Pine Ridge Indian Reservation: 2012 Fisheries Survey Report

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

The Pine Ridge Indian Reservation, located in southwest South Dakota, was established in 1889 and currently comprises approximately 648,000 ha (1.6 million acres). The land is primarily located within Shannon, Jackson, and Bennett counties, SD and a small portion in Sheridan County, NE. The general terrain on Pine Ridge consists of rolling grassland prairie and deep canyons while the northern portion of the reservation consists mainly of badlands. The region is semi-arid with temperatures that range from more than 38^{o}C (100°F) in the summer to -40^{o}C (-40°F) in the winter. The growing season averages 130 days and average rainfall is 41 cm (16 in).

Three primary watersheds are located on the Pine Ridge Indian Reservation that includes the Cheyenne, White, and Little White rivers (Figure Introduction-1). The Cheyenne River borders the northwest corner of the Reservation and drains the badlands. The White River is largest watershed and has numerous intermittent tributaries, which drains the highly erodible badlands and carries much sediment. The Little White River originates in the sandhills and flows eastward across the southeast corner of the reservation.

Most streams on the reservation are low gradient, silt laden, and generally unsuitable for game fish. However, these streams contain numerous native cyprinids and catostomids. A few streams originate in the sandhills (e.g. Denby creek) or in pine covered canyons (e.g. No Flesh Creek and Corn Creek); these are relatively clear, cool, and have maintained stocked trout populations on occasion.

Currently, most game fish populations are found in six reservoirs across the reservation including Denby, Kyle, Oglala, White Clay, Wolf Creek, and Yellow Bear reservoirs.

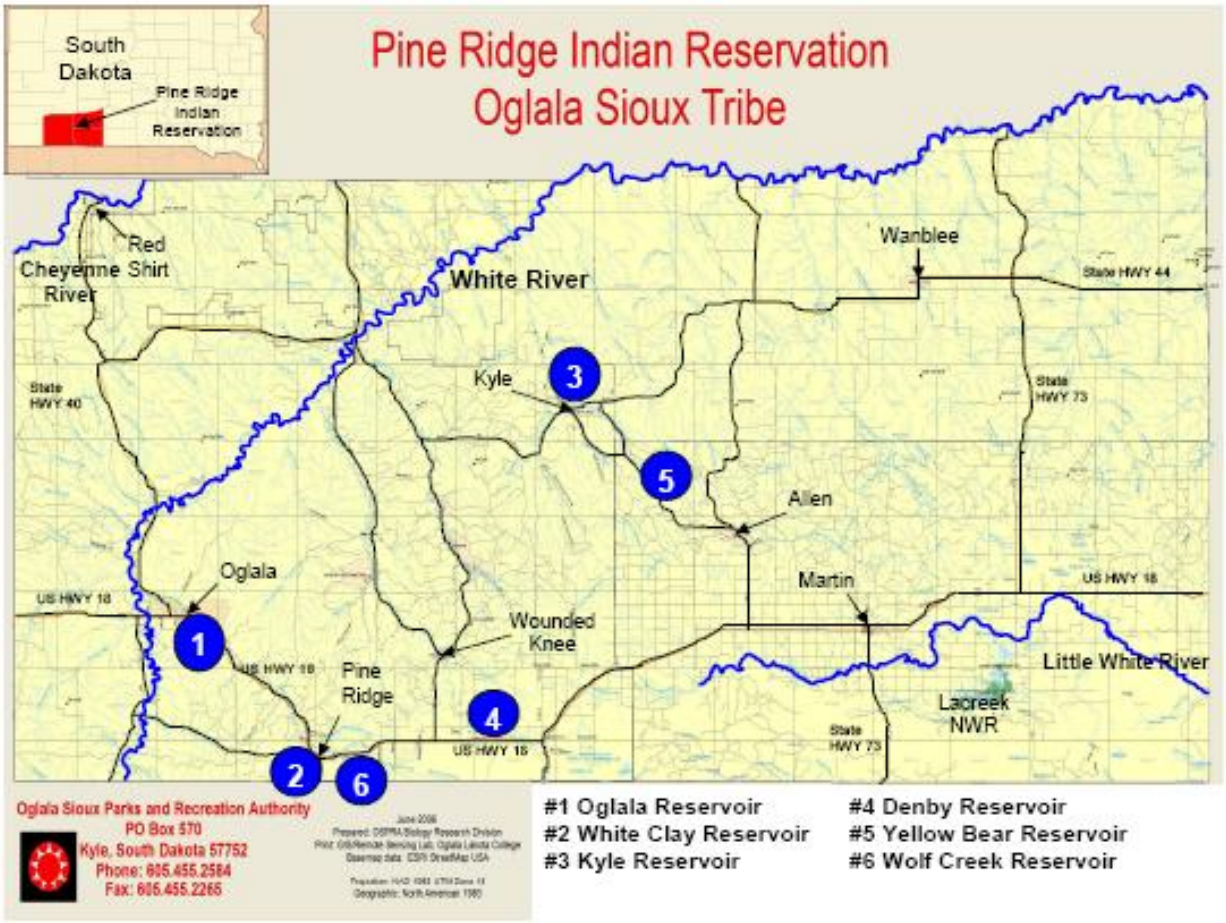

Figure Introduction-1. Map of the Pine Ridge Indian Reservation identifying major rivers and reservoirs managed for recreational fisheries.

GENERAL METHODS

Sampling

Electrofishing is the primary method for collecting fisheries information from reservoirs in Pine Ridge. Electrofishing was conducted at both night and day from a boat using a Smith Root model 5.0 GPP electrofishing system rated at 5,000 watts of output power and 4–6 amps pulsed DC (60 pulses per second). Electrofishing was typically conducted in 10 minute transects along the shoreline. All fish species captured were measured for total length (TL, mm) and weighed (g). A list of common names, scientific names, and acronyms for fish in this report is reported in Appendix 1.

Effort

Denby, Oglala, and White Clay reservoirs were surveyed in 2012 (Table Introduction-1). Oglala and White Clay were surveyed at night on 26 June and Denby was surveyed during the day on 9 August.

Table Introduction-1. Total effort by gear in reservoirs sampled on the Pine Ridge Indian Reservation during 2012.

Lake	Electrofishing transects (n)	Electrofishing (minutes)	Survey time
Denby	2	20	day
Oglala	6	65	night
White Clay	3	30	night (1) / day (2)

Analyses

Catch per unit effort (*C/f*) was assessed with number of fish (by species) per electrofishing hour. Size structure was assessed using stock indices (i.e., proportional size distribution) and length frequency histograms. Length categories and references used for stock indices are reported in Appendix 2-1. Condition of fish was assessed using relative weight (W_r). Standard weight (Ws) parameters and sources are reported in Appendix 2-2.

Water Quality

Surface water quality was measured at one site in each reservoir at the time of each survey. Water temperature (^{o}C), dissolved oxygen (mg/L), pH, and conductivity (µS/cm) were measured with a HACH HQ40d multi-parameter meter (HACH, Loveland, CO, USA). Phenolphthalein alkalinity (mg/L) and total alkalinity (mg/L) were measured with a HACH water quality test kit. Turbidity was quantified using a HACH 2100P Turbidometer.

DENBY RESERVOIR

Lake Description

Denby Reservoir (Figure Denby-1; 43.053867, -102.316683) is located 32 km east of Pine Ridge and approximately 1.6 km north of U.S. Highway 18 (Figure Introduction-1). At full pool, Denby has a surface area of 8 ha (20 ac), an average depth of 3.0 m (9.8 ft), and a maximum depth of 5.0 m (16.4 ft). Denby Creek is the primary water source for the reservoir, but a small, intermittent unnamed creek on the southwest corner contributes during precipitation events. A 33 m (108 ft) earthen dam across Denby Creek contains water in the impoundment. The dam has one box-type, fixed crest spillway and a screw gate that allows for complete water draw down.

