NWRT Final Progress Report
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1. NWRT Project Number: 3-18-05

2. Project Title: Cambridge Bay Arctic Char Research: Fishery Independent Sampling of Cambridge Bay Arctic Char with Emphasis on the Lauchlan River Stock

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4. Summary

This project will involve fishery independent sampling of Arctic Char from the Lauchlan River, NU using multi-mesh research gill-nets. The use of multi-mesh gill nets will permit the capture of a representative sample (with respect to length and age) of Arctic Char. Arctic Char from this system will be sampled for a suite of biological characteristics and these data will be compared to those collected as part of the commercial plant sampling program. Additionally, valuable catch and effort information will also be collected which will be incorporated into stock assessment models for estimating abundance assessing sustainability of this fishery. All told, the results of this work will ensure the sustainable harvest of the Lauchlan River commercial fishery, a system that has not been commercially fished since 2011.

5. Project Objectives

In response to the above knowledge gaps, the purpose of this proposed research is to develop a fishery-independent sampling program for Arctic char from the Lauchlan River, NU. The specific objectives of this proposed research are to:

1. Initiate the collection of fishery-independent data from Lauchlan River Arctic char to establish a time series of biological (including, length, weight and age) and catch-effort data from this system. This will be done in tandem with the fishery-dependent data collection program in the region.
2. After five consecutive years, use these data to assess the sustainability of the Lauchlan River fishery and to set total allowable harvests for this location which will be incorporated into an updated version of the IFMP for Cambridge Bay Arctic char.

6. Materials and Methods

Fishery-independent sampling of Lauchlan River Arctic char in 2018 focused on the biological sampling of char during downstream migration, after having spent the winter in freshwater. The study was designed and carried out in cooperation with the Ekaluktutiak HTO (EHTO) and two local field technicians chosen by the EHTO assisted with all aspects of the field component of the work. The field work portion of this project was conducted with little variance from the summary provided in the initial proposal and thus only a brief summary of our sampling is provided below. We do, however, expand on some preliminary data analyses that have commenced.

Field sampling:
Fish were captured using multi-mesh gillnets permitting the capture of Arctic char of all sizes and ages. Location and general environmental data such as position (determined by GPS), time of year, time of day, net depth, water temperature, weather and other environmental conditions were recorded for each net set. To estimate catch-per-unit-effort, the net type and soak time were recorded. The fork length, round weight, gonad weight, sex and maturity stage were recorded for each fish. Additionally, structures for determining the age and stomach contents of each fish were all taken as well as tissues were collected for contaminants (mercury and radium) and for future molecular assessments. Ages of sampled fish are in the process of being determined by embedding, sectioning and reading the aging structures (i.e., otoliths). Preserved eggs will be measured and counted to determine egg size and fecundity of trout.

Data Analyses:

Fishery-independent data, CPUE was calculated as the number of Arctic char landed per 150 ft of stretched multi-mesh gill net per 24 hours of fishing. Frequency distributions were generated for fork length, weight, and Fulton's condition factor.

Fulton's relative condition factor (K; Ricker 1975) was calculated as:

$$\mathbf{K} = \frac{W \times 10^5}{L^3}$$

where W and L are weight (g) and fork length (mm) respectively. Condition was summarized as the annual mean determined from individual specimens and was also compared across years for each fishery. Condition factor was only displayed visually for fishery-dependant and –independent data as described above.

Weight-length relationships for Arctic Char were described using a linear regression model for both data sets. The weight-length relationship,

$$W_i = aL_i^b$$

was transformed into its logarithmic form expressed as:

$$\log(W_i) = log(a) + b * log(L_i) + \varepsilon_i$$

where *W* is the round weight (g), *L* is the fork length (mm), *a* is the y-intercept, *b* is the slope of the regression and ε_i is a normally distributed error term for the *i*th fish. The parameters *a* and *b* were calculated by least-squares regression separately for each sampling year (fishery-independent data) or by decade (fishery-dependent data).

