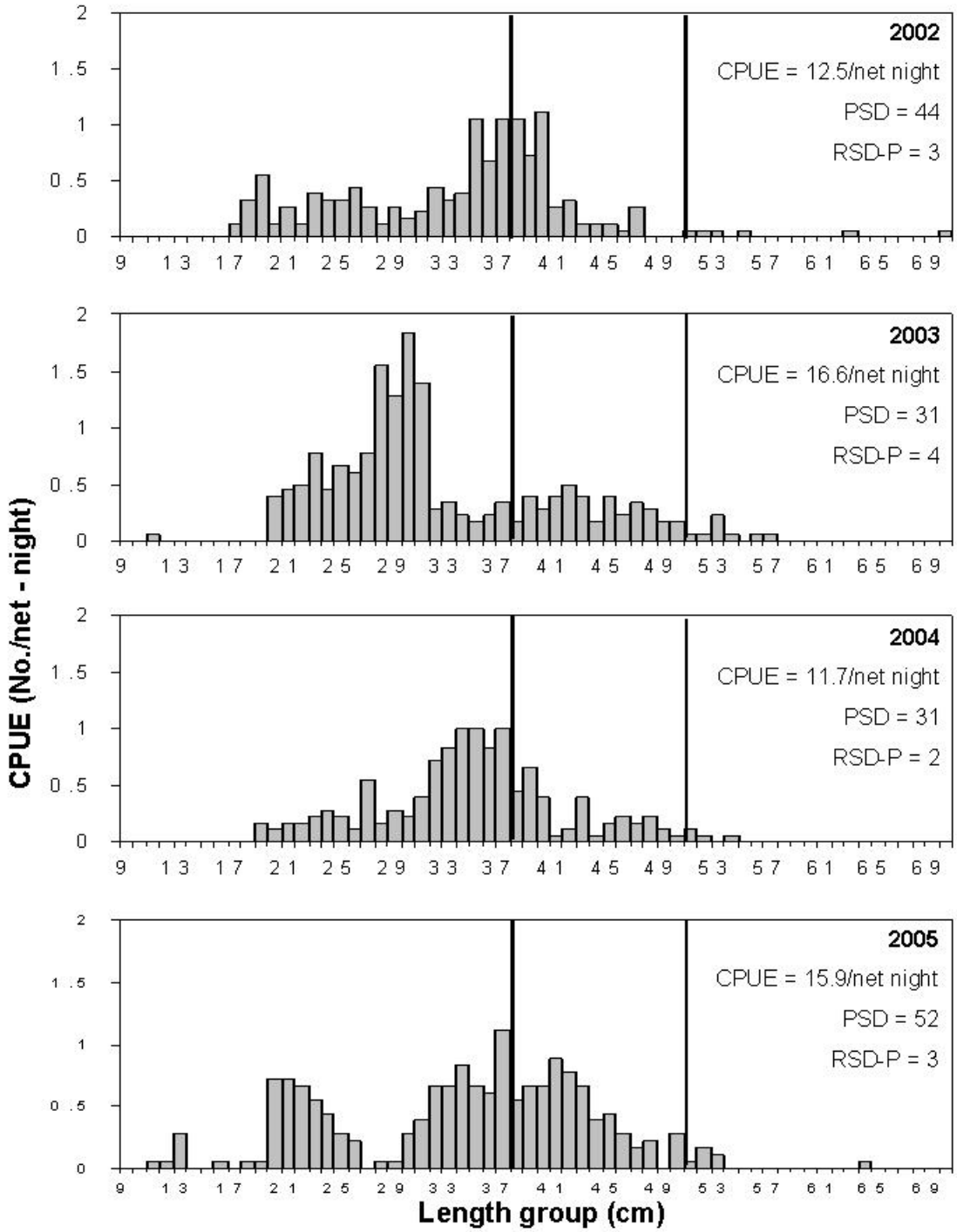

Figure 9. Middle zone of Lake Oahe, South Dakota, length frequency, by catch per unit effort, of walleye collected in standard gill-net sets during August 2002 through 2005. Vertical lines represent the 15-inch and 20-inch classifications. Catch per unit effort (CPUE), PSD and RSD-P are presented for each year.

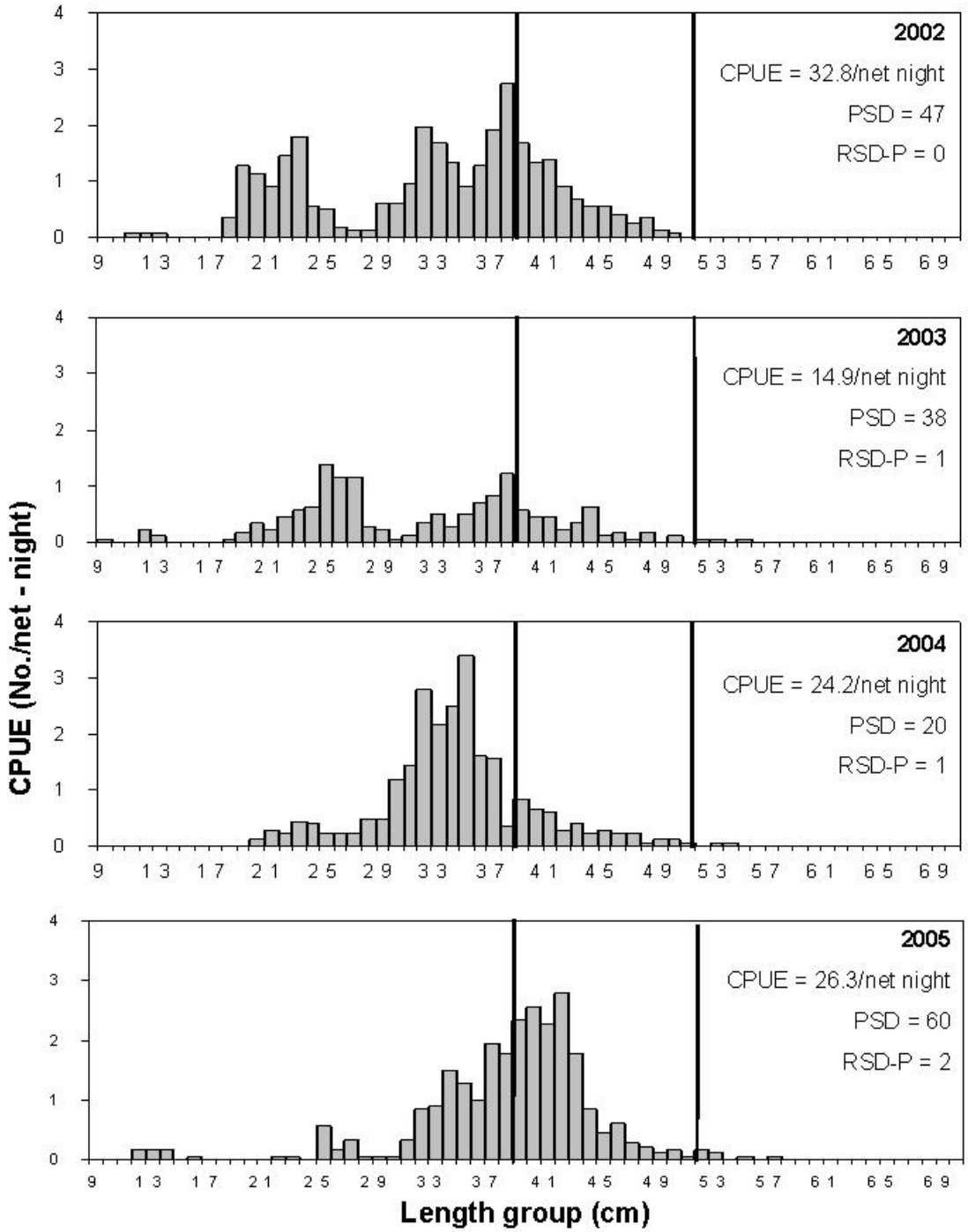

Figure 10. Upper zone of Lake Oahe, South Dakota, length frequency, by catch per unit effort, of walleye collected in standard gill-net sets during August 2002 through 2005. Vertical lines represent the 15-inch and 20-inch classifications. Catch per unit effort (CPUE), PSD and RSD-P are presented for each year.

Population Parameters for Channel Catfish

Proportional stock density for the overall Lake Oahe 2005 gill net sample of channel catfish, at 43, was significantly higher than the 2004 value of 31, and similar to values for 2001 through 2003 (Table 16). Mean *Wr* in 2005, at 80, was similar to the 2004 value of 81 (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, 2006). Channel catfish growth rates have slowed considerably since the impoundment of Lake Oahe (Starostka and Nelson 1974; Lott et al. 2003a). Quality length for channel catfish is 410 mm, or approximately 16 inches. While, 42% of the channel catfish sampled in the standard gill net survey in 2005 were longer than 16 inches (Figure 11) angler use and harvest of this species remains low. Mean CPUE of channel catfish in the 2004 standard gill net survey, at 20.5, was similar to the 2004 value of 20.7 fish/net-night (Table 6). The next year that pectoral spines will be collected from Lake Oahe for age and growth analysis will be 2007.

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 1997-2005, for Lake Oahe, South Dakota. Mean Wr values for 2002-2005 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

