South Buffalo Lake
Site Description

Location

Water designation number (WDN)	48-0034-00
Legal description	T125N-R53W-Sec.2,10,11,14-17
County (ies)	Marshall
Location from nearest town	six miles east of Eden, SD

Survey Dates and Sampling Information

Dates of current survey	June 12-14, 2007; September 25, 2007
Dates of last survey	June 13-15, June 22, 2006
Gill nets (n)	6
Frame nets (n)	18
Fall electrofishing (min)	30

Morphometry (Figure 1)

Watershed area (acres)	16,000
Surface area (acres)	1,788
Maximum depth (ft)	14
Mean depth (ft)	8

Ownership and Public Access

South Buffalo Lake is a meandered lake managed by the SDGFP. Two public access sites are present, and are located on the northeast and southwest shorelines (Figure 1). Both are maintained by the SDGFP (Figure 1). South Buffalo Lake is owned by the State of South Dakota and lands adjacent to the lake are generally under State of South Dakota, Bureau of Indian Affairs, and private ownership.

Watershed and Land Use

The South Buffalo Lake watershed is primarily comprised of agricultural grazing land, with some cropland (Hanson 2007). The shoreline is heavily wooded with scattered lake cabins primarily along the northern shore.

Water Level Observations

The Water Management Board established Ordinary High Water Mark is 1835.4 fmsl (feet above mean sea level), and the outlet elevation of South Buffalo Lake is 1834.8 fmsl. On May 3, 2007, South Buffalo Lake was above the Ordinary High Water Mark with an elevation of 1837.6 fmsl. On October 16, 2007 South Buffalo Lake remained above the Ordinary High Water Mark at an elevation of 1836.5 fmsl.

Aquatic Vegetation and Exotics

Emergent and submergent vegetation are present in South Buffalo Lake. Hanson (2007) reported emergent vegetation in the form of cattails (*Typha* spp.) and bulrush (*Scirpus* spp.) along the shoreline and a scattered to moderate mix of submerged vegetation consisting of coontail (*Ceratophyllum demersum*), *Chara* spp. and sago pondweed (*Potamogeton pectinatus)*). Common carp were the only exotic species encountered during this survey.

Fish Management Information

Primary species	bluegill, walleye, yellow perch
Other species	black bullhead, black crappie, common carp, fathead minnow, largemouth bass, golden shiner, johnny darter, northern pike, smallmouth bass, spottail shiner, white sucker
Management classification	warm-water permanent
Fish Consumption Advisories	none

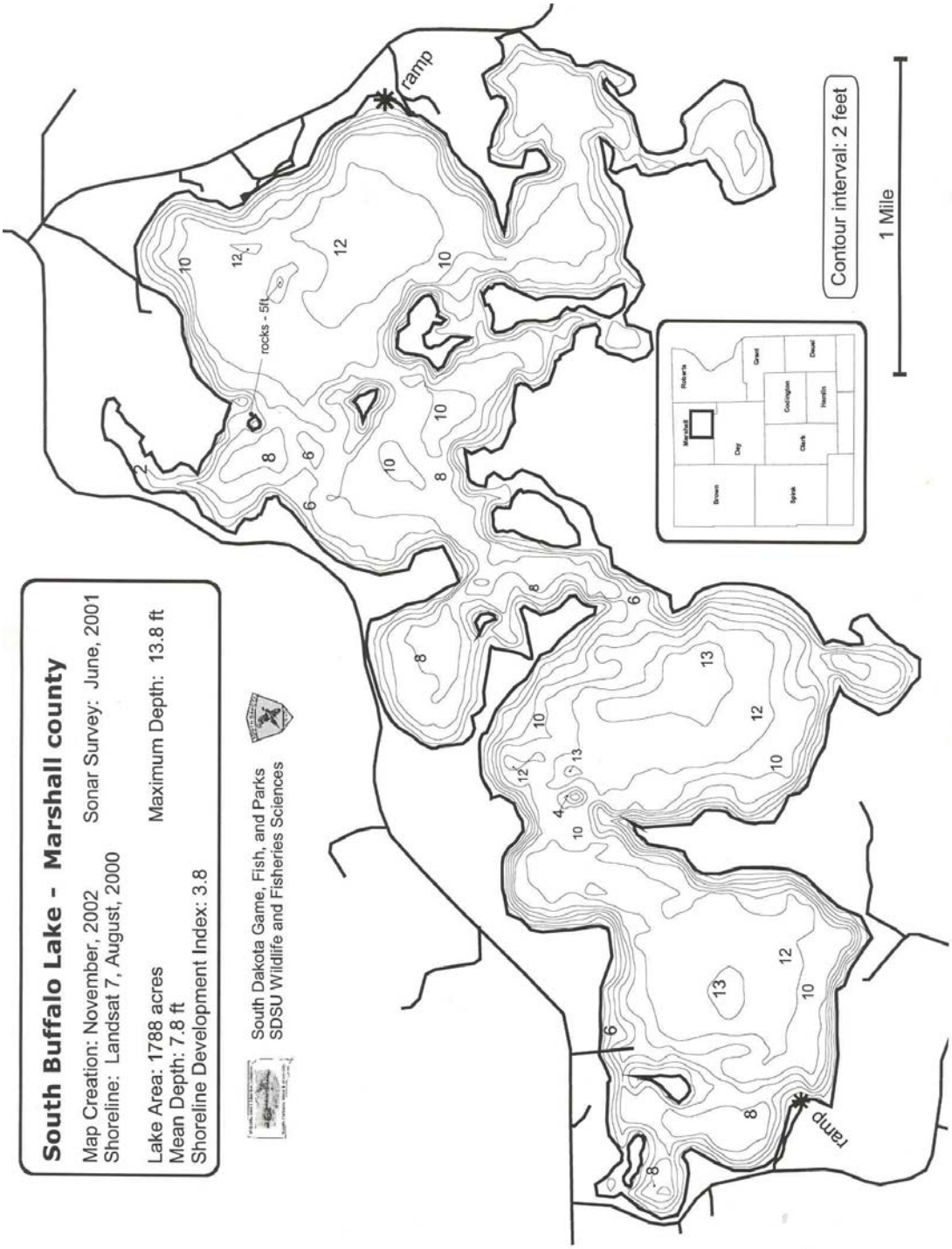

Figure 1. South Buffalo Lake contour map.

