Establishing a benchmark population status for Arctic Char in the Five Mile Inlet system, Inukjuak, 2018

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30 November 2021

MINISTÈRE DES FORÊTS, DE LA FAUNE ET DES PARCS

Votre gouvernement

Québec

Cover page photograph:

Pascal Ouellet — Arctic Char in Aipparusik River, Tasiujaq, August 2017

Photographs in the report:

Employees of the Ministère des Forêts, de la Faune et des Parcs (MFFP) who were involved in the research project

MAINGUY, J., and L. BEAUPRÉ (2021). *Establishing a benchmark population status for Arctic Char in the Five Mile Inlet system, Inukjuak, 2018*, ministère des Forêts, de la Faune et des Parcs, Direction de l'expertise sur la faune aquatique et Direction de la gestion de la faune du Nord-du-Québec, 32 p.

Ministère des Forêts, de la Faune et des Parcs

Legal deposit - Bibliothèque et Archives nationales du Québec, 2021

ISBN (PDF) : 978-2-550-90785-5

ISBN (print version) : 978-2-550-90784-8

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Acknowledgements

First of all, we would like to thank the members of the Inukjuak community for their collaboration in the Arctic Char research project. Without their involvement, we would not have been able to carry out the work described in this report. Special thanks go to the Pituvik Landholding Corporation, including its General Manager, Michael Qasaluaq, and to Minnie Palliser, Megan Epoo and Nancy Nastapoka for their help in obtaining permission for our work on their land, as well as for their assistance in coordinating payment of the Inuit assistants who took part in the project. *Nakurmiik* especially to Pauloosie Kasudluak, the Mayor of Inukjuak, during the fieldwork period, for his help with the planning aspects of the project. We also thank him and his family for allowing us to rent their house in the early days of the project, before our camp could be set up in the Five Mile Inlet system. Thanks also to Jobie Oweetaluktuk, Lasayusi "Laz" Tukai, Arthur Elijassiapik and the other members of the *Local Nunavimmi Umajulirijiit Katujjiqatigiinninga* (LNUK) for the discussions on the *iqaluppik* (Arctic Char), and for selecting the location of the counting fence and our camp. *Nakurmiik* also to Lasayusi Tukai, Andy Weetaluktuk, Isa Tukai, Leo Weetaluktuk, Daniel Weetaluktuk, George Kasudluak, Eric Kasudluak, Dania Ohaituk, Samwillie Kutchaka and Hans Godbout for their logistics assistance, which included transporting materials and personnel by boat, truck and ATV, and for the help provided within the Inukjuak community. Additional thanks to Pauloosie Kasudluak, his son Eric, his nephews George Kasudluak and Dania Ohaituk, and his father Abraham, who generously welcomed two members of our team (Jonathan Frenette and Julien Mainguy) to their family fishing camp to complete our sampling of Arctic Char in the Ipikituk and Saputaliuk systems, located more than 30 km north of Five Mile Inlet. We are also grateful to Frankie Jean-Gagnon, Mark Basterfield and Tommy Palliser from the Nunavik Marine Region Wildlife Board for their valuable help at different stages of the project. In addition, we thank Arctic Char experts Michael Power, Brian Dempson and Jean-Sébastien Moore for sharing their experience and helping us to prepare the study described in this report. Lastly, we thank the Société du Plan Nord for funding our work.

Highlights

1. Upstream migration of Arctic Char in the Five Mile Inlet system was monitored to establish a benchmark population status. In all, 189 Arctic Char were enumerated at the counting fence between August 12 and September 7, 2018, and 57 were sampled at random during that period to characterize various biological parameters.

2. Following a flood that swept away the counting fence during the night of September 7 to 8, terminating the upstream migration survey in the Five Mile Inlet system, additional sampling was carried out in the systems connecting to Ipikituk Lake (*n* = 24) and Saputaliuk Lake (*n* = 20). This was done by accompanying Inuit community members to their family fishing camp.

3. The Fulton's condition factor (*K*) for the Arctic Char sampled in the Five Mile Inlet system is considered to be good, with a value (± standard deviation) of 1.13 ± 0.10 for the sample analyzed (*n* = 57). It is also considered to be good in the Ipikituk (*K* = 1.16 ± 0.10, *n* = 22) and Saputaliuk (*K* = 1.14 ± 0.07, *n* = 17) systems.

4. The percentage of current-year spawners among sampled Arctic Char in the Five Mile Inlet system was very low, with no females (0 %, *n* = 27) and only 6.6 % of males (*n* = 30) having mature gonads. These values were also low for Ipikituk (females: 0 %, *n* = 11; males: 15 %, *n* = 13) and Saputaliuk (females: 0 %, *n* = 12; males: 0 %, *n* = 5).

5. The deduced total annual mortality based on age structure data, for which the sample was small, was estimated at 81.8 % for Arctic Char in the Five Mile Inlet system, with a 95% confidence interval of [62.6; 94.0]. This value is considered very high compared to those of other Arctic Char populations.

6. Mercury concentrations (Hg) in Arctic Char sampled in the Five Mile Inlet system were below the 0.5 mg/kg threshold set by Health Canada, suggesting that mercury contamination is not an obstacle to the consumption of anadromous Arctic Char in this sector.

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1. ᒪᔪᖃᑦᑕᑐᐃᑦ ᑕᓯᕐᓄᑦ ᐃᖃᓗᐻᑦ 5-ᒣᓕᒥᒃ ᑕᑭᓂᓕᒻᒥ ᑲᖏᕐᓱᒥ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᓂᖏᑦ ᐱᒋᐊᕐᑎᑕᐅᓚᐅᕗᒻᒪᑕ ᓯᕗᓂᖃᑦᓯᐊᕐᑯᓪᓗᒋᑦ ᐊᒥᓲᓂᖏᑦᑕ ᖃᓄᐃᓕᖓᓂᖏᑦ. ᐃᓘᓐᓇᓕᒫᑎᒃ, 189-ᖑᔪᑦ ᐃᖃᓗᐻᑦ ᓇᓗᓃᒃᑯᓯᕐᑕᐅᓚᐅᕗᒻᒪᑕ ᑭᓯᑦᑕᐅᑦᓱᑎᒃ ᑭᓯᑦᓴᕕᓕᐊᓇᓯᒪᔪᒥ ᐱᒋᐊᕐᓱᑎᒃ ᐊᐅᒡᒍᓯ 12-ᒥᑦ ᓱᑎᐱᓇ 7-ᒧᑦ, 2018-ᒥ, ᐊᒻᒪᓗ ᑖᒃᑯᓇᖕᖓᑦ 57-ᖑᔪᑦ ᓇᓗᓃᒃᑯᓯᕐᑕᐅᑦᓱᑎᒃ ᖃᐅᔨᓴᕐᑕᐅᑦᓱᑎᓪᓗ ᑖᒃᑯᓇᓂ ᓇᓪᓕᐊᓐᓂᐅᑎᓪᓗᒍ ᖃᓄᐃᑦᑑᓂᖏᑦ ᓇᓗᓃᕐᑕᐅᑦᓴᐊᓱᑎᒃ ᐊᑦᔨᒌᖏᑦᑐᓄᑦ ᖃᐅᔨᓴᐅᑎᑖᕐᑕᐅᑦᓱᑎᒃ.

2. ᖄᒥᑦᑐᒧᑦ ᓱᒃᑯᑕᐅᓚᐅᕗᒻᒪᑕ ᑭᓯᑦᓯᒍᑕᐅᔪᑦ ᑭᓯᑦᓴᕕᓕᐊᓇᓯᒪᔪᖅ ᐊᕙᓗᓕᐅᕐᓯᒪᑦᓱᓂ ᐅᓐᓄᒃᑯᑦ ᓱᑎᐱᓇ 7-ᒥᑦ- 8-ᒧᑦ, ᑭᓯᑦᓯᓂᐅᔪᖅ ᓄᖅᑲᑎᑕᐅᓚᐅᕗᒻᒪᑦ ᒪᔪᕐᐸᓪᓕᐊᔪᓄᑦ ᖃᐅᔨᓴᐅᑕᐅᔪᖅ ᑕᒡᕙᓂ 5-ᒣᓕᒥᒃ ᑕᑭᓂᓕᒻᒥ ᑲᖏᕐᓱᒥ, ᖃᐅᔨᓴᓇᐊᓪᓚᓚᐅᕐᒪᑕ ᓇᓗᓃᒃᑯᓯᕐᓯᐃᑦᓱᑎᓪᓗ ᑕᒡᕙᓂ ᑎᑭᑦᓯᒋᑦ ᐃᐱᑭᑦᑐᒧᑦ ᑕᓯᕐᒧᑦ (*n* = 24) ᐊᒻᒪᓗ ᓴᐳᑕᓕᐅᑉ ᑕᓯᖕᖓᓄᑦ (*n* = 20). ᑕᒪᓐᓇ ᐱᓇᓱᐊᕐᑕᐅᒍᓐᓇᓚᐅᔪᔪᖅ ᐃᓄᓐᓂᒃ ᐃᑲᔪᕐᑎᖃᕐᓱᑎᒃ ᓄᓇᓕᓐᓂᑦ ᐃᓚᒌᓄᑦ ᐃᖃᓗᒐᓯᖃᑦᑕᑐᓄᑦ ᒪᖁᕝᕕᐅᓲᒥ.

3. ᓀᓪᑕᓐ (Fulton's) ᖃᓄᐃᓕᖓᓂᖏᓐᓂᒃ ᖃᐅᔨᓴᕈᑎᒃ (*K*) ᐃᖃᓗᐻᑦ ᖃᐅᔨᓴᕐᑕᐅᓚᐅᔪᑦ 5-ᒣᓕᒥᒃ ᑕᑭᓂᓕᒻᒥ ᑲᖏᕐᓱᒥ ᐃᓱᒪᒋᔭᐅᓚᐅᕐᐳᑦ ᐱᐅᔫᔪᓇᔭᐅᑦᓱᑎᒃ, ᐊᑑᑎᖃᑦᓯᐊᓱᑎᓪᓗ ᓇᓗᓃᒃᑯᑕᓕᓐᓄᑦ ᐃᒫᒃ (± standard deviation ᐊᐅᓚᓂᓇᖃᑦᑕᑕᖏᑦ) ᐃᒣᑦᑐᒥ 1.13 ± 0.10 ᖃᐅᔨᓴᐅᑎᓄᑦ ᓇᓗᓃᕐᑕᐅᑦᓱᑎᒃ (*n* = 57). ᐃᓱᒪᒋᔭᐅᓚᐅᕐᐳᓪᓗ ᐱᐅᔫᔪᓇᔭᐅᑦᓱᑎᒃ ᐃᒃᐱᑭᑦᑑᑉ ᑕᓯᖓᓂ (*K* = 1.16 ± 0.10, *n* = 22) ᐊᒻᒪᓗ ᓴᐳᑕᓕᐅᑉ ᑕᓯᖓᓂ (*K* = 1.14 ± 0.07, *n* = 17) ᖃᐅᔨᓴᐅᑎᖃᕐᓱᑎᒃ.

4. ᑖᒃᑯᐊ ᐊᕐᖑᒍᒥ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓂᖏᑦᑎᒍᑦ ᓱᕉᐃᔭᕐᑕᐅᓯᒪᔪᑦ ᖃᐅᔨᓴᕐᑕᐅᓚᐅᕐᑐᑦ ᐃᖃᓗᐻᑦ ᑕᒡᕙᓂ 5-ᒣᓕᒥᒃ ᑕᑭᓂᓕᒻᒥ ᑲᖏᕐᓱᒥ ᐊᑉᐸᓯᑦᑐᕐᒪᓇᐅᓚᐅᕐᐸᑦ, ᐊᕐᓇᓪᓗᑦᑕᖃᓚᐅᖏᒻᒪᑦ (0 %, *n* = 27) ᐊᒻᒪᓗ ᑭᓯᐊᓂ 6.6 % ᐊᖑᑎᑕᖃᓚᐅᕐᓯᓂ (*n* = 30) ᐱᕈᓃᖅᓯᒪᔪᓂᒃ ᖃᕙᔭᕈᓐᓇᓕᕐᑐᓂᒃ. ᑕᒪᒃᑯᐊᑦᑕᐅᖅ ᐊᑉᐸᓯᑦᑐᕐᒪᓇᐅᓚᐅᓇᕗᑦ ᐃᒃᐱᑭᑦᑐᒥ ᑕᓯᕐᒥ (ᐊᕐᓇᓪᓗᐃᑦ: 0 %, *n* = 11; ᐊᖑᑏᑦ: 15 %, *n* = 13) ᐊᒻᒪᓗ ᓴᐳᑕᓕᒻᒥ ᑕᓯᕐᒥ (ᐊᕐᓇᓪᓗᐃᑦ: 0 %, *n* = 12; ᐊᖑᑏᑦ: 0 %, *n* = 5).

