

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-40

Name: Shadehill Reservoir County: Perkins
Legal description: T 21N, R 15E Sec. 1,2,3,4,8,9,10,15,16,17,20,21,22,23,26,27,34,35,
Location from nearest town: 12 miles south of Lemmon, SD
Dates of present survey: August 9, 6-8, 2007
Date last surveyed: August 3, 7-9, 2006
Most recent lake management plan: F21-R-36 Date: 2004
Management classification: Warmwater permanent
Contour mapped: July 1985

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 redbhorse
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

1. Describe ownership of lake and adjacent lakeshore property:

Shadehill Reservoir is, maintained and operated by the U.S. Bureau of Reclamation. South Dakota Department of Game, Fish and Parks maintains a recreation area/campground and game production area along much of the shoreline.

2. Describe watershed condition and percentages of land use:

The Shadehill Reservoir watershed is approximately 3,400 square miles, 75% of which is pasture and grassland, 20% agricultural cropland, and 5% forest and park land.

3. Describe aquatic vegetative condition:

Due in part to its contour and yearly water level fluctuations, Shadehill Reservoir has limited emergent and submergent vegetation. Recent drought conditions have left no vegetation in the lake.

4. Describe pollution problems:

Department personnel identified no pollution problems during the 2007 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

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

BIOLOGICAL DATA

Methods

A lake survey was conducted on Shadehill Reservoir August 6-8, 2007. Sampling consisted of 6 gill net nights and 8 trap net nights (Appendix C). All gill nets were monofilament experimental 150 foot nets. The switch from 300 foot gill nets was to get better confidence in our catch rate data. The gill net was a monofilament experimental net 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). Trap nets were set at eight stations consisting of 1 trap net nights each. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm ($\frac{3}{4}$ -in) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE; number of fish collected per net night or number of fish collected per hour of electrofishing), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per net night). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr for stock length and larger fish.

Results and Discussion

Age-0 Fish Survey

Electrofishing

Ten sites around the lake were completed during daylight hours on August 9, 2007. Seven of ten sites produced shad (Table 1). A total of 423 shad were captured in the 1.12 hours of electrofishing. This gave a CPUE of 377.7 young of year shad per hour. Last year, a total of four hundred sixty three shad were sampled for a CPUE of 505.0 per hour and shad were found at all ten sites. Total shocking time was .92 hours.

Table 1. Daytime electrofishing results for age-0 shad at Shadehill Reservoir, August 9, 2007.

Site	#/Site	Time(sec)	#/hr
South Arm #3	0	463	0
South Arm #4	0	508	0
South Arm #5	0	432	0
South Arm #6	1	560	6.4
Main #1	40	300	480
Main #2	100	300	1200
Upper #9	120	250	1728
Upper #10	30	600	180
North Arm #7	7	600	42
North Arm #8	125	300	1500
Total	423	1.12	377.7

Fish Community Survey

Gill and Trap Net Catch

Thirteen species were collected in the six gill nets during the 2007 lake survey of Shadehill Reservoir, for a total of 312 fish. Channel catfish were the most abundant species comprising 37.2% of the total, while white bass were second most at 23.4% and walleye were third with 17.9%.

Eight trap nets sampled eleven species for a total of 78 fish in 2007. Black crappie and white bass were most abundant with 15.4%. Smallmouth bass was the third most abundant species, comprising 14.1% of the total catch.

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses), and fish condition for fish larger than stock length (Wr>S; 90% CI's in parentheses) for all fish species collected from six, 150-ft experimental sinking gill nets in Shadehill Reservoir, Perkins County, August 6-8, 2007.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black crappie	1	0.2 (0.2)	0.2 (0.2)	--	--	90.8 (--)
Channel catfish	116	19.3 (4.0)	18.7 (4.1)	38 (8)	1 (1)	76.5 (0.7)
Common carp	18	3.0 (2.5)	3.0 (2.5)	72 (19)	6 (9)	99.4 (17.2)
Freshwater drum	15	2.5 (1.5)	2.3 (1.4)	14 (17)	0 (--)	93.2 (1.8)
Gizzard shad	2	0.3 (0.5)	0.3 (0.5)	--	--	90.8 (--)
Goldeye	4	0.7 (0.6)	--	--	--	--
Northern pike	3	0.5 (0.3)	0.5 (0.3)	--	--	76.2 (9.0)
River carpsucker	3	0.5 (0.3)	0.5 (0.3)	--	--	86.9 (2.8)
Shorthead redhorse	5	0.8 (0.6)	0.8 (0.6)	--	--	85.9 (7.0)
Walleye	56	9.3 (2.8)	8.2 (3.1)	33 (12)	2 (3)	80.1 (0.8)
White bass	73	12.2 (7.1)	12.2 (7.1)	100 (--)	18 (8)	81.5 (0.1)
White crappie	10	1.7 (0.9)	1.5 (0.8)	56 (33)	44 (33)	94.1 (2.9)
Yellow perch	6	1.0 (1.0)	1.0 (1.0)	33 (43)	17 (43)	84.9 (8.3)
Totals	312					