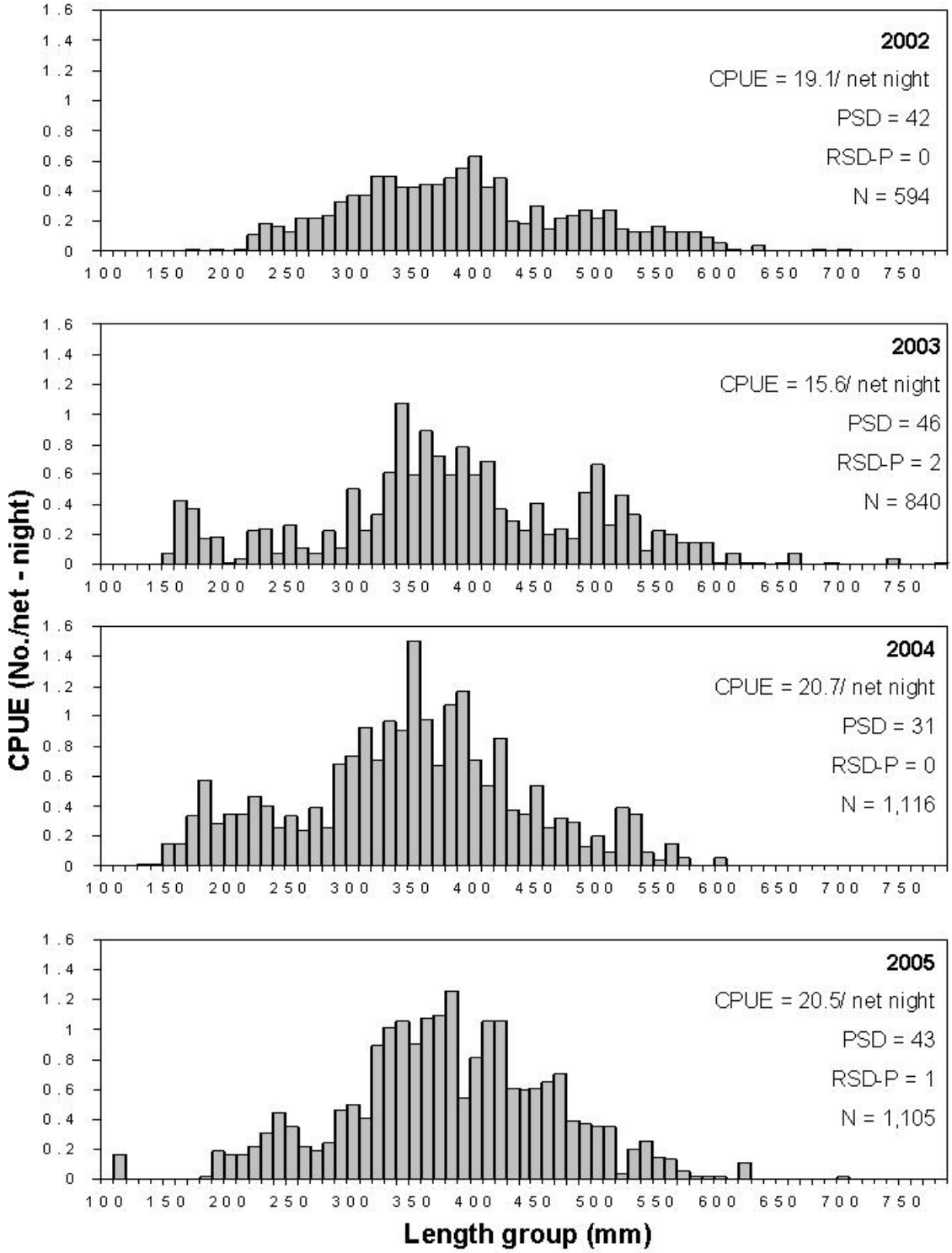

Figure 11. Length frequency of channel catfish, in terms of catch per unit effort (CPUE), collected during the standard coolwater gill net survey in 2002 through 2005. N is number of channel catfish sampled.

Larval Trawling

Mean peak larval rainbow smelt density for 2005 was the highest estimated since 1995, increasing for the forth consecutive year (Table 17. Yellow perch densities in 2005 were similar to 2003 and 2004 and flooded or submerged vegetation, a necessity for perch spawning was lacking in 2005. Spottail shiners larval density in 2005 was the highest of the 1995-2005 period, at 14.3 fish/100 m^3.

Table 17. Mean larval densities (No./100 m3) of selected prey species, by reservoir zone, in Lake Oahe, South Dakota, during late May and early June, 1995-2005. Trace (T) indicates values <0.05.

Species	Year	Zone			Lake Oahe total
		Lower	Middle	Upper	
Rainbow smelt	1995	165.9	39.7	131.2	112.3
	1996	9.2	11.3	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	0.0	0.0	0.3
	2000	9.3	0.3	0.1	3.3
	2001	2.5	0.0	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	15.3	36.1
	2005	95.2	43.9	52.7	63.9
Yellow perch	1995	42.6	22.7	15.9	27.1
	1996	11.7	2.8	30.0	14.9
	1997	26.3	26.6	77.8	43.6
	1998	19.4	10.7	10.7	13.6
	1999	3.3	3.3	3.3	3.3
	2000	0.4	1.6	1.1	1.1
	2001	0.0	0.2	0.1	0.1
	2002	1.9	1.3	5.2	2.8
	2003	1.3	7.4	12.2	7.0
	2004	0.8	9.5	10.5	6.9
	2005	1.1	1.4	15.4	6.0
Spottail shiner	1995	4.4	1.0	2.6	2.7
	1996	0.3	0.6	0.1	0.3
	1997	1.9	0.1	2.3	1.4
	1998	0.0	0.0	0.0	0.0
	1999	2.6	5.2	2.7	3.5
	2000	0.5	3.3	0.0	1.3
	2001	0.4	5.0	11.2	5.5
	2002	0.1	0.1	0.0	0.0
	2003	1.5	1.5	0.3	1.1
	2004	0.0	0.0	0.0	0.0
	2005	5.7	3.4	33.9	14.3

2005 WHITE BASS DIE-OFF INVESTIGATION

Methods

On-site fish die-off investigations by Missouri River fisheries staff and Region 2 personnel involved 402 m (1/4 mile) shoreline walks. Bay and main lake sites were sampled on both sides of the lake in areas that were not accessible to the public. Fish washed up on the shoreline as well as fish visible and easily collected from shore were counted (Southwick and Loftus 2003). Shoreline distance searched was logged with a global positioning system (GPS) and all dead fish encountered were identified and counted. A sub-sample of white bass was measured to the nearest millimeter.

Results/Discussion

In early August 2005 a significant white bass die-off occurred on Lake Oahe. The die-off was primarily limited to adults between 254-406 mm (10-16 inches). However, one dozen dead age-1 white bass were found in Sutton Bay (8/4/05). Other fish species were documented such as northern pike, channel catfish, freshwater drum, smallmouth bass and white crappie. However, the number of each of other species was within the range of expected natural mortality.

Inspection of the upper zone of Lake Oahe on August 8 and 9 revealed a mortality count of 496 white bass, three catfish, two northern pike and one lake herring in 3,200 m (2 miles) of shoreline. The estimated white bass mortality was 62 fish per 402 m (¼ mile) of shoreline (Table 18). Surface water temperature averaged 25°C (77 ^{o}F) for each zone. Inspection of the middle zone of Lake Oahe on August 9th and 10th revealed 341 white bass, one white crappie, two freshwater drum, one white sucker and one northern pike in 2,400 m (1.5 miles) of shoreline. The estimated mortality was 57 white bass per 402 m (¼ mile) of shoreline (Table 18). The lower zone was inspected August 3rd thru the 11th and revealed 105 dead white bass, one smallmouth bass, one common carp, one channel catfish and one spottail shiner in 5,600 m (3.5 miles) of shoreline. The estimated mortality was 7.5 white bass per 402 m (¼ mile) of shoreline (Table 1). Dead white bass condition ranged from bloated to decomposed with only skin and bones remaining. Estimated length of time fish were dead ranged from currently dying up to two weeks old.

Field crews were successful at collecting near-dead or impaired white bass to be tested. Four near dead/fresh white bass were sent off for testing (8/5/05) to the Wisconsin Veterinary Diagnostic Laboratories in Madison, Wisconsin. The samples included two adult white bass and two age-1 white bass. The laboratory was unable to run tests on the age-1 fish. An additional five impaired white bass were shipped to the Wisconsin Laboratory testing (8/9/05). A total of seven adult white bass were shipped to Wisconsin for testing. The laboratory report stated visual observation of eroded gills, results of bacterial culture as well as histological evaluation support the diagnosis of columnaris caused by Flavobacterium columnare. Columnaris bacteria is always present in the water and increases or decreases in density for a variety of reasons including water temperature, turbidity, decomposing nutrients, sunlight and lack of oxygen. Most species of fish are susceptible to columnaris following environmental stress and elevated water temperatures > 20°C and schooling species of fish, like white bass, are especially susceptible (Wakabayashi 1991) and media accounts have related increased susceptibility to columnaris due to white bass post-spawning stress. In addition, high angler catch rates of adult white bass on Lake Oahe in 2004 and 2005 indicated the reservoir had a high abundance of adult white bass prior to the die-off (Lott et. al. 2006, this report).

Table 18. Lake Oahe bay and main lake shore line counts for dead white bass on Lake Oahe August 3-11, 2005.

Location	Date	Distance (m)	Count	Temperature (^{o}C)
Upper Zone				
Pollock	Aug. 8	800	5	25.0
Grand R.	Aug. 8	800	90	26.6
Blue Blanket	Aug 9	400	120	23.8
Lecompt Bay	Aug. 9	400	120	24.4
Moreau River	Aug. 9	800	161	25.0
Tally		3200	496	
No. fish per 402 m			62	
Middle Zone				
Swan Creek	Aug. 9	800	202	26.1
Whitlocks Bay	Aug. 10	800	119	23.3
Sutton Bay	Aug. 10	800	20	
Tally		2400	341	
No. fish per 402 m			57	
Lower Zone				
Minneconjou Bay	Aug. 3	800	15	25.9
Rosseau Creek	Aug. 3	800	21	
Brush Creek	Aug. 3	800	54	
Cow Creek	Aug 10	800	11	25.0
Chantier Creek	Aug. 11	1600	2	24.6
East Shore	Aug. 10	800	2	25.2
Tally		5600	105	
No. fish per 402 m			7.5	

Similar white bass die-offs have been documented both in-state in Lake Sharpe July 2005 (Lott et. al. 2007) and Lake Francis Case July 1998 (Stone and Sorensen 1999) and out-of-state in numerous Kansas reservoirs (Pollack 1999-Popular Press). The white bass die-off in Lake Oahe and in numerous Kansas and Oklahoma reservoirs (Pollack 1999-Popular Press) was attributed to outbreaks of Columnaris bacteria.

Four hundred and two meter shoreline fish counts were multiplied by the number of kilometers of shoreline in each area. The estimated number of dead white bass that washed up on the Lake Oahe shoreline was 75,863 fish in the upper zone, 91,971 fish in the middle zone and 16,863 fish in the lower zone (Table 19). It is important to note estimates of losses based on countable dead fish will be conservative. Very seldom do counts represent more than a fraction of the actual fish killed: the counts are based only on fish actually seen once during a dynamic, ongoing process (Southwick and Loftus 2003). The Lake Sharpe fish kill counts did not take into account white bass mortalities that were floating offshore on the surface, sunk, decomposed, covered with shoreline materials, carried off by animals or overlooked (human error). In addition, the length of time fish were dead (i.e., one to three weeks) exacerbated many of the factors listed above. A more realistic die-off estimate of Lake Oahe white bass was approximately 615,000 fish (Table 19).

Table 19. Estimated count of 2005 Lake Oahe white bass mortality per zone corrected for number unseen.

