Bitter Lake Survey Summary

Bitter Lake, located on the southern edge of Waubay, is managed as a walleye and yellow perch fishery but other fish species such as northern pike and white bass also contribute to the fishery.

- **Northern pike.** Relative abundance has remained low (i.e., <1.0/gill net) from 2016 to 2019. In 2019, only five northern pike ranging in length from 25.2 to 35.6 inches were sampled. Northern pike respond to rising water levels and population increases are expected following high-water conditions experienced across northeast South Dakota in 2019.

- **Walleye.** Walleye numbers were the highest recorded since 2016. At 13.5/gill net, relative abundance was considered high. A wide length range of walleyes (8.7 to 27.6 inches) was sampled, of those that were at least 10.0 inches 32% were ≥ 15.0 inches and 9% were 20.0 inches or longer. Individuals from 10 consecutive year classes (2009 – 2018) contributed to the catch. Fish from the naturally-produced 2017 (age-2) cohort were the most abundant accounting for 47% of walleyes in the sample. Year classes produced in 2011 (11%), 2016 (17%), and 2018 (14%), two of which were naturally produced (2011 and 2018), made up an additional 42%. Growth has improved in recent years. Since 2010, mean length at capture values at age 3 have varied from 12.4 to 18.3 inches. In 2019, the mean length at capture of age-3 fish was 15.2 inches.

- **White bass.** White bass were first sampled in 2005 and have been present in the gill net catch each year since 2011. In 2019, white bass were abundant in the gill net catch; however most (70%) were ≤6.0 inches and likely born this spring. Relative abundance of white bass ≥6.0 inches was low (3.1/gill net), those sampled ranged in length from 9.1 to 17.3 inches with most (82%) being 12.0 inches or longer.

- **Yellow perch**. Yellow perch numbers were lower in 2019 than 2018, as fewer individuals from the 2017 cohort, which was believed to be strong, were sampled. At 8.6/gill net, relative abundance was considered low to moderate in 2019. Sampled yellow perch ranged in length from 5.1 to 12.6 inches, 28% were ≥8.0 inches and 7% were 10.0 inches or longer. Fish from seven year classes (2010, and 2013 – 2018) contributed to the catch, those from the 2018 (age-1) cohort were the most abundant accounting for 69% of yellow perch in the sample. Since 2010, growth has varied with mean length at capture values at age 2 from 7.6 to 10.2 inches. In 2019, the mean length at capture for age-2 fish was 8.9 inches.

For more detailed results see the computer generated South Dakota Statewide Fisheries Survey for Bitter (Day; below).

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY
Bitter, Day County
UBS-Lake-409-800
2019

Lake Information

Name: Bitter

County: Day

Surface Area: 18,783 Acres

Maximum Depth: 32 Feet

Surveys and Investigations

Survey methods used by gear type, date, and effort.

Gear	Date	Effort
AFS std gill net	Sep 04, 2019	6 net-nights
AFS std gill net	Sep 05, 2019	6 net-nights
AFS std gill net	Sep 06, 2019	4 net-nights

Common Fish Species Present

Northern Pike

Walleye

Yellow Perch

White Bass

Rock Bass

Common Carp

Black Bullhead

Terminology

Catch per unit effort (**CPUE**) refers to the relative abundance of a species. It is defined as the number of fish captured per unit of effort (i.e., number of fish captured per net-night or number of fish captured per hour electrofishing). In this report CPUE is typically given for only stock-length fish (see length categories table for stock lengths).

A statewide effort to help make netting efforts comparable to all waters sampled across the state, occurred in 2017, with a switch to American Fisheries Society gill nets. Past gill netting efforts were completed with different style/types of nets and are not comparable side by side.

- **AFS std gill net** – 80 ft experimental gill net containing eight panels (10 ft each) of varying monofilament meshes of 0.75, 1.00, 1.25, 1.50, 1.75, 2.00, 2.25 and 2.50 inches.
- **std experimental gill net for non-Missouri River waters** - 150 ft experimental gill net containing six panels (25 ft each) of varying monofilament meshes of 0.5, 0.75, 1.00, 1.25, 1.50 and 2.00 inches.
- s**td experimental gill net for Missouri River reservoirs** – 300 ft experimental gill net containing six panels (50 ft each) of varying multifilament meshes of 0.5, 0.75, 1.00, 1.25, 1.50 and 2.00 inches.

$$CPUE = \frac{number\ of\ fish}{effort}$$

Population size structure is quantified using the indices proportional size distribution of quality-length fish (**PSD**) and proportional size distribution of preferred-length fish (**PSD-P**). These indices indicate the proportion of stock-length fish that are equal to or greater than a given length. Minimum lengths for stock, quality and preferred length fish are given in the length categories table.

$$PSD = \left(\frac{number\ of fish \geq quality\ length}{number\ of\ fish \geq stock\ length}\right) \text{x } 100$$

$$PSD - P = \left(\frac{number\ of fish\ \geq preferred\ length}{number\ of\ fish \geq stock\ length}\right) \text{x } 100$$

Relative weight (**Wr**) is used to quantify fish plumpness. Relative weight is the ratio of what a fish weighs (W) compared to a length-specific standard weight (Ws) multiplied by 100. Relative weight values of 95-105 are commonly cited as optimum values, but values in the 80s are common during summer sampling in South Dakota.

$$Wr = \left(\frac{W}{Ws}\right) \text{x } 100$$

Confidence intervals (**CI**) are provided for many of the estimates calculated in this report. The confidence interval provides a range in which the true mean is expected to fall. For example, with an 80% CI we are 80% confident that the interval contains the true value.

Length categories include stock (**S**), quality (**Q**), preferred (**P**), memorable (**M**) and trophy (**T**). Length categories for most species have been defined based on a percentage of the world record length for that species. Some species mentioned in this report do not have defined length categories. Length categories for species used in this report are provided in the following table. Measurements are the minimum total length for each category and are reported in inches (in) and centimeters (cm).

	Stock		Quality		Preferred		Memorable		Trophy	
Species Name	(in)	(cm)	(in)	(cm)	(in)	(cm)	(in)	(cm)	(in)	(cm)
Black Bullhead	6	15	9	23	12	30	15	38	18	46
Black Crappie	5	13	8	20	10	25	12	30	15	38
Bluegill	3	8	6	15	8	20	10	25	12	30
Brown Trout	8	20	12	30	16	40	20	50	18	46
Channel Catfish	11	28	16	41	24	61	28	71	36	91
Freshwater Drum	8	20	12	30	15	38	20	51	25	63
Lake Trout	12	30	20	50	26	65	31	80	39	100
Largemouth Bass	8	20	12	30	15	38	20	51	25	63
Muskellunge	20	51	30	76	38	97	42	107	50	127
Northern Pike	14	35	21	53	28	71	34	86	44	112
Pumpkinseed	3	8	6	15	8	20	10	25	12	30
Rainbow Trout	10	25	16	40	20	50	26	65	31	80
Rudd	6	15	10	25	12	30	15	38	19	48
Sauger	8	20	12	30	15	38	20	51	25	63
Smallmouth Bass	7	18	11	28	14	35	17	43	20	51
Walleye	10	25	15	38	20	51	25	63	30	76
White Bass	6	15	9	23	12	30	15	38	18	46
White Crappie	5	13	8	20	10	25	12	30	15	38
Yellow Bullhead	4	10	7	18	9	23	11	28	14	36
Yellow Perch	5	13	8	20	10	25	12	30	15	38

Catch Summary of Stock Length Fish

Catch per unit effort (CPUE), proportional size distribution (PSD), proportional size distribution of preferred length fish (PSD-P), and relative weight (Wr) for species sampled in survey with 80% confidence interval (CI-80).

