Appendix V5-6G

Doris North Gold Mine Project: Doris Mine Site Fisheries Authorization Monitoring Report 2011

Hope Bay Mining Limited

DORIS NORTH GOLD MINE PROJECT
Doris Mine Site Fisheries Authorization Monitoring Report 2011

NEWMONT™ NORTH AMERICA

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DORIS NORTH GOLD MINE PROJECT

DORIS MINE SITE FISHERIES AUTHORIZATION MONITORING REPORT 2011

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Executive Summary

Executive Summary

The purpose of the 2011 Doris Mine Site Fish and Fish Habitat Compensation Monitoring Program was to comply with Fisheries Authorization No: NU-02-0117.3 for the compensation programs associated with the loss of fish habitat at the Doris North mine site. A separate fisheries authorization exists for habitat loss due to construction of the Roberts Bay Jetty (DFO File No: NU-02-0117) and further Jetty improvements (DFO File No: NU-10-0028). An approved No Net Loss Plan exists for the loss of Tail Lake and Tail Outflow. This plan was followed for the 2011 monitoring work. This report presents the required compensation monitoring as outlined in the No Net Loss Plan (and 2010 modifications) as well as additional supporting information collected in 2011.

The No Net Loss Plan provides three strategies to compensate for the loss of fish habitat in Tail Lake:

- Create a narrow channel through the Roberts Outflow boulder garden to improve access of fish, primarily Arctic char (*Salvelinus alpinus*), to Roberts Lake to increase the productive capacity of the lake;
- Create pool habitat in stream E09, a tributary to Roberts Lake, to increase the quantity and quality of nursery habitat for Arctic char; and
- Install four rock shoals in Windy Lake to increase the quantity and quality of juvenile lake trout rearing habitat.

The No Net Loss Plan provides one strategy to compensate for the loss of fish habitat in Tail Outflow as follows:

- Install two additional rock shoals in Windy Lake to further increase the quantity and quality of juvenile lake trout rearing habitat.

The six rock shoals were installed in Windy Lake in April, 2011. Monitoring of the shoals is scheduled to begin in the summer of 2012 and is therefore not covered in this report.

Migration of Arctic char and lake trout (*Salvelinus namaycush*) was monitored using a fish fence in Roberts Outflow, where an existing boulder garden is scheduled to be enhanced to increase adult migration into Roberts Lake during low-water years. The fish fence was installed downstream of the boulder garden on July 13, 2011, which was the earliest that the fish fence could safely be installed due to high water levels and fast currents. Only two Arctic char smolts were captured in the fish fence migrating downstream from Roberts Lake from mid-July through mid-August. A large upstream spawning run of adult lake trout occurred during the third week of July. The fish fences were dismantled on August 9. Adult lake trout migrated upstream into Roberts Lake over the entire sampling period. These patterns differ from those found in previous studies of Arctic char and lake trout migration in the Roberts Lake system, in which much larger numbers of smolts were observed migrating downstream in July.

Water levels in Roberts Outflow were high during freshet, resulting in delayed installation of the fish fence. However, water levels dropped rapidly and stranding of adult Arctic char in the boulder garden was observed by the second week of August. On August 14, a total of 13 adult Arctic char were found stranded.

Production of juvenile Arctic char was measured in Roberts Lake stream tributaries as well as the littoral zone of Roberts Lake. Trap net catches of Arctic char smolts were low, which suggested that the Arctic char smolts may instead forage primarily in the deeper basin areas. The fish community of Roberts Lake tributaries consisted of three species: Arctic char, ninespine stickleback (*Pungitius pungitius*) and lake trout. The largest catches of juvenile Arctic char were in stream E14, on the northwest side of Roberts Lake. Stream E09 also contained juvenile Arctic char in lesser numbers. Creation of additional pool habitat may increase the numbers of juvenile Arctic char rearing in Stream E09.

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Glossary, Acronyms, and Abbreviations

Glossary, Acronyms, and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

CPUE	Catch per Unit Effort
DFO	Fisheries and Oceans Canada
FL	Fork Length
Fulton's K	A measure of fish condition (weight relative to length cubed)
Golder	Golder Associates Limited
HADD	Harmful Alteration, Disruption, or Destruction (of fish habitat)
HBML	Hope Bay Mining Limited
hyposmoregulatory	Having the capacity to regulate body fluids to survive in high salinity environments (e.g., seawater)
MMER	Metal Mining Effluent Regulations
monotonic	A mathematical function or transform that preserves the order of the data
NFC	No fish caught
PIT	Passive Integrated Transponder (an electronic tag injected into the body cavity of fish to allow individual recognition)
POPEST	Software for estimated population size of fish based on 3-pass removal electrofishing method. Developed by BC Hydro.
QA/QC	Quality Assurance/Quality Control
Rescan	Rescan Environmental Services Limited
rheotactic	A behavioural response involving orientation with respect to currents
smolt	A salmonid fish migrating or preparing to migrate to seawater
smoltify	To become physiologically prepared for migration to seawater
TIA	Tailings Impoundment Area

1. Introduction

1. Introduction

Fish and fish habitat monitoring was conducted by Rescan Environmental Services Ltd. (Rescan) on behalf of Hope Bay Mining Ltd. (HBML) at the Doris North Project in 2011. The Doris North Project is located approximately 125 km southwest of Cambridge Bay, Nunavut, on the southern shore of Melville Sound (Figure 1-1).

An approved No Net Loss Plan (Golder 2007a) exists for the loss of Tail Lake and Tail Outflow and this plan, along with updates (Rescan 2010a, 2010b) was followed for the 2011 monitoring program. DFO issued a Fisheries Authorization for the loss of Tail Outflow on January 19, 2011 (DFO File No: 02-HCAA-CA7-000-000117, Authorization No: NU-02-0117.3).

The purpose of the 2011 Doris Mine Site Fish and Fish Habitat Compensation Monitoring Program was to comply with the Fisheries Authorization (NU-02-0117.3) and the No Net Loss Plan for the compensation programs associated with the loss of fish habitat at the Doris North mine site. This report presents the compensation monitoring results as outlined in the No Net Loss Plan (and modifications; Golder 2007a; Rescan 2010a, 2010b) as well as additional supporting information collected in 2011.

Tail Lake is the site of the tailings impoundment area (TIA) for the Doris North Project. Tail Lake was placed on Schedule 2 of the Metal Mines Effluent Regulations (MMER) on January 19, 2008 (Canada Gazette 2008). The north dam, located across the upper part of Tail Outflow, was partially constructed in 2011 and will be completed in 2012 (Figure 1-2). Operation of the TIA will result in complete loss of fish habitat in Tail Lake and Tail Outflow.

The fish habitat compensation program for the Doris North Project has been designed to ensure the "net gain of productive capacity of fish habitat" as stated in Fisheries and Oceans Canada's (DFO) Policy for the Management of Fish Habitat (DFO 1986). The program is designed to monitor habitat specifically designed to compensate for the harmful alteration, disruption and destruction of fish habitat (HADD) in Tail Lake and Tail Outflow. The No Net Loss Plan provides three strategies to compensate for the loss of fish habitat in Tail Lake:

- Create a narrow channel through the Roberts Outflow boulder garden to improve access of fish, primarily Arctic char (*Salvelinus alpinus*), to Roberts Lake to increase the productive capacity of the lake;
- Create pool habitat in stream E09, a tributary to Roberts Lake, to increase the quantity and quality of nursery habitat for Arctic char; and
- Install four rock shoals in Windy Lake to increase the quantity and quality of juvenile lake trout (*Salvelinus namaycush*) rearing habitat.

The No Net Loss Plan also provides one strategy to compensate for the loss of fish habitat in Tail Outflow as follows:

- Install two additional rock shoals in Windy Lake to further increase the quantity and quality of juvenile lake trout rearing habitat.

The six rock shoals were installed in Windy Lake in April, 2011. Monitoring of the shoals is scheduled to begin in the summer of 2012 and therefore will not be covered in this 2011 report.

Figure 1-1

Hope Bay Belt Project Location

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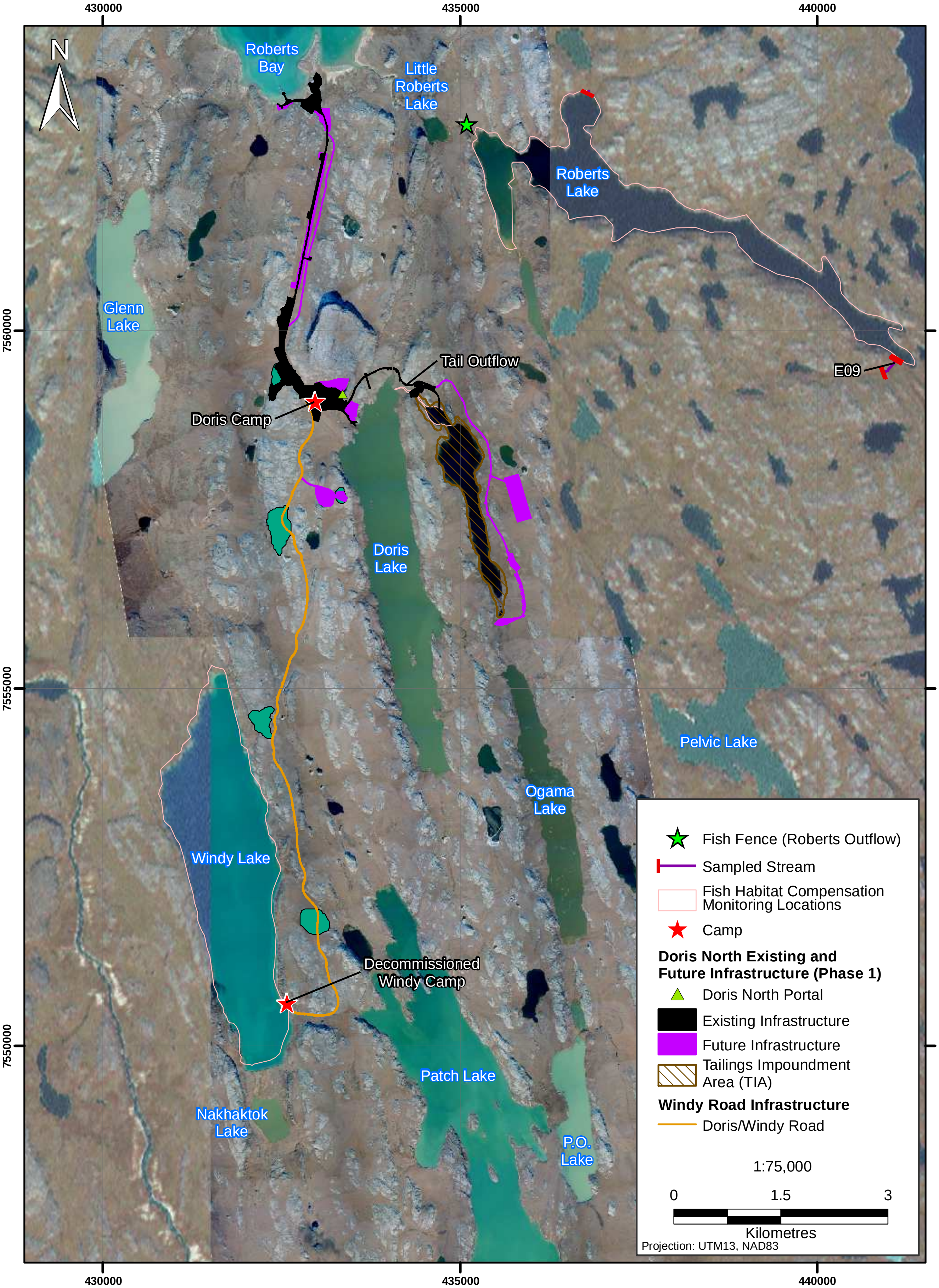

Figure 1-2

Overview of Fish Habitat Compensation Monitoring Locations, Doris North Project

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During low-flow years, the movement of adult Arctic char through the boulder garden is hindered or blocked. Enhancement of the boulder garden will involve the removal of select boulders to create an unobstructed channel that will increase accessibility to Roberts Lake. This is expected to reduce mortalities of Arctic char and lake trout that become stranded in the boulder garden during low flow years. In turn, this is expected to increase spawning success and the production of Arctic char smolts. The number of smolts that migrate to sea is a measure of Arctic char production in the Roberts Lake system (Golder 2007a).

Stream E09 contains suitable rearing habitat for juvenile Arctic char. However, the number of juveniles supported by this stream is relatively low because of the boulders and cascades that restrict upstream passage. The stream enhancement program will remove some of the boulders and create further pool habitat. This will improve access to Stream E09 for juvenile Arctic char and will provide additional rearing habitat, thus increasing juvenile survival.

The 2011 Doris Mine Site Fisheries Authorization Monitoring Program addresses the compensation strategies proposed in the No Net Loss Plan by providing additional baseline data that can be used for comparison with post-enhancement monitoring. The following components of the monitoring program were completed:

- Monitoring the outmigration of Arctic char smolts through Roberts Outflow using a fish fence;
- Monitoring adult Arctic char stranding at the boulder garden in Roberts Outflow;
- Assessing Arctic char smolt production in Roberts Lake using trap nets; and
- Assessing Arctic char smolt production in Roberts Lake tributaries using backpack electrofishing.

Chapter 2 of this report presents the methods used for monitoring fish migration in Roberts Outflow and for monitoring fish production in Roberts Lake and its tributaries. Chapter 3 presents the results and discussion of the Fisheries Authorization monitoring work, and a Summary is provided in Chapter 4. All raw data are included as appendices to this report.

2. Materials and Methods

2. Materials and Methods

2.1 MONITORING MIGRATION OF ARCTIC CHAR IN ROBERTS OUTFLOW

2.1.1 Fish Fences

The Doris North No Net Loss Plan requires annual monitoring of smolt migration from Roberts Lake using a fish fence to capture and tag Arctic char in Roberts Outflow. Arctic char smolts generally leave Roberts Lake in July (Golder 2005, 2006, 2007b; Rescan 2011). A fish fence was installed on July 13, 2011, at the downstream end of the boulder garden in Roberts Outflow (Figure 2.1-1).

The fish fence consisted of three rigid panels (each 3.1 m in length and 1.5 m in height) and two box traps: one trap capturing fish moving in the upstream direction and the other trap capturing fish moving in the downstream direction. The panels consisted of aluminum frames with removable conduit rods (1.8 cm diameter) spaced 1.3 cm apart. Wooden "A" frames supported the panels and were held in position with large weighted buckets. Each box trap consisted of an aluminum frame (1.8 m long, 1.2 m wide and 1.5 m high) with removable conduit rods (1.8 cm diameter) spaced 1.3 cm apart. The entrance to the trap consisted of a conduit funnel, similar in construction to the trap walls, allowing the opening width to be adjusted to maximize capture and minimize escape. Galvanized hardware cloth was sewn into the bottom of the trap to prevent escape of fish in the event that the stream bed became eroded under the trap.

Assembly of the fish fence initially began on June 27, 2011, but late ice break-up on Roberts Lake and high water levels (Plate 2.1-1) forced the removal of portions of the fence until July 13, 2011, at which point fence assembly was completed and fishing began (Plate 2.1-2). The number of Arctic char and lake trout that migrated through Roberts Outflow was monitored daily and all fish captured were sampled as described below. During each daily check of the fence, the date, time of day and water temperature were recorded. The fence was opened to allow free passage of fish on August 9 and then disassembled and removed during the following week. Monitoring of the fish fence was discontinued after August 9 because the upstream migration of adult Arctic char attracted bears and experience from 2010 indicated a high probability of human-bear interaction.

Following removal of the fish fence, further data on stranding of adult char in the boulder garden were obtained from Dr. Heidi Swanson of the University of Alberta. Starting in the first week of August 2011, when flows had become substantially reduced, observers conducted 15-minute visual surveys of the boulder garden, searching for stranded fish and recording them as one of the following:

- moving through the boulder garden;
- alive but stranded (unable to make further headway); or
- dead/dying (Plate 2.1-3).

2.1.2 Fish Sampling and Tagging

Biological data collected for all captured fish included species, fork length, body weight, general physical observations and direction of travel. Pelvic fin rays and scales were collected from Arctic char and lake trout for aging purposes.

Arctic char and lake trout were marked using Passive Integrated Transponder (PIT) tags. The use of PIT tags was necessary due to concerns about T-bar tag loss and infection caused by T-bar tags, and to allow tagging of fish <300 mm. A PIT tag gun was used to insert a uniquely numbered PIT tag under the skin at the pelvic girdle of each Arctic char and lake trout.

PROJECT # 1009-008-08 GIS # HB-06-135 February 02 2012

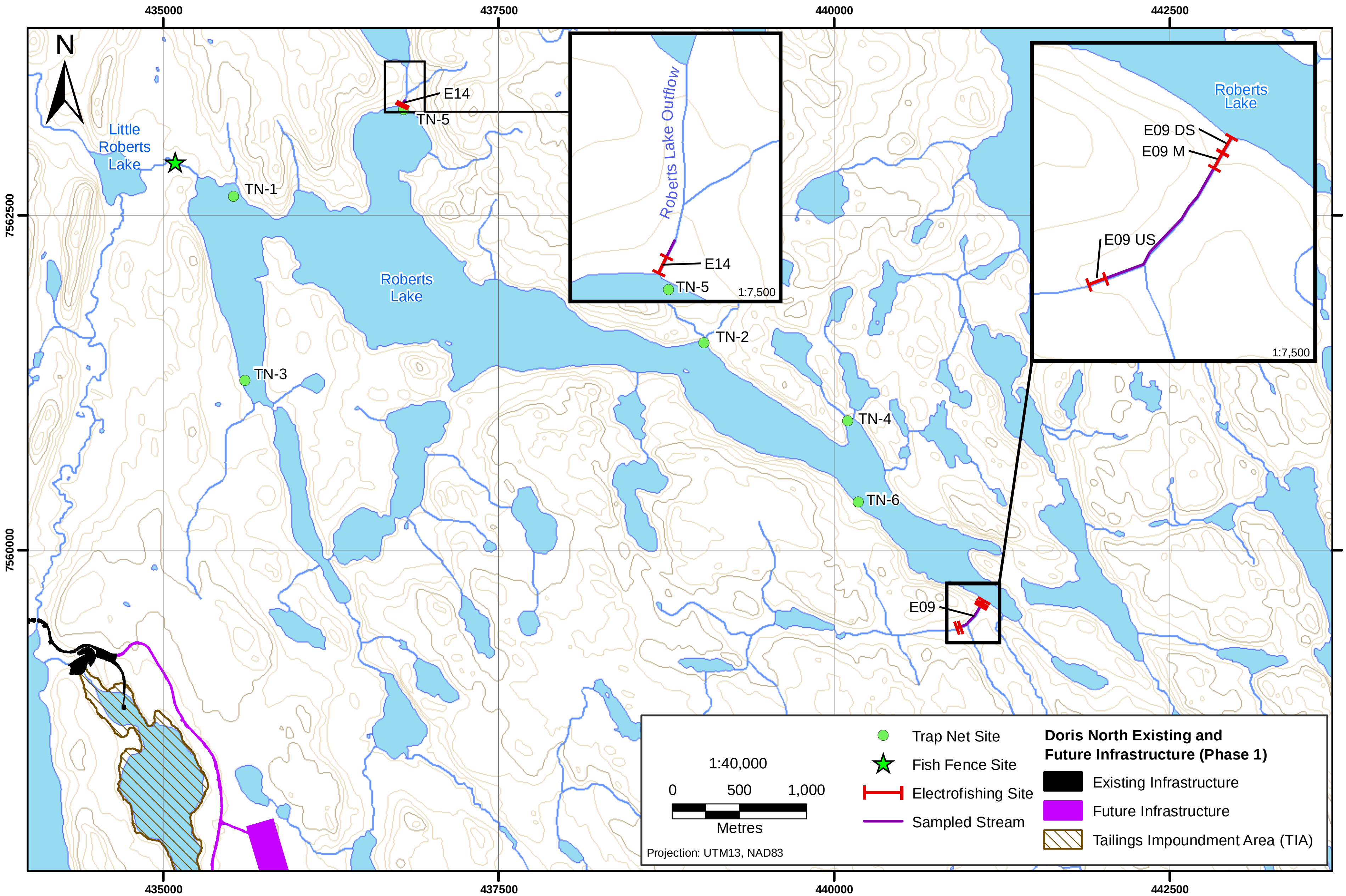

Figure 2.1-1

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2011 Sampling Locations for the Doris Mine Site Fisheries Authorization Monitoring Program, Doris North Project

Figure 2.1-1

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Plate 2.1-1. High flows and ice in Roberts Outflow forced removal of the fish fence on July 3, 2011.

Plate 2.1-2. The completed fish fence in Roberts Outflow, July 13, 2011.

The PIT tagging program in the Roberts Lake system has been ongoing since 2006; therefore, all captured Arctic char and lake trout were scanned using an AVID microchip scanner (PETIDCO, Calgary, Canada). If the fish had been previously tagged, the unique number was recorded. Those without tags were injected with their own unique PIT tag. Arctic char and lake trout greater than 300 mm fork length were also marked using a uniquely labelled Floy tag affixed at the base of the dorsal fin into the sinus of the fish (Plate 2.1-4). Fish greater than 300 mm FL were less likely to suffer loss of Floy tags and infection than smaller fish. The unique tag number was then recorded. After processing, all fish were released live into Roberts Outflow, in the same direction of travel they were following prior to capture.

Plate 2.1-3. Surveying the boulder garden in Roberts Outflow for stranded fish, August 8, 2011.

Plate 2.1-4. Subadult lake trout tagged with T-bar anchor tag, July 25, 2011.

Age reading of pelvic fin rays was conducted by Kenneth Ambrose of North/South Consultants, Winnipeg, Manitoba. Scales were collected but not used for ageing Arctic char and lake trout because the highly vascular nature of these structures tends to underestimate true age, particularly in older fish (Sharp and Bernard 1988). Fin rays were air-dried and then mounted in a 50:50 epoxy medium. Microsections (0.50 to 0.75 mm thickness) were cut using a Beuler Isomet diamond saw and mounted on slides. Annuli were then counted with a compound light microscope.

2.2 ROBERTS LAKE AND TRIBUTARY FISH MONITORING

2.2.1 Roberts Lake Trap Net Program

Trap nets were used to sample potential Arctic char juvenile rearing habitat within the littoral zone of Roberts Lake (Plate 2.2-1). Gillnets and other semi-lethal gear were not used in order to reduce potential capture mortality. Trap nets are a passive method which captures fish as a result of their movement and subsequent reaction to the net. The nets are comprised of three components: the lead net, two wings (one for each side), and the box trap. The lead net was a single 50 m x 1.8 m seine net of 1" stretch mesh which was anchored to shore and stretched perpendicularly to a depth of 1.8 m (the depth of the nets used). As the lead net interrupted any fish movements parallel to the shoreline, the natural reaction of the fish would have been to follow the net, either to shore (where they will turn around) or to the box trap. The box trap was directly attached to the lead net and made of 0.5" stretch mesh measuring 1.8 m deep x 3.7 m long x 1.8 m wide. The theoretical result would be that all fish intercepted by the lead net will swim into the box trap under their own power; however, lateral movements away from the trap are possible. Therefore, wings extended 15 m from either side of box trap at a 45° angle towards shore in order to funnel fish towards the box trap. All components of the trap net array consisted of a float line of large yellow buoys (for easy location by boat operators) and a weighted lead line. Therefore, the nets remained vertical in the water, preventing fish from escaping either along the lake bed or the surface. Furthermore, to secure the net against swells and wind-driven waves, the ends of the box trap and wings were each anchored with gravel-filled sandbags weighing approximately 35 kg. Meanwhile, the lead net was firmly tied or anchored onshore.

Plate 2.2-1. Trap net set in Roberts Lake, July 25, 2011.

Trap nets were deployed at six sites around Roberts Lake (Figure 2.1-1). Two trap nets were set up within Roberts Lake and monitored daily for a one week period. At the end of the week, the nets were moved to new sites and monitoring continued for an additional one week. A total of nine weeks of monitoring were conducted in Roberts Lake, with monitoring of the same sites repeating after a three-week period.

Between July 16 and August 6, 2011, two trap nets were checked and processed on a daily basis, except when weather conditions prevented boat operations. On each sampling day, all fish were removed from the box end and transferred to a 50 L fish bin filled with ambient lake water during data collection on shore.

All fish were identified to species and counted. Fork length (FL) was measured to the nearest 1 mm with a measuring board and weight was measured to the nearest 1 g with an electronic balance. For large fish (>3,000 g), a spring scale was used to estimate weight to the nearest 100 g. Wounds, tag numbers, fin clips and other external marks were recorded for each captured fish. Scales and pelvic fin rays were collected for aging purposes from Arctic char and lake trout with fork lengths (FL) greater than 70 mm. Only fin rays were used for ageing as previously described. All fish were scanned with a hand-held scanner for PIT tags and those without tags were injected with a PIT tag. In addition, fish greater than 300 mm in length were given a uniquely numbered Floy tag. Upon the completion of data collection, fish were placed into a second water-filled bin for recovery prior to their release back at the trap net location.

2.2.2 Roberts Lake Tributary Sampling

Two tributaries to Roberts Lake were surveyed in 2011 to monitor abundance of juvenile Arctic char and lake trout (Table 2.2-1 and Figure 2.1-1). Stream fish assessments were conducted over 25 m sections of each tributary sampled for fish. Three 25 m sections were surveyed at stream E09 because this stream is a candidate for future habitat compensation activities. A single 25 m section was assessed at stream E14.

