Willow Area

Fish Surveys in the Northeastern NPR-A: 2018

April 2019

Prepared for:

ConocoPhillips Alaska, Inc.
700 G Street
Anchorage, Alaska 99501

Prepared by:

Owl Ridge Natural Resource Consultants, Inc.
2121 Abbott Road, Suite 201
Anchorage, Alaska 99507
T: 907.344.3448
F: 907.344.3445
www.owlridgenrc.com

Document Number: CPA016-19-001F0

- Page Intentionally Left Blank -

EXECUTIVE SUMMARY

This report documents the results of the second year of a 3-year study required by Operating Procedure E-14 of the Bureau of Land Management February 2013 Record of Decision for the Northeast National Petroleum Reserve – Alaska Integrated Activity Plan (BLM 2013).

During summer 2018, fyke and seine nets were used to sample 21 sites distributed in the Iqalliqpik Creek (Judy Creek), Uvlutuuq Creek (Fish Creek), Kalikpik River, and Tinmiaqsiugvik River (Ublutuoch River) drainages throughout the open water season in the northeastern National Petroleum Reserve- Alaska (NPR-A). Sampling was focused on the post break-up period in June, mid-summer period in July, and just before freeze-up in late August. Fyke nets were arranged to sample fish moving both upstream and downstream. Captured fish were identified and measured to the nearest millimeter (mm) in fork length (FL) and released. Fish longer than 180 mm FL were tagged with an individually numbered tag to evaluate movement patterns within and between drainages.

Sampling in June was delayed nearly a week later than surveys in 2017 due to a late and prolonged spring break-up. Water temperatures fluctuated during each sampling period, however, were generally cool just after spring break-up in June, warmest in July, and cool again in August. Specific conductance and pH were lowest in June as snowmelt and runoff decreased and measured slightly higher and more stable during July and August. Turbidity was generally highest during June, which likely resulted from break-up related high runoff, and was lowest in August. Overall, stream temperatures throughout the 2018 season were cooler than during 2017, while specific conductance, pH, and turbidity were relatively consistent between years.

A total of 119,682 fish comprised of 12 species was captured in the nine drainages sampled. Resident fish were captured at all sites, while anadromous fish were captured at all sites except Willow 1 and Willow 3. Uvlutuuq Creek and the Kalikpik River were identified as migratory corridors for all species sampled. Chum salmon were captured at two sites and a sockeye salmon was captured at one site. Sampling at eight of the 15 sites captured at least six species of fish. Ninespine stickleback were the most abundant fish species captured and accounted for over 92% of the total catch, followed by Arctic grayling, least cisco, and broad whitefish. Fish catch rates were highest in Willow 4 and in a Uvlutuuq Creek tributary, which both consisted mostly of ninespine stickleback. The nearly 120,000 fish captured in 2018 was considerably greater than the 38,044 fish captured in 2017, though sampling effort was also greater in 2018. Overall 2018 total catch rates were greater than 2017 total catch rates. However, this was reversed when ninespine stickleback were excluded. Species composition between 2018 and 2017 was similar, with ninespine stickleback dominating catch in both years, followed by Arctic grayling.

Length frequency distributions of Arctic grayling, broad whitefish, and least cisco showed seasonal patterns of different length classes of fish using the sampled streams throughout the open water season. Distinct length classes likely representing age-0, age-1, and age-2 juvenile fish were captured across most sites and months. Ages of fish were not confirmed; however, age was assigned based on monthly length frequency distributions, with each size class denoted by group as size-0, size-1, and size-2 fish. In June, size-1 and size-2 Arctic grayling were captured, in addition to relatively low numbers of a wide range of larger-sized Arctic grayling, presumably moving upstream to spawning and feeding habitats. During this same time period, few apparent size-1 and size-2 broad whitefish and least cisco were captured, in addition to a wide

range of larger-sized fish. Multiple size classes of Arctic grayling, broad whitefish, and least cisco were captured in July, particularly juveniles. In August, all size classes of fish were less abundant as fish likely had moved downstream to overwintering and spawning habitats.

Arctic grayling juveniles were larger in size and grew faster, while adults had greater spawning success in 2017 than in 2018. Mean fork length of size-0, size-1, and size-2 fish in August 2017 was 10.2 mm, 25.3 mm, and 21.2 mm larger than fish in August 2018. Growth from June through August 2017 of size-1 and size-2 fish was 54.9 mm and 54.6 mm, compared to 26.1 mm and 31.4 mm for the same months in 2018. Annual production of size-0 fish also differed between years. Over the 2018 season, fishing effort was more than double that of 2017, yet only 15 size-0 Arctic grayling were captured, compared to 200 size-0 Arctic grayling captured in 2017, which indicates poor spawning and recruitment success. Differences in Arctic grayling size, growth, and annual production is likely due to the delayed spring and season-long cool stream temperatures and high flows experienced during 2018.

A total of 2,046 fish were tagged between the 15 fyke net sites in 2018. A total of seven species were tagged, with Arctic grayling accounting for over 65%, followed by broad whitefish, least cisco, humpback whitefish, round whitefish, burbot, and Alaska blackfish. There were 457 recaptures of tagged fish, of which 90% were Arctic grayling. A total of 123 recaptured fish in 2018 were initially tagged and released in 2017, two were initially tagged and released in 2013, and the remaining 332 fish were tagged and released in 2018. Approximately 41% of the fish were recaptured at different sites than they were initially tagged and released from and about 10% of fish were recaptured in different streams. Most fish were recaptured less than a month after being released and within a few miles of their release location; however, some fish traveled considerable distances. For example, two broad whitefish released in 2018 in small tributaries of the Tinmiaqsiugvik River and Uvlutuuq Creek were each recaptured approximately a month later in different drainages over 60 miles away. Trends in recaptured fish in 2018 were similar to 2017, with most of the fish recaptured in the same drainage as originally released, while others were recaptured in different, and occasionally distant, drainages.

FISH SURVEYS IN THE NORTHEASTERN NPR-A: 2018

Willow Final Report

April 2019

Prepared by:

Jason J. McFarland
William A. Morris
Lawrence L. Moulton
Kathleen M. Ferry
Craig R. Moulton

Owl Ridge Natural Resource Consultants, Inc.
2121 Abbott Road, Suite 201
Anchorage, Alaska 99507

Prepared for:

ConocoPhillips Alaska, Inc.
700 G Street
Anchorage, Alaska 99501

- Page Intentionally Left Blank -

TABLE OF CONTENTS

List of Tables

List of Figures

Appendices

ACRONYMS AND ABBREVIATIONS

ABBREVIATION	DEFINITION
ADF&G	Alaska Department of Fish and Game
BLM	Bureau of Land Management
CPAI	ConocoPhillips Alaska, Inc.
NPR-A	National Petroleum Reserve-Alaska
U.S.	United States

UNITS OF MEASUREMENT

ABBREVIATION	DEFINITION
%	Percent
°C	Degrees Celsius
cm	Centimeters
CPUE	Catch Per Unit Effort (fish per day)
DO	Dissolved Oxygen
ft	Feet
FL	Fork Length
km	Kilometers
LM	Linear meter/meters
m	Meter(s)
mi	Miles
mg/L	Milligrams per Liter
mm	Millimeters
N	Number of samples
NTU	Nephelometric Turbidity Units
pH	Potential Hydrogen
µS/cm	Microsiemen

- Page Intentionally Left Blank -

1 INTRODUCTION

ConocoPhillips Alaska, Inc. (CPAI) has been exploring for oil within the northeastern portion of the National Petroleum Reserve – Alaska (NPR-A) since the winter of 1999/2000. Oil reserves have been located in the region and permitting for a new producing field, Willow, has been initiated. Potential development in the Willow Area may cross several drainages including Iqalliqpik Creek, Uvlutuuq Creek, and the Tinmiaqsiugvik River (Figure 1). Development is not expected to cross the Kalikpik River or substantial tributaries; however, it is also included in the study area (Figure 1). This report documents the results of the second year of a 3-year study required by Operating Procedure E-14 of the Bureau of Land Management (BLM) February 2013 Record of Decision for the Northeast National Petroleum Reserve – Alaska Supplemental Integrated Activity Plan (BLM 2013).

Several waterbodies in the study region have previously been investigated by Netsch et al. (1977) and Bendock and Burr (1984). These surveys consisted of 1-day visits at each site for inventory-level surveys over a wide area, with sampling by gill net, seine, minnow trap, and angling. Species reported from Uvlutuuq Creek and Iqalliqpik Creek included broad whitefish, Arctic grayling, round whitefish, slimy sculpin, and ninespine stickleback. The Tinmiaqsiugvik River was also reported to contain Arctic grayling, slimy sculpin, and ninespine stickleback.

An in-depth study of streams in this region began in 2001, with the first detailed examination of fish habitats and populations in the northeastern NPR-A study area (Moulton 2002, 2003, 2005, 2006, 2009; Moulton and Moulton 2014; Moulton and Seigle 2007, and Morris 2003). The Alaska Department of Fish and Game (ADF&G) participated in the 2001 study with a radio-telemetry program to provide details of fish populations in the northeastern NPR-A and the habitats used by those populations (Morris 2003). The University of Alaska Fairbanks (UAF) and BLM jointly conducted a study in 2016 that demonstrated fish use of small tundra streams in the northeastern NPR-A as key summer rearing and foraging habitats for fish (McFarland et al. 2016). All studies were designed to help ensure oilfield facilities are sited, designed, and constructed in a manner to avoid or minimize impacts to fish resources. Sampling efforts were conducted under an Owl Ridge ADF&G research permit.

The goal of the current multi-year study is to develop information needed to evaluate fish populations using waterbodies that could potentially be impacted by oilfield development.

Objectives of the 2018 fish survey were to:

1. Obtain information on the composition and seasonal distribution of fish populations within the drainages.
2. Obtain information on fish movements within the drainages.

- Page Intentionally Left Blank -

2 METHODS

2.1 Biological Sampling

During summer 2018, fyke and seine nets were used to sample waterbodies in the Willow Area (Figure 1). Sampling was conducted at 21 locations comprised of 15 fyke net sites and six seine net sites throughout the open water season during the post break-up period in June, July, and in late August/early September just before freeze-up (Table 1). Fyke net sites were established in Uvlutuuq Creek and one tributary, the Kalikpik River, five tundra stream/lake systems tributary to Iqalliqpik Creek, and one tundra stream/lake system tributary to the Tinmiaqsiugvik River (Table 1, Figure 1). Seine nets were used to sample six wetland sites in the area once during the season to evaluate potential fish bearing habitat. Data collected from these sites confirmed minimal fish habitat use (by ninespine stickleback only), and the sites were not included in further fisheries investigations (Table 1, Figure 1).

Fyke nets were used to provide 24 hours per day sampling and release of the fish unharmed. Three sizes of fyke nets were used to accommodate for differences in stream types; one with an opening 0.9 meters (m) deep by 1.1 m wide, another with an opening of 0.9 m deep by 0.9 m wide, and a third with an opening of 1.2 m deep by 1.2 m wide. All three fyke nets had a 4.9 m-long trap end, made of 9.5 millimeters (mm) mesh, with 5-m long wings and a 15-m long center lead made of 12.7 mm mesh. Fyke nets were arranged to sample fish moving both upstream and downstream, and when possible, two nets were deployed – one facing upstream and one downstream to quantify directional fish movement (Figure 2). Nets were checked and fish released daily. The duration of each set was recorded to allow calculation of catch rates.

Captured fish were identified, measured to the nearest mm in fork length (FL), and released near the site of capture. Fish longer than 180 mm FL, excluding salmon, were tagged with individually numbered tags to evaluate movement patterns within the sampling area. Tags consisted of Floy® FF-94 T-bar anchor tags for fish between 180 and 249 mm FL and FD-94 T-bar anchor tags for fish 250 mm FL or larger.

2.2 Water Chemistry Sampling

Water chemistry parameters were measured at each net set and checked to assess habitat conditions during sampling periods. A calibrated YSI ProPlus water quality meter was used to measure stream temperature, specific conductance, dissolved oxygen percent (%) saturation, and dissolved oxygen concentration in milligrams per liter (mg/L). A water sample was also collected at each site and returned to the field laboratory for determination of potential hydrogen (pH) and turbidity. The pH was measured with an Oakton Acorn Series 5 pH meter and turbidity was measured with an H.F. Scientific turbidimeter.

- Page Intentionally Left Blank -

3 RESULTS AND DISCUSSION

3.1 Physical Environment

Sampling began in June 2018 when stream flows were near peak or receding from peak break-up flows. At the onset of sampling on June 21, most of the channel ice had melted and water temperatures had reached 5.0 to 5.3 degrees Celsius (ºC). However, nets could be deployed at only two sites due to continual ice flow and high stream stage. By June 23, ice and stream flow had receded, and nets were deployed at all sites. Stream temperatures ranged from 4.1 to 9.7 ºC (Figure 2, Appendix A). Temperatures fluctuated considerably over the duration of the June 21 to July 3 sampling period and ranged from 4.1 to 13.9 ºC. The June 2018 sampling was delayed four days later than the 2017 sampling effort due to a late and prolonged spring break-up. At the onset of the July sampling period (July 18), water temperatures ranged from 11.3 to 13.1 ºC and increased to 15.0 to 17.9 ºC by the end of the sampling period on July 25 (Figure 2, Appendix A). By late August, stream temperatures had cooled to 3.6 to 6.5 ºC on August 22 and continued to cool until a slight increase on the final day of sampling (August 29) to 3.7 to 6.3 (Figure 2, Appendix A). Stream temperatures in 2018, on average, were cooler during the early summer and late summer sampling periods than temperatures in 2017 (McFarland et al. 2017). However, temperatures in July 2018 were slightly warmer than during July 2017, mostly because of an unseasonably warm and dry period experienced during the 2018 July sampling.

Specific conductance remained relatively stable across sites over the June sampling period as snowmelt and runoff decreased, except for a decreasing trend at site FT1803 in a tributary of Uvlutuuq (Figure 2, Appendix A). Specific conductance was slightly higher during July and August than in June, however, remained stable across sites during each of the sampling periods. The pH values slightly increased through the summer and were generally in the range of 7.0 to 8.0 pH units (Appendix A). Turbidity was generally highest during June, likely a result of snowmelt-related high runoff (Appendix A). Over the season, turbidity was lowest in the smaller tributary tundra streams and averaged 1.35 Nephelometric Turbidity Units (NTUs). Conversely, turbidity was highest at in Uvlutuuq Creek and the Kalikpik River, which averaged 10.4 NTU and 6.0 NTU, likely because of the higher stream order and downstream transport of suspended sediments related to the fine streambed substrates that characterize each river. Water chemistry parameters measured are presented in Appendix A.

3.2 Biological Observations

3.2.1 Species Composition

A total of 119,682 fish comprised of 12 species were captured at 15 sample sites in the northeastern NPR-A Willow Area in 2018. Resident fish were captured at all sites while anadromous fish were captured at all sites except Willow 1 and Willow 3. Uvlutuuq Creek and the Kalikpik River were identified as migratory corridors for all species encountered based on the range of species and size classes captured through the season. Ninespine stickleback were the most abundant fish species captured and accounted for over 92% of the total catch, followed by Arctic grayling, least cisco, and broad whitefish (Table 2A, Table 2B, Figure 3). Excluding ninespine stickleback, Arctic grayling accounted for nearly 78% of the total catch, followed by least cisco and broad whitefish, which accounted for 12% and 6% of the total catch. All other species

accounted for less than 3% of total catch (Table 2A, Table 2B, Figure 3). Catch per unit of effort (CPUE), expressed as number of fish captured per day, was highest in Willow 4 at site W18405 and in an Uvlutuuq Creek tributary (Willow 8), both of which consisted mostly of ninespine stickleback (Table 2A, Table 2B). Excluding ninespine stickleback, catch rates were highest in Willow 2 (sites W17201, W18204), Willow 4 (sites W17401, W18401, W18402) and Bill's Creek (site BC1 located in a Tinmiaqsiugvik River tributary).

The nearly 120,000 fish captured in 2018 was considerably greater than the 38,044 fish captured in 2017, and was mostly due to increased sampling effort and large catches of ninespine stickleback in 2018 (Table 2A, Table 2B, Figure 3) (McFarland et al. 2017). Overall, 2018 catch rates were higher than 2017 catch rates (~345 fish per day in 2018 versus ~225 fish per day in 2017). However, when ninespine stickleback are excluded from the catch results, the 2018 catch rates are lower than the 2017 catch rates (~27 fish per day in 2018 versus ~40 fish per day in 2017) (Table 2A, Table 2B, Figure 3). Differences in annual catch rates might be attributed to the late 2018 spring break-up period, followed by relatively cool water temperatures (McFarland et al. 2017). Species composition between 2018 and 2017 remained relatively similar, with ninespine stickleback dominating the catch in both years, followed by Arctic grayling. Two differences between the 2017 and 2018 sampling were, for 2018, greater catch rates of least cisco and lower catch rates of broad whitefish (Figure 3).

Species composition differences were found between sites in 2018. Seasonal efforts at eight of the 15 sites captured at least six species of fish (Table 2A, Table 2B, Figure 4). Species diversity was greatest in Willow 4 (sites W17401, W18402, W18405) with 10 species captured, comprised of mostly ninespine stickleback, Arctic grayling, and least cisco. Species diversity in 2017 was also greatest in Willow 4, with nine fish species captured. The least diverse catch occurred at site W17301 in Willow 3 during both 2018 and 2017 and was limited to ninespine stickleback and Alaska blackfish.

Fyke net capture efficiency in Uvlutuuq Creek (FC1801) and the Kalikpik River (K1802) was occasionally compromised due to the continuously shifting sand substrate, coupled with relatively high water velocities, which scoured or buried nets, and wide/deep stream channels. Nets were strategically placed in areas that provided some shelter from high water velocities and closely monitored and maintained to maximize catch rate efficiency. Results from these sites are conservative and underestimate seasonal fish abundance and species composition.

As noted in Section 2.1, six seasonal wetland habitats were each sampled once in July (five in early July and one in mid-July) with seine nets to evaluate their potential for use by fish. A total of 15 ninespine stickleback were captured from four of the six sites. No fish were captured at two of the seine net sites (SW1/SW8, SW23) over a combined seven seine hauls totaling 122 linear meters (LM) of habitat sampled. At the four fish-bearing sites (SW2, SN18102, SN1820, SW14), 15 ninespine stickleback were captured over a combined 11 seine hauls totaling 215.3 LM of habitat sampled. All seine sites sampled were visually monitored during the season and determined to have insufficient water and flow for further sampling efforts in July and August.

3.2.2 Seasonal and Size Distribution

Paired fyke nets were placed in four creeks (Willow 2 (W17203), Willow 4 (W17401), Willow 8 (FT1803), and Bill's Creek (BC1)) during July and August 2018 sampling periods. Nets were positioned to catch fish moving both upstream and downstream to evaluate seasonal patterns in fish movement. Fyke nets were not

paired in June due to high stream flows, water velocity, and ice floes resulting from spring break-up. Paired fyke nets were not practical to use in Uvlutuuq Creek (FC1801) and the Kalikpik River (K1802) because wide stream widths and high flow precluded blocking these higher order streams with nets. Similarly, paired nets were not used in lake sets in Willow 1 (W17101) or Willow 3 (W17301, W18302).

Trends in fish movement were observed in catch patterns. During July, broad whitefish and least cisco were captured moving both upstream and downstream, with a near equal proportion moving in either direction. Arctic grayling were captured moving both directions in July, however, most movement was upstream (Figure 5). In August, lower numbers of all three species of fish were captured, however, a greater proportion of broad whitefish and least cisco were moving downstream, while Arctic grayling moved in near equal proportions in both directions (Figure 5). Trends in fish movement during 2018 were consistent with 2017 data and past surveys in the area, which show the bulk of fish moving upstream in June and early-July, immediately after spring break-up, and downstream in August, prior to freeze-up (Morris 2003, Moulton and Seigle 2007, Moulton and Moulton 2014).

Ninespine stickleback dominated catch at nearly all sites during each season sampled in 2018. Abundance was highest in July and lowest in June. Catch rates were highest at four sites (W18405, FT1803, W17301, W18302) and accounted for nearly 97% of all ninespine stickleback caught (Table 2A, Table 2B). These sites occurred in proximity to headwater lake outlets and wetland connections. Ninespine stickleback also dominated catch in 2017, with catch rates highest in August and at sites with similar habitat characteristics consisting of lacustrine environments, headwater lakes, and wetland complexes with defined stream channels (McFarland et al. 2017).

Length frequency distributions of Arctic grayling, broad whitefish, and least cisco showed seasonal patterns of different length classes of fish using the sampled streams throughout the 2018 open water season. Distinct length classes likely representing age-0, age-1, and age-2 juvenile fish were captured across most sites and months. Ages of fish were not confirmed; however, age was assigned based on monthly length frequency distributions, with each size class denoted hereafter by group as size-0, size-1, and size-2 fish. Adult fish were unable to be assigned age classes due to considerable overlap of length distributions, which is common across most long-lived freshwater species.

During June, juvenile Arctic grayling of two distinct size classes (size-1 and size-2 fish), were captured (shown by the bimodal distribution of fish between 50 and 150 mm), in addition to relatively low numbers of a wide range of larger sized fish (Appendix B). Smaller Arctic grayling were likely moving to upstream rearing and feeding habitats or rearing within the stream of capture. The bulk of the larger-sized Arctic grayling (> 250 mm) were also likely moving upstream either to spawn or were moving downstream from spawning areas. During July, higher numbers of size-1 and size-2 Arctic grayling were captured, while considerably fewer larger-sized Arctic grayling were captured (Appendix C and Appendix D). During August, lower numbers of all size classes of Arctic grayling were captured, as most fish had likely already moved downstream to overwintering habitats. Seasonal growth from June to August, illustrated by minor shifts in the bimodal distribution of size-1 and size-2 Arctic grayling, is further discussed below in Section 3.2.4.

Trends in broad whitefish length frequency distributions were also observed in 2018, though were not as clear as for Arctic grayling due to lower catch rates (Appendix B). Only a few size-1 and size-2 (75 to 150 mm) broad whitefish were captured in June (mostly in Judy Creek Kayyaaq), along with a wide range of

larger-sized fish. Most of the fish were likely moving upstream to summer feeding habitats in headwater lakes. During July, greater numbers of all size classes of broad whitefish were captured in nearly all streams, including size-1 and size-2 fish (Appendix C and Appendix D).

Few size-0 broad whitefish were captured in June, July, or August in 2018, however, during July 2017, size-0 broad whitefish were captured in several streams. Because greater numbers of size-1 and size-2 broad whitefish were caught in July in both years sampled, and size-0 fish were not caught until July in 2017, it is likely that significant overwintering or spawning areas for the species are a considerable distance from the project area, likely in the Colville River or potentially the lower Tinmiaqsiugvik River. The majority of broad whitefish caught during August were moving downstream, likely towards overwintering and spawning habitats.

Length frequency distributions of least cisco caught in 2018 indicate substantial summer rearing of mixed age classes throughout most well-defined streams sampled (Appendix B). Low numbers of a wide range of length classes of least cisco were captured in June, likely moving upstream to rearing and feeding habitats. In July, far greater numbers of least cisco were captured, particularly size-1 fish (75 to 125 mm), which indicates that, similar to broad whitefish, overwintering and spawning habitats may be a considerable distance from the project area. In August, lower numbers of a wide range of size classes were captured (Appendix C and Appendix D). The majority of these fish were traveling downstream, likely to overwintering and spawning habitats.

Three chum salmon and one sockeye salmon were captured at three sites in Willow 4 during August 2018. A ripe male and female chum salmon were captured moving downstream at site W17401 and a third was captured moving upstream at site (Appendix C and Appendix D). One female sockeye salmon in pre-spawning condition and also moving upstream was captured at site W17401. In 2017, 11 adult chum salmon and 4 adult sockeye salmon were captured in August in Willow 4 and Judy Creek Kayyaaq.

3.2.3 Tag Returns

A total of 2,046 fish comprised of seven species were tagged between the 15 fyke net sites, with Arctic grayling accounting for over 65%. Broad whitefish, least cisco, humpback whitefish, round whitefish, burbot, and Alaska blackfish accounted for 18%, 7%, 5%, 4%, < 1%, and < 1% of tags deployed (Table 3). Nearly 74% of the tagged fish were released at sites BCI, W17401, W18401, and W17201. No fish were tagged at sites W17301, W8302, and W18405 (Table 4).

There were 457 recaptures of tagged fish in 2018 (Table 4, Appendix E). Arctic grayling comprised nearly 90% of fish recaptured. Least cisco, broad whitefish, round white fish, and burbot accounted for 5%, 4%, < 1%, and <1%. A total of 123 recaptured fish were initially tagged and released in 2017, two were initially tagged and released in 2013, and the remaining 332 fish were tagged and released in 2018 (Table 4, Appendix E). Approximately 41% of the fish were recaptured at different sites than they were initially tagged and released from and about 10% of fish were recaptured in different drainages. Recaptured fish were at large for a mean of 117.2 days and a median of 22.8 days. The two fish recaptured from 2013 were at large for 1,760 and 1,798 days, increased in length by 60 and 107 mm, and were each captured approximately five river miles from their release location in the Tinmiaqsiugvik River (Figure 7). Most fish were recaptured within a few miles of where they were initially tagged and released, however, some traveled considerable distances. A large, mature broad whitefish was released in Bill's Creek (tributary of the

Tingmiaqsiugvik River) in June 2018 and was recaptured 28 days later at Willow 8 (tributary to Uvlutuuq Creek), approximately 63 river miles away. Another large, mature broad whitefish was released at Willow 8 in July 2018 and was recaptured 35 days later at Willow 4 (tributary to Iqalliqpik Creek), nearly 65 river miles away (Figure 7). In 2017, similar trends of recaptured fish were observed as those in 2018, as most of the fish were recaptured in the same drainage as originally released, while others were recaptured in different, and occasionally distant, drainages.