Table 3. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock-length (Wr>S; 90% CI's in parentheses) for all fish species collected from 8 modified-fyke trap nets in Shadehill Reservoir, Perkins County, August 6-8, 2007.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black crappie	12	1.5 (0.9)	1.4 (0.9)	73 (26)	18 (22)	92.9 (2.6)
Bluegill	7	0.9 (0.7)	0.9 (0.7)	--	--	101.5 (8.5)
Channel catfish	3	0.4 (0.3)	0.4 (0.3)	--	--	--
Freshwater drum	5	0.6 (0.5)	0.5 (0.4)	--	--	94.3 (--)
Northern pike	3	0.4 (0.4)	0.4 (0.4)	--	--	84.3 (8.9)
River carpsucker	7	0.9 (0.7)	0.9 (0.7)	--	--	--
Shorthead redhorse	3	0.4 (0.4)	0.4 (0.4)	--	--	83.1 (--)
Smallmouth bass	11	1.4 (0.8)	1.1 (0.6)	22 (28)	0 (--)	92.6 (3.0)
Walleye	7	0.9 (0.4)	0.9 (0.4)	71 (35)	43 (39)	78.1 (2.6)
White bass	12	1.5 (1.1)	1.5 (1.1)	92 (15)	17 (20)	--
White crappie	8	1.0 (1.1)	1.0 (1.1)	25 (31)	13 (23)	94.6 (5.2)
Totals	78					

Black crappies

Black crappie density remains low with a trap net CPUE of 1.5 (Table 4). Stock indices decreased to a PSD of 73 and an RSD-P of 18, compared to 83 and 67 last year, respectively. Crappie condition was similar to last year with a mean W_r for stock-length and larger fish of 92.9. These numbers should be taken with a grain of salt as the black crappie sample only had 12 fish.

Table 4. Composite listing of sample size (N), catch-per-unit-effort (CPUE; 80% confidence intervals are given in parentheses), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock-length ($W_r > S$; 90% CI's in parentheses) for black crappie collected by trap nets in Shadehill Reservoir, 2000-2007.

Year	N	CPUE	PSD	RSD-P	$W_r > Stock$
2000	16	1.3 (0.8)	69 (21)	50 (23)	101.6 (8.7)
2001	16	1.5 (0.6)	47 (23)	20 (19)	98.8 (6.2)
2002	42	5.3 (2.8)	10 (8)	0 (na)	99.1 (0.5)
2003	57	9.5 (3.3)	51 (11)	2 (3)	101.8 (1.4)
2004	45	5.6 (4.9)	96 (6)	7 (6)	101.3 (0.9)
2005	19	2.4 (1.9)	26 (18)	5 (9)	99.5 (2.6)
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)

Channel Catfish

Channel catfish continue to be the most abundant species sampled in gill nets with a CPUE of 19.3. Last year's CPUE was 24.9. PSD was 38 with a single fish over preferred-length (Table 5). It's puzzling how none of these abundant catfish ever reach larger sizes. Possibly, our gear does not sample the larger fish. Past data shows very few catfish reach preferred-length. Condition was low with a mean W_r for stock-length and larger fish of 76.5. This steady population seems to change very little year after year.

Table 5. Composite listing of sample size (N), catch-per-unit-effort (CPUE; 80% confidence intervals are given in parentheses), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock-length ($W_r > S$; 90% CI's in parentheses) for channel catfish collected by gillnets in Shadehill Reservoir, 2001-2007.

