Bitter Lake Survey Summary

Bitter Lake, located on the southern edge of the city 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.** Stable or falling water levels in Bitter Lake since 2011 have limited recruitment and resulted in decreased northern pike numbers. In 2018, only two northern pike were sampled and relative abundance (0.1/gill net) was considered low. Opportunities to catch northern pike still exist but anglers may encounter less northern pike than they did a few years ago (e.g., 2012 – 2014).

- **Walleye.** Gill net CPUE's have remained stable in recent years (2016 – 2018) and relative abundance in 2018 was considered high at 10.3 walleyes per gill net. A wide length range of walleyes (7.5 to 27.6 inches) was sampled as 10 year classes (2005, 2008, 2009, and 2011 - 2017) were represented. More than half (56%) of the walleyes sampled were from cohorts produced in 2011 and 2016. Growth has improved in recent years. In 2018, mean length at capture values for age 3 and age 4 walleyes were 12.7 and 16.5 inches, respectively.

- **White bass.** White bass were first sampled in 2005 and have been present in the gill net catch each year since 2012. In 2018, sampled white bass ranged from 4.7 to 17.7 inches; most were 12.2 to 13.8 inches and likely from the recently produced 2016 cohort.

- **Yellow perch**. Addition of a strong 2017 year class to the population increased the relative abundance (25.1/gill net) of yellow perch in 2018. The 2017 cohort accounted for 88% of yellow perch in the gill net catch. Yellow perch from the strong 2017 cohort grew well averaging 6.5 inches at age 1 and should approach sizes that interest anglers in 2019.

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

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY
Bitter, Day County
UBS-Lake-409-800
2018

Lake Information

Name: Bitter   **Maximum Depth:** 32 Feet

County: Day

Surface Area: 18,783 Acres

Surveys and Investigations

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

Gear	Date	Effort
AFS std gill net	Aug 28, 2018	6 net-nights
AFS std gill net	Aug 29, 2018	6 net-nights
AFS std gill net	Aug 30, 2018	4 net-nights
fall night EF-WAE	Oct 01, 2018	3600 seconds

Common Fish Species Present

Northern Pike

Walleye

Yellow Perch

White Bass

Common Carp

Rock Bass

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.

- **std 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.

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

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

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.

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

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).

Species Name	Stock (in)	(cm)	Quality (in)	(cm)	Preferred (in)	(cm)	Memorable (in)	(cm)	Trophy (in)	(cm)
Bigmouth Buffalo	11	28	18	46	24	61	30	76	37	94
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
Channel Catfish	11	28	16	41	24	61	28	71	36	91
Common Carp	11	28	16	41	21	53	26	66	33	84
Freshwater Drum	8	20	12	30	15	38	20	51	25	63
Gizzard Shad	7	18	11	28						
Green Sunfish	3	8	6	15	8	20	10	25	12	30
Lake Herring	5	13	8	20	11	28	14	35	17	43
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
Rock Bass	4	10	7	18	9	23	11	28	13	33
Rudd	6	15	10	25	12	30	15	38	19	48
Saugeye	9	23	14	35	18	46	22	56	27	69
Shorthead Redhorse	6	15	10	25	13	33	16	41	20	51
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
White Sucker	6	15	10	25	13	33	16	41	20	51
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

Gear	Species	Abundance		Stock Density Indices				Condition	
		CPUE	CI-80	PSD	CI-80	PSD-P	CI-80	Wr	CI-80
AFS std gill net	Black Bullhead	0.1	0.1	100		50		108	1
	Black Crappie	0.1	0.1	0		0		125	
	Common Carp	1.2	0.6	84		58	18	106	2
	Northern Pike	0.1	0.1	100		100		90	3
	Rock Bass	0.3	0.1	50		0		110	3
	Walleye	10.3	1.2	59	5	16	4	88	1
	White Bass	4.1	2.5	98		97		107	1
	Yellow Perch	25.1	4.6	11	2	4	1	112	1
fall night EF-WAE*	Walleye	53.0	22.3					87	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

Gear	Species	CPUE										
		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Avg
AFS std gill net	Black Bullhead								0.0	0.0	0.1	0.0
	Black Crappie								0.1	0.0	0.1	0.1
	Common Carp								0.4	1.9	1.2	1.2
	Gizzard Shad								0.7	0.0	0.0	0.2
	Northern Pike								0.7	0.5	0.1	0.4
	Rock Bass								0.0	0.1	0.3	0.1
	Walleye								12.8	10.5	10.3	11.2
	White Bass								1.0	5.3	4.1	3.5
	White Sucker								0.2	0.0	0.0	0.1
	Yellow Perch								9.3	5.3	25.1	13.2
fall night EF-WAE*	Walleye	422.2		377.0	36.0	34.0	9.6	2.0	37.0	136.0	53.0	123.0
frame net (std 3/4 in)	Black Bullhead					0.2						0.2
	Common Carp					1.4						1.4
	Northern Pike					2.3						2.3
	Walleye					5.7						5.7
	White Bass					0.2						0.2
	Yellow Perch					0.2						0.2
std exp gill net	Black Crappie	0.0	0.1	0.5	0.0	0.0	0.0	0.0				0.1
	Common Carp	0.0	0.3	1.4	0.1	0.0	1.4	0.1				0.5
	Northern Pike	0.5	1.0	1.5	5.0	4.1	1.5	1.5				2.2
	Rock Bass	0.0	0.0	0.0	0.4	0.0	0.0	0.0				0.1
	Spottail Shiner*	0.0	0.0	0.1	0.0	0.0	0.0	0.0				0.0
	Walleye	11.0	50.6	20.1	19.8	18.0	38.8	41.4				28.5
	White Bass	0.0	0.0	0.0	0.1	0.0	1.9	0.5				0.4
	White Sucker	0.3	0.3	0.3	0.0	0.4	0.0	0.0				0.2
	Yellow Perch	20.8	25.9	39.0	67.3	21.4	5.8	8.4				26.9

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.