5. ᐃᓱᒪᒋᔭᐅᔪᑦ ᑲᑎᑦᓯᒋᑦ ᐊᕐᖑᒍᓕᒫᒥ ᑐᖕᖓᕕᖃᕐᓯᑎᒃ ᐊᑯᓂᐅᓂᖏᓐᓂᒃ ᑲᑎᖅᓯᑕᐅᓯᒪᔪᑦ, ᑕᒪᒃᑯᐊ ᖃᐅᔨᓴᕿᓴᐅᔪᑦ ᒥᑭᔫᓂᖏᓐᓄᑦ, ᐃᒻᒪᖃᐅᑦᓵᑕᐅᓯᒪᕗᑦ ᐃᒣᓪᓗᐊᑐᒥᒃ 81.8 % ᐃᖃᓗᐻᑦ 5-ᒣᓕᒥᒃ ᑲᖏᕐᓱᒥ ᓂᒪᖃᑦᑕᓂᖏᑦ, ᐃᓚᖃᕐᑎᓪᓗᒋᑦ 95% ᖁᓚᕐᓂᓯᒪᔪᓂᒃ ᖃᐅᔨᓴᐅᑎᓂᒃ [62.6; 94.0]. ᑕᒪᑦᓯᒪ ᐊᑑᑎᖃᕐᓂᖓ ᐃᓱᒪᒋᔭᐅᕚᖅ ᐊᑑᑎᖃᒻᒪᕆᒃᑐᕆᔭᐅᑦᓱᓂ ᐆᑦᑑᑎᒋᓗᒋᑦ ᐃᖃᓗᐸᓐᓂᒃ ᐊᓯᖏᓐᓂᒃ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᓯᒪᔪᑦ ᐊᒥᓲᓂᖏᓐᓂᒃ.

6. ᒨᑯᓇᖃᕐᓂᖏᑦ ᐃᓱᒪᒋᓗᒋᑦ (Hg) ᐃᖃᓗᐸᓐᓂ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔪᑦ ᑕᒡᕙᓂ 5-ᒣᓕᒥ ᑕᑭᓂᓕᒻᒥ ᑲᖏᕐᓱᒥ ᐊᑖᓃᓚᐅᕐᐸᑦ 0.5 mg/kg ᐃᓱᒪᒋᔭᐅᓯᒪᔪᓂᑦ ᑲᓇᑕᒥ ᖃᓂᒪᖃᕐᓇᖏᑦᑐᓕᕆᒃᑯᖓᓂᑦ, ᐃᓱᒪᒋᔭᐅᕗᑦ ᒨᑯᓇᑖᕐᓯᒪᓂᖏᑦ ᐊᕝᕕᐊᕈᑕᐅᒐᓛᖏᑦᑐᐃᑦ ᑖᒃᑯᓇᓂ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔪᓂ ᐃᓗᐊᓃᑦᑐᐃᑦ ᐃᖃᓗᐻᑦ ᑕᒡᕙᓂ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔪᑦ ᐃᓗᐊᓂ.

Introduction

Background to the study

Thanks to a financial agreement between the Société du Plan Nord and the Ministère des Forêts, de la Faune et des Parcs (MFFP), a number of projects have been carried out in several regions in the area covered by the Plan Nord (Côte-Nord, Saguenay–Lac-Saint-Jean and Nord-du-Québec) to prepare benchmark population status reports for fish species and habitats. As the Arctic Char (*Salvelinus alpinus*) is important to Inuit communities, most benchmark population status studies in Nunavik have focused on this species and its associated habitats, although some other species have also been taken into consideration.

General objective

The general objective of the project was to gather information on anadromous Arctic Char in the Five Mile Inlet system found north of the Inukjuak community.

Specific objectives

The specific objectives were to acquire information on the Arctic Char population in the Five Mile Inlet system during the upstream migration period by:

- Using a counting fence to estimate the size of the anadromous Arctic Char population and describe the phenology of the upstream migration.
- Characterizing a random sample of the Arctic Char population by establishing its age and obtaining morphometric measurements and other biological parameters.
- Assessing concentrations of mercury (Hg) and other contaminants in the sampled fish.

Materials and Methods

Counting fence

A temporary counting fence (Figure 1) was installed on the river flowing into Five Mile Inlet (connected to Hudson Bay) and was operational from August 12 to September 7, 2018. This V-shaped installation was used to guide fish into a holding cage, the mesh size of which was chosen to avoid the possibility of fish becoming entangled. The two fence wings were composed of tripods made of steel pipes measuring 6 and 9 feet in length, with a 1 square inch diameter grid to prevent fish from swimming through. The holding cage was used to count the number of migrating Arctic Char and fish of other species. The holding cage (Figure 1), which measured 8 feet (length) by 4 feet (width) by 5 feet (height), with 1 ¼ inch meshing, was visited several times per day, usually every hour or every two hours, to check whether Arctic Char or other species had been caught. A thermograph was installed at the bottom of the holding cage to record the water temperature on an hourly basis throughout the monitoring period.

Figure 1. Counting fence and holding cage used to monitor Arctic Char during its upstream migration in August and September 2018 in the Five Mile Inlet system north of Inukjuak, Nunavik.

The fish caught in the holding cage were identified to species and their fork length was measured with a rule (± 1 mm) fixed on a wooden board, directly in the cage (Figure 2). Most were then released upstream of the fence so that they could continue their migration. Some specimens were sacrificed at random to take morphometric measurements and collect samples. The cage was visited for the last time on the morning of September 7. At that stage the water level in the river was too high for the operation to continue. The cage doors were left open to allow the fish to circulate freely, and the entire counting fence installation was swept away by a flooding event during the night of September 7 to 8. The team recovered all the equipment and dismantle the temporary camp, thereby terminating the work at the site.

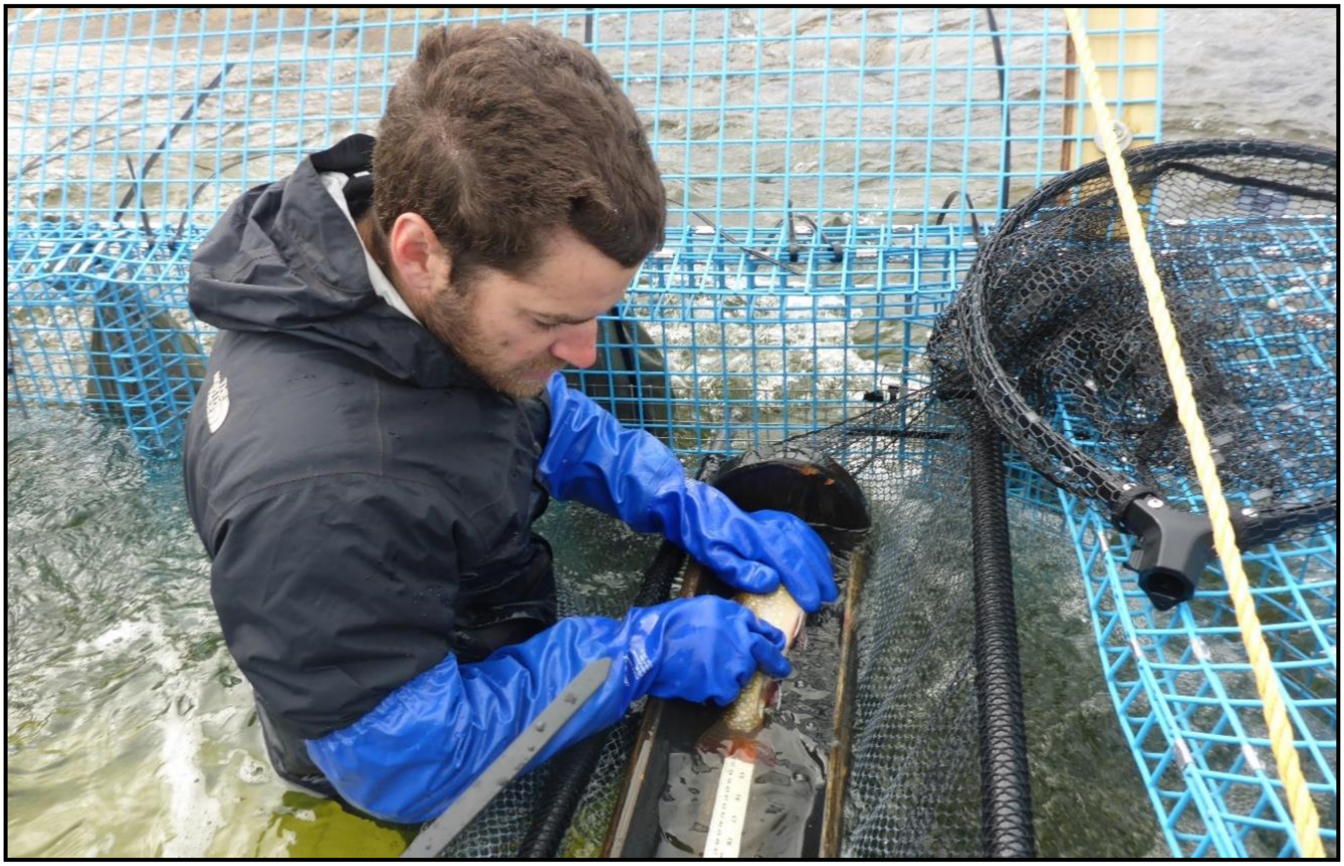

Figure 2. Measuring the fork length of a Brook Char (*Salvelinus fontinalis*) in the holding cage before releasing it upstream of the counting fence in the Five Mile Inlet system, north of Inukjuak.

The team then asked for help from members of the Inukjuak community to increase the size of the Arctic Char sample in the area. Following discussions with Pauloosie Kasudluak, he proposed to sample *iqaluppik* with gill nets at his family camp located north of Five Mile Inlet (Figure 3). From September 11 to 13, two teams each composed of two members of the Inukjuak community fished using 4 ½ inch (102 mm) gill nets at two sites located near Pauloosie Kasudluak's camp, namely: 1) the Ipikituk Lake discharge (Pauloosie and Eric Kasudluak, Figure 4); and 2) the Saputaliuk Lake discharge (George Kasudluak and Dania Ohaituk). Jonathan Frenette and Julien Mainguy from the MFFP accompanied the teams to help install the nets and were then responsible for sampling the captured Arctic Char. In all, 44 Arctic Char were caught on September 12 and 13, 24 in the Ipikituk system and 20 in the Saputaliuk system. Of these fish, five (two from Ipikituk and three from Saputaliuk) were partially consumed by seagulls when they were trapped in the nets and were only partially sampled as a result (e.g. mass could not be used to calculate a condition factor).

