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, 2014 THROUGH JUNE 30, 2015
REPORT PERIOD: MARCH 1, 2014 THROUGH FEBRUARY 29, 2015

ABSTRACT

Fort Peck Reservoir reached peak elevation on December 31st, 2014 at 2233.53 mean feet above sea level (MSL) from a minimum elevation on March 7th, 2014 at 2222.33 MSL, a rise of 11.2 feet. Spawning walleye and northern pike populations were sampled in the upper Big Dry Arm with modified fyke nets from April 18th to May 5th. Walleye and northern pike eggs were collected. The fertilized eggs were sent to Fort Peck and Miles City fish hatcheries. Trap netting captured 1,670 walleye for a catch rate of 4.6 per net night in 2014 which was similar to the previous year of 4.5 per net night. Due to favorable spawning conditions, 62 million walleye eggs were collected in 2014. A total of 14.7 million fry and 2.2 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 17th to August 7th. Walleye, northern pike, and channel catfish were the most abundant species captured overall, with catch rates of 4.7, 3.4, and 2.5 per net night, respectively. Relative abundance of walleye in 2014 was similar to the previous year at 4.8 per net night which is above the long-term average of 3.7 per net for the period from 1984 to 2014. Gill-netted walleye averaged 15.5 inches and 1.7 pounds. In 2014, relative abundance increased slightly for stock and preferred-size walleye while catch rates of all other length groups decreased. Relative weights of walleye increased slightly for all length groups. Northern pike relative abundance in 2014 was similar to the previous year at 3.2 per net night which is above the long term average of 1.7 per net night for the period of 1984 to 2014. Average size of gill-netted northern pike in 2014 was 25.8 inches and 4.6 pounds. Overall, relative abundance of shoreline forage increased slightly to 126 per haul in 2014 but was below the long-term average of 169 per haul from 1984 to 2014. Relative abundance of young-of-year yellow perch continued to decrease in 2014 to 17 per seine haul. In June of 2014, 230,840chinook salmon were stocked at Duck Creek, Marina, and Milk Coulee. Young-of-year cisco relative abundance decreased to 140 per net night in 2014 but was above the long-term average of 79 per net night for the period of 1986 to 2014.

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). 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 the Home Run Pond kids fishing clinics. Staff also assisted the regional information and education officer with multiple press releases and as science fair judges. Staff attended Walleyes Unlimited meetings in Lewistown and Glasgow to present annual updates on the status of the Fort Peck Reservoir fishery. 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 December 31st, 2014 at 2233.53 mean feet above sea level (MSL) from a minimum elevation on March 7th, 2014 at 2222.33 MSL, a rise of 11.2 feet (Figure 2). Reservoir elevations are predicted to rise approximately eight feet from March through June and fall beginning in August of 2015based on the March 2015 basic forecast (USACE 2014).

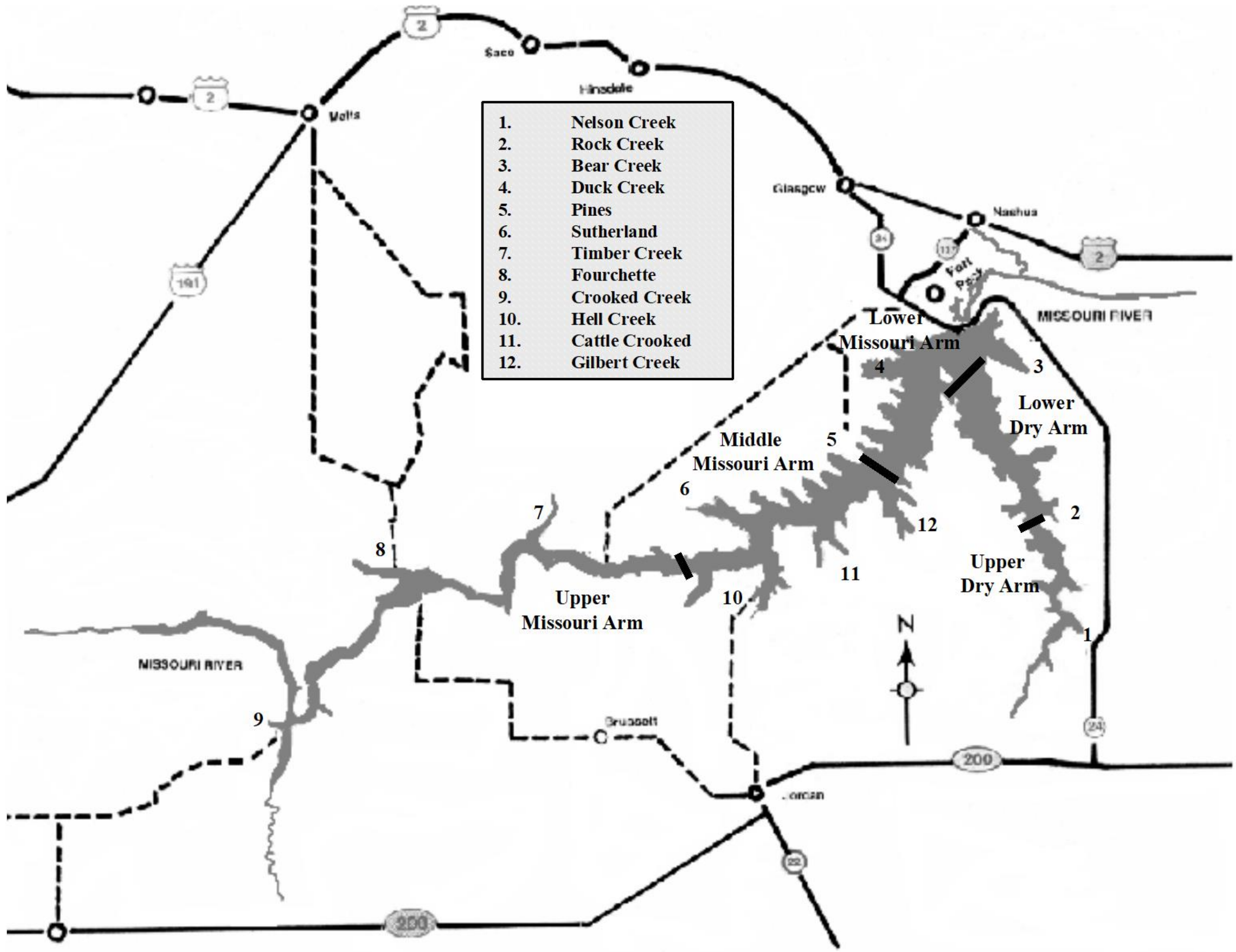


Figure 1. Fort Peck study area describing major sampling zones and select specific locations.

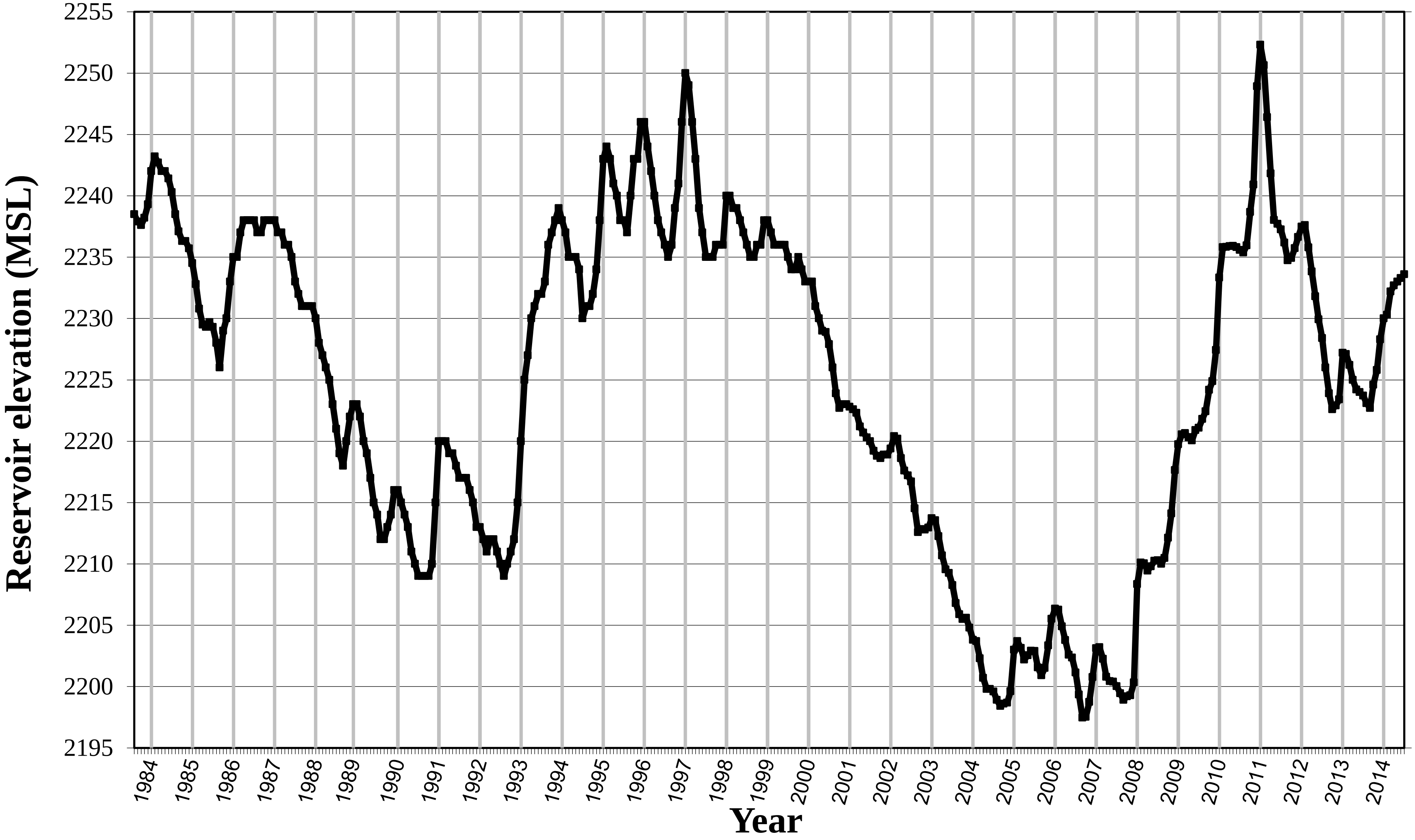


Figure 2. Peak monthly reservoir elevations on Fort Peck Reservoir from January 1984 to January 2014 (Data provided by the U.S. Army Corps of Engineers).

SAMPLING METHODS

Data Collection

- Spring sampling was conducted from April 18th to May 5th, 2014 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 17th to August 7th, 2014 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 due to the otolith microchemistry study.
- Beach seining was conducted from August 4th to August 29th, 2014 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 18th to September 26th, 2014. Only the lower Big Dry, lower Missouri, and middle Missouri Arms were sampled because they contained sufficient depths of 100 ft. In previous years when reservoir elevations were higher, other locations were sampled as shown in Table 15.
- Electrofishing was used during October 3rd to October 28th, 2014 to locate, sample, and collect chinook salmon as part of the annual egg-take effort.
- Chinook salmon otoliths were collected from all deceased fish 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 April 18th to May 5th, 2014. A total of 363-trap days were committed to walleye spawning efforts in 2014. Netting effort was lower than previous year due to late ice cover and reaching the goal of walleye eggs needed for hatchery production. 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 42°F when trap netting efforts commenced and gradually increased to 52°F over the course of a week. Becker (1983) reported that walleye spawning activity peaks when water temperatures are 43°F to 50°F in the north-central United States.

Because of the gradual warming and favorable water temperatures in 2014, more ripe female walleye were collected resulting in 62 million total eggs. Fluctuations and declines in water temperatures have been shown to prolong spawning or result in females retaining their eggs (Derback 1947). In addition, 1.4 million northern pike eggs were collected to meet statewide stocking requests. The fertilized walleye and northern pike eggs were sent to the Fort Peck and Miles City Fish Hatcheries. A total of 14.7 million fry and 2.2 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 not met (FPRFMP 2012). This was due to below average fingerling production at the Miles City and Fort Peck hatcheries.

Walleye

Relative abundance of walleye in 2014 was 4.6 per net, which was similar to the previous year, but below the long-term average of 7.2 per net (1982-2014; Table 2). Average length and weight increased from 17.6 inches and 2.5 pounds in 2013to19.8 inches and 3.6 pounds in 2014. Furthermore, length frequency distributions showed 45% of walleye were greater than 20 inches in 2014 compared to 26% in 2013(Figure 3).

Northern Pike

Relative abundance of northern pike decreased from a record 10.5 per net in 2013 to 7.9 per net in 2014 (Table 2). The decrease in relative abundance can be attributed to warmer water temperatures that limited spawning activity. Typically, northern pike have spawned by the time the walleye egg-taking operation has commenced when water temperatures are below 43°F (Frost and Kipling 1967). Average length and weight increased from 24.2 inches and 3.8 pounds in 2013 to 27.5 inches and 5.7 pounds in 2014. In addition, length frequency distributions showed 65% of northern pike were greater than 26 inches in 2014 compared to 27% in 2013 (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, 1982-2014. 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

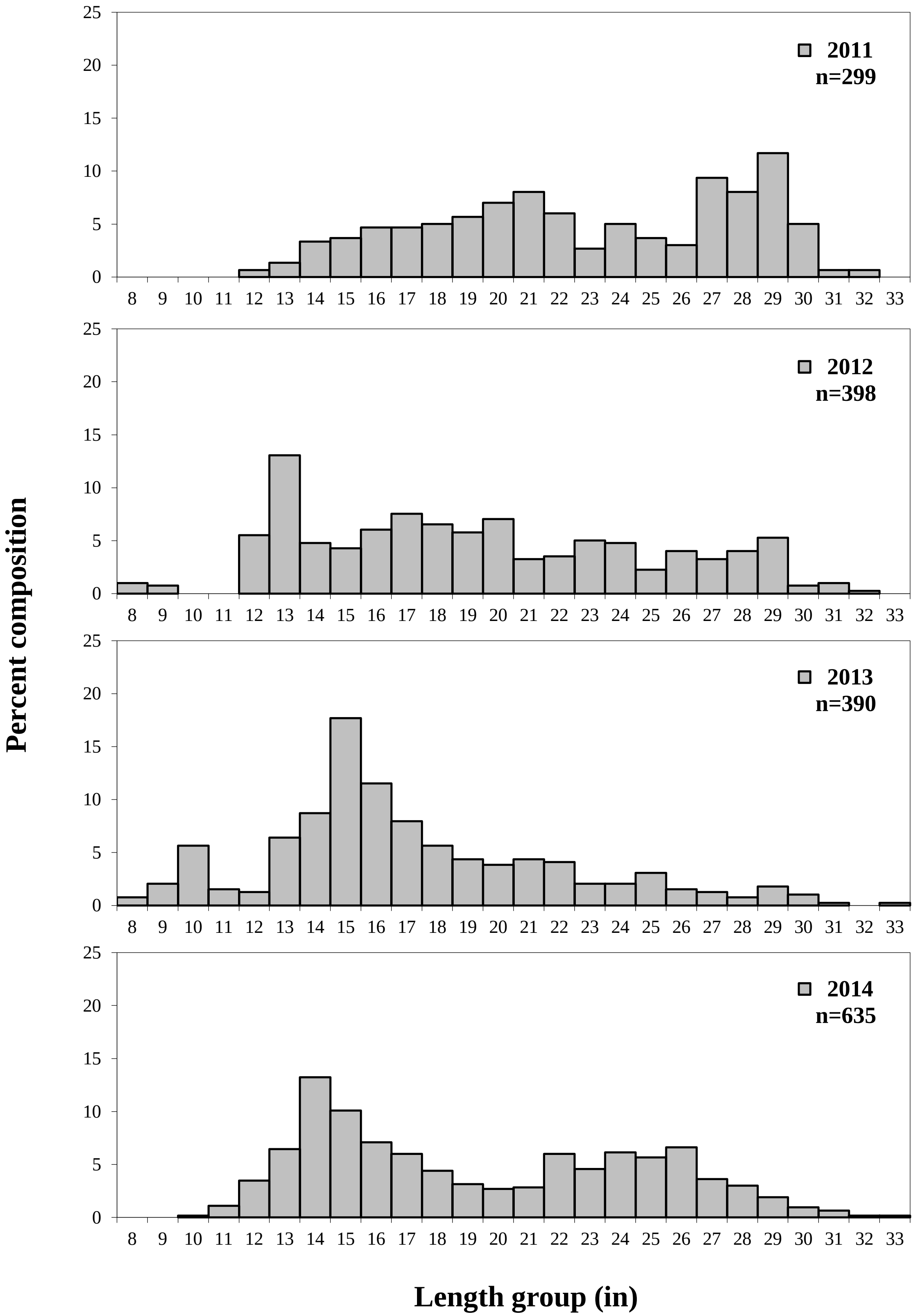


Figure 3. Length frequency of subsampled walleye collected during spring trap netting in the upper Big Dry Arm of Fort Peck Reservoir, 2011-2014.

