SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-45

Name: Deerfield Reservoir County: Pennington

Legal description: Sec. 25,R2E,T1N and Sec 19, 20, 29, 30, 32,R3E,T1N
Location from nearest town: 12 miles northwest of Hill City, South Dakota
Dates of present survey: August 13-15, 2012
Date last surveyed: August 16-17, 2011
Most recent lake management plan: F21-R-40 Date: 2008 - 2012
Management classification: Coldwater Permanent
Contour mapped: 1987

Primary Species:	Secondary and other species:
1. Rainbow Trout	1. White Sucker
2. Splake Trout	2. Golden Shiner
3. Brook Trout	3. Rock Bass
4.	4. Yellow Perch
5.	5. Lake Chub
6.	

PHYSICAL CHARACTERISTICS

Surface Area: 435 acres **Watershed:** 60,800 acres
Maximum depth: 95 feet **Mean depth:** 35 feet
Lake elevation at survey (from known benchmark): 5,907 feet; (approximately 97% of full pool)

Ownership of lake and adjacent lakeshore property:

The Bureau of Reclamation (BOR) maintains and operates Deerfield Reservoir and dam. The United States Forest Service (USFS) maintains and operates the campground and boat launch facilities at Deerfield Reservoir.

Fishing Access

Deerfield Reservoir has boat ramps with docks located on the northeast and southeast sides of the lake. Shore fishing access is available via a walking trail around the lake. Additionally, a campground and picnic area on the southwest shore also allow for fishing access. A no-wake regulation (< 5 mph maximum speed) exists for the reservoir and reduces speedboat recreation. All areas require a USFS pass except when parking along the road at the Castle Creek inlet.

Watershed condition and land use:

The Deerfield Reservoir watershed consists of approximately 95 square miles of forested land located within the Black Hills National Forest. The USFS has management authority on approximately 75% of the watershed and the remaining 25% is controlled by private landowners. A small portion of the privately owned land is cultivated and most of the remaining private land is open meadowland used for grazing or haying interspersed with coniferous forest.

Observations of Water Quality and Aquatic Vegetation

Vegetation density in most of the reservoir is low. In the shallow ends of most bays and at the inlet of Castle Creek and Gold Run Creek, small concentrations of heavy vegetation were present. Minor input of silt and nutrients washes into Deerfield Reservoir from Castle/Ditch Creek and Gold Run Creek as well as other smaller drainages. Cattle grazing, a limited amount of agricultural tillage, and cattle feeding contribute to siltation and nutrient loads.

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

The dam and spillway were reconstructed in 1986. A new valve at the outlet of Deerfield Reservoir was installed in December of 1995 allowing more precise control of flows into Castle Creek. The USFS is responsible for management and repair of boat ramps at Deerfield Reservoir. The south boat ramp was replaced in the fall of 2012 and the Rapid City Walleyes Unlimited Chapter donated a new boat dock that was installed in spring 2013.

CURRENT MANAGEMENT OBJECTIVES

Objective 1. Maintain a quality Rainbow Trout fishery at Deerfield Reservoir where catch rates exceed 0.50 Rainbow Trout per hour.

Objective 2. Annually monitor the White Sucker population, continue White Sucker removals when densities appear high (i.e. gill net CPUE >30).

Objective 3. Maintain a secondary fishery of Splake Trout.

Objective 4. Continue to work towards reducing Rock Bass density within the reservoir.

BIOLOGICAL DATA

Methods

The annual fisheries survey on Deerfield Reservoir consisted of two experimental gill (gill) nets (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]) and three modified fyke (trap) nets with 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. Gill and trap nets were set in standardized locations on August 14, 2012 and re-set on August 15, 2012 (Figure 1). All nets remained in the water overnight for a total of six trap net and four gill net nights. Collected fish were measured for total length (TL) to the nearest millimeter (mm) and weighed to the nearest gram (g). Discussion on selected fish species follows and completes this report.