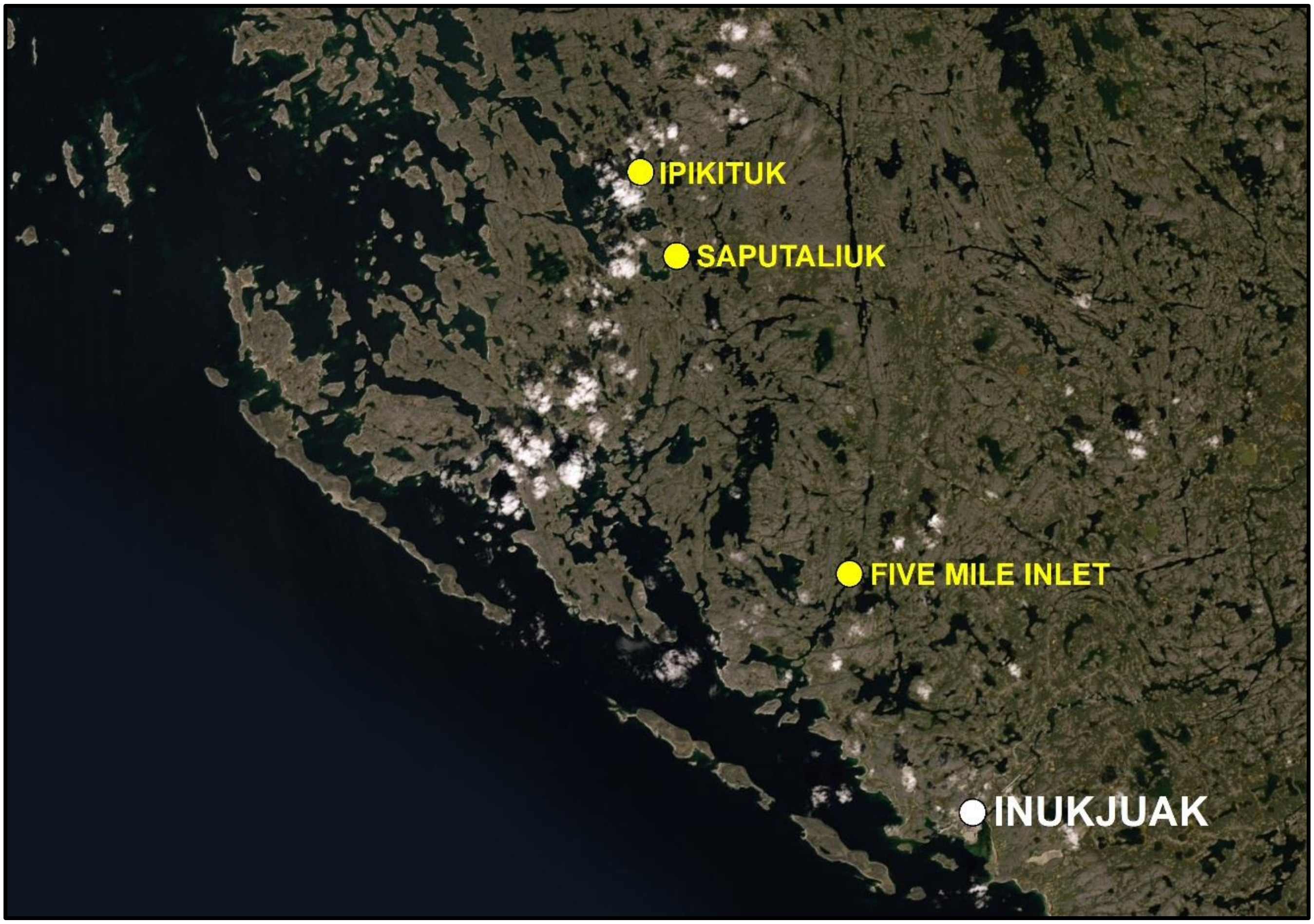

Figure 3. Map showing the location of the Inukjuak community, the Five Mile Inlet site where a temporary counting fence and camp were installed by the Ministère des Forêts, de la Faune et des Parcs, and the Ipikituk and Saputaliuk sites where gill net fishing was carried out with assistance from members of the Inukjuak community to harvest additional fish.

Figure 4. Pauloosie Kasudluak's boat at the mouth of the Ipikituk system, north of Inukjuak, near the gill net fishing location.

Measurements and samples

All the Arctic Char that were randomly sacrificed from the holding cage were taken to a temporary laboratory set up near the river, where they were measured and weighed, and samples were collected (Figure 5). The fish taken from the Ipikituk and Saputaliuk systems were processed in an improvised "laboratory" at Pauloosie Kasudluak's camp, or back in the village of Inukjuak.

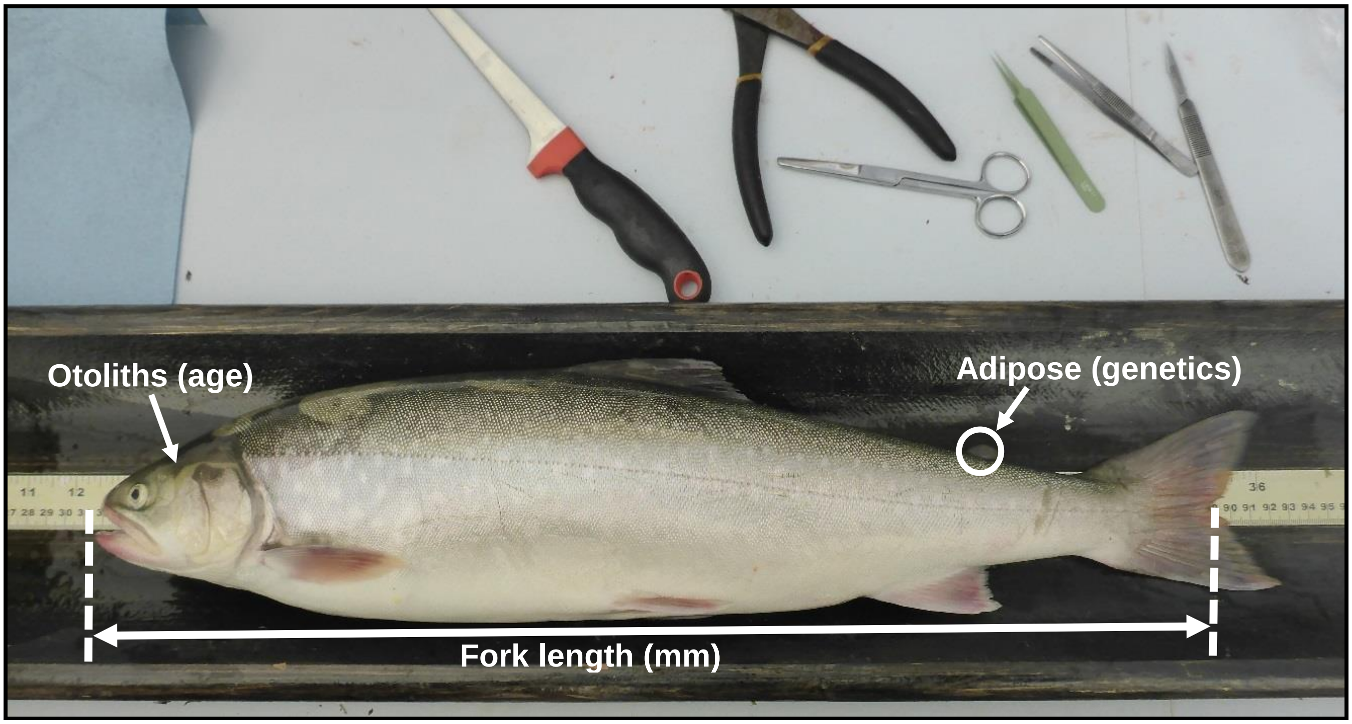

Figure 5. An anadromous Arctic Char taken from the holding cage, prior to autopsy. The fork length was measured and the specimen was weighed before samples were taken and gender was determined by opening the abdominal cavity.

For the sampled fish, fork length was measured using a ruler (± 1 mm; Figure 5) and mass was measured using an electronic scale (O'Haus, Valor 3000 model, ± 0.1 g). The abdominal cavity of each fish was then opened using round-ended scissors. This was done by cutting from the urogenital opening to the base of the operculum to first determine gender. Gonad status was then classified as mature or immature (i.e. mature if the gonads were fully developed, and immature in all other cases). Stomach contents were described and categorized as either insects, small fish or crustaceans. Some stomach samples were preserved in 95% ethanol for more detailed analysis at the MFFP's central laboratory. The adipose fin was harvested and preserved in 95% ethanol for genetic analysis in collaboration with Laval University (at Jean-Sébastien Moore's laboratory). A muscle sample (≈ 100-200 g) was then taken laterally, behind the dorsal fin, and was placed in a thick, inner plastic Ziploc™ bag before being inserted into a second, outer plastic bag into which an identification label was also placed. The samples were frozen (–18 °C) for subsequent contaminant analyses by the Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC), performed according to specimen size (Table 1). The muscle samples were examined individually for mercury (Hg), and some specimens were combined (i.e., as homogenate) and examined for other contaminants. Other types of samples were also taken for research use by academic or federal partners (see Appendix 1).

Table 1. Length classes (mm and inch equivalence) used for contaminant analysis by the MELCC (2017). Fork length was used for length classification assignments.*

Small	Medium	Large
300-449 mm	450-549 mm	≥ 550 mm
11 ⅞-17 ⅔ in.	17 ⅔-21 ⅝ in.	≥ 21 ⅔ in.

* The thresholds used for length classification were reviewed to reflect the size variability among anadromous Arctic Char (*S. a. erythrinus*) in Nunavik. In the past, the MELCC used the size classifications adopted for *S. a. oquassa*, (i.e. inland, non-anadromous Arctic Char): 150-300 mm for “Small”, 301-400 mm for “Medium” and over 400 mm for “Large”. The *oquassa* thresholds were thus used in previous reports for the Aupaluk and Tasiujaq communities (Mainguy and Beaupré, 2019a, b), but to better reflect the large size of anadromous Arctic Char, they have been modified.

The age of the sampled fish was calculated by analyzing the otolith structure in a laboratory, using a binocular microscope. Independent readings by two wildlife technicians allowed to determine the age with a high level of certainty.

All the sacrificed fish were given to community members after measurements and samples had been taken, as agreed with the Hunting, Fishing and Trapping Coordinating Committee (HFTCC), and with the Northern Village, the Pituvik Landholding Corporation and the Inukjuak LNUK.

Analyses

Condition factor

Fulton's factor (*K*) was used to calculate the length-weight relationship of the sampled fish. It is described by means of the following equation (Neumann et al., 2012):

$K = (M/L^3) \times 100\ 000$

where

M: mass (g)

L: length (mm)

Fork length was chosen to calculate the condition factor, because it has been used in almost every other study of Arctic Char, thereby allowing for more valid comparisons with other populations. Generally, in Arctic Char, body condition is considered to be "good" when $K > 1$, "acceptable" when $K \approx 1$ and "poor" when $K < 1$.

Mortality rate

The age of the fish sacrificed at random in the counting fence holding cage ($n = 57$), determined individually from the otoliths, was used to establish an age structure from which an annual mortality rate was estimated (Miranda and Bettoli, 2007). To do this, we used four total annual mortality estimation methods, namely those proposed by Chapman and Robson (1960), Smith et al. (2012), Nelson (2019), and Mainguy and Moral (2021). The estimates for the first three methods were obtained using the `fishmethods` R package and its `agesurv()` function, while a generalized linear model (GLM) with a Poisson distribution was used to determine the dispersion of the age-frequency data before estimating mortality using the method proposed by Mainguy and Moral (2021). In all cases, we followed the recommendation by Smith et al. (2012) to use the "Peak Plus" criterion, i.e. using the age class after the "Peak" (i.e. the most frequent age class) as the starting point for mortality estimates.

Results

Counting fence

Installation of the counting fence was completed on August 12, the date at which the upstream migration monitoring operations began. The fence remained functional until the morning of September 7, when it was decided to abandon operations due to a flooding incident that destroyed the counting fence overnight. In all, 189 anadromous Arctic Char were captured in the holding cage during the monitoring period, with a peak in captures on August 28 (Figure 6).

