Waubay Lake

Site Description

Location

Water designation number (WDN)	22-0031-00
Legal description	T122N-R54 W-Sec. 4-6; T122N-R55W-Sec. 1-5, 7-10, 15-19 T123N-R53W-Sec. 17,20; T123N-R54W-Sec. 7, 18-20, 29-32 T123N-R55W-Sec. 12-14, 23-28, 31-36
County (ies)	Day
Location from nearest town	Southeast of Grenville, SD.

Survey Dates and Sampling Information

Survey dates	June 3, 2015 (EF-SMB) August 11-12, 2015 (GN) September 21, 2015 (EF-WAE)
Spring electrofishing-SMB (min)	60
Gill net sets (n)	8
Fall electrofishing-WAE (min)	50

Morphometry (Figure 1)

Watershed area (acres)	186,967
Surface area (acres)	≈15,540
Maximum depth (ft)	≈31
Mean depth (ft)	13

Ownership and Public Access

Waubay Lake is a meandered lake owned by the State of South Dakota and the fishery is managed by the SDGFP. Eight public access sites are present on Waubay Lake (Figure 1). Two (Kanago and Grenville) are maintained by the SDGFP, and six (Buster's, West Bay Ranch, Breske's Bay, Vic's Landing, Wika's Access, and Buckshot/Neil's) are privately maintained and require a fee or donation for access (Figure 1; Figure 2). Lands adjacent to Waubay Lake are under mixed ownership by the State of South Dakota, private parties, and the U.S. Fish and Wildlife Service (i.e., Waubay National Wildlife Refuge).

Watershed and Land Use

Land use within the Waubay Lakes (HUC-10) watershed is primarily agricultural including cropland, pasture or grassland, and small wooded areas (e.g., shelterbelts).

Water Level Observations

The South Dakota Water Management Board established OHWM on Waubay Lake of 1787.0 fmsl is below the current water elevation. On April 28, 2015 the elevation was 1802.5 fmsl; 0.1 ft above the fall 2014 elevation of 1802.4 fmsl. By October 19, 2015 the water level had declined to an elevation of 1801.8 fmsl.

Fish Management Information

Primary species	smallmouth bass, walleye, yellow perch
Other species	black bullhead, black crappie, bluegill, common carp, lake herring, northern pike, rock bass, spottail shiner, white bass, white sucker
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	warmwater semi-permanent
Fish consumption advisories	none

