MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION
JOB PROGRESS REPORT

STATE: MONTANA PROJECT TITLE: STATEWIDE FISHERIES INVESTIGATIONS

PROJECT NO.: F-78-R-6 STUDY TITLE: SURVEY AND INVENTORY OF WARMWATER LAKES

JOB NO.: IV-C JOB TITLE: FORT PECK RESERVOIR STUDY

PROJECT PERIOD: JULY 1, 2015 THROUGH JUNE 30, 2016
REPORT PERIOD: MARCH 1, 2015 THROUGH FEBRUARY 29, 2016

ABSTRACT

Fort Peck Reservoir reached peak elevation on June 20th, 2015 at 2237.17 mean feet above sea level (MSL) from a minimum elevation on January 11th, 2015 at 2233.34 MSL, a rise of 3.83 feet. Spawning walleye populations were sampled in the upper Big Dry Arm with modified fyke nets from March 31st to April 23rd. Walleye eggs were collected and the fertilized eggs were sent to Fort Peck and Miles City fish hatcheries. Trap netting captured 1,740 walleye for a catch rate of 4.3 per net night in 2015 which was down slightly from the previous year of 4.5 per net night. Due to favorable spawning conditions, 67 million walleye eggs were collected in 2015. A total of 25.3 million fry and 3.6 million walleye fingerlings were stocked in various locations throughout Fort Peck Reservoir. One hundred gill nets were set in standard locations throughout the reservoir from July 21st to August 13th, 2015. Walleye, northern pike, and goldeye were the most abundant species captured overall, with catch rates of 4.9, 2.6, and 2.1 per net night, respectively. Relative abundance of walleye in 2015 was similar to the previous year at 4.9 per net night which is above the long-term average of 3.8 per net for the period from 1984 to 2015. Gill-netted walleye averaged 16.6 inches and 2.1 pounds. In 2015, relative abundance increased slightly for quality-size walleye while catch rates of all other length groups remained similar. Relative weights of walleye increased for quality length and greater while stock length remained similar. Northern pike relative abundance in 2015 decreased to 2.6 per net night but was above the long-term average of 1.8 per net night for the period of 1984 to 2015. Average size of gill-netted northern pike in 2015 was 26.3 inches and 5.0 pounds. Overall, relative abundance of shoreline forage decreased to 80.5 per haul in 2015 and was below the long-term average of 169 per haul from 1984 to 2015. Relative abundance of young-of-year yellow perch continued to decrease in 2015 to 10.5 per seine haul. In June of 2015, 54,534 chinook salmon were stocked at the Fort Peck Marina and Milk Coulee. Young-of-year cisco relative abundance decreased to 25.4 per net night in 2015 which was below the long-term average of 77 per net night for the period of 1986 to 2015.

OBJECTIVES AND DEGREE OF ATTAINMENT

Activity 1 - Survey and Inventory

Objective: To survey and monitor the characteristics and trends of fish populations and to assess habitat conditions in Fort Peck Reservoir. This objective was met and is presented in the Results and Discussion section of this report.

Activity 2 - Fish Population Management

Objective: To implement fish stocking programs to maintain fish populations at levels consistent with habitat conditions and other limiting factors. This objective was met and results are presented in Results and Discussion of this report.

Activity 3 - Technical Guidance

Objective: To review projects by government agencies and private parties that have the potential to affect fisheries resources, provide technical advice or decisions to mitigate effects on these resources, and provide landowners and other private parties with technical advice and information to sustain and enhance fisheries resources. This objective was met by evaluating the impact of reservoir water levels on the fishery and was presented to North and South Dakota fisheries personnel during annual Missouri River mainstem reservoir meetings. This information was also presented to Corps of Engineers to make recommendations for Annual Operating Plan (AOP). Objectives of the Fort Peck Reservoir Fisheries Management Plan (FPRFMP) are presented in the Results and Discussion of this report. The FPRFMP will guide fisheries management activities on Fort Peck Reservoir for a ten-year period (2012-2022). Staff assisted the regional fisheries manager during the 2016 fishing regulation setting process. Objective accomplished.

Activity 4 - Aquatic Education

Objective: To enhance the public's understanding, awareness and support of the state's fishery and aquatic resources and to assist young people to develop angling skills and to appreciate the aquatic environment. Sixty-three volunteers assisted with the annual walleye egg-taking operation in the upper Big Dry Arm of Fort Peck Reservoir. Reservoir staff assisted with kids fishing clinics and as science fair judges. Staff also assisted the regional information and education officer with multiple press and fisheries information for the R6 Facebook page. Staff attended Walleyes Unlimited meetings in Billings and Malta to present annual updates on the status of the Fort Peck Reservoir fishery. Staff submitted a fisheries related article to Walleyes Unlimited that was presented in the fall issue of Fish Tales magazine. Objective accomplished.

STUDY AREA

Fort Peck Reservoir is a large earth-filled dam on the Missouri River located in northeastern Montana. Figure 1 depicts major roads around Fort Peck Reservoir, select locations and 5 sampling regions the reservoir is divided into: upper Big Dry Arm (UBD), lower Big Dry Arm (LBD), lower Missouri Arm (LMA), middle Missouri Arm (MMA), and upper Missouri Arm (UMA). The dam was closed in 1937 and is the largest water body in the state of Montana, with 240,000 surface acres at full multiple use pool. Full flood pool is reached at 2250 and multiple use pool is reached at 2246 mean feet above sea level (MSL). At full multiple use pool 1,500 miles of shoreline exists in 130 linear miles of the reservoir with a maximum depth of 220 feet. The bottom of the multiple use pool is 2234.19 MSL and the bottom of the multipurpose carryover zone is 2160 feet MSL. The reservoir reached peak elevation on June 20th, 2015 at 2237.17 mean feet above sea level (MSL) from a minimum elevation on January 11th, 2015 at 2233.34 MSL, a rise of 3.83 feet (Figure 2). Reservoir elevations are predicted to rise approximately four feet from March through June and fall beginning in August of 2016based on the March 2016 basic forecast (USACE 2015).

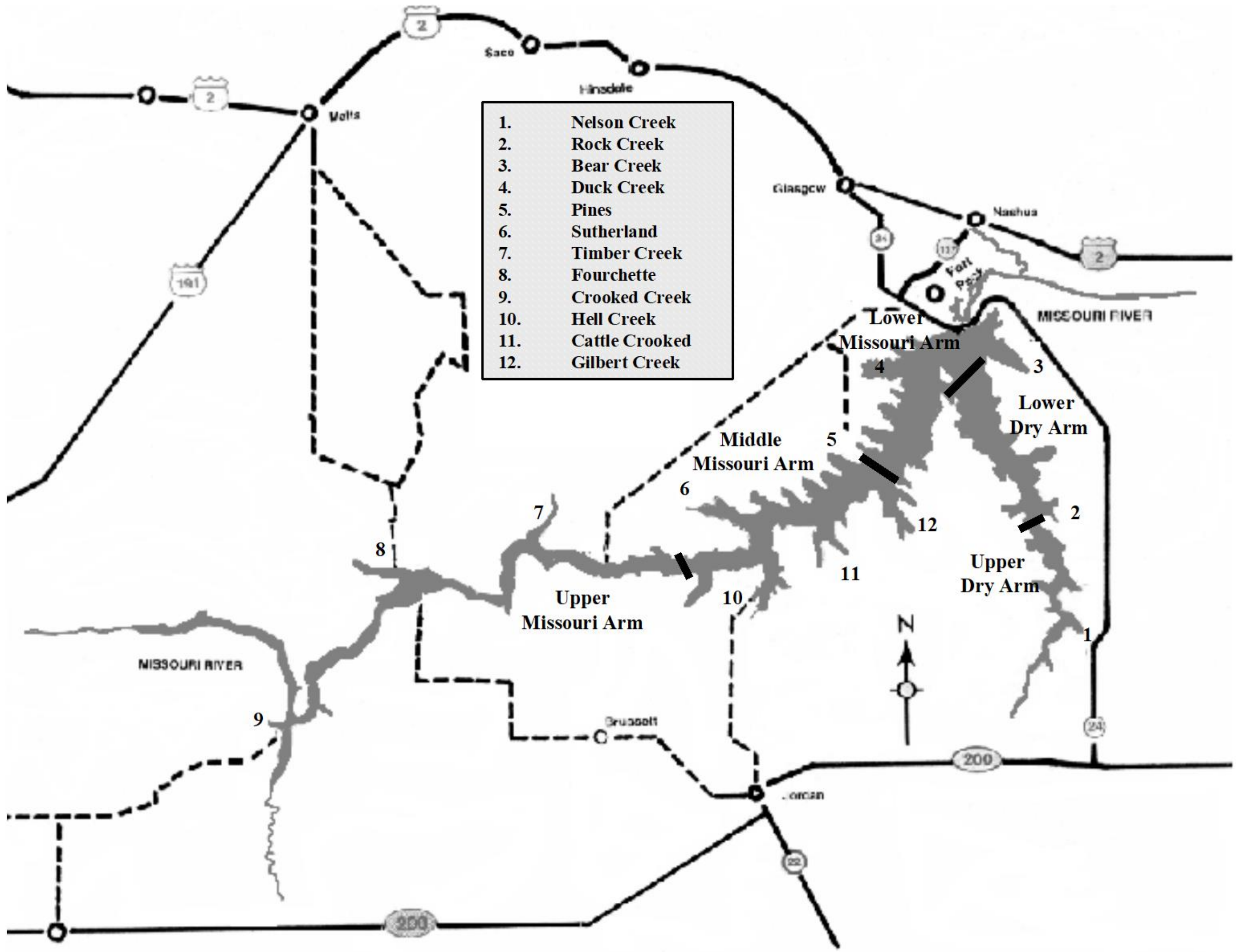


Figure 1. Fort Peck study area describing major sampling zones and select specific locations.

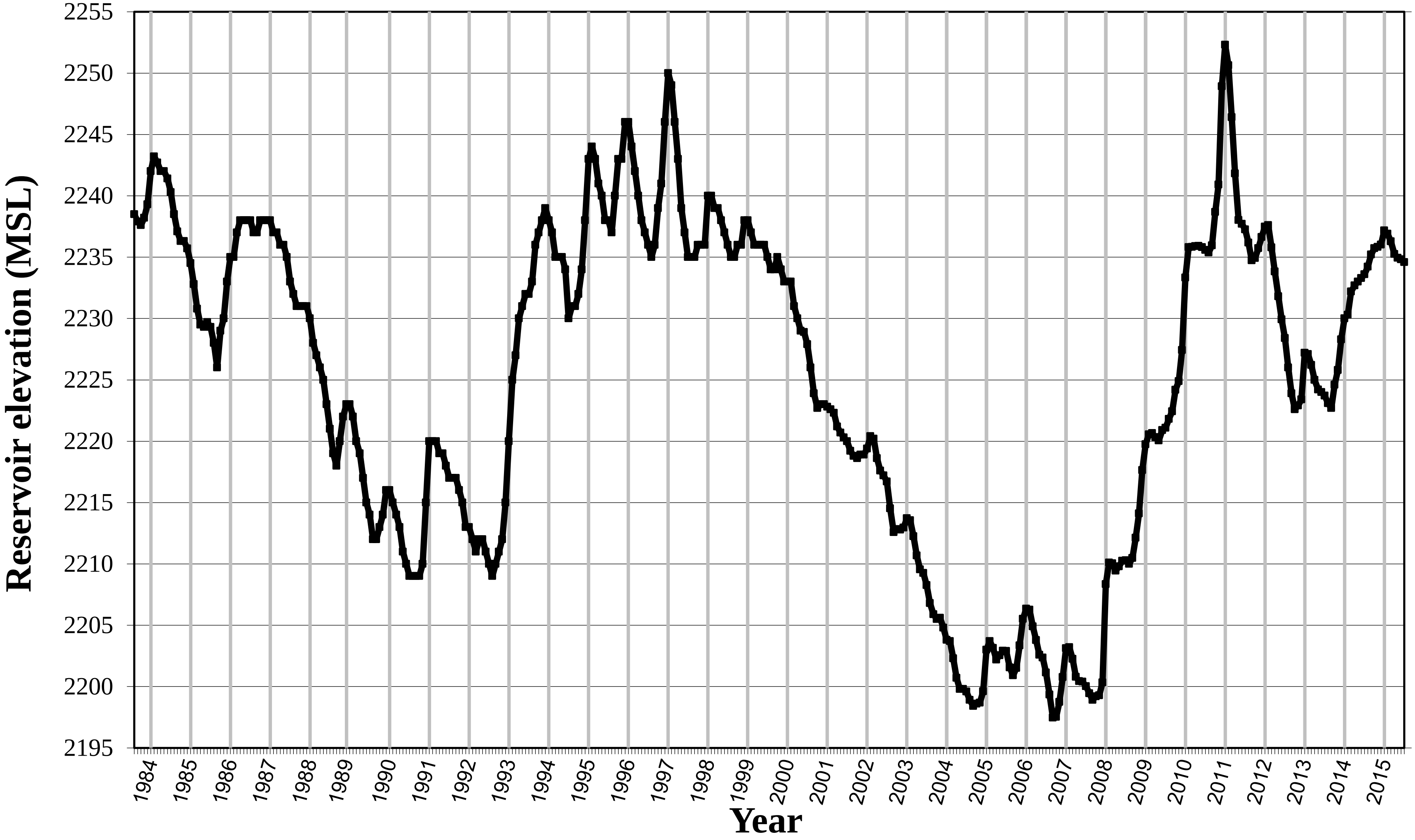


Figure 2. Peak monthly reservoir elevations on Fort Peck Reservoir from January 1984 to January 2015 (Data provided by the U.S. Army Corps of Engineers).

SAMPLING METHODS

Data Collection

- Spring sampling was conducted from March 31st to April 23rd, 2015 in the Big Dry Arm with 4-ft x 6-ft modified fyke nets of 1-in square mesh rigged and 30 to 50-ft leads. This netting effort is targeted for collection of walleye and northern pike to provide an egg source to meet stocking requests for Fort Peck Reservoir and other sport fisheries for the state of Montana. Not all fish are weighed and measured during the egg-taking effort due to time constraints, limited manpower, and rough conditions at times. Therefore, subsamples of fish are presented in the tables and length frequency distributions of this report. Vokoun et al. (2001) recommended using 300-400 individuals when constructing length frequency distributions with a given accuracy and precision.
- Limnological sampling was conducted at six sites (Bug Creek, Spring Creek, Haxby, Pines, Hell Creek, and Timber Creek) throughout the reservoir. Profile measurements were collected at 10-ft intervals using a Hydrolab equipped with a DS5 probe and Surveyor 4 data logger from May through September during the middle of each month. Profile measurements were recorded from the subsurface to the maximum depth at each site. Specific measurements included: temperature (°C), dissolved oxygen (mg/L), pH (standard units), turbidity (NTU), and total dissolved solids (g/L). A detailed table is located in Appendix 3 of the report.
- Zooplankton samples were collected using a 153 µ mesh net with a 12-in diameter opening and a 1:3 cone. Sampling was conducted at the same six sites listed above to address differences in general productivity and morphology of the reservoir. Fifty foot vertical tows were made monthly at each of the sampling stations from May through September. Two tows were conducted at each site and pooled into one sample. Zooplankton processing methods follow those described by Leathe and Graham (1982).
- One hundred sinking experimental multifilament gill nets 125-ft x 6-ft deep consisting of 25-ft panels of ¾, 1, 1 ¼, 1 ½, and 2-in square mesh were fished from 10 to 30-ft depths. Gill netting occurred from July 21st to August 13th, 2015 to monitor distribution, species composition, relative abundance, and population parameters for game and native species throughout the reservoir. A list of sampling dates by region, water surface temperature and reservoir elevation during time of sampling are presented in Appendix 3.
- All walleye otoliths were collected at all sampling locations. Otoliths were mounted in epoxy and cut into thin sections on an Isomet saw and later mounted on glass slides. Walleye otoliths were used as an aging structure because of their higher precision when compared to scales and spines (Erickson 1983; Isermann et al. 2003). Growth was expressed as mean length-at-age at time of capture in July/August for walleye. No age and growth information are available for 2013 and 2015 due to the otolith microchemistry study.
- Beach seining was conducted from August 10th to September 8th, 2015 using a 100-ft x 9-ft beach seine of 3/16-in square mesh at 100 locations throughout the reservoir, to determine relative abundance and reproductive success of game and forage fish.
- Twelve multifilament gill nets 100-ft x 6-ft with ½-in square mesh were fished vertically from the water's surface to sample young-of-year cisco from September 16th to September 24th, 2015. Additional mesh sizes of ¾, 1, 1 ¼, 1 ½-in mesh were incorporated in 2013 to sample adult cisco. Only the lower Big Dry, lower Missouri, and middle Missouri Arms were sampled because they contained sufficient depths of 100 ft.
- Electrofishing was used during September 28th to November 2nd, 2015 to locate, sample, and collect chinook salmon as part of the annual egg-take effort.
- Chinook salmon otoliths were collected from all mortalities used in the egg taking process. Otolith preparation followed methods outlined by Secor et al. (1992). Otoliths were mounted in epoxy and cut into thin sections on an Isomet saw and later mounted on glass slides.

Data Analysis

Relative abundance of fish species was expressed as mean catch per unit effort (CPUE) for modified fyke nets (No./net night), gill net (No./net night), and seine catches (No./haul).

Proportional stock density (PSD; Anderson and Weithman 1978) and relative stock density (RSD) values were calculated for channel catfish, northern pike, sauger, smallmouth bass, and walleye (Gablehouse 1984). Length categories used to calculate PSD and RSD values are listed in Table 1.

Table 1. Minimum lengths (in) 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	11	16	24	28	36
Northern pike	14	21	28	34	44
Sauger	8	12	15	20	25
Smallmouth bass	7	11	14	17	20
Walleye	10	15	20	25	30

Relative weights (*Wr*; Anderson 1980) were calculated using the standard weight (*Ws*) equations developed for channel catfish (Brown et al. 1995), northern pike (Willis 1989), and walleye (Murphy et al. 1990). Calculated values for channel catfish and northern pike are presented in Appendix 4, while values for walleye are presented in the results and discussion section of this report. Proportional stock density, RSD, and *Wr* values were calculated using EXCEL.

RESULTS AND DISCUSSION

Spring Trap Netting

Spawning walleye and northern pike populations were sampled in the Nelson Creek to McGuire Creek area of Fort Peck Reservoir from March 31st to April 23rd, 2015. A total of 405-trap days were committed to walleye spawning efforts in 2015. Netting effort was higher than the previous year due to earlier ice out. Ice cover has typically receded by the first week in April and the walleye spawning operation concludes in three to four weeks. Water surface temperatures were 52°F when trap netting efforts commenced and but decreased to 42°F over the course of a week due to cold fronts that moved through the area. Walleye spawning activity peaks when water temperatures are 43°F to 50°F in the north-central United States (Becker 1983).

Because of the declining water temperatures in 2015, walleye egg collection efforts lasted nearly five weeks. Fluctuations and declines in water temperatures have been shown to prolong spawning or result in females retaining their eggs (Derback 1947). However, the egg-take goal of 60 million was met and 67 million total eggs were collected. The fertilized walleye eggs were sent to the Fort Peck and Miles City Fish Hatcheries. A total of 25.3million fry and 3.6 million walleye fingerlings were stocked in various locations throughout Fort Peck Reservoir (Appendix 2). Kerr (2011) recommended walleye release sites should be increased as size and basin complexity of the waterbody increases to distribute them over as wide an area as possible. The goal of 3 million fingerlings for Fort Peck Reservoir was met (FPRFMP 2012). This was due to above average fingerling production at the Miles City and Fort Peck hatcheries. Warmer water temperatures and increased zooplankton densities were observed in the rearing ponds at Fort Peck and Miles City hatcheries during the time of fry stocking (i.e., Wade Geraets, personal communication). These conditions have been shown to be favorable for growth and survival of newly stocked walleye fry.

Walleye

Relative abundance of walleye in spring trap nets was 4.3 per net in 2015, which decreased slightly from the previous year, and below the long-term average of 7.2 per net (1982-2015; Table 2). Average length and weight increased from19.8 inches and 3.6 pounds in 2014 to 21.1 inches and 4.5 pounds in 2015. Furthermore, length frequency distributions showed 59% of walleye were greater than 20 inches in 2015 compared to 45% in 2014 (Figure 3). In general, length frequency distributions during the spring trap netting effort indicated male walleye were smaller when compared to female; however, male walleye up to 29 inches were captured (Figure 4).