To compare potential differences in maturity indices (sexes combined) across sampling years for the fishery-independent data, the length at 50% maturity (L_{50}) was determined using logistic regression. The proportion mature within a given length or age class was modeled as:

$$x = \frac{log\left(\frac{\mathrm{p}}{1-\mathrm{p}}\right) - \alpha}{\beta_1}$$

where *p* is the proportion mature (0.00-1.00) in length class (x) or age class (x). For determining *x* for 50% maturity, (i.e., *p* = 0.05) the above formula reduces to:

$$x = -\frac{\alpha}{\beta_1}$$

Finally, although maturity was qualitatively assessed in the field, gonadosomatic index (GSI) was determined for all Arctic char to provide a more objective assessment of maturity and gonad development. GSI was calculated as follows:

GSI = [gonad weight/(g) round weight (g)] X 100.

7. Results

The Lauchlan River was sampled using multi-mesh gill nets from July 9-13th and during that time 195 Arctic Char were captured and sampled. Interestingly 22 anadromous lake trout were also sampled at this location. Fishery-independent average CPUE, calculated as the number of fish landed per 24 hours of fishing (all mesh sizes combined) was 54.8 Arctic char/24 hours.

Of the 195 Arctic char that were sampled, 95 were males and 100 were females. The majority were in “resting” condition (74%) meaning they were not going to spawn the year that they were sampled. The remaining fish that were sampled were all immature (26%), which indicates migration to freshwater for overwintering purposes instead of spawning.

Individual fork lengths ranged from 192 mm to 940 mm, with an average fork length of 601 mm Individual fork lengths for males ranged from 192 mm to 940 mm, with an average fork length of 601 mm. Fork lengths for females ranged from 250 mm to 838 mm, with an average fork length of 556 mm. The fork length distribution of Arctic char sampled in 2018 is shown in Figure 1.

Individual weights ranged from 53 g to 9100 g with an average weight of 2519 g. Males were on average heavier (mean = 2844 g) than females (mean = 2209 g). Males ranged in weight from 53 g to 6600 g and females ranged from 82 g to 9100 g. The weight distribution of Arctic char sampled in 2018 is shown in Figure 2 and the relationship between fork length and weight is shown in Figure 3.

Fulton's condition factor from 0.67 to 1.26, averaging 0.99 across all samples. Males were in better condition (mean = 1.00) than females (mean = 0.97). Males ranged in condition from 0.67 to 1.22 and females ranged from 0.70 to 1.26. The distribution of Arctic char condition factor sampled in 2018 is shown in Figure 4.

We also calculated the length at 50% maturity (L50) to use as an index for reproductive potential. For the calculation of L50, we combined sexes. Using the 2018 fishery-independent data, the overall L50 for Lauchlan River char was 590 mm (Figure 5).

Finally, GSI was extremely low averaging 0.50 across all samples. This is not surprising given char were sampled during the downstream run and all fish were classified as either resting or immature.

8. Discussion/Management Implications:

The Arctic char harvested at the Lauchlan River are considered by some to be the best quality char in the Cambridge Bay region (Stephane Lacasse, Kitikmeot Foods Ltd. pers. comm). The fishery here also occurs early in the summer (first week of July) thereby bringing Arctic char into the fish plant early within the season for processing. Combined, these factors rendered Lauchlan River Arctic char a highly sought after resource. The quota at the Lauchlan River, however, was reduced from 9100 kg to 2400 kg in 2005, largely in part due to concerns over the number of char that were counted (n = 10,850) in a 1983 enumeration. This rendered the fishery economically unviable due to the rising costs of transportation and its distance from the community of Cambridge Bay. As such, it had not been fished since 2008 despite keen interest form Kitikmeot Foods Ltd. in continuing harvesting at this location.