Zone	Area/Zone	Fish/Mile Shoreline	Count Extrap.	Est. % Count	Unseen Fish Cor. Factor	Fish/Zone
Upper	305.9	248	75,863	0.3	0.7	252,877
Middle	404.8	227.2	91,971	0.3	0.7	306,569
Lower	413.3	40.8	16,863	0.3	0.7	56,209
			184,696		Grand Total	615,655

Two items are different now than in the past with white bass on Lake Oahe. First, low Lake Oahe elevation (i.e., August mean 1575 ft.msl.) made the upper South Dakota portion of Lake Oahe a true riverine stretch and likely caused abrupt water temperature changes due to decreased depth and increased turbidity. Both of these conditions could be increased stressors for white bass and provide the columnaris bacteria the right conditions to thrive. Dr. Brad Chadwick, fish pathologist for Agriculture , Fisheries and Forestry Department Hong Kong from the ProMed-mail website noted Flavobacterium columnaris is a sediment associated bacterium, so any stirring up of the sediment, as with flooding or a storm, seems to lead to a much greater baseline exposure. In upper Lake Oahe the low lake elevations have exposed shallow sediment-laden lake bottoms to stirring through wind events and elevated water temperatures. These conditions create conditions where Columnaris bacteria could load the system. This followed by infection, disease, and rapid horizontal spread, which amplifies the process. Second, the relatively new arrival of gizzard shad could be part of the puzzle. Scott and Crossman (1973) note white bass typically inhabit the upper 20 feet of the water column and they prefer clear water because they are sight feeders that hunt in schools. Scott and Crossman note white bass have an affinity for juvenile gizzard shad. Schools of gizzard shad will typically school near the surface and white bass have a tendency to herd and attack shad just under the surface during the day. In the summer of 2005 the Mobridge fisheries crew witnessed schools of white bass frothing the water and driving baitfish onto the beach in late July. Schools of white bass are usually composed of adults that are of a size that cannot eat each other. During schooling and feeding, white bass are in close contact and likely brushing against each other even occasionally getting spined by each other providing the potential for horizontal transmission of disease.

The question of why white bass were affected and no other species comes to light. Dr Chadwick responded to this question stating the degree of tolerance seems to vary a lot between species, so it is often the case that one species will succumb first to an environment-related disease epidemic.

ANGLER USE, SPORTFISH HARVEST, AND PREFERENCE SURVEYS

Angler Use

In the process of conducting the 2005 angler use and harvest survey, 1,780 angling parties were interviewed during the April-October 2005 daytime period. The estimated fishing pressure for the South Dakota portion of Lake Oahe in 2005, at 460,334 h, was the lowest of all years in which surveys have been conducted (Table 20). The estimated number of angler trips for 2005, at 87,433, was also the lowest estimated for any year in which angler use and harvest surveys have been conducted. The highest estimated fishing pressure occurred in 1996 at 1,968,525 hours and 338,880 angler trips. In 2005, estimated fishing pressure and angler days for the April-October daytime period were 24% and 26% of the estimates for 1996, respectively.

Table 20. 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	This study

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

Estimated fishing pressure peaked in June in 2005 at an estimated 162,479 h (Table 21). During the 1991-2005 period when April-October daytime surveys have annually been conducted, patterns in distribution of fishing pressure among months have changed. Over time, total estimated fishing pressure has become more concentrated around the peak in pressure. As an example, 69% of the estimated fishing pressure during the 2005 April-October survey period occurred during June and July. In 2003 and 2004, 68% and 79% of the estimated fishing pressure for the April-October period occurred during June and July, respectively (Lott et al., 2004, 2006). Angling pressure was the highest in the middle zone of Oahe in 2005 at 52% of the total for the reservoir, followed by the upper and lower zones at 25% and 23%, respectively (Table 21).

Table 21. Estimated fishing pressure (angler hours), by month and zone, with 95% confidence intervals (CI), for the April-October 2005 daylight period on Lake Oahe, South Dakota.

Zone	Month							
	April	May	June	July	August	Sept.	Oct.	Total
Lower	2,123	9,833	19,975	49,287	16,454	5,820	3,893	107,385
95% CI	1,272	5,896	9,836	28,486	11,248	4,089	1,774	33,030
Middle	3,675	29,528	100,940	74,360	16,368	7,533	5,799	238,202
95% CI	2,396	26,908	39,038	59,927	10,688	5,109	3,845	77,460
Upper	4,916	32,084	41,564	18,614	5,825	4,025	7,719	114,747
95% CI	2,399	18,672	25,740	9,403	2,701	1,272	3,104	33,524
Total	10,714	71,444	162,479	142,261	38,647	17,378	17,411	460,334
95% CI	3,621	33,278	47,783	67,016	15,750	6,666	5,250	90,636

Lake Oahe is mostly a boat fishery, as indicated by the low estimates of total angler hours spent shore angling during the 2001-2005 period (Table 22). During the 2001-2005 period, the percentage of estimated angler hours attributed to shore anglers ranged from 1% to 8%. The lowest estimated number of shore angler hours occurred during 2003, at 5,257 h.

Table 22. Estimated fishing pressure, expressed as angler-hours (h) and hours per hectare (h/ha), by type of fishing, with 95% confidence intervals (CI), for the standard April-October daylight survey period, on Lake Oahe, South Dakota, from 2001 through 2005. Estimates were generated using aerial counts of fishing pressure.

Type of fishing	Year				
	2001	2002	2003	2004	2005
Boat (h)	986,964	827,891	613,954	634,135	437,908
95% CI	162,278	146,403	133,047	106,583	89,140
h/ha	8.9	7.5	5.5	5.7	4.0
Shore (h)	27,627	28,169	5,257	26,838	22,426
95% CI	6,605	5,511	10,304	6,500	4,799
h/ha	0.2	0.3	T	0.2	0.2
Combined (h)	1,014,591	856,059	651,557	660,973	460,334
95% CI	163,469	147,557	134,356	107,480	90,636
h/ha	9.2	7.7	5.9	6.0	4.2

Estimated fishing pressure (based on surface area at full pool elevation) was 4.2 h per hectare for the April-October period in 2005, the lowest of any year in the 1994-2005 period (Table 23). Estimated fishing pressure peaked in 1996 at 22.9 h/ha, and estimated hours per hectare have been below 10 since 1999.

Table 23. 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 2005.

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

Catch, Harvest and Release Estimates

Of the estimated 210,953 fish harvested from Oahe in 2005, 164,428 (78%) were walleye, similar to 2004 (Lott et al. 2006). Harvest of walleye was followed by white bass (15%), channel catfish (4%) and Chinook salmon (1%), in terms of decreasing number harvested. The estimated walleye harvest during June and July 2005, at 142,986 fish, comprised 87% of the total walleye harvest during the April-October 2005 period (Table 24). As with fishing pressure, walleye harvest has become more concentrated around the peak months of harvest since the early 1990's (Johnson et al. 1996; Lott et al. 2000).

Patterns in estimated number of fish released follow those of fishing pressure and fish harvest, peaking during the June-July period in 2005 (Table 25). Of the 215,163 walleyes estimated to have been caught by anglers during the April-October 2005 survey period, 50,735 (24%) were released (Table 25). Estimated number of channel catfish and smallmouth bass released exceeded estimates of fish kept, while approximately the same number of white bass was kept as released (Table 25 and Table 26). Approximately 89% of the estimated catch of Chinook salmon was kept.

Table 24. Estimated number of fish harvested, by species and month, with 95% confidence intervals (CI), for the April-October 2005 daylight period, on Lake Oahe, South Dakota.

Species	Month							
	April	May	June	July	Aug.	Sept.	Oct.	Total
Walleye	447	10,898	85,885	57,101	6,051	1,567	2,478	164,428
95% CI	426	7,493	21,870	28,083	3,494	1,446	1,572	36,607
Channel catfish	1,175	957	948	2,515	1,634	1,615	491	9,335
95% CI	339	788	747	2,229	899	1,234	346	2,951
White bass	607	21,282	6,660	2,585	93	17	14	31,258
95% CI	632	28,140	3,485	2,141	0	37	24	28,443
Smallmouth bass	0	134	220	292	32	157	11	846
95% CI	0	146	125	191	10	250	0	369
Northern pike	717	73	26	38	0	26	58	938
95% CI	899	0	57	78	0	--	52	905
Chinook salmon	0	12	1,148	688	138	420	234	2,639
95% CI	0	11	991	--	145	286	191	1,059
Other*	0	1044	267	82	115	1	0	1509
95% CI	--	--	--	--	--	--	--	--
Total	2,946	34,400	95,154	63,301	8,063	3,803	3,286	210,953
95% CI	1,574	28,732	23,561	30,381	3,900	2,063	1,728	48,255

*Other includes common carp, black bullhead, yellow perch, largemouth bass, white crappie, black crappie, sauger and freshwater drum.

Table 25. Estimated number of fish released, by species and month, for the April-October 2005 daylight period, on Lake Oahe, South Dakota.

Species	Month							
	April	May	June	July	Aug.	Sept.	Oct.	Total
Walleye	0	1,235	21,199	25,733	1,755	610	204	50,735
Channel catfish	722	68	1,518	11,180	7,688	454	313	21,942
White bass	0	8,215	16,809	8,529	602	63	267	34,485
Smallmouth bass	13	838	1,933	2,220	611	187	494	6,296
Northern pike	118	92	146	108	54	9	178	704
Chinook salmon	0	0	150	98	44	0	39	331
Other*	12	874	4953	7757	1607	322	505	16,030
Total	865	11,322	46,708	55,625	12,361	1,645	2,000	130,526

*Other includes shovelnose sturgeon, goldeye, gizzard shad, white sucker, bigmouth buffalo, common carp, black bullhead, yellow perch, white crappie, black crappie, sauger and freshwater drum.

An estimated 341,479 fish were caught in Lake Oahe during the April-October 2005 period, and of these, 63% (215,163 fish) were walleye (Table 24, Table 25and Figure 12). White bass (65,743), channel catfish (31,277), smallmouth bass (7,142), Chinook salmon (2,970) and northern pike (1,642) followed walleye in estimated catch in 2005 (Figure 12). Approximately 62% of the fish caught in 2005 were harvested.

Estimated harvest of all species combined, for the April-October daytime period, was the highest in the middle zone of Oahe with a harvest of 106,041 fish, followed by the upper (77,742) and the lower zones (27,170). Estimated channel catfish, white bass, and northern pike harvest were highest in upper Oahe, walleye harvest was highest in middle Oahe, and Chinook salmon and smallmouth bass harvest were highest in lower Oahe (Table 26). Approximately 60% of the total estimated walleye harvest in for the standard survey period in 2005 occurred in middle Oahe (98,464 fish).

The estimated total number of walleye caught during the standard survey period each year and the percent kept by anglers, have varied greatly over time in response to changes in fishing pressure, hourly catch rates, daily limits, and size distribution of walleyes in the angler catch (Table 27). An April-June 356-mm (14-inch) minimum length limit was in effect during 1998 and 1999 and likely contributed to high percentages of walleyes caught being released during those years. However, the trend of high percentages of walleye caught being released continued in 1999 and 2000, when no minimum length limit was in effect, suggesting that high hourly catch

rates of walleye (Lott et al. 2001) and the four fish daily limit were also affecting angler harvest behavior.

One goal of the 14-fish daily limit for walleye implemented in 2001 was to increase total walleye harvest. It was believed that making the daily limit 14 and stipulating that at most four fish could be 381-mm (15 inches) or longer, would make anglers more willing to harvest abundant small walleye and reverse the trend in low percentage of walleye caught that were harvested from 1997-2000. The percentage of walleye caught that were kept increased from 37% in 2000, to 81% in 2001.

