Summer profundal index netting for tracking trends in the abundance of lake trout in coldwater lakes and reservoirs of Colorado: results from 2018

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Introduction

Summer profundal index netting (SPIN) is a quantitative method for rapidly estimating the population size of lake trout (Sandstrom and Lester 2009). Previous investigations by Colorado Parks and Wildlife concluded that SPIN is a viable alternative to more intensive methods (e.g., mark-recapture) for estimating and tracking trends in the abundance of lake trout in key coldwater lakes and reservoirs of Colorado to help guide management (Lepak 2011; Lepak 2013). Currently, four water bodies are sampled using SPIN methodology: Taylor Park Reservoir (surveyed in 2013), Lake Granby (2014), Grand Lake (2013, 2016), and Blue Mesa Reservoir (2011, 2014, 2016, 2018). Each reservoir is on either a two or three year survey rotation. During the 2018 field season, SPIN was conducted in Blue Mesa Reservoir (in collaboration with aquatic biologists Dan Brauch and Estevan Vigil) to obtain a lake trout population estimate. Results from this survey are reported here.

Methods

Summer profundal index netting methodology was developed by the Ontario Ministry of Natural Resources. For a detailed description of SPIN see Sandstrom and Lester (2009). In brief, this method uses suites of standardized gill nets (three 1.8 × 64 m nets consisting of eight panels with stretch mesh sizes of 57, 64, 70, 76, 89, 102, 114 and 127 mm placed in random order) to capture lake trout in such a way that allows us to estimate the density of lake trout directly (i.e., number per ha). These estimates of density are then scaled up to a total abundance based on the area of the lake or reservoir that was surveyed.

Catch rates of lake trout in gill nets (i.e., number caught per gill net set) fished in Colorado reservoirs are compared to catch rates of lake trout in the same type of gill nets in other water bodies where concurrent estimates of lake trout density were available. The catch is adjusted for the size-selectivity of the gill nets. Nets are set along the bottom in random orientation. Set locations are selected at random and stratified by depth (2-10 m, 10-20 m, 20-30 m, 30-40 m, 40-60 m, 60-80 m, and >80 m). Sampling is also stratified by different regions within the lake or reservoir if necessary, to account for potential differences in lake trout habitat. Sampling is conducted when surface temperatures exceed 18°C and the nets are set for two hours during daylight. Netting was conducted from 9 to 12 July, 2018 in Blue Mesa Reservoir (**Figure 1**). The power of this particular method is the use of data from numerous other systems as a calibration tool to quantify lake trout densities in Colorado that can be used to estimate total abundance, versus techniques that just provide estimates of relative abundance through time and across systems.