*** Methods/Species that ignore stock length**

			Abundance		Stock Density Indices				Condition	
Gear	Species	Sample Size (n)*	CPUE	CI-80	PSD	CI-80	PSD-P	CI-80	Wr	CI-80
AFS std gill net	Black Bullhead	3	0.2	0.1	100		100		97	6
	Common Carp	5	0.2	0.1	100		67		116	18
	Northern Pike	5	0.3	0.3	100		40		82	5
	Rock Bass	5	0.3	0.2	80		20		121	8
	Walleye	226	13.5	1.5	32	4	9	3	94	1
	White Bass	162	3.1	1.9	100		82	8	109	1
	Yellow Perch	138	8.6	1.9	28	5	7	3	115	1

10-Year Catch Per Unit Effort by Gear and Species

Catch per unit effort (CPUE) and average (Avg) of species across 10 years using different gear types.

*** Methods/Species that ignore stock length**

		CPUE										
Gear	Species	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Avg
AFS std gill net	Black Bullhead							0.0	0.0	0.1	0.2	0.1
	Black Crappie							0.1	0.0	0.1	0.0	0.1
	Common Carp							0.4	1.9	1.2	0.2	0.9
	Gizzard Shad							0.7	0.0	0.0	0.0	0.2
	Northern Pike							0.7	0.5	0.1	0.3	0.4
	Rock Bass							0.0	0.1	0.3	0.3	0.2
	Walleye							12.8	10.5	10.3	13.5	11.8
	White Bass							1.0	5.3	4.1	3.1	3.4
	White Sucker							0.2	0.0	0.0	0.0	0.1
	Yellow Perch							9.3	5.3	25.1	8.6	12.1
fall night EF-WAE	Walleye		377.0	36.0	34.0	9.6	2.0	37.0	136.0	60.0		86.5
std exp gill net	Black Crappie	0.0	0.2	0.0	0.0	0.0	0.0					0.0
	Common Carp	0.1	0.5	0.1	0.0	1.4	0.1					0.4
	Northern Pike	0.3	0.5	5.0	4.1	1.5	1.5					2.2
	Rock Bass	0.0	0.0	0.4	0.0	0.0	0.0					0.1
	Spottail Shiner*	0.0	0.1	0.0	0.0	0.0	0.0					0.0
	Walleye	16.9	6.7	19.8	18.0	38.8	41.4					23.6
	White Bass	0.0	0.0	0.1	0.0	1.9	0.5					0.4
	White Sucker	0.1	0.1	0.0	0.4	0.0	0.0					0.1
	Yellow Perch	8.6	13.0	67.3	21.4	5.8	8.4					20.8

10-Year Size Structure and Condition Statistics by Gear and Species

Species proportional size distribution (PSD), proportional size distribution of preferred length fish (PSD-P), and relative weight (Wr) collected by different gear types across 10 years.

			Year									
Gear	Species	Index	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
AFS std gill net	Walleye	PSD							50	49	59	32
		PSD-P							5	2	16	9
		Wr							89	92	88	94
	White Bass	PSD							94	92	98	100
		PSD-P							94	32	97	82
		Wr							107	116	107	109
	Yellow Perch	PSD							72	31	11	28
		PSD-P							31	15	4	7
		Wr							120	120	112	115
std exp gill net	Walleye	PSD	19	76	58	30	8	14				
		PSD-P	3	4	4	6	3	1				
		Wr	102	93	86	83	91	89				
	White Bass	PSD		0	100	0	100	100				
		PSD-P		0	0	0	100	100				
		Wr			97		107	108				
	Yellow Perch	PSD	29	84	59	78	80	40				
		PSD-P	22	14	40	49	48	21				
		Wr	107	110	106	111	111	112				

Length at Capture

Mean length at capture by age across years sampled, sample size (N).

Species: Walleye

		Mean Length (expanded sample number) at capture by age									
Year	N	1	2	3	4	5	6	7	8	9	10+
2019	226	260 (31)	313 (107)	385 (38)	478 (3)	464 (10)	519 (2)	451 (3)	494 (25)	661 (1)	620 (5)
2018	193	232 (36)	322 (52)	398 (8)	420 (23)	460 (5)	448 (6)	486 (56)		598 (6)	626 (2)
2017	202	254 (77)	333 (18)	370 (23)	401 (13)	411 (6)	421 (61)		558 (4)		
2016	207	264 (6)	319 (33)	346 (13)	377 (18)	395 (120)		531 (11)	623 (1)	653 (1)	607 (3)
2015	348	228 (18)	290 (15)	315 (10)	356 (297)		479 (6)			606 (1)	538 (1)
2014	329	202 (18)	255 (13)	321 (280)	416 (2)	486 (12)	575 (1)		543 (1)	551 (1)	675 (1)
2013	150	209 (4)	276 (102)	389 (3)	471 (33)	499 (3)	503 (1)		528 (2)		584 (2)
2012	203	251 (107)	387 (15)	447 (73)	527 (4)			592 (2)			679 (2)
2011	161	313 (6)	397 (137)	464 (11)	474 (1)		545 (2)			653 (1)	594 (3)
2010	408	306 (328)	407 (42)	443 (16)		513 (15)		561 (1)	543 (3)	635 (1)	559 (2)

Species: Yellow Perch

		Mean Length (expanded sample number) at capture by age									
Year	N	1	2	3	4	5	6	7	8	9	10+
2019	138	167 (95)	225 (35)	261 (2)	316 (1)	275 (3)	325 (1)			325 (1)	
2018	401	164 (351)	222 (34)	269 (9)	256 (4)	323 (1)	317 (2)				
2017	84	169 (54)	205 (9)	255 (12)	259 (5)	297 (3)		301 (1)			
2016	148	169 (9)	206 (79)	237 (21)	277 (4)	298 (12)	312 (13)	314 (8)			
2015	70	141 (27)	194 (22)	243 (3)	248 (9)	303 (3)	312 (6)				
2014	48	135 (8)	194 (3)	239 (19)	264 (7)	303 (10)	313 (1)				
2013	171	147 (1)	200 (65)	266 (20)	267 (82)	285 (3)					
2012	565	152 (249)	227 (53)	265 (251)	302 (12)	335 (2)					
2011	312	171 (28)	227 (268)	291 (11)	324 (6)						
2010	207	172 (152)	258 (48)	285 (8)							

