

Horseshoe Lake

Site Description

Location

Water designation number (WDN)	22-0008-00
Legal description	T120N-R57W-Sec. 13,14,24
County (ies)	Day
Location from nearest town	9 miles south and 4.5 miles west of Webster, SD

Survey Dates and Sampling Information

Survey dates	May 21, 2015 (EF-SMB) July 7-9, 2015 (FN, GN)
Electrofishing-SMB(min)	60
Frame net sets (n)	18
Gill net sets (n)	6

Morphometry (Figure 1)

Watershed area (acres)	14,264
Surface area (acres)	627
Maximum depth (ft)	24
Mean depth (ft)	15

Ownership and Public Access

Horseshoe Lake is a meandered lake owned by the State of South Dakota and managed by the SDGFP. A single public access site which includes boat ramp and landing dock is located on the east shore (Figure 1). Lands adjacent to Horseshoe Lake are owned by the State of South Dakota and private individuals.

Watershed and Land Use

The 14,264 acre Horseshoe Lake sub-watershed (HUC-12) is located within the larger Grass, Dry, and Still Lakes (HUC-10) watershed. Land use within the watershed is primarily agricultural with a mix of pasture or grassland, cropland, and scattered shelterbelts.

Water Level Observations

Water levels on Horseshoe Lake are not monitored by SDDENR; however, visual observation indicated that the lake experienced a substantial increase in water levels prior to 2013, similar to other waters in the area (i.e., Antelope, Bitter, Reetz and Waubay Lakes). However, since 2013, the water level has decreased.

Fish Management Information

Primary species	smallmouth bass, walleye, yellow perch
Other species	black bullhead, black crappie, bluegill, green sunfish, largemouth bass, northern pike
Lake-specific regulations	smallmouth/largemouth bass: only those <14" or 18" and longer may be taken; of those no more than one may be 18" or longer
Management classification	none
Fish Consumption Advisories	none

