

# SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-40

Name: Belle Fourche Reservoir (Orman Dam) County: Butte  
Legal description: T 9N, R 3E Sec. 1, 2, 3, 7, 11-14, 19, 23-26, 29  
Location from nearest town: 9 miles east of Belle Fourche, SD  
Dates of present survey: July 10-12, 30-August 1, 2007  
Date last surveyed: July 12-13, 31; August 1-2, 2006  
Most recent lake management plan: F21-R-36 Date: 2004  
Management classification: Warmwater permanent  
Contour mapped: 1985

Primary Species: (game and forage)

1. Walleye
2. Channel catfish
3. Gizzard shad
4. Black crappie
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_

Secondary and other species:

1. Yellow perch
2. Smallmouth bass
3. White bass
4. Longnose sucker
5. Spottail shiner
6. Common carp
7. Tiger muskie

## PHYSICAL CHARACTERISTICS

Surface Area: 8,063 acres; Watershed: 2,867,200 acres  
Maximum depth: 55 feet; Mean depth: 25 feet  
Lake elevation at survey: approximately 33% of capacity

1. Describe ownership of lake and adjacent lakeshore property:

The U.S. Bureau of Reclamation (BOR) and the Belle Fourche Irrigation District performs the operation and maintenance of Orman Dam. The South Dakota Department of Game, Fish and Parks, Division of Wildlife manages 164 acres of land below the dam grade and the Division of Parks manages 350 acres around the boat ramp (T9N R3E, Sec. 24, 25). The U.S. BOR also manages 6,617 acres around the reservoir as wildlife habitat and for public access although irrigation has priority for water rights.

2. Describe watershed condition and percentages of land use:

The Belle Fourche Reservoir watershed is approximately 4,480 square miles consisting mostly of private land used for livestock grazing.

3. Describe aquatic vegetative condition:

Belle Fourche Reservoir is an irrigation source and typically at low levels during the annual survey. In 2007 the reservoir was near 60% capacity during the survey. Little vegetation was found in the lake at the time of netting.

#### 4. Describe pollution problems:

Departmental personnel identified no pollution problems during the 2007 survey.

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

All structures appear to be in excellent condition. Repairs were performed on the outlets to reduce the amount of seepage from the reservoir. The Parks division put in a low water ramp, which is normally needed after August 1<sup>st</sup>.

## BIOLOGICAL DATA

### Methods

#### *Electrofishing*

Age-0 gizzard shad were collected using a Smith-Root electrofishing boat during the day on July 30, 2007. Ten-five minute runs were made around the lake. During each run, as many age-0 shad were netted as possible and counted.

#### *Netting*

A fisheries survey was conducted at Belle Fourche Reservoir on July 12-13 for frame nets and August 1-2 for the gill nets. Gill net sampling consisted of 6 net nights (Appendix C). All gill nets were monofilament experimental 150 foot nets. The switch from 300 foot gill nets was made to get better confidence in our catch rate data in 2006. 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). 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).

#### *Data Analysis*

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE), 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.

### Results and Discussion

#### *Age-0 Fish Survey*

Ten sites around the lake were boat electrofished during daylight hours on July 30 to index gizzard shad reproduction. All ten sites produced shad indicating excellent reproduction through

the summer (Table 1). A total of 1,179 shad were captured in 50 minutes of electrofishing. This gave a CPUE of 1,414.8 young of year shad per hour.

**Table 1.** Results for daytime electrofishing catch of age-0 gizzard shad from the Belle Fourche Reservoir, July 30, 2007.

