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 (e.g., northern pike, white bass) also contribute to the fishery.

- **Walleye.** Although fewer walleyes were sampled in 2021 than in 2020, at 10.3 per gill net, the relative abundance walleyes ≥10.0 inches remained moderate to high. A wide length range of walleyes (5.9 to 27.2 inches) was sampled, of those that were at least 10.0 inches 89% were ≥ 15.0 inches and 13% were ≥20.0 inches. Individuals from 11 consecutive year-classes (2011 – 2021) contributed to the catch, those from natural produced cohorts in 2017 (age 4) and 2018 (age 3) were the most abundant accounting for more than half (52%) of the fish in the sample. The 2021 sample suggests good walleye growth with mean lengths at capture for age-3 and age-4 fish of 15.7 and 17.4 inches.

- **White bass.** Relative abundance of white bass ≥6.0 inches was higher in 2021 (6.6 per gill net) than in 2020 (3.9 per gill net). In 2021, 141 white bass from 4.7 to 17.7 inches were netted, one-fourth (25%) were <6.0 inches and likely born this spring. Of those that were at least 6.0 inches, 84% were ≥9.0 inches and 73% were ≥12.0 inches.

- **Yellow perch**. Yellow perch numbers increased for the third straight year. At 16.1 per gill net, relative abundance was considered high for Bitter Lake in 2021. Sampled yellow perch ranged in length from 5.5 to 11.8 inches, 47% were ≥8.0 inches and 33% were ≥10.0 inches. Fish from five consecutive year-classes (2016 - 2020) contributed to the catch. Individuals from the 2020 (age-1) cohort were the most abundant accounting for 60% of yellow perch in the sample, while those from the 2018 (age-3) and 2019 (age-2) year-classes made up an additional 39%. Growth tends to be moderate to fast with mean length at capture of age-3 fish from 9.3 to 11.1 inches since 2012. In 2021, the mean length at capture for age-3 yellow perch was 11.1 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
2021

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 08, 2021	4 net-nights
AFS std gill net	Sep 09, 2021	6 net-nights
AFS std gill net	Sep 10, 2021	6 net-nights
fall night EF-WAE	Sep 21, 2021	3600 seconds

Common Fish Species Present

Northern Pike

Walleye

Yellow Perch

White Bass

Rock Bass

Common Carp

Black Crappie

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).

			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	2	0.1	0.2	100		50		99	9
	Black Crappie	7	0.3	0.3	40		0		123	1
	Common Carp	20	1.3	0.4	100		45	18	112	2
	Northern Pike	7	0.4	0.2	100		29		91	2
	Rock Bass	32	1.9	0.6	74	12	16		117	2
	Walleye	188	10.3	1.5	89	4	13	4	96	1
	White Bass	141	6.6	2.6	84	5	73	6	113	1
	Yellow Perch	257	16.1	5.3	47	4	33	4	114	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	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Avg
AFS std gill net	Black Bullhead					0.0	0.0	0.1	0.2	0.2	0.1	0.10
	Black Crappie					0.1	0.0	0.1	0.0	0.7	0.3	0.20
	Common Carp					0.4	1.9	1.2	0.2	1.8	1.3	1.13
	Gizzard Shad					0.7	0.0	0.0	0.0	0.0	0.0	0.12
	Northern Pike					0.7	0.5	0.1	0.3	0.3	0.4	0.38
	Rock Bass					0.0	0.1	0.3	0.3	1.3	1.9	0.65
	Walleye					12.8	10.5	10.3	13.5	13.4	10.3	11.80
	White Bass					1.0	5.3	4.1	3.1	3.9	6.6	4.00
	White Sucker					0.2	0.0	0.0	0.0	0.1	0.0	0.05
	Yellow Perch					9.3	5.3	25.1	8.6	12.6	16.1	12.83
fall night EF-WAE*	Walleye	36.0	34.0	9.6	2.0	37.0	136.0	60.0		3.0	412.0	81.07
std exp gill net	Black Crappie	0.0	0.0	0.0	0.0							0.00
	Common Carp	0.1	0.0	1.4	0.1							0.40
	Northern Pike	5.0	4.1	1.5	1.5							3.03
	Rock Bass	0.4	0.0	0.0	0.0							0.10
	Walleye	19.8	18.0	38.8	41.4							29.50
	White Bass	0.1	0.0	1.9	0.5							0.63
	White Sucker	0.0	0.4	0.0	0.0							0.10
	Yellow Perch	67.3	21.4	5.8	8.4							25.73

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	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
AFS std gill net	Walleye	PSD					50	49	59	32	57	89
		PSD-P					5	2	16	9	7	13
		Wr					89	92	88	94	96	96
	White Bass	PSD					94	92	98	100	85	84
		PSD-P					94	32	97	82	85	73
		Wr					107	116	107	109	110	113
	Yellow Perch	PSD					72	31	11	28	47	47
		PSD-P					31	15	4	7	11	33
		Wr					120	120	112	115	112	114
std exp gill net	Walleye	PSD	58	30	8	14						
		PSD-P	4	6	3	1						
		Wr	86	83	91	89						
	White Bass	PSD	100	0	100	100						
		PSD-P	0	0	100	100						
		Wr	97		107	108						
	Yellow Perch	PSD	59	78	80	40						
		PSD-P	40	49	48	21						
		Wr	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+
2021	165	315 (14)	398 (27)	443 (53)	455 (45)	527 (5)	475 (2)	525 (7)	563 (1)	596 (1)	615 (9)
2020	214	297 (31)	350 (24)	391 (105)	462 (28)	496 (2)	512 (5)	494 (3)	551 (3)	520 (10)	606 (2)
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)

