

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 ½ miles west of Webster, SD.

Survey Dates and Sampling Information

Dates of current survey	June 17-19, 2008 (FN,GN) June 28-29, 2005 (FN,GN)
Date of most recent survey	none
Gill net sets (n)	4 (2005), 6 (2008)
Frame net sets (n)	12 (2005), 18 (2008)

Morphometry (Figure 1)

Watershed area (acres)	Unknown
Surface area (acres)	570
Maximum depth (ft)	≈20
Mean depth (ft)	unknown

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 metal boat ramp and landing dock is located on the east shore of Horseshoe Lake (Figure 1). Lands adjacent to Horseshoe Lake are primarily owned by the State of South Dakota and private individuals.

Watershed and Land Use

Land-use within the Horseshoe Lake watershed is primarily agricultural including grass/pasture land, cropland, and scattered shelterbelts.

Water Level Observations

Water levels in Horseshoe Lake increased during the mid to late 1990's. Currently, water levels are below those observed during the late 1990's, but remain sufficient to support the sport fishery.

Aquatic Vegetation and Exotics

Emergent vegetation is sparse in Horseshoe Lake while submerged vegetation is abundant; however, the type and extent has not been documented. No exotic species have been reported in Horseshoe Lake.

Fish Management Information

Primary species	smallmouth bass, walleye, yellow perch
Other species	black crappie, bluegill, green sunfish, largemouth bass, northern pike
Lake-Specific regulations	NE Panfish Management Area: 10 daily; 50 possession smallmouth/largemouth bass daily limit of 3. Only those <12", 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