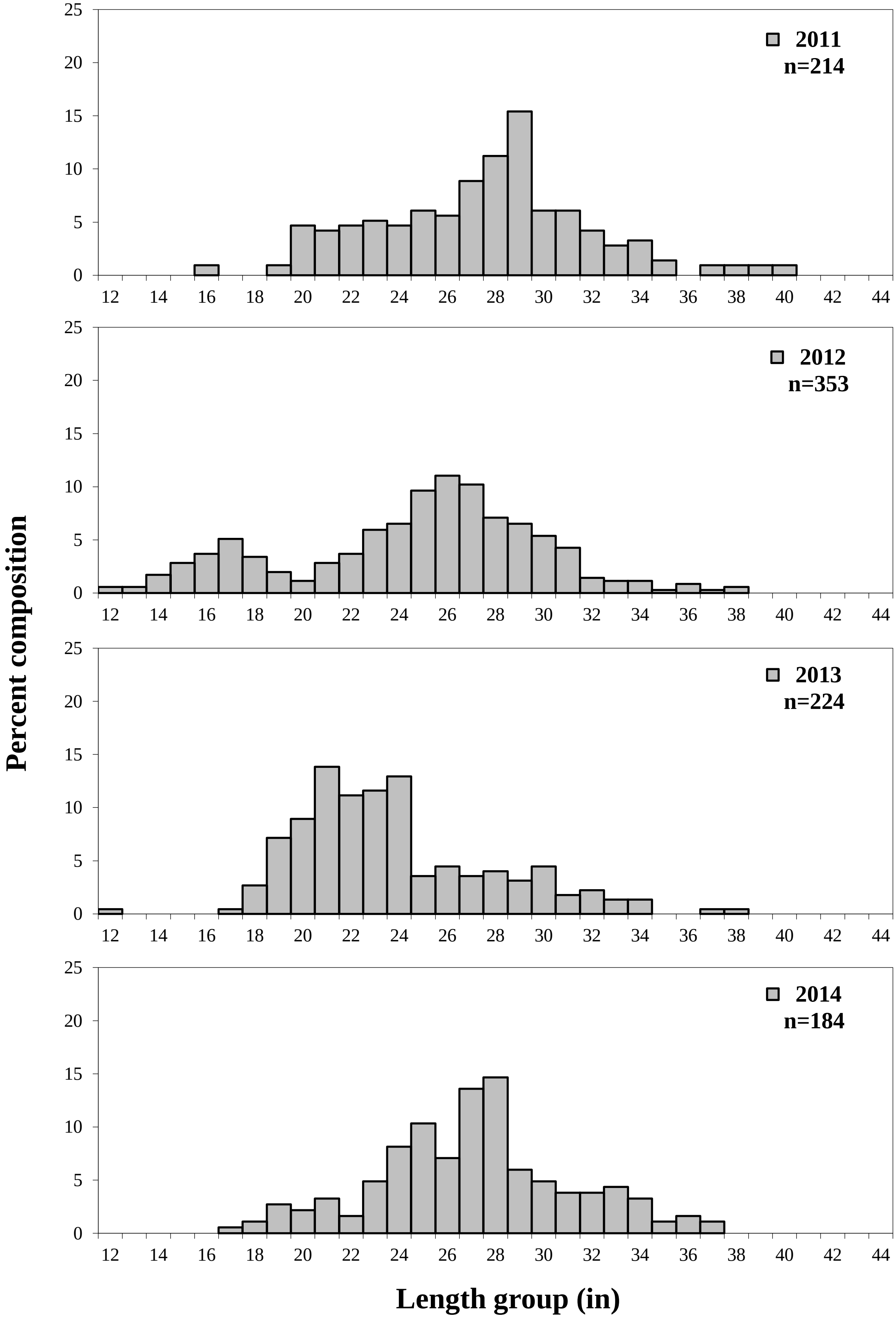


Figure 4. Length frequency of subsampled northern pike collected during spring trap netting in the upper Big Dry Arm of Fort Peck Reservoir, 2011-2014.

LIMNOLOGY AND ZOOPLANKTON MONITORING

Water temperature in Fort Peck Reservoir ranged from 25.3°C below the water surface to 5.5°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 (10.8 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 2014, dissolved oxygen levels of less than 5 mg/L may limit some deep-water salmonid habitat (e.g., lake trout; Sellers et al. 1998).

Zooplankton samples were collected monthly at six stations throughout Fort Peck Reservoir from May through September. The purpose of this sampling was to determine the difference in zooplankton populations in various portions of the reservoir, and to determine seasonal fluctuations in densities and composition of principal zooplankton at each station.

The maximum estimated zooplankton density was 77.4/L which occurred in June of 2014. Cyclopoids dominated the zooplankton community from May through September but reached peak density in May and again in August at 27/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). Based on these seasonal peaks in abundance, survival of stocked fish (i.e.,walleye fry) may be reduced since walleye are stocked a month prior to peak zooplankton abundance.

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

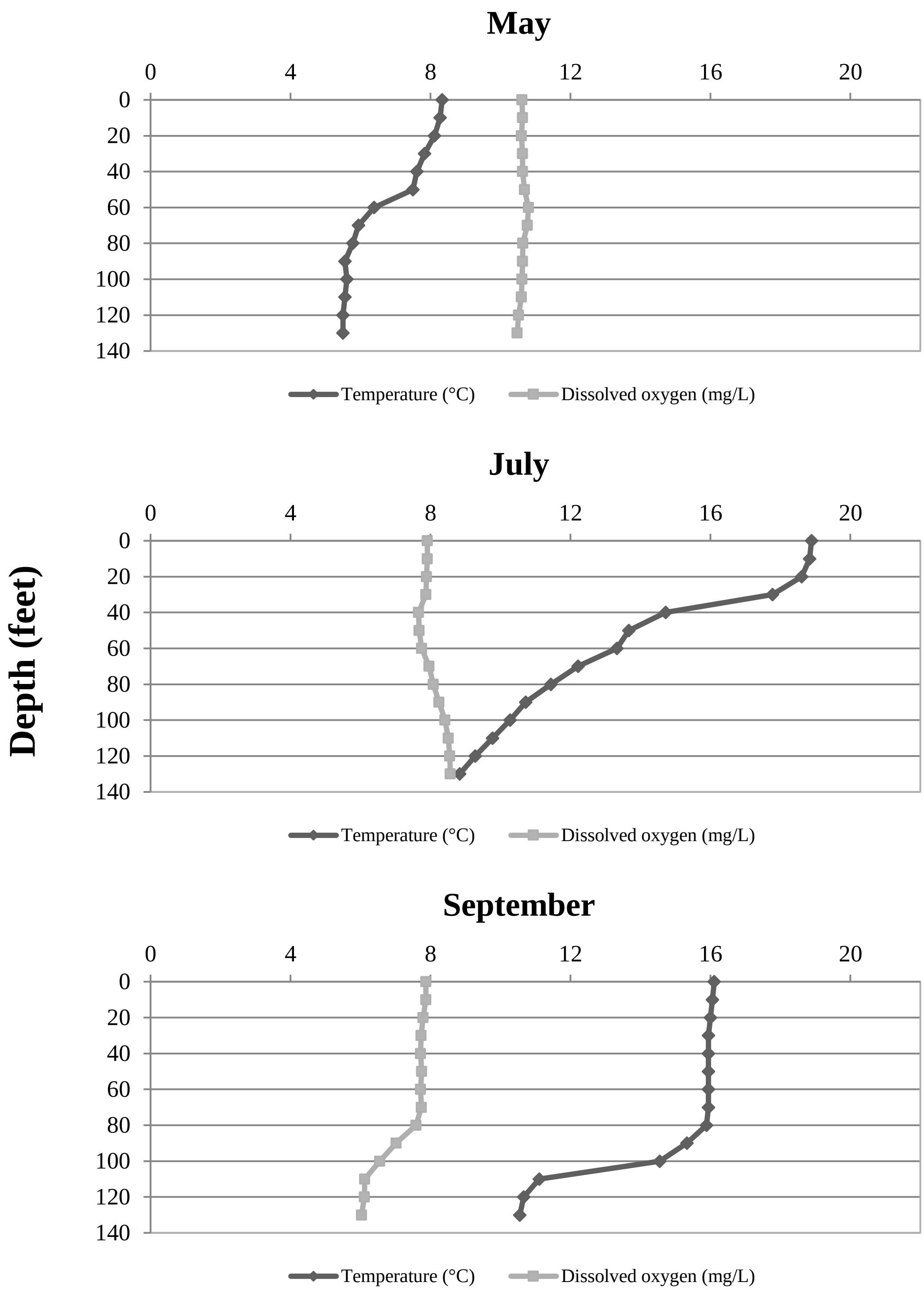


Figure 5. Depth profiles of temperature (°C) and oxygen (mg/L) located near Haxby Point on Fort Peck Reservoir, May-September 2014.

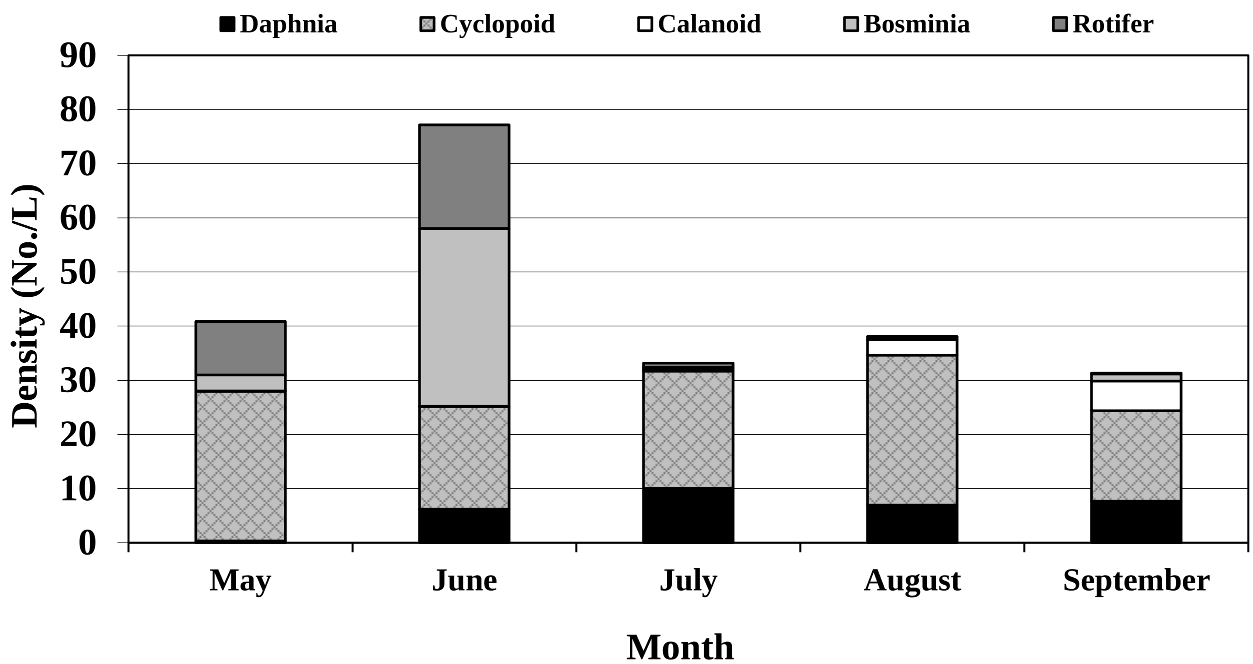


Figure 6. Mean zooplankton density (number of organisms/L) by taxonomic group and month for Fort Peck Reservoir, 2014.

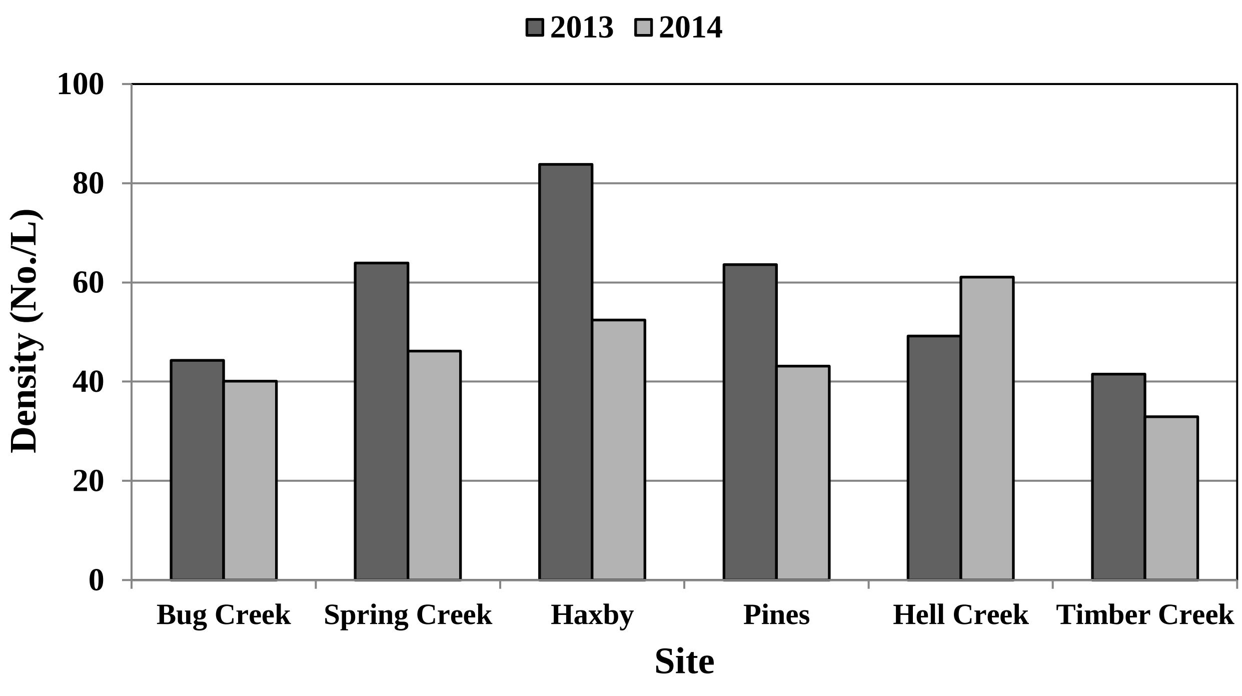


Figure 7. Mean zooplankton density (number of organisms/L) by site for Fort Peck Reservoir, 2013-2014.

RESERVOIR-WIDE GILL NETTING

Standard experimental gill nets were set throughout the reservoir from July 17th to August 7th, 2014 when water surface temperatures ranged from 68°F to 80°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 channel catfish were the most abundant species captured overall, with catch rates of 4.7, 3.4, and 2.5 per net night, respectively. Fish with catch rates equal to or greater than 1.0 per-net night include: common carp, goldeye, shorthead redhorse, river carpsucker, and smallmouth bass.

Walleye

Relative abundance of walleye in 2014 was 4.7 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 2014. The three-year running average goal of 3.6 per net was met (5.4 per net in 2012-2014) as outlined in the FPRFMP. Similar to previous years, stock length groups comprised the largest group of gill-netted walleye (Figure 8). Relative abundance of walleye was greatest in the upper Big Dry arm and middle Missouri arm with a catch rate of 5.3 per net (Table 3).

Length frequency distributions of walleye in 2014 indicated a large group of fish in the 10 to 15- inch range (Figure 9). This group represented 57% of all walleye gill netted in 2014 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. 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 slightly from 2013 to 2014. Relative weights increased for all length groups, but the most notable increase was for the quality length group (Figure 10). This can be attributed to a large year class of cisco produced in 2014. Cisco have been found to be an important prey item for walleye greater than 18 inches in Fort Peck Reservoir (Mullins 1991).

Mean length-at-age for walleye in 2014 was generally higher compared to the six-year average (Table 5). Higher mean lengths-at-age were observed for age-4 through age-10 walleye indicating favorable growth over the last few years. However, mean lengths-at-age 3 for walleye were lower in 2014 compared to previous years. It should also be noted that a large group of 3 and 4-year old fish (2010 and 2011 year classes) were observed in 2014 and comprised 59% of all walleye aged. Similar to previous years, multiple year classes were present with walleye up to age-24.

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 1987, 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 2014 with a value of 59 (Table 6). RSD-P was 13 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, 2014. *N* is total number collected for length and weight measurements.

			Average			
			Length		Weight	
Species	Number	CPUE	Inches	*N*	Pounds	*N*
Black bullhead	18	0.2	8.7	18	0.3	18
Black crappie	29	0.3	8.6	29	0.4	29
Channel catfish	246	2.5	18.0	246	2.0	246
Cisco	11	0.1	10.0	11	0.4	11
Common carp	153	1.5	20.9	153	4.3	153
Freshwater drum	71	0.7	14.6	71	1.6	71
Goldeye	214	2.1	12.8	207	0.7	207
Northern pike	336	3.4	25.8	336	4.6	336
Paddlefish	1	0.0	55.1	1	68.3	1
River carpsucker	136	1.4	18.6	136	3.8	136
Sauger	21	0.2	14.0	21	0.7	21
Shorthead redhorse	133	1.3	14.5	133	1.3	133
Shovlenose sturgeon	1	<0.1	28.1	1	3.1	1
Smallmouth bass	142	1.4	13.1	142	1.4	142
Smallmouth buffalo	86	0.9	22.2	86	7.3	86
Walleye	466	4.7	15.5	466	1.7	466
White crappie	5	0.1	8.6	5	0.4	5
White sucker	44	0.4	16.0	44	1.8	44
Yellow perch	35	0.4	6.6	35	0.2	35

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, 2014.