Management Objectives

1) Maintain a mean frame net CPUE of stock-length bluegill ≥ 25, a PSD of 30-60, and an RSD-P of 5-10.

2) Maintain a mean gill net CPUE of stock-length northern pike ≥ 3, a PSD of 30-60, and an RSD-P of 5-10.

3) Maintain a mean gill net CPUE of stock-length walleye ≥ 10, a PSD of 30 – 60, and an RSD-P of 5 – 10.

4) Maintain a mean gill net CPUE of stock-length yellow perch ≥ 25, a PSD of 30-60, and an RSD-P of 5-10.

5) Maintain a mean frame net CPUE of stock-length bullhead ≤ 100, and encourage commercial harvest during periods of high abundance.

Results and Discussion

South Buffalo Lake is a large, permanent, natural lake with complex morphometry (i.e., numerous basins, islands, and bays) located in Marshall County, South Dakota. South Buffalo Lake was named after Buffalo Township. The major inlet to South Buffalo Lake is located at the northeast corner of the lake. Other tributaries enter at the south and southeast, one of which drains Lake Martha. Water exiting South Buffalo Lake runs into North Buffalo and Almos Lakes then through a chain of Coteau Lakes and eventually emptying into the James River.

Currently, South Buffalo Lake is primarily managed as a bluegill, walleye and yellow perch fishery. Overall, as many as 16 species of fish contribute to the fishery in South Buffalo Lake.

Primary Species

Bluegill: The mean frame net CPUE of stock-length bluegill during 2007 was 255.6, and above the minimum objective (≥ 25 stock-length fish/net night) for bluegill in South Buffalo Lake (Tables 1-3). Since 2000, the mean frame net CPUE of bluegill has ranged from a low of 4.8 (2000) to a high of 255.6 (2007; Table 2). Age structure information suggests consistent recruitment of varying magnitude, with strong year-classes produced in 2003 and 2004 (Table 8). Strong year-classes produced in 2003 and 2004 have increased relative abundance substantially (Table 2). Relative abundance of bluegill was considered high in 2007.

The total length of bluegill captured in frame nets during 2007 ranged from 80 to 260 mm (Figure 2). The 2007 PSD of 40 and RSD-P of 6 for bluegill captured in frame nets indicated a balanced population, as defined by objective PSD and RSD-P values

between 30-60 and 5-10, respectively (Tables 1-3; Figure 2). PSD and RSD-P values will likely increase as fish from the strong 2003 and 2004 year-classes continue to grow and achieve quality-(150 mm) and preferred-lengths (200 mm).

Bluegills in South Buffalo Lake typically attain quality-length (150 mm) at approximately age-4 and preferred-length (200 mm) between age-5 and age-6. Weighted mean length at capture for age-4, age-5, and age-6 bluegill during 2007 was 153 mm, 179 mm, and 223 mm, respectively (Table 5). Mean Wr values for frame net captured bluegills exceeded 115 for all length groups sampled. The mean Wr for stock-length bluegill was 119 and no length-related trends in mean Wr values were observed (Table 1). Pre-spawn condition may have influenced Wr values, as sampling took place in mid-June

Northern Pike: Since 2000, northern pike relative abundance has generally been considered to be moderate to high, with mean gill net CPUE values ranging from a low of 2.8 (2001) to a high of 14.2 (2007; Table 2). The increase in northern pike relative abundance during 2006 and 2007 can likely be attributed to increased recruitment resulting from substantial increases in spring water levels since 2005 (Table 2; Table 3). Northern pike depend heavily on flooded vegetation for spawning and recruitment, and tend to have improved recruitment during springs that have rising water levels in northeastern South Dakota lakes.

Northern pike collected in gill nets from South Buffalo Lake ranged in total length from 320 to 860 mm (Figure 3). The PSD was 48 and the RSD-P was 7 for northern pike captured in gill nets (Table 1; Table 3). Although occasionally sampled, larger northern pike are rare in the gill net catch (Figure 3). Neumann et al. (1994) reported that marginal summer habitat due to high water temperatures may limit production of larger trophy-sized (i.e., < 1000 mm) northern pike in Lake Thompson, and other shallow glacial lakes.

No growth information was collected in 2007. Mean Wr values exceeded 85 for all length groups sampled, with the mean Wr for stock-length northern pike being 92 (Table 1). No length-related trends in Wr values were observed in 2007.

Walleye: The mean gill net CPUE of stock-length walleye during 2007 was 4.5, and below the minimum objective (≥ 10 stock-length fish/net night; Table 3). Since 2000, the mean gillnet CPUE of walleye has fluctuated from a low of 1.2 (2005) to a high of 10.5 (2002; Table 2). Recruitment of walleye has been poor in recent years, with the exception of the 2005 year-class (Table 7). Walleye from the 2005 year-class were the most represented in the 2007 gill net catch (56%) and coincided with a small fingerling stocking (Table 6; Table 7). Walleye fry stocked in 2006 may not have been recruited to our gear at time of sampling in 2007. Fall electrofishing in 2007 indicated poor natural reproduction, with a CPUE of 4.0 age-0 walleye/hour (Table 1). Typically, fall electrofishing CPUE values of ≥ 75 age-0 walleye/hour indicate a strong year-class.