Brook trout (*S. fontinalis*), round whitefish (*Prosopium cylindraceum*), lake whitefish (*Coregonus clupeaformis*), lake trout (*S. naymachus*) and lake herring (*Cisco* sp.) were all captured in the holding cage during the period in which the counting fence was operational (Figure 7, Table 2). Some smaller lake whitefish may have been however classified erroneously as lake herring (and vice-versa), meaning that the data on lake herring and, to a lesser extent, lake whitefish, should be interpreted with caution. In addition, a certain number of smaller round whitefish unfortunately became trapped in the counting fence, causing occasional mortality among this species.

The observed variations in water temperature values recorded in the holding cage are presented in Figure 8. Water temperatures decreased over the period, and this coincided with an increase in the number of Arctic Char caught at the fence (Figure 6).

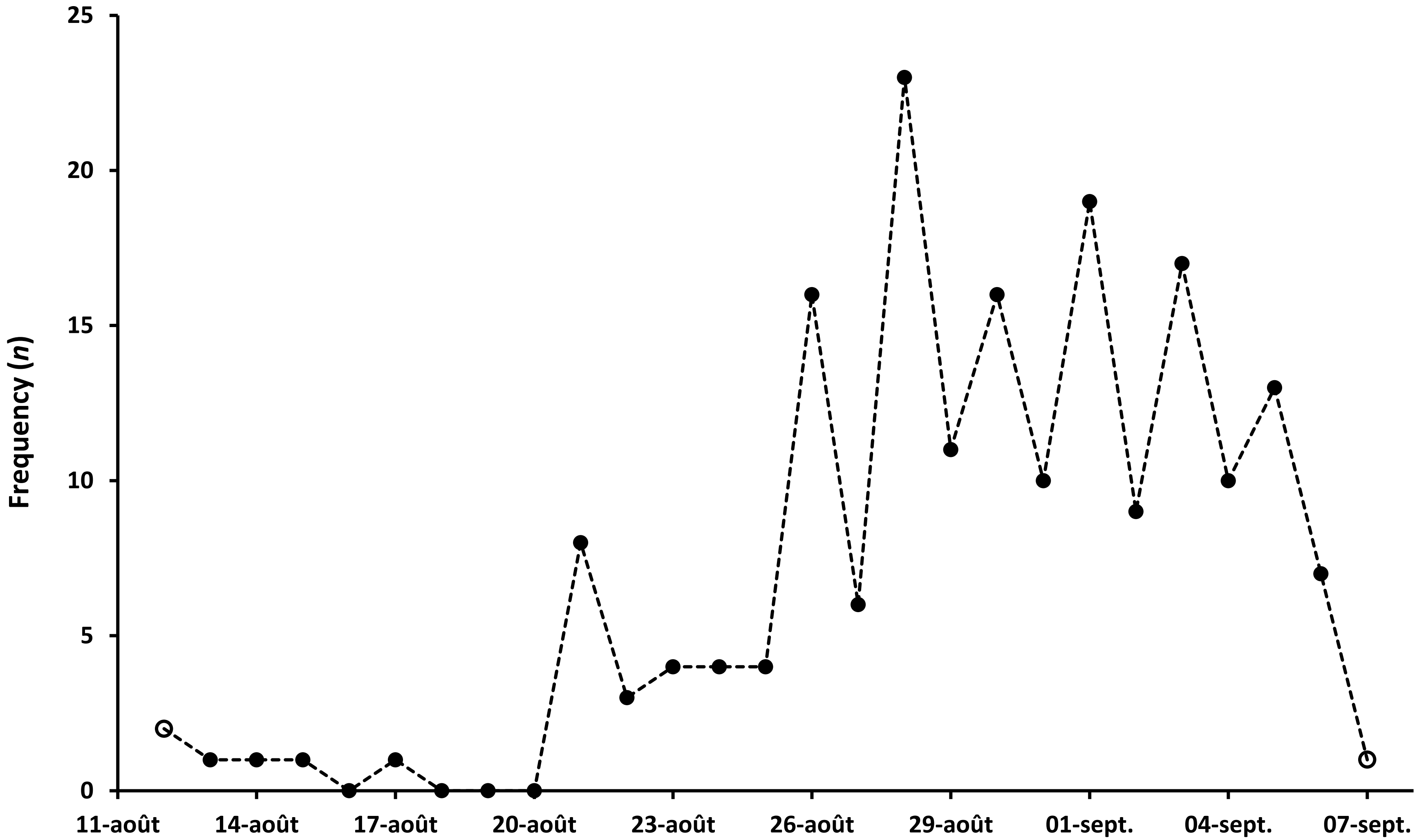

Figure 6. Number of anadromous Arctic Char monitored on a daily basis at the counting fence on the river flowing into Five Mile Inlet, at Inukjuak, in Nunavik, from August 12 (x-axis = *août*) to September 7, 2018. The data for August 12 and September 7 (white circles) are incomplete because the counting fence was not operational for the whole day on those dates.

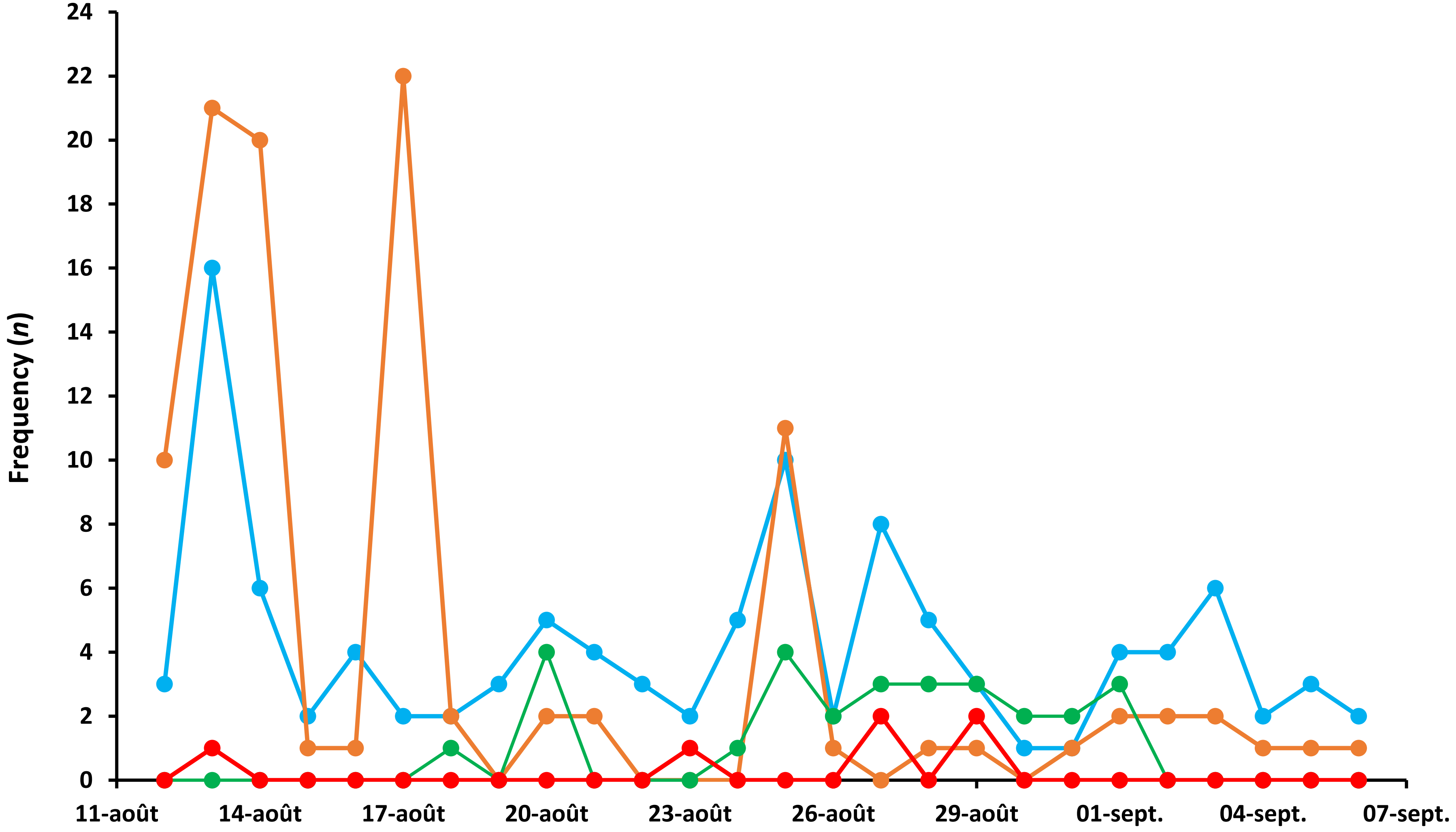

Figure 7. Daily counts of specimens of species other than anadromous Arctic Char observed at the counting fence on the river flowing into Five Mile Inlet at Inukjuak, in Nunavik, from August 12 (x-axis: *août*) to September 6, 2018. Brook trout (blue), round whitefish (orange), lake whitefish (green) and lake trout (red) were all observed.

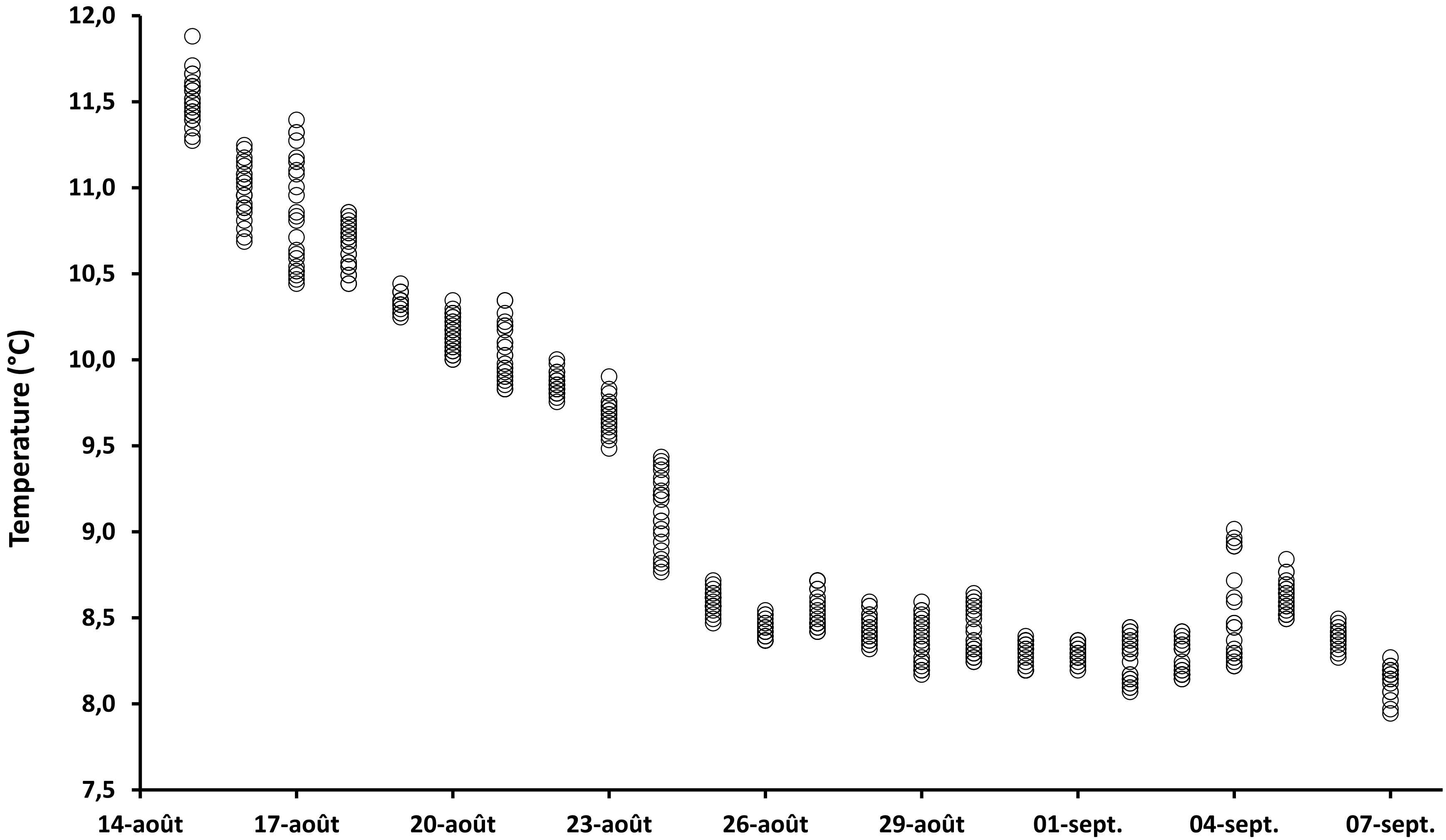

Figure 8. Variations in the water temperature of the river flowing into Five Mile Inlet at the counting fence north of Inukjuak, from August 15 (x-axis = *août*) to September 7, 2018. The circles show water temperatures measured hourly (*n* = 24/day) using a *Tidbit v2* thermograph (± 0.2 °C).