Table 2.2-1. Roberts Lake Tributary Fish Sampling Locations, Doris North Project, 2011

	UTM	
Tributary	Easting	Northing
E09	440900	7559411
E14	436380	7559560

Based on detailed fish habitat assessment and fish community sampling in tributaries of Roberts Lake in previous years (Golder 2007a; Rescan 2011), two streams, Stream E09 and Stream E14, were chosen for assessment of juvenile Arctic char abundance in 2011.

Stream E09 is actually the confluence of two streams flowing from lakes to the south of the eastern end of Roberts Lake. Three sections (upstream, middle and downstream), covering a total of 75 m of this stream, were sampled. The upstream section consisted of several large pools connected by a narrow channel flowing overland through sedge grass (Plate 2.2-2). The middle (Plate 2.2-3) and downstream (Plate 2.2-4) sections consisted of riffles and cascades over abundant boulders, with small pools at the foot of the cascades. In addition to boulders and pools, dense overhanging willow provided abundant fish cover in the middle and lower sections.

Stream E14 flows into a bay on the northwest side of Roberts Lake. Fish passage from Roberts Lake to the upstream lake is prevented by a 1.5 m vertical cascade approximately 140 m upstream of the lake. Dominant cover types were pool and instream vegetation, with smaller proportions of boulder, overhanging vegetation and undercut bank (Plate 2.2-5).

Plate 2.2-2. Upstream section of stream E09 showing typical glide habitat with instream vegetation (sedge grass), July 6, 2011.

Plate 2.2-3. Middle section of stream E09 showing riffle habitat with boulder/cobble substrate and overhanging riparian willow, July 6, 2011.

Plate 2.2-4. Downstream section of stream E09 showing boulders and riffle/cascade habitat with overhanging riparian willow, July 5, 2011.

Plate 2.2-5. Sampling site at stream E14 with block net set at downstream end, July 5, 2011.

A Smith-Root LR-24 backpack electrofisher was used to sample fish in tributaries. Sampling of the tributaries began shortly after freshet (late June) and was repeated every two weeks until late August, coinciding with the sub-adult and adult monitoring programs on Roberts Outflow. Streams that dried up over the summer were dropped from the sampling program. For stream E14, a 25 m section was delineated near its inflow to the lake. Each stream section was blocked with small-mesh stop nets prior to electrofishing, preventing fish from moving into or out of the section. Once isolated, a minimum of three electrofishing passes were carried out. The number of fish caught in each pass and the amount of electrofishing time spent on each pass were recorded. If catches on any pass were greater than the proceeding pass, additional electrofishing passes were performed until catches showed a consistent decline or reached zero. Due to its importance as a habitat compensation site, additional sampling was done for stream EO9. In this stream, three 25 m sections were sampled.

Fish captured during each pass were kept separate from other passes until all electrofishing had been completed at that section. Fish were held in 20 L white plastic buckets and a 50% water change was conducted every 30 minutes. The longest any fish were held was 90 minutes. Fork lengths of captured fish were measured to the nearest 1 mm and weighed to the nearest 1 g using a 300 g electronic balance. Scales and pelvic fin rays were collected for ageing purposes but only fin rays were used for age determination. After processing, fish were released back into the stream at the site of capture.

2.3 QUALITY ASSURANCE/QUALITY CONTROL

For all fish habitat and community surveys, data sheets were reviewed at the end of each field day to ensure data were complete and collected properly. Field notes were transcribed onto electronic spreadsheets once in the office and all transcriptions were checked visually against the field forms and any errors corrected. The data were also plotted (e.g., weight-length plots) to identify any outliers that may have resulted from transcription errors that occurred in the field.

All age structures were viewed (read) a minimum of two times. If consistency was not met between the first two reads, a third was undertaken. If consistency was not accomplished within three reads, the structure was deemed un-ageable and no age was assigned. Age readers were given no information on weight, length or sex, so that age estimates were based solely on the annular structure of the fin ray. All readings were conducted as “blind” (independent from each other). Quality assurance and quality control (QA/QC) was then conducted by an alternate ageing technician on 10% of randomly selected structures. The QA/QC readings were also conducted “blind” to determine consistency and accuracy.

2.4 DATA ANALYSIS

The variables used to assess the fish community included: relative species abundance, length, weight, condition and CPUE. Data analysis and interpretation for these variables followed Guy and Brown (2007).

The CPUE statistic is used as an estimate of relative abundance of fish (Hubert and Fabrizio 2007). A key factor that allows comparison of CPUE data is the standardization of catch by effort.

For trap nets, CPUE was calculated from the number of fish caught per trap per day.

CPUE = number of fish ÷ set time (h) x 24 h

For electrofishing, CPUE was calculated as the number of fish caught per 100 s of electrofishing.

CPUE = number of fish caught/100 s

Three-pass removal sampling is a common method for determining population density of freshwater fishes using electrofishing; however, the calculations are data intensive and require large sample sizes and high catchability to yield reliable estimates of density (Carle and Strub 1978). POPEST software was used to estimate population density and 95% confidence limits from three-pass removal data. A Bayesian estimation procedure was followed because the sample sizes were insufficient for the more commonly-used Exact Maximum Likelihood estimation.

Condition and weight-length regressions are indicators of the relative health of fish within a lake. Condition factor (Fulton's K) was based on the following formula from Ricker (1975):

$$Condition = weight\ (g) \times 10^5 / length^3\ (mm)$$

Weight was multiplied by 10^5 to avoid fractional values, and a weight-length exponent of exactly 3 was assumed to apply to all species of fish. Weight-length relationships (Pope and Kruse 2007) were calculated for fish species captured in sufficient numbers (e.g., greater than 10). Logarithmic transformations were performed to normalize the data and equalize the variance prior to conducting the regression.

$$ln(weight) = ln(a) + b[ln(length)]$$

Weight is in grams, a is a coefficient, b is the slope of the regression, and length is in mm.

Length-age relationships were described with the von Bertalanffy growth model (Isley and Grabowski 2007):

$$L_t = L_\infty(1 - e\ [-K(t - t_0)])$$

where L_t = length at age (mm), L_∞ = asymptotic length (mm; i.e., length at infinite age), K = growth rate ($year^{-1}$) and t_0 = age (years) at L = 0 mm. Where length and age data was limited for small and/or young fish, t_0 was fixed at zero to force the x-intercept through the graph origin and create a more realistic model of juvenile growth.

All statistics were conducted according to Zar (1984) using SigmaPlot 12.0 software. All linear regressions were reported with the appropriate sample size (n), coefficient of determination (r^2, the fraction of variation in the independent parameter that was explained by the dependent parameter) and P value. Only n and r^2 were reported for non-linear regressions. All r^2 for linear or non-linear regressions were not adjusted for the degrees of freedom of the regression. Spearman Rank Correlation was used where data did not meet the assumptions of normality and heterogeneity, particularly where outliers in the tails of data distributions warranted inclusion in the analysis.

3. Results and Discussion

3. Results and Discussion

3.1 MONITORING MIGRATION OF ARCTIC CHAR IN ROBERTS OUTFLOW

3.1.1 Number and Direction of Migrating Fish

A total of 275 fish (78 Arctic char, 174 lake trout, nine lake whitefish (*Coregonus clupeaformis)* and two cisco (*Coregonus artedi*)) were captured at the fish fence from July 14 to August 9, 2011. Only 13 fish were caught moving downstream; the remainder were moving upstream into Roberts Lake. The maximum number of fish caught per day was 33 and the minimum was 0. Appendix 3.1-1 lists all fish caught at the fish fence and their date of capture, direction of migration, length, weight, condition, age and tag number.

Of the total 275 fish, 73 (15 Arctic char and 58 lake trout) were tagged in 2010 and 52 (seven Arctic char and 45 lake trout) were tagged in previous years (i.e., 2002 to 2007). Of the 125 recaptures from previous years, 122 were caught while moving upstream into Roberts Lake. Recaptures from previous years comprised 28% of the Arctic char catch.

In addition to the 125 fish tagged in previous years, four fish (two Arctic char, one lake trout, and one lake whitefish) were recaptured at least once during the 2011 season. Of these, the two Arctic char and the lake trout were recaptured once each between the wings of the fence. This indicated the presence of an opening through which fish could travel through the upstream wing of the fence. The opening was found to have been caused by scour along the stream bank. The fence was repaired and no further escapements were recorded. However, water and ice flows during freshet were high and erosion occurred along the banks and soft-sediment stream bed areas of Roberts Outflow, particularly after heavy rainfalls. Possible undiscovered escape routes included scouring under the fence traps and undercutting of the banks away from the rigid fence wings.

Based on fork length, Arctic char can be broadly characterized as juveniles (0-200 mm FL), smolts (200-350 mm FL) or adults (>350 mm FL). In 2010, 20 juveniles and 49 smolts were captured moving downstream in July (Rescan 2011). In contrast, only two smolts and one juvenile Arctic char were captured moving downstream in 2011. High water flows and ice floating downstream prevented the fish fence from operating until July 13, 2011. The outmigration of Arctic char smolts may have occurred during this high-flow period, before the fence was installed. In general, the pattern of Arctic char migration and recapture in 2011 differed from previous years (Table 3.1-1).

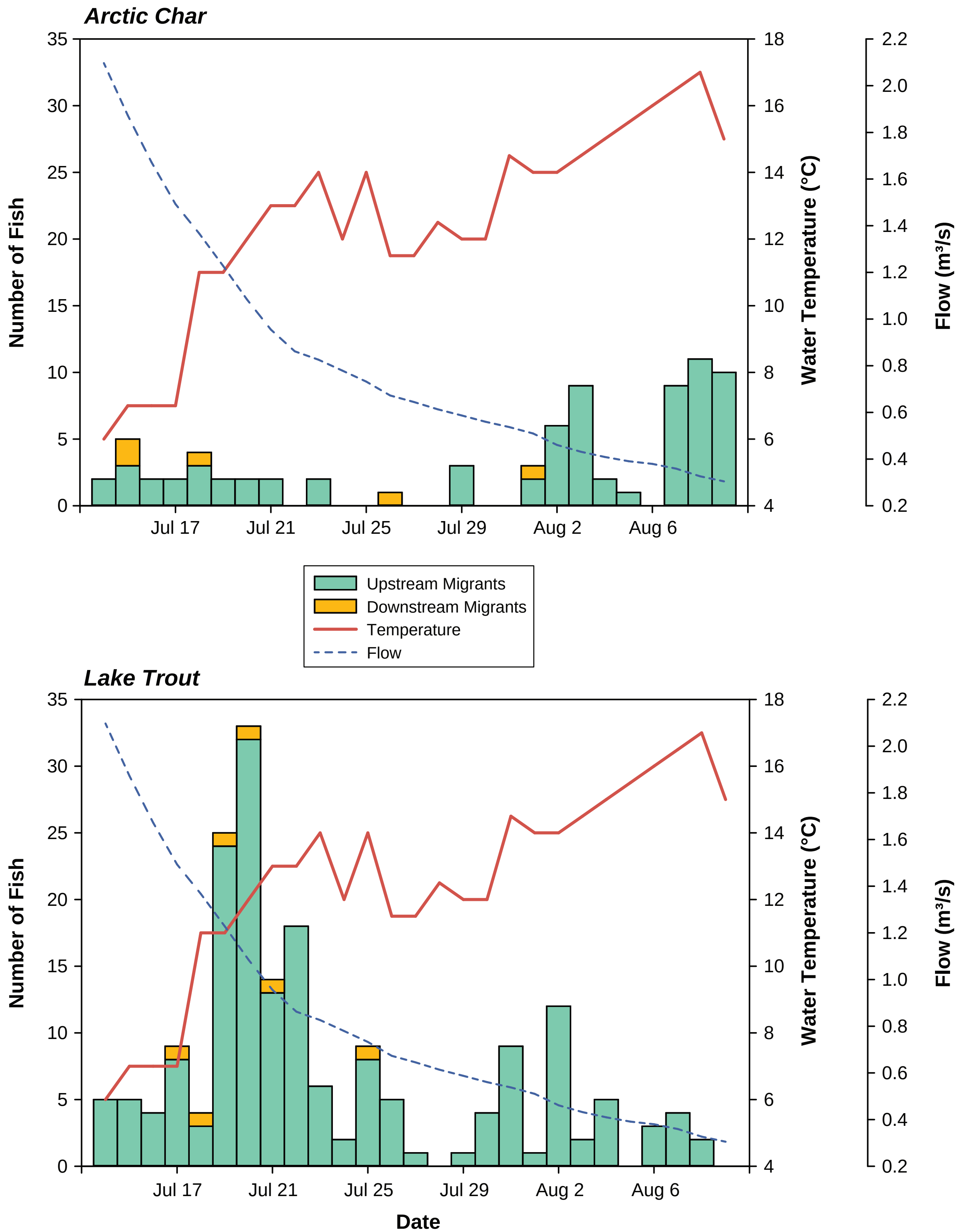
Only one juvenile (<200 mm FL) lake trout was caught swimming downstream and none were caught swimming upstream. This result was identical to 2010 (Rescan 2011). Although a portion of the lake trout population in Roberts Lake is anadromous, their first migration does not occur until age 13, at a fork length of 400 to 450 mm (Swanson et al. 2010). It is impossible to visually distinguish lake trout smolts from adults or sub-adults and therefore no comment can be made on the number of lake trout smolts versus adults in Roberts Outflow.

In previous years, migration of Arctic char through Roberts Outflow was strongly seasonal (Golder 2005, 2006, 2007b, 2008; Rescan 2011). In 2010, there appeared to be two pulses of downstream movement: one in the first week of July and another during the third week of July (Rescan 2011). In 2011, Arctic char migrated almost exclusively upstream from mid-July through early August (Figure 3.1-1). Lake trout showed a similar upstream migration pattern. Migration of lake trout was primarily upstream over the entire sampling period, with only 9 of 147 lake trout captured while moving downstream (Figure 3.1-1).

Table 3.1-1. Arctic Char Movements through Roberts Lake System, Doris North Project

Year	Stream	Operation Dates	Total Capture	Length Range (mm)	Length Mean (mm)	Age	Ageing Structure	Percent Moving Downstream	Percent Moving Upstream	Recapture from Previous Years (2002 to 2010)
2004	Roberts Outflow	Aug 8 to Sep 8	185	259 to 860	433	-	-	-	100	47 (2002)
2005	Roberts Outflow	Aug 4 to Sep 12	193	266 to 883	468	-	-	-	100	40 (2004 or previous)
2006	Little Roberts Outflow	Jun 19 to Jul 22	142	108 to 845	125	n = 12 (2 to 15 years, mean = 5 years) [1]	scale/fin ray/otolith	100 [2]	-	36 (2005 or previous)
2007	Little Roberts Outflow	Jun 28 to Jul 26	375	175 to 898	382	-	-	78	22	16 (2006 or previous)
2010	Roberts Outflow	Jun 25 to Aug 22	360	88 to 912	533	n = 298 (0 to 15 years, mean = 6 years)	pelvic fin ray	24	76	23 (2007 or previous)
2011	Roberts Outflow	Jul 14 to Aug 9	78	115 to 900	634	n = 54 (2 to 16 years, mean = 7 years)	pelvic fin ray	5	95	22 (2010 or previous)

[1] *Samples collected from Arctic Char between fork lengths 200 and 400 mm.*
[2] *Only downstream migrants sampled.*



Number of Fish per Day and Direction, Water Temperature and Flow in Roberts Outflow, Doris North Project, 2011

Figure 3.1-1

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In 2010, there were no large runs of lake trout during July or August (Rescan 2011). In contrast, there was a large pulse of upstream migration during the third week of July 2011 (Figure 3.1-1).

3.1.2 Environmental Effects on Arctic Char Smolt Migration

3.1.2.1 Factors Responsible for Char Migration

Observed migration patterns of Arctic char in Roberts Outflow during 2011 differed from previous years. This may result from differing environmental conditions and their influence on the migration process. This section summarizes the effects of environmental variables on Arctic char migration and how these may have influenced the results of the fish fence monitoring.

Arctic char are the world's northernmost living freshwater fish and are circumpolar in distribution (Aas-Hansen et al. 2005). Following parr–smolt transformation and first seaward migration, anadromous Arctic char spend only 1–2 months during the summer feeding in the ocean. Following this marine foraging period, both immature and adult char return to rivers and lakes for spawning and/or overwintering (Nordeng 1983; Klemetsen et al. 2003). Food availability is higher in marine environments than in freshwater, and anadromous Arctic char may double their weight and increase their lipid deposits by a factor of three or more (Jørgensen et al. 1997). In freshwater, food availability is poor and prolonged fasting results in the mobilization and consumption of stored energy accumulated during summer (Boivin and Power 1990; Jørgensen et al. 1997). Condition of anadromous Arctic char is therefore reduced when returning to the sea each summer (Jørgensen et al. 1997).

The primary trigger for downstream migration in in Arctic char appears to be insufficient food intake to meet immediate energy needs (Metcalfe 1998; Thorpe and Metcalfe 1998; Thorpe et al. 1998; Forseth et al. 1999). The developmental trigger for smoltification (physiological preparation for a high-salinity environment) can occur several months before the actual migration (e.g., Thorpe et al. 1998). Several investigators have addressed the role of environmental conditions in the downstream migration of salmonids (e.g., Peake and McKinley 1998; Gulseth and Nilssen 2000). Three main environmental variables appear to dominate: diel light periodicity, water temperature and water flow (e.g., Groot et al. 1995; Hvidsten et al. 1995; Aprahiam and Jones 1997). These three environmental variables are interdependent. For example, water temperatures will decrease with increasing flow if the discharge mainly results from melting ice or snow. Conversely, water temperatures will increase as flow decreases during the summer months. There is a lack of consensus on the effect of light, river flow and temperature on the downstream migration of smolts.

In the Roberts Lake system, outmigration of Arctic char smolts was monitored during 2006 and 2007 in Little Roberts Outflow (Golder 2007b, 2008) and during 2010 and 2011 in Roberts Outflow (Rescan 2011; this study). Temperature, water flow and fish condition data are available for the Roberts Lake system and are discussed here with respect to published laboratory and field results from other studies of Arctic char migration.

3.1.2.2 Condition

Anadromous Arctic char resmoltify every spring. This involves a physiological shift from energy conservation during winter to osmotic and metabolic preparation for their annual downstream migration to seawater in spring (Aas-Hansen et al. 2005). Naslund (1991) found that Arctic char fed reduced rations showed a stronger rheotactic response (orientation relative to current) than in fish fed surplus rations, suggesting that depleted energy reserves after overwintering were the cue to begin downstream migration. In Roberts Outflow, mean condition of downstream migrants in 2011 was 0.90, compared to 1.35 for upstream migrants (see Section 3.1.3). In 2010, mean condition of downstream migrants in Roberts Outflow was 0.86, compared to 1.73 for upstream migrants (Rescan 2011). In Little Roberts Outflow, mean condition of downstream migrants in 2006 was 0.85, while mean condition of upstream migrants was 0.96 (Golder 2007b). Note that upstream migrants in 2006 were not captured in the fish fence and were captured earlier in the year, which may explain the lower condition of upstream migrants. In 2007, mean condition of downstream migrants in Little Roberts Outflow was 0.90, while mean condition of upstream migrants was 1.07 (Golder 2008). In general, these results fit the paradigm that Arctic char migrate downstream when their energy reserves are depleted and return in much better condition after 1-2 months of foraging in the marine environment.

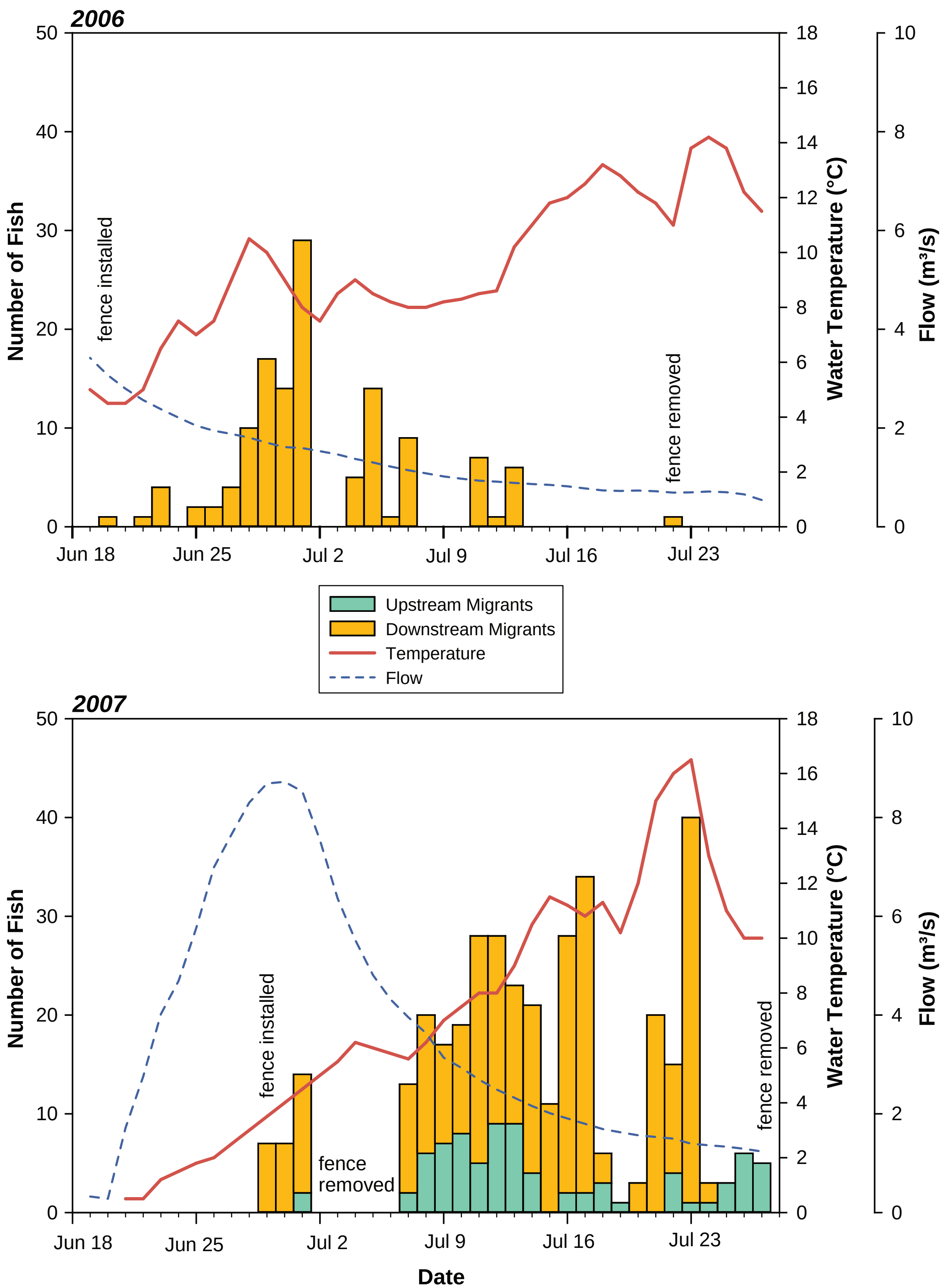
3.1.2.3 Photoperiod

Studies have shown that downstream migrants of anadromous Arctic char possess a predeveloped hyposmoregulatory capacity (e.g., Nilssen et al. 1997). The development of hyposmoregulatory capacity and a corresponding increase in gill Na+/K+ ATPase activity are stimulated by increased day length in spring (Arnesen et al. 1992; Johnsen et al. 2000). Carlsen et al. (2004) found that Arctic char in the Halselva River in northern Norway began their seaward migration at the end of May, approximately one month earlier than Arctic char in Roberts Outflow. Although the midnight sun shines continuously during the downstream migration period, the sunlight has a diel intensity pattern. The majority of the seaward migrants were recorded during the night. In northerly areas such as Cumberland Sound (66° N), Baffin Island, Canada, Moore (1975) observed that Arctic char migrated to sea both during day and night. The Roberts Outflow fish fence was sampled only during the day, so no comment can be made on the influence of photoperiod on Arctic char migration in the Hope Bay area. However, the published literature suggests that Arctic char smolts will begin downstream migration early in the summer season, likely during the period in which the fish fence could not be installed due to high flows.

3.1.2.4 Temperature

Naslund (1991) found that more than 50% of Arctic char from Lake Hornavan in Norway, held in circular stream tanks, tended to orient their swimming downstream during February through May, but nearly all fish oriented their swimming downstream in June. A gradual increase in water temperature played an important role in stimulating these rheotactic responses. In northern Norway, Arctic char smolts normally migrate seaward at a water temperature above 3°C (Berg 1995; Carlsen et al. 2004). During spring freshet, weather changes leading to increase in melting of snow and ice, raise the level of water in the river with a consequent reduction in water temperature. Water level and temperature, therefore, have a strong, and usually opposite, interdependence. The literature on downstream migration in salmonids in relation to water temperature describes three different patterns: (1) increased downstream migration with increases in water temperature (a positive correlation) (Jonsson and Ruud-Hansen 1985; Jonsson and Jonsson 2002), (2) reductions in number of migrants with increases in water temperature (a negative correlation) (Hvidsten et al. 1995; Carlsen et al. 2004) or (3) migration not correlated with water temperature (Heggberget et al. 1993). Migration in response to water temperature suggests a selection for entry to seawater at an optimal seawater temperature (Hansen and Jonsson 1989), because freshwater and seawater temperatures are, in most cases, significantly correlated (Berg and Berg 1989).