The percentage of walleye caught that were kept increased from 63% in 2004 to 76% in 2005 (Table 27). This is likely due to increases in walleye population quality in all three reservoir zones and the total Oahe sample from 2004 to 2005 (Table 9 and Figure 12).

The estimated walleye catch for the April-October 1998 daytime period was the highest estimated for any year that angler use and harvest surveys have been conducted, at over 2 million walleyes (Table 27). However, only 23% of walleye caught were harvested in 1998. The estimated 215,164 walleyes caught in 2005 was only 10% of the record catch in 1998, but harvest in 2005 was 34% of the 1998 estimate because 76% of the catch was harvested in 2005 (Table 27).

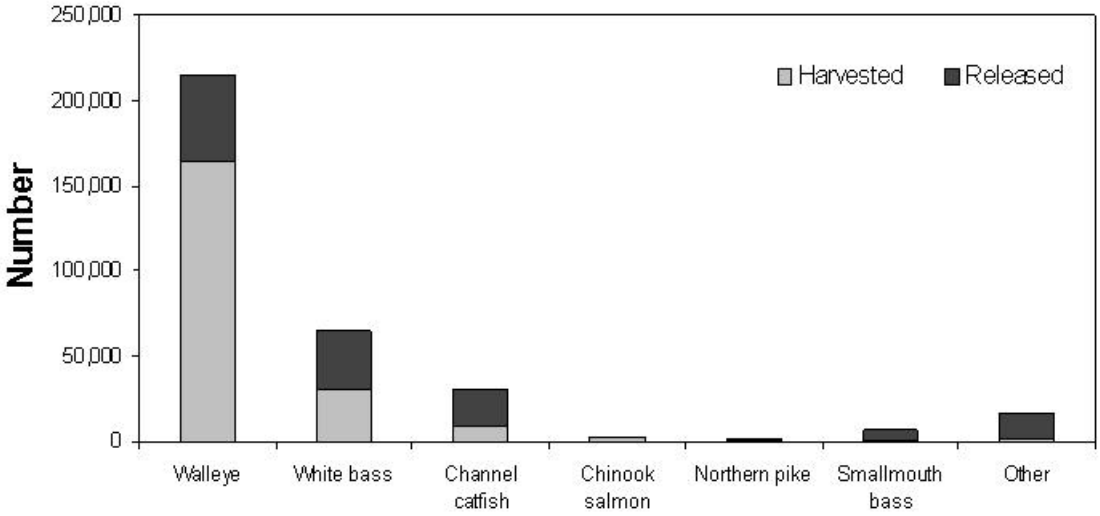

Figure 12. Estimated number of fish harvested and released, for selected species, for the April-October 2005 daylight period, on Lake Oahe, South Dakota. Other includes shovelnose sturgeon, gizzard shad, goldeye, common carp, white sucker, bigmouth buffalo, black bullhead, largemouth bass, white crappie, black crappie, yellow perch, sauger, and freshwater drum.

Table 26. Estimated number of fish harvested, for selected species, by zone, with 95% confidence intervals (CI), for the April-October 2005 daylight period, on Lake Oahe, South Dakota.

Species	Zone			
	Lower	Middle	Upper	Total
Walleye	21,381	98,464	44,583	164,428
95% CI	10,692	28,347	20,547	36,607
Channel catfish	951	2,084	6,300	9,335
95% CI	687	1,838	2,205	2,951
White bass	1,534	3,956	25,767	31,258
95% CI	751	2,376	28,334	28,443
Chinook salmon	2,310	321	9	2,639
95% CI	1,042	191	--	1,059
Smallmouth bass	501	303	43	846
95% CI	326	166	50	369
Northern pike	78	38	821	938
95% CI	59	78	900	905
Total	27,170	106,041	77,742	210,953
95% CI	11,155	30,399	35,777	48,255

Table 27. 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 2005.

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%

Length histograms of walleye harvested by anglers for all of Lake Oahe (Figure 13), when compared to those for the standard gill net survey (Figure 7) show the non-selective nature of the angler harvest. The mean length of walleye harvested during the April-October 2005 period, at 402 mm, was higher than the 2004 value of 384 mm (Lott et al. 2006). As you move up the reservoir from lower Oahe to upper Oahe, mean length of harvested walleye decreased from 433 mm to 381 mm (Figure 14 through Figure 16). Examination of all the length frequency histograms suggests anglers begin to harvest walleyes at approximately 300 mm (12 inches). The quality of the walleye population increased from 2004 to 2005 as indicated by increases in PSD and RSD-P values for the standard gill net survey (Table 10) that were reflected in lengths of walleye harvested by anglers.

Smallmouth bass are typically an incidental catch of walleye anglers and harvested by generalist anglers. The mean length of smallmouth bass harvested in 2005 was 316 mm (Figure 17) and harvest of bass appeared to be non selective, though sample size was low.

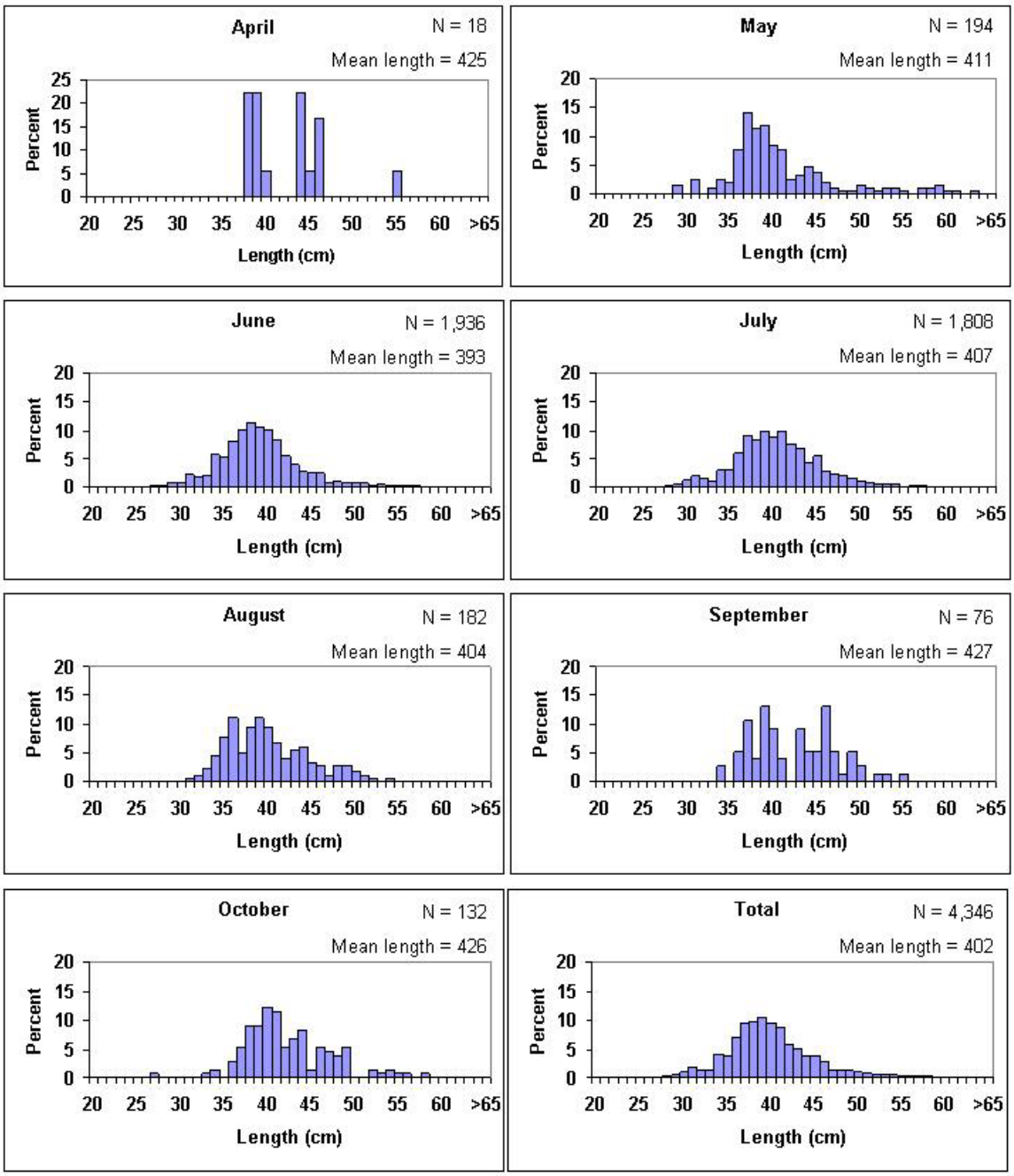

Figure 13. Length frequency distribution of walleye harvested by anglers fishing Lake Oahe, South Dakota, during the May-September 2005 daylight period.