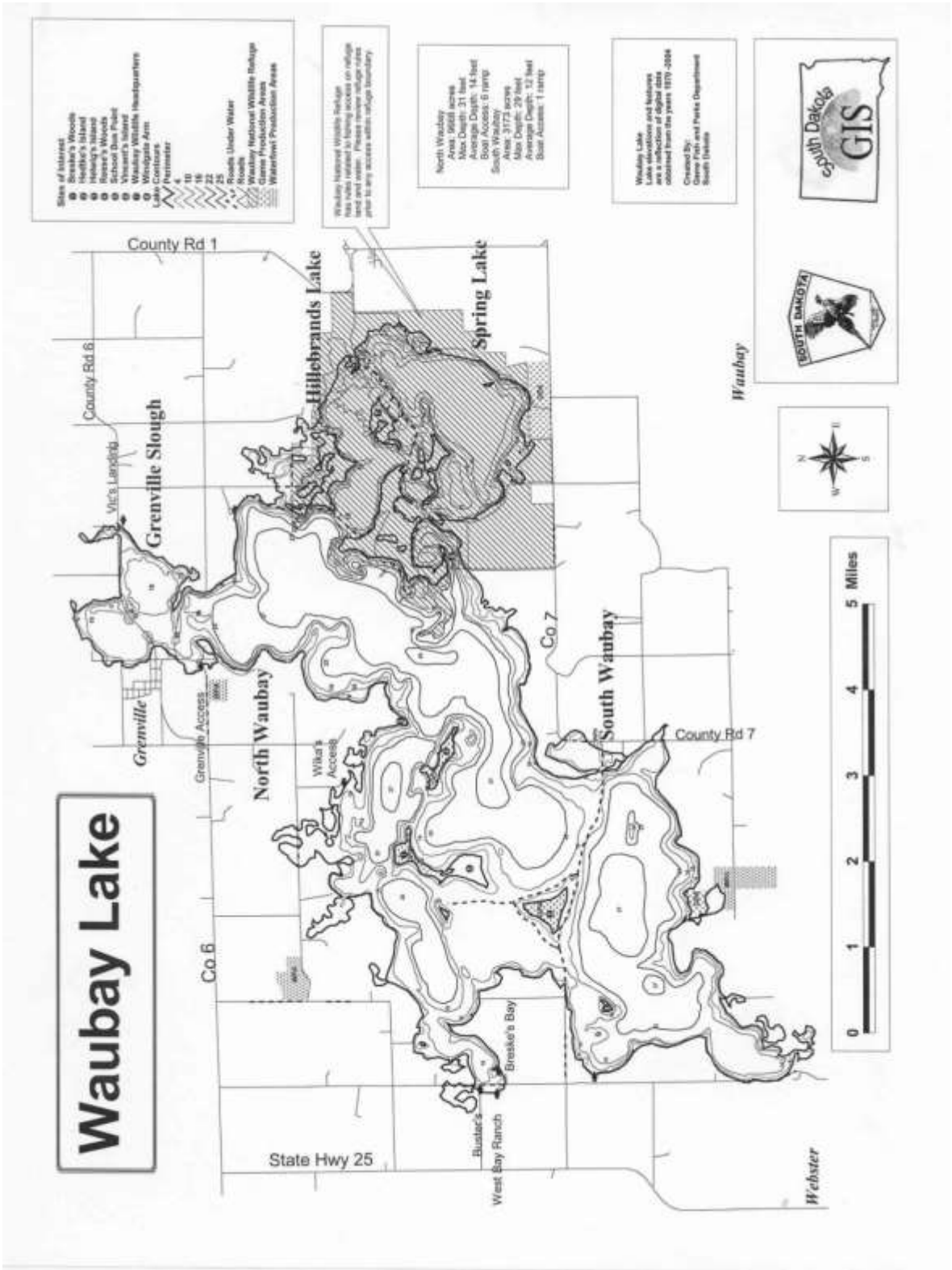

Figure 1. Map depicting access locations and depth contours for Waubay Lake, Day County, South Dakota.

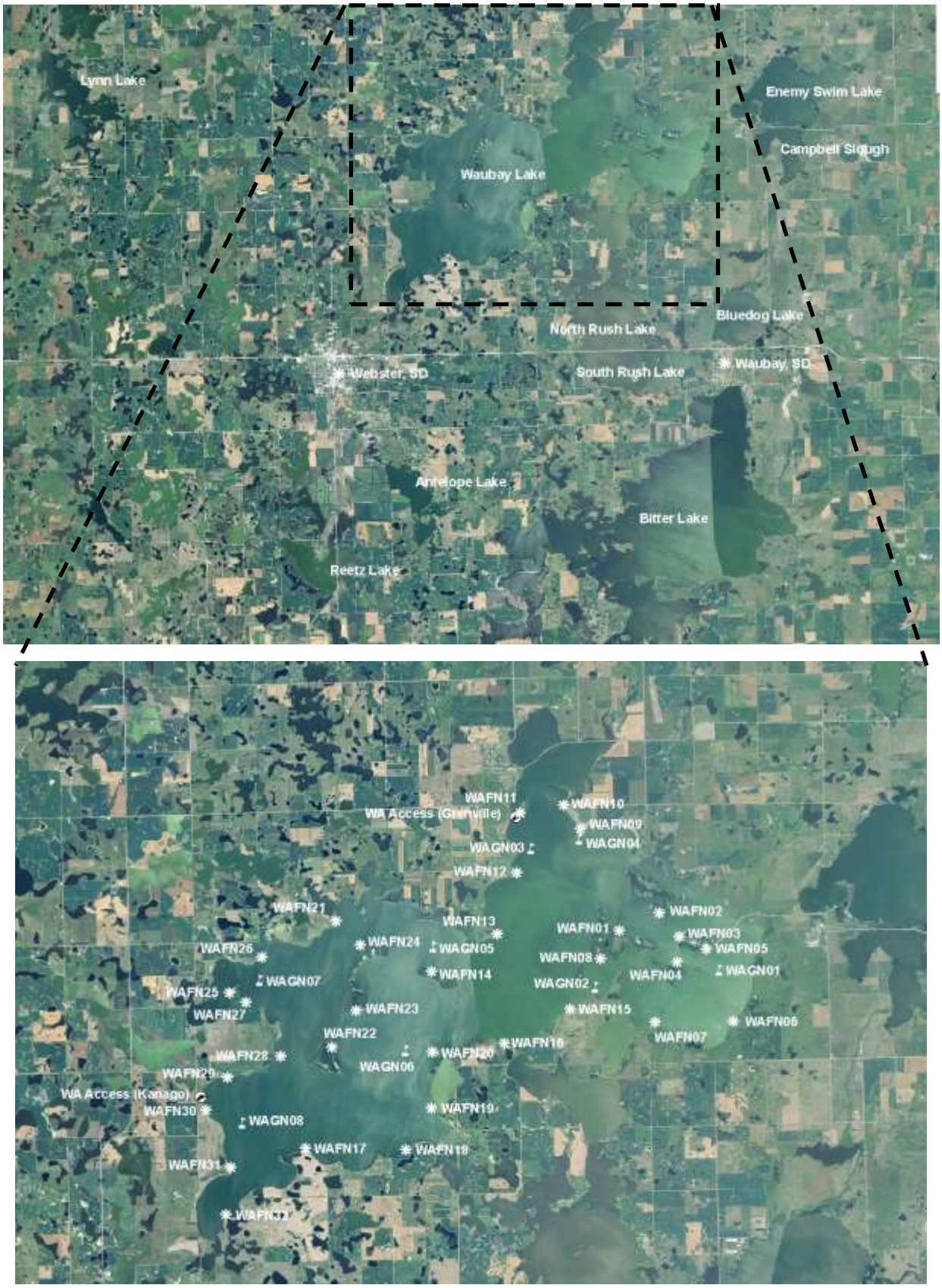

Figure 2. Map depicting geographic location of several Day County, South Dakota lakes including Waubay Lake (top). Also noted are state-owned public access locations and standardized net locations for Waubay Lake (bottom). WAFN= frame nets; WAGN= gill nets

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.