3.2.4 Fish Size and Growth

Length frequency distributions were compared across years sampled, stream types, and sites to evaluate seasonal and annual differences in fish size and growth. Arctic grayling was selected as the study species due to the large sample size and range of size classes captured. Three distinct length classes of juvenile Arctic grayling representing age-0, age-1, and age-2 fish were captured during most months of sampling in 2017 and 2018 (Figure 8). Ages of fish were not confirmed; however, age was assigned based on monthly length frequency distributions, with each size class denoted by group as size-0, size-1, and size-2 fish. Length criteria used to determine fish size classes are shown in Figure 9. Descriptive and comparative statistics were made using the program Statistix® 10. Kruskal-Wallis (KW) one-way analysis of variance (AOV) of the ranked data was used for comparisons and Dunn's multiple comparison tests were used to identify statistically significant differences ($p \leq 0.05$).

Differences in juvenile Arctic grayling size distribution, mean FL, and abundance between tributary and mainstem sites by size class were observed. When sample size allowed for comparison, size distribution and mean FL of nearly all size classes of juvenile Arctic grayling captured in tributary sites in 2017 were greater than fish captured in mainstem sites (Figure 9). Sample size at mainstem sites was not adequate to make comparisons in 2018. Data and comparisons presented hereafter include only tributary sites, unless otherwise stated. Differences in fish size distributions and abundance between tributary and mainstem environments were likely a result of differences in habitat. Tributary habitats in the Willow area are often high quality and complex rearing habitats characterized by deep pools connected by shallow runs, vegetated undercut stream banks and channels, and direct connections to lacustrine environments, headwater lakes, and wetlands. In contrast, mainstem habitats are generally less complex, consisting of shifting sand substrates, wide barren floodplains, and frequently lacking vegetated or undercut stream banks that provide cover and food resources to rearing juvenile fish.

Juvenile Arctic grayling length and growth also differed among tributary sites sampled. During both 2017 and 2018, mean FL and growth of fish were greatest at small tributary sites connected to shallow wetland complexes, ponds, and lakes, such as Willow 1 (site W17101), and was smallest at larger, cooler, and faster moving tributaries, such as Judy Creek Kayyaaq (sites JK1702 and JK1703) (Figure 10A and Figure 10B). Among other factors, elevated water temperatures in small and slow-moving tributary sites may have accelerated primary production and, in turn, prey densities for rearing Arctic grayling, while slow water velocities may have reduced overall energy expenditure, resulting in increased growth and overall length of fish. Despite differences of juvenile Arctic grayling length and growth among tributary sites, sample size was not sufficient to make further comparisons among them, therefore all tributary sites were combined for further analysis.

Size distribution, mean FL, and growth of juvenile Arctic grayling in tributaries differed between years sampled, with fish growing faster and larger in 2017 than in 2018. Despite size-1 and size-2 fish being

smaller at the beginning of the growing season in June 2017 (Table 5, Figure 8, Figure 11) mean FL during both July and August were significantly greater in 2017 than in 2018 (Table 5, Figure 12A, Figure 12B, and Figure 12C). Mean FL of size-1 and size-2 fish in August 2017 was 25.3 mm and 21.2 mm larger than fish in August 2018 (size-1 comparison: KW = 53.1, $p < 0.0001$; size-2 comparison: KW = 30.63, $p < 0.0001$) (Table 5, Figure 11, Figure 12). Growth from June through August 2017 of size-1 and size-2 fish was 54.9 mm and 54.6 mm, compared to 26.1 mm and 31.4 mm for the same months in 2018 (Table 5, Figure 11).

Size-0 Arctic grayling were also larger and more abundant in 2017 than in 2018. Mean FL of size-0 fish in August 2017 (n = 67) was 10.2 mm larger than size-0 fish in August 2018 (n = 14) (KW = 15.6, $p < 0.001$) (Figure 12A and Figure 13). Comparisons of size-0 fish in July between years were not possible because of low sample size in 2018 (July 2017, n = 133; July 2018, n = 1) (Table 5 and Figure 8). Despite low catch rates in 2018, fishing effort hours were more than double that of 2017, which further highlights the large difference in size, growth, and annual production of size-0 fish captured between years sampled.

Differences in Arctic grayling production, length, and growth between 2017 and 2018 are likely related to differences in water temperature and flow. On average, stream temperatures were warmer, flows were lower, and the ice-free season was longer in 2017 than in 2018 (Figure 14A and Figure 14B). As a result, fish successfully reproduced, and grew faster and larger in 2017 than in 2018. Arctic grayling spawning and size-0 survival were most likely to have been impacted by differences in late May temperature and flow. Spawning initiates immediately preceding spring break-up, when daily maximum water temperatures reach about 4 °C. Most spawning tributaries in the Willow area approached 4°C nearly two weeks later in 2018 than 2017, which resulted in a mostly failed spawning year in 2018. The low numbers and small size of size-0 Arctic grayling produced in spring 2018 is likely the result of the late spring warm-up and prolonged break-up period characterized by high flows and continued cool water temperatures. This extended cold period delayed spawning, prolonged incubation, reduced survival, and shortened the overall growing season by 16%. Sampling in 2019 will help determine overwintering success of 2018 size-0 Arctic grayling and continue to monitor and evaluate growth of other size classes. Results from this analysis demonstrate the high annual variance in fish growth and production in the Arctic.

4 CONCLUSION

Results of sampling from 2017 and 2018 indicate that study area streams are used by fish species common to the region, including Alaska blackfish, Arctic grayling, broad whitefish, burbot, chum salmon, humpback whitefish, least cisco, ninespine stickleback, round whitefish, slimy sculpin, and sockeye salmon. Resident fish were captured at all sites, while anadromous fish were captured at all sites except Willow 1 and Willow 3. Ninespine stickleback, Arctic grayling, and least cisco were most abundant in the streams sampled during 2018. Uvlutuuq Creek and the Kalikpik River were identified as major migratory corridors for all species sampled. Sockeye and chum salmon spawning creeks were identified at Willow 4. Sampling in 2017 and 2018 identified multiple size classes of adult and juvenile Arctic grayling across sites and highlighted the annual differences in juvenile production and growth that can be observed between years. Overall, high catch rates of Arctic grayling in both years of sampling indicates the relative dominance of the species and importance of aquatic habitats supporting them and other fish species.

- Page Intentionally Left Blank -

5 REFERENCES

Bendock, T.N. and J. Burr. 1984. Freshwater fish distributions in the Central Arctic Coastal Plain (Ikpikpuk River to Colville River). Alaska Department of Fish and Game, Sport Fish Division, Fairbanks, AK. 52p.

BLM. 2013. Record of Decision: National Petroleum Reserve-Alaska, Integrated Activity Plan. U.S. Department of the Interior. Bureau of Land Management. Anchorage, AK. 114p.

McFarland, J. J., Wipfli, M. S., & Whitman, M. S. 2017. Trophic pathways supporting Arctic Grayling in a small stream on the Arctic Coastal Plain, Alaska. Ecology of Freshwater Fish. 14p.

Morris, W. 2003. Seasonal movements and habitat use of arctic grayling (*Thymallus arcticus*), burbot (*Lota lota*), and broad whitefish (*Coregonus nasus*) within the Fish Creek drainage of the National Petroleum Reserve-Alaska, 2001-2002. Alaska Department of Natural Resources, Office of Habitat Management and Permitting. Technical Report No. 03-02. Fairbanks, AK. 71p. + appendices.

Moulton, L.L. 2000a. Fish utilization of lakes in eastern NPR-A – 1999. Report by MJM Research to ARCO Alaska Inc. Lopez Island, WA. 248p.

Moulton, L.L. 2000b. Fish utilization of lakes in eastern NPR-A – 1999-2000. Report by MJM Research to ARCO Alaska Inc. Lopez Island, WA. 124p.

Moulton, L.L. 2001a. Fish utilization of lakes in eastern NPR-A: 1999-2001. Report by MJM Research to Phillips Alaska Inc. Lopez Island, WA. 83p.

Moulton, L.L. 2001b. Harvest estimate and associated information for the 2000 Colville River fall fishery. Report by MJM Research to Phillips Alaska, Inc and BP Exploration (Alaska). Lopez Island, WA. 53p. + appendices.

Moulton, L.L. 2002. Baseline surveys of fish habitats in eastern NPR-A: 2001. Report by MJM Research to Phillips Alaska, Inc. Lopez, Island., WA. 130p.

Moulton, L.L. 2003. Fish utilization of lakes in eastern NPR-A: 1999-2001. Report by MJM Research to Phillips Alaska, Inc. Lopez, Island., WA. 83p.

Moulton, L.L. 2005. Baseline surveys of fish habitats in eastern NPR-A: 2004. Report by MJM Research to ConocoPhillips Alaska, Inc. and Anadarko Petroleum Co. Lopez Island., WA. 33p. + appendices.

Moulton, L.L. 2006. Monitoring fish populations in the Ublutuoch River drainage in eastern NPR-A: 2004-2005. Report by MJM Research to ConocoPhillips Alaska, Inc. and Anadarko Petroleum Co. Lopez Island., WA. 28p. + appendices.

Moulton, L.L. 2009. Fish populations in streams to be crossed by a proposed road to the GMT-1 well pad in eastern NPR-A: 2009. Report by MJM Research to ConocoPhillips Alaska, Inc. and Anadarko Petroleum Co. Lopez Island., WA. 20.p + appendices.

Moulton, L.L. and C.R. Moulton. 2014. Fish populations in streams to be crossed by a proposed road to the GMT-1 well pad in eastern NPR-A: 2013. Report by MJM Research to ConocoPhillips Alaska, Inc. and Anadarko Petroleum Co. Lopez Island., WA. 30p. + appendices.

Moulton, L.L. and J. Seigle. 2007. Monitoring fish populations in the Ublutuoch River drainage in eastern NPR-A: 2004-2006. Report by MJM Research to ConocoPhillips Alaska, Inc. and Anadarko Petroleum Co. Lopez Island., WA. 28p. + appendices.

Netsch, N., E. Crateau, G. Love and N. Swanton. 1977. Freshwater fisheries reconnaissance of the coastal plain of National Petroleum Reserve-Alaska (NPR-A), July and August 1977. Preliminary report. USDI: U.S. Fish and Wildlife Service. Anchorage, AK. 214p.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fisheries Research Board of Canada. No. 191, 382p.

TABLES

- Page Intentionally Left Blank -

Table 1. Location of fyke and seine net stations fished in northeastern NPR-A during 2017 and 2018.

Location		2017			2018		
		Dates Fished	Latitude (NAD83)	Longitude (NAD83)	Dates Fished	Latitude (NAD83)	Longitude (NAD83)
Fyke Net Sites							
Tinmiaqsiugvik River Tributary Sites							
BC1	Bills Creek	-	-	-	Jun 21 -28	70.21243	-151.24730
		-	-	-	Jul 18-25	70.21230	-151.24742
		-	-	-	Aug 22 -29	70.21230	-151.24742
Uvlutuuq Creek Sites							
FC1801	Fish Creek	-	-	-	Jun 24 -Jul 2	70.25113	-152.18906
		-	-	-	Jul 18 -25	70.25000	-152.18979
		-	-	-	Aug 22 -29	70.25111	-152.18286
Uvlutuuq Creek Tributary Sites							
FT1802	Willow 8	-	-	-	Jun 23 -30	70.26294	-152.18381
		-	-	-	Jul 18 -25	70.26294	-152.18381
		-	-	-	Aug 22 -29	70.26289	-152.18391
FT1803	Willow 8	-	-	-	Jun 23 -30	70.27795	-152.18988
		-	-	-	Jul 18 -25	70.27795	-152.18988
		-	-	-	Aug 22 -29	70.27795	-152.18988
Kalikpik River Sites							
K1802	Kalikpik River	-	-	-	Jun 23 -30	70.31631	-152.24010
		-	-	-	Jul 18 -25	70.31591	-152.23885
		-	-	-	Aug 22 -29	70.31591	-152.23885
Iqalliqpik Creek Tributary Sites							
JK1701	Judy Creek Kayyaaq	Jun 17-19	70.20281	-152.07515	-	-	-
JK1702	Judy Creek Kayyaaq	Jun 17-24	70.18517	-152.12392	-	-	-
		Jul 21-28	70.18517	-152.12392	-	-	-
JK1703	Judy Creek Kayyaaq	-	-	-	Jun 24 -Jul 1	70.18057	-152.14136

		2017			2018		
	Location	Dates Fished	Latitude (NAD83)	Longitude	Dates Fished	Latitude (NAD83)	Longitude
		-	-	-	Jul 18 - 25	70.18057	-152.14136
		Aug 26-Sep 2	70.18068	-152.14101	Aug 22 -29	70.18075	-152.14096
W17101	Willow 1	Jun 17-24	70.16694	-151.86176	Jun 21 -30	70.16703	-151.85899
		Jul 21-28	70.16694	-151.86176	Jul 18 -25	70.16710	-151.85893
		Aug 28-Sep 2	70.16694	-151.86176	Aug 22 -29	70.16710	-151.85893
W17201	Willow 2	Jun 18-24	70.17058	-151.94106	Jun 23 -30	70.17316	-151.94376
		-	-	-	Jul 18 -25	70.17319	-151.94368
		-	-	-	Aug 23 -29	70.17323	-151.94398
W17202	Willow 2	Jun 18-19	70.15627	-151.93256	-	-	-
		Jul 24-28	70.15627	-151.93256	-	-	-
W17203	Willow 2	Jul 21-28	70.1405	-151.95709	-	-	-
		Aug 26-Sep 2	70.1405	-151.95709	-	-	-
W18204	Willow 2	-	-	-	Jun 23 - Jul 1	70.13928	-151.96359
		-	-	-	Jul 18 -25	70.13923	-151.96373
		-	-	-	Aug 22 -29	70.13923	-151.96373
W17301	Willow 3/Lake M0015	Jul 21-24	70.11221	-152.07718	Jul 18 -21	70.11221	-152.07718
W18302	Willow 3	-	-	-	Jun 26 - Jul 2	70.12409	-152.11249
		-	-	-	Jul 18 -25	70.12419	-152.11252
		-	-	-	Aug 22 -29	70.12419	-152.11252
W17401	Willow 4	Jun 17-24	70.09472	-152.1824	-	-	-
		Jul 21-28	70.09472	-152.1824	Jul 18 -25	70.09472	-152.18240
		Aug 26-Sep 2	70.09472	-152.1824	Aug 22 -29	70.09472	-152.18240
W18401	Willow 4	-	-	-	Jun 23 - Jul 2	70.07395	-152.20070
		-	-	-	Jul 18 -25	70.07395	-152.20070

		2017			2018		
	Location	Dates Fished	Latitude (NAD83)	Longitude	Dates Fished	Latitude (NAD83)	Longitude
		-	-	-	Aug 22 -29	70.07394	-152.20074
W18402	Willow 4	-	-	-	Jun 23 -30	70.08125	-152.12788
		-	-	-	Jul 18 -25	70.07998	-152.13721
		-	-	-	Aug 22 -29	70.07998	-152.13721
W18405	Willow 4	-	-	-	Jun 23 -30	70.03282	-152.19400
		-	-	-	Jul 18 -25	70.03604	-152.20155
		-	-	-	Aug 22 -29	70.03604	-152.20155
Seine Net Sites							
SW7	Unnamed wetland tributary of Iqalliqpik Creek	24-Jun	70.19886	-152.25694	-	-	-
SN172	Unnamed wetland tributary of Willow 3	24-Jun	70.11557	-152.09387	-	-	-
SW14	Unnamed wetland tributary to Willow 3	-	-	-	18-Jul	70.123543	-152.07906
SW23	Unnamed wetland tributary of Kalikpik River	-	-	-	1-Jul	70.31355	-152.21393
SW2	Unnamed wetland tributary of Iqalliqpik Creek	-	-	-	1-Jul	70.12873	-152.06277
SN18102	Unnamed wetland tributary of Willow 1	-	-	-	1-Jul	70.24829	-152.18876
SN1820	Unnamed wetland tributary of Uvlutuuq Creek	-	-	-	1-Jul	70.24829	-152.18875
SW1/SW8	Unnamed wetland tributary of Iqalliqpik Creek	-	-	-	1-Jul	70.13580	-152.01340

Table 2. Comparison of a) Number of fish caught, and b) CPUE (fish per day) across sites and years sampled at fyke net stations in northeastern NPR-A streams during 2018 and 2017.

a) Number of fish caught.

	Bill's Creek	Uvlutuuq Creek	Uvlutuuq Creek Tributaries (Willow 8)		Judy Creek Kayyaaq	Kalikpik River	Willow 1	Willow 2		Willow 3		Willow 4				2018			2017		
Species	BC1	FC1801	FT1802	FT1803	JK1703	K1802	W17101	W17201	W18204	W17301	W18302	W17401	W18401	W18402	W18405	Total	% Total	% Total (excluding stickleback)	Total	% Total	% Total (excluding stickleback)
Alaska blackfish	1			4			12	2		1	11	1	1		23	56	< 1%	1%	98	< 1%	1%
Arctic grayling	1,364	121	638	29	196	30	174	1,327	1,102		13	839	713	854		7,400	6%	78%	5,785	15%	85%
Broad whitefish	184	15	113		37	6		70	2			90	37	53	1	608	1%	6%	465	1%	7%
Burbot		3	1									1				5	< 1%	< 1%	1	< 1%	< 1%
Chum salmon												2		1		3	< 1%	< 1%	11	< 1%	< 1%
Humpback whitefish	47	1	9					11				32	8	17		125	< 1%	1%	33	< 1%	< 1%
Least cisco	10	57	107	1	196	26		193	7			327	187	60		1,171	1%	12%	293	1%	4%
Ninespine stickleback	129	51	64	40,777	1,030	77	293	660	473	204	1,244	221	73	234	64,641	110,171	92%		31,224	82%	
Round whitefish	5	14			8	5		12	6			40	2	44		136	< 1%	1%	89	< 1%	1%
Slimy sculpin		2						1								3	< 1%	< 1%	14	< 1%	< 1%
Sockeye salmon												1				1	< 1%	< 1%	4	< 1%	< 1%
Threespine stickleback						3										3	< 1%	< 1%			
Total Catch	1,740	264	932	40,811	1,467	147	479	2,276	1,590	205	1,268	1,554	1,021	1,263	64,665	119,682	119,682	9,511	38,017	38,017	6,793
Number of Species	7	8	6	4	5	6	3	8	5	2	3	10	7	7	3	12	12	11	11	11	10
Effort (hours)	833.9	501.2	502.5	848.4	493.3	505.2	543.3	828.1	525.8	70.0	474.8	654.5	546.8	494.6	500.5	8,322.9	8,322.9	8,322.9	4,051.7	4,051.7	4,051.7

b) CPUE (fish per day) across sites and years sampled.

	Bill's Creek	Uvlutuuq Creek	Uvlutuuq Creek Tributaries (Willow 8)		Judy Creek Kayyaaq	Kalikpik River	Willow 1	Willow 2		Willow 3		Willow 4				2018 Total CPUE	2017 Total CPUE
Species	BC1	FC1801	FT1802	FT1803	JK1703	K1802	W17101	W17201	W18204	W17301	W18302	W17401	W18401	W18402	W18405		
Alaska blackfish	0.03			0.11			0.53	0.06		0.34	0.56	0.04	0.04		1.10	0.16	0.58
Arctic grayling	39.26	5.79	30.47	0.82	9.54	1.43	7.69	38.46	50.30		0.66	30.77	31.29	41.44		21.34	34.27
Broad whitefish	5.30	0.72	5.40		1.80	0.29		2.03	0.09			3.30	1.62	2.57	0.05	1.75	2.75
Burbot		0.14	0.05									0.04				0.01	0.01
Chum salmon												0.07		0.05		0.01	0.07
Humpback whitefish	1.35	0.05	0.43					0.32				1.17	0.35	0.82		0.36	0.20
Least cisco	0.29	2.73	5.11	0.03	9.54	1.24		5.59	0.32			11.99	8.21	2.91		3.38	1.74
Ninespine stickleback	3.71	2.44	3.06	1,153.45	50.11	3.66	12.94	19.13	21.59	69.94	62.89	8.10	3.20	11.35	3,099.77	317.69	184.95
Round whitefish	0.14	0.67			0.39	0.24		0.35	0.27			1.47	0.09	2.13		0.39	0.53
Slimy sculpin		0.10						0.03								0.01	0.08
Sockeye salmon												0.04				0.00	0.02
Threespine stickleback						0.14										0.01	
2018 Total CPUE	50.08	12.64	44.51	1,154.42	71.37	6.98	21.16	65.96	72.58	70.29	64.10	56.98	44.81	61.28	3,100.92	345.12	
CPUE (excluding stickleback)	46.37	10.20	41.45	0.96	21.26	3.33	8.22	46.83	50.99	0.34	1.21	48.88	41.61	49.93	1.15	27.43	
2017 Total CPUE					49.06		118.82	64.51		8,204.60		44.05					225.19
CPUE (excluding stickleback)					48.62		12.96	62.50		0.00		41.27					40.24

Table 3. Fish tagged and released by station during 2018.

	Bill's Creek	Uvlutuuq Creek	Uvlutuuq Creek Tribs (Willow 8)		Judy Creek Kayyaaq	Kalikpik River	Willow 1	Willow 2		Willow 3		Willow 4				Total fish released	% Total
Species	BC1	FC1801	FT1802	FT1803	JK1703	K1802	W17101	W17201	W18204	W17301	W18302	W17401	W18401	W18402	W18405		
Broad whitefish	137	9	55		1			31				73	19	48		373	18%
Alaska blackfish				1												1	< 1%
Burbot		2	1									1				4	< 1%
Arctic grayling	363	40	57	1	13	3	4	173	105			227	263	88		1,337	65%
Humpback whitefish	42	1	4					1				32	8	17		105	5%
Least cisco	5	8	23		1	9		23	2			49	23	11		154	8%
Round whitefish	4	10			1	1		9	6			17	2	22		72	4%
Total fish released	551	70	140	2	16	13	4	237	113			399	315	186		2,046	100%
% Total	0.27	0.03	0.07	< 0.01	0.01	0.01	< 0.01	0.12	0.05			0.19	0.15	0.09			

Table 4. Locations of tagged fish released and recaptured during 2018.

Note: Shaded cells designate fish released and recaptured at the same location.

		2018 Recapture Stations																	
		Bill's Creek	Uvlutuuq Creek	Uvlutuuq Creek Tributaries (Willow 8)		Judy Creek Kayyaaq	Kalikpik River	Willow 1	Willow 2		Willow 3		Willow 4				Total Recaptured	Total Tags Deployed
Release Stations		BC1	FC1801	FT1802	FT1803	JK1703	K1802	W17101	W17201	W18204	W17301	W18302	W17401	W18401	W18402	W18405		
Bills Creek	BC1	**67**	-	1	-	-	-	-	-	-	-	-	-	-	-	-	68	551
Uvlutuuq Creek	FC1801	-	**2**	-	-	-	-	-	1	-	-	-	-	-	-	-	3	70
Uvlutuuq Creek Tributaries (Willow 8)	FT1802	-	2	**16**	-	-	-	-	-	-	-	-	-	-	1	-	19	140
	FT1803	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Judy Creek Kayyaaq	JK1702*	1	1	1	-	-	-	-	1	1	-	-	2	1	-	-	8	-
	JK1703	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
Kalikpik River	K1802	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
Willow 1	W17101	-	-	-	-	-	-	**5**	-	-	-	-	-	-	-	-	5	4
Willow 2	W17201	-	-	-	-	-	-	-	**67**	16	-	-	2	1	-	-	86	237
	W17202*	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2	-
	W17203*	1	-	-	-	-	-	-	26	28	-	-	1	1	-	-	57	-
	W18204	-	-	-	-	1	-	-	24	**49**	-	-	-	-	-	-	74	113
Willow 3	W17301	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	W18302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Willow 4	W17401	-	-	-	-	-	-	-	3	1	-	-	**27**	17	3	-	51	399
	W18401	-	1	-	-	-	-	-	1	-	-	-	14	**29**	2	-	47	315
	W18402	-	-	-	-	-	-	-	-	-	-	-	2	4	**5**	-	11	186
	W18405	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tinmiaqsiugvik River	U0901*	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
	UBLU26.0*	5	1	-	-	-	-	-	1	-	-	-	-	-	-		7	-
Iqalliqpik Creek	J1701*	-	1	-	-	-	-	-	5	2	-	-	1	2	1	-	12	-
	J1703*	-	-	-	-	-	-	-	2	-	-	-	1	1	1	-	5	-
	Total	76	8	18	-	1	-	5	131	99	-	-	50	56	13	-	457	2,046

*Station established prior to 2018 for other surveys.

Table 5. Descriptive statistics for Arctic grayling fork length by size class and year at tributary sites in the Willow area, 2017 (a) and 2018 (b).