Species: Yellow Perch

		Mean Length (expanded sample number) at capture by age									
Year	N	1	2	3	4	5	6	7	8	9	10+
2021	257	177 (153)	253 (49)	281 (50)	304 (4)	304 (1)					
2020	201	169 (88)	221 (95)	257 (17)							358 (1)
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)					

Fish Condition

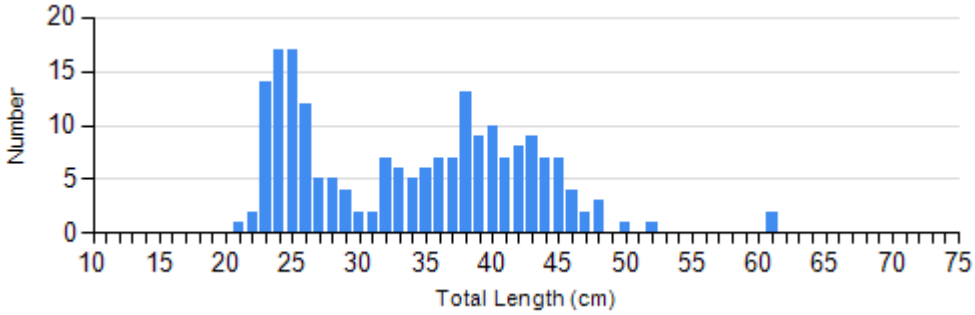
Mean relative weight (Wr) by sample size (N), length category stock to quality (S-Q), quality to preferred (Q-P), preferred to memorable (P-M), and memorable (M) for species collected across survey years with standard error (SE).

		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	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)
	2020	91	96 (0.7)	108	95 (0.5)	14	96 (1.2)	1	103
	2021	18	89 (1.4)	125	97 (0.6)	18	97 (1.7)	4	92 (2.5)
White Bass Gill Net	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)
	2020	9	116 (2.1)	0		12	109 (1.7)	41	109 (0.9)
	2021	17	118 (1.4)	12	109 (1.5)	24	113 (2.2)	53	113 (1.1)
Yellow Perch Gill Net	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)
	2020	107	113 (0.7)	72	112 (1.1)	21	107 (2.1)	1	91
	2021	137	116 (0.8)	34	116 (1.8)	80	111 (0.7)	6	107 (2.8)

Length Frequency Distribution

Length frequency histogram of species sampled by year.

Species: Walleye
Gear: AFS std gill net



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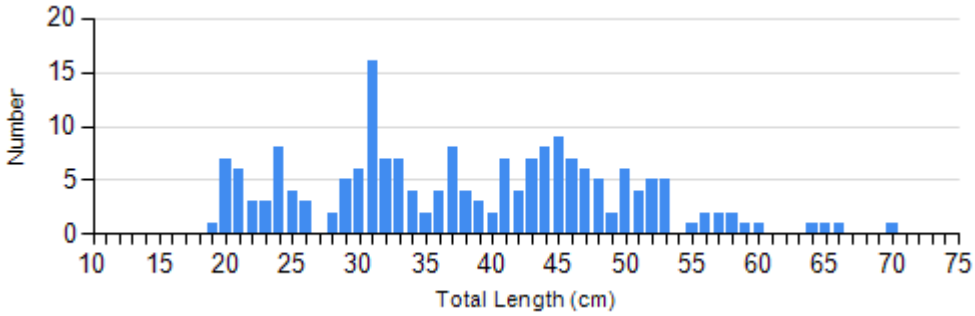

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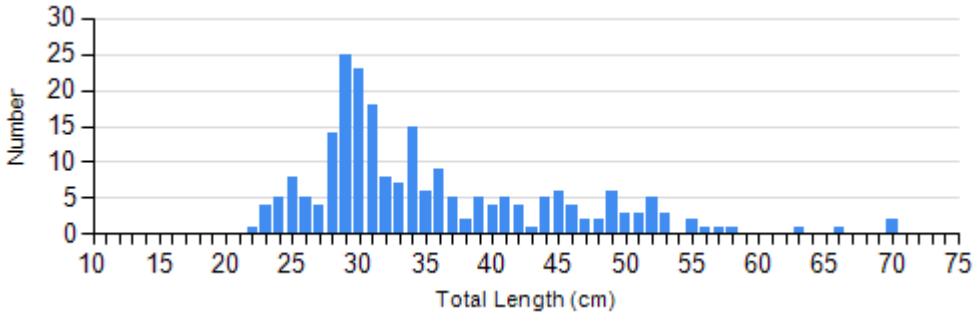

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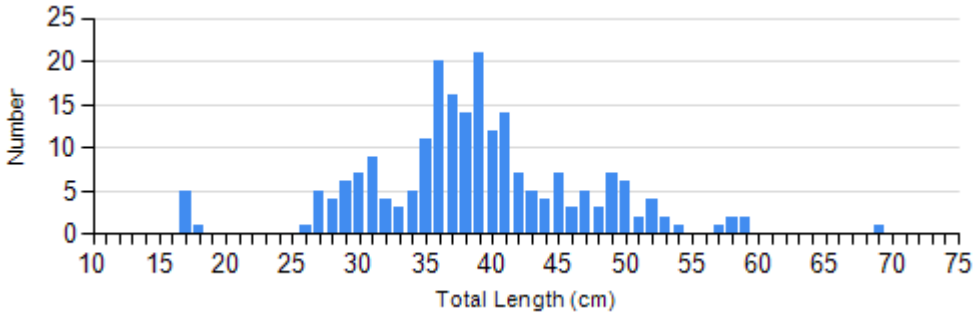

