Protocol for Summarizing Status Indicators for Lake Champlain Atlantic Salmon and Lake Trout

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Lake Champlain Fisheries Technical Committee Salmonid Working Group

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Introduction

This document outlines a process for annually evaluating the status of landlocked Atlantic salmon (salmon) and lake trout in Lake Champlain. The salmonid working group of the Fisheries Technical Committee (FTC) reviewed relevant fisheries indicators that are part of annual monitoring efforts. A suite of 16 indicators were identified to monitor salmon and lake trout fisheries and progress towards restoration of natural populations.

The period from 2011 to 2017 was identified as the "desired state" for salmon and lake trout in Lake Champlain. This time period was selected based on the effectiveness of sea lamprey control efforts, stability and quality of the fishery, and evidence of natural reproduction for both salmonid species. To maintain the desired state, target goals were developed for all 16 indicators. Target goals were identified and 25th and 75th percentile "threshold bounds" set for indicators over the seven-year desired state period. In some cases, thresholds were identified using expert opinion and are based on a single threshold level rather than percentiles. In future years, if an indicator value falls outside of the threshold bounds it will be flagged as a concern. Thresholds may change if there are long-term changes to the Lake Champlain fishery but they will generally not be adjusted annually. Status of each indicator will be included in a report card format as part of the FTC annual report. This report card format will provide an easy-to-understand summary the state of salmon and lake trout in Lake Champlain based on current monitoring efforts. Changes in hatchery stocking targets or fishing regulations may be required when indicators fall outside of threshold bounds.

We believe indicators identified in this report, based on conceptual threshold modeling, long-term monitoring, and expert knowledge, will provide information that is useful and timely for managing the Lake Champlain salmonid fishery. In the past, Lake Champlain forage surveys were based on the premise that changes in forage abundance would provide early warning signs of forage limitations and lead to management actions, such as reducing stocking or regulation changes, that would be aimed at reducing predation on forage stocks. Forage monitoring surveys were conducted by the Vermont Fish & Wildlife Department for over 30 years but the project was discontinued in 2015 because the information provided by the surveys did not demonstrate a clear, consistent, and timely link between forage metrics and predator species in Lake Champlain and has not been used to make management decisions. A new research effort is underway by the University of Vermont to update forage fish monitoring efforts with the goal of providing clear links to fisheries management. If annual forage fish monitoring is reestablished in Lake Champlain, we suggest it be incorporated into this broader indicator threshold approach developed here.

This is a "living" document that may change as new information becomes available. We acknowledge that indicators identified in this report are just a start and that there are likely unidentified or missing indictors. Given the complex dynamics of Lake Champlain we recommend extending and strengthening this indicator approach using adaptive management, focused experiments, and scenario model building.

Landlocked Atlantic Salmon Annual Indictors and Targets

Hatchery stocking of nearly 300,000 salmon annually provides popular lake and river fisheries that are improving. Since 2016, evidence of natural reproduction in landlocked Atlantic salmon has been identified for the first time in over 150 years. Indicators are based on in-lake annual monitoring of salmon populations in the fall.

1. Median condition factor of age-0 lake-year landlocked Atlantic salmon

Indicator Description and Goal:
Maintain an annual median Fulton's condition factor (K) of age-0 lake-year landlocked Atlantic salmon collected in fall nearshore assessments within the 25th and 75th percentile (1.00 to 1.19) of the median K value of 1.09, calculated with data collected from 2011 through 2017 (Table 1, Figure 1).

Table 1. Sample size, mean, median, standard deviation (SD) and percentiles for K of age 0 lake year landlocked Atlantic salmon collected during fall nearshore assessments, 2011 to 2017.

					Percentiles	
Year	N	Mean	Median	SD	25th	75th
2011	141	1.05	1.05	0.12	0.96	1.14
2012	44	0.97	0.95	0.15	0.88	1.03
2013	25	1.32	1.30	0.12	1.20	1.41
2014	145	1.09	1.08	0.10	1.02	1.15
2015	74	1.05	1.03	0.10	0.99	1.11
2016	85	1.09	1.09	0.13	1.03	1.17
2017	99	1.27	1.30	0.19	1.17	1.36
Combined	613	1.10	1.09	0.16	1.00	1.19

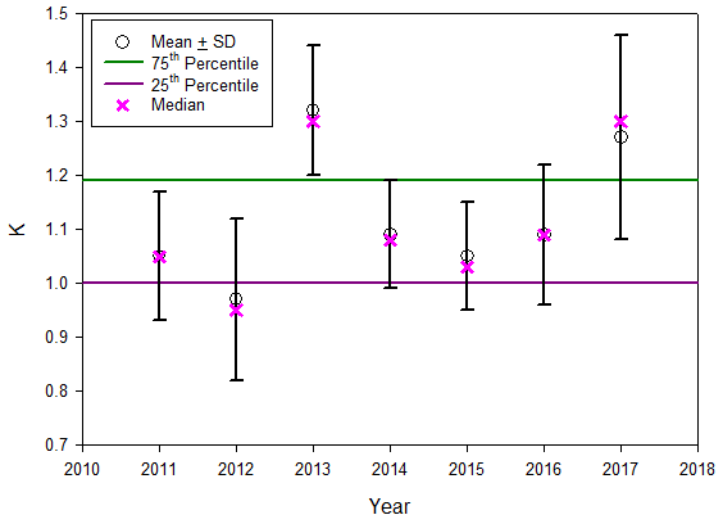

Figure 1. Annual mean ± SD and median for K of age 0 lake-year landlocked Atlantic salmon collected during fall nearshore assessments, 2011 to 2017. Reference lines are 25th and 75th percentiles of K for the entire period.

2. Median condition factor of age-1 lake-year landlocked Atlantic salmon

Indicator Description and Goal:
Maintain an annual median Fulton's condition factor (K) of age-1 lake-year male landlocked Atlantic salmon collected in fall tributary assessments within the 25th and 75th percentile (0.86 to 1.01) of the median K value of 0.94, calculated from data collected from 2011 through 2017 (Table 2, Figure 2).