In 2017, Fisheries and Oceans Canada (DFO) along with the Integrated Fisheries Management Plan (IFMP) working group (composed of DFO, the EHTO, local resource users and elder and youth representatives) and the NWMB have agreed to increase the quota for 5 years (to a minimum of 5000 kgs – the quota number that Kitikmeot Foods would harvest), after which the stock will be assessed to evaluate whether harvest at the new level is sustainable. At that time, it was also decided that a 5-year fishery-independent and –dependent sampling programs be

established for the collection of biological and catch-per-unit-effort data. Furthermore, as recommended within the DFO Exploratory Fisheries Protocol, upon commencement of fishing at a waterbody that has never been fished or one that has had a lapse in fishing, biological, CPUE, and total harvest data should be collected every year for a minimum of five years before stocks are assessed and recommendations are made about the biological viability of a commercial fishery. The data collected as part of this research will form the backbone of the stock assessment subsequent to the five year data collection period and the results from this work will be used for updating the IFMP for this fishery and for potentially refining management strategies that are considerably outdated for this species in the region.

This is the first year of fishery independent sampling at the Lauchlan River and more thorough and comparative analyses can proceed in subsequent years after multiple years of data have been collected. These data, along with catch and effort data, can subsequently be used in more derived analyses such as in stock assessment modelling exercises that aim to estimate safe removal levels. Models (e.g., depletion corrected average catch (DCAC) and surplus production models) are currently being developed for Cambridge Bay Arctic char fisheries as a means to resolve precautionary limit reference points (LRPs) and to estimate safe and sustainable harvest levels. Information/data collected (e.g., CPUE, fecundity, etc.) as part of this five-year plan can be used to support models noted above and to develop age-structured predictive models for the fishery that will help define total allowable harvest. Furthermore, analyses of trends in biological characteristics and mortality rates will allow us to assess how Lauchlan River Arctic Char are responding to this newly re-established commercial harvest. This information will allow us to adjust current quota recommendations and validate current stock assessment models.

9. Report by Inuit participants:

Attached as a separate document.

10. Reporting to communities/resource users:

Numerous telephone and email communications took place with the EHTO manager (Beverly Maksagak) and the EHTO president (Bobby Greenley) to discuss the project and as a means to incorporate local knowledge into the timing of sampling at the Lauchlan River and field camp logistics. Meetings in Cambridge Bay occurred in December 2017 where we discussed and presented this project at the at the EHTO annual general meeting. Approval for the project was also received at that time. Additionally, we met with the HTO in June as part of our pre-season fishing meetings and we met with board members multiple times throughout the summer while in Cambridge Bay when we were conducting our field work. Summary reports for the Ekaluktutiak HTO and residents of Cambridge Bay have been prepared and distributed and HTO meetings (the annual general meeting) will be attended and community presentations will be given in January 2019. This work is also being presented at the Kitikmeot Regional Wildlife Boards AGM in September 2019. There were no deviations from the originally planned consultations and reporting.