Gear	Species	Index	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
AFS std gill net	Northern Pike	PSD								91	100	100
		PSD-P								36	38	100
		Wr								88	86	90
	Walleye	PSD								50	49	59
		PSD-P								5	2	16
		Wr								89	92	88
	White Bass	PSD								94	92	98
		PSD-P								94	32	97
		Wr								107	116	107
	Yellow Perch	PSD								72	31	11
		PSD-P								31	15	4
		Wr								120	120	112
std exp gill net	Northern Pike	PSD	100	63	100	98	100	100	100			
		PSD-P	25	13	33	28	18	50	33			
		Wr	88	93	89	86	76	75	78			
	Walleye	PSD	24	19	76	58	30	8	14			
		PSD-P	2	3	4	4	6	3	1			
		Wr	95	102	93	86	83	91	89			
	White Bass	PSD				100		100	100			
		PSD-P				0		100	100			
		Wr				97		107	108			
	Yellow Perch	PSD	34	29	84	59	78	80	40			
		PSD-P	13	22	14	40	49	48	21			
		Wr	117	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+
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)
2009	88	287 (53)	358 (15)	457 (3)	474 (13)			483 (1)		496 (1)	574 (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+
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)							
2009	166	173 (108)	238 (55)	263 (2)	263 (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)
Northern Pike Gill Net	2014	0		6	74 (3.3)	5	76 (3.4)	1	78
	2015	0		8	78 (3.1)	4	78 (3.3)	0	
	2016	1	94	6	90 (6.0)	3	84 (2.8)	1	81
	2017	0		5	89 (2.8)	2	82 (2.7)	1	74
	2018	0		0		2	90 (2.4)	0	
Walleye Gill Net	2014	285	92 (0.3)	17	85 (1.5)	7	77 (2.4)	1	75
	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)
White Bass Gill Net	2014	0		0		9	106 (0.8)	6	108 (1.1)
	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)
Yellow Perch Gill Net	2014	9	106 (4.0)	15	116 (1.9)	14	110 (2.6)	8	110 (1.4)
	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)

Length Frequency Distribution

Length frequency histogram of species sampled by year.

Species: Northern Pike
Gear: AFS std gill net
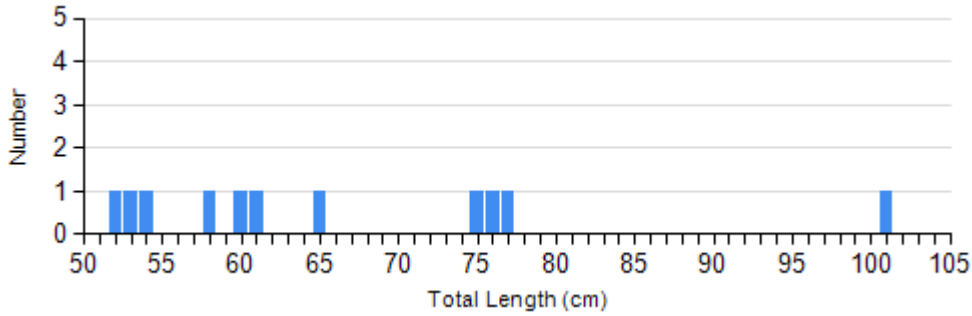
2016

Species: Northern Pike
Gear: std exp gill net
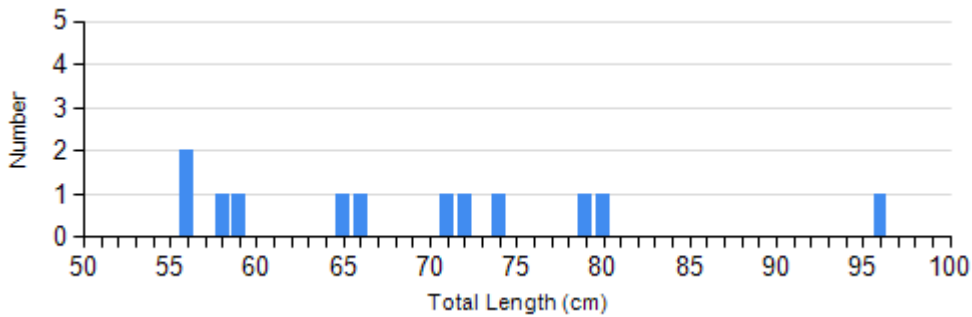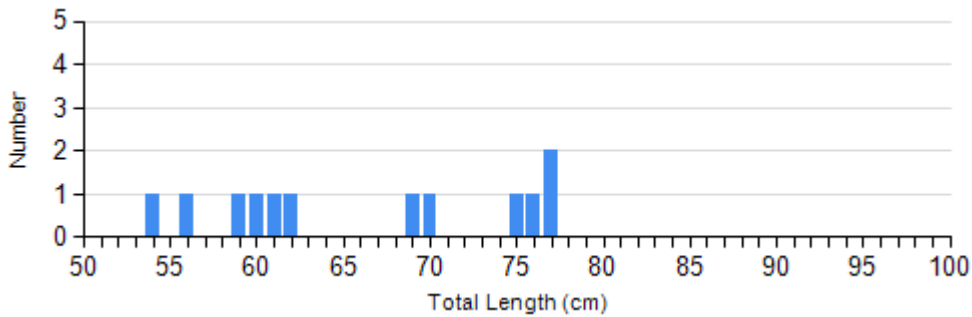
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2015

Species: Walleye
Gear: AFS std gill net
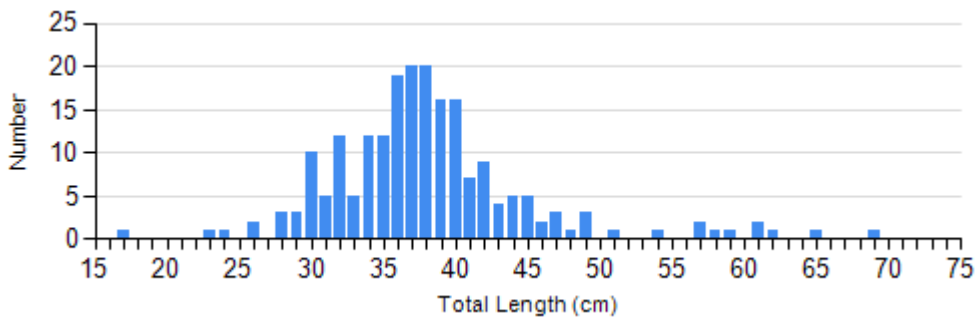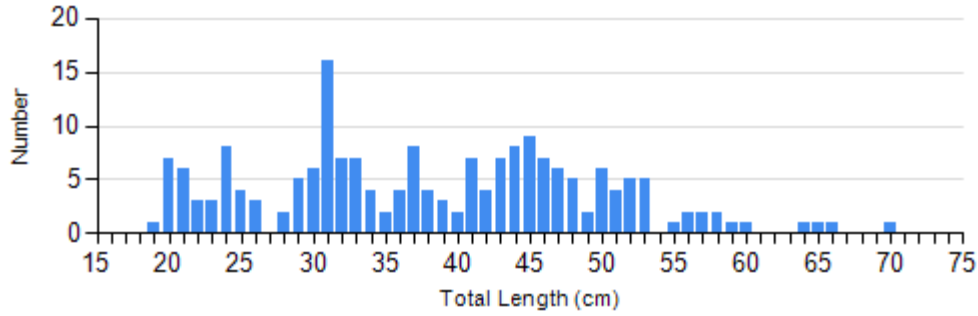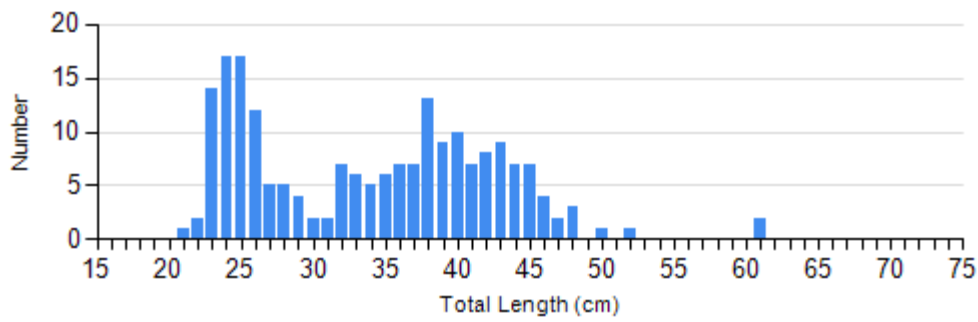
2016