(a)

		Size-0			Size-1			Size-2	
	June	July	August	June	July	August	June	July	August
2017									
Mean FL (mm)		45.1	64.2	73.4	93.8	128.3	129.1	153.2	183.7
SE		0.3	1.0	0.2	0.3	2.4	0.7	0.8	1.7
N	n/a	133	67	880	1,114	40	655	216	28
Minimum		29	50	49	72	105	96	131	166
Median		45	65	73	93	126	124	153	184
Maximum		53	78	95	129	156	170	180	199

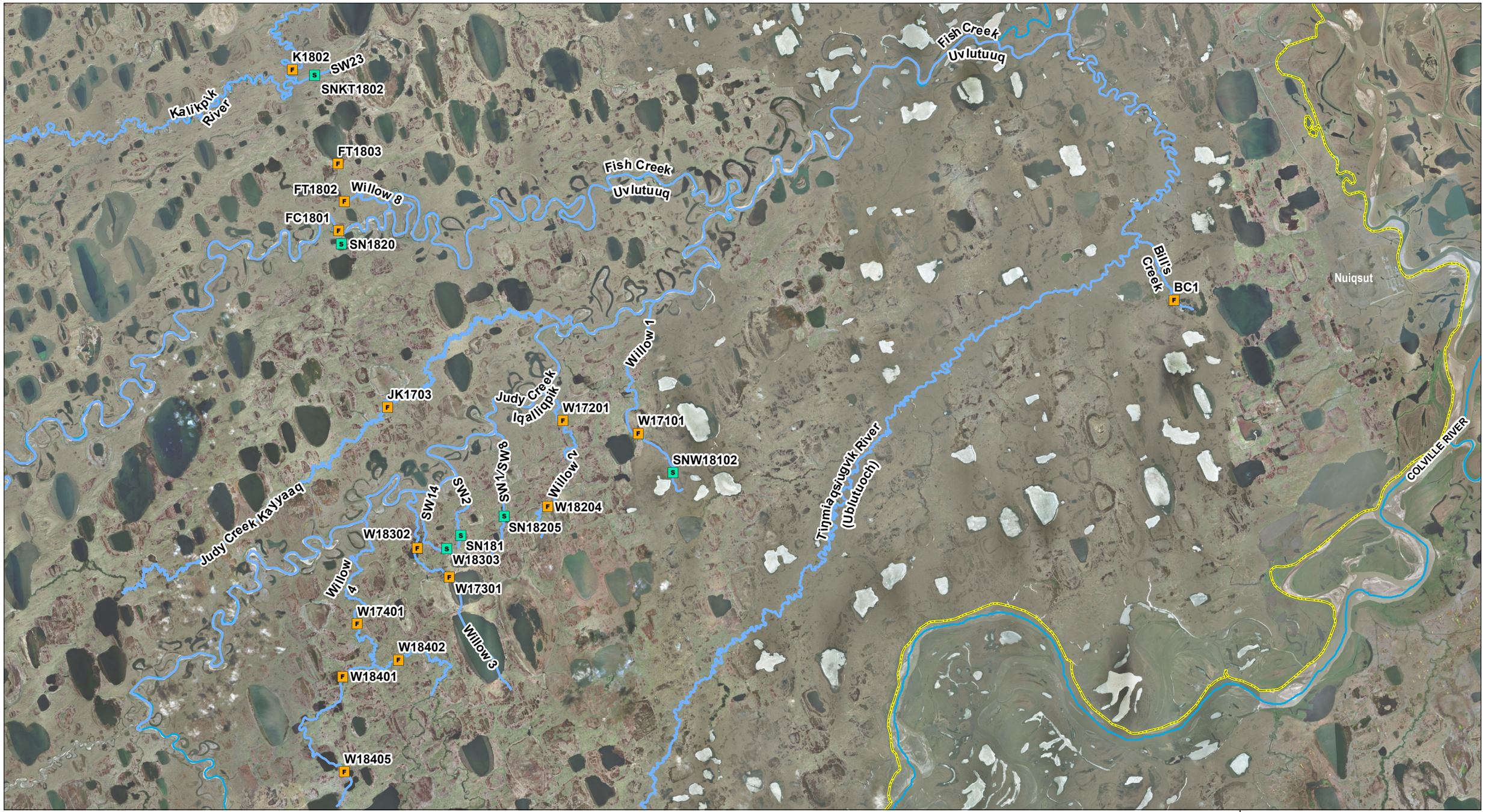
(b)

2018									
Mean FL (mm)		38	54.0	76.9	81.0	103.0	131.1	139.6	162.5
SE		0	1.9	1.0	0.2	1.1	0.5	0.4	1.9
N	n/a	1	14	72	3,391	178	800	727	62
Minimum		38	43	59	66	79	96	121	141
Median		38	54	77	79	100	130	138	159
Maximum		38	68	94	120	140	165	170	194

- Page Intentionally Left Blank -

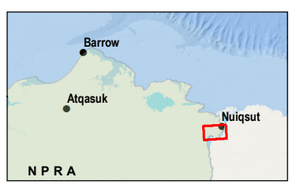
FIGURES

- Page Intentionally Left Blank -



2018 Sampling Location

- F — Fyke Net Site
- S — Seine Net Site
- NHD Named Streams
- National Petroleum Reserve - Alaska



ConocoPhillips Alaska

WILLOW FISHERIES OVERVIEW

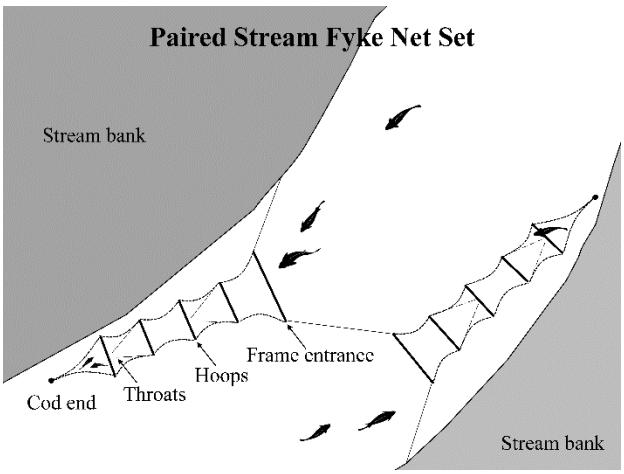
0 1 2 3 mi

FIGURE: 1

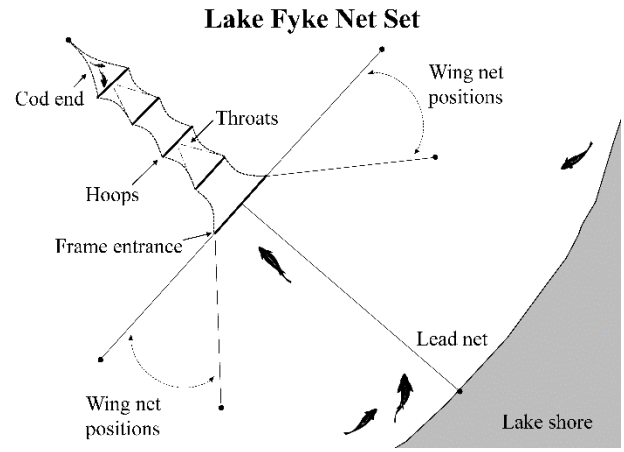
CPAI_030.mxd, 3/5/2019 4:36:30 PM, R03

Figure 2. Fyke net schematics of a paired stream set (a), a lake set (b), and a single net stream set (c) used to capture fish.

(a)



(b)



(c)

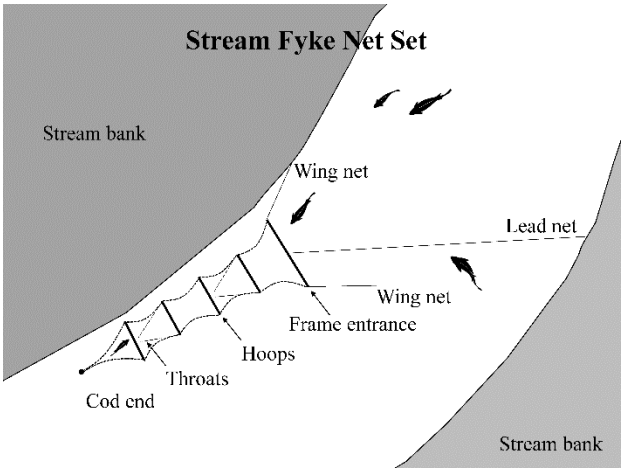
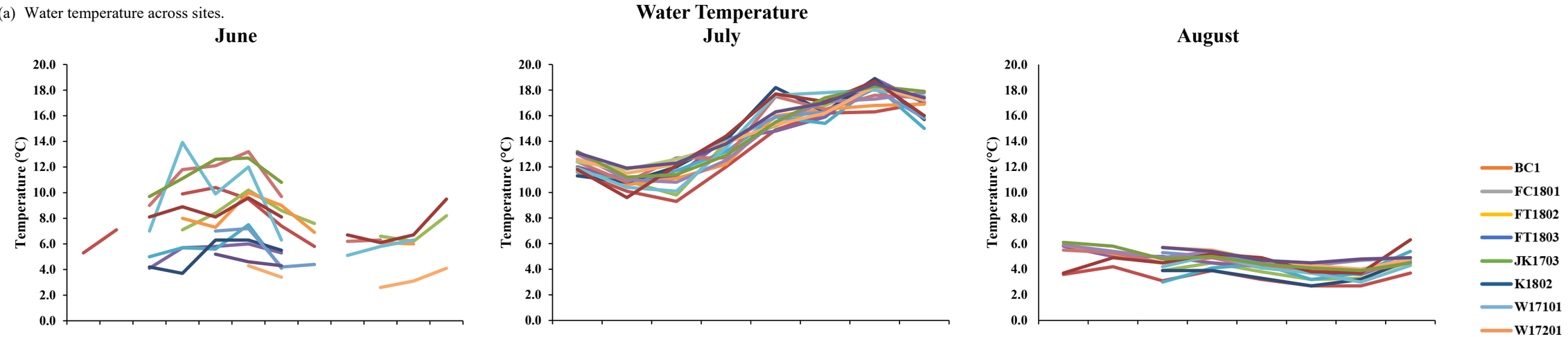


Figure 3. Water temperature (a), and specific conductivity (b), at streams sampled in the northeastern NPR-A study area, 2018.

(a) Water temperature across sites.



(b) Specific conductivity across sites.

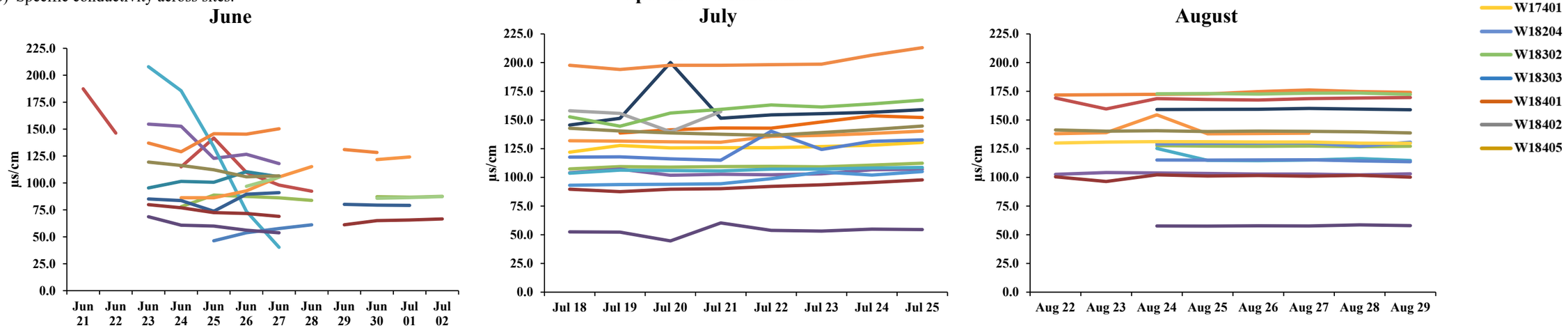
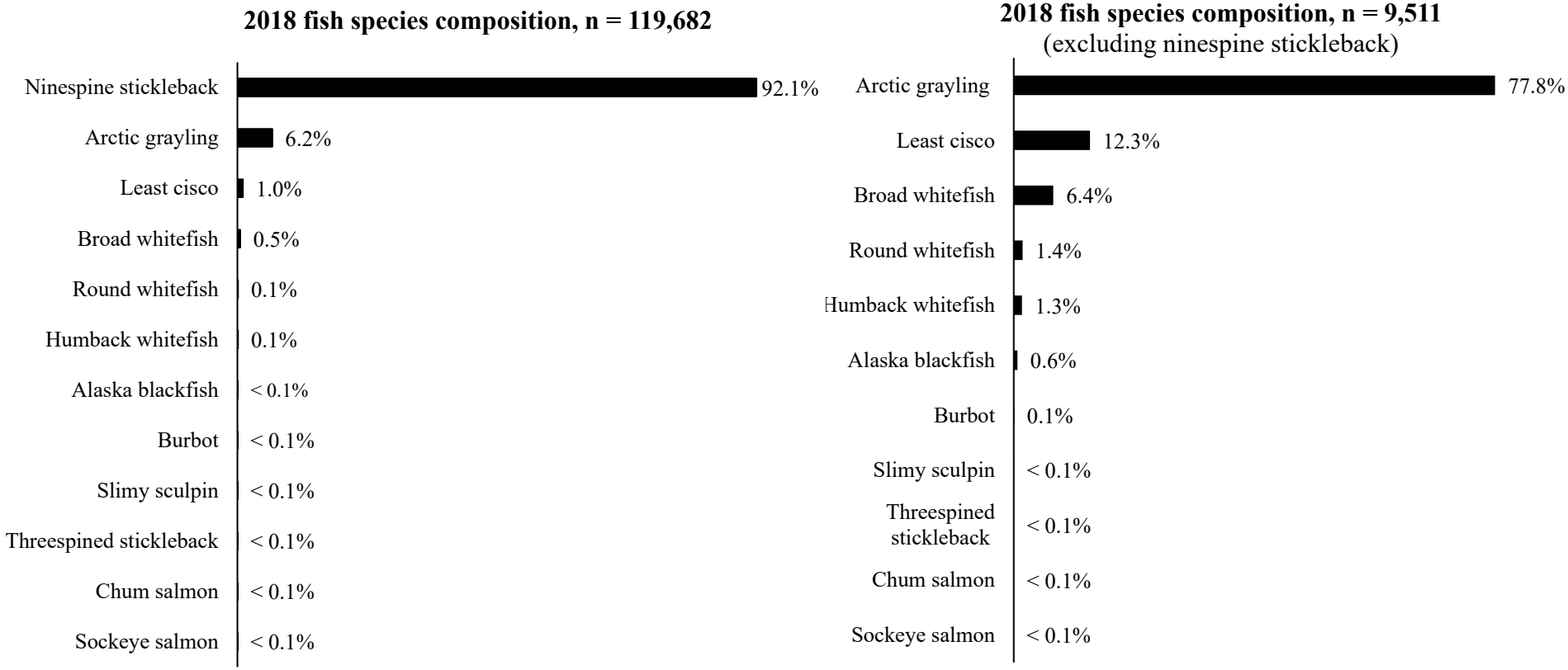
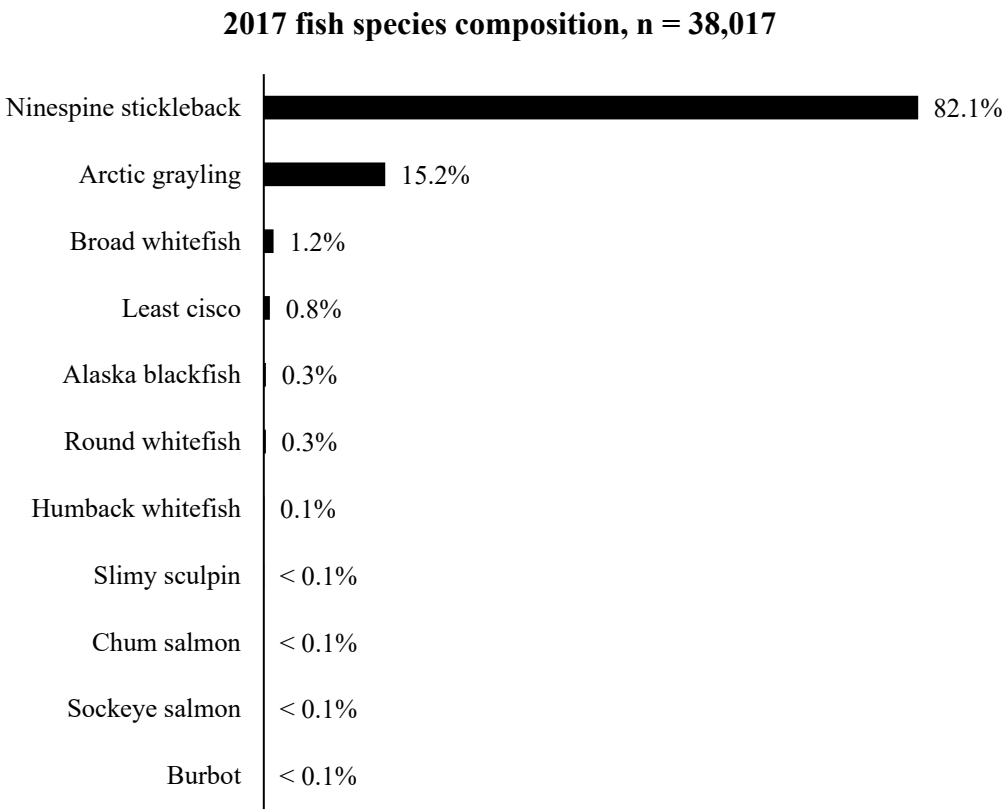


Figure 4. Fish species composition during 2018 (a), and 2017 (b).

(a) 2018 fish species composition.



(b) 2017 fish species composition.



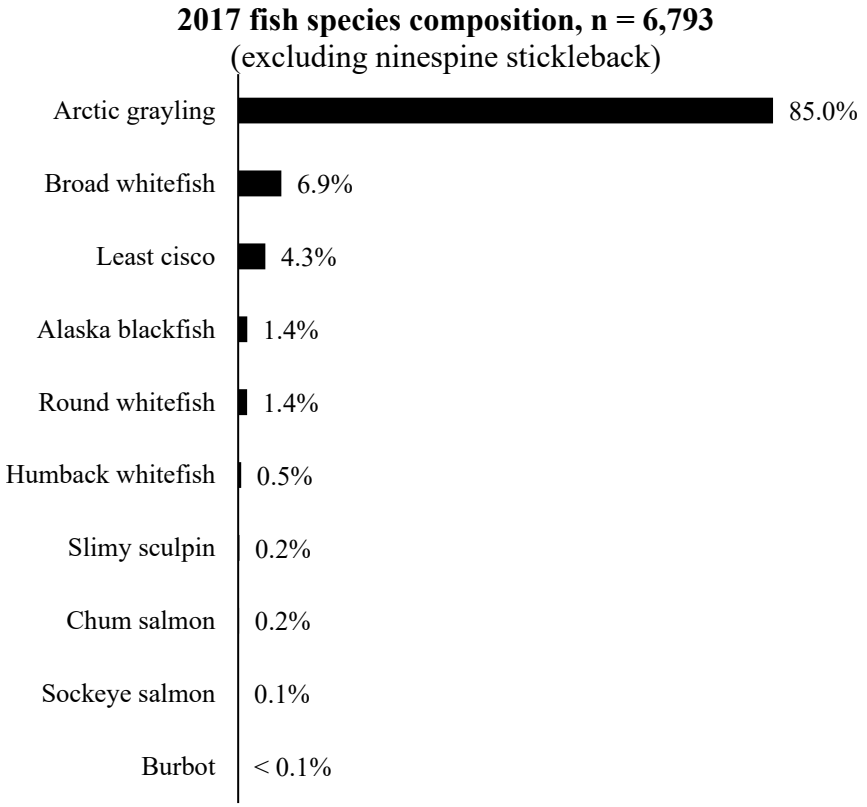


Figure 5. Catch per unit of effort (CPUE; fish per day) across streams sampled, 2018.

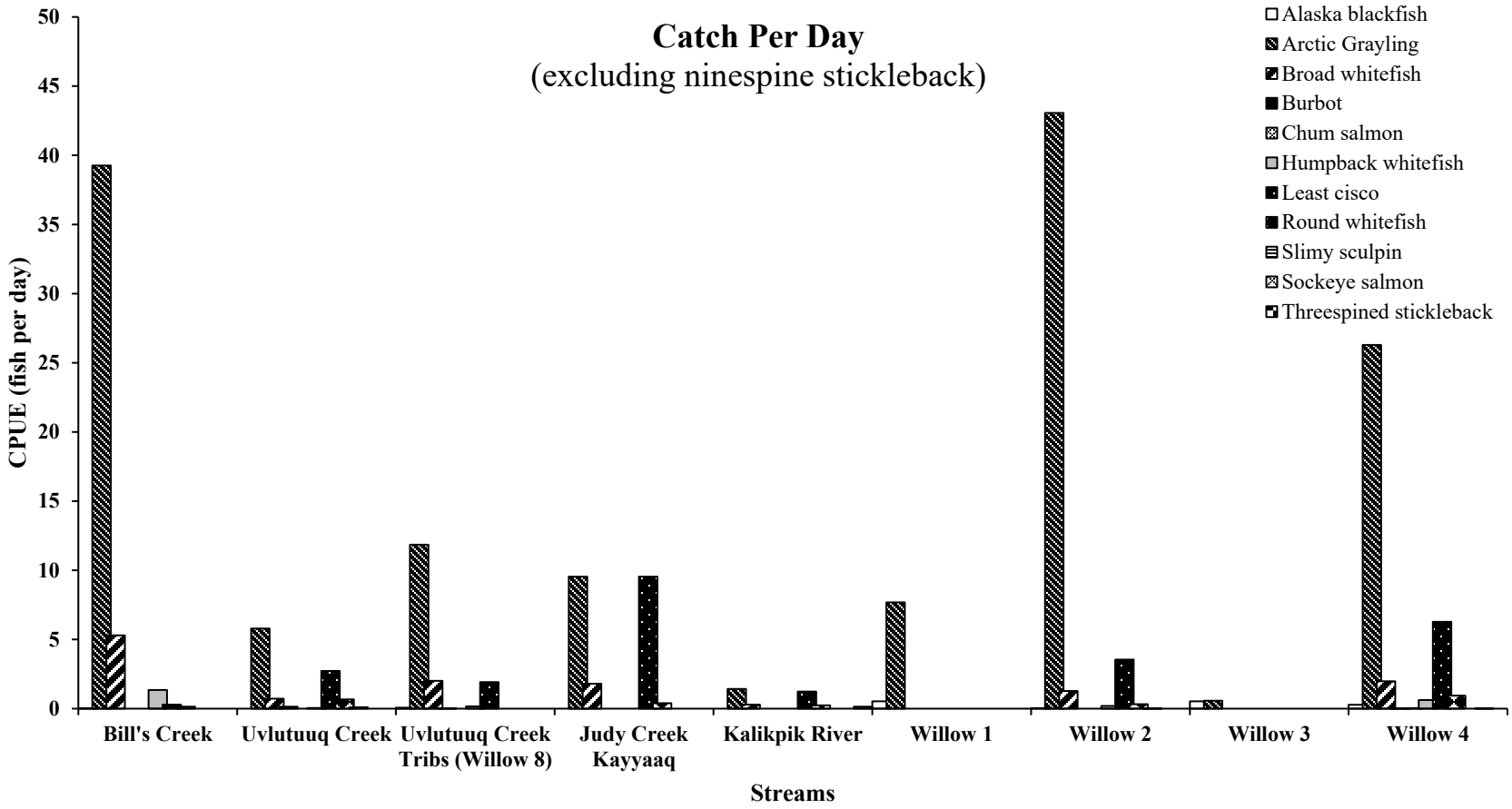
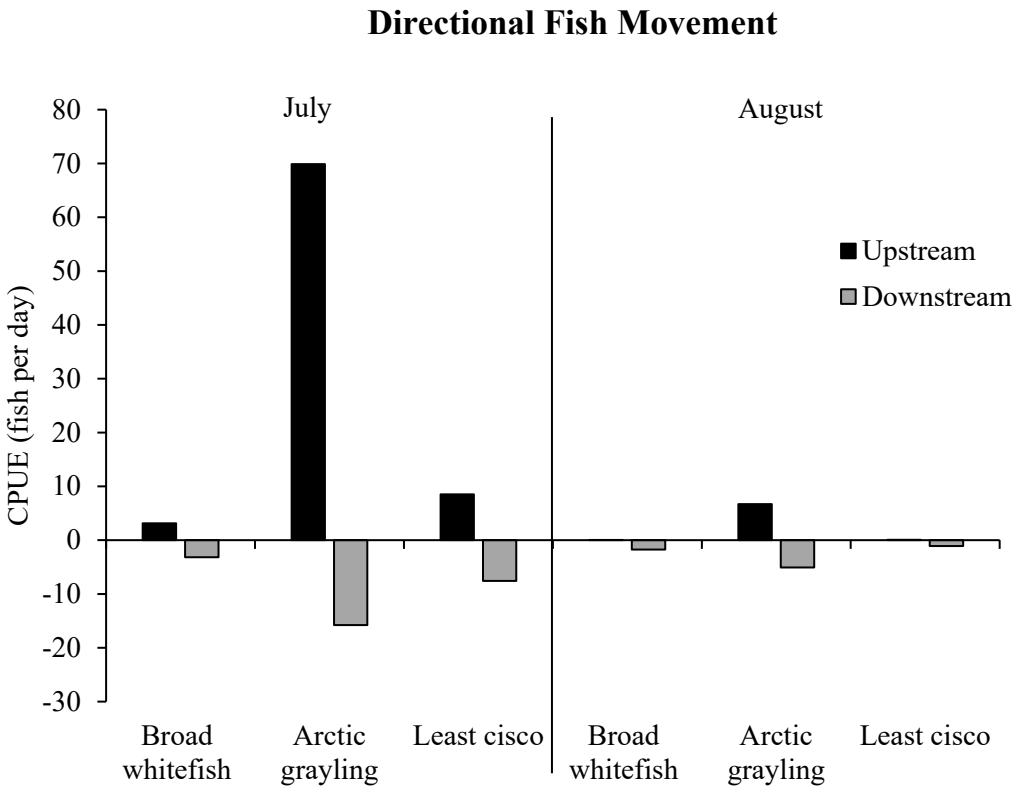
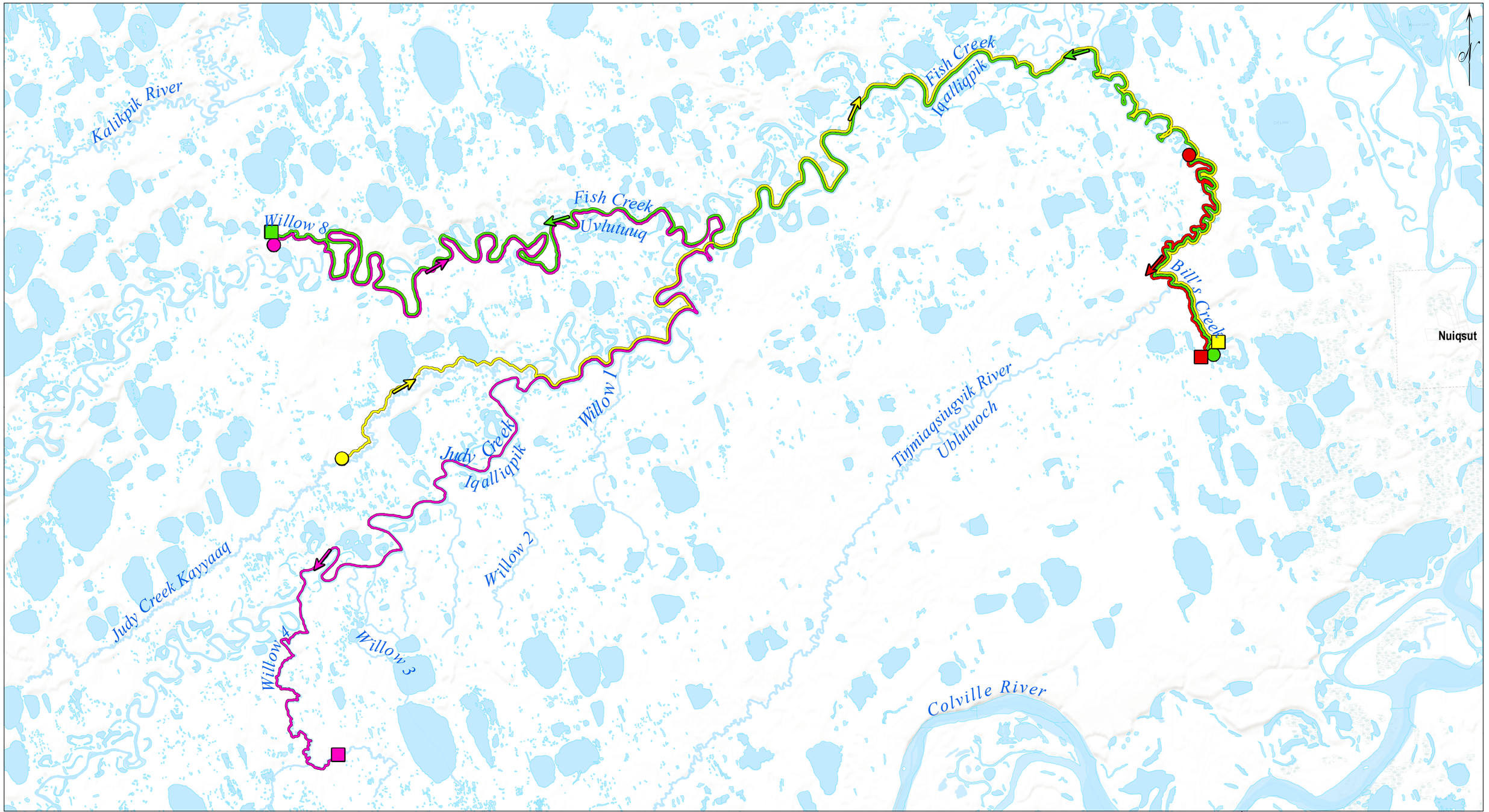


Figure 6. Directional movements of three most abundant fish species (excluding ninespine stickleback) captured by month, 2018.