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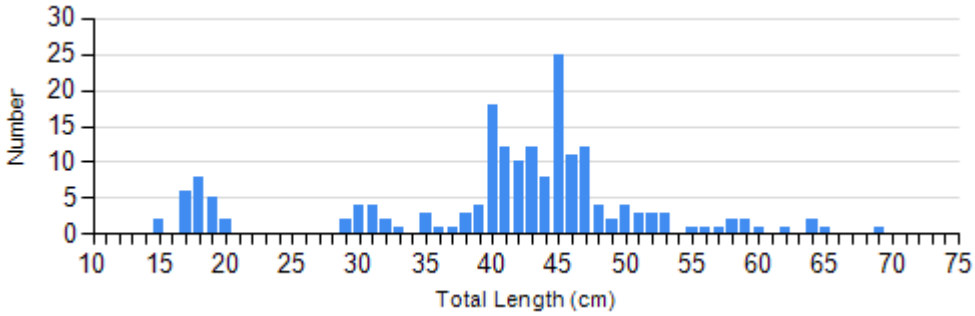
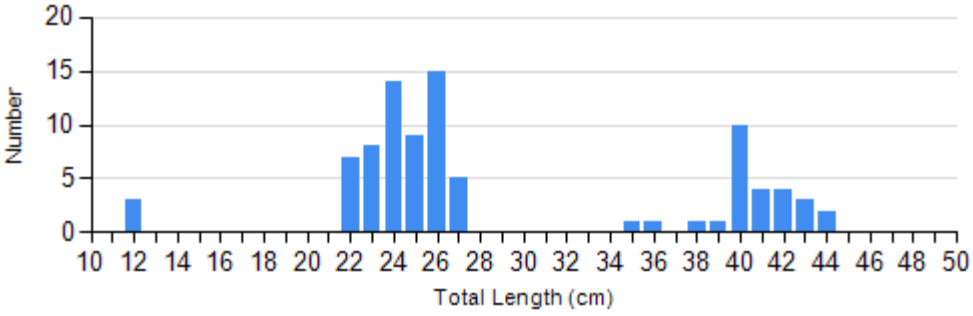


2021

Species: White Bass
Gear: AFS std gill net



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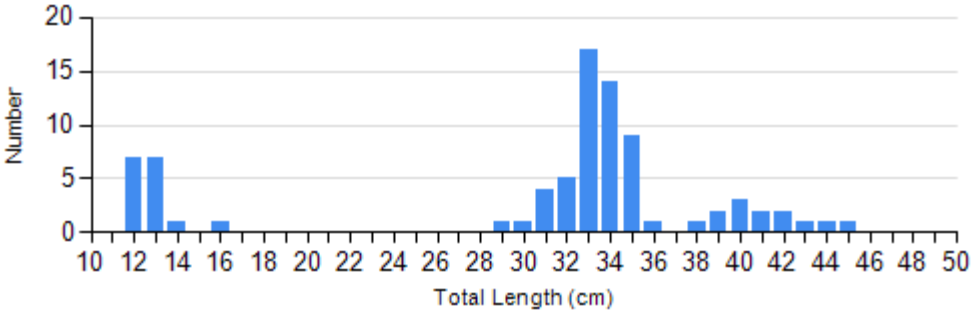

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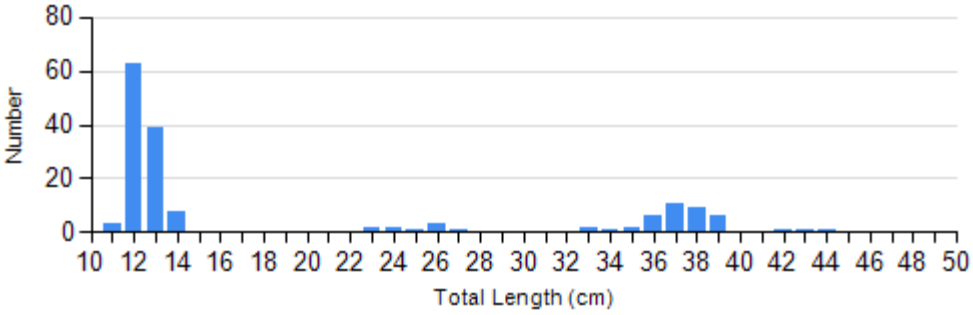

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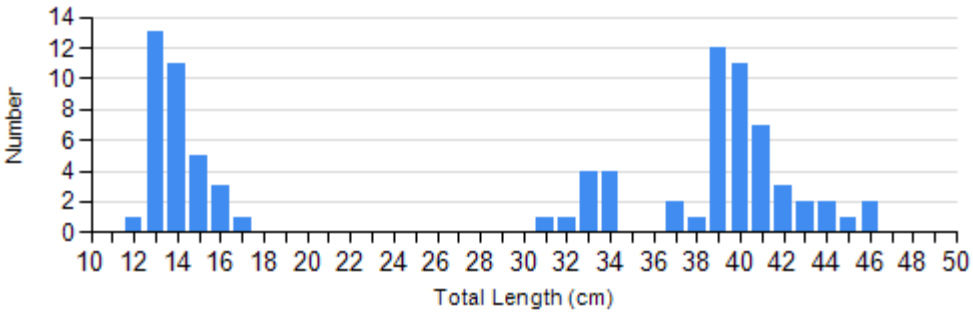
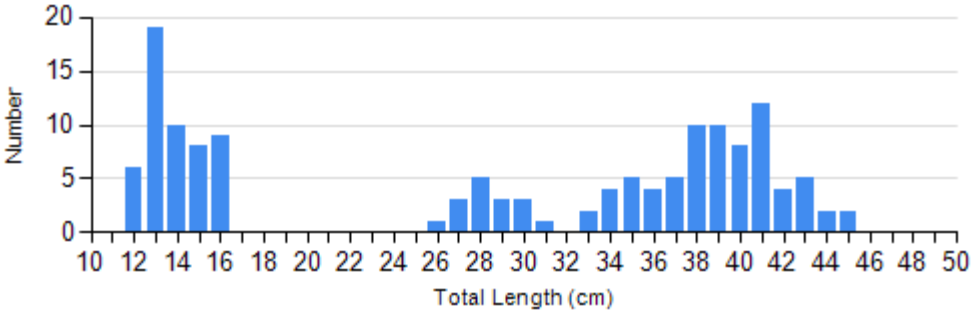