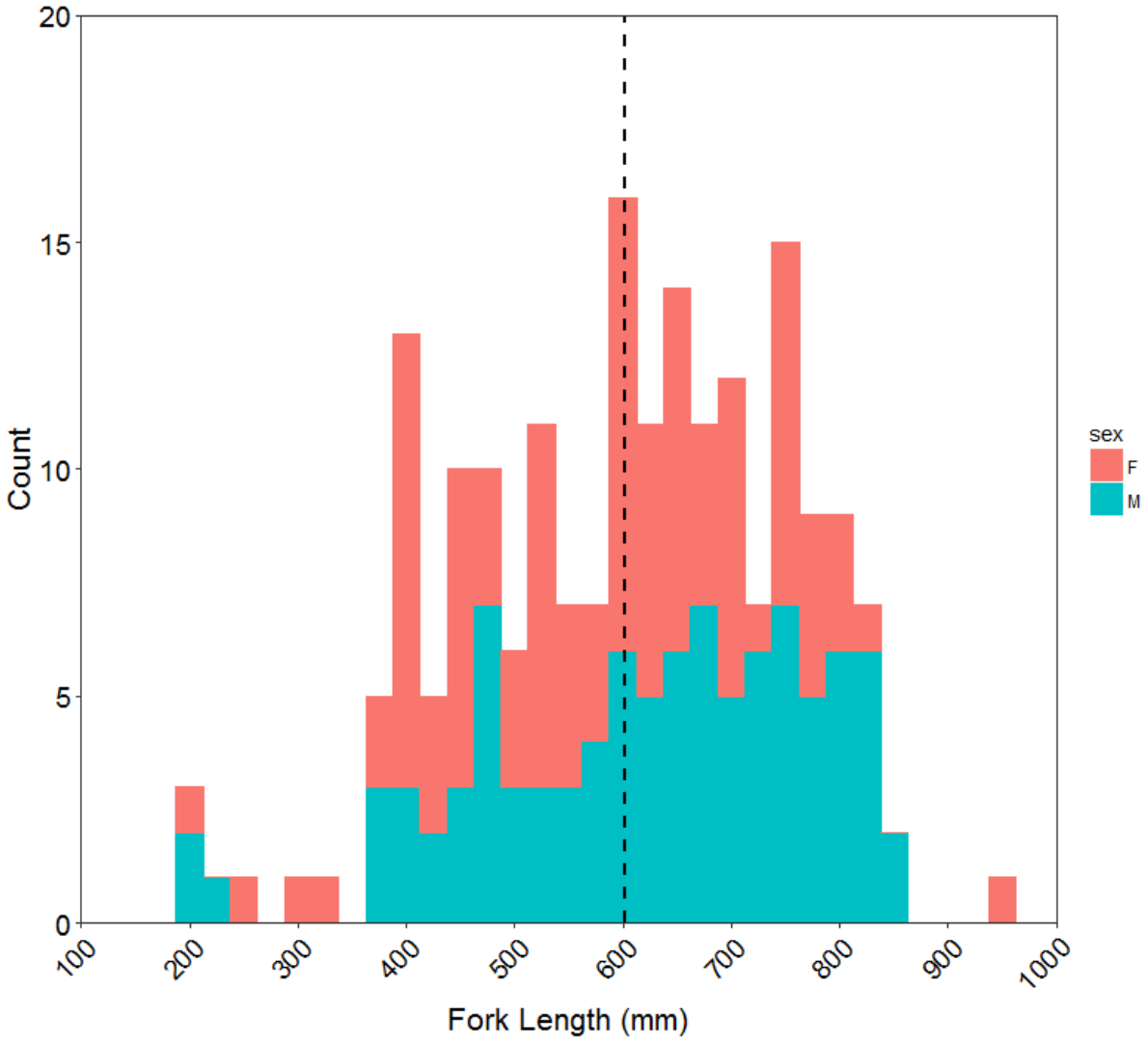

Figure 1. Frequency distributions of fork length (mm) collected from fishery-independent sampling of Arctic char at the Lauchlan River in 2018. Females are shown in red and males are shown in blue. The mean fork length (sexes combined) is shown as a black dotted line.