	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	17	0.9	1	<0.1	0	--	0	--	0	--	18	0.2
Black crappie	2	0.1	0	--	0	--	0	--	27	1.4	29	0.3
Channel catfish	54	2.7	16	0.8	5	0.3	38	1.9	133	6.7	246	2.5
Cisco	8	0.4	1	<0.1	1	<0.1	0	--	1	<0.1	11	0.1
Common carp	13	0.7	37	1.9	39	2.0	38	1.9	26	1.3	153	1.5
Freshwater drum	8	0.4	7	0.4	11	0.6	15	0.8	30	1.5	71	0.7
Goldeye	42	2.1	10	0.5	24	1.2	18	0.9	120	6.0	214	2.1
Northern pike	109	5.5	66	3.3	80	4.0	55	2.8	26	1.3	336	3.4
Paddlefish	0	--	1	<0.1	0	--	0	--	0	--	1	<0.1
River carpsucker	46	2.3	18	0.9	5	0.3	22	1.1	45	2.3	136	1.4
Sauger	2	0.1	0	--	1	<0.1	10	0.5	8	0.4	21	0.2
Shorthead redhorse	5	0.3	11	0.6	2	0.1	28	1.4	87	4.4	133	1.3
Shovelnose sturgeon	1	<0.1	0	--	0	--	0	--	0	--	1	<0.1
Smallmouth bass	12	0.6	37	1.9	26	1.3	41	2.1	26	1.3	142	1.4
Smallmouth buffalo	19	1.0	22	1.1	12	0.6	20	1.0	13	0.7	86	0.9
Walleye	105	5.3	77	3.9	95	4.8	106	5.3	83	4.2	466	4.7
White crappie	0	--	0	--	0	--	0	--	5	0.3	5	<0.1
White sucker	27	1.4	10	0.5	4	0.2	3	0.2	0	--	44	0.4
Yellow perch	5	0.3	2	0.1	6	0.3	16	0.8	6	0.3	35	0.4
Total	475	23.8	316	15.8	311	15.6	410	20.5	636	31.8	2,148	21.5

[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

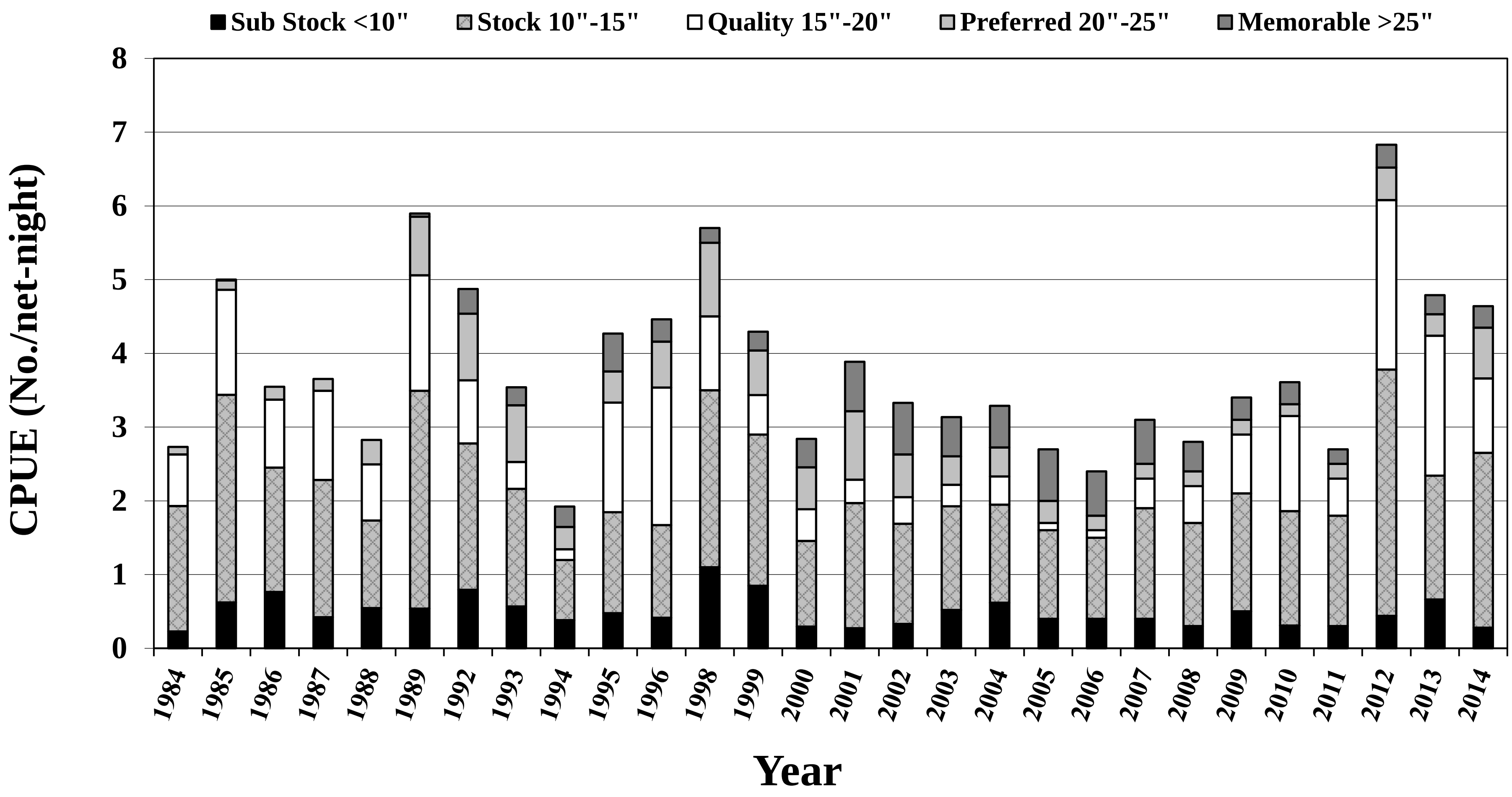


Figure 8. Length structure, in terms of catch per unit effort (CPUE), of walleye collected by experimental gill nets in Fort Peck Reservoir during July-August, 1984-2014 (no data for 1990-1991 and 1997).

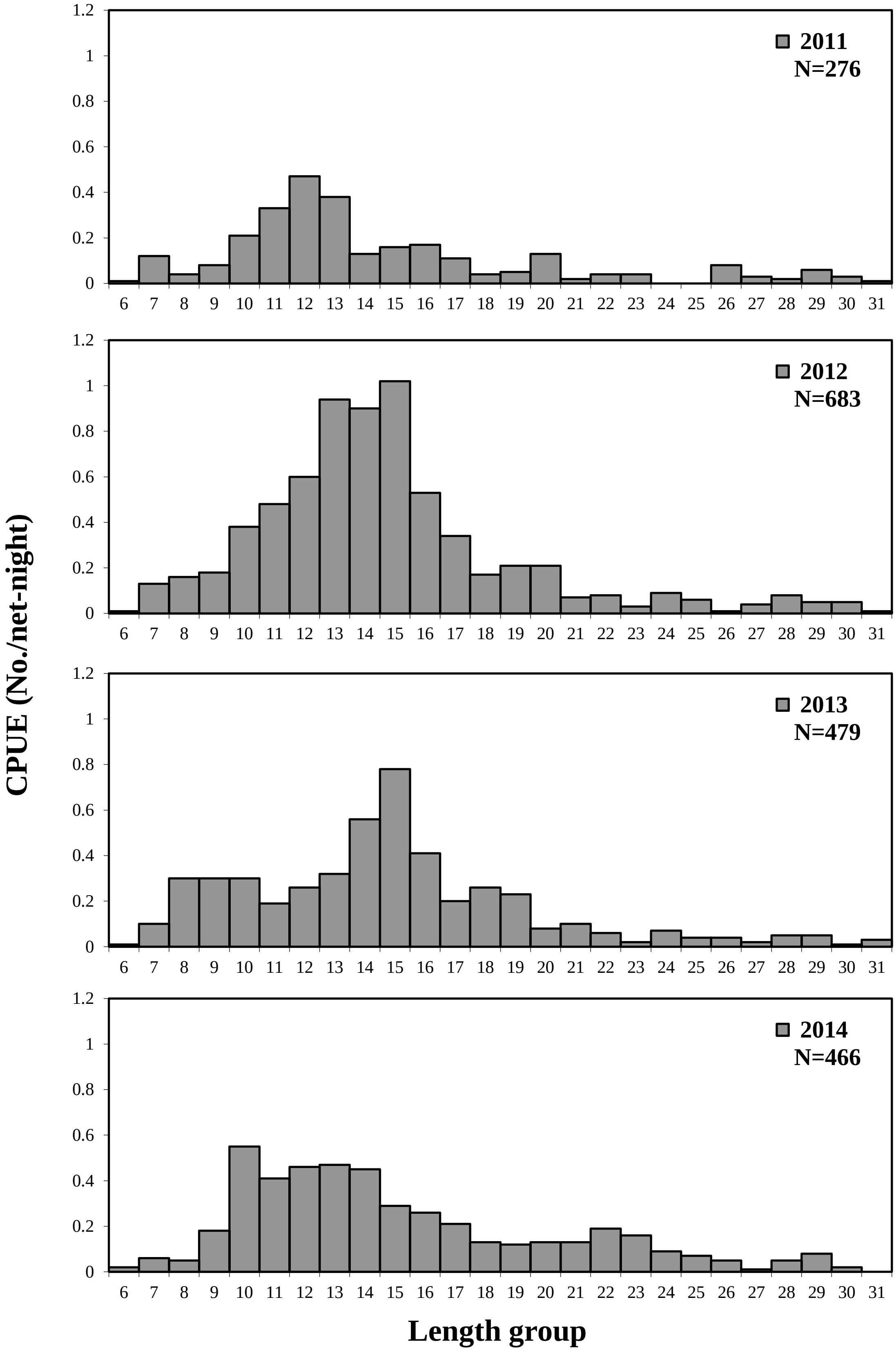
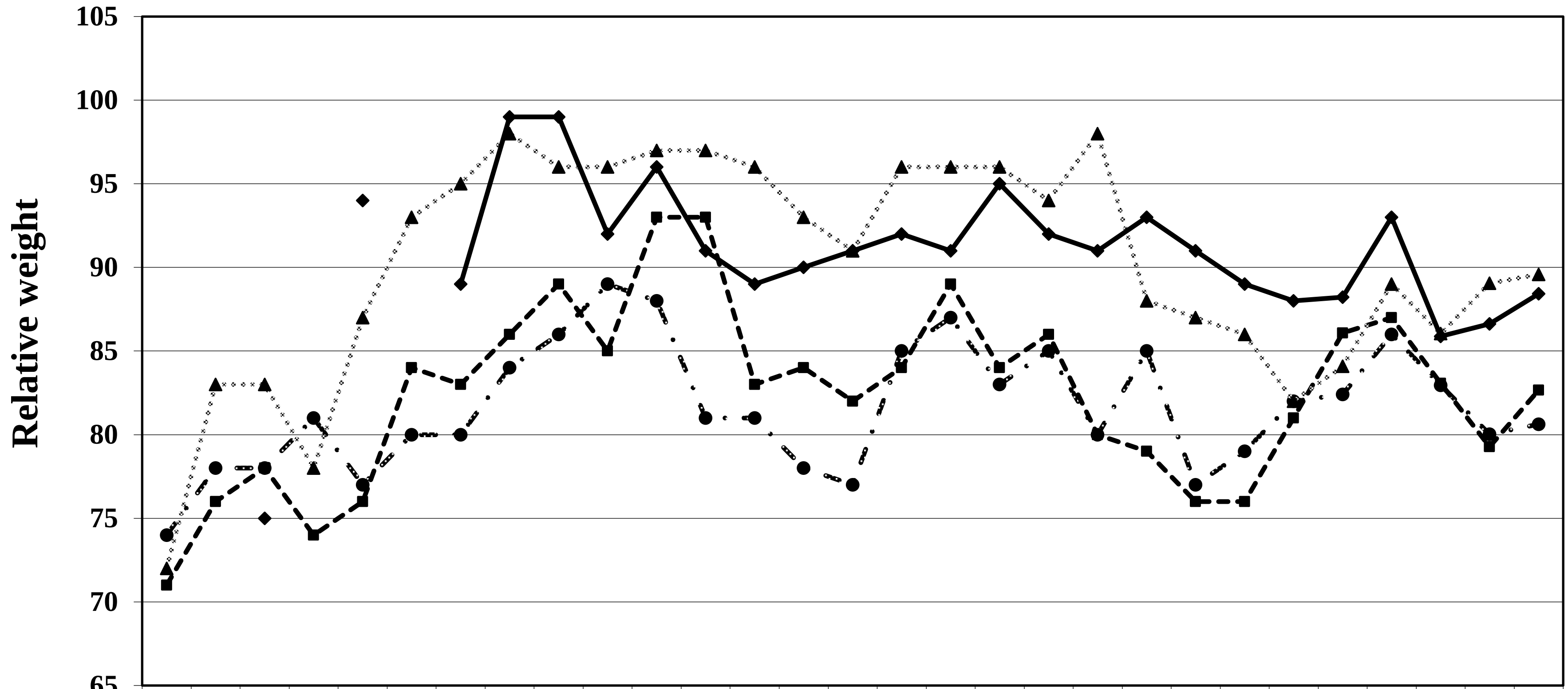


Figure 9. Length frequency, as catch per unit effort, of walleye collected by experimental gill nets in Fort Peck Reservoir during July-August, 2011-2014.



	1983	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
Stock 10"-15"	74	78	78	81	77	80	80	84	86	89	88	81	81	78	77	85	87	83	85	80	85	77	79	82	82	86	83	80	81
Quality 15"-20"	71	76	78	74	76	84	83	86	89	85	93	93	83	84	82	84	89	84	86	80	79	76	76	81	86	87	83	79	83
Preferred 20"-25"	72	83	83	78	87	93	95	98	96	96	97	97	96	93	91	96	96	96	94	98	88	87	86	82	84	89	86	89	90
Memorable >25"			75		94		89	99	99	92	96	91	89	90	91	92	91	95	92	91	93	91	89	88	88	93	86	87	88

Year

Figure 10. Relative weights for stock, quality, preferred, and memorable length groups of walleye collected by experimental gill nets in Fort Peck Reservoir, 1983-2014 (no data for 1990-1991 and 1997)

Table 5. Mean length-at-age at time of capture (in) for walleye collected in experimental gill nets, 2008-2014, on Fort Peck Reservoir. No data for 2013. All walleyes were aged from sectioned otoliths.

Year		Length at age at capture (in)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
2008	Mean	8.1	10.6	11.9	13	14.3	14.9	17.5	15.8	16.4	19.5	23.9	24.2	25.6	26.3
	N	12	31	57	14	15	21	23	8	3	2	5	4	2	2
	SE	0.2	0.2	0.2	0.3	0.5	0.3	0.6	0.7	0.8	4.9	2.2	1.5	3	1.8
	Range	7.9-9.3	8.0-12.3	9.1-15.4	11.4-14.6	9.5-19.4	12.1-18.0	13.8-24.8	13.1-19.7	14.9-17.3	14.6-24.4	15.4-28.3	20.3-27.4	22.5-28.6	24.5-28.1
2009	Mean	7.8	10.8	12.7	14.5	15.1	16.2	17.3	17.8	19.5	15.7	23	15.6	26.7	26.4
	N	47	57	49	100	16	20	27	14	6	1	1	1	4	4
	SE	0.1	0.2	0.2	0.1	0.4	0.4	0.5	0.7	1.4	--	--	--	1.9	1
	Range	7.0-9.3	7.8-14.0	10.5-15.7	11.7-18.3	13.0-18.3	13.8-21.2	13.4-22.3	14.0-21.6	14.6-23.3	--	--	--	21.5-29.5	24.2-29.0
2010	Mean	7.4	10.3	13.3	14.9	16.1	16.5	17.8	19.1	18.7	23.6	--	--	27.8	26.3
	N	2	95	40	50	79	12	18	15	5	2	--	--	1	1
	SE	1.5	0.1	0.2	0.2	0.2	0.6	0.6	0.6	1.4	3.1	--	--	--	--
	Range	5.9-8.2	7.6-15.0	7.6-15.1	10.4-19.4	11.0-22.5	14.4-21.3	13.3-22.9	14.4-23.2	14.0-23.1	20.5-26.8	--	--	--	--
2011	Mean	7.6	9.7	12.4	14.2	17.3	18.4	14.5	21.3	20.7	26.5	--	--	--	28.8
	N	11	22	120	36	17	32	1	5	5	1	--	--	--	2
	SE	0.2	0.3	0.1	0.3	0.5	0.5	--	1.6	1.2	--	--	--	--	1.2
	Range	6.5-8.7	7.3-12.2	9.3-17.7	11.6-16.9	13.8-22.4	12.9-22.9	--	17.9-26.3	17.3-23.9	--	--	--	--	27.6-30.1
2012	Mean	8.4	12.2	13.0	15.3	16.7	18.3	19.8	18.8	21.1	21.8	18.9	17.7	20.3	28.6
	N	34	181	67	235	42	28	22	3	5	7	2	1	1	2
	SE	0.2	0.1	0.2	0.1	0.3	0.3	0.5	1.6	1.4	1.6	2.8	--	--	0.4
	Range	6.1-10.5	7.9-16.7	10.4-17.0	10.6-20.6	13.6-20.5	15.5-21.1	14.7-22.9	15.7-21.3	16.7-24.6	15.9-27.3	16.1-21.8	--	--	28.2-28.9
2014	Mean	7.1	10.5	11.6	14.6	16.0	19.3	20.2	22.6	22.3	21.0	25.2	21.2	26.9	--
	N	5	14	169	89	39	56	11	15	12	4	1	3	3	--
	SE	0.1	0.4	0.1	0.2	0.4	0.4	1.0	0.5	0.9	1.2	--	1.0	2.4	--
	Range	6.8-7.3	6.9-12.6	7.7-17.1	11.4-23.2	10.4-21.6	13.2-24.4	14.7-24.1	19.2-25.2	15.5-26.5	17.8-23.2	--	19.3-22.4	22.2-30.1	--
Mean of means		7.7	10.7	12.5	14.4	15.9	17.3	17.8	19.2	19.8	21.4	22.8	19.7	25.5	27.3

Northern Pike

Relative abundance of northern pike captured in gill nets was 3.4 per net in 2014 which was similar to the previous year (Figure 11). The three-year running average goal of 2.0 northern pike per net was met (3.7 per net in 2013) as outlined in the FPRFMP. Average length and weight of northern pike in 2014 was 25.8 inches and 4.6 pounds, respectively, which was lower when compared to the drought years (2000-2006; Table 7). This is due to smaller individuals recruiting into the population as a result of natural reproduction following several years where reservoir water levels were increasing and flooding suitable habitat. Furthermore, 41% of the northern pike captured in 2014 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 2014, northern pike PSD was 82 and RSD-P was 33 indicating improved growth and recruitment. 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 increasing water levels from 2008 to 2011, terrestrial vegetation has become submerged throughout the reservoir creating ideal spawning and rearing habitat. As a result, relative abundance of stock and quality sized northern pike has continued to increase. Relative weight of northern pike increased from 93 in 2013 to 96 in 2014.