In the Roberts Lake system, downstream migration of Arctic char appeared to increase with increasing water temperature during early summer, soon after freshet in 2006 and 2007 (Figure 3.1-2) and also in 2010 (Figure 3.1-3). In all three years, downstream migration appeared to cease once water temperature exceeded 12-14°C. Because the number of downstream migrants and the temperature data were not normally distributed and monotonic transformations failed to normalize the data, Spearman rank correlation was used to determine relationships between the number of downstream migrants and temperature. There were insufficient smolts captured in 2011 for analysis of environmental effects on downstream migration.



Number of Arctic Char per Day and Direction, Water Temperature and Flow in Little Roberts Outflow, Doris North Project, 2006 to 2007

Figure 3.1-2

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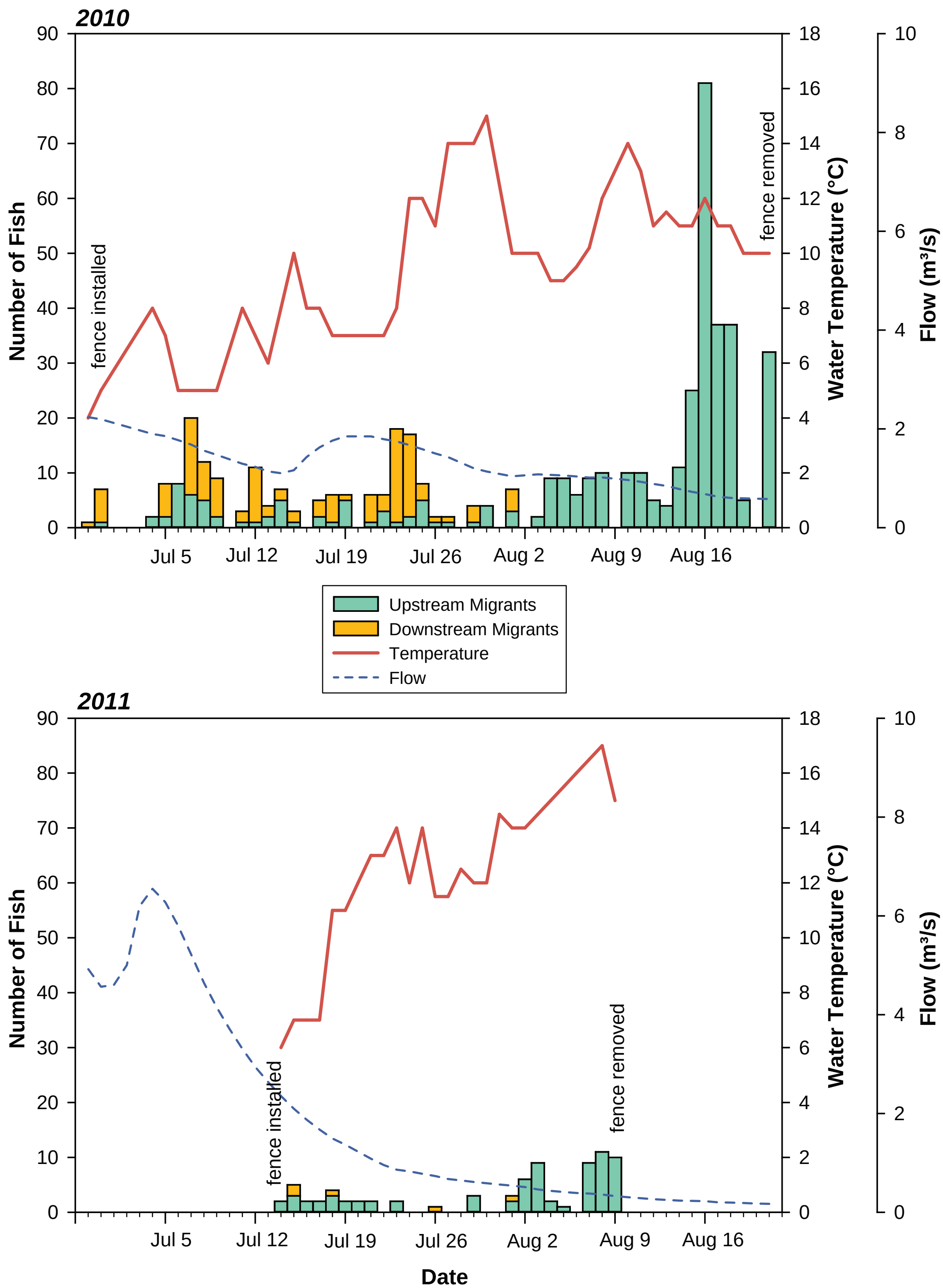

Figure 3.1-3

Number of Arctic Char per Day and Direction, Water Temperature and Flow in Roberts Outflow, Doris North Project, 2010 to 2011

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The relationship between temperature and downstream migration varied widely among years. When considering the entire downstream migration period, there was no correlation between temperature and downstream migration in 2006 (r_S = -0.15, P = 0.41) or 2007 (r_S = 0.09, P = 0.68). In 2010, there was a significant negative relationship between temperature and the number of downstream migrants (r_S = -0.48, $P < 0.005$). It should be noted that correlations between environmental factors and the number of downstream migrants usually explain only a minor part of the total variance in the number of migrating fish. This is partly due to the fact that once all the fish capable of migrating downstream have done so, the seaward migration stops, even if the environmental conditions are favourable. As a consequence, the coefficients of determination (r_S) in correlation analyses will be relatively low between environmental factors and the number of migrants (Vøllestad et al. 1986). Furthermore, body size, condition, sex and other life history variables influence downstream migration behaviour, probably in a pattern that optimizes survival (Bohlin et al. 1993, 1996).

During the initial downstream migration period (i.e., from first migration until the maximum number of downstream migrants per day), downstream migration in Roberts Outflow increases with increasing temperature (Figure 3.1-2). If the correlation analysis is repeated using only the first 2 to 3 weeks after freshet, a different pattern emerges. Downstream migration in this early period was positively correlated with temperature in 2006 (r_S = 0.76, $P < 0.001$) and in 2007 (r_S = 0.67, $P < 0.01$), but not in 2010 (r_S = 0.06, $P > 0.81$).

In the Roberts lake system, water temperature at the time of fish fence installation was 3°C in 2007, 4°C in 2006 and 2010, and 5.5°C in 2011. Since downstream migration is thought not to occur at temperatures below 3°C, it is likely that the data from 2006, 2007 and 2010 represent most of the downstream migrants for those years, except for fish that may have moved downstream when the fence was opened due to high water flows. In 2011, however, it is possible that much of the migration may have occurred before the fence was operational.

<u>Flow</u>

Carlsen et al. (2004) found that the number of smolts in the river Halselva increased with increasing water level and decreased with increasing water temperature. The increase in water level was largely caused by snowmelt and was correlated with lower water temperatures. Notably, Carlsen et al. (2004) found that the increase in number of smolts was also correlated with the increase in water level the following day, indicating that smolt movements were a response to conditions that would flow to increase the next day. This means that the downstream migration rate rapidly increased with the onset of rain or sunny weather (which leads to a more rapid melting of snow). Greenstreet (1992) reported an increase in downstream migration under turbid conditions typically encountered during spring freshet or following heavy rainfall. Berg (1995) also reported similar responses to rainy weather conditions. Many studies pertaining to downstream migration in salmonids have noted a correlation between number of migrants and water level (or other aspects of increased water level like turbidity changes; e.g., Greenstreet 1992; Bohlin et al. 1993; Berg 1995; Hvidsten et al. 1995; McCormick et al. 1998).

In Roberts Outflow and Little Roberts Outflow, the number of downstream Arctic char migrants tended to increase with flow when viewed over the entire sampling period. Spearman rank correlation analysis indicated a non-significant positive trend in 2006 (r_S = 0.32, P = 0.06), no correlation in 2007 (r_S = 0.29, P = 0.16) and a significant positive correlation in 2010 (r_S = 0.65, $P < 0.06$). However, similar to temperature, the relationship between downstream migration and flow differed if the analysis focused on the early portion of the season. Downstream migration at this time was negatively correlated with flow in 2006 (r_S = -0.89, $P < 0.0001$) and in 2007 (r_S = -0.75, $P < 0.01$), but positively correlated with flow in 2010 (r_S = 0.46, P = 0.05). The positive correlation in 2010 appeared to result from (1) a pulse of downstream migration associated with heavy rainfall that reduced temperature from 10°C to 7°C

(Figure 3.1-3) and increased turbidity, and (2) the cessation of downstream migration in late July, when flow dropped below 1 m^3/s.

Greenstreet (1992) suggested the following hierarchy of environmental clues controlling downstream migration in salmonids: discharge > light intensity > water temperature. This hierarchy reflects the value of high discharge and associated turbidity in avoiding predators. Evidence suggests that turbid waters may act as a refuge from predation, and that salmonid smolts are more likely to forage and migrate in turbid water than in clear waters, where they may be forced to find shelter from predators (Gregory 1993; Gregory and Northcote 1993). The relative importance of these environmental cues remains unclear for Arctic char in the Roberts Lake system. The influence of temperature and flow varies within each migration season, in addition to the variance from year to year.

3.1.3 Length, Weight and Condition of Migrating Fish

Arctic char ranged in size from 115 to 900 mm FL (Table 3.1-2). The dominant size classes of Arctic char were 501 to 600 mm and 701 to 800 mm FL (Figure 3.1-4) and all downstream migrants were less than 300 mm FL. Arctic char smolts (first time migrants to seawater) are generally 200 to 350 mm FL. The downstream migration consisted of a few juveniles probably rearing in Roberts Outflow. Arctic char migrating upstream were mainly large, adult fish. Lake trout ranged in size from 192 to 920 mm FL. The dominant size class of lake trout was 401 to 500 mm FL.

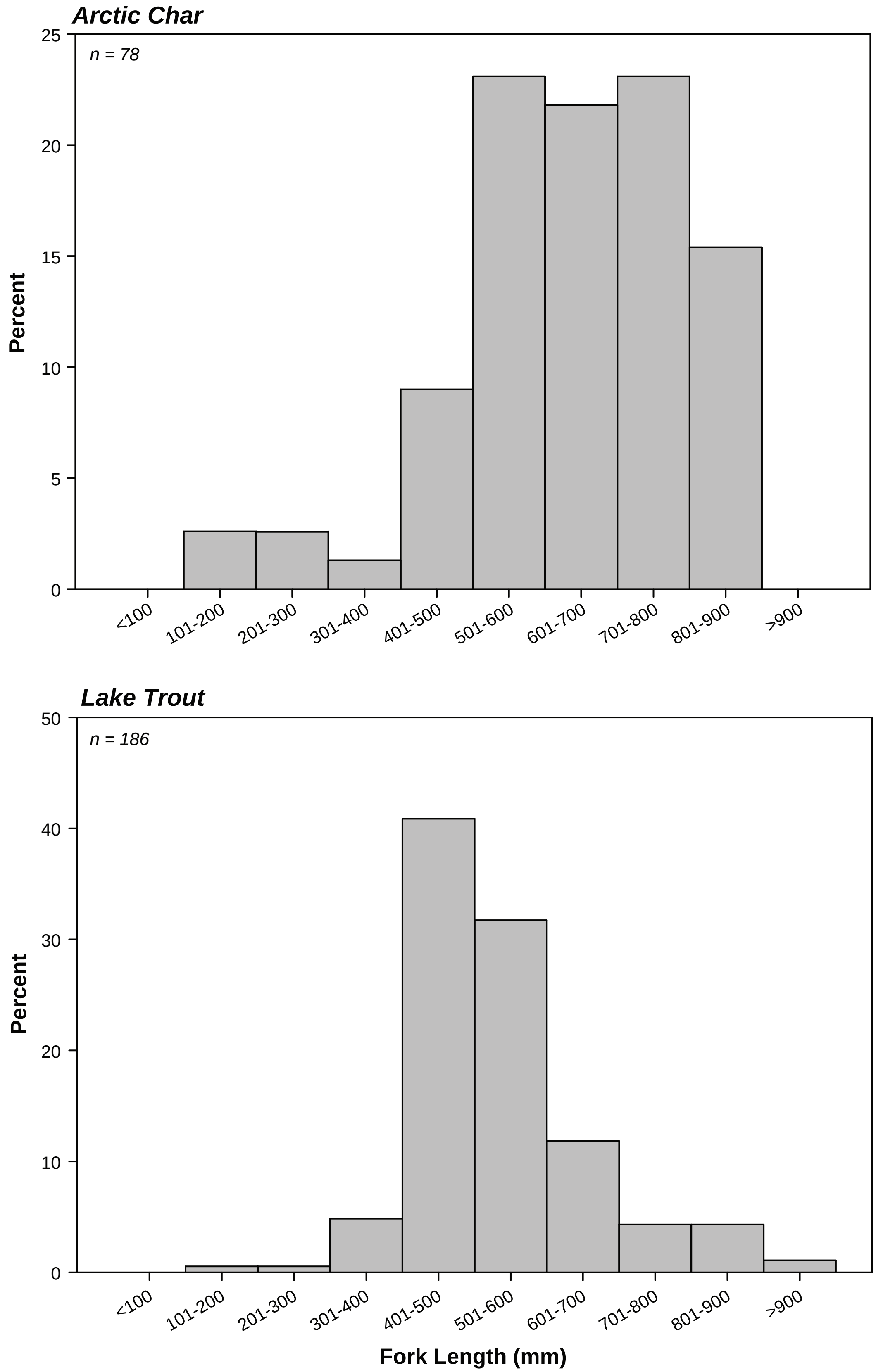
Table 3.1-2. Summary of Length and Weight Data for Arctic Char and Lake Trout Sampled from the Fish Fences in Roberts Outflow, Doris North Project, 2011

		Length (mm)				Weight (g)			
Species	**Direction**	**n**	**Range**	**Mean**	**SE**	**n**	**Range**	**Mean**	**SE**
AC	D	4	115 - 273	200	36	4	12 – 221	97	44
AC	U	74	395 - 900	649	15	74	450 – 9,700	4,183	248
LT	D	6	192 - 695	392	73	6	83 – 2,700	954	430
LT	U	180	369 - 920	549	9	180	600 – 8,950	2,205	116

Species code: AC = Arctic char, LT = lake trout
n = sample size; SE = standard error
Direction: D = downstream, U = upstream

The weight-length regression for Arctic char was significant ($P<0.0001$) and explained 99% of the variance in ln(weight). The weight-length regression for lake trout was also significant ($P<0.0001$) and explained 96% of the variance in ln(weight). The slopes of these regressions are 3.21 for Arctic char and 2.77 for lake trout, indicating that weight increases as roughly a cubic function of length for both species (Figure 3.1-5). Note that weight of Arctic char increases with length at a slightly higher rate than lake trout. This agrees with visual observations that Arctic char tended to be more "plump" than lake trout. Also, the weight-length regression slopes validate the use of weight/length^3 as an estimate of condition.

Fork length and weight were also used to calculate condition factor for Arctic char and lake trout in Roberts Outflow (Table 3.1-3). Mean condition of downstream-migrating Arctic char was 0.90, compared to 1.35 for upstream migrating fish. This presumably reflects the lower energy uptake during overwintering, followed by a heavy feeding over the summer. Downstream-migrating lake trout had a mean condition of 1.12, compared to 1.20 for upstream migrants. Condition of both Arctic char and lake trout did not follow a clear temporal pattern over the sampling period (Figure 3.1-6).



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Arctic Char and Lake Trout Length-Frequency in Roberts Outflow, Doris North Project, 2011

Figure 3.1-4

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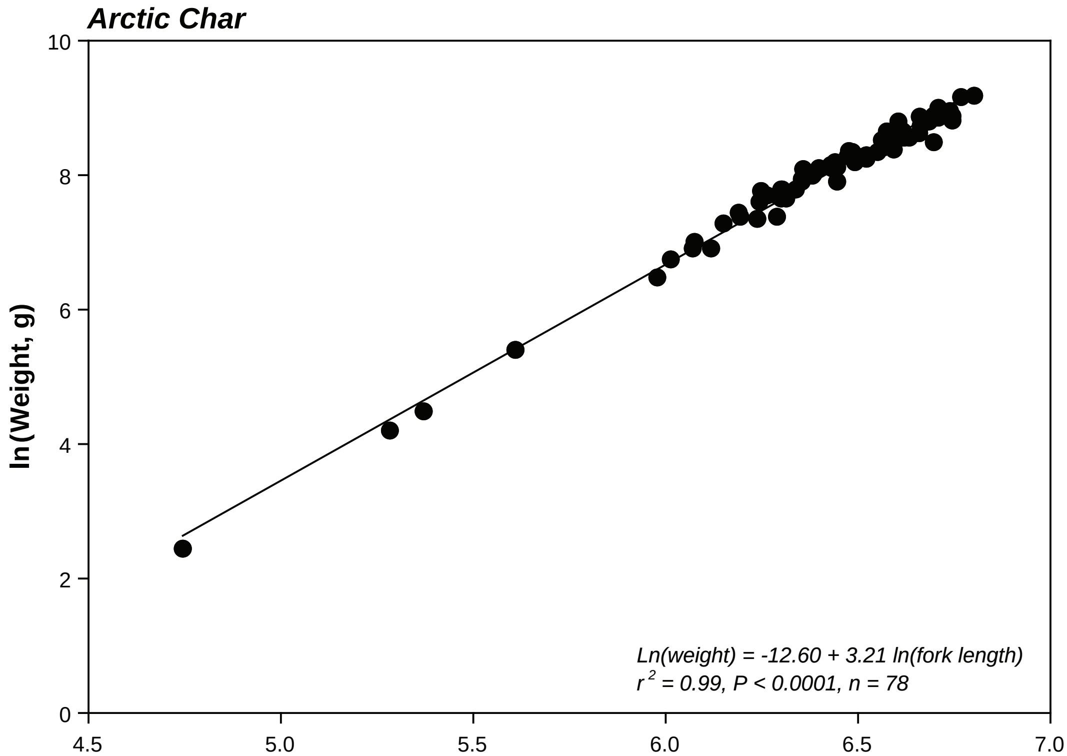

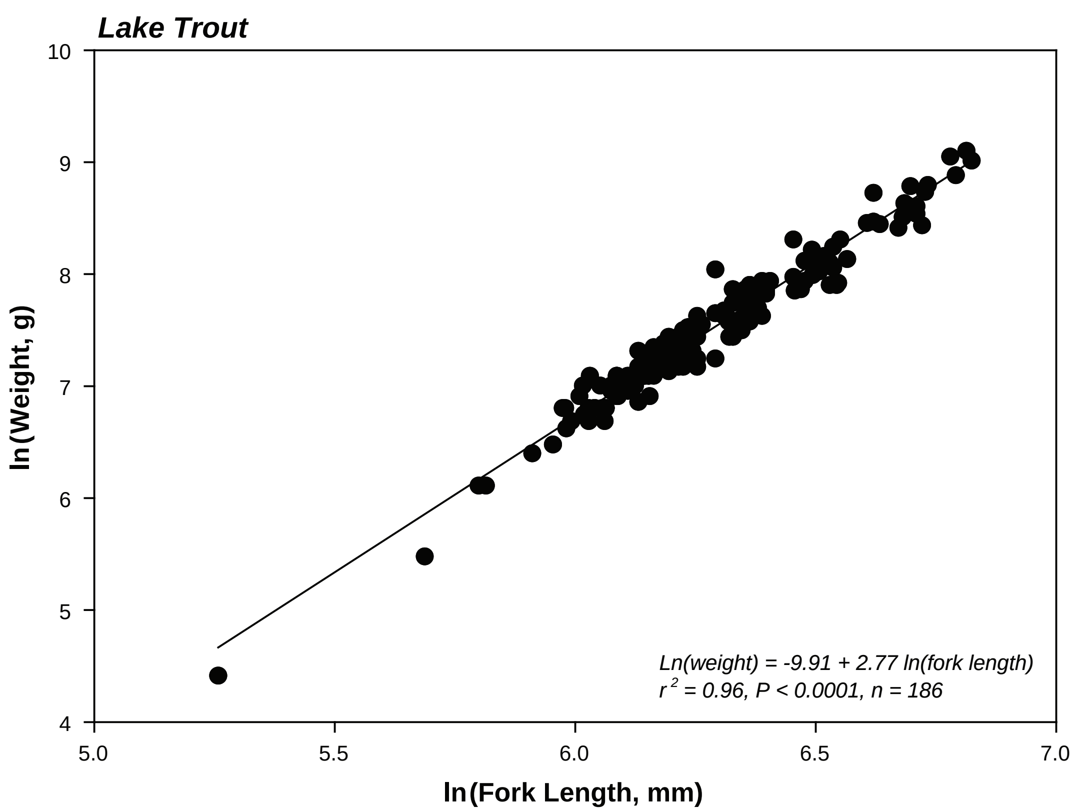

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Weight-Length Regression of Arctic Char and Lake Trout in Roberts Outflow, Doris North Project, 2011

Figure 3.1-5

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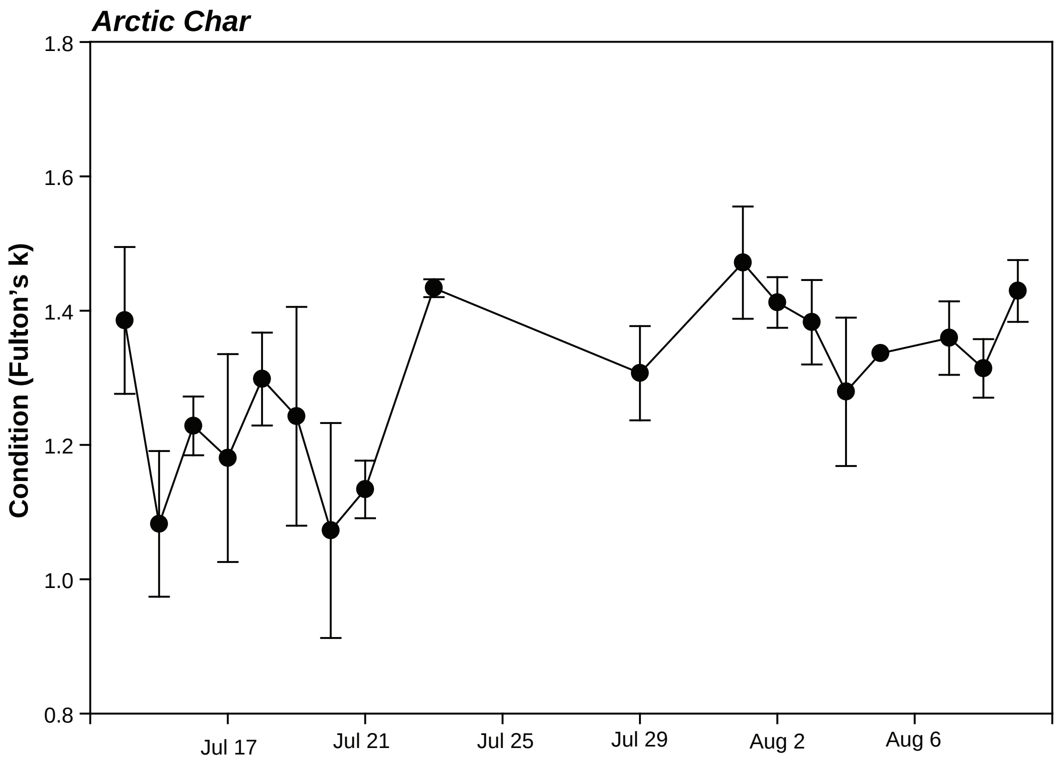

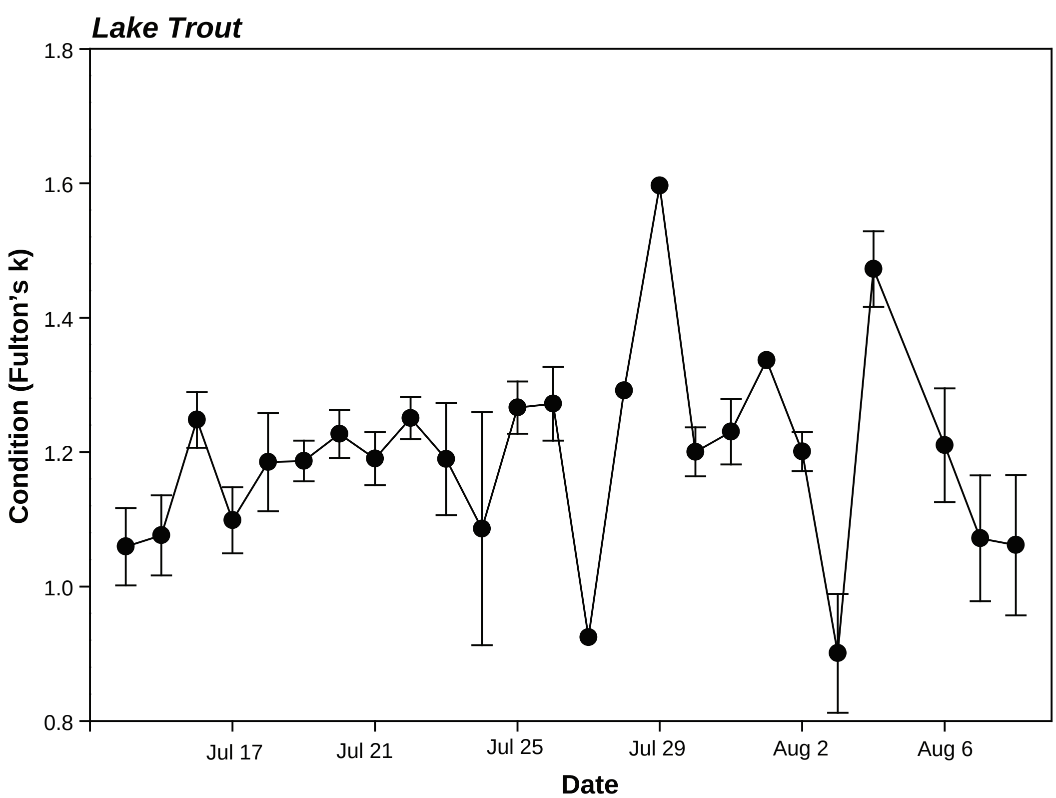

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Fish Condition Over Time in Roberts Outflow, Doris North Project, 2011

Figure 3.1-6

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Table 3.1-3. Summary of Condition Data for Arctic Char and Lake Trout Sampled from the Fish Fences in Roberts Outflow, Doris North Project, 2011

		Condition (Fulton's K)			
Species	Direction	n	Range	Mean	SE
AC	Downstream	4	0.76 – 1.69	0.90	0.07
AC	Upstream	74	0.91 – 1.70	1.35	0.02
LT	Downstream	6	0.80 – 1.40	1.12	0.09
LT	Upstream	180	0.80 – 1.97	1.20	0.01

Species code: AC = Arctic char, LT = lake trout
n = sample size; SE = standard error

3.1.4 Age and Growth

Age was determined from pelvic fin ray counts for 54 Arctic char and 81 lake trout. Age data for both species are summarized in Table 3.1-4. The age of Arctic char captured in the fish fence ranged from 1 to 16 years, with a median age of 6 years (Figure 3.1-7). Downstream migrants had a mean age of 4.3 years, while Arctic char migrating upstream had a mean age of 7.6 years. Lake trout ranged from 5 to 29 years in age, with a median age of 10 years (Figure 3.1-7). Age of downstream migrants ranged from 5 to 8 years, with a mean age of 6.5 years. Lake trout migrating upstream ranged from 8 to 29 years of age, with a mean age of 12.3 years.