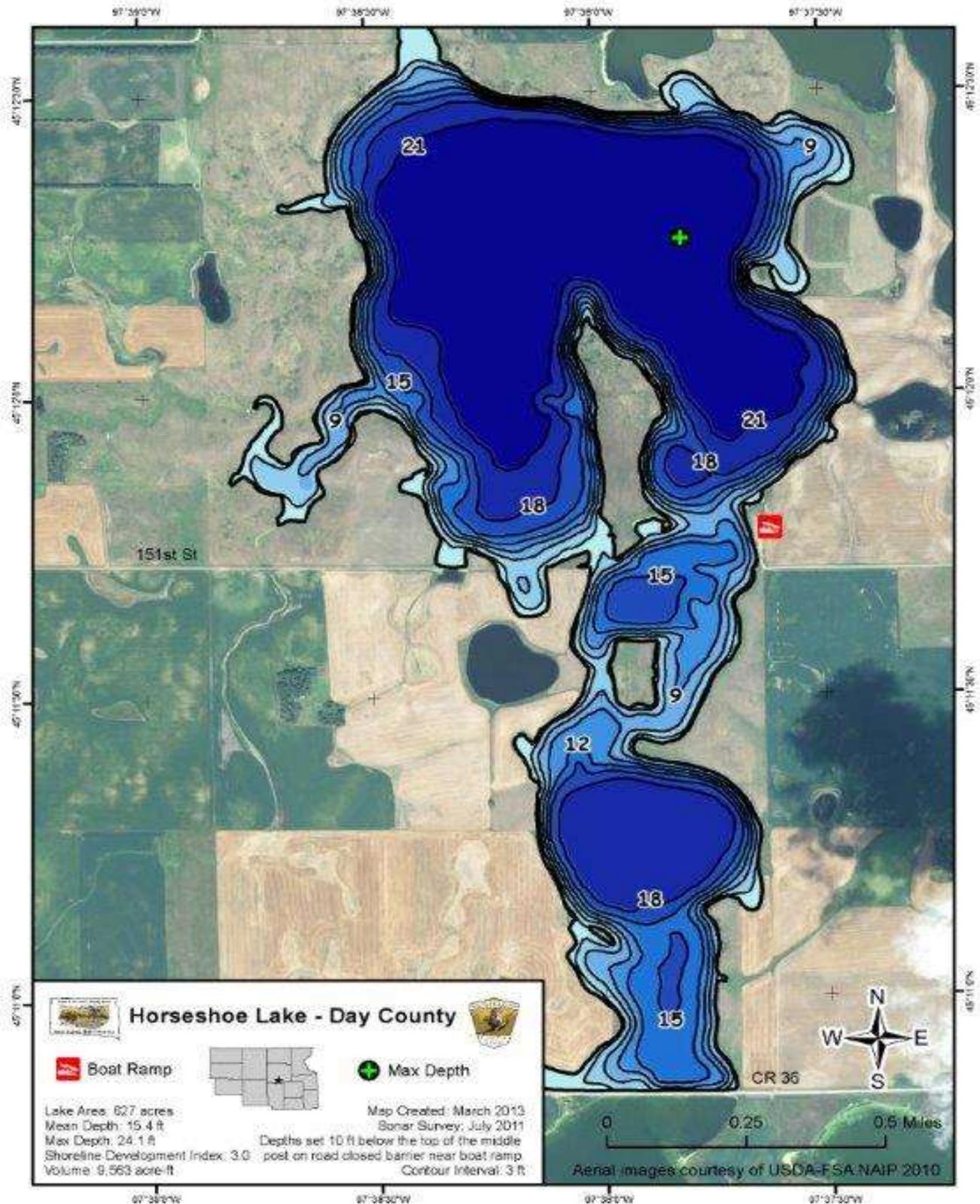


Figure 1. Map depicting depth contours of Horseshoe Lake.



Figure 2. Map depicting geographic location of Horseshoe Lake from Webster, South Dakota (top). Also noted is the public access and standardized net locations for Horseshoe Lake. HFN= frame nets; HGN= gill nets

Management Objectives

- 1) Maintain a moderate density smallmouth bass population with a PSD of 40-70, and a PSD-P of 10-40.
- 2) Maintain a mean gill net CPUE of stock-length walleye ≥ 10 , a PSD of 30-60, and a PSD-P of 5-10.
- 3) Maintain a mean gill net CPUE of stock-length yellow perch ≥ 30 , a PSD of 30-60, and a PSD-P of 5-10.

Results and Discussion

Prior to the 1990's Horseshoe Lake was a shallow slough with limited sport fishery potential. However, above normal precipitation during the mid to late 1990's increased the surface area and depth of Horseshoe Lake diminishing the threat of winterkill and created habitat capable of sustaining a sport fishery.

Initial walleye stockings into the expanded Horseshoe Lake were successful. In addition to walleye, yellow perch populations were also abundant creating an initial "boom" in sport fish populations making Horseshoe Lake a popular destination for anglers during the late 1990's. Today, Horseshoe Lake remains a popular destination for anglers and is managed as a smallmouth bass, walleye, and yellow perch fishery.

Primary Species

Smallmouth bass: Spring electrofishing is used to monitor population parameters for smallmouth bass and is conducted biennially during odd years (i.e., 2015, 2017, 2019....) at Horseshoe Lake. The mean spring electrofishing CPUE for stock-length smallmouth bass in 2015 was 11.0 (Table 1). The mean spring electrofishing CPUE has ranged from 11.0 (2015) to 45.3 (2009; Table 2).

Smallmouth bass ranged in TL from 23 to 48 cm (9.1 in to 18.9 in; Figure 3) and PSD and PSD-P were both 91 (Table 1). The PSD and PSD-P values were above management objectives of 40-70 and 10-40 (Table 3); respectively, indicating a population dominated by large fish (≥ 35 cm; 13.8 in). The size structure of smallmouth bass in Horseshoe Lake has historically exceeded management objectives (Table 3).

Scales were utilized to assess age structure of the smallmouth bass sample. Recruitment has typically been consistent; however small sample size in 2015 limits the utility of age and growth data. Six year-classes (2005, 2007-2009, 2011 and 2013) were represented in the spring electrofishing sample (Table 6).

Condition of smallmouth bass in Horseshoe Lake has historically been excellent with mean W_r values ≥ 112 for all years sampled (Table 3). In 2015 the mean W_r value was 120 (Table 1).

Walleye: The mean gill net CPUE of stock-length walleye during 2015 was 4.0 (Table 1) and below the minimum objective (≥ 10 stock-length walleye/net night; Table 3). Based on the 2015 gill net catch, relative abundance appears to be moderate.