Table 2. Summary of mean CPUE (No./net-night), mean length (in), and mean weight (lb)walleye and northern pike captured during spring trap netting in the upper Big Dry Arm of Fort Peck Reservoir, 1982-2015. N is the total number of walleye and northern pike collected.

Year	Date	Net-Nights	Walleye N	Walleye CPUE	Northern pike N	Northern pike CPUE
1982	(4/21-5/07)	89	655	7.4	221	2.5
1983	(4/06-5/09)	106	725	6.8	87	0.8
1984	(4/10-5/04)	96	579	6	21	0.2
1985	(4/08-4/26)	97	1,202	12.4	69	0.7
1986	(4/07-4/24)	102	1,448	14.2	174	1.7
1987	(4/07-4/24)	220	1,512	6.9	78	0.3
1988	(4/06-4/22)	214	1,610	7.5	163	0.8
1989	(4/25-5/06)	207	2,360	11.4	383	1.9
1990	(4/05-5/04)	292	1,863	6.4	513	1.8
1991	(4/09-5/10)	375	793	2.1	491	1.3
1992	(4/07-4/29)	278	1,585	5.7	684	2.5
1993	(4/15-4/30)	172	1,945	11.3	201	1.2
1994	(4/12-4/26)	168	1,882	11.2	160	1
1995	(4/11-4/28)	473	3,284	6.9	648	1.4
1996	(4/15-5/02)	391	3,231	8.3	2,307	5.9
1997	(4/15-4/29)	307	3,937	12.8	2,652	8.6
1998	(4/04-4/29)	477	2,806	5.9	1,354	2.8
1999	(3/27-4/26)	434	5,673	13.1	2,573	5.9
2000	(4/04-4/28)	392	2,126	5.4	603	1.5
2001	(4/06-4/27)	328	3,362	10.3	1,922	5.9
2002	(4/17-5/09)	349	2,377	6.8	1,713	4.9
2003	(4/11-5/01)	426	2,366	5.6	1,579	3.7
2004	(4/09-4/26)	324	2,323	7.2	2,174	6.7
2005	(4/06-4/27)	537	2,030	3.8	1,327	2.5
2006	(4/12-5/01)	579	2,345	4.1	503	0.9
2007	(4/03-5/01)	617	2,478	4	1,425	2.3
2008	(4/18-5/07)	383	1,151	3	629	1.6
2009	(4/18-4/28)	176	1,740	9.9	813	4.6
2010	(4/13-4/30)	289	1,470	5.1	525	1.8
2011	(4/18-5/06)	399	1,341	2.8	911	2.3
2012	(3/27-5/01)	730	1,576	2.2	1,499	2.1
2013	(4/17-5/10)	484	2,176	4.5	5,082	10.5
2014	(4/18-5/5)	363	1,670	4.6	2,864	7.9
2015	(3/31-4/23)	405	1,740	4.3	1,147	2.8

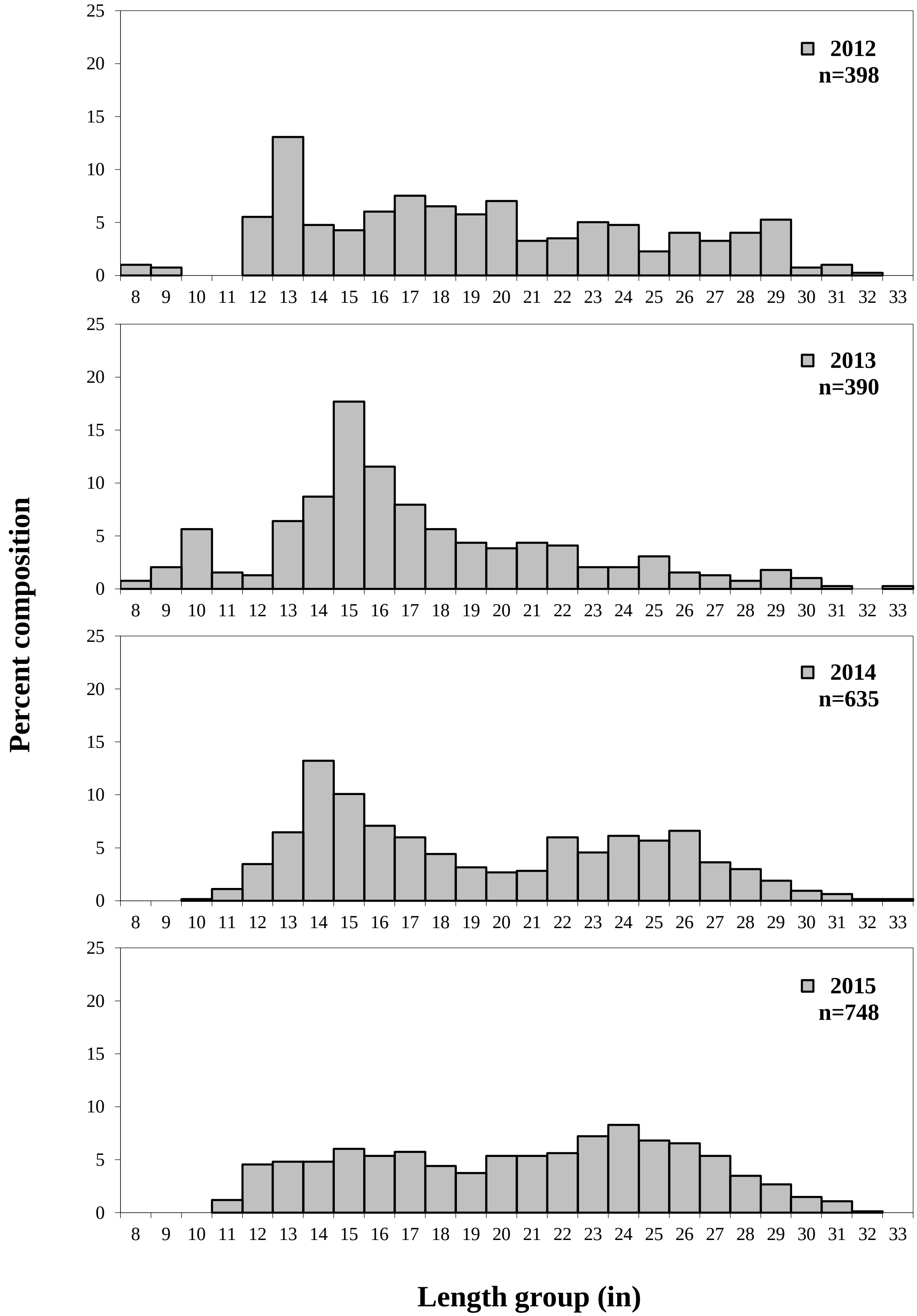


Figure 3. Length frequency of subsampled walleye collected during spring trap netting in the upper Big Dry Arm of Fort Peck Reservoir, 2012-2015.

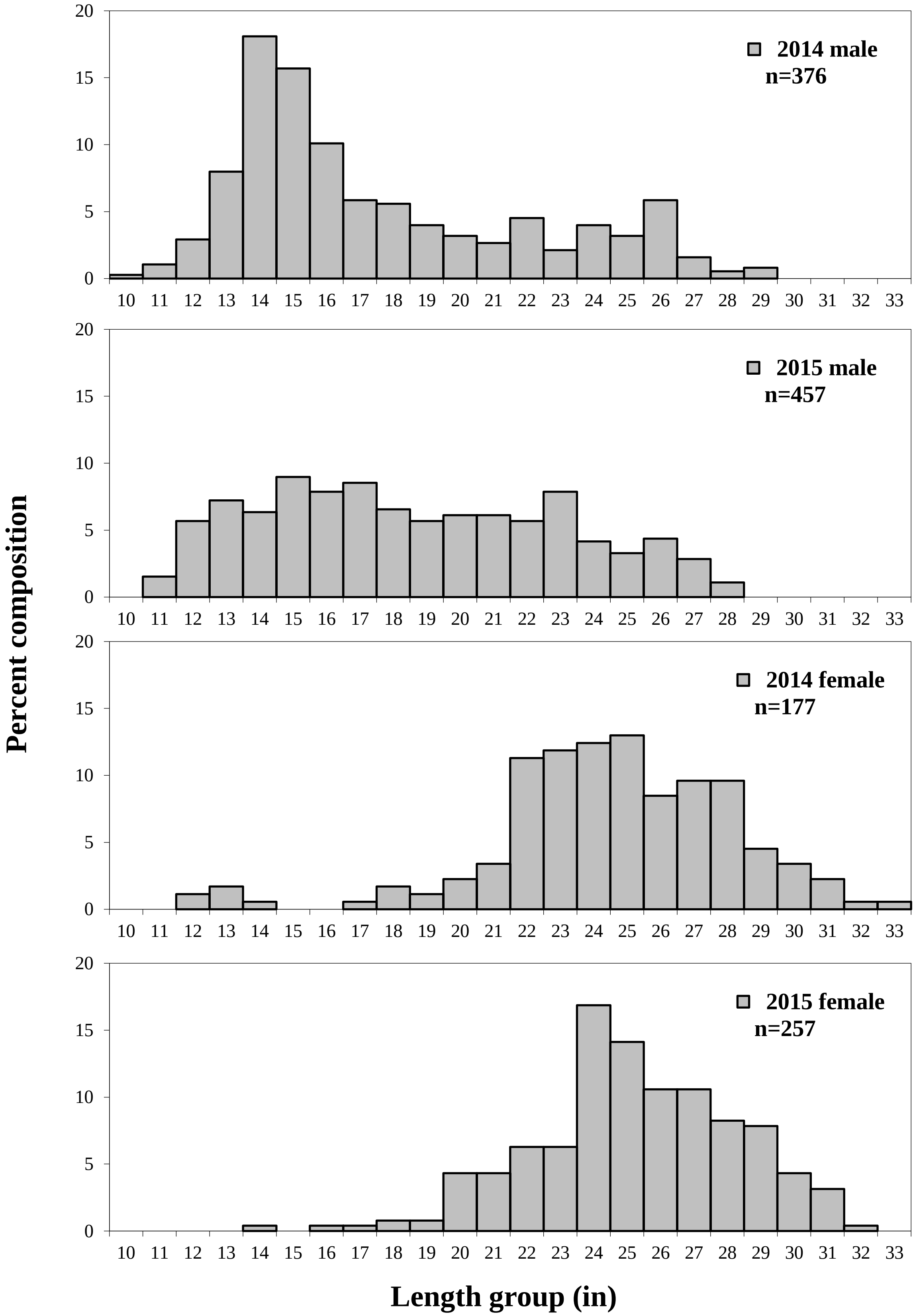


Figure 4. Length frequency of subsampled male and female walleye collected during spring trap netting in the upper Big Dry Arm of Fort Peck Reservoir, 2014-2015.

LIMNOLOGY AND ZOOPLANKTON MONITORING

Water temperature in Fort Peck Reservoir ranged from 24.3°C below the water surface to 4.9°C at the bottom (Appendix 3). Temperatures throughout the water column were coolest during May and warmest during August. Water temperatures below the surface were warmest at the uppermost sites (Timber Creek and Bug Creek) during the sampling period but gradually decreased at each site moving downstream towards the dam area.

Near isothermal conditions were observed during the month of May at each site. Thermal stratification of Fort Peck Reservoir was not observed until July and strong thermoclines were present in August (Appendix 3). Each site was thermally stratified during the month of August with the exception of Timber Creek. Thermocline depth varied by month and site. The most pronounced thermocline was located at the Haxby site during July (Figure 5; Appendix 3).

Dissolved oxygen concentrations were highest (10.4 mg/L) during May when the reservoir was coolest. Uniform dissolved oxygen levels were also observed during this time when near isothermal conditions were present (Appendix 3). Dissolved oxygen concentrations decreased to their lowest levels during late summer/early fall. Dissolved oxygen levels fell below 5 mg/L at Pines during September. Although no anoxic conditions were observed at any of the locations in 2015, dissolved oxygen levels of less than 5 mg/L may limit some deep-water salmonid habitat (e.g., lake trout; Sellers et al. 1998).

The maximum estimated zooplankton density was 59.3/L which occurred in May of 2015 and was comprised largely of rotifers. With the exception of May, cyclopoids dominated the zooplankton community into September and reached peak density in August at 19.6/L. *Bosmina* and *Daphnia* were the two most abundant cladocerans sampled. *Bosmina* were more abundant in June while *Daphnia* where more abundant in July through September (Figure 6). Cladocerans, *Leptodora* and *Diaphanosoma*, were present in small numbers and were only collected periodically. These trends in seasonal abundance are similar to previous findings on Fort Peck Reservoir and other large mainstem Missouri River Reservoir systems (Wiedenheft 1985; Mullins 1991; Fielder 1992).

Comparison of total densities for all zooplankton from each station indicated that the mid to lower portions of Fort Peck Reservoir were slightly more productive than other areas sampled (Figure 7). Wiedenheft (1985) noted a similar trend in zooplankton density. Mean densities of zooplankton were similar to lower in 2015at all locations with the exception of the Pines. A possible explanation for similar zooplankton densities in 2014 and 2015 could be explained by stable reservoir elevations and similar flows into the reservoir. Reduced inflows were characteristic of Fort Peck Reservoir in 2014 and 2015, which have been shown to decrease standing crops of zooplankton and diversity of the zooplankton community (Martin et al. 1981).

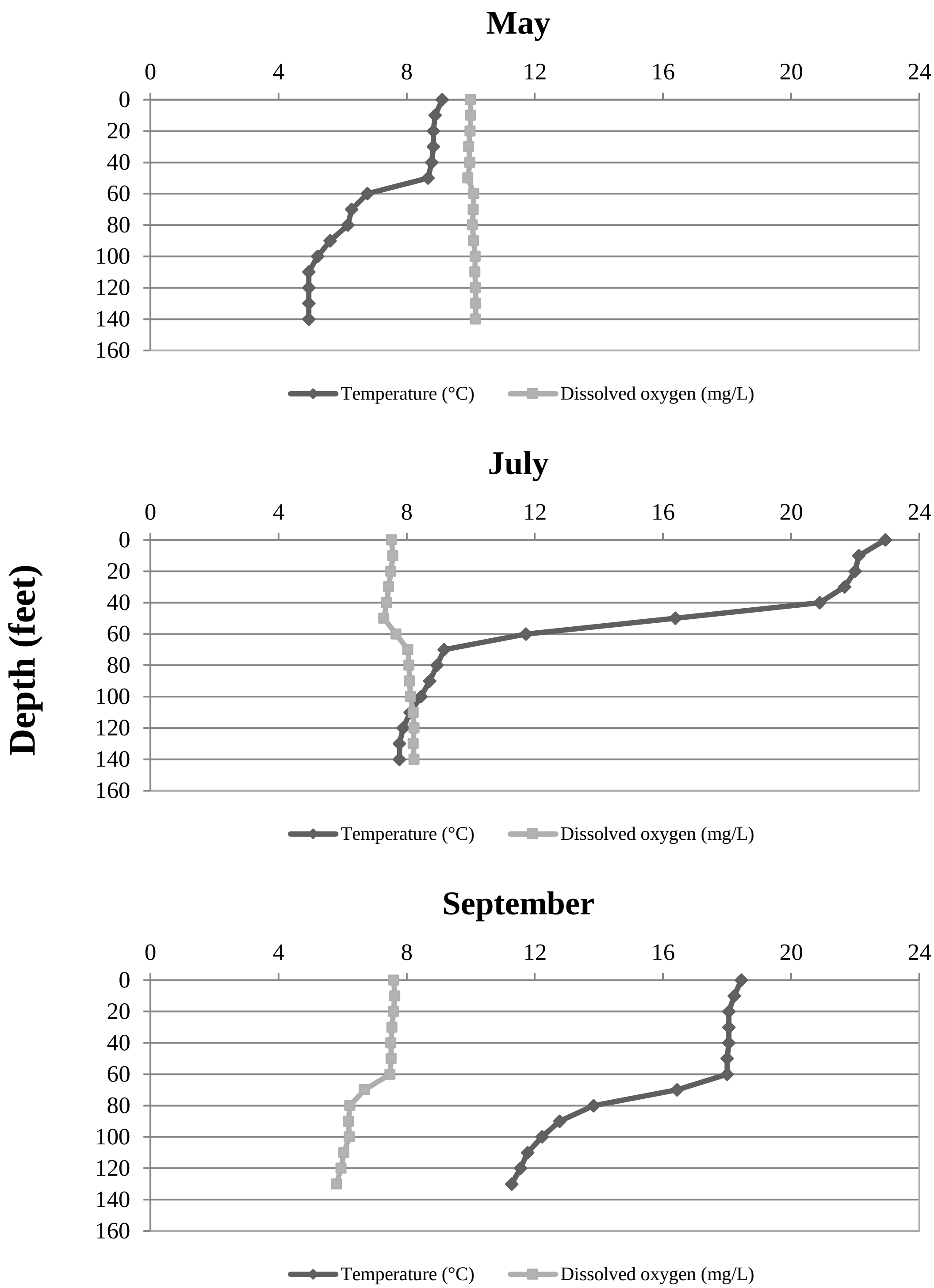


Figure 5. Depth profiles of temperature (°C) and oxygen (mg/L) located near Haxby Point on Fort Peck Reservoir, May-September 2015.

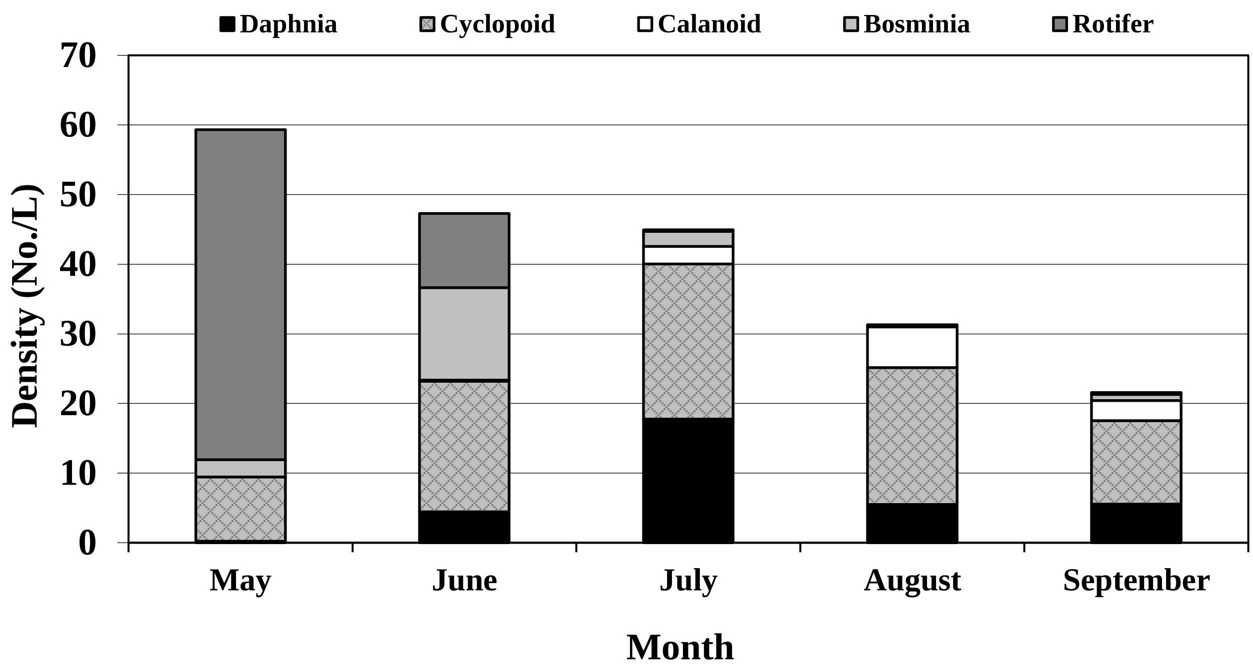


Figure 6. Mean zooplankton density (number of organisms/L) pooled from reservoir-wide samples by taxonomic group and month for Fort Peck Reservoir, 2015.