Tag no.	Species	Capture Date	Recapture Date	Growth (mm)	Days at large	Distance traveled (mi)
OR2395	Broad whitefish	6/26/2018	7/24/2018	0	28	66
OR5056	Broad whitefish	7/20/2018	8/24/2018	2	35	65
OR1852	Arctic grayling	6/23/2017	6/25/2018	42	367	63
MJM090502	Arctic grayling	7/21/2013	6/23/2018	107	1798	10

Recapture Location

Direction of Travel

Capture Location

LOCATIONS OF SEVERAL RECAPTURED ARCTIC GRAYLING AND BROAD WHITEFISH TAGGED IN THE WILLOW AREA, 2018

ConocoPhillips Alaska

SCALE: 0 1 2 3 mi

FIGURE: 7

CPAI_032.mxd, 3/8/2019 11:41:11 AM, R06

Figure 8. Length frequency distributions of Arctic grayling captured across sites during June (a), July (b), and August (c) 2017 (grey bars) and 2018 (black bars).

Note: Length distributions of each size class are depicted by brackets shown above bars. Note the slight right shift (growth) of all size classes of fish through the season, particularly in 2017. Also, note the relative abundance and length difference of size-0 fish during July and August 2017 compared to 2018.

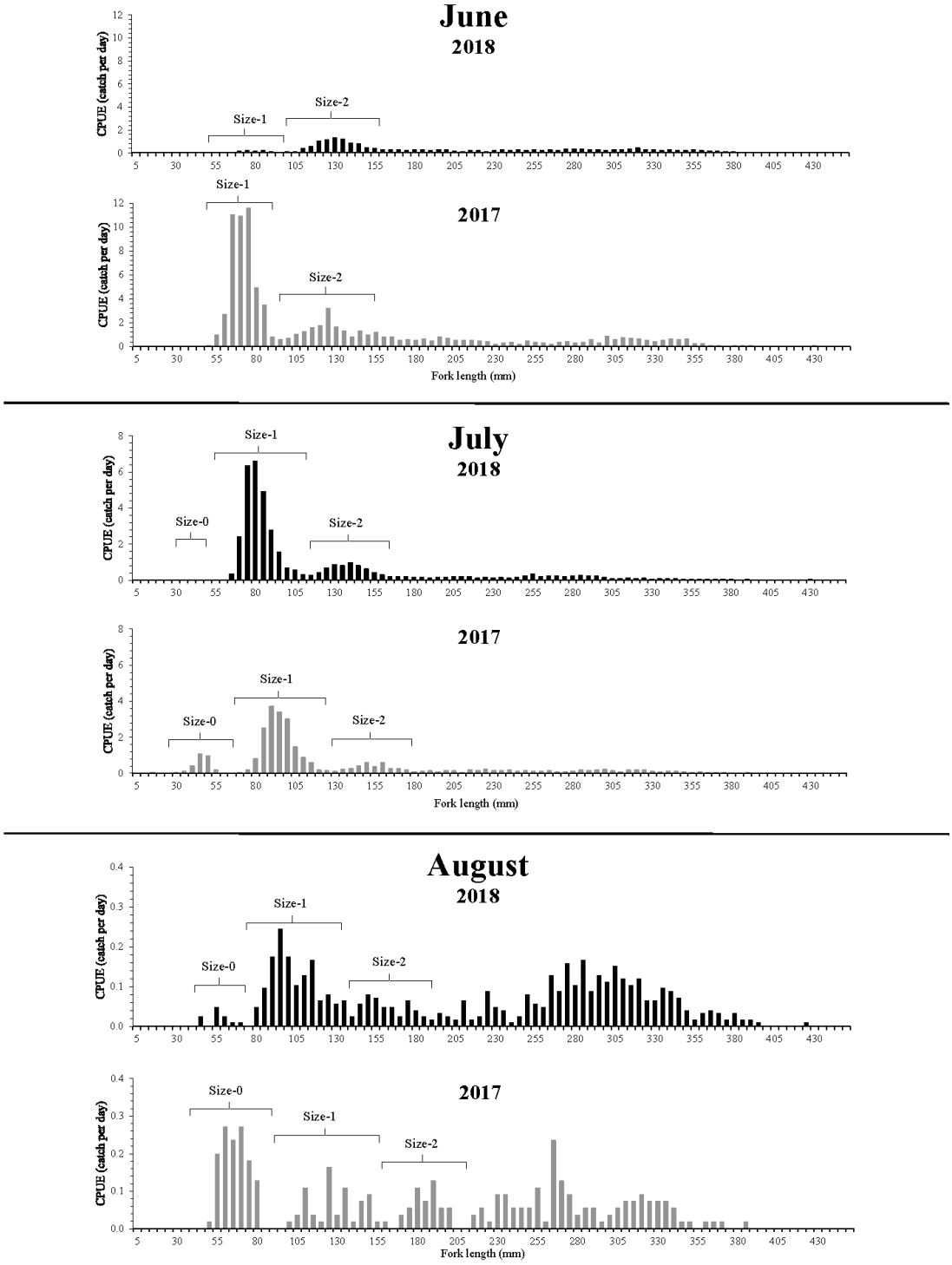


Figure 9. Mean fork length comparisons of size-0 (a), size-1 (b), and size-2 (c) Arctic grayling captured from tributary and mainstem sites from the Willow Area, July 2017.

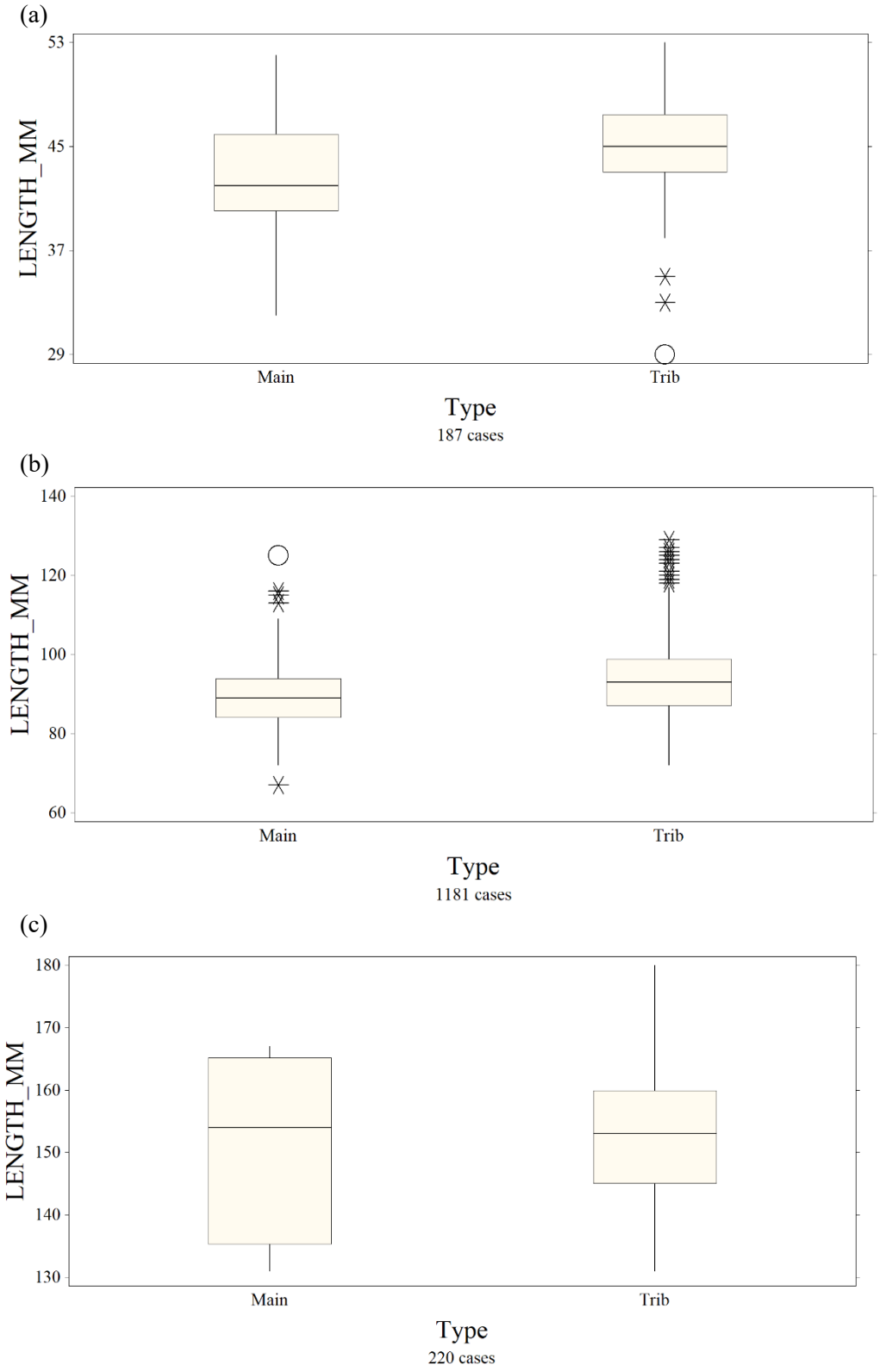
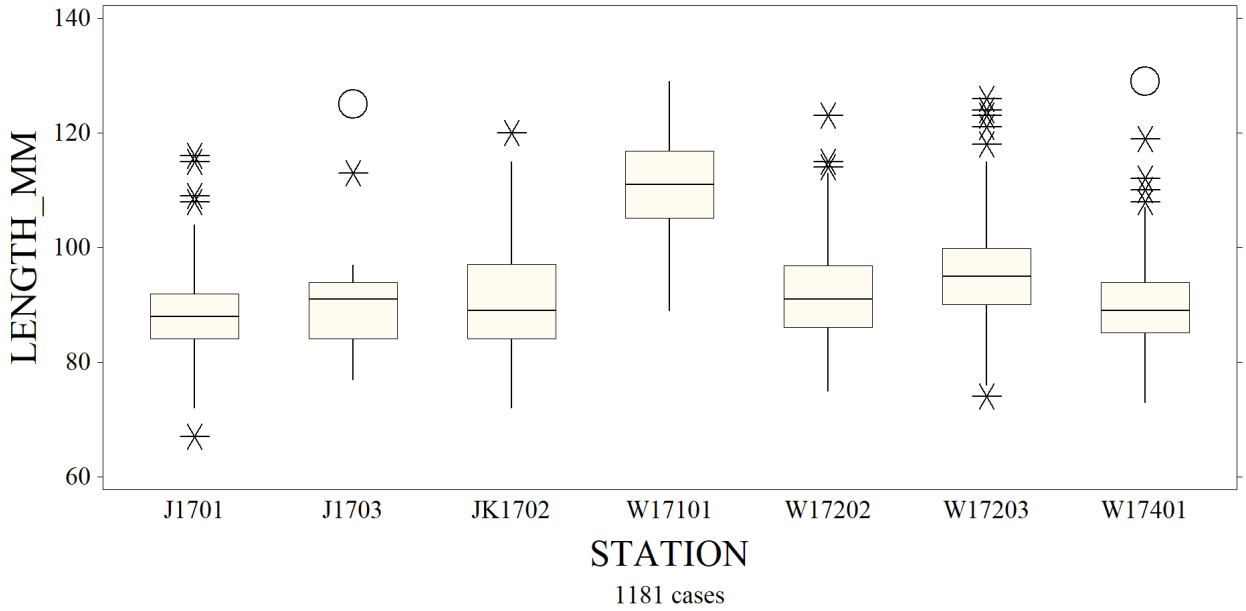


Figure 10. Mean fork length comparison of size-1 Arctic grayling across sites during July 2017 (a), and July 2018 (b).

(a)



(b)

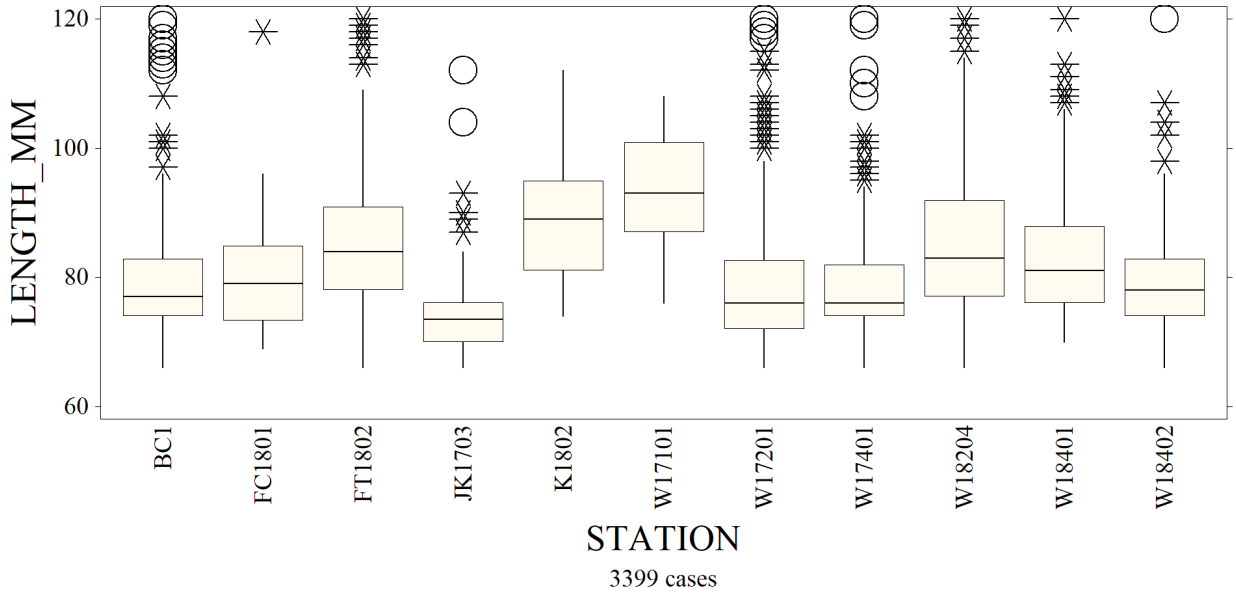
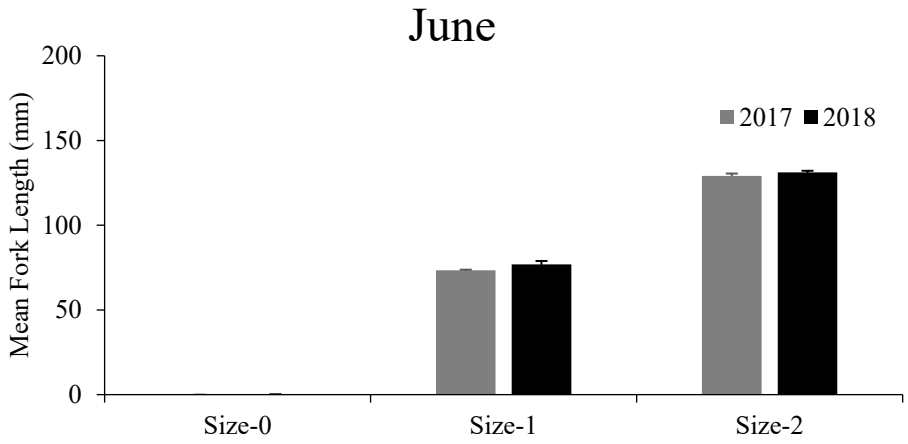
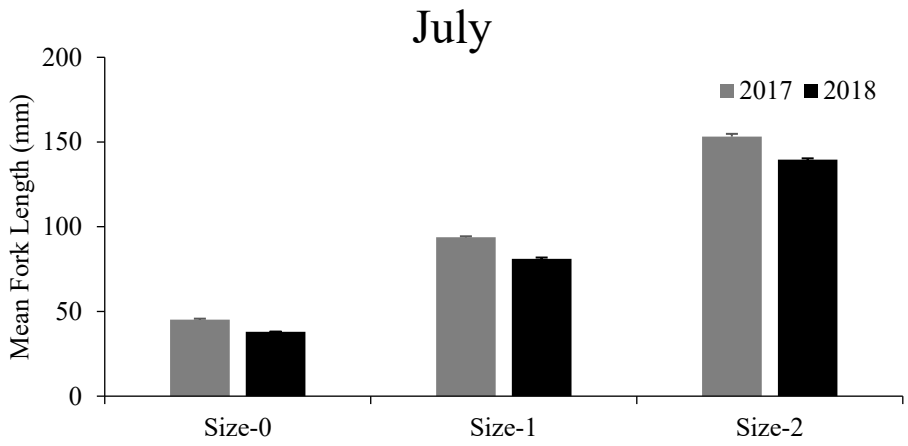


Figure 11. Comparison of Arctic grayling mean fork length per size group and year in June (a), July (b), and August (c) in the Willow area, 2017 and 2018. Error bars represent one standard error of the mean.

(a)



(b)



(c)

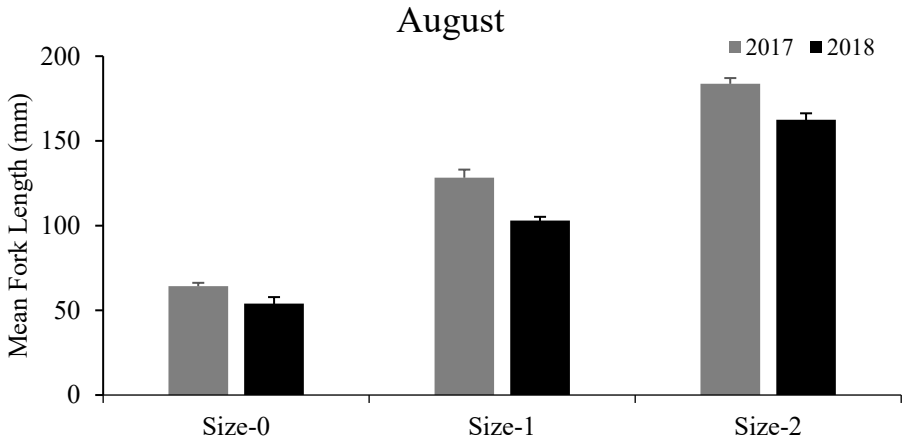


Figure 12. Mean fork length of Arctic grayling by size group during August 2017 and August 2018 in the Willow area.

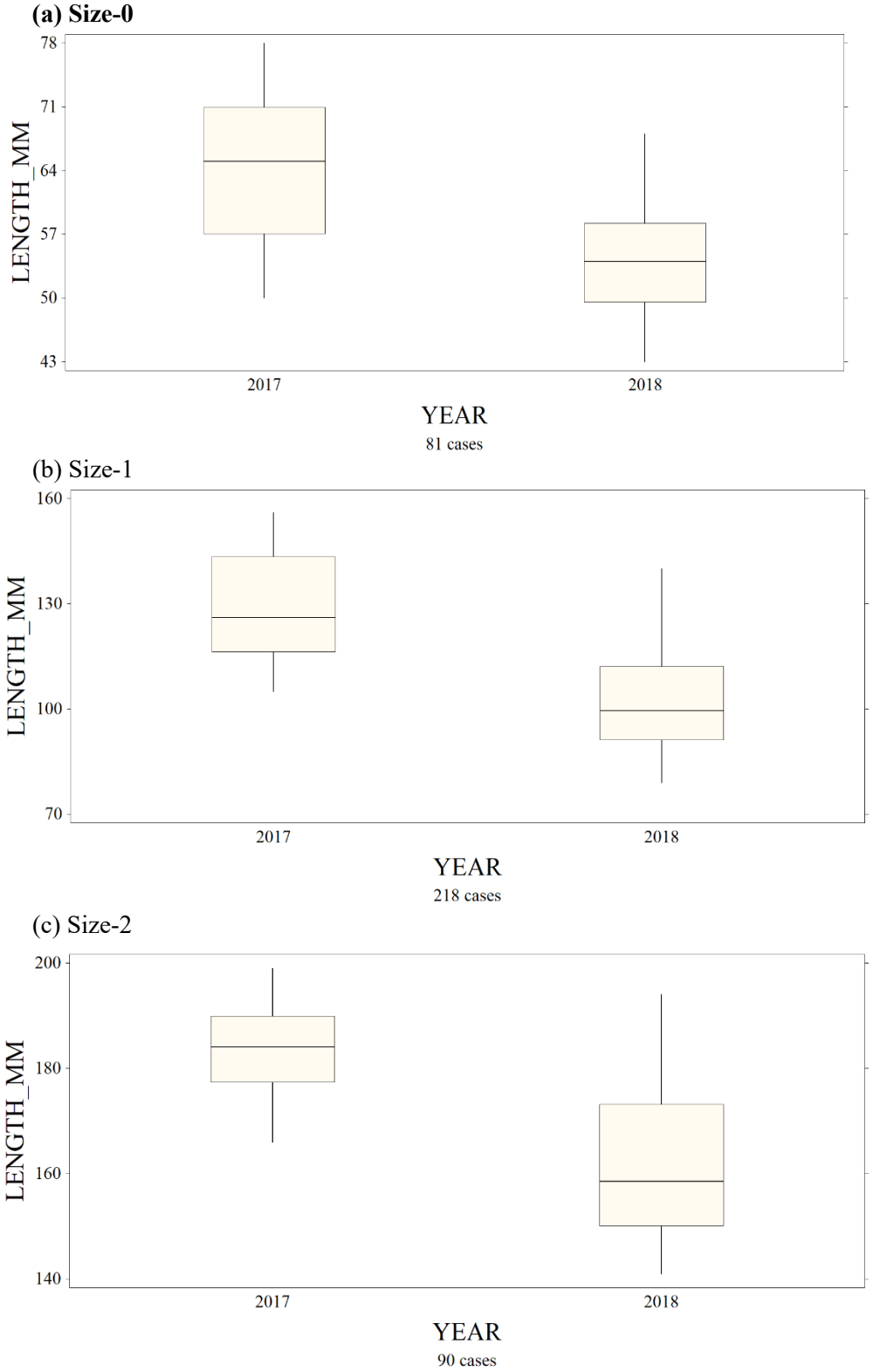


Figure 13. Size-0 Arctic grayling length frequency distributions during August 2017 and August 2018 in the Willow area.