Biological parameters of sampled fish

The average fork length (± standard deviation) for all the Arctic Char enumerated at the counting fence (n = 189), including those that were released back into the water (n = 130), those that died in the holding cage (n = 2) and those that were harvested for sampling (n = 57), was 380 ± 60 mm. Lengths varied from 196 to 615 mm. Fork length frequency distribution is shown in Figure 9 for all Arctic Char captured at the counting fence and for the sacrificed subsample. Specimens ≥ 600 mm accounted for < 1% of the Arctic Char recorded at the counting fence (1 out of 189). At Ipikituk, the average fork length was 461 ± 59 mm (range: 320-551 mm, n = 24), while at Saputaliuk, the average was 449 ± 55 mm (range: 358-562 mm, n = 20). In other words, no fish measuring ≥ 600 mm were caught at these two sites located north of Five Mile Inlet, reducing the percentage of large specimens to 0.43% for the combined three sites. Generally, the specimens measured at the counting fence were smaller than those caught in Ipikituk (–81 mm) and Saputaliuk (–69 mm). Sampling at these two more northerly sites took place over only two days, compared to almost a month at Five Mile Inlet. In addition, the gill nets used at Ipikituk and Saputaliuk targeted medium to large fish, and may have been responsible for some of the size difference. For the other species caught at the Five Mile Inlet counting fence, fork length measurements are described in Table 2.

Tableau 2. Fork length (average length ± sd) for species other than Arctic Char caught at the counting fence in August and September 2018, at Inukjuak, in Nunavik. Fork length range [minimum, maximum] and sample size (*n*) are also shown for each species.

Species	Length (mm)	
Brook trout	336 ± 60 [184-481]	(107)
Round whitefish	334 ± 48 [214-446]	(104)
Lake whitefish	328 ± 27 [234-373]	(30)
Lake trout	382 ± 75 [272-495]	(6)

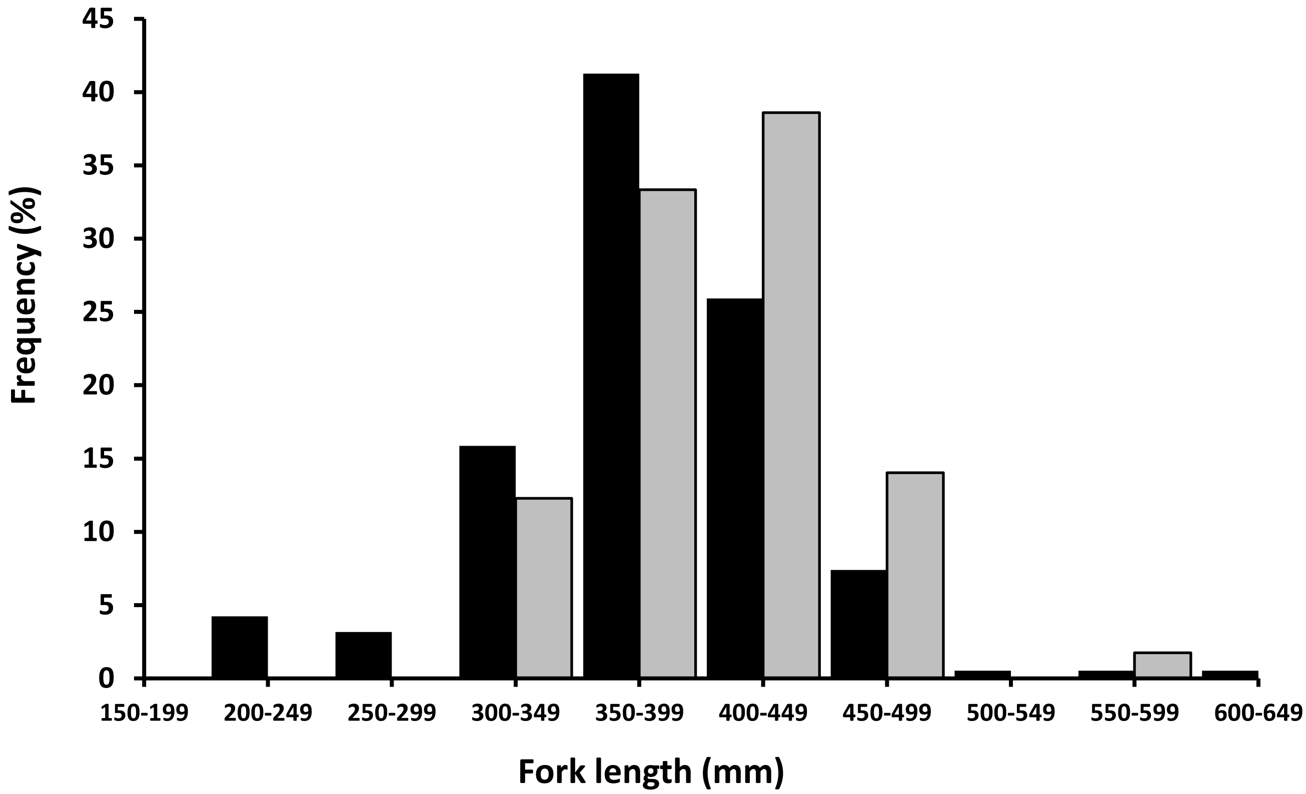

Figure 9. Fork length relative frequency distribution according to 50 mm classes, for anadromous Arctic Char caught in the holding cage at the counting fence on the river flowing into Five Mile Inlet, at Inukjuak, in Nunavik, from August 12 to September 7, 2018. The total number of Arctic Char measured (*n* = 189) is shown in black, and those sampled out of these (*n* = 57) is shown in grey.

Arctic Char – condition factor

The condition factor (*K*) for Arctic Char from the monitored river in the Five Mile Inlet system had a mean of 1.13 ± 0.10 (range: 0.91 to 1.37). In addition, seven of 58 specimens (12 %) at this site had an individual *K* < 1. In the Ipikituk system, the average value of *K* was 1.16 ± 0.10 (range: 0.93 to 1.37) and only two individuals out of 22 (9 %) had a *K* < 1. Lastly, in the Saputaliuk system, the mean for *K* was 1.14 ± 0.07 with a range of 1.04 to 1.24 and none of the fish (0 %) in this sector had a *K* < 1. Overall, for the anadromous Arctic Char caught at the three sites, *K* was 1.14 ± 0.10.

Sex ratio and gonad maturity

The overall sex ratio for Arctic Char sampled at the three study sites (number of females [F] per male [M]) was 1.04:1. At Five Mile Inlet, it was 0.90:1 (*n* = 57), while at Ipikituk it was 0.85:1 (*n* = 24) and at Saputaliuk 2.40:1 (*n* = 17).

Out of the 98 Arctic Char (50 F, 48 M) analyzed in the laboratory, four (4.1 %) had mature gonads and all were male. Gonad maturity among females (Figure 10) was therefore zero (0 %), and among males it was low (8.3 %). Of the males with mature gonads, one was 4 years of age and the other three were 5 years of age. Limiting the descriptive statistics to fish aged ≥ 4 years, 9.5% (*n* = 42) of the males had mature gonads. Two of the males with mature gonads were from Five Mile Inlet and the other two were from Ipikituk.

Figure 10. **Female Artric Char sampled at Aupaluk in 2016 with mature gonads (current-year spawner) and non-developed gonads (right). From Mainguy and Beaupré (2019a).**

Age structure and annual mortality

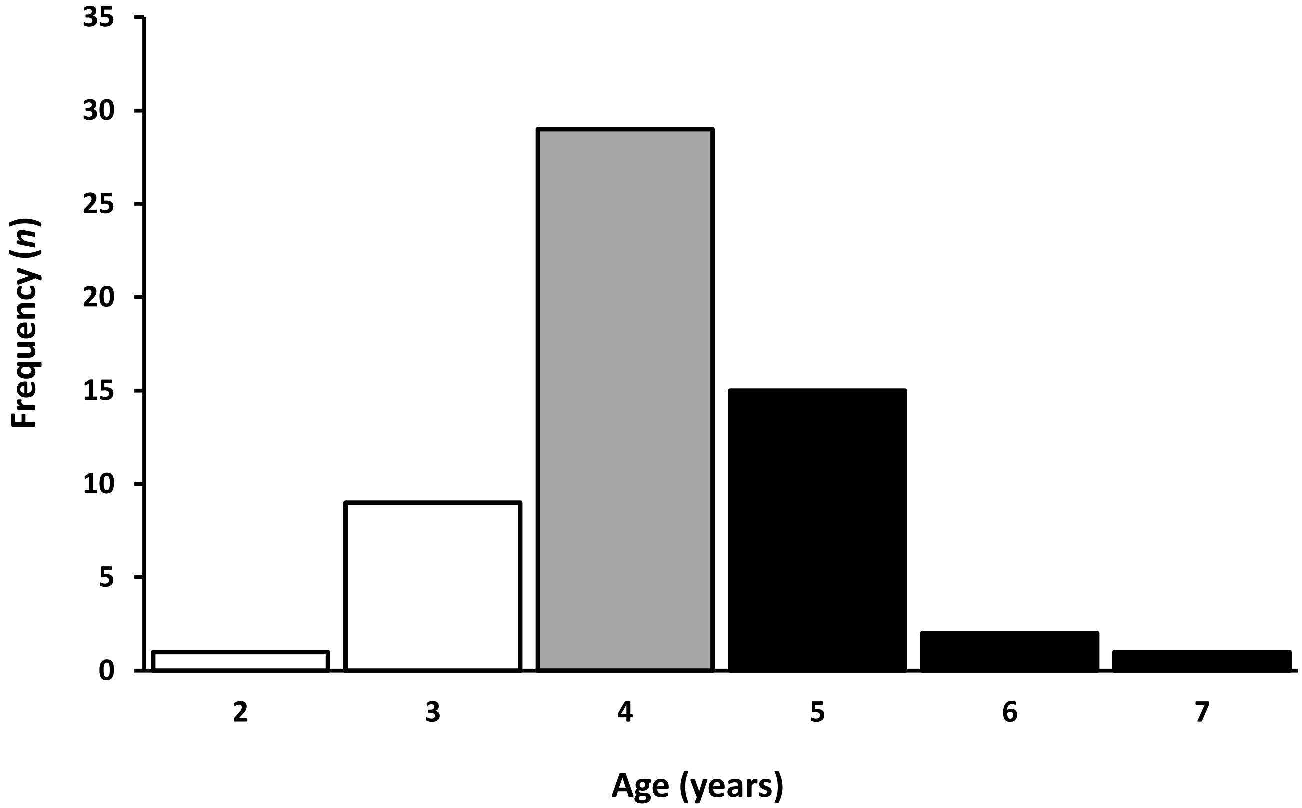

Figure 11. Age structure of Arctic Char sampled at the counting fence on the river flowing into Five Mile Inlet. The age classes recruited entirely by means of fishing equipment are shown in grey (i.e., the mode), and those partially recruited by means of fishing equipment are shown in white.