Walleye captured in gill nets during 2007 ranged in total length from 190 to 690 mm (Figure 4). The PSD of walleye captured in gill nets during 2007 was 59 and the RSD-P was 30 (Table 1; Table 3; Figure 4). The decline in PSD observed in 2007 resulted from the 2005 year-class beginning to reach stock-length. PSD values are

expected to decrease as walleye from the 2005 year-class, which comprised the majority of walleye sampled, attain stock-length.

Walleyes in South Buffalo Lake typically reach quality-length (380 mm) beginning at age-3. Weighted mean length at capture of age-3 walleyes was similar in 2006 and 2007, with values of 390 mm and 380 mm (Table 4). Mean Wr values were 95 or greater for all length groups sampled. The mean Wr for stock-length fish in 2007 was 100, and no length-related trends in Wr were observed (Table 1).

Yellow Perch: The mean gill net CPUE of stock-length (130 mm) yellow perch in 2007 was 47.3, and above the minimum objective (≥ 25 fish/net night; Table 1; Table 2; Table 3). Since 2000, the gill net CPUE of stock-length yellow perch has ranged from 4.7 (2004) to 57.0 (2002; Table 2; Table 3). Length-frequency analysis indicates consistent recruitment in recent years (Figure 5). In 2007, relative abundance of yellow perch was considered moderate-high.

Yellow perch captured in gillnets during 2007 ranged in total length from 120 to 210 mm, had a PSD of 2 and RSD-P of 0 (Figure 5). Low PSD and RSD-P values indicate a population dominated by yellow perch less than quality-length (200 mm). No growth information was available during 2007. The mean Wr of stock-length yellow perch was 101, and no length-related trends in Wr values were apparent (Table 1).

Other Species

Black bullhead: Black bullhead relative abundance, as indexed by frame net CPUE, has declined in each of the past two population assessments (Table 2). In 2007, the mean frame net CPUE was 21.2, and represents the second lowest CPUE reported since 2000. Black bullhead recruitment appears to be relatively consistent although, limited in magnitude in recent years resulting in decreased abundance (Table 2; Figure 6). In 2005, a strong sub-stock year-class was present; however sampling in 2007 did not indicate the presence of a strong year-class (Figure 6). It is unclear whether black bullheads from the sub-stock year-class in 2005 sustained high mortality or were not sampled effectively in 2007. Relative abundance was considered low in 2007, and the frame net CPUE was within the objective (≤ 100 stock-length black bullhead/net night).

Black bullhead captured in frame nets during 2007 ranged in total length from 130 to 340 mm, had a PSD of 52, and an RSD-P of 15 (Table 1; Figure 6). No growth information was collected during 2007. Condition of frame net captured black bullheads was acceptable with mean Wr values of 95 or greater for all length groups sampled. No length-related trends in Wr were apparent.

Black crappie: The mean frame net CPUE of black crappie in South Buffalo Lake during 2007 was 6.1, and the highest observed from 2000-2007 (Table 2). Length-frequency analysis suggests successful recruitment in recent years, with what appears to be a relatively-strong year-class ranging in total length from 130 to 170 mm (Figure 7). Relative abundance increased in 2007; however, it was still considered low.

Black crappie sampled in frame nets during 2007 ranged in total length from 90 to 330 mm, had a PSD of 31 and RSD-P of 20 (Table 1; Figure 7). Black crappie size structure is heavily influenced by intermittently produced large year-classes.

No growth information was collected in 2007. Mean Wr values were lowest for preferred-memorable and memorable-trophy length categories (i.e., 98 and 93, respectively); however, mean Wr values exceeded 90 for all length groups sampled.

Other: Common carp, golden shiner, largemouth bass, smallmouth bass and white sucker were other fish species captured during the 2007 survey. Black bass (i.e., largemouth and smallmouth bass) are typically assessed during biennial electrofishing surveys in South Buffalo Lake. Electrofishing will be conducted in 2009 to monitor black bass population parameters. Common carp, golden shiner, and white suckers were sampled in low numbers during 2007 (Table 1).

Management Recommendations

1) Conduct fish population assessment surveys on a biennial basis (next survey scheduled in summer 2009) to monitor fish relative abundance, fish population size structures, fish growth, and stocking success.

2) Conduct spring electrofishing biennially (2009) to monitor the black bass population in South Buffalo Lake.

3) Collect otoliths from bluegill, walleye, and yellow perch; scales from largemouth and smallmouth bass to assess age structure and growth rates of the population.

4) Stock walleye on a biennial basis (100 small fingerlings/acre) to supplement the walleye population.

6) Monitor water levels and winter/summer kill events. Stock northern pike and yellow perch in cases of complete winterkill events to establish a fish population.

7) Maintain a mean frame net CPUE of stock-length bullhead ≤ 100, and encourage commercial harvest during periods of high abundance.

Table 1. Mean catch rate (CPUE; gill nets = catch/net night, electrofishing = catch/hour) of stock-length fish, mean relative weight (Wr) of stock-length fish, proportional stock density (PSD) and relative stock density of preferred-length fish (RSD-P) of various fish species captured using experimental gill nets and fall night electrofishing in South Buffalo Lake, 2007. Confidence intervals include 80 percent (± CI-80) or 90 percent (± CI-90). BLB= black bullhead; BLC= black crappie; BLG= bluegill; COC= common carp; GOS= golden shiner; LMB= largemouth bass; NOP= northern pike; SMB= smallmouth bass; WAE= walleye; WHS= white sucker; YEP= yellow perch