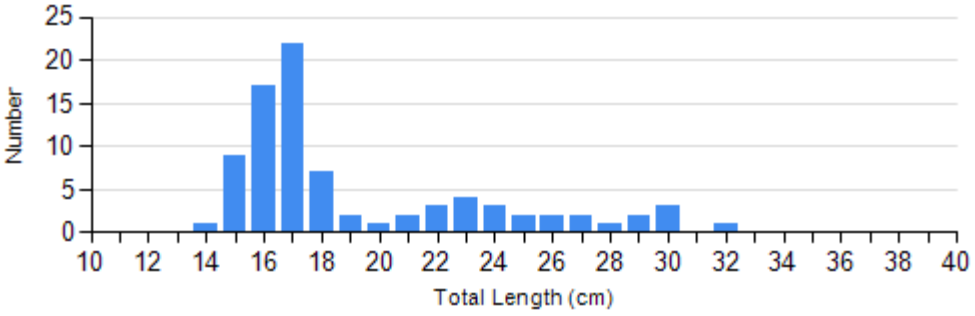
2020



2021

Species: Yellow Perch
Gear: AFS std gill net

2017



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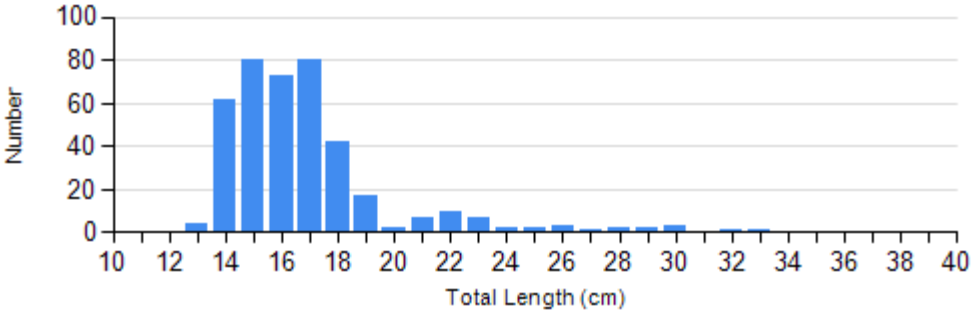
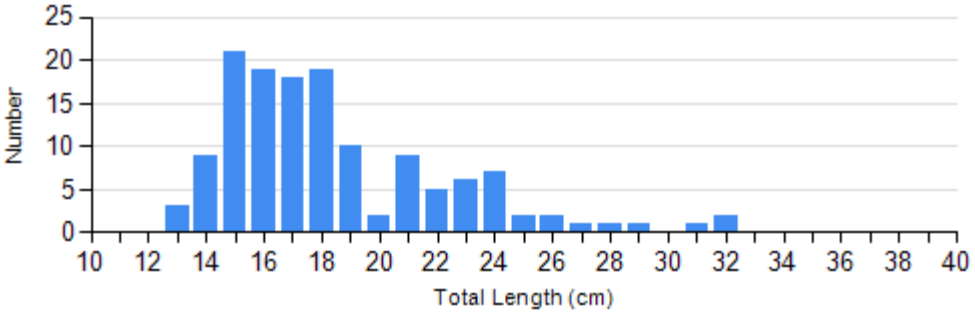


2019



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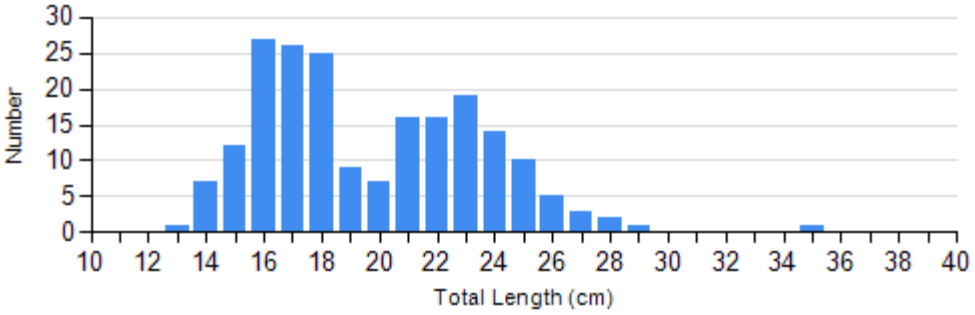