2017

2018

Species: Walleye
Gear: std exp gill net
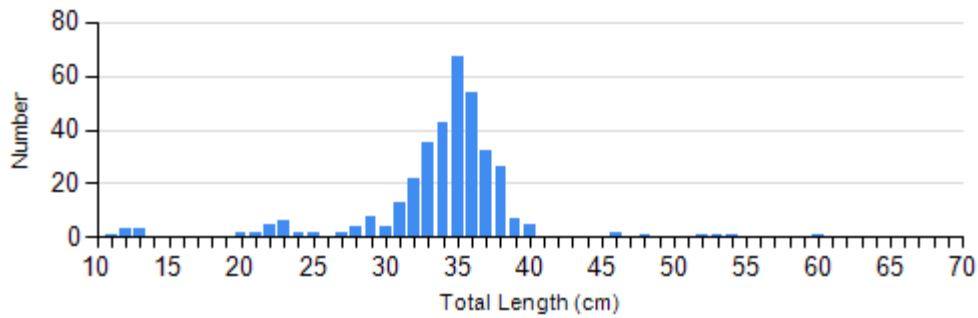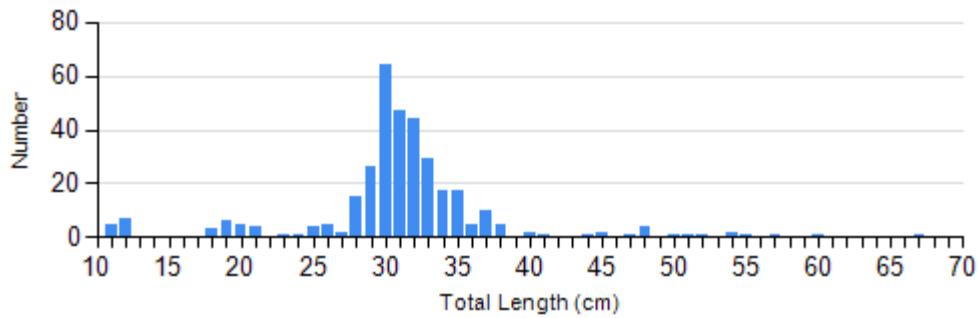
2014

2015

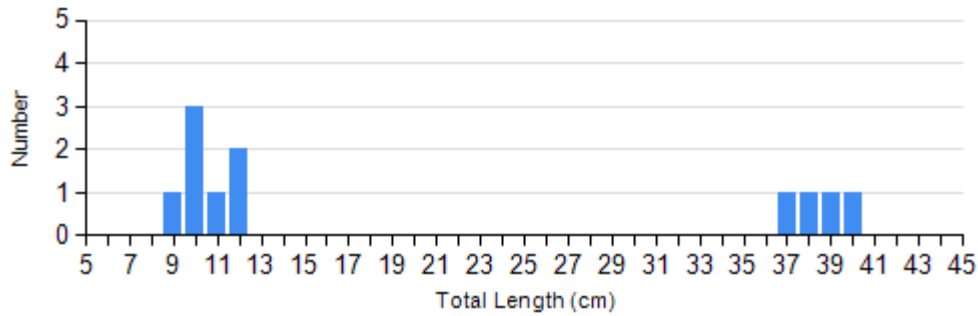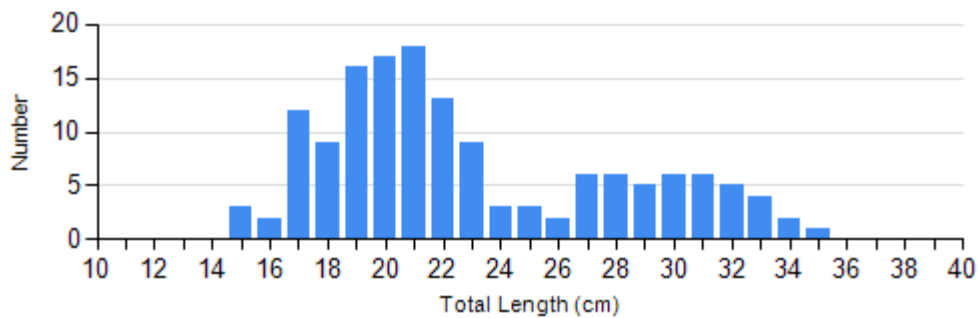Species: White Bass
Gear: AFS std gill net
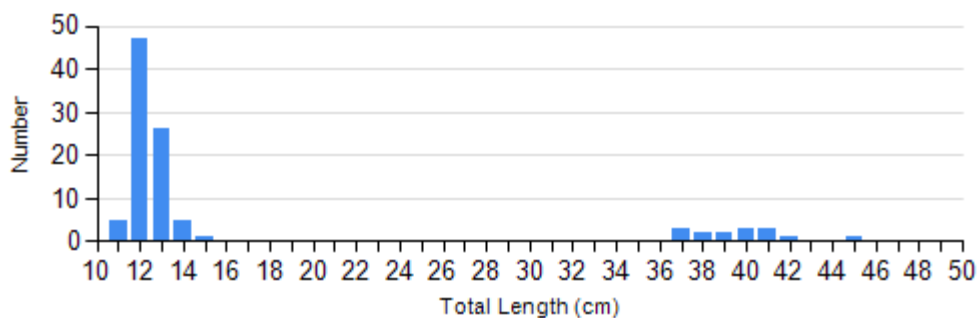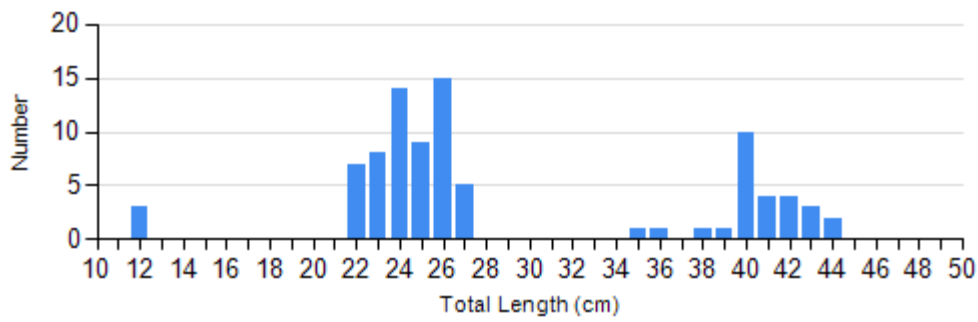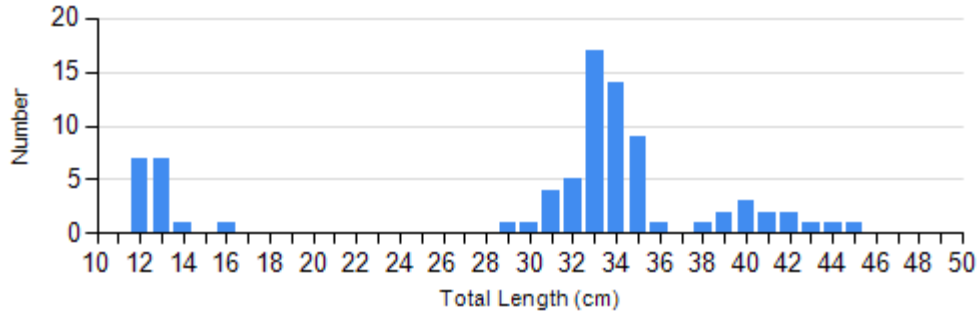
2016