Channel Catfish

Relative abundance of channel catfish captured by gill netting was 2.5 per net in 2014. This was similar to the previous year but above the 28-year average of 1.9 per net (Figure 13). The higher relative abundance could be explained by downstream movement due to increased flows over the last few years. North Dakota fisheries personnel have observed similar trends in Lake Sakakawea (Dave Fryda, personal communication). Similar to previous years, the highest abundance was observed in the Upper Missouri Arm at 6.7 per net (Table 4). In 2014, mean length and weight was 18 inches and 2.0 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 decreased slightly from 86 in 2013 to 85 in 2014. Catfish PSD and RSD-P were 80 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. Angling regulations during this time ranged from 10 walleye/sauger in any combination to a more restrictive bag limit of 5 walleye/sauger with only one being a sauger. This more restrictive regulation was implemented in 2002. Relative abundance in 2014 was 0.2 per net which was similar to the previous year. Average size of sauger in 2014 was 14inches and 0.7 pounds with a relative weight of 75. 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, 1988-2014 (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

[1]Substock is the sum of all walleye less than 10inches, [2]Stock is the sum of all walleye greater than 10 inches, [3]Quality is the sum of all walleye greater than 15 inches, [4]Prefered is the sum 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, 1984-2014.

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

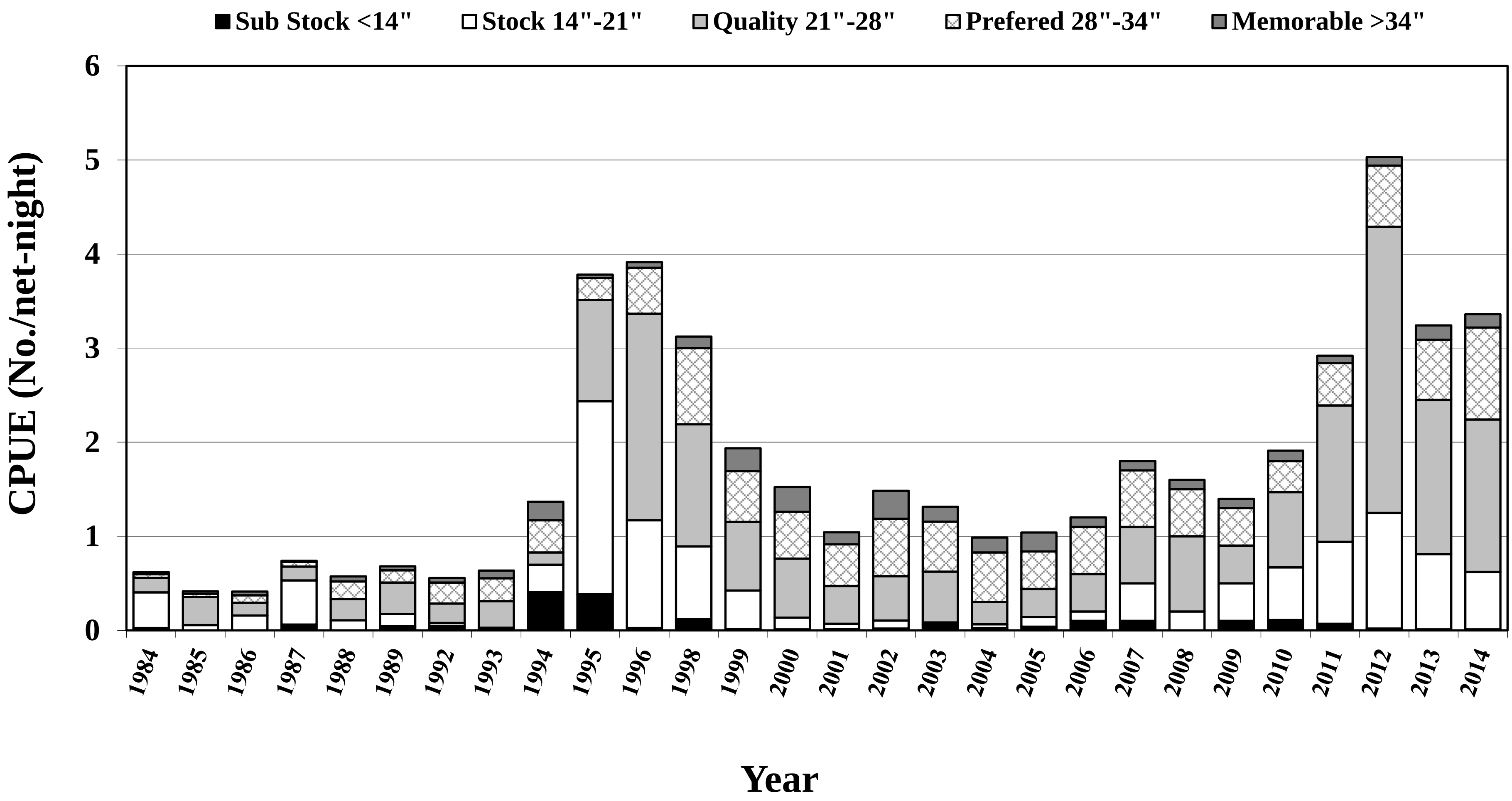


Figure 11. Length structure, in terms of catch per unit effort (CPUE), of northern pike collected by experimental gill nets in Fort Peck Reservoir during, July-August, 1984-2014, (no data for 1990-1991 and 1997).

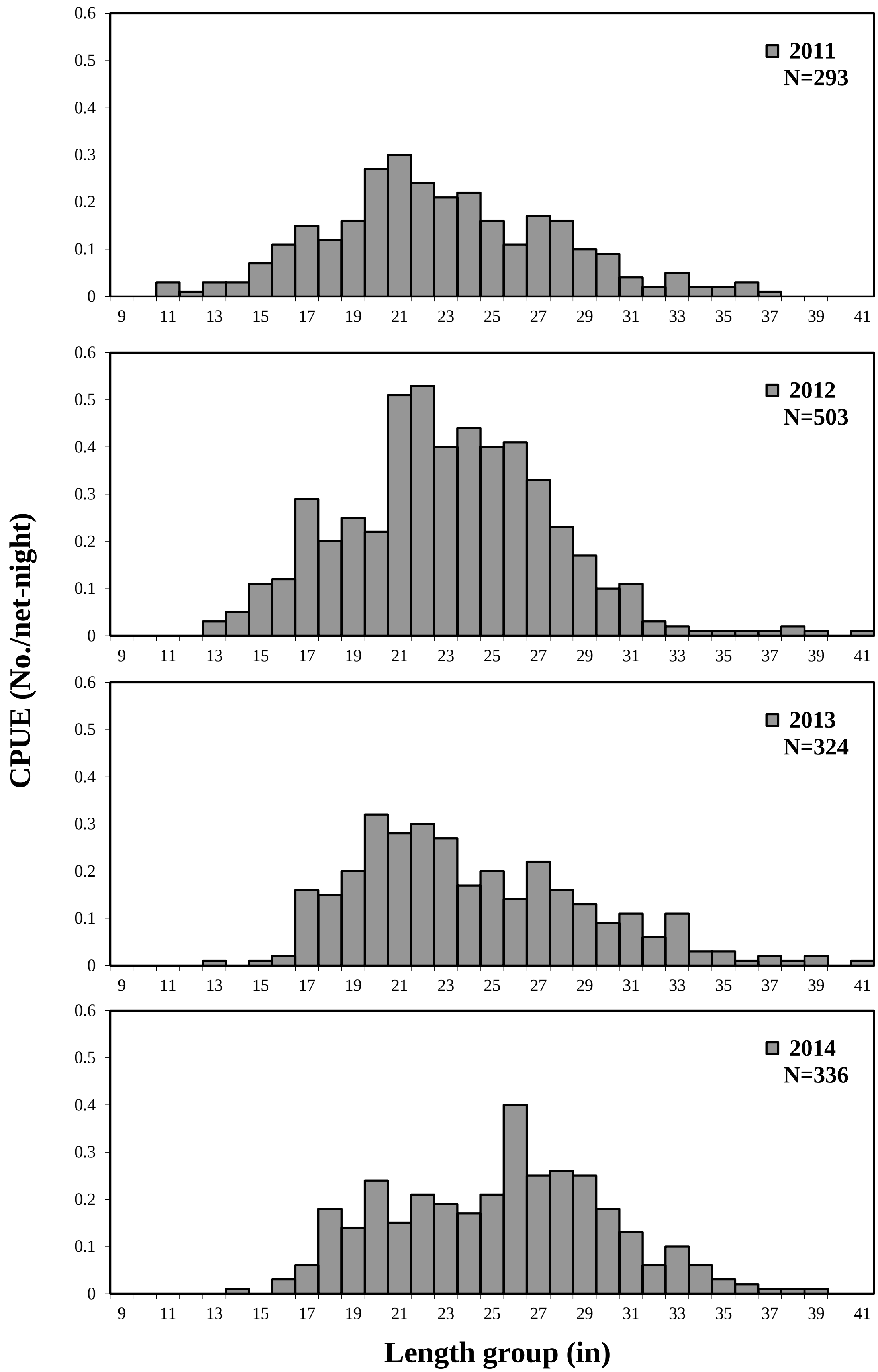
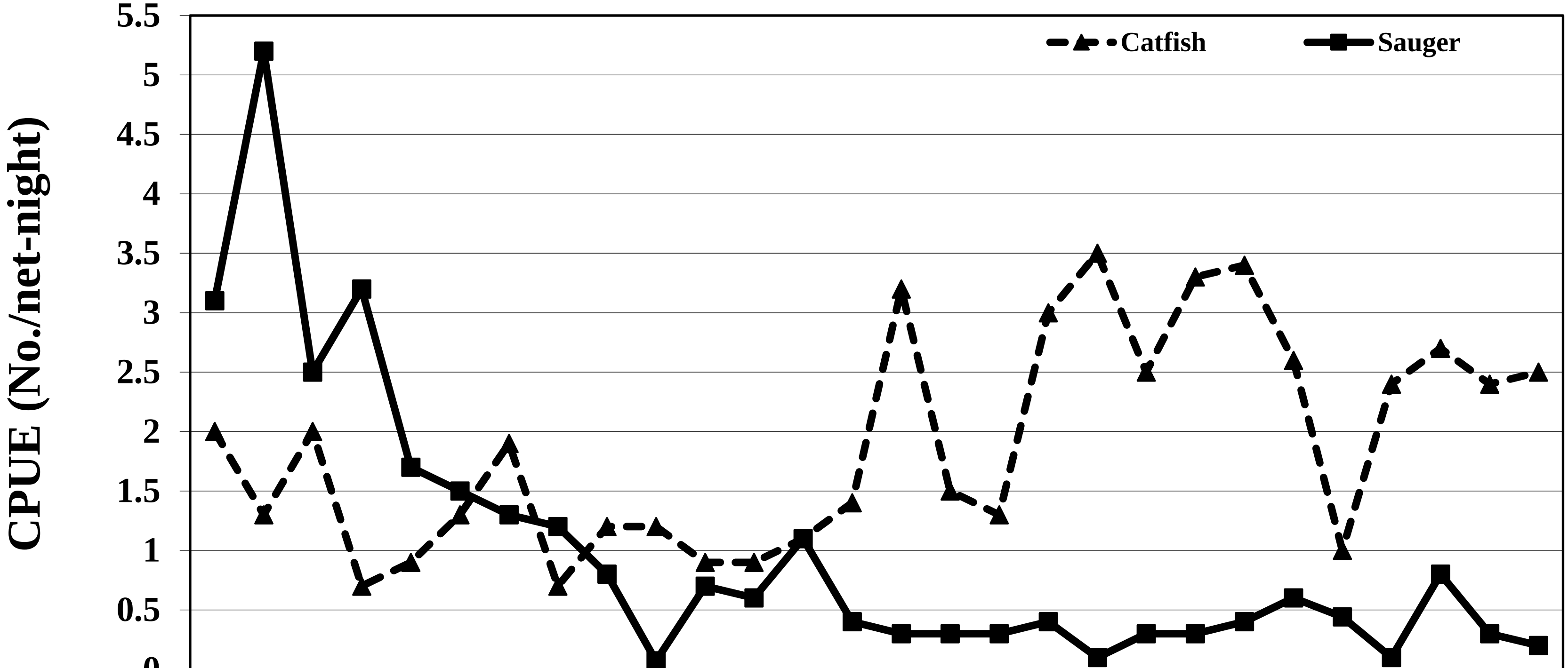


Figure 12. Length frequency, as catch per unit effort (CPUE), of northern pike collected by experimental gill nets in Fort Peck Reservoir during July-August, 2011-2014.



	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
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
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

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, 1984-2014 (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, 1984-2014.

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

STOMACH CONTENTS OF GILL NETTED GAME FISH

Stomach contents of walleye, northern pike, sauger, and smallmouth bass captured in experimental gill nets from July 17th to August 7th, 2014 were examined for the presence of forage items. Walleye had the most diverse diet (Table 9). Invertebrates were the most commonly identified item found in walleye at 22.3% followed by cisco at 5.5%. Cisco were the most commonly identified fish found in northern pike at 25.3%. 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 2014. 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 2014. Sample size is given in parentheses.

Forage items	Northern pike (*N*=320)	Sauger (*N*=20)	Smallmouth bass (*N*=95)	Walleye (*N*=435)
Chinook salmon			1.1%	0.2%
Cisco	25.3%		3.2%	5.5%
Pomoxis spp.	0.3%			0.2%
Crayfish	2.5%		7.4%	0.5%
Empty	55.3%	75.0%	36.8%	48.7%
Invertebrates	2.5%	10.0%	14.7%	22.3%
Northern pike			1.1%	
Zooplankton				0.2%
Smallmouth bass				0.2%
Spottail shiner				0.5%
Unknown	13.1%	10.0%	33.7%	20.9%
Walleye	0.6%		2.1%	0.2%
Yellow perch	0.3%	5.0%		0.5%

BEACH SEINING

Shoreline beach seining was conducted to determine reproductive success of age-0 game and non-game fish from August 8th to August 29th, 2014. Seine hauls at 100 locations throughout the reservoir captured 18 species of young-of-year and forage fish for a total of 15,875 fish (Table 10). Relative abundance of shoreline forage typically follows changes in reservoir elevations (Figure 17). In 2014, reservoir elevations remained stable over the winter months due to reduced discharges Reservoir elevations increased approximately six feet from May to July due to runoff from mountain snowpack (Figure 14). A limited amount of terrestrial vegetation was inundated in 2014.

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 while conducting shoreline beach seining surveys. 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. The continued decrease in EWM could be attributed to oscillating reservoir elevations from 2012-2013 (loss of 15 feet) to 2013-2014 (gain of 10 feet). These fluctuations would make it difficult for EWM to become established in littoral areas of the reservoir. The loss of established EWM stands and no shoreline vegetation inundated in 2014 could explain the low relative abundance of shoreline forage fish.

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). However, 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.