Table 3.1-4. Summary of Age Data for Arctic Char and Lake Trout Sampled from the Fish Fences in Roberts Outflow, Doris North Project, 2011

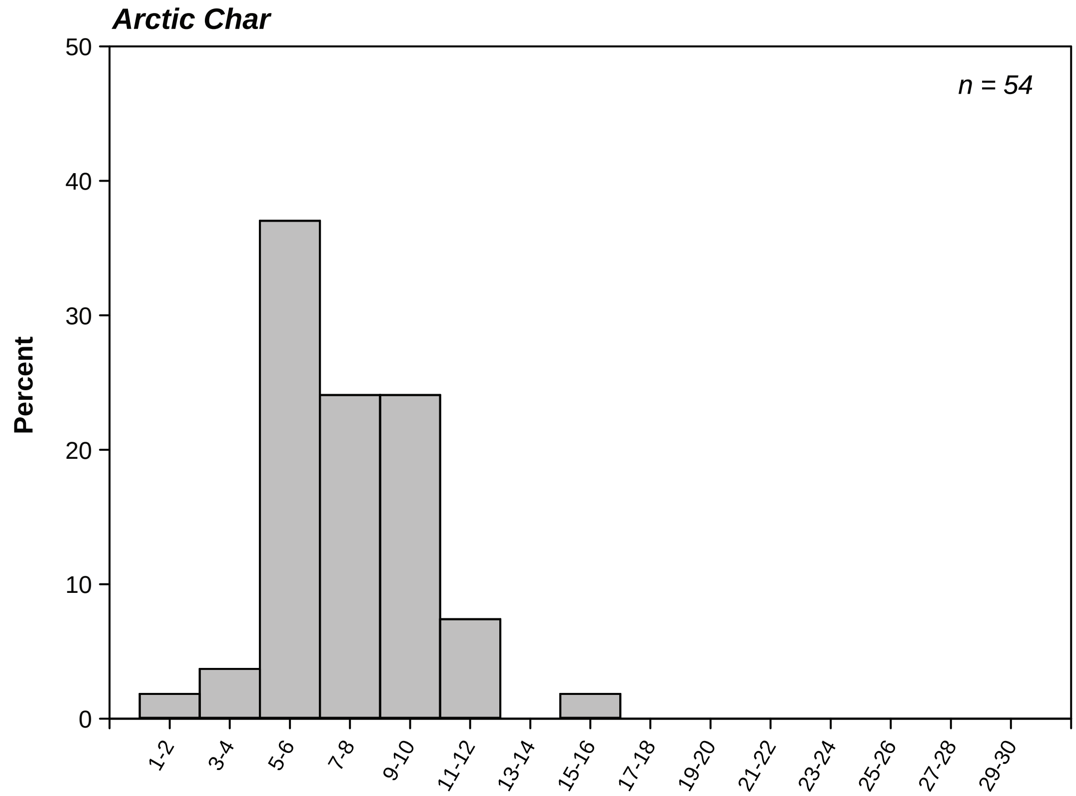
		Age (years)			
Species	Direction	n	Range	Mean	SE
AC	Downstream	4	2 - 7	4.3	1.1
AC	Upstream	50	3 - 16	7.6	0.3
LT	Downstream	4	5 - 8	6.5	0.6
LT	Upstream	80	6 - 29	12.3	0.5

Species code: AC = Arctic char, LT = lake trout
n = sample size; SE = standard error

Von Bertalanffy growth models explained 70% of the variance in length-at-age of Arctic char and 61% of the variance in length-at-age of lake trout (Figure 3.1-8). Growth coefficients (K) were 0.111 year^{-1} for Arctic char and 0.045 year^{-1} for lake trout. Arctic char sampled in Roberts Outflow in 2010 had a K of 0.131 year^{-1} (Rescan 2011). Lake trout sampled from Roberts Outflow in 2010 had a K of 0.038 year^{-1}, so the growth of Arctic char and lake trout in Roberts Outflow in 2011 was comparable to values obtained in 2010.

3.1.5 Stranding of Adult Arctic Char in Roberts Outflow Boulder Garden

Stranding of adult Arctic char and lake trout in the Roberts Outflow boulder garden has been reported in previous years when summer flows were low (RL&L/Golder 2003). In 2011, following high flows at spring freshet in early July, water levels in Roberts Outflow dropped rapidly (Plates 3.1-1 and 3.1-2). Adult fish were found stranded in the boulder garden by the first week of August (Plate 3.1-3). On August 14, 13 fish were recorded stranded in shallow pools between boulders (H. Swanson, University of Alberta, unpublished data). Most stranded fish were dead or dying when observed (Plate 3.1-4).



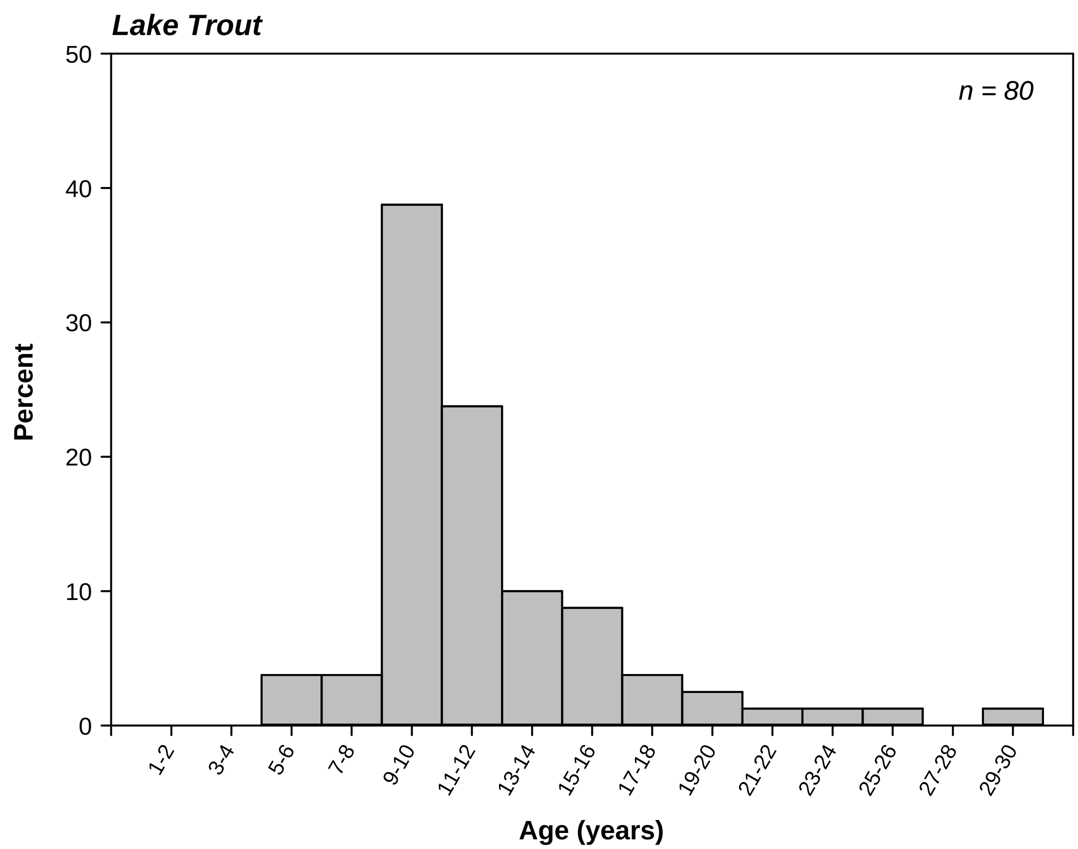


Figure 3.1-7

Age-Frequency of Arctic Char and Lake Trout in Roberts Outflow, Doris North Project, 2011

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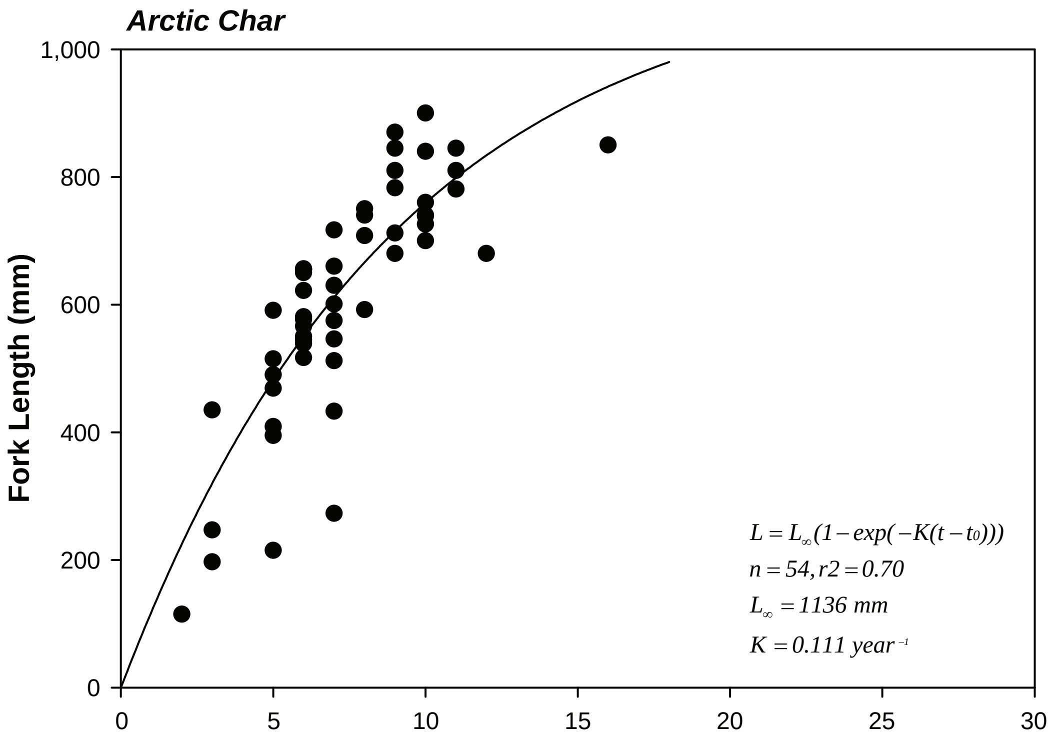


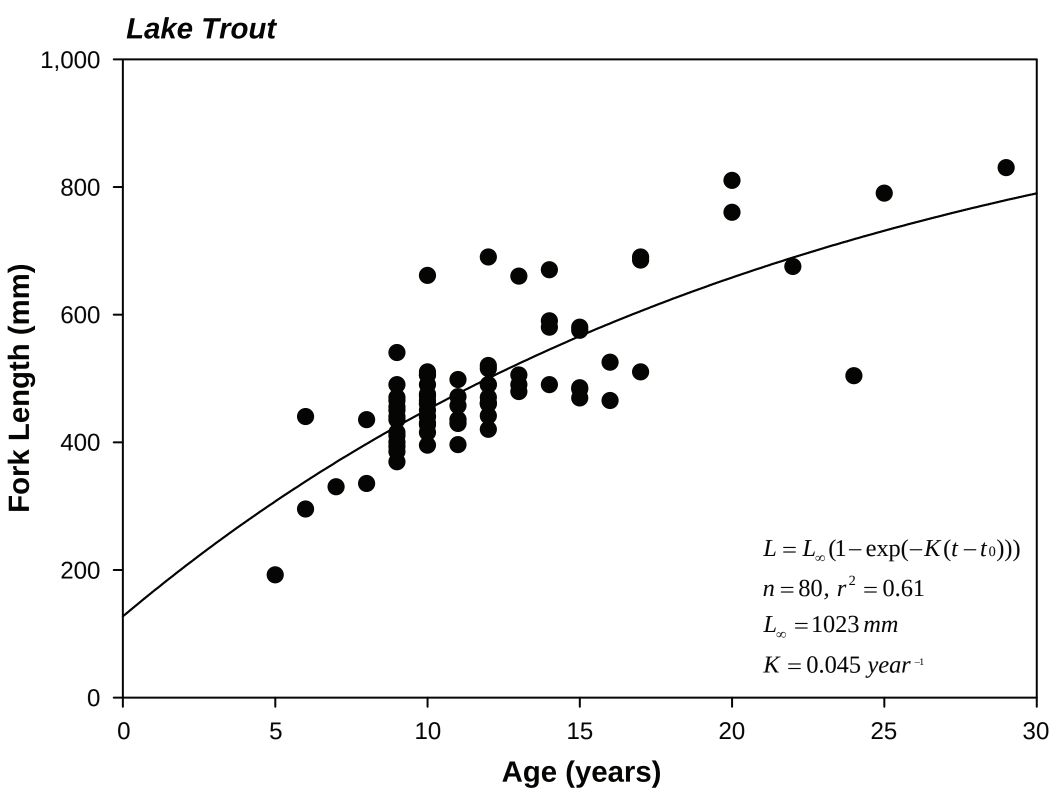


Figure 3.1-8

Fork Length by Age of Arctic Char and Lake Trout in Roberts Outflow, Doris North Project, 2011

Plate 3.1-1. View of the boulder garden and fish fence in Roberts Outflow; looking downstream on July 22, 2011.

Plate 3.1-2. View of the boulder garden and partially dismantled fish fence in Roberts Outflow; looking downstream on August 9, 2011.

Plate 3.1-3. Tagged Arctic char stranded in boulder garden, August 10, 2011.

Plate 3.1-4. Dead Arctic char in boulder garden; partially eaten by ravens. August 14, 2011. Photo courtesy of Heidi Swanson.

3.2 ROBERTS LAKE FISH COMMUNITY MONITORING

3.2.1 Roberts Lake Trap Net Program

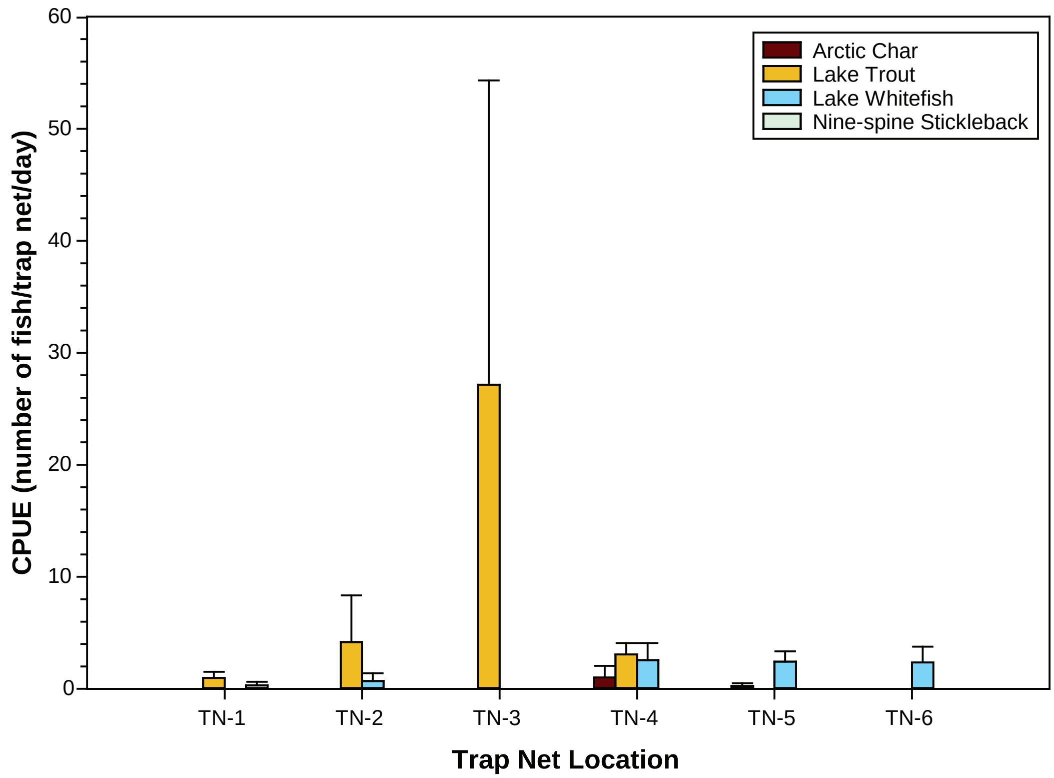
Trap nets set in Roberts Lake captured 122 fish of four species (Arctic char, lake trout, lake whitefish, and ninespine stickleback). Appendix 3.2-1 summarizes all biological data for trap net catches. Appendix 3.2-2 summarizes catch and effort for each trap net site. Ninespine stickleback was the most abundant species caught in the trap nets, followed by lake trout, Arctic char and lake whitefish (Figure 3.2-1). Only three Arctic char were caught in trap nets in 2011: two at site TN-4 and one at site TN-5. Lake trout were captured at all six trap net sites. The highest catch of lake trout (six fish) occurred at site TN-5, on the northernmost point of Roberts Lake, adjacent to the inflow of stream E14 (see Figure 2.1-1). Ninespine stickleback were captured at five of the six trap net sites. The highest catch of ninespine stickleback occurred at site TN-3.

Table 3.2-1 summarizes the length and weight of trap net catches. All three Arctic char were juveniles, ranging in size from 73 to 141 mm FL. A total of 42 trap net sets captured 21 lake trout, ranging in size from 116 to 740 mm FL and weighing 14 to 1,200 g. Figure 3.2-2 shows the length-frequency and weight-length relationship of lake trout captured in trap nets. The dominant size class of lake trout was 201 to 300 mm FL. Fish of this size are subadults, possibly preying on smaller fish such as ninespine stickleback in the shallow littoral areas of Roberts Lake. The weight-length regression for lake trout was statistically significant ($P<0.001$) and ln(fork length) explained 99% of the variance in ln(weight). Ninespine stickleback ranged in size from 19 to 64 mm FL and were too light to accurately weigh in the typically windy conditions on Roberts Lake.

Table 3.2-1. Summary of Length and Weight Data for Fish Sampled from Roberts Lake Trap Nets, Doris North Project, 2011

		Length (mm)				Weight (g)			
Site	Species	n	Range	Mean	SE	n	Range	Mean	SE
TN-1	LT	1	740	740	-	1	-	-	-
	NSB	3	39 - 45	42	2	2	-	-	-
	LW	1	390	390	-	1	-	-	-
TN-2	LT	2	410 - 570	490	80	2	550 – 1,200	875	325
	NSB	12	38 - 64	49	2	1	-	-	-
TN-3	LT	3	194 - 200	196	2	1	68 - 73	70	1
	NSB	74	19 - 61	42	1	74	-	-	-
TN-4	AC	2	73 - 90	82	9	2	3 - 7	5	2
	LT	5	194 - 395	269	45	5	68 - 496	177	106
	NSB	6	45 - 60	52	3	6	-	-	-
TN-5	AC	1	141	141	-	1	32	32	-
	LT	6	116 - 551	274	60	6	14 - 239	125	37
	NSB	2	48 - 50	49	1	2	-	-	-
TN-6	LT	4	232 - 389	304	32	4	128 - 609	329	144

Species code: AC = Arctic char, LT = lake trout, LW = lake whitefish, NSB = ninespine stickleback
n = sample size; SE = standard error
Dashes (-) indicate data not available.



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Number of Fish by Trap Net Location in Roberts Lake, Doris North Project, 2011

Figure 3.2-1

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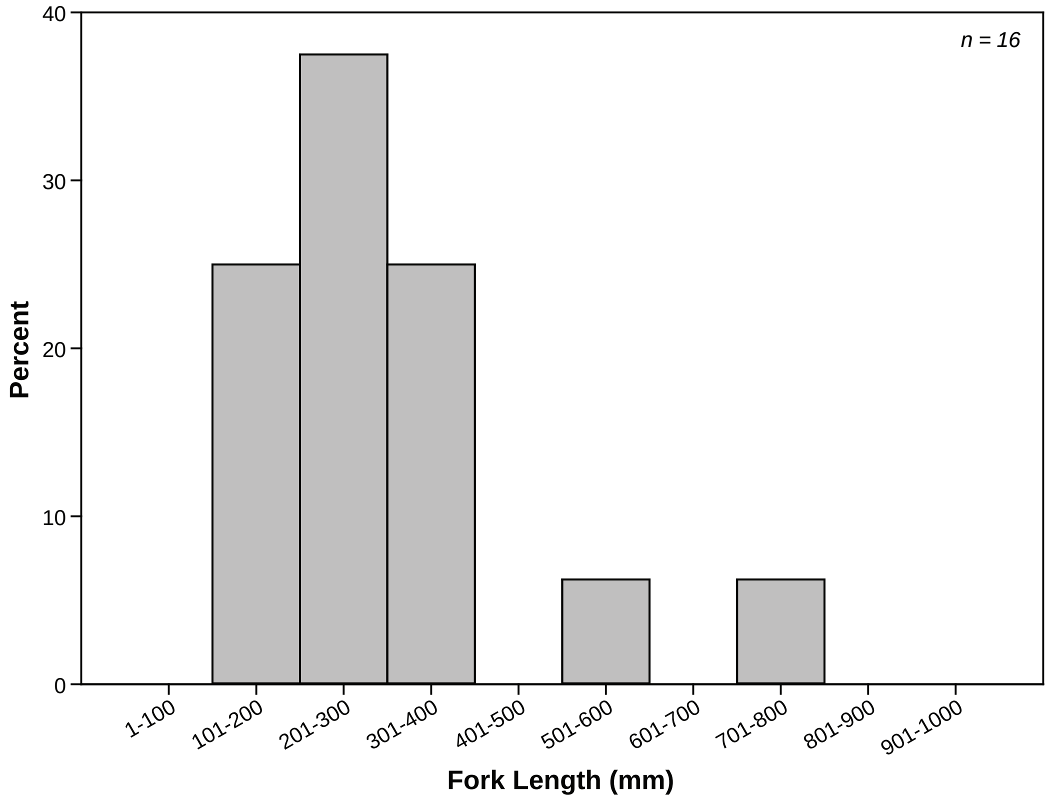

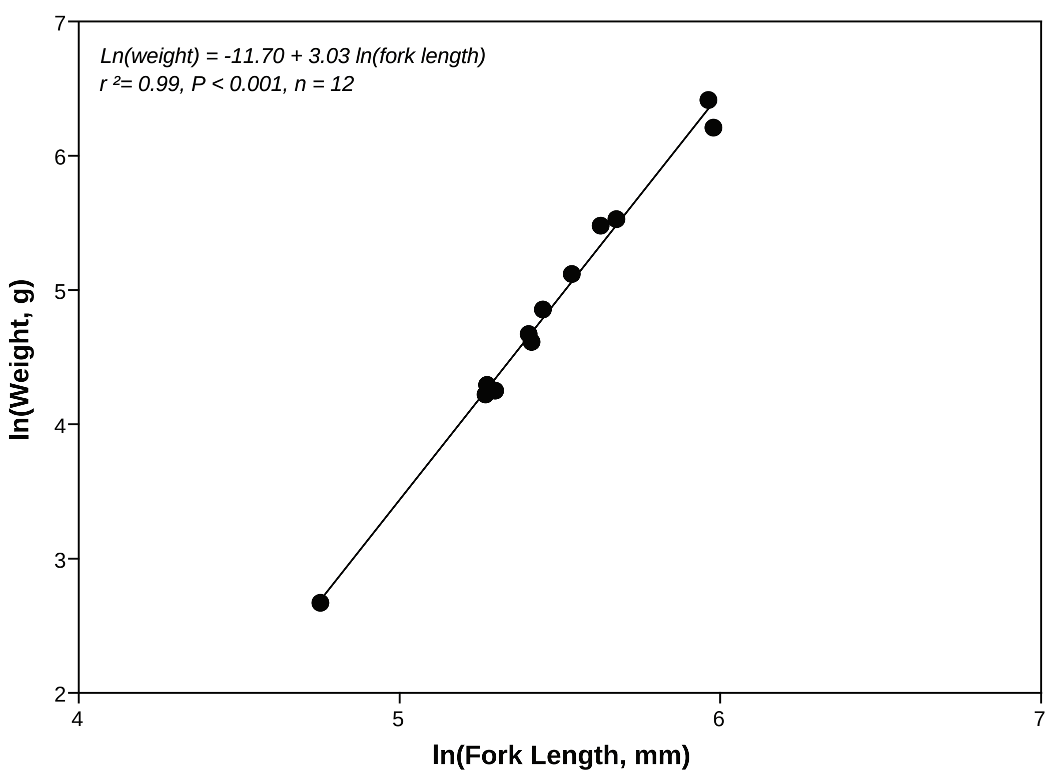

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Length-Frequency and Weight-Length Regression of Lake Trout Caught by Trap Nets in Roberts Lake, Doris North Project, 2011

Figure 3.2-2

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Table 3.2-2 shows the age of 2 Arctic char and 16 lake trout caught in trap nets in Roberts Lake. Analysis of fin rays indicated that Arctic char caught in trap nets were 1 to 2 years old. There were insufficient data to calculate length-at-age of Arctic char.