2017

2018
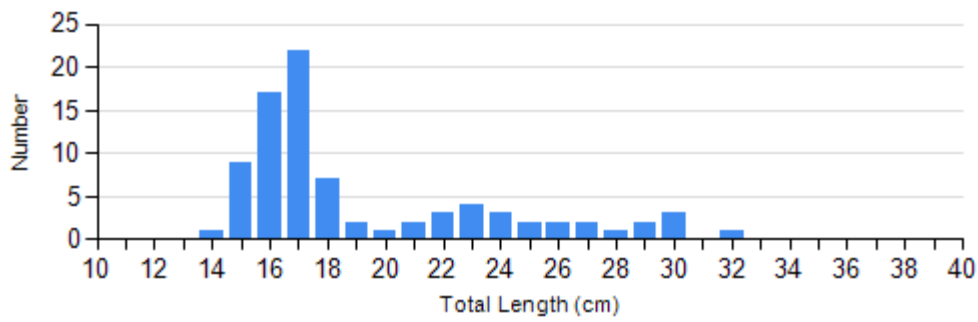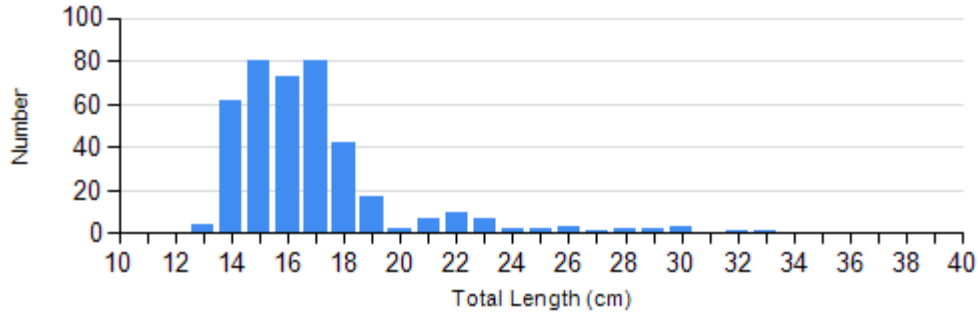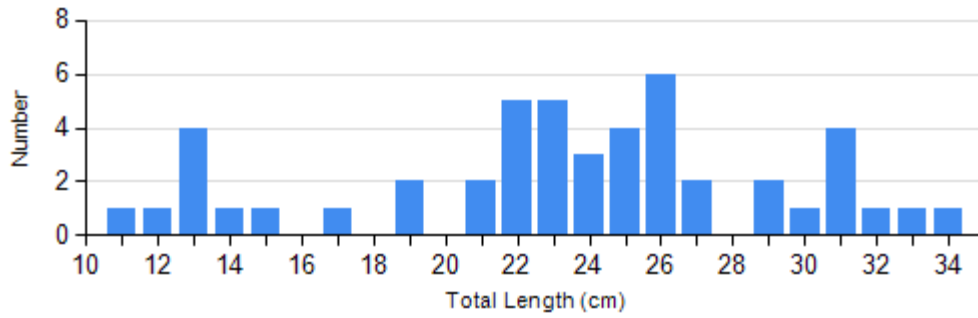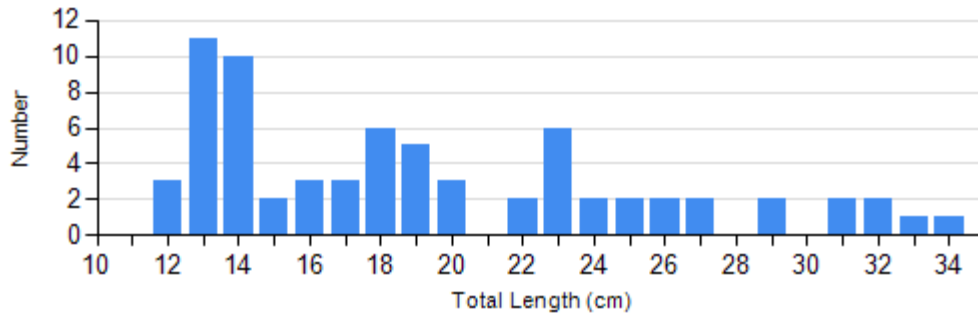