	Abundance		Stock Density Indices				Condition	
Species	CPUE	CI-80	PSD	CI-90	RSD-P	CI-90	Wr	CI-90
Frame nets								
BLB	21.2	6.9	52	4	15	3	98	1
BLC	6.1	1.4	31	7	20	6	103	1
BLG	255.6	59.7	40	1	6	1	119	3
COC	0.1	<0.1	100	---	100	---	---	---
LMB	0.1	<0.1	---	---	---	---	119	---
NOP	0.9	0.3	81	18	6	11	87	1
SMB	0.2	0.1	67	33	0	---	113	17
WAE	0.1	0.1	100	0	100	0	97	<1
WHS	0.2	0.1	100	0	67	33	91	20
YEP	16.7	5.7	4	2	0	1	89	1
Gill nets								
BLB	7.8	2.0	40	13	2	4	102	<1
BLC	6.7	1.7	18	10	13	8	121	1
BLG	2.8	1.4	18	16	12	14	118	5
GOS[1]	0.2	0.2	---	---	---	---	---	---
NOP	14.2	4.4	48	9	7	5	92	1
WAE	4.5	2.3	59	17	30	15	100	5
WHS	4.3	1.7	100	0	73	15	105	2
YEP	47.3	9.4	2	2	0	---	101	<1
Fall electrofishing								
WAE	4.0	---	---	---	---	---	---	---

[1]all fish sizes

Table 2. Historic mean catch rate (CPUE; gill nets= catch/net night, electrofishing= catch/hour) of stock-length fish for various fish species captured using frame nets, experimental gill nets and fall night electrofishing in South Buffalo Lake, 2000-2007. BLB= black bullhead; BLC= black crappie; BLG= bluegill; COC= common carp; GOS= golden shiner; LMB= largemouth bass; NOP= northern pike; SMB= smallmouth bass; WAE= walleye; WHS= white sucker; YEP= yellow perch

Species	2000	2001	2002	2003	2004	2005	2006[2]	2007[2]	Mean
Frame nets									
BLB	71.1	103.4	112.9	18.4	121.9	45.7	---	21.2	70.6
BLC	2.9	2.0	1.7	2.4	2.4	0.5	---	6.1	2.5
BLG	4.8	19.1	40.9	47.5	44.0	19.3	---	255.6	69.7
COC	0.1	0.0	0.2	0.2	0.2	0.2	---	0.1	0.1
LMB	0.0	0.0	0.0	0.1	0.0	0.0	---	0.1	0.0
NOP	0.1	0.7	0.2	2.2	0.8	0.4	---	0.9	0.9
SMB	0.0	0.0	0.0	0.2	0.0	0.0	---	0.2	0.1
WAE	0.1	0.3	0.3	0.4	0.4	0.1	---	0.1	0.3
WHS	0.1	0.1	0.1	0.6	0.3	0.1	---	0.2	0.2
YEP	0.9	1.4	8.1	0.4	0.1	0.2	---	16.7	4.4
Gill nets									
BLB	103.5	97.5	61.3	39.8	126.7	0.7	0.8	7.8	54.8
BLC	0.3	0.3	0.5	2.8	1.0	0.5	0.7	6.7	1.6
BLG	0.0	0.2	0.2	0.2	0.2	0.0	3.7	2.8	0.9
COC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GOS[1]	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.2	0.1
NOP	3.3	2.8	8.7	12.8	3.5	3.0	8.5	14.2	7.1
SMB	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
WAE	3.8	6.2	10.5	7.2	7.2	1.2	3.5	4.5	5.5
WHS	9.5	7.8	9.7	5.2	6.8	5.2	4.7	4.3	6.7
YEP	11.2	28.7	57.0	18.3	4.7	13.3	47.7	47.3	28.5
Spring electrofishing									
LMB	---	---	---	---	---	---	18.9	---	18.9
Fall electrofishing									
WAE	---	---	---	---	---	---	---	4.0	4.0

[1]all fish sizes

[2] Monofilament gill net mesh size change (.75”, 1”, 1.25”, 1.5”, 2” and 2.5”), previous years (.5”, .75”, 1”, 1.25”, 1.5” and 2”).

Table 3. Mean catch rate (CPUE; gill net= catch/net night, electrofishing = catch/hour) of stock-length fish, proportional stock density (PSD), relative stock density of preferred-length fish (RSD-P), and relative weight (Wr) for selected species captured using frame nets and experimental gill nets in South Buffalo Lake, 2000-2007. BLG= bluegill; NOP= northern pike; WAE= walleye; YEP= yellow perch

Species	2000	2001	2002	2003	2004	2005	2006[1]	2007[1]	Average	Objective
Frame nets										
BLG										
CPUE	5	19	41	48	44	19	---	256	62	≥ 3
PSD	64	76	78	86	82	14	---	40	63	30-60
RSD-P	37	43	13	19	42	9	---	6	24	5-10
Wr	127	116	113	110	123	112	---	119	117	---
Gill nets										
NOP										
CPUE	2	3	9	13	4	3	9	14	7	---
PSD	50	29	56	29	43	22	53	48	41	---
RSD-P	10	12	0	3	5	0	2	7	5	---
Wr	77	84	86	84	81	85	94	92	85	---
WAE										
CPUE	4	6	11	7	7	1	4	5	6	≥ 10
PSD	22	14	35	53	63	43	90	59	47	30 – 60
RSD-P	0	3	3	9	21	0	33	30	12	5 – 10
Wr	93	91	93	90	90	98	98	100	94	---
YEP										
CPUE	11	29	57	18	5	13	48	47	29	≥ 25
PSD	13	7	14	6	18	5	2	2	8	30-60
RSD-P	0	0	0	1	0	0	0	0	0	5-10
Wr	98	101	93	92	104	104	108	101	100	---

[1] Monofilament gill net mesh size change (.75”, 1”, 1.25”, 1.5”, 2” and 2.5”), previous years (.5”, .75”, 1”, 1.25”, 1.5” and 2”).

