

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-46

Name: Shadehill Reservoir

County: Perkins

Legal description: Sec. 1-4,8-10,15-17,20-23,26,27,34,35; T 21N, R 15E

Location from nearest town: 12 miles south of Lemmon, SD

Dates of present survey: May 28-30, August 8, 12-14, 2013

Date last surveyed: May 29-31, August 13-15, 2012

Management classification: Warmwater permanent

Primary Species: (game and forage)

1. Walleye
2. Smallmouth Bass
3. Channel Catfish
4. Black Crappie
5. Yellow Perch
6. Emerald Shiner
7. Gizzard Shad
8. _____

Secondary and other species:

1. Northern Pike
2. Bluegill
3. White Bass
4. Spottail Shiner
5. Common Carp
6. River Carpsucker
7. Northern Redhorse
8. White Sucker

PHYSICAL CHARACTERISTICS

Surface Area: 4,693 acres

Watershed: 2,176,000 acres

Maximum depth: 62 feet

Mean depth: 21.8 feet

Lake elevation at survey (from known benchmark): unknown

Ownership of lake and adjacent lakeshore property:

Shadehill Reservoir is, maintained and operated by the United States Bureau of Reclamation. The South Dakota Department of Game, Fish and Parks Department maintains a recreation area/campground and Game Production Area along much of the shoreline.

Fishing Access

Shadehill Reservoir has excellent fishing access for shore and boat anglers alike. Shadehill State Park has four public boat ramps. Many two-track trails around the lake offer the shore angler good access to the water's edge when conditions are dry.

Observations of Water Quality and aquatic vegetation

Due in part to its contour and yearly water level fluctuations, Shadehill Reservoir has limited emergent and submergent vegetation. The lake refilled in 2009 and flooded a ring of vegetation around the lake that was a result of drought during a couple previous years.

Observations on conditions of structures (i.e. spillway, boat ramps and docks, roads, etc)

All access and regulatory structures are in excellent condition. A state park at the reservoir provides excellent facilities for visitors to Shadehill Reservoir.

MANAGEMENT OBJECTIVES

Objective 1. Maintain a Walleye fishery with a minimum gill-net CPUE for stock-length and longer walleye of 15, a PSD range of 30-60, a PSD-P greater than 5.

Objective 2. Maintain the Gizzard Shad population through adult stockings.

BIOLOGICAL DATA

Sampling Effort and Catch

Ten modified fyke (trap) nets and five experimental gill nets were used to sample the adult fish population (Figure 1). Trap nets consisting of a 1.3 X 1.5 m frame, 19.1 mm (0.75 in) mesh and a 1.2 X 23 m (3.9 X 75.5 ft) lead were set May 28-30, 2013 and caught 1,285 fish (Table 1). Gill nets measured 45.7 m (150 ft) long and 1.8 m (6 ft) deep with six 7.6 m (25 ft) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). Gill nets were set August 12-14, 2013 and caught 295 fish (Table 2). Day electrofishing was also completed on August 8, 2013 to index Gizzard Shad reproduction. Discussion on selected fish species follows and completes this report.