Fish Condition

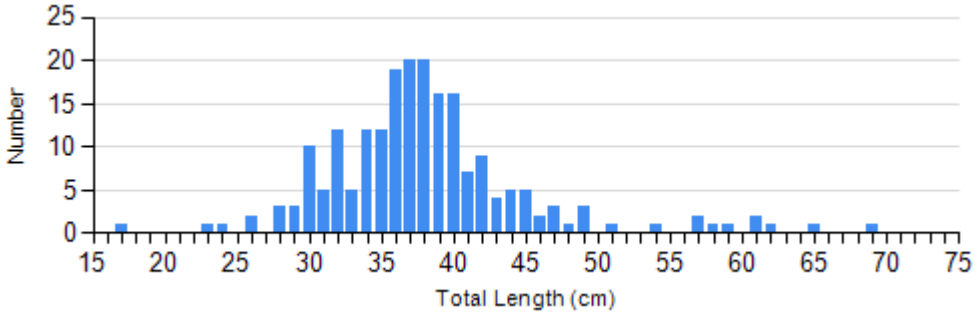
Mean relative weight (Wr) by sample size (N), length category stock to quality (S-Q), quality to preferred (Q-P), preferred to memorable (P-M), and memorable (M) for species collected across survey years with standard error (SE).

		Length Groups							
		S-Q		Q-P		P-M		M	
Species	Year	N	Wr (SE)	N	Wr (SE)	N	Wr (SE)	N	Wr (SE)
Walleye Gill Net	2015	286	90 (0.3)	41	87 (0.9)	4	77 (1.7)	0	
	2016	103	89 (0.6)	91	90 (0.5)	9	90 (2.7)	2	84 (1.1)
	2017	85	93 (1.2)	80	91 (0.7)	3	95 (3.1)	0	
	2018	68	86 (0.8)	70	89 (0.7)	23	92 (1.2)	4	94 (1.9)
	2019	147	94 (0.5)	49	95 (0.8)	16	93 (1.8)	4	92 (1.8)
White Bass Gill Net	2015	0		0		1	110	3	108 (1.3)
	2016	1	120	0		3	111 (2.5)	12	105 (1.7)
	2017	7	115 (2.6)	51	117 (1.1)	2	112 (0.9)	25	113 (1.2)
	2018	1	118	1	101	51	107 (0.6)	13	107 (1.0)
	2019	0		9	112 (1.3)	22	109 (0.9)	18	108 (0.9)
Yellow Perch Gill Net	2015	40	112 (1.3)	13	118 (2.5)	8	104 (6.0)	6	110 (2.4)
	2016	42	122 (1.7)	60	124 (1.3)	22	115 (1.6)	24	110 (1.8)
	2017	58	121 (1.3)	13	120 (2.6)	9	115 (4.4)	4	112 (5.0)
	2018	358	111 (0.4)	28	122 (1.8)	10	116 (3.3)	5	106 (3.4)
	2019	99	115 (1.1)	29	117 (1.8)	7	116 (3.2)	3	111 (3.1)

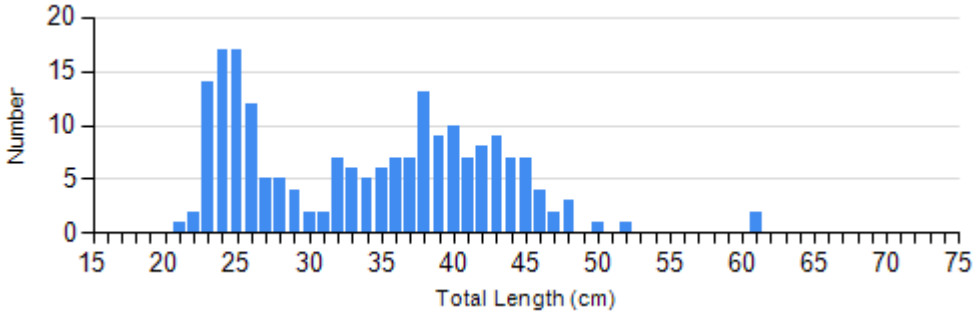
Length Frequency Distribution

Length frequency histogram of species sampled by year.

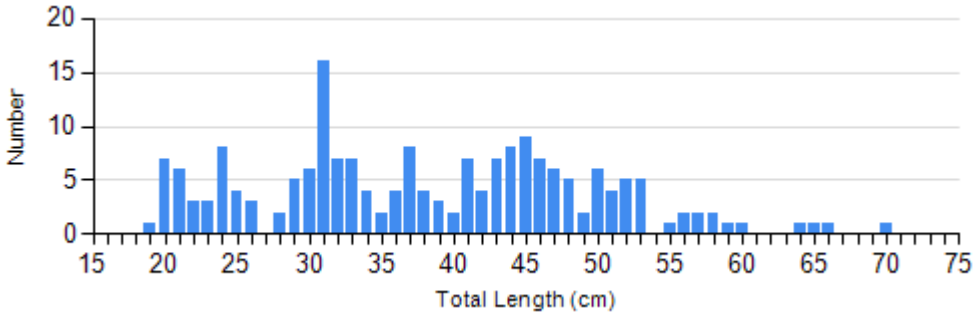
Species: Walleye
Gear: AFS std gill net



2016



2017



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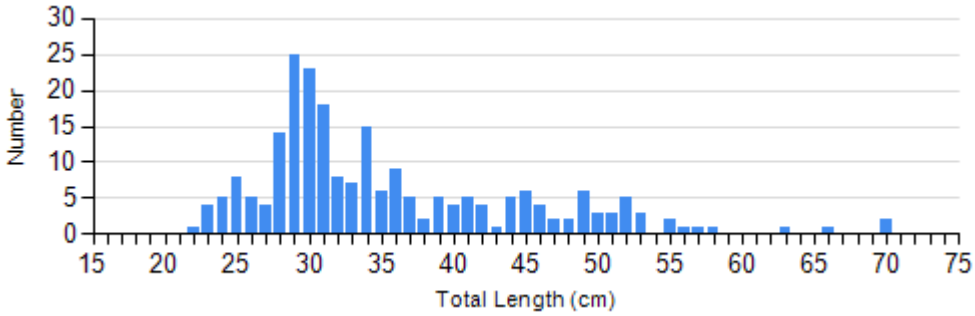
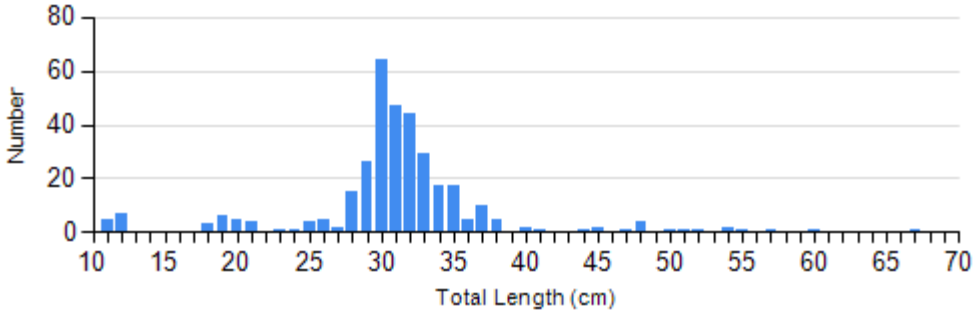
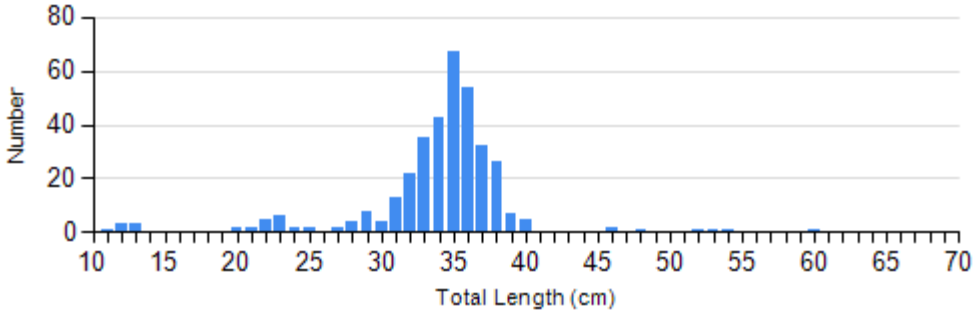