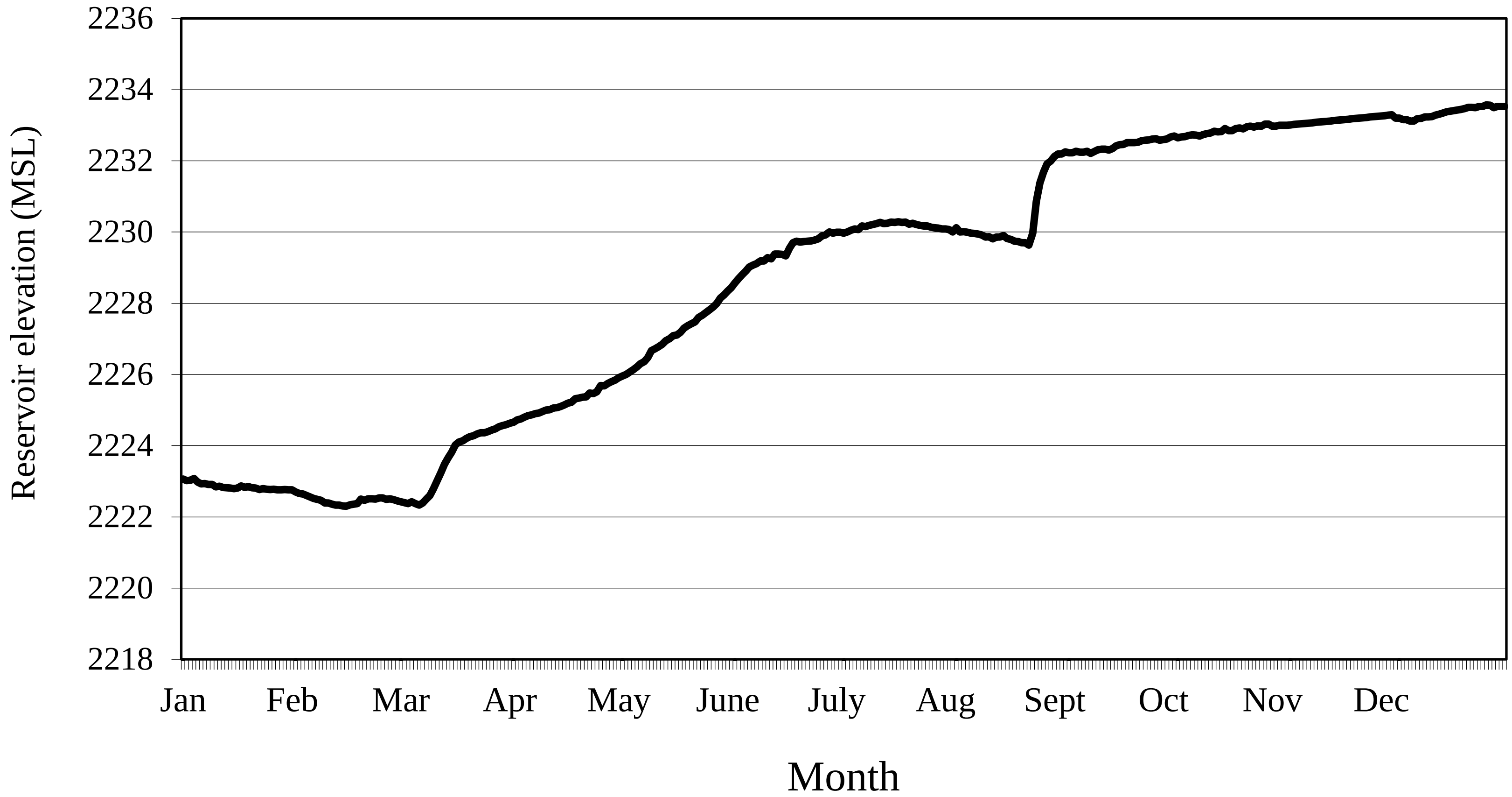


Figure 14. Average daily reservoir elevation for Fort Peck Reservoir from January 1, 2014 to December 31, 2014 (data provided by USACE).

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 2014. 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
Bigmouth buffalo	0	--	0	--	0	--	2	0.1	6	0.3	8	<0.1
Black bullhead	2,903	145.2	0	--	0	--	0	--	0	--	2,903	29.0
Common carp	7	0.4	3	0.2	5	0.3	1	0.1	2	0.1	18	0.2
Emerald shiner*	4	0.2	12	0.6	4	0.2	56	2.8	116	5.8	192	1.9
Fathead minnow*	6	0.3	0	--	0	--	0	--	3	0.2	9	0.1
Flathead chub*	1	0.1	0	--	0	--	0	--	0	--	1	<0.1
Freshwater drum	4	0.2	0	--	0	--	0	--	3	0.2	7	<0.1
Goldeye	0	--	0	--	0	--	0	--	8	0.4	8	0.1
*Hybognathus spp.**	0	--	0	--	0	--	1	0.1	5	0.3	6	<0.1
Northern pike	12	0.6	13	0.7	9	0.5	9	0.5	5	0.3	48	0.5
Pomoxis spp.	572	28.6	60	3.0	66	3.3	923	46.2	3,574	178.7	5,195	52.0
Sauger	0	--	0	--	0	--	0	--	2	0.1	2	<0.1
Smallmouth bass	24	1.2	26	1.3	12	0.6	17	0.9	84	4.2	163	1.6
Smallmouth buffalo	20	1.0	0	--	1	0.1	0	--	132	6.6	153	1.5
Spottail shiner*	222	11.1	618	30.9	1,152	57.6	1,737	86.9	1,759	88.0	5,488	54.9
Walleye	0	--	2	0.1	0	--	1	0.1	1	0.1	4	<0.1
White sucker	0	--	0	--	0	--	1	0.1	0	--	1	<0.1
Yellow perch	709	35.5	157	7.9	222	11.1	146	7.3	434	21.7	1668	16.7
Total	4,484	224.2	891	44.6	1,471	73.6	2,894	144.7	6,134	306.7	15,875	158.8

*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.

Walleye

Relative abundance of young-of-year walleye decreased from 0.2 per seine haul in 2013 to 0.04 per seine haul in 2014(Figure 15). In 2014, young-of-year walleye were captured in the lower Big Dry arm, middle Missouri arm, and upper Missouri arm (Table 10). Typically, the highest catch rates are observed in the upper Missouri arm (Brunsing 1998). No hatchery-reared walleye fry or fingerlings are released in this area suggesting all fingerlings captured were a product of natural reproduction. Dispersal of young-of-year walleye has been shown to be limited 2 to 3 months after release (Paragamian and Kingery 1992). In addition, the Missouri River above Fort Peck Reservoir has been shown to support walleye spawning activity (Billington et al. 2005; Bellgraph et al. 2008). Pyloric caecums were counted to identify *Sander spp.* in question.

Sauger

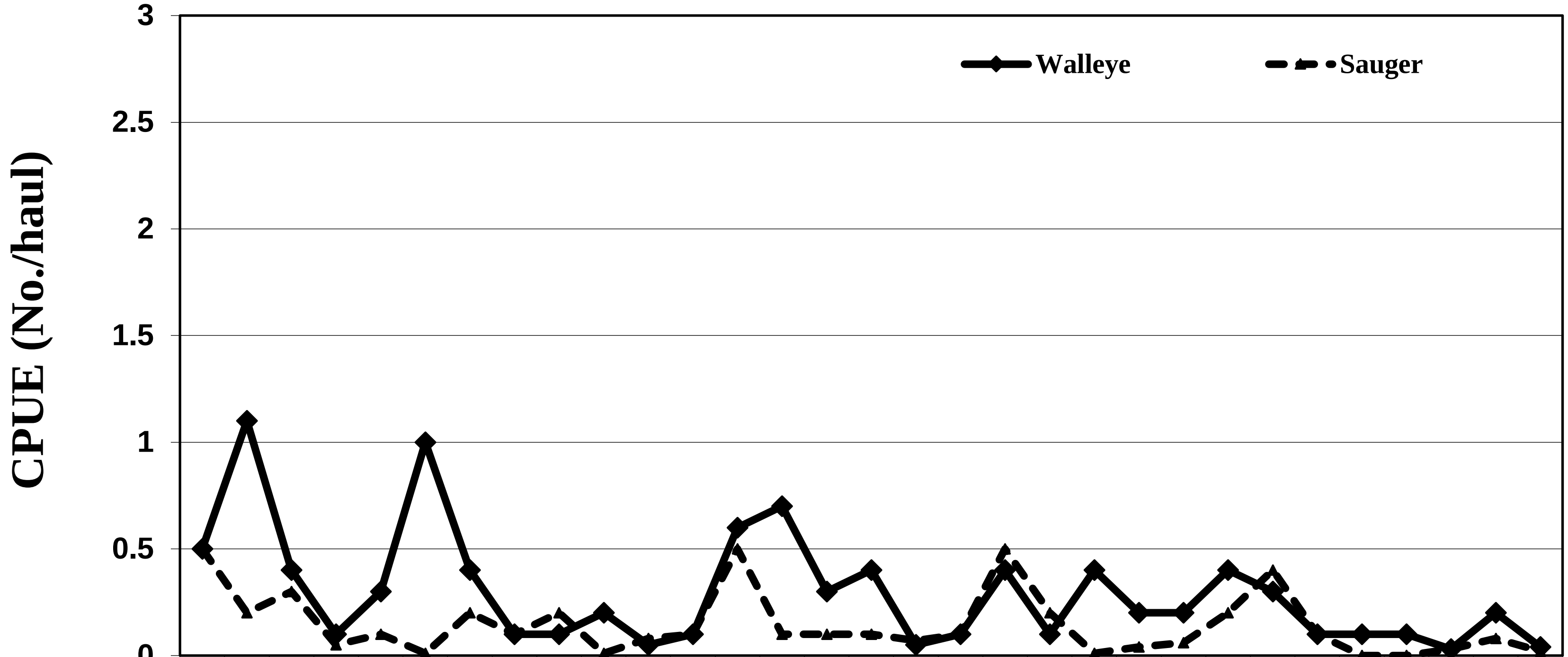
Relative abundance of young-of-year sauger in 2014 was similar to those observed during the years of 1987, 1989, 1993, and 2004 through 2006 (Figure 15). These years of low relative abundances coincide with severe drought conditions (i.e., declining reservoir elevations and low inflows) and have been suggested to be the reason for decline of sauger populations (McMahon and Gardner 2001). The Missouri and Musselshell Rivers above Fort Peck Reservoir have been identified as spawning areas for sauger (McMahon and Gardner 2001; Bellgraph et al. 2008). Young-of-year sauger were only captured in the upper Missouri arm in 2014.

Northern Pike

Young-of-year northern pike relative abundance increased from 0.03 per seine haul in 2013 to 0.5 per seine haul in 2014. Despite the increase, relative abundance was similar to the long-term average from 1984-2014 (Figure 16). The most notable increases in young-of-year northern pike occurred in 1994, 2009, and 2011 when large amounts of shoreline vegetation were inundated due to rising reservoir elevations. Young-of-year northern pike were captured in all sampling regions of the reservoir but were more abundant in the upper and lower Big Dry arm in 2014 (Table 10).

Smallmouth Bass

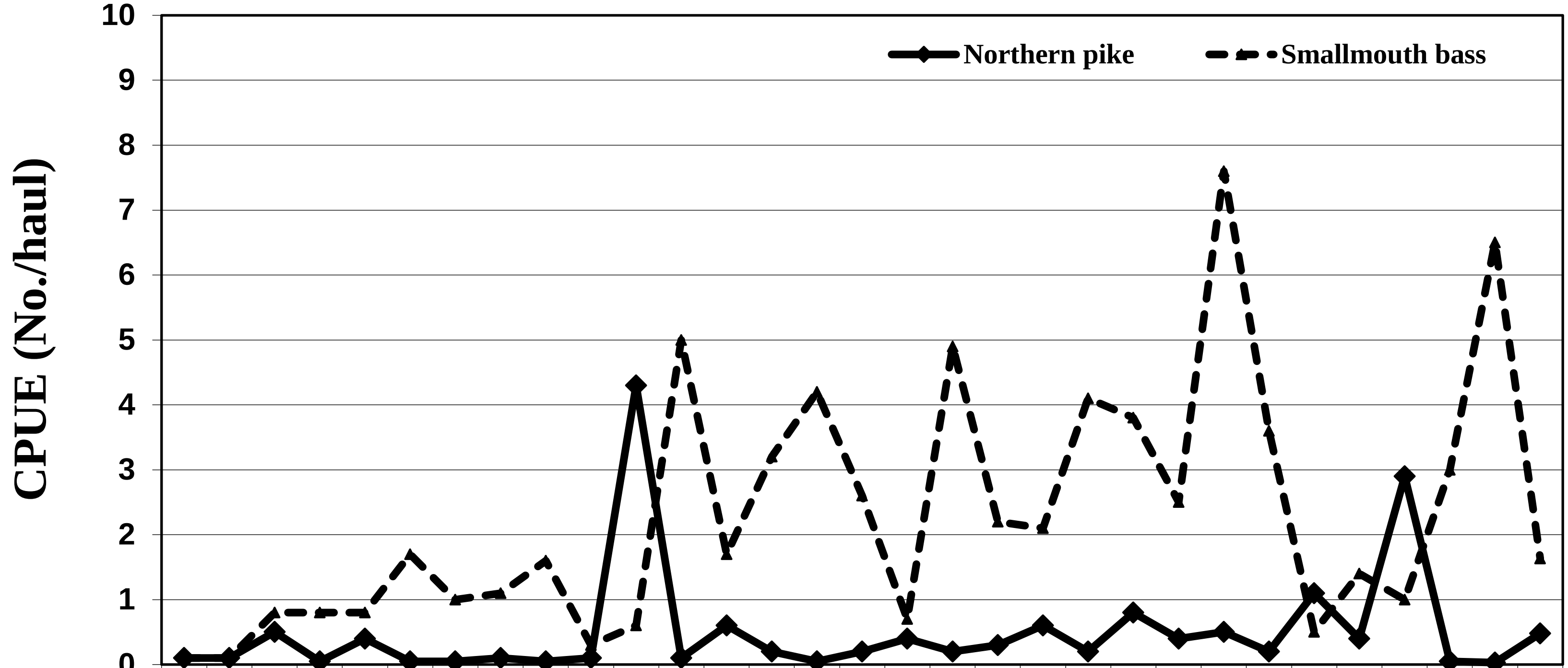
Smallmouth bass continue to be the most abundant game species captured during annual seining surveys. However, relative abundance decreased from 6.5 per seine haul in 2013 to1.6 per seine haul in 2014. Relative abundance has fluctuated greatly over the years (Figure 16). Smallmouth bass were captured in all regions with the highest catch rate in the upper Missouri arm at 4.2 fish per haul (Table 10). As indicated by seining surveys, smallmouth bass have successfully spread to all areas of the reservoir.



	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Walleye	0.5	1.1	0.4	0.1	0.3	1	0.4	0.1	0.1	0.2	0.05	0.1	0.6	0.7	0.3	0.4	0.05	0.1	0.4	0.1	0.4	0.2	0.2	0.4	0.3	0.1	0.1	0.1	0.03	0.2	0.04
Sauger	0.5	0.2	0.3	0.05	0.1	0.01	0.2	0.1	0.2	0.01	0.08	0.1	0.5	0.1	0.1	0.1	0.07	0.1	0.5	0.2	0.01	0.04	0.06	0.2	0.4	0.1	0	0	0.03	0.08	0.02

Year

Figure 15. Mean catch per unit effort (CPUE; No./haul) of walleye and sauger young-of-year collected by seine hauls in Fort Peck Reservoir from 1984-2014.



	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Northern pike	0.1	0.1	0.5	0.05	0.4	0.05	0.05	0.1	0.05	0.1	4.3	0.1	0.6	0.2	0.05	0.2
Smallmouth bass	0.1	0.1	0.8	0.8	0.8	1.7	1	1.1	1.6	0.3	0.6	5	1.7	3.2	4.2	2.6

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Northern pike	0.4	0.2	0.3	0.6	0.2	0.8	0.4	0.5	0.2	1.1	0.4	2.9	0.05	0.03	0.48
Smallmouth bass	0.7	4.9	2.2	2.1	4.1	3.8	2.5	7.6	3.6	0.5	1.4	1	3	6.5	1.63

Year

Figure 16. Mean catch per unit effort (CPUE; No./haul) of northern pike and smallmouth bass young-of-year collected by seine hauls in Fort Peck Reservoir from 1984-2014.

Yellow Perch

Young-of-year yellow perch relative abundance in 2014 decreased to 16.75per seine haul from 29.6 per seine haul in 2013. The continued decline in relative abundance can be explained by limited spawning and rearing habitat. Despite the spring rise in 2014, a limited amount of terrestrial vegetation was inundated from April to May. Relative abundance of young-of-year yellow perch in 2014 was similar to levels observed during the drought years (i.e., 1998-2006; Figure 17). Yellow perch were most abundant in the upper Big Dry arm with a catch rate of 35.5 per seine haul in 2014 (Table 10).