Year	N	CPUE	PSD	RSD-P	$W_r > Stock$
2001	97	19.4 (11.3)	36 (9)	0 (--)	96.5 (0.8)
2002	117	29.3 (17.3)	56 (0)	0 (--)	84.0 (0.6)
2003	139	34.8 (14.9)	48 (9)	0 (--)	90.6 (0.9)
2004	105	26.3 (7.5)	71 (9)	0 (--)	88.8 (0.6)
2005	129	32.3 (7.7)	58 (9)	0 (--)	82.7 (0.7)
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)

*150 foot gill net compared to 300 foot nets in previous years

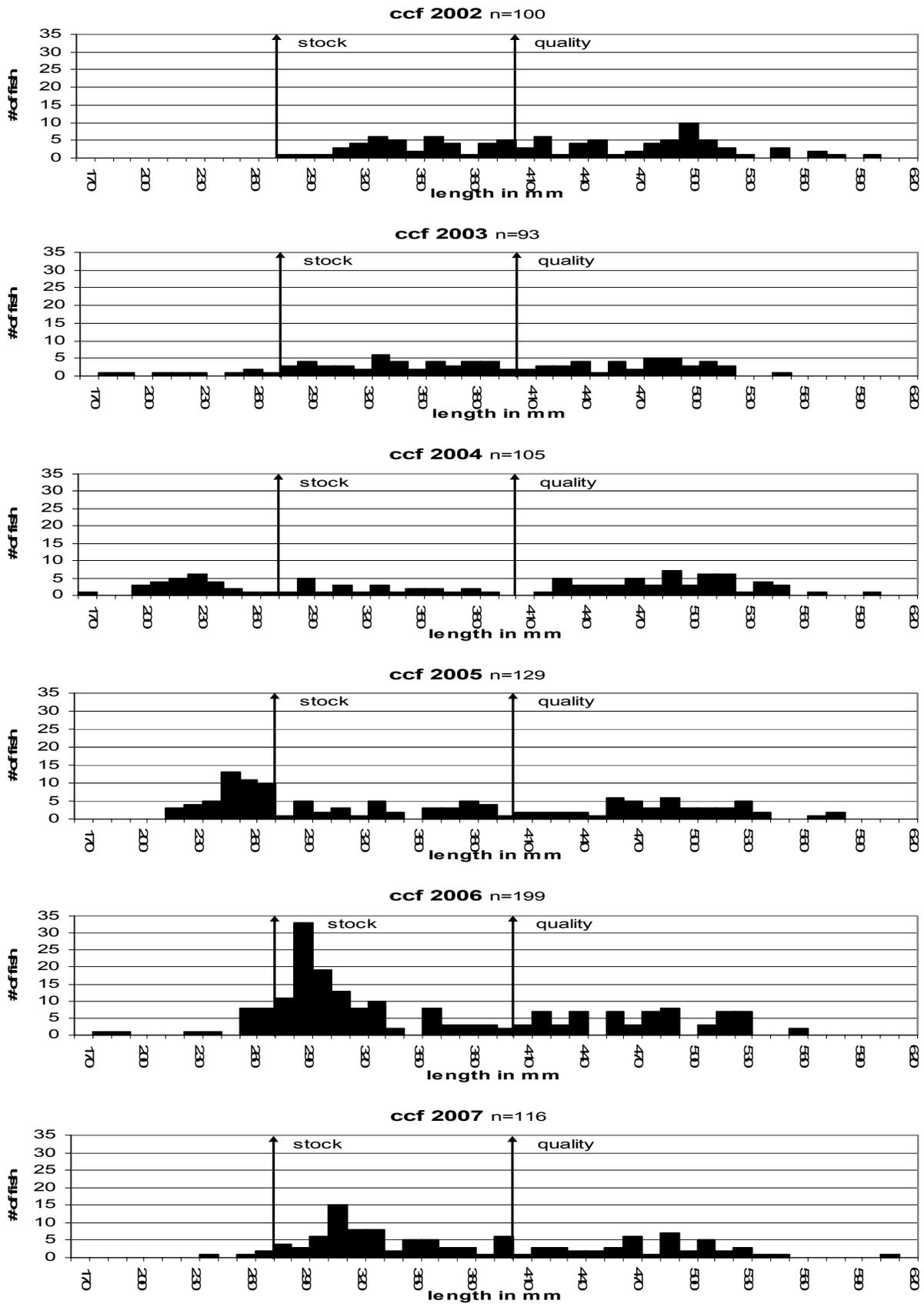


Figure 1. Length frequency for channel catfish from gillnets at Shadehill Reservoir 2002-2007.