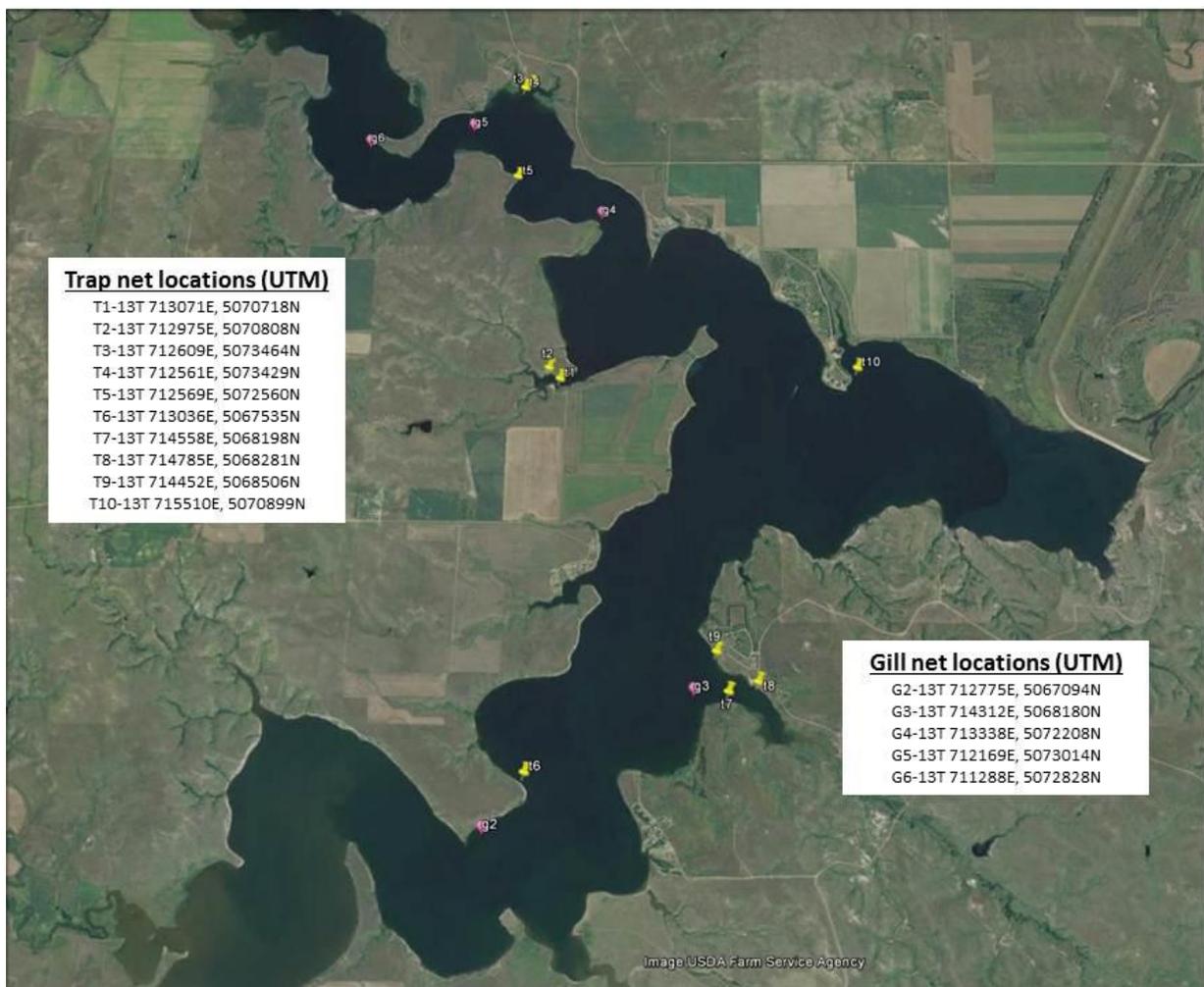


Figure 1. Locations, including GPS coordinates, for trap (t) and experimental gill (g) nets set during the fisheries survey of Shadehill Reservoir, Perkins County, South Dakota, 2013.

Table 1. Catch data from all species collected in ten trap nets in Shadehill Reservoir, Perkins County, South Dakota, May 28-30, 2013. CPUE's with 80% confidence intervals in parentheses. PSD, PSD-P and *Wr* with 90% confidence intervals in parentheses.

Species	N	CPUE	CPUE-S	PSD	PSD-P	<i>Wr</i> >S
Black Bullhead	29	3.2 (2.1)	3.0 (2.1)	7 (9)	0	86.5 (2.2)
Black Crappie	678	75.3 (38.9)	75.3 (38.9)	99 (1)	2 (1)	97.9 (1.1)
Channel Catfish	1	0.1 (0.2)	0.0 (--)	--	--	--
Common Carp	57	6.3 (4.2)	6.3 (4.2)	25 (10)	4 (4)	91.0 (1.0)
Freshwater Drum	2	0.2 (0.2)	0.2 (0.2)	--	--	95.6 (--)
Gizzard Shad	8	0.9 (1.1)	0.9 (1.1)	13 (23)	0	83.5 (0.9)
Northern Pike	15	1.7 (0.9)	1.7 (0.9)	100	73 (21)	98.0 (4.4)
River Carpsucker	4	0.4 (0.3)	0.4 (0.3)	--	--	85.5 (10.6)
Shorthead Redhorse	1	0.1 (0.2)	0.1 (0.2)	--	--	123.4 (--)
Smallmouth Bass	2	0.2 (0.2)	0.2 (0.2)	--	--	77.2 (40.6)
Walleye	34	3.8 (1.6)	3.8 (1.6)	62 (14)	9 (8)	81.2 (2.1)
White Bass	5	0.6 (0.8)	0.6 (0.8)	--	--	85.4 (1.5)
White Crappie	446	49.6 (39.8)	49.6 (39.8)	100	63 (4)	96.1 (1.6)
White Sucker	1	0.1 (0.2)	0.1 (0.2)	--	--	95.0 (--)
Yellow Perch	2	0.2 (0.2)	0.2 (0.2)	--	--	86.2 (56.8)

Table 2. Catch data from all species collected in five gill nets in Shadehill Reservoir, Perkins County, August 12-14, 2013. CPUE's with 80% confidence intervals in parentheses. PSD, PSD-P and *Wr* with 90% confidence intervals in parentheses.

Species	N	CPUE	CPUE-S	PSD	PSD-P	<i>Wr</i> >S
Black Crappie	14	2.8 (2.2)	2.8 (2.2)	100	43 (24)	109.9 (2.2)
Channel Catfish	77	15.4 (4.4)	14.8 (4.7)	53 (10)	1 (3)	86.2 (0.7)
Common Carp	2	0.4 (0.4)	0.4 (0.4)	--	--	83.9 (30.0)
Freshwater Drum	2	0.4 (0.6)	0.4 (0.6)	--	--	111.3 (--)
Gizzard Shad	18	3.6 (2.5)	3.6 (2.5)	94 (9)	0	89.0 (1.1)
Northern Pike	4	0.8 (0.3)	0.8 (0.3)	--	--	92.8 (5.7)
River Carpsucker	7	1.4 (0.6)	1.4 (0.6)	--	--	86.6 (1.1)
Shorthead Redhorse	8	1.8 (0.9)	1.8 (0.9)	--	--	89.1 (2.9)
Walleye	129	25.8 (8.1)	25.4 (7.9)	21 (6)	1 (1)	85.5 (0.1)
White Bass	7	1.4 (1.1)	1.0 (1.2)	--	--	103.9 (3.9)
White Crappie	3	0.6 (0.4)	0.6 (0.4)	--	--	101.1 (14.1)
White Sucker	1	0.2 (0.3)	0.2 (0.3)	--	--	98.8 (--)
Yellow Perch	23	4.6 (1.6)	4.4 (1.3)	77 (15)	0	98.1 (2.3)