Table 2. Total sample size, sample size by location, mean, median, standard deviation (SD) and percentiles for K of age-1 lake year male landlocked Atlantic salmon collected during fall tributary assessments, 2011 to 2017.

	Total	Specific River Location						Percentile	
Year	N	Hatchery	Winooski	Others	Mean	Median	SD	25th	75th
2011	240	143	68	29	0.89	0.88	0.11	0.83	0.94
2012	169	137	14	18	0.93	0.94	0.11	0.84	1.00
2013	189	105	35	49	0.97	0.97	0.12	0.89	1.04
2014	288	144	69	75	1.00	1.00	0.11	0.92	1.07
2015	432	287	58	87	0.93	0.94	0.09	0.88	0.99
2016	266	183	41	42	0.90	0.89	0.13	0.83	0.97
2017	62	40	18	4	1.03	1.04	0.13	0.96	1.11
Combined	1,646	1,039	303	304	0.94	0.94	0.12	0.86	1.01

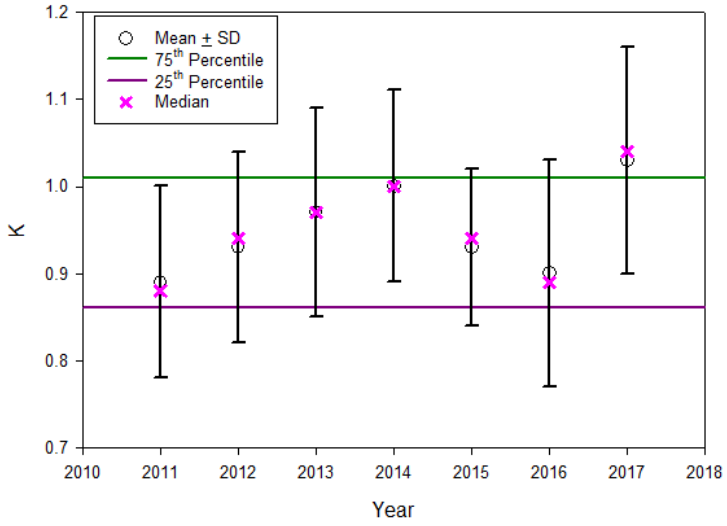

Figure 2. Annual mean ± SD and median for K of age-1 lake-year male landlocked Atlantic salmon collected during fall tributary assessments, 2011 to 2017. Reference lines are 25th and 75th percentiles of K for the entire period.

3. Median condition factor of landlocked Atlantic salmon entered in the LCI Father's Day Fishing Derby

Indicator Description and Goal:
Maintain an annual median Fulton's condition factor (K) of landlocked Atlantic salmon entered in the LCI Father's Day Fishing Derby within the 25th and 75th percentile (1.01 to 1.22) of the median K value of 1.11, calculated from derby entry data collected from 2011 through 2017 (Table 3, Figure 3).

Table 3. Sample size, mean, median, standard deviation (SD) and percentiles for K of all landlocked Atlantic salmon entered in the LCI Father's Day Derby, 2011 to 2017.

					Percentiles	
Year	N	Mean	Median	SD	25th	75th
2011	108	1.07	1.06	0.16	0.95	1.17
2012	40	1.11	1.12	0.13	1.01	1.21
2013	47	1.22	1.21	0.15	1.11	1.30
2014	51	1.19	1.20	0.14	1.11	1.30
2015	101	1.10	1.10	0.13	1.03	1.17
2016	96	1.08	1.09	0.15	1.00	1.17
2017	28	1.13	1.15	0.17	0.98	1.26
Combined	471	1.12	1.11	0.15	1.01	1.22

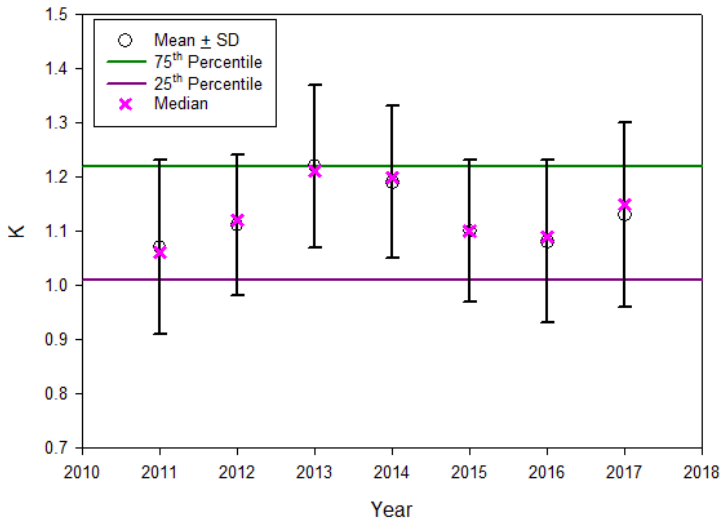

Figure 3. Annual mean ± SD and median for K of all landlocked Atlantic salmon entered in the LCI Father's Day Derby, 2011 to 2017. Reference lines are 25th and 75th percentiles of K for the entire period.

4. Sea lamprey wounding rate for landlocked Atlantic salmon

Indicator Description and Goal:
The target wounding rate for landlocked Atlantic salmon is 15 fresh and healing (A1-A3) wounds per 100 fish between 432 and 533 mm (17 - 21 inches) total length. Salmon wounding rates from 2011 - 2017 remained substantially lower than the average rates observed during the period from 2000 – 2009 (Figure 4).