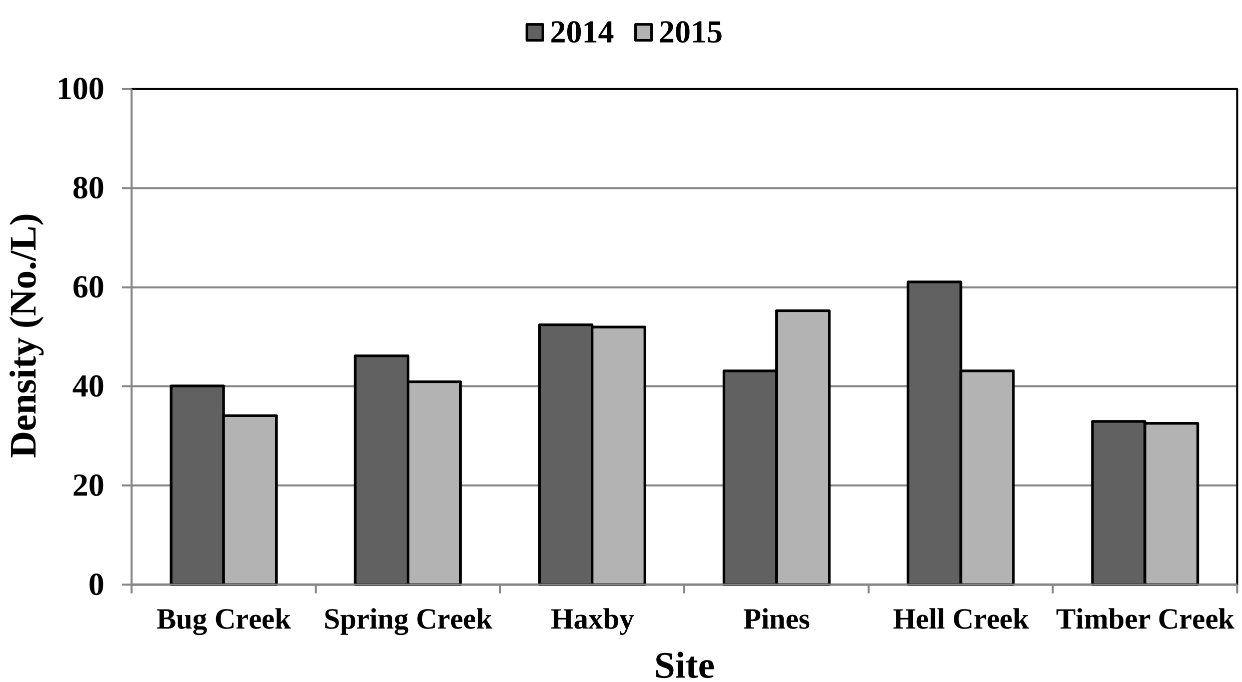


Figure 7. Mean zooplankton density (number of organisms/L) pooled from monthly samples for Fort Peck Reservoir, 2014-2015.

RESERVOIR-WIDE GILL NETTING

Standard experimental gill nets were set throughout the reservoir from July 21st to August 13th, 2015 when water surface temperatures ranged from 68°F to 79°F. Gill netting provides information on species distribution; composition, relative abundance, population parameters, and stomach contents of game species. Nineteen species were captured for a total of 2,148 fish (Table 2). Walleye, northern pike, and goldeye were the most abundant species captured overall, with catch rates of 4.6, 2.6, and 2.1 per net night, respectively. Fish with catch rates equal to or greater than 1.0 per-net night include: channel catfish, common carp, shorthead redhorse, river carpsucker, smallmouth bass, smallmouth buffalo, and yellow perch.

Walleye

Relative abundance of walleye in 2015 was 4.9 per net which was similar to the previous year (Figure 8). This was above the long term average of 3.7 per net from 1984 to 2015. The three-year running average goal of 3.6 per net was met (4.8 per net in 2013-2015) as outlined in the FPRFMP. Similar to previous years, stock and quality length groups comprised the largest group of gill-netted walleye (Figure 8). Relative abundance of walleye was greatest in the middle Missouri arm with a catch rate of 7.3 per net (Table 3).

Length frequency distributions of walleye in 2015 indicated a large group of fish in the 12 to 16- inch range (Figure 9). This group represented 50% of all walleye gill netted in 2015 and would suggest a large year class(es). In 2013, this group of fish was in the 8 to 10-inch range and comprised 19% of all walleye gill netted and as 10 to 12-inch fish in 2014 they comprised 31% of all fish sampled. Based on length frequencies, walleye in Fort Peck Reservoir don't recruit to experimental gill nets until they are greater than 10 inches in length.

Relative weight of walleye increased from 2014 to 2015. Relative weights increased for quality and greater length groups, but remained similar for stock length fish (Figure 10). This can be attributed to two large year classes of cisco produced in 2013 and 2014. Cisco have been found to be an important prey item for walleye greater than 18 inches in Fort Peck Reservoir (Mullins 1991).

Proportional stock density (PSD) and relative stock density-preferred (RSD-P) are measures of balance for fish populations (Gabelhouse 1984). The measures are percents of fish captured at substock (<10"), and numbers of fish of each size and larger for stock (> 10"), quality (>15"), preferred (>20"), and memorable (>25") size fish. Changes in in each group can be from increases or decreases in recruitment and natural or fishing mortality. Anderson and Weithman (1978) models of walleye PSD's suggest a range of 30-60 as favorable values for walleye populations. Since 1988, walleye PSD would have fallen into the favorable category, with the exception of 1995 and 1996. The favorable trend resumed in 1998 and continued into 2015 with a value of 59 (Table 6). RSD-P was 24 indicating a greater abundance of stock and quality size walleye. A ratio between 10 and 20 is considered desirable as a RSD-P for a balanced population. High values of RSD-P indicate an abundance of larger fish with a small stock size available.

Table 3. Mean CPUE (No./net-night), mean length (in), and mean weight (lb) of fish collected by experimental gill nets in Fort Peck Reservoir during July-August, 2015. *N* is total number collected for length and weight measurements.

			Average			
			Length		Weight	
Species	Number	CPUE	Inches	*N*	Pounds	*N*
Bigmouth buffalo	1	<0.1	26.0	1	11.1	1
Black bullhead	5	<0.1	9.6	5	0.4	5
Black crappie	18	0.2	8.6	18	0.4	18
Channel catfish	201	2.0	18.5	201	2.1	201
Cisco	42	0.4	8.7	41	0.2	41
Common carp	147	1.5	21.1	147	4.4	147
Freshwater drum	49	0.5	14.6	49	1.4	49
Goldeye	209	2.1	13.4	205	0.7	205
Northern pike	264	2.6	26.3	264	5.0	264
Paddlefish	1	<0.1	42.9	1	--	1
River carpsucker	172	1.7	18.7	172	3.7	172
Sauger	22	0.2	15.0	22	1.0	22
Shorthead redhorse	122	1.2	14.9	122	1.4	122
Smallmouth bass	125	1.3	12.8	125	1.3	125
Smallmouth buffalo	100	1.0	21.9	100	7.3	100
Walleye	486	4.9	16.6	486	2.1	486
White sucker	24	0.2	16.4	24	1.9	24
Yellow perch	143	1.4	6.6	143	0.1	143

Table 4. Number (*N*) and mean catch per unit effort (CPUE; No./net-night) of fish species collected by experimental gill nets in Fort Peck Reservoir during July-August, 2015.

	UBD[1]		LBD[2]		LMA[3]		MMA[4]		UMA[5]		Total	
Species	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE
Bigmouth buffalo	0	--	1	<0.1	0	--	0	--	0	--	1	<0.1
Black bullhead	5	0.3	0	--	0	--	0	--	0	--	5	<0.1
Black crappie	7	0.4	0	--	0	--	1	0.1	10	0.5	18	0.2
Channel catfish	34	1.7	24	1.2	11	0.6	40	2.0	92	4.6	201	2.0
Cisco	1	<0.1	10	0.5	17	0.9	4	0.2	10	0.5	42	0.4
Common carp	21	1.1	15	0.8	34	1.7	45	2.3	32	1.6	147	1.5
Freshwater drum	5	0.3	8	0.4	7	0.4	8	0.4	21	1.1	49	0.5
Goldeye	34	1.7	20	1.0	33	1.7	29	1.5	93	4.7	209	2.1
Northern pike	91	4.6	67	3.4	45	2.3	32	1.6	29	1.5	264	2.6
Paddlefish	0	--	0	--	0	--	1	<0.1	0	--	1	<0.1
River carpsucker	96	4.8	24	1.2	13	0.7	16	0.8	23	1.2	172	1.7
Sauger	0	--	3	0.2	4	0.2	8	0.4	7	0.4	22	0.2
Shorthead redhorse	12	0.6	16	0.8	3	0.2	6	0.3	85	4.3	122	1.2
Smallmouth bass	35	1.8	33	1.7	18	0.9	22	1.1	17	0.9	125	1.3
Smallmouth buffalo	40	2.0	17	0.9	18	0.9	15	0.8	10	0.5	100	1.0
Walleye	39	2.0	73	3.7	140	7.0	145	7.3	89	4.5	486	4.9
White sucker	5	0.3	11	0.6	3	0.2	3	0.2	2	0.1	24	0.2
Yellow perch	21	1.1	19	1.0	39	2.0	53	2.7	11	0.6	143	1.4
Total	446	22.3	341	17.1	385	19.3	428	21.4	531	26.6	2,131	21.3

[1]Upper Big Dry (UBD): Nelson Creek., Lone Tree Creek, McGuire Creek, Bug Creek, Lost Creek
[2]Lower Big Dry (LBD): Box Creek, South Fork Rock Creek, North Fork Rock Creek, Box Elder Creek, Sand Arroyo, Spring Creek
[3]Lower Missouri Arm (LMA): Spillway Bay, Bear Creek, North Fork Duck Creek, South Fork Duck Creek, Main Duck Creek
[4]Middle Missouri Arm (MMA): Pines Bay, Gilbert Creek, Cattle/Crooked Creek, Hell Creek, Sutherland Creek, Snow Creek
[5]Upper Missouri Arm (UMA): Cabin Coulee, Wagon Coulee, Bone Trail, Timber Creek, Seven Blackfoot, Fourchette Bay, Devils Creek

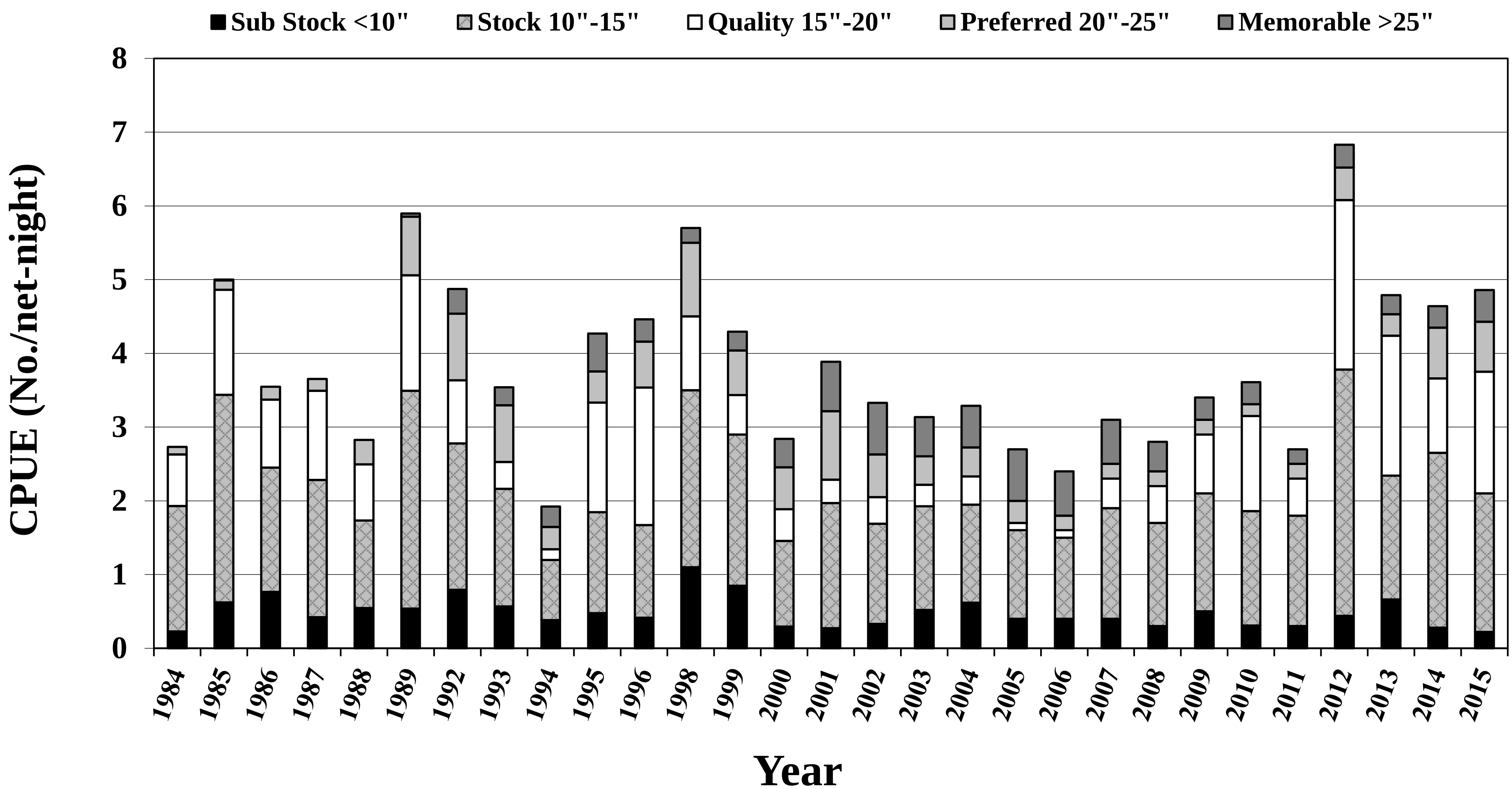


Figure 8. Length structure, in terms of catch per unit effort (CPUE), of walleye collected by experimental gill nets in Fort Peck Reservoir during July-August, 1984-2015 (no data for 1990-1991 and 1997).

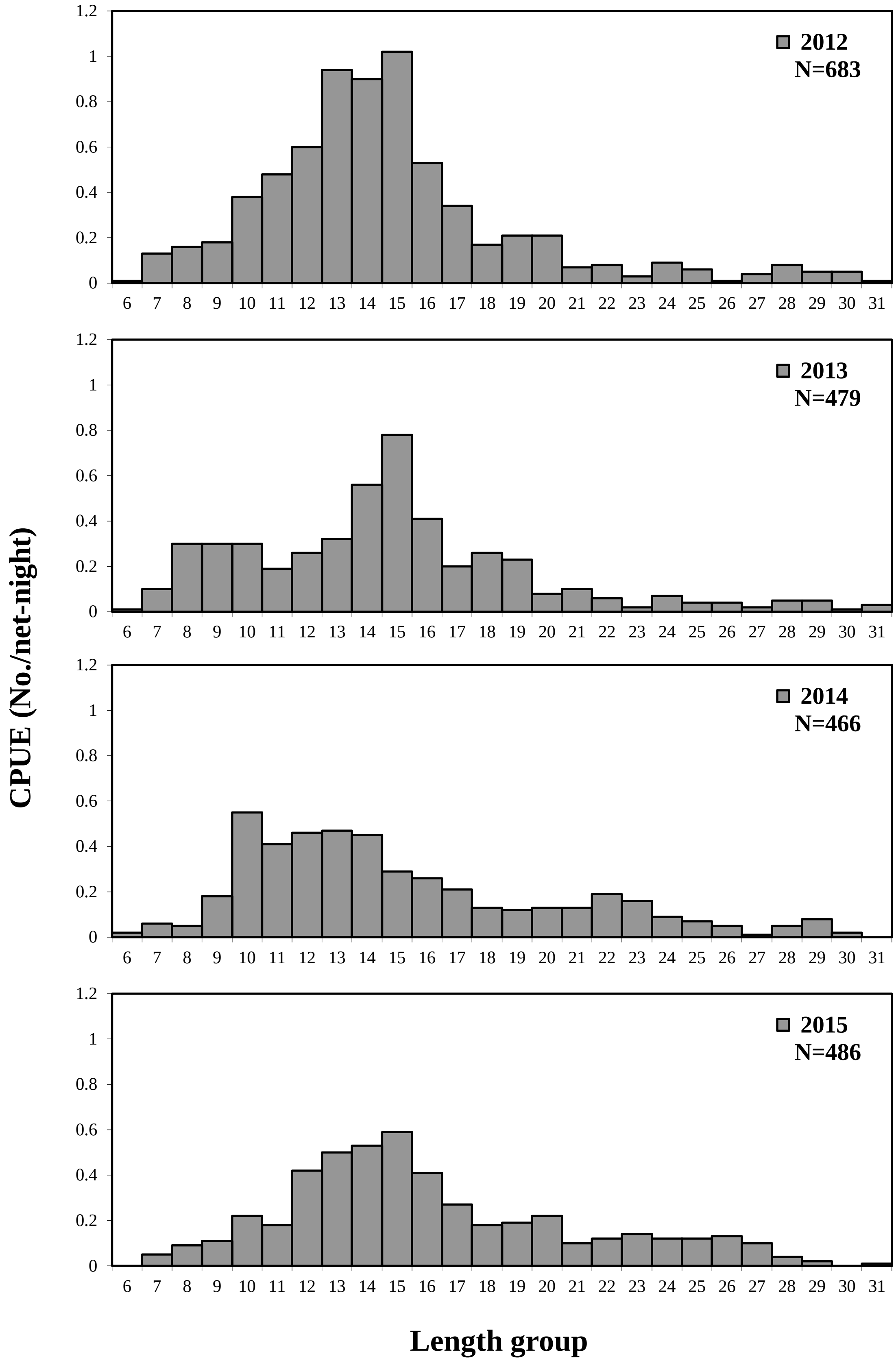
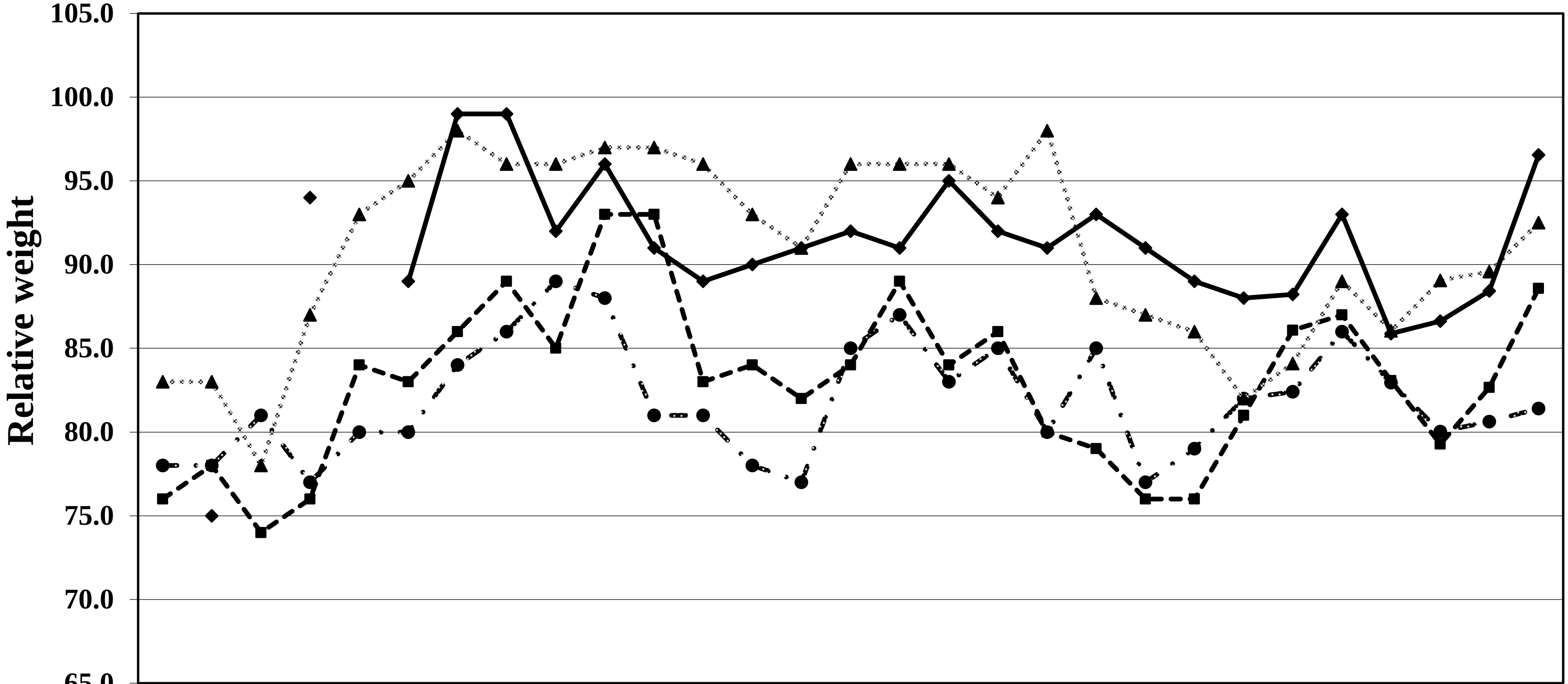


Figure 9. Length frequency, as catch per unit effort, of walleye collected by experimental gill nets in Fort Peck Reservoir during July-August, 2012-2015.