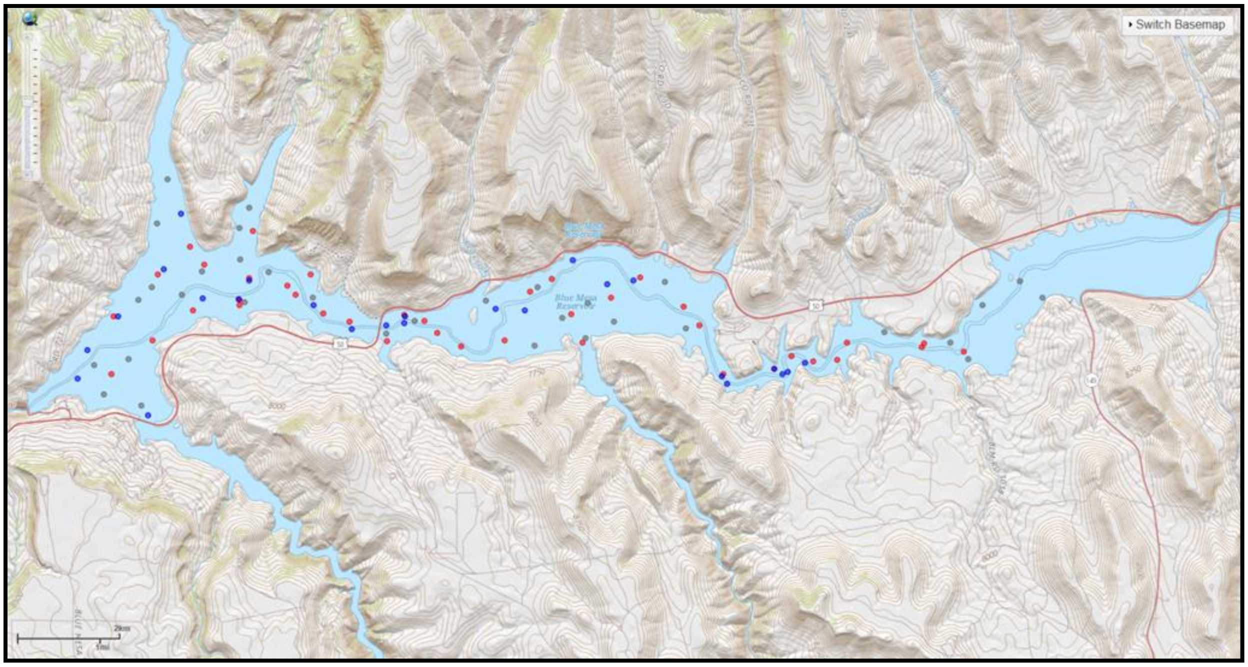

Figure 1. Map of Blue Mesa Reservoir, Colorado showing gill net set locations (N = 95 dots) during the 2018 SPIN survey. Red and blue dots represent set locations within the 20-30 m and 30-40 m depth strata, respectively. These depths contained the highest concentration of lake trout. Gray dots represent set locations within the other depth strata (2-10 m; 10-20 m; 40-60 m; 60-80 m).

Results and Discussion

Sampling was completed over the course of four days, during which 95 nets were set capturing a total of 313 lake trout ranging in size from 210 mm to 862 mm FL (mean = 374 mm ± 88 mm S.D.). Lake trout were most prevalent in 20-30 and 30-40 m depths across Iola, Cebolla, and Sapinero Basins. The depth distribution of lake trout captured in 2018 was similar to those captured in 2016, despite the surface elevation of the reservoir being 13 m lower (~43 ft) in 2018 compared to a nearly full reservoir in 2016 (Hansen 2016).

The depth distribution, size structure, and extent of the catch in 2018 at the corresponding water surface elevation of the reservoir produced a total lake trout abundance estimate of 29,857 lake trout ≥210 mm FL (lower 68% confidence limit = 23,826; upper 68% confidence limit = 36,702). The catch of lake trout <250 mm FL was incidental (0.32% of catch). This abundance estimate best reflects that of fish ≥250 mm FL as in previous SPIN surveys on Blue Mesa Reservoir (Sandstrom and Lester 2009; **Table 1**). The abundance estimate from 2018 was higher than the 2016 estimate (**Figure 2**).

Table 1. Summary data from each SPIN survey conducted to date. Abundance estimates are for all lake trout vulnerable to the sampling gear (generally those ≥250 mm FL or 275 mm TL). The acronym LCL stands for lower 68% confidence limit, and UCL stands for upper 68% confidence limit for the abundance estimate. Adjusted CUE is the area-weighted (area of different depth strata) catch of lake trout per gill net set, after correcting the catch for size-selectivity. Asterisks indicate the presence of *Mysis diluviana*.

Survey year	Lake or reservoir	Number of net sets	Number of lake trout caught	Mean total length (mm)	SD of total length (mm)	Adjusted CUE	Density (fish/ha)	Total area surveyed (ha)	Abundance estimate	LCL	UCL
2011											
	Blue Mesa	81	129	437	110	2.29	11.14	3,059	34,071	27,144	41,929
2013											
	Grand Lake*	36	87	419	107	2.61	12.71	193	2,452	1,974	2,996
	Taylor Park*	36	271	416	94	4.03	19.61	610	11,950	9,871	14,341
2014											
	Blue Mesa	81	211	425	97	1.61	7.85	3,409	26,753	18,383	33,716
	[a]Lake Granby*	71	501	417	79	11.78	57.26	2,780	159,193	135,533	186,844
2016											
	Blue Mesa	83	180	438	114	1.47	7.15	3,409	24,368	16,538	30,948
	Grand Lake*	36	109	436	147	3.34	16.22	193	3,131	2,561	3,783
2018											
	Blue Mesa	95	313	414	98	2.34	11.36	2,629	29,857	23,826	36,702

[a]Estimates for Lake Granby are subject to change. Food web interactions could make lake trout more vulnerable to the sampling gear causing the SPIN method to overestimate their abundance. This is currently being evaluated.

We examined whether there has been a disproportionate change in the estimated abundance of lake trout ≥363 mm FL or 400 mm TL (predominately age-4 and older) when compared to all fish vulnerable to the gear in Blue Mesa Reservoir over the period of record. In general, this length cutoff encompasses the most piscivorous fraction of the lake trout population, and those most vulnerable to anglers and ongoing suppression efforts (Lepak 2011; Pate et al. 2014).