The reservoir bottom is primarily composed of fine silt and organic matter with an area of gravel on the southeast corner. Emergent vegetation present in Denby Reservoir is cattail *Typha* sp. and softstem bulrush *Scirpus validus*. Submerged vegetation is abundant throughout the reservoir and consists primarily of coontail *Ceratophyllum demersum*. Inundated trees are abundant on the west side. The lake is surrounded by dense vegetation and trees and shows little sign of livestock use.

Access to the reservoir is limited to a dirt road northwest of the lake. The lake is used primarily for recreation, but the surrounding watershed is used for livestock grazing. A small housing development lies near the southwest corner.

The reservoir was chemically renovated and restocked in 1955, 1958, 1964, and 1971 in an attempt to control green sunfish and white sucker. Attempts to stock catchable size trout have had little to no success likely due to high summer water temperatures. Previous fisheries surveys were conducted in 1996, 2008, and 2010.

Primary sport fish in Denby Reservoir are bluegill, largemouth bass, northern pike, and yellow perch. Golden shiners are also present.

Figure Denby-1. Denby Reservoir on the Pine Ridge Indian Reservation, SD. The white lines indicate electrofishing transects in 2012. (Image credit: http://www.bing.com/maps)

Results and Discussion

Water quality

Table Denby-1. Surface water quality values from Denby Reservoir, Pine Ridge Indian Reservation from 2008 to 2012.

Year	Temp. (°C)	Dissolved oxygen (mg/L)	pH	Pheno. alkal. (mg/L)	Total alkal. (mg/L)	Conduc-tivity (µS/cm)	Tur-bidity (NTU)
2012	28.0	20.0	10.0	34	137	273	27
2010	24.0	18.4	9.7	34	68	254	.
2008	22.5	12.2	.	34	137	220	.

Bluegill

The relative abundance of bluegill in Denby Reservoir has increased nearly three fold since 2008 (Figure Denby-2). The size structure has not improved much, although more fish > 150 mm are now present (Figure Denby-3). Growth appears to be very slow. Bluegill condition was very good (>115; Figure Denby-4).

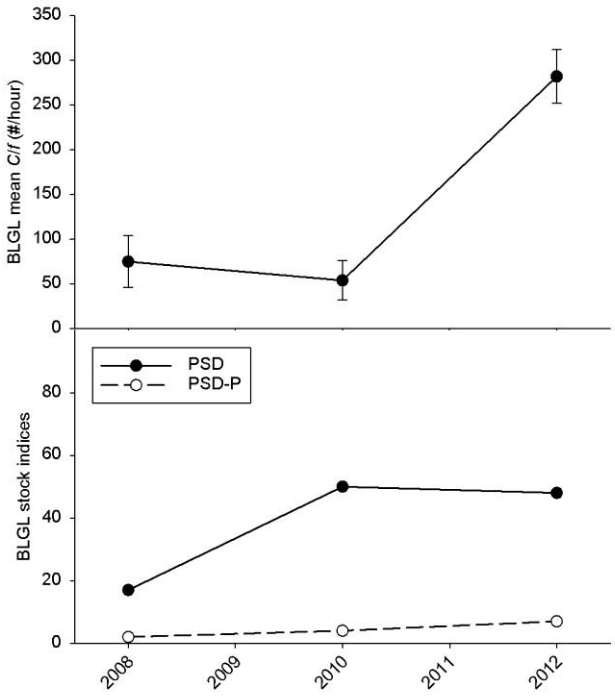

Figure Denby-2. Mean relative abundance ($C/f \pm 1$ SE; top panel) and stock indices (bottom panel) of bluegills caught by electrofishing in Denby Reservoir from 2008 to 2012.

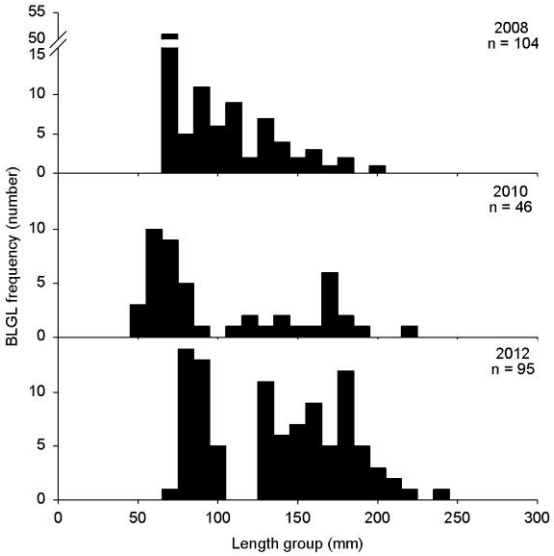

Figure Denby-3. Length frequency histograms (10 mm groups) of bluegill caught by electrofishing in Denby Reservoir from 2008 to 2012.

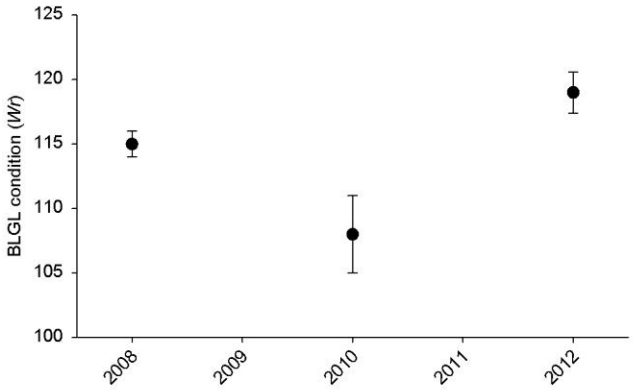

Figure Denby-4. Mean condition (*Wr*) of bluegill caught by electrofishing in Denby Reservoir from 2008 to 2012. Error bars represent ± 1 SE.

Largemouth bass

Mean relative abundance of largemouth bass in 2012 (*C*/*f* = 18/hour) was similar to 2008 (*C*/*f* = 15/hour; Figure Denby-5). Stock indices are satisfactory (Figure Denby-5), but abundance is low, so this should be interpreted with caution. The length frequency histogram suggests that some reproduction and recruitment are likely occurring (Figure Denby-6). Condition was again excellent (*Wr* > 120; Figure Denby-7).

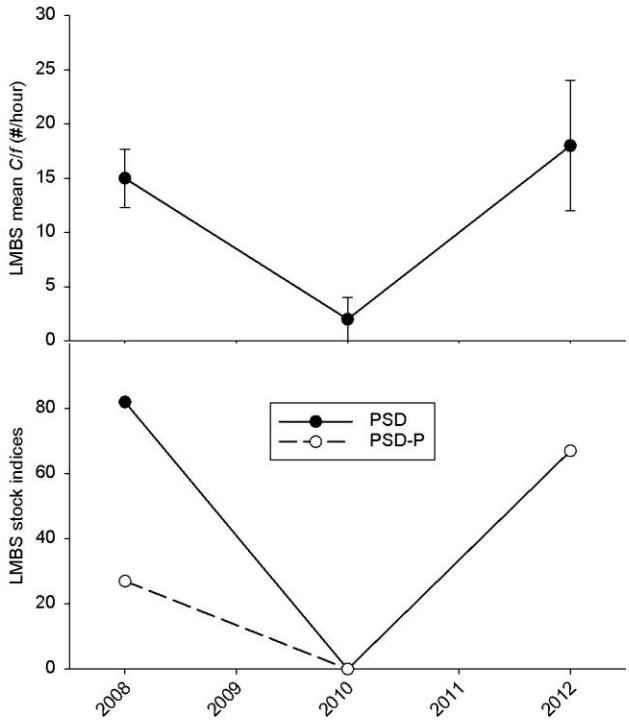

Figure Denby-5. Mean relative abundance (*C/f* ± 1 SE; top panel) and stock indices (bottom panel) of largemouth bass caught by electrofishing in Denby Reservoir from 2008 to 2012.