Site	No./Site	Time (sec)	No./hr
#1 Lower-1	28	300	336
#1 Lower-2	200	300	2,400
#1 Lower-3	135	300	1,620
#2 Lower-1	55	300	660
#2 Lower-2	297	300	3,564
#2 Lower-3	40	300	480
Middle-1	180	300	2,160
Middle-2	150	300	1,800
Middle-3	75	300	900
Upper-1	19	300	228
<b>Total</b>	<b>1,179</b>	<b>3,000</b>	<b>1,414.8</b>

#### *Fish Community Survey*

Twelve different species were sampled between the gears during the 2007 survey. Nine species totaling 285 fish were collected in gill nets during the 2007 lake survey of Belle Fourche Reservoir. Walleye dominated the catch, comprising 40.0% of the total. Yellow perch were the second most common at 19.6%. Channel catfish were the third most abundant species with 15.4%. Other species collected were common carp, freshwater drum, river carpsucker, white bass and gizzard shad (Table 2). Frame nets sampled eleven different species for a total of 126 fish. River carpsucker was the most abundant species sampled with 38.1% of the total catch. Walleye were second most abundant at 16.7% with catfish third at 12.7%.

**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 Orman Reservoir, July 30-Aug 1, 2007.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Channel catfish	44	7.3 (3.9)	6.5 (4.0)	49 (14)	0 (--)	85.8 (1.0)
Common carp	11	1.8 (0.5)	1.3 (0.5)	100 (--)	0(--)	84.1 (4.8)
Gizzard shad	31	5.2 (4.5)	0.3 (0.3)	100 (--)	0 (--)	--
River carpsucker	10	1.7 (1.5)	1.7 (1.5)	100 (--)	100 (--)	98.8 (15.3)
Shorthead Redhorse	1	0.2 (0.2)	--	--	--	--
Spottail Shiner	7	1.2 (0.9)	--	--	--	--

Walleye	114	19.0 (10.5)	14.0 (8.4)	69 (8)	0 (--)	80.2 (0.6)
White bass	11	1.8 (0.8)	1.7 (0.7)	90 (18)	90 (18)	97.8 (3.6)
Yellow perch	56	9.3 (9.2)	0.8 (0.5)	100 (--)	60(52)	87.5 (5.9)
Totals	285					