According to the methods proposed by Chapman and Robson (1960), Smith et al. (2012) and Nelson (2019) using the "Peak Plus" criterion, total annual mortality is 80.9%, 78.0% and 81.8% based on Figure 11, respectively. The approach proposed by Mainguy and Moral (2021) estimates mortality at 81.8% with a confidence interval of 95 % [62.6; 94.0]. Using the "Peak" criterion instead – i.e. including the 4-year-old age class leads to lower mortality rates, although still relatively high at 67.6%, 66.7%, 68.1% and 68.1% respectively.

It was impossible to estimate the annual mortality rate for the Ipikituk and Saputaliuk sites because the sample size was too small and the equipment used targeted fish of similar sizes (i.e. approximately the same age).

Contaminants

In all, 58 Arctic Char (57 sacrificed at random + 1 that died in the holding cage) were examined individually for mercury (Hg) concentrations. Average mercury concentrations ranged from 0.06 to 0.10 mg/kg in the river flowing into Five Mile Inlet, depending on length class (Table 3). No muscle samples were taken from the Arctic Char caught at Ipikituk or Saputaliuk, because the fish were kept whole by the Inuit fishermen.

Eighteen other contaminants (metals) were analyzed and the concentration levels obtained are shown in Table 4. The values for these other contaminants were obtained from homogenates of ten fish combined by length class as shown in Table 1, except for the “Large” length class, where only one specimen was caught. In all cases, a single value is shown per homogenate.

Tableau 3. Mercury concentrations (Hg; mean ± sd) in Arctic Char sampled in the Five Mile Inlet system north of Inukjuak in the summer of 2018, by length class.

Length class [1]	Hg (mg/kg)	*n*
Small	0.06 ± 0.06	49
Medium	0.10 ± 0.14	8
Large	0.07	1

[1] Length classes are shown in Table 1.

Tableau 4. Contaminant concentrations[1] (mg/kg) in Arctic Char during upstream migration in the Five Mile Inlet system north of Inukjuak, in 2018. One value is shown per length class and is obtained from a homogenate of 1 to 10 fish for each length class.

Length class [2]	*n*	Al	As	Ba	Cd	Cr	Co	Cu	Fe	Mn	Mo	Ni	Pb	Se	Sr	Tl	U	V	Zn
Small	10	< 0.5	1.6	0.036	< 0,02	< 0.007	0.004	0.51	4.2	0.06	0.002	< 0.006	< 0.002	0.43	0.25	0.001	< 0.001	< 0.02	4.6
Small	10	< 0.5	1.3	0.028	< 0,02	0.008	0.005	0.48	3.3	0.05	0.002	< 0.006	< 0.002	0.43	0.07	0.001	< 0.001	< 0.02	4.6
Medium [3]	10	< 0.5	1.6	0.013	< 0,02	0.008	0.004	0.50	3.7	0.05	0.002	0.011	< 0.002	0.42	0.08	0.001	< 0.001	< 0.02	4.8
Large	1	< 0.5	1.5	< 0.006	< 0,02	< 0.007	0.002	0.40	3.0	0.04	0.002	< 0.006	< 0.002	0.44	< 0.07	0.001	< 0.001	< 0.02	4.3

[1] Al : Aluminium; As : Arsenic; Ba : Barium; Ca : Cadmium; Cr : Chrome; Co : Cobalt; Cu : Copper; Fe : Iron; Ma : Magnesium; Mo : Molybdenum; Ni : Nickel; Pb : Lead; Se : Selenium; Sr : Strontium; Tl : Thallium; U : Uranium; V : Vanadium; Zn : Zinc.

[2] See Table 1 for details of length classes.

[3] To obtain a homogenate of 10 fish for the “Medium” length class (450-549 mm), two fish at the upper limit of the “Small” length class (300-449 mm) with fork lengths of 446 mm and 447 mm respectively were included in the group by the MELCC’s laboratory.

Discussion

The monitoring of the upstream migration on one of the rivers linked to the Five Mile Inlet system produced some useful data on the biology of Arctic Char found in this area. Although fragmentary, the data provides a 2018 benchmark status in this sector for body condition, estimated annual mortality, reproduction, and concentrations of certain contaminants including mercury. Given that the study took place over a single summer and covered only part of the upstream migration period, the findings should be regarded (at best) as a partial representation of the Arctic Char population in question. The information presented here may prove to be useful if anthropic developments should take place in the future and impact the river flowing into Five Mile Inlet. In addition, if the Inukjuak community eventually decides to institute fishing management rules for the species, the data contained in this report could easily be compared to future data to eventually verify the effects of those rules. In the following sections, the study's main findings in connection with the Five Mile Inlet Arctic Char population and, to a lesser extent, the Ipikituk and Saputaliuk populations, are interpreted in light of the available knowledge and documentation.

Monitoring of Arctic Char at the counting fence

In all, 189 Arctic Char were enumerated between August 12 and September 7. More would have been enumerated if 1) the counting fence had been in position from the beginning of the upstream migration period, which sometimes starts as early as mid-July (Dempson and Green, 1985), and 2) if we had been able to continue the monitoring until the end of the upstream migration, towards the end of September. It was therefore not possible to establish the precise number of anadromous Arctic Char using the Five Mile Inlet system in 2018, but the findings nevertheless suggest that the population is fairly small. Regardless, the information collected at the counting fence and during the fishing expeditions in Ipikituk and Saputaliuk was sufficient for us to establish some useful biological parameters, ranging from condition factor to annual mortality estimates deduced from age structure data.

Condition factor

Most of the sampled fish exhibited condition factors ranging from "acceptable" to "good". Overall, the condition factor for sampled Arctic Char in the sector north of Inukjuak (K = 1.14) was similar to other values published in the scientific literature for Canadian populations. For example, in Cambridge Bay (Nunavut), Moore et al. (2016) reported an average K value of 1.02 ± 0.14 for resident Arctic Char and 1.06 ± 0.08 for non-residents. For the Hornaday River in Paulatuk (Northwest Territories), Harwood (2009) reported an annual average K value of 1.24 (range: 1.15-1.38). In Nunavik, Boivin (1994) reported a condition factor for Arctic Char caught in the Sapukkait system, north of the Kangiqsualujjuaq community, of 1.08 to 1.11 for the period 1990 to 1992. In 2016, the anadromous Arctic Char sampled in the Red Dog River and Voltz River, near Aupaluk, and in Hopes Advance Bay, had an average K value of 1.23 ± 0.15 (n = 228; Mainguy and Beaupré, 2019a), while in 2017 the Arctic Char in Aipparusik River in Tasiujaq exhibited an average K value of 1.28 ± 0.19 (n = 73; Mainguy and Beaupré, 2019b). It is therefore possible to conclude that the condition factor of Arctic Char sampled in the Inukjuak region was generally similar to that of other Arctic Char populations in Nunavik and Nunavut. In light of these findings, it is probable that most of the Arctic Char caught in the river flowing into the Five Mile Inlet system, and those caught in Ipikituk and Saputaliuk, were able to obtain the resources they needed to maintain a condition factor of over 1, even though the K average was slightly lower than that observed in Ungava

Bay for Aupaluk in 2016 (Mainguy and Beaupré, 2019a) and Tasiujaq in 2017 (Mainguy and Beaupré, 2019b).

Reproduction

Very few of the Arctic Char sampled in Inukjuak were current-year spawners. Similar situations have also been observed elsewhere in Nunavik. For example, Boivin (1994) reported that only 0.9% of the 1,839 Arctic Char sampled randomly at the counting fence in the Sapukkait system during upstream migration between 1990 and 1992 had developed gonads. These data on reproduction suggest that Ungava Bay Arctic Char may have a fairly long reproductive periodicity; in other words, most do not reproduce every year. Moreover, most Arctic Char may not reproduce for the first time until they are 8 to 10 years old, as reported by Boivin (1994) for Arctic Char in the Sapukkait and Sannirarsiq systems, north of Kangiqsualujjuaq. In Aupaluk in 2016, in the sample of Arctic Char 5 years of age or over, reproductively ready fish accounted for 5.6 % of females and just 1.9 % of males (Mainguy and Beaupré, 2019a). In the Tasiujaq region, current-year spawners were all aged between 4 and 7 years and in the population segment aged ≥ 5 years, they accounted for 8.1% of females and 19.2% of males (Mainguy and Beaupré, 2019b). Of the Arctic Char sampled in Aipparusik River in Tasiujaq, for which it was possible to determine their age (*n* = 80), only 3.8 % were ≥ 8 years of age, whereas in Aupaluk in 2016, for comparison purposes, the figure was 7.5 % (*n* = 280; Mainguy and Beaupré, 2019a, b). Lastly, in the Salluit area, the age at which 50% of fish across both genders can be expected to have mature gonads was found to be 10 years (Mainguy and Beaupré, unpublished data). Although age at maturity is not known for Arctic Char in Inukjuak due to the low number of reproductively ready fish sampled, it is likely to be the same as has been observed elsewhere in Nunavik, i.e. between 5 and more probably 8 to 10 years of age. Therefore, given the fairly high total annual estimated mortality rate, it is possible that an undetermined number of Arctic Char of both genders are unable to survive long enough to attain maturity, which effectively reduces the number of potential reproductive fish in the system.

As we mentioned earlier, we were only able to study part of the upstream migration period in the Five Mile Inlet system. In Labrador, Dempson and Green (1985) reported that Arctic Char sometimes begin their upstream migration in mid-July and that larger fish tend to begin earlier than smaller fish. A similar observation was made for an Arctic Char population on an island in the Svalbard archipelago in Norway (Gulseth and Nilssen, 2000). With this in mind, it is possible that some reproductively-ready fish passed through the site before the counting fence was installed (August 12). If so, and we believe this may be the case, the percentage of reproductive fish captured in the Five Mile Inlet system may be biased downwards, and the estimated annual mortality rate may be biased upwards. Moreover, since it was not possible to determine whether there are any major spawning grounds upstream of the system, it becomes more probable that some Arctic Char may enter the system seeking a coastal lake in which to spend the winter in freshwater, as the species' biology requires, rather than seeking a spawning site. The fact that two males with mature gonads were captured at our counting fence suggests that reproductive activities may take place in the system under study, unless the fish concerned were simply exploring prior to fall spawning. Given the broad range of life strategies that have been observed in this species in the past, including differences in migratory tactics, it is therefore difficult to make informed observations without a study covering at least one full summer, and ideally more than one (Gilbert et al., 2016).

Annual mortality of Arctic Char

In the Inukjuak Arctic Char population, the annual mortality rate of 68% to 82% is considered high and is therefore of concern demographically. Compared to other populations fished in the Northern Canadian communities, including the Hornaday River population in Paulatuk, Northwest Territories, where Arctic

Char between 6 and 14 years of age had an total annual mortality rate of 53.8 % (range: 35.4% to 70.7 % over 18 years, 1990-2007; Harwood, 2009), the value observed at Inukjuak is substantially higher. In the Isuituq River near Pangnirtung on Baffin Island in Nunavut, Arctic Char between 11 and 21 years of age had an annual average mortality rate of 34.5 % (range: 24 to 49% over six years, 2002-2006 and 2008; DFO, 2010). In the Cumberland Sound region, also on Baffin Island in Nunavut, Moore (1975) estimated that annual mortality was 16% with the highest values (25 to 30%) observed in fish that were between 10 and 15 to 17 years of age. In the Kuujjua River, on Victoria Island in the Northwest Territories, Harwood et al. (2013) reported an annual average mortality rate of 45% (95% confidence interval: 42 to 48%) in the period of 1992 to 2009. In Labrador, Dempson and Green (1987) estimated an annual mortality rate of 44 to 49% in the Fraser River. In Nunavik, Boivin (1994) estimated an annual mortality rate of 28% in 1990 and 40% in 1992 in the Sapukkait system. In Aupaluk in 2016, the estimated annual mortality rate in two rivers and in Hopes Advance Bay varied from 47 to 52% (Mainguy and Beaupré, 2019a), and was of 50% in Tasiujaq (Mainguy and Beaupré, 2019b). These more recently observed values in the Ungava Bay are well below those observed in Inukjuak in 2018. Power et al. (2008) reviewed the literature on annual mortality rates among Arctic Char between 6 and 15 years of age in Canadian anadromous and lacustrine populations. Their main finding was to the effect that, generally speaking, annual mortality rates vary between 30 and 45%, although they also noted that some populations exhibit rates below 25%.