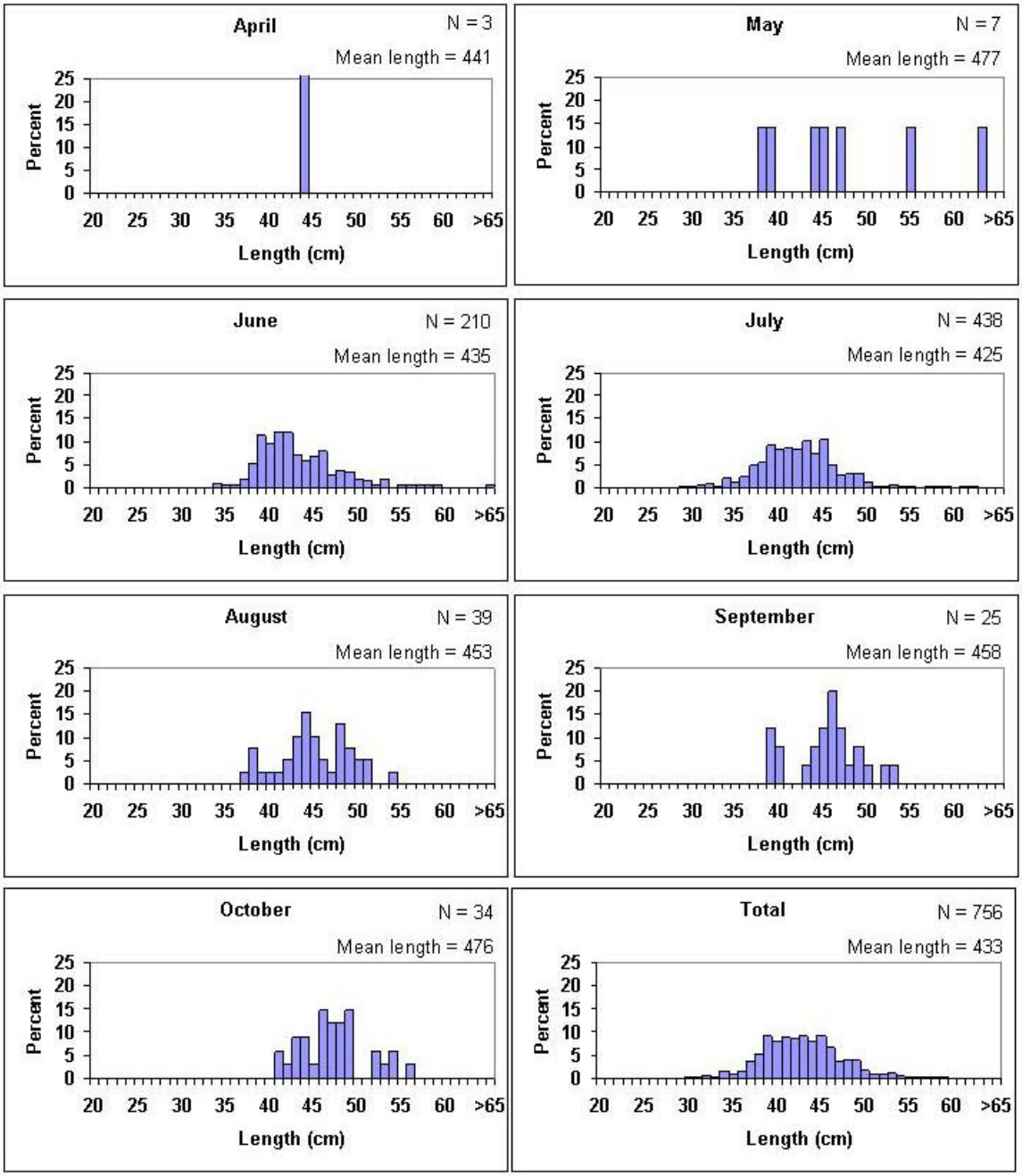

Figure 14. Length frequency distribution of walleye harvested by anglers fishing lower Lake Oahe, South Dakota, during the May-September 2005 daylight period.

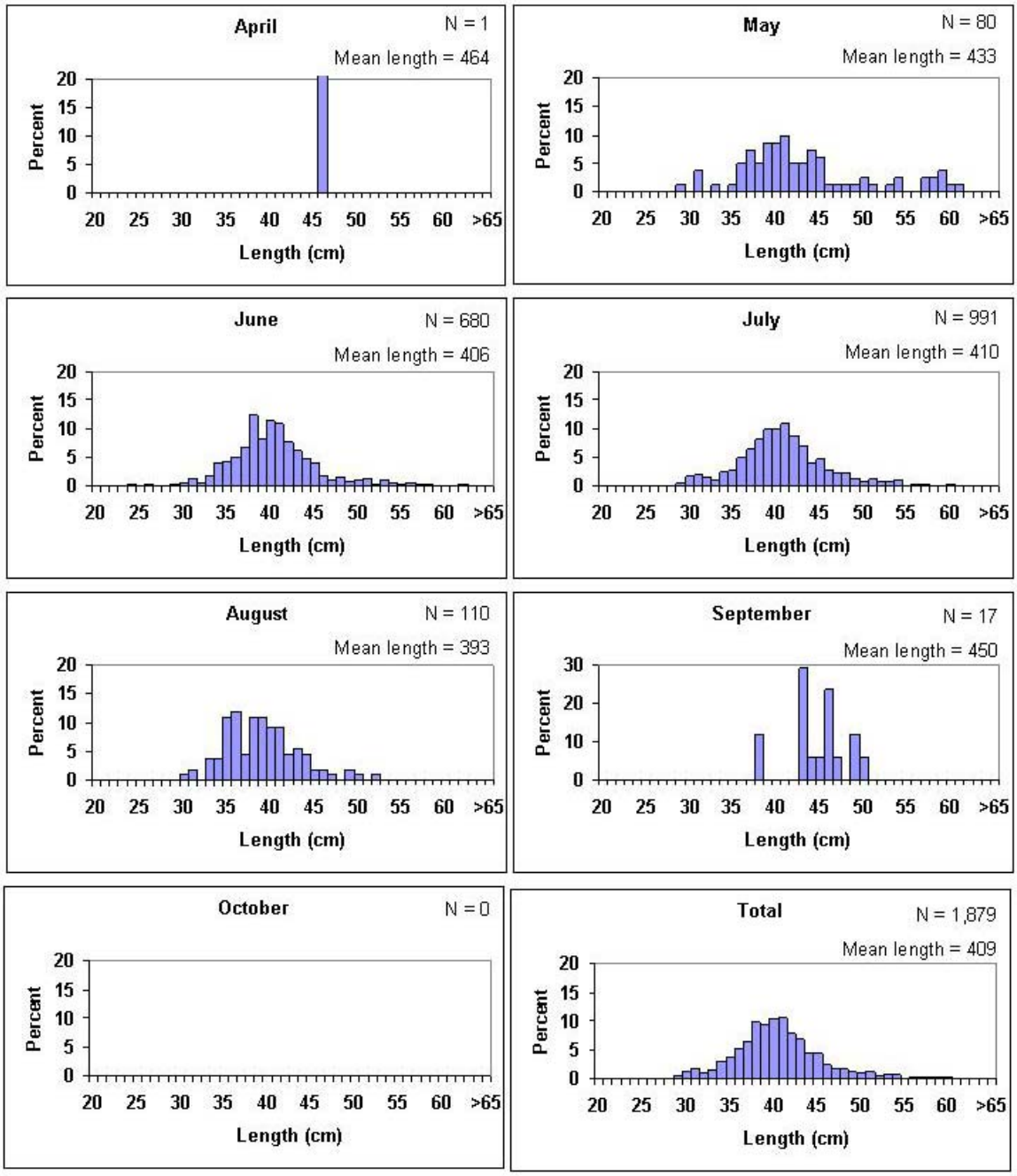

Figure 15. Length frequency distribution of walleye harvested by anglers fishing middle Lake Oahe, South Dakota, during the May-September 2005 daylight period.

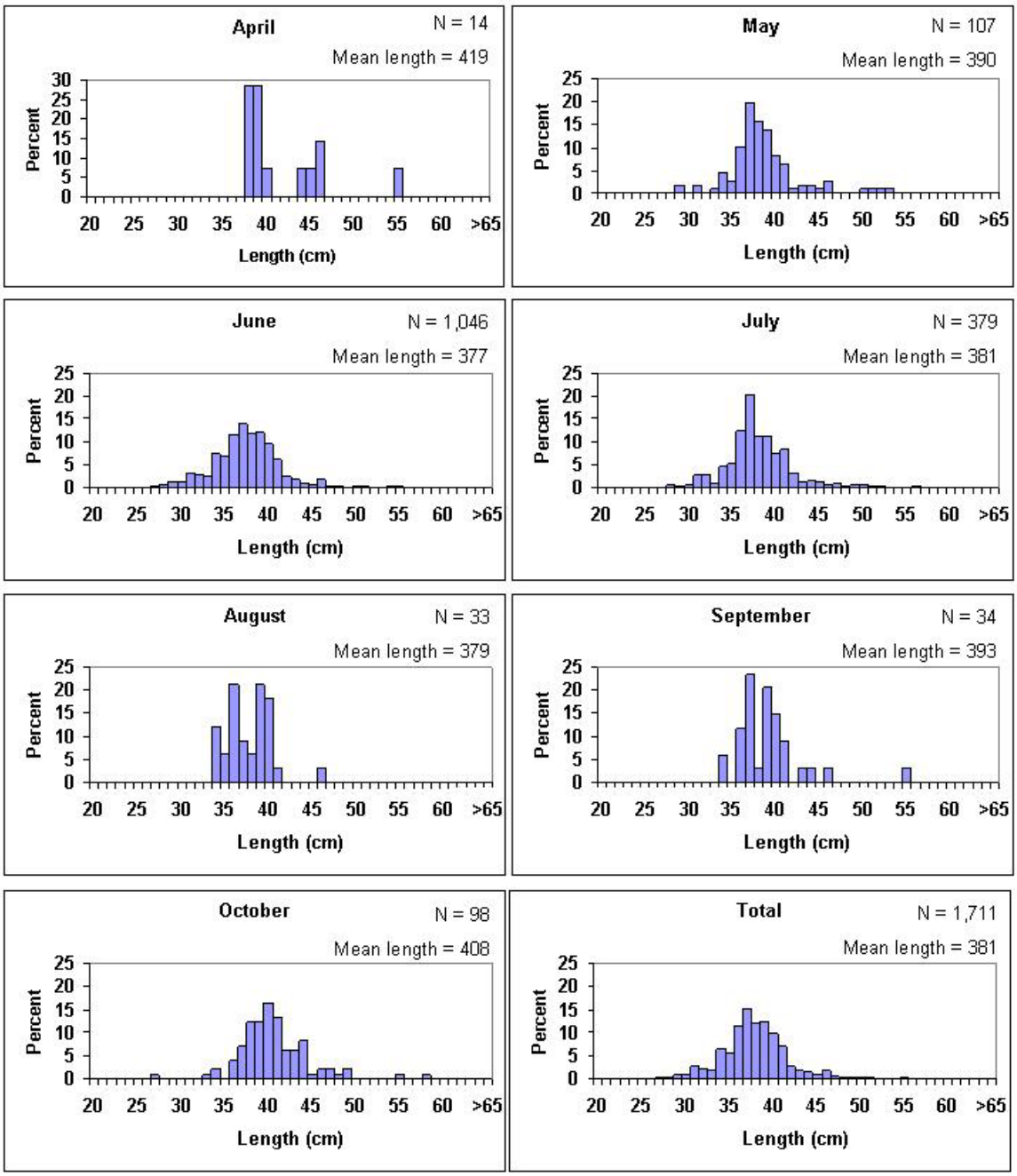

Figure 16. Length frequency distribution of walleye harvested by anglers fishing upper Lake Oahe, South Dakota, during the May-September 2005 daylight period.

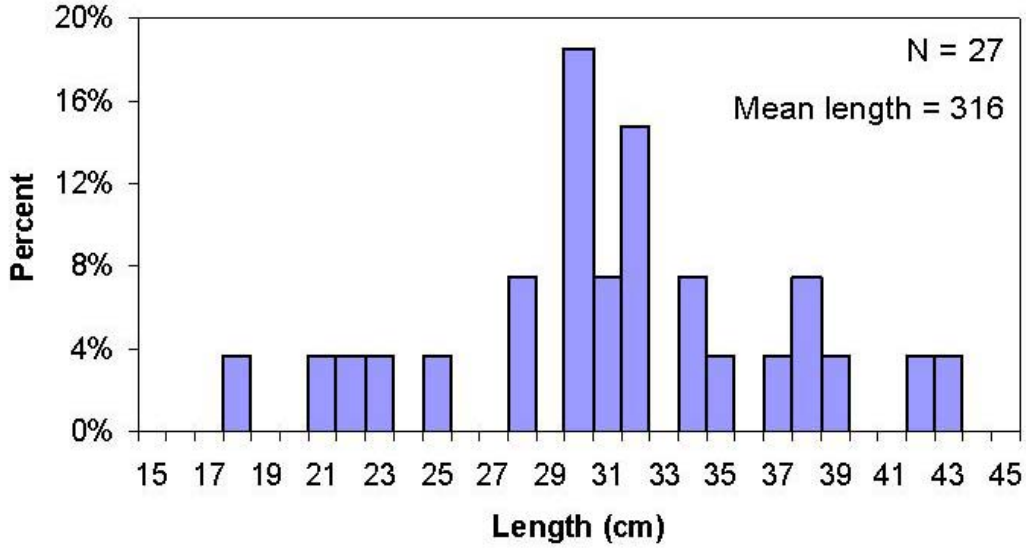

Figure 17. Length frequency distribution of smallmouth bass harvested by anglers fishing Lake Oahe, South Dakota, during the April-October 2005 daylight period.