Black Crappie

In 2012, catch per unit effort (CPUE) was 44.6 with a PSD of 97 and a PSD-P of 12 (Table 3). This year numbers were similar with a CPUE of 75.3, a PSD of 99 and a PSD-P of 2. It should be noted that net locations vary year to year with fluctuating water levels. Fish condition was good with a mean relative weight for stock length and larger fish ($Wr>S$) of 97.9. Length frequency histograms indicate a large portion of the population between 210 and 240 mm (Figure 2). Growth was faster than the regional average (Table 4). Age data shows this population is dominated by the 2009 year class which was hatched during a year of high water levels.

Table 3. Composite listing of data for Black Crappie collected by trap nets in Shadehill Reservoir, Perkins County 2006-2013. CPUE's with 80% confidence intervals in parentheses. PSD and PSD-P and Wr with 90% confidence intervals in parentheses.

Year	N	CPUE	PSD	PSD-P	$Wr>S$
2006	11	1.4 (0.7)	83 (33)	67 (43)	91.8 (3.1)
2007	12	1.5 (0.9)	73 (26)	18 (22)	92.9 (2.6)
2008	5	0.6 (0.3)	40 (52)	0	95.1 (3.6)
2009	14	2.0 (1.0)	93 (13)	57 (24)	102.3 (4.2)
2010	49	6.1 (2.3)	31 (12)	16 (9)	106.7 (1.9)
2011*	69	6.9 (6.6)	97 (3)	41 (10)	106.9 (1.9)
2012*	357	44.6 (18.9)	97 (2)	12 (3)	108.6 (1.0)
2013*	678	75.3 (38.9)	99 (1)	2 (1)	97.9 (1.1)

*spring trap net sample

Table 4. Shadehill Reservoir Black Crappie year class, age in 2013, sample size (N), mean back-calculated total length-at-age, the Region 1 mean length-at-age, and the South Dakota state-wide Black Crappie mean length-at-age (Willis et al 2001). Standard errors are in parentheses.

Year Class	Age	N	1	2	3	4	5
2009	4	635	85	164	212	227	
2008	5	17	109	176	207	219	240
2013 Pop. Mean (SE)		652	97 (12)	170 (6)	210 (2)	223 (4)	240
Region 1			74 (3)	122 (7)	158 (9)	197 (13)	217 (16)
South Dakota			83 (2)	147 (4)	195 (5)	229 (6)	249 (6)