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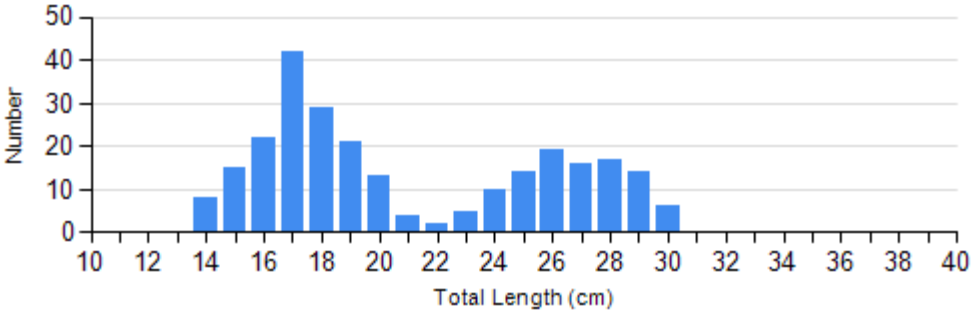
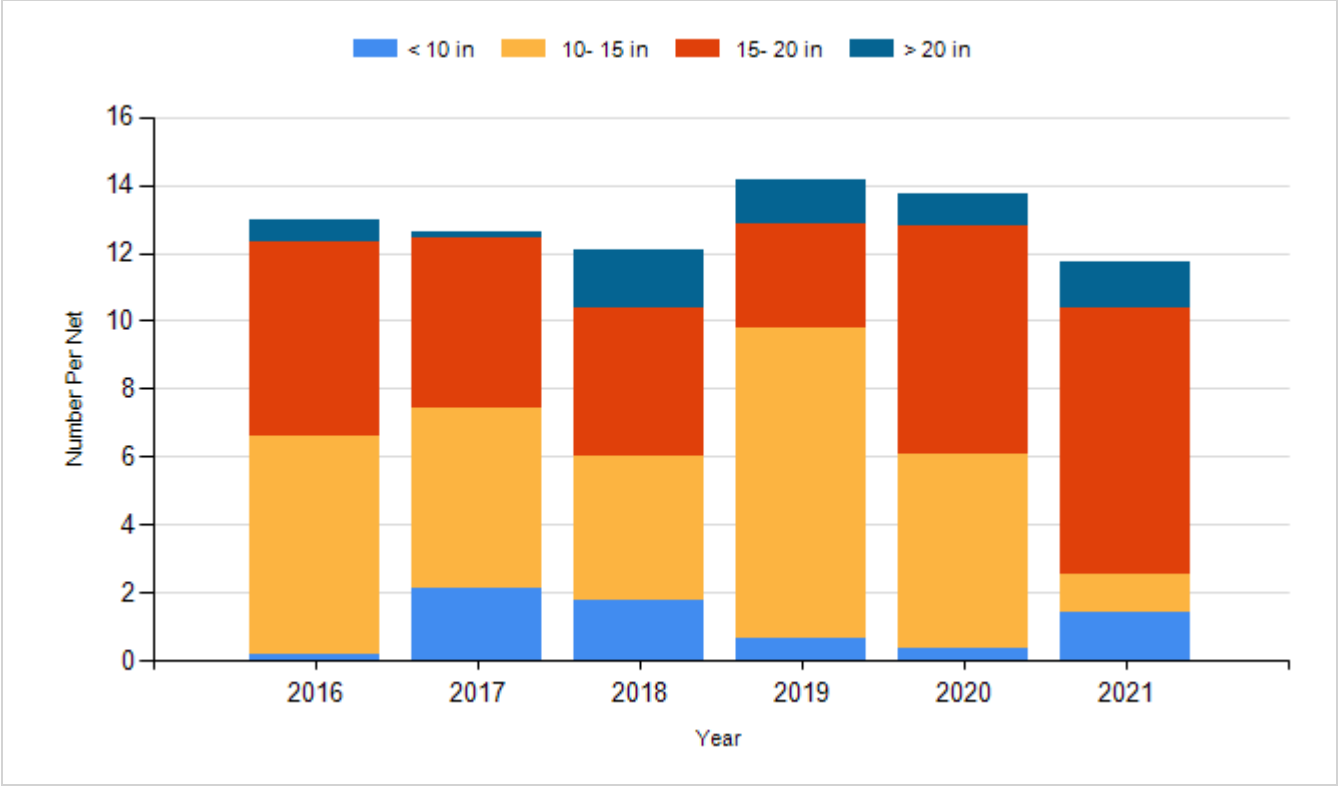