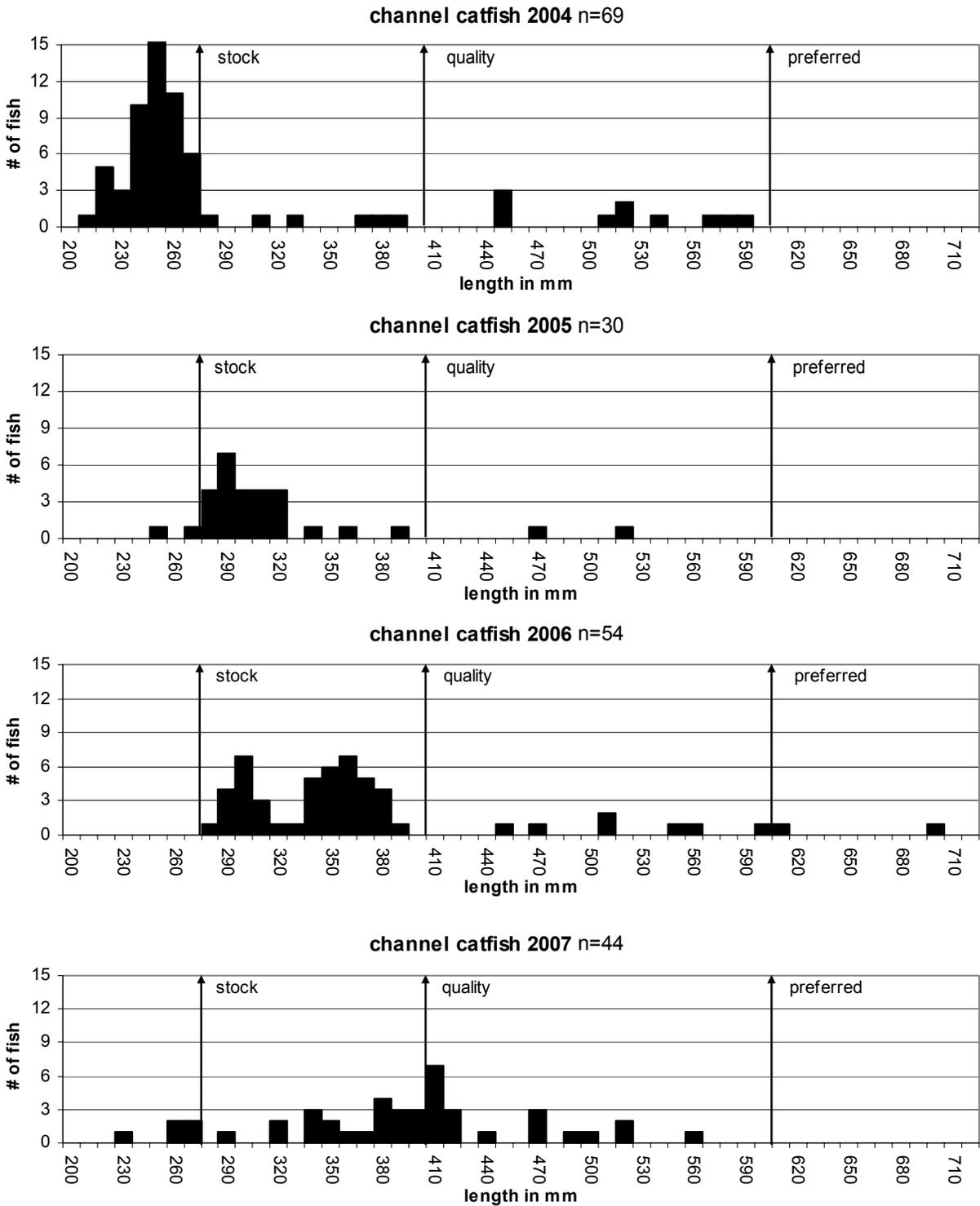
**Table 3.** Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock-length (Wr>S; 90% CI's in parentheses) for all fish species collected from 8 modified-fyke trap nets in Belle Fourche Reservoir, Butte County, July 30-Aug 1, 2007.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black Crappie	8	1.0 (0.8)	0.3 (0.2)	75 (31)	100 (--)	81.9 (--)
Channel Catfish	16	2.0 (1.9)	2.0 (1.9)	44 (23)	--	86.9 (4.6)
Common Carp	14	1.8 (1.5)	1.6 (1.5)	100 (--)	23 (22)	83.5 (3.5)
River Carpsucker	48	6.0 (5.1)	5.6 (4.9)	98 (4)	96 (6)	87.9 (0.9)
Rudd	2	0.3 (0.4)	--	--	--	--
Shorthead Redhorse	3	0.4 (0.5)	0.4 (0.5)	--	--	87.4 (10.6)
Smallmouth Bass	2	0.3 (0.2)	0.3 (0.2)	--	--	85.2 (9.2)
Walleye	21	2.6 (0.9)	1.6 (0.8)	69 (24)	0 (--)	78.1 (2.3)
White Bass	9	1.1 (1.2)	1.1 (1.2)	33 (31)	33 (31)	94.6 (9.6)
White Sucker	1	0.1 (0.2)	0.1 (0.2)	--	--	89.2 (--)
Yellow Perch	2	0.3 (0.4)	0.1 (0.2)	--	--	100.1 (--)
Totals	126					

### Channel Catfish

Channel catfish were the third most abundant species in the gill net sample. CPUE was 7.3, a decrease from 13.5 last year (Table 4). The proportion of quality fish increased this year with a PSD of 49 compared to 17 last year. However, no preferred length (24 inch) catfish were collected in 2007, whereas 2 were caught in 2006.

Fish condition was average with a mean Wr for stock length and larger catfish of 85.8, which is up from 79.4 last year. Length frequency shows most catfish are around quality length. Few under stock length were caught would mean density will drop if more catfish aren't produced to replace the older year classes.



**Figure 1.** Length histogram of channel catfish collected in gillnets from Belle Fourche Reservoir, Butte County 2004-2007.

**Table 4.** Composite listing of sample size (N), catch per gillnet night (CPUE; 80% CI's in parentheses), and proportional stock densities (PSD, RSD; 90% CI's in parentheses) for channel catfish from Belle Fourche Reservoir, 1999-2007.