4) Maintain a mean frame net CPUE of stock-length black bullhead ≤ 100.

Results and Discussion

Waubay Lake, a meandered lake located in Day County, South Dakota, is comprised of four previously distinct waters (North Waubay, South Waubay, Spring Lake, and Hillebrands). High water conditions since the mid-1990s have connected these four lakes and formed a single lake (Waubay Lake). Currently, the surface area of Waubay Lake exceeds 15,000 acres and has a maximum depth of >31 ft. A portion of Waubay Lake is located within the boundaries of the Waubay National Wildlife Refuge (Figure 1). Neither boating nor fishing is allowed within the refuge boundaries during open-water periods; however, fishing is allowed during the winter months.

Currently, Waubay Lake is primarily managed for smallmouth bass, walleye, and yellow perch; however, a variety of fish species including but not limited to black crappie, bluegill, northern pike, rock bass, and white bass may contribute to the fishery (Table 2). In recent years, white bass have become an increasingly important component of the fishery.

Primary Species

Smallmouth bass: Spring night electrofishing to monitor smallmouth bass population parameters in Waubay Lake is scheduled to be conducted biennially during odd years (e.g., 2015, 2017, 2019…). In 2015 the mean CPUE for stock-length smallmouth bass was 8.0 (Table 1) and represents a substantial decrease from the 98.0 observed in 2013 (Table 2). The observed decline may be the result of sampling variability and does not necessarily indicate a decrease in relative abundance.

Smallmouth bass ranged in TL from 26 to 41 cm (10.2 in to 16.1 in). Small sample size limits the utility of size structure and condition data.

Walleye: Walleye were the most abundant species in the 2015 gill net catch. The mean gill net CPUE of stock-length walleye was 14.1 (Table 1) and above the minimum objective (≥ 10 stock-length walleye/net night; Table 3). Since 2006, the mean gill net CPUE has ranged from a low of 11.1 (2012) to a high of 34.4 (2007; Table 2). Based on the 2015 gill net CPUE, relative abundance is considered high.

Gill net captured walleye ranged in TL from 20 to 45 cm (7.9 to 17.7 in), had a PSD of 8 and a PSD-P of 0 (Table 1; Figure 3). Both the PSD and PSD-P were below management objective ranges of 30-60 and 5-10 indicating a population skewed towards smaller individuals (Table 3; Figure 3). Reductions in PSD values in each of the past two surveys can be attributed, in large part, to growth of individuals from the relatively-strong 2011 cohort into the stock-quality length category (25-38 cm; 10-15 in; Table 4; Table 5; Figure 3).

Since 2006, otoliths have been collected from a sub-sample of gill net captured walleye. Age structure information suggested that natural recruitment has contributed to the population (e.g., 2008. 2010, and 2013); however, the strongest year classes tend to coincide with fry stockings (Table 4; Table 6). Five year classes (2005, 2009, 2011, and 2013-2014) were represented in the 2015 gill net catch; individuals from the strong 2011 cohort comprised 89% of walleye sampled (Table 4). Despite the stocking of 8 million fry in 2012 and 8.5 million fry in 2014, it appears that only weak cohorts were produced (Table 4). In 2015, survey results suggest limited survival of stocked or naturally-produced walleye, as no age-0 walleye were captured in gill nets and only one individual was sampled during fall night electrofishing (i.e., mean CPUE of 2.0; Table 1; Table 4; Table 6). However, mean fall night electrofishing CPUE for age-0 walleye in 2011 was low, when a strong cohort was produced (Table 2; Table 4). Walleye fry stocked in 2009, 2011, and 2014 were marked with Oxytetracycline (OTC) so that the contribution of stocked fish could be evaluated. The estimated stocking contribution for the 2009 year class was 90% (Table 4). In 2011 and 2014, OTC marking suggested that natural reproduction contributed a higher proportion of fish to year classes produced; estimated stocking contributions were 14% and 62%, respectively, but sample size was low and results should be interpreted with caution (Table 4).

Walleye growth in Waubay Lake tends to be highly variable (Table 5). Since 2006, the weighted mean TL at capture of age-4 walleye has ranged from 331 to 402 mm (13.0 to 15.8 in; Table 5). In 2015, the weighted mean TL at capture of age-4 fish was 331 mm (13.0 in) and the lowest reported since 2006 (Table 5). A slight decreasing trend in walleye condition was apparent as TL increased; those in the stock-quality length category had a mean Wr of 86; while those in quality-preferred length category had a mean Wr of 81.