Walleye

Our walleye sample showed similar abundance to last year's sample. Gill net CPUE was 9.3, compared to 7.1 last year (Table 6). Catch for stock length and larger fish followed the same trend. PSD for this sample was 33, which is up from 27 last year. Fish, over 20 inches, decreased from a RSD-P of 4 to 2 this year. Length frequency histogram shows a little more "balanced" population compared to a few years ago (Figure 2). A one fish over twenty inches regulation was added in 2003, hopefully protecting some of the larger fish and helping improve size structure. Growth was slower than the state and regional averages (Table 7). Fish condition was average with stock length and larger fish having a mean W_r of 80.1, slightly lower than last year's mean of 84.0.

Current walleye management objectives for the Shadehill walleye fishery is to maintain a minimum gillnet CPUE of 10 with a PSD of 30-60, and increase RSD-P to 10 or greater, and increase growth rates to near or at the regional mean. At this point, we are a little low on most aspects of the objectives, but we are also close to meeting all these objectives. Hopefully some additional stocking, and an increase in the shad population will push us into our objective ranges.

Table 6. Catch data for walleye collected by gill net in Shadehill Reservoir, 2000-2007.

Year	N	CPUE	CPUE-S	PSD	RSD-P	W_r >Stock
2000	122	20.3 (6.9)	20.3 (6.9)	9 (4)	2 (2)	81.2 (0.2)
2001	93	18.6 (10.1)	17.4 (10.2)	31 (8)	0 (--)	81.9 (1.1)
2002	42	10.5 (5.1)	8.5 (3.4)	82 (12)	0 (--)	83.2 (1.1)
2003	70	17.5 (7.2)	9.0 (5.7)	31 (14)	3 (4)	84.6 (1.2)
2004	42	10.5 (2.7)	9.5 (2.2)	32 (13)	5 (6)	84.6 (1.0)
2005	75	18.8 (10.1)	17.3 (9.8)	4 (4)	0 (--)	82.5 (0.3)
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)

*150 foot gill net compared to 300 foot nets in previous years

Table 7. Shadehill Reservoir walleye year class, age in 2007, sample size (N), mean back-calculated total length at age, population standard error (SE), the Region 1 and South Dakota walleye mean length at ages (Willis et al. 2001).

Year Class	Age	N	1	2	3	4	5
2006	1	6	176				
2005	2	14	190	290			
2004	3	17	139	255	330		
2003	4	10	161	261	326	377	
2002	5	6	127	206	290	355	403
Mean (SE)		53	159 (11)	253 (17)	315 (13)	366 (11)	403 (0)
Region 1			164 (17)	260 (22)	332 (27)	385 (32)	444 (42)
South Dakota			168 (3)	279 (6)	360 (7)	425 (8)	490 (9)