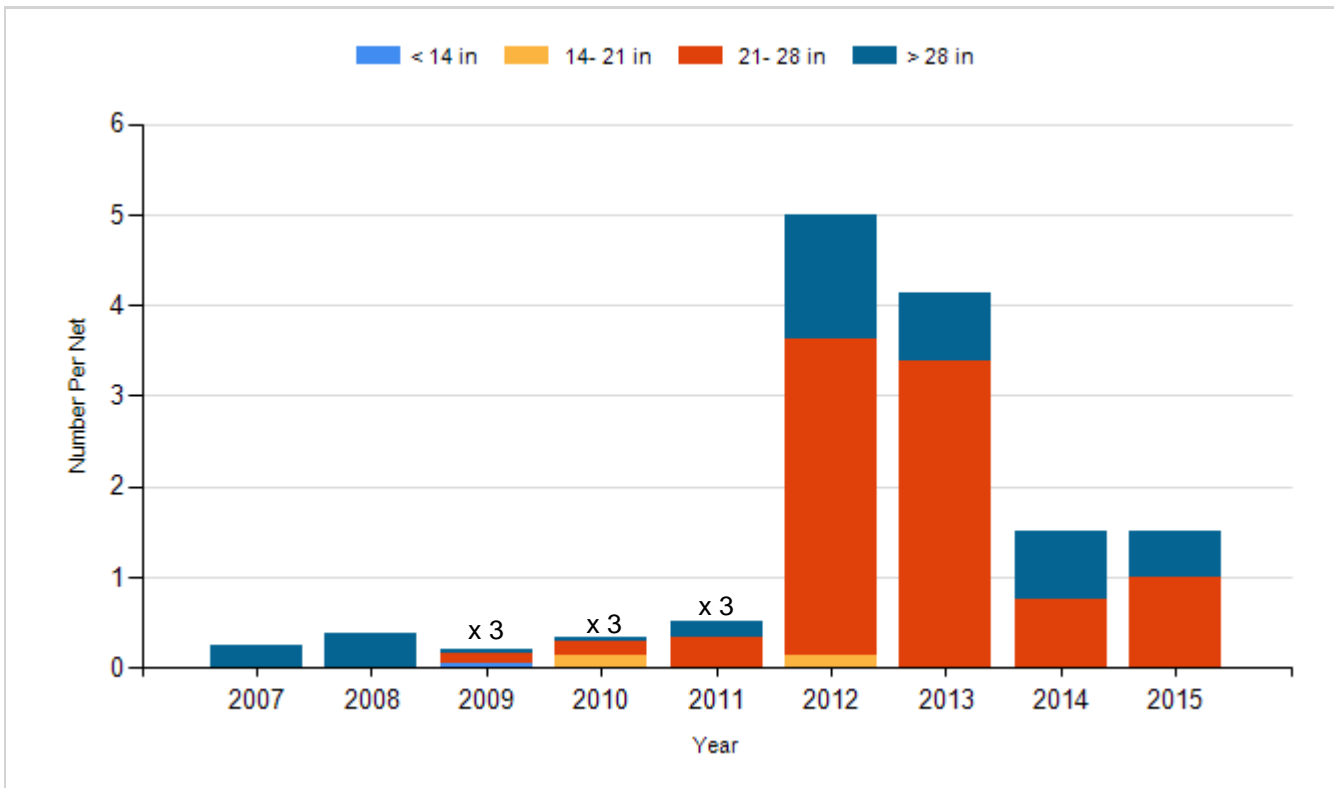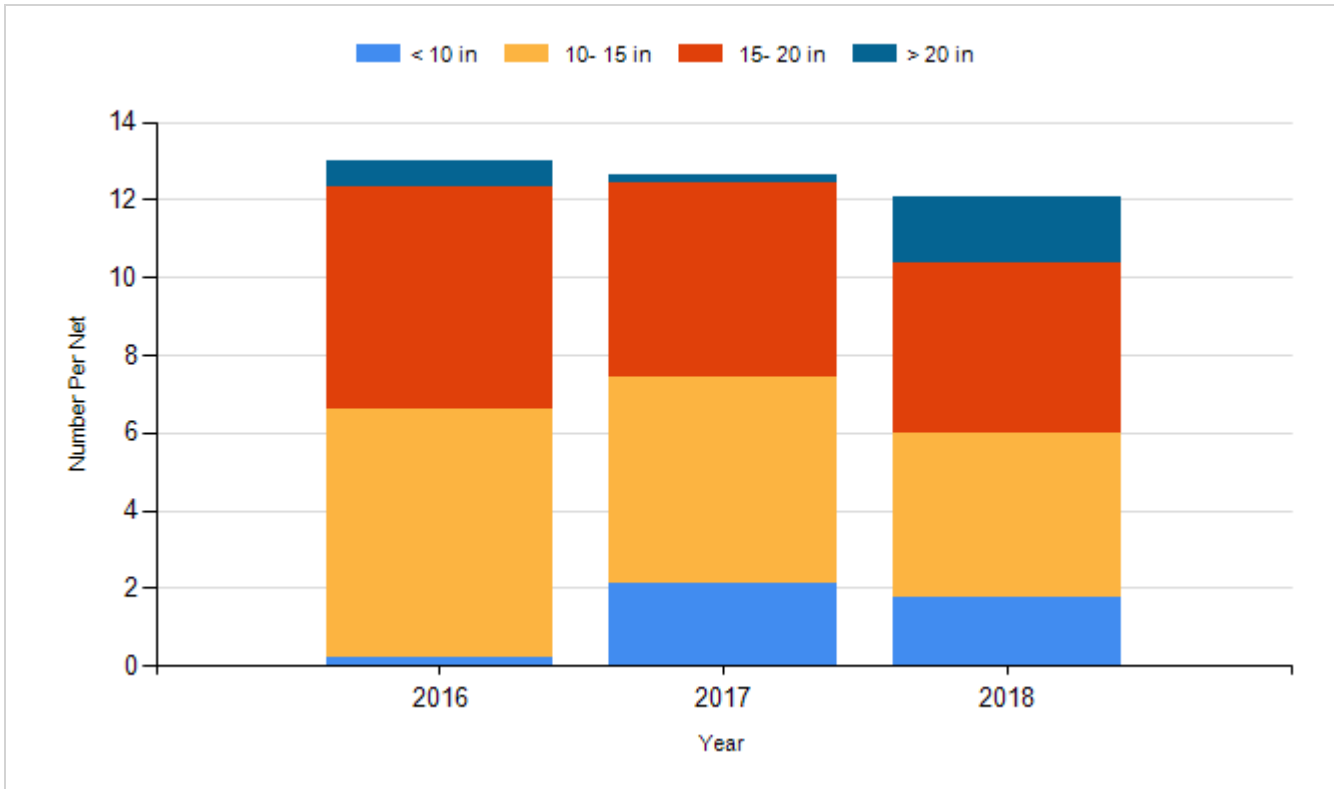
Species: White Bass
Gear: std exp gill net
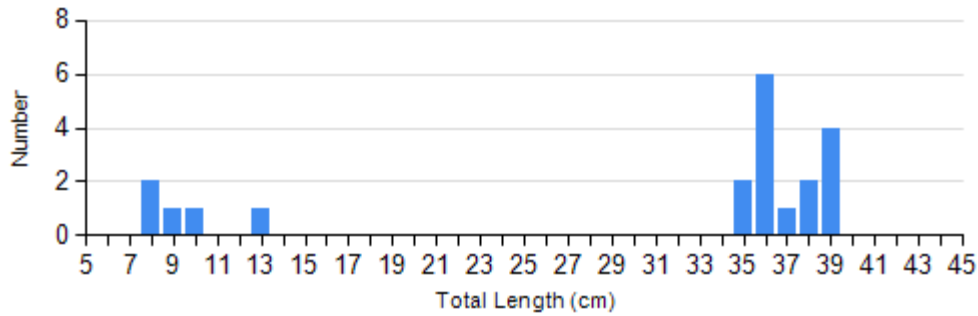
2014