2019

Species: Walleye
Gear: std exp gill net

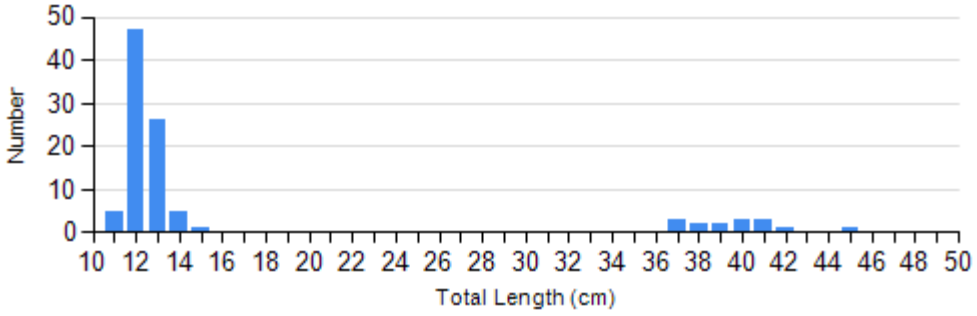


2014



2015

Species: White Bass
Gear: AFS std gill net



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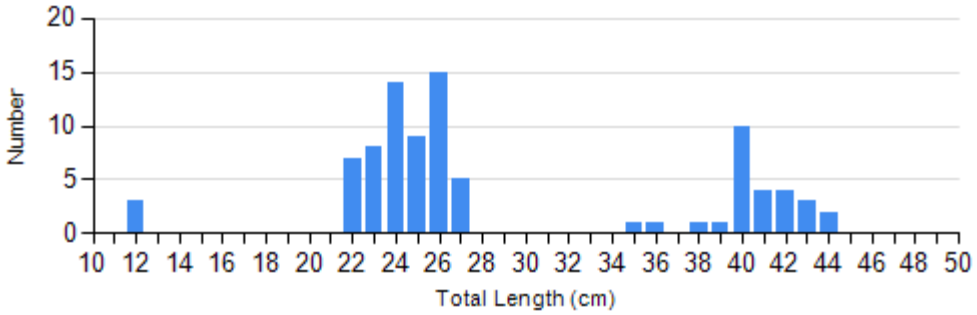

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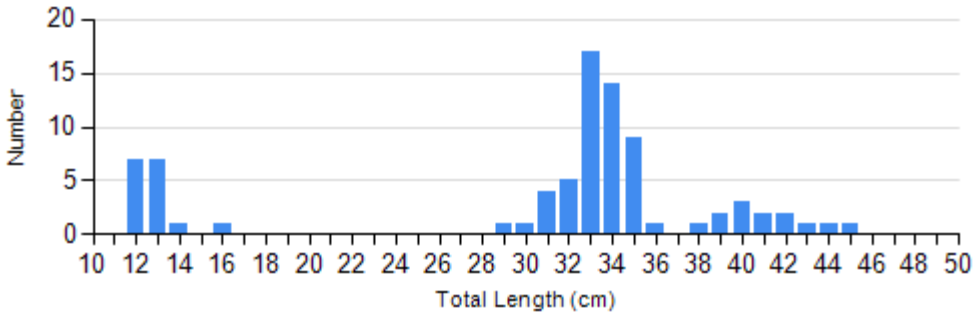

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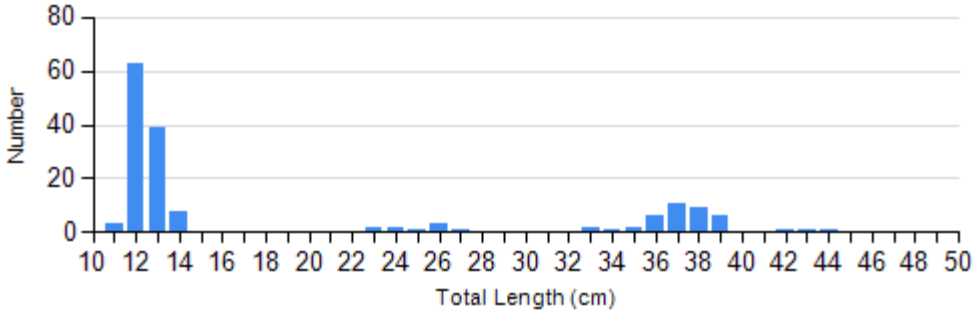

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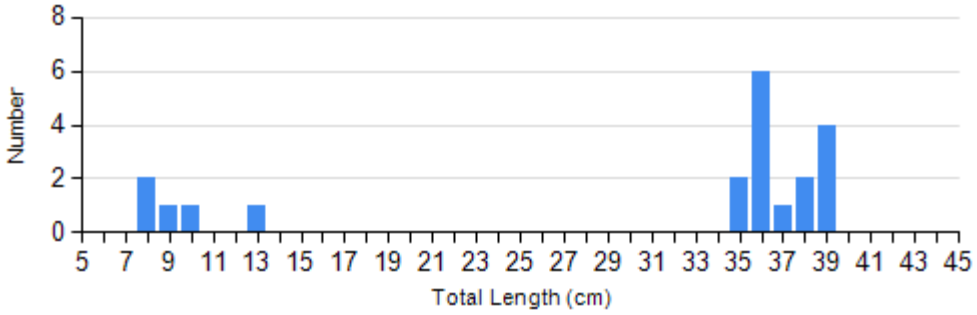
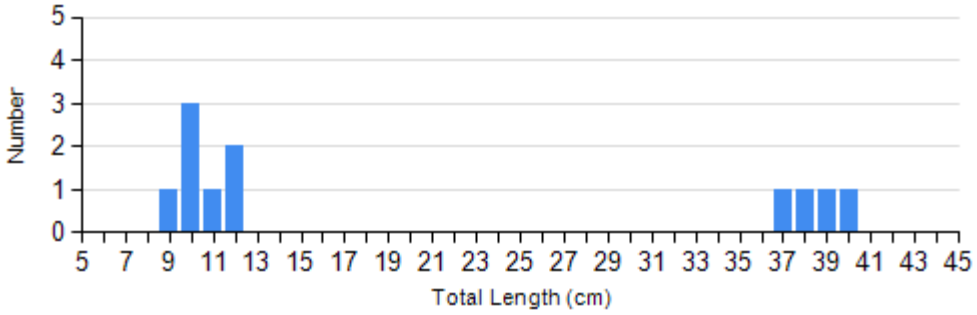
Species: White Bass
Gear: std exp gill net