Hourly Catch, Harvest, and Release Rates

Catch rates for walleye exceeding 0.3 fish/angler-h are considered excellent (Colby 1979) and the mean hourly catch rate for walleye in 2005, at 0.47 fish/angler-h, exceeded that value (Table 28). The mean hourly catch rate for walleye for the 2004 and 2005 standard angler surveys were similar at 0.54 fish/angler-h (Lott et al. 2006) and 0.47 fish/angler-h, respectively. Mean hourly catch rate for all species combined decreased from 0.87 fish/angler-h in 2004 (Lott et al. 2006) to 0.74 fish/angler-h in 2005.

Table 28. Estimated hourly catch, harvest, and release rates, by species, for all anglers interviewed on Lake Oahe, South Dakota, during the April-October 2005 daylight survey period. Trace (T) indicates values >0.0 but <0.02.

Species	Catch rate (fish/angler-h)	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)
Walleye	0.47	0.36	0.11
Channel catfish	0.07	0.02	0.05
White bass	0.14	0.07	0.07
Smallmouth bass	0.02	T	T
Northern pike	T	T	T
Yellow perch	T	T	T
Other*	0.04	0.01	0.05
Total	0.74	0.46	0.28

*Other includes shovelnose sturgeon, goldeye, gizzard shad, white sucker, bigmouth buffalo, common carp, black bullhead, yellow perch, white crappie, black crappie, sauger and freshwater drum.

Mean hourly catch rates for anglers specifically fishing for a certain species are substantially higher than for mean values for all anglers combined (Table 28 and Table 29). As an example, mean hourly catch rate for smallmouth bass for anglers specifically fishing for smallmouth bass was 1.74 fish/angler-h, compared to a mean catch rate of 0.02 fish/angler-h, for the total sample of angler trips. Anglers targeting walleye, white bass, channel catfish, and Chinook salmon all had mean hourly catch rates that greatly exceeded those for the entire sample of angling trips.

Table 29. 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 2005 daylight period. Trace (T) indicates values >0.0 but <0.02.

Species	Catch rate (fish/angler-h)	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)
Walleye	0.80	0.61	0.19
White bass	0.85	0	0.85
Smallmouth bass	1.74	0	1.74
Channel catfish	1.66	1.52	0.14
Chinook salmon	0.34	0.31	0.03
Northern pike	0.03	0.03	T

Catch rates for walleye, white bass and channel catfish varied greatly during the 1994-2005 period (Table 30), while the mean catch rate for smallmouth bass has remained stable. Walleye catch rates were highest during the 1997 through 2001 period, peaking in 1998 at 1.18 walleye/angler-h. White bass and channel catfish catch rates have generally increased during the past 12 years from 0.02 and 0.01 in 1994 for white bass and channel catfish, respectively, to 0.14 and 0.07, respectively, in 2005. Catch rates, for walleye and for all species combined, peaked during the months of June and July in 2005 (Table 31), the same months that fishing pressure was the highest (Table 21).

In 2005, 79% of angling parties harvested an average of four or less walleyes per person during the April-October period, compared to 83% for 2004 (Table 32). Approximately 21% of angling parties averaged four or more walleye harvested per angler in 2005 (Table 32). Only 7% of angling parties during both 2004 and 2005 harvested a daily limit of six walleye per angler.

The percentage of angling parties harvesting a six-fish limit of walleyes was highest in upper Lake Oahe in 2005, at 13% and lowest in lower Lake Oahe at 1% (Table 32). The percentage of parties harvesting zero walleye per angler was lowest in middle Oahe in 2005, at 22% and highest in lower Oahe at 54%. Percentages of anglers harvesting a limit or zero fish per angler follow trends in walleye abundance among zones (Table 7).

Table 30. 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, 1993 through 2005.

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

Table 31. Estimated hourly catch, harvest, and release rates (fish/angler-h), for walleye and all species combined, by month, for the April-October 2005 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	0.04	0.04	0	0.36	0.28	0.08
May	0.17	0.15	0.02	0.64	0.48	0.16
June	0.66	0.53	0.13	0.87	0.58	0.29
July	0.58	0.40	0.18	0.84	0.45	0.39
August	0.20	0.16	0.04	0.53	0.21	0.32
September	0.13	0.09	0.04	0.31	0.22	0.09
October	0.15	0.14	T	0.30	0.19	0.11
Total	0.47	0.36	0.11	0.74	0.46	0.28

Table 32. 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 2004 and 2005 daylight survey periods.

Number /trip	Catch per trip							
	2004				2005			
	Lower	Middle	Upper	Total	Lower	Middle	Upper	Total
0	37	19	32	29	51	17	41	35
0-1	16	12	11	13	13	11	6	10
1-2	14	12	17	14	12	14	11	12
2-3	10	10	14	11	8	11	8	9
3-4	7	10	9	9	5	10	5	7
4-5	2	6	5	4	5	9	5	7
5-6	3	5	2	4	2	7	4	5
6-7	3	7	4	5	2	8	8	6
7-8	1	5	1	3	1	4	2	3
8-9	2	3	1	2	T	3	3	2
9-10	1	2	1	1	T	2	2	1
≥10	4	9	3	5	1	4	5	3

Number /trip	Harvest per trip							
	2004				2005			
	Lower	Middle	Upper	Total	Lower	Middle	Upper	Total
0	46	26	45	38	54	22	47	39
0-1	13	10	10	11	11	10	5	9
1-2	13	17	19	16	12	15	12	13
2-3	9	11	13	11	7	13	8	10
3-4	7	10	5	7	5	11	5	8
4-5	5	8	5	6	8	12	6	9
5-6	3	6	1	4	2	9	4	5
6	4	12	2	7	1	8	13	7

Angler Demographics and Economic Impacts

Average party size was 2.3 anglers/party, average trip length was 4.7 h, and 1780 parties were interviewed by angler use and harvest survey clerks during the April-October 2005 period. Approximately 77% of angler parties interviewed in 2005 were South Dakota residents (Table 33). The lower and upper zone had the highest percentage of angling parties that were South Dakota residents, at 78% and 80%, respectively. The percentage of total angling parties composed of non-residents was highest in middle Oahe in 2005, at 27%. During the 2002-2005 period, percentages of angling parties interviewed that were composed of residents and non-residents were similar among years (Table 33). Percentage of angling parties interviewed in lower and upper Oahe composed of non-residents generally declined during the 2002-2005 period.

Anglers from three states, Nebraska (33%), Iowa (16%), and Minnesota (23%) comprised 72% of the non-resident angler parties interviewed on Lake Oahe in 2005 (Table 34). Nebraska, Iowa, Minnesota, and North Dakota anglers had comprised the majority of non-resident angler trips to Lake Oahe, South Dakota during all years in the 2000-2005 period. For the April-October 2005 daytime period, the Lake Oahe fishery had a direct economic impact of 5.3 million dollars based on a 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).

Table 33. Percentage of total angler contacts for resident and non-resident (states combined) anglers fishing Lake Oahe during the April-October daylight period, 2002-2005. N is the number of parties interviewed.

Zone		Year			
		2002	2003	2004	2005
Lower	**N**	634	595	595	591
	Residents (%)	73	75	83	78
	Non-residents (%)	27	25	17	22
Middle	**N**	608	797	670	696
	Residents (%)	73	71	71	73
	Non-residents (%)	27	29	29	27
Upper	**N**	957	620	471	488
	Residents (%)	63	76	82	80
	Non-residents (%)	37	24	18	20
Total	**N**	2,199	2,012	1,736	1,778
	Residents (%)	68	74	78	77
	Non-residents (%)	32	26	22	23

Table 34. 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, 2000-2005.

State	Percent by year					
	2000	2001	2002	2003	2004	2005
Iowa	20	16	18	17	16	16
Nebraska	22	13	14	24	39	33
North Dakota	8	15	14	8	8	8
Colorado	5	4	5	5	8	4
Minnesota	22	32	30	25	14	23
Wisconsin	3	7	5	6	3	3
Wyoming	1	1	2	2	6	1
Other*	19	12	12	13	6	12

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

County of residence information for South Dakota resident anglers that fished Lake Oahe in 2005 are depicted in Figure 18 through Figure 21. The majority of resident anglers fishing lower Oahe in 2005 were from Hughes, Pennington, and Minnehaha counties, with 41% of resident anglers being from Hughes County (Figure 18). Because of travel distances of middle Oahe to major population centers in South Dakota, no one county comprised a high percentage of total resident angler contacts in this zone (Figure 19)Though anglers from Minnehaha, Hughes, Beadle, and Codington counties were well represented in the simple of angler interviews. Residents of Walworth and Brown counties comprised 45% and 24% of total resident angler contacts in upper Lake Oahe in 2005 (Figure 20).

During 2005 for all of Lake Oahe, Hughes County (Pierre) anglers comprised the greatest percentage of resident anglers fishing Oahe at 17% of interviews, followed by Walworth County at 13% (Mobridge), and Minnehaha County at 9% (Sioux Falls, Figure 21 and Table 35). During the 2000-2005 period, approximately 40% of angler interviews were annually from anglers traveling 200 miles or more, one way, to fish Lake Oahe, showing anglers are willing to travel substantial distances to fish Lake Oahe (Table 36).