Crappie

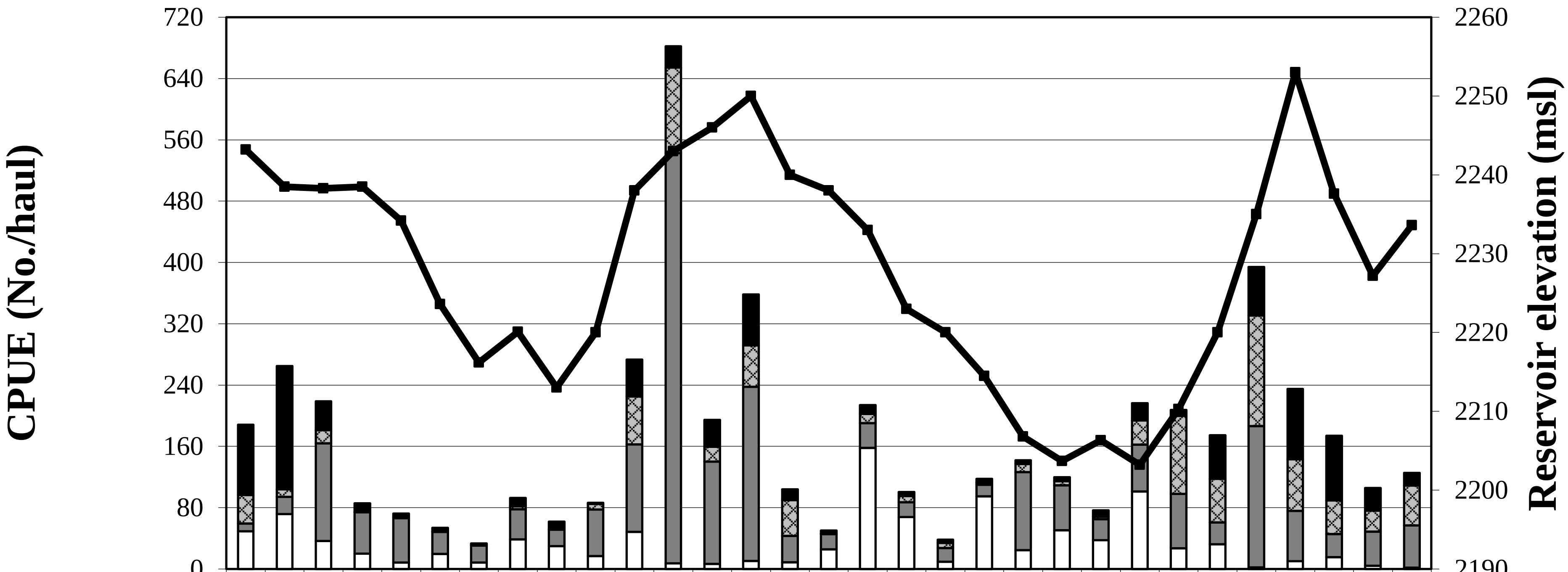
Young-of-year crappie relative abundance increased from 27.4 per seine haul in 2013 to 52 per seine haul in 2014. The increase in relative abundance may be due to increasing reservoir elevations from May into August that provided rearing habitat by inundating additional shoreline vegetation. Unlike young-of-year yellow perch, relative abundance of young-of-year crappie was still higher than during the drought years (Figure 17). Crappie were most abundant in the upper Missouri arm with a catch rate of 178.7 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.

Emerald Shiner

Emerald shiner relative abundance in 2014 was 1.9 per seine haul, which was lower than 4.1 per seine haul in 2013. 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 17). A possible explanation for these decreases could be upstream movement into more riverine type habitat. In 2014, 60% of the emerald shiners were captured in the upper Missouri arm (Table 10).

Spottail Shiner

Relative abundance of spottail shiners increased slightly from 44.7 per seine haul in 2013 to 55 per seine haul in 2014 but was lower than long-term average of 75 per seine haul. Relative abundance was highest in the upper Missouri arm at 117.3 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. It is uncertain what caused this shift in 2014.



	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
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
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
Spottails	10.1	22.6	128	54.2	58	28.9	22	39.2	21.4	60.7	114	535	134	228	34.4
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
Elevation	2243	2239	2238	2239	2234	2224	2216	2220	2213	2220	2238	2243	2246	2250	2240

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Perch	4.4	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
Crappie	0.2	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
Spottails	20	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
Emeralds	25.5	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
Elevation	2238	2233	2223	2220	2215	2207	2204	2206	2203	2210	2220	2235	2253	2238	2227	2234

Year

Figure 17. 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 1984-2014.

Chinook salmon

Chinook salmon were stocked in Fort Peck Reservoir in the spring of 2014 and the minimum objective of 200,000 fingerlings was met as outlined in the FPRFMP. A total of 230,840 spring-stocked chinook salmon were released in June at 22and 35 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 18 and 19).

Return of salmon to the release site has been variable over the years. In 2014, the number of females spawned and eggs collected nearly doubled from the previous year (Figure 20). The 2014 egg-take effort for Montana resulted in 339,000 green eggs which averaged approximately 4,134 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 October 3rd to October 28th 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 2013, 68% of females spawned were 4-year olds and (Table 12). Similarly, 70% of females spawned in 2014 were 4-year olds (Table 13). A greater return from the 2010 brood year (4-year old) in 2014 was anticipated due to increased stocking numbers compared to previous years (255,492;Table 11) and improved growing conditions (i.e., increases in reservoir elevations and cisco abundance).

Mean weight of pre-spawn female chinook salmon decreased from 16.5 pounds in 2013 to14 pounds in 2014. When examining mean weight at age, age-4 male and female salmon collected in 2014 were lower than those collected in 2013 (Table 12; Table 13). Four-year old males and females averaged 15.6 and 15.5 pounds, respectively in 2014 compared to 18.3 and 17.5 pounds in 2013. The higher relative abundance of cisco from 2013 and 2014 should have contributed to increased weights in 2014. Cisco have been found to be the primary forage item of age 1+ chinook salmon in Fort Peck Reservoir (Brunsing 1998; Headley 2010). It should be noted that salmon released in 2011 averaged 62/pound compared which was smaller when compared to previous years (30-35/pound;Table 11).

Table 11. Chinook salmon stocked by number, size, and location in Fort Peck Reservoir, 2004-2014.

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

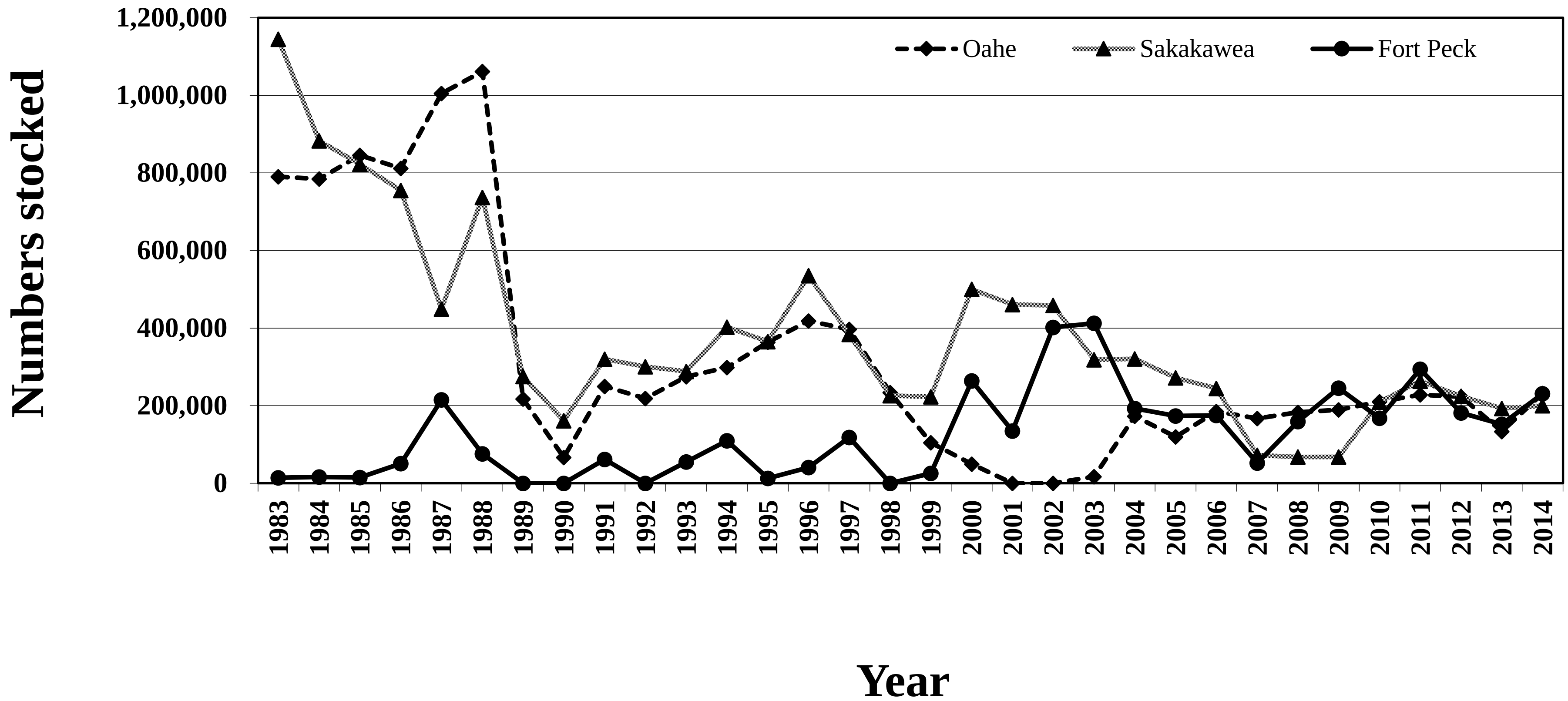


Figure 18. Annual comparison of total chinook salmon numbers stocked in Oahe, Sakakawea, and Fort Peck Reservoir, 1983-2014**.**

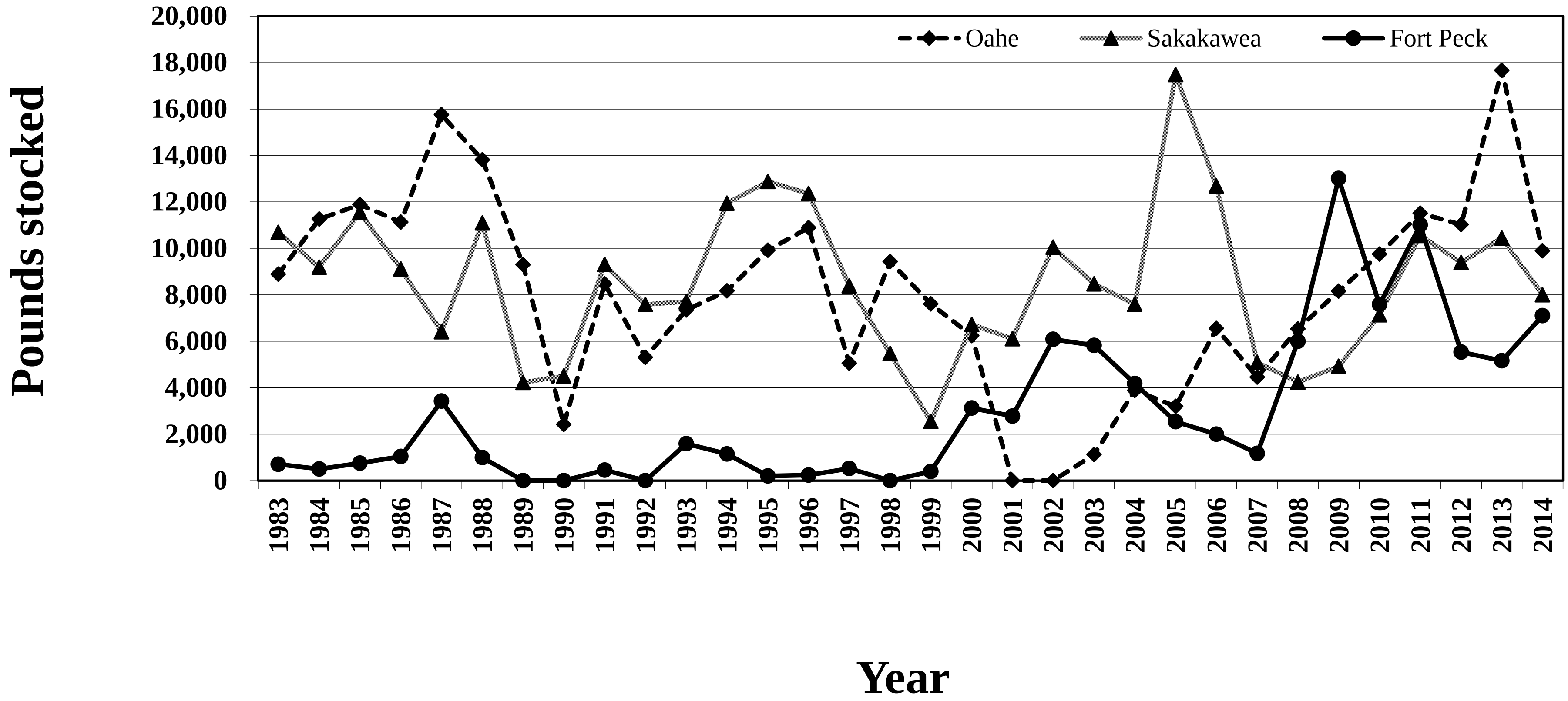


Figure 19. Annual comparison of total chinook salmon pounds stocked in Oahe, Sakakawea, and Fort Peck Reservoir, 1983-2014.

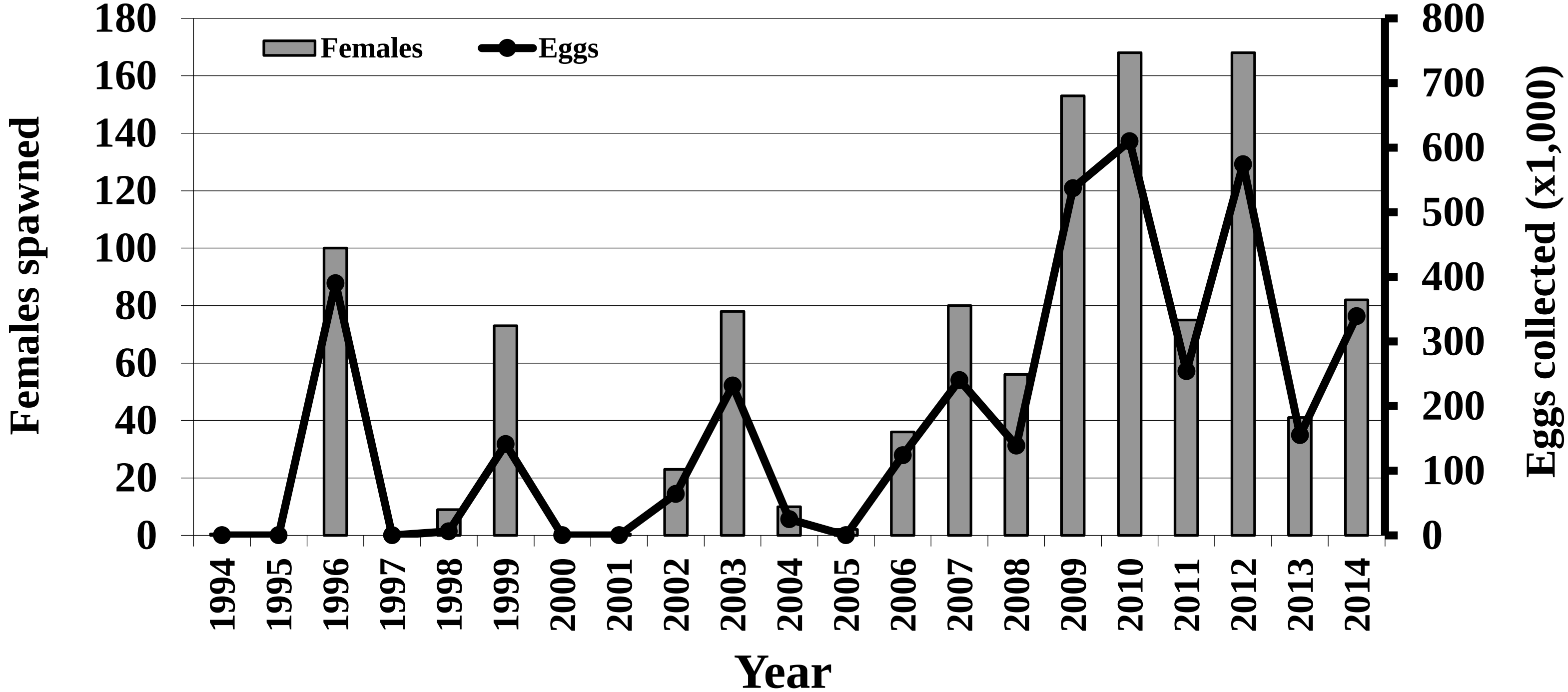


Figure 20. Annual comparison of female chinook salmon spawned and eggs collected from Fort Peck Reservoir, 1994-2014.

Table 12. Age composition, length and weight of 183chinook salmon collected by electrofishing, fall 2013.