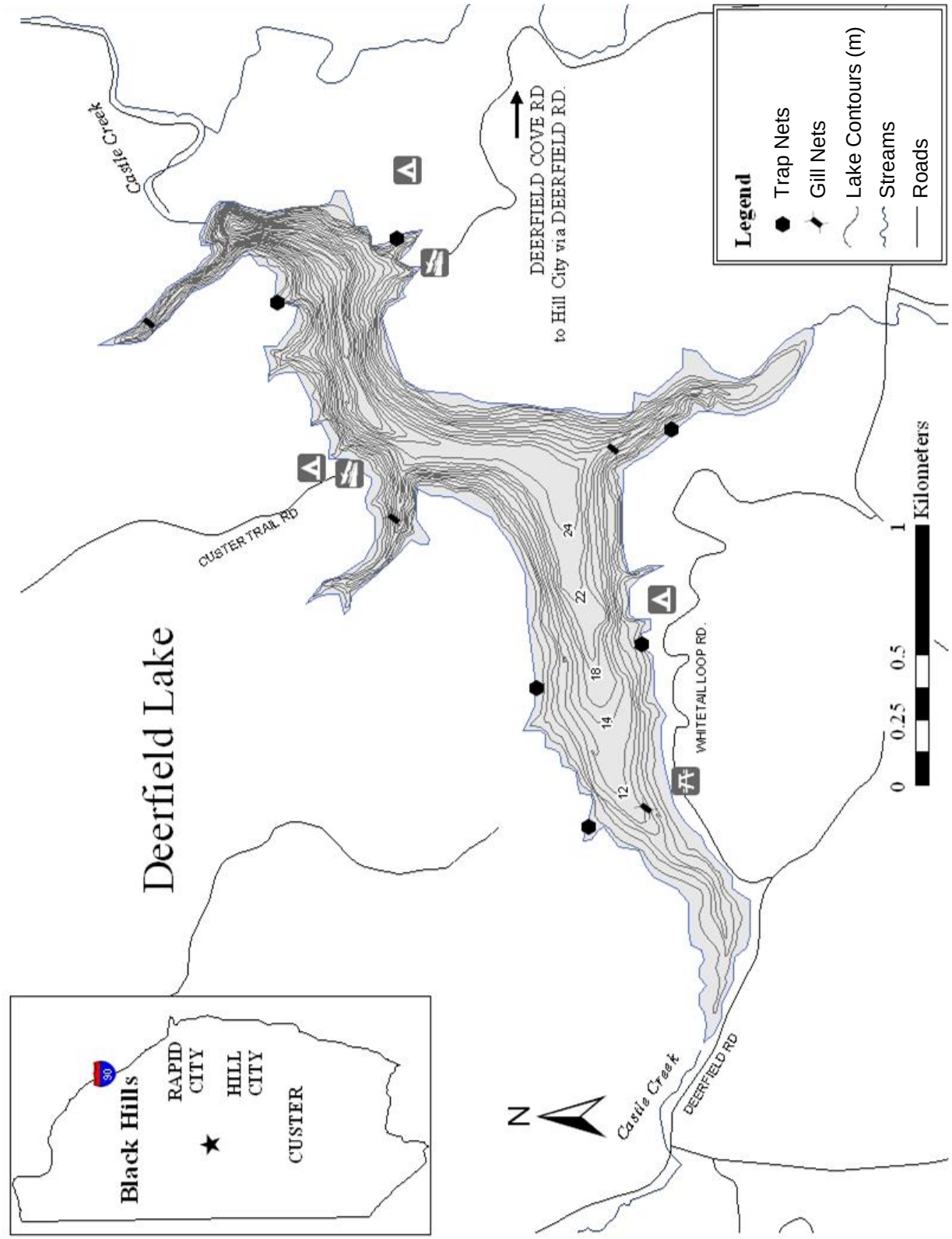

Figure 1. Locations of experimental gill and modified fyke nets during the annual fisheries survey at Deerfield Reservoir, Pennington County, South Dakota, 2012.

Results and Discussion

Six fish species were sampled in experimental gill nets and five species in trap nets totaling 400 and 480 fish captured, respectively (Tables 1 and 2). Rock Bass continued to be the most abundant species sampled in trap nets, while Yellow Perch were the most abundant in gill nets.