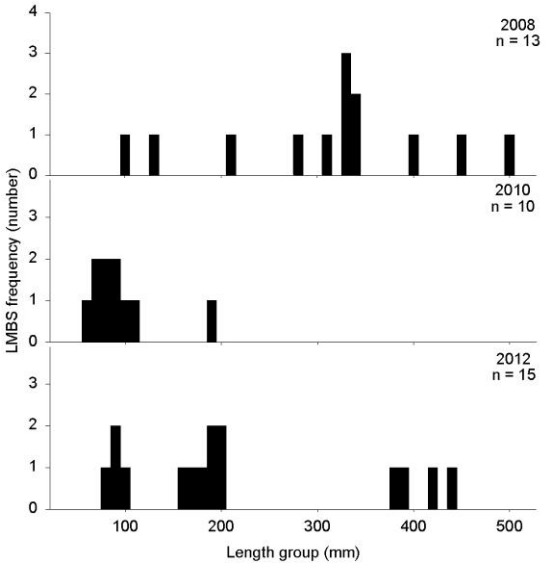

Figure Denby-6. Length frequency histograms (10 mm groups) of largemouth bass caught by electrofishing in Denby Reservoir from 2008 to 2012.

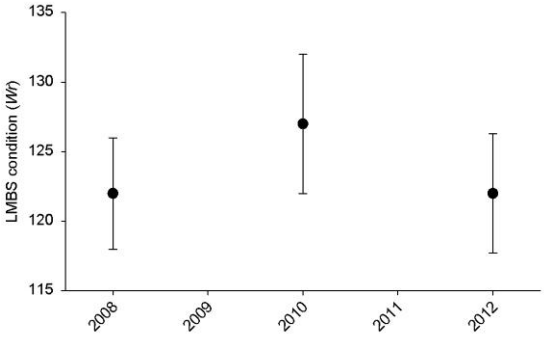

Figure Denby-7. Mean condition (*Wr*) of largemouth bass caught by electrofishing in Denby Reservoir from 2008 to 2012. Error bars represent ± 1 SE.

Northern pike

Only four northern pike (all < 320 mm) were caught during electrofishing in 2012. Northern pike were not caught in 2010, though a few were observed during sampling. Only a few northern pike were measured in 2008, which ranged in size from 74–500 mm, suggesting that recruitment of northern pike in Denby Reservoir is limited.

Yellow perch

Mean relative abundance in Denby Reservoir in 2012 (*C/f* = 327/hour) has more than doubled since 2008 and 2010 (Figure Denby-8). The stock indices and size structure have also shown signs of improvement (Figure Denby-8 and Denby-9). Growth appears to be slow, but if it continues, yellow perch exceeding 250 mm could be possible in the next couple of years. Mean condition (*Wr* > 90) was satisfactory (Figure Denby-10).

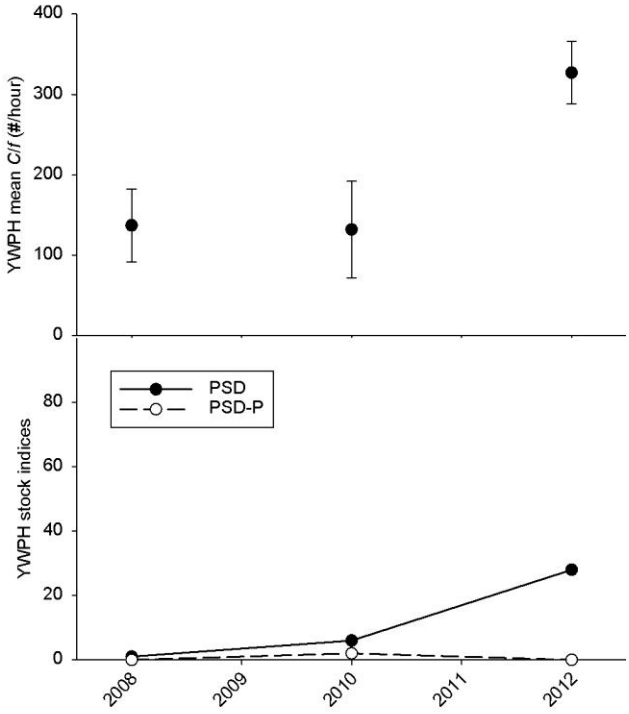

Figure Denby-8. Mean relative abundance (*C/f* ± 1 SE; top panel) and stock indices (bottom panel) of yellow perch caught by electrofishing in Denby Reservoir from 2008 to 2012.

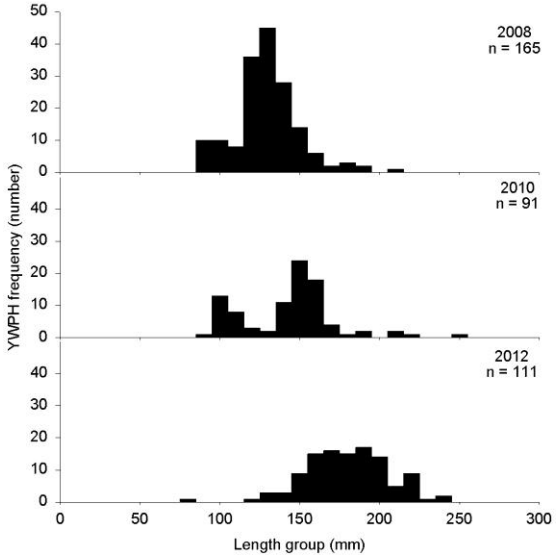

Figure Denby-9. Length frequency histograms (10 mm groups) of yellow perch caught by electrofishing in Denby Reservoir from 2008 to 2012.

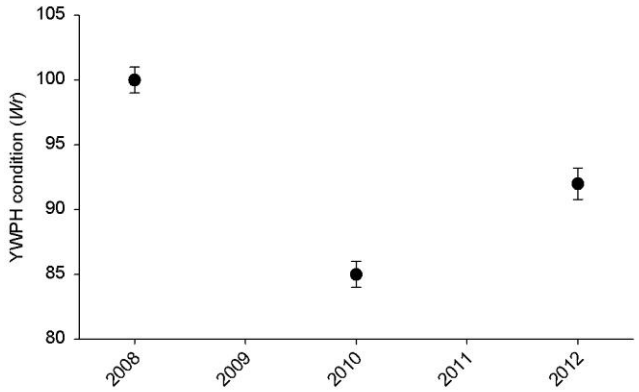

Figure Denby-10. Mean condition (*Wr*) of yellow perch caught by electrofishing in Denby Reservoir from 2008 to 2012. Error bars represent ± 1 SE.

Black bullhead

Similar to 2010, black bullhead were not caught during surveys in 2012. In 2008, a single 220 mm bullhead was captured. If black bullhead are still present in Denby Reservoir, numbers are likely low.

Golden shiner

In 2012, 11 golden shiners were caught that ranged in size from 100–150 mm. Five golden shiners (85–130 mm) were caught in 2010 and 17 were captured in 2008.

Grass pickerel

Grass pickerel were not caught in 2012. One grass pickerel (81 mm) was captured in 2010.

WHITE CLAY RESERVOIR

Lake Description

White Clay Reservoir (Figure White Clay-1; 43.00424, -102.56272) is located on the border of Nebraska and South Dakota north of White Clay, NE and south of Pine Ridge, SD (Figure Introduction-1). At full pool, White Clay has a surface area of 36 ha (90 ac), an average depth of 3 m (9.8 ft), and a maximum depth of 7.0 m (23 ft). The primary water source for the reservoir is White Clay Creek, but one unnamed creek on the southwest corner of the impoundment provides intermittent run-off during spring snow runoff and heavy rain events. The earthen dam and emergency spillway have a screw-gate that allows for manipulation of the water level. The surrounding watershed is steep and rocky with scattered grassland and ponderosa pine *Pinus ponderosa*.

The reservoir bottom is primarily composed of sand, clay, and scattered rock outcrops. White Clay has a large littoral area due to a moderately sloped shoreline. Submerged vegetation is abundant including coontail, milfoil *Myriophyllum sp.*, and pondweeds. During summer, submerged vegetation on the southeast and two small bays on the west typically become too dense for boat use. Emergent vegetation includes cattail, sedges, and bulrush that form a narrow band around most of the impoundment.