Year	N	CPUE	PSD	RSD-P	Wr>S
1999	34	5.7 (2.0)	78 (12)	0 (na)	--
2000	54	13.5 (9.9)	69 (12)	2 (4)	90.6 (1.9)
2001	107	26.8 (10.3)	56 (8)	3 (3)	85.6 (0.8)
2002	45	22.5 (41.6)	51 (2)	2 (4)	82.5 (1.4)
2003	22	11.0 (12.3)	46 (26)	8 (13)	82.1 (4.5)
2004	69	34.5 (44.6)	63 (22)	0 (-)	83.5 (3.6)
2005	30	15.0 (46.2)	7 (9)	0 (-)	88.4 (3.3)
2006*	54	13.5 (2.5)	17 (9)	4 (4)	79.4 (0.7)
2007*	44	7.3 (3.9)	49 (14)	0 (--)	85.8 (1.0)

\*150 foot gillnets instead of 300 footers pre-2006.

### Gizzard Shad

Gizzard shad are thought to be the driving force behind the thriving walleye population. Since the shads' reintroduction in 1997, walleye growth rates have improved dramatically. Adult shad stocking was done annually to ensure adequate reproduction (i.e. forage) in case of a total winterkill. Due to a mild winter and high numbers of adult shad in the previous surveys, no adult shad were stocked in 2006 or 2007. In spite of not stocking adults, daytime electrofishing yielded an average CPUE of 1,415 young of year shad per hour in 2007 and 3,734 in 2006. Indicating higher densities than in 2005 when 182 adults were stocked and CPUE was 916 young of year shad per hour. This year six 150 foot gillnets yielded 2 adults and 29 young of year shad. Over winter survival must be monitored to ensure walleye forage the following summer.

### Walleye

Walleye abundance seems to have decreased since last year when CPUE was 27.5 versus a CPUE of 19.0 this year (Table 5). It should be noted that water levels were quite a bit higher during the 2007 survey which may have allowed the population to disperse and affected our catch rates. During 2006, sampling was changed from 300 foot gill nets to 150 foot nets. Very high confidence levels the years before 2006 in CPUE data, makes comparing abundance difficult. Hopefully, the switch to 150 foot nets will tighten up our data's reliability.

Sixty nine percent of the walleye over stock length (10 inches) were also over 15 inches, which is the highest recorded in recent history. This may be an early influence of the slot regulation implemented in January of 2005 which protects fish over 15 inches and under 18 inches. Fish condition was average at Belle Fourche with a mean Wr for stock length and larger fish of 80.2. Growth was slightly below the state average, but good for the region (Table 6). Our current management objective for walleye size structure is a PSD between 30 and 60 and a RSD-P of at least 10. Our PSD number is a little high, but a large year class of age one fish are nearing stock length and should bring the population within our objective range next year.

**Table 5.** Composite listing of sample size (N), catch per unit effort (CPUE; 80% confidence intervals are given in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), and proportional stock densities (PSD, RSD; 90% CI's are given in parentheses) for walleye collected by gill net in Belle Fourche Reservoir, 1998-2007.

Year	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
1998	87	9.6	---	2	0	--
1999	133	22.2	---	21 (6)	0	--
2000	109	27.3 (17.6)	22.3 (11.1)	65 (9)	0 (na)	84.0 (0.4)
2001	283	70.8 (33.2)	63.8 (31.3)	47 (5)	4 (2)	86.1 (0.2)
2002	178	89.0 (40.0)	87.5 (41.6)	38 (6)	3 (2)	84.7 (0.5)
2003	317	158.5 (297.0)	125.0 (255.5)	29 (5)	1 (1)	85.6 (0.1)
2004	227	113.5 (207.8)	95.0 (153.9)	27 (5)	1 (1)	85.3 (0.6)
2005	251	125.5 (185.2)	125.5 (185.2)	40 (5)	0 (na)	76.1 (0.2)
2006*	110	27.5 (15.7)	25.3 (14.9)	45 (9)	0 (--)	81.5 (0.2)
2007*	114	19.0 (10.5)	14.0 (8.4)	69 (8)	0 (--)	80.2 (0.6)