Table 1. Species, number sampled (N), mean catch per unit effort (CPUE), proportional stock density (PSD), mean proportional stock density of preferred length fish (PSD-P) and mean relative weight of fish stock length or greater (*Wr*≥S) from species sampled in experimental gill nets in Deerfield Reservoir, Pennington County, South Dakota, 2012. CPUE values with 80% confidence intervals in parentheses. PSD and *Wr* ≥S values with 90% confidence intervals in parentheses.

Species	N	CPUE	PSD	*Wr*≥S
Golden Shiner	6	1.5 (2.4)	-	-
Splake Trout	32	8.0 (9.2)	-	
Rainbow Trout	17	4.2 (1.9)	0	65.5 (2.2)
Rock Bass	89	22.3 (20.1)	0	74.2 (0.4)
White Sucker	29	7.2 (6.4)	100	99.1 (1.6)
Yellow Perch	227	56.8 (92.9)	26 (5)	83.3 (0.5)
Total	400	99.2		

Table 2. Species, number sampled (N), mean catch per unit effort (CPUE), proportional stock density (PSD), mean proportional stock density of preferred length fish (PSD-P) and mean relative weight of fish stock length or greater (*Wr*≥S) from species sampled in modified fyke nets in Deerfield Reservoir, Pennington County, South Dakota, 2012. CPUE values with 80% confidence intervals in parentheses. PSD and *Wr* ≥S values with 90% confidence intervals in parentheses.

Species	N	CPUE	PSD	Wr≥S
Golden Shiner	12	2.0 (1.9)	-	-
Rainbow Trout	3	0.5 (0.5)	100	59.5 (11.6)
Rock Bass	251	41.8 (23.2)	3 (2)	76.7 (1.0)
White Sucker	99	16.5 (9.5)	96 (3)	94.6 (0.6)
Yellow Perch	115	19.2 (19.2)	16 (6)	82.9 (0.4)
Total	480	53.7		

Rainbow Trout

Catchable (279-381 mm) Rainbow Trout are stocked into Deerfield Reservoir at a rate of approximately 2,000 per month from May through October (Table 3). Survey catch per unit effort (CPUE) and relative weight (*Wr*) are often influenced by the presence of hatchery-reared Rainbow Trout present in the survey. Seventeen Rainbow Trout were collected from experimental gill nets during the 2012 survey. This is slightly less than the 24 that were collected in 2011. Mean Rainbow Trout *Wr* declined from 75 in 2011 to 65.5 in 2012. Length frequencies (Figure 2) indicated a size structure consistent with the length of hatchery-reared catchable fish, showing that most are between 280 mm and 360 mm (11-14 in); however, four were under 280 mm and two over 360 mm.

A study occurred in 2009-2011 looking at the potential contribution of naturally reproduced Rainbow Trout in Deerfield Reservoir its primary tributary system, Castle Creek. Stocked Rainbow Trout have received adipose clips since 2008. During the 2012 survey, seven of the 13 fish captured possessed adipose fins. The lack of an adipose clip on a fish indicates it was either stocked prior to August 2008 or is from natural reproduction. Since 2010, almost 50% of the Rainbow Trout captured have been unclipped and are of unknown natal origin.

While carry-over is expected in Deerfield Reservoir, the extent to which it occurs has never been quantified. In many situations, low survival has been exhibited by hatchery-reared Rainbow Trout in the wild (Vincent 1975; 1987; Marchetti and Nevitt 2003; Rikardson and Sandring 2006). While carry-over has been exhibited in Deerfield Reservoir through the return of Passive Integrated Transponders (PIT) tags by anglers from harvested hatchery-reared Rainbow Trout, the extent of carryover has not been quantified. These tagged fish were part of the study looking at natural reproduction and were stocked May-October 2010. Their availability in the fishery for a period of up to 18 months post-stocking may indicate a need to better evaluate carry-over by stocked fish within the reservoir.