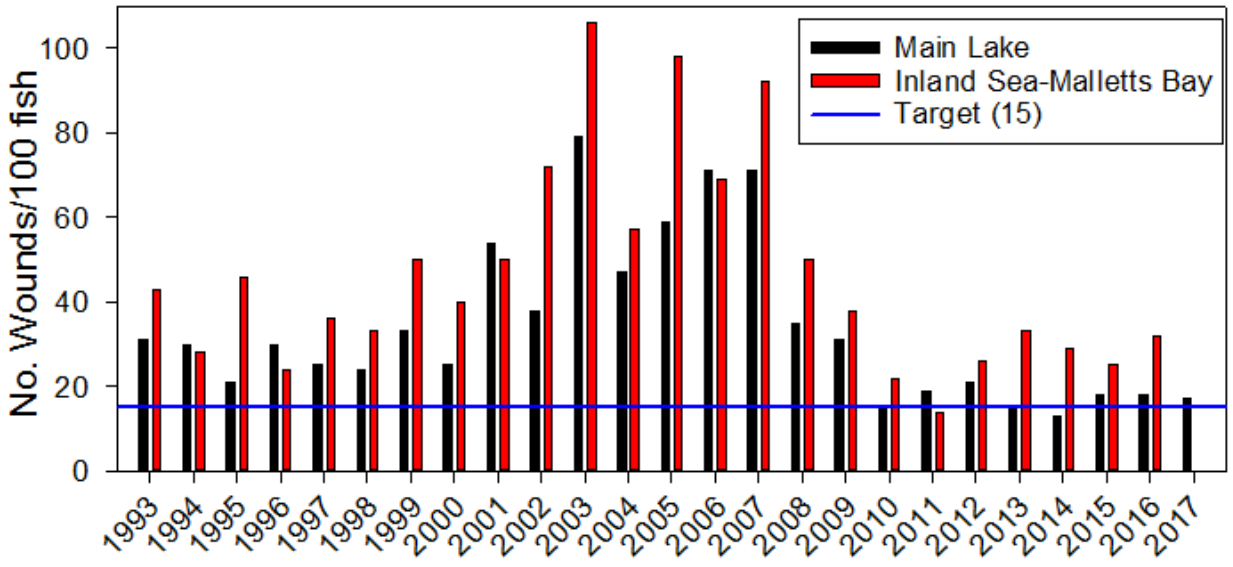

Figure 4. Sea lamprey wounds (fresh and healing – A1-A3) per 100 salmon between 432 and 533 mm (17-21 inches) total length from fall sampling in the Main Lake and Inland Sea-Malletts Bay basins, 1993-2017. The target wounding rate of 15 wounds per 100 fish is presented for reference (blue line).

5. Median weight of top 10 landlocked Atlantic salmon entered in LCI Father's Day Fishing Derby

Indicator Description and Goal:
Maintain an annual median weight of the top 10 landlocked Atlantic salmon entered in the LCI Father's Day Fishing Derby within the 25th and 75th percentiles (2.86 to 3.68 kg) of the median weight value of 3.27 kg, calculated with data collected from 2011 through 2017 (Table 4, Figure 5).

Table 4. Sample size, mean, median, standard deviation (SD) and percentiles for the weight (kg) of the top ten landlocked Atlantic salmon entered in the LCI Father's Day Fishing Derby, 2011 to 2017.

					Percentile	
Year	N	Mean	Median	SD	25th	75th
2011	10	3.82	3.69	0.55	3.33	4.08
2012	10	2.97	2.91	0.28	2.69	3.28
2013	10	3.53	3.21	0.83	2.87	4.53
2014	10	3.10	3.05	0.43	2.69	3.31
2015	10	2.98	2.83	0.35	2.66	3.31
2016	10	3.98	3.86	0.45	3.61	4.38
2017	10	3.20	3.17	0.36	2.91	3.41
Combined	70	3.37	3.27	0.62	2.86	3.68

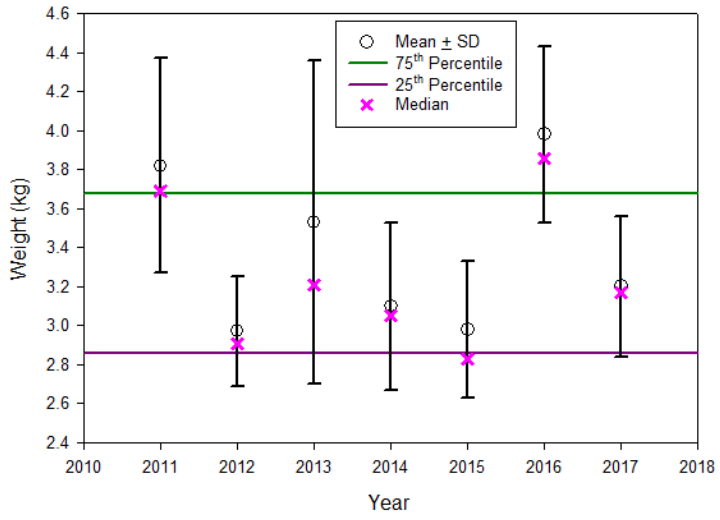

Figure 5. Annual mean ± SD and median for weights of the Top Ten landlocked Atlantic salmon entered in the LCI Father's Day Fishing Derby, 2011 to 2017. Reference lines are 25th and 75th percentiles of weight.

6. Median total length of landlocked Atlantic salmon at age 1 lake year

Indicator Description and Goal:
Maintain an annual median total length (TL) of age 1 lake year landlocked Atlantic salmon collected in fall tributary assessments within the 25th and 75th percentile (494 to 562 mm) of the median TL value of 526 mm, calculated from data collected from 2011 through 2017 (Table 5, Figure 6).

Table 5. Sample size, mean, median, standard deviation (SD) and percentiles for TL (mm) of age 1 lake year landlocked Atlantic salmon collected in fall tributary assessments, 2011 to 2017.