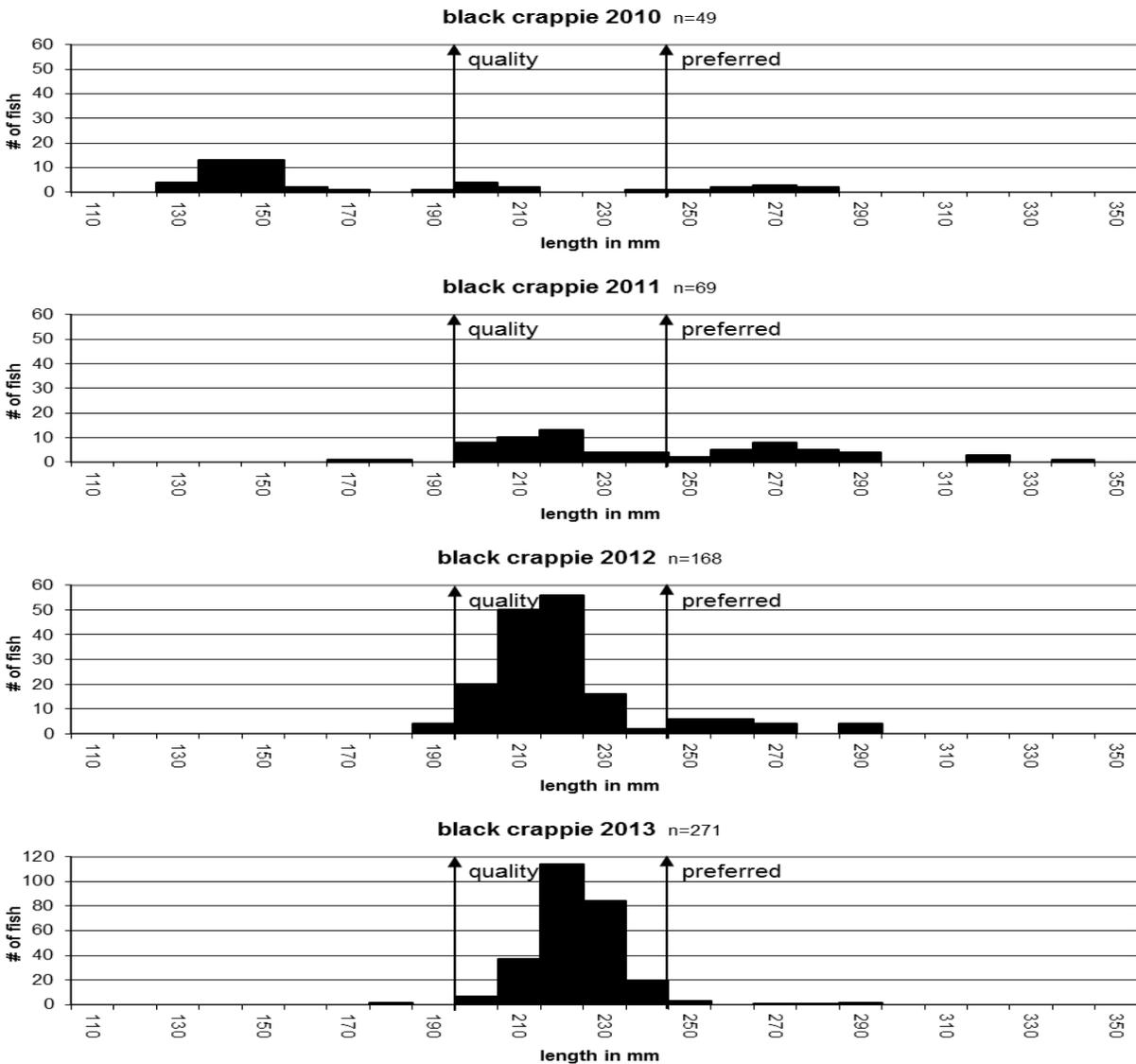


Figure 2. Length frequency histograms for Black Crappie sampled in trap nets in Shadehill Reservoir, Perkins County, South Dakota, 2010-2013.

Channel Catfish

Channel Catfish numbers remain stable with a gill net CPUE of 15.4 compared to 21.3 in 2012 (Table 5). Size structure also remained similar with a PSD of 53 this year compared to 56 last year. Proportional stock density of preferred-length fish (PSD-P) has been zero or one for the last eight years. Very few of these abundant Channel Catfish appear to ever reach larger preferred sizes, and possibly our gear does not sample the larger fish (Figure 3). Fish condition of adults ($W_{t>S}$) was below average at 86.2, and similar to 84.7 in 2012.

Table 5. Composite listing of data for Channel Catfish collected by gill nets in Shadehill Reservoir, Perkins County 2006-2013. CPUE's with 80% confidence intervals in parentheses. PSD and PSD-P and Wr with 90% confidence intervals in parentheses.

Year	N	CPUE	PSD	PSD-P	$Wr > S$
2006	199	24.9 (6.6)	36 (6)	0	78.9 (0.7)
2007	116	19.3 (4.0)	38 (8)	1 (1)	76.5 (0.7)
2008	196	32.7 (9.7)	26 (5)	1 (--)	75.1 (0.8)
2009	29	4.8 (1.4)	41 (16)	0	97.1 (3.5)
2010	81	13.5 (4.9)	67 (9)	0	82.6 (0.2)
2011	137	22.8 (7.9)	71 (7)	1 (1)	88.8 (3.4)
2012	128	21.3 (5.8)	56 (8)	0	84.7 (0.7)
2013	77	15.4 (4.4)	53 (10)	1 (3)	86.2 (0.7)