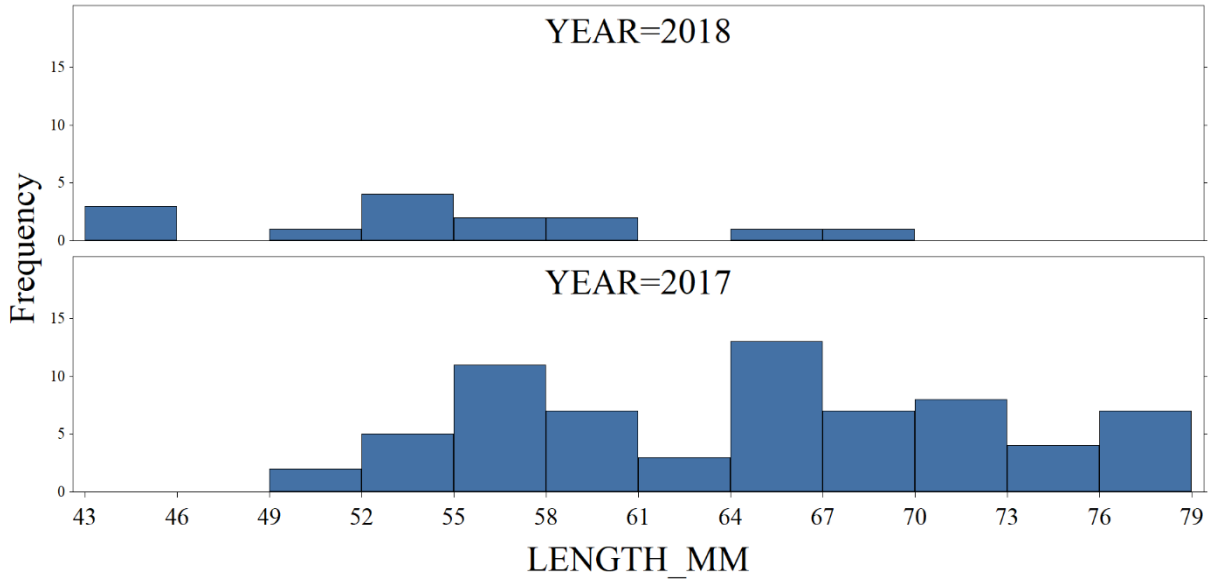
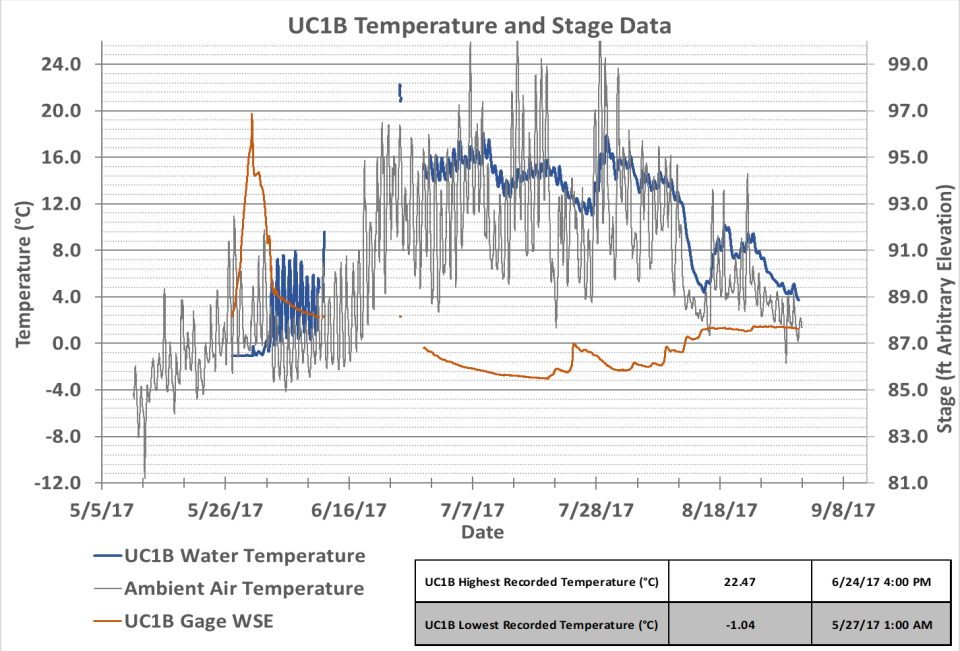


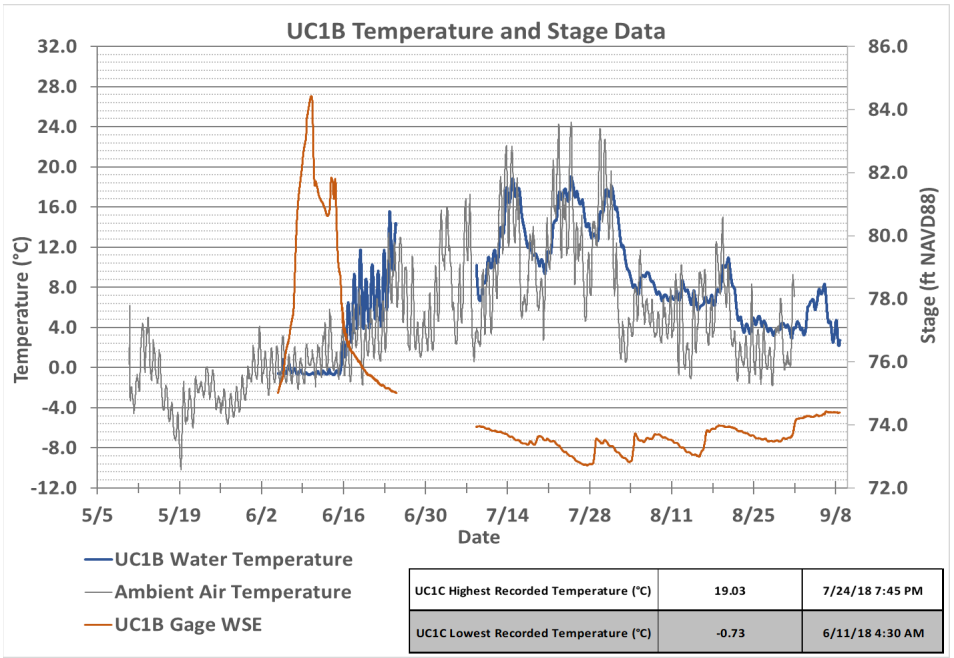
Figure 14. Water temperature, ambient air temperature, and stream stage of Willow 2 during 2017 (a), and 2018 (b) in the Willow area.

Note: Different metrics used on right y-axis for stage height. Data courtesy of Garett Yager, Michael Baker Intl. 2019.

(a)



(b)



APPENDICES

- Page Intentionally Left Blank -

APPENDIX A

Water Chemistry from Willow Area Fyke Net Stations in Northeastern NPR-A, 2018.

Appendix A. Water chemistry from Willow Area fyke net stations in northeastern NPR-A, 2018.

Station	Date	Water Temp (°C)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH
BC1					
	6/21/2018	5.3	187.4	0.92	7.58
	6/22/2018	7.1	146.3	1.04	7.58
	6/24/2018	9.9	115.0	0.80	7.57
	6/25/2018	10.4	141.7	0.61	7.45
	6/26/2018	9.5	109.8	0.61	7.64
	6/27/2018	7.4	98.1	0.63	7.55
	6/28/2018	5.8	92.4	0.43	7.39
	7/18/2018	11.6		0.72	7.64
	7/19/2018	10.1	138.7	0.68	7.69
	7/20/2018	9.3	141.4	0.92	7.69
	7/21/2018	12.0	143.0	0.82	7.68
	7/22/2018	14.9	142.9	0.88	7.63
	7/23/2018	16.2	148.3	5.05	7.59
	7/24/2018	16.3	153.6	2.73	7.70
	7/25/2018	17.0	152.1	0.93	7.69
	8/22/2018	3.6	169.1	0.91	7.89
	8/23/2018	4.2	159.6	0.91	7.82
	8/24/2018	3.1	168.6	0.83	7.76
	8/25/2018	3.9	167.8	0.86	7.79
	8/26/2018	3.2	167.4	0.78	7.67
	8/27/2018	2.7	168.6	0.79	7.72
	8/28/2018	2.7	169.1	0.76	7.77
	8/29/2018	3.7	169.6	0.77	7.65
FC1801					
	6/24/2018	7.1	78.0	31.90	7.80
	6/25/2018	8.4	88.7	22.70	7.77
	6/26/2018	10.2	87.5	23.30	7.74
	6/27/2018	8.6	86.2	20.15	7.69
	6/28/2018	7.6	83.9	18.98	7.77
	6/30/2018	6.6	87.3	18.99	7.79
	7/1/2018	6.2	86.8	13.44	7.60
	7/2/2018	8.2	87.6	12.73	7.84
	7/18/2018	12.0	107.4	8.22	7.89

Station	Date	Water Temp (°C)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH
	7/19/2018	10.9	109.3	11.27	7.75
	7/20/2018	9.8	108.9	6.74	7.83
	7/21/2018	13.9	109.4	5.82	7.97
	7/22/2018	15.2	109.6	6.31	7.86
	7/23/2018	16.8	109.2	6.06	7.87
	7/24/2018	18.4	110.6	6.67	7.96
	7/25/2018	17.1	112.4	6.46	7.94
	8/22/2018	4.5	129.7	3.09	8.02
	8/24/2018	3.9	127.6	2.79	7.86
	8/25/2018	4.5	127.2	2.78	7.90
	8/26/2018	3.8	127.0	2.58	7.86
	8/27/2018	3.2	127.3	2.84	7.66
	8/28/2018	3.3	126.7	2.50	7.90
	8/29/2018	4.6	127.1	2.89	7.97
FT1802					
	6/23/2018	4.1	154.6	1.07	7.34
	6/24/2018	5.7	152.7	1.03	7.38
	6/25/2018	5.8	122.9	0.95	7.33
	6/26/2018	6.0	126.7	0.85	7.30
	6/27/2018	5.3	118.0	0.83	7.45
	6/30/2018	5.5	94.5	0.81	7.49
	7/18/2018	12.0	104.0	0.59	7.58
	7/19/2018	11.0	107.2	0.78	7.59
	7/20/2018	11.3	101.9	0.67	7.67
	7/21/2018	14.2	102.7	0.60	7.76
	7/22/2018	14.8	102.2	0.59	7.67
	7/23/2018	15.9	103.1	0.62	7.64
	7/24/2018	18.9	106.6	0.69	7.43
	7/25/2018	17.0	107.1	0.62	7.43
	8/22/2018	5.8	102.6	0.99	8.00
	8/23/2018	5.0	104.2	0.74	7.74
	8/24/2018	5.0	103.9	1.25	7.68
	8/25/2018	4.5	103.4	3.32	7.56
	8/26/2018	4.2	102.9	0.99	7.65
	8/27/2018	3.7	102.8	2.05	7.53
	8/28/2018	3.6	102.2	1.04	7.67

Station	Date	Water Temp (°C)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH
	8/29/2018	4.9	103.1	1.29	7.77
FT1803					
	6/23/2018	5.0	207.9	1.37	7.27
	6/24/2018	5.7	185.6	1.34	7.20
	6/25/2018	5.6	133.6	1.10	7.23
	6/26/2018	7.5	73.8	0.49	7.21
	6/27/2018	4.1	40.3	0.53	7.22
	6/30/2018	4.8	135.5	0.91	7.47
	7/18/2018	11.6	103.6	1.70	7.58
	7/19/2018	10.8	106.3	2.08	7.53
	7/20/2018	11.7	105.9	1.28	7.65
	7/21/2018	13.2	105.6	9.44	7.58
	7/22/2018	15.9	107.1	1.17	7.67
	7/23/2018	15.4	107.3	1.33	7.70
	7/24/2018	18.4	108.1	1.35	7.72
	7/25/2018	15.0	108.7	1.63	7.72
	8/22/2018	4.9	113.6	1.85	7.77
	8/24/2018	3.0	125.2	3.24	7.66
	8/25/2018	4.1	114.8	5.80	7.59
	8/26/2018	4.4	114.6	5.00	7.59
	8/27/2018	3.2	115.1	2.81	7.63
	8/28/2018	3.7	116.3	2.19	7.70
	8/29/2018	5.4	114.8	4.57	7.72
JK1703					
	6/24/2018	8.0	86.3	10.97	7.30
	6/25/2018	7.3	86.3	5.18	7.18
	6/26/2018	10.0	92.6	6.16	7.32
	6/27/2018	9.0	105.6	5.70	7.33
	6/28/2018	6.9	115.2	10.56	7.40
	6/30/2018	6.1	121.8	6.19	7.53
	7/1/2018	6.0	124.2	4.20	7.47
	7/18/2018	11.7	131.9	4.55	7.70
	7/19/2018	10.6	131.6	3.33	7.62
	7/20/2018	11.1	131.0	2.65	7.74
	7/21/2018	12.2	130.6	3.18	7.72

Station	Date	Water Temp (°C)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH
	7/22/2018	16.0	135.7	2.91	7.75
	7/23/2018	16.5	136.6	2.96	7.77
	7/24/2018	16.8	138.3	3.80	7.79
	7/25/2018	16.9	140.3	12.76	7.72
	8/22/2018	5.9	138.1	1.43	7.93
	8/23/2018	5.2	138.9	1.73	7.87
	8/24/2018	4.5	154.5	1.54	7.76
	8/25/2018	4.9	138.0	1.60	7.81
	8/26/2018	4.4	138.2	1.64	7.75
	8/27/2018	4.1	138.5	1.63	7.72
	8/29/2018	4.3	137.9	1.59	7.77
K1802					
	6/23/2018	4.2	95.4	11.30	7.69
	6/24/2018	3.7	101.5	12.30	7.71
	6/25/2018	6.3	100.6	8.98	7.70
	6/26/2018	6.3	110.4	8.46	7.73
	6/27/2018	5.5	105.8	14.90	7.81
	6/30/2018	4.2	127.9	7.02	7.84
	7/18/2018	11.3	145.6	6.50	7.93
	7/19/2018	10.8	151.5	5.53	7.76
	7/20/2018	12.0	200.1	5.55	8.01
	7/21/2018	14.1	151.6	5.53	8.03
	7/22/2018	18.2	154.5	7.02	8.02
	7/23/2018	16.3	155.5	5.87	8.00
	7/24/2018	18.9	156.8	4.92	8.07
	7/25/2018	15.7	158.9	5.96	8.08
	8/22/2018	4.1	160.1	2.11	7.96
	8/24/2018	3.9	159.1	2.24	8.03
	8/25/2018	3.9	159.3	2.45	7.99
	8/26/2018	3.3	159.3	2.27	8.00
	8/27/2018	2.7	160.1	2.51	7.86
	8/28/2018	3.2	159.5	2.22	7.97
	8/29/2018	4.8	158.9	2.44	8.00

Station	Date	Water Temp (°C)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH
W17101					
	6/21/2018	5.0	48.4	0.67	7.20
	6/23/2018	5.7	55.1	1.11	7.10
	6/25/2018	7.0	46.3	0.97	7.12
	6/26/2018	7.2	53.8	3.33	7.07
	6/27/2018	4.2	57.7	9.23	7.04
	6/28/2018	4.4	61.2	11.56	7.10
	6/30/2018	3.7	61.7	6.09	7.14
	7/18/2018	12.4	93.1	4.50	7.49
	7/19/2018	11.9	93.8	1.10	7.61
	7/20/2018	12.2	94.0	3.33	7.57
	7/21/2018	14.0	94.4	5.39	7.54
	7/22/2018	15.9	98.9	0.76	7.60
	7/23/2018	16.3	104.7	5.72	7.49
	7/24/2018	18.1	102.0	4.68	7.56
	7/25/2018	15.8	105.1	3.62	7.59
	8/22/2018	6.0	127.9	3.05	7.73
	8/24/2018	5.3	129.1	1.35	7.71
	8/25/2018	5.0	129.6	0.91	7.74
	8/26/2018	4.6	129.8	4.38	7.66
	8/27/2018	4.1	130.0	1.12	7.67
	8/28/2018	4.0	127.1	0.83	7.54
	8/29/2018	4.7	130.7	0.82	7.76
W17201					
	6/23/2018	9.0	137.1	2.14	7.54
	6/24/2018	11.8	129.0	2.07	7.51
	6/25/2018	12.1	145.7	1.93	7.48
	6/26/2018	13.2	145.4	1.41	7.58
	6/27/2018	9.7	150.3	1.30	7.59
	6/29/2018	6.2	131.1	8.09	7.63
	6/30/2018	6.3	128.3	0.98	7.62
	7/18/2018	12.4	197.7	2.07	7.77
	7/19/2018	10.8	194.0	1.98	7.62
	7/20/2018	12.7	197.6	1.72	7.81
	7/21/2018	12.7	197.6	1.99	7.75
	7/22/2018	17.5	198.2	1.58	7.79

Station	Date	Water Temp (°C)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH
	7/23/2018	16.5	198.7	1.52	7.75
	7/24/2018	17.6	206.5	2.10	7.81
	7/25/2018	17.4	213.0	2.26	7.65
	8/22/2018	5.5	171.8	1.22	7.80
	8/23/2018	5.3	172.0	1.06	7.75
	8/24/2018	4.5	172.4	1.22	7.62
	8/25/2018	4.9	172.7	1.18	7.61
	8/26/2018	4.1	174.8	1.25	7.62
	8/27/2018	4.0	176.2	1.34	7.59
	8/28/2018	3.8	174.8	2.70	7.65
	8/29/2018	4.5	174.0	2.43	7.70
W17301					
	7/18/2018	12.4	158.0	4.52	7.91
	7/19/2018	11.8	155.8	33.26	7.66
	7/20/2018	12.6	139.8	8.41	7.86
	7/21/2018	13.7	157.2	6.92	7.95
W17401					
	7/18/2018	13.0	122.0	2.51	7.67
	7/19/2018	11.0	127.8	2.30	7.66
	7/20/2018	10.8	125.7	2.30	7.71
	7/21/2018	12.5	125.8	1.30	7.73
	7/22/2018	15.5	125.8	1.50	7.69
	7/23/2018	17.1	126.8	1.66	7.72
	7/24/2018	17.3	128.0	1.14	7.73
	7/25/2018	17.8	130.4	1.32	7.76
	8/22/2018	5.9	129.9	1.60	7.72
	8/23/2018	5.4	130.7	2.09	7.72
	8/24/2018	4.9	131.1	1.61	7.70
	8/25/2018	5.4	131.1	1.77	7.70
	8/26/2018	4.7	130.8	1.52	7.68
	8/27/2018	4.3	130.8	1.55	7.63
	8/28/2018	4.7	129.8	1.70	7.72
	8/29/2018	4.9	129.7	4.25	7.60
W18204					
	6/23/2018	7.0	85.2	0.54	7.31

Station	Date	Water Temp (°C)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH
	6/24/2018	13.9	83.7	0.61	7.26
	6/25/2018	9.9	73.8	0.79	7.25
	6/26/2018	12.0	89.5	0.66	7.32
	6/27/2018	6.3	91.0	0.71	7.34
	6/29/2018	5.1	80.2	2.46	7.36
	6/30/2018	5.8	79.4	0.65	7.38
	7/1/2018	6.3	79.2	0.62	7.19
	7/18/2018	11.9	117.6	1.40	7.51
	7/19/2018	10.4	117.9	1.23	7.50
	7/20/2018	10.1	116.2	1.06	7.53
	7/21/2018	13.5	114.9	1.21	7.51
	7/22/2018	17.6	140.2	1.30	7.48
	7/23/2018	17.8	124.3	1.50	7.54
	7/24/2018	18.0	131.4	1.81	7.64
	7/25/2018	17.5	132.7	28.18	7.47
	8/22/2018	4.6	117.0	1.04	7.58
	8/24/2018	4.2	115.1	2.68	7.50
	8/25/2018	5.1	115.0	5.21	7.50
	8/26/2018	4.1	115.2	7.40	7.49
	8/27/2018	3.7	115.3	0.81	7.48
	8/28/2018	3.0	114.3	0.60	7.51
	8/29/2018	4.3	113.6	1.74	7.44
W18302					
	6/26/2018	4.3	96.9	1.32	7.23
	6/27/2018	3.4	105.4	1.07	7.23
	6/30/2018	2.6	85.8	0.87	7.40
	7/1/2018	3.1	86.5	0.78	7.37
	7/2/2018	4.1	87.4	0.53	7.43
	7/18/2018	12.6	152.8	31.43	7.51
	7/19/2018	11.5	144.6	11.24	7.67
	7/20/2018	12.2	156.1	2.32	7.80
	7/21/2018	13.9	159.3	1.41	7.88
	7/22/2018	15.3	163.1	1.34	7.85
	7/23/2018	16.2	161.3	1.25	7.79
	7/24/2018	18.3	164.0	1.30	7.85
	7/25/2018	17.2	167.3	1.21	7.88

Station	Date	Water Temp (°C)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH
	8/22/2018	6.5	172.3	1.93	7.98
	8/24/2018	5.7	172.8	2.03	7.82
	8/25/2018	5.5	173.1	2.02	7.86
	8/26/2018	4.7	172.6	1.66	7.86
	8/27/2018	4.3	173.3	1.76	7.78
	8/28/2018	4.0	173.5	1.34	7.89
	8/29/2018	4.8	172.3	2.85	7.85
W18303					
	7/18/2018	12.0	184.6	0.85	7.90
W18401					
	6/23/2018	8.1	79.9	1.06	7.25
	6/24/2018	8.9	77.0	1.06	7.29
	6/25/2018	8.1	72.5	0.95	7.19
	6/26/2018	9.6	71.7	0.72	7.34
	6/27/2018	8.1	69.0	0.88	7.34
	6/29/2018	6.7	61.2	0.65	7.43
	6/30/2018	6.1	65.1	0.66	7.48
	7/1/2018	6.7	65.6	0.72	7.30
	7/2/2018	9.5	66.6	0.76	7.28
	7/18/2018	11.8	89.7	4.47	7.60
	7/19/2018	9.6	87.6	13.04	7.64
	7/20/2018	12.1	89.7	1.81	7.66
	7/21/2018	14.4	90.2	1.22	7.68
	7/22/2018	17.7	92.1	1.04	7.66
	7/23/2018	17.1	93.5	3.31	7.60
	7/24/2018	18.7	95.5	0.96	7.56
	7/25/2018	16.0	97.8	1.32	7.45
	8/22/2018	3.7	100.5	2.33	7.52
	8/23/2018	4.9	96.4	4.23	7.74
	8/24/2018	4.5	102.2	3.86	7.56
	8/25/2018	5.2	101.2	5.31	7.53
	8/26/2018	4.9	101.6	6.57	7.52
	8/27/2018	3.8	101.0	3.56	7.50
	8/28/2018	3.7	101.8	4.40	7.56
	8/29/2018	6.3	100.2	25.74	7.65

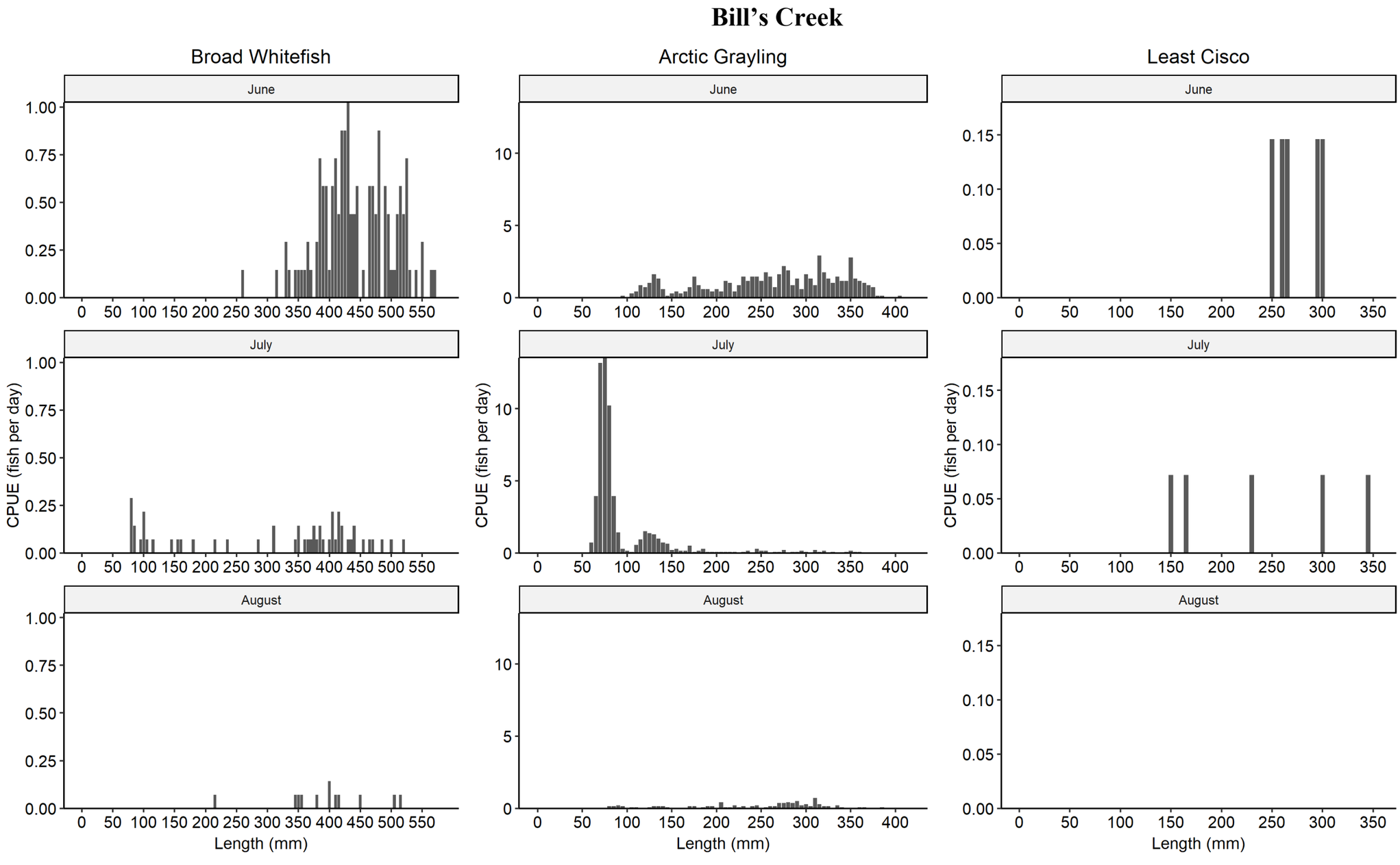
Station	Date	Water Temp (°C)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH
W18402					
	6/23/2018	9.7	119.4	1.58	7.44
	6/24/2018	11.1	116.3	1.75	7.40
	6/25/2018	12.6	112.3	1.17	7.42
	6/26/2018	12.7	105.7	2.72	7.38
	6/27/2018	10.8	106.6	1.18	7.47
	6/30/2018	6.3	92.4	0.67	7.34
	7/18/2018	13.2	142.8	1.28	7.79
	7/19/2018	11.2	140.4	1.27	7.78
	7/20/2018	11.4	138.7	1.04	7.78
	7/21/2018	12.9	137.6	0.95	7.84
	7/22/2018	15.5	136.6	1.18	7.78
	7/23/2018	17.4	139.1	1.04	7.79
	7/24/2018	18.3	141.6	1.08	7.85
	7/25/2018	17.9	144.7	1.26	7.79
	8/22/2018	6.1	141.3	1.27	7.82
	8/23/2018	5.8	140.2	2.63	7.85
	8/24/2018	4.8	140.7	1.01	7.81
	8/25/2018	5.0	140.0	1.12	7.77
	8/26/2018	4.4	140.3	1.03	7.77
	8/27/2018	4.1	140.1	18.96	7.54
	8/28/2018	3.9	139.7	1.46	7.76
	8/29/2018	4.5	138.7	1.04	7.62
W18405					
	6/23/2018	5.2	68.7	1.11	7.24
	6/24/2018		60.8	1.18	7.10
	6/25/2018	5.2	60.0	0.95	7.06
	6/26/2018	4.6	56.2	0.91	7.04
	6/27/2018	4.3	53.8	1.81	7.15
	6/30/2018	3.6	44.3	4.55	7.26
	7/18/2018	13.1	52.5	3.64	7.44
	7/19/2018	11.9	52.3	1.36	7.51
	7/20/2018	12.3	44.6	1.20	7.52
	7/21/2018	13.8	60.3	0.99	7.52
	7/22/2018	16.3	53.8	1.19	7.49