					Percentile	
Year	N	Mean	Median	SD	25th	75th
2011	584	511.1	508	36.6	486.0	534.0
2012	343	543.5	545	48.0	510.0	574.0
2013	481	533.9	528	51.8	495.0	570.5
2014	649	535.7	533	53.8	494.0	573.0
2015	711	529.9	530	45.9	495.0	562.0
2016	413	531.8	530	43.4	502.0	562.0
2017	81	516.4	514	51.3	474.5	557.5
Combined	3,262	529.6	526	48.1	494.0	562.0

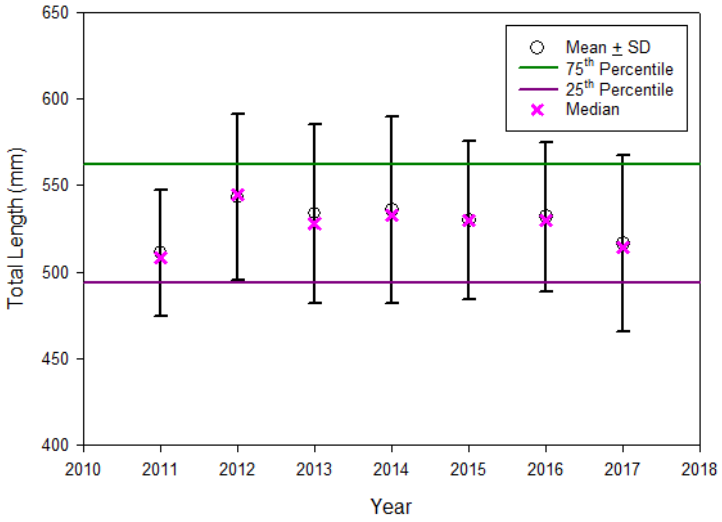

Figure 6. Annual mean ± SD and median for TL of age 1 lake year landlocked Atlantic salmon collected in fall tributary assessments, 2011 to 2017. Reference lines are 25th and 75th percentile of TL for the entire period.

7. Median total length of landlocked Atlantic salmon at age 0 lake year

Indicator Description and Goal:
Maintain an annual median total length of age 0 lake year landlocked salmon collected in fall nearshore assessments within the 25th and 75th percentile (390.3 to 426.8 mm) of the median TL value of 410.0 mm, calculated from data collected from 2011 through 2017 (Table 6, Figure 7).

Table 6. Sample size, mean, median, standard deviation (SD) and percentiles for total lengths (mm) of age 0 lake year landlocked Atlantic salmon collected in fall nearshore assessments, 2011 to 2017.

					Percentile	
Year	N	Mean	Median	SD	25th	75th
2011	141	384.6	385	21.6	370.0	395.0
2012	52	419.3	418	37.3	400.3	448.0
2013	30	434.5	438	23.9	418.8	450.3
2014	377	419.4	419	23.1	404.0	435.0
2015	79	392.3	394	18.9	378.0	405.0
2016	85	397.7	394	18.0	382.5	412.0
2017	100	414.7	418	21.7	400.5	427.8
Combined	864	409.1	410	27.4	390.3	426.8

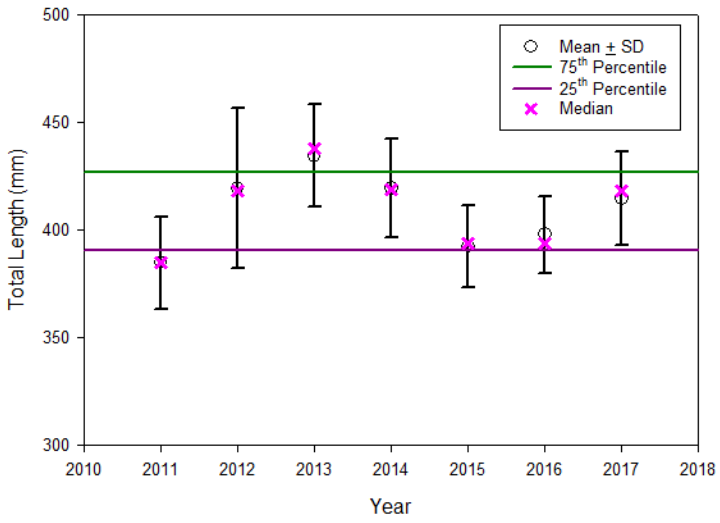

Figure 7. Annual mean ± SD and median for TL (mm) for age 0 lake year landlocked Atlantic salmon collected in fall tributary assessments, 2011 to 2017. Reference lines are 25th and 75th percentiles of TL for the entire period.

Lake Trout Annual Indictors and Targets

Hatchery stocking of approximately 82,000 lake trout annually provides a popular fishery in the Main Lake section of Lake Champlain. Spawning aggregations are sampled in the fall at two sites (Gordon Landing, VT and Whallon Bay, NY). Despite strong spawning stock size, egg deposition, and abundance of free embryos at multiple sites, natural recruitment to the fishery and spawning stock has been low. Recent sampling targeting juveniles has documented several age classes of naturally produced juvenile lake trout (ages 0-3) that have yet to appear in spawning aggregations during the fall sampling.

8. Median condition factor of lake trout entered in the LCI Father's Day Fishing Derby

Indicator Description and Goal:
Maintain an annual median Fulton's condition factor (K) of all lake trout entered in the LCI Father's Day Fishing Derby within the 25th and 75th percentile (0.93 to 1.09) of the median K value of 1.02, calculated from derby entry data collected from 2011 through 2017 (Table 7, Figure 8).

Table 7. Sample size, mean, median, standard deviation (SD) and percentiles for K of all lake trout entered in the LCI Father's Day Derby, 2011 to 2017.