Access is limited to one road in South Dakota from the east and one from the south in Nebraska. The area is used primarily for livestock grazing and can often be heavily grazed.

The impoundment was drained for four years to facilitate repairs on the dam during the late 1980s and early 1990s. Within one year of refilling, bluegill, largemouth bass, northern pike, yellow perch, and white sucker were observed during surveys. In 1993, 60 adult largemouth bass were transferred from Yellow Bear Reservoir to White Clay Reservoir and fingerling largemouth bass were stocked during the summer of 1994. The dam had been periodically managed for catchable trout, but success of trout stocking has had limited success.

Primary sport fish in White Clay Reservoir are bluegill, largemouth bass, and yellow perch. Common carp are present.

Figure White Clay-1. White Clay Reservoir on the Pine Ridge Indian Reservation. The white lines indicate electrofishing transects in 2012. (Image credit: http://www.bing.com/maps)

Results and Discussion

Water quality

Table White Clay-1. Surface water quality values from White Clay Reservoir, Pine Ridge Indian Reservation from 2008 to 2012.

Year	Temp. (°C)	Dissolved oxygen (mg/L)	pH	Pheno. alkal. (mg/L)	Total alkal. (mg/L)	Conduc-tivity (µS/cm)	Tur-bidity (NTU)
2012	25.0	9.4	8.6	0	171	406	41
2010	24.1	12.2	8.9	17	153	504	.
2008	23.7	7.6	.	0	188	408	.

Black bullhead

Black bullheads were not observed in 2012 or 2010. In 2008, six black bullheads were caught. If this species is still present in White Clay Reservoir, numbers are likely low.

Bluegill

Mean relative abundance of bluegill in White Clay (C/f = 50/hour) again declined since surveys in 2008 and 2010 (Figure White Clay-2). Stock indices and size structure suggest that the remaining bluegill are slow growing (Figure White Clay-2 and White Clay-3) and have limited recruitment. Bluegill condition (Wr > 100) remains excellent (Figure White Clay-4).

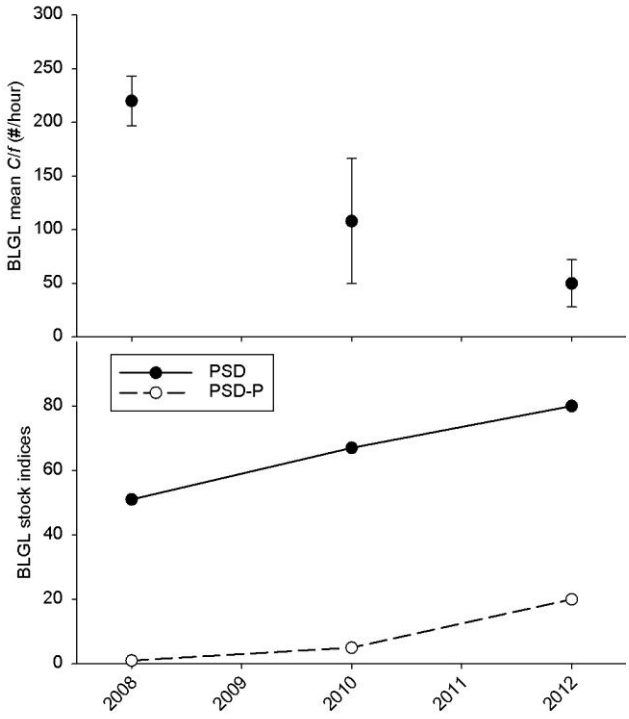

Figure White Clay-2. Mean relative abundance (*C/f* ± 1 SE; top panel) and stock indices (bottom panel) of bluegill caught by electrofishing in White Clay Reservoir from 2008 to 2012.

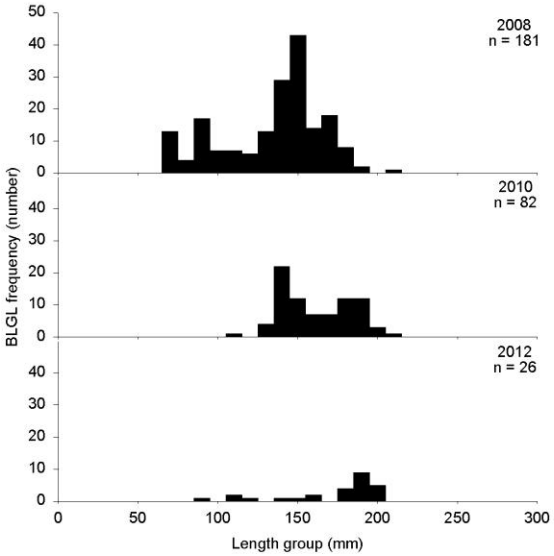

Figure White Clay-3. Length frequency histograms (10 mm groups) of bluegill caught by electrofishing in White Clay Reservoir from 2008 to 2012.

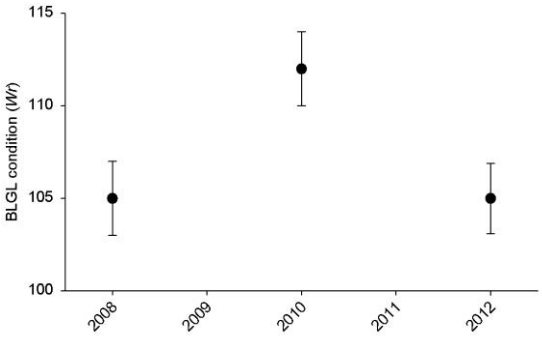

Figure White Clay-4. Mean condition (*Wr*) of bluegill caught by electrofishing in White Clay Reservoir from 2008 to 2012. Error bars represent ± 1 SE.

Common carp

Thirty-five common carp were caught during the 2012 survey. Compared to only one common carp (500 mm) caught in 2010, this catch was a fairly large increase. Mean *C/f* in 2012 was 70/hour (SE=2.0). All of the common carp measured were > 400 mm (Figure White Clay-5).

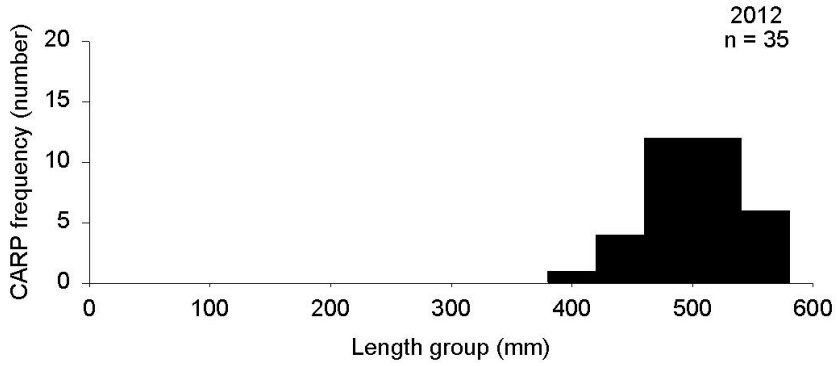

Figure White Clay-5. Length frequency histogram (40 mm groups) of common carp caught by electrofishing in White Clay Reservoir in 2012.

Golden shiner

Although one golden shiner (115 mm) was caught in 2010 and mean *C*/*f* was 24/hour (SE=4.6; n=18) in 2008, zero golden shiners were caught in 2012.

Largemouth bass

Mean relative abundance of largemouth bass (*C*/*f* = 88) was average compared to surveys in 2008 and 2010 (Figure White Clay-6). Stock indices declined some (Figure White Clay-6), but the size structure histogram indicates a good size distribution of largemouth bass (Figure White Clay-7). Mean condition of largemouth bass (*Wr* > 110) is excellent (Figure White Clay-8).