Table 4. Weighted mean length at capture (mm) for walleye captured in experimental gill net sets in South Buffalo Lake, 2000-2007. Note: sampling was conducted at approximately the same time during each year allowing comparisons among years to monitor growth trends.

		Age											
Year	N	1	2	3	4	5	6	7	8	9	10	11	12
2007[1]	38	---	256	380	489	---	488	478	545	545	675	695	---
2006[1]	24	181	---	390	---	452	517	---	---	593	---	---	560
2005[1]	4	---	238	---	372	---	---	---	---	---	---	---	---
2004	44	154	---	303	395	473	471	548	582	---	---	---	---
2003	49	---	257	354	419	459	458	561	---	---	---	---	---
2002	70	205	301	362	396	493	605	---	---	---	---	---	---
2001	41	183	283	340	377	---	523	493	---	---	---	---	---
2000	33	178	262	334	432	---	---	---	---	---	---	---	---

[1]Fish aged using otoliths, scales were used in previous years.

Table 5. Weighted mean length at capture (mm) for bluegill captured using frame nets in South Buffalo Lake, 2007.

		Age											
Year	N	1	2	3	4	5	6	7	8	9	10	11	12
2007	4,597	---	84	117	153	179	223	227	240	257	248	---	266

Table 6. Stocking history including size and number for fishes stocked into South Buffalo Lake, 1996 - 2007. (WAE= walleye; LMB= largemouth bass)

Year	Species	Size	Number
1996	WAE	fry	1,780,000
1998	WAE	fry	900,000
2003	WAE	small fingerling	220,430
2005	WAE	small fingerling	437,300
2006	WAE	fry	2,200,000
2006	LMB	fingerlings	100,320

Table 7. Numbers of walleye sampled (n) by year class and associated stocking history (Number stocked x 1,000) for walleye captured in South Buffalo Lake, 2000-2007.

	Year Class											
Survey Year	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996
2007[1,2]			22	1	2		6	1	1	3	1	1
2006[1,2]	---		3		5		6	5			4	
2005[1]	---	---			1		3					
2004	---	---	---		1		13	9	9	7	2	3
2003	---	---	---	---			19	8	8	8	2	4
2002	---	---	---	---	---		7	24	11	24	3	1
2001	---	---	---	---	---	---		4	21	8	5	
2000	---	---	---	---	---	---	---		4	12	12	5
Number stocked												
fry		2,200								900		1,780
small fingerling			437		220							
large fingerling												

[1]Fish aged using otoliths, scales were used in previous years.
[2] Monofilament gill net mesh size change (.75”, 1”, 1.25”, 1.5”, 2” and 2.5”), previous years (.5”, .75”, 1”, 1.25”, 1.5” and 2”).

Table 8. Numbers of bluegill sampled (n) using frame nets by year class in South Buffalo Lake, 2007.

	Year Class											
Survey Year	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996
2007			71	2,223	1,748	338	16	48	110	67	36	23

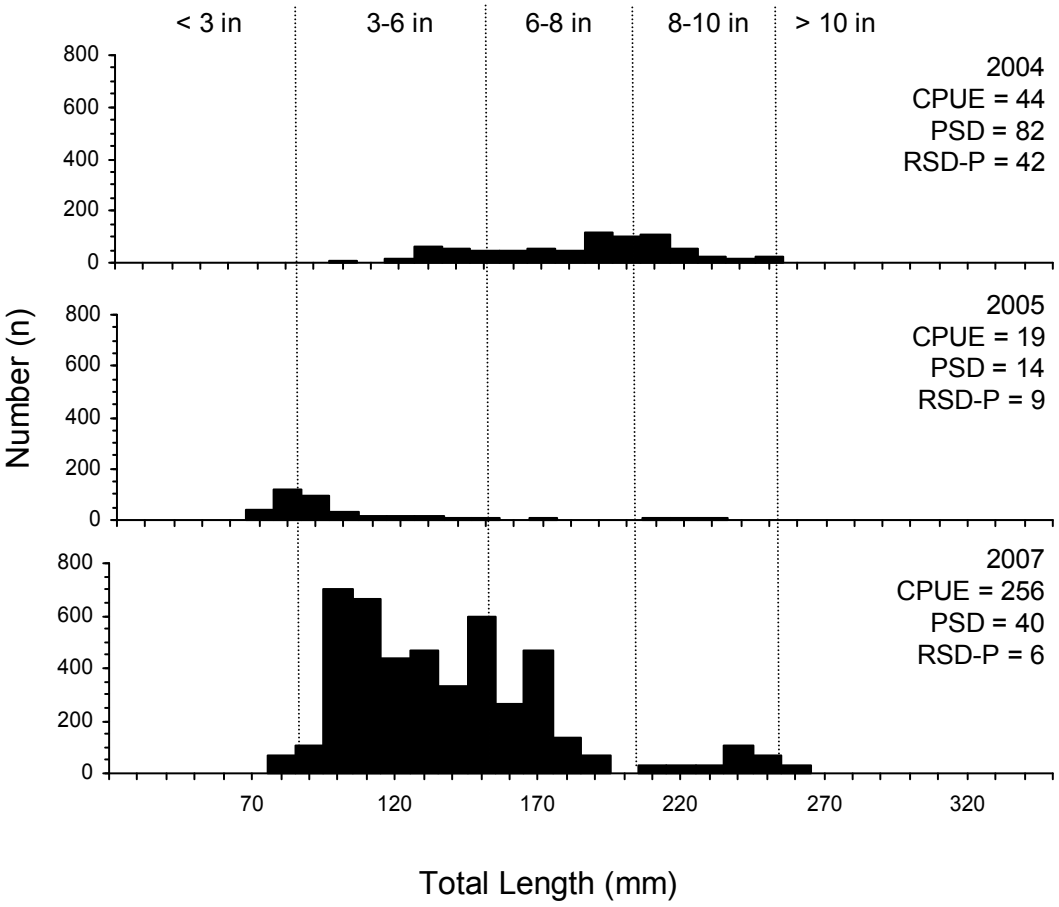

Figure 2. Length-frequency histogram, catch rate of stock-length fish (CPUE), proportional stock density (PSD), and relative stock density of preferred-length fish (RSD-P) for bluegill captured using frame nets in South Buffalo Lake, 2004-2005 and 2007.