					Percentile	
Year	N	Mean	Median	SD	25th	75th
2011	103	1.05	1.03	0.15	0.96	1.12
2012	231	0.96	0.96	0.12	0.88	1.05
2013	189	1.12	1.11	0.13	1.03	1.20
2014	219	1.05	1.04	0.24	0.96	1.11
2015	106	0.98	0.98	0.13	0.90	1.06
2016	185	0.97	0.96	0.10	0.90	1.03
2017	153	0.98	0.99	0.11	0.92	1.05
Combined	1,186	1.02	1.01	0.16	0.93	1.09

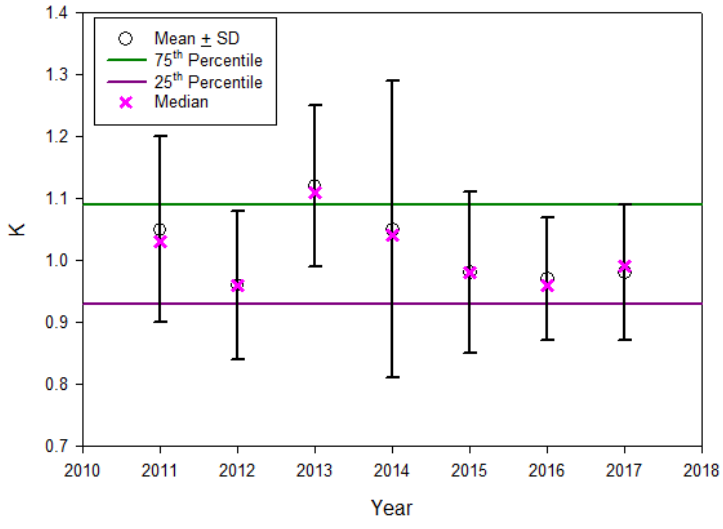

Figure 8. Annual mean ± SD and median for K of all lake trout entered in the LCI Father's Day Derby, 2011 to 2017. Reference lines are 25th and 75th percentiles of K for the entire period.

9. Median condition factor of male lake trout collected in fall spawning stock assessments

Indicator Description and Goal:
Maintain an annual median Fulton's condition factor (K) of male lake trout collected in fall spawning stock assessments within the 25th and 75th percentile (0.84 to 0.94) of the median K value of 0.89, calculated from data collected from 2011 through 2017 (Table 8, Figure 9).

Table 8. Sample size, mean, median, standard deviation (SD) and percentiles for K of male lake trout collected during fall spawning stock assessments, 2011 to 2017.

					Percentile	
Year	N	Mean	Median	SD	25th	75th
2011	128	0.86	0.85	0.07	0.81	0.91
2012	324	0.87	0.87	0.07	0.82	0.92
2013	185	0.91	0.91	0.08	0.86	0.96
2014	208	0.96	0.93	0.14	0.87	1.03
2015	135	0.92	0.91	0.19	0.85	0.96
2016	126	0.88	0.88	0.07	0.83	0.93
2017	124	0.91	0.91	0.07	0.87	0.96
Combined	1,230	0.90	0.89	0.11	0.84	0.94

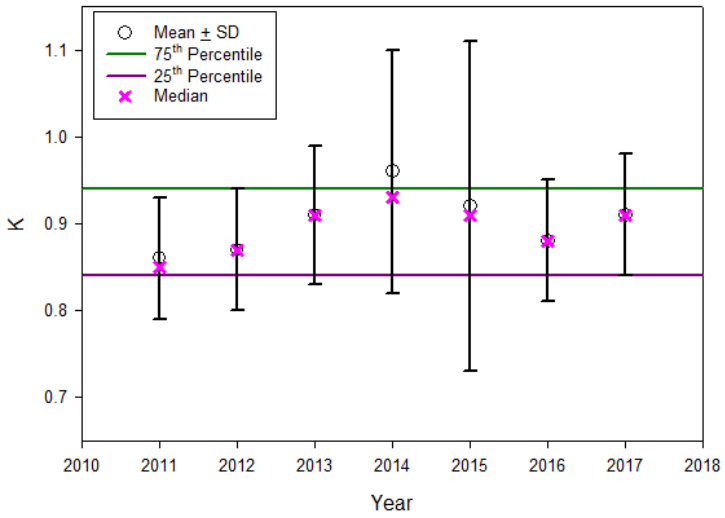

Figure 9. Annual mean ± SD and median for K of male lake trout collected during fall spawning stock assessments, 2011 to 2017. Reference lines are 25th and 75th percentiles of K for the entire period.

10. Lake trout sea lamprey wounding rate

Indicator Description and Goal:
Maintain annual sea lamprey wounding rate of 25 or less for fresh and healing (A1-A3) wounds per 100 on lake trout between 533 and 633 mm (21 – 24.9 inches) total length from fall sampling in the Main Lake basin (Figure 10).

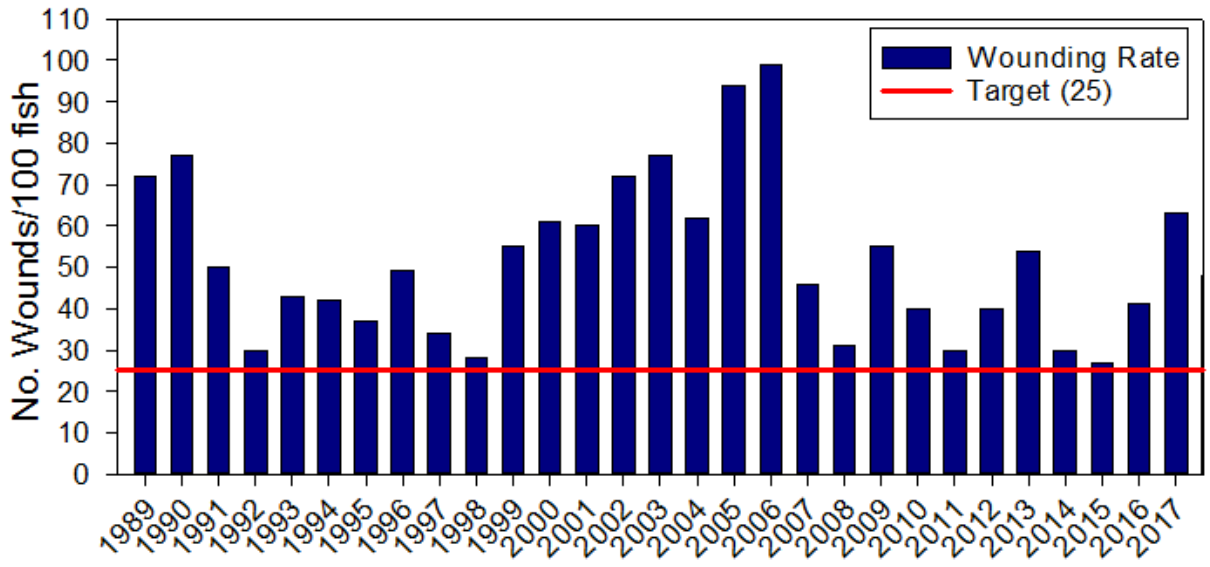

Figure 10. Sea lamprey wounding rate for fresh and healing (A1-A3) wounds per 100 for lake trout between 533 and 633 mm (21 – 24.9 mm) total length from fall sampling in the Main Lake basin, 1989-2017. The target wounding rate of 25 wounds per 100 fish is presented for reference (red line).