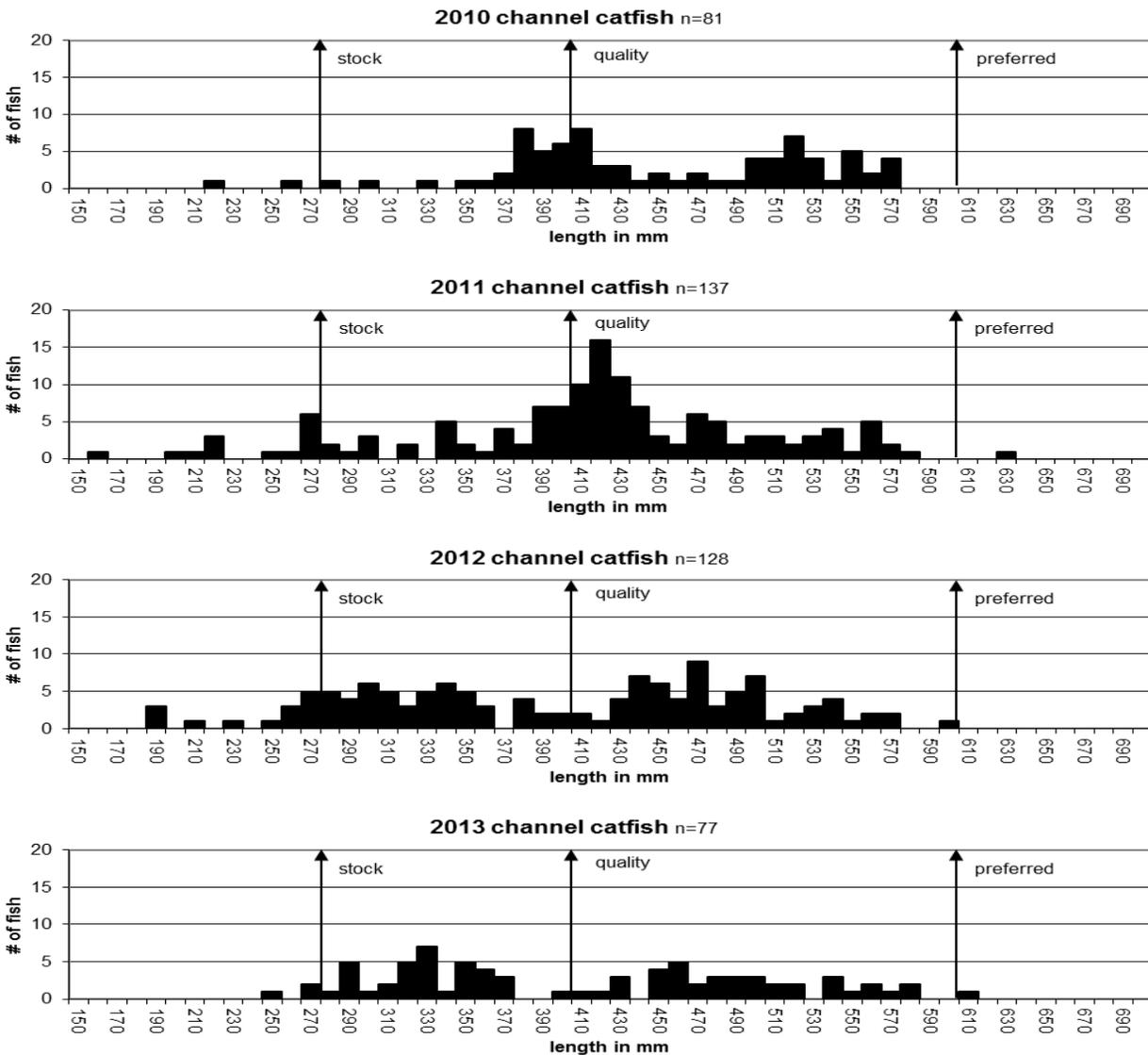


Figure 3. Length frequency histograms for Channel Catfish sampled in experimental gill nets in Shadehill Reservoir, Perkins County, South Dakota, 2010-2013.

Gizzard Shad

Age-0 Gizzard Shad numbers were the highest recorded so far in Shadehill Reservoir with an electrofishing CPUE of 752 per hour (Figure 4) and with all ten sites producing fish. The adult Gizzard Shad population had a gill net CPUE of 3.6 (Table 2). This is also the highest ever recorded. The length frequency histogram shows most fish in the 11 to 13 inch range (Figure 5). Hopefully, a severe winter doesn't kill the adult brood fish present.

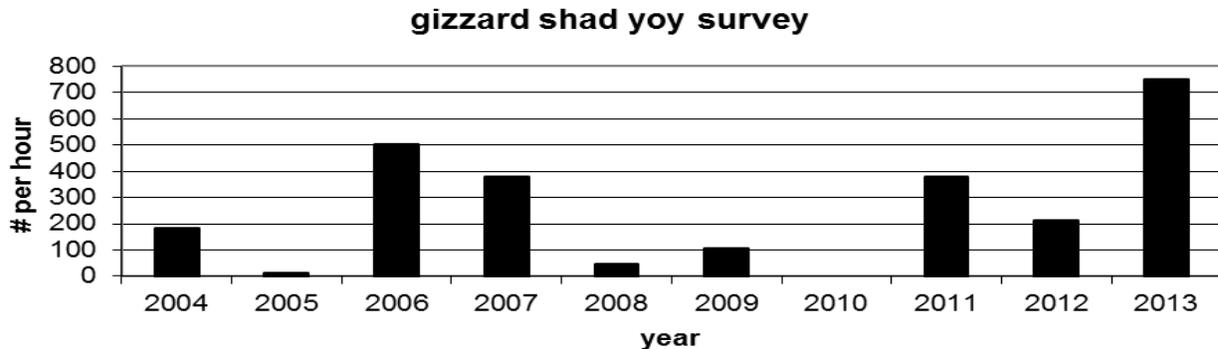


Figure 4. Number of age-0 Gizzard Shad caught per hour during daytime boat electrofishing surveys from Shadehill Reservoir, Perkins County, South Dakota, 2004-2013.