Gill net captured walleye ranged in TL from 17 to 60 cm (6.7 to 23.6 in; Figure 4). The 2015 PSD and PSD-P values were 63 and 21, respectively (Table 1). Both the PSD and PSD-P were above the management objectives of 30-60 and 5-10, respectively (Table 1, Figure 4).

Otoliths were collected from a sub-sample of gill net captured walleye. Five year classes (2009, 2010, 2012-2014) were present in the gill net catch; each was represented by few individuals (Table 8). The 2009 and 2013 classes were naturally produced; while, the 2010, 2012 and 2014 cohorts coincide with stockings (Table 8; Table 10). The contribution of naturally-produced walleye to year classes produced during stocked years is unknown, as stocked walleye were unmarked making it difficult to differentiate stocked from naturally-produced walleye.

Although sample size was low, growth rates appear to be fair with the weighted mean TL at capture for age-3 walleye being 375 mm (14.8 in; Table 9). Mean Wr values ranged from 87 to 106 for all length categories (i.e., stock-quality) sampled; a slight increasing trend in Wr was apparent as TL increased. The mean Wr of stock-length walleye was 99 (Table 1).

Yellow Perch: The mean gill net CPUE of stock-length yellow perch was 29.6 (Table 1) and slightly below the minimum objective (≥ 30 stock-length yellow perch/net; Table 3). Since 2002, the mean gill net CPUE of stock-length yellow perch has fluctuated from a low of 6.5 (2002) to a high of 29.6 (2015; Table 2). The 2015 mean gill net CPUE indicated moderate to high relative abundance.

Yellow perch captured in the 2015 gill net catch ranged in TL from 15 to 30 cm (5.9 to 11.8 in; Figure 5). The 2015 PSD and PSD-P were 33 and 3, respectively (Table 1). The PSD was within the management objective range (30-60) whereas the PSD-P value was below the objective range (5-10; Table 3, Figure 5).

Otoliths were collected from a sub-sample of yellow perch in the gill net catch; four year-classes (2010-2013) were identified (Table 11). The 2013 cohort was the most represented comprising 97% of yellow perch in the gill net catch (Table 11). Weighted mean TL at capture for age-2 yellow perch was 191 mm (7.5 in; Table 12). The mean Wr of stock-length yellow perch was 109 (Table 1) and no length-related trends in Wr were apparent.

Other Species

Bluegill: The mean frame net CPUE of stock-length bluegill in 2015 was 3.5 (Table 1). This represents a decrease from the 17.9 observed in 2014 (Table 2). However, the 2015 mean frame net CPUE is similar to surveys conducted in 2005, 2008 and 2011 (Table 2). Relative abundance is considered to be low.

Bluegill ranged in TL from 8 to 24 cm (3.1 in to 9.4 in), and had PSD of 25 and PSD-P of 3 (Table 1). Otoliths were collected from a sub-sample of frame net captured

bluegill in 2015. Four year-classes (2011-2014) were represented with the 2013 year class comprising 81% of the sample (Table 4). The 2013 year class (age-2) had a weighted mean length at capture of 133 mm (5.2 in; Table 5).

Condition was good with mean W_r of 117 (Table 1). However, seasonal influences (i.e., spawning behavior) may have influenced W_r values. No length-related trends in W_r were observed.

Northern Pike: Northern pike relative abundance remained low from 2002-2008 with mean gill net CPUE values between 0.3 and 0.5 (Table 2). The 2011 survey indicated an increase in relative abundance with a mean gill net CPUE of 2.0 (Table 2). In 2015, gill nets captured eight northern pike that ranged in TL from 60 to 74 cm (23.6 in to 29.1 in.) resulting in a mean gill net CPUE of 1.2 (Table 1). Currently, relative abundance is considered moderate.

Although sample size was low, sampled northern pike were in good condition with mean W_r values that ranged from 82-95 for all 10-mm length groups represented. The mean W_r of stock-length individuals was 89 (Table 1).

Management Recommendations

- 1) Conduct fish community assessment surveys utilizing spring electrofishing and experimental gill nets biennially (next survey scheduled for summer 2017) and utilizing frame nets on an every four year basis (next survey scheduled for summer of 2017) to monitor fish relative abundance, fish population size structures, fish growth, and stocking success.
- 2) Collect otoliths from walleye and yellow perch and scales from smallmouth bass to assess age structure and growth rates of each population.
- 3) Maintain length limit on largemouth and smallmouth bass to benefit population and comply with toolbox options (Blackwell and Lucchesi 2009). Largemouth and smallmouth bass must be less than 14" or longer than 18", but only one 18" or longer can be kept in the daily creel.
- 4) Stock walleye (\approx 500 fry/acre) on a biennial basis (even years) to establish additional year classes.