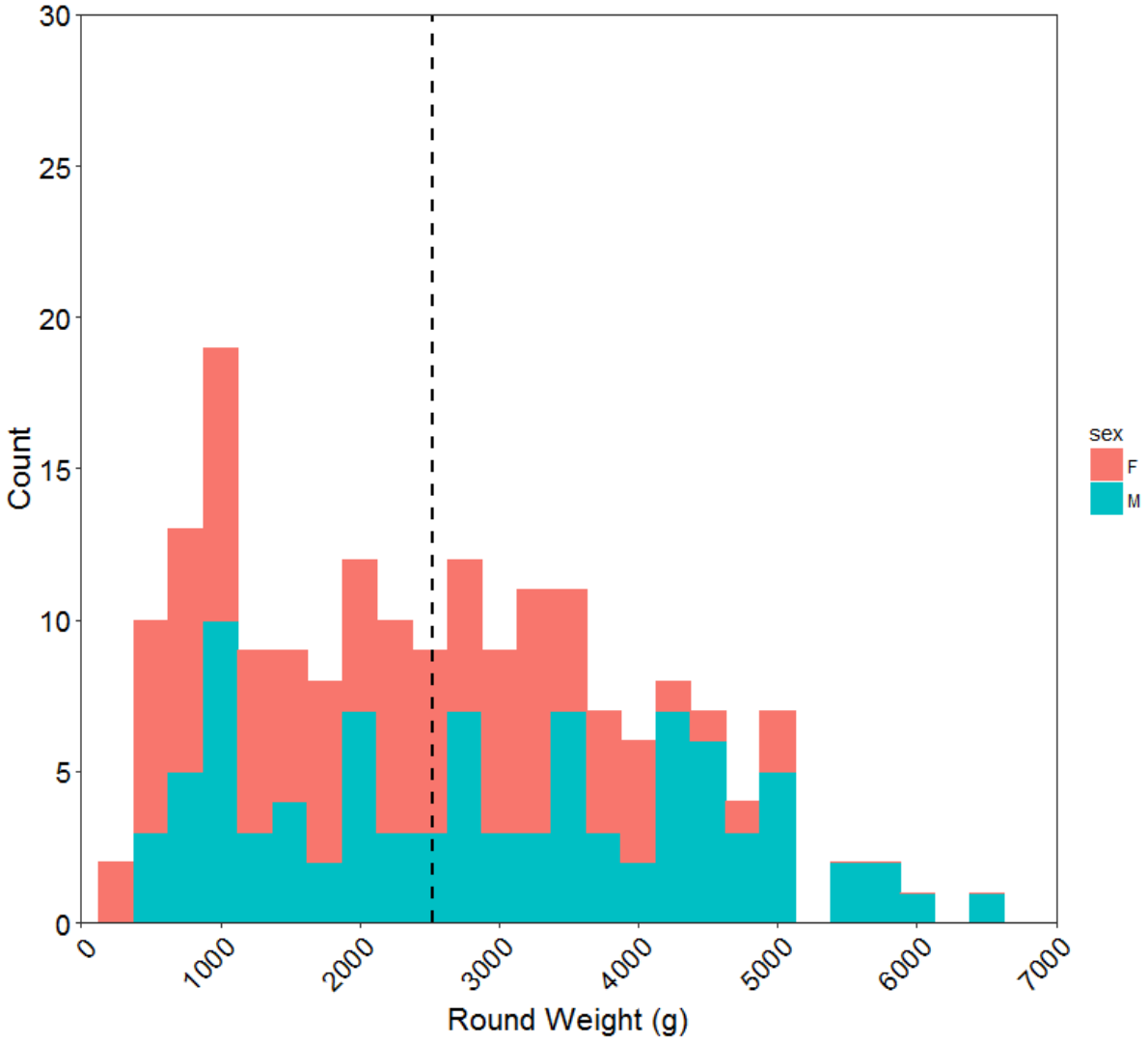

Figure 2. Frequency distributions of round weight (g) collected from fishery-independent sampling of Arctic char at the Lauchlan River in 2018. Females are shown in red and males are shown in blue. The mean round weight (sexes combined) is shown as a black dotted line.