In light of all this information, it is clear that the Arctic Char north of Inukjuak fall into the higher portion of the range for total annual mortality, a situation that may be interpreted as worrying for demographic stability. However, as noted earlier, it is possible that some larger, and hence older, fish may have migrated up the Five Mile Inlet system before the counting fence was installed, which would affect the estimated rate. This scenario is likely, based on previous observations on the Fraser River at Nain in Labrador (Dempson and Green, 1985). If this was in fact the case, it would create an upward bias for mortality rates, since certain individuals over 6 to 8 years of age would not have been taken into account. Based on our findings, which point towards a fairly high mortality rate, this important bio-demographic parameter deserves to be studied in greater depth. The observations shared with us by fishers from the Inukjuak community support the hypothesis of high mortality in this sector. The concerns expressed by Inukjuak community members regarding declining harvests in recent years, combined with the smaller size of Arctic Char caught in nets and the need to travel further from Inukjuak in order to find a sufficient supply of Arctic Char, all suggest that the fairly high estimated mortality rate found in this study may be an accurate reflection of the species' biological situation in the Five Mile Inlet sector north of Inukjuak

Contaminants found in Arctic Char

Based on the MELCC laboratory findings, the Arctic Char taken from the Five Mile Inlet system exhibited mercury concentration levels below the recommended Health Canada threshold (0.5 mg/kg), suggesting at first glance that mercury contamination is not an obstacle to the consumption of Arctic Char in this sector. However, it is important to note that, for questions concerning levels of mercury and other contaminants in fish for human consumption, Inukjuak community members should still refer to their local, provincial and federal health authorities. The concentration levels of contaminants listed in Table 4 are provided for reference purposes only, in connection with the fish sampled in this study. Any attempt to interpret these findings from a public health perspective should be undertaken only with expert assistance.

Conclusion

Generally speaking, the Arctic Char sampled north of the Inukjuak community exhibited a condition factor ranging from “acceptable” to “good”, along with low mercury concentrations, both of which are interpreted as good indicators of population health. However, the percentage of current-year spawners was zero for females and very low for males, and no fish 8 years of age or over were caught at any of the three study sites. In the Five Mile Inlet system, our study of age structure revealed an annual mortality rate of nearly 82%, although it was based on small sample size. According to Boivin (1994), Arctic Char in another Ungava Bay system (Sapukkait) did not reach sexual maturity until they were 8 to 10 years of age. It is therefore very probable that some Arctic Char die or are fished before their first reproductive experience, thereby reducing the population’s reproductive potential.

The findings from this study suggest that the Arctic Char population north of Inukjuak may be in demographic decline, a situation that could be explained by a high mortality rate and a low percentage of fish reaching sexual maturity, resulting in poor recruitment. One way of allowing more fish to grow sufficiently to reproduce at least once would be to consider the possibility of reducing the pressure from fishing. If the number of gill nets used were to be reduced over time and space (e.g. by avoiding the upstream migration period in certain sectors), more Arctic Char of both genders would be able to survive long enough to attain sexual maturity and hence play a role in maintaining the population.

Given the long life cycle of the Arctic Char, which requires several years of growth in to first participate in reproduction, and the low survival rate observed in this study, it is unlikely that this particular population will be able to maintain its numbers or recover demographically. However, it is important to note that, in the absence of long-term data, it is impossible to establish a clear benchmark either for the population itself or for its demographic trends. The biological parameters documented in 2018 and the observations reported by members of the community suggest that additional monitoring is needed to understand the biological situation of the anadromous Arctic Char populations near Inukjuak.

If the Inukjuak community wishes to set up a monitoring program to be carried out and managed by its members (e.g. the LNUK), it is encouraged to contact the representatives of the MFFP’s Direction de la gestion de la faune du Nord-du-Québec. Contact information for the MFFP’s current respondents for Arctic Char is as follows:

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ᓱᓇᓕᒫᓂᒃ ᐅᖃᐅᓯᖃᖅᑐᑕ, ᑖᒃᑯᐊ ᐃᖃᓗᑉᐲᑦ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔪᑦ ᐃᓄᒃᔪᐊᑉ ᓄᓇᓕᖓᑕ ᑕᕐᕋᖓᓂ ᖃᐅᔨᓴᖅᕕᐅᔪᒥ ᖃᓄᐃᓕᖓᓂᖏᑦ ᐱᒋᐊᖅᕕᖃᕐᐳᑦ "ᖃᓄᐃᖏᑦᓯᐊᕐᓂᖏᓐᓂᑦ" ᐅᕝᕙᖓ "ᐱᐅᔪᒧᑦ", ᐃᓚᖃᕐᑎᓪᓗᒋᑦ ᒨᑯᓇᖃᕐᓂᖏᑦ ᐊᑉᐸᓯᑦᑐᐹᓘᒻᒪᑕ, ᑕᒪᖏᑦ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔪᑦ ᐱᐅᑦᓯᐊᕐᓂᖏᓐᓂᒃ ᖃᐅᔨᔭᐅᓯᒪᒻᒪᑕ ᖃᓄᐃᒍᑎᖃᖏᑦᓯᐊᕐᓂᖏᑦ. ᑭᓯᐊᓂᓕ, ᐳᓴᑎᖏᑦᑎᒍᑦ ᑕᒡᒐᓂ ᐊᕐᕋᒍᒥ ᓱᕙᓖᑦ ᐊᕐᓇᓪᓗᐃᑦ ᐱᑕᖃᓚᐅᖏᒻᒪᑕ ᐊᒻᒪᓗ ᐊᖑᑏᑦ ᐱᕈᕆᖅᓯᒪᔪᑦ ᐃᑭᑦᑐᐹᓘᑦᓯᑎᒃ, ᐃᖃᓗᒻᒥᒃ ᓯᑕᒪᐅᔪᕐᑐᓂᒃ ᐊᕐᕋᒍᓕᓐᓂᒃ ᐅᖓᑖᓄᓪᓘᓐᓃᑦ ᐱᔪᖃᓚᐅᖏᒻᒪᑦ ᑖᒃᑯᓇᓂ ᐱᖓᓱᓂ ᖃᐅᔨᓴᖅᕕᐅᔪᓂ. ᑕᒡᒐᓂ 5-ᒣᓕᒥ ᑕᑭᓂᓕᒻᒥ ᑲᖏᕐᓱᒥ, ᖃᐅᔨᓴᕐᓂᕆᓚᐅᖅᑕᕗᑦ ᐊᕐᕋᒍᖏᓐᓂᒃ ᖃᐅᔨᓚᐅᕐᐳᒍᑦ ᐊᕐᕋᒍᑕᓖᑦ ᐃᖃᓗᑦᓴᓕᐅᕐᓂᖏᑦ ᐃᒣᓗᐊᑐᒦᑲᓵᐸᑦ 82%, ᑕᒪᒃᑯᐊ ᑐᓐᖓᕙᖃᕐᑎᓪᓗᒋᑦ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔪᓂ (ᓴᐳᒃᑫᓂ) ᐅᖃᖅᓯᒪᒻᒪᑕ ᓄᓕᐊᕈᓐᓇᓯᓲᖑᖏᓐᓂᖏᓐᓂᒃ ᐊᕐᕋᒍᖃᓚᐅᖏᓐᓂᒥᓐᓂ 8-ᒥᑦ 10-ᒧᑦ. ᐅᑎᒻᒪᑦ ᑲᖏᕿᔭᐅᕝᕙᑦ ᐃᓱᒪᓇᓪᓚᓐᓇᓂᖏᑦ ᐃᓚᖏᑦ ᐃᖃᓗᑉᐲᑦ ᑐᕐᑯᖃᑦᑕᐸᓪᓗᓂᖏᓐᓂᒃ ᐅᕝᕙᓗ ᐃᖃᓗᑦᑕᐅᖃᑦᑕᓂᖏᓐᓂᒃ ᐃᖃᓗᑦᓴᓕᐅᕈᓐᓇᓯᓚᐅᕐᑎᓐᓇᖏᑦ, ᐅᑎᓐᓂᖓᓄᑦ ᐊᒥᓲᔫᓐᓄᐸᓪᓕᐊᓕᕐᐳᑦ ᐃᖃᓗᐃᑦ ᐃᖃᓗᑦᓴᓕᐅᕈᓐᓇᓯᑎᑕᐅᓯᒪᔫᓐᓄᓪᓗᑕ ᐃᖃᓗᑦᓴᓕᐅᕿᔭᓚᐅᕐᑑᓗᐊᑦ.

ᖃᐅᔨᓴᕐᓂᒃᑯᑦ ᑕᒻᒨᓇ ᖃᐅᔨᔭᐅᓯᒪᓱᓂ ᐃᓱᒪᒋᔭᐅᓯᒪᕗᑦ ᑕᒪᒃᑯᐊ ᐃᖃᓗᑉᐲᑦ ᐃᓄᒃᔪᐊᑉ ᑕᕐᕋᖓᓃᑦᑐᑦ ᐊᒥᓲᒍᓐᓄᐸᓪᓕᐊᒍᓇᐅᒻᒪᑕ, ᑕᒪᓐᓇ ᐱᐅᓯᐅᓯᒪᔪᖅ ᑐᑭᓯᓇᖅᓯᑎᑦᓯᕗᖅ ᖁᕝᕙᓯᑦᑐᒻᒪᕆᐅᒻᒪᑕ ᑐᖁᑕᐅᖃᑦᑕᓂᖏᑦ ᐊᒻᒪᓗ ᐊᑉᐸᓯᑦᑐᒻᒪᓇᐅᑦᓯᑎᒃ ᐃᖃᓗᐃᑦ ᐱᕈᕆᖅᓯᒪᑦᓯᐊᕐᑐᑦ ᐃᖃᓗᒃᓴᓕᐅᕈᓐᓇᓯᔭᐃᑦ ᓄᓕᐊᕈᓐᓇᓯᔪᑦ ᐱᑕᖃᕐᓂᖏᓐᓂᑦ, ᐅᑎᓐᓂᖓᓄᑦ ᐊᒥᓱᕈᖅᐸᓪᓕᐊᔪᓐᓇᓕᕿᓯᒪᓕᕐᑐᑦ. ᐊᒥᓱᕈᖅᐸᓪᓕᐊᔪᓐᓇᓘᓗᐊᑦ ᐃᖃᓗᐃᑦ ᐱᕈᖅᐸᓪᓕᐊᑦᓯᐊᓂᖏᑦ ᑲᔪᓯᓗᑎᒃ ᐃᓱᒪᒋᔭᐅᔪᓐᓇᖃᕿᔭᖅᐸᑕ ᐱᔭᐅᓗᐊᖅᑌᓕᕐᓇᓗᑎᒃ ᐃᖃᓗᒐᓯᐊᖅᑕᐅᓂᖏᑦ. ᐊᒻᒪᓗ ᓄᓗᐊᕐᓂᐊᑐᖃᖃᑦᑕᐸᑦ ᐊᒥᓯᓂᒃ ᓄᓗᐊᕐᓂᐊᑐᖃᖃᑦᑕᖏᓐᓂᓴᐅᓕᕐᓗᓂ ᐊᑯᓂᓚᒌᒃ (ᐆᒃᑑᑎᒋᓗᒍ, ᒪᔪᕕᐅᖃᑦᑕᑐᐃᑦ ᐃᓚᖓᓂᒃ ᑲᒪᒋᔭᐅᔪᖃᑦᑕᙵᕆᐊᓇᓗᑎᒃ ᒪᔪᕕᐅᖃᑦᑕᑐᖅ ᑰᖑᔪᖅ), ᑕᒪᒃᑯᐊ ᐃᖃᓗᑉᐲᑦ ᑕᒪᖏᑦ ᐊᖑᑏᑦ ᐊᕐᓇᓪᓗᐃᓪᓗ ᐊᓐᓇᒍᓐᓇᕐᑯᓪᓗᒋᑦ ᐊᑯᓂᐅᓕᕐᐸᑦ ᐱᕈᖅᓗᑎᒃ ᓄᓕᐊᕈᓐᓇᓯᕐᑯᓪᓗᒋᑦ ᐊᒻᒪᓗ ᐅᑎᒍᓐᓇᐸᑕ ᑕᐅ ᐊᒥᓱᕈᖅᐸᓪᓕᐊᔪᓐᓇᓯᒐᔭᕐᒪᑕ.