Table 1. Mean catch rate (CPUE; gill nets = catch/net night) of stock-length fish, proportional size distribution of quality- (PSD) and preferred-length (PSD-P) fish, and mean relative weight (Wr) of stock-length fish for various fish species captured in frame nets, experimental gill nets, and electrofishing in Horseshoe Lake, 2015. Confidence intervals include 80 percent (\pm CI-80) or 90 percent (\pm CI-90). BLG= bluegill; NOP= northern pike; SMB= smallmouth bass; WAE= walleye; YEP= yellow perch

Species	Abundance		Stock Density Indices				Condition	
	CPUE	CI-80	PSD	CI-90	PSD-P	CI-90	Wr	CI-90
<i>Frame nets</i>								
BLG	3.5	1.3	25	9	3	4	117	1
NOP	0.4	0.2	100	0	25	31	90	6
SMB	1.7	0.7	91	9	91	9	121	3
WAE	0.3	0.2	100	0	100	0	75	4
YEP	0.2	0.1	0	---	0	---	103	12
<i>Gill nets</i>								
BLG	0.3	0.3	0	---	0	---	129	<1
NOP	1.2	0.6	100	0	14	28	89	5
WAE	4.0	1.6	63	18	21	15	99	3
YEP	29.6	21.2	33	6	3	3	109	1
<i>Electrofishing</i>								
SMB	11.0	5.1	91	17	91	17	120	5

Table 2. Historic mean catch rate (CPUE; gill nets = catch/net night, electrofishing= catch/hour) of stock-length fish for various fish species captured in frame nets, experimental gill nets, and electrofishing from Horseshoe Lake, 2002-2015. BLB= black bullhead; BLC= black crappie; BLG= bluegill; GSF= green sunfish; HYB= hybrid sunfish; NOP= northern pike; SMB= smallmouth bass; WAE= walleye; YEP= yellow perch

Species	CPUE							
	2002	2005	2008	2009	2011	2013	2014	2015
<i>Frame nets</i>								
BLB	---	---	---	---	---	---	0.1	0.0
BLC	---	0.0	0.1	---	0.0	---	0.1	0.0
BLG	---	0.1	2.4	---	1.4	---	17.9	3.5
GSF	---	0.1	0.6	---	0.0	---	0.4	0.0
HYB ¹	---	0.0	0.0	---	0.0	---	0.1	0.0
NOP	---	0.4	0.2	---	0.6	---	1.6	0.4
SMB	---	1.8	4.4	---	0.8	---	2.5	1.7
WAE	---	3.3	1.1	---	0.8	---	1.4	0.3
YEP	---	0.1	0.0	---	0.4	---	2.5	0.2
<i>Gill nets</i>								
BLG	0.0	0.0	0.0	---	0.0	---	0.0	0.3
NOP	0.3	0.5	0.5	---	2.0	---	1.3	1.2
SMB	0.5	0.0	0.0	---	0.0	---	0.3	0.0
WAE	12.0	4.5	3.2	---	8.3	---	3.5	4.0
YEP	6.5	20.3	10.8	---	18.2	---	8.2	29.6
<i>Electrofishing</i>								
SMB ²	---	---	---	45.3	23.9	38.9	---	11.0

¹All fish sizes; *Lepomis spp.*

²Spring Electrofishing-SMB

Table 3. Mean catch rate (CPUE; gill/frame nets = catch/net night, electrofishing= catch/hour), proportional size distribution of quality- (PSD) and preferred-length (PSD-P) fish, and mean relative weight (Wr) for selected species captured by experimental gill nets and electrofishing from Horseshoe Lake, 2002-2015. SMB= smallmouth bass; WAE= walleye; YEP= yellow perch