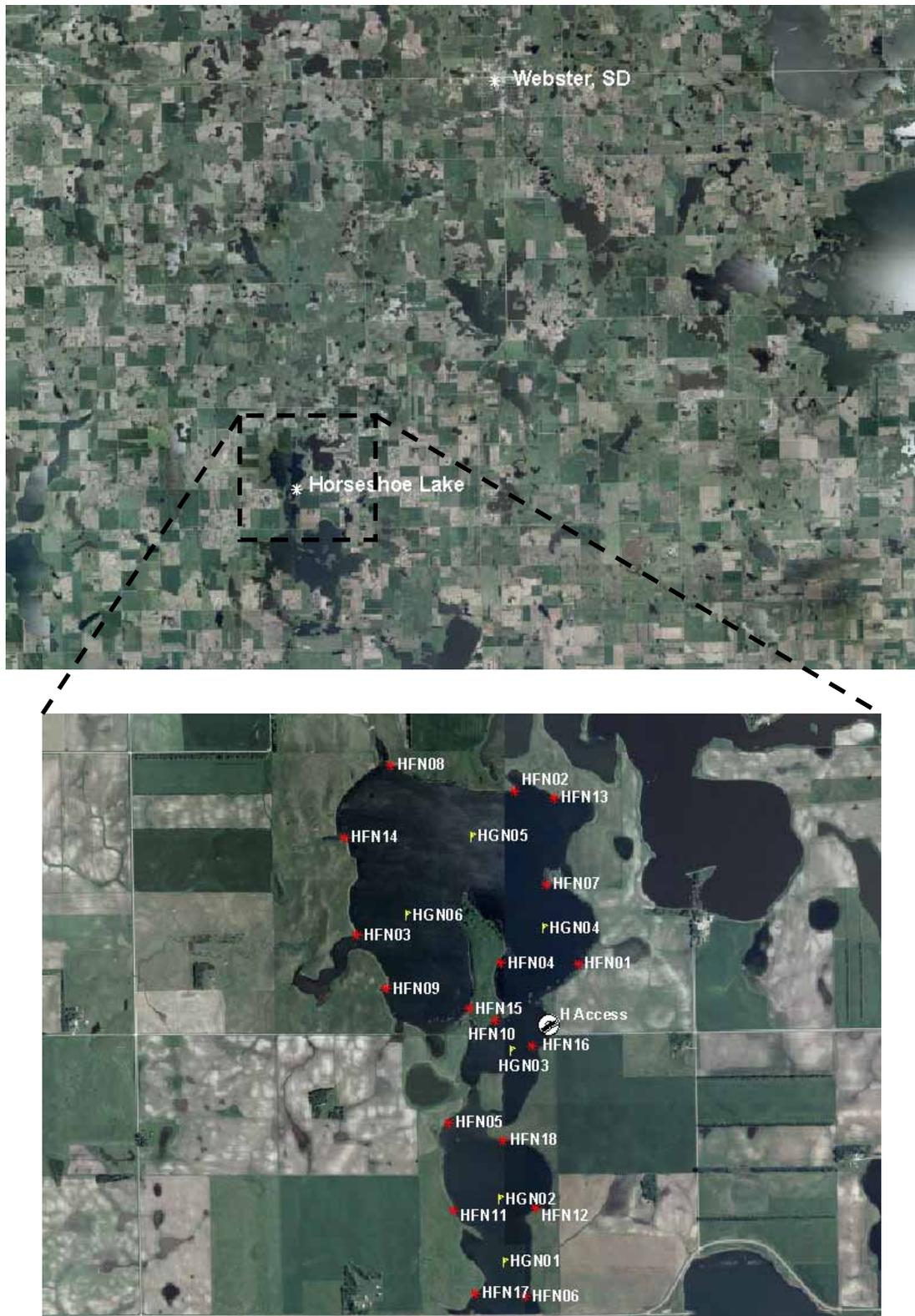


Figure 1. Map depicting location of Horseshoe Lake from Webster, SD; including access site, and standardized net locations. HFN= frame nets; HGN= gill nets

Management Objectives

- 1) Maintain a moderate density black bass (primarily smallmouth bass) population with a PSD of 40-70, and a PSD-P of 10-20.
- 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 ≥ 25 , 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 recently expanded Horseshoe Lake were highly successful. In addition to walleye, yellow perch populations were also highly 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 black bass (primarily smallmouth), walleye, and yellow perch fishery.

Primary Species

Smallmouth bass: The mean frame net CPUE for smallmouth bass in 2008 was 4.4 (Tables 1-3, Figure 2). The CPUE was substantially higher than the value of 1.8 observed in 2005 (Tables 1-3, Figure 2). It is difficult to determine whether the increase from 2005 to 2008 is due to an increase in abundance or sampling variability.

Smallmouth bass captured in frame nets in 2008 ranged from 13 to 47 cm TL (5.1 to 18.5 inches; Figure 2). The 2008 population had a PSD of 84 and PSD-P of 61 (Tables 1, 3, Figure 2). The PSD and PSD-P values increased from those observed in 2005 (77 and 50, respectively; Tables 1, 3, Figure 2). Length-frequency and age-structure analysis indicate consistent recruitment in recent years.

Growth of smallmouth bass captured in frame nets was excellent with the mean back-calculated length at age-3 being 309 mm (12.2 inches) (Table 5). The 2008 mean back-calculated length at age-3 was greater than the regional mean (249 mm, 9.8 inches) and the 2005 mean (300 mm, 11.8 inches; Tables 4-5). The condition of smallmouth bass in 2008 was excellent with mean W_r values ranging from 99 to 118. No length related trends in W_r were observed in 2008.

On January 1, 2008 a new regulation was enacted on Horseshoe Lake to maintain a quality black bass fishery for anglers. The regulation allows for the harvest of only those black bass less than 12 inches or greater than 18 inches. The daily limit is three black bass of which no more than one may be 18 inches or longer.

Walleye: The mean gill net CPUE of stock-length walleye during 2008 was 3.2 (Tables 1-3). The low CPUE is indicative of a low abundance population and is below the minimum management objective (≥ 10 walleye/net night). Relative abundance is similar to that observed in 2005 when the CPUE of stock-length walleye was 4.5 (Tables 1-3). Walleye reproduction in Horseshoe Lake appears to be limited and recent walleye stockings have been only moderately successful. In 2008, only three walleye year classes were represented in the gill net catch; 2004, 2005, and 2006 (Table 8). The largest proportion of the sample (95 %) was from the 2005 and 2006 cohorts and corresponds with fingerling stockings. The 2005 and 2002 surveys had similar results with 74% (2005) and 76% (2002) of gill net captured walleye corresponding to stocked years.

Walleye captured in gill nets during 2008 ranged in total length from 31 to 43 cm (12.2 to 16.9 inches; Figure 3). The PSD of walleye captured in gill nets during 2008 was 42 and the PSD-P was 0 (Table 1; Table 3; Figure 3). The PSD was within the objective range of 30-60; while the PSD-P was below the desired range of 5-10.

Growth of walleye in 2008 was slower than what was observed in 2005. Age-3 walleye had a weighted mean length at capture of 377 mm (14.8 inches) in 2008 compared to 460 mm (18.1 inches) in 2005 (Table 6). The mean W_r of stock-length walleye was 94 (Table 1). A slight increasing trend in W_r was observed as total length increased in the 2008 survey.