	1984	1985	1986	1987	1988	1989	1992	1993	1994	1995	1996	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Stock 10"-15"	78.0	78.0	81.0	77.0	80.0	80.0	84.0	86.0	89.0	88.0	81.0	81.0	78.0	77.0	85.0	87.0	83.0	85.0	80.0	85.0	77.0	79.0	82.0	82.4	86.0	83.0	80.0	80.6	81.4
Quality 15"-20"	76.0	78.0	74.0	76.0	84.0	83.0	86.0	89.0	85.0	93.0	93.0	83.0	84.0	82.0	84.0	89.0	84.0	86.0	80.0	79.0	76.0	76.0	81.0	86.1	87.0	83.1	79.3	82.7	88.6
Preferred 20"-25"	83.0	83.0	78.0	87.0	93.0	95.0	98.0	96.0	96.0	97.0	97.0	96.0	93.0	91.0	96.0	96.0	96.0	94.0	98.0	88.0	87.0	86.0	82.0	84.1	89.0	86.0	89.1	89.6	92.5
Memorable >25"		75.0		94.0		89.0	99.0	99.0	92.0	96.0	91.0	89.0	90.0	91.0	92.0	91.0	95.0	92.0	91.0	93.0	91.0	89.0	88.0	88.2	93.0	85.9	86.6	88.4	96.5

Year

Figure 10. Relative weights for stock, quality, preferred, and memorable length groups of walleye collected by experimental gill nets in Fort Peck Reservoir, 1984-2015 (no data for 1990-1991 and 1997).

Northern Pike

Relative abundance of northern pike captured in gill nets was 2.6 per net in 2015 which decreased from the previous year (Figure 11). The three-year running average goal of 2.0 northern pike per net was met (3.1 per net in 2013) as outlined in the FPRFMP. Average length and weight of northern pike in 2015 was 26.3 inches and 5.0 pounds, respectively which was lower when compared to the drought years (2000-2006; Table 7). This is due to small to medium-sized individuals recruiting into the population as a result of natural reproduction following several years where reservoir water levels were increasing and flooding suitable habitat. In 2015, 32% of the northern pike captured were less than 25 inches (Figure 12). This was an improvement compared to 2005-2006 when 20% of the northern pike captured in gill nets were less than 25 inches (Headley 2007).

In 2015, northern pike PSD was 88 and RSD-P was 40. During the drought years, PSD ranged from 93 to 98 and RSD-P ranged from 55-71 indicating a population comprised of larger fish. With decreasing to stable water levels from 2011 to 2015, inundation of terrestrial vegetation has become limited throughout the reservoir decreasing the amount of ideal spawning and rearing habitat. As a result, relative abundance of stock length groups of northern pike has started to decrease. Relative weight of northern pike increased slightly from 96 in 2014 to 98 in 2015.

Channel Catfish

Relative abundance of channel catfish captured by gill netting was 2.0 per net in 2015. This was a decrease compared to the previous year but slightly above the 29-year average of 1.9 per net (Figure 13). Similar to previous years, the highest abundance was observed in the Upper Missouri Arm at 4.6 per net (Table 4). In 2015, mean length and weight was 18.5 inches and 2.1 pounds, respectively. This was slightly higher than the long term average of 16.2 inches and 1.7 pounds (Table 8). Relative weights of channel catfish increased slightly from 85 in 2014 to 86 in 2015. Catfish PSD and RSD-P were 86 and 3, respectively, indicating a population comprised of good numbers of larger fish.

Sauger

Sauger numbers have declined in Fort Peck Reservoir since 1985 and remained low since then (Figure 13). This decline has occurred in spite of restrictive angling regulations (i.e., 1 sauger daily and 2 in possession) implemented in 2002. However, fishing regulations changed in 2016 allowing anglers to keep 2 sauger daily and 4 in possession within the walleye/sauger combination of 5 daily and 10 in possession. Relative abundance in 2015 was 0.2 per net which was similar to the previous year. Average size of sauger in 2015 was 15 inches and 1.0 pounds with a relative weight of 72. This population relies on natural reproduction from the Missouri River where more suitable spawning habitat is available (Bellgraph et al. 2008). Relative abundance for sauger was highest in the upper Missouri arm with a catch rate of 0.4 per net (Table 4).

Table 6. Summary of mean catch per unit of effort (CPUE; No./net-night), standard error (SE), mean length (in), mean weight (lb), mean *Wr*, and stock density indices of walleye collected in experimental gill nets on Fort Peck Reservoir, 1988-2015 (no data for 1990-1991 and 1997).

Year	No. walleye	CPUE	SE	Length	Weight	*Wr*	Substock[1]	Stock[2]	Quality[3]	Preferred[4]	PSD[5]	RSD-P[6]
1988	207	2.8	0.3	14.3	1.2	83	36	171	82	21	48	15
1989	404	5.9	0.5	14.8	1.3	83	36	367	166	58	45	16
1992	297	4.7	0.4	15.8	2	88	39	257	132	78	51	30
1993	258	3.5	0.4	15.3	2	91	38	219	101	75	46	34
1994	139	1.8	0.2	15.9	2.4	92	23	116	54	43	47	37
1995	330	4.2	0.3	16.6	2.4	91	34	295	189	73	64	25
1996	361	4.4	0.4	16.5	2.1	89	31	327	228	75	70	23
1998	418	5.6	0.4	14.8	1.6	86	79	339	159	89	47	26
1999	329	4.2	0.3	14.4	1.5	90	63	266	108	67	41	25
2000	250	2.8	0.2	16.6	2.3	83	26	224	122	84	54	38
2001	272	3.9	0.4	17.4	2.8	88	19	253	134	112	53	44
2002	324	3.3	0.2	17.4	2.8	90	32	291	159	124	55	43
2003	301	3.1	0.3	17.3	2.8	88	38	263	156	105	59	40
2004	250	3.3	0.3	15.9	2.3	88	47	203	102	73	50	36
2005	227	2.7	0.3	16.3	2.6	85	37	190	88	78	46	41
2006	207	2.4	0.2	16.2	2.6	87	38	168	78	66	46	39
2007	261	3.1	0.3	16.2	2.3	81	36	225	100	70	44	31
2008	234	2.8	0.3	15.5	1.9	81	21	212	89	45	42	21
2009	393	3.3	0.3	14.6	1.4	83	59	332	143	53	43	16
2010	361	3.6	0.3	15.4	1.7	84	31	330	175	46	53	13
2011	267	2.8	0.3	14.9	1.7	88	25	251	99	45	39	18
2012	683	6.8	0.4	15.1	1.4	83	44	639	305	75	47	12
2013	479	4.8	0.4	15.0	1.5	81	66	413	245	55	59	13
2014	466	4.7	0.3	15.5	1.7	84	28	436	199	98	46	22
2015	486	4.9	0.4	16.6	2.1	87	22	464	276	111	59	24

[1]Substock is the number of all walleye less than 10 inches, [2]Stock is the number of all walleye greater than 10 inches, [3]Quality is the number of all walleye greater than 15 inches, [4]Prefered is the number of all walleye greater than 20 inches, [5]PSD is the proportional stock density (Quality/Stock), [6]RSD-P is the relative stock density, preferred (Preferred/Stock).

Table 7. Summary of mean catch per unit of effort (CPUE; No./net-night), mean length (in), mean weight (lb), and mean *Wr* of northern pike collected in experimental gill nets on Fort Peck Reservoir during July-August, 1984-2015.

Year	*N*	CPUE	Length	Weight	*Wr*
1984	52	0.6	20.8	2.4	94
1985	36	0.4	24.1	3.5	97.8
1986	21	0.4	23.7	3.6	94.3
1987	60	0.7	19.7	2.3	106.7
1988	43	0.6	26.4	5.3	107
1989	47	0.7	24.4	4.5	110.2
1992	35	0.6	26.6	5.5	112.3
1993	47	0.6	28.3	6.4	113.9
1994	104	1.4	22.6	4.4	107.3
1995	295	3.8	20.1	2.5	114.6
1996	321	3.9	23.3	3.7	112.8
1998	231	3.1	24.7	4.3	104.6
1999	151	1.9	26.5	5.1	103.2
2000	134	1.5	28	6	106.5
2001	73	1	28.6	6.5	110.6
2002	144	1.5	29.5	7.2	102
2003	126	1.3	28.1	6.2	101.1
2004	75	1	29.1	6.7	100.1
2005	86	1	28.4	6.5	100.3
2006	108	1.3	26.1	5.2	98.9
2007	147	1.7	24.8	4.6	101
2008	137	1.6	26.6	5.2	100
2009	176	1.5	24.5	4.3	93.1
2010	191	1.9	23.4	3.9	100
2011	293	2.9	23.2	3.6	100
2012	503	5.0	23.6	3.6	99.3
2013	324	3.2	24.6	3.9	93.0
2014	336	3.4	25.8	4.6	96.2
2015	264	2.6	26.3	5.0	97.5

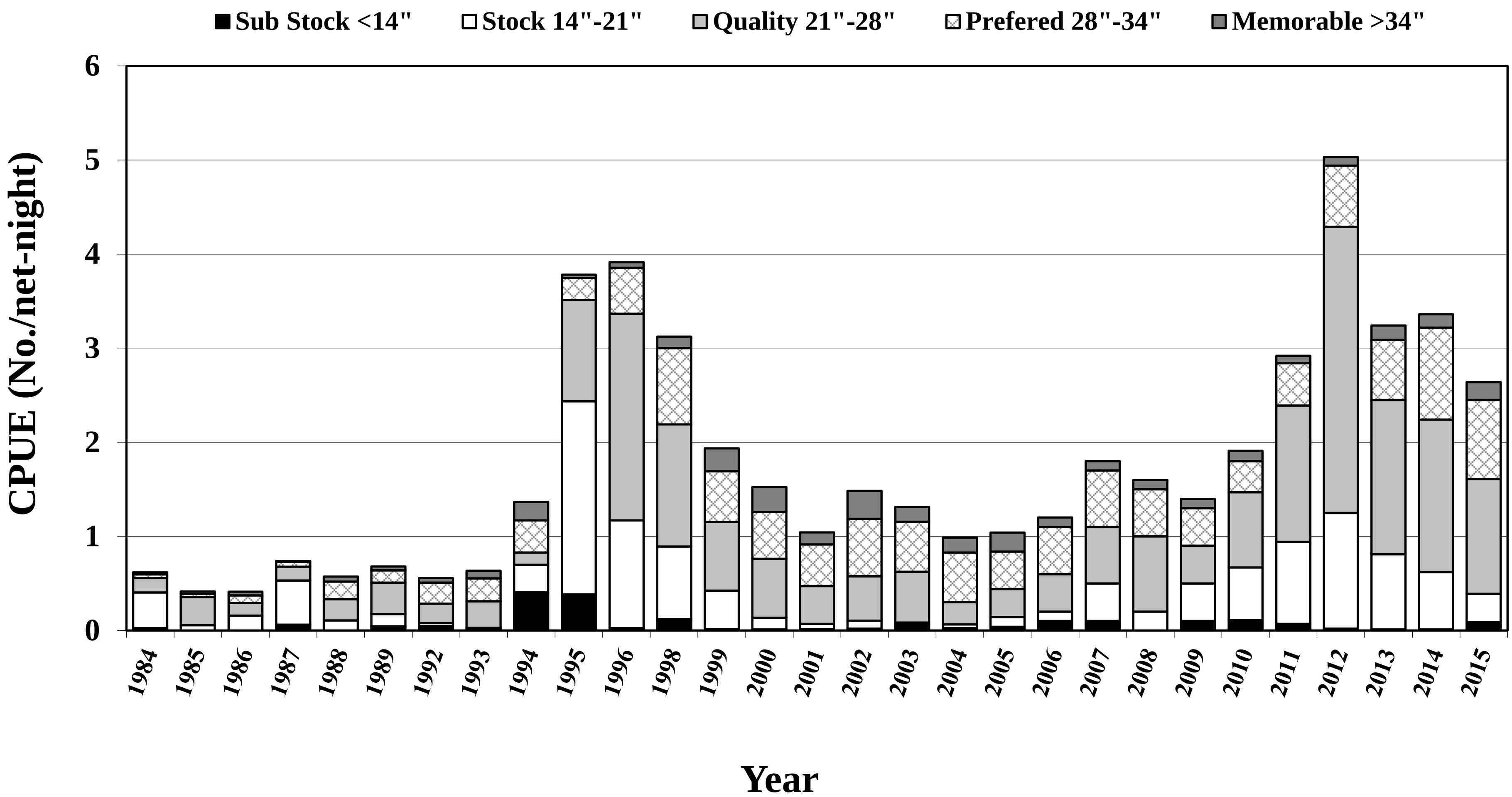


Figure 11. Length structure, in terms of catch per unit effort (CPUE), of northern pike collected by experimental gill nets in Fort Peck Reservoir during, July-August, 1984-2015, (no data for 1990-1991 and 1997).

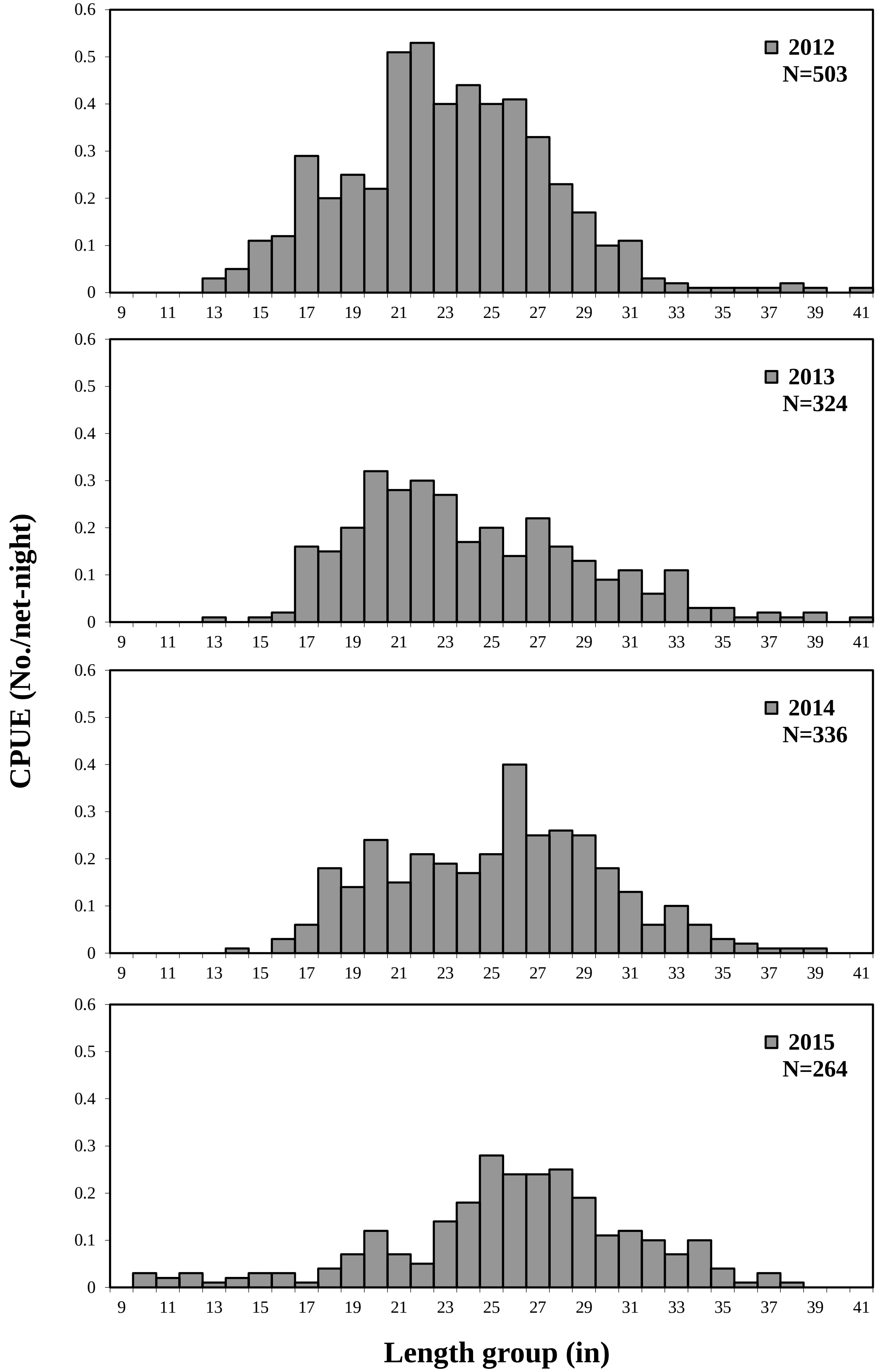
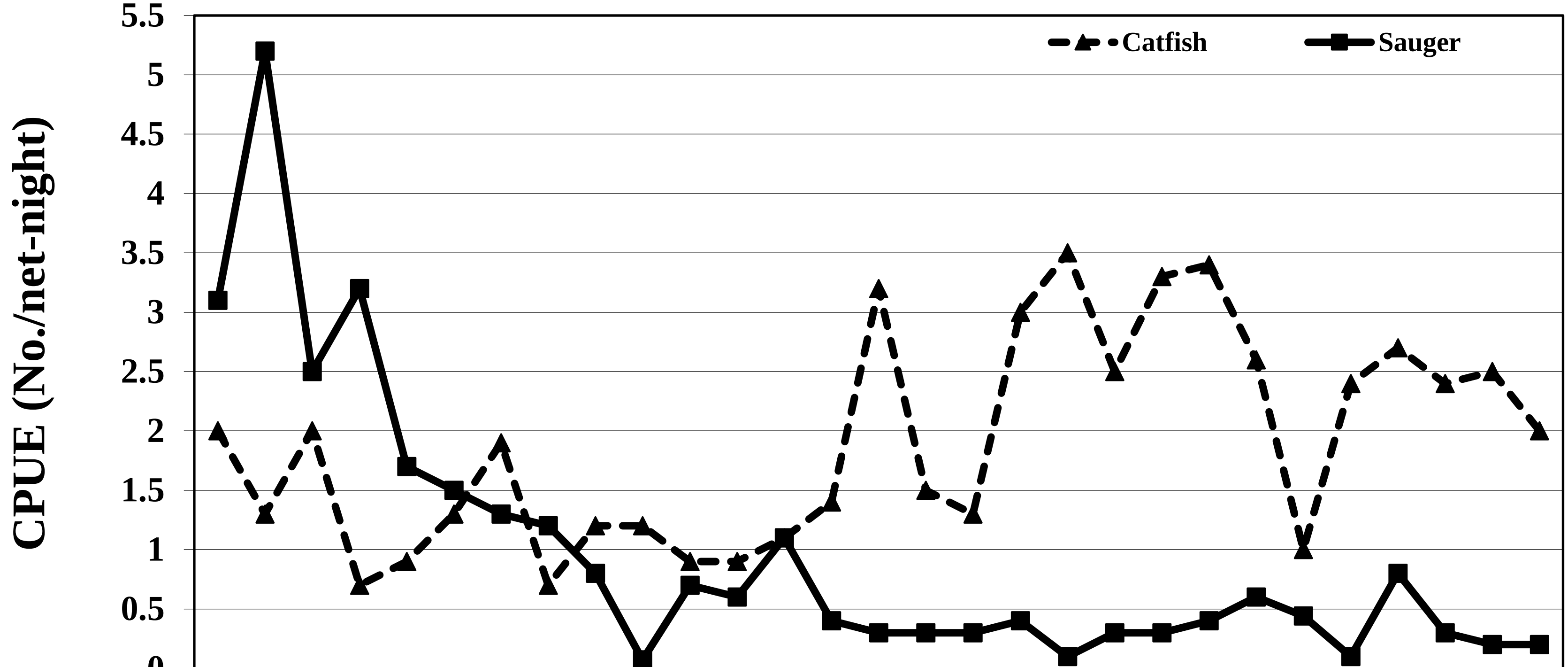


Figure 12. Length frequency, as catch per unit effort (CPUE), of northern pike collected by experimental gill nets in Fort Peck Reservoir during July-August, 2012-2015.