Yellow Perch: The mean gill net CPUE of stock-length yellow perch was 19.5 (Table 1) and below the minimum objective (≥ 30 stock-length perch/net night; Table 3). Since 2006, the gill net CPUE of stock-length yellow perch has fluctuated from a low of 11.1 (2012) to a high of 42.8 (2007; Table 2). The 2015 gill net CPUE represented an increase from the 2014 CPUE of 18.5 (Table 2), but still indicated moderate relative abundance.

Gill net captured yellow perch ranged in TL from 12 to 31 cm (4.7 to 12.2 in), with a high proportion being ≥ quality-length (20 cm; 8 in; Figure 5). The PSD was 83 and the PSD-P was 38; both exceeded management objectives of 30-60 and 5-10 (Table 3).

Otoliths collected from a sub-sample of gill net captured individuals suggested consistent recruitment with seven consecutive year classes (2008-2014) represented (Table 7). Year classes produced in 2011-2012 were the most abundant and collectively comprised 59% of perch in the gill net catch (Table 7).

Yellow perch in Waubay Lake display moderate growth and typically approach or surpass quality-length (20 cm; 8 in) by age 2 (Table 8). Since 2009, weighted mean TL at capture values for age-2 yellow perch have ranged from 186 to 216 mm (7.3 to 8.5 in); while the weighted mean TL at capture for age-3 fish has ranged from 233 to 249 mm (9.2 to 9.8 in; Table 8). In 2015, the weighted mean TL at capture was lower than previous years at both ages 2 and 3, with values of 190 and 236 mm (7.5 in to 9.3; Table 8). Condition of gill net captured perch was high with mean Wr values that ranged from 112 to 120 for all length categories (e.g., stock to quality) sampled. No length related trend in Wr was observed; the mean Wr of stock-length yellow perch was 117 (Table 1).

Other Species

Lake Herring: Lake Herring were first captured from Waubay Lake during 2002, and have been sampled in low numbers annually from 2006-2015 (Table 2). In 2015, the mean gill net CPUE of stock-length Lake Herring was 0.3 (Table 1). Gill nets captured two individuals with TL values of 23 cm and 42 cm (9.1 and 16.5 in).

Northern Pike: Northern pike typically are not sampled effectively during standardized mid-summer fish community surveys. As a result, mean gill net CPUE values are often low. From 2006-2015, northern pike relative abundance has generally been low, with mean gill net CPUE values $\leq$ 1.0 (Table 2). In 2015, the mean gill net CPUE was 0.4 (Table 1), as three stock-length individuals that ranged from 73 to 89 cm (28.7 to 35.0 in) were captured.

No age or growth information was collected. Few inferences can be made concerning size structure and condition due to the low sample size.

White bass: White bass were first sampled in Waubay Lake during 2001 and have become an important component of the fishery. In 2015, mean CPUE value for stock-length white bass in gill nets was 23.9 (Table 1).

White bass ranged in TL from 8 to 42 cm (3.1 in to 16.5 in), had a PSD of 100 and a PSD-P of 99 (Table 1). Limited recruitment and relatively fast growth to quality- and preferred-lengths contribute to the high size structure.

No age and growth information was available in 2015. A decreasing trend in condition was apparent as TL increased; mean Wr values ranged from 79 to 99 for all 10-mm length groups sampled.

Other: Black bullhead, common carp and rock bass were captured in low numbers during the 2015 survey (Table 1).

Management Recommendations

1) Conduct fish population assessment surveys utilizing gill nets on an annual basis (next survey scheduled in summer 2016) and frame nets every third year (next survey scheduled in summer of 2017) to monitor fish relative abundance, fish population size structures, fish growth, and stocking success.

2) Conduct fall night electrofishing on an annual basis to monitor age-0 walleye relative abundance.

3) Stock walleye (≈500 fry/acre) to establish additional year-classes if gill netting and/or fall night electrofishing CPUE of age-0 walleye results warrant [i.e., low gill net CPUE of sub-stock (< 25 cm; 10 in) walleye and/or fall night electrofishing CPUE of age-0 walleye < 75 fish/hour].

4) Collect otoliths from walleye and yellow perch, and scales from smallmouth bass to assess age structure and growth rates of each population.

5) Conduct spring night electrofishing on a biennial basis (odd years) to monitor smallmouth bass population parameters.

6) Consider enhancements that would improve shore fishing opportunities at the Kanago Public Access Area (i.e., fishing pier, fishing platforms, etc.)

7) Consider removal of the protective slot regulation on smallmouth bass. Regulation is unnecessary on Waubay Lake and difficulty in consistently sampling smallmouth bass limits our ability to effectively evaluate special regulations.