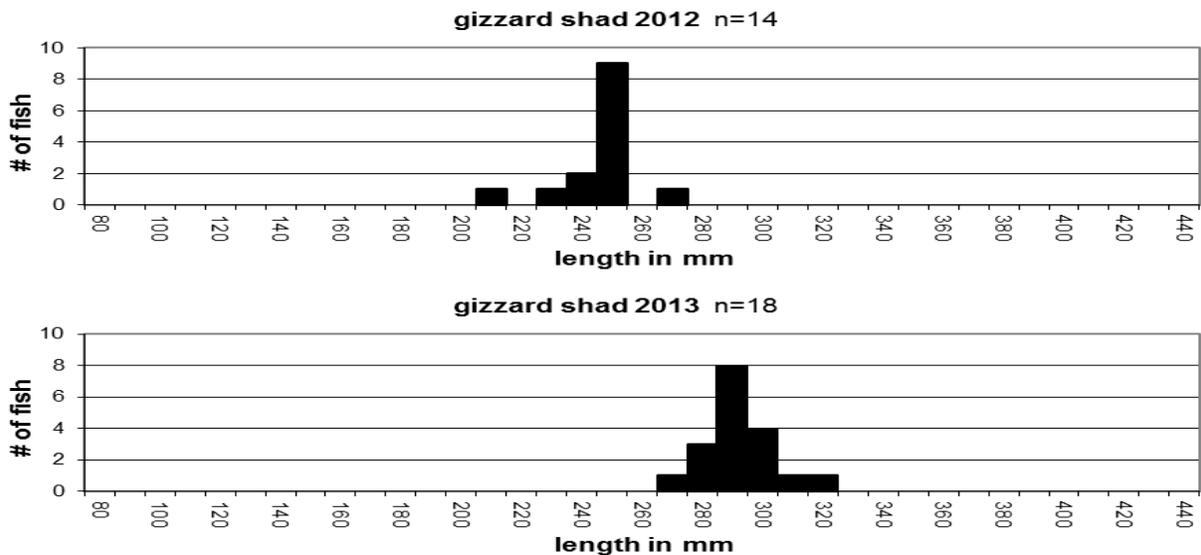


Figure 5. Length frequency histogram for Gizzard Shad sampled in experimental gill nets at Shadehill Reservoir, Perkins County, South Dakota, August 13-15, 2012.

Walleye

Walleye showed an increase in abundance this year. Gill net CPUE was 25.8, compared to 14.3 in 2012 (Table 6). Catch for stock length and larger fish also showed an increase with CPUE going from 14.2 to 25.4, which exceeds the management goal of CPUE for stock length walleye of 15. Size structure, however, was still low with a PSD of 21, an improvement from 6

last year but below the management objective of 30-60. Length frequencies also show most of the sampled Walleye were between 290-400 mm (Figure 6). Age data indicated that age-3 Walleye averaged roughly 300 mm (12 in) (Table 8), which is slightly lower than last year's 325 mm (Table 7). The large year class of age 4's are just starting to surpass the 15 inch minimum and should provide quality angling for the next couple years. Walleye condition was good with a mean $Wr>S$ of 85.5, an increase from a mean of 77.4 in 2012. This is possibly a reflection of the high Gizzard Shad reproduction recorded this summer.

Table 6. Composite listing of data for Walleye collected by gill nets in Shadehill Reservoir, Perkins County, 2006-2013. CPUE's with 80% confidence intervals in parentheses. PSD, PSD-P and $Wr>S$ with 90% confidence intervals in parentheses.

Year	N	CPUE	CPUE-S	PSD	PSD-P	$Wr>S$
2006	57	7.1 (1.8)	6.1 (1.7)	27(10)	4 (5)	84.0 (1.0)
2007	56	9.3 (2.8)	8.2 (3.1)	33 (12)	2 (3)	80.1 (0.8)
2008	57	9.5 (3.0)	7.5 (2.3)	27 (11)	2 (4)	81.9 (0.7)
2009	100	16.7 (8.3)	13.5 (6.7)	19 (8)	1 (2)	86.0 (0.1)
2010	64	10.7 (3.1)	5.8 (1.7)	34 (14)	0	80.9 (0.7)
2011	82	13.7 (4.8)	11.5 (4.0)	20 (8)	0	83.2 (2.7)
2012	86	14.3 (8.4)	14.2 (8.4)	6 (4)	1 (2)	77.4 (0.5)
2013	129	25.8 (8.1)	25.4 (7.9)	21 (6)	1 (1)	85.5 (0.1)

Table 7. Age, minimum, maximum and weighted mean lengths (mm) at capture by age (determined from otoliths) for Walleye sampled in experimental gill nets in Shadehill Reservoir, Perkins County, South Dakota, August 13-15, 2012.

Age	Minimum length @ capture	Weighted mean length @ capture	Maximum length @ capture	Number of fish in survey
2	244	287	330	8
3	251	325	389	75
5	556	556	556	1

Table 8. Age, minimum, maximum and weighted mean lengths (mm) at capture by age (determined from otoliths) for Walleye sampled in experimental gill nets in Shadehill Reservoir, Perkins County, South Dakota, 2013.

Age	Minimum length @ capture	Weighted mean length @ capture	Maximum length @ capture	Number of fish in survey
1	210	221	232	2
2	272	297	313	4
3	281	300	315	11
4	272	349	428	102
5	333	418	505	4
9	507	526	545	2