Table 3.2-2. Summary of Age Data for Fish Sampled from Roberts Lake Trap Nets, Doris North Project, 2011

Site	Species	Age (years)			
		n	Range	Mean	SE
TN-1	AC	0	-	-	-
	LT	1	15	15	-
TN-2	AC	0	-	-	-
	LT	2	11 -15	13	2
TN-3	AC	0	-	-	-
	LT	0	-	-	-
TN-4	AC	1	1	1	-
	LT	4	3 - 12	6	3
TN-5	AC	1	2	2	-
	LT	4	2 - 11	6	2
TN-6	AC	0	-	-	-
	LT	9	2 - 16	8	3

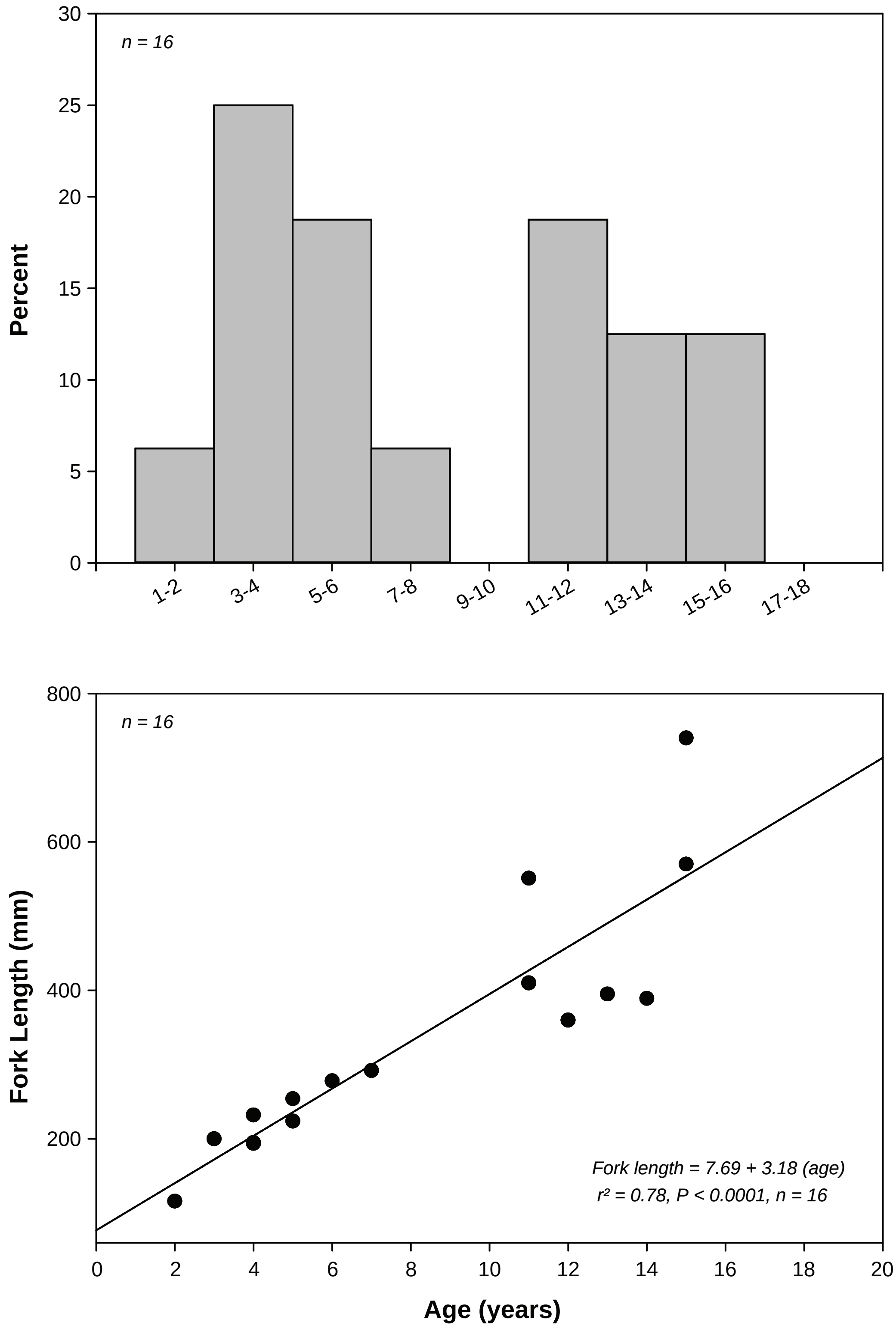
Species code: AC = Arctic char, LT = lake trout
n = sample size; SE = standard error
Dashes (-) indicate data not available.

Lake trout caught in trap nets ranged in age from 2 to 15 years, with a mean of 8 years (Figure 3.2-3). The dominant year class was 4 years. Fork length increased with age (Figure 3.2-3) but there was insufficient data to calculate a von Bertalanffy growth model.

3.2.2 Roberts Lake Tributary Sampling

Catch and effort data for each electrofishing pass in Roberts lake Tributaries are shown in Appendix 3.2-3. Backpack electrofishing captured 24 fish in stream E09 and 60 fish in stream E14. Individual fish data are presented in Appendix 3.2-3. Arctic char was the most common species (n = 71), followed by ninespine stickleback (n = 15; Table 3.2-3). Only two lake trout were caught in the tributaries (both in stream E09), suggesting that lake trout do not use the tributaries as rearing habitat to the same degree as Arctic char.

CPUE of Arctic char, lake trout and ninespine stickleback were all highest in E14, followed by the downstream section of E09 (Table 3.2-4). No fish were caught in the upstream section of stream E09. In 2011, CPUE of Arctic char in stream E09 (0.83 fish/100 sec) and total CPUE (1.00 fish/100 sec), were more than double the CPUE for 2010 (0.40 fish/100 sec for Arctic char and 0.45 fish/100 sec total (Rescan 2011)). In stream E14, CPUE was also notably higher in 2011 (1.99 fish/100 sec for Arctic char and 2.54 fish/100 sec total) than in 2010 (1.44 fish/100 sec for Arctic char and 1.48 fish/100 sec total).



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Age-Frequency and Length-at-Age of Lake Trout Caught by Trap Nets in Roberts Lake, Doris North Project, 2011

Figure 3.2-3

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Table 3.2-3. Fish Species and Numbers Captured from Roberts Lake Tributaries, 2011

		Number of Fish by Species			
Tributary	Date	AC	LT	NSB	Total
E09 downstream	5-Jul-11	13	0	2	**15**
E09 downstream	23-Jul-11	1	1	0	**2**
E09 downstream	26-Jul-11	4	1	0	**5**
E09 downstream	11-Aug-11	1	0	0	**1**
E09 central	6-Jul-11	5	0	0	**5**
E09 central	23-Jul-11	0	0	0	**0**
E09 central	26-Jul-11	0	0	0	**0**
E09 central	11-Aug-11	0	0	0	**0**
E09 upstream	6-Jul-11	0	0	0	**0**
E09 upstream	23-Jul-11	0	0	0	**0**
E09 upstream	26-Jul-11	0	0	0	**0**
E09 upstream	11-Aug-11	0	0	0	**0**
E14	4-Jul-11	33	0	0	**33**
E14	24-Jul-11	8	0	8	**16**
E14	27-Jul-11	5	0	3	**8**
E14	8-Aug-11	1	0	2	**3**
Total		**71**	**2**	**15**	**88**

Fish Species Codes: AC = Arctic char, LT = lake trout, NSB = ninespine stickleback

Table 3.2-4. Electrofishing Effort, Catch and CPUE for Roberts Lake Tributaries, 2011

	Total	Number of Fish				CPUE (Fish/100s)			
Tributary	Electrofishing Effort(s)	AC	LT	NSB	Total	AC	LT	NSB	Total
E09 downstream	2,292	19	2	2	**23**	0.83	0.09	0.09	**1.00**
E09 central	1,332	5	0	0	**5**	0.38	0.00	0.00	**0.38**
E09 upstream	1,854	0	0	0	**0**	0.00	0.00	0.00	**0.00**
E14	2,359	47	0	13	**60**	1.99	0.00	0.55	**2.54**
Total	**7,837**	**71**	**2**	**15**	**88**				

Species code: AC = Arctic char, LT = lake trout, NSB = ninespine stickleback

Juvenile Arctic char (Plate 3.2-1) were most abundant in stream E14, followed by stream E09 (Table 3.2-5). In 2006, 62 juvenile Arctic char were found in stream E14 (Golder 2007b) and 95 juvenile Arctic char were captured in stream E14 in 2010 (Rescan 2011). The high catches suggest that this tributary provides important nursery habitat for Arctic char (Golder 2007b). Stream E14 flows from a small lake immediately north of Roberts Lake (see Figure 2.1-1) but a waterfall downstream of the outlet prevents fish migration into the lake. Juveniles rearing in E14 therefore probably emerged in Roberts Lake. In contrast, stream E09 connects Roberts Lake to a small lake to the south with no barriers to fish passage, although a number of cascades in stream E09 could make upstream migration difficult for small juveniles. A spawning population of Arctic char exists in that lake (Golder 2006). Juvenile Arctic char rearing in stream E09 may therefore be spawned in the upstream lake and be transported downstream into E09. However, since the majority of fish in stream E09 were captured in the downstream section, near the inflow to Roberts Lake, it is likely that these fish moved in from the lake to rear in the downstream section of the tributary.

Plate 3.2-1. Juvenile Arctic char caught by electrofishing in stream E14, July 4, 2011.

Table 3.2-5. Population Density of Arctic Char in Roberts Lake Tributaries, 2011

Site	Date	Population Estimate	Area Sampled (m^2)	Density (fish/100 m^2)	95% Confidence Interval
E09 downstream	5-Jul-11	13	58	22.4	20.7 – 32.2
E09 downstream	23-Jul-11	1	58	1.7	1.7 – 4.1
E09 downstream	26-Jul-11	4	58	6.9	6.9
E09 downstream	11-Aug-11	1	58	1.7	1.7 – 4.1
E09 central	6-Jul-11	5	88	5.7	5.7 – 6.7
E09 central	23-Jul-11	0	88	0.0	-
E09 central	26-Jul-11	0	88	0.0	-
E09 central	11-Aug-11	0	88	0.0	-
E09 upstream	6-Jul-11	0	88	0.0	-
E09 upstream	23-Jul-11	0	88	0.0	-
E09 upstream	26-Jul-11	0	88	0.0	-
E09 upstream	11-Aug-11	0	88	0.0	-
E14	4-Jul-11	31	75	41.3	40.0 – 46.7
E14	24-Jul-11	9	75	12.0	12.0 – 12.3
E14	27-Jul-11	4	75	5.3	5.3 – 5.9
E14	8-Aug-11	1	75	1.3	1.3 – 5.2

Population density of Arctic char in both tributaries was highest in early July, soon after freshet, and declined over the summer (Table 3.2-5). Population density was highest in the downstream section of stream E09 and was zero in the upstream section. Since the sampling site at E14 is also near the mouth of the stream, these results suggest that young-of-the-year Arctic char use the lower reaches of the tributaries as rearing habitats immediately after hatching, and then return to Roberts Lake to forage when they have outgrown the smaller size classes which are typically more vulnerable to predation.

Biological data for fish captured in Roberts Lake tributaries are summarized in Appendix 3.2-4. Arctic char in Roberts Lake tributaries ranged in length from 54 to 155 mm FL and weighed 1.5 to 34.6 g (Table 3.2-6). Lake trout were 114 to 241 mm FL and weighed 13.5 to 155 g. Ninespine stickleback were 25 to 77 mm FL and weighed 1.6 to 6.4 g.

Table 3.2-6. Summary of Length and Weight Data for Fish Sampled from Roberts Lake Tributaries, Doris North Project, 2011

		Length (mm)				Weight (g)			
Site	Species	n	Range	Mean	SE	n	Range	Mean	SE
E09	AC	24	63-155	91	5	24	1.6 – 34.6	8.4	1.7
	LT	2	114 - 241	178	18	2	13.5 - 153.0	83.3	20.6
	NSB	2	63 - 67	65	1.8	2	1.8	1.8	-
E14	AC	47	54 - 146	91	3	47	1.5 – 25.4	8.6	1.0
	LT	0	-	-	-	0	-	-	-
	NSB	13	41 - 77	53	4	13	1.6 – 6.4	4.5	1.5

Species code: AC = Arctic char, LT = lake trout, NSB = ninespine stickleback
n = sample size; SE = standard error
Dashes (-) indicate data not available.

The dominant size class of Arctic char in stream E09 was 61 to 80 mm FL (Figure 3.2-4). The weight-length regression was significant ($P < 0.0001$) and ln(fork length) explained 97% of the variance in ln(weight).

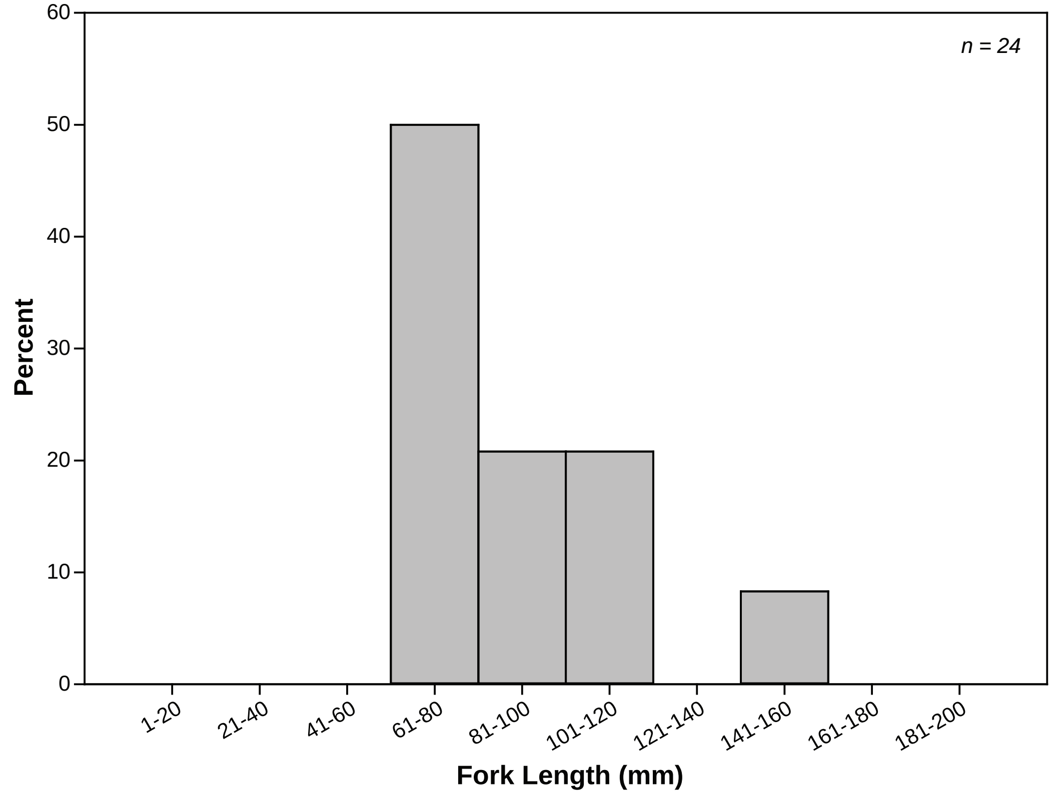
The dominant size class of Arctic char in stream E14 was also 61 to 80 mm FL, although fish 81 to 120 mm FL were also common (Figure 3.2-5). The weight-length regression was significant ($P < 0.0001$) and ln(fork length) explained 94% of the variance in ln(weight).

Arctic char caught in Roberts Lake tributaries were 0 years to 3 years old (Table 3.2-7). The mean age of Arctic char was 0.8 years in stream E09 and 0.6 years in stream E14, indicating that the majority of fish were young-of-the-year or age 1. Only two lake trout were caught in tributaries (both in stream E09). Lake trout were 2 year to 6 years old, with a mean age of 4 years (Table 3.2-7).

Table 3.2-7. Summary of Age Data for Fish Sampled from Roberts Lake Tributaries, Doris North Project, 2011

		Age (years)			
Site	Species	n	Range	Mean	SE
E09	AC	24	0 - 3	0.8	0.2
	LT	2	2 - 6	4	2
E14	AC	39	0 - 3	0.6	0.1
	LT	0	-	-	-

Species code: AC = Arctic char, LT = lake trout
n = sample size; SE = standard error
Dashes (-) indicate data were not available.



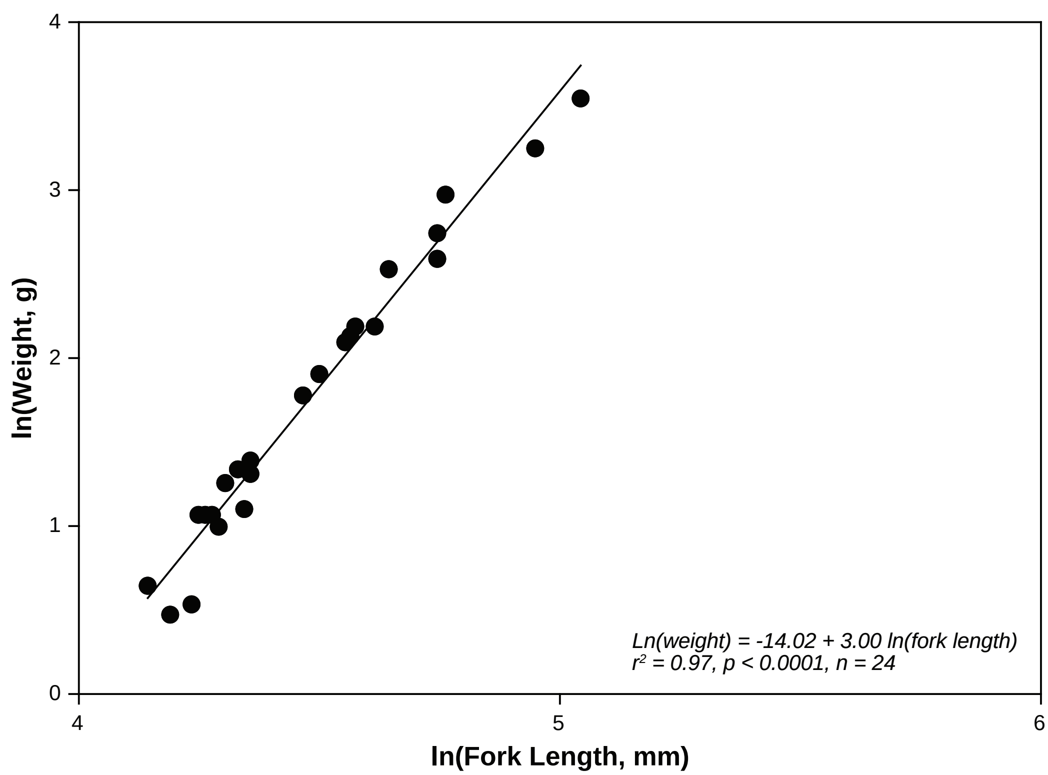


Figure 3.2-4

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Length-Frequency and Weight-Length Regression of Arctic Char in Stream E09, Doris North Project, 2011

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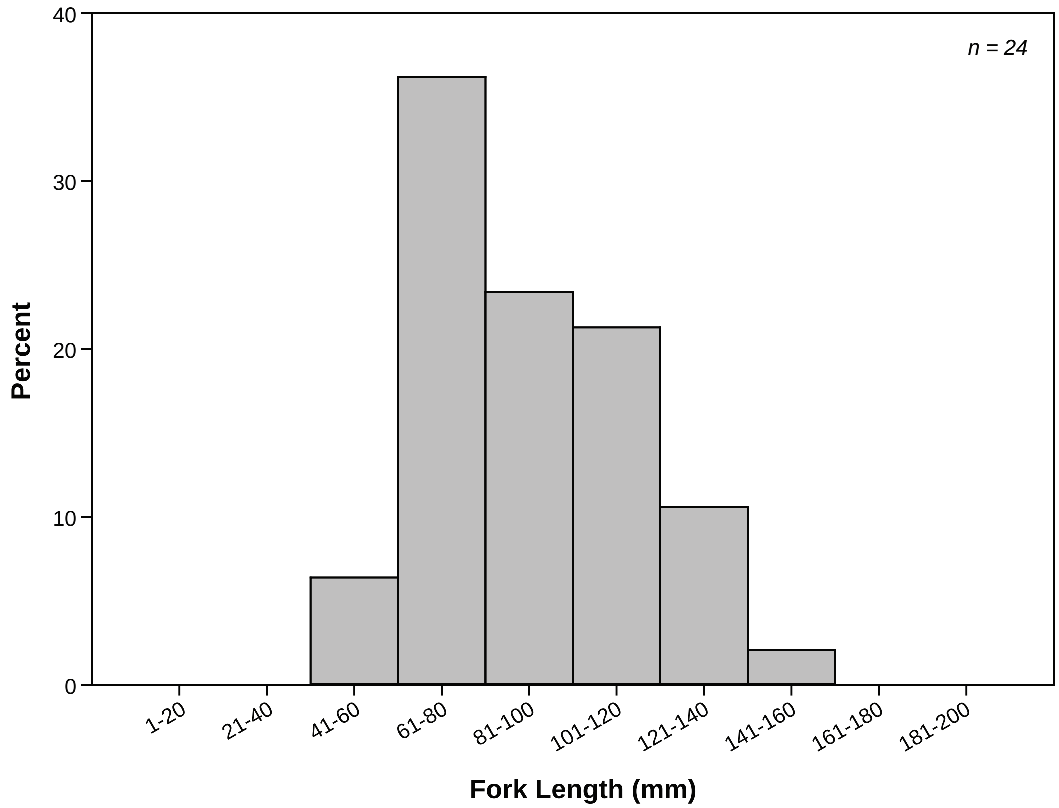

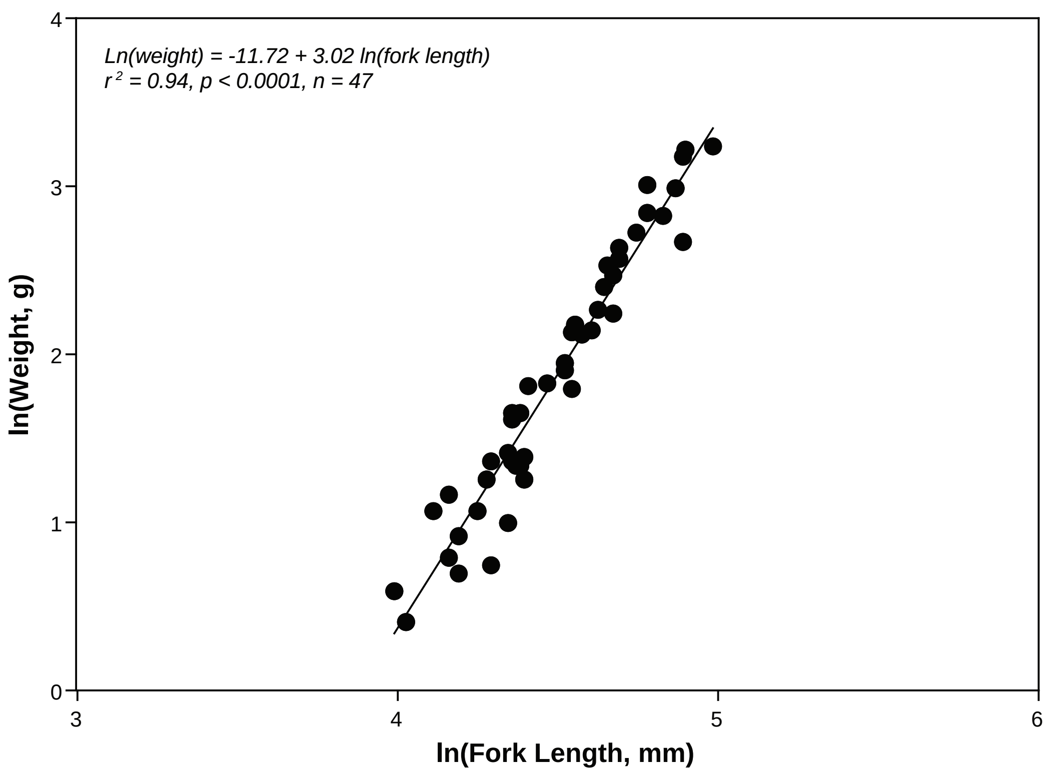

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Length-Frequency and Weight-Length Regression of Arctic Char in Stream E14, Doris North Project, 2011