2015

Species: Yellow Perch
Gear: AFS std gill net

2016

2017

2018

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.
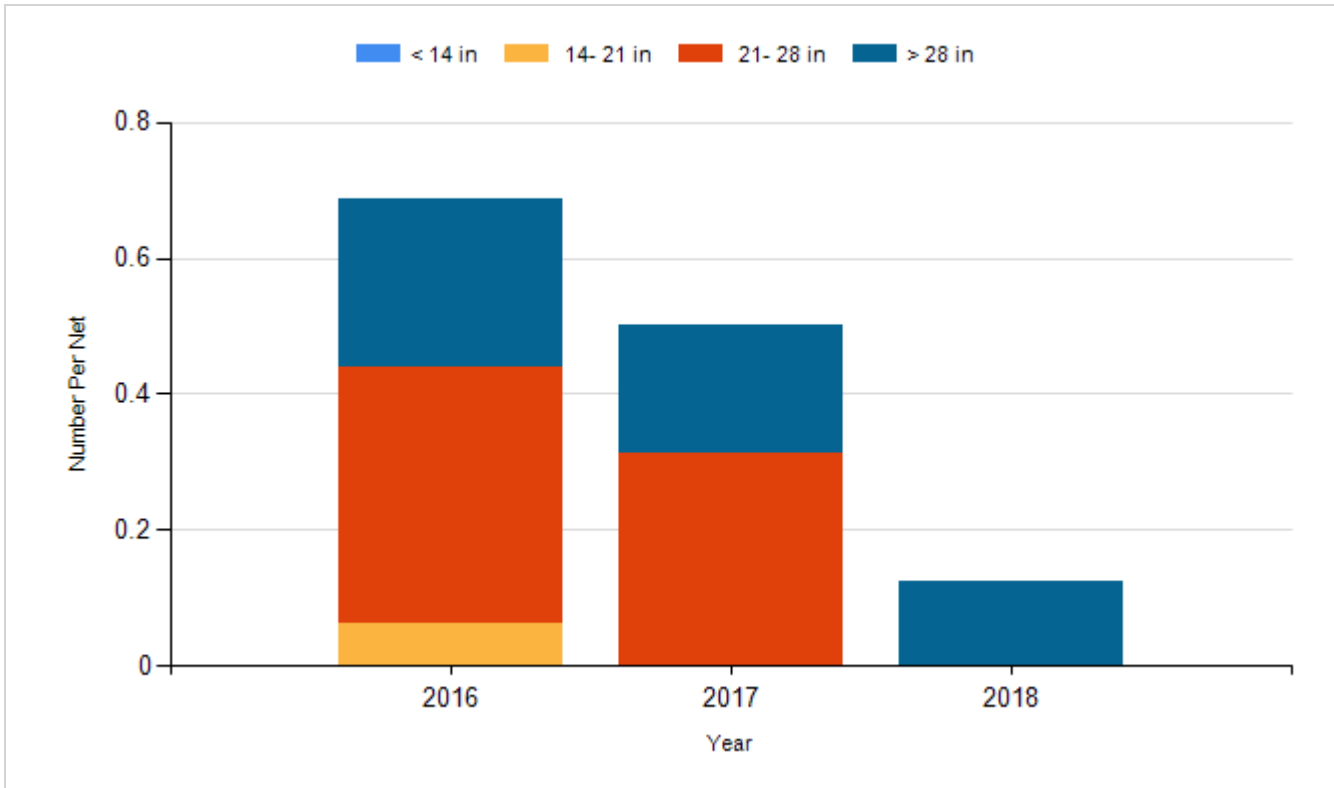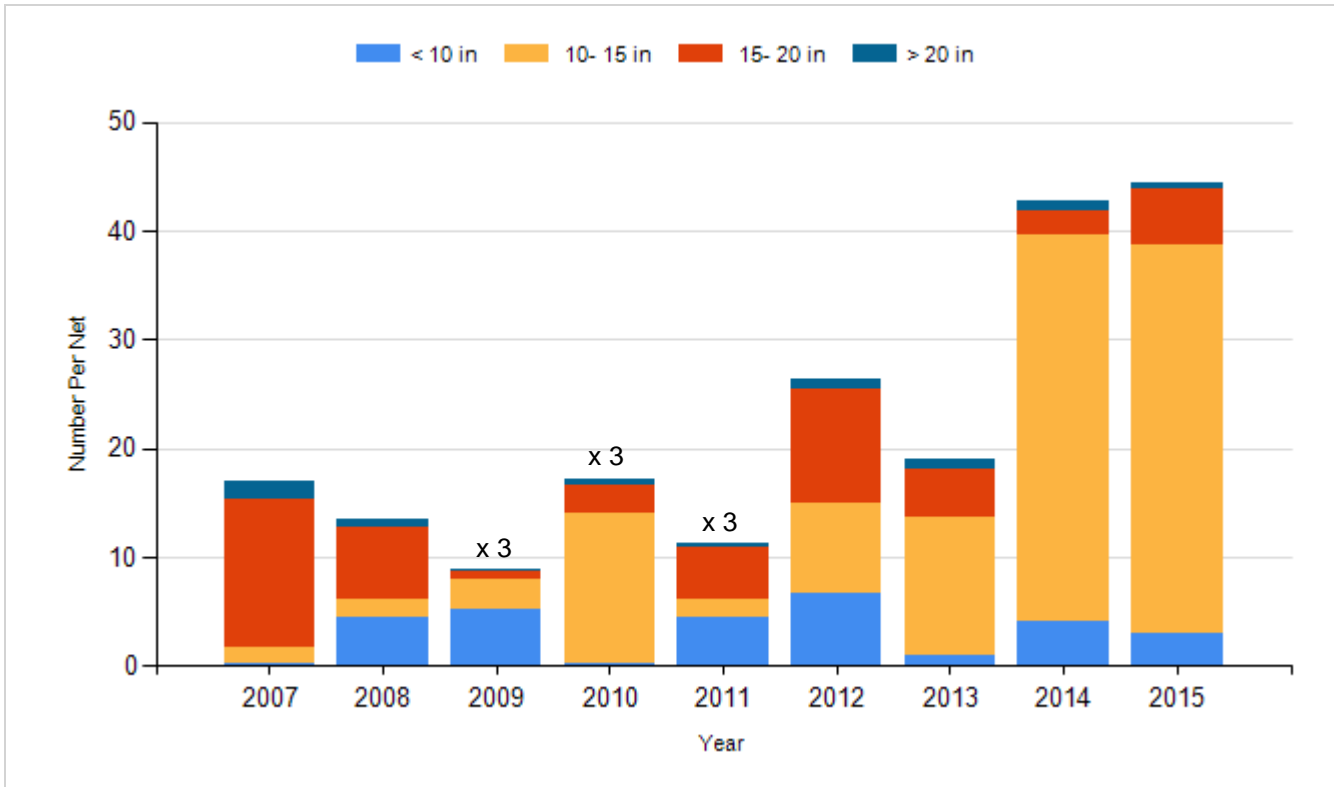
Species: Northern Pike
Gear: AFS std gill net