Table 3. Stocking history, including number stocked (# stocked), number sampled (N), mean catch per unit effort (CPUE), and mean relative weight (*Wr*) from experimental gill net surveys of Rainbow Trout in Deerfield Reservoir, Pennington County, South Dakota, 2004-2012.

Year	# stocked	N	CPUE (80%CI)	*Wr*
2004	12,010	86	21.5 (9.3)	75.6
2005	12,010	64	16.0 (12.0)	74.2
2006	12,124	77	19.3 (13.6)	74.2
2007	8,400	71	17.8 (8.6)	67.0
2008	12,280	53	13.3 (5.3)	79.1
2009	11,883	17*	8.5 (7.7)	81.9
2010	11,864	30	7.5 (5.4)	69.1
2011	12,000	23	5.7 (6.0)	74.9
2012	12,500	17	4.2 (1.9)	65.5

*Only 2 gillnets were set and in different locations than previous years.

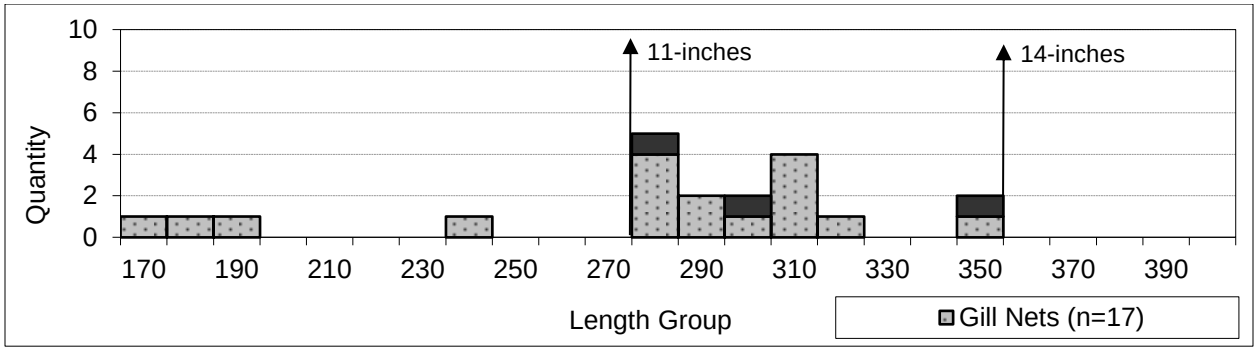

Figure 2. Length frequency histogram for Rainbow Trout collected from Deerfield Reservoir, Pennington County, South Dakota, 2012.

Rock Bass

In 2008, trap nets were added to the annual sampling to more effectively sample the fish assemblage. In 2012, Rock Bass were the most numerous species captured comprising 24% and 78% of the fish caught in experimental gill nets and trap nets, respectively. Mean CPUE declined to 41.8 in 2012 from 152.5 in 2011 (Table 5). Size structure indicated most of these fish were between 80 mm and 140 mm (3 in - 5 in), putting them at less than quality length (180 mm or 7 in). Mean *Wr* was 74 for gill nets (Table 4) and 77 for trap nets (Table 5), which indicates poor condition and may indicate intraspecific competition.

Angler complaints have resulted in the removal of Rock Bass, which has occurred concurrently with White Sucker removal and Yellow Perch trap and transfer. All Rock Bass captured during the annual lake survey are disposed of as well. Additional removals were also conducted by boat electrofishing in late summer 2011 and 2012, with over 1,000 removed each time. Discussion is ongoing to develop a solution to the overabundance of Rock Bass in Deerfield Reservoir.

Table 4. Number sampled (N), mean catch per unit effort (CPUE), proportional stock density (PSD) and mean relative weight for stock length and greater (*Wr*≥S) for Rock Bass collected with experimental gill nets from Deerfield Reservoir, Pennington County, South Dakota, 2007-2012. CPUE values with 80% confidence intervals in parentheses. PSD and *Wr* ≥S values with 90% confidence intervals in parentheses.