Species	2002	2005	2008	2009	2011	2013	2014	2015	Objective
<i>Gill nets</i>									
WAE									
CPUE	12	5	3	---	8	---	4	4	≥ 10
PSD	94	28	42	---	16	---	52	63	30-60
PSD-P	0	0	0	---	6	---	24	21	5-10
Wr	95	98	94	---	92	---	89	99	---
YEP									
CPUE	7	20	11	---	18	---	8	30	≥ 30
PSD	35	37	43	---	69	---	45	33	30-60
PSD-P	31	0	5	---	43	---	22	3	5-10
Wr	100	108	109	---	109	---	103	109	---
<i>Electrofishing</i>									
SMB ¹									
CPUE	---	---	---	45	24	39	---	11	---
PSD	---	---	---	92	71	96	---	91	40-70
PSD-P	---	---	---	77	67	83	---	91	10-40
Wr	---	---	---	112	117	149	---	120	---

¹ Spring Electrofishing-SMB

Table 4. Year class distribution based on the expanded age/length summary for bluegill sampled in frame nets from Horseshoe Lake, 2015.

Survey Year	Year Class				
	2015	2014	2013	2012	2011
2015		9	52	1	2

Table 5. Weighted mean total length at capture (mm) for bluegill age-1 through age-4 sampled in experimental gill nets (expanded sample size) from Horseshoe Lake, 2015. Note: sampling was conducted at approximately the same time during each year allowing comparisons among years to monitor growth trends.

Year	Age			
	1	2	3	4
2015	94(9)	133(52)	196(1)	245(2)

Table 6. Year class distribution based on the expanded age/length summary for smallmouth bass sampled during spring electrofishing from Horseshoe Lake, 2009-2015; includes both day and night samples (2015).

Year	Year Class														
	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001
2015			1		3		1	3	1		1				
2013	---	---			1	5	7	8	6	8	5	9	6	3	1
2011	---	---	---	---			7		4		5	5	1	1	
2009	---	---	---	---	---	---			4	2	16	8	6	6	2

¹ Older smallmouth bass were sampled, but are not reported in this table.

Table 7. Weighted mean TL (mm) at capture for smallmouth bass age-2 through age-10 sampled during spring electrofishing (expanded sample size) from Horseshoe Lake, 2009-2015; includes both day and night samples (2015).

Year	Age									
	2	3	4	5	6	7	8	9	10	
2015	233(1)	---	368(3)	---	443(1)	457(3)	452(1)	---	485(1)	
2013 ¹	253(1)	338(5)	376(7)	387(8)	434(6)	440(8)	453(5)	467(9)	473(6)	
2011	237(7)	---	369(4)	---	436(5)	441(5)	452(1)	454(1)	---	
2009	206(4)	319(2)	358(16)	411(8)	434(6)	447(6)	453(2)	463(4)	---	

¹ Older smallmouth bass were sampled, but are not reported in this table.

Table 8. Year class distribution based on the expanded age/length summary for walleye sampled in gill nets and associated stocking history (# stocked x 1,000) from Horseshoe Lake, 2005-2015.

Survey Year	Year Class													
	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002
2015		11	3	7		11	3							
2014 ¹	---			6	7	5	3							
2011 ¹	---	---	---	---		32	45	2		1				
2008	---	---	---	---	---	---	---			3	15	1		
2005 ¹	---	---	---	---	---	---	---	---	---	---		5	13	1
# stocked														
fry		300				600							900	1000
sm. fingerling				60				55		61	101			
lg. fingerling														

¹ Older walleye were sampled but are not reported in this table

Table 9. Weighted mean total length at capture (mm) for walleye age-1 through age-7 sampled in experimental gill nets (expanded sample size) from Horseshoe Lake, 2005-2015. Note: sampling was conducted at approximately the same time during each year allowing comparisons among years to monitor growth trends.

Year	Age						
	1	2	3	4	5	6	7
2015	185(11)	276(3)	375(7)	---	483(11)	568(3)	---
2014 ¹	---	274(6)	367(7)	397(5)	567(3)	---	---
2011 ¹	189(32)	346(45)	438(2)	---	556(1)	---	---
2008	---	337(3)	377(15)	370(1)	---	---	---
2005	239(5)	338(13)	460(1)	502(1)	---	---	494(3)

¹ Older walleye were sampled but are not reported in this table

Table 10. Stocking history including size and number for fishes stocked into Horseshoe Lake, 2002-2015. WAE= walleye

Year	Species	Size	Number
2002	WAE	fry	1,000,000
2003	WAE	fry	900,000
2005	WAE	sm. fingerling	101,200
2006	WAE	sm. fingerling	60,800
2008	WAE	sm. fingerling	55,480
2010	WAE	fry	600,000
2012	WAE	sm. fingerling	60,510
2014	WAE	fry	300,000

Table 11. Year class distribution based on the expanded age/length summary for yellow perch sampled in gill nets from Horseshoe Lake, 2011-2015.