Station	Date	Water Temp (°C)	Specific Conductance (µS/cm)	Turbidity (NTU)	pH
	7/23/2018	17.0	53.2	1.09	7.51
	7/24/2018	18.5	54.9	1.11	7.48
	7/25/2018	17.4	54.5	12.98	7.62
	8/22/2018	6.2	58.2	1.77	7.63
	8/24/2018	5.7	57.7	1.42	7.60
	8/25/2018	5.4	57.5	1.87	7.55
	8/26/2018	4.7	57.8	1.31	7.55
	8/27/2018	4.5	57.7	1.34	7.47
	8/28/2018	4.8	58.6	1.31	7.52
	8/29/2018	4.9	57.9	1.15	7.55

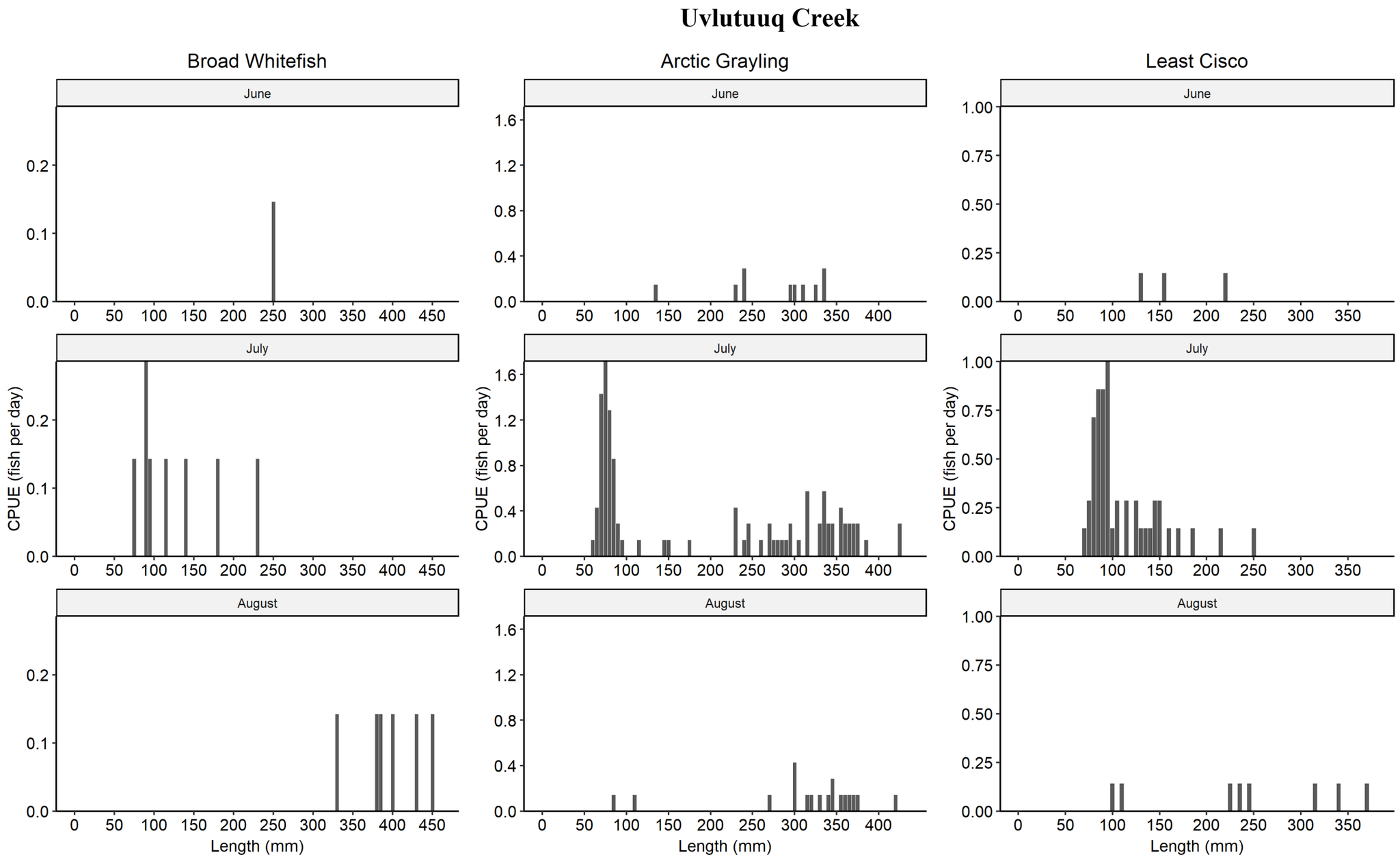
APPENDIX B

Length Frequency Distribution of Broad Whitefish, Arctic Grayling, and Least Cisco Captured During June, July, and August in the Willow Area, 2018.

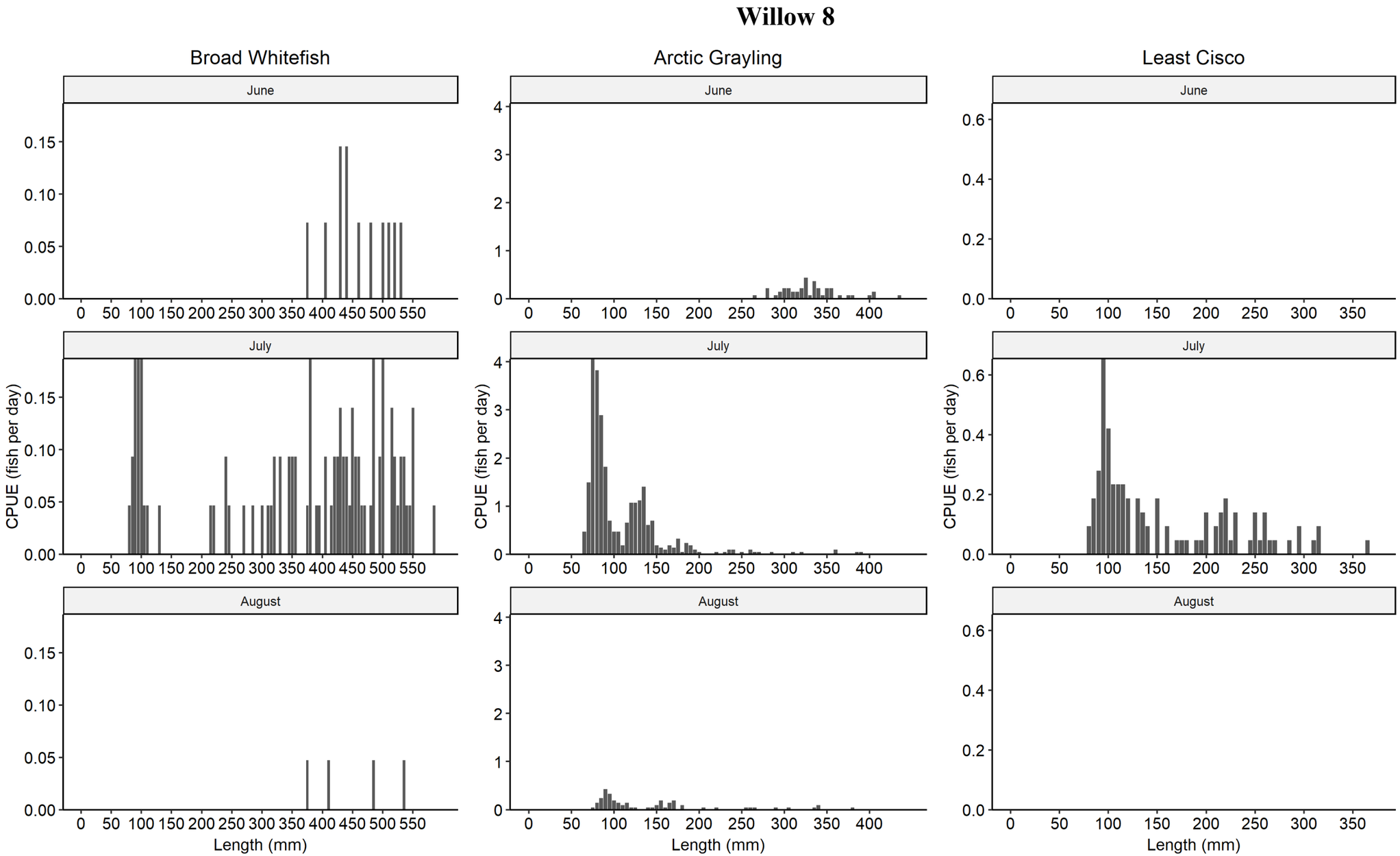
Appendix B. Length frequency distribution of broad whitefish, Arctic grayling, and least cisco captured during June, July, and August in the Willow Area, 2018.



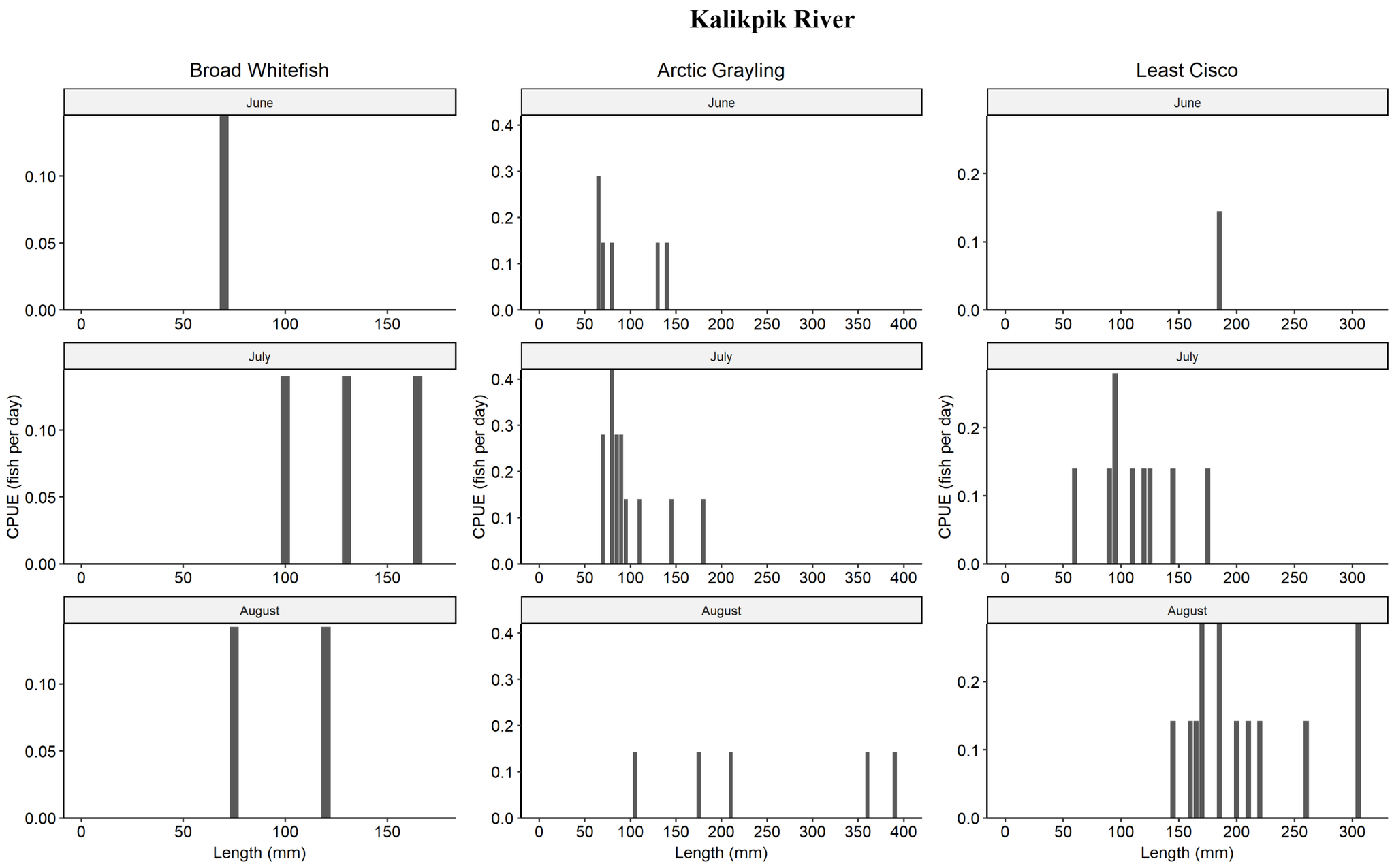
Appendix B (contd.)



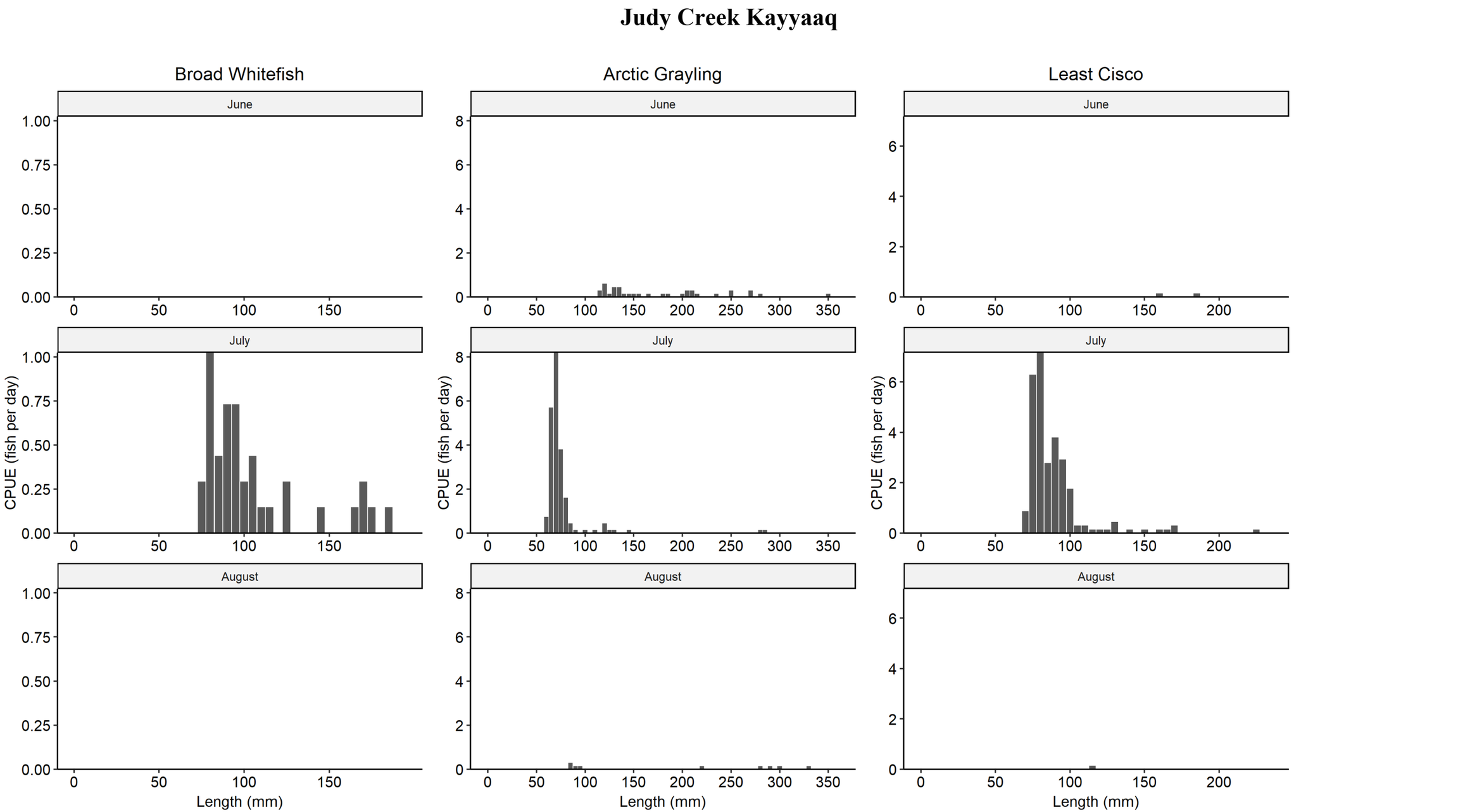
Appendix B (contd.)



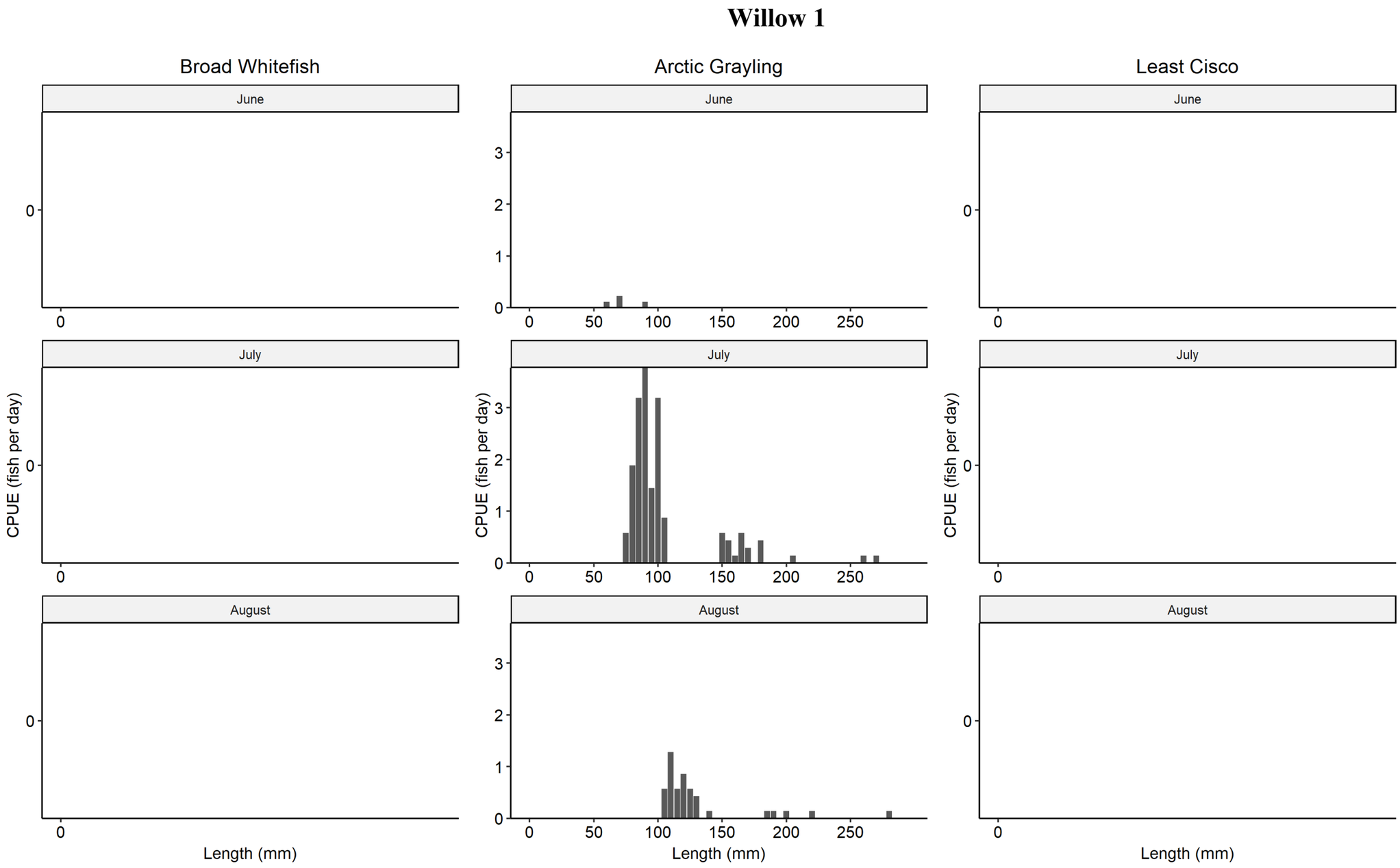
Appendix B (contd.)



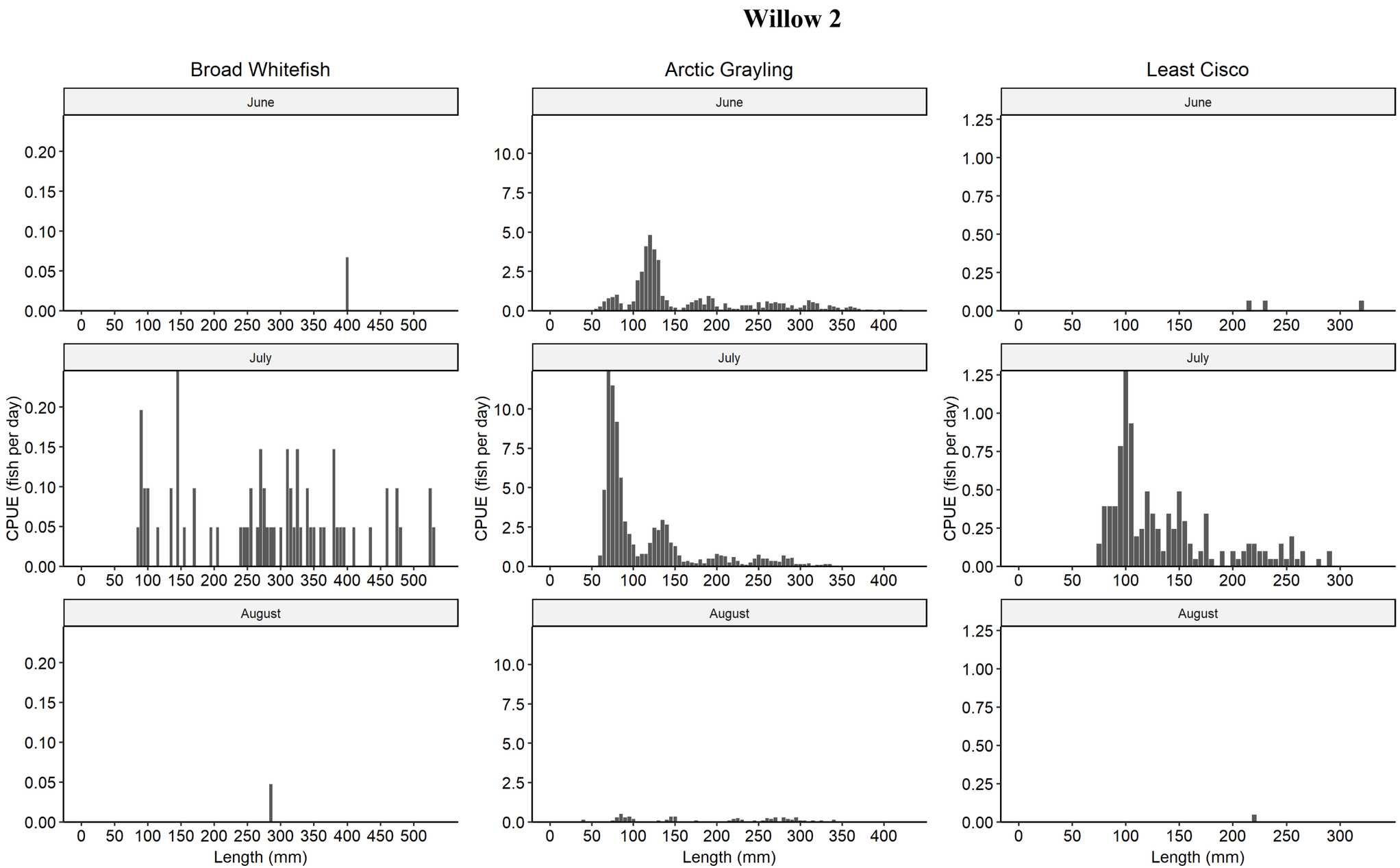
Appendix B (contd.)



Appendix B (contd.)