Year	N	CPUE	PSD	*Wr*≥S
2007	137	29.5 (16.4)	0	-
2008	37	9.3 (6.7)	0	80.2 (0.4)
2009	81	40.5 (38.5)	1 (2)	82.3 (1.2)
2010	201	50.2 (62.2)	14 (4)	86.0 (2.2)
2011	64	16.0 (10.8)	0	79.7 (1.1)
2012	89	22.3 (20.1)	0	74.2 (0.4)

Table 5. Number sampled (N), mean catch per unit effort (CPUE), proportional stock density (PSD) and mean relative weight for stock length and greater (*Wr*≥S) for Rock Bass surveyed with modified fyke nets in Deerfield Reservoir, Pennington County, South Dakota, 2007-2012. CPUE values with 80% confidence intervals in parentheses. PSD and *Wr* ≥S values with 90% confidence intervals in parentheses.

Year	N	CPUE	PSD	*Wr*≥S
2008	1,060	212.0 (126.3)	1 (2)	80.2 (0.4)
2009	449	112.3 (57.6)	6 (10)	79.9 (1.5)
2010	445	111.0 (54.7)	0	82.0 (2)
2011	915	152.5 (47)	2 (1)	78.5 (1)
2012	251	41.8 (23.2)	3 (2)	76.7(1.0)

Brook Trout and Splake Trout

Splake Trout are a hybrid between Brook Trout and Lake Trout. Initial stockings in the 1990s involved fingerlings, but recent stockings in 2006 and 2012 have utilized advanced fingerlings. In 2012, stocked Splake Trout were adipose clipped to identify them from other Splake Trout already occurring in the lake. Thirty-two fish identified as Splake Trout or Brook Trout were captured in during the 2012 gill net survey (Table 1 and Table 6). No clips have been observed since 2007 and all fish surveyed in 2012 were 130-290 mm (5-11 in) in length indicating no fish from the 2006 stocking were found.

In recent years, some fish caught in gill nets have been difficult to differentiate between Brook Trout and possibly naturally produced Splake Trout. Morphological characteristics, as well as meristic counts, have made distinguishing between the two species difficult. During the 2010 survey, all but 3 of these fish were identified as Brook Trout, while in 2012 they were all identified as possibly Splake Trout because of their intermediate appearance. The small size of individuals and lack of fin clips seems to suggest that Splake Trout may be crossing back with Brook Trout or naturally reproducing with other Splake Trout in the system. A research study including genetics identification is being considered to determine the reproductive contribution of the species. This would be important in correctly identifying fish in annual surveys, as well as potential state record individuals.

Table 6. Year, number of catchable Splake Trout stocked (# stocked), number sampled (N), mean experimental gill net catch per unit effort (CPUE) and mean total length (TL; mm) for Deerfield Reservoir, Pennington County, South Dakota, 2004-2012. CPUE values with 80% confidence intervals in parentheses.

Year	# Stocked	N	CPUE	TL
2004	0	44	11.0 (6.3)	271
2005	0	26	6.5 (2.2)	247
2006	7,164	78	19.5 (10.8)	247
2007	0	48	12.0 (6.0)	264
2008	0	84	21.0 (5.5)	271
2009	0	16	8.0 (12.3)	322
2010	0	2	0.5 (0.8)	-
2011	0	30	7.5 (6.2)	227
2012*	0	32	8.0 (9.2)	214

*5,853 Splake Trout were stocked after sampling

White Sucker

White Sucker densities appeared to increase dramatically in the late 1990s. To reduce the density of White Suckers, removal efforts were conducted from 1999 to 2001, 2006-2009, and 2012 using trap nets during the spring spawning period (Table 7). The removals appeared to lower densities as experimental gill net catch did decrease immediately following removals. White Suckers will not be targeted for removals next year as catch rates were less than 30 individuals per net, however, individuals caught will be removed during any future Yellow Perch trap and transfer and Rock Bass removals.

Size structure of White Suckers appears to have increased in recent years with mean proportional stock density of preferred length fish (PSD-P) values of 40 in 2001 to almost 100

since 2008 (Figure 3). In 2012, the majority of fish were over memorable length (410 mm or 16 in) with a proportional stock densisty of memorable sized fish (PSD-M) value of 81 and an mean total length of 433mm (17 in). Condition also increased in 2009-2011 with a mean for stock length and larger fish (*Wr*≥S) of around 100 (Table 7), but decreased to 94.6 in 2012.