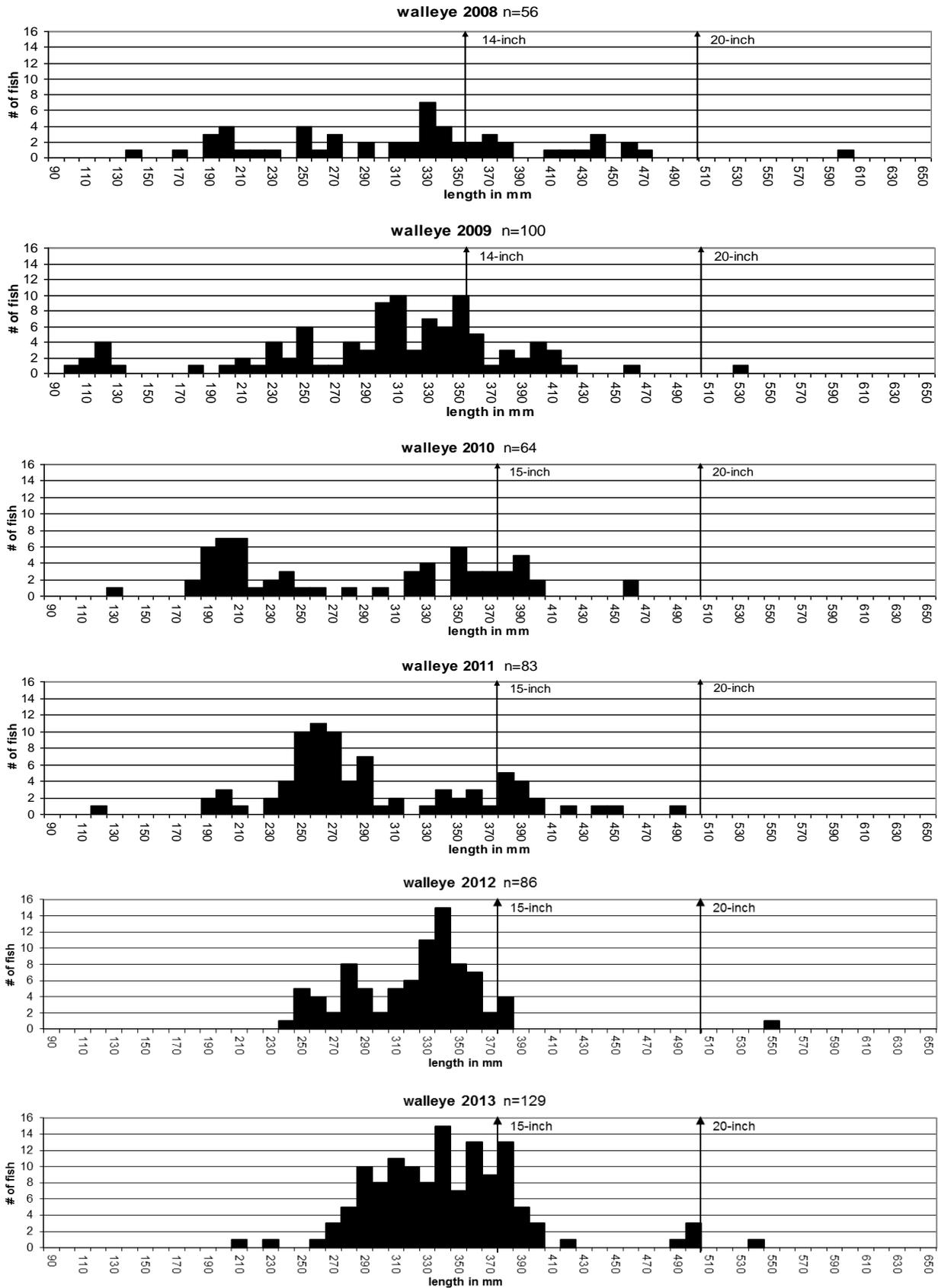


Figure 6. Length frequency histograms for Walleye collected in experimental gill nets from Shadehill Reservoir, Perkins County, South Dakota, 2008-2013.

White Bass

White Bass abundance has been declining since 2010, with gill net catch per unit effort of stock-length fish (CPUE-S) falling to 0.7 in 2012 (Table 9). This year was similar to last with a CPUE of 1.4. Fish condition was much higher than last year with $Wr>S$ at 103.9, compared to 85.5 in 2012, possibly a result of the high Gizzard Shad reproduction this year.

Table 9. Composite listing of data for White Bass collected by gill nets in Shadehill Reservoir, Perkins County, 2006-2013. CPUE's with 80% confidence intervals in parentheses. PSD, PSD-P and $Wr>S$ with 90% confidence intervals in parentheses.

Year	N	CPUE	CPUE-S	PSD	PSD-P	$Wr>S$
2006	85	10.6 (5.8)	10.6 (5.8)	99 (2)	9 (6)	84.3 (0.2)
2007	73	12.2 (7.1)	12.2 (7.1)	100	18 (8)	81.5 (0.1)
2008	53	8.8 (5.0)	8.8 (5.0)	96 (4)	30 (11)	82.1 (1.0)
2009	47	7.8 (3.7)	5.3 (3.8)	100	69 (14)	92.1 (0.8)
2010	69	11.5 (5.0)	11.5 (5.0)	74 (9)	68 (9)	90.4 (0.2)
2011	49	8.2 (5.1)	8.0 (5.1)	92 (7)	50 (12)	90.7 (0.7)
2012	4	0.7 (0.5)	0.7 (0.5)	--	--	85.5 (0.0)
2013	7	1.4 (1.1)	1.0 (1.2)	--	--	103.9 (3.9)

White Crappie

White Crappie abundance was high this year with a trap net CPUE of 49.6 (Table 1), compared to 4.1 in 2012. Stock indices were also high with a PSD of 100 and a PSD-P of 63. The length frequency histogram shows a continued high proportion of individuals over memorable length (Figure 7). It also shows very little recruitment occurring in recent years. Growth was slower than the statewide average for the first two years but appears to be above the average after that (Table 10).

Table 10. Shadehill Reservoir White Crappie year class, age in 2013, sample size (N), mean back-calculated total length-at-age, the Region 1 mean length-at-age, and the South Dakota state-wide White Crappie mean length-at-age (Willis et al 2001). Standard errors are in parentheses.