	1984	1985	1986	1987	1988	1989	1992	1993	1994	1995	1996	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Catfish	2	1.3	2	0.7	0.9	1.3	1.9	0.7	1.2	1.2	0.9	0.9	1.1	1.4	3.2	1.5	1.3	3	3.5	2.5	3.3	3.4	2.6	1.0	2.4	2.7	2.4	2.5	2
Sauger	3.1	5.2	2.5	3.2	1.7	1.5	1.3	1.2	0.8	0.07	0.7	0.6	1.1	0.4	0.3	0.3	0.3	0.4	0.1	0.3	0.3	0.4	0.6	0.4	0.1	0.8	0.3	0.2	0.2

Year

Figure 13. Mean catch per unit of effort (CPUE; No./net-night) of channel catfish and sauger collected by experimental gill nets in Fort Peck Reservoir, 1984-2015 (no data for 1990-1991 and 1997).

Table 8. Summary of mean catch per unit of effort (CPUE; No./net-night), mean length (in) and mean weight (lb) of channel catfish collected in experimental gill nets on Fort Peck Reservoir, 1984-2015.

Year	*N*	CPUE	Length	Weight
1984	167	2.0	14.2	0.9
1985	115	1.3	14.5	1.1
1986	105	2.0	14.6	1.1
1987	53	0.7	15.3	1.2
1988	69	0.9	15.9	1.7
1989	99	1.4	16.5	1.5
1992	165	2.6	15	1.4
1993	68	0.9	14.9	1.4
1994	119	1.6	14.4	1.1
1995	123	1.6	16.3	1.6
1996	93	1.1	15.6	1.4
1998	91	1.2	18	2.3
1999	88	1.1	17.2	2.0
2000	122	1.4	17.5	2.0
2001	222	3.2	17.6	2.1
2002	145	1.5	18	2.1
2003	129	1.3	17.6	2.1
2004	227	3.0	15.7	1.8
2005	297	3.5	14.3	1.3
2006	215	2.5	15.1	1.4
2007	278	3.3	15.3	1.3
2008	289	3.4	14.2	1.1
2009	314	2.6	16.8	1.9
2010	104	1.0	18.4	2.4
2011	241	2.4	17.9	2.3
2012	272	2.7	17.4	1.8
2013	240	2.4	17.5	1.9
2014	246	2.5	18.0	2.0
2015	201	2.0	18.5	2.1

STOMACH CONTENTS OF GILL NETTED GAME FISH

Stomach contents of walleye, northern pike, sauger, and smallmouth bass captured in experimental gill nets from July 21st to August 13th, 2015 were examined for the presence of forage items. Walleye had the most diverse diet (Table 9). Cisco were the most commonly identified item found in walleye at 14.4% followed by invertebrates at 9.2%. Cisco were the most commonly identified fish found in northern pike at 23.6%. The high frequency of occurrence of cisco in the stomachs of northern pike and walleye can be explained by the high abundance of young-of-year and adult cisco observed in 2015 (Table 14). Empty stomach contents comprised a large portion of the walleye, northern pike, sauger, and smallmouth bass stomachs, which is attributed to purging of the stomach during stress.

Table 9. Percent frequency of occurrence for various forage items found in stomach contents of northern pike, sauger, smallmouth bass, and walleye collected in experimental gill nets in Fort Peck Reservoir 2015. Sample size is given in parentheses.

Forage items	Northern pike (*N*=254)	Sauger (*N*=20)	Smallmouth bass (*N*=76)	Walleye (*N*=466)
Black bullhead				0.2%
Channel catfish	0.4%			0.0%
Cisco	23.6%	5.0%		14.4%
Crayfish	1.6%		10.5%	
Empty	63.4%	65.0%	51.3%	51.1%
Invertebrates	0.4%	10.0%	11.8%	9.2%
Smallmouth bass	0.4%			0.2%
Spottail shiner				0.2%
Unknown	8.7%	20.0%	26.3%	23.8%
Walleye	0.8%			0.4%
Yellow perch	0.8%			0.4%

BEACH SEINING

Shoreline beach seining was conducted to determine reproductive success of age-0 game and non-game fish from August 10th to September 8th, 2015. Seine hauls at 100 locations throughout the reservoir captured 13 species of young-of-year and forage fish for a total of 8,319 fish (Table 10). Overall, relative abundance in 2015 reached a 5-year low of 83.2 fish per seine haul. Relative abundance of shoreline forage typically follows changes in reservoir elevations (Figure 15). In 2015, reservoir elevations increased slightly over the winter months due to reduced discharges. Reservoir elevations increased approximately two feet from May to June due to runoff from mountain snowpack (Figure 14). A limited amount of terrestrial vegetation was inundated in 2015.

Eurasian watermilfoil (EWM) was first discovered in Fort Peck Reservoir by Montana Fish, Wildlife & Parks and the U.S. Army Corp of Engineers in 2010. Since then, it has become established throughout the reservoir. Seining surveys in 2013 indicated that it was present at 46% of the seining sites. This trend decreased sharply in 2014 to only 24% of the seining sites containing EWM. However, EWM was documented at 70% of the seining sites in 2015. This large increase in EWM could be attributed to stable reservoir elevations from 2014-2015. Prior to this, reservoir elevations fluctuated greatly. For example, reservoir elevations during 2012-2013 experienced a loss of 15 feet compared to a gain of 10 feet in 2013-2014. These fluctuations would make it difficult for EWM to become established in littoral areas of the reservoir.

It is uncertain what impacts EWM have to the fishery on Fort Peck Reservoir. Some studies have suggested slow growth and poor size structure for some fish species (Unmuth et al. 1999). In contrast, EWM has proved beneficial to fisheries if it occurs in lakes that typically do not support much growth of native submersed species (Engel 1995). Similarly, Pratt and Smokorowski (2003) found more fish and invertebrates in areas with EWM than areas devoid of any submerged aquatic vegetation. Due to Fort Peck Reservoir's fluctuating reservoir elevation, lack of native submerged aquatic vegetation, and complex basin characteristics, it is possible that EWM may provide spawning and rearing habitat for some forage and/or game fish species. However, dense stands of EWM were observed at some seining sites in 2015 and could explain the overall decrease in relative abundance due to reduced seining efficiency.

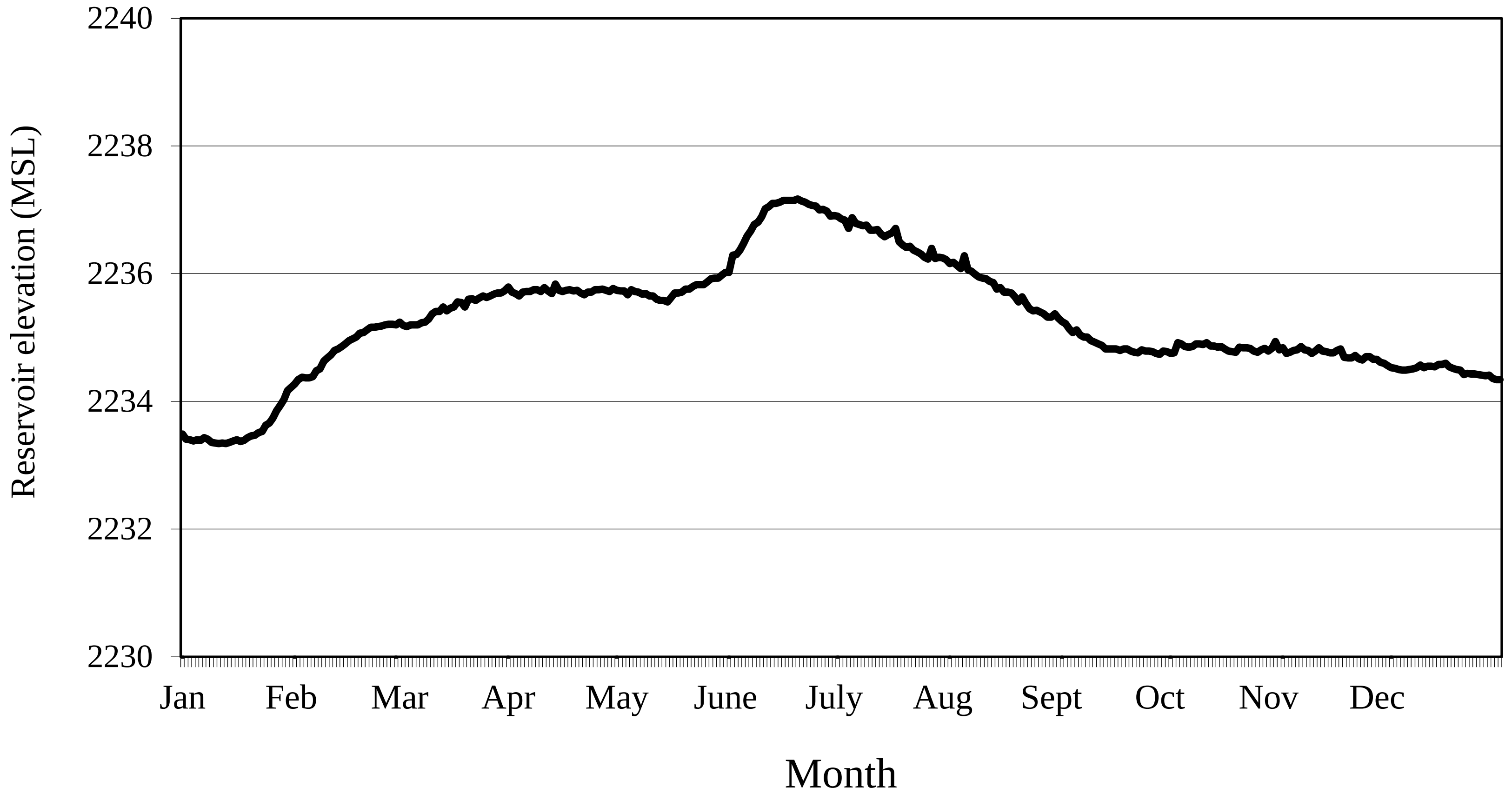


Figure 14. Average daily reservoir elevation for Fort Peck Reservoir from January 1, 2015 to December 31, 2015 (data provided by USACE).

Table 10. Number (*N*) and mean catch per unit effort (CPUE; No./haul) for fish species collected by seine hauls in Fort Peck Reservoir during August-September 2015. Catches are for young-of-year fishes except where noted.

	UBD[1]		LBD[2]		LMA[3]		MMA[4]		UMA[5]		Total	
Species	*N*	CPUE	*N*	CPUE	*N*	CPUE	*N*	CPUE	*N*	CPUE	*N*	CPUE
Black bullhead	3	0.2	1	<0.1	0	--	0	--	0	--	4	<0.1
Common carp	2	0.1	3	0.2	4	0.2	0	--	5	0.3	14	0.1
Emerald shiner*	64	3.2	55	2.8	9	0.5	30	1.5	401	20.1	559	5.6
Goldeye	0	--	0	--	0	--	0	--	1	<0.1	1	<0.1
Green sunfish	0	--	1	<0.1	0	--	0	--	1	<0.1	2	<0.1
*Hybognathus spp.**	0	--	0	--	0	--	0	--	1	<0.1	1	<0.1
Northern pike	10	0.5	24	1.2	17	0.9	14	0.7	4	0.2	69	0.7
Pomoxis spp.	422	21.1	193	9.7	92	4.6	800	40.0	2,456	122.8	3,963	39.6
Smallmouth bass	32	1.6	16	0.8	9	0.5	45	2.3	66	3.3	168	1.7
Smallmouth buffalo	0	--	0	--	4	0.2	0	--	0	--	4	<0.1
Spottail shiner*	35	1.8	651	32.6	1,172	58.6	264	13.2	358	17.9	2,480	24.8
Walleye	0	--	1	<0.1	1	<0.1	0	--	0	--	2	<0.1
Yellow perch	108	5.4	53	2.7	190	9.5	292	14.6	409	20.5	1,052	10.5
Total	676	33.8	998	49.9	1,498	74.9	1,445	72.25	3,702	185.1	8,319	83.2

*Includes all ages.
[1]Upper Big Dry (UBD): Nelson Cr., Lone Tree Cr., McGuire Cr., Bug Cr., Lost Cr.
[2]Lower Big Dry (LBD): Box Cr., S. Fork Rock Cr., N. Fork Rock Cr., Box Elder Cr., Sand Arroyo, Spring Cr.
[3]Lower Missouri Arm (LMA): Spillway Bay, Bear Cr., N.Fork Duck Cr., S. Fork Duck Cr., Main Duck
[4]Middle Missouri Arm (MMA): Pines, Gilbert Cr., Cattle Crooked Cr., Hell Cr., Sutherland Cr., Snow Cr.
[5]Upper Missouri Arm (UMA): Bone Trail, Timber Cr., Seven Blackfoot, Fourchette Bay, Devils Cr.

Yellow Perch

Young-of-year yellow perch relative abundance in 2015 decreased to 10.5 per seine haul from 16.8 per seine haul in 2014. The small increase in reservoir elevation limited the amount of terrestrial vegetation that was inundated from April to May and could explain the decrease. Relative abundance of young-of-year yellow perch in 2015 was similar to levels observed during the drought years (i.e., 1998-2006; Figure 15). Yellow perch were most abundant in the upper Missouri arm with a catch rate of 20.5 per seine haul in 2015 (Table 10).

Crappie

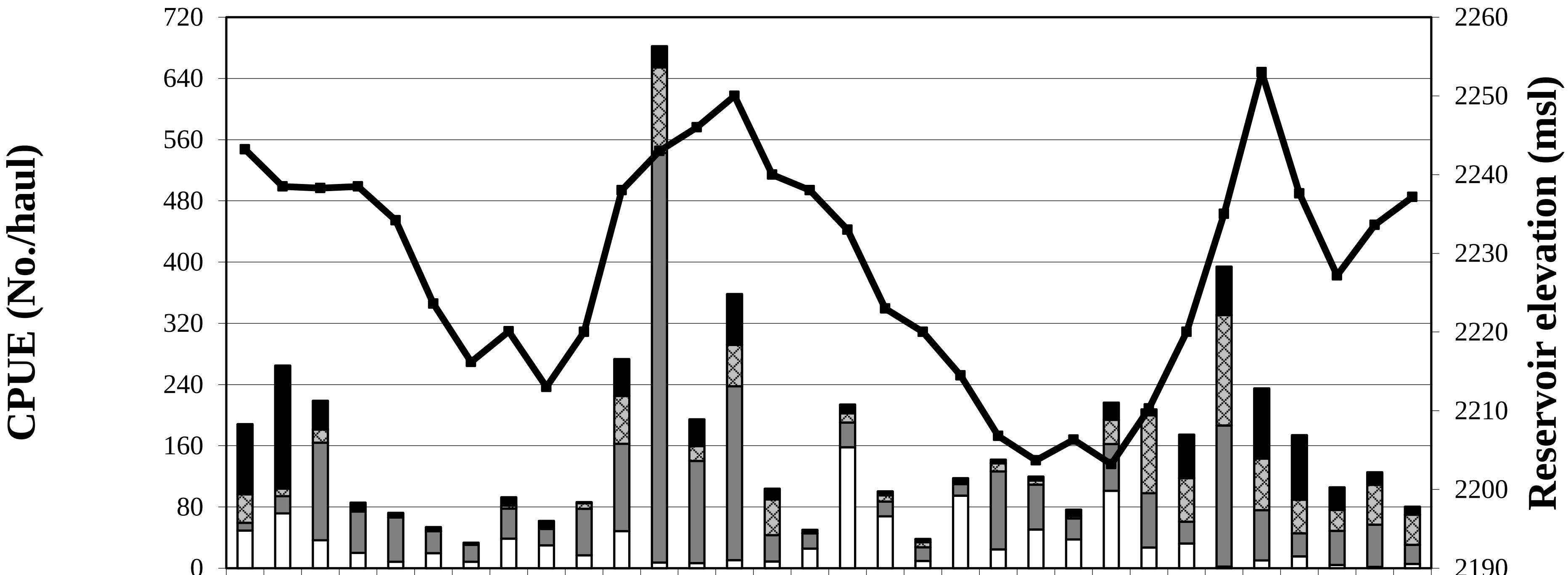
Young-of-year crappie relative abundance decreased from 52 per seine haul in 2014 to 39.6 per seine haul in 2015. Unlike young-of-year yellow perch, relative abundance of young-of-year crappie was still higher than during the drought years (Figure 15). Crappie were most abundant in the upper Missouri arm with a catch rate of 122.8 per seine haul (Table 10). In the past, the upper Missouri arm contained +90% of the young-of-year crappie collected due to more suitable spawning and rearing habitat (i.e., submerged brush and aquatic macrophytes).

Emerald Shiner

Emerald shiner relative abundance in 2015 was 5.6 per seine haul, which was lower than 1.9 per seine haul in 2014. Relative abundance of emerald shiners has been relatively low over the last several years making them similar to the mid to late 1990's when reservoir elevations were increasing (Figure 15). A possible explanation for these decreases could be upstream movement into more riverine type habitat. In 2015, 72% of the emerald shiners were captured in the upper Missouri arm (Table 10).

Spottail Shiner

Relative abundance of spottail shiners decreased from 55 per seine haul in 2014 to 24.8 per seine haul in 2015 and was lower than long-term average of 75 per seine haul. Relative abundance was highest in the lower Missouri arm at 58.6 per seine haul (Table 10). Typically, relative abundance is higher in the main lake portions (i.e., lower Big Dry arm, lower Missouri arm, middle Missouri arm) of the reservoir.



	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Perch	91.8	161	37.5	11.3	6	5.1	1.9	10.9	10	1.3	47.9	27.9	35.1	66.5	14.1	4.4
Crappie	37.4	9.7	17.1	0.2	0	0.1	0.7	4.1	0.4	7.6	62.6	112	19.3	54	46.7	0.2
Spottails	10.1	22.6	128	54.2	58	28.9	22	39.2	21.4	60.7	114	535	134	228	34.4	20
Emeralds	49.1	71.6	36.6	19.9	8.3	19.6	8.6	38.7	29.9	16.8	48.4	7.3	6.5	10.4	8.8	25.5
Elevation	2243	2239	2238	2239	2234	2224	2216	2220	2213	2220	2238	2243	2246	2250	2240	2238

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Perch	11.4	5.3	4.3	5	4.9	5.2	8.4	22.6	8.01	57.2	63.3	91.8	84.5	29.6	16.7	10.5
Crappie	11.9	8.2	6.7	2.5	10.6	5.2	3.1	31.6	102	56.9	144.	67.3	43.7	27.4	52	39.6
Spottails	32.6	19.1	17.7	15.2	102	58.8	27.4	61.1	70.8	28.2	184.	65.7	30.2	44.7	54.9	24.8
Emeralds	158	67.9	9.6	94.8	24.6	50.5	37.6	101	27.1	32.4	2.2	10.3	15.6	4.1	1.9	5.6
Elevation	2233	2223	2220	2215	2207	2204	2206	2203	2210	2220	2235	2253	2238	2227	2234	2237

Year

Figure 15. Maximum annual reservoir elevation compared to mean catch per unit effort (CPUE; No./haul) of emerald, spottail, young-of-year yellow perch, and young-of-year crappie collected by seine hauls in Fort Peck Reservoir from 1984-2015.

Chinook salmon

Chinook salmon were stocked in Fort Peck Reservoir in the spring of 2015 and the minimum objective of 200,000 fingerlings was not met as outlined in the FPRFMP. A total of 54,534 spring-stocked chinook salmon were released in June at 24 per pound (Table 11). The spring-stocked fish were reared to a larger size in an attempt to create salmon large enough to avoid predation. Both North and South Dakota Game and Fish have used this strategy and been successful in developing a return run from larger spring-stocked chinook salmon (Lott et al. 1997). In the past, Montana has typically stocked fewer fingerlings and less total pounds than North and South Dakota. However, Montana has increased stocking numbers and/or size in efforts to create a more stable fishery and more fish for spawning beginning in 2000 (Figure 16 and 17).