While future White Sucker removals may be necessary to keep numbers down, values from this survey suggest the population is maintaining a low density with reduced recruitment. It is possible this is a result of Rock bass and Yellow perch populations displaying a predatory pressure on juvenile White Suckers.

Table 7. Year, estimated number and pounds of White Suckers removed by modified fyke nets and mean catch per unit effort (CPUE), proportional stock density (PSD) and relative weight for stock length and greater White Sucker (*Wr*≥S) collected during experimental gill net surveys from Deerfield Reservoir, Pennington County, South Dakota, 1999-2012. CPUE values with 80% confidence intervals in parentheses

Year	Number Removed	Pounds Removed	CPUE	PSD	*Wr*≥S
1999	3,136	4,504	85.5 (--)	-	-
2000	9,571	13,400	52.8 (--)	-	-
2001	4,355	5,401	46.5 (29.0)	89	-
2002	0	0	22.3 (14.0)	99	-
2003	0	0	26.8 (23.1)	100	-
2004	0	0	36.3 (14.0)	100	89.8
2005	0	0	35.0 (18.3)	99	90.7
2006	9,020	14,432	25.8 (13.5)	94	89.3
2007	1,064	1,809	15.8 (13.5)	95	93.4
2008	4,706	8,000	11.0 (7.8)	100	94.7
2009	1,500	2,600	24.0 (49.2)	100	101.0
2010	0	0	23.8(22)	100	100.0
2011	0	0	7(5.2)	96	99.6
2012	~500	NA	16.5(9.5)	96	94.6

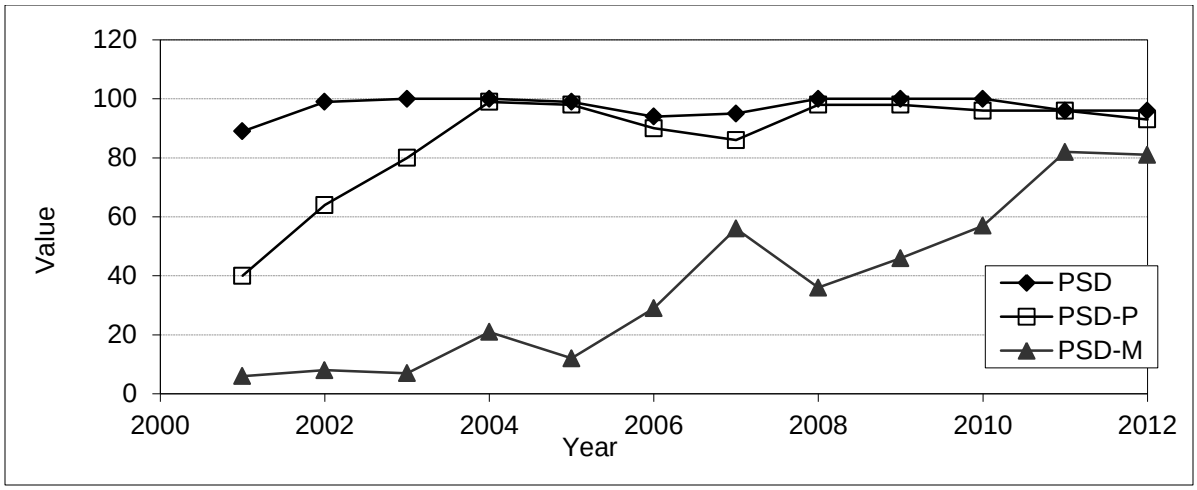

Figure 3. Proportional stock densities of stock (PSD), preferred (PSD-P) and memorable (PSD-M) of White Suckers sampled in experimental gill net surveys from Deerfield Reservoir, Pennington County, South Dakota, 2001-2012.