Table 1. Mean catch rate (CPUE; gill/frame nets= catch/net night, electrofishing = catch/hour) 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, frame nets, and electrofishing in Waubay Lake, 2015. Confidence intervals include 80 percent (± CI-80) or 90 percent (± CI-90). BLB= black bullhead; COC= common carp; LAH= lake herring; NOP= northern pike; ROB= rock bass; SMB= smallmouth bass; WAE= walleye; WHB= white bass; WHS= white sucker; YEP= yellow perch

	Abundance		Stock Density Indices			Condition		
Species	CPUE	CI-80	PSD	CI-90	PSD-P	CI-90	Wr	CI-90
Gill nets								
BLB	0.1	0.2	0	---	0	---	127	---
COC	0.1	0.2	100	---	100	---	119	---
LAH	0.3	0.2	100	0	50	50	122	---
NOP	0.4	0.3	100	0	100	0	77	4
ROB	0.4	0.3	100	0	0	---	111	13
WAE	14.1	4.9	8	4	0	---	85	<1
WHB	23.9	7.3	100	0	99	1	97	2
YEP	19.5	3.4	83	5	38	7	117	1
Electrofishing								
SMB[1]	8.0	1.8	88	24	38	35	85	5
WAE[2]	1.2	---	---	---	---	---	---	---

[1] Spring night electrofishing for-SMB
[2] Fall night electrofishing-WAE; catch rate (CPUE) represents age-0 walleye not stock length

Table 2. Historic mean catch rate (CPUE; gill/frame nets= catch/net night, electrofishing= catch/hour) of stock-length fish for various fish species captured in experimental gill nets, frame nets, and electrofishing in Waubay Lake, 2006-2015. BLB= black bullhead; BLC= black crappie; BLG= bluegill; COC= common carp; LAH= lake herring; NOP= northern pike; ROB= rock bass; SMB= smallmouth bass; SPS= spottail shiner; WAE= walleye; WHB= white bass; WHS= white sucker; YEP= yellow perch

	CPUE									
Species	2006[1]	2007[1]	2008	2009	2010	2011	2012	2013	2014	2015
Frame nets										
BLB	3.8	1.7	0.8	0.9	0.8	0.4	1.5	3.5	2.0	---
BLC	0.2	0.2	0.3	0.1	0.2	0.3	1.3	1.5	2.6	---
BLG	<0.1	0.2	0.1	0.1	0.6	0.7	0.9	0.4	0.3	---
COC	0.7	1.1	0.4	0.3	0.5	0.5	0.5	0.3	0.2	---
NOP	0.2	0.4	0.8	0.7	0.4	0.1	0.2	0.3	0.6	---
ROB	0.0	<0.1	0.3	0.7	0.9	0.6	0.9	2.6	1.2	---
SMB	2.1	6.3	1.9	3.4	6.3	6.1	5.1	6.2	3.5	---
WAE	9.7	8.3	6.1	5.4	5.5	3.1	2.9	2.5	2.8	---
WHB	9.1	6.6	3.2	7.1	3.1	6.5	5.1	3.8	2.5	---
WHS	0.7	0.4	0.1	0.2	0.1	0.1	0.1	0.1	<0.1	---
YEP	<0.1	<0.1	0.0	0.3	0.2	<0.1	0.1	<0.1	0.0	---
Gill nets										
BLB	0.3	0.6	0.0	0.1	0.0	0.5	4.3	4.1	1.4	0.1
BLG	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
COC	1.9	1.5	0.6	0.0	0.8	0.1	0.5	0.0	0.5	0.1
LAH	2.3	1.9	0.6	1.5	4.3	1.0	0.1	0.4	0.3	0.3
NOP	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.5	1.0	0.4
ROB	0.0	0.0	0.0	0.0	0.3	0.5	1.4	1.3	2.0	0.4
SMB	0.0	0.4	0.9	0.1	0.1	0.1	0.0	0.3	0.3	0.0
SPS[2]	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
WAE	13.5	34.3	28.8	12.4	16.0	15.9	11.1	11.8	19.3	14.1
WHB	0.3	2.0	4.6	0.3	0.9	2.9	1.5	17.6	8.1	23.9
WHS	0.0	0.3	0.1	0.0	0.4	0.0	0.0	0.3	0.1	0.0
YEP	27.6	42.8	32.4	13.8	19.8	27.6	28.1	21.9	18.5	19.5
Electrofishing										
SMB[3]	---	---	---	40.4	---	---	---	98.0	---	8.0
WAE[4]	2.0	0.0	5.0	88.0	0.0	6.0	5.0	1.0	15.0	1.2

[1] Monofilament gill net mesh size change (0.75”, 1.00”, 1.25”, 1.50”, 2.00” and 2.50”)
[2] All fish sizes
[3] Spring night electrofishing-SMB
[4] Fall night electrofishing-WAE; catch rate (CPUE) represents age-0 Walleye not stock length