Return of salmon to the release site has been variable over the years. In 2015, the number of females spawned and eggs collected decreased slightly from the previous year (Figure 18). The 2015 egg-take effort for Montana resulted in 243,000 green eggs which averaged approximately 3,328 eggs per female. North Dakota and South Dakota were unable to supplement eggs needed to approach the stocking goal of 200,000+ fingerlings for 2015 due to increased stocking goals and limited numbers of eggs collected.

Fisheries personnel relied exclusively on electrofishing to obtain brood stock for the annual chinook salmon egg-take. This has proved to be a more cost effective and efficient manner due to limited time and manpower issues as opposed to the fish ladder. Electrofishing was conducted from September 28th to November 2nd in various embayments adjacent to the marina, spillway, off the face of the dam, Duck Creek, and Bear Creek.

Biological data was collected from adult chinook salmon during spawning to provide more information on age, growth, and stocking-and-rearing history. In 2014, 70% of females spawned in were 4-year old (Table 12). In contrast, 40% of females spawned in 2015 were 4-year old and 46% were 3-year old. Similarly, a very high number of younger, mature male salmon were observed and captured in 2015 when compared to previous years. Age-2 male salmon comprised 84% of all males captured during the 2015 egg collection efforts. The earlier maturity observed for both sexes in 2015 could be attributed to improved growing conditions (i.e., increases in cisco abundance) which would allow more energy to be allocated to gonad production instead of somatic growth. Lott et al. (1997) noted a similar trend with chinook salmon age classes in Lake Oahe, SD when rainbow smelt populations, which are the primary forage, were at peak abundances.

Mean weight of pre-spawn female chinook salmon decreased slightly from 14 pounds in 2014 to13.3 pounds in 2015. When examining mean weight at each age, a majority of male and female salmon collected in 2015 were similar to those collected in 2014 (Table 12; Table 13). Four-year old females averaged 15.5 pounds in 2015 compared to 15.5 pounds in 2014. However, age-2 males increased from 5.2 pounds in 2014 to 6.4 in pounds in 2015. The higher relative abundance of cisco from 2013 and 2014 could have contributed to increased weights for age-2 males as well as the improved numbers observed. Cisco have been found to be the primary forage item of age 1+ chinook salmon in Fort Peck Reservoir (Brunsing 1998; Headley 2010).

Table 11. Chinook salmon stocked by number, size, and location in Fort Peck Reservoir, 2004-2015.

Date	Number	Pounds Stocked	No./lb	Mark	Location
6/14/2004	70,537	2,574	27.4	None	Marina Bay
10/5/2004	13,622	1,603	8.5	Adipose Clip	Marina Bay
6/30/2005	97,008	1,647	58.9	None	Marina Bay
9/28/2005	11,534	923	12.5	Adipose Clip	Marina Bay
6/7/2006	65,558	509	128.92	None	Marina Bay
6/14/2006	60,283	502	120	None	Milk Coulee Bay
6/15/2006	49,376	457	108	None	Marina Bay
10/13/2006	4,988	529	9.43	Adipose Clip	Marina Bay
6/18/2007	36,418	331	110	None	Marina Bay
10/25/2007	15,559	841	18.5	Adipose Clip	Marina Bay
6/5/2008	60,482	1,960	30.86	None	Marina Bay
6/11/2008	35,100	716	49	None	Marina Bay
6/12/2008	30,900	1,000	30.9	None	Marina Bay
8/12/2008	12,913	683	18.9	None	Marina Bay
8/12/2008	15,291	823	18.58	None	Marina Bay
11/18/2008	4,402	823	5.35	Adipose Clip	Marina Bay
6/16/2009	188,906	5,145	36.71	None	Marina Bay
11/4/2009	56,513	7,859	7.19	Adipose Clip	Marina Bay
6/10/2010	143,966	4,223	34.09	None	Marina Bay
10/22/2010	23,801	3,365	7.1	Adipose Clip	Marina Bay
6/10/2011	108,760	1,729	62.9	None	Duck Creek
6/10/2011	108,706	1,828	59.4	None	Pines Bay
6/15/2011	38,026	561	67.8	None	Rock Creek
11/1/2011	38,605	6,893	5.6	Adipose Clip	Marina Bay
6/4/2012	55,366	1,700	32.6	None	Duck Creek
6/4/2012	50,203	1,512	33.2	None	Bear Creek
6/5/2012	75,750	2,320	32.6	None	Marina Bay
6/6/2013	11,247	530	21.2	Adipose Clip	Marina Bay
6/6/2013	15,915	750	21.2	Adipose Clip	Milk Coulee Bay
6/10/2013	33,772	1,018	34	None	Duck Creek
6/10/2013	59,870	1,878	33.4	None	Marina Bay
6/10/2013	30,892	987	32.1	None	Milk Coulee Bay
6/2/2014	32,173	663	35.2	None	Marina
6/2/2014	32,137	915	35.1	None	Milk Coulee Bay
6/2/2014	25,040	714	35.1	None	Duck Creek
6/3/2014	31,123	1,350	23	Adipose Clip	Marina Bay
6/3/2014	15,213	660	21.2	Adipose Clip	Milk Coulee Bay
6/9/2014	42,868	1,261	34	None	Marina
6/9/2014	17,084	502	34	None	Milk Coulee Bay
6/9/2014	35,202	1,034	34	None	Duck Creek
6/8/2015	27,224	1,131	24.1	None	Milk Coulee Bay
6/8/2015	27,310	1,134	24.1	None	Marina

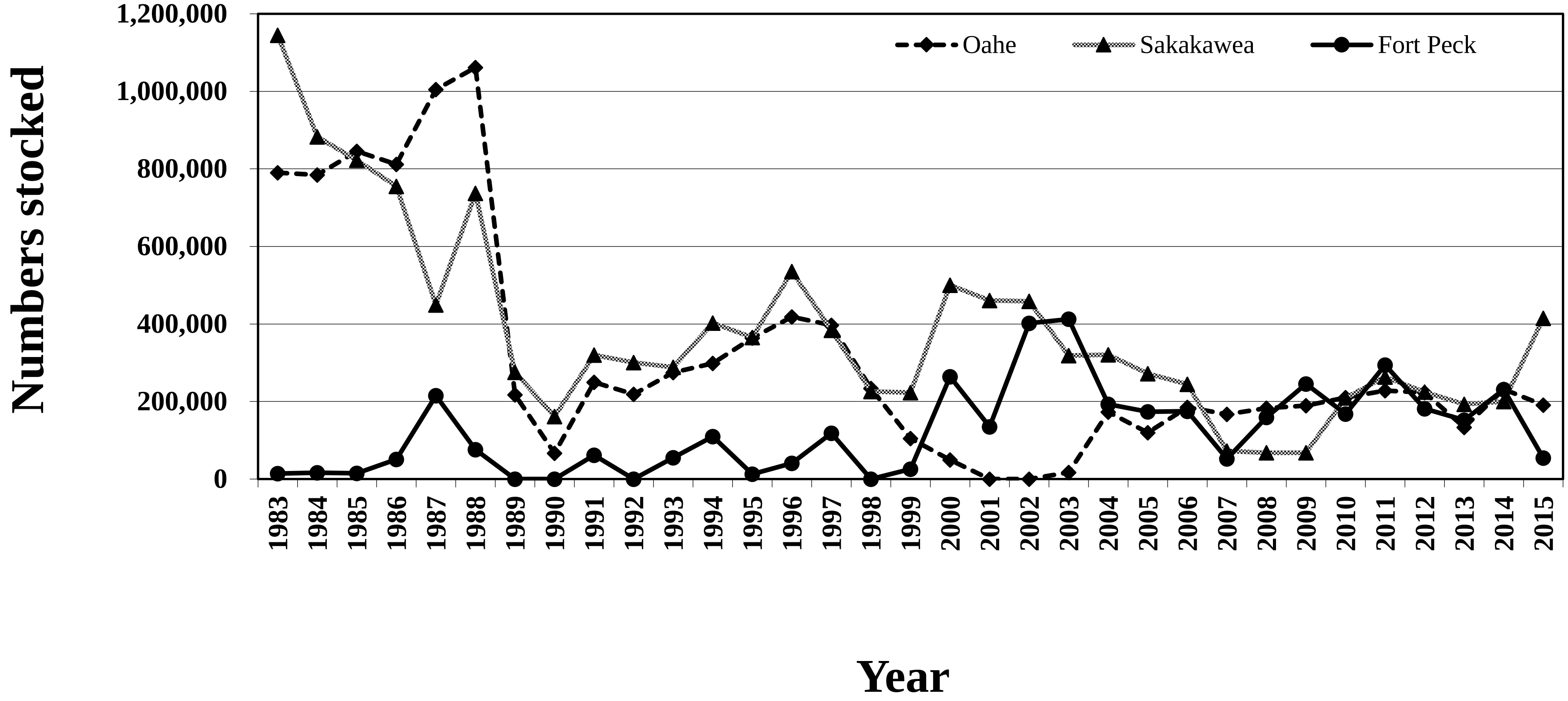


Figure 16. Annual comparison of total chinook salmon numbers stocked in Oahe, Sakakawea, and Fort Peck Reservoir, 1983-2015**.**

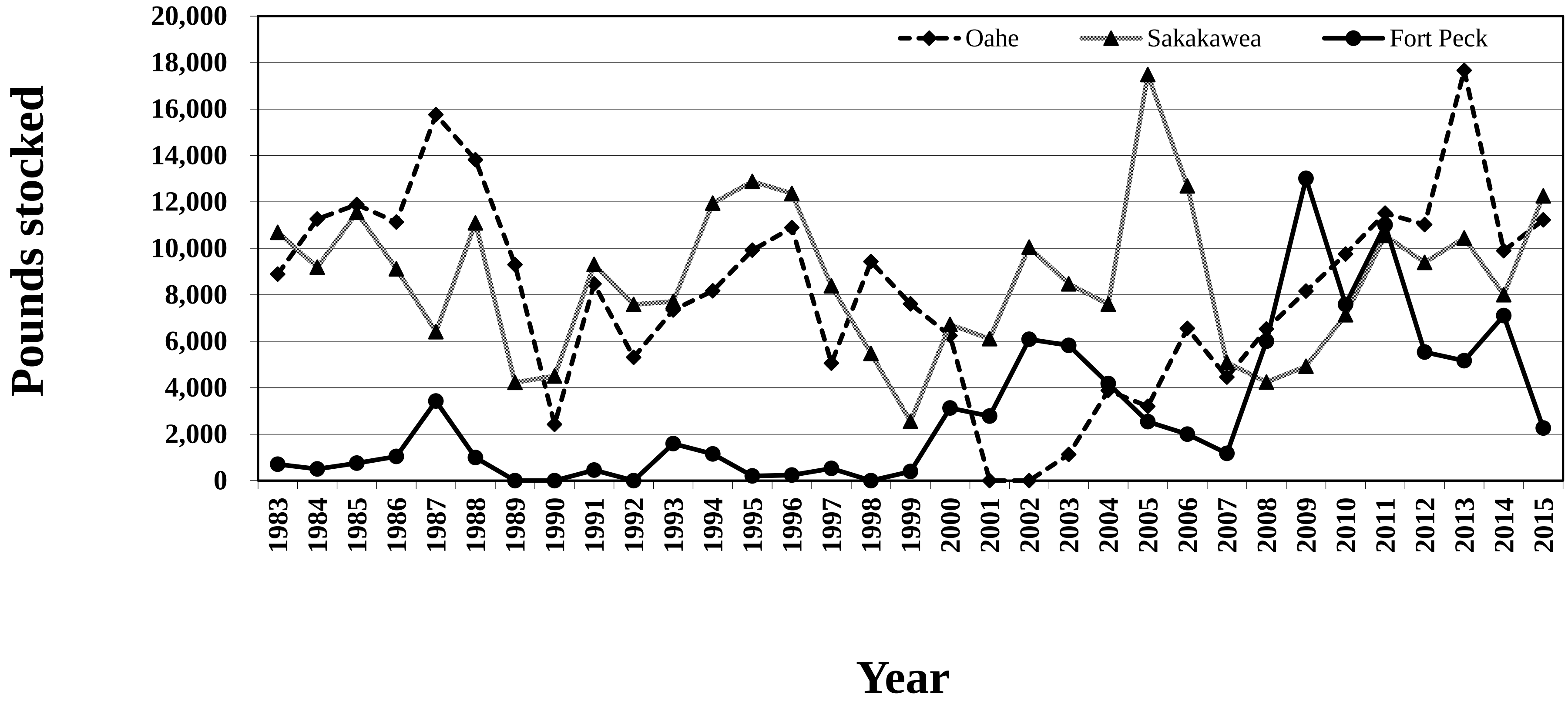


Figure 17. Annual comparison of total chinook salmon pounds stocked in Oahe, Sakakawea, and Fort Peck Reservoir, 1983-2015.

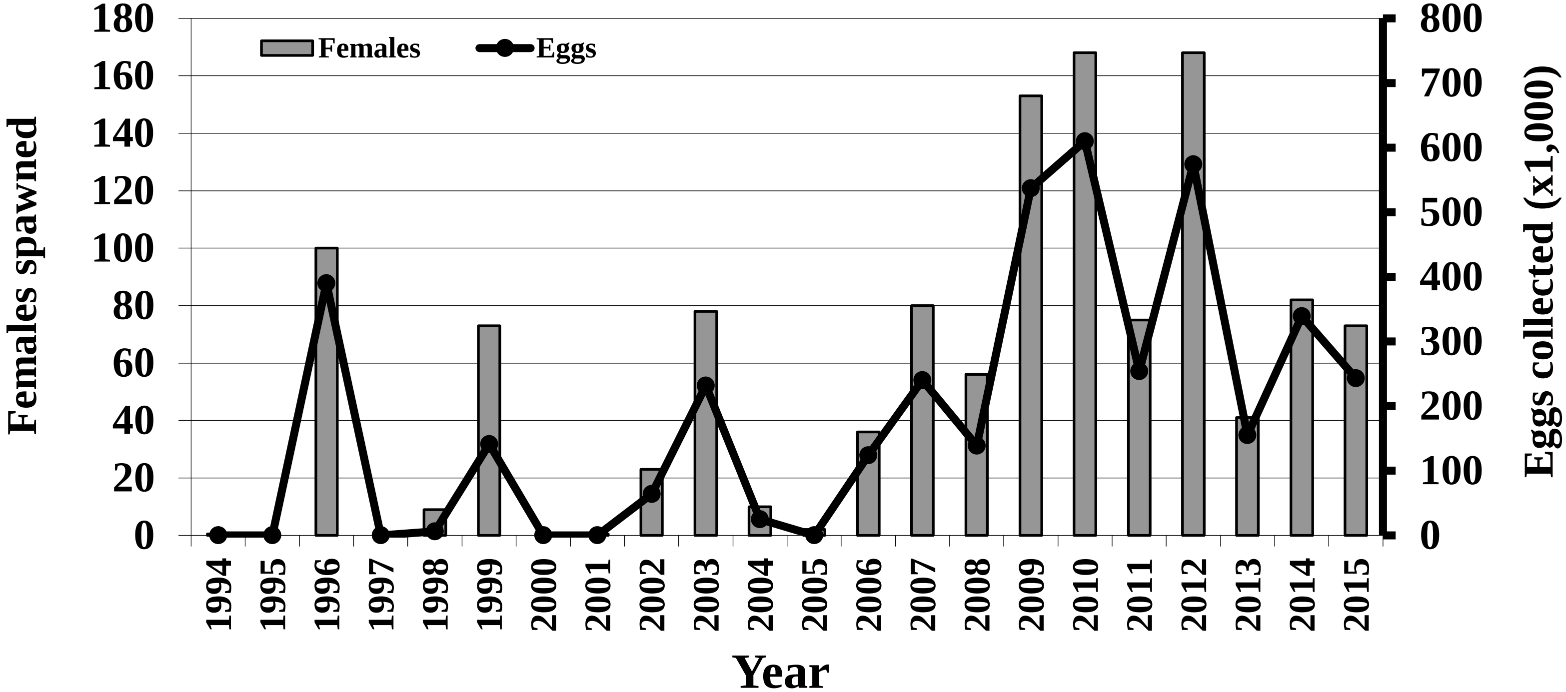


Figure 18. Annual comparison of female chinook salmon spawned and eggs collected from Fort Peck Reservoir, 1994-2015.

Table 12. Age composition, length and weight of 231chinook salmon collected by electrofishing, fall 2014.

Age	Sex	Brood year	Number	Mean length (in)	Range	Mean weight (lb)	Range
1	Male	2013	0	--	--	--	--
	Female		0	--	--	--	--
2	Male	2012	41	22.0	17.7-25.4	5.2	2.2-8.4
	Female		1	24.0	--	6.9	--
3	Male	2011	49	28.9	23.5-34.6	11.1	6.2-19.2
	Female		28	28.0	24.4-31.1	10.7	6.6-14.0
4	Male	2010	44	32.5	27.0-36.1	15.6	6.5-21.4
	Female		68	31.4	25.3-35.1	15.5	8.3-22.6
5	Male	2009	0	--	--	--	--
	Female		0	--	--	--	--

Table 13. Age composition, length and weight of 247chinook salmon collected by electrofishing, fall 2015.

Age	Sex	Brood year	Number	Mean length (in)	Range	Mean weight (lb)	Range
1	Male	2014	0	--	--	--	--
	Female		0	--	--	--	--
2	Male	2013	143	24.2	20.7-32.6	6.4	2.9-13.1
	Female		4	27.5	24.0-31.5	9.2	5.2-14.6
3	Male	2012	27	29.1	22.9-34.1	11.1	5.0-20.1
	Female		36	28.3	23.9-32.2	11.0	6.6-20.2
4	Male	2011	0	--	--	--	--
	Female		31	32.7	29.3-36.8	15.5	9.1-23.5
5	Male	2010	0	--	--	--	--
	Female		6	34.6	32.3-36.9	17.9	12.7-22.4

Cisco Vertical Gill Netting

Young-of-year cisco

Relative abundance of young-of-year cisco in Fort Peck Reservoir decreased to 25 per net-night in 2015; down from 140 net-night in 2014. This decrease was below the long term average of 76 per net-night from 1986 to 2015. Young-of-year cisco relative abundance has fluctuated over the years and similar trends have been observed in other reservoirs where cisco populations occur (Dave Yerk, personal communication; Figure 19).

Late ice cover appears to correlate with decreases in young-of-year cisco relative abundance on Fort Peck Reservoir. Duration of ice cover has been shown to reduce the wind and wave action, which decreases sedimentation over incubating eggs, and ultimately reduces mortality (Freeberg et al. 1990; Rook et al. 2013). For example, in 1987 and 1992 the reservoir did not freeze over and resulted in very few young-of-year cisco captured. Similarly, ice cover occurred on January 17th, 2015 and receded early on March 23rd, 2015 resulting in one of the smaller year class on record. In contrast, ice cover occurred on December 13th, 1985 and December 21st, 2000 resulting in two of the largest year classes ever produced.

Decreases in reservoir elevation could also explain reductions in young-of-year cisco on Fort Peck Reservoir. Decreases in reservoir elevation, which dewater incubating eggs, have been shown to reduce to young-of-year cisco abundance in other reservoir systems (Gaboury and Patalas 1984; Zollweg and Leathe 2006). For example, large decreases in reservoir elevation during 1989, 1996, 2003, and 2007 resulted in low relative abundance of young-of-year cisco (Figure 19). In contrast, reservoir elevations increased 1.4 feet during the winter months which should have favored young-of-year cisco production in 2015. It should be noted when water levels were increasing over winter of 1993-1994 and again in 2008-2009, two of the best year classes of cisco were produced. It is possible that short duration of ice cover influenced young-of-year cisco abundance more in 2015 than reservoir elevations.

Adult cisco

Additional mesh sizes (¾, 1, 1 ¼, 1 ½-in) were incorporated in 2013 vertical gill netting efforts in an attempt to provide additional information on the adult cisco population in Fort Peck Reservoir. This technique has been used successfully on other water bodies that contain cisco and other pelagic species (Dave Yerk, personal communication). The large year classes of cisco produced in 2013 and 2014 on Fort Peck Reservoir have recruited to the population as indicated by the increase in relative abundance of cisco captured in some of the larger mesh size. Since 2013, relative abundance of adult cisco have gradually increased in ¾-in mesh (Figure 20). Relative abundance of cisco was 169 per net-night in 2015 compared to 19 per net-night in 2013. Less than 1 cisco per net-night were captured in 1 ½-in mesh.