Survey Year	Year Class								
	2015	2014	2013	2012	2011	2010	2009	2008	2007
2015	---	---	172	2	3	1	---	---	---
2014	---	---	48	5	11	10	---	---	---
2011	---	---	---	---	---	50	24	---	51

Table 12. Weighted mean total length (mm) at capture for yellow perch captured in experimental gill nets (expanded sample size) from Horseshoe Lake, 2011-2015.

Year	Age				
	1	2	3	4	5
2015	---	191(172)	264(2)	285(3)	308(1)
2014	128(48)	167(5)	228(11)	260(10)	---
2011	132(50)	224(24)	---	286(51)	---

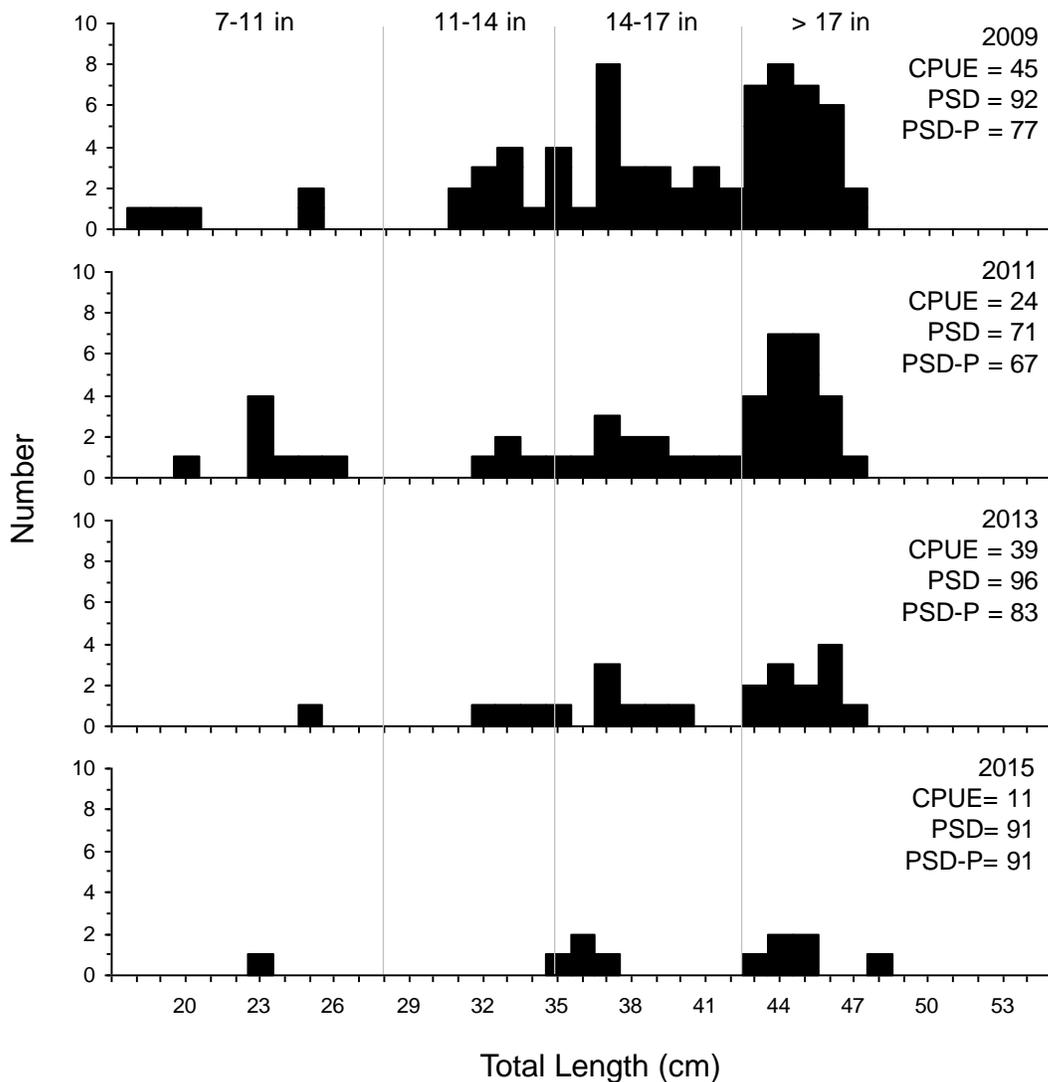


Figure 3. Length-frequency histogram, catch rate of stock-length fish (CPUE), proportional size distribution of quality- (PSD) and preferred-length (PSD-P) fish for smallmouth bass captured by spring electrofishing 2009-2015 from Horseshoe Lake.