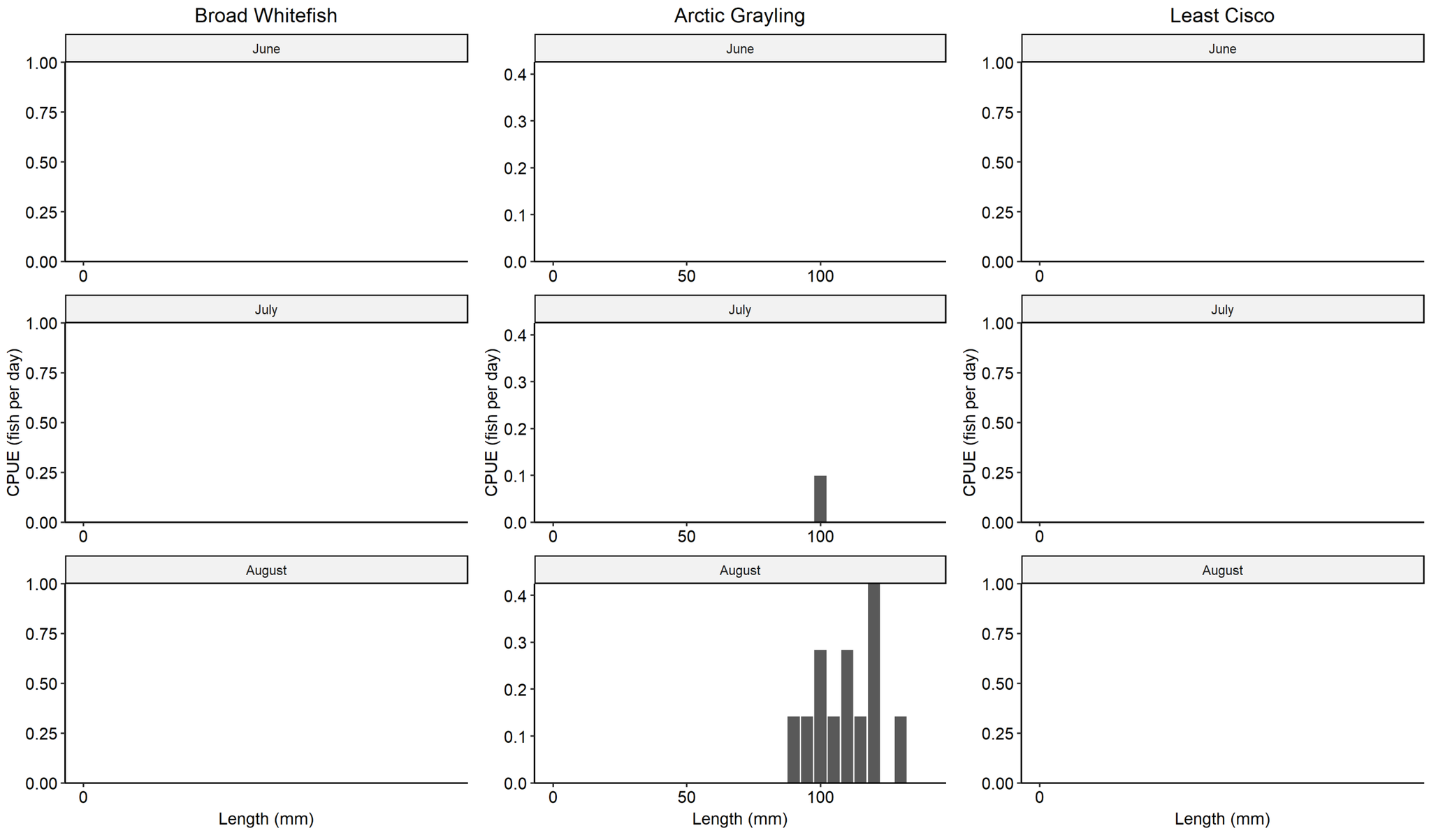


Appendix B (contd.)



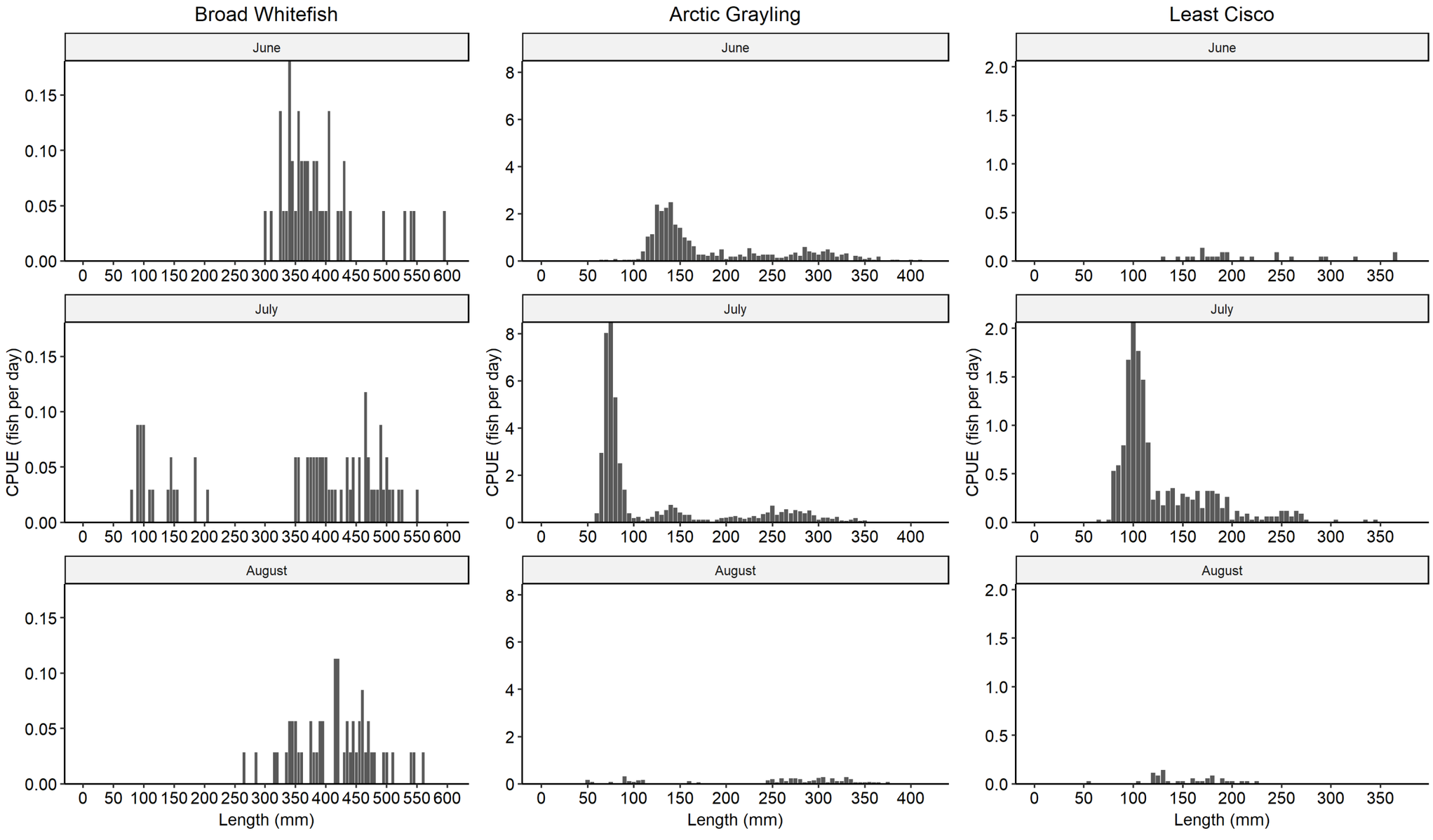
Appendix B (contd.)

Willow 3



Appendix B (contd.)

Willow 4



APPENDIX C

Number of Captured Fish by Direction and Season at Willow Fyke Net Locations in Northeastern NPR-A, 2018.

Appendix C. Numbers of captured fish by direction and season at Willow Area fyke net locations in northeastern NPR-A, 2018.

Note: 'US' = captured moving upstream and 'DS' = captured moving downstream.

Tinmiaqsiugvik River Tributaries

Station: BC1 - Bills Creek Method: Fyke net Species	June	July		August		Total catch	% of catch
		(US)	(DS)	(US)	(DS)		
Alaska blackfish	--	--	--	--	1	1	< 1%
Arctic grayling	411	794	43	71	45	1,364	78%
Broad whitefish	118	33	21	--	12	184	11%
Humpback whitefish	36	--	10	--	1	47	3%
Least cisco	5	4	1	--	--	10	1%
Ninespine stickleback	3	113	6	4	3	129	7%
Round whitefish	2	1	1	--	1	5	< 1%
Total Catch	575	945	82	75	63	1,740	--
Number of Species	6	5	6	2	6	7	--
Effort (hours)	164.05	165.90	167.81	168.35	167.78	833.90	--

Uvlutuuq Creek

Station: FC1801 - Uvlutuuq Creek Method: Fyke net Species	June	July	August	Total catch	% of catch
Arctic grayling	10	93	18	121	46%
Broad whitefish	1	8	6	15	6%
Burbot	1	--	2	3	1%
Humpback whitefish	1	--	--	1	< 1%
Least cisco	3	46	8	57	22%
Ninespine stickleback	40	11	--	51	19%
Round whitefish	11	3	--	14	5%
Slimy sculpin	1	1	--	2	1%
Total Catch	68	162	34	264	--
Number of Species	8	6	4	8	--
Effort (hours)	164.25	167.90	169.00	501.20	--

Uvlutuuq Creek Tributaries

Station: FT1802 - Willow 8 Method: Fyke net Species	June	July	August	Total catch	% of catch
Arctic grayling	49	547	42	638	68%
Broad whitefish	12	97	4	113	12%
Burbot	--	--	1	1	< 1%
Humpback whitefish	2	7	--	9	1%
Least cisco	--	107	--	107	12%
Ninespine stickleback	5	53	6	64	7%
Total Catch	68	811	53	932	--
Number of Species	4	5	4	6	--
Effort (hours)	163.93	169.38	169.23	502.55	--

Station: FT1803 - Willow 8 Method: Fyke net	June	July		August		Total catch	% of catch
Species		(US)	(DS)	(US)	(DS)		
Alaska blackfish	--	--	1	2	1	4	< 1%
Arctic grayling	--	--	3	24	2	29	< 1%
Least cisco	--	1	--	--	--	1	<1%
Ninespine stickleback	239	30,605	908	5,551	3,474	40,777	> 99%
Total Catch	239	30,606	912	5,577	3,477	40,811	--
Number of Species	1	2	3	3	3	4	--
Effort (hours)	165.23	172.33	172.50	169.13	169.25	848.40	--

Kalikpik River

Station: K1802 - Kalikpik River Method: Fyke net Species	June	July	August	Total catch	% of catch
Arctic grayling	6	19	5	30	20%
Broad whitefish	1	3	2	6	4%
Least cisco	1	12	13	26	18%
Ninespine stickleback	4	73	--	77	53%
Round whitefish	--	3	2	5	3%
Threespine stickleback	--	--	3	3	2%
Total Catch	12	110	25	147	--
Number of Species	4	5	5	6	--
Effort (hours)	165.50	171.40	168.31	505.20	--

Iqalliqpik Creek Tributary Sites

Station: JK1703 - Judy Creek Kayyaaq Method: Fyke net Species	June	July	August	Total catch	% of catch
Arctic grayling	36	151	9	196	13%
Broad whitefish	--	37	--	37	3%
Least cisco	2	193	1	196	13%
Ninespine stickleback	31	961	38	1,030	70%
Round whitefish	--	7	1	8	1%
Total Catch	69	1,349	49	1,467	--
Number of Species	3	5	4	5	--
Effort (hours)	160.43	164.03	168.81	493.30	--

Station: W17101 - Willow 1 Method: Fyke net Species	June	July	August	Total catch	% of catch
Alaska blackfish	2	1	9	12	3%
Arctic grayling	4	134	36	174	36%
Ninespine stickleback	27	154	112	293	61%
Total Catch	33	289	157	479	--
Number of Species	3	3	3	3	--
Effort (hours)	209.55	165.32	168.47	543.30	--

Iqalliqpik Creek Tributary Sites (contd.)

Station: W17201 - Willow 2

Method: Fyke net	June	July		August		Total	% of
Species		(US)	(DS)	(US)	(DS)	catch	catch
Alaska whitefish	1	--	1	--	--	2	<1%
Arctic grayling	372	678	213	52	12	1,327	58%
Broad whitefish	1	42	26	1	--	70	3%
Humpback whitefish	1	7	3	--	--	11	<1%
Least cisco	2	79	111	--	1	193	8%
Ninespine stickleback	371	124	150	5	10	660	29%
Round whitefish	7	2	1	2	--	12	<1%
Slimy sculpin	--	1	--	--	--	1	<1%
Total Catch	755	933	505	60	23	2,276	--
Number of Species	7	7	7	4	3	8	--
Effort (hours)	166.63	161.98	161.60	168.81	168.88	828.10	--

Station: W18204 - Willow 2

Method: Fyke net	June	July	August	Total	% of
Species				catch	catch
Arctic grayling	274	758	70	1,102	69%
Broad whitefish	--	2	--	2	<1%
Least cisco	1	6	--	7	<1%
Ninespine stickleback	166	284	23	473	30%
Round whitefish	4	--	2	6	<1%
Total Catch	445	1,050	95	1,590	--
Number of Species	4	4	3	5	--
Effort (hours)	191.28	165.36	169.15	525.80	--

Station: W17301 - Willow 3/Lake M0015

Method: Fyke net	June	July	August	Total	% of
Species				catch	catch
Alaska blackfish	--	1	--	1	<1%
Ninespine stickleback	--	204	--	204	99%
Total Catch	--	205	--	205	--
Number of Species	--	2	--	2	--
Effort (hours)	--	70.00	--	70.00	--

Iqalliqpik Creek Tributary Sites (contd.)

Station: W18302 - Willow 3 Method: Fyke net Species	June	July	August	Total catch	% of catch
Alaska blackfish	1	1	9	11	<1%
Arctic grayling	--	1	12	13	1%
Ninespine stickleback	41	617	586	1,244	98%
Total Catch	42	619	607	1,268	--
Number of Species	2	3	3	3	--
Effort (hours)	134.18	171.26	169.31	474.80	--

Station: W17401 - Willow 4 Method: Fyke net	June	July 18[1]	July		August		Total	% of
Species			(US)	(DS)	(US)	(DS)	catch	catch
Alaska blackfish	--	--	--	--	--	1	1	<1%
Arctic grayling	--	70	475	167	42	85	839	54%
Broad whitefish	--	2	12	39	--	37	90	8%
Burbot	--	--	--	--	--	1	1	<1%
Chum salmon	--	--	--	--	--	2	2	<1%
Humpback whitefish	--	1	--	30	--	1	32	2%
Least cisco	--	49	153	92	2	31	327	21%
Ninespine stickleback	--	3	193	4	14	7	221	14%
Round whitefish	--	2	12	8	2	16	40	3%
Sockeye salmon	--	--	--	--	1	--	1	<1%
Total Catch	--	127	845	340	61	181	1,554	--
Number of Species	--	6	5	6	5	9	10	--
Effort (hours)	--	22.83	145.70	145.71	169.61	170.63	654.48	--

[1] July 18 only. One net set to fish bidirectionally. Second net added July 19.

Station: W18401 - Willow 4 Method: Fyke net Species	June	July	August	Total catch	% of catch
Alaska blackfish	--	1	--	1	<1%
Arctic grayling	299	407	7	713	70%
Broad whitefish	23	12	2	37	4%
Humpback whitefish	8	--	--	8	<1%
Least cisco	3	184	--	187	18%
Ninespine stickleback	10	17	46	73	7%
Round whitefish	1	1	--	2	<1%
Total Catch	344	622	55	1,021	--
Number of Species	6	6	3	7	--
Effort (hours)	208.85	165.53	172.41	546.80	--

Iqalliqpik Creek Tributary Sites (contd.)

Station: W18402 - Willow 4 Method: Fyke net Species	June	July	August	Total catch	% of catch
Arctic grayling	383	414	57	854	67%
Broad whitefish	36	4	13	53	4%
Chum salmon	--	--	1	1	<1%
Humpback whitefish	17	--	--	17	1%
Least cisco	16	44	--	60	5%
Ninespine stickleback	32	172	30	234	19%
Round whitefish	7	9	28	44	3%
Total Catch	491	643	129	1,263	--
Number of Species	6	5	5	7	--
Effort (hours)	159.30	167.25	168.06	494.60	--

Station: W18405 - Willow 4 Method: Fyke net Species	June	July	August	Total catch	% of catch
Alaska blackfish	--	--	23	23	<1%
Broad whitefish	1	--	--	1	<1%
Ninespine stickleback	1,133	54,862	8,646	64,641	>99%
Total Catch	1134	54,862	8669	64,665	--
Number of Species	2	1	2	3	--
Effort (hours)	163.38	169.01	168.08	500.50	--

APPENDIX D

Fish Catch Per Unit of Effort (CPUE) (fish per day) by Direction and Season at Willow Area Fyke Net Locations in Northeastern NPR-A, 2018.

Appendix D. Fish catch per unit of effort (CPUE) (fish per day) by direction and season at Willow area fyke net locations in Northeastern NPR-A, 2018.

Note: 'US' = captured moving upstream and 'DS' = captured moving downstream.

Tinmiaqsiugvik River Tributaries

Station: BC1 - Bills Creek					
Method: Fyke net	**June**	**July**		**August**	
Species		(US)	(DS)	(US)	(DS)
Alaska blackfish	--	--	--	--	0.14
Arctic grayling	60.13	114.86	6.15	10.12	6.44
Broad whitefish	17.26	4.77	3.00	--	1.72
Humpback whitefish	5.27	--	1.43	--	0.14
Least cisco	0.73	0.58	0.14	--	--
Ninespine stickleback	0.44	16.35	0.86	0.57	0.43
Round whitefish	0.29	0.14	0.14	--	0.14
Total CPUE	84.12	136.71	11.73	10.69	9.01
Number of Species	6	5	6	2	6
Effort (hours)	164.05	165.90	167.81	168.35	167.78

Uvlutuuq Creek Sites

Station: FC1801-Uvlutuuq Creek			
Method: Fyke net	**June**	**July**	**August**
Species			
Arctic grayling	1.46	13.29	2.56
Broad whitefish	0.15	1.14	0.85
Burbot	0.15	--	0.28
Humpback whitefish	0.15	--	--
Least cisco	0.44	6.58	1.14
Ninespine stickleback	5.84	1.57	--
Round whitefish	1.61	0.43	--
Slimy sculpin	0.15	0.14	--
Total CPUE	9.94	23.16	4.83
Number of Species	8	6	4
Effort (hours)	164.25	167.90	169.00

Uvlutuuq Creek Tributaries

Station: FT1802 - Willow 8 Method: Fyke net Species	June	July	August
Arctic grayling	7.17	77.50	5.96
Broad whitefish	1.76	13.74	0.57
Burbot	--	--	0.14
Humpback whitefish	0.29	0.99	--
Least cisco	--	15.16	--
Ninespine stickleback	0.73	7.51	0.85
Total CPUE	9.96	114.91	7.52
Number of Species	4	5	4
Effort (hours)	163.93	169.38	169.23

Station: FT1803 - Willow 8 Method: Fyke net	June	July		August	
Species		(US)	(DS)	(US)	(DS)
Alaska blackfish	--	--	0.14	0.28	0.14
Arctic grayling	--	--	0.42	3.41	0.28
Least cisco	--	0.14	--	--	--
Ninespine stickleback	34.72	4262.29	126.33	787.70	492.62
Total CPUE	34.72	4262.43	126.89	791.39	493.05
Number of Species	1	2	3	3	3
Effort (hours)	165.23	172.33	172.50	169.13	169.25

Kalikpik River Sites

Station: K1802 - Kalikpik River Method: Fyke net Species	June	July	August
Arctic grayling	0.87	2.66	0.71
Broad whitefish	1.74	0.42	0.29
Least cisco	0.15	1.68	1.85
Ninespine stickleback	0.58	10.22	--
Round whitefish	--	0.42	0.29
Threespine stickleback	--	--	0.43
Total CPUE	3.34	15.40	3.56
Number of Species	4	5	5
Effort (hours)	165.50	171.40	168.31

Iqalliqpik Creek Tributaries

Station: JK1703 - Judy Creek Kayyaaq Method: Fyke net Species	June	July	August
Arctic grayling	5.39	22.09	1.28
Broad whitefish	--	5.41	--
Least cisco	0.30	28.24	0.14
Ninespine stickleback	4.64	140.61	5.40
Round whitefish	--	1.02	0.14
Total CPUE	10.32	197.38	6.97
Number of Species	3	5	4
Effort (hours)	160.43	164.03	168.81

Station: W17101 - Willow 1 Method: Fyke net Species	June	July	August
Alaska blackfish	0.23	0.15	1.28
Arctic grayling	0.46	19.45	5.13
Ninespine stickleback	3.09	22.36	15.96
Total CPUE	3.78	41.95	22.37
Number of Species	3	3	3
Effort (hours)	209.55	165.32	168.47

Station: W17201 - Willow 2 Method: Fyke net	June	July		August	
Species		(US)	(DS)	(US)	(DS)
Alaska whitefish	0.14	--	0.15	--	--
Arctic grayling	53.58	100.46	31.63	7.39	1.71
Broad whitefish	0.14	6.22	3.86	0.14	--
Humpback whitefish	0.14	1.04	0.45	--	--
Least cisco	0.29	11.71	16.49	--	0.14
Ninespine stickleback	53.44	18.37	22.28	0.71	1.42
Round whitefish	1.01	0.30	0.15	0.28	--
Slimy sculpin	--	0.15	--	--	--
Total CPUE	108.74	138.24	75	8.53	3.27
Number of Species	7	7	7	4	3
Effort (hours)	166.63	161.98	161.60	168.81	168.88

Iqalliqpik Creek Tributaries (contd.)

Station: W18204 - Willow 2 Method: Fyke net Species	June	July	August
Arctic grayling	34.38	110.01	9.93
Broad whitefish	--	0.29	--
Least cisco	0.13	0.87	--
Ninespine stickleback	20.83	41.22	3.26
Round whitefish	0.50	--	0.28
Total CPUE	55.83	152.39	13.48
Number of Species	4	4	3
Effort (hours)	191.28	165.36	169.15

Station: W17301 - Willow 3/Lake M0015 Method: Fyke net Species	June	July	August
Alaska blackfish	--	0.34	--
Ninespine stickleback	--	69.94	--
Total CPUE	--	70.29	--
Number of Species	--	2	--
Effort (hours)	--	70.00	--

Station: W18302 - Willow 3 Method: Fyke net Species	June	July	August
Alaska blackfish	0.18	0.14	1.28
Arctic grayling	--	0.14	1.70
Ninespine stickleback	7.33	86.47	83.07
Total CPUE	7.51	86.75	86.04
Number of Species	2	3	3
Effort (hours)	134.18	171.26	169.31

Iqalliqpik Creek Tributaries (contd.)

Station: W17401 - Willow 4						
Method: Fyke net	**June**	**July 18[1]**	**July**		**August**	
Species			(US)	(DS)	(US)	(DS)
Alaska blackfish	--	--	--	--	--	0.14
Arctic grayling	--	73.59	78.24	27.51	5.94	11.96
Broad whitefish	--	2.10	1.98	6.42	--	5.20
Burbot	--	--	--	--	--	
Chum salmon	--	--	--	--	--	
Humpback whitefish	--	1.05	--	4.94	--	0.14
Least cisco	--	51.51	25.20	15.15	0.28	4.36
Ninespine stickleback	--	3.15	31.79	0.66	1.98	0.98
Round whitefish	--	2.10	1.98	1.32	0.28	2.25
Sockeye salmon	--	--	--	--	0.14	--
Total CPUE	--	133.51	139.19	56.00	8.63	25.04
Number of Species	--	6	5	6	5	9
Effort (hours)	--	22.83	145.70	145.71	169.61	170.63

[1] July 18 only. One net set to fish bidirectionally. Second net added July 19.

Station: W18401 - Willow 4			
Method: Fyke net	**June**	**July**	**August**
Species			
Alaska blackfish	--	0.14	--
Arctic grayling	34.36	59.01	0.97
Broad whitefish	2.64	1.74	0.28
Humpback whitefish	0.92	--	--
Least cisco	0.34	26.68	--
Ninespine stickleback	1.15	2.46	6.40
Round whitefish	0.11	0.14	--
Total CPUE	39.53	90.18	7.66
Number of Species	6	6	3
Effort (hours)	208.85	165.53	172.41

Iqalliqpik Creek Tributaries (contd.)

Station: W18402 - Willow 4 Method: Fyke net Species	June	July	August
Arctic grayling	57.70	59.41	8.14
Broad whitefish	5.42	0.57	1.86
Chum salmon	--	--	0.14
Humpback whitefish	2.56	--	--
Least cisco	2.41	6.31	--
Ninespine stickleback	4.82	24.68	4.28
Round whitefish	1.05	1.29	4.00
Total CPUE	73.97	92.27	18.42
Number of Species	6	5	5
Effort (hours)	159.30	167.25	168.06

Station: W18405 - Willow 4 Method: Fyke net Species	June	July	August
Alaska blackfish	--	--	3.28
Broad whitefish	0.15	--	--
Ninespine stickleback	166.43	7,790.59	1,234.55
Total CPUE	166.58	7,790.59	1,237.84
Number of Species	2	1	2
Effort (hours)	163.38	169.01	168.08

APPENDIX E

Recapture and Release Data for Fish Recaptured in Willow Area, 2018.

Appendix E. Recapture and release data for fish recaptured in Willow Area, 2018.

Note: Bold italics = different release and recapture stations, '*' = mortality and no measurement taken, '-' = no data available, 'BDWF' = Broad whitefish, 'GRAY' = Arctic grayling, 'HBWF' = Humpback whitefish, 'LSCS' = Least cisco, 'RDWF' = Round whitefish.