Figure 3.2-5

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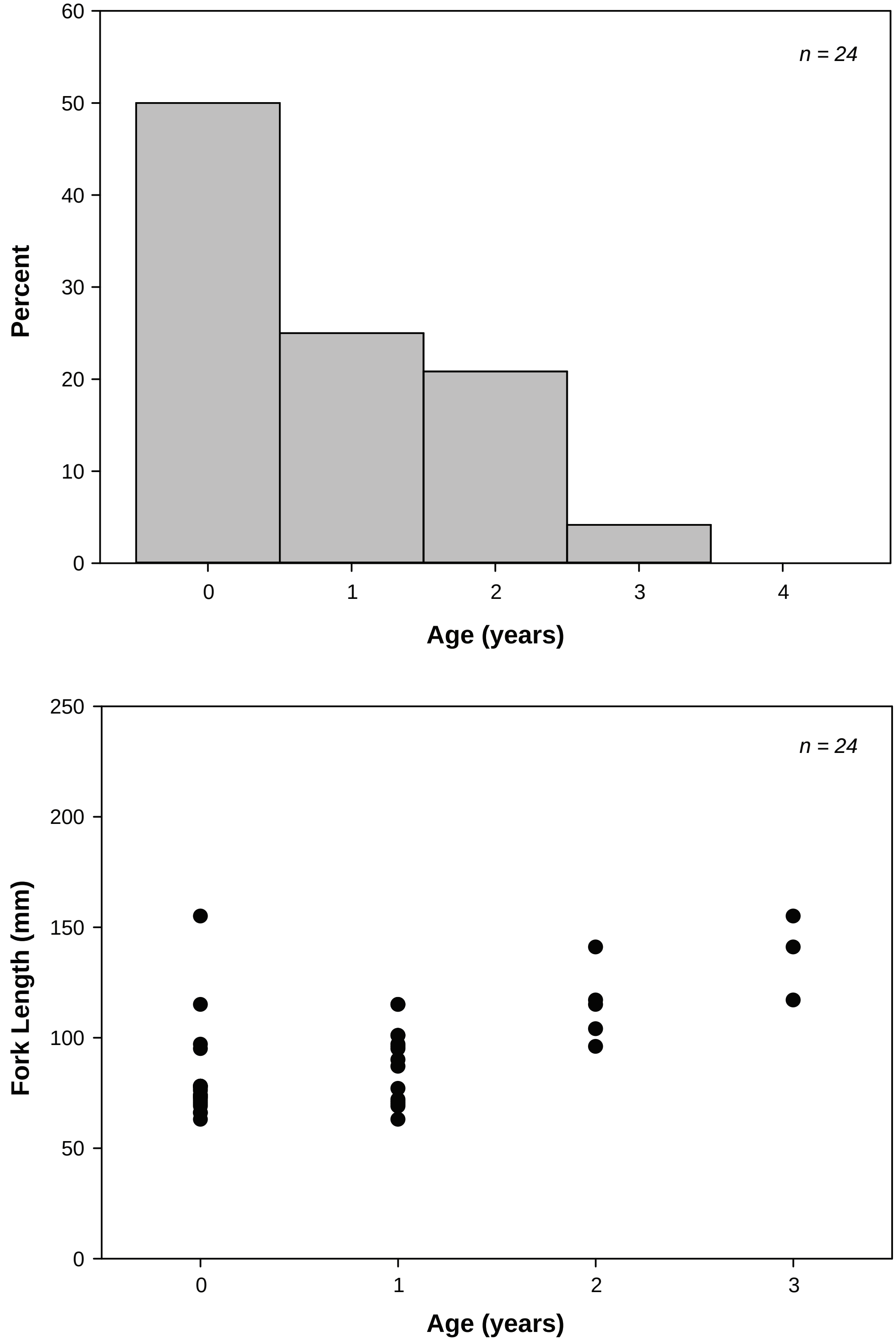
The dominant age class of Arctic char in stream E09 was 0 (young-of-the-year; Figure 3.2-6). Length increased with age, but with only three age classes present, there were insufficient data to calculate a von Bertalanffy growth model.

As with stream E09, the dominant age class of Arctic char in stream E14 was 0 (young-of-the-year; Figure 3.2-7). Length increased with age, but with only three age classes present, there were insufficient data to calculate a von Bertalanffy growth model.



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Age-Frequency and Length-at-Age of Arctic Char in Stream E09, Doris North Project, 2011

Figure 3.2-6

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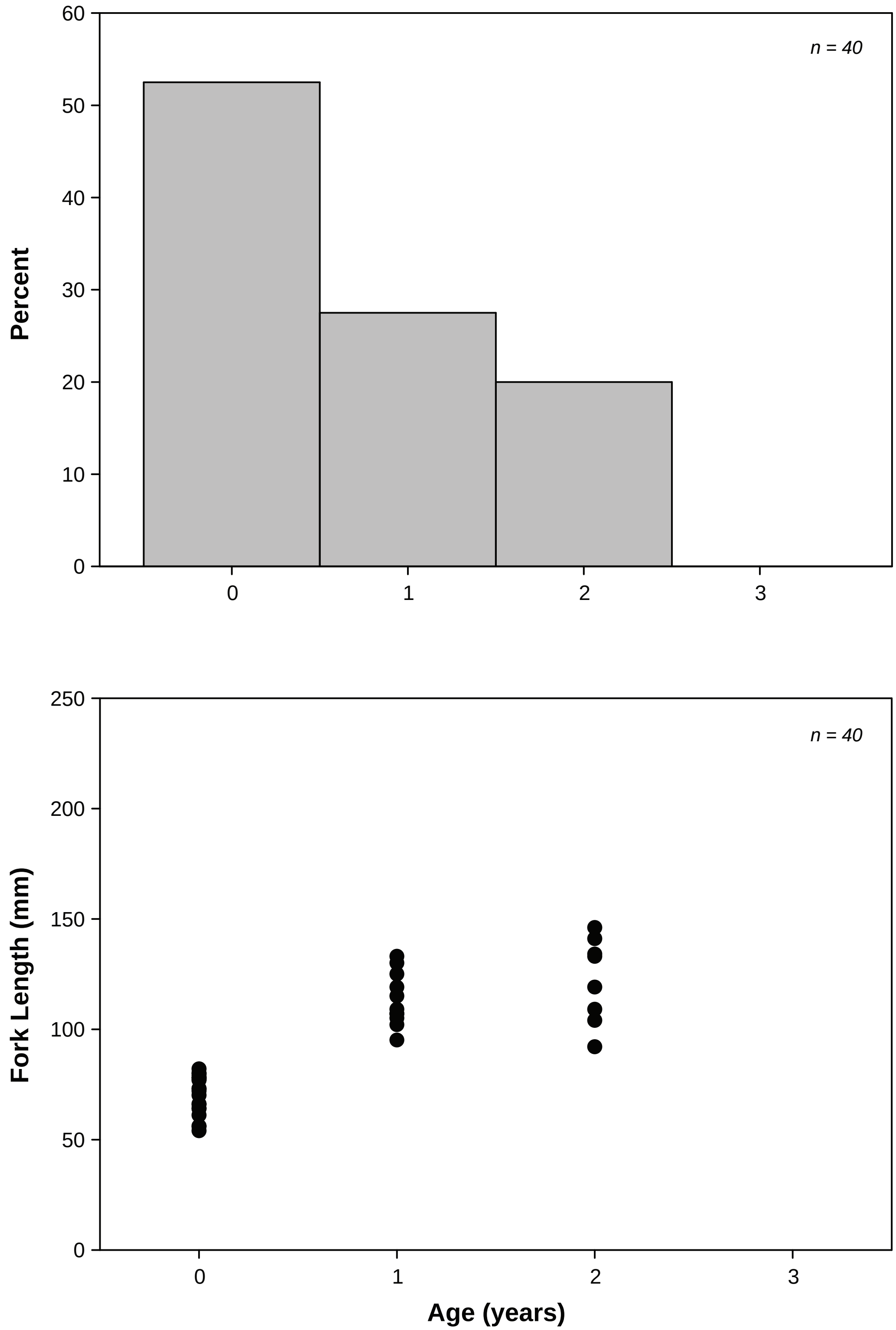

Figure 3.2-7

Age-Frequency and Length-at-Age of Arctic Char in Stream E14, Doris North Project, 2011

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4. Summary

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4. Summary

The monitoring requirements of the Doris Mine Site Fisheries Authorization Monitoring Program for 2011 are outlined in the No Net Loss Plan as follows:

- Monitor the outmigration of Arctic char smolts through Roberts Outflow using fish fences installed upstream and downstream of the boulder garden;
- Monitor adult Arctic char stranding at the boulder garden in Roberts Outflow;
- Assess Arctic char smolt production in Roberts Lake using trap nets; and
- Assess Arctic char smolt production in Roberts Lake tributaries using backpack electrofishing.

All required minoring programs for 2011 were implemented. However, delayed fish fence installation and low trap net catches indicate that shallow trap nets are not a suitable gear for sampling smolts in Roberts Lake. The following are summaries of the monitoring programs undertaken in 2011.

4.1 MONITORING MIGRATION OF ARCTIC CHAR IN ROBERTS OUTFLOW

A total of 78 Arctic char were captured in the fish fence at Roberts Outflow from July 14 to August 9, 2011. Only two smolts and one juvenile were captured migrating downstream. The remaining 75 fish were all captured moving upstream. Migrating Arctic char were mostly adults with a median age of 6 years and a mean fork length of 634 mm. This was the largest mean size recorded in any year of monitoring Arctic char migration in Roberts Outflow. A large upstream run of adult lake trout occurred during the third week of July, 2011. The fish fence also captured 186 lake trout. Of these, 177 were moving upstream and all upstream migrants were adults. Migrating lake trout had a median age of 7 years and a mean fork length of 621 mm.

Water levels in Roberts Outflow were high during freshet, resulting in delayed installation of the fish fence and very low catches of downstream migrating fish. However, water levels dropped rapidly and stranding of adult Arctic char in the boulder garden was observed by the second week of August. On August 14, 2011, a total of 13 adult Arctic char were found stranded.

A Spearman rank correlation analysis was conducted using four years of fish fence data at Little Roberts Outflow and Roberts Outflow. Water temperature and water flow were both correlated with seaward migration of Arctic char in some years but not in others. Moreover, the type of correlation (negative vs. positive) and its magnitude varied both within and among years.

4.2 ARCTIC CHAR PRODUCTION IN ROBERTS LAKE AND TRIBUTARIES

Trap nets were used to characterize fish communities and estimate Arctic char juvenile production in Roberts Lake. Four species (Arctic char, lake trout, lake whitefish, and ninespine stickleback) were caught in the trap nets. Only two Arctic char were captured in trap nets. This was the second year that trap nets were set in Roberts Lake, and the results from 2010 and 2011 indicate that trap nets set in the littoral zone are not a suitable gear for estimating smolt production in Roberts lake.

Juvenile Arctic char use specific tributaries of Roberts Lake as rearing habitat and possible migration routes to spawning areas in adjacent, smaller lakes. Large numbers of juvenile (age 0 to 3 years) Arctic char inhabited Stream E14 on the northwest side of Roberts Lake. Stream E09 also contained juvenile (age 0 to 3 years) Arctic char, although in lesser numbers than stream E14. The dominant age class in both streams was 0 years (young-of-the-year). Population density of Arctic char in both tributaries was highest immediately after freshet and declined over the summer. Stream E09 was selected for habitat enhancement on the basis that removal of boulders would improve access and create further pool habitat suitable for juvenile rearing.

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Appendix 3.1-1

Biological and Tagging Data from Fish Fence in Roberts Outflow, Doris North Project, 2011

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Appendix 3.1-1. Biological and Tagging Data from Fish Fence in Roberts Outflow, Doris North Project, 2011

Date	Box (U/D)	Water temp (ºC)	Sample #	Species	FL (mm)	Weight (g)	Condition	Age (y)	PIT tag #	PIT tag year	Recap (Y/N)	Prev. Floy Tag	New Floy Tag
14-Jul-11	U	6.0	1	LWF	555	1950	1.14	-	-	-	N	-	-
14-Jul-11	U	6.0	2	LT	890	7200	1.02	-	-	-	Y	G-4699	-
14-Jul-11	U	6.0	3	LT	661	2950	1.02	10	965000000072798	2011	N	-	Y-2011-0001
14-Jul-11	U	6.0	4	AC	655	4200	1.49	6	965000000001785	2011	N	-	Y-2011-0002
14-Jul-11	U	6.0	5	LT	797	4950	0.98	-	965000000004630	2011	Y	Y-RL10-0332	-
14-Jul-11	U	6.0	6	AC	845	7700	1.28	11	965000000069024	2011	N	-	Y-2011-0003
14-Jul-11	U	6.0	7	LT	660	3700	1.29	-	965000000066385	2010	Y	Y-RL10-0343	-
14-Jul-11	U	6.0	8	LT	820	5450	0.99	-	985120031583871	2010	Y	G-4685	-
14-Jul-11	D	6.0	NFC	-	-	-	-	-	-	-	-	-	-
15-Jul-11	U	7.0	9	AC	660	3600	1.25	7	965000000007237	2011	N	-	Y-2011-0004
15-Jul-11	U	7.0	10	LT	740	4700	1.16	-	985120031627753	2010	Y	G-4702	-
15-Jul-11	U	7.0	11	AC	700	4200	1.22	10	965000000067493	2011	N	-	Y-2011-0005
15-Jul-11	U	7.0	12	LT	540	1400	0.89	9	965000000069168	2011	N	-	Y-2011-0006
15-Jul-11	U	7.0	13	AC	800	6600	1.29	-	985120031618446	2010	Y	G-3844	-
15-Jul-11	U	7.0	14	LT	650	2800	1.02	-	985153000021421	2010	Y	G-4096	-
15-Jul-11	U	7.0	15	LT	570	1800	0.97	-	965000000068892	2010	Y	Y-RL10-0404	-
15-Jul-11	U	7.0	16	LT	570	2400	1.30	-	965000000068398	2010	Y	Y-RL10-0487	-
15-Jul-11	D	7.0	17	AC	215	88.5	0.89	5	965000000071782	2011	N	-	-
15-Jul-11	D	7.0	18	AC	115	11.5	0.76	2	-	-	N	-	(dead)
15-Jul-11	U	7.0	19	LT	475	1200	1.12	-	985153000021429	2010	Y	Y-RL10-0121	-
16-Jul-11	U	7.0	20	AC	760	5200	1.18	10	965000000068229	2011	N	-	Y-2011-0008
16-Jul-11	U	7.0	21	LT	505	1500	1.16	10	965000000070130	2011	N	-	Y-2011-0009
16-Jul-11	U	7.0	22	LT	660	3500	1.22	13	695000000069475	2011	N	-	Y-2011-0010
16-Jul-11	U	7.0	23	LT	585	2500	1.25	-	985153000021495	2010	Y	G-3990	-
16-Jul-11	U	7.0	24	LT	500	1700	1.36	-	-	-	Y	G-4312	-
16-Jul-11	U	7.0	25	AC	680	4000	1.27	12	965000000068915	2011	N	-	Y-2011-0011
16-Jul-11	U	7.0	26	LWF	479	1400	1.27	-	-	-	-	-	-
16-Jul-11	D	7.0	NFC	-	-	-	-	-	-	-	-	-	-
17-Jul-11	U	7.0	27	LWF	490	1800	1.53	-	-	-	N	-	Y-2011-0017
17-Jul-11	U	7.0	28	LT	470	1250	1.20	-	985120031587303	2010	Y	None	-
17-Jul-11	U	7.0	29	LT	910	8950	1.19	-	965000000072302	2010	Y	Y-RL10-0337	-
17-Jul-11	U	7.0	30	LT	800	5600	1.09	-	-	-	Y	G-4650	-
17-Jul-11	U	7.0	31	LT	500	1550	1.24	-	965000000068332	2010	Y	Y-RL10-0780	-
17-Jul-11	U	7.0	32	AC	900	9700	1.33	10	965000000072584	2011	N	-	Y-2011-0012
17-Jul-11	U	7.0	33	LT	690	3800	1.16	12	965000000069609	2011	N	-	Y-2011-0013
17-Jul-11	U	7.0	34	LT	710	3400	0.95	-	985153000021483	2010	Y	G-3981	-

Note: AC =Arctic char, LT = lake trout, LWF = lake whitefish

FL = fork length, U = upstream, D = downstream, UW = upstream between the fence wings, Y = Yes, N = No

Appendix 3.1-1. Biological and Tagging Data from Fish Fence in Roberts Outflow, Doris North Project, 2011

Date	Box (U/D)	Water temp (ºC)	Sample #	Species	FL (mm)	Weight (g)	Condition	Age (y)	PIT tag #	PIT tag year	Recap (Y/N)	Prev. Floy Tag	New Floy Tag
17-Jul-11	U	7.0	35	AC	630	3350	1.34	7	965000000072367	2011	N	-	Y-2011-0014
17-Jul-11	U	7.0	36	LT	810	6525	1.23	20	965000000070952	2011	N	-	Y-2011-0015
17-Jul-11	U	7.0	37	LT	590	2100	1.02	14	965000000067896	2011	N	-	Y-2011-0016
17-Jul-11	U	7.0	38	LWF	530	1800	1.21	-	-	-	-	-	-
17-Jul-11	D	7.0	39	AC	197	66.6	0.87	3	965000000068749	2011	N	-	-
17-Jul-11	D	7.0	40	LT	695	2700	0.80	-	-	-	Y	O-0908	-
17-Jul-11	D	7.0	41	LWF	490	-	-	-	-	-	Y	Y-2011-0017	-
18-Jul-11	U	11.0	42	LT	590	2200	1.07	-	985153000021489	2010	Y	G-3983	-
18-Jul-11	U	11.0	43	AC	850	7150	1.16	16	965000000067886	2011	N	-	Y-2011-0018
18-Jul-11	U	11.0	44	AC	740	5650	1.39	10	965000000067236	2011	N	-	Y-2011-0019
18-Jul-11	U	11.0	45	AC	810	7100	1.34	11	965000000068220	2011	N	-	Y-2011-0020
18-Jul-11	U	11.0	46	LT	840	6600	1.11	-	985120031614241	2010	Y	G-4667	-
18-Jul-11	U	11.0	47	LT	600	2500	1.16	-	985153000021420	2010	Y	G-4063	-
18-Jul-11	D	11.0	48	LT	505	1800	1.40	-	965000000067065	2010	Y	Y-RL10-0506	-
19-Jul-11	U	11.0	49	AC	655	3950	1.41	6	965000000009853	2011	N	-	Y-2011-0021
19-Jul-11	U	11.0	50	LT	600	2600	1.20	-	-	-	Y	G-4267	-
19-Jul-11	U	11.0	51	LWF	500	1350	1.08	-	-	-	N	-	Y-2011-0022
19-Jul-11	U	11.0	52	LT	505	1300	1.01	-	965000000071691	2010	Y	Y-RL10-0528	-
19-Jul-11	U	11.0	53	LT	920	8200	1.05	-	985120031573882	2010	Y	G-4343	-
19-Jul-11	U	11.0	54	LT	501	1350	1.07	-	965000000070115	2010	Y	Y-RL10-0432	-
19-Jul-11	U	11.0	55	LT	515	1750	1.28	-	965000000066513	2010	Y	Y-RL10-0502	-
19-Jul-11	U	11.0	56	LT	575	2150	1.13	15	965000000002742	2011	N	-	Y-2011-0023
19-Jul-11	U	11.0	57	LT	750	4750	1.13	-	985120031632031	2010	Y	G-4646	-
19-Jul-11	U	11.0	58	AC	630	2700	1.08	-	985120031567021	2010	Y	None	-
19-Jul-11	U	11.0	59	LT	470	1200	1.16	-	965000000069275	2011	N	-	Y-2011-0025
19-Jul-11	U	11.0	60	LT	690	3150	0.96	17	965000000070194	2011	N	-	Y-2011-0026
19-Jul-11	U	11.0	61	LT	595	2650	1.26	-	985153000021435	2010	Y	G-3992	-
19-Jul-11	U	11.0	62	LT	575	2600	1.37	-	985120031630304	2010	Y	G-4889	-
19-Jul-11	U	11.0	63	LT	580	2700	1.38	-	985153000021428	2010	Y	G-3994	-
19-Jul-11	U	11.0	64	LT	760	4650	1.06	20	965000000071092	2011	N	-	Y-2011-0027
19-Jul-11	U	11.0	65	LT	670	3050	1.01	14	965000000070109	2011	N	-	Y-2011-0028
19-Jul-11	U	11.0	66	LT	585	2350	1.17	-	965000000071203	2010	Y	Y-RL10-0508	-
19-Jul-11	U	11.0	67	LT	555	2000	1.17	-	985153000021467	2010	Y	B-045	-
19-Jul-11	U	11.0	68	LT	560	1700	0.97	-	965000000070682	2010	Y	Y-RL10-0493	-
19-Jul-11	U	11.0	69	LT	595	2800	1.33	-	985153000021457	2010	Y	G-3984	-
19-Jul-11	U	11.0	70	LT	635	4050	1.58	-	965000000070509	2010	Y	Y-RL10-0778	-

Note: AC =Arctic char, LT = lake trout, LWF = lake whitefish

FL = fork length, U = upstream, D = downstream, UW = upstream between the fence wings, Y = Yes, N = No

Appendix 3.1-1. Biological and Tagging Data from Fish Fence in Roberts Outflow, Doris North Project, 2011

Date	Box (U/D)	Water temp (ºC)	Sample #	Species	FL (mm)	Weight (g)	Condition	Age (y)	PIT tag #	PIT tag year	Recap (Y/N)	Prev. Floy Tag	New Floy Tag
19-Jul-11	U	11.0	71	LT	495	1550	1.28	-	965000000089654	2010	Y	Y-RL10-0403	-
19-Jul-11	U	11.0	72	LT	555	1950	1.14	-	965000000068804	2010	Y	Y-RL10-0510	-
19-Jul-11	U	11.0	73	LT	600	2700	1.25	-	965000000069901	2010	Y	Y-RL10-0509	-
19-Jul-11	U	11.0	74	LT	580	2700	1.38	14	965000000070179	2011	N	-	Y-2011-0029
19-Jul-11	U	11.0	75	LT	490	1250	1.06	9	965000000072357	2011	N	-	Y-2011-0030
19-Jul-11	D	11.0	76	LT	330	450	1.25	7	965000000071218	2011	N	-	Y-2011-0031
20-Jul-11	U	12.0	77	LT	645	2600	0.97	-	965000000068897	2010	Y	Y-RL10-0501	-
20-Jul-11	U	12.0	78	LT	685	3300	1.03	-	985120031616738	2010	Y	G-4222	-
20-Jul-11	U	12.0	79	LT	550	2150	1.29	-	985153000021422	2010	Y	G-4034	-
20-Jul-11	U	12.0	80	LT	455	1100	1.17	9	965000000069076	2011	N	-	Y-2011-0032
20-Jul-11	U	12.0	81	LT	570	2550	1.38	-	985153000021447	2010	Y	G-4055	-
20-Jul-11	U	12.0	82	LT	470	1200	1.16	9	965000000070980	2011	N	-	Y-2011-0033
20-Jul-11	U	12.0	83	LT	520	1700	1.21	-	965000000069736	2010	Y	Y-RL10-0567	-
20-Jul-11	U	12.0	84	LT	510	1550	1.17	17	965000000070448	2011	N	-	Y-2011-0034
20-Jul-11	U	12.0	85	LT	510	1450	1.09	-	965000000069320	2010	Y	Y-RL10-0429	-
20-Jul-11	U	12.0	86	LT	490	1500	1.27	-	965000000068822	2010	Y	Y-RL10-0838	-
20-Jul-11	U	12.0	87	LT	580	2500	1.28	-	965000000067520	2010	Y	G-3809	-
20-Jul-11	U	12.0	88	LT	505	1550	1.20	13	965000000072089	2011	N	-	Y-2011-0035
20-Jul-11	U	12.0	89	LT	545	2100	1.30	-	985153000021484	2010	Y	G-3982	-
20-Jul-11	U	12.0	90	LT	505	1700	1.32	10	965000000071329	2011	N	-	Y-2011-0037
20-Jul-11	U	12.0	91	LT	665	3050	1.04	-	-	-	Y	G-4064	-
20-Jul-11	U	12.0	92	LT	540	3100	1.97	-	985153000021410	2010	Y	Y-RL10-0344	-
20-Jul-11	U	12.0	93	LT	520	2050	1.46	12	965000000072438	2011	N	-	Y-2011-0038
20-Jul-11	U	12.0	94	LT	515	1700	1.24	-	965000000068947	2010	Y	Y-RL10-0428	-
20-Jul-11	U	12.0	95	LT	520	1400	1.00	-	985120031599158	2010	Y	G-4016	-
20-Jul-11	U	12.0	96	LT	485	1600	1.40	15	965000000070661	2011	N	-	Y-2011-0039
20-Jul-11	U	12.0	97	AC	810	4850	0.91	-	965000000068220	2010	Y	Y-2011-0020	-
20-Jul-11	U	12.0	98	AC	750	5200	1.23	8	965000000004626	2011	N	-	Y-2011-0040
20-Jul-11	U	12.0	99	LT	750	6150	1.46	-	-	-	Y	G-4474	-
20-Jul-11	U	12.0	100	LT	675	3400	1.11	22	965000000071214	2011	N	-	Y-2011-0041
20-Jul-11	U	12.0	101	LT	835	6200	1.06	-	-	-	Y	G-4184	-
20-Jul-11	U	12.0	102	LT	650	3350	1.22	-	985153000021482	2010	Y	G-4895	-
20-Jul-11	U	12.0	103	LT	820	5100	0.92	-	965000000069905	2010	Y	Y-RL10-0308	-
20-Jul-11	U	12.0	104	LT	670	3300	1.10	-	965000000065971	2010	Y	Y-RL10-0339	-
20-Jul-11	U	12.0	105	LT	560	2300	1.31	-	985153000021460	2010	Y	G-3988	-
20-Jul-11	U	12.0	106	LT	570	1900	1.03	-	965000000070805	2010	Y	Y-RL10-0497	-