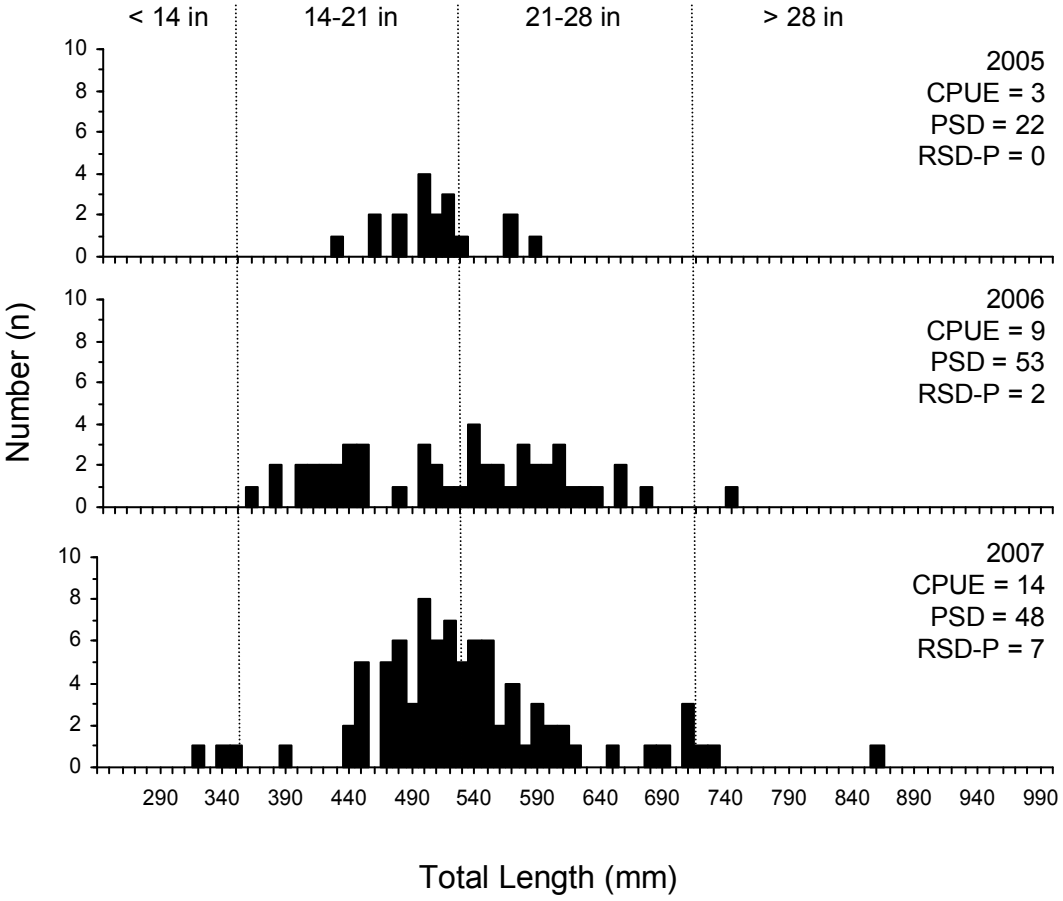

Figure 3. Length-frequency histogram, catch rate of stock-length fish (CPUE), proportional stock density (PSD), and relative stock density of preferred-length fish (RSD-P) for northern pike captured in gill nets in South Buffalo Lake, 2005-2007.