Yellow perch: The mean gill net CPUE of stock-length yellow perch in 2008 was 10.8 and below the minimum objective (≥ 25 fish/net night) for perch in Horseshoe Lake (Tables 1 – 3; Figure 4). The CPUE in 2008 was lower than that observed in 2005 when the CPUE for stock-length yellow perch was 20.3 (Tables 1-3, Figure 4). The decline in relative abundance may be attributed to poor reproduction. However, large numbers of sub-stock yellow perch were captured in 2008 indicating good reproduction the past two years. The improved reproduction may be a result of rising water levels the past two springs.

In 2008, collected yellow perch ranged from 9 to 31 cm TL (3.5 to 12.2 inches; Figure 4). The PSD and PSD-P of the yellow perch sample were 43 and 5, respectively (Tables 1, 3, Figure 4). Both the PSD and PSD-P were within the management objective ranges (30-60 and 5-10, respectively) indicating a balanced population.

No growth information was available in 2008. The condition of yellow perch in Horseshoe Lake was excellent, with the mean W_r of stock-length yellow perch ranging from 103 to 114. No length related trends in W_r were apparent during 2008.

Other Species

Black crappie: Black crappies were collected from Horseshoe Lake for the first time in 2008. The CPUE of stock-length black crappie captured in frame nets was 0.1 (Tables 1-2). At this time abundance appears to be low.

Bluegill: The CPUE of stock-length bluegill captured in frame nets in 2008 was 2.4 (Tables 1-2). This was an increase from the 0.1 observed in 2005 (Tables 1-2). No growth information was available in 2008. Mean W_r values for bluegill sampled in 2008 ranged from 72 to 152 for all length categories sampled. Stock-length bluegill had a mean W_r of 132 (Table 1). The high W_r observed is likely the result of the survey being conducted prior to the bluegill spawn.

Green sunfish: The CPUE for stock-length green sunfish captured in the frame nets in 2008 survey was 0.6 (Tables 1-2). This was an increase from the 0.1 observed in 2005 (Tables 1-2). Green sunfish abundance is currently low and the population should have minimal impact on the fishery in Horseshoe Lake.

Northern pike: The gill net CPUE for stock-length northern pike in 2008 was 0.5 (Tables 1-2). The population continues to be present at a low abundance. However, northern pike typically are not sampled consistently using standard lake survey methods; therefore reported values may not accurately represent the at-large population.

Largemouth Bass: No largemouth bass were captured in the 2008 survey. A low density population does exist in Horseshoe Lake.

Management Recommendations

- 1) Conduct fish population assessment surveys utilizing gill nets and frame nets every third year (next survey scheduled for summer 2011) 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 black bass to assess the age structure and growth rates of each population.
- 3) Change biennial walleye stocking from small to large fingerlings (≈ 25 large fingerlings/acre) which may improve survival and increase relative abundance.
- 4) Evaluate black bass population dynamics and implement regulations to benefit the population and comply with tool box options.
- 5) Conduct spring night electrofishing on an annual basis to monitor the relative abundance, fish size structures, and growth rates of the black bass populations.

Table 1. Mean catch rate (CPUE; gill/frame 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 experimental gill nets, and frame nets in Horseshoe Lake, 2008. Confidence intervals include 80 percent (\pm CI-80) or 90 percent (\pm CI-90). BLC= black crappie; BLG= bluegill; GSF= green sunfish; NOP= northern pike; SMB= smallmouth bass; WAE= walleye; YEP= yellow perch

Survey Year Species	Abundance		Stock Density Indices				Condition	
	CPUE	CI-80	PSD	CI-90	PSD-P	CI-90	Wr	CI-90
2005								
<i>Frame nets</i>								
BLG	0.1	0.1	0	---	0	---	129	---
GSF	0.1	0.1	0	---	0	---	---	---
NOP	0.4	0.3	100	0	40	52	94	5
SMB	1.8	0.6	77	16	50	19	121	4
WAE	3.3	1.2	95	5	90	8	91	2
YEP	0.1	0.1	100	---	0	---	98	---
<i>Gill nets</i>								
NOP	0.5	0.5	100	0	50	50	93	10
WAE	4.5	1.1	28	19	0	---	98	2
YEP	20.3	3.9	37	9	0	---	108	0
2008								
<i>Frame nets</i>								
BLC	0.1	0	0	---	0	---	116	---
BLG	2.4	1.5	91	7	35	12	132	2
GSF	0.6	0.5	9	17	0	---	115	2
NOP	0.2	0.2	50	50	25	59	93	16
SMB	4.4	1.4	84	7	61	9	106	1
WAE	1.1	0.3	85	14	80	16	86	3
<i>Gill nets</i>								
NOP	0.5	0.5	100	0	33	67	89	20
WAE	3.2	1.3	42	20	0	---	94	3
YEP	10.8	6.3	43	10	5	4	109	<1