Note: AC =Arctic char, LT = lake trout, LWF = lake whitefish

FL = fork length, U = upstream, D = downstream, UW = upstream between the fence wings, Y = Yes, N = No

Appendix 3.1-1. Biological and Tagging Data from Fish Fence in Roberts Outflow, Doris North Project, 2011

Date	Box (U/D)	Water temp (ºC)	Sample #	Species	FL (mm)	Weight (g)	Condition	Age (y)	PIT tag #	PIT tag year	Recap (Y/N)	Prev. Floy Tag	New Floy Tag
20-Jul-11	U	14.0	107	LT	560	2600	1.48	-	985153000021068	2010	Y	B-068	-
20-Jul-11	U	14.0	108	LT	490	1650	1.40	10	965000000068366	2011	N	-	Y-2011-0042
20-Jul-11	U	14.0	109	LT	460	1250	1.28	-	965000000067798	2010	Y	Y-RL10-0310	-
20-Jul-11	U	14.0	110	LT	880	8500	1.25	-	-	-	Y	G-4595	-
20-Jul-11	D	14.0	111	LT	295	239	0.93	6	965000000070620	2011	N	-	(too small)
20-Jul-11	D	12.0	NFC	-	-	-	-	-	-	-	-	-	-
21-Jul-11	U	13.0	112	LT	570	2000	1.08	-	985153000021419	2010	Y	G-3993	-
21-Jul-11	U	13.0	113	LT	580	1950	1.00	15	965000000072406	2011	N	-	Y-2011-0043
21-Jul-11	U	13.0	114	LT	700	4050	1.18	-	985153000021086	2010	Y	G-4877	-
21-Jul-11	U	13.0	115	LT	635	2900	1.13	-	985153000021472	2010	Y	G-4896	-
21-Jul-11	U	13.0	116	AC	850	6700	1.09	-	965000000067886	2010	Y	Y-2011-0018	-
21-Jul-11	U	13.0	117	AC	845	7100	1.18	9	965000000003803	2011	N	-	Y-2011-0044
21-Jul-11	U	13.0	118	LT	485	1600	1.40	-	965000000072444	2010	Y	Y-RL10-0408	-
21-Jul-11	U	13.0	119	LT	605	2800	1.26	-	965000000069230	2010	Y	Y-RL10-0527	-
21-Jul-11	U	13.0	120	LT	510	1850	1.39	-	985120031656284	2010	Y	None	-
21-Jul-11	U	13.0	121	LT	595	2050	0.97	-	-	-	Y	Y-RL10-0430	-
21-Jul-11	U	13.0	122	LT	570	1900	1.03	-	985153000021402	2010	Y	Y-RL10-0341	-
21-Jul-11	U	13.0	123	LT	595	2500	1.19	-	985153000021455	2010	Y	G-3989	-
21-Jul-11	U	13.0	124	LT	400	800	1.25	9	965000000069175	2011	N	-	Y-2011-0045
21-Jul-11	U	13.0	125	LT	450	1200	1.32	9	965000000068115	2011	N	-	Y-2011-0046
21-Jul-11	U	13.0	126	LT	480	1400	1.27	-	965000000077507	2010	Y	Y-RL10-0423	-
21-Jul-11	D	12.0	dead	LT	-	-	-	-	985153000021472	2010	Y	G-4896	-
22-Jul-11	U	13.0	127	LT	550	2050	1.23	-	-	-	Y	Y-RL10-0492	-
22-Jul-11	U	13.0	128	LT	555	2000	1.17	-	985153000021438	2010	Y	G-4266	-
22-Jul-11	U	13.0	129	LT	411	850	1.22	-	965000000066934	2010	Y	Y-RL10-0548	-
22-Jul-11	U	13.0	130	LT	805	5500	1.05	-	985120031554950	2010	Y	Y-RL10-0012	-
22-Jul-11	U	13.0	131	LT	600	2550	1.18	-	-	-	Y	G-4724	-
22-Jul-11	U	13.0	132	LT	677	3500	1.13	-	985153000021042	2010	Y	G-4884	-
22-Jul-11	U	13.0	133	LT	460	1250	1.28	10	965000000067661	2011	N	-	Y-2011-0048
22-Jul-11	U	13.0	134	LT	470	1350	1.30	12	965000000004082	2011	N	-	Y-2011-0049
22-Jul-11	U	13.0	135	LT	585	2550	1.27	-	965000000066375	2010	Y	Y-RL10-0338	-
22-Jul-11	U	13.0	136	LT	505	1800	1.40	-	965000000064367	2010	Y	Y-RL10-0124	-
22-Jul-11	U	13.0	137	LT	510	1850	1.39	-	965000000071348	2010	Y	Y-RL10-0503	-
22-Jul-11	U	13.0	138	LT	540	2100	1.33	-	985120031587003	2010	Y	Y-RL10-0507	-
22-Jul-11	U	13.0	139	LT	440	1200	1.41	10	965000000009960	2011	N	-	Y-2011-0050
22-Jul-11	U	13.0	140	LT	497	1450	1.18	-	965000000070205	2010	Y	Y-RL10-0530	-

Note: AC =Arctic char, LT = lake trout, LWF = lake whitefish

FL = fork length, U = upstream, D = downstream, UW = upstream between the fence wings, Y = Yes, N = No

Appendix 3.1-1. Biological and Tagging Data from Fish Fence in Roberts Outflow, Doris North Project, 2011

Date	Box (U/D)	Water temp (ºC)	Sample #	Species	FL (mm)	Weight (g)	Condition	Age (y)	PIT tag #	PIT tag year	Recap (Y/N)	Prev. Floy Tag	New Floy Tag
22-Jul-11	U	13.0	141	LT	637	2570	0.99	-	-	-	Y	G-4280	-
22-Jul-11	U	13.0	142	LT	440	1200	1.41	-	965000000072235	2010	Y	Y-RL10-0840	-
22-Jul-11	U	13.0	143	LT	490	1700	1.44	13	965000000002264	2011	N	-	Y-2011-0051
22-Jul-11	U	13.0	144	LT	515	1500	1.10	12	965000000003805	2011	N	-	Y-2011-0052
23-Jul-11	U	14.0	145	AC	720	5400	1.45	-	985153000021006	2010	Y	G-4873	-
23-Jul-11	U	14.0	146	AC	575	2700	1.42	7	965000000002261	2011	N	-	Y-2011-0053
23-Jul-11	U	14.0	147	LT	475	1550	1.45	10	965000000069746	2011	N	-	Y-2011-0054
23-Jul-11	U	14.0	148	LT	510	1750	1.32	10	965000000071673	2011	N	-	Y-2011-0055
23-Jul-11	U	14.0	149	LT	490	1350	1.15	14	900026000062759	2011	N	-	Y-2011-0056
23-Jul-11	U	14.0	150	LT	685	2700	0.84	17	900026000062800	2011	N	-	Y-2011-0057
23-Jul-11	U	14.0	151	LT	460	1200	1.23	12	900026000062801	2011	N	-	Y-2011-0058
23-Jul-11	U	14.0	152	LT	450	1050	1.15	-	-	-	Y	G-4268	-
24-Jul-11	U	12.0	153	LWF	385	800	1.40	-	-	-	N	-	-
24-Jul-11	U	12.0	154	LT	415	900	1.26	9	900026000062657	2011	N	-	Y-2011-0059
24-Jul-11	U	12.0	155	LT	790	4500	0.91	25	900026000062663	2011	N	-	Y-2011-0061
24-Jul-11	D	12.0	NFC	-	-	-		-	-	-	-	-	-
25-Jul-11	U	14.0	156	LT	435	1050	1.28	11	900026000062656	2011	N	-	Y-2011-0064
25-Jul-11	U	14.0	157	LKCI	355	450	1.01	-	-	-	-	-	-
25-Jul-11	U	14.0	158	LT	462	1250	1.27	12	900026000062789	2011	N	-	Y-2011-0066
25-Jul-11	U	14.0	159	LT	495	1550	1.28	-	965000000091341	2010	Y	Y-RL10-0594	-
25-Jul-11	U	14.0	160	LT	525	1900	1.31	16	900026000062808	2011	N	-	Y-2011-0067
25-Jul-11	U	14.0	161	LT	467	1200	1.18	-	965000000077102	2010	Y	Y-RL10-0228	-
25-Jul-11	U	14.0	162	LT	465	1200	1.19	16	900026000062658	2011	N	-	Y-2011-0068
25-Jul-11	U	14.0	163	LT	460	1500	1.54	-	965000000009939	2010	Y	Y-RL10-0416	-
25-Jul-11	U	14.0	164	LT	450	1050	1.15	10	900026000062693	2011	N	-	Y-2011-0069
25-Jul-11	D	14.0	165	LT	335	450	1.20	8	900026000062779	2011	N	-	Y-2011-0070
26-Jul-11	U	11.5	166	LT	460	1300	1.34	10	900026000062767	2011	N	-	Y-2011-0073
26-Jul-11	U	11.5	167	LT	465	1400	1.39	10	900026000062727	2011	N	-	Y-2011-0074
26-Jul-11	U	11.5	168	LT	385	650	1.14	9	900026000062643	2011	N	-	Y-2011-0075
26-Jul-11	U	11.5	169	LT	485	1300	1.14	-	-	-	Y	G-4365	-
26-Jul-11	U	11.5	170	LT	475	1450	1.35	-	985120031605864	2010	Y	Y-RL10-0447	-
27-Jul-11	U	11.5	171	LT	520	1300	0.92	-	-	-	Y	Y-RL10-0576	-
27-Jul-11	U	11.0	NFC	-	-	-	-	-	-	-	-	-	-
28-Jul-11	U	12.5	172	LKCI	345	450	1.10	-	-	-	-	-	-
28-Jul-11	D	12.5	173	UNID	37	-	-	-	-	-	-	-	-
28-Jul-11	UW	12.5	174	LT	440	1100	1.29	-	965000000068115	2010	Y	Y-2011-0046	-

Note: AC =Arctic char, LT = lake trout, LWF = lake whitefish

FL = fork length, U = upstream, D = downstream, UW = upstream between the fence wings, Y = Yes, N = No

Appendix 3.1-1. Biological and Tagging Data from Fish Fence in Roberts Outflow, Doris North Project, 2011

Date	Box (U/D)	Water temp (ºC)	Sample #	Species	FL (mm)	Weight (g)	Condition	Age (y)	PIT tag #	PIT tag year	Recap (Y/N)	Prev. Floy Tag	New Floy Tag
29-Jul-11	U	12.0	200	AC	680	3800	1.21	9	900026000062783	2011	N	-	Y-2011-0076
29-Jul-11	U	12.0	201	AC	870	9500	1.44	9	900026000062786	2011	N	-	Y-2011-0077
29-Jul-11	U	12.0	202	AC	820	7000	1.27	-	965000000070703	2010	Y	Y-RL10-0410	-
29-Jul-11	UW	12.0	203	LT	410	1100	1.60	9	900026000062719	2011	N	-	Y-2011-0078
29-Jul-11	D	12.0	NFC	-	-	-	-	-	-	-	-	-	-
30-Jul-11	U	12.0	204	LT	438	1100	1.31	-	965000000069491	2010	Y	Y-RL10-0032	-
30-Jul-11	U	12.0	205	LT	440	1000	1.17	9	900026000062738	2011	N	-	Y-2011-0080
30-Jul-11	U	12.0	206	LT	457	1100	1.15	11	900026000062675	2011	N	-	Y-2011-0081
30-Jul-11	D	12.0	207	LT	192	82.5	1.17	5	900026000062812	2011	N	-	-
31-Jul-11	U	14.5	208	LWF	495	1700	1.40	-	-	-	-	-	-
31-Jul-11	U	14.5	209	LT	483	1500	1.33	15	900026000062659	2011	N	-	Y-2011-0082
31-Jul-11	U	14.5	210	LT	369	600	1.19	9	900026000062649	2011	N	-	Y-2011-0083
31-Jul-11	UW	14.5	211	LT	465	1200	1.19	9	900026000062835	2011	N	-	Y-2011-0084
31-Jul-11	UW	14.5	212	LT	435	1050	1.28	9	900026000062776	2011	N	-	Y-2011-0085
31-Jul-11	UW	14.5	213	LT	498	1350	1.09	11	900026000062699	2011	N	-	Y-2011-0086
31-Jul-11	UW	14.5	214	LT	490	1550	1.32	12	900026000062828	2011	N	-	Y-2011-0087
31-Jul-11	UW	14.5	215	LT	396	750	1.21	11	900026000062785	2011	N	-	Y-2011-0088
31-Jul-11	UW	14.5	216	LT	407	1000	1.48	-	965000000069961	2010	Y	-	-
31-Jul-11	U	14.5	217	LT	460	950	0.98	-	-	-	Y	G-4342	-
31-Jul-11	D	14.5	NFC	-	-	-	-	-	-	-	-	-	-
1-Aug-11	U	14.0	218	AC	739	6600	1.64	10	900026000062733	2011	N	-	Y-2011-0090
1-Aug-11	U	14.0	219	AC	748	5700	1.36	-	985153000021088	2010	Y	G-4883	-
1-Aug-11	U	14.0	220	LT	435	1100	1.34	8	900026000062794	2011	N	-	Y-2011-0091
1-Aug-11	U	14.0	221	AC	656	4000	1.42	6	900026000062805	2011	N	-	Y-2011-0092
2-Aug-11	U	14.0	222	LT	420	900	1.21	-	965000000072150	2010	Y	Y-RL10-0414	-
2-Aug-11	U	14.0	223	AC	620	3450	1.45	-	965000000066113	2010	Y	-	-
2-Aug-11	U	14.0	224	AC	725	5200	1.36	-	965000000066924	2010	Y	-	-
2-Aug-11	UW	14.0	225	LT	440	1050	1.23	6	900026000062739	2011	N	-	Y-2011-0093
2-Aug-11	UW	14.0	226	LT	429	900	1.14	11	900026000062762	2011	N	-	Y-2011-0094
2-Aug-11	UW	14.0	227	LT	430	900	1.13	11	900026000062731	2011	N	-	Y-2011-0095
2-Aug-11	UW	14.0	228	LT	500	1300	1.04	-	965000000071531	2010	Y	Y-RL10-0448	-
2-Aug-11	UW	14.0	229	LT	420	900	1.21	12	900026000062687	2011	N	-	Y-2011-0096
2-Aug-11	UW	14.0	230	LT	435	1100	1.34	11	900026000062732	2011	N	-	Y-2011-0097
2-Aug-11	UW	14.0	231	LT	429	800	1.01	-	965000000069964	2010	Y	Y-RL10-0242	-
2-Aug-11	UW	14.0	232	LT	490	1550	1.32	12	900026000062821	2011	N	-	Y-2011-0098
2-Aug-11	UW	14.0	233	LT	460	1200	1.23	12	900026000062662	2011	N	-	Y-2011-0099

Note: AC =Arctic char, LT = lake trout, LWF = lake whitefish

FL = fork length, U = upstream, D = downstream, UW = upstream between the fence wings, Y = Yes, N = No

Appendix 3.1-1. Biological and Tagging Data from Fish Fence in Roberts Outflow, Doris North Project, 2011

Date	Box (U/D)	Water temp (ºC)	Sample #	Species	FL (mm)	Weight (g)	Condition	Age (y)	PIT tag #	PIT tag year	Recap (Y/N)	Prev. Floy Tag	New Floy Tag
2-Aug-11	U	14.0	234	AC	648	3950	1.45	-	985120031624361	2010	Y	-	-
2-Aug-11	U	14.0	235	AC	783	6200	1.29	9	900026000062729	2011	N	-	Y-2011-0100
2-Aug-11	U	14.0	236	LT	479	1400	1.27	13	965000000072641	2011	N	-	Y-2011-0101
2-Aug-11	U	14.0	237	AC	740	6100	1.51	8	900026000062679	2011	N	-	Y-2011-0102
2-Aug-11	U	14.0	238	AC	581	3000	1.53	6	900026000062765	2011	N	-	Y-2011-0103
2-Aug-11	U	14.0	239	LT	469	1300	1.26	15	900026000062781	2011	N	-	Y-2011-0104
3-Aug-11	U	14.5	240	LWF	392	1000	1.66	-	-	-	-	-	-
3-Aug-11	U	14.5	241	LT	697	2750	0.81	-	-	-	Y	O-0908	-
3-Aug-11	U	14.5	242	AC	577	3250	1.69	6	900026000062740	2011	N	-	Y-2011-0105
3-Aug-11	U	14.5	243	LT	556	1700	0.99	-	900026000062664	2011	N	-	-
3-Aug-11	U	14.5	244	AC	726	5000	1.31	10	900026000062678	2011	N	-	Y-2011-0106
3-Aug-11	U	14.5	245	AC	810	7200	1.35	9	900026000062661	2011	N	-	Y-2011-0107
3-Aug-11	U	14.5	246	AC	708	5000	1.41	8	900026000062741	2011	N	-	Y-2011-0108
3-Aug-11	U	14.5	247	AC	601	3300	1.52	7	900026000062668	2011	N	-	Y-2011-0109
3-Aug-11	U	14.5	248	AC	592	3000	1.45	8	900026000062655	2011	N	-	Y-2011-0110
3-Aug-11	U	14.5	249	AC	488	1700	1.46	-	965000000110644	2010	Y	Y-RL10-0230	-
3-Aug-11	U	14.5	250	AC	433	1000	1.23	7	900026000062694	2011	N	-	Y-2011-0111
3-Aug-11	U	14.5	251	AC	539	1600	1.02	-	-	-	Y	G-4203	-
3-Aug-11	D	14.5	NFC	-	-	-	-	-	-	-	-	-	-
4-Aug-11	U	15.0	252	AC	820	8100	1.47	-	965000000085858	2010	Y	Y-RL10-0415	-
4-Aug-11	U	15.0	253	AC	840	7600	1.28	10	900026000062749	2011	N	-	Y-2011-0112
4-Aug-11	U	15.0	254	LT	437	1100	1.32	-	-	-	Y	G-4335	-
4-Aug-11	U	15.0	255	LT	395	900	1.46	10	900026000062763	2011	N	-	Y-2011-0113
4-Aug-11	D	15.0	256	AC	273	221	1.09	7	900026000062710	2011	N	-	-
4-Aug-11	UW	15.0	257	LT	416	1200	1.67	-	965000000069906	2010	Y	Y-RL10-0222	-
4-Aug-11	UW	15.0	258	LT	393	900	1.48	9	900026000062669	2011	N	-	Y-2011-0114
4-Aug-11	UW	15.0	259	LT	425	1100	1.43	-	-	-	Y	Y-RB10-0044	-
5-Aug-11	U	15.5	260	AC	435	1100	1.34	3	900026000062681	2011	N	-	Y-2011-0015
6-Aug-11	UW	16.0	261	LT	472	1450	1.38	10	900026000062653	2011	N	-	Y-2011-0016
6-Aug-11	UW	16.0	262	LT	430	900	1.13	10	900026000062711	2011	N	-	Y-2011-0017
6-Aug-11	UW	16.0	263	LT	415	800	1.12	10	900026000062796	2011	N	-	Y-2011-0018
7-Aug-11	U	16.5	264	AC	781	7100	1.49	11	900026000062809	2011	N	-	Y-2011-0120
7-Aug-11	U	16.5	265	LT	830	4600	0.80	29	900026000062706	2011	N	-	Y-2011-0121
7-Aug-11	U	16.5	266	AC	674	3900	1.27	-	965000000092609	2010	Y	Y-RL10-0214	-
7-Aug-11	U	16.5	267	AC	545	2400	1.48	6	900026000062736	2011	N	-	Y-2011-0122
7-Aug-11	U	16.5	268	AC	395	650	1.05	5	900026000062712	2011	N	-	Y-2011-0123

Note: AC =Arctic char, LT = lake trout, LWF = lake whitefish

FL = fork length, U = upstream, D = downstream, UW = upstream between the fence wings, Y = Yes, N = No

Appendix 3.1-1. Biological and Tagging Data from Fish Fence in Roberts Outflow, Doris North Project, 2011

Date	Box (U/D)	Water temp (ºC)	Sample #	Species	FL (mm)	Weight (g)	Condition	Age (y)	PIT tag #	PIT tag year	Recap (Y/N)	Prev. Floy Tag	New Floy Tag
7-Aug-11	U	16.5	269	AC	550	2300	1.38	6	900026000062810	2011	N	-	Y-2011-0124
7-Aug-11	U	16.5	270	AC	515	2000	1.46	5	900026000062674	2011	N	-	Y-2011-0125
7-Aug-11	U	16.5	271	LT	427	900	1.16	10	900026000062825	2011	N	-	Y-2011-0126
7-Aug-11	U	16.5	272	AC	715	5000	1.37	-	965000000065710	2010	Y	Y-RL10-0534	-
7-Aug-11	U	16.5	273	AC	650	4250	1.55	6	900026000062651	2011	N	-	Y-2011-0127
7-Aug-11	U	16.5	274	AC	780	5550	1.17	-	-	-	Y	G-4288	-
7-Aug-11	U	16.5	275	LT	504	1400	1.09	24	900026000062660	2011	N	-	Y-2011-0128
7-Aug-11	U	16.5	276	LT	440	1050	1.23	10	900026000062751	2011	N	-	Y-2011-0129
8-Aug-11	U	17.0	277	AC	622	3300	1.37	6	900026000062813	2011	N	-	Y-2011-0130
8-Aug-11	U	17.0	278	AC	539	2200	1.40	6	900026000062757	2011	N	-	Y-2011-0131
8-Aug-11	U	17.0	279	AC	627	3600	1.46	-	965000000071162	2010	Y	Y-RL10-0802	-
8-Aug-11	U	17.0	280	AC	566	2400	1.32	6	900026000062671	2011	N	-	Y-2011-0132
8-Aug-11	U	17.0	281	AC	454	1000	1.07	-	965000000069334	2010	Y	Y-RL10-0224	-
8-Aug-11	U	17.0	282	AC	512	1550	1.15	7	900026000062696	2011	N	-	Y-2011-0133
8-Aug-11	U	17.0	283	LT	471	1000	0.96	11	900026000062722	2011	N	-	Y-2011-0134
8-Aug-11	U	17.0	284	AC	409	850	1.24	5	900026000062716	2011	N	-	Y-2011-0135
8-Aug-11	U	17.0	285	AC	546	2400	1.47	7	900026000062690	2011	N	-	Y-2011-0136
8-Aug-11	U	17.0	286	AC	730	4350	1.12	-	-	-	Y	G-4278	-
8-Aug-11	U	17.0	287	AC	591	2950	1.43	5	900026000062724	2011	N	-	Y-2011-0137
8-Aug-11	U	17.0	288	AC	469	1450	1.41	5	900026000062811	2011	N	-	Y-2011-0138
8-Aug-11	U	17.0	289	LT	441	1000	1.17	12	900026000062697	2011	N	-	Y-2011-0139
9-Aug-11	U	15.0	290	AC	552	2100	1.25	-	965000000069447	2010	Y	Y-RL10-0827	-
9-Aug-11	U	15.0	291	AC	545	2100	1.30	-	-	-	Y	Y-RB10-0237	-
9-Aug-11	U	15.0	292	AC	717	5700	1.55	7	900026000062641	2011	N	-	Y-2011-0140
9-Aug-11	U	15.0	293	AC	712	4500	1.25	9	900026000062698	2011	N	-	Y-2011-0141
9-Aug-11	U	15.0	294	AC	525	2200	1.52	-	965000000072022	2010	Y	Y-RL10-0129	-
9-Aug-11	U	15.0	295	AC	655	4200	1.49	-	965000000071225	2010	Y	Y-RL10-0557	-
9-Aug-11	U	15.0	296	AC	490	1600	1.36	5	900026000062648	2011	N	-	Y-2011-0142
9-Aug-11	U	15.0	297	AC	623	3400	1.41	-	985120031586022	2010	Y	Y-RL10-0207	-
9-Aug-11	U	15.0	298	AC	517	2350	1.70	6	900026000062764	2011	N	-	Y-2011-0143
9-Aug-11	U	15.0	299	AC	575	2800	1.47	5	900026000062680	2011	N	-	Y-2011-0144