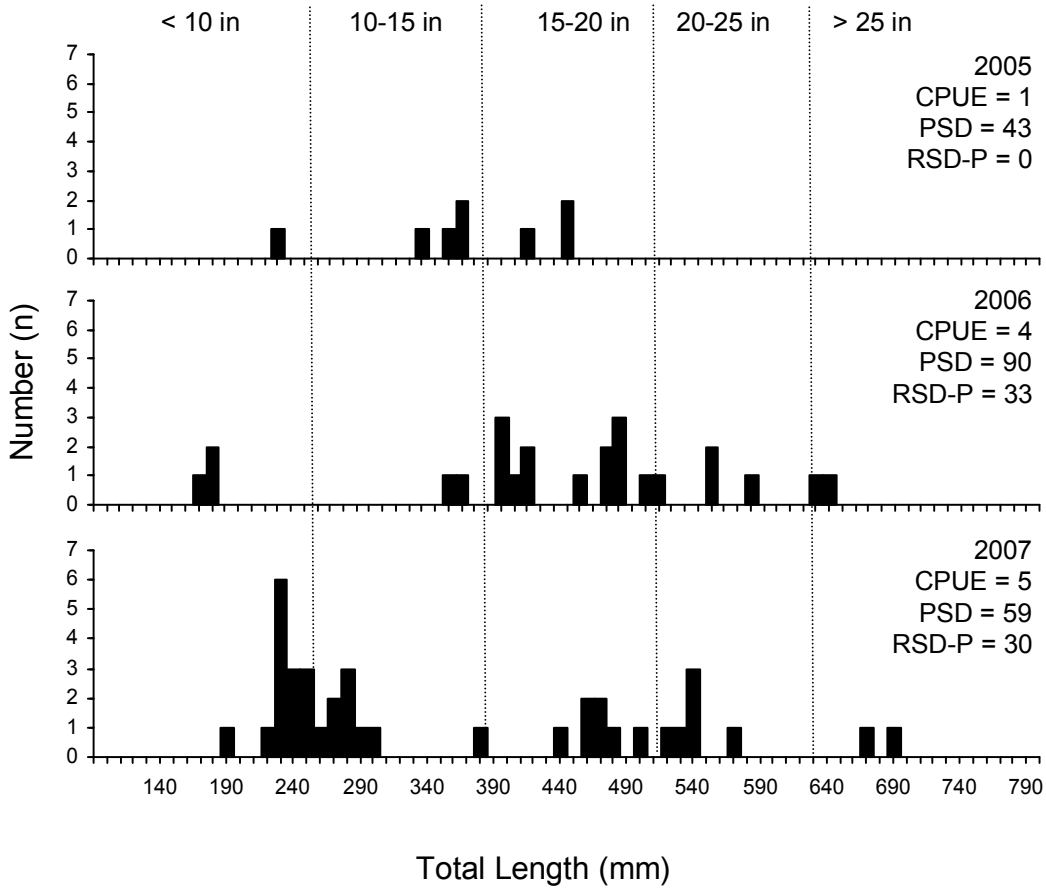

Figure 4. Length-frequency histogram, catch rate of stock-length fish (CPUE), proportional stock density (PSD), and relative stock density of preferred-length fish (RSD-P) for walleye captured in gill nets in South Buffalo Lake, 2005-2007.

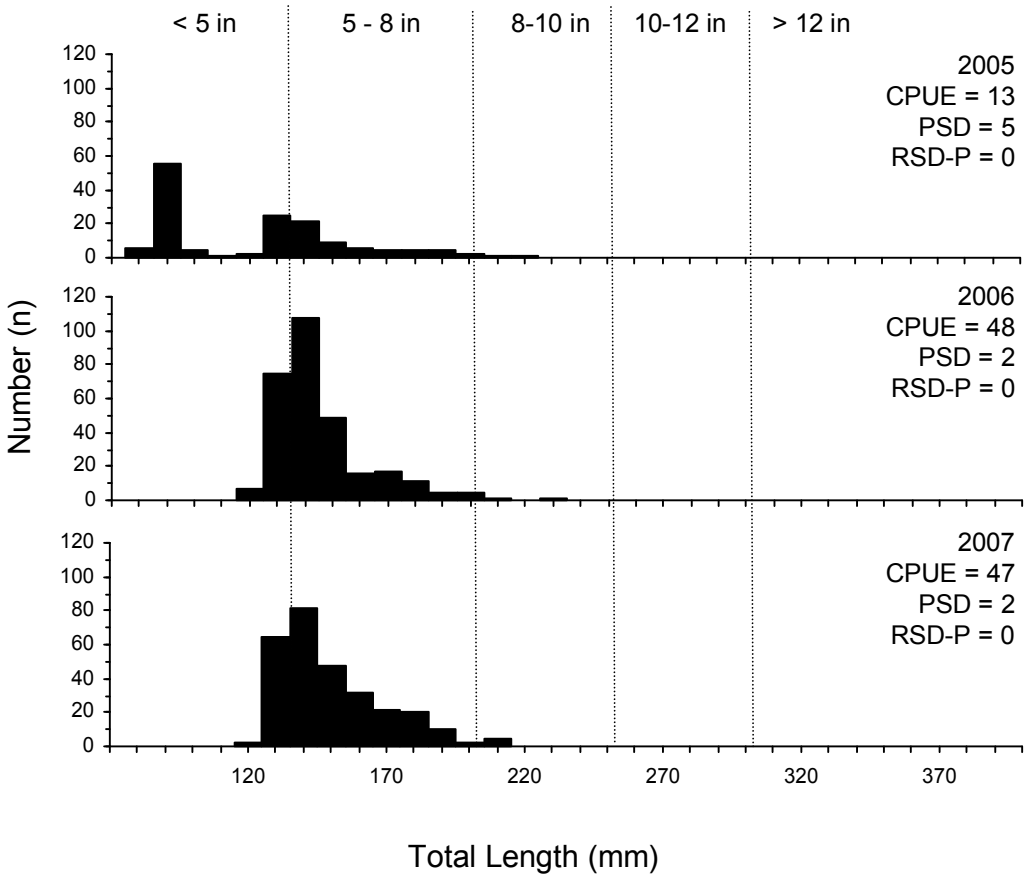

Figure 5. Length-frequency histogram, catch rate of stock-length fish (CPUE), proportional stock density (PSD), and relative stock density of preferred-length fish (RSD-P) for yellow perch captured in gill nets in South Buffalo Lake, 2005-2007.