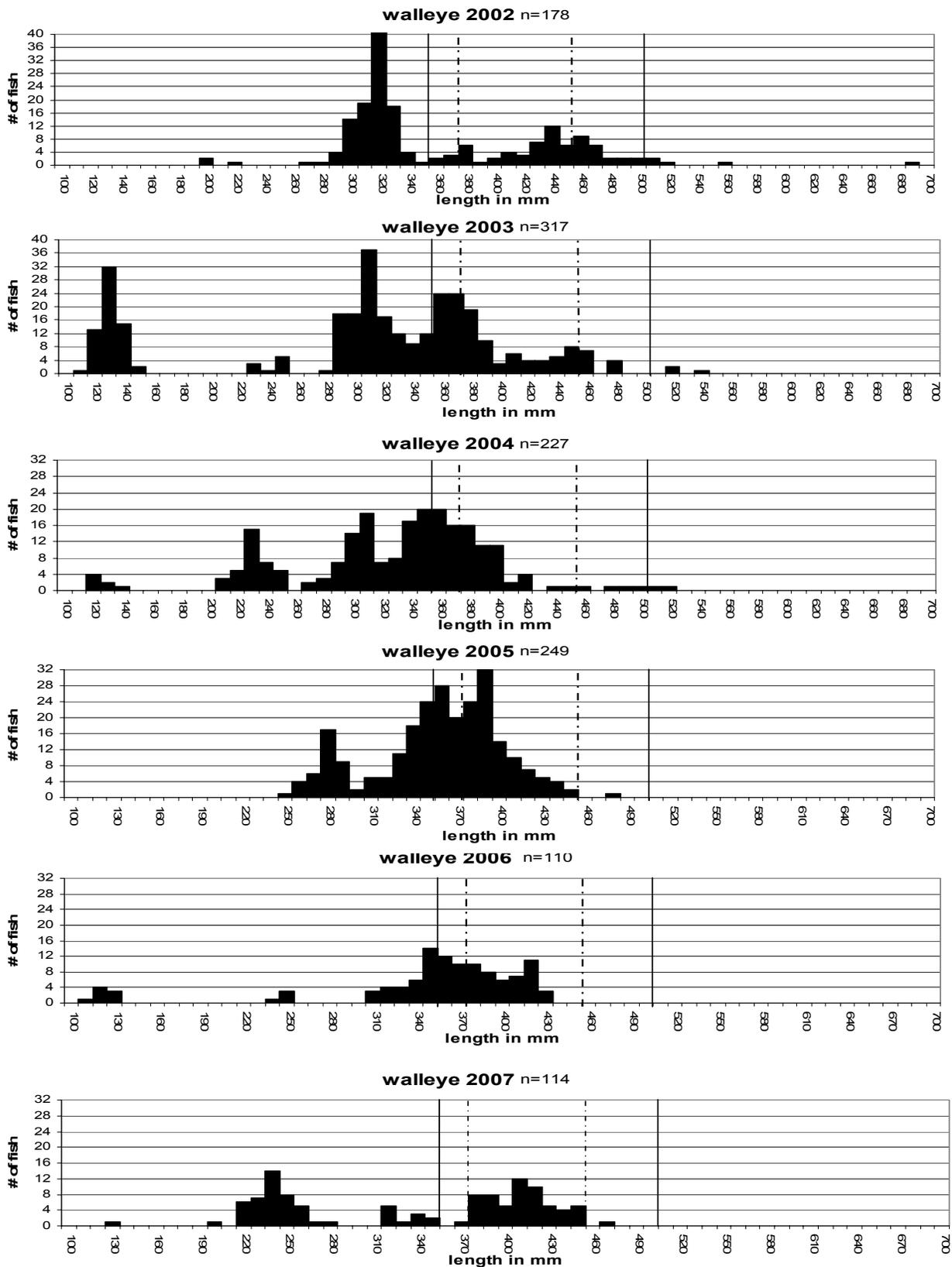
\*150 foot gillnets instead of 300 footers pre-2006.