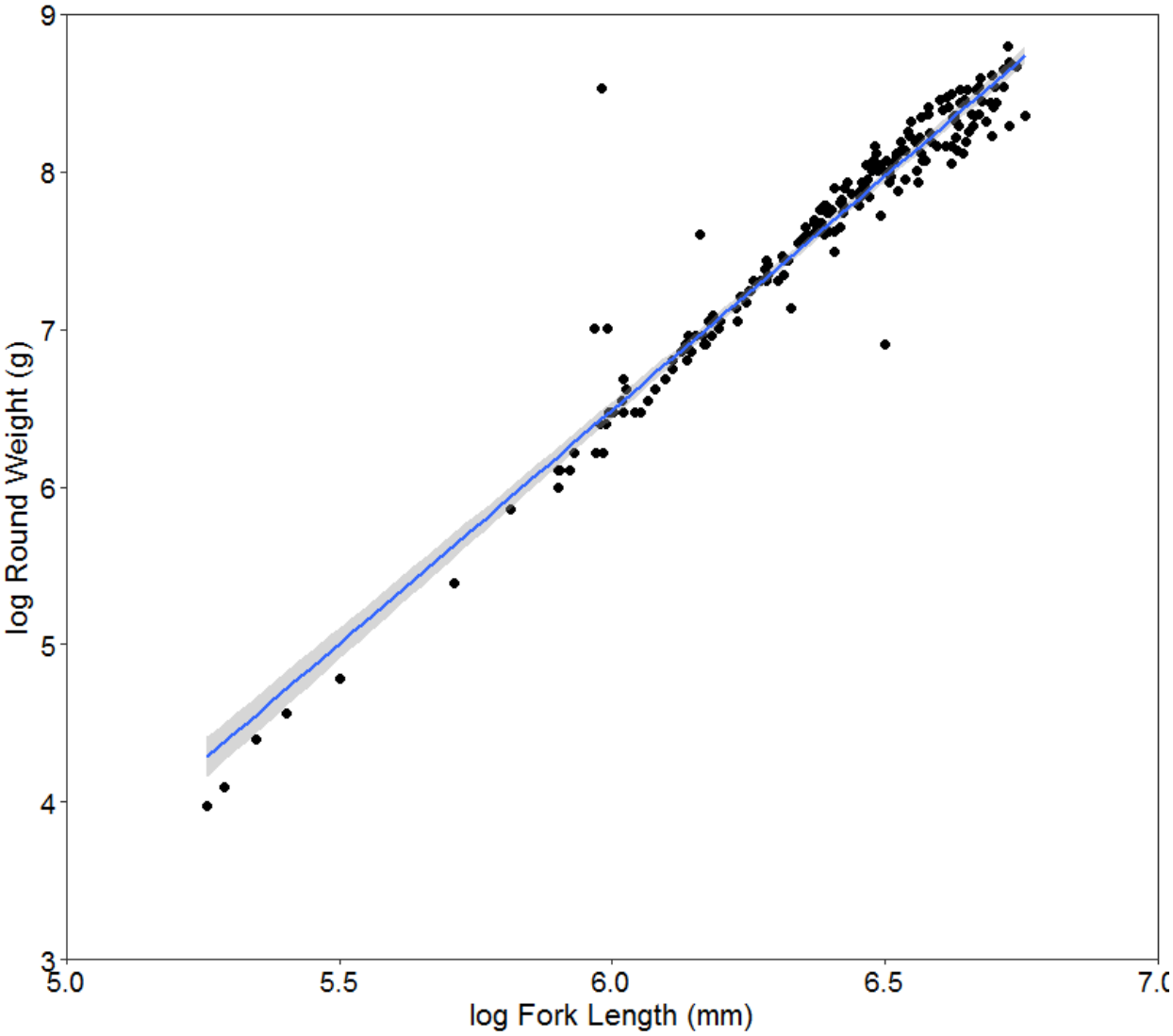

Figure 3. Weight-length relationship of Lauchlan River Arctic Char collected from fishery-independent sampling in 2018.