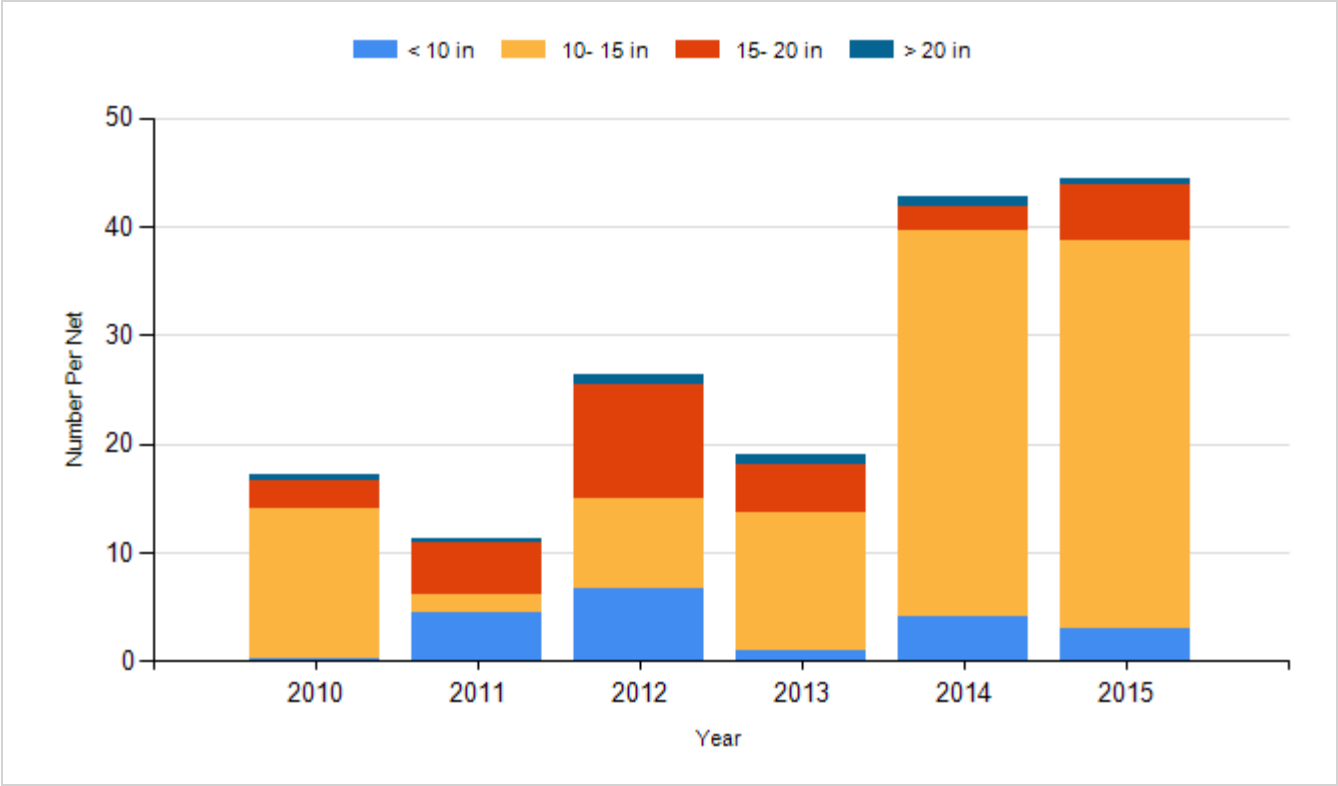
Historic Fish Sizes and Relative Abundance