Table 2. Historic mean catch rate (CPUE; gill/frame nets = catch/net night) of stock-length fish for various fish species captured in experimental gill nets and frame nets in Horseshoe Lake, 2002-2008. BLC= black crappie; BLG= bluegill; GSF= green sunfish; NOP= northern pike; SMB= smallmouth bass; WAE= walleye; YEP= yellow perch

Species	CPUE							Mean
	2002	2003	2004	2005	2006	2007	2008	
<i>Frame nets</i>								
BLC	---	---	---	0.0	---	---	0.1	0.1
BLG	---	---	---	0.1	---	---	2.4	1.3
GSF	---	---	---	0.1	---	---	0.6	0.4
NOP	---	---	---	0.4	---	---	0.2	0.3
SMB	---	---	---	1.8	---	---	4.4	3.1
WAE	---	---	---	3.3	---	---	1.1	2.2
YEP	---	---	---	0.1	---	---	0.0	0.1
<i>Gill nets</i>								
NOP	0.3	---	---	0.5	---	---	0.5	0.4
SMB	0.5	---	---	0.0	---	---	0.0	0.2
WAE	12.0	---	---	4.5	---	---	3.2	6.6
YEP	6.5	---	---	20.3	---	---	10.8	12.5

Table 3. Mean catch rate (CPUE; gill/frame nets = catch/net night), proportional size distribution of quality- (PSD) and preferred-length (PSD-P) fish, and relative weight (Wr) for selected species captured in experimental gill nets and frame nets in Horseshoe Lake, 2002-2008. SMB= smallmouth bass; WAE= walleye; YEP= yellow perch

Species	2002	2003	2004	2005	2006	2007	2008	Average	Objective
<i>Frame nets</i>									
SMB									
CPUE	---	---	---	2	---	---	4	3	---
PSD	---	---	---	77	---	---	84	81	---
PSD-P	---	---	---	50	---	---	61	56	---
Wr	---	---	---	121	---	---	106	114	---
<i>Gill nets</i>									
WAE									
CPUE	12	---	---	5	---	---	3	6	≥ 10
PSD	94	---	---	28	---	---	42	55	30-60
PSD-P	0	---	---	0	---	---	0	0	5-10
Wr	95	---	---	98	---	---	94	96	---
YEP									
CPUE	7	---	---	20	---	---	11	13	≥ 25
PSD	35	---	---	37	---	---	43	38	30-60
PSD-P	31	---	---	0	---	---	5	12	5-10
Wr	100	---	---	108	---	---	109	106	---

Table 4. Mean back-calculated length (mm) at age and standard error (SE) for smallmouth bass captured using frame nets in Horseshoe Lake, 2005.

Year	Age	N	Age							
			1	2	3	4	5	6	7	8
2004	1	5	113							
2003	2	6	94	166						
2002	3	5	84	185	283					
2001	4	6	122	243	332	377				
2000	5	3	102	221	317	365	385			
1999	6	1	102	217	326	396	425	450		
1998	7	0								
1997	8	1	79	188	243	299	364	392	410	432
Mean	---	27	99	204	300	359	391	421	410	432
SE	---	---	6	12	17	21	18	29	0	0
<i>Mean Comparison</i> ¹										
			98	180	241	291	---	---	---	---
			92	169	237	304	335	---	---	---
			96	179	249	316	339	---	---	---
			91	171	242	300	333	---	---	---

¹ Willis et al. 2001.

Table 5. Mean back-calculated length (mm) at age and standard error (SE) for smallmouth bass captured using frame nets in Horseshoe Lake, 2008.