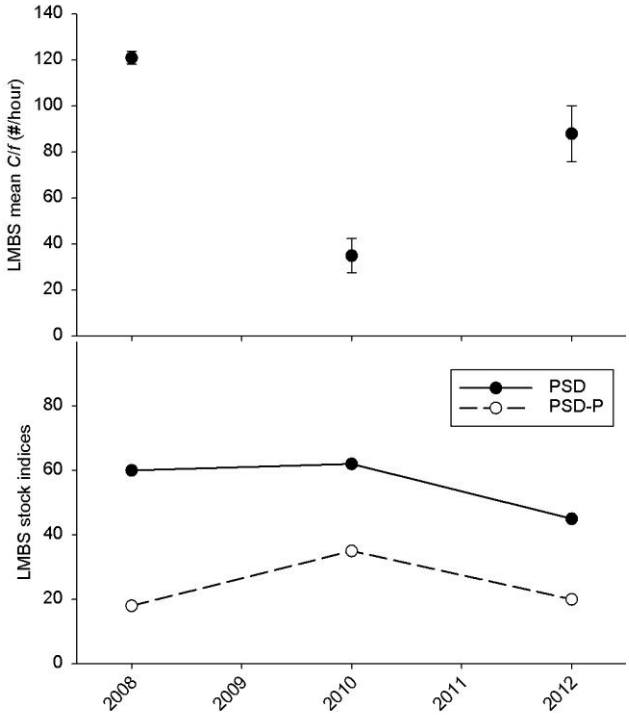

Figure White Clay-6. Mean relative abundance (*C*/*f* ± 1 SE; top panel) and stock indices (bottom panel) of largemouth bass caught by electrofishing in White Clay Reservoir from 2008 to 2012.

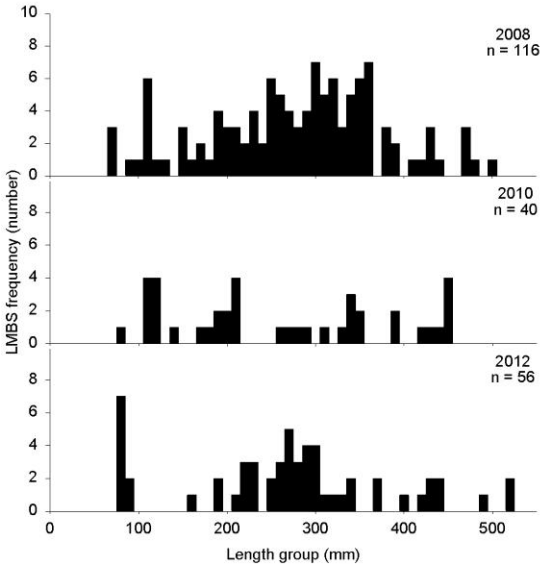

Figure White Clay-7. Length frequency histograms (10 mm groups) of largemouth bass caught by electrofishing in White Clay Reservoir from 2008 to 2012.

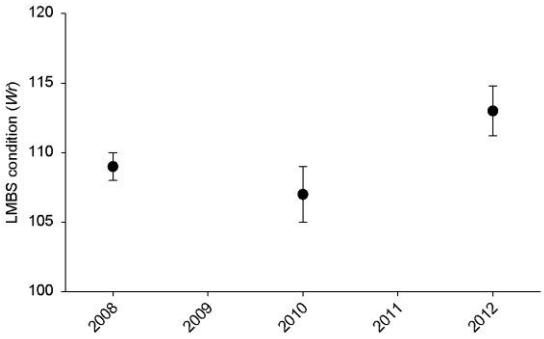

Figure White Clay-8. Mean condition (*Wr*) of largemouth bass caught by electrofishing in White Clay Reservoir from 2008 to 2012. Error bars represent ± 1 SE.

Yellow perch

Mean relative abundance of yellow perch in 2012 was the lowest recorded (*C*/*f* = 26) of the past three surveys (Figure White Clay-9). Stock indices (Figure White Clay-9) and size structure (Figure White Clay-10) information both suggest the yellow perch are growing but reproduction

and recruitment may be limited. Mean condition (*Wr* > 90) is satisfactory (Figure White Clay-11).

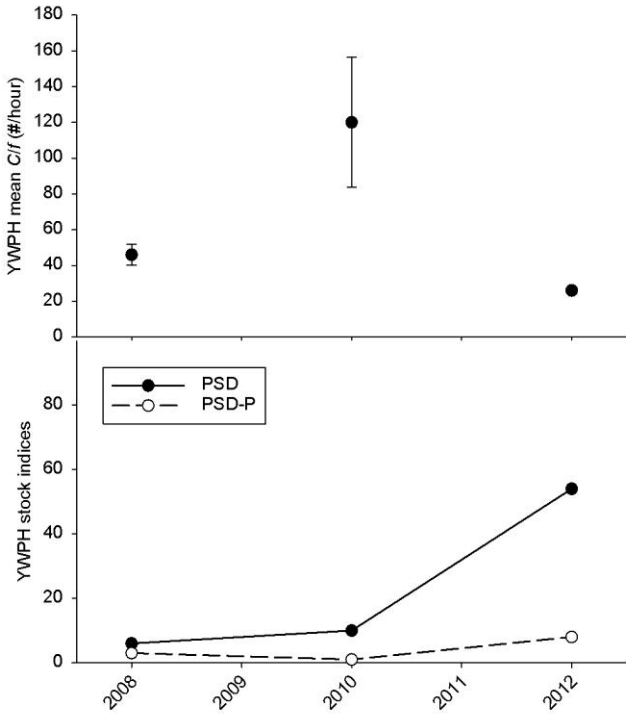

Figure White Clay-9. Mean relative abundance (*C/f* ± 1 SE; top panel) and stock indices (bottom panel) of yellow perch caught by electrofishing in White Clay Reservoir from 2008 to 2012.

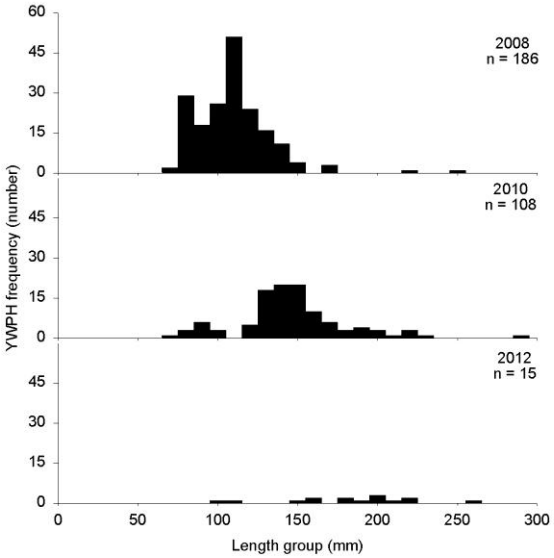

Figure White Clay-10. Length frequency histograms (10 mm groups) of yellow perch caught by electrofishing in White Clay Reservoir from 2008 to 2012.

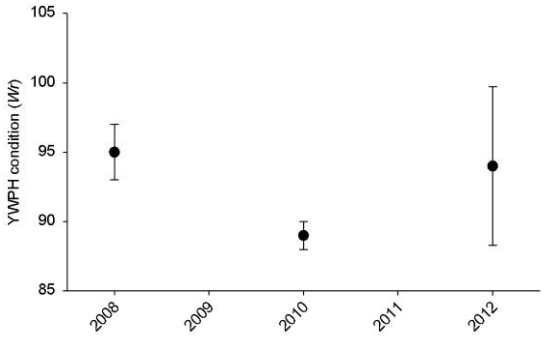

Figure White Clay-11. Mean condition (*Wr*) of yellow perch caught by electrofishing in White Clay Reservoir from 2008 to 2012. Error bars represent ± 1 SE.

OGLALA RESERVOIR

Introduction

Oglala Reservoir (Figure Oglala-1; 43.17891, -102.73895) is located near the city of Oglala, SD (Figure Introduction-1). At full pool, Oglala Reservoir has 283 surface ha (700 ac) and a maximum depth of 6.7 m (22 ft). The primary water source of the reservoir is White Clay Creek. The reservoir bottom is composed mostly of silt and has little aquatic vegetation.

Figure Oglala-1. Oglala Reservoir on the Pine Ridge Indian Reservation. The white lines indicate electrofishing transects in 2012. (Image credit: http://www.bing.com/maps)

Results and Discussion

Water quality

Table Oglala-1. Surface water quality values from Oglala Reservoir, Pine Ridge Indian Reservation in 2009 and 2012.