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

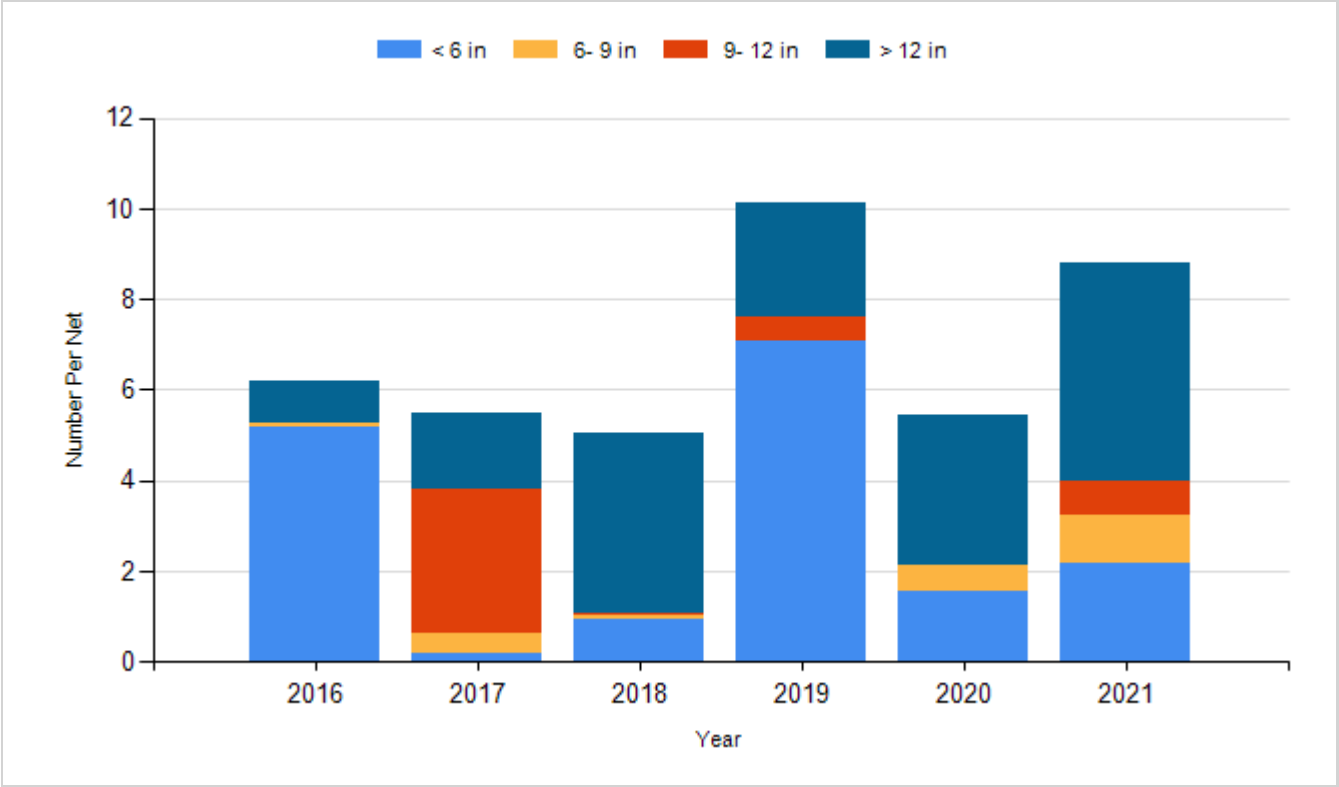
Species: Walleye
Gear: AFS std gill net



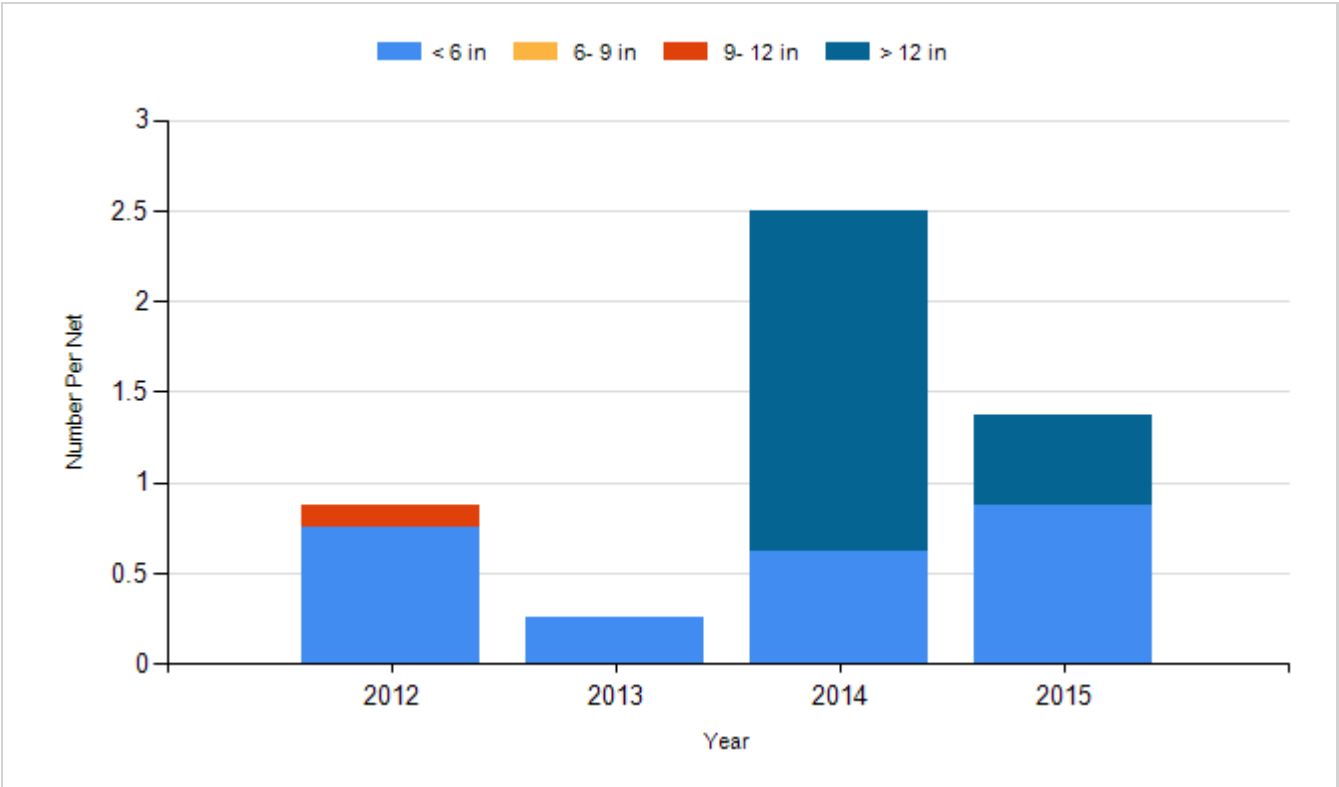
Species: Walleye
Gear: std exp gill net