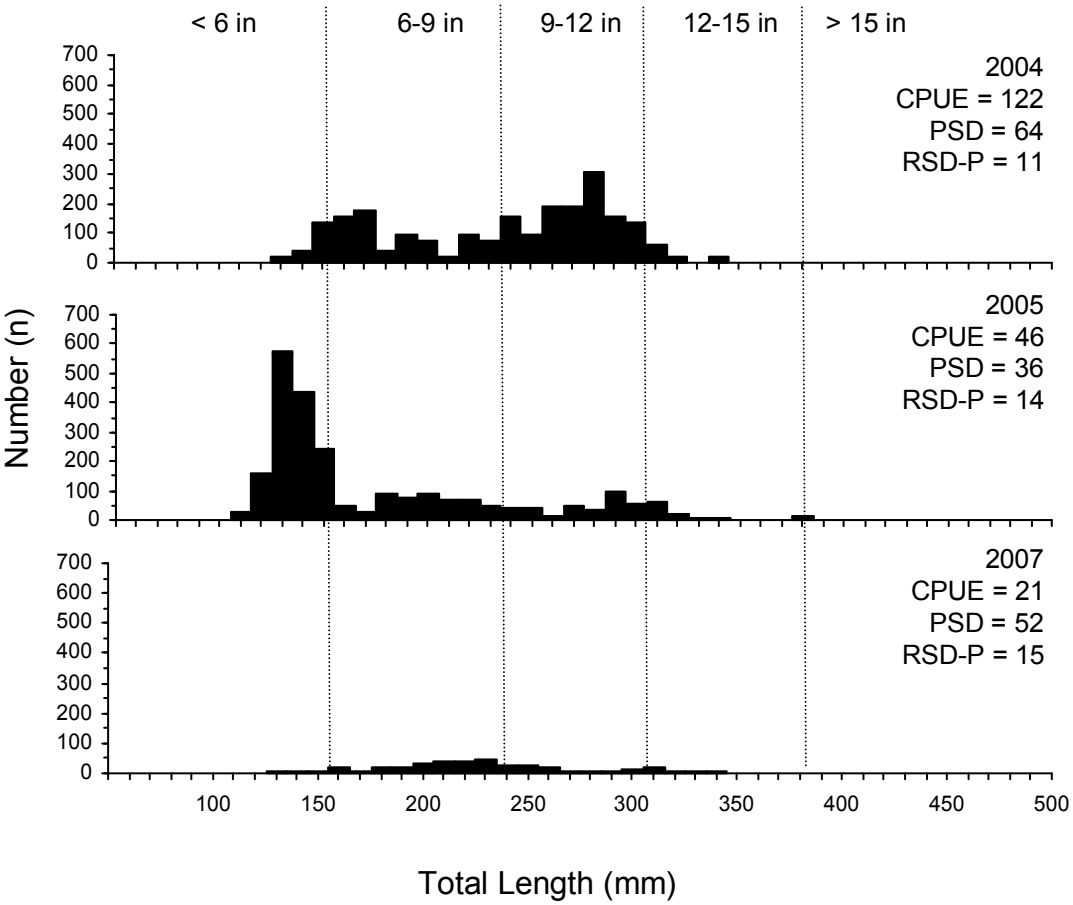

Figure 6. Length-frequency histogram, catch rate of stock-length fish (CPUE), proportional stock density (PSD), and relative stock density of preferred-length fish (RSD-P) for black bullhead captured in frame nets in South Buffalo Lake, 2004, 2005, and 2007.

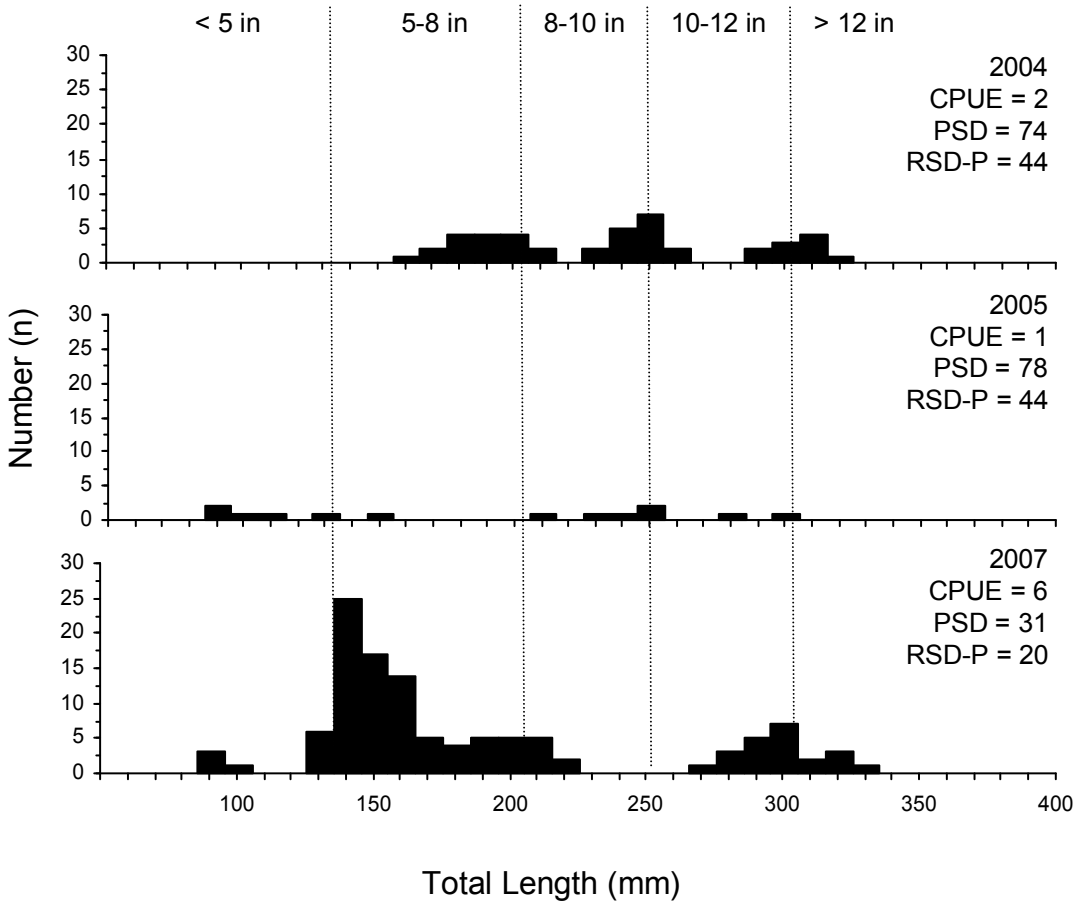

Figure 7. Length-frequency histogram, catch rate of stock-length fish (CPUE), proportional stock density (PSD), and relative stock density of preferred-length fish (RSD-P) for black crappie captured in frame nets in South Buffalo Lake, 2004, 2005, and 2007.