Year Class	Age	N	1	2	3	4	5	6	7
2010	3	46	94	196	253				
2009	4	324	78	176	233	252			
2007	6	58	73	162	226	264	288	305	
2006	7	19	63	154	222	248	266	281	296
2013 Pop. Mean (SE)		447	77 (7)	172(9)	233 (7)	255 (5)	277 (11)	293 (12)	296
South Dakota			93 (4)	183 (10)	221 (12)	252 (12)	275 (17)		

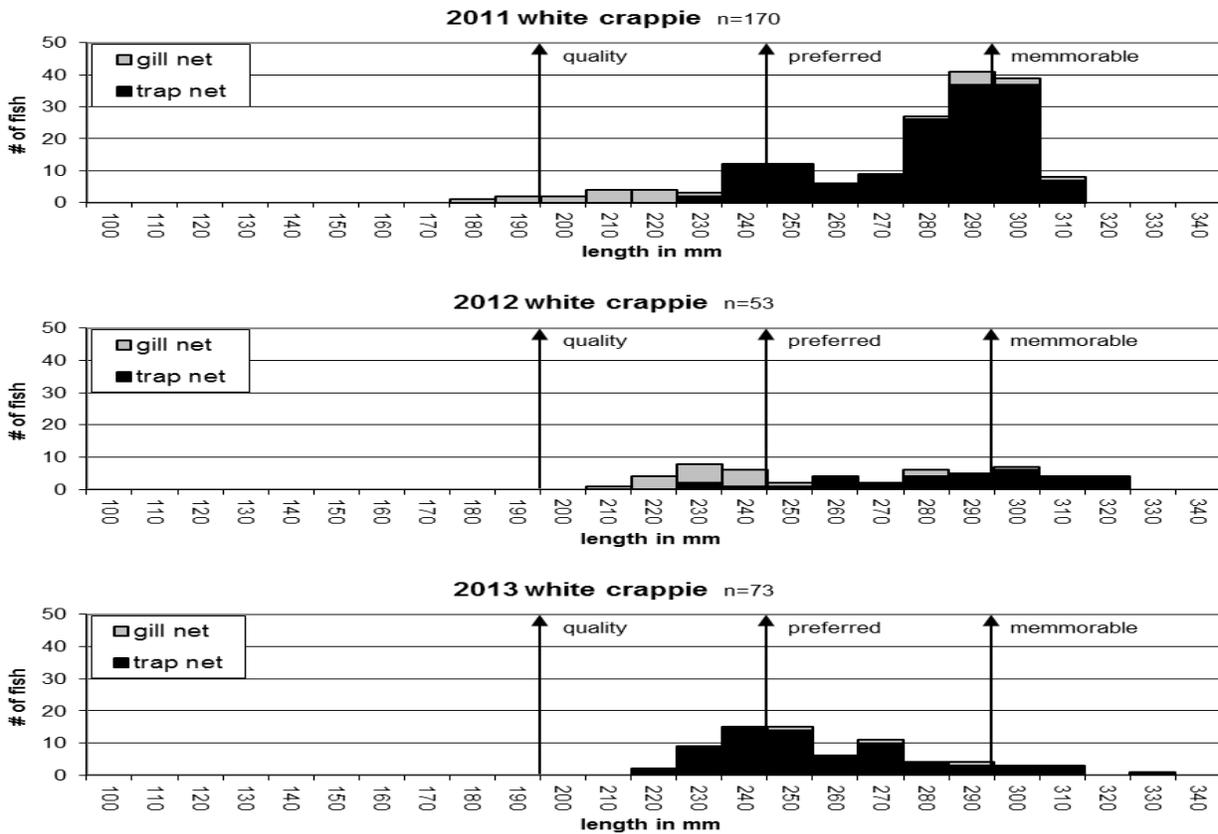


Figure 7. Length frequency histograms of White Crappie collected by experimental gill nets and trap nets in Shadehill Reservoir, Perkins County, South Dakota, 2011-2013.

RECOMMENDATIONS

1. Continue conducting annual surveys of the fishery to evaluate populations and stocking success (i.e. Gizzard Shad introductions, Walleye, and Smallmouth Bass).
2. Stock adult pre-spawn Gizzard Shad annually to maintain high forage potential for Walleye and other predatory fish.

REFERENCES

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes: A Statewide Summary with means by region and Water Type. Special Report. South Dakota Department of Game, Fish and Parks. Pierre, South Dakota.

APPENDIX

Appendix A. Stocking history, including year, number stocked, species and size of stocking within Shadehill Reservoir, Perkins County, South Dakota, 2002-2013.

Year	Number	Species	Size
2002	50,000	Walleye	Fingerlings
2003	251	Gizzard Shad	Adult
2004	233 162,700	Gizzard Shad Walleye	Adult Fingerlings
2005	250 200,300	Gizzard Shad Walleye	Adult Fingerlings
2006	65 166,698	Gizzard Shad Walleye	Adult Fingerlings
2007	192,953	Walleye	Fingerlings
2008	409,235	Walleye	Fingerlings
2009	420,652 85	Walleye Gizzard Shad	Fingerlings Adult
2010	90 385,829	Gizzard Shad Walleye	Adult Fingerlings
2011	225 278,922	Gizzard Shad Walleye	Adult Fingerlings
2012	6,000,000 28,832 30,173	Walleye Rainbow Trout Smallmouth Bass	Fry Fingerlings Fingerlings
2013	100 112,275	Gizzard Shad Walleye	Adult Fingerlings