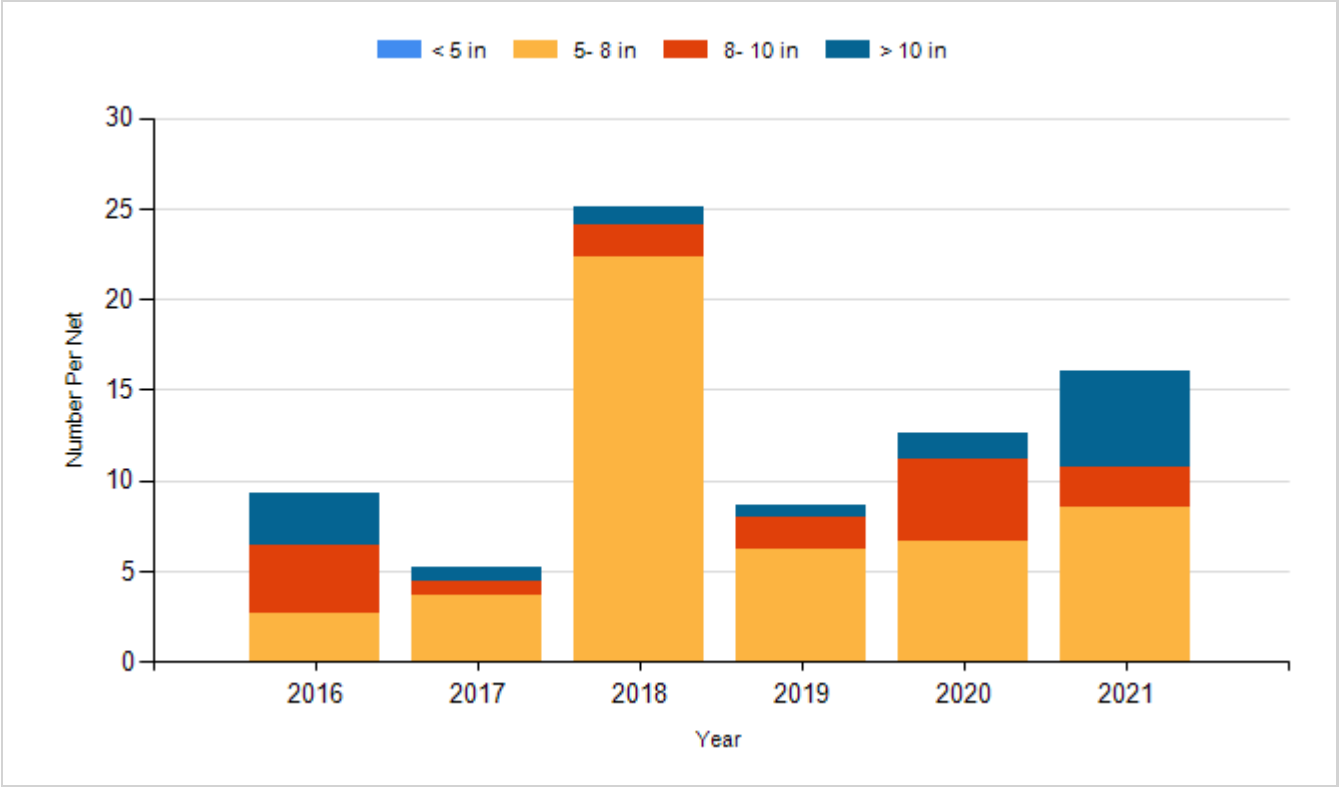
Species: White Bass
Gear: AFS std gill net



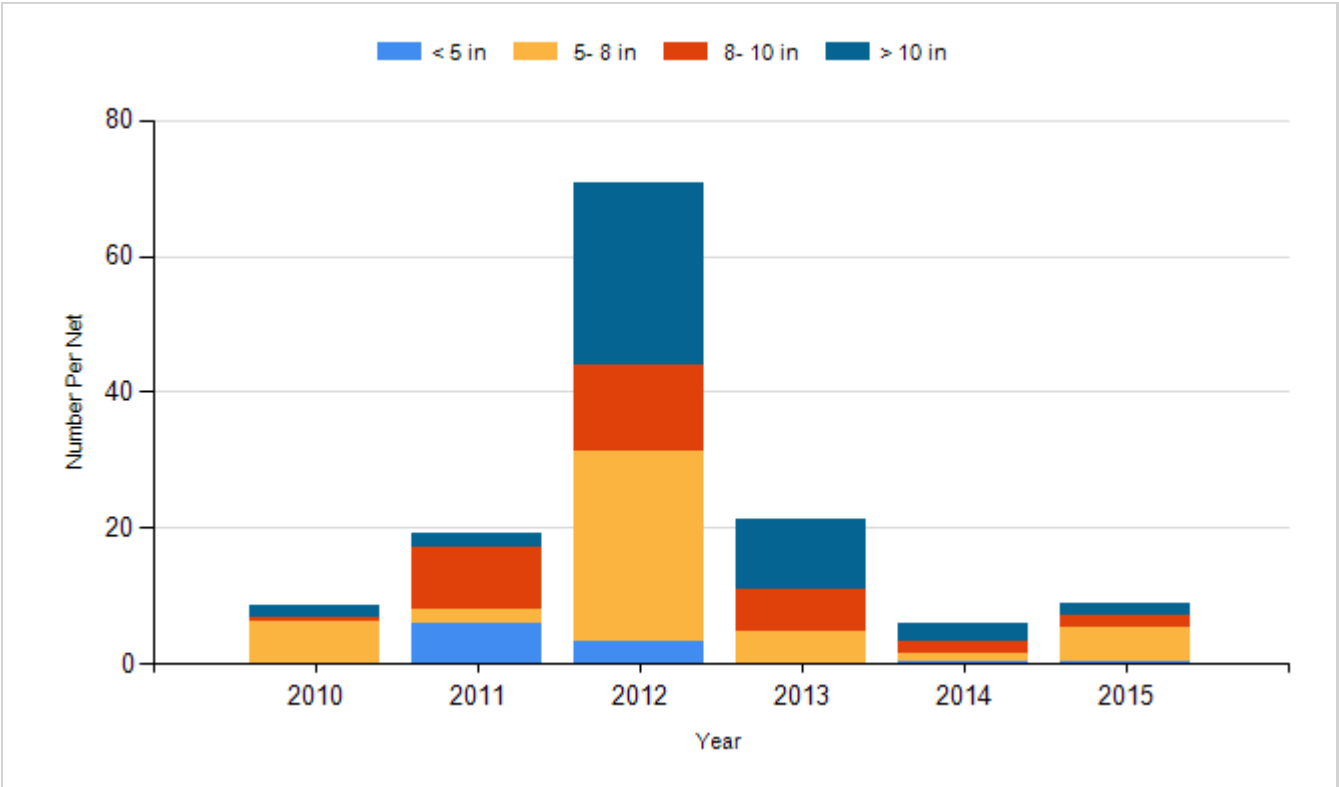
Species: White Bass
Gear: std exp gill net



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
2021	Walleye	Fry	8,000,000