Age	Sex	Brood year	Number	Mean length (in)	Range	Mean weight (lb)	Range
1	Male	2012	0	--	--	--	--
	Female		0	--	--	--	--
2	Male	2011	14	21.1	16.8-24.5	4.4	2.0-6.8
	Female		1	23.2	--	6.5	--
3	Male	2010	115	25.8	18.9-34.4	8.4	3.2-19.2
	Female		14	30.8	24.6-35.6	14.3	7.3-20.7
4	Male	2009	4	35.3	34.1-37.1	18.3	15.1-21.7
	Female		34	33.4	27.8-39.5	17.5	9.1-29.5
5	Male	2008	0	--	--	--	--
	Female		1	36.5	--	21.7	--

Table 13. 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	--	--	--	--

Cisco Vertical Gill Netting

Young-of-year cisco

Relative abundance of young-of-year cisco decreased to 140 per net-night in 2014; down from 191net-night in 2013. Despite the decrease, this was well above the long term average of 76 per net-night from 1986 to 2014. Young-of-year cisco relative abundance on Fort Peck Reservoir has fluctuated over the years and similar trends have been observed in other reservoirs where cisco populations occur (Dave Yerk, personal communication; Table14).

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. In contrast, ice cover occurred on December 13th, 1985 and December 21st, 2000 resulting in two of the largest year classes ever produced. Similarly, ice cover occurred on December 23rd, 2013 and receded late on April 22nd, 2014 resulting in the sixth largest year class on record.

Decreases in reservoir elevation could also explain the significant reduction 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 21). In contrast, reservoir elevations decreased only 1.4 feet during the winter months which favored young-of-year cisco production in 2014. 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.

Table 14. Mean CPUE (No./net-night) of young-of-year cisco collected in vertical gill nets and netting location on Fort Peck Reservoir during September-October 2004-2014.

	Young-of-year cisco CPUE										
Location	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Lower Big Dry											
Bear Creek West	18	0	37	26	44	155	12	24	0	104	2
Spring Creek	13	16	--	--	--	--	--	--	--	--	--
Bobcat	2	3	100	13	16	221	11	11	0	11	18
Lower Missouri Arm											
Duck Creek	31	321	139	102	263	185	53	36	2	243	238
Fifth Coulee	--	--	200	42	281	201	152	51	0	179	114
Marina	2	26	256	5	17	7	39	31	0	3	2
Milk Coulee	--	121	--	117	174	366	60	77	0	201	256
Sage Creek	1	82	201	13	33	188	44	67	0	101	80
Shaft Houses	86	--	70	--	--	--	--	--	--	--	--
Bear Creek	213	261	58	58	225	897	120	249	2	451	165
Middle Missouri Arm											
Cattle/Crooked Creek	2	77	67	5	107	--	96	879	1	190	76
Pines Bay	14	55	225	12	76	239	122	102	1	591	306
Gilbert Creek	9	22	270	51	20	285	21	119	2	126	212
7th Point	8	32	--	--	--	--	--	--	--	--	--
8th Point	8	82	27	8	108	--	107	81	0	96	209
Mean CPUE	31	84	137	37	113	274	70	144	<1.0	191	140

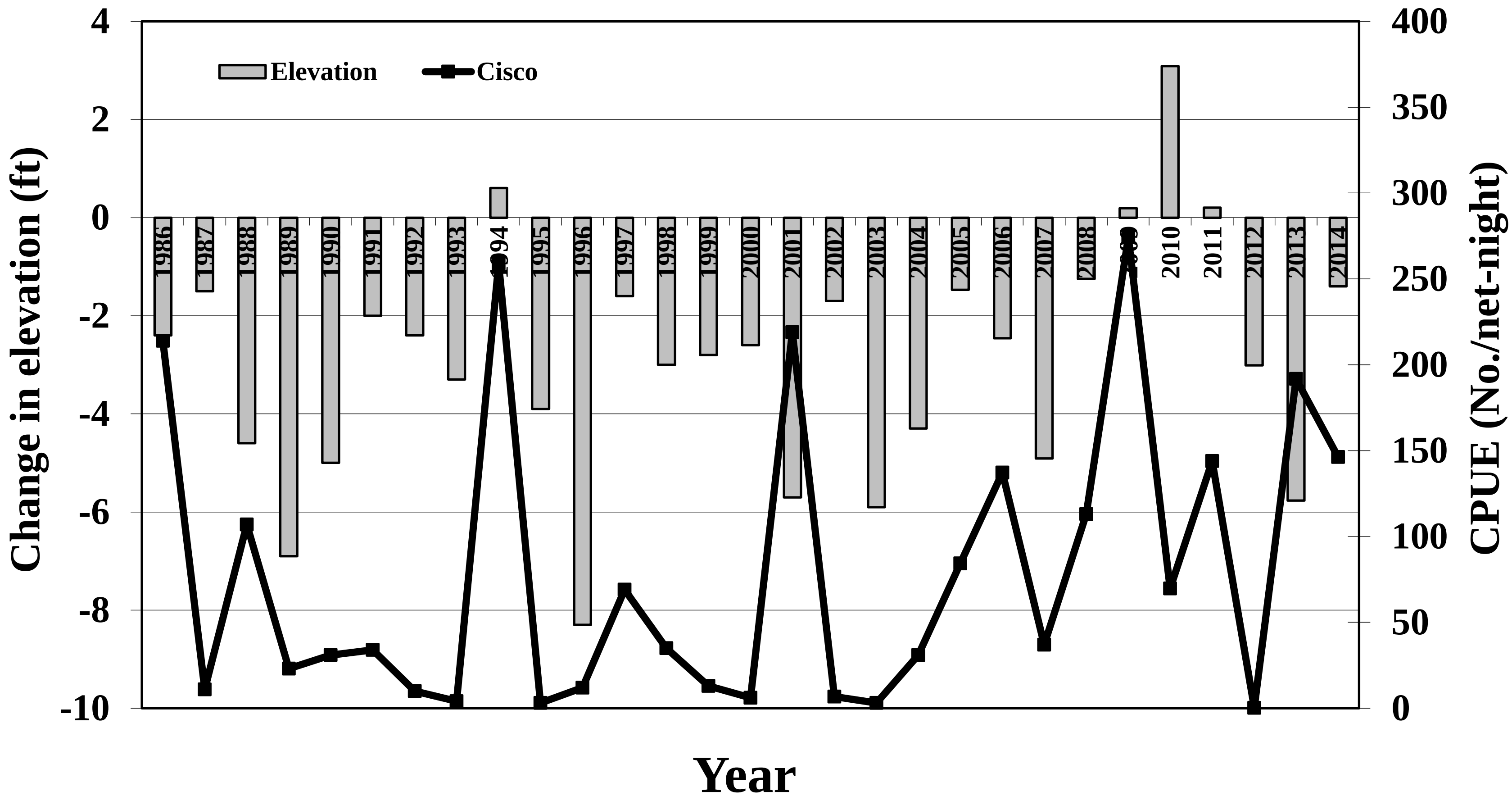


Figure 21. Change in reservoir elevation from December high to March low in contrast to mean CPUE (No./net-night) of young-of-year cisco collected in vertical gill nets on Fort Peck Reservoir, 1986-2014.

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.

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

- Evaluate native species (sauger, channel catfish, and 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. In 2015, plans are in place to produce larger spring stocked fingerlings (21/lb.).

- 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.

- Incorporate adult cisco monitoring (vertical gill netting) results into the 2015 annual report to further explore the population dynamics of this species.

- 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.

LITERATURE CITED

Anderson, R. O. and A. S. Weithman. 1978. The concept of balance for coolwater fish populations. Pages 371-378 in R. L. Kendall, editor. Selected coolwater fishes of North America. American Fisheries Society, Bethesda, Maryland.

Anderson, R. O. 1980. Proportional stock density (PSD) and relative weight (*Wr*): interpretive indices for fish populations and communities. Pages 27-33 *in* S. Gloss and B. Shupp, editors. Practical fisheries management: more with less in the 1980's. New York Chapter American Fisheries Society, Ithaca.

Becker, G. C. 1983. Fishes of Wisconsin. University of Wisconsin Press, Madison.

Bellgraph, B. J., C. S. Guy, W. M. Gardner, and S. A. Leathe. 2008. Competition potential between saugers and walleyes in nonnative sympatry. Transactions of the American Fisheries Society 137:790-800.

Billington, N., R.N. Koigi, and J. Xiong. 2005. Genetic variation and hybridization with walleye in Montana sauger populations determined by protein electrophoresis. Report of Troy State University to Montana Department of Fish, Wildlife and Parks, Helena.

Brown, M. L., F. Jaramillo, J., D. M. Gatlin, III, and B. R. Murphy. 1995. A revised standard weight (*Ws*) equation for channel catfish. Journal of Freshwater Ecology 10:295-302.

Brunsing, M. 1998. Fort Peck Reservoir study, Montana Department of Fish, Wildlife & Parks, Fisheries Division, Annual report, Helena.

Derback, B. 1947. The adverse effect of cold weather upon the successful reproduction of pickerel, *Stizostedion vitreum vitreum*, in Heming Lake, Manitoba in 1947. Canadian Fish Culturist 2:22-23.

Engel, S. 1995. Eurasian Watermilfoil as a fishery management tool. Fisheries 20:20-27.

Erickson, C. M. 1983. Age determination of Manitoban walleyes using otoliths, dorsal spines, and scales. North American Journal of Fisheries Management 3:176-181

Fielder, D. G. 1992. Evaluation of stocking walleye fry and fingerlings and factors affecting their success in lower Lake Oahe, South Dakota. North American Journal of Fisheries Management 12:336-345.

Freeberg, M. H., W. W. Taylor, and R. W. Brown. 1990. Effect of egg and larval survival on year-class strength of lake whitefish in Grand Traverse Bay, Lake Michigan. Transactions of the American Fisheries Society 119: 92-100.

Frost, W. E. and C. Kipling. 1967. A study of reproduction, early life, weight-length relationship and growth of pike, *Esox lucius* L.,in Windmere. Journal of Animal Ecology 36:651-693.

Gablehouse, D. W., Jr., 1984. A length-categorization system to assess fish stocks. North American Journal of Fisheries Management 4:273-285.

Gaboury, M. N. and J. W. Patalas. 1984. Influence of water level drawdown on the fish populations in Cross Lake, Manitoba. Canadian Journal of Fisheries and Aquatic Sciences. 41:118-125.

Headley, H. C. 2007. Statewide fisheries investigations, Fort Peck Reservoir Study. Montana Fish Wildlife and Parks, Fisheries Division, Annual report, Helena.

Headley, H. C. 2010. Statewide fisheries investigations, Fort Peck Reservoir Study. Montana Fish Wildlife and Parks, Fisheries Division, Annual report, Helena.

Isermann, D. A., J. R. Meerbeek, G. D. Scholten, and D. W. Willis. 2003. Evaluation of three different structures used for walleye age estimation with emphasis on removal and processing times. North American Journal of Fisheries Management 23:625-631.

Kerr, S. J. 2011. Stocking and marking: Lessons learned over the past century. Pages 423-449 *in* B. A. Barton, editor. Biology, management, and culture of walleye and sauger. American Fisheries Society, Bethesda, Maryland.

Leathe, S. A. and P. J. Graham. 1982. Flathead Lake fish food habits study-Final report. Montana Department of Fish, Wildlife and Parks, Kalispell, Montana. 137p.

Liebelt, J. 1979. Establishment of Aquatic Baselines in Large Inland Impoundments. National Marine Fisheries Service, U.S. Dept. of Commerce, NOAA.

Lott, J., G. Marrone, D. Stout. 1997. Influences of size-and-date at stocking, imprinting attempts and growth on initial survival, homing ability, maturation patterns and angler harvest of Chinook salmon in Lake Oahe, SD. South Dakota Department of Game, Fish and Parks, Wildlife Division, Report 97-20, Pierre.

Martin, D. B., L. J. Mengel, J. F. Novotny, and C. H. Walburg. 1981. Spring and summer water levels in a Missouri River Reservoir: Effects on age-0 fish and zooplankton. Transactions of the American Fishreies Society 110:370-381.

McMahon, T. E., and W. M. Gardner. 2001. Status of sauger in Montana. Intermountain Journal of Sciences 7:1-21.

Mullins, M. S. 1991. Biology and predator use of cisco (*Coregonus artedi*) in Fort Peck Reservoir, Montana. Master's thesis. Montana State University, Bozeman.

Murphy, B. R., M. L. Brown, and T. A. Springer. 1990. Evaluation of the relative weight (*Wr*) index, with new applications to walleye. North American Journal of Fisheries Management, 10:85-97.

Nielsen, L. A., D. L. Johnson, and S. S. Lampton. 1989. Fisheries techniques. American Fisheries Society, Bethesda, Maryland.

Paragamian, V. L., and R. Kingery. 1992. A comparison of walleye fry and fingerling stockings in three rivers in Iowa. North American Journal of Fisheries Management 12:313-320.

Pratt, T. C., and K. E. Smokorowski. 2003. Fish habitat management implications of the summer habitat use by littoral fishes in a north temperate, mesotrophic lake. Canadian Journal of Fisheries and Aquatic Sciences 60:286-300.

Rook, B. J., M. J. Hansen, and O. T. Gorman. 2013. Biotic and abiotic factors influencing cisco recruitment dynamics in Lake Superior during 1978-2007. North American Journal of Fisheries Management 33:1243-1257.

Ruggles, M. P. 2005. Statewide fisheries investigations, Fort Peck Reservoir Study. Montana Fish, Wildlife and Parks, Fisheries Division, Annual report, Helena.

Secor, D. H., J. M. Dean, and E. L. Laban. 1992. Otolith removal and preparation for microstructural examination. Pages 19-57 *in* D. K. Stevenson, and S. E. Campana, editors. Otolith microsturucre examination and analysis. Canadian Special Publication of Fisheries and Aquatic Sciences No. 117.

Sellers, T. J., B. R. Parker, D. W. Schindler, and W. M. Tonn. 1998. Pelagic distribution of lake trout in small Canadian Shield lakes with respect to temperature, dissolved oxygen, and light. Canadian Journal of Fisheries and Aquatic Sciences 55:170-179.

Scott, W. B., and E. J. Crossman. 1973. The freshwater fishes of Canada. Fisheries Research Board of Canada, Ottawa.

United States Army Corp of Engineers. 2009. Water Quality Modeling Report. Application of the CE-QUAL-W2 hydrodynamic and water quality model to Fort Peck Reservoir, Montana. Omaha, Nebraska.

United States Army Corp of Engineers, Omaha District. 2014. Missouri River Mainstem System 2014-2015 Annual Operating Plan.

Unmuth, J. M. L., M. J. Hansen, and T. D. Pellet. 1999. Effects of mechanical harvesting Eurasian watermilfoil on largemouth bass and bluegill population in Fish Lake, Wisconsin. North American Journal of Fisheries Management 19:1089-1098.

Vokoun, J. C., C. F. Rabeni, and J. S. Stanovick. 2001. Sample-size requirements for evaluating population size structure. North American Journal of Fisheries Management 21:660-665.

Wiedenheft, W. 1985. Development and management of commercial fishing practices in Fort Peck Reservoir. National Marine Fisheries Service, U.S. Department of Commerce, NOAA.

Willis, D. W. 1989. Proposed standard length-weight equation for northern pike. North American Journal of Fisheries Management 9: 203-208.

Zollweg, C. E., and S. Leathe. 2000. Tiber Cisco Spawning Study. Montana Fish, Wildlife and Parks, Fisheries Division, Project report, Helena.

Prepared by: Heath Headley
Date: May 1st , 2014

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 2014 by date, region, location, and size.

Date	Location	Region	Fry	Fingerling	Advanced	Hatchery
5/7/2014	Nelson Creek	UBD	2,700,000			Miles City
5/22/2014	McGuire Creek	UBD	1,200,000			Fort Peck
5/22/2014	Little Bug	UBD	1,200,000			Fort Peck
5/21/2014	Rock Creek	LBD	3,600,000			Fort Peck
6/27/2014	Rock Creek	LBD		127,219		Fort Peck
5/29/2014	Milk Coulee	LMA	1,158,331			Fort Peck
6/18/2014	Box Elder	LMA		107,828		Miles City
6/18/2014	Duck Creek	LMA		101,238		Fort Peck
6/18/2014	Marina Bay	LMA		120,255		Fort Peck
6/19/2014	Third Coulee	LMA		92,849		Fort Peck
6/23/2014	North of Sage Creek	LMA		77,898		Fort Peck
6/23/2014	Milk Coulee	LMA		24,773		Fort Peck
6/24/2014	Main Duck	LMA		83,572		Fort Peck
6/25/2014	Bear Creek	LMA		117,229		Fort Peck
6/26/2014	Milk Coulee	LMA		45,445		Fort Peck
6/26/2014	Duck Creek	LMA		5,083		Fort Peck
6/30/2014	Duck Creek	LMA		50,992		Fort Peck
6/30/2014	Milk Coulee	LMA		45,115		Fort Peck
7/1/2014	Marina Bay	LMA		16,864		Fort Peck
7/2/2014	Haxby	LMA		16,864		Fort Peck
7/2/2014	Duck Creek	LMA		86,043		Fort Peck
7/3/2014	Milk Coulee	LMA		35,116		Fort Peck
7/23/2014	Marina Bay	LMA			5,491	Fort Peck
5/9/2014	Hell Creek	MMA	2,600,000			Miles City
5/19/2014	Hell Creek	MMA	2,300,000			Miles City
6/10/2014	Cattle/Crooked Bay	MMA		111,348		Miles City
6/12/2014	Hell Creek	MMA		121,922		Miles City
6/16/2014	Sutherland Bay	MMA		163,300		Miles City
6/17/2014	Hell Creek	MMA		96,360		Miles City
6/20/2014	Hell Creek	MMA		204,344		Miles City
6/20/2014	Upper Eighth Coulee	MMA		50,000		Miles City
6/20/2014	Middle Eighth Coulee	MMA		50,000		Miles City
6/20/2014	Pines Bay	MMA		94,625		Fort Peck
6/24/2014	Hell Creek	MMA		92,618		Miles City
6/26/2014	Upper Duck Creek	MMA		90,000		Miles City
6/26/2014	Hell Creek	MMA		45,450		Miles City
Total			14,758,331	2,274,350	5,491	

[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, 2014.