11. Assessment of wild lake trout contribution: proportion of unclipped trout captured during fall sampling

Indicator Description and Goal:
Increases in the numbers of wild lake trout in the population will increase pressure on available forage and therefore needs to be monitored. An increase in wild lake trout may require changes to stocking rates or harvest regulations without similar trends being apparent in other indicators because lake trout are long lived and the impacts of natural recruitment by lake trout are unknown. Assessment of wild lake trout contribution to the Lake Champlain lake trout population is done by examining the proportion of unclipped to clipped lake trout captured in fall sampling. Specifically, the proportion of unclipped lake trout less than 660 mm total length to clipped lake trout less than 660 mm and with fin-clips corresponding to age 4 or 5 (first ages of recruitment to the fall spawning population). A small proportion of lake trout are stocked each year with poor or missing fin-clips. Fin clip quality control checks are done with at least 100 lake trout examined annually prior to stocking. This value has ranged from 0% to 6% and averaged 1% for lake trout stocked from the Ed Weed FCS from 2008 to 2018 (Table 9). Lake trout stocked by New York with poor or missing fin clips ranged from 0 to 16% from 2008 to 2018 (Table 9). The percentage of unclipped lake trout seen during spawning assessments needs to be account for the proportion of poorly clipped yearling lake trout stocked 3 and 4 years earlier.

Table 9. Results of lake trout fin clip quality control checks prior to stocking from Vermont and New York Fish Culture Stations, 2008 to 2018.

Year	Fin Clip	VT Percent Poor clips	NY Percent Poor clips
2008	Left Pectoral	6	0
2009	Right Pectoral	0	8
2010	Adipose	1	2
2011	Left Ventral	0	16
2012	Right Ventral	0	-
2013	Left Pectoral	0	-
2014	Right Pectoral	0	10
2015	Adipose	1	-
2016	Left Ventral	1	2
2017	Right Ventral	1	0
2018	Left Pectoral	1	1

Examination of data from 2011 to 2017 fall sampling found the proportion of unclipped lake trout ranged from 0 to 5.5 percent (Table 10, Figure 11). Based on these values and the missed clipped information we propose that if the proportion of unclipped fish for the defined size and age ranges exceeds 15 percent (wild + missed clip) management actions will occur. We recommend cutting lake trout stocking by 25 percent. If the proportion of unclipped lake trout continues to increase in the fall assessment and the proportion reaches 25 percent, could be reduced by 50%. Further reductions would depend on the trend in wild lake trout abundance. Recommendations to stocking numbers could be modified as additional information is collected.

Currently fall lake trout sampling only occurs at two locations (Hatchery Cove at Gordon Landing, Vermont and Whallon Bay, New York). We recommend that the number of locations sampled in the fall for spawning lake trout be increased. Possible spawning sites include Appletree Shoal, Colchester Reef, and Arnold Bay on the Vermont side of the lake, and Willsboro Bay on the New York side.

Table 10. Fin clip rotations for age 4 and 5 stocked lake trout; counts of clipped, unclipped, and total lake trout < 660 mm; and percentage of unclipped lake trout collected during fall spawning assessments, 2011-2017.

			Lake Trout Collected			
	Fin Clip		Clipped	Unclipped	Total	Percent
Year	Age 4	Age 5	< 660 mm	< 660 mm	< 660 mm	Unclipped
2011	Left Pectoral	Right Ventral	137	3	140	2.1
2012	Right Pectoral	Left Pectoral	128	4	132	3.0
2013	Adipose	Right Pectoral	52	3	55	5.5
2014	Left Ventral	Adipose	305	7	312	2.2
2015	Right Ventral	Left Ventral	328	5	333	1.5
2016	Left Pectoral	Right Ventral	144	0	144	0.0
2017	Right Pectoral	Left Pectoral	91	4	95	4.2

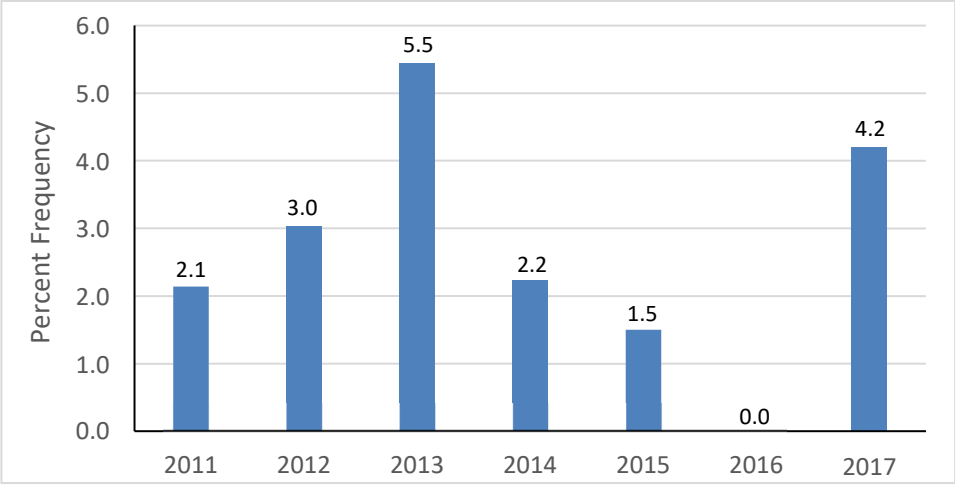

Figure 11. Percent unclipped lake trout < 26" TL collected during fall spawning assessments, 2011-2017.