Note: AC =Arctic char, LT = lake trout, LWF = lake whitefish

FL = fork length, U = upstream, D = downstream, UW = upstream between the fence wings, Y = Yes, N = No

Appendix 3.2-1

Biological and Tagging Data from Trap Nets in Roberts Lake, Doris North Project, 2011

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Appendix 3.2-1. Biological and Tagging Data from Trap Nets in Roberts Lake, Doris North Project, 2011

Date	Site #	Sample #	Species Code	Fork Length (mm)	Weight (g)	Condition	Age (y)	PIT #	Floy #	Recap (Y/N)
17-Jul-11	TN1	1	NSB	45	-	-	-	-	-	-
21-Jul-11	TN1	2	LT	740	-	-	15	-	Y-2011-0047	N
21-Jul-11	TN1	3	LWF	390	-	-	-	-	-	-
21-Jul-11	TN1	4	NSB	39	-	-	-	-	-	-
21-Jul-11	TN1	5	NSB	41	-	-	-	-	-	-
24-Jul-11	TN2	1	NSB	40	-	-	-	-	-	-
24-Jul-11	TN2	2	NSB	38	-	-	-	-	-	-
24-Jul-11	TN2	3	NSB	50	-	-	-	-	-	-
24-Jul-11	TN2	4	NSB	46	-	-	-	-	-	-
24-Jul-11	TN2	5	NSB	46	-	-	-	-	-	-
24-Jul-11	TN2	6	NSB	64	-	-	-	-	-	-
24-Jul-11	TN2	7	NSB	51	-	-	-	-	-	-
24-Jul-11	TN2	8	NSB	40	-	-	-	-	-	-
24-Jul-11	TN2	9	NSB	52	-	-	-	-	-	-
24-Jul-11	TN2	10	NSB	60	-	-	-	-	-	-
24-Jul-11	TN2	11	NSB	43	-	-	-	-	-	-
24-Jul-11	TN2	12	NSB	55	-	-	-	-	-	-
24-Jul-11	TN2	13	LT	410	550	0.80	11	-	Y-2011-0062	N
24-Jul-11	TN2	14	LT	570	1200	0.65	15	-	Y-2011-0063	N
6-Aug-11	TN3	1	NSB	54	-	-	-	-	-	-
6-Aug-11	TN3	2	NSB	48	-	-	-	-	-	-
6-Aug-11	TN3	3	NSB	53	-	-	-	-	-	-
6-Aug-11	TN3	4	NSB	38	-	-	-	-	-	-
6-Aug-11	TN3	5	NSB	46	-	-	-	-	-	-
6-Aug-11	TN3	6	NSB	44	-	-	-	-	-	-
6-Aug-11	TN3	7	NSB	46	-	-	-	-	-	-
6-Aug-11	TN3	8	NSB	22	-	-	-	-	-	-
6-Aug-11	TN3	9	NSB	43	-	-	-	-	-	-
6-Aug-11	TN3	10	NSB	37	-	-	-	-	-	-
6-Aug-11	TN3	11	NSB	26	-	-	-	-	-	-
6-Aug-11	TN3	12	NSB	57	-	-	-	-	-	-
6-Aug-11	TN3	13	NSB	54	-	-	-	-	-	-
6-Aug-11	TN3	14	NSB	42	-	-	-	-	-	-
6-Aug-11	TN3	15	NSB	26	-	-	-	-	-	-
6-Aug-11	TN3	16	NSB	57	-	-	-	-	-	-
6-Aug-11	TN3	17	NSB	46	-	-	-	-	-	-
6-Aug-11	TN3	18	NSB	23	-	-	-	-	-	-
6-Aug-11	TN3	19	NSB	53	-	-	-	-	-	-
6-Aug-11	TN3	20	NSB	52	-	-	-	-	-	-
6-Aug-11	TN3	21	NSB	54	-	-	-	-	-	-
6-Aug-11	TN3	22	NSB	21	-	-	-	-	-	-
6-Aug-11	TN3	23	NSB	22	-	-	-	-	-	-
6-Aug-11	TN3	24	NSB	26	-	-	-	-	-	-
6-Aug-11	TN3	25	NSB	49	-	-	-	-	-	-
6-Aug-11	TN3	26	NSB	52	-	-	-	-	-	-
6-Aug-11	TN3	27	NSB	51	-	-	-	-	-	-
6-Aug-11	TN3	28	NSB	42	-	-	-	-	-	-
6-Aug-11	TN3	29	NSB	51	-	-	-	-	-	-

Note: AC =Arctic char, LT = lake trout, NSB = ninespine stickleback

TN1 through TN6 = Trap Net Site 1 through Trap Net Site 6 (see Figure 2.1-1), FL = fork length, Y = Yes, N = No

Appendix 3.2-1. Biological and Tagging Data from Trap Nets in Roberts Lake, Doris North Project, 2011

Date	Site #	Sample #	Species Code	Fork Length (mm)	Weight (g)	Condition	Age (y)	PIT #	Floy #	Recap (Y/N)
6-Aug-11	TN3	30	NSB	42	-	-	-	-	-	-
6-Aug-11	TN3	31	NSB	49	-	-	-	-	-	-
6-Aug-11	TN3	32	NSB	24	-	-	-	-	-	-
6-Aug-11	TN3	33	NSB	56	-	-	-	-	-	-
6-Aug-11	TN3	34	NSB	56	-	-	-	-	-	-
6-Aug-11	TN3	35	NSB	49	-	-	-	-	-	-
6-Aug-11	TN3	36	NSB	43	-	-	-	-	-	-
6-Aug-11	TN3	37	NSB	49	-	-	-	-	-	-
6-Aug-11	TN3	38	NSB	56	-	-	-	-	-	-
6-Aug-11	TN3	39	NSB	47	-	-	-	-	-	-
6-Aug-11	TN3	40	NSB	47	-	-	-	-	-	-
6-Aug-11	TN3	41	NSB	52	-	-	-	-	-	-
6-Aug-11	TN3	42	NSB	23	-	-	-	-	-	-
6-Aug-11	TN3	43	NSB	47	-	-	-	-	-	-
6-Aug-11	TN3	44	NSB	43	-	-	-	-	-	-
6-Aug-11	TN3	45	NSB	56	-	-	-	-	-	-
6-Aug-11	TN3	46	NSB	58	-	-	-	-	-	-
6-Aug-11	TN3	47	NSB	52	-	-	-	-	-	-
6-Aug-11	TN3	48	NSB	50	-	-	-	-	-	-
6-Aug-11	TN3	49	NSB	52	-	-	-	-	-	-
6-Aug-11	TN3	50	NSB	61	-	-	-	-	-	-
6-Aug-11	TN3	51	NSB	51	-	-	-	-	-	-
6-Aug-11	TN3	52	NSB	52	-	-	-	-	-	-
6-Aug-11	TN3	53	NSB	52	-	-	-	-	-	-
6-Aug-11	TN3	54	NSB	48	-	-	-	-	-	-
6-Aug-11	TN3	55	NSB	25	-	-	-	-	-	-
6-Aug-11	TN3	56	NSB	21	-	-	-	-	-	-
6-Aug-11	TN3	57	NSB	19	-	-	-	-	-	-
6-Aug-11	TN3	58	NSB	47	-	-	-	-	-	-
6-Aug-11	TN3	59	NSB	51	-	-	-	-	-	-
6-Aug-11	TN3	60	NSB	48	-	-	-	-	-	-
6-Aug-11	TN3	61	NSB	46	-	-	-	-	-	-
6-Aug-11	TN3	62	NSB	47	-	-	-	-	-	-
6-Aug-11	TN3	63	NSB	42	-	-	-	-	-	-
6-Aug-11	TN3	64	NSB	22	-	-	-	-	-	-
6-Aug-11	TN3	65	NSB	25	-	-	-	-	-	-
6-Aug-11	TN3	66	NSB	49	-	-	-	-	-	-
6-Aug-11	TN3	67	NSB	27	-	-	-	-	-	-
6-Aug-11	TN3	68	NSB	21	-	-	-	-	-	-
6-Aug-11	TN3	69	NSB	25	-	-	-	-	-	-
6-Aug-11	TN3	70	NSB	22	-	-	-	-	-	-
6-Aug-11	TN3	71	NSB	19	-	-	-	-	-	-
6-Aug-11	TN3	72	NSB	31	-	-	-	-	-	-
6-Aug-11	TN3	73	NSB	26	-	-	-	-	-	-
6-Aug-11	TN3	74	NSB	32	-	-	-	-	-	-
25-Jul-11	TN4	1	LT	194	68	0.93	4	900026000062758	-	N
25-Jul-11	TN4	2	LT	200	70	0.88	3	900026000062803	-	N
25-Jul-11	TN4	3	LT	195	73	0.98	4	900026000062730	-	N

Note: AC =Arctic char, LT = lake trout, NSB = ninespine stickleback

TN1 through TN6 = Trap Net Site 1 through Trap Net Site 6 (see Figure 2.1-1), FL = fork length, Y = Yes, N = No

Appendix 3.2-1. Biological and Tagging Data from Trap Nets in Roberts Lake, Doris North Project, 2011

Date	Site #	Sample #	Species Code	Fork Length (mm)	Weight (g)	Condition	Age (y)	PIT #	Floy #	Recap (Y/N)
25-Jul-11	TN4	4	NSB	51	-	-	-	-	-	-
25-Jul-11	TN4	5	LT	360	-	-	12	900026000062670	Y-2011-0071	N
25-Jul-11	TN4	6	AC	90	6.8	0.93	-	-	-	-
25-Jul-11	TN4	7	NSB	50	-	-	-	-	-	-
25-Jul-11	TN4	8	AC	73	3.4	0.87	1	900026000062737		
25-Jul-11	TN4	9	NSB	-	-	-	-	-	-	-
25-Jul-11	TN4	10	NSB	-	-	-	-	-	-	-
28-Jul-11	TN4	1	LT	395	496	0.80	13	900026000062816	-	N
28-Jul-11	TN4	2	NSB	45	-	-	-	-	-	-
28-Jul-11	TN4	3	NSB	60	-	-	-	-	-	-
28-Jul-11	TN5	1	AC	141	32.4	1.16	2	900026000062700	-	N
28-Jul-11	TN5	2	NSB	50	-	-	-	-	-	-
28-Jul-11	TN5	3	NSB	48	-	-	-	-	-	-
30-Jul-11	TN5	1	LT	116	14.4	0.92	2	-	-	N
30-Jul-11	TN5	2	LT	254	166.8	1.02	5	900026000062760	-	N
30-Jul-11	TN5	3	LT	224	100.5	0.89	5	900026000062691	-	N
30-Jul-11	TN5	4	LT	222	106.6	0.97	-	900026000062793	-	N
31-Jul-11	TN5	1	LT	551	-	-	11	900026000062689	Y-2011-0089	N
31-Jul-11	TN5	2	LT	278	239.1	1.11	6	900026000062753	-	N
3-Aug-11	TN6	1	LT	302	-	-	-	900026000062654	-	-
6-Aug-11	TN6	1	LT	292	251	1.01	7	900026000062832	Y-RL10-0351	Y
6-Aug-11	TN6	2	LT	389	609	1.03	14	900026000062709	Y-2011-0119	N
6-Aug-11	TN6	3	LT	232	128	1.03	4	900026000062705		N

Note: AC =Arctic char, LT = lake trout, NSB = ninespine stickleback

TN1 through TN6 = Trap Net Site 1 through Trap Net Site 6 (see Figure 2.1-1), FL = fork length, Y = Yes, N = No

Appendix 3.2-2

Trap Net Catch per Unit Effort in Roberts Lake, Doris North Project, 2011

Rescan™ Engineers and Scientists

Appendix 3.2-2. Trap Net Catch per Unit Effort in Roberts Lake, Doris North Project, 2011

Site	Haul	Date	Zone	Easting	Northing	Max Depth (m)	Date In	Time In	Date Out	Time Out	# Fish/ Species AC	NSB	LT	LW	TOTAL	Effort H	CPUE (fish/trap/day) AC	NSB	LT	LW	TOTAL
TN1	1	16-Jul-11	13W	435564	7562696	2	16-Jul-11	16:00	17-Jul-11	15:00	0	1	0	0	1	23.0	0	1.04	0.00	0.00	1.04
	2	17-Jul-11	13W	435564	7562696	2	17-Jul-11	15:00	18-Jul-11	14:00	0	0	0	0	0	23.0	0	0.00	0.00	0.00	0.00
	3	18-Jul-11	13W	435564	7562696	2	18-Jul-11	14:00	21-Jul-11	15:30	0	2	0	1	3	25.5	0	1.88	0.00	0.94	2.82
TN2	1	17-Jul-11	13W	439043	7561556	2	17-Jul-11	14:00	18-Jul-11	15:00	0	0	0	0	0	25.0	0	0.00	0.00	0.00	0.00
	2	18-Jul-11	13W	439043	7561556	2	18-Jul-11	15:00	21-Jul-11	17:00	0	0	0	0	0	26.0	0	0.00	0.00	0.00	0.00
	3	21-Jul-11	13W	439043	7561556	2	21-Jul-11	17:00	24-Jul-11	16:00	0	12	2	0	14	23.0	0	12.52	2.09	0.00	14.61
TN3	1	28-Jul-11	13W	435559	7561288	1.5	28-Jul-11	16:45	30-Jul-11	15:00	0	0	0	0	0	22.3	0	0.00	0.00	0.00	0.00
	2	30-Jul-11	13W	435559	7561288	1.5	30-Jul-11	16:00	3-Aug-11	15:30	0	0	0	0	0	23.5	0	0.00	0.00	0.00	0.00
	3	3-Aug-11	13W	435559	7561288	1.5	3-Aug-11	16:15	6-Aug-11	14:00	0	74	0	0	74	21.8	0	81.47	0.00	0.00	81.47
TN4	1	21-Jul-11	13W	440096	7560986	2	21-Jul-11	17:00	25-Jul-11	16:30	2	4	4	0	10	23.5	2.04	4.09	4.09	0.00	10.21
	2	25-Jul-11	13W	440096	7560986	2	25-Jul-11	16:30	28-Jul-11	15:45	0	2	1	0	3	23.3	0	2.06	1.03	0.00	3.09
TN5	1	24-Jul-11	13W	436794	7563311	2	24-Jul-11	17:30	25-Jul-11	17:30	1	0	0	0	1	24.0	1	0.00	0.00	0.00	1.00
	2	25-Jul-11	13W	436794	7563311	2	25-Jul-11	17:30	28-Jul-11	14:45	0	0	3	0	3	21.3	0	0.00	3.38	0.00	3.38
	3	28-Jul-11	13W	436794	7563311	2	28-Jul-11	16:00	30-Jul-11	14:33	0	0	4	0	4	22.5	0	0.00	4.27	0.00	4.27
	4	30-Jul-11	13W	436794	7563311	2	30-Jul-11	15:00	31-Jul-11	14:00	0	0	2	0	2	23.0	0	0.00	2.09	0.00	2.09
TN6	1	31-Jul-11	13W	440161	7560349	2	31-Jul-11	15:00	3-Aug-11	16:30	0	0	1	0	1	25.5	0	0.00	0.94	0.00	0.94
	2	3-Aug-11	13W	440161	7560349	2	3-Aug-11	17:00	6-Aug-11	12:55	0	0	3	0	3	19.1	0	0.00	3.77	0.00	3.77

Note: AC = Arctic char, LT = lake trout, NSB = ninespine stickleback

TN1 through TN6 = Trap Net Site 1 through Trap Net Site 6 (see Figure 2.1-1), H = hours

Appendix 3.2-3

Catch and Effort Data from Electrofishing in Tributaries of Roberts Lake, Doris North Project, 2011

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Appendix 3.2-3. Catch and Effort Data from Electrofishing in Tributaries of Roberts Lake, Doris North Project, 2011

Date	Site	Pass #	Effort (sec)	Species Code	Catch	Comments
4-Jul-11	E14	1	555	AC	14	
4-Jul-11	E14	1	555	NSB	3	
4-Jul-11	E14	2	476	AC	10	
4-Jul-11	E14	3	400	AC	4	
4-Jul-11	E14	3	400	NSB	3	
4-Jul-11	E14	4	315	AC	2	
5-Jul-11	E09-DS	1	371	AC	4	
5-Jul-11	E09-DS	2	306	AC	3	
5-Jul-11	E09-DS	3	339	AC	4	
5-Jul-11	E09-DS	3	339	NSB	1	
5-Jul-11	E09-DS	4	302	AC	2	
5-Jul-11	E09-DS	4	302	NSB	1	
5-Jul-11	E09-MS	1	323	AC	3	
5-Jul-11	E09-MS	2	306	AC	2	
5-Jul-11	E09-MS	3	302	-	0	
6-Jul-11	E09-US	1	361	-	0	
6-Jul-11	E09-US	2	368	-	0	
11-Jul-11	E09-DS	1	116	-	0	stream very dry, difficult to shock
11-Jul-11	E09-DS	2	100	AC	1	stream very dry, difficult to shock
11-Jul-11	E09-DS	3	105	-	0	stream very dry, difficult to shock
11-Jul-11	E09-MS	1	76	-	0	stream very dry, difficult to shock
11-Jul-11	E09-MS	2	69	-	0	stream very dry, difficult to shock
23-Jul-11	E09-DS	1	92	LT	1	
23-Jul-11	E09-DS	2	254	AC	1	
23-Jul-11	E09-DS	3	203	-	0	
23-Jul-11	E09-MS	1	215	-	0	
23-Jul-11	E09-MS	2	194	-	0	
23-Jul-11	E09-MS	3	232	-	0	
23-Jul-11	E09-US	1	157	-	0	
23-Jul-11	E09-US	2	213	-	0	
23-Jul-11	E09-US	3	195	-	0	
24-Jul-11	E14	1	326	AC	8	
24-Jul-11	E14	1	326	NSB	4	
24-Jul-11	E14	2	328	AC	1	
24-Jul-11	E14	2	328	NSB	2	
24-Jul-11	E14	3	355	NSB	1	
26-Jul-11	E09-DS	1	237	AC	4	
26-Jul-11	E09-DS	2	213	LT	1	
26-Jul-11	E09-DS	3	242	-	0	
26-Jul-11	E09-MS	1	178	-	0	
26-Jul-11	E09-MS	2	218	-	0	
26-Jul-11	E09-MS	3	208	-	0	
26-Jul-11	E09-US	1	161	-	0	
26-Jul-11	E09-US	2	180	-	0	
26-Jul-11	E09-US	3	210	-	0	
27-Jul-11	E14	1	276	AC	3	
27-Jul-11	E14	1	276	NSB	4	
27-Jul-11	E14	2	345	AC	1	
27-Jul-11	E14	3	229	AC	1	
8-Aug-11	E14	1	196	-	0	water very low and turbid
8-Aug-11	E14	2	156	AC	1	
8-Aug-11	E14	2	156	NSB	2	
8-Aug-11	E14	3	151	-	0	water almost stagnant

Note: AC = Arctic char; LT = lake trout; NSB = ninespine stickleback

Appendix 3.2-4

Biological Data from Electrofishing in Roberts Lake Tributaries, Doris North Project, 2011

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Appendix 3.2-4. Biological Data from Electrofishing in Roberts Lake Tributaries, Doris North Project, 2011

Date	Site #	Sample #	Species Code	Length (mm)	Weight (g)	Age (y)
4-Jul-11	E14	1	AC	125	16.8	1
4-Jul-11	E14	2	AC	104	11	2
4-Jul-11	E14	3	AC	119	17.1	2
4-Jul-11	E14	4	AC	107	9.4	1
4-Jul-11	E14	5	AC	92	6.7	2
4-Jul-11	E14	6	AC	73	3.9	0
4-Jul-11	E14	7	AC	94	6	-
4-Jul-11	E14	8	AC	61	2.9	0
4-Jul-11	E14	9	AC	64	2.2	0
4-Jul-11	E14	10	AC	73	2.1	0
4-Jul-11	E14	11	AC	66	2	0
4-Jul-11	E14	12	AC	87	6.2	-
4-Jul-11	E14	13	AC	70	2.9	0
4-Jul-11	E14	14	AC	78	3.9	0
4-Jul-11	E14	15	AC	72	3.5	0
4-Jul-11	E14	16	AC	146	25.4	2
4-Jul-11	E14	17	AC	109	13.9	2
4-Jul-11	E14	18	AC	94	8.4	-
4-Jul-11	E14	19	AC	100	8.5	-
4-Jul-11	E14	20	AC	81	3.5	-
4-Jul-11	E14	21	AC	77	2.7	0
4-Jul-11	E14	22	AC	64	3.2	0
4-Jul-11	E14	23	AC	92	7	-
4-Jul-11	E14	24	AC	102	9.6	1
4-Jul-11	E14	25	AC	134	24.9	2
4-Jul-11	E14	26	AC	133	14.4	2
4-Jul-11	E14	27	AC	107	11.8	1
4-Jul-11	E14	28	AC	97	8.3	-
4-Jul-11	E14	29	AC	66	2.5	0
4-Jul-11	E14	30	AC	56	1.5	0
4-Jul-11	E14	31	AC	54	1.8	0
4-Jul-11	E14	32	AC	109	13	1
4-Jul-11	E14	33	AC	130	19.8	1
5-Jul-11	E09-DS	1	AC	78	3.7	0
5-Jul-11	E09-DS	2	AC	78	4	0
5-Jul-11	E09-DS	3	AC	74	3.5	0
5-Jul-11	E09-DS	4	AC	72	2.9	0
5-Jul-11	E09-DS	5	AC	76	3.8	0
5-Jul-11	E09-DS	6	AC	77	3	0
5-Jul-11	E09-DS	7	AC	70	2.9	0
5-Jul-11	E09-DS	8	AC	63	1.9	0
5-Jul-11	E09-DS	9	AC	69	1.7	0
5-Jul-11	E09-DS	10	AC	97	8.9	1
5-Jul-11	E09-DS	11	NSB	67	1.8	-
5-Jul-11	E09-DS	12	AC	71	2.9	0
5-Jul-11	E09-DS	13	AC	73	2.7	0

Notes: AC = Arctic char; LT = lake trout; NSB = ninespine stickleback.

Arctic char and lake trout were aged from pelvic fin ray samples.

Where fin rays could not be collected or read, Arctic char and lake trout <80 mm FL were assumed to be age 0.

Ageing structures were not collected from ninespine stickleback.

Appendix 3.2-4. Biological Data from Electrofishing in Roberts Lake Tributaries, Doris North Project, 2011

Date	Site #	Sample #	Species Code	Length (mm)	Weight (g)	Age (y)
5-Jul-11	E09-DS	14	AC	66	1.6	0
5-Jul-11	E09-DS	15	NSB	63	-	-
6-Jul-11	E09-MID	16	AC	115	15.5	2
6-Jul-11	E09-MID	17	AC	117	19.5	2
6-Jul-11	E09-MID	18	AC	155	34.6	3
6-Jul-11	E09-MID	19	AC	96	8.4	2
6-Jul-11	E09-MID	20	AC	104	12.5	2
23-Jul-11	E09-DS	1	LT	114	13.5	2
23-Jul-11	E09-DS	2	AC	141	25.7	2
24-Jul-11	E14	1	AC	78	5.2	0
24-Jul-11	E14	2	AC	82	6.1	0
24-Jul-11	E14	3	NSB	77	5.4	-
24-Jul-11	E14	4	NSB	50	-	-
24-Jul-11	E14	5	NSB	44	-	-
24-Jul-11	E14	6	NSB	51	-	-
24-Jul-11	E14	7	AC	80	5.2	0
24-Jul-11	E14	8	AC	78	5	0
24-Jul-11	E14	9	AC	80	3.8	0
24-Jul-11	E14	10	AC	77	4.1	0
24-Jul-11	E14	11	AC	79	3.8	0
24-Jul-11	E14	12	NSB	41	-	-
24-Jul-11	E14	13	AC	115	15.2	1
24-Jul-11	E14	14	NSB	52	-	-
24-Jul-11	E14	15	NSB	70	-	-
24-Jul-11	E14	16	NSB	45	-	-
26-Jul-11	E09-DS	1	AC	95	8.1	1
26-Jul-11	E09-DS	2	AC	90	6.7	1
26-Jul-11	E09-DS	3	AC	115	13.3	1
26-Jul-11	E09-DS	4	AC	87	5.9	1
26-Jul-11	E09-DS	5	LT	241	153	6
27-Jul-11	E14	1	NSB	49	10	-
27-Jul-11	E14	2	NSB	46	8	-
27-Jul-11	E14	3	NSB	35	6	-
27-Jul-11	E14	4	AC	56	9	0
27-Jul-11	E14	5	AC	133	23.9	1
27-Jul-11	E14	6	AC	105	12.5	1
27-Jul-11	E14	7	AC	95	8.8	1
27-Jul-11	E14	8	AC	119	20.2	1
8-Aug-11	E14	1	AC	81	4	-
8-Aug-11	E14	2	NSB	59	6.4	-
8-Aug-11	E14	3	NSB	43	1.6	-
11-Aug-11	E09-DS	1	AC	101	8.9	1

Notes: AC = Arctic char; LT = lake trout; NSB = ninespine stickleback.

Arctic char and lake trout were aged from pelvic fin ray samples.

Where fin rays could not be collected or read, Arctic char and lake trout <80 mm FL were assumed to be age 0.

Ageing structures were not collected from ninespine stickleback.