Year	Age	N	Age								
			1	2	3	4	5	6	7	8	9
2007	1	1	125								
2006	2	11	117	233							
2005	3	17	96	202	306						
2004	4	11	97	226	329	376					
2003	5	3	109	220	310	366	405				
2002	6	14	97	201	294	366	407	433			
2001	7	9	101	214	314	377	414	440	452		
2000	8	9	95	198	302	367	393	415	436	453	
1999	9	4	99	201	307	364	400	417	435	453	462
Mean	---	79	104	212	309	369	404	426	441	453	462
SE	---	---	4	5	4	2	4	6	5	0	0
<i>Mean Comparison</i> ¹											
			98	180	241	291	---	---	---	---	---
			92	169	237	304	335	---	---	---	---
			96	179	249	316	339	---	---	---	---
			91	171	242	300	333	---	---	---	---

¹ Willis et al. 2001.

Table 6. Weighted mean length at capture (mm) for walleye captured in experimental gill nets in Horseshoe Lake, 2002-2008. Note: sampling was conducted one-month later in 2002; other years sampling was conducted in mid-June.

Year	N	Age						
		1	2	3	4	5	6	7
2008 ¹	19	---	337	377	370	---	---	---
2005 ¹	23	239	338	460	502	---	---	494
2002	54	221	373	395	432	---	---	---

¹Age assignments made using otoliths; scales were used in previous years.

Table 7. Stocking history including size and number for fishes stocked into Horseshoe Lake, 1996-2008.

Year	Species	Size	Number
1996	WAE	fry	400,000
1996	LMB/SMB	fingerling	7,400
1998	WAE	fry	500,000
2000	WAE	fry	1,000,000
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

Table 8. Numbers of walleye sampled using gill nets (n) by year class and associated stocking history (Number stocked x 1,000) for walleye captured in Horseshoe Lake, 2002-2008.

Survey Year	Year Class										
	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998
2008 ¹			3	15	1						
2005 ¹	---	---	---		5	13	1	1			3
2002	---	---	---	---	---	---		5	4	8	37
Number stocked											
fry						900	1,000		1,000		500
small fingerling	55		61	101							
large fingerling											

¹Age assignments made using otoliths; scales were used in previous years.

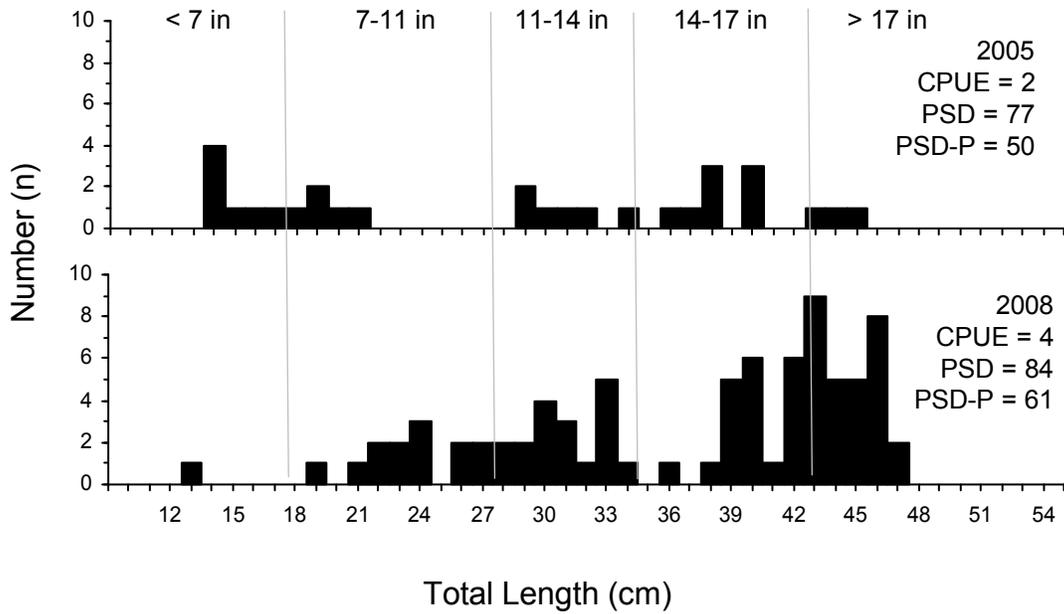


Figure 2. Length-frequency histogram, catch rate of stock-length fish (CPUE), proportional size distribution of quality- (PSD) and preferred-length (PSD-P) fish for smallmouth bass captured by frame nets in Horseshoe Lake, 2005 and 2008.