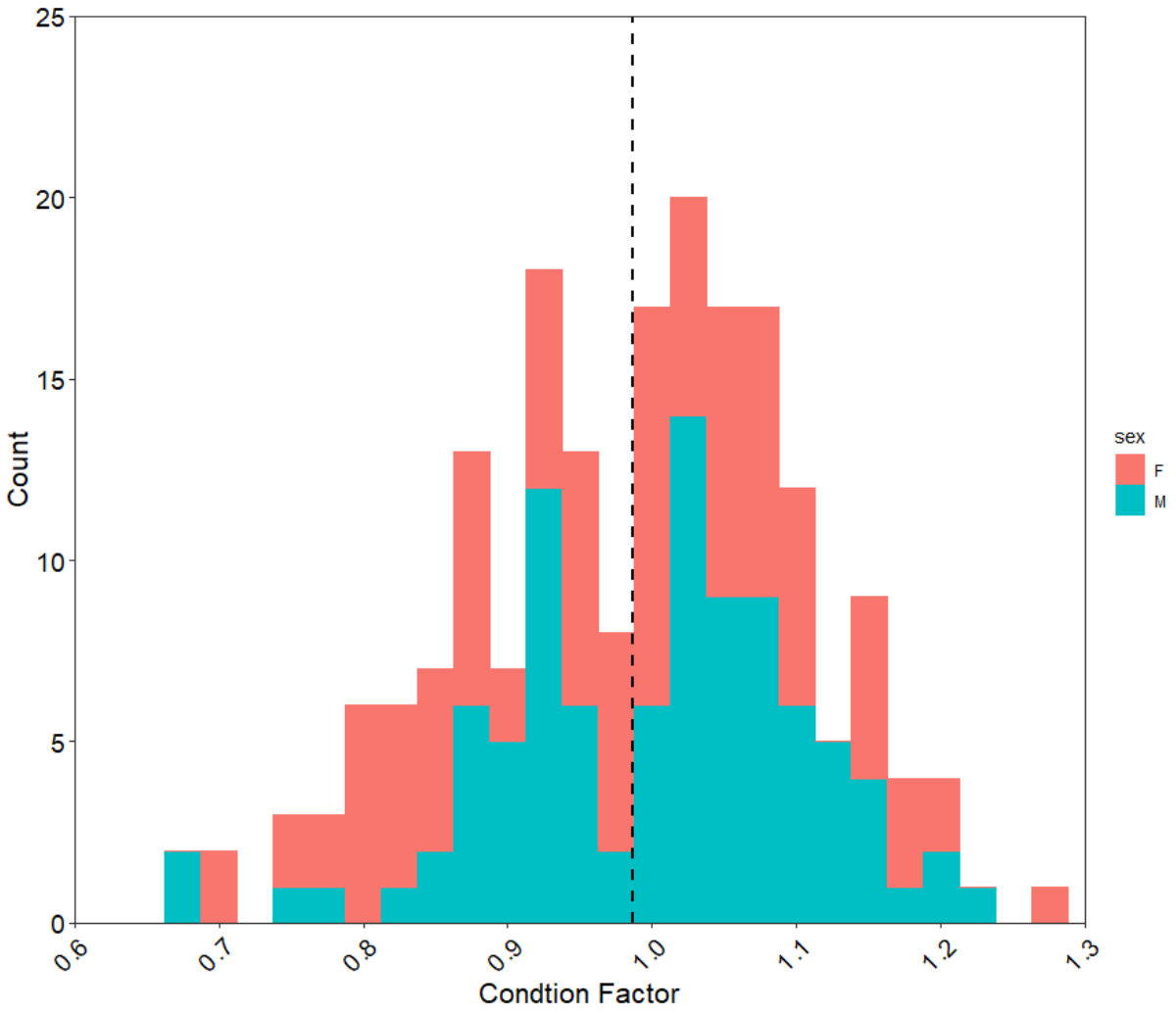

Figure 4. Frequency distributions of condition factor collected from fishery-independent sampling of Arctic char at the Lauchlan River in 2018. Females are shown in red and males are shown in blue. The mean condition factor year (sexes combined) is shown as a black dotted line.