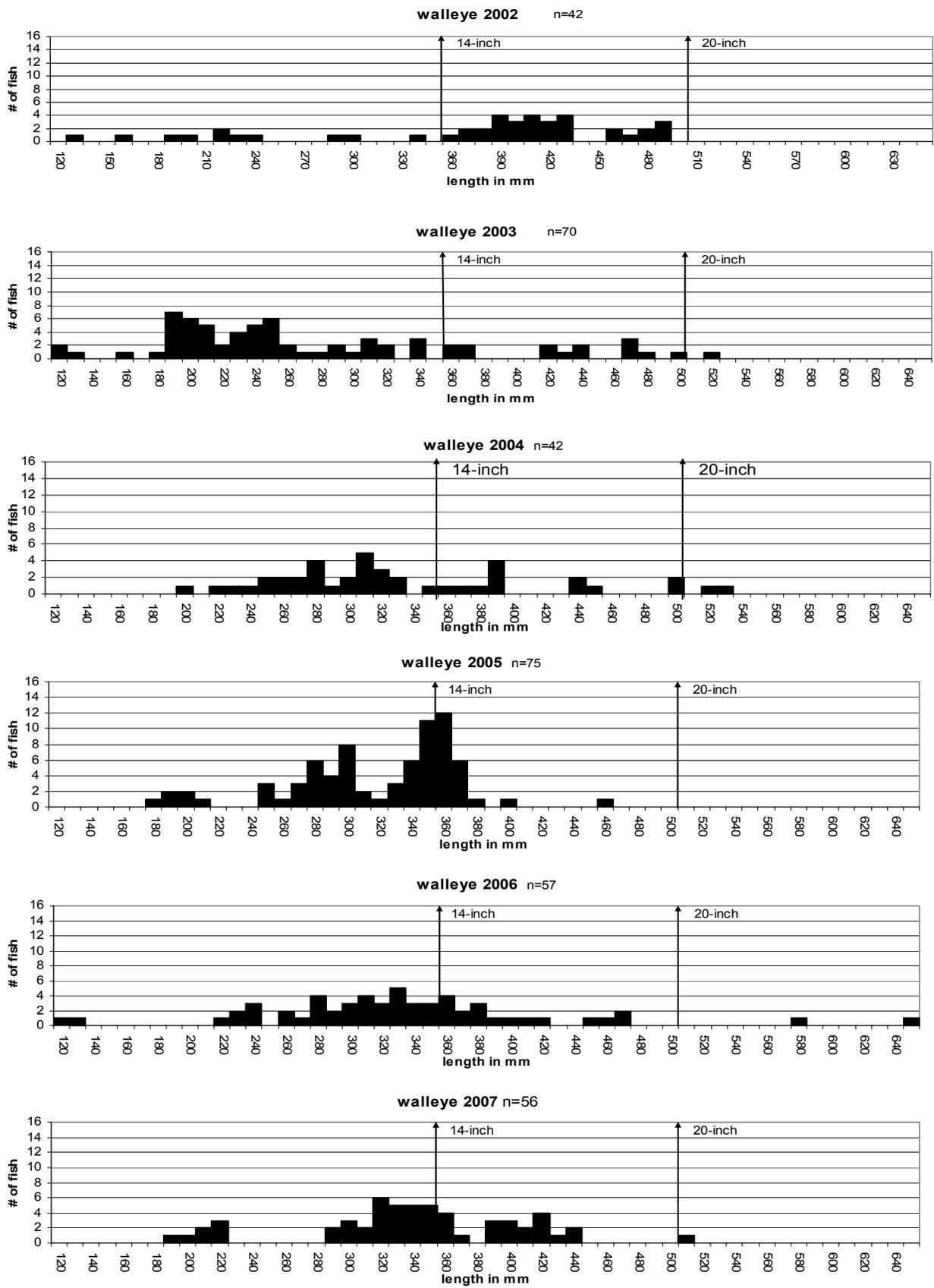


Figure 2. Length frequency histograms for walleye from gillnets at Shadehill from 2002-2007.

White Bass

White bass abundance has remained steady since last year when gill net CPUE was 10.6 for stock length and larger fish (Table 8). This year's gill net CPUE was 12.2 using one hundred-fifty foot gillnets. Stock indices were similar with a PSD of 100 and an RSD-P of 18. Last year, PSD was 99 with an RSD-P of 9. Fish condition was down slightly with a W_r for stock length and larger fish of 81.5, last year it was 84.3. Most fish are from the 2001 year class. Length frequency shows that the fish seem to growing about 10 to 20 millimeters per year (Figure 3).

Table 8. Composite listing of sample size (N), catch-per-unit-effort (CPUE; 80% confidence intervals are given in parentheses), mean total length (TL; standard error is given in parentheses), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock-length ($W_r > S$; 90% CI's in parentheses) for white bass collected by gill net in Shadehill Reservoir, 1999-2007.

Year	N	CPUE	CPUE-S	PSD	RSD-P	$W_r > Stock$
1999	13	1.4 (0.9)	0.9 (0.9)	100 (--)	25 (31)	77.7 (0.6)
2000	44	7.3 (7.0)	7.3 (7.0)	98 (4)	23 (11)	83.0 (0.8)
2001	93	18.6 (22.9)	4.6 (4.4)	91 (10)	74 (16)	88.0 (2.0)
2002	51	12.8 (8.9)	12.8 (8.9)	63 (12)	35 (12)	85.6 (1.1)
2003	293	73.3 (72.9)	73.3 (72.9)	91 (3)	1 (1)	87.6 (0.6)
2004	176	44.0 (45.0)	44.0 (45.0)	100 (-)	7 (4)	90.0 (1.9)
2005	242	60.5 (42.6)	60.5 (42.6)	100(--)	2 (2)	85.5 (0.0)
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)