Mean length for cisco captured by vertical gill nets in Fort Peck Reservoir during 2015 was 5.5, 7.8, 9.7, 8.4, and 8.3 inches for ¾, 1, 1 ¼, 1 ½-in mesh, respectively. Overall, relative weight of cisco captured in 2015 was 76. The high abundance of adult cisco and low relative weights would suggest intraspecific competition. Rook et al. (2013) observed similar trends with cisco in Lake Superior and also found a negative correlation to post year class survival. Currently, it is uncertain what impacts these large year classes are having on the overall zooplankton density and composition in Fort Peck Reservoir because long-term zooplankton data is unavailable. Large year classes of cisco have been shown to alter the zooplankton community by selecting for the largest zooplankters in the system (Rudstrum et al. 1993).

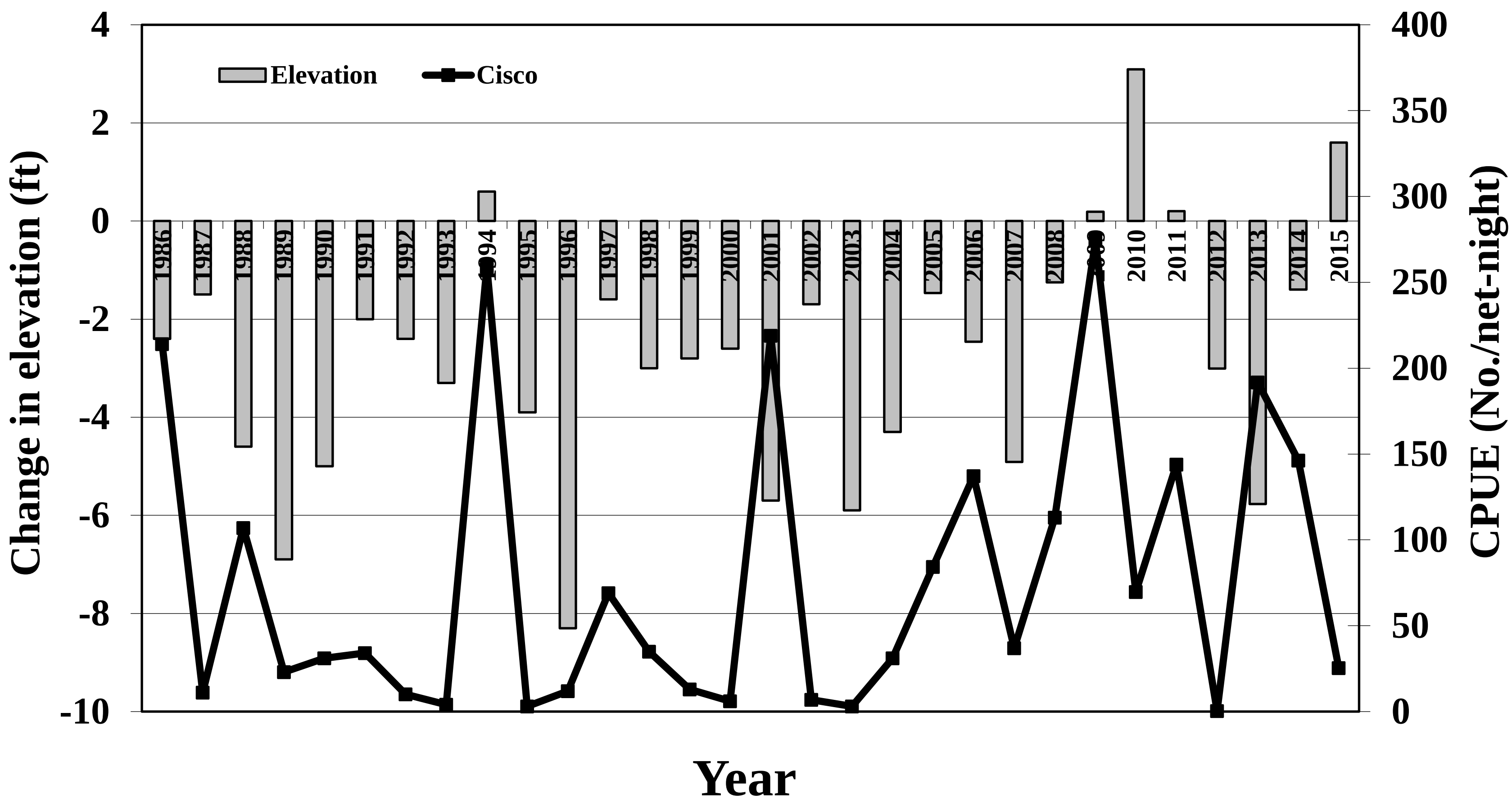


Figure 19. Change in reservoir elevation from December high to March low in contrast to mean CPUE (No./net-night) of young-of-year cisco collected in vertical gill nets on Fort Peck Reservoir, 1986-2015.

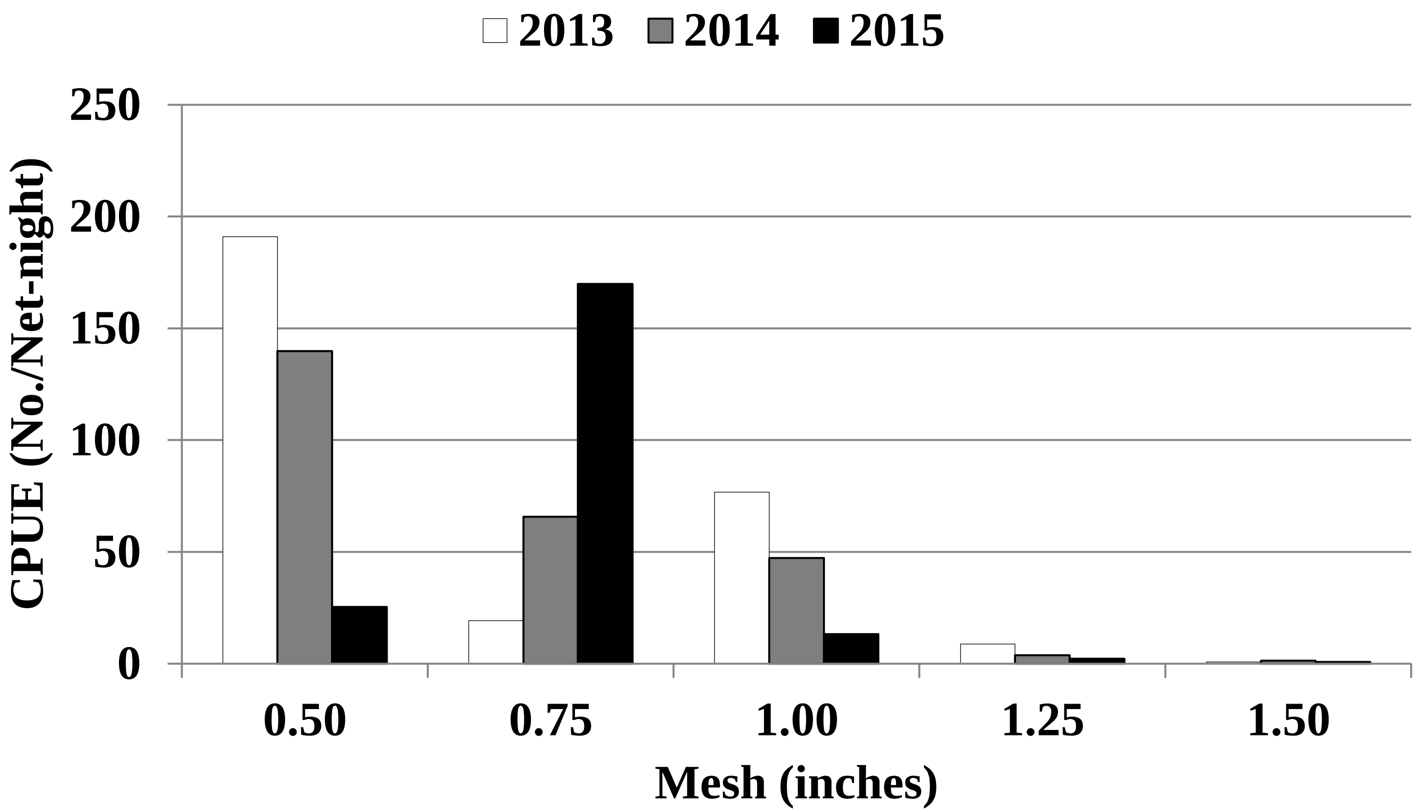


Figure 20. Mean CPUE (No./net-night) of cisco by mesh size collected in vertical gill nets on Fort Peck Reservoir, 2013-2015.

RECOMMENDATIONS

- Spring trapping of walleye and northern pike will continue to provide an egg source for sustaining Fort Peck Reservoir and sport fisheries in and out of state.

- Provide walleye eggs to Fort Peck Hatchery staff to develop methods to produce sterile walleye.

- Annual standardized sampling with modified fyke nets, experimental gill nets, vertical gill nets and beach seines will continue to obtain relative abundance data on game and forage fish distribution, abundance, production and condition.

- Evaluate native species (sauger, channel catfish, burbot) more closely by continuing to collect additional length, weight, and age information during routine sampling.

- Reservoir water levels will be monitored to determine impacts to the overall fishery. Information will be utilized to make recommendations to Corps of Engineers for Annual Operating Plan in conjunction with the Missouri River Natural Resource Committee.

- Continue working with South Dakota and North Dakota to develop a stronger tri-state chinook salmon fishery. This may require traveling out of-state to help collect and spawn salmon to receive additional eggs or collection of eggs from Fort Peck to support North and South Dakota needs.

- An evaluation of stocking strategies indicates the size of salmon released is more important than the timing of release. Efforts should be made to increase the numbers of total pounds stocked as opposed to total numbers of fish.

- Continue efforts to spawn Fort Peck salmon when numbers of adults permit. Adults should be captured with the aid of an electrofishing boat due to time and manpower constraints.

- Investigate using fisheries computer models to evaluate angler exploitation of the lake trout population. Continue to evaluate the use of spring and fall gill netting surveys to determine relative abundance and population dynamics of lake trout.

- Continue young-of-year and adult cisco standardized monitoring (vertical gill netting) to further explore the population dynamics of this species. Work to develop age structure and growth information for adult cisco.

- Continue annual public informational meetings and press releases to disseminate information from the previous year's work and to discuss stocking goals and work plans for the coming year.

- Continue transferring or entering historical data to create a full database of all documented work with Fort Peck's fishery while ensuring data is proofed and error checked.

- Continue limnological sampling program for Fort Peck Reservoir and collect water samples for "baseline" information to use in conjunction with walleye otolith microchemistry study. Evaluate chemical marking of hatchery-reared walleye fry for the use of otolith microchemistry.

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Prepared by: Heath Headley
Date: March 25th, 2016

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*
Brook stickleback	*Culaea inconstans*
Brown trout	*Salmo trutta*
Burbot	*Lota lota*
Channel catfish	*Ictalurus punctatus*
Chinook salmon	*Oncorhynchus tshawytscha*
Cisco	*Coregonus artedii*
Common carp	*Cyprinus carpio*
Creek chub	*Semotilus atromaculatus*
Emerald shiner	*Notropis atherionoides*
Fathead minnow	*Pimephales promelas*
Flathead chub	*Hybopsis gracilis*
Freshwater drum	*Aplodinotous grunniens*
Goldeye	*Hiodon alosoides*
Green sunfish	*Lepomis cyanellus*
Lake chub	*Couesius plumbeus*
Lake trout	*Salvelinus namaycush*
Largemouth bass	*Micropterus salmoides*
Northern pike	*Esox lucious*
Paddlefish	*Polyodon spathula*
Pallid sturgeon	*Scaphirhynchus albus*
Plains minnow	*Hybognathus placitus*
Rainbow trout	*Oncorhynchus mykiss*
River carpsucker	*Carpoides carpio*
Sauger	*Sander canadense*
Shorthead redhorse	*Moxostoma macrolepidotum*
Shovelnose sturgeon	*Scaphiryhynchus platorynchus*
Silvery minnow	*Hybognathus argyritis*
Smallmouth bass	*Micropterus dolemieu*
Smallmouth buffalo	*Ictiobus bubalus*
Spottail shiner	*Notropis hudsonius*
Walleye	*Sander vitreum*
White crappie	*Pomoxis annularis*
White sucker	*Catostomus commersoni*
Yellow perch	*Perca flavescens*

Appendix 2. Number of walleye stocked in Fort Peck Reservoir during 2015 by date, region, location, and size.

Date	Location	Region[1]	Fry	Fingerling	Advanced	Hatchery
4/30/2015	Nelson Creek	UBD	800,000			Fort Peck
5/5/2015	McGuire Creek	UBD	1,999,996			Fort Peck
5/6/2015	McGuire Creek	UBD	2,000,000			Fort Peck
5/12/2015	Little Bug Creek	UBD	2,000,000			Fort Peck
5/18/2015	Nelson Creek	UBD	1,900,000			Fort Peck
5/13/2015	Rock Creek	LBD	2,000,000			Fort Peck
6/15/2015	Bobcat Bay	LBD		169,901		Fort Peck
6/16/2015	South Fork Rock Creek	LBD		94,192		Miles City
6/16/2015	Sand Arroyo	LBD		94,192		Miles City
6/18/2015	Box Creek	LBD		140,000		Fort Peck
6/18/2015	Rock Creek	LBD		21,648		Fort Peck
6/24/2015	Box Elder Creek	LBD		110,239		Fort Peck
6/24/2015	Spring Creek	LBD		118,837		Fort Peck
5/15/2015	Duck Creek	LMA	2,000,000			Fort Peck
6/12/2015	Milk Coulee	LMA		104,424		Fort Peck
6/12/2015	Duck Creek	LMA		82,264		Fort Peck
6/15/2015	Bear Creek	LMA		86,362		Fort Peck
6/17/2015	Milk Coulee	LMA		26,991		Fort Peck
6/17/2015	Mid Duck	LMA		86,093		Fort Peck
6/17/2015	South Fork Duck Creek	LMA		125,235		Fort Peck
6/18/2015	Marina	LMA		45,092		Fort Peck
6/18/2015	Milk Coulee	LMA		60,782		Fort Peck
6/19/2015	Marina	LMA		203,583		Fort Peck
6/22/2015	Third Coulee	LMA		82,553		Fort Peck
6/22/2015	Skunk Coulee	LMA		40,162		Fort Peck
6/23/2015	Youth Camp	LMA		81,424		Fort Peck
6/25/2015	Sage Creek	LMA		133,788		Fort Peck
6/29/2015	Haxby	LMA		150,000		Fort Peck
6/29/2015	Milk Coulee	LMA		79,596		Fort Peck
6/30/2015	Sturgeon Bay	LMA		37,178		Fort Peck
6/30/2015	Catfish Bay	LMA		23,732		Fort Peck
7/1/2015	Main Duck	LMA		169,812		Fort Peck
7/1/2015	Duck Creek	LMA		35,296		Fort Peck
7/23/2015	Duck Creek	LMA			4,249	Fort Peck
5/1/2015	Hell Creek	MMA	6,400,000			Miles City
5/4/2015	Hell Creek	MMA	6,200,000			Miles City
6/11/2015	Beebe Coulee	MMA		101,190		Fort Peck
6/11/2015	Upper 8th	MMA		101,190		Fort Peck
6/12/2015	Hell Creek	MMA		260,748		Miles City
6/16/2015	Pines	MMA		163,556		Fort Peck
6/17/2015	Johnson Coulee	MMA		63,766		Miles City
6/17/2015	Cattle/Crooked Creek	MMA		63,767		Miles City
6/19/2015	Hell Creek	MMA		37,507		Miles City
6/23/2015	Sutherland Bay	MMA		73,714		Miles City
6/23/2015	Gilbert Creek	MMA		81,423		Fort Peck
6/25/2015	Seventh Coulee	MMA		133,789		Fort Peck
6/26/2015	Upper Duck	MMA		107,370		Miles City
Total			25,299,996	3,591,396	4,249	

[1]Upper Big Dry (UBD), Lower Big Dry (LBD), Lower Missouri Arm (LMA), Middle Missouri Arm (MMA).

Appendix 3. Temperature (°C), dissolved oxygen (mg/L), pH (standard units), turbidity (NTU), and total dissolved solids (g/L), profiles by month at Bug Creek site, Fort Peck Reservoir, 2015.

Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)		Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)
		May							**June**			
0	10.4	9.37	8.03	0.8	0.4468		0	16.6	8.47	8.16	1.9	0.4541
10	10.3	9.35	8.06	1	0.447		10	16.5	8.47	8.19	2.1	0.4538
20	10.2	9.35	8.08	1.3	0.4475		20	16.5	8.5	8.19	2.6	0.4532
30	9.1	9.51	8.07	1.2	0.4467		30	16.4	8.5	8.19	2.7	0.4532
40	8.6	9.64	8.08	2	0.4461		40	15.7	8.6	8.19	3	0.4522
50	8.2	9.59	8.06	1.6	0.4464		50	14.4	8.64	8.14	5.4	0.4528
60	7.5	9.44	8.02	1.9	0.4473		60	11.6	8.64	8.05	3.2	0.4529
		July							**August**			
0	22.4	7.3	8.29	2.2	0.4621		0	24.3	7.27	8.37	3.3	0.4771
10	22.4	7.27	8.29	22.4	0.4619		10	23.9	7.3	8.37	3.5	0.4751
20	22.8	7.21	8.29	2.8	0.4619		20	22.3	7.42	8.35	3.9	0.4715
30	22.1	7.18	8.27	3.3	0.462		30	19.7	6.81	8.25	3.5	0.4595
40	20.7	6.89	8.18	5.2	0.4647		40	18.1	6.28	8.12	4.7	0.4588
50	13.8	6.76	7.9	5.8	0.4544		50	16.6	5.87	8.02	4.7	0.4573
60	11.3	6.96	7.83	5.3	0.4509		60	14.7	5.75	7.89	6.6	0.4545
		September										
0	18.6	7.48	8.44	3.4	0.4655							
10	18.6	7.46	8.44	4.2	0.4653							
20	18.5	7.39	8.43	4.8	0.4656							
30	18.4	7.27	8.41	4.9	0.4665							
40	18.3	7.21	8.41	5.4	0.47							
50	18.3	7.18	8.41	5.5	0.4695							
60	18.1	6.81	8.39	7.9	0.4694							

Appendix 3 continued. Temperature (°C), dissolved oxygen (mg/L), pH (standard units), turbidity (NTU), and total dissolved solids (g/L), profiles by month at Spring Creek site, Fort Peck Reservoir, 2015.

Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)		Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)
		May							**June**			
0	9.4	9.72	7.61	1.2	0.4466		0	15.6	8.75	8.17	1.9	0.4516
10	9.4	9.71	7.85	1.1	0.4472		10	15.6	8.73	8.18	2	0.4516
20	9.3	9.72	7.92	1.2	0.4474		20	15.4	8.75	8.19	2.7	0.4516
30	9.2	9.74	7.99	1.3	0.4472		30	15.3	8.77	8.19	2.6	0.4514
40	9.1	9.71	8	1.6	0.4472		40	14.8	8.86	8.17	3.2	0.4506
50	9.0	9.7	8.02	1.7	0.4471		50	14.4	8.9	8.18	4	0.4507
60	8.9	9.73	8.04	1.7	0.4471		60	13.7	8.96	8.15	6.3	0.4505
70	8.7	9.71	8.03	1.7	0.4455		70	12.3	8.97	8.1	4.5	0.447
		July							**August**			
0	22.1	7.48	8.33	2.3	0.4595		0	23.8	7.35	8.37	2.1	0.4649
10	22.1	7.44	8.33	2.5	0.4593		10	23.6	7.39	8.38	2	0.4656
20	22.1	7.43	8.33	3	0.459		20	22.9	7.34	8.35	3.4	0.4643
30	21.9	7.39	8.32	3.8	0.4591		30	19.2	6.49	8.22	3.3	0.4589
40	20.1	7.17	8.22	5.6	0.4584		40	17.9	6.44	8.15	2.8	0.4566
50	14.4	7.24	8	5	0.4531		50	16.8	6.44	8.1	2.5	0.4556
60	11.3	7.48	7.89	3.5	0.4503		60	15.4	6.53	8.05	2.7	0.454
70	9.4	7.58	7.82	3.9	0.4494		70	14.1	6.61	7.98	2	0.4531
80	8.9	7.71	7.82	3.7	0.4482		80	12.6	6.57	7.89	2.9	0.4529
90	8.7	7.86	7.81	3	0.4477		90	11.6	6.54	7.84	2.6	0.451
		September										
0	18.9	7.59	8.43	3.4	0.4628							
10	18.3	7.61	8.44	3.7	0.4618							
20	18.3	7.52	8.44	4	0.4619							
30	18.2	7.41	8.43	4.7	0.4615							
40	18.2	7.37	8.42	5	0.4615							
50	18.1	7.39	8.42	5	0.4616							
60	18.1	7.39	8.42	4.7	0.4615							
70	14.4	5.82	8.07	6.3	0.4562							
80	12.7	5.86	7.97	5.8	0.4532							

Appendix 3 continued. Temperature (°C), dissolved oxygen (mg/L), pH (standard units), turbidity (NTU), and total dissolved solids (g/L), profiles by month at Haxby site, Fort Peck Reservoir, 2015.

Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)		Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)
		May							**June**			
0	9.1	10.0	8.1	1.7	0.444		0	18.7	8.5	8.2	1.7	0.4554
10	8.9	10.0	8.1	1.6	0.4438		10	16.4	8.8	8.2	2	0.4523
20	8.8	10.0	8.2	1.8	0.4439		20	16.2	8.8	8.2	2.8	0.452
30	8.8	9.9	8.2	2.3	0.4439		30	14.2	8.8	8.2	3.2	0.4475
40	8.8	10.0	8.2	2.7	0.4441		40	12.9	8.8	8.1	2.7	0.446
50	8.7	9.9	8.1	3.4	0.4461		50	12.2	7.6	8.0	2.6	0.4452
60	6.8	10.1	8.1	3.2	0.4452		60	10.9	7.5	8.0	2.3	0.4439
70	6.3	10.1	8.1	2.4	0.4446		70	9.9	8.5	7.9	2	0.4431
80	6.2	10.1	8.1	2.2	0.4439		80	9.2	8.7	8.0	1.8	0.4442
90	5.6	10.1	8.1	2.3	0.4444		90	8.9	8.8	7.9	1.6	0.4443
100	5.2	10.1	8.1	2.2	0.4446		100	8.6	8.9	7.9	1.5	0.4451
110	4.9	10.1	8.0	2.1	0.4452		110	8.3	8.9	7.9	1.3	0.445
120	4.9	10.2	8.0	1.5	0.4454		120	7.3	9.0	7.9	1.4	0.4456
130	4.9	10.2	8.0	1.3	0.4451		130	6.8	9.1	7.9	1	0.4463
140	4.9	10.2	8.0	1.4	0.4456		140	6.7	9.1	7.9	0.7	0.4463
		July							**August**			
0	22.9	7.5	8.3	1.4	0.4598		0	22.8	7.7	8.4	2.0	0.4623
10	22.1	7.6	8.3	1.8	0.45585		10	22.7	7.7	8.4	2.0	0.4625
20	22.0	7.5	8.3	2.1	0.458		20	22.4	7.7	8.4	2.4	0.4625
30	21.7	7.4	8.3	2.7	0.4575		30	21.0	7.2	8.3	2.3	0.4608
40	20.9	7.4	8.3	2.7	0.4563		40	18.9	6.7	8.2	2.3	0.4579
50	16.4	7.3	8.1	3.0	0.4539		50	17.7	6.5	8.1	2.3	0.4563
60	11.7	7.7	7.9	2.6	0.45		60	15.5	6.6	8.0	2.4	0.4542
70	9.2	8.0	7.9	2.4	0.4464		70	13.4	7.0	8.0	2.2	0.4516
80	8.9	8.1	7.8	2.3	0.4468		80	12.1	7.3	8.0	2.1	0.4497
90	8.7	8.1	7.8	1.9	0.4462		90	11.6	7.3	7.9	2.2	0.4495
100	8.4	8.1	7.8	2.0	0.4461		100	10.9	7.3	7.9	2.4	0.449
110	8.1	8.2	7.8	2.1	0.4458		110	10.6	7.3	7.9	2.2	0.4489
120	7.9	8.2	7.8	1.7	0.4455		120	10.4	7.3	7.8	2.4	0.4488
130	7.8	8.2	7.8	1.5	0.4461		130	9.8	7.2	7.8	2.1	0.4479
140	7.8	8.2	7.8	1.4	0.4457							
		September										
0	18.4	7.6	8.5	3.2	0.461							
10	18.2	7.6	8.5	3.8	0.4608							
20	18.1	7.6	8.5	3.8	0.4606							
30	18.1	7.5	8.4	4.2	0.4607							
40	18.1	7.5	8.4	4.3	0.4605							
50	18.0	7.5	8.4	4.4	0.4608							
60	18.0	7.5	8.4	4.8	0.4609							
70	16.4	6.7	8.3	4.9	0.4573							
80	13.8	6.2	8.1	4.4	0.454							
90	12.8	6.2	8.0	4.7	0.4518							
100	12.2	6.2	8.0	4.7	0.4515							
110	11.8	6.0	7.9	4.5	0.4509							
120	11.6	6.0	7.9	5.3	0.4505							
130	11.3	5.8	7.9	13.1	0.4503							

Appendix 3 continued. Temperature (°C), dissolved oxygen (mg/L), pH (standard units), turbidity (NTU), and total dissolved solids (g/L), profiles by month at Pines site, Fort Peck Reservoir, 2015.

Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)	Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)
		May						**June**			
0	9.9	10.4	8.11	1.7	0.4427	0	18.4	8.52	8.24	3.7	0.4517
10	9.9	10.03	8.15	1.8	0.4424	10	17.8	8.64	8.27	4.2	0.4506
20	9.3	10.14	8.16	2.2	0.4398	20	17.3	8.66	8.25	4	0.4503
30	8.7	10.09	8.14	2.4	0.4387	30	17.0	8.62	8.22	4.4	0.4514
40	8.6	10.01	8.14	2.5	0.4387	40	13.5	8.34	8.05	3.1	0.4467
50	8.4	10.01	8.14	2.4	0.4392	50	11.8	8.46	8.01	2.9	0.4456
60	8.3	9.95	8.14	2.6	0.4396	60	10.2	8.4	7.94	2.5	0.4432
70	8.0	10.06	8.2	2.5	0.442	70	9.4	8.49	7.93	2.2	0.4432
80	7.4	10.03	8.09	2.7	0.4425	80	8.5	8.73	7.93	2.3	0.4426
90	7.2	10.03	8.08	2.6	0.4429	90	7.7	8.99	7.93	2	0.4424
100	7	9.99	8.07	2.7	0.4438	100	7.6	9.03	7.91	1.3	0.4443
						110	7.1	8.99	7.88	1.4	0.444
		July						**August**			
0	23.1	7.26	8.33	1.8	0.4639	0	24.3	7.71	8.43	8.6	0.4648
10	22.9	7.28	8.33	2.4	0.4635	10	22.7	7.92	8.41	4.1	0.4634
20	21.5	7.31	8.3	3	0.4595	20	21.2	7.53	8.35	3.1	0.4609
30	21.1	7.25	8.28	3	0.4575	30	20.3	6.94	8.27	2.5	0.4602
40	19.2	7.1	8.17	3.7	0.4557	40	18.4	6.41	8.16	2.1	0.4571
50	17.0	7.04	8.05	3.5	0.4526	50	17.1	6.4	8.1	1.9	0.4565
60	13.3	7.15	7.89	3	0.4499	60	14.6	6.37	7.95	2.7	0.4536
70	11.8	7.37	7.85	3.3	0.4487	70	13.3	6.54	7.91	2.8	0.4513
80	10.9	7.52	7.51	3.1	0.4476	80	11.7	6.69	7.85	2.4	0.4491
90	10.1	7.46	7.77	3.1	0.4458	90	11.1	6.74	7.83	1.8	0.4485
100	9.0	7.84	7.74	4.1	0.4446	100	10.4	6.85	7.8	1.7	0.4484
		September									
0	19.1	7.58	8.42	3.1	0.4617						
10	18.6	7.61	8.46	4.8	0.4613						
20	18.5	7.52	8.46	4.4	0.4601						
30	18.4	7.49	8.46	3.7	0.461						
40	18.4	7.39	8.44	3.9	0.4612						
50	18.2	7.24	8.43	4.1	0.4607						
60	16.7	6.32	8.25	4.9	0.4583						
70	15.9	6.22	8.19	4.7	0.4569						
80	15.1	6.02	8.11	4.9	0.4559						
90	14.8	5.89	8.07	5.5	0.4546						
100	13.4	5.6	7.94	6.1	0.4532						

Appendix 3 continued. Temperature (°C), dissolved oxygen (mg/L), pH (standard units), turbidity (NTU), and total dissolved solids (g/L), profiles by month at Hell Creek site, Fort Peck Reservoir, 2015.

Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)		Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)
		May							**June**			
0	11.2	10.11	8.17	1.9	0.4386		0	19.5	8.43	8.31	4.3	0.4513
10	10.3	9.93	8.15	1.8	0.4382		10	19.2	8.41	8.32	5.1	0.4505
20	8.6	9.6	8.05	1.1	0.4362		20	19.0	8.27	8.32	6.3	0.4508
30	8.2	9.57	8.03	1	0.4353		30	18.8	8.2	8.29	6	0.4506
40	8.0	9.57	8.01	1.1	0.438		40	13.2	7.75	8.01	4.7	0.4487
50	7.7	9.59	8	1.1	0.4347		50	11.3	7.83	7.93	3.2	0.4461
60	7.4	9.54	7.99	1.3	0.435		60	8.6	8.35	7.91	2.1	0.4404
70	7.3	9.57	8	1.3	0.4347		70	8.2	8.32	7.87	1.7	0.4401
80	7.1	9.47	7.98	1.6	0.4345		80	7.9	8.38	7.86	1.6	0.4402
90	7.1	9.42	7.97	1.8	0.4347		90	7.9	8.39	7.86	1.4	0.4404
100	6.8	9.41	7.97	1.6	0.4346		100	7.7	8.32	7.82	1.9	0.4405
		July							**August**			
0	23.8	7.26	8.33	5.5	0.4675		0	24.3	7.79	8.43	3	0.4636
10	23.2	7.14	8.29	4.7	0.4717		10	22.8	7.97	8.45	2.8	0.4621
20	22.4	6.58	8.28	4.1	0.4632		20	22.1	7.63	8.39	3	0.4618
30	16.9	6.17	7.96	3.9	0.4578		30	20.0	6.4	8.17	3.2	0.459
40	12.9	6.21	7.77	3.4	0.4484		40	19.1	5.95	8.08	3.2	0.4582
50	11.1	6.78	73.73	2.9	0.4461		50	17.4	5.56	7.94	3.2	0.4536
60	9.8	6.96	7.69	2.7	0.4461		60	16.3	5.57	7.9	3.1	0.4529
70	9.1	7.23	7.7	2.6	0.444		70	13.9	5.5	7.79	4	0.4486
80	8.7	7.36	7.69	2.8	0.4443		80	12.9	5.45	7.73	4.3	0.4492
90	8.4	7.39	7.68	3	0.4437		90	12.0	5.3	7.68	9.8	0.4491
100	8.2	7.35	7.65	4	0.444		100	11.0	5.31	7.62	10.5	0.4477
		September										
0	19.2	7.73	8.44	3.9	0.4562							
10	18.9	7.7	8.47	4	0.4555							
20	18.9	7.65	8.46	4.4	0.4547							
30	18.6	7.32	8.42	4.4	0.4549							
40	18.4	7.17	8.41	4.5	0.4554							
50	18.1	6.78	8.35	4.8	0.4555							
60	16.7	5.92	8.17	6.3	0.4569							
70	15.2	5.02	7.95	5.8	0.4539							
80	13.9	4.49	7.81	7	0.4527							
90	12.6	4.2	7.71	11	0.4508							
100	12.3	4.13	7.69	11.5	0.4509							

Appendix 3 continued. Temperature (°C), dissolved oxygen (mg/L), pH (standard units), turbidity (NTU), and total dissolved solids (g/L), profiles by month at Timber Creek site, Fort Peck Reservoir, 2015.

Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)		Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)
		May							**June**			
0	12.4	9.63	8.04	3.1	0.452		0	19.7	8.32	8.28	5.1	0.4612
10	12.4	9.65	8.09	3.5	0.4524		10	19.1	8.31	8.4	5.5	0.4594
20	12.3	9.61	8.09	3.8	0.4518		20	18.5	7.77	8.27	5.1	0.4587
30	11.9	9.34	8.1	3.5	0.4506		30	15.0	6.33	7.92	5	0.4677
40	11.3	9.21	8.06	4.2	0.452		40	14.5	5.92	7.84	5.4	0.476
50	9.2	8.61	7.86	5.2	0.4519		50	13.6	5.81	7.78	5	0.4714
60	7.7	8.44	7.75	3.3	0.4476		60	12.2	5.45	7.64	7	0.4665
		July							**August**			
0	23.3	7.17	8.23	3.8	0.443		0	23.7	7.89	8.41	4.7	0.4497
10	23.2	7.1	8.24	3.9	0.4429		10	23.2	8.1	8.42	3.7	0.4505
20	16.1	3.9	7.61	5.7	0.4653		20	22.0	7.9	8.37	3.8	0.4471
30	12.6	4.88	7.58	4.6	0.456		30	20.7	6.8	8.19	4.4	0.447
40	11.2	5.19	7.56	5.5	0.4515		40	18.1	4.91	7.83	7	0.4492
50	10.6	5.12	7.5	6.4	0.4509		50	17.0	4.28	7.69	8.8	0.4469
60	9.9	5.39	7.51	9.8	0.4479		60	14.7	2.83	7.43	16.6	0.4489
		September										
0	18.6	7.99	8.38	5.4	0.4323							
10	18.4	7.85	8.4	5.8	0.4319							
20	18.2	7.68	8.41	6.5	0.4307							
30	17.9	6.81	8.25	5.6	0.4308							
40	17.5	6.08	8.15	7.1	0.4373							
50	17.1	5.18	8.01	9	0.4413							
60	14.8	2.04	7.52	20.5	0.4506							

Appendix 4. Gill netting dates by region, water surface temperature range (°F), and reservoir elevation (MSL) during standard experimental gill net surveys on Fort Peck Reservoir. Mean water surface temperatures are given in parentheses.

	Region[1]					Water surface	Reservoir
Year	UBD	LBD	LMA	MMA	UMA	Temperature (°F)	Elevation (MSL)
1992	7/27 to 7/28	7/22 to 7/30	7/21 to 8/5	8/6 to 8/20	8/18 to 8/19	66 to 75 (69.3)	2212.9 to 2211.9
1993	7/27 to 8/3	8/10 to 8/20	8/25 to 8/27	8/10 to 8/20	8/5 to 8/6	64 to 72 (67.9)	2219.6 to 2224.7
1994	7/19 to 7/27	7/26 to 7/29	8/2 to 8/3	8/4 to 8/16	8/16 to 8/18	68 to 76 (72.6)	2238.1 to 2236.7
1995	7/18 to 7/21	7/25 to 7/28	8/8 to 8/24	8/1 to 8/15	8/15 to 8/17	68 to 76 (71.0)	2242.6 to 2244.1
1996	7/16 to 7/18	7/23 to 7/25	7/30 to 8/1	8/6 to 8/13	8/13 to 8/15	66 to 74 (69.4)	2246.5 to 2244.2
1998	7/17 to 7/28	7/15 to 7/21	7/14 to 7/30	8/5 to 8/11	8/11 to 8/13	NA	2239.7 to 2239.9
1999	7/13 to 7/20	7/15 to 7/22	7/23 to 7/28	7/29 to to 8/9	8/10 to 8/11	67 to 76 (71.6)	2238.0 to 2236.9
2000	7/26 to 9/8	7/19 to 7/27	7/11 to 7/14	8/8 to 8/11	8/23 to 8/24	NA	2232.6 to 2231.0
2001	7/31 to 8/2	8/7 to 8/16	8/16 to 8/17	8/21 to 8/28	7/23 to 8/28	NA	2222.5 to 2221.8
2002	7/17 to 9/6	7/18 to 9/6	7/23 to 8/1	7/25 to 9/4	8/6 to 8/14	68 to 81 (74.3)	2220.2 to 2219.3
2003	7/10 to 8/20	7/10 to 8/5	7/8 to 8/13	7/15 to 8/12	7/22 to 7/24	NA	2213.0 to 2211.6
2004	7/14 to 7/15	7/13 to 7/15	7/20 to 7/22	7/21 to 7/27	7/27 to 7/29	69 to 77 (73.6)	2203.2 to 2201.6
2005	7/19 to 7/21	7/21 to 7/27	7/28 to 8/2	8/2 to 8/17	8/16 to 8/17	68 to 78 (72.1)	2203.4 to 2202.7
2006	7/11 to 7/13	7/18 to 7/20	7/20 to 7/26	7/26 to 8/3	8/3 to 8/16	69 to 80 (74.3)	2205.6 to 2204.2
2007	7/17 to 7/24	7/24 to 7/27	7/27 to 8/1	8/1 to 8/7	8/14 to 8/15	70.3 to 84.9 (78.2)	2202.9 to 2201.6
2008	7/15 to 7/17	7/17 to 7/23	7/24 to 7/30	7/30 to 8/4	8/4 to 8/6	67.1 to 80.2 (74.3)	2209.9 to 2210.0
2009	7/16 to 7/21	7/21 to 7/23	7/24 to 7/28	7/29 to 8/3	8/3 to 8/5	66.7 to 76.3 (71.1)	2220.5 to 2220.4
2010	7/13 to 7/20	7/20 to 7/22	7/22 to 7/28	7/28 to 8/5	8/3 to 8/5	67.3 to 77.9 (73.3)	2235.2 to 2235.7
2011	7/26 to 7/28	7/28 to 7/29	8/2 to 8/3	8/3 to 8/5	8/9 to 8/11	70.5 to 79.8 (75.2)	2249.3 to 2244.7
2012	7/17 to 7/19	7/19 to 7/20	7/24 to 7/25	7/25 to 8/1	7/30 to 8/1	67.2 to 83.5 (75.5)	2236.6 to 2235.8
2013	7/23 to 7/25	7/25 to 8/1	8/1 to 8/7	8/8 to 8/9	8/13 to 8/15	63.5 to 77.9 (72.3)	2236.3 to 2234.9
2014	7/17 to 7/22	7/22 to 7/24	7/24 to 7/30	7/30 to 8/7	8/5 to 8/7	67.8 to 79.8 (74.0)	2230.3 to 2229.9
2015	7/21 to 7/23	7/23 to 7/31	7/31 to 8/5	8/5 to 8/13	8/11 to 8/13	67.9 to 79.2 (73.0)	2236.4 to 2235.9

[1]Upper Big Dry (UBD), Lower Big Dry (LBD), Lower Missouri Arm (LMA), Middle Missouri Arm (MMA), and upper Missouri Arm (UMA).

Appendix 5. Northern pike and channel catfish proportional stock density (PSD) relative stock density of preferred-length (RSD-P) fish and mean relative weight values (*Wr*), for 2002-2015, for fish collected in the standard July-August gill net survey, on Fort Peck Reservoir.

Northern pike				
Year	PSD	RSD-P	*Wr*	Sample size
2002	94	62	102.0	144
2003	98	55	101.1	126
2004	96	71	100.1	75
2005	93	59	100.3	86
2006	89	60	98.9	108
2007	75	41	101.0	147
2008	89	39	100.0	137
2009	73	39	93.1	176
2010	68	24	100.0	191
2011	69	18	100.5	293
2012	75	15	99.0	503
2013	75	24	93.1	324
2014	82	33	96.2	336
2015	88	40	97.5	264

Channel catfish				
Year	PSD	RSD-P	*Wr*	Sample size
2002	74	3	89.9	145
2003	71	5	89.4	129
2004	57	11	98.1	227
2005	35	6	91.3	297
2006	46	10	95.1	215
2007	38	4	85.3	278
2008	35	2	88.2	289
2009	57	5	91.6	314
2010	74	11	88.2	104
2011	72	8	90.5	241
2012	65	3	87.9	272
2013	64	4	85.7	240
2014	80	3	84.7	246
2015	86	3	85.5	201