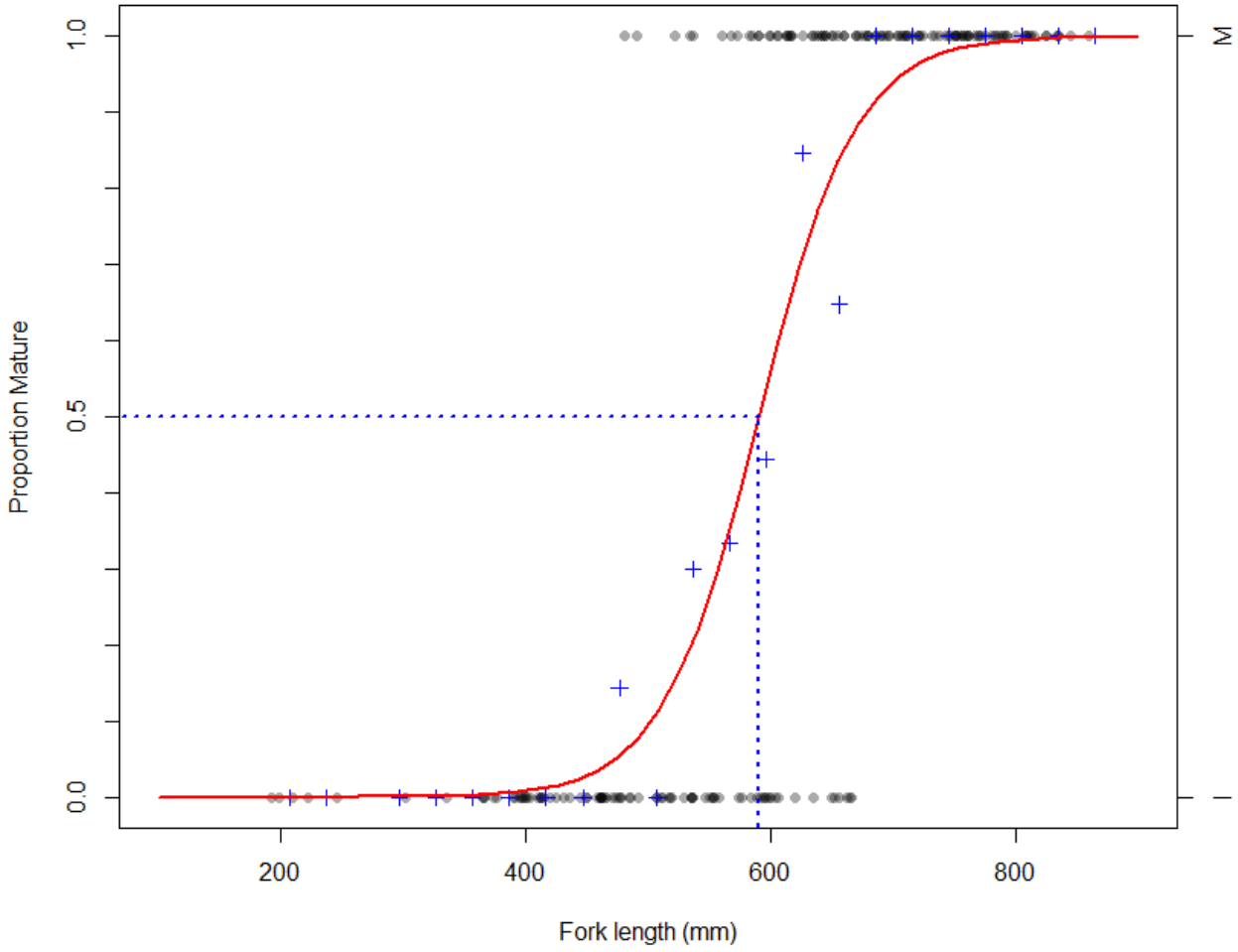

Figure 5. Length at 50% maturity (L50) for Arctic Char (sexes combined) captured at the Lauchlan River, NU, in 2018 as part of our fishery-independent sampling program. The length at 50% maturity for Arctic char sampled in 2018 was 590 mm.