Year	Temp. (°C)	Dissolved oxygen (mg/L)	pH	Pheno. alkal. (mg/L)	Total alkal. (mg/L)	Conduc-tivity (µS/cm)	Tur-bidity (NTU)
2012	27.3	11.4	8.7	0	171	442	49
2009	23.6	13.5	8.7	0	188	506	.

Black bullhead

Black bullhead numbers have increased since 2009. In 2012, the mean relative abundance (*C*/*f* = 78/hour) was much larger than in 2009 (n = 2; 130 and 150 mm). The size structure of black bullhead in Oglala Reservoir is small (Figure Oglala-2) as PSD was 4 and PSD-P was 0.

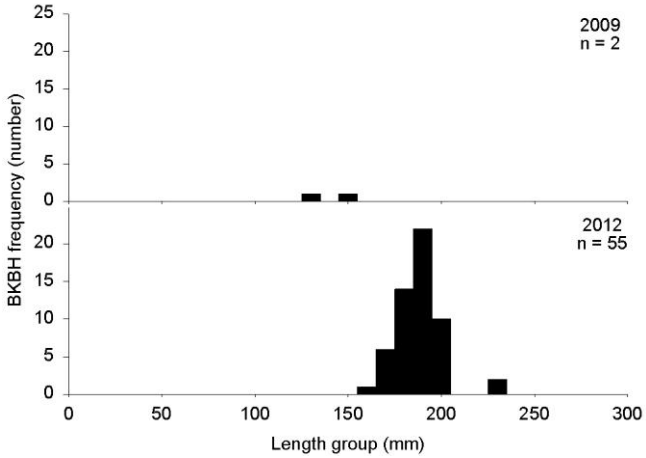

Figure Oglala-2. Length frequency histograms (10 mm groups) of black bullhead caught by electrofishing from Oglala Reservoir in 2009 and 2012.

Common carp

Mean relative abundance of common carp in 2012 (*C*/*f* = 58) was similar to numbers in 2009 (Figure Oglala-3). Individuals in the population are showing signs of growth, but recruitment was not evident by examining length frequency histograms (Figure Oglala-4).

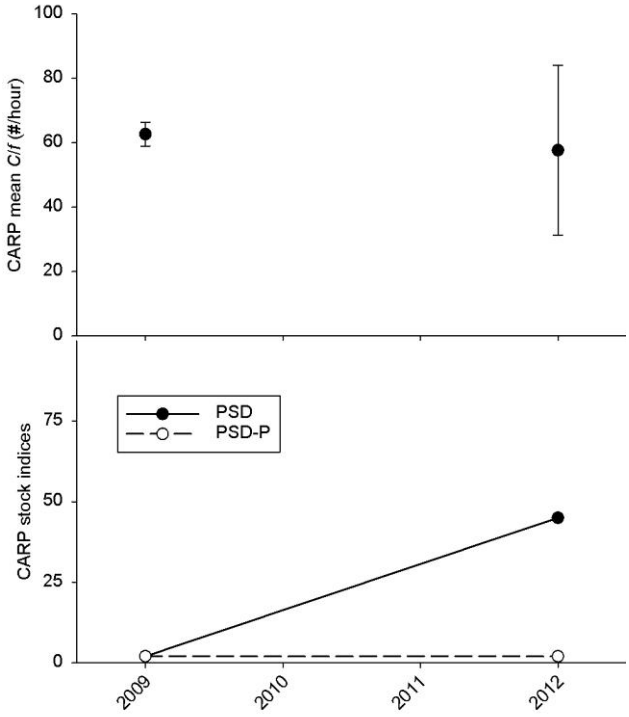

Figure Oglala-3. Mean relative abundance (*C/f* ± 1 SE; top panel) and stock indices (bottom panel) of common carp caught by electrofishing from Oglala Reservoir in 2009 and 2012.

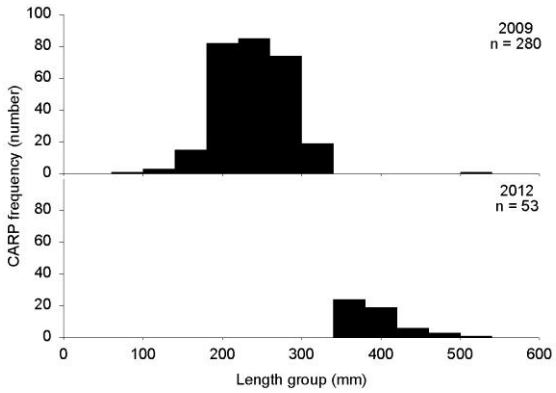

Figure Oglala-4. Length frequency histograms (40 mm groups) of common carp caught by electrofishing from Oglala Reservoir in 2009 and 2012.

Green sunfish

In 2012, 12 green sunfish (length range: 80–160 mm) and one hybrid (146 mm) were caught. Three green sunfish (lengths = 105, 116, and 124 mm) were caught 2009.

Largemouth bass

Approximately 17,000 fingerling largemouth bass were stocked in 2012. Few (n = 4) largemouth bass were caught (186, 372, 382, 392 mm). Mean *C/f* was 3.0 (SE = 2.0), but condition was excellent (*Wr* = 113; SE = 6.5).

Walleye

In 2008, 35,000 walleye fry were stocked in Oglala Reservoir. Data suggests that the stocking had some success. Mean relative abundance increased (Figure Oglala-5), stock indices (Figure Oglala-5), and length frequency histograms (Figure Oglala-6) suggest that walleye have survived, are growing, and are possibly reproducing. Mean condition (*Wr* > 90) is adequate (Figure Oglala-7).

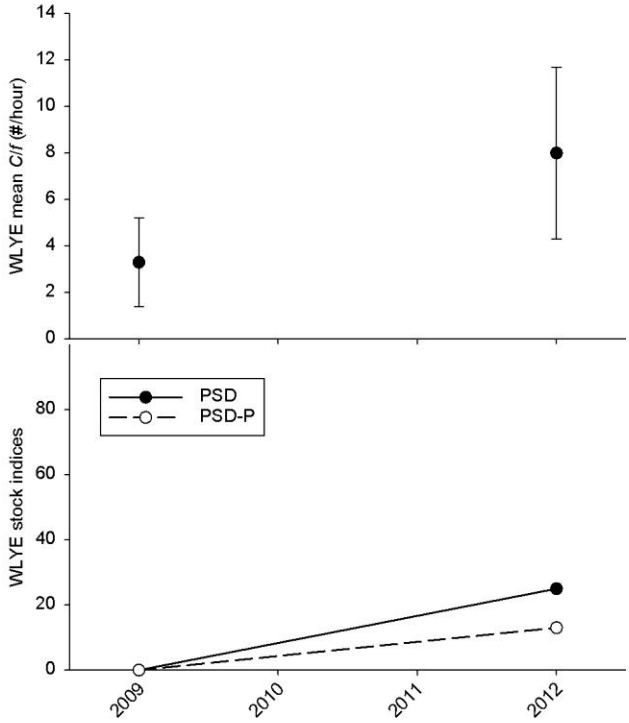

Figure Oglala-5. Mean relative abundance (*C/f* ± 1 SE; top panel) and stock indices (bottom panel) of walleye caught by electrofishing from Oglala Reservoir in 2009 and 2012.

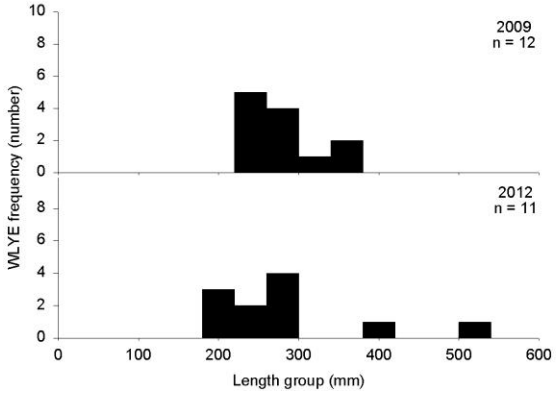

Figure Oglala-6. Length frequency histograms (40 mm groups) of walleye caught by electrofishing from Oglala Reservoir in 2009 and 2012.