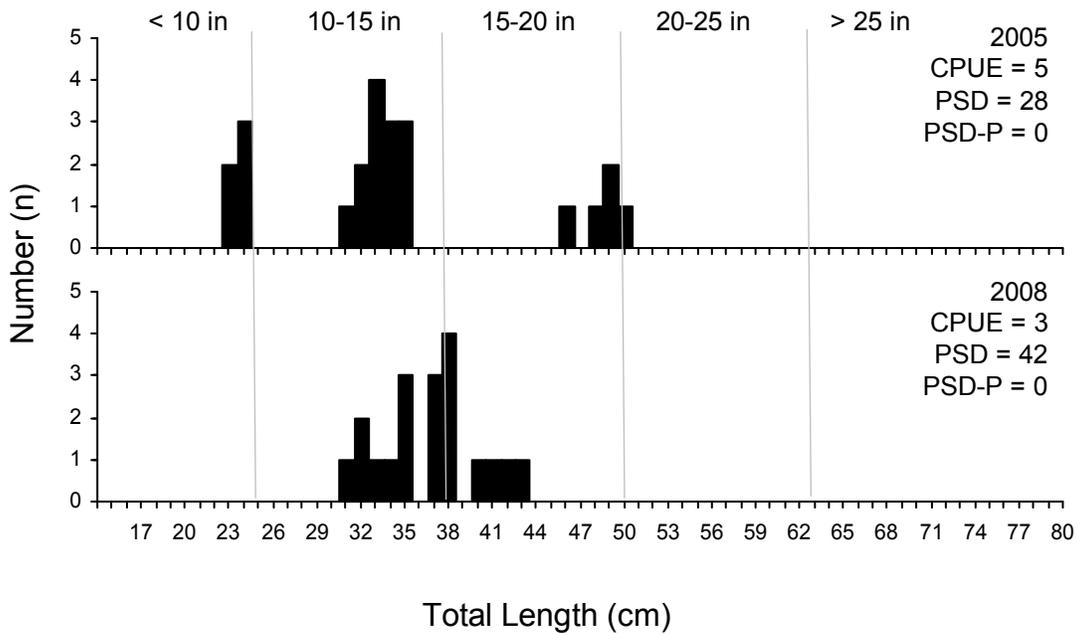


Figure 3. Length-frequency histogram, catch rate of stock-length fish (CPUE), proportional size distribution of quality- (PSD) and preferred-length (PSD-P) fish for walleye captured in gill nets in Horseshoe Lake, 2005 and 2008.

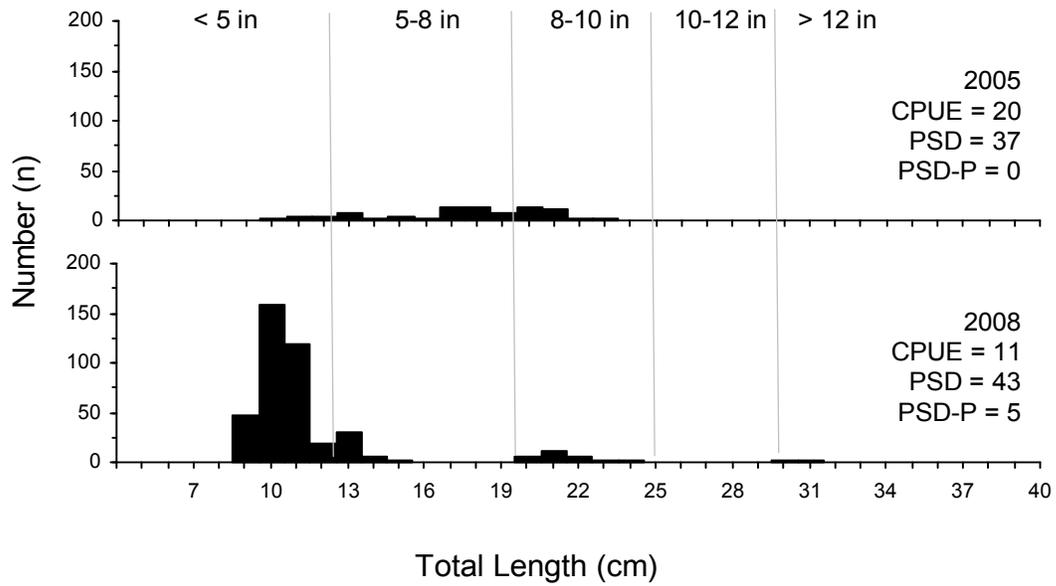


Figure 4. Length-frequency histogram, catch rate of stock-length fish (CPUE), proportional size distribution of quality- (PSD) and preferred-length (PSD-P) fish for yellow perch captured in gill nets in Horseshoe Lake, 2005 and 2008.