ᑖᒃᑯᐊ ᐊᑯᓂ ᐃᓅᔪᓐᓇᓯᕐᑯᓪᓗᒋᑦ ᐃᖃᓗᑉᐲᑦ, ᑕᒪᒃᑯᐊ ᐊᑯᓂᓚᒌᒃ ᐊᕐᕋᒍᓂᒃ ᐱᕈᕆᕋᓯᐊᕈᓇᓚᑕ ᐊᒥᓱᕈᕐᐸᓪᓕᐊᔪᓐᓇᓯᕐᑯᓪᓗᒋᑦ ᕿᑐᕐᖏᕈᐳᓐᓇᓯᓗᑎᒃ, ᐊᒻᒪᓗ ᑕᒪᐅᓇ ᖃᐅᔨᓴᖅᑕᐅᒍᑎᖏᑦᑎᒍᑦ ᐊᒥᓲᖏᒻᒪᑕ ᐊᑯᓂ ᐃᓅᖃᑦᑐᑦ ᐃᖃᓗᐃᑦ, ᑕᒪᒃᑯᐊᓗ ᐅᑎᓕᕐᖓᑐᐃᓐᓇᓗᑎᒃ ᐊᒥᓱᕐᓂᐊᒍᕐᔭᐳᓂᓯᑎᒃ ᐅᕝᕙᓗᓘᓐᓃᑦ ᐃᒻᒥᓂᒃ ᐱᕈᕈᓐᓇᓯᑎᐊᕐᕿᓇᐅᒍᓐᓂᓗᑕ ᑲᔪᓯᑦᓯᐊᓗᑎᒃ. ᑭᓯᐊᓂᓕ, ᐸᓚᕆᐅᕝᕙ ᖃᐅᔨᒋᐊᖓ ᑕᒪᓐᓇ, ᐊᑯᓂ ᓯᕕᑐᔪᒥᒃ ᑲᒪᒋᔭᐅᙳᕐᑕᐅᕐᑐᕈᓇᐸᑕ, ᑭᓯᐊᓂ ᐊᔪᕐᓇᒪᑦ ᓇᓗᓇᖏᑦᓯᐊᑐᒥᒃ ᓄᐃᑦᓯᒐᔭᕆᐊᖅ ᖁᓚᕐᓂᓕᓯᒪᑦᓯᐊᑐᒥᒃ ᐃᖃᓗᐃᓪᓗ ᐊᒥᓲᓂᖏᑦ ᐃᓱᒣᓇᕐᕆᐊᕈᓗᒋᑦ ᐅᕝᕙᓗ ᑲᒪᒋᔭᐅᙳᕐᑕᐅᕐᑐᕈᓗᒋᑦ ᐃᓱᒣᓇᕐᕆᐊᕈᓇᐅᕐᑐᕈᓗᒋᑦ. ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔪᑦ ᖃᐅᔨᓴᐅᑎᒻᒪᕆᖓᓄᑦ ᐅᓂᒃᑲᓕᐊᖑᓯᒪᔪᑦ ᐊᓪᓚᓯᒪᑦᓯᑎᒃ 2018-ᒥ ᖃᐅᔨᓴᕐᓯᒪᔪᑦ ᐅᓂᒃᑲᓕᐅᕐᓯᒪᒻᒪᑕ ᐃᓚᒋᔭᖏᑦ ᓄᓇᓕᓐᓂ ᐃᓱᒪᓕᐅᕆᑦᓯᑎᒃ ᖃᐅᔨᓴᕆᐊᓪᓚᕐᑯᑖᑦᓯᑎᒃ ᑐᑭᓯᔭᐅᑦᓯᐊᕐᑯᓪᓗᒋᑦ ᖃᓄᐃᓕᖓᓂᓪᓚᕆᖏᑦ ᖃᐅᔨᓴᐅᑎᓪᓚᕆᑦ ᐊᑐᖅᑕᐅᒐᔭᕐᓂᖏᑦ ᑕᕆᐅᒧᑦ ᓯᑐᕆᑦ ᑕᓯᕐᒧᓪᓗ ᒪᔫᑦ ᐃᖃᓗᑉᐲᑦ ᐊᒥᓲᓂᖏᑦ ᐃᓄᒃᔪᐊᑉ ᖃᓂᒋᔮᓂᑦᑐᑦ.

ᐃᓄᒃᔪᐊᒥᐅᑦ ᓄᓇᓖᑦ ᐋᖅᑭᓯᔪᒪᒍᑎᒃ ᖃᐅᔨᓴᖅᕕᓴᒥᒃ ᑲᔪᓯᑎᑕᐅᓚᔭᕐᑎᓪᓗᒋᑦ ᐊᐅᓚᑕᐅᓗᑎᓪᓗ ᓄᓇᖃᕐᑎᒋᔭᒥᓄᑦ (ᐆᒃᑑᑎᒋᓗᒍ ᐅᕙᓂ LNUK), ᐃᑲᔪᖅᑐᑕᐅᑦᓯᐊᕗᑦ ᖃᐅᔨᑎᑦᓯᖁᔭᐅᑦᓯᑎᒃ ᐅᑯᓇᓂ ᐱᒍᑦᔨᔨᐅᔪᓄᑦ MFFP's ᑲᒫᒻᒪᕆᖕᓄᑦ de la gestion de la faune du Nord-du-Québec. ᖃᐅᔨᕆᐊᖅᕕᒋᔪᒋᑦ ᑖᒃᑯᐊ MFFP's ᑕᓚᑕᓚᐅᑎᓪᓗᒍ ᑭᐅᒍᓐᓇᕋᔭᖅᑐᐃᑦ ᐃᖃᓗᑉᐱᓕᕆᓂᕐᒧᑦ ᐅᑯᓇᓂ:

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Photo: Jonathan Frenette

Aerial view of the camp and counting fence at the point where the freshwater riverine lake, in the foreground, flows into the salt waters of Five Mile Inlet.

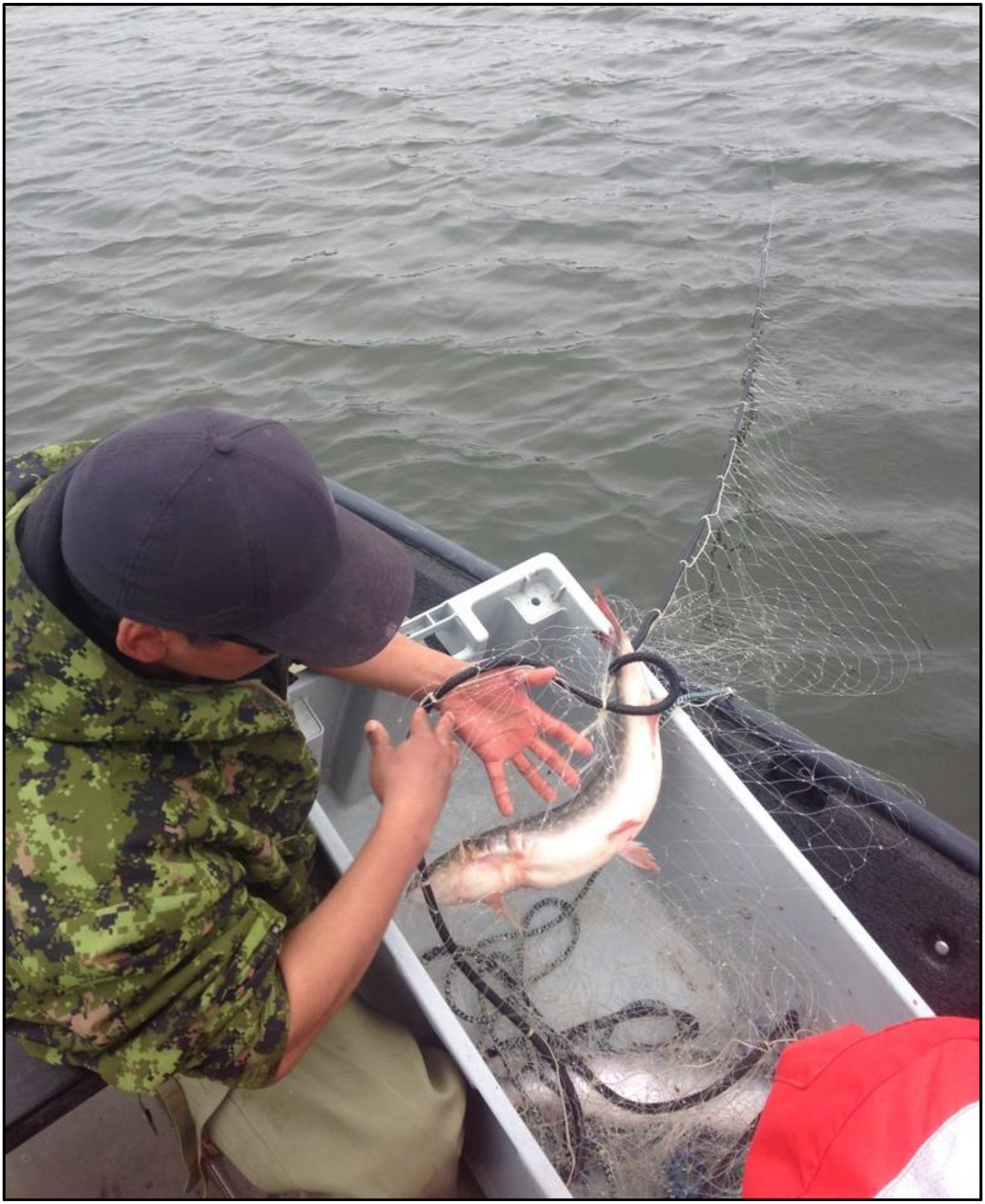

Photo : Jonathan Frenette

Arctic Char caught in a gill net by Pauloosie and Eric (photo) Kasudluak in the Ipikituk system north of Inukjuak, September 2018.

Appendix 1

List of projects for which biological samples were harvested

1) Toxoplasmosis: The brain, heart and a muscle samples were given to Health Canada (Brent Dixon) for research into the protozoan *Toxoplasma gondii*.

2) Microbiota: A swab from the mucus covering the skin, gill arches, sections of the intestine and the liver was harvested for research into the micro-organisms found in these tissues and organs, by Université Laval (Nicolas Derome) as part of the BriGHT project (*Bridging Global change, Inuit Health and the Transforming Arctic Ocean*).

3) Nutritional value: A muscle sample was given to Université Laval (Jean-Sébastien Moore) for research into fatty acids and other elements found in Arctic char flesh, again as part of the BriGHT project.

4) Genetics: An adipose fin sample, preserved in 95% ethanol, was given to Université Laval (Jean-Sébastien Moore) for research into the genetic structure of Arctic char in Nunavik, since published,* again as part of the BriGHT project.

5) Genetics: An adipose fin sample, preserved in 95% ethanol, was given to Fisheries and Oceans Canada (Ian Bradbury) for research into the structure of Arctic char in Nunatsiavut, Labrador.

* DALLAIRE, X., É. NORMANDEAU, J. MAINGUY, J.-É. TREMBLAY, L. BERNATCHEZ and J.-S. MOORE (2021). “Genomic data support management of anadromous Arctic Char fisheries in Nunavik by highlighting neutral and putatively adaptive genetic variation”, in *Evolutionary Applications*, vol. 14, p.1880-1897.

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