12. Median weight of the top 10 lake trout entered in the LCI Father's Day Fishing Derby

Indicator Description and Goal:
Maintain an annual median weight of the top 10 lake trout entered in the LCI Father's Day Fishing Derby within the 25th and 75th percentiles (5.65 to 6.42 kg) of the median weight value of 5.99 kg, calculated with data collected from 2011 through 2017 (Table 11, Figure 12).

Table 11. Sample size, mean, median, standard deviation (SD) and percentiles for weights (kg) of the top ten lake trout entered in the LCI Father's Day Fishing Derby, 2011 to 2017.

					Percentage	
Year	N	Mean	Median	SD	25th	75th
2011	10	5.44	5.34	0.33	5.15	5.76
2012	10	5.66	5.60	0.32	5.37	5.85
2013	10	6.88	6.77	0.48	6.41	7.38
2014	10	6.52	6.30	0.68	5.95	7.02
2015	10	6.17	6.13	0.39	5.93	6.38
2016	10	5.99	5.91	0.36	5.61	6.41
2017	10	6.05	5.99	0.44	5.67	6.37
Combined	70	6.10	5.99	0.63	5.65	6.42

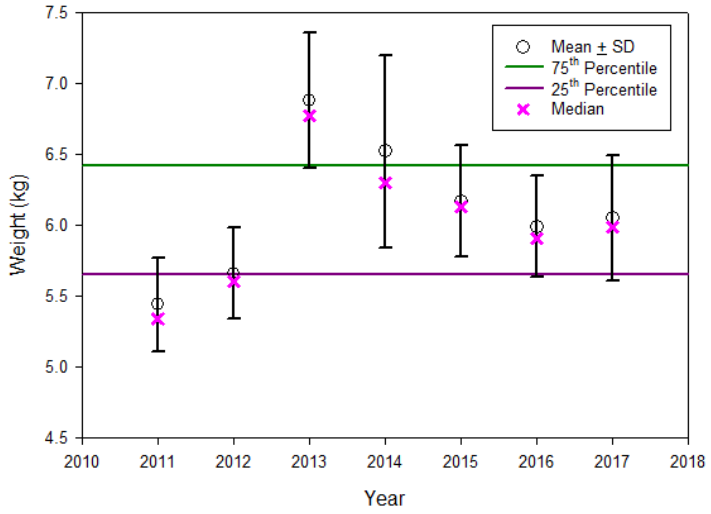

Figure 12. Annual mean ± SD and median for weights of the top ten lake trout entered in the LCI Father's Day Fishing Derby: 2011 to 2017. Reference lines are 25th and 75th percentiles of weights for the entire period.

Walleye Annual Indictors and Targets

Walleye and salmonid diets overlap so walleye are included as an indicator of forage fish status for salmonids. Walleye are an important component of the Lake Champlain ecosystem as a top predator within the system and provide a valuable recreational fishery. Additionally, they are stocked annually into Lake Champlain. VTFWD monitors spawning populations in four Vermont tributaries and systematically collects brood stock each year to sustain an annual stocking program of young walleye.

13. Median condition factor of small male walleye collected during the spawning assessment

Indicator Description and Goal:
Maintain an annual median Fulton's condition factor (K) of small male walleye with total length between 350 and 475 mm (13.8 to 18.7 inches) collected during the spawning assessments on Lake Champlain tributaries within the 25th and 75th percentile (0.88 to 0.99) of the median K value of 0.94, calculated from 2011 to 2017 (Table 12).

Table 12. Sample size, mean, median, standard deviation (SD) and percentiles for K of male walleye with total lengths between 350 and 475 mm (13.8 to 18.7 inches) collected during spawning assessments on multiple tributaries to Lake Champlain between 2011 to 2017.

						Percentile	
Year	River	N	Mean	Median	SD	25th	75th
2011	Lamoille	9	0.93	0.93	0.06	0.90	0.97
2011	Poultney	40	0.86	0.85	0.06	0.82	0.90
2012	Winooski	32	0.98	0.97	0.05	0.95	1.01
2013	Missisquoi	56	0.98	0.96	0.17	0.92	1.00
2014	Lamoille	66	0.93	0.94	0.09	0.89	0.98
2014	Poultney	42	0.91	0.90	0.06	0.86	0.96
2015	Winooski	52	0.91	0.92	0.15	0.86	0.98
2016	Missisquoi	58	0.99	0.98	0.06	0.95	1.04
2017	Lamoille	12	0.97	0.96	0.06	0.93	1.02
2017	Poultney	49	0.92	0.93	0.07	0.87	0.96
Combined		465	0.94	0.94	0.11	0.88	0.99

Hatchery Production Annual Indictors and Targets

Currently, almost all observed adult salmonids are hatchery origin so changes in stocking numbers will have major impacts on salmonid abundance. We also included percentage of stocked fish that are viable smolts as an indicator because fish that do not reach this size threshold remain as parr and will have low survival and recruitment to the lake.

14. Pre-stocking landlocked Atlantic salmon smolt size assessment

Indicator Description and Goal:
Produce and stock viable salmon smolts into lake and rivers. Viable smolt are greater than or equal to 150 mm total length before spring stocking. Maintain annual smolt stocking (currently 304,000) such that at least 90 percent are viable smolts (≥ 150 mm).

Table 13. Pre-stocking assessment of yearling landlocked Atlantic salmon stocked in Lake Champlain from Adirondack Hatchery Dwight D.Eisenhower NFH, and Ed Weed FCS. Total number of yearling salmon stocked and the number that reached the smolt size (greater than or equal to 150 mm total length) are reported for stocking years from 2011-2017. Assessment was not performed in 2011.