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	11.6	9.81	8.11	5.6	0.4485		0	16.4	8	8.16	5.4	0.4148
10	11.4	9.79	8.13	5.6	0.4488		10	16.4	7.93	8.16	9.9	0.4739
20	9.9	9.87	8.1	5.5	0.4542		20	16.3	7.95	8.16	8.9	0.4753
30	8.7	9.94	8.09	4.5	0.4624		30	16.1	7.9	8.15	8	0.4737
40	7.7	10	8.08	4.3	0.4654		40	13.7	7.96	8.07	10.4	0.475
50	7.3	9.98	8.07	4.3	0.4662		50	11.7	8.18	8.03	7	0.4736
		July							**August**			
0	21.5	7.69	8.23	2.2	0.4897		0	22.6	7.58	8.31	2	0.4857
10	21.4	7.58	8.25	2.7	0.49		10	22.3	7.58	8.31	2.5	0.4869
20	21.4	7.56	8.24	3	0.4912		20	22.0	7.53	8.28	3	0.4904
30	20.2	7.33	8.18	3.4	0.4874		30	21.4	7.3	8.23	4.1	0.4978
40	13.9	7.29	7.99	3.8	0.4755		40	20.6	6.84	8.15	7.4	0.4999
50	12.1	7.57	7.97	3.9	0.471		50	20.1	6.48	8.1	8.9	0.5003
		September										
0	15.2	7.9	8.33	7.4	0.4717							
10	15.2	7.79	8.34	7.8	0.4729							
20	15.2	7.79	8.33	8.3	0.473							
30	15.2	7.76	8.34	8.8	0.473							
40	15.2	7.79	8.33	9.1	0.4783							
50	15.2	7.79	8.33	9.2	0.4725							

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, 2014.

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	10.16	8.13	4.8	0.471	0	15.2	8.51	8.22	4.4	0.4704
10	9.6	10.18	8.14	5	0.4707	10	14.9	8.57	8.22	5.7	0.4701
20	8.2	10.35	8.14	4.3	0.4703	20	14.8	8.54	8.22	5.5	0.4707
30	7.8	10.4	8.13	3.9	0.4694	30	14.8	8.52	8.22	5.7	0.4712
40	7.5	10.41	8.13	3.8	0.469	40	12.3	8.75	8.14	7	0.4724
50	7.1	10.42	8.12	4.1	0.4697	50	8.4	9.32	8.05	5.1	0.4705
60	6.6	10.41	8.1	4	0.4687	60	7.3	9.5	8.04	3.5	0.4705
70	6.3	10.38	8.1	3.9	0.4685	70	7.2	9.55	8.04	3.7	0.4697
80	6.3	10.4	8.04	4	0.4682	80	7.1	9.57	8.03	3.2	0.4697
90						90	6.9	9.6	8.02	3.6	0.47
		July						**August**			
0	20.4	7.87	8.26	1.3	0.4765	0	22.1	7.56	8.31	4.1	0.4725
10	20.3	7.82	8.26	1.4	0.4766	10	21.9	7.59	8.32	4.2	0.4731
20	20.2	7.83	8.25	2.2	0.4762	20	21.6	7.59	8.3	3.7	0.474
30	19.8	7.82	8.24	3	0.4759	30	20.2	7.16	8.21	3.9	0.4801
40	14.8	7.51	8.07	3.1	0.4688	40	19.5	6.92	8.19	4.7	0.4737
50	12.8	7.78	8.03	2.8	0.4674	50	18.9	6.66	8.13	4.6	0.4727
60	10.9	8.08	7.99	2.9	0.4694	60	16.7	6.33	8	6.4	0.4697
70	9.8	8.24	7.96	2.9	0.4698	70	15.1	6.39	7.91	5.2	0.47
80						80	11.9	6.6	7.85	5	0.4701
90						90	10.9	6.79	7.83	4.2	0.4701
		September									
0	15.8	8.08	8.35	5.1	0.463						
10	15.8	8.02	8.36	5.6	0.463						
20	15.7	8	8.37	5.7	0.4634						
30	15.7	7.94	8.35	6	0.4636						
40	15.7	7.94	8.35	6.3	0.4624						
50	15.6	7.94	8.35	6.6	0.4623						
60	15.6	7.96	8.35	7.3	0.4622						
70	15.4	8.02	8.35	10	0.4624						
80	15.3	7.94	8.34	10.9	0.4628						
90	13.8	6.59	8.06	9.2	0.4658						

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, 2014.

Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)
		May			
0	8.3	10.6	8.2	2.3	0.4653
10	8.3	10.6	8.2	3	0.4658
20	8.1	10.6	8.2	2.9	0.4644
30	7.8	10.6	8.2	3.6	0.4652
40	7.6	10.6	8.2	3.9	0.4653
50	7.5	10.7	8.2	3.7	0.4653
60	6.4	10.8	8.2	3.4	0.4651
70	5.9	10.8	8.2	3.4	0.4661
80	5.8	10.6	8.1	3.4	0.4659
90	5.6	10.6	8.1	3.4	0.4664
100	5.6	10.6	8.1	3.5	0.467
110	5.6	10.6	8.1	3.8	0.4674
120	5.5	10.5	8.1	4.2	0.4678
130	5.5	10.5	8.1	4.3	0.4677
		July			
0	18.9	7.9	8.2	2.5	0.4642
10	18.8	7.9	8.2	2.5	0.4634
20	18.6	7.9	8.2	2.8	0.4629
30	17.8	7.9	8.2	3.2	0.4606
40	14.7	7.7	8.1	3.7	0.4599
50	13.7	7.7	8.0	4.2	0.4594
60	13.3	7.8	8.0	3.9	0.46
70	12.2	8.0	8.0	3.9	0.4622
80	11.4	8.1	8.0	3.7	0.4579
90	10.7	8.2	8.0	3.7	0.4601
100	10.3	8.4	8.0	3.3	0.4635
110	9.8	8.5	8.0	3.4	0.4657
120	9.3	8.6	8.0	3.6	0.4658
130	8.8	8.6	7.9	3.5	0.4665
		September			
0	16.1	7.9	8.3	2.9	0.4559
10	16.1	7.9	8.3	3.5	0.4558
20	16.0	7.8	8.3	3.8	0.4558
30	15.9	7.7	8.3	3.6	0.4552
40	15.9	7.7	8.3	3.8	0.4552
50	15.9	7.8	8.3	4.0	0.4552
60	15.9	7.7	8.3	4.5	0.4551
70	15.9	7.7	8.3	4.2	0.4551
80	15.9	7.6	8.3	4.3	0.4555
90	15.3	7.0	8.2	4.3	0.4577
100	14.6	6.6	8.1	3.7	0.4606
110	11.1	6.1	7.9	3.3	0.4647
120	10.7	6.1	7.8	3.5	0.4651
130	10.6	6.0	7.8	3.1	0.4656

Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)
		June			
0	15.0	8.6	8.2	3.9	0.468
10	14.8	8.6	8.2	4.3	0.4682
20	14.7	8.5	8.2	4.3	0.464
30	14.7	8.5	8.2	4.7	0.4683
40	11.6	9.0	8.2	4.8	0.4682
50	10.1	9.3	8.1	4.1	0.4693
60	8.8	9.5	8.1	3.1	0.4694
70	8.3	9.6	8.1	3.3	0.4696
80	7.9	9.6	8.1	2.8	0.4693
90	7.6	9.6	8.1	2.6	0.4691
100	7.3	9.7	8.1	2.7	0.469
110	7.1	9.7	8.0	2.8	0.4688
120	6.8	9.7	8.0	2.3	0.4686
130	6.4	9.8	8.0	2.2	0.4689
		August			
0	22.6	7.7	8.4	1.5	0.4664
10	22.4	7.9	8.4	2.0	0.4644
20	22.3	7.9	8.4	2.0	0.4635
30	21.5	7.6	8.3	2.5	0.4589
40	20.4	7.0	8.2	2.6	0.4585
50	19.0	6.3	8.1	2.2	0.4525
60	15.8	6.4	8.0	2.2	0.4655
70	13.8	6.6	7.9	2.2	0.4667
80	12.1	6.9	7.9	1.9	0.4688
90	10.8	7.2	7.9	1.7	0.467
100	10.2	7.4	7.9	1.7	0.4668
110	9.8	7.4	7.8	1.6	0.4664
120	9.3	7.5	7.8	1.5	0.4666
130	9.1	7.4	7.8	1.4	0.4662

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, 2014.

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	7.0	10.8	8.17	1.9	0.4569		0	15.8	8.47	8.27	6	0.4233
10	7.0	10.85	8.18	2.1	0.4575		10	15.9	8.45	8.29	6.7	0.4234
20	6.9	10.88	8.17	2.2	0.458		20	15.8	8.39	8.29	6.9	0.429
30	6.8	10.87	8.17	2.3	0.4582		30	15.5	8.41	8.28	8.1	0.4367
40	6.3	10.81	8.15	2.4	0.4577		40	13.4	8.64	8.18	7.6	0.458
50	5.8	10.76	8.14	2.2	0.4582		50	10.9	9.09	8.12	5.9	0.4654
60	5.7	10.7	8.13	2.2	0.4598		60	9.1	9.37	8.09	4.9	0.4665
70	5.7	10.81	8.13	2.5	0.4626		70	8.6	9.47	8.08	3.8	0.4665
80	5.7	10.79	8.13	2.7	0.4635		80	7.5	9.62	8.06	3.3	0.4656
90	5.6	10.74	8.15	8	0.5414		90	6.7	9.69	8.05	3	0.4679
100							100	6.4	9.71	8.05	3.1	0.467
		July							**August**			
0	20.7	7.87	8.28	2.9	0.4573		0	23.0	7.7	8.37	4.7	0.4598
10	20.6	7.84	8.29	2.9	0.4571		10	22.8	7.81	8.38	4.6	0.4594
20	20.4	7.84	8.29	2.7	0.4583		20	22.5	7.83	8.37	5	0.4588
30	20.3	7.82	8.29	2.7	0.4577		30	22.1	7.73	8.35	5	0.4518
40	17.6	7.44	8.16	3.2	0.4529		40	20.7	6.67	8.22	5.2	0.4539
50	14.8	7.39	8.08	3.7	0.4541		50	16.8	5.64	7.92	5.8	0.4533
60	13.3	7.58	8.03	3.6	0.4553		60	15.1	5.92	7.89	5.8	0.4433
70	12.6	7.65	8.02	3.6	0.4562		70	12.7	6.49	7.87	5.4	0.4503
80	11.1	7.99	7.98	4.6	0.4552		80	11.8	6.69	7.87	3.1	0.4571
90	8.4	8.42	7.95	3.9	0.4652		90	11.1	6.96	7.87	2.8	0.4593
100	7.9	8.58	7.96	3.9	0.4675		100	10.3	7.01	7.84	2.7	0.4616
		September										
0	17.5	8.06	8.35	2.4	0.4343							
10	16.4	8.16	8.37	3.1	0.4347							
20	16.4	7.85	8.34	3.2	0.4353							
30	16.2	7.52	8.31	3	0.4367							
40	16.2	7.53	8.31	3.5	0.4369							
50	16.2	7.54	8.31	3.6	0.4371							
60	15.9	7.2	8.25	3.9	0.4437							
70	15.1	6.61	8.11	4.1	0.4591							
80	14.6	6.32	8.03	3.6	0.4597							
90	14.0	6.19	8	3.4	0.461							
100	13.7	6.08	7.96	4.1	0.4601							

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, 2014.

Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)
		May			
0	8.9	9.83	7.97	3.3	0.4491
10	8.8	9.85	7.97	3.7	0.4491
20	8.7	9.76	7.96	4.1	0.45
30	8.6	9.72	7.93	4.1	0.4507
40	8.4	9.61	7.91	4.4	0.4513
50	8.4	9.64	7.91	4.5	0.4514
60	8.0	9.9	7.97	4.8	0.4469
70	7.9	10.05	8	5	0.4455
80	7.6	10.02	8	5.1	0.4436
90	7.2	9.82	7.97	5.2	0.4426
		July			
0	21.5	8.06	8.32	46.5	0.4237
10	21.2	8.07	8.32	21.7	0.4247
20	20.9	8.04	8.32	13	0.4245
30	20.4	7.78	8.26	8.7	0.4236
40	17.1	7.24	8.06	3	0.4074
50	15.1	7.08	7.98	2.9	0.4189
60	13.9	7.16	7.95	3.1	0.4254
70	11.6	7.23	7.85	3.2	0.4295
80	10.1	7.16	7.77	5.4	0.4362
90	8.9	7.31	7.77	6	0.4468
		September			
0	17.1	7.8	8.29	2.5	0.4176
10	16.6	7.88	8.31	2.8	0.4167
20	16.4	7.74	8.29	2.9	0.417
30	16.4	7.5	8.27	3.3	0.4169
40	16.3	7.39	8.26	3.7	0.4167
50	16.3	7.52	8.28	4.1	0.4188
60	16.3	7.39	8.26	4.6	0.4184
70	15.2	5.71	7.95	5	0.4333
80	13.6	5.02	7.81	5.5	0.4477
90	12.9	4.81	7.75	7	0.4512

Depth (feet)	Temperature (C)	Dissolved oxygen (mg/L)	pH (units)	Turbidity (NTU)	TDS (g/L)
		June			
0	16.9	8.29	8.3	8.3	0.4029
10	16.9	8.3	8.31	9.8	0.4026
20	16.8	8.29	8.19	10.7	0.4043
30	16.1	8.29	8.23	10.4	0.3826
40	14.2	8.08	8.16	14.9	0.4175
50	9.0	8.67	7.98	8.1	0.4506
60	6.7	9.18	8	7	0.4614
70	6.7	9.26	7.99	6.1	0.4613
80	6.6	9.25	7.99	5.7	0.4616
90	6.6	9.25	7.9	5.7	0.461
		August			
0	23.5	7.68	8.37	2.6	0.4264
10	23.1	7.8	8.38	3.2	0.4253
20	22.8	7.44	8.34	3.5	0.4212
30	22.3	6.63	8.24	3.6	0.4102
40	21.8	5.96	8.13	3.8	0.4035
50	18.9	4.91	7.87	4.2	0.4064
60	15.6	4.92	7.74	4.4	0.4263
70	14.0	5.08	7.68	4.7	0.4307
80	11.6	5.18	7.59	6.5	0.4387
90	10.7	5.42	7.6	7.1	0.4433

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, 2014.

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	12.0	10.08	8.26	8.7	0.3962		0	16.7	8.2	8.13	12.2	0.3402
10	11.9	10.08	8.27	9.5	0.4006		10	16.1	8.01	8.11	12.7	0.3389
20	9.7	9.47	8.01	7.7	0.4391		20	15.4	7.72	8.02	14.4	0.3544
30	7.9	9.07	7.82	5.6	0.4476		30	12.4	7.66	7.91	14.1	0.39
40	7.4	8.82	7.79	5.3	0.45		40	10.6	7.48	7.75	12.3	0.4141
50	7.0	8.71	7.74	5.5	0.4521		50	8.3	7.12	7.57	12	0.4383
		July							**August**			
0	22.2	8.18	8.36	4.9	0.3716		0	25.3	7.3	8.34	4.1	0.3914
10	22.1	8.11	8.36	5.1	0.3715		10	24.0	7.39	8.34	3.3	0.3884
20	21.2	8.01	8.32	5	0.371		20	23.8	7.25	8.33	4.2	0.3881
30	19.3	7.34	8.13	5.7	0.3756		30	23.2	6.5	8.22	4.2	0.3769
40	17.4	6.93	7.97	5.1	0.383		40	22.4	5.16	8.01	9.5	0.3663
50	15.5	5.9	7.71	14.6	0.3903		50	16.6	1.95	7.34	9.7	0.3856
		September										
0	16.8	7.84	8.17	4.7	0.391							
10	16.3	7.78	8.13	5.3	0.3906							
20	16.3	7.56	8.13	5.6	0.3902							
30	16.0	7.27	8.09	6.2	0.3915							
40	15.9	7.18	8.09	6.6	0.3906							
50	15.8	7.23	8.09	8.1	0.3901							

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)
1988	7/26 to 7/29	8/2 to 8/6	8/9 to 8/16	7/26 to 8/4	7/27 to 8/18	70 to 78 (74.5)	2229.7 to 2228.0
1989	7/25 to 7/26	7/27 to 8/1	8/2 to 8/4	8/4 to 8/11	8/15 to 8/16	70 to 78 (72.6)	2222.9 to 2221.6
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

[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 2002-2014, 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

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