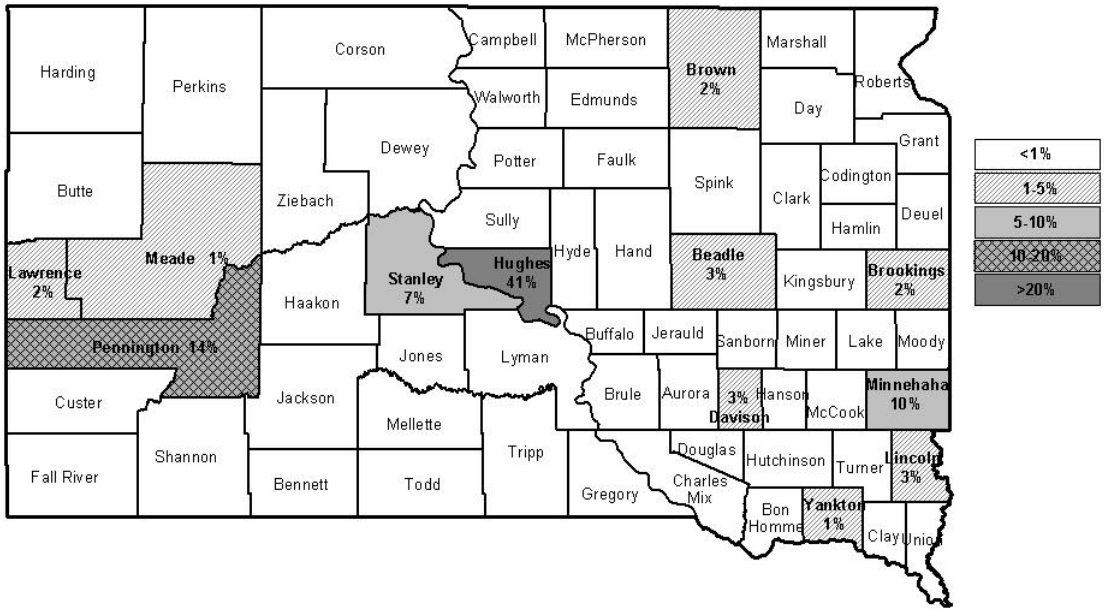

Figure 18.County of residency for South Dakota residents fishing lower Lake Oahe during the April-October 2005 daylight survey period.

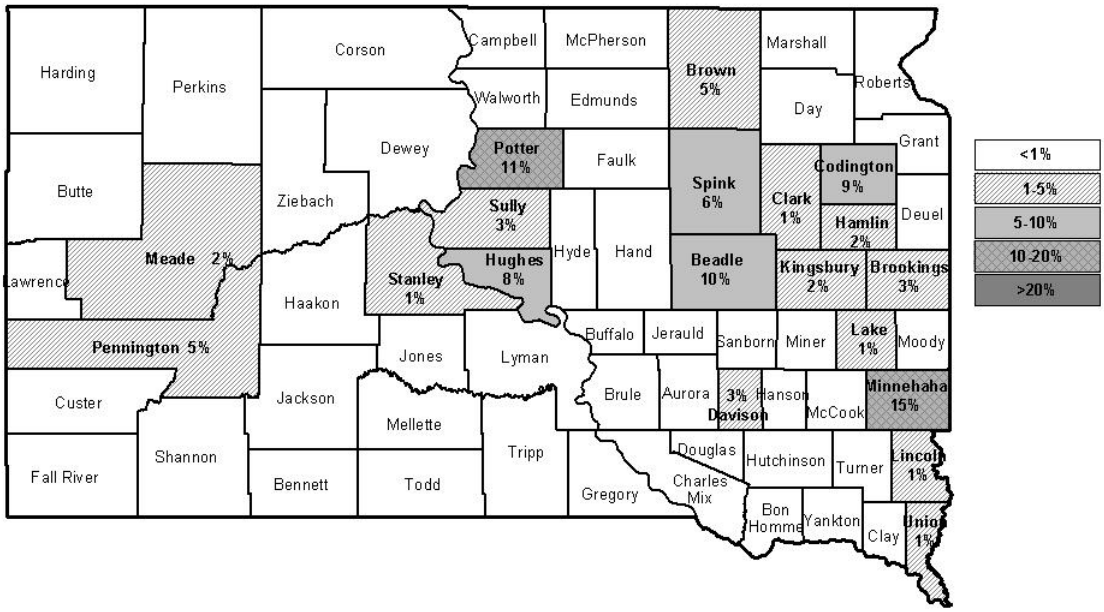

Figure 19. County of residency for South Dakota residents fishing middle Lake Oahe during the April-October 2005 daylight survey period.

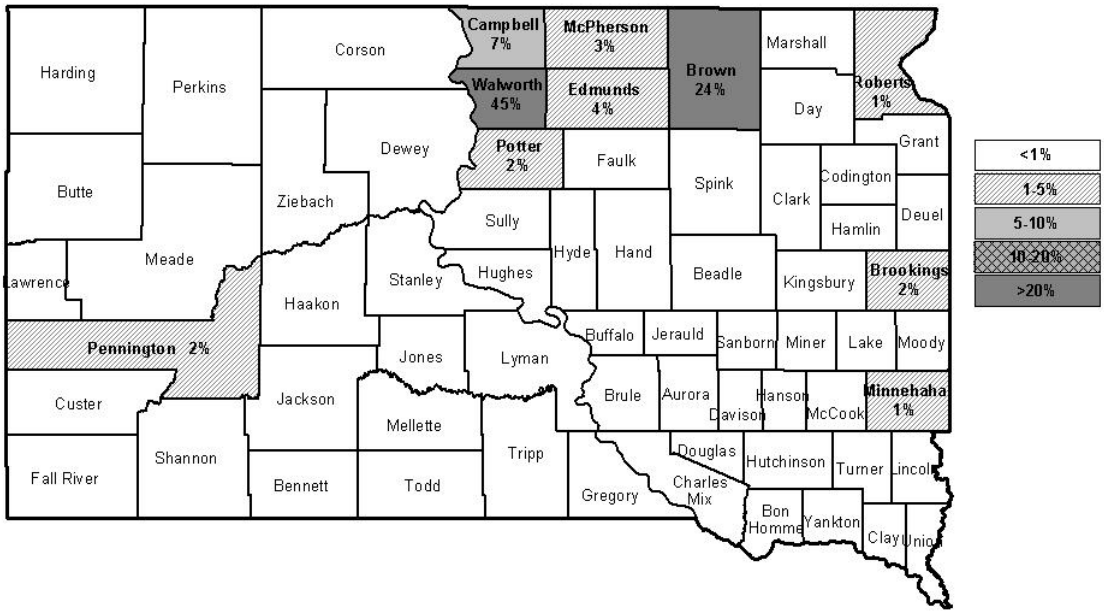

Figure 20. County of residency for South Dakota residents fishing upper Lake Oahe during the April-October 2005 daylight survey period.

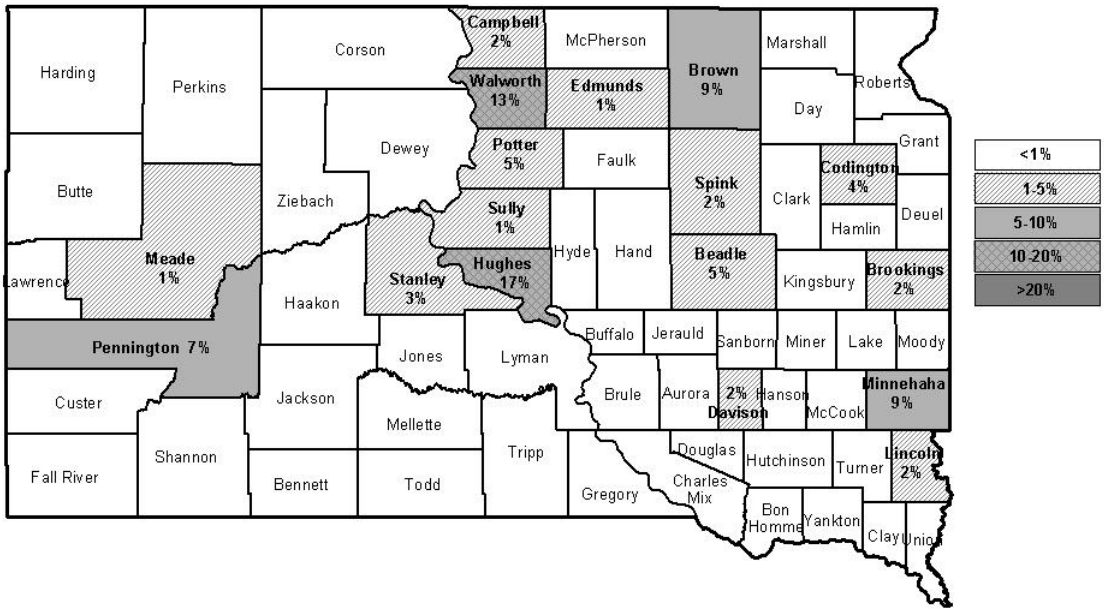

Figure 21. County of residency for South Dakota residents fishing Lake Oahe during the April-October 2005 daylight survey period.

Table 35. 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, 2002-2005.

County	Major city	Percent by year			
		2002	2003	2004	2005
Beadlle	Huron	2	4	3	5
Brown	Aberdeen	13	8	9	9
Campbell	Pollock	5	7	3	2
Codington	Watertown	3	3	2	4
Davison	Mitchell	2	2	2	2
Hughes	Pierre	11	17	25	17
Minnehaha	Sioux Falls	7	8	9	9
Pennington	Rapid City	8	7	6	7
Potter	Gettysburg	8	6	4	5
Stanley	Fort Pierre	4	2	2	3
Sully	Onida	2	2	2	1
Walworth	Mobridge	15	13	16	13
Other		20	21	17	23

Table 36. Percentage of anglers driving the specified distances, one way, to fish Lake Oahe, South Dakota, during the April-October daylight survey period, 2000-2005.

Distance (miles)	Percent by year					
	2000	2001	2002	2003	2004	2005
<25	27	29	24	25	27	22
25-49	6	2	7	8	11	10
50-99	5	10	12	4	5	4
100-199	21	18	14	19	18	22
≥200	41	41	43	44	39	42

The majority of anglers fishing Lake Oahe during the April-October 2005 period were targeting walleye (78%, Table 37). The percentage of angling parties fishing for "anything" in 2005, at 12%, was similar to other years in the 2001-2005 period and the percentage of anglers specifically fishing for salmon increased from 1% in 2004 to 6% in 2005.

Table 37. Target species of anglers fishing Lake Oahe, South Dakota, during the April-October daylight survey period, expressed as percent of total, 2001 - 2005. T (trace) indicates values > 0.0 but < 0.5.

Target species	Percent by year				
	2001	2002	2003	2004	2005
Walleye	82	78	75	82	78
Anything	13	14	15	13	12
Chinook salmon	2	4	5	1	6
Northern pike	2	4	4	2	2
White bass	T	T	0	T	T
Channel catfish	1	T	1	1	1
Smallmouth bass	1	T	T	1	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.

Anglers were asked two questions during their interview on their satisfaction and attitudes. Anglers fishing Lake Oahe were asked how satisfied they were with their fishing trip considering all factors and if they were on a professionally guided trip.

The overall satisfaction of the anglers interviewed during 2005 was "slightly satisfied." In 2004, the median satisfaction rating was also "slightly satisfied" (Lott et al 2006). Overall satisfaction on Lake Oahe during the April-October period of 2005 was 62% (Table 38), similar to the 2004 value of 60%,(Lott et al. 2006) but a significant increase over the 38% of anglers expressing some degree of satisfaction with their trip in 2003 (Lott et al. 2004). This increase in satisfaction from 2003 to 2004 and 2005 could be attributed to angler catches. Angler parties that caught or harvested 3.0 or more walleye per person in 2005 had "moderately satisfied" or "highly satisfied" ratings (Table 39). The fewer walleye each person in a party caught or harvested, the lower the corresponding trip rating tended to be (Table 39).