Species: Northern Pike
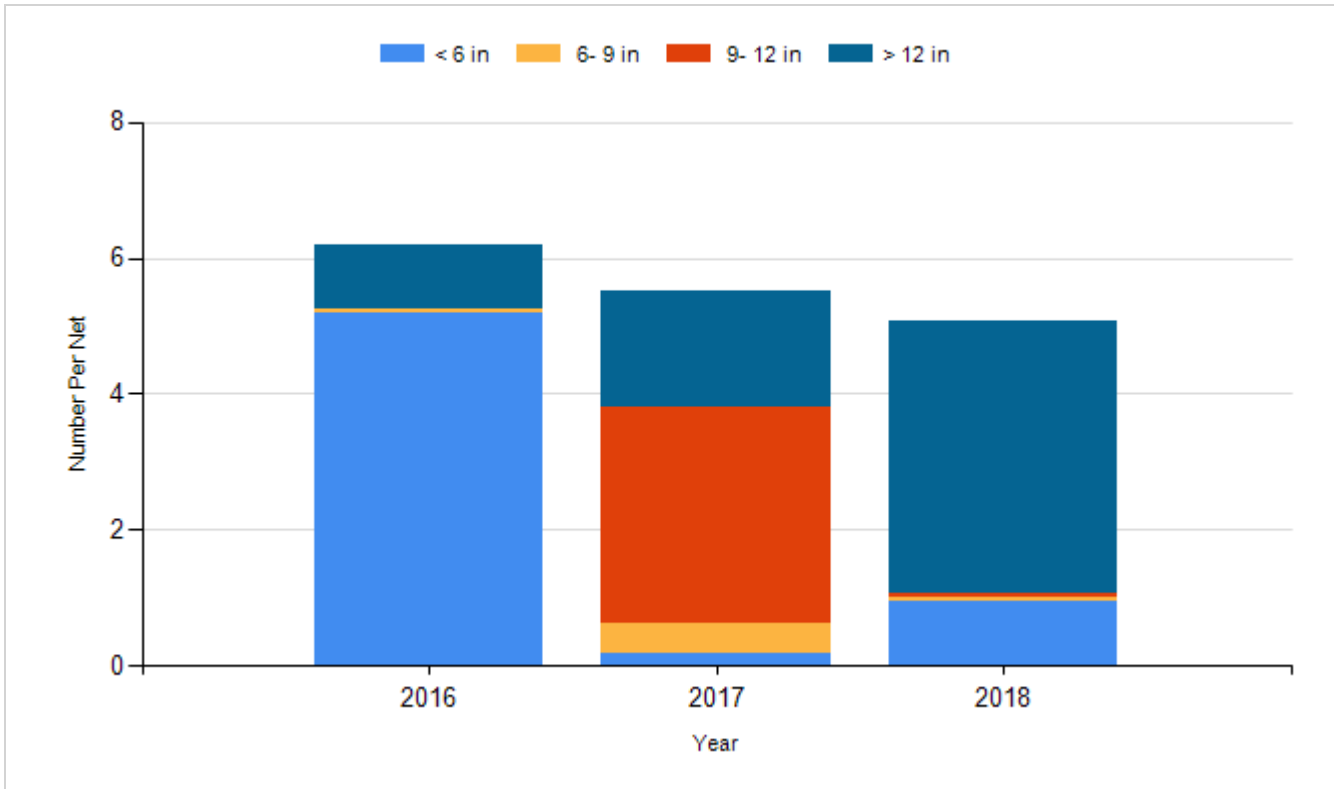Gear: std exp gill net