Abundance estimates for this separate size group of fish were lower, but exhibited a similar declining temporal trend as those incorporating all sizes of lake trout between 2011-2016. This indicates that there was not a disproportionate change in the abundance of this secondary size group when compared to all sizes of fish over the 2011-2016 period (**Figure 2**). However, this pattern changed in 2018 whereby the abundance of lake trout ≥400 mm TL continued to decline while the estimated abundance of all fish vulnerable increased (**Figure 2**). This indicates that there is a pulse of small fish that are not yet fully vulnerable to capture by anglers or suppression efforts about to enter the piscivorous size range.

Comparing the size-structure of lake trout captured during the 2018 SPIN survey to previous years confirmed that there is a higher frequency of small fish <400 mm TL (predominately age 2-3; Pate et al. 2014) currently present in the system, and that these fish will grow into a more piscivorous size range within the next 1-2 years (**Figure 3**). In addition to being ecologically significant, we did detect a statistically significant difference in the size structure of lake trout captured during SPIN in 2011, 2014, 2016, and 2018 (Kruskal-Wallis One Way Analysis of

Variance on Ranks; $H = 11.63$; $P = 0.009$) (**Figure 3**). Post-hoc comparisons to determine which years differed from each other indicated that the size-structure of lake trout captured in 2018 differed from those captured in 2014 and 2016 ($P = 0.005$), largely due to the greater frequency of fish <400 mm TL (**Figure 3**). Because this pulse of small fish are likely age 2-3, it appears that reservoir conditions during the 2014-2015 spawning seasons for lake trout were favorable.

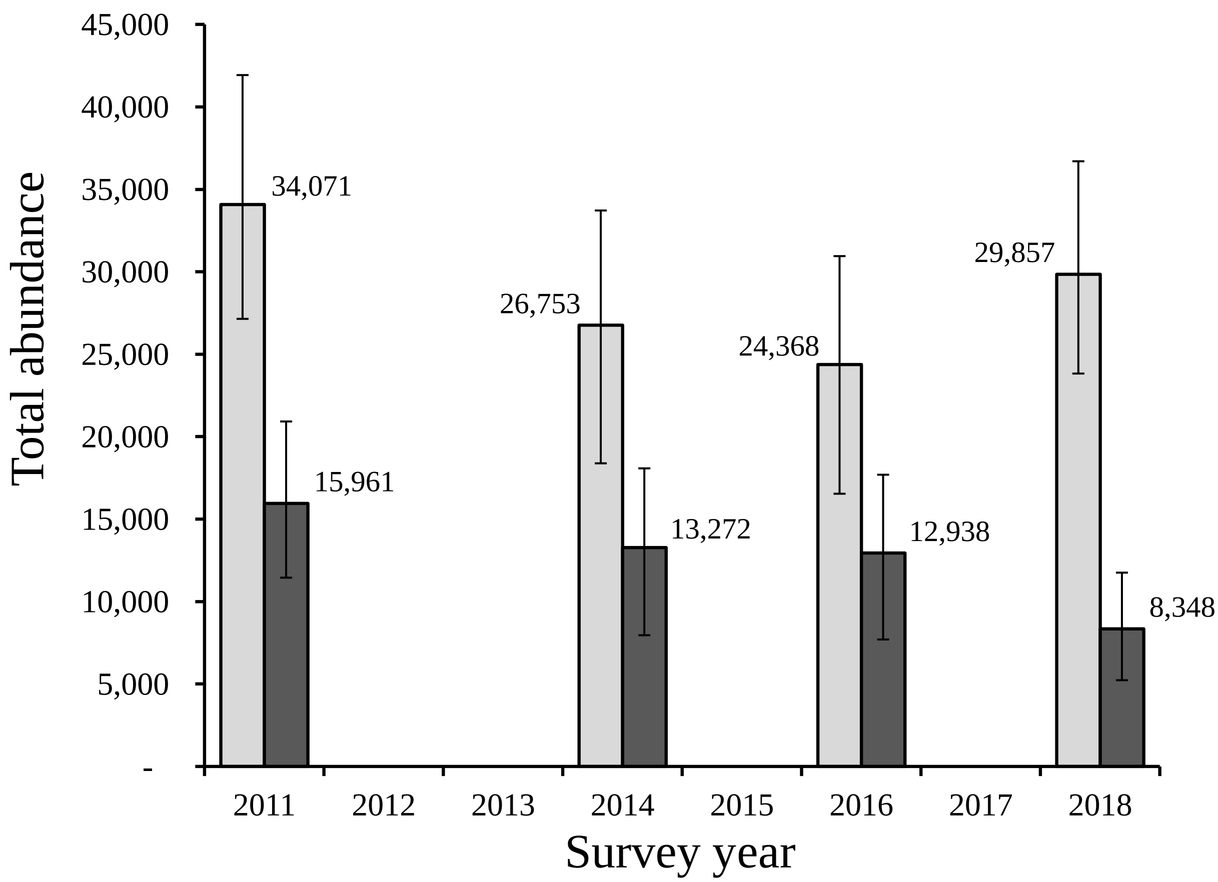

Figure 2. Abundance estimates for all lake trout vulnerable to the sampling gear (generally those ≥250 mm FL or 275 mm TL) in Blue Mesa Reservoir (light gray bars) and just those ≥363 mm FL or 400 mm TL (dark gray bars) from all SPIN surveys conducted in this reservoir to date. Error bars represent 68% confidence intervals.