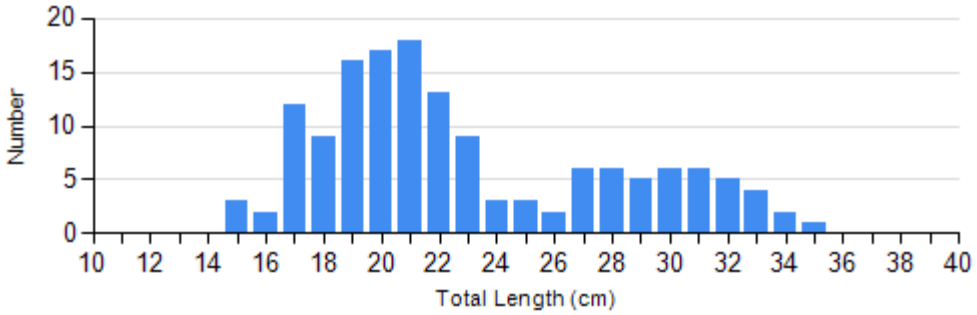


2014



2015

Species: Yellow Perch
Gear: AFS std gill net



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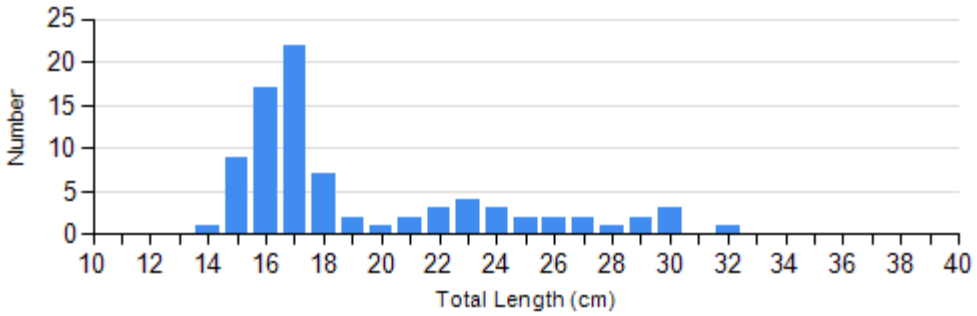
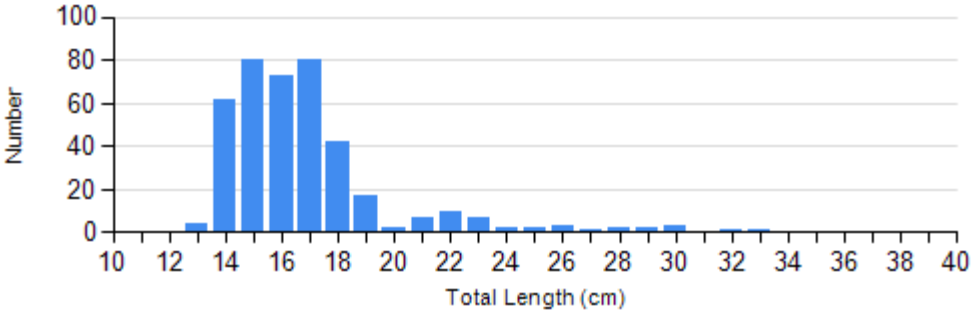


2017



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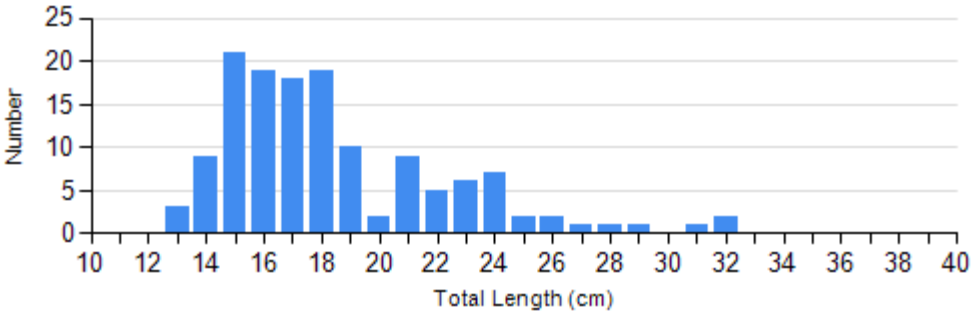
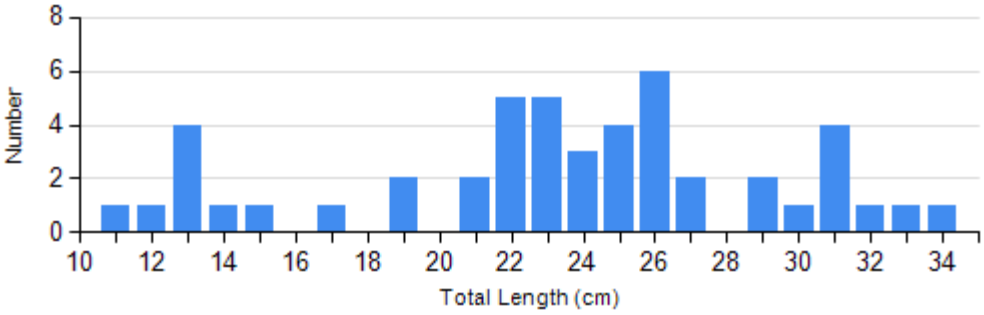
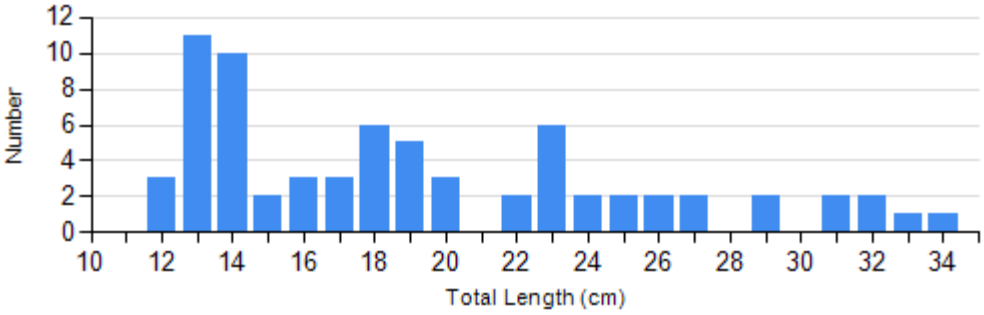