*150 foot gill net compared to 300 foot nets in previous years

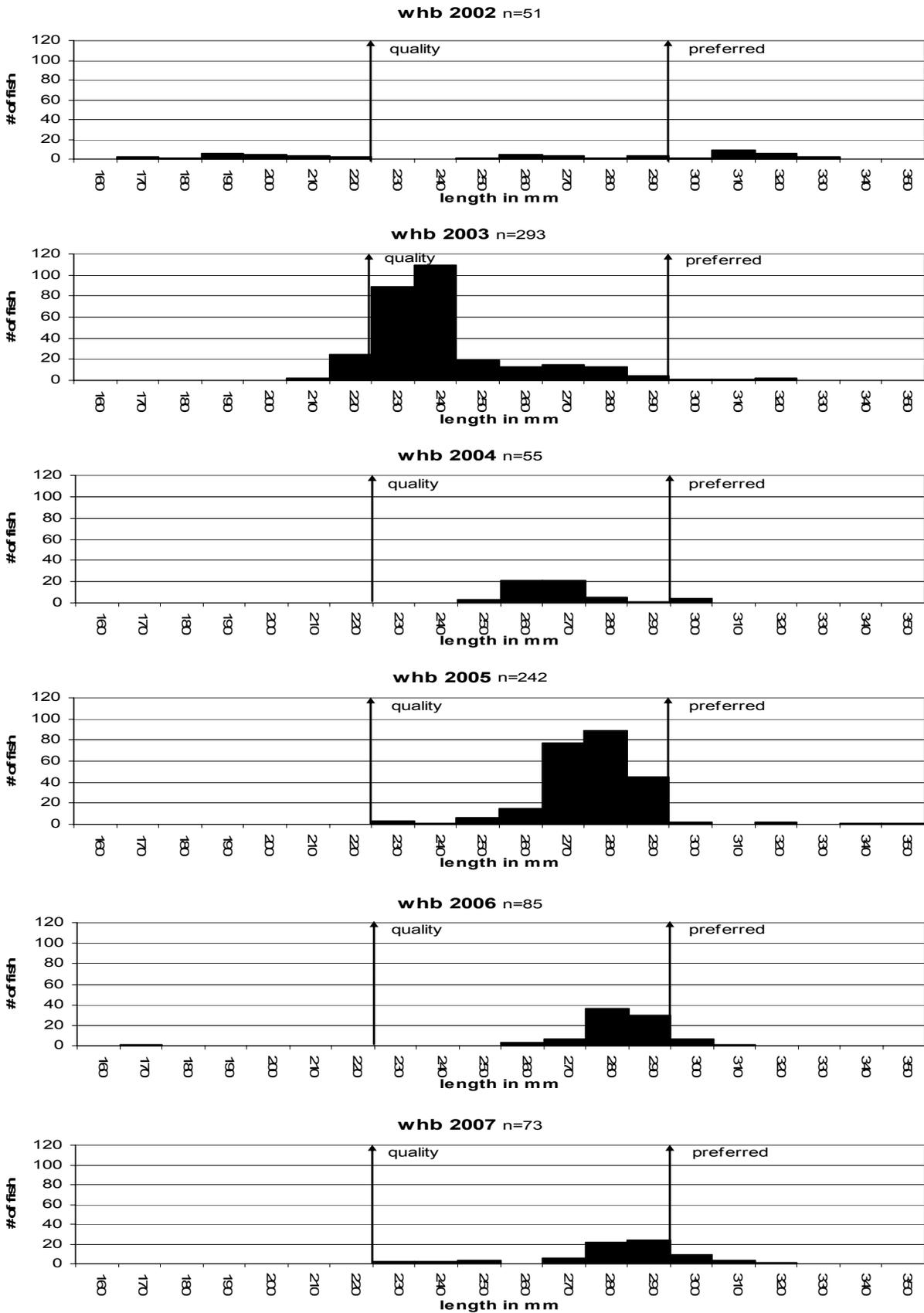


Figure 3. Length frequency histograms of white bass collected by gillnet in Shadehill Reservoir from 2002-2007.

White Crappie

White crappie CPUE was similar to last year. In 2006 gill net CPUE was 1.4 with a frame net CPUE of 2.6. This year gill net CPUE was 1.7 with a frame net CPUE of 1.0. Fish condition was good with stock length and larger fish averaging a Wr of 94.1. Hopefully, these numbers will increase in the future, to levels that will provide a good fishery as well as an additional forage base.