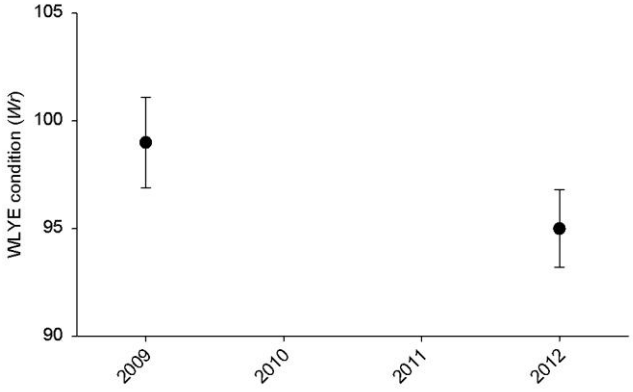

Figure Oglala-7. Mean condition (*Wr*) of walleye caught by electrofishing from Oglala Reservoir in 2009 and 2012. Error bars represent ± 1 SE.

Yellow perch

In 2008, 190,000 yellow perch fry were stocked in Oglala Reservoir. The data suggests this stocking was successful. Mean relative abundance has greatly increased (Figure Oglala-8) and

growth is occurring (although slowly; Figure-9 and Figure-9). Mean condition (*Wr* > 85) was satisfactory, but should be monitored as it declined about 25% since the last survey.

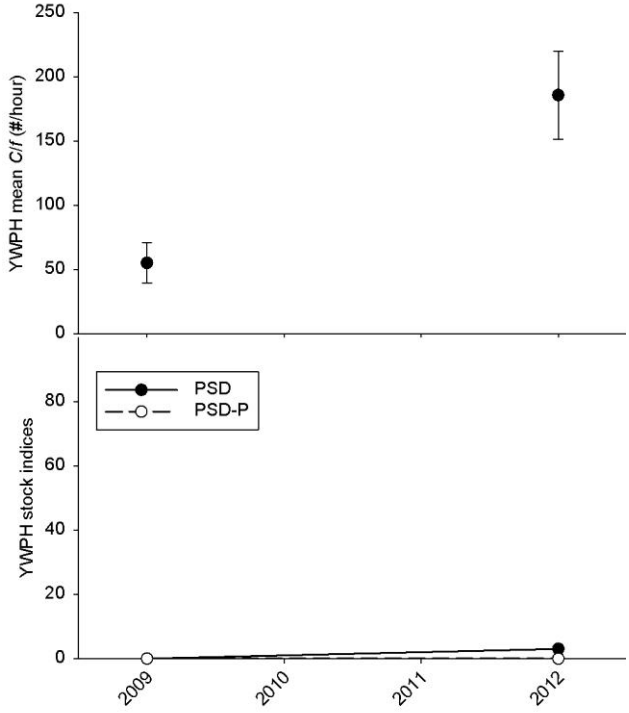

Figure Oglala-8. Mean relative abundance (*C/f* ± 1 SE; top panel) and stock indices (bottom panel) of yellow perch caught by electrofishing from Oglala Reservoir in 2009 and 2012.

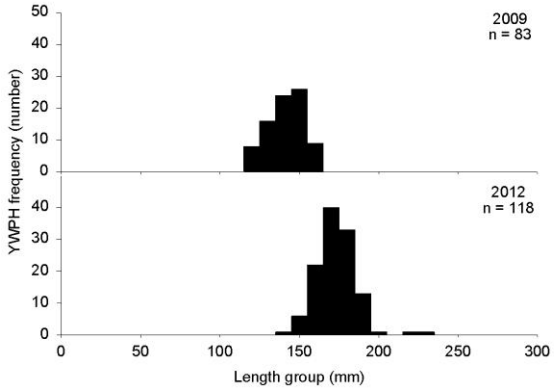

Figure Oglala-9. Length frequency histograms (10 mm groups) of yellow perch caught by electrofishing from Oglala Reservoir in 2009 and 2012.

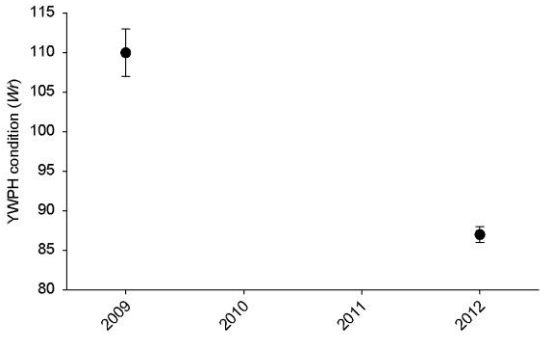

Figure Oglala-10. Mean condition (*Wr*) of yellow perch caught by electrofishing from Oglala Reservoir in 2009 and 2012. Error bars represent ± 1 SE.

MANAGEMENT RECOMMENDATIONS

General

- Conduct electrofishing surveys during the day.
  - In 2012, electrofishing was completed both during the night and day. Research suggests that *C/f* is generally better during night electrofishing, but length-frequency and PSD comparisons between day and night electrofishing are similar for many species, especially as water turbidity increases (Dumont and Dennis 1997; Pierce et al. 2001). Due to minor fisheries data differences and increased logistical advantages, we recommend completing future surveys with daytime electrofishing.
- Survey reservoirs every two years.
  - Kyle and Yellow Bear reservoirs in 2013.
  - Denby, Oglala, and White Clay reservoirs in 2014.

Denby Reservoir

- Conduct fisheries survey in 2014.
- Stock largemouth bass because relative abundance is low. Increasing largemouth bass numbers should help to increase size structure of bluegill and yellow perch.
- Encourage harvest of bluegill and yellow perch, especially those that are < 8 inches.

Oglala Reservoir

- Conduct fisheries survey in 2014.
- Consider another stocking of walleye fry to bolster current population. The previous stocking has shown signs of success.
- Abundance of largemouth bass is exceptionally low. Consider stocking more largemouth bass and encourage catch and release of all largemouth bass < 15 inches to increase the abundance of predators on panfish, which may lead to faster panfish growth.

White Clay Reservoir

- Conduct fisheries survey in 2014.
- Consider stocking bluegill and yellow perch because abundance is decreasing.
- Do not stock largemouth bass. Natural reproduction and recruitment seems apparent and size distribution is good.

ACKNOWLEDGMENTS

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REFERENCES

Dumont, S.C., and J.A. Dennis. 1997. Comparison of day and night electrofishing in Texas reservoirs. North American Journal of Fisheries Management 17: 939–946.

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

Henson, J.C. 1991. Quantitative description and development of a species-specific growth from for largemouth bass, with application to the relative weight index. Master's thesis. University of Missouri, Columbia.

Hillman, W.P. 1982. Structure and dynamics of unique bluegill populations. Master's thesis. University of Missouri, Columbia.

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

Neumann, R.M., and B.R. Murphy. 1991. Evaluation of the relative weight (*Wr*) index for assessment of white crappie and black crappie populations. North American Journal of Fisheries Management 11: 243–251.

Pierce, C.L., A.M. Corcoran, A.N. Gronbach, S. Hsia, B.J. Mullarkey, and A.J. Schwartzhoff. 2001. Influence of diel period on electrofishing and beach seining assessments of littoral fish assemblages. North American Journal of Fisheries Management 21: 918–926.

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

Willis, D.W., C.S. Guy, and B.R. Murphy. 1991. Development and evaluation of a standard weight (Ws) equation for yellow perch. North American Journal of Fisheries Management 11: 374–380.

APPENDICES

Appendix 1. Common and scientific names of fishes mentioned in this report.