2019

Species: Yellow Perch
Gear: std exp gill net



2014

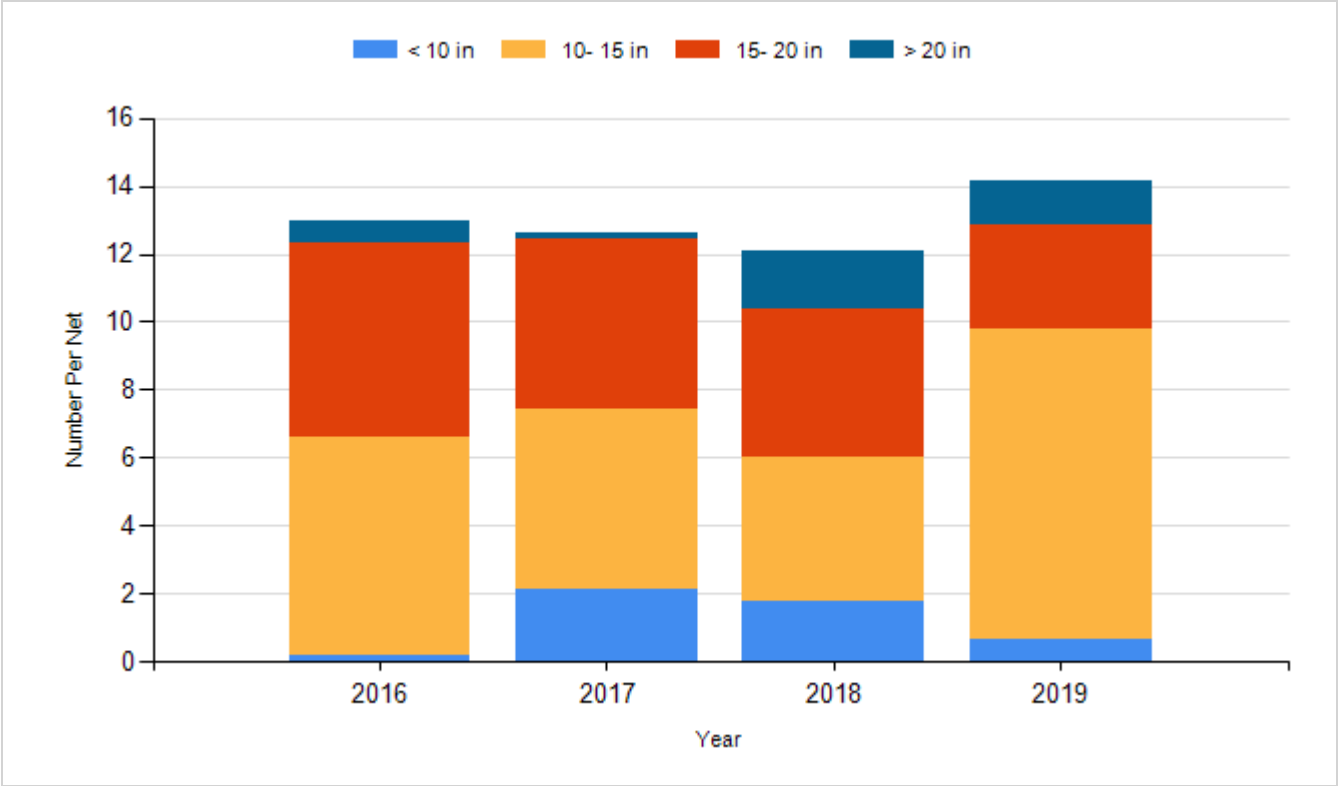


2015

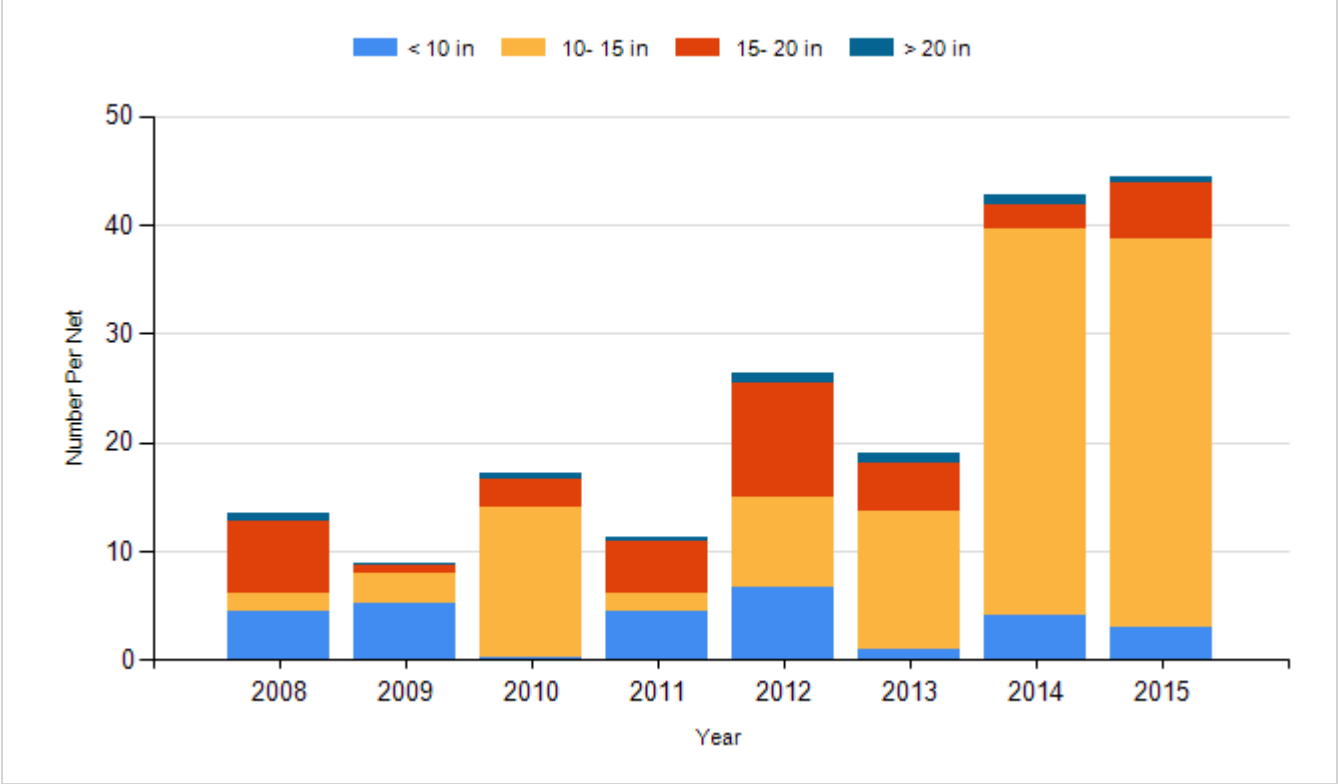
Historic Fish Sizes and Relative Abundance

Size distribution per net by color for species sampled by year.