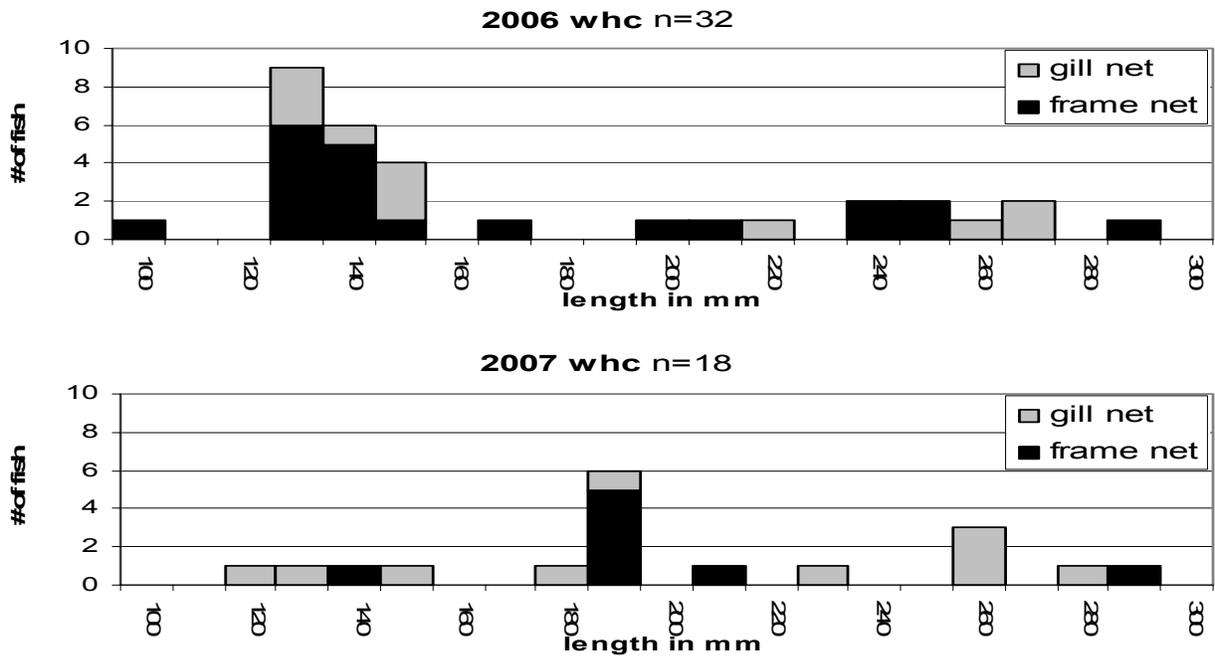


Figure 4. White crappie length frequency histogram in Shadehill Reservoir 2006-2007.

Other fish species

Nine other fish species were collected during the annual lake survey: bluegill, common carp, freshwater drum, gizzard shad, goldeye, northern pike, river carpsucker, shorthead redhorse, and yellow perch. Other species listed had low catch rates (Tables 2 and 3). According to past surveys, this is normally the case with these species.

LITERATURE CITED

- Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.
- Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

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.