Common name	Acronym	Scientific name
Black bullhead	BKBH	*Ameiurus melas*
Black crappie	BKCP	*Pomoxis nigromaculatus*
Bluegill	BLGL	*Lepomis macrochirus*
Common carp	CARP	*Cyprinus carpio*
Golden shiner	GDSN	*Notemigonus crysoleucas*
Green sunfish	GNSF	*Lepomis cyanellus*
Largemouth bass	LMBS	*Micropterus salmoides*
Northern pike	NTPK	*Esox lucius*
Walleye	WLYE	*Sander vitreus*
Yellow perch	YWPH	*Perca flavescens*

Appendix 2. Length category and condition parameters.

Appendix 2-1. Minimum total length (mm) for length categories of selected fish species commonly observed in Pine Ridge Indian Reservation reservoirs.

Species	Stock	Quality	Preferred	Memorable	Trophy	Reference
Black bullhead	150	230	300	380	450	Gabelhouse 1984
Black crappie	130	200	250	300	380	Gabelhouse 1984
Bluegill	80	150	200	250	300	Gabelhouse 1984
Green sunfish	80	150	200	250	300	Gabelhouse 1984
Largemouth bass	200	300	380	510	630	Gabelhouse 1984
Northern pike	350	530	710	860	1120	Gabelhouse 1984
Walleye	250	380	510	630	760	Gabelhouse 1984
Yellow perch	130	200	250	300	380	Gabelhouse 1984

Appendix 2-2. Intercept (a) and slope (b) parameters for standard weight (Ws) equations and the minimum total length (TL, mm) recommended for calculating relative weight (*Wr*).

Species	Intercept (a)	Slope (b)	Minimum TL	Reference
Black crappie	-5.618	3.345	100	Neumann and Murphy 1991
Bluegill	-5.374	3.316	80	Hillman 1982
Largemouth bass	-5.528	3.273	150	Henson 1991
Northern pike	-5.437	3.059	100	Willis 1989
Walleye	-5.453	3.180	150	Murphy et al. 1990
Yellow perch	-5.386	3.230	100	Willis et al. 1991

Appendix 3. Glossary of fisheries terms.

Alkalinity: a measure of the resistance of water to change in pH, expressed in mg/L or ppm. Because alkalinity is dependent on minerals such as calcium (Ca) and is related to aquatic vegetation production, alkalinity is an indicator of a water body's potential to produce biomass. An alkalinity value less than 40 mg/L is considered soft water while a value greater than 40 mg/L is considered hard water.

Catch per unit effort (*C*/*f*): an index of abundance used to document relative changes over time (also known as relative abundance), calculated as,

$$C/f = \frac{\text{number of fish (per length group, category, or sample)}}{\text{effort in unit of time (e.g., hour or net night)}}$$

Conductivity: a measure of water's ability to conduct electrical current, which is dependent on the amount of ions in the water. Total dissolved solids (TDS) are equal to ~0.5*conductivity. Conductivity is an approximate measure of a water body's productivity due to a relationship between minerals and productivity.

Effort: the amount of time expended in collecting a sample (e.g., hours, minutes, or net nights). Effort is used to calculate C/f.

Memorable length: the length of a fish (unique to each species) considered as the length that most anglers remember catching, quantified as 59–64% of the world record length for that species.

Net-night: a unit of time (i.e., overnight, <24 hr.) describing the effort expended for a sampling gear, such as a gill net or trap net. For example, if five gill nets were left in the water overnight, five gill net nights of effort were expended.

pH: a measure of how basic or acidic water is. Pure water is considered neutral with a pH of 7. Because pH is on a log10 scale, a change of 1 pH unit equates to a 10-fold increase in H^+ (hydrogen ions).

Preferred length: the length of a fish (unique to each species) that is considered the preferred length that most anglers want to catch, quantified as 45–55% of the world record length for that species.

Proportional size distribution (PSD): the percentage of a sample of stock length fish that are also greater than the number of fish ≥ a fish's length category (i.e., quality, preferred, memorable, trophy), calculated as,

$$\text{PSD} = \frac{\text{number of fish} \geq \text{quality length}}{\text{number of fish} \geq \text{stock length}} \text{ X } 100$$

$$\text{PSD} - \text{P} = \frac{\text{number of fish} \geq \text{preferred length}}{\text{number of fish} \geq \text{stock length}} \text{ X } 100$$

$$\text{PSD} - \text{M} = \frac{\text{number of fish} \geq \text{memorable length}}{\text{number of fish} \geq \text{stock length}} \text{ X } 100$$

$$\text{PSD} - \text{T} = \frac{\text{number of fish} \geq \text{trophy length}}{\text{number of fish} \geq \text{stock length}} \text{ X } 100$$

Relative weight (W_r): an index of the condition, or general well-being, of a fish, calculated as,

$$W_r = \frac{\text{weight (W)}}{\text{standard weight (Ws)}} \times 100$$

where W is the weight (g) of an individual fish and Ws is a length specific standard weight.

Quality length: the length of a fish (unique to each species) that is considered the minimum length most anglers would keep, quantified as 36–41% of the world record length for that species.

Standard error (SE): the **standard** deviation of the sampling distribution of a statistic, calculated as,

$$\frac{\text{standard deviation}}{\sqrt{\text{n}}}$$

or,

$$\frac{}{\frac{\text{variance}}{\text{n}}}$$

where n is the sample number.

Standard weight: weight of a fish standardized by regression of weight on length for a particular species, often determined by the 75th percentile weight rather than average weight in a length-class.

Stock length: the length of a fish (unique for each species) considered as the length that a fish reaches sexual maturity, quantified as 20–26% of the world record length for that species.

Trophy length: the length of a fish (unique to each species) considered to be a length worthy of acknowledgement, quantified as 74–80% of the world record length for that species.

Variance: a measure of the dispersion around the average of the sample, calculated as,

$$(\text{observed value} - \text{sample mean})^2$$

Appendix 4. Fish stocking history in Pine Ridge Indian Reservation reservoirs. Stocking size abbreviations are fry (FY; Hatch to 1.49 in), fingerling (FG; 1.5 to 5.49 in), sub-adult (SA; ≥ 5.5 in, not sexually mature), adult (AD; sexually mature, regardless of size), and mixed (MX; transplanted from natural sources).

		Largemouth bass			Bluegill			Northern pike			Yellow perch			Rainbow trout			Channel catfish			Walleye		
Reservoir	Year	Month	N	Size	Month	N	Size	Month	N	Size	Month	N	Size	Month	N	Size	Month	N	Size	Month	N	Size
Denby	2008	7	2000	FY																		
	1991													4	1,500	AD						
	1988				9	2,500	FY															
Kyle	2008	7	6500	FY																		
	1991																9	5,000	FG			
	1990																9	5,000	FG			
	1989																9	5,000	FG			
	1988	7	5,000	FG																		
Oglala	2012		17,000	FG																		
	2010																			6	70,000	FY
	2009										6	170,900	FY							6	71,400	FY
	2008										6	190,000	FY							6	35,000	FY
	1996	7	80,000	FG				4	60,000	FG												
	1995	7	70,000	FG				4	70,000	FG	?	9 quarts	eggs									
White Clay	2008	7	9000	FY																6	35,000	FY
	1994	?	60	AD																		
	1992	9	30,000	FG																		
	1989	9	5,000	FG													7	5,000	FG			
Wolf Creek	1992													4	1,000	AD						
	1991													4	1,500	AD						
	1990																					
	1989													4	1,000	AD						
	1988													4	1,000	AD						
Yellow Bear	2012													5	1,440	AD						
	2010													5	1,500	AD						
	2009													4	503	AD						
	2008	7	1500	FY							6	1800	FY	5	1,500	AD						
	1992													4	1,000	AD						
	1991													4	1,000	AD						
	1990																					
	1989													4	1,000	AD						
	1988				9	2,500	FY															

Appendix 5. Harvest and length limits for fish in reservoirs on the Pine Ridge Indian Reservation.

Species	Daily limit	Possession limit	Length limit
Black crappie	5	10	
Bluegill	8	16	
Largemouth bass	2	4	one over 12 inches
Northern pike	unlimited	unlimited	
Trout	4	8	
Walleye	2	4	one over 14 inches
Yellow perch	4	8	