**Table 6.** Belle Fourche Reservoir walleye year class, age in 2006, 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	6
2006	1	44	177					
2005	2	10	144	303				
2004	3	1	143	270	357			
2003	4	35	171	260	332	396		
2002	5	9	155	273	331	378	421	
2001	6	13	168	281	344	378	401	421
<b>Sample Size</b>		<b>112</b>	<b>159 (6)</b>	<b>277 (7)</b>	<b>341 (6)</b>	<b>384 (6)</b>	<b>411 (10)</b>	<b>421 (0)</b>
Region 1 Mean			164 (17)	260 (22)	332 (27)	385 (32)	444 (42)	
Statewide Mean			168 (3)	279 (6)	360 (7)	425 (8)	490 (9)	

**Table 7.** Mean condition (Wr) with 90% CI in parenthesis for gillnet walleye by length categories at Belle Fourche Reservoir 2001-2007.

Description	2001	2002	2003	2004	2005	2006	2007
Substock	95.5 (1.0)	82.5 (1.2)	84.6 (2.8)	92.4 (0.4)	na	88.3 (--)	80.2 (0.6)
Stock to quality	88.0 (0.4)	87.3 (0.2)	87.3 (0.1)	87.2 (0.5)	78.5 (0.3)	83.6 (0.4)	83.8 (1.3)
Quality to preferred	84.5 (0.2)	80.4 (0.4)	81.8 (0.1)	80.9 (0.6)	72.5 (0.5)	78.9 (0.3)	78.6 (0.4)



**Figure 2.** Lengths for gill net walleye from Belle Fourche Reservoir 2002-2007. The dotted line represents 15" to 18" (fish within the protected slot) and the solid line shows 14" and 20".