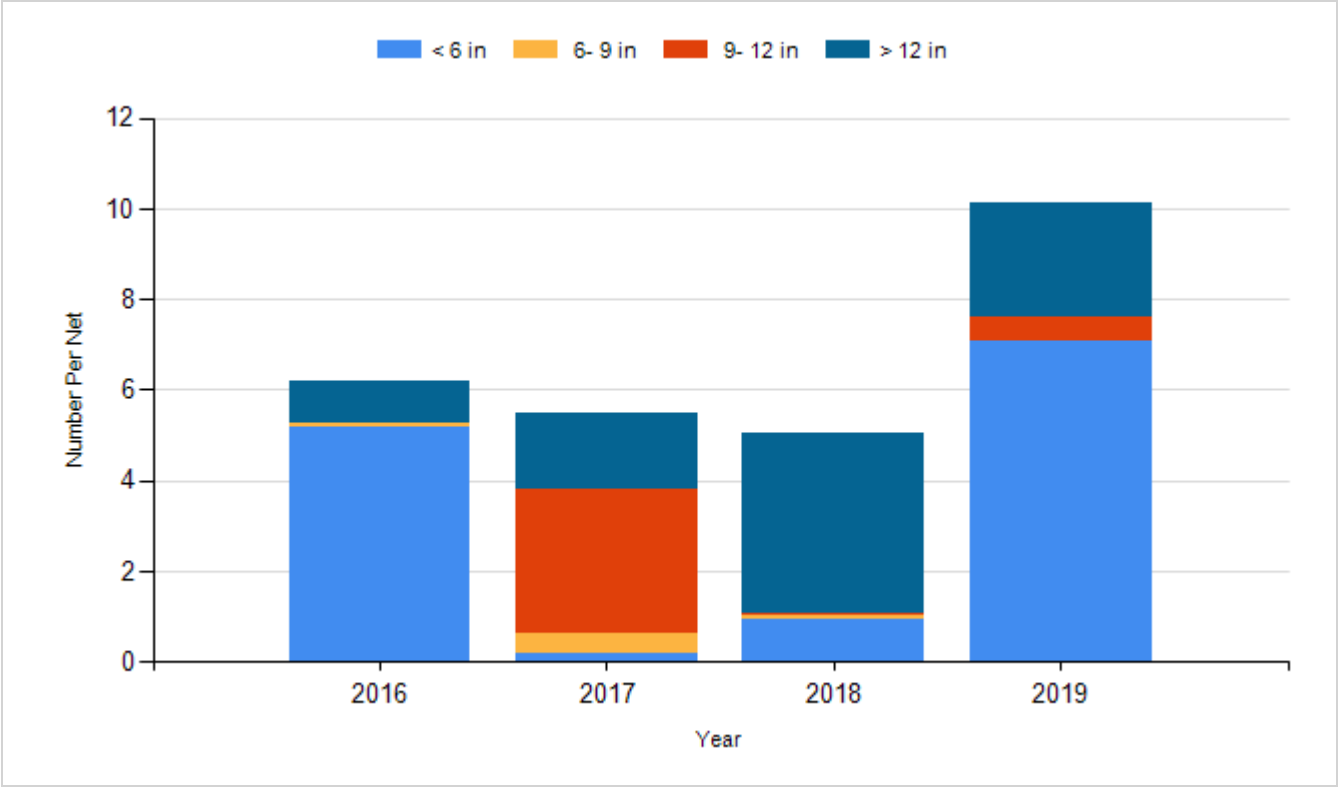
Species: Walleye
Gear: AFS std gill net



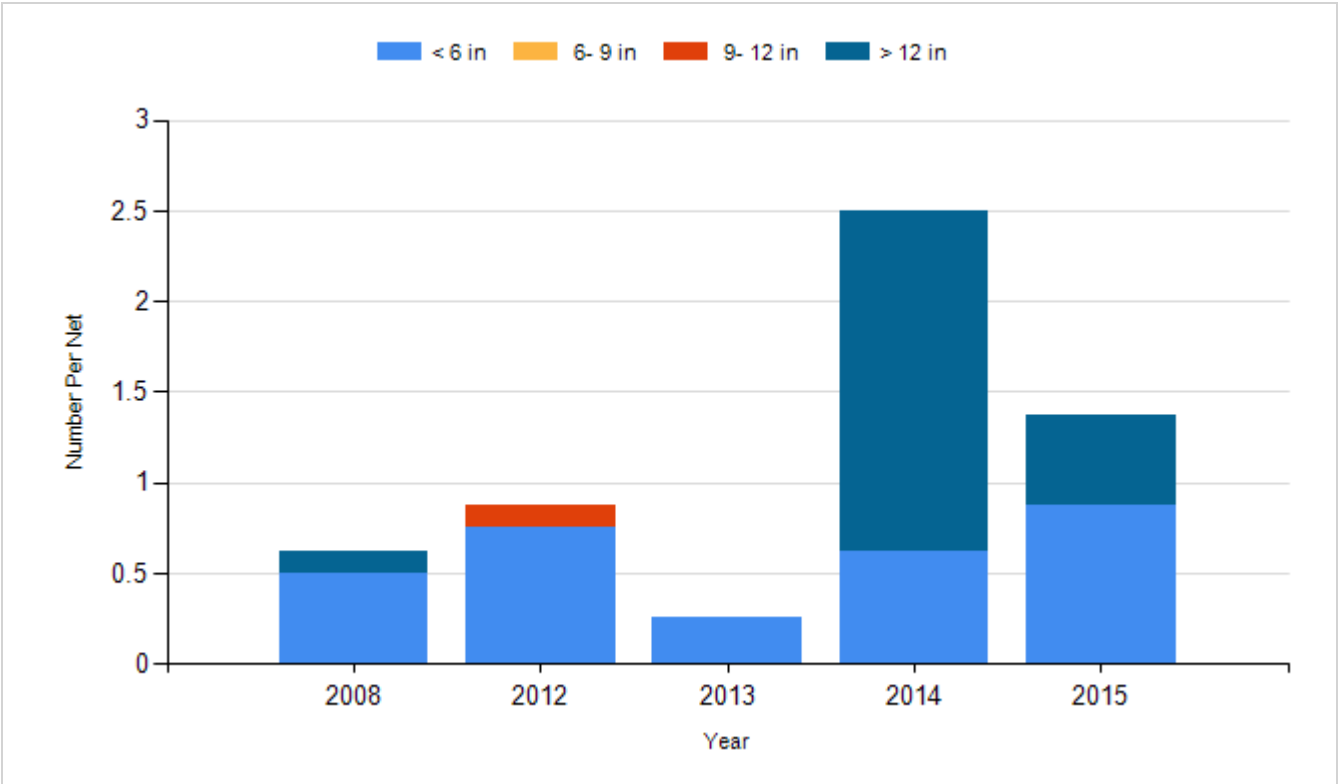
Species: Walleye
Gear: std exp gill net



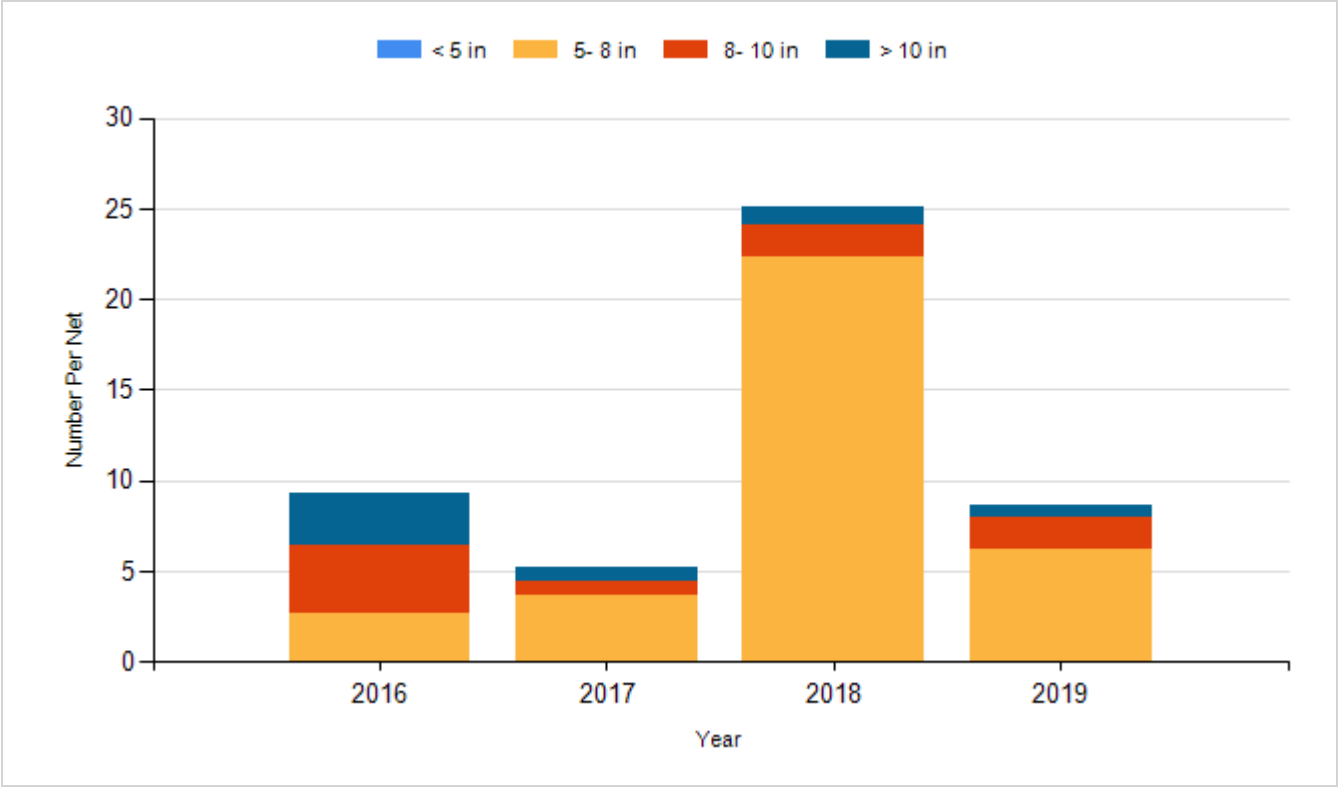
Species: White Bass
Gear: AFS std gill net



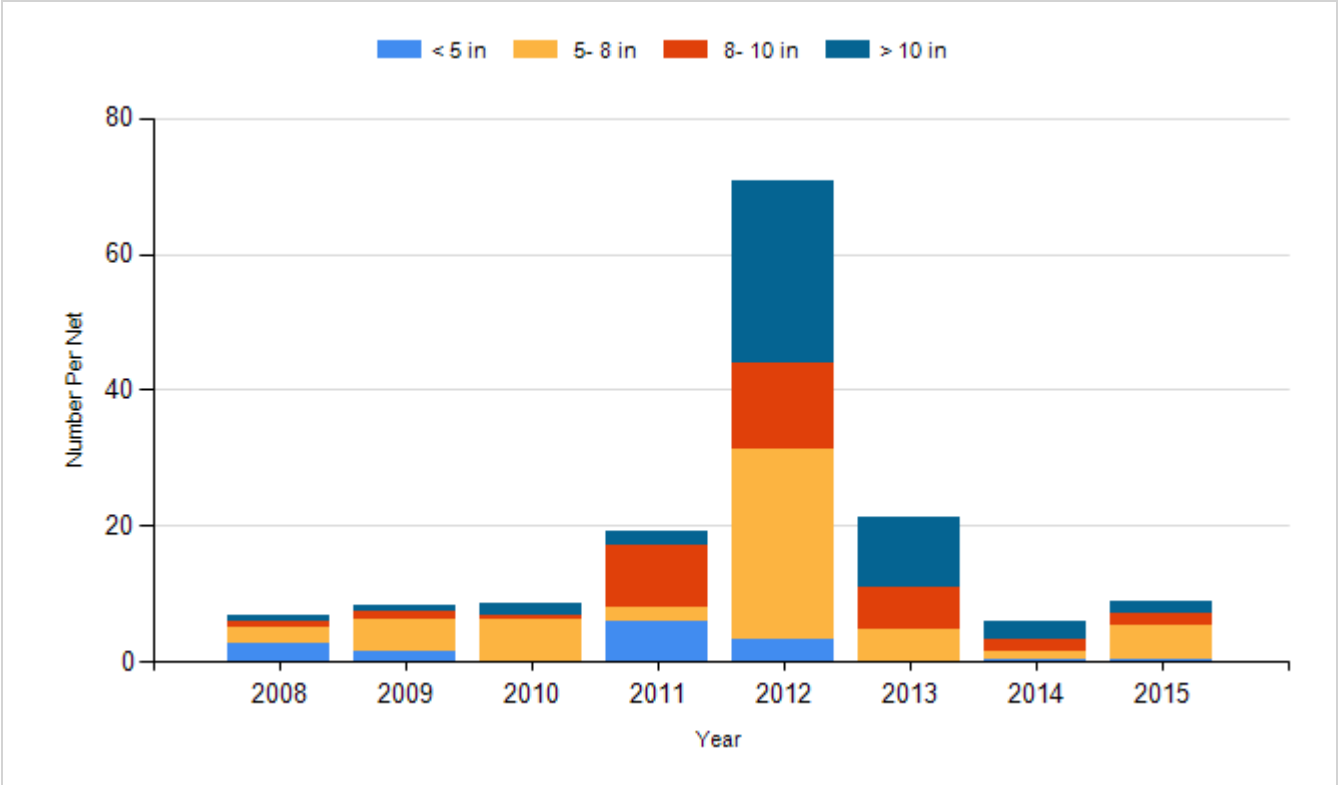
Species: White Bass
Gear: std exp gill net



Species: Yellow Perch
Gear: AFS std gill net



Species: Yellow Perch
Gear: std exp gill net



Fish Stocking

Number of fish stocked by year, species, and size.

Year	Species	Size	Number
2013	Walleye	Fry	7,500,000
2015	Walleye	Fry	4,000,000
2016	Gizzard Shad	Adult	600
2016	Walleye	Fry	6,500,000