Yellow Perch

Yellow Perch densities continue to increase in Deerfield Reservoir. Gill net CPUE has increased from 3 in 2003 to 75 in 2010 and 57 in 2012 (Table 8). Some of the decrease in 2011 could be due to placement of nets, specifically a change in depth. In 2012, mean *Wr* was 83.3 and has decreased since 2010, The low PSD value of 26 and *Wr* of 83 likely indicate a population experiencing slow growth due to overabundance or competition with other species (i.e. Rock Bass and hatchery-reared Rainbow Trout).

The Yellow Perch population appears to have become established. Length-frequency indicates most fish 150 mm to 200 mm (six to eight inches) with few larger than that and possibly three year classes (Figure 4). In recent years, Deerfield Reservoir has been a source for Yellow Perch trap and transfer. Over 5,000 were relocated to other aquatic systems in early May 2012.

Table 8. Number captured (N), mean catch per unit effort (CPUE), proportional stock density (PSD) and mean relative weight of stock length and greater (*Wr*>S) Yellow Perch from experimental gill nets surveys from 2003-2012 in Deerfield Reservoir, Pennington County, South Dakota. CPUE values with 80% confidence intervals in parentheses. PSD and *Wr* ≥S values with 90% confidence intervals in parentheses.

Year	N	CPUE	PSD	*Wr*>S
2003	12	3.0 (4.9)	33 (26)	83.7 (2.2)
2004	2	0.5 (0.8)	--	80.3 (19.9)
2005	24	6.0 (3.9)	38 (18)	86.7 (1.7)
2006	31	7.8 (6.3)	35 (--)	88.4 (2.0)
2007	155	38.8 (38.0)	20 (6)	90.0 (1.4)
2008	241	60.3 (59.0)	23 (5)	92.4 (0.1)
2009	125	62.5 (81.6)	55 (10)	91.0 (1.1)
2010	300	75.0 (76.0)	39 (5)	92.0 (2.0)
2011	31	7.8 (8.8)	39 (0)	89.7 (2.4)
2012	227	56.8 (92.9)	26 (5)	83.3 (0.5)