Species: Walleye
Gear: AFS std gill net
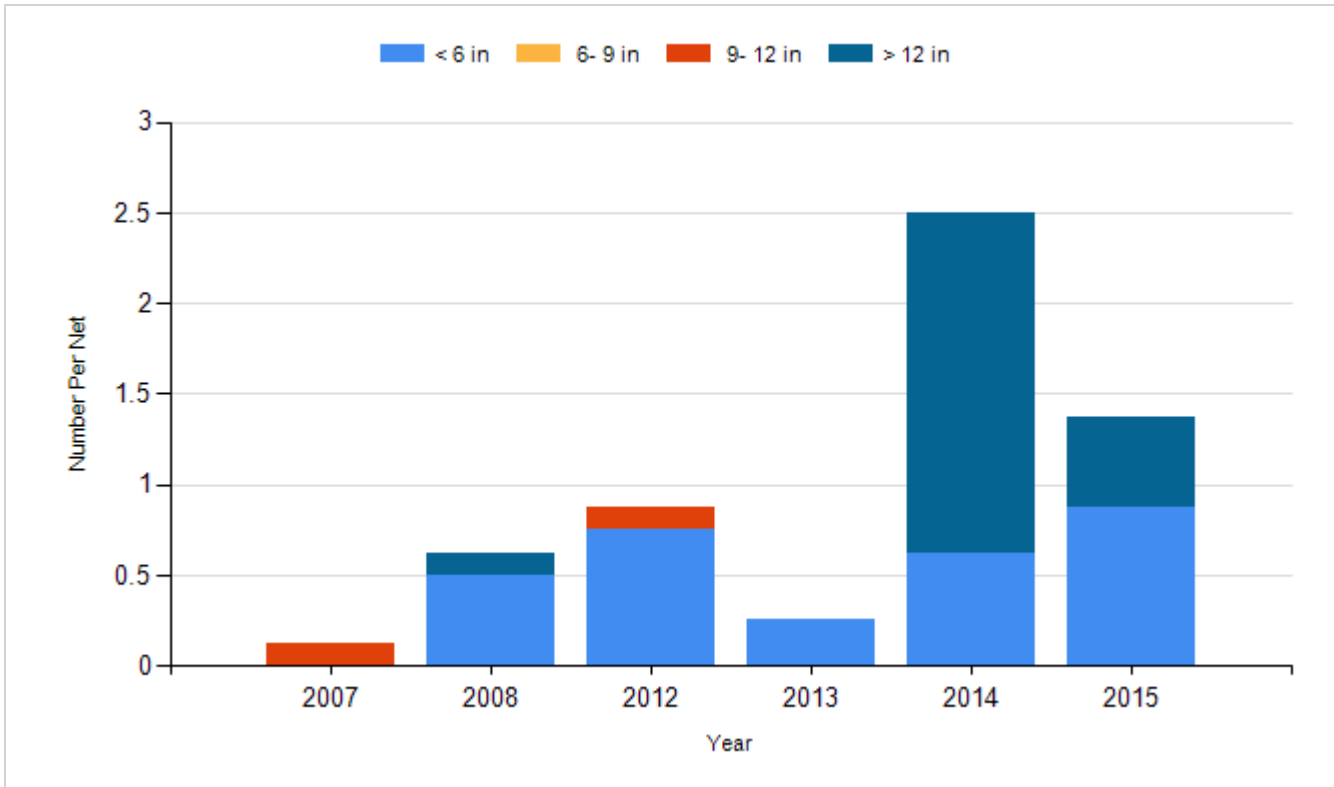

Species: Walleye
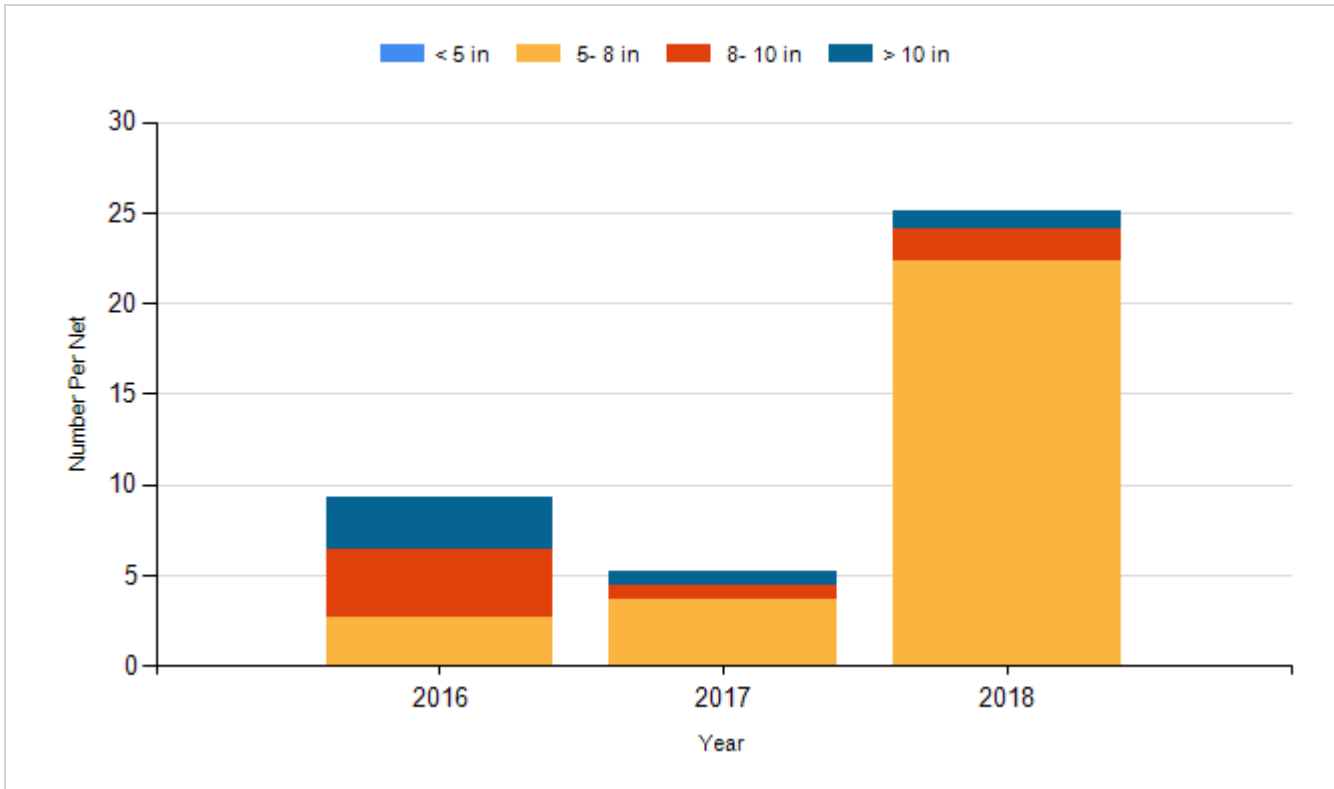Gear: std exp gill net
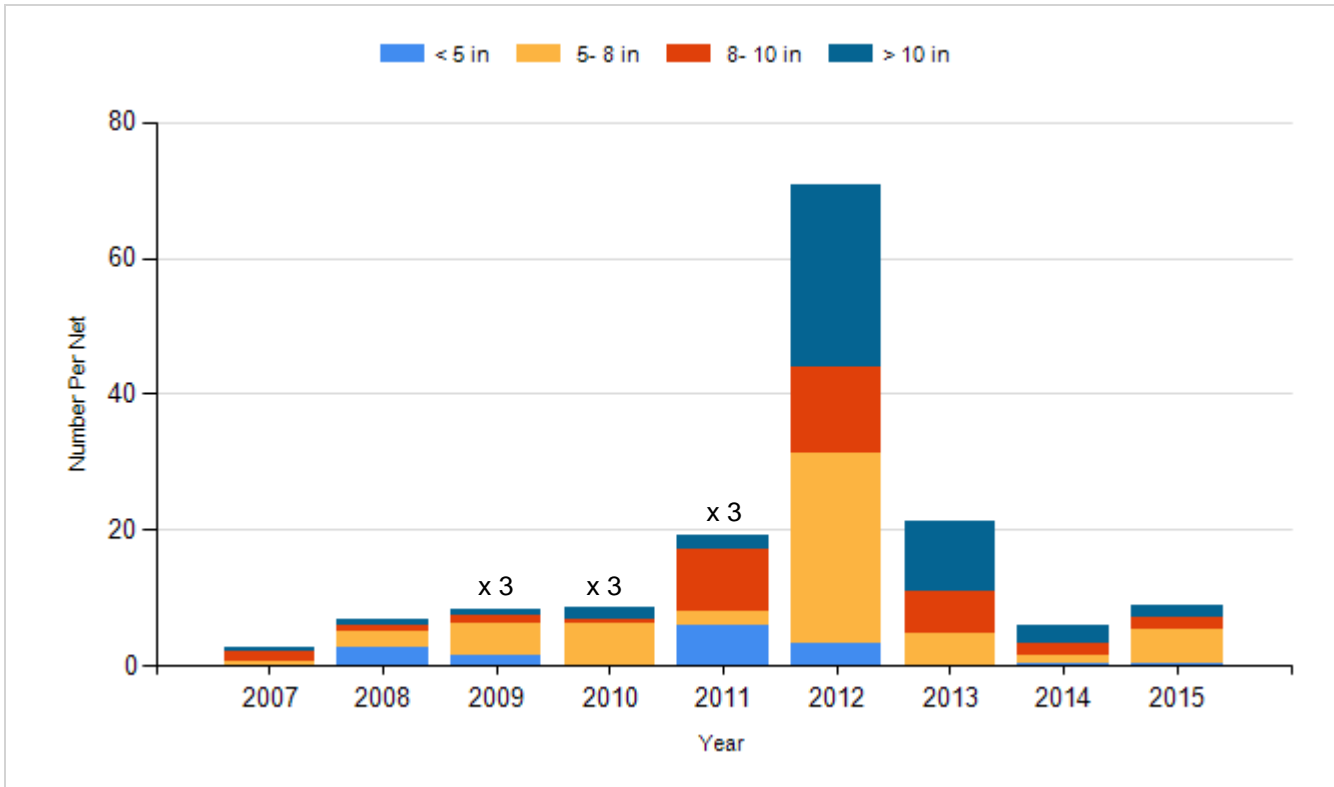
Species: White Bass
Gear: AFS std gill net

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
2007	Walleye	Fry	10,000,000
2013	Walleye	Fry	7,500,000
2015	Walleye	Fry	4,000,000
2016	Gizzard Shad	Adult	600
2016	Walleye	Fry	6,500,000