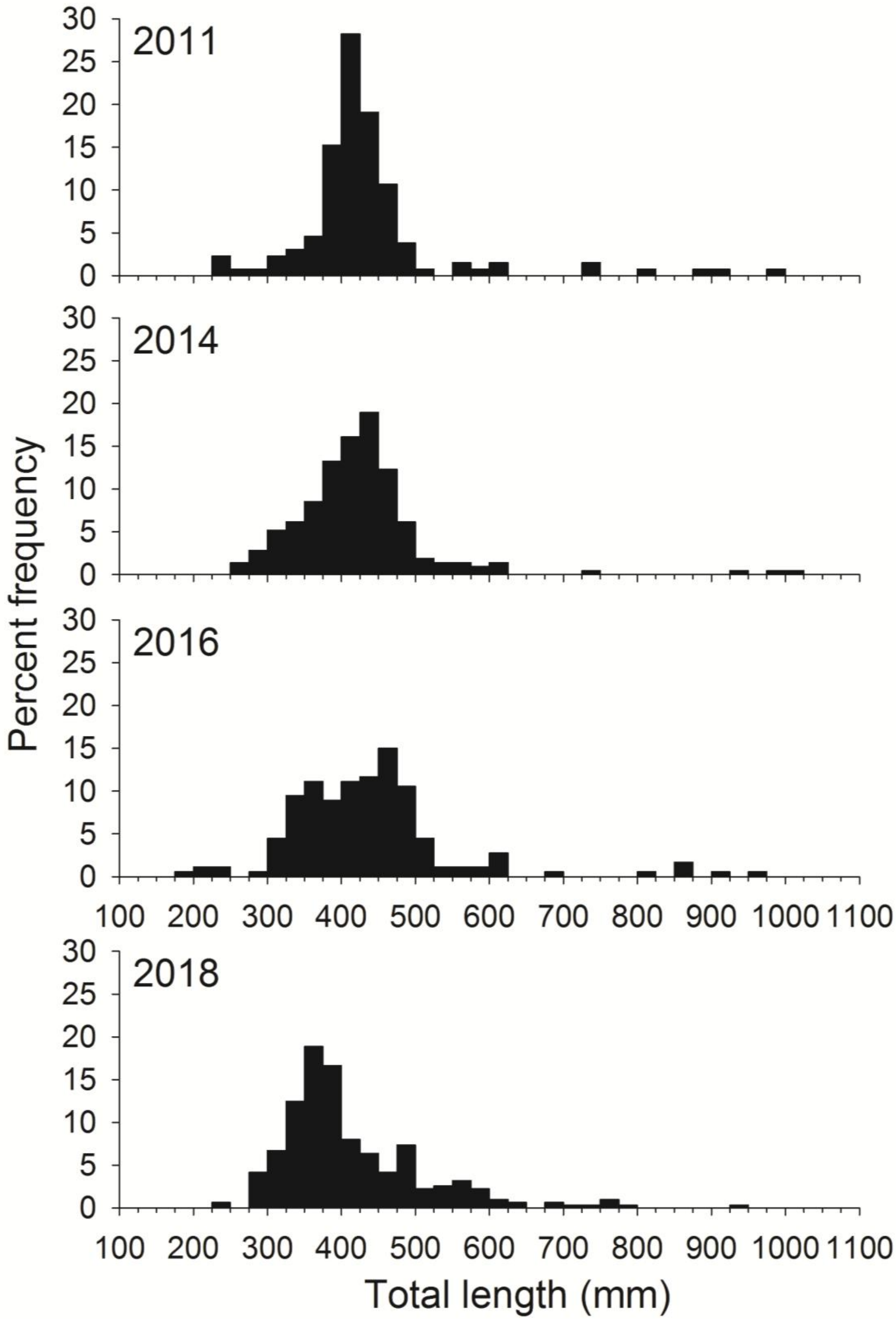

Figure 3. Length-frequency distributions (25 mm size bins) of lake trout captured during consecutive SPIN surveys on Blue Mesa Reservoir.

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