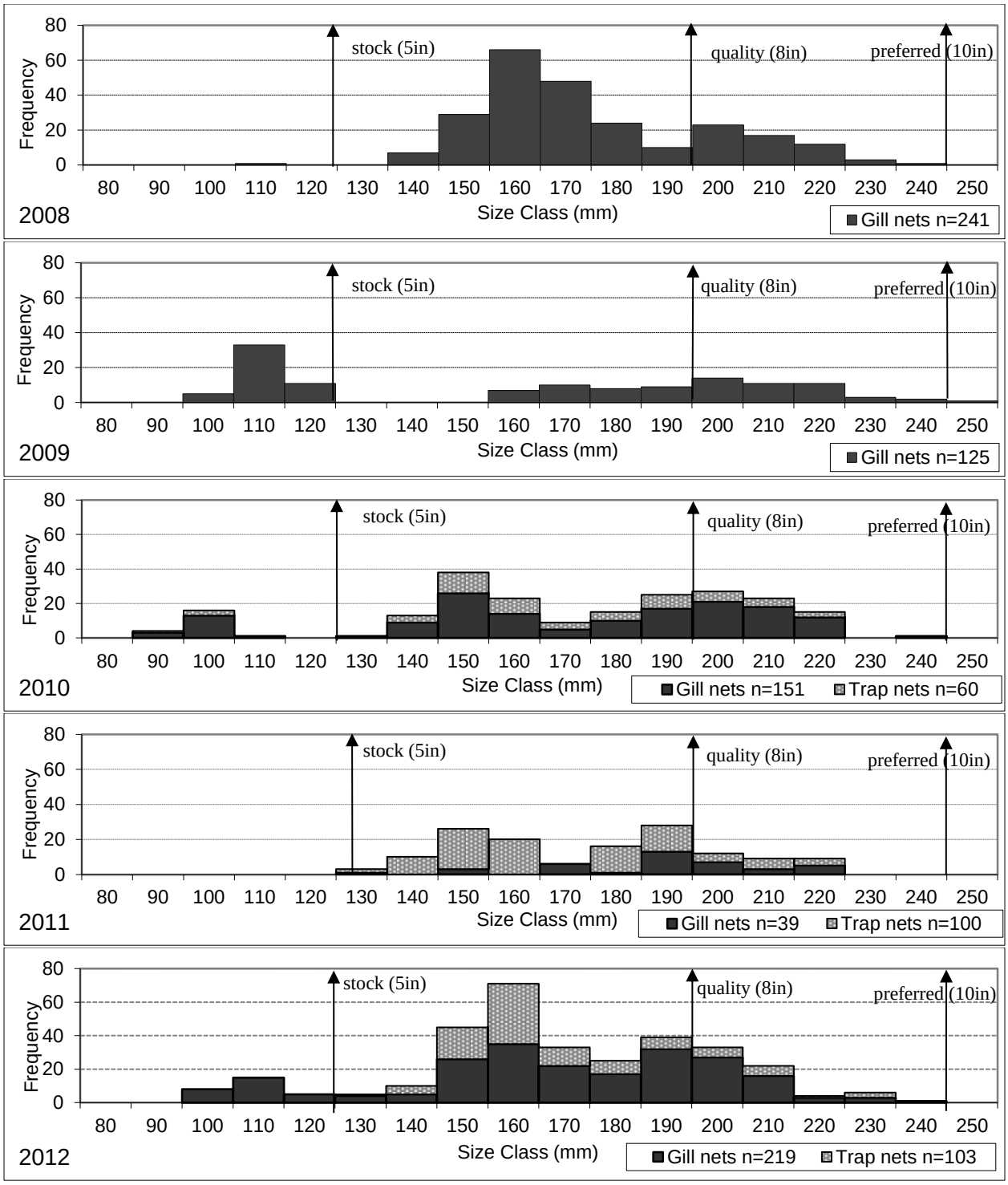

Figure 4. Length frequency histograms for Yellow Perch collected in experimental gill net and modified fyke (trap) net surveys from Deerfield Reservoir, Pennington County, South Dakota, 2008-2012.

LITERATURE CITED

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RECOMMENDATIONS

1. Stock catchable Rainbow Trout to keep the trout catch and harvest successful.

2. Complete standard lake surveys annually to continue monitoring Rock Bass, Yellow Perch, Splake Trout and White Sucker numbers, condition, and size structure, and monitor Rainbow Trout sizes and clipped fins for hatchery vs. natural fish.

3. White Sucker CPUE trends seem to decrease with removals. Consider annual spring removal of White Suckers when gill net CPUS exceeds 30.

4. Attempt Rock Bass removals by electrofishing and/or trap netting.

APPENDIX

Appendix A. Stocking history, including year, number stocked, species and size of fish stocked for Deerfield Reservoir, Pennington County, South Dakota, 1997-2012.

Year	Number	Species	Size
1999	120,000	Rainbow Trout	fingerling
	2,538	Rainbow Trout	catchable
	23,373	Splake Trout	fingerling
2000	120,000	Rainbow Trout	fingerling
	2,125	Rainbow Trout	catchable
	210	Rainbow Trout	catchable
2001	60,612	Rainbow Trout	fingerling
	7,219	Rainbow Trout	catchable
2002	60,000	Rainbow Trout	fingerling
	10,164	Rainbow Trout	catchable
	307	Rainbow Trout	catchable
2003	350	Rainbow Trout	catchable
	8,409	Rainbow Trout	catchable
	60,625	Rainbow Trout	fingerling
2004	10	Rainbow Trout	catchable
	12,000	Rainbow Trout	catchable
2005	12,000	Rainbow Trout	catchable
2006	12,124	Rainbow Trout	catchable
	7,124	Splake Trout	catchable
2007	8,400	Rainbow Trout	catchable
2008	12,280	Rainbow Trout	catchable
2009	11,883	Rainbow Trout	catchable
2010	11,864	Rainbow Trout	catchable
2011	12,000	Rainbow Trout	catchable
2012	12,500	Rainbow Trout	catchable
	5,853	Splake Trout	advanced fingerling