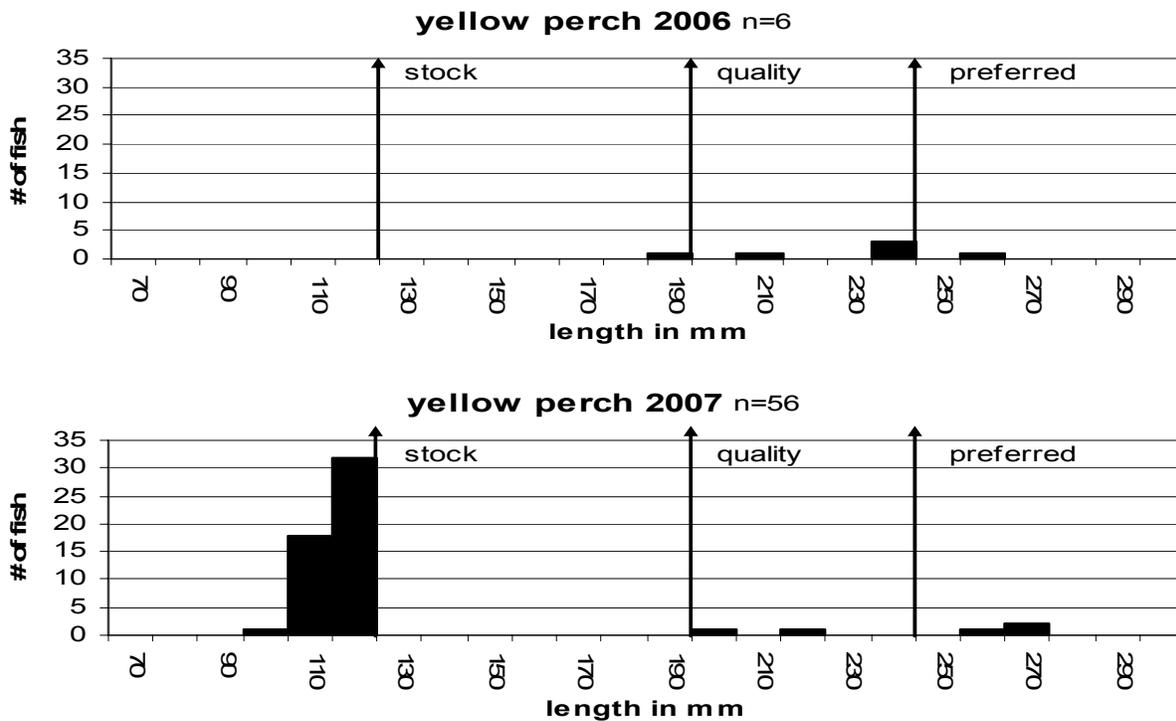
## Yellow Perch

The SD GF&P put Christmas trees in Belle Fourche Reservoir the spring of 2006 right at ice out and stocked 96 prespawn adult perch shortly after. It appears these fish produced a good year class, as they recruited to our gear in 2007. Last year six adult perch were captured in the gill nets compared to five adults and 51 age one perch in 2007 (Table 8). It is hoped that perch can become established through spawning structures and adult stockings to create an alternative forage base in addition to gizzard shad.

**Table 8.** Composite listing of sample size (N), catch per unit effort (CPUE; 80% confidence intervals are given in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), for yellow perch collected by gill net in Belle Fourche Reservoir, 2002-2007.

Year	N	CPUE	CPUE-S
2002	2	1.0 (3.1)	1.0 (3.1)
2003	17	8.5 (13.9)	3.5 (1.5)
2004	11	5.5 (1.5)	5.5 (1.5)
2005	4	2.0 (6.2)	2.0 (6.2)
2006*	6	1.5 (1.1)	1.5 (1.1)
2007*	56	9.3 (9.2)	0.8 (0.5)

\*150 foot gillnets instead of 300 footers pre-2006, post 2006 CPUE should be doubled to compare to pre 2006 CPUE numbers.



**Figure 3.** Length histogram of yellow perch collected in gillnets from Belle Fourche Reservoir, Butte County 2006-2007.