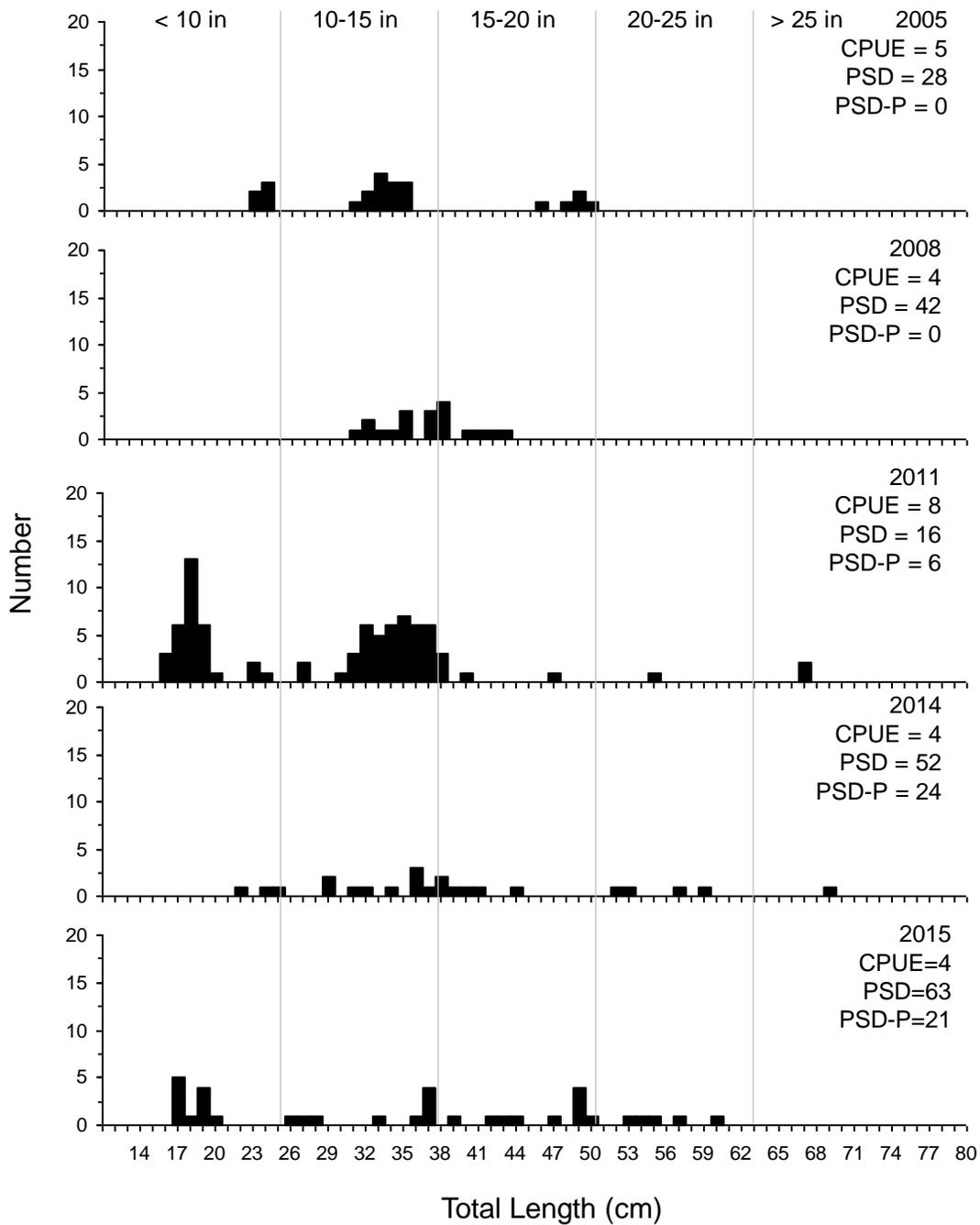


Figure 4. Length-frequency histogram, catch rate of stock-length fish (CPUE), proportional size distribution of quality- (PSD) and preferred-length (PSD-P) fish for walleye captured using experimental gill nets in Horseshoe Lake, 2005-2015.