Table 3. Mean catch rate (CPUE; gill/frame nets= catch/net night, electrofishing= catch/hour), proportional stock density of quality- (PSD) and preferred-length (PSD-P) fish, and relative weight (Wr) for selected species captured in experimental gill nets, frame nets, and electrofishing in Waubay Lake, 2006-2015. BLB= black bullhead; SMB= smallmouth bass; WAE= walleye; YEP= yellow perch

Species	2006[1]	2007[1]	2008	2009	2010	2011	2012	2013	2014	2015	Objective
Frame nets											
BLB											
CPUE	4	2	1	1	1	<1	2	4	2	---	≤ 100
PSD	96	98	96	100	83	91	78	73	100	---	---
PSD-P	90	87	96	100	78	45	13	37	94	---	---
Wr	83	86	86	96	92	84	93	86	90	---	---
Gill nets											
WAE											
CPUE	14	34	29	12	16	16	11	12	19	14	≥ 10
PSD	29	7	12	16	25	42	48	28	17	8	30-60
PSD-P	1	0	1	3	0	0	7	2	1	0	5-10
Wr	81	88	85	90	88	83	83	81	84	85	---
YEP											
CPUE	28	43	32	14	20	28	28	22	19	20	≥ 30
PSD	86	79	61	75	59	72	85	79	87	83	30-60
PSD-P	43	32	33	20	22	22	32	36	41	38	5-10
Wr	116	121	114	116	114	114	117	115	114	117	---
Electrofishing											
SMB[2]											
CPUE	---	---	---	40	---	---	---	98	---	8	---
PSD	---	---	---	57	---	---	---	53	---	88	40-70
PSD-P	---	---	---	27	---	---	---	18	---	38	10-20
Wr	---	---	---	102	---	---	---	89	---	85	---

[1] Monofilament gill net mesh size change (0.75”, 1.00”, 1.25”, 1.50”, 2.00” and 2.50”).
[2] Spring night electrofishing-SMB

Table 4. Year class distribution based on the expanded age/length summary for walleye sampled in gill nets and associated stocking history (# stocked x 10,000) from Waubay Lake, 2011-2015.

	Year Class												
Survey Year	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003
2015		4	1		104		4				4		
2014	---		3		120		21	3			9		
2013[1]	---	---		4	61	2	28	2		3	11	1	
2012[1]	---	---	---		131	14	30	7	1	2	30		
2011	---	---	---	---	1	5	50	17			54	3	1
# stocked													
fry		850[2]		800	800[3]		400[4]				600	870	900
sm. fingerling													49
lg. fingerling													

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

[2] 53% of stocked walleye were OTC marked; 4 of 12 otoliths collected from fall electrofished age-0 walleye exhibited marks. The estimated stocking contribution was 62%, but sample size was low and the results should be interpreted with caution

[3] 56% of stocked walleye were OTC marked; 1 of 12 otoliths collected from fall electrofished age-0 walleye exhibited marks. The estimated stocking contribution was 14%, but sample size was low and the results should be interpreted with caution

[4] Stocked walleye were OTC marked; 45 of 50 otoliths collected from fall electrofished age-0 walleye exhibited marks for an estimated stocking contribution of 90%

Table 5. Weighted mean TL (mm) at capture for walleye age-0 through age-10 sampled in experimental gill nets (expanded sample size) from Waubay Lake, 2006-2015. Note: sampling was conducted at approximately the same time during each year allowing comparisons among years to monitor growth trends.

	Age										
Year	0	1	2	3	4	5	6	7	8	9	10
2015	---	215(4)	280(1)	---	331(104)	---	388(4)	---	---	---	418(4)
2014	---	228(3)	---	304(120)	---	386(21)	401(3)	---	---	435(9)	---
2013[1]	---	234(4)	259(61)	350(2)	374(28)	429(2)	---	374(3)	447(11)	418(1)	---
2012[1]	---	213(131)	325(14)	367(30)	402(7)	488(1)	360(2)	447(30)	---	---	---
2011	119(1)	248(5)	322(50)	366(17)	---	---	407(54)	392(3)	457(1)	---	---
2010	151(1)	270(47)	347(24)	---	---	380(55)	394(3)	---	---	---	---
2009[1]	120(4)	239(6)	315(6)	---	349(77)	377(6)	---	368(2)	492(2)	---	422(3)
2008	---	214(2)	267(1)	314(188)	377(10)	383(13)	---	407(5)	405(3)	425(11)	---
2007	---	246(5)	280(190)	332(25)	354(34)	---	---	437(1)	412(20)	657(1)	---
2006[1]	---	223(72)	289(26)	332(20)	---	381(4)	---	385(54)	---	---	---

[1] Older walleye were sampled, but are not reported in this table.

Table 6. Stocking history including size and number for fishes stocked into Waubay Lake, 2003-2014. WAE= walleye

Year	Species	Size	Number
2003	WAE	fry	9,000,000
2003	WAE	small fingerling	496,655
2004	WAE	fry	8,700,000
2005	WAE	fry	6,000,000
2009	WAE	fry	4,000,000
2011	WAE	fry	8,000,000
2012	WAE	fry	8,000,000
2014	WAE	fry	8,500,000

Table 7. Year class distribution based on the age/length summary for yellow perch sampled in gill nets from Waubay Lake, 2011-2015.