## 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.

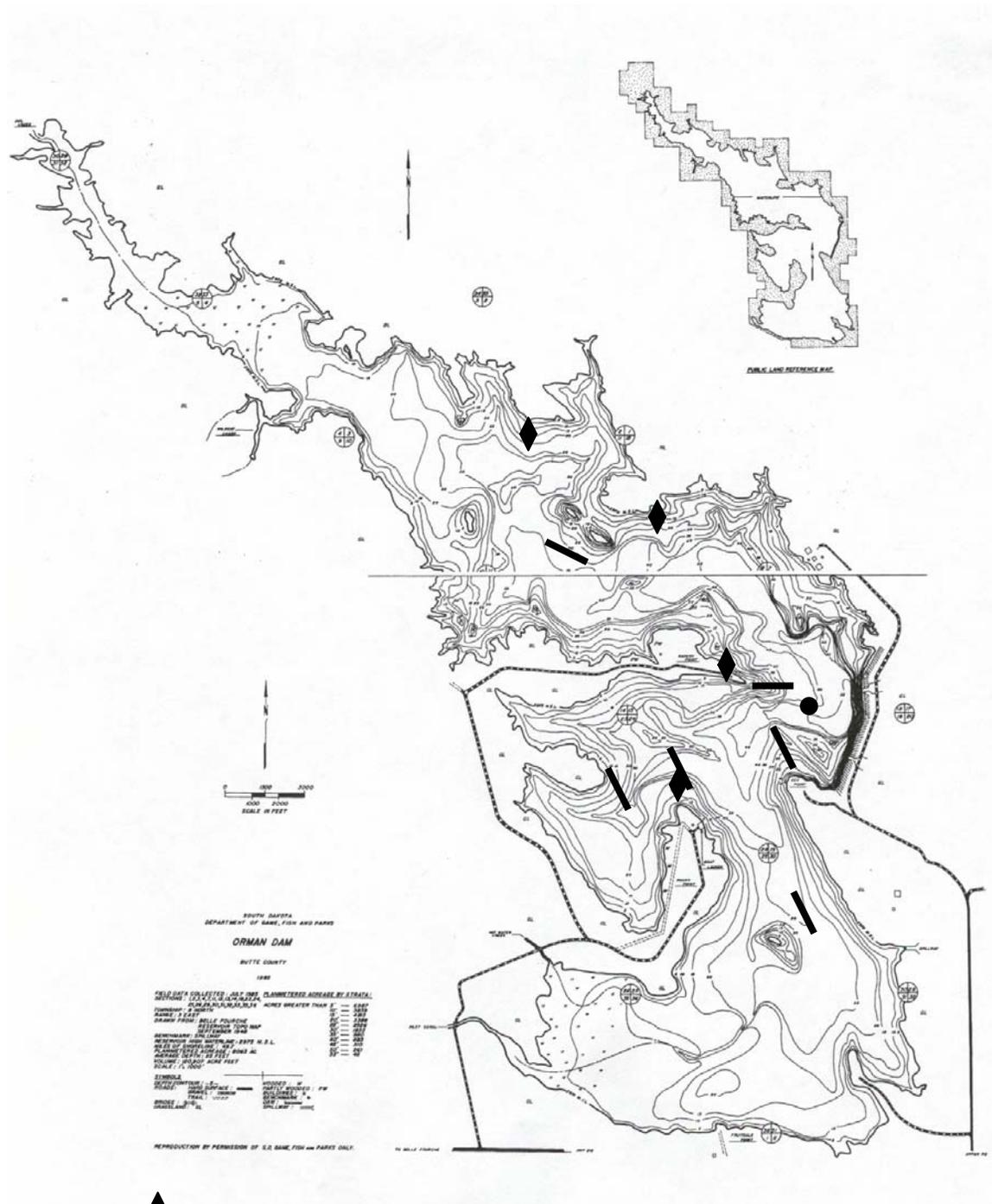
## RECOMMENDATIONS

1. Continue conducting lake surveys annually to evaluate fish populations and monitor new regulation effects.
2. Stock with adult gizzard shad annually to ensure forage base for walleye as over winter survival of shad is questionable.
3. Place Christmas trees in lake to provide yellow perch spawning habitat, which could help provide forage for walleye before the shad young of year become available.

## APPENDICES

**Appendix A.** Stocking record for Belle Fourche Reservoir Reservoir, Butte County, 1996-2007.

Year	Number	Species	Size
1996	7,414	Rainbow trout	Fingerling
	25,000	Tiger muskie	Fingerling
1997	95	Gizzard shad	Adult
	1,969	Rainbow trout	Catchable
	239,503	Walleye	Fingerling
1998	516	Gizzard shad	Adult
	22,819	Rainbow trout (S)	Fingerling
	37,130	Tiger muskie	Fingerling
	250,000	Walleye	Fingerling
1999	522	Gizzard shad	Adult
	640	Muskellunge	Large fingerling
	2,000	Tiger muskie	Large fingerling
2000	493	Gizzard shad	Adult
	14,867	Rainbow trout (C)	Fingerling
	39,162	Rainbow trout (M)	Fingerling
	40,000	Rainbow trout (S)	Fingerling
	2,600	Tiger muskie	Large fingerling
2001	48	Gizzard shad	Adult
	1,900	Tiger muskie	Large fingerling
2002	2,000	Tiger muskie	Large fingerling
	23	Gizzard shad	Adult
2003	171,893	Walleye	Fingerling
	18,436	Rainbow trout	Fingerling
	1,500	Tiger muskie	Large fingerling
	102	Gizzard shad	Adult
2004	1,605	Tiger muskie	Large fingerling
	120	Gizzard shad	Adult
2005	182	Gizzard shad	Adult
	2,263	Splake trout	Fingerling
2006	96	Yellow perch	Adult
2007	52,800	Rainbow trout	Fingerling



- ◆ Frame net stations
- Water chemistry
- Gill net location

**Appendix B.** Locations of sampling sites on the Belle Fourche Reservoir, Butte County, 2007.