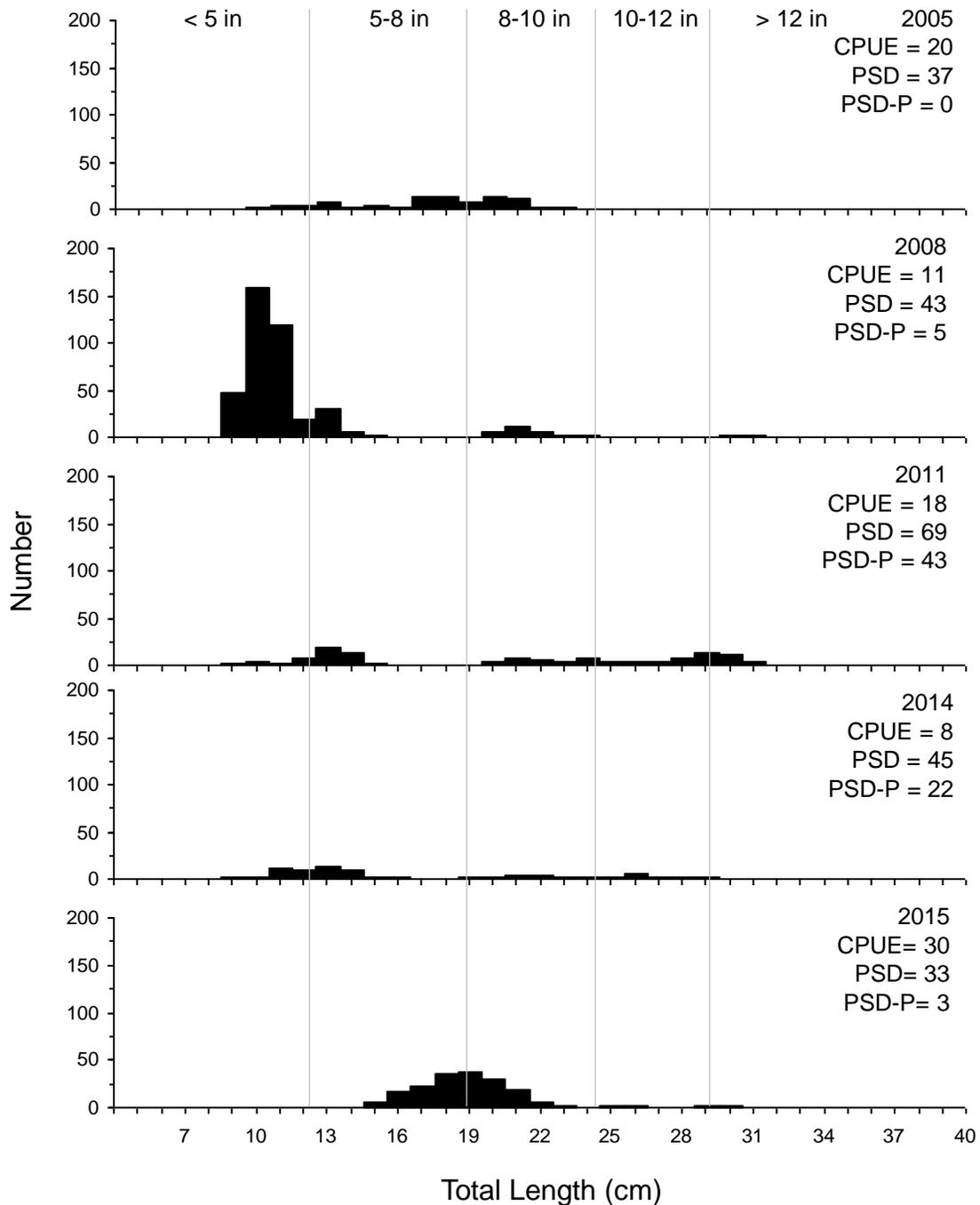


Figure 5. Length-frequency histogram, catch rate of stock-length fish (CPUE), proportional size distribution of quality- (PSD) and preferred-length (PSD-P) fish for yellow perch captured using experimental gill nets in Horseshoe Lake, 2005-2015.