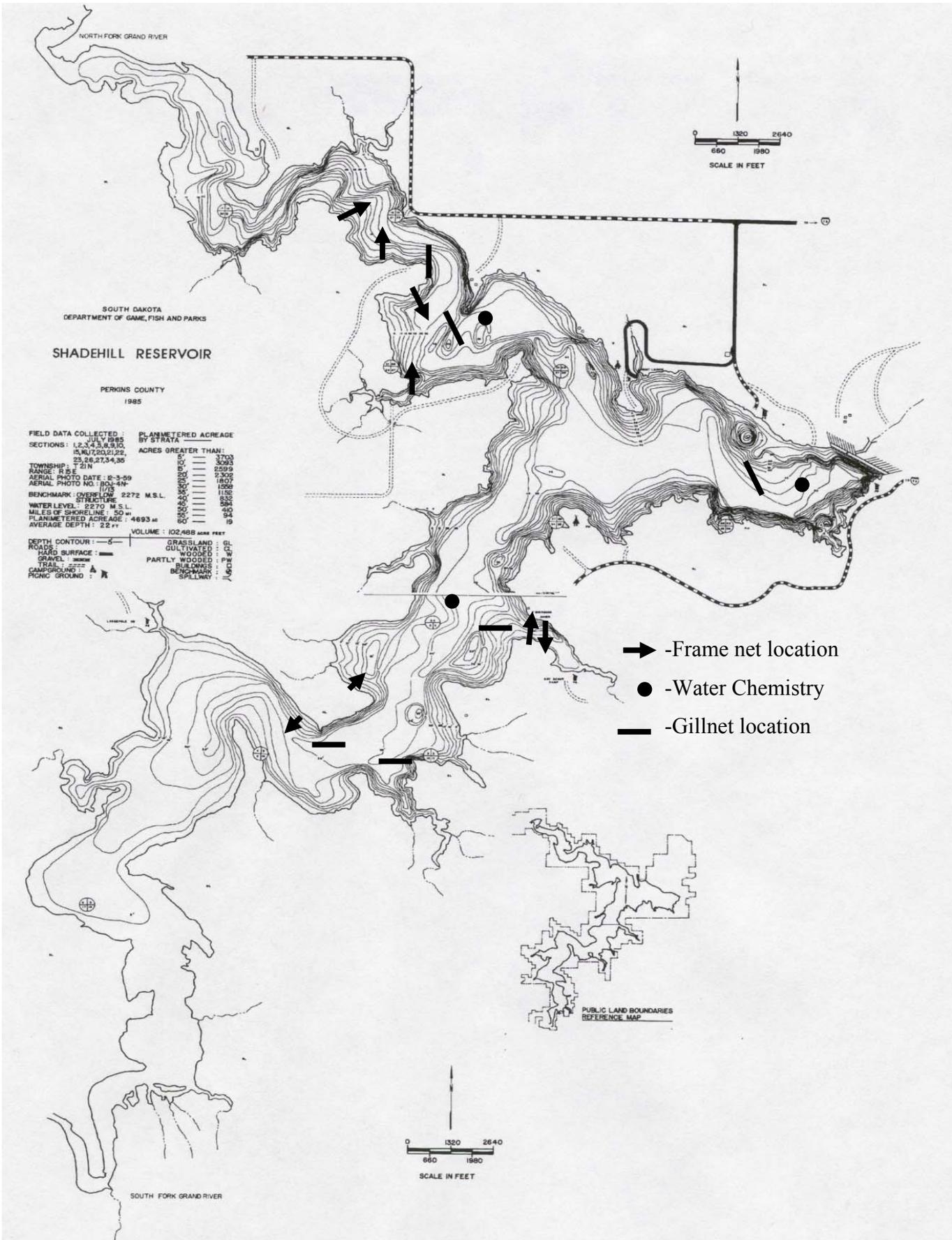
RECOMMENDATIONS

1. Continue conducting a lake survey every year to evaluate fish populations and stocking success (i.e. gizzard shad introductions, walleye, and smallmouth bass).
2. Continue stocking adult gizzard shad annually to ensure adequate forage for the walleye and other predatory fish.
3. Stock small walleye fingerlings at 1 pound per acre to try to increase walleye density.

APPENDICES

Appendix A. Stocking record for Shadehill Reservoir, Perkins County, 1995-2007.

Year	Number	Species	Size
1995	25,000	Rainbow trout	Fingerling
1996	25,000	Rainbow trout	Fingerling
	50,550	Smallmouth bass	Fingerling
	393,000	Walleye	Fingerling
1997	24,053	Rainbow trout	Fingerling
	57,300	Smallmouth bass	Fingerling
	194,772	Walleye	Fingerling
1998	51,666	Smallmouth bass	Fingerling
	400	Yellow perch	Adult
1999	96	Gizzard shad	Adult
	50,000	Smallmouth bass	Fingerling
	150,918	Walleye	Fingerling
	6,750	Yellow perch	Adult
2000	251	Gizzard shad	Adult
	30,590	Smallmouth bass	Fingerling
2001	57	Gizzard shad	Adult
	138,075	Walleye	Fingerlings
2002	50,000	Walleye	Fingerlings
2003	251	Gizzard shad	Adult
2004	233	Gizzard shad	Adult
	162,700	Walleye	Fingerlings
2005	250	Gizzard shad	Adult
	200,300	Walleye	Fingerlings
2006	65	Gizzard shad	Adult
	166,698	Walleye	Fingerlings
2007	192,953	Walleye	Fingerlings



Appendix C. Sampling locations on Shadehill Reservoir, 2007.