	Year Class													
Survey Year	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002
2015		17	14	37	56	14	19	1						
2014	---		9	12	61	33	31	3	1	1				
2013	---	---		5	51	38	61	4	10		1	4		
2012[1]	---	---	---		26	63	111	13	7			1	1	
2011	---	---	---	---		23	131	26	31	8				

[1] Older yellow perch were sampled, but are not reported in this table.

Table 8. Weighted mean TL (mm) at capture for yellow perch age-1 through age-10 captured in experimental gill nets (expanded sample size) from Waubay Lake, 2009-2015.

	Age									
Year	1	2	3	4	5	6	7	8	9	10
2015	136(17)	190(14)	236(37)	248(56)	261(14)	268(19)	311(1)	---	---	---
2014	138(9)	186(12)	233(61)	261(33)	251(31)	301(3)	343(1)	303(1)	---	---
2013	150(5)	198(51)	237(38)	249(61)	245(4)	280(10)	---	323(1)	271(4)	---
2012[1]	143(26)	216(63)	245(111)	266(13)	262(7)	---	---	309(1)	335(1)	---
2011	152(23)	206(131)	242(26)	269(31)	281(8)	---	---	---	---	---
2010	151(60)	216(31)	245(61)	251(7)		280(3)	---	---	---	---
2009[1]	147(2)	204(75)	249(14)	261(2)	267(5)	255(1)	---	291(4)	267(2)	299(2)

[1] Older yellow perch were sampled, but are not reported in this table.