Year	Mean Size (mm)	Numbered Sampled	Percent Viable Smolts	Total stocked	Viable Smolts Stocked
2011	NA	NA	NA	NA	NA
2012	185	2,299	92	304,995	280,792
2013	193	2,600	97	280,451	271,372
2014	178	2,398	94	271,710	254,024
2015	171	2,600	91	311,257	282,379
2016	167	2,623	86	297,116	254,580
2017	171	3,300	88	318,975	290,113
Stocking Target	150	2,500	90	304,000	273,000

15. Number of all salmonids stocked annually

Indicator Description and Goal:
Meet annual total and species-specific stocking targets for landlocked Atlantic salmon, lake trout, steelhead, and brown trout (Table 14). Total stocking goal is 512,000 salmonids annually into Lake Champlain and its tributaries.

Table 14. Numbers (in stocking equivalents) of salmonids stocked in Lake Champlain from 2011 to 2017, and stocking targets for the lake.

Year	LL At. Salmon	Lake Trout	Steelhead	Brown Trout	Total
2011	313,664	85,989	53,143	58,909	511,705
2012	311,804	89,877	57,368	77,273	536,322
2013	295,842	84,534	56,930	65,147	502,453
2014	302,438	80,635	59,738	64,772	507,583
2015	333,770	83,350	65,350	44,309	526,779
2016	306,046	86,107	63,691	63,871	519,715
2017	340,009	78,050	68,831	69,237	556,127
Stocking Target	304,000	82,000	58,000	68,000	512,000

Fish health Annual Indictors and Targets

Fish diseases such as bacterial kidney disease (BKD) can have major impacts on salmonid abundance and condition factor. Viral Hemorrhagic Septicemia (VHS) in the St. Lawrence River and other emerging fish diseases could have major impacts in the Lake Champlain basin. Identification of a new disease in Lake Champlain salmonids would trigger a warning flag.

16. Annual fish health testing

Indicator Description and Goal:
Summary of results from annual fish health testing. All brood fish collected from Lake Champlain for fish culture programs are tested for fish pathogens. Additionally, a variety of other fish species are collected annually from multiple sites on Lake Champlain to monitor for VHS and other pathogens. Results from fish disease monitoring will be included in the annual report of the FTC.

Fish pathogens monitored for Lake Champlain feral Landlocked Atlantic salmon and lake trout include:

Infectious Pancreatic necrosis – IPN (virus)
Viral Hemorrhagic Septicemia - VHS
Infectious Hematopoietic Necrosis – IHN (virus)
Onchorhynchus masou Virus – OMV
Renibacterium salmoninarum – BKD (bacteria)
Aeromonas salmonicida – Furunculosis (bacteria)
Yersinia ruckeri – Enteric Redmouth Disease; ERM (bacteria)
Aquareovirus A–Aqua-A; 1st confirmed detection: Fall 2018 (virus)
Namaycush Herpesvirus - NamHV; SalHV5; 1st confirmed detection: 2008 (virus)
Epizootic Epitheliotropic Disease Virus -EEDV; SalHV3; 1st confirmed detection: 2015 (virus)

Table 15. History of pathogen detection in Lake Champlain LAS feral broodstock (Ed Weed FCS feral broodstock program).

	IPN	VHS	IHN	OMV	BKD	Aqua-A
2018	NEG	NEG	NEG	NEG	NEG	POS
2017	NEG	NEG	NEG	NEG	NEG	N/A
2016	NEG	NEG	NEG	NEG	NEG	N/A
2015	NEG	NEG	NEG	NEG	NEG	N/A
2014	NEG	NEG	NEG	NEG	NEG	N/A

Table 16. History of pathogen detection in Lake Champlain feral landlocked Atlantic salmon (trap netting project at Gordon Landing, Grand Isle), EEDV Research Project.

	IPN	VHS	IHN	OMV	BKD	SalHV3	SalHV5
2018	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2017	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2016	NEG	NEG	NEG	NEG	NEG	POS	POS
2015	NEG	NEG	NEG	NEG	NEG	POS	POS
2014	N/A	N/A	N/A	N/A	N/A	NA	N/A

Annual Reporting and Assessment of Status

Monitoring is key to management of complex systems. The salmonid assessment workgroup will review indicators each year and discuss the need for any changes to fisheries management. Changes to a single indicator or changes for one year may not be reason for action. Changes and trends for all indicators will be considered during the review. Any proposed changes to fisheries management will be submitted to Fisheries Technical Committee (FTC) for review. Time series analysis, abrupt transitions over time, increased variability, and slower return to target levels will all be evaluated with considering status of indicators.

The FTC will draft proposed changes, if needed, and develop a process for public involvement if major management actions are proposed.

Table 17. Status of 16 indicators for annually evaluating the status of landlocked Atlantic salmon (salmon) and lake trout in Lake Champlain. Status colors for each indicator are green for within threshold targets and yellow for falling outside of threshold values and requires additional management attention and possible action.

Species and Indicators	2019 Value	2019 Status	2018 Status	2017 Status
Landlocked Atlantic Salmon				
Pre-stock smolt size percentage	95.2 %			
Median Condition Factor – Lake Age 0	1.17			
Median Condition Factor – Lake Age 1	0.99			
Median Total Length – Lake Age 0	429 mm			
Median Total Length – Lake Age 1	508 mm			
Sea Lamprey Wounding (lake-wide)	19.5			
Median Weight of top 10 salmon in Lake Champlain Inter. Derby	1.9 kg			
Median Condition Factor salmon in Lake Champlain Inter. Derby	1.06			
Lake Trout				
Median Condition Factor - Males	0.86			
Sea Lamprey Wounding (Main-lake)	57.4			
Wild Lake Trout - Proportion Unclipped	3.8 %			
Median Weight of top 10 lake trout in Lake Champlain Inter. Derby	5.9 kg			
Median Condition Factor lake trout in Lake Champlain Inter. Derby	0.99			
Salmonid Stocking				
Number of salmonids stocked annually	460,631			
Walleye				
Walleye Median Condition Factor (Males 350 –475 mm)	0.94			
Fish Health Testing Results	No detections			