Table 38. Responses of Lake Oahe anglers who were asked the following question during the April-October 2005 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	13	22	17	16	17	2	1	0	88	3
May	22	48	28	42	40	28	20	1	229	4
June	155	97	69	57	46	18	18	3	463	2
July	206	173	88	50	33	37	37	1	625	2
August	22	51	27	29	19	26	17	1	192	3
September	2	13	21	6	17	16	8	2	85	4.5
October	5	11	12	10	23	25	10	0	96	5
Total	425	415	262	210	195	152	111	8	1,778	3
Percent		62				26				

Table 39. Responses of Lake Oahe anglers who were asked the following question during the April-October 2005 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	64	120	98	99	111	109	86	5	692	4
0-0.9	10	43	34	28	19	15	16	1	166	3
1.0-1.9	29	73	48	38	32	11	3	0	234	3
2.0-2.9	36	52	32	29	14	9	3	0	175	2
3.0-3.9	38	41	24	9	10	6	3	1	132	2
4.0-4.9	79	50	12	4	5	2	0	1	153	1
5.0-5.9	56	26	6	3	3	0	0	0	94	1
6.0	108	9	6	0	1	0	0	0	124	1
Percent		62				26				

While many factors influence the level of satisfaction anglers have with a fishing trip (Gigliotti 1996), the percentage of the daily limit anglers are able to harvest also influences angler trip satisfaction. A significant positive correlation ($P<0.001$, $r=0.89$, $d.f.=9$) existed between the percentage of the daily limit an angling party was able to attain and their expressing some level of satisfaction with their fishing trip (Figure 22). During years when the daily limit exceeded four walleye, satisfaction ratings were often below the management objective of 70% because anglers were not able to attain a high enough percentage of the daily limit to be satisfied. Angler expectations for walleye harvest are set, in part, by the daily limit, and high daily limits that are unattainable during the majority of trips result in low angler satisfaction ratings.

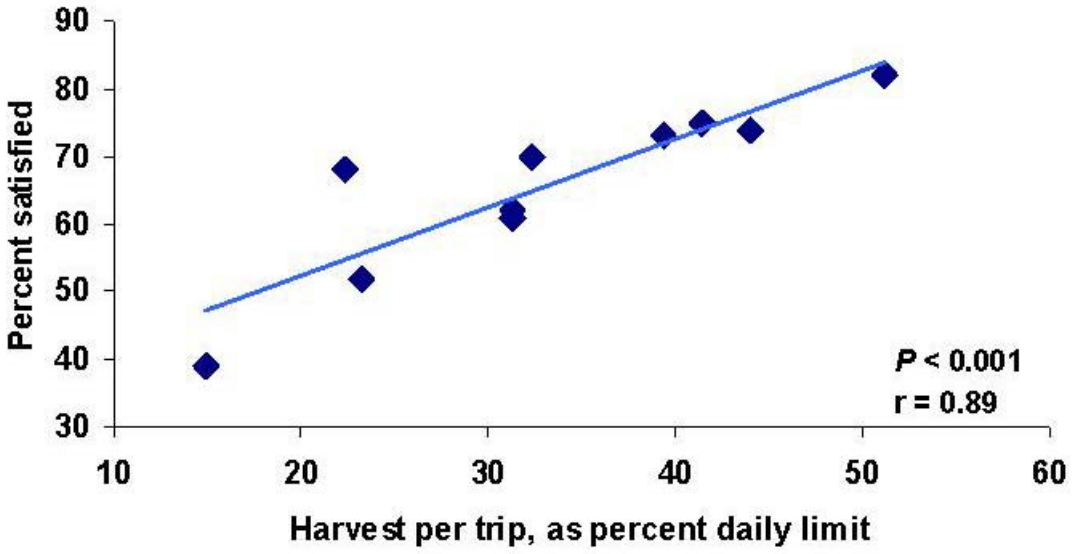

Figure 22. Relationship between the average percentage of the daily limit an angling party attained and the percentage of parties expressing some level of satisfaction with their fishing trip, 1996-2005 data.

As part of angler interviews conducted during the 2005 angler use and harvest survey, anglers were asked if they were on a guided fishing trip. For the April-October survey period, 4% of parties stated they were on a guided trip (Table 40). The highest percentage of total trips consisting of guided trips was 7% in August.

Table 40. Percentage of anglers interviewed during the April-October 2005 daytime survey on Lake Oahe that were angling with a guide. N is sample size.

	Month							
	April	**May**	**June**	**July**	**August**	**Sept.**	**Oct.**	**Total**
N	81	227	463	625	188	84	95	1,763
Yes (%)	0	1	5	3	7	4	3	4
No (%)	100	99	95	97	93	96	97	96

While only 4% of angling parties interviewed by survey clerks were guided parties, average harvest per angler frequencies differed markedly between anglers on guided and. non-guided trips (Figure 23). As an example, the percentage of trips where zero walleye were harvested per angler was 3% for guided parties but 40% for non-guided trips. Likewise, 15% of guided parties harvested a six-fish daily limit per angler, compared to 7% for anglers in non-guided parties.

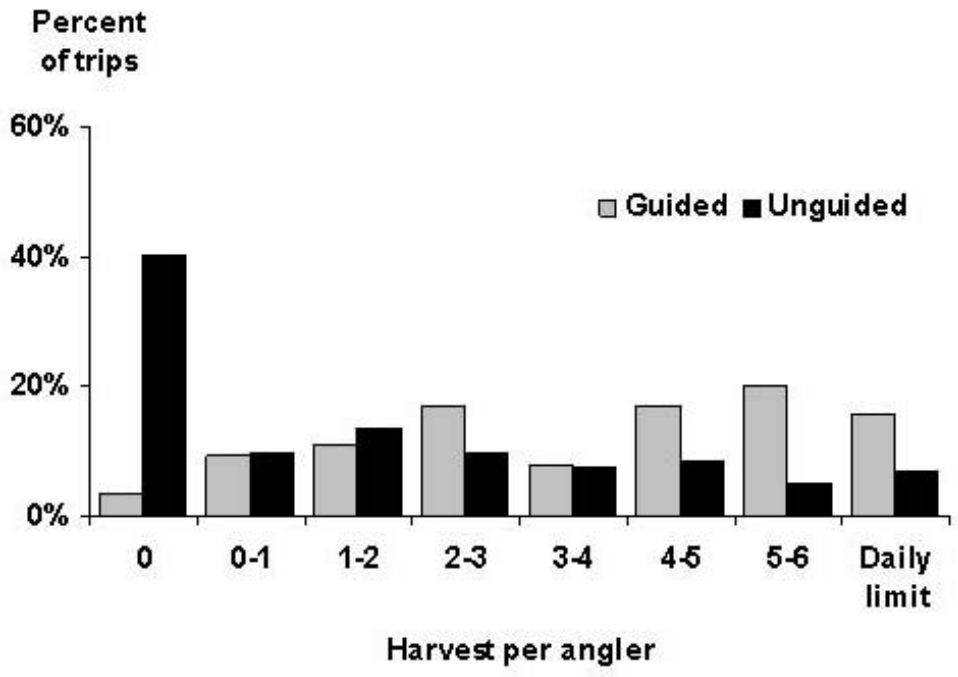

Figure 23. Average harvest of walleye per angler frequencies for guided and non-guided trips on Lake Oahe, South Dakota, April-October 2005.

FISHERY STATUS AND 2006 OUTLOOK

A number of issues currently affect the Lake Oahe walleye fishery. Walleye recruitment has been low to moderate since 1995 (Figure 4). The 2001 year class comprised the largest portion of the population and the angler harvest in 2005 (Table 15) and recruitment of walleye has been lower in the lower zone of the reservoir than in the upper two zones. Only 4% of the 2005 gill net sample of walleye from lower Oahe was ≤380 mm TL. While recruitment is occurring in the upper two-thirds of Oahe, walleye do not appear to be migrating downstream into the lower zone of the reservoir.

Low walleye recruitment in lower Lake Oahe was first discussed by Riis (1983). Lower and middle Oahe were annually stocked with walleye fry or small fingerlings (700-2,000 per pound) from the early 1980's through 1998. Stocking was discontinued after 1999 because of a high abundance of naturally produced fish in the 1990's and a need to reduce total predator numbers because of a substantial reduction in rainbow smelt abundance. However, the feasibility of re-initiating stocking efforts to increase recruitment and walleye abundance in lower Lake Oahe should be investigated. Catch and harvest per trip frequencies (Table 32), estimated walleye harvest (Table 26), estimated fishing pressure (Table 23), and a lack of fish less than quality length (Table 10 and Figure 6) in lower Oahe, all suggest an increase in recruitment in this portion of the reservoir is needed.

While the percentage of angling parties expressing some degree of satisfaction with their fishing trip during 2005, at 62%, was below the LOSP objective of 70%, it was substantially higher than values for the 2001-2003 period, when the daily limit for walleye was 14 or 10. The number of walleye that can be harvested on a trip is a function of hourly harvest rate and trip length. With average trip length being about five hours for Lake Oahe and the highest annual hourly walleye harvest rate by anglers estimated at 0.62 fish/angler-h in 2001 (Lott et al. 2002), average harvest per angler trip has not exceeded about three walleye. When the relationship between angler satisfaction and the average percentage of the daily limit harvested by anglers is referenced (Figure 22), lower daily limits, for a given harvest rate, result in a higher percentage of satisfied anglers. Therefore, if the six fish daily limit is only attainable by a small percentage of anglers (Table 32) and decreasing the daily limit would mean anglers, on average, would be attaining a higher percentage of the daily limit and be more satisfied, decreasing the daily limit back to four fish should seriously be considered.

The white bass die off during the summer of 2005 resulting from an outbreak of Columnaris bacteria will certainly affect white bass abundance and angler catch rates during the next few years. An estimated 65,743 white bass were caught (Table 25 and Table 26) by anglers during the April-October 2005 period but less than 0.5% of anglers fishing Lake Oahe were specifically targeting white bass (Table 37).

MANAGEMENT RECOMMENDATIONS

1. Update the Missouri River Fisheries Management Plan by the end of June 2007.

2. 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

3. Reduce the daily limit for walleye to four and stipulate that at most one fish in the daily limit may be 20 inches or longer.

4. Investigate possible reasons for low walleye recruitment in lower Lake Oahe and investigate possible stocking options to supplement natural reproduction.

5. Continue to conduct annual creel and angler harvest surveys.

6. Continue to conduct annual fish population surveys.

7. Incorporate smelt spawn, larval trawl, and hydroacoustic surveys into annual report.

8. Continue to stock Chinook salmon and evaluate the contribution of stocked salmon to the fishery.

9. Re-establish the July 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 1997-2005, for fish collected in the standard August gill net survey, on Lake Oahe, South Dakota. Mean *Wr* values for 2002-2005 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

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

Appendix 3. Angler satisfaction, preference, and attitude questions asked as part of the April-October 2005 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

Guided Trip Question:

Guided Trip: Yes or No