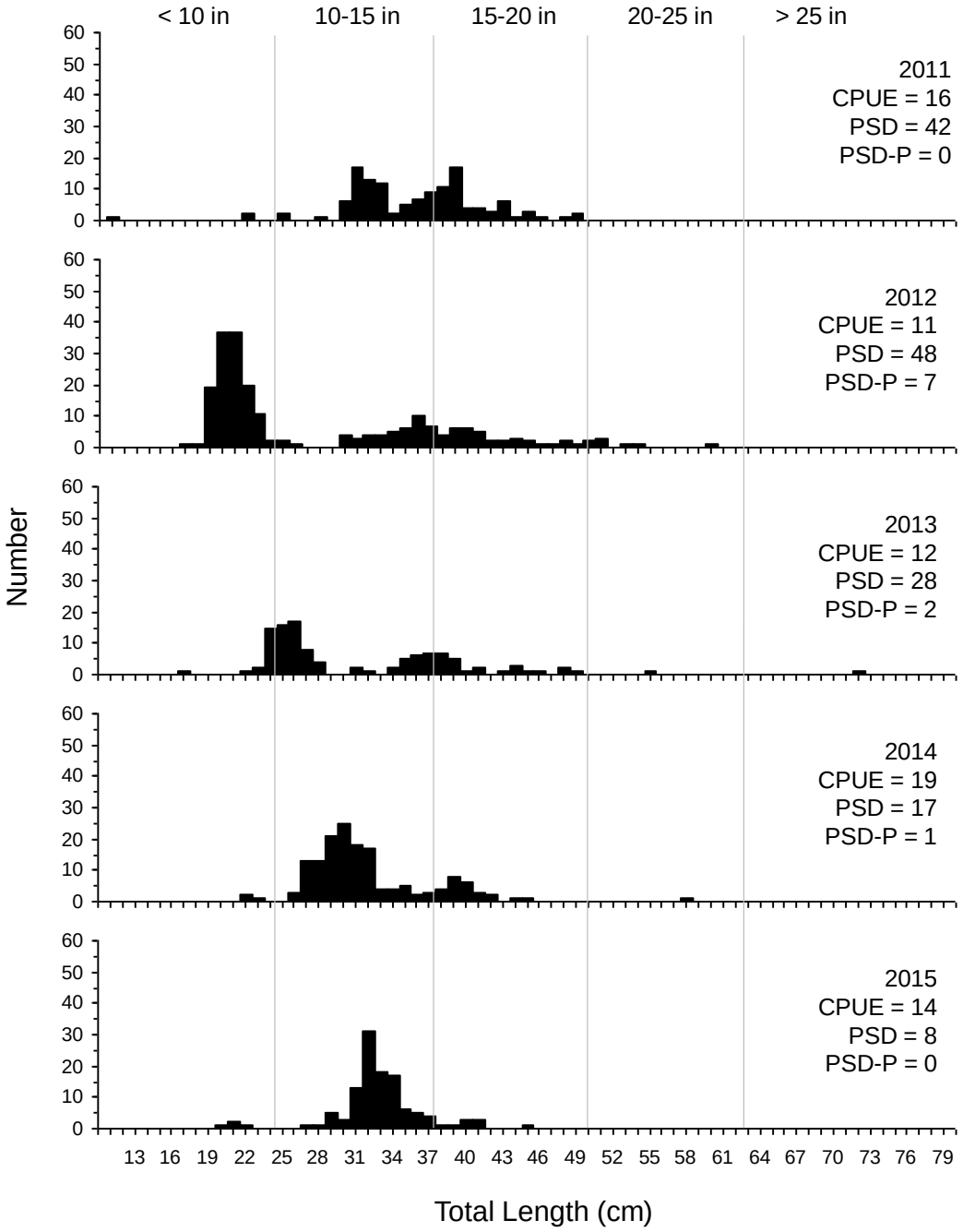

Figure 3. Length-frequency histogram, catch rate of stock-length fish (CPUE), proportional size distribution of quality- (PSD) and preferred-length (PSD-P) fish for walleye captured using experimental gill nets in Waubay Lake, 2011-2015.

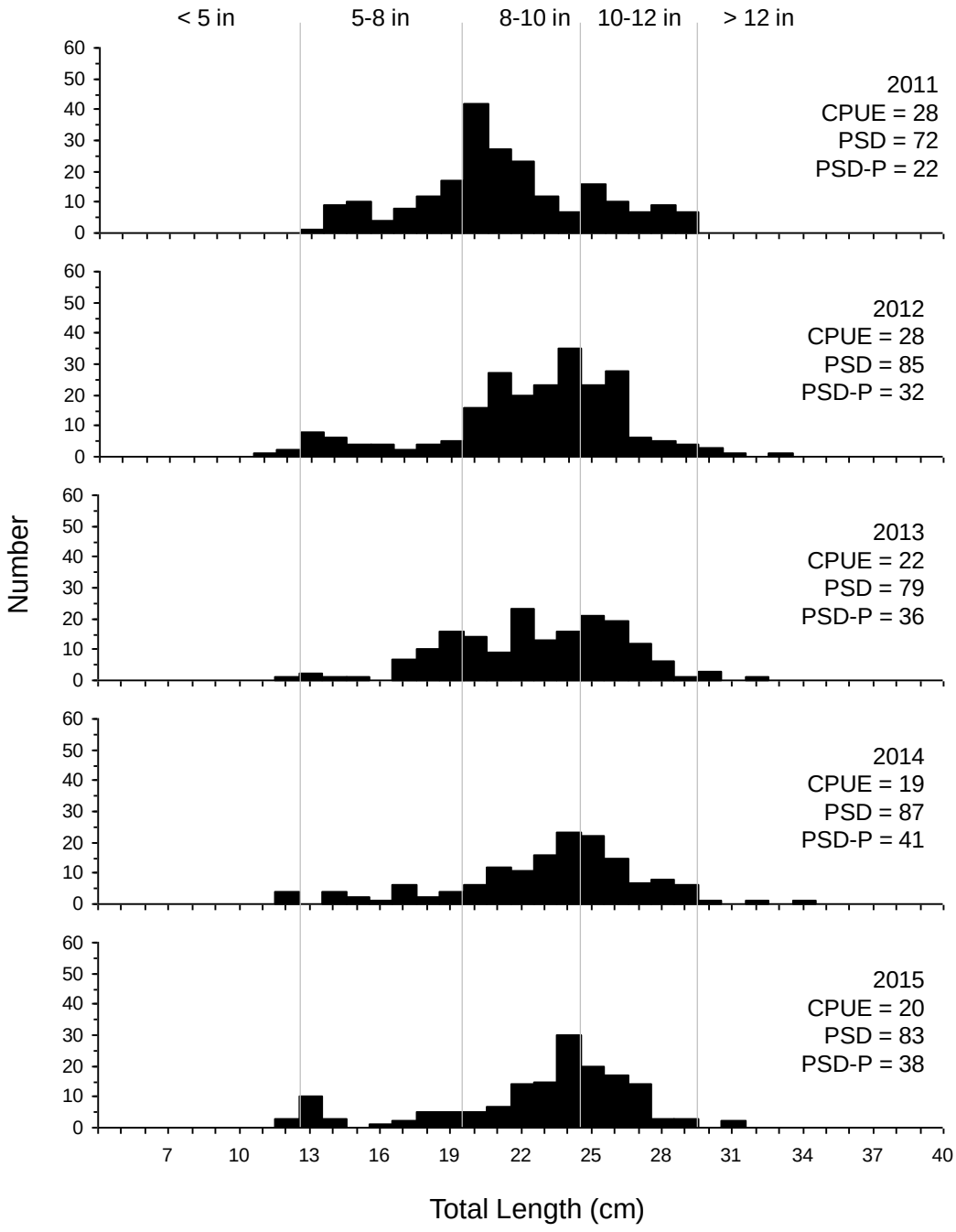

Figure 4. Length-frequency histogram, catch rate of stock-length fish (CPUE), proportional size distribution of quality- (PSD) and preferred-length (PSD-P) fish for yellow perch captured using experimental gill nets in Waubay Lake, 2011-2015.