		Release Data			Recapture Data			
Tag Number	**Species**	**Station**	**Date**	**Length**	**Station**	**Date**	**Length**	**Days At Large**
MJM090502	***GRAY***	***U0901***	***7/21/2013***	***219***	***BC1***	***6/23/2018***	***326***	***1798***
MJM0102393	***GRAY***	***U0901***	***8/28/2013***	***256***	***BC1***	***6/23/2018***	***316***	***1760***
OR1599	***GRAY***	***J1701***	***6/20/2017***	***322***	***FC1801***	***8/28/2018***	***422***	***434***
OR1856	GRAY	W17401	6/22/2017	270	W17401	8/29/2018	342	433
OR0205	GRAY	W17401	6/22/2017	207	W17401	8/29/2018	295	433
OR0112	***GRAY***	***W17401***	***6/21/2017***	***245***	***W18402***	***8/28/2018***	***301***	***433***
OR0016	***GRAY***	***J1701***	***6/18/2017***	***195***	***W18402***	***8/25/2018***	***262***	***433***
OR1503	GRAY	W17401	6/18/2017	262	W17401	8/23/2018	307	432
OR0228	GRAY	W17201	6/20/2017	201	W17201	8/25/2018	274	431
OR1907	***GRAY***	***JK1702***	***7/22/2017***	***295***	***W17401***	***8/29/2018***	***335***	***403***
OR1907	***GRAY***	***JK1702***	***7/22/2017***	***295***	***W17401***	***8/28/2018***	***335***	***403***
OR0324	GRAY	W17401	7/24/2017	225	W17401	8/29/2018	293	401
OR0367	***GRAY***	***W17203***	***7/24/2017***	***199***	***W17201***	***8/29/2018***	***261***	***401***
OR0032	GRAY	W17401	6/18/2017	210	W18401	7/24/2018	278	401
OR0012	GRAY	W17401	6/18/2017	201	W17401	7/24/2018	286	401
OR0155	***GRAY***	***J1701***	***6/20/2017***	***180***	***W17201***	***7/25/2018***	***259***	***400***
OR0065	GRAY	W17401	6/20/2017	205	W18401	7/25/2018	266	400
OR0031	GRAY	W17401	6/18/2017	205	W17401	7/23/2018	286	400
OR0172	GRAY	W17401	6/19/2017	275	W18401	7/23/2018	279	399
OR0240	GRAY	W17201	6/19/2017	209	W17201	7/23/2018	280	399
OR0256	***GRAY***	***W17203***	***6/20/2017***	***233***	***W17201***	***7/23/2018***	***293***	***398***
OR0011	GRAY	W17401	6/18/2017	209	W18401	7/21/2018	265	398
OR1365	***GRAY***	***W17202***	***7/28/2017***	***229***	***W18204***	***8/29/2018***	***288***	***398***
OR1636	***RDWF***	***W17401***	***6/19/2017***	***368***	***W18402***	***7/21/2018***	***377***	***397***
OR1695	***GRAY***	***W17203***	***6/21/2017***	***257***	***BC1***	***7/23/2018***	***276***	***397***
OR2063	***GRAY***	***J1701***	***7/24/2017***	***285***	***W18204***	***8/24/2018***	***325***	***397***
OR1365	***GRAY***	***W17202***	***7/28/2017***	***229***	***W18204***	***8/28/2018***	***285***	***396***
OR1622	***GRAY***	***W17203***	***6/22/2017***	***288***	***W17201***	***7/23/2018***	***333***	***396***
OR2069	***GRAY***	***W17401***	***7/24/2017***	***261***	***W17201***	***8/23/2018***	***300***	***396***
OR0224	GRAY	W17201	6/22/2017	224	W17201	7/22/2018	270	396
OR0312	***GRAY***	***W17203***	***7/25/2017***	***211***	***W18204***	***8/24/2018***	***272***	***396***
OR1598	***GRAY***	***J1701***	***6/20/2017***	***318***	***W17401***	***7/20/2018***	***352***	***395***
OR1862	GRAY	W17401	6/22/2017	275	W17401	7/21/2018	320	394

		Release Data			Recapture Data			
Tag Number	**Species**	**Station**	**Date**	**Length**	**Station**	**Date**	**Length**	**Days At Large**
OR1624	***GRAY***	***W17203***	***6/22/2017***	***297***	***W17201***	***7/21/2018***	***315***	***394***
OR1657	***GRAY***	***W17201***	***6/24/2017***	***332***	***W17401***	***7/22/2018***	***348***	***393***
OR1772	GRAY	W17201	6/23/2017	254	W17201	7/20/2018	314	393
OR0439	GRAY	W17401	6/24/2017	183	W18401	7/21/2018	262	393
OR1790	GRAY	W17401	6/23/2017	260	W17401	7/20/2018	325	392
OR0128	***GRAY***	***W17203***	***6/24/2017***	***203***	***W17201***	***7/20/2018***	***263***	***392***
OR1772	GRAY	W17201	6/23/2017	254	W17201	7/19/2018	314	391
OR1522	***GRAY***	***J1701***	***6/18/2017***	***255***	***W18401***	***7/2/2018***	***295***	***379***
OR1683	***GRAY***	***W17201***	***6/20/2017***	***328***	***W18401***	***7/2/2018***	***345***	***377***
OR1693	***GRAY***	***W17203***	***6/20/2017***	***315***	***W17201***	***6/29/2018***	***340***	***375***
OR0004	GRAY	W17401	6/18/2017	211	W18401	6/27/2018	239	374
OR0010	***GRAY***	***W17401***	***6/18/2017***	***214***	***W18204***	***6/27/2018***	***258***	***374***
OR0260	GRAY	W17201	6/21/2017	182	W17201	6/29/2018	212	374
OR1596	GRAY	W17401	6/20/2017	275	W18401	6/27/2018	300	373
OR1688	***GRAY***	***W17203***	***6/20/2017***	***295***	***W18204***	***6/27/2018***	***316***	***372***
OR0152	***GRAY***	***J1701***	***6/20/2017***	***217***	***W17201***	***6/27/2018***	***270***	***372***
OR1679	GRAY	W17201	6/20/2017	277	W17201	6/27/2018	310	372
OR1721	GRAY	W17201	6/20/2017	293	W17201	6/27/2018	316	372
OR0253	***GRAY***	***W17203***	***6/20/2017***	***206***	***W17201***	***6/27/2018***	***271***	***372***
OR1685	***GRAY***	***W17203***	***6/20/2017***	***280***	***W17201***	***6/27/2018***	***320***	***372***
OR1766	***GRAY***	***J1701***	***6/23/2017***	***351***	***W18204***	***6/29/2018***	***361***	***372***
OR1772	GRAY	W17201	6/23/2017	254	W17201	6/29/2018	308	372
OR1666	GRAY	W17201	6/19/2017	346	W17201	6/24/2018	362	371
OR0127	***GRAY***	***W17203***	***6/24/2017***	***242***	***W18204***	***6/29/2018***	***285***	***371***
OR0174	GRAY	W17401	6/19/2017	186	W18401	6/24/2018	258	371
OR0229	***GRAY***	***W17201***	***6/20/2017***	***189***	***W18204***	***6/25/2018***	***254***	***370***
OR0225	GRAY	W17203	6/22/2017	180	W17201	6/27/2018	254	370
OR0220	GRAY	W17201	6/22/2017	218	W17201	6/26/2018	264	370
OR1679	GRAY	W17201	6/20/2017	277	W17201	6/24/2018	313	370
OR1721	GRAY	W17201	6/20/2017	293	W17201	6/24/2018	306	370
OR1625	***GRAY***	***W17203***	***6/22/2017***	***313***	***W18204***	***6/24/2018***	***337***	***368***
OR1785	***GRAY***	***W17203***	***6/24/2017***	***343***	***W18204***	***6/26/2018***	***357***	***368***
OR0274	***GRAY***	***J1701***	***6/24/2017***	***217***	***W18401***	***6/26/2018***	***266***	***368***
OR1783	***GRAY***	***W17203***	***6/24/2017***	***275***	***W18401***	***6/26/2018***	***306***	***368***
OR0471	***GRAY***	***W17201***	***6/23/2017***	***225***	***W18204***	***6/25/2018***	***277***	***367***
OR0383	GRAY	W17401	8/27/2017	275	W17401	8/29/2018	303	367
OR1852	***GRAY***	***JK1702***	***6/23/2017***	***317***	***BC1***	***6/25/2018***	***359***	***367***
OR1767	***GRAY***	***J1701***	***6/23/2017***	***366***	***W17201***	***6/24/2018***	***381***	***367***
OR2207	***GRAY***	***W17203***	***8/28/2017***	***323***	***W17401***	***8/29/2018***	***339***	***366***

		Release Data			Recapture Data			
Tag Number	Species	Station	Date	Length	Station	Date	Length	Days At Large
OR1785	***GRAY***	***W17203***	***6/24/2017***	***343***	***W17201***	***6/24/2018***	***358***	***366***
OR0370	***GRAY***	***W17203***	***7/24/2017***	***182***	***W17201***	***7/24/2018***	***243***	***366***
OR0362	***GRAY***	***J1703***	***7/24/2017***	***238***	***W17201***	***7/24/2018***	***252***	***366***
OR0499	GRAY	W17101	7/22/2017	206	W17101	7/22/2018	273	366
OR1395	***GRAY***	***W17203***	***8/29/2017***	***231***	***W18204***	***8/29/2018***	***274***	***366***
OR0500	GRAY	W17101	7/22/2017	196	W17101	7/21/2018	265	365
OR1395	***GRAY***	***W17203***	***8/29/2017***	***231***	***W18204***	***8/28/2018***	***266***	***364***
OR0375	***GRAY***	***W17203***	***7/24/2017***	***215***	***W17201***	***7/23/2018***	***274***	***364***
OR0359	***GRAY***	***J1703***	***7/24/2017***	***213***	***W17401***	***7/22/2018***	***256***	***363***
OR2674	***GRAY***	***JK1702***	***7/27/2017***	***345***	***FC1801***	***7/24/2018***	***357***	***363***
OR0374	***GRAY***	***W17203***	***7/24/2017***	***200***	***W18204***	***7/21/2018***	***260***	***363***
OR2118	***GRAY***	***J1703***	***7/24/2017***	***264***	***W17201***	***7/21/2018***	***292***	***362***
OR2062	***GRAY***	***J1701***	***7/24/2017***	***316***	***W17201***	***7/21/2018***	***332***	***362***
OR1333	***GRAY***	***W17203***	***7/26/2017***	***180***	***W17201***	***7/23/2018***	***227***	***362***
OR1343	GRAY	W17401	7/25/2017	223	W18401	7/21/2018	262	362
OR1395	***GRAY***	***W17203***	***8/29/2017***	***231***	***W17201***	***8/25/2018***	***269***	***361***
OR1373	RDWF	W17401	7/26/2017	189	W17401	7/21/2018	194	360
OR2609	***GRAY***	***W17203***	***8/30/2017***	***336***	***W18204***	***8/24/2018***	***344***	***360***
OR2725	***GRAY***	***W17203***	***8/31/2017***	***264***	***W18204***	***8/24/2018***	***288***	***359***
OR2702	***GRAY***	***W17203***	***9/2/2017***	***268***	***W18204***	***8/24/2018***	***300***	***357***
OR2145	***GRAY***	***JK1702***	***7/25/2017***	***305***	***W18401***	***7/2/2018***	***314***	***342***
OR2106	***GRAY***	***J1703***	***7/24/2017***	***340***	***W18401***	***7/1/2018***	***351***	***342***
OR0276	***GRAY***	***W17203***	***7/24/2017***	***186***	***W18204***	***6/29/2018***	***236***	***341***
OR0280	***GRAY***	***W17203***	***7/24/2017***	***196***	***W17201***	***6/29/2018***	***238***	***341***
OR2149	***GRAY***	***W17203***	***7/25/2017***	***250***	***W18204***	***6/29/2018***	***286***	***340***
OR2092	***GRAY***	***JK1702***	***7/24/2017***	***305***	***W17201***	***6/27/2018***	***319***	***338***
OR1914	***GRAY***	***JK1702***	***7/22/2017***	***360***	***FT1802***	***6/24/2018***	***379***	***338***
OR2110	***GRAY***	***J1703***	***7/24/2017***	***290***	***W18402***	***6/26/2018***	***325***	***338***
OR0309	***GRAY***	***W17203***	***7/25/2017***	***215***	***W17201***	***6/27/2018***	***247***	***337***
OR1333	***GRAY***	***W17203***	***7/26/2017***	***180***	***W18204***	***6/27/2018***	***212***	***336***
OR1335	***GRAY***	***W17203***	***7/26/2017***	***240***	***W18204***	***6/27/2018***	***274***	***336***
OR0277	***GRAY***	***W17203***	***7/24/2017***	***201***	***W18204***	***6/24/2018***	***243***	***336***
OR2142	***GRAY***	***JK1702***	***7/25/2017***	***356***	***W18204***	***6/24/2018***	***370***	***335***
OR1396	***GRAY***	***W17203***	***8/27/2017***	***189***	***W18204***	***7/25/2018***	***216***	***333***
OR1381	***GRAY***	***W17203***	***8/28/2017***	***180***	***W18204***	***7/22/2018***	***210***	***329***
OR1383	***GRAY***	***W17203***	***8/28/2017***	***182***	***W18204***	***7/22/2018***	***211***	***329***
OR1397	***GRAY***	***W17203***	***8/27/2017***	***185***	***W18204***	***7/21/2018***	***210***	***329***
OR2601	***GRAY***	***W17203***	***8/31/2017***	***263***	***W17201***	***7/24/2018***	***284***	***328***
OR2724	***GRAY***	***W17203***	***8/31/2017***	***304***	***W17201***	***7/24/2018***	***337***	***328***

		Release Data			Recapture Data			
Tag Number	**Species**	**Station**	**Date**	**Length**	**Station**	**Date**	**Length**	**Days At Large**
OR1383	***GRAY***	***W17203***	***8/28/2017***	***182***	***W18204***	***7/19/2018***	***211***	***326***
OR2725	***GRAY***	***W17203***	***8/31/2017***	***264***	***W17201***	***7/22/2018***	***283***	***326***
OR1412	***GRAY***	***W17203***	***9/1/2017***	***241***	***W17201***	***7/23/2018***	***262***	***325***
OR2609	***GRAY***	***W17203***	***8/30/2017***	***336***	***W17201***	***7/20/2018***	***340***	***325***
OR2725	***GRAY***	***W17203***	***8/31/2017***	***264***	***W18204***	***7/19/2018***	***285***	***323***
OR2575	GRAY	W17203	9/2/2017	261	W17201	7/19/2018	281	320
OR2618	***GRAY***	***W17203***	***8/29/2017***	***273***	***W18204***	***7/1/2018***	***291***	***306***
OR2617	***GRAY***	***W17203***	***8/29/2017***	***265***	***W17201***	***6/29/2018***	***272***	***305***
OR2605	***GRAY***	***W17203***	***8/31/2017***	***252***	***W17201***	***6/29/2018***	***261***	***303***
OR1388	GRAY	W17401	8/28/2017	241	W18401	6/25/2018	251	302
OR1407	***GRAY***	***W17203***	***9/2/2017***	***199***	***W18204***	***6/29/2018***	***211***	***301***
OR2701	***GRAY***	***W17203***	***9/2/2017***	***273***	***W18204***	***6/29/2018***	***285***	***301***
OR1388	***GRAY***	***W17401***	***8/28/2017***	***241***	***W18402***	***6/24/2018***	***252***	***301***
OR2712	***GRAY***	***W17203***	***9/1/2017***	***265***	***W18204***	***6/24/2018***	***283***	***297***
OR2360	GRAY	BC1	6/22/2018	353	BC1	8/27/2018	369	66
OR2943	GRAY	FT1802	6/24/2018	330	FT1802	8/28/2018	344	65
OR2628	GRAY	BC1	6/24/2018	261	BC1	8/27/2018	289	64
OR5573	GRAY	BC1	6/24/2018	281	BC1	8/27/2018	296	64
OR5575	GRAY	BC1	6/24/2018	271	BC1	8/27/2018	295	64
OR5533	GRAY	BC1	6/25/2018	280	BC1	8/27/2018	294	63
OR1017	***GRAY***	***UB26***	***6/25/2018***	***184***	***BC1***	***8/27/2018***	***275***	***63***
OR4504	GRAY	W17201	6/26/2018	265	W17201	8/28/2018	271	63
OR0681	***GRAY***	***UB26***	***6/26/2018***	***242***	***BC1***	***8/27/2018***	***271***	***62***
OR1169	GRAY	BC1	6/25/2018	188	BC1	8/26/2018	215	62
OR5524	***GRAY***	***UB26***	***6/25/2018***	***307***	***BC1***	***8/26/2018***	***315***	***62***
OR2396	GRAY	BC1	6/26/2018	291	BC1	8/27/2018	299	62
OR5077	GRAY	BC1	6/26/2018	290	BC1	8/27/2018	313	62
OR0530	GRAY	BC1	6/26/2018	248	BC1	8/27/2018	286	62
OR5935	GRAY	BC1	6/28/2018	315	BC1	8/29/2018	330	62
OR0865	GRAY	BC1	6/26/2018	248	BC1	8/26/2018	267	61
OR5912	GRAY	BC1	6/27/2018	306	BC1	8/27/2018	316	61
OR5622	GRAY	BC1	6/27/2018	270	BC1	8/26/2018	284	60
OR2995	GRAY	BC1	6/28/2018	281	BC1	8/27/2018	300	60
OR5954	GRAY	W18204	7/1/2018	285	W18204	8/29/2018	303	59
OR0891	***GRAY***	***UB26***	***6/28/2018***	***205***	***FC1801***	***8/26/2018***	***333***	***59***
OR4598	GRAY	W17201	6/26/2018	338	W17201	8/24/2018	341	59
OR2559	GRAY	W18401	7/1/2018	288	W18401	8/28/2018	310	58
OR4011	GRAY	W18401	7/1/2018	241	W18401	8/28/2018	274	58
OR5918	GRAY	BC1	6/27/2018	276	BC1	8/24/2018	292	58

		Release Data			Recapture Data			
Tag Number	**Species**	**Station**	**Date**	**Length**	**Station**	**Date**	**Length**	**Days At Large**
OR4510	GRAY	W17201	6/27/2018	275	W17201	8/23/2018	298	57
OR4511	GRAY	W17201	6/27/2018	286	W17201	8/23/2018	312	57
OR4520	***GRAY***	***W18204***	***6/27/2018***	***321***	***W17201***	***8/23/2018***	***328***	***57***
OR2979	GRAY	W18401	7/2/2018	361	W18401	8/28/2018	379	57
OR5856	GRAY	W18204	6/29/2018	285	W18204	8/24/2018	297	56
OR5855	GRAY	W18204	6/29/2018	276	W17201	8/24/2018	297	56
OR5964	***GRAY***	***W18204***	***7/1/2018***	***263***	***JK1703***	***8/23/2018***	***283***	***53***
OR5165	GRAY	W17401	7/20/2018	285	W17401	8/29/2018	297	40
OR5171	GRAY	W17401	7/20/2018	295	W17401	8/28/2018	306	39
OR5310	GRAY	W18401	7/21/2018	290	W17401	8/29/2018	304	39
OR5179	GRAY	W17401	7/22/2018	292	W17401	8/29/2018	305	38
OR4054	GRAY	W18401	7/22/2018	255	W17401	8/29/2018	279	38
OR5894	GRAY	W17201	7/23/2018	304	W17401	8/29/2018	383	37
OR0558	GRAY	BC1	7/20/2018	190	BC1	8/26/2018	209	37
OR0499	GRAY	W17101	7/22/2018	206	W17101	8/28/2018	285	37
OR5645	GRAY	W18204	7/21/2018	255	W18204	8/26/2018	265	36
OR1211	***GRAY***	***W17201***	***7/23/2018***	***227***	***W18204***	***8/27/2018***	***234***	***35***
OR1456	GRAY	W17401	7/25/2018	232	W17401	8/29/2018	255	35
OR5056	***BDWF***	***FT1802***	***7/20/2018***	***463***	***W18402***	***8/24/2018***	***465***	***35***
OR3342	***GRAY***	***W17201***	***7/22/2018***	***248***	***W18204***	***8/26/2018***	***256***	***35***
OR5371	***GRAY***	***W17201***	***7/22/2018***	***275***	***W18204***	***8/26/2018***	***282***	***35***
OR5024	GRAY	W17201	7/20/2018	285	W17201	8/24/2018	295	35
OR1210	***GRAY***	***W17201***	***7/23/2018***	***212***	***W18204***	***8/26/2018***	***225***	***34***
OR5014	GRAY	W17201	7/21/2018	295	W17201	8/23/2018	297	33
OR5047	GRAY	W17201	7/21/2018	315	W17201	8/23/2018	318	33
OR2773	***GRAY***	***W17401***	***7/22/2018***	***268***	***W17201***	***8/24/2018***	***268***	***33***
OR0564	GRAY	W18204	7/22/2018	211	W18204	8/24/2018	220	33
OR0838	GRAY	W17101	7/22/2018	206	W17101	8/24/2018	225	33
OR0839	GRAY	W17101	7/22/2018	184	W17101	8/24/2018	204	33
OR2446	***GRAY***	***FC1801***	***7/23/2018***	***283***	***W17201***	***8/25/2018***	***290***	***33***
OR0960	***GRAY***	***W17201***	***7/23/2018***	***222***	***W18204***	***8/24/2018***	***229***	***32***
OR4596	GRAY	W17201	7/23/2018	257	W17201	8/24/2018	261	32
OR0837	***LSCS***	***W18204***	***7/22/2018***	***219***	***W17201***	***8/23/2018***	***223***	***32***
OR5634	GRAY	W17201	7/22/2018	286	W17201	8/23/2018	293	32
OR4204	***GRAY***	***W18401***	***7/23/2018***	***245***	***W18402***	***8/24/2018***	***262***	***32***
OR0935	***GRAY***	***W17201***	***6/24/2018***	***180***	***W18204***	***7/25/2018***	***195***	***31***
OR5558	GRAY	BC1	6/24/2018	377	BC1	7/25/2018	288	31
OR1463	GRAY	W18401	7/24/2018	235	W17401	8/23/2018	250	30
OR0565	GRAY	W18204	7/25/2018	210	W18204	8/24/2018	216	30

		Release Data			Recapture Data			
Tag Number	**Species**	**Station**	**Date**	**Length**	**Station**	**Date**	**Length**	**Days At Large**
OR2861	GRAY	BC1	6/23/2018	317	BC1	7/23/2018	323	30
OR1290	GRAY	W18401	6/25/2018	181	W18401	7/24/2018	196	29
OR2395	***BDWF***	***BC1***	***6/26/2018***	***530***	***FT1802***	***7/24/2018***	***529***	***28***
OR1214	GRAY	W18204	6/26/2018	190	W18204	7/24/2018	207	28
OR2813	GRAY	W18401	6/25/2018	273	W17401	7/23/2018	278	28
OR0277	***GRAY***	***W17203***	***6/25/2018***	***201***	***W17201***	***7/23/2018***	***252***	***28***
OR1047	***GRAY***	***UB26***	***6/25/2018***	***246***	***W17201***	***7/23/2018***	***222***	***28***
OR0948	***GRAY***	***W18402***	***6/24/2018***	***198***	***W18401***	***7/21/2018***	***211***	***27***
OR5723	***GRAY***	***FT1802***	***6/26/2018***	***294***	***FC1801***	***7/23/2018***	***297***	***27***
OR1296	GRAY	W18401	6/26/2018	186	W18401	7/23/2018	200	27
OR2841	GRAY	W18204	6/24/2018	254	W18204	7/21/2018	266	27
OR1204	GRAY	W18401	6/26/2018	231	W17401	7/23/2018	250	27
OR4596	***GRAY***	***W18204***	***6/26/2018***	***253***	***W17201***	***7/23/2018***	***257***	***27***
OR1216	GRAY	W17201	6/26/2018	243	W17201	7/23/2018	254	27
OR5504	GRAY	FC1801	6/26/2018	360	FC1801	7/22/2018	363	26
OR0968	***GRAY***	***W17201***	***6/27/2018***	***192***	***W18204***	***7/23/2018***	***205***	***26***
OR1210	GRAY	W18204	6/26/2018	199	W18204	7/22/2018	213	26
OR0965	GRAY	W17201	6/27/2018	199	W17201	7/23/2018	212	26
OR2826	GRAY	W17201	6/27/2018	264	W17201	7/23/2018	273	26
OR5982	GRAY	W18401	6/27/2018	252	W17401	7/23/2018	275	26
OR0152	***GRAY***	***J1701***	***6/27/2018***	***217***	***W17201***	***7/22/2018***	***276***	***25***
OR4515	***GRAY***	***W18204***	***6/27/2018***	***275***	***W17201***	***7/22/2018***	***285***	***25***
OR0961	***GRAY***	***W18204***	***6/27/2018***	***239***	***W17201***	***7/22/2018***	***254***	***25***
OR4582	GRAY	W18401	6/26/2018	272	W18401	7/21/2018	281	25
OR4018	GRAY	W17201	6/29/2018	187	W17201	7/24/2018	198	25
OR0931	GRAY	W18204	6/25/2018	194	W18204	7/19/2018	204	24
OR4516	GRAY	W18204	6/27/2018	321	W18204	7/21/2018	323	24
OR4584	GRAY	W18401	6/26/2018	268	W18401	7/20/2018	280	24
OR0522	GRAY	W18401	6/30/2018	226	W17401	7/24/2018	244	24
OR0952	***GRAY***	***W18401***	***6/27/2018***	***246***	***W17401***	***7/21/2018***	***262***	***24***
OR1211	GRAY	W17201	6/29/2018	220	W17201	7/23/2018	227	24
OR1097	GRAY	BC1	6/28/2018	243	BC1	7/22/2018	250	24
OR1093	***GRAY***	***W18204***	***6/29/2018***	***215***	***W17201***	***7/23/2018***	***226***	***24***
OR0514	GRAY	W18401	7/1/2018	237	W18401	7/24/2018	214	23
OR4014	GRAY	W18401	7/1/2018	189	W18401	7/24/2018	202	23
OR2444	GRAY	W18401	7/2/2018	298	W17401	7/25/2018	305	23
OR0971	GRAY	W17201	6/29/2018	233	W17201	7/22/2018	240	23
OR1094	***GRAY***	***W17201***	***6/29/2018***	***194***	***W18204***	***7/22/2018***	***205***	***23***
OR5939	GRAY	BC1	6/28/2018	306	BC1	7/21/2018	313	23

		Release Data			Recapture Data			
Tag Number	**Species**	**Station**	**Date**	**Length**	**Station**	**Date**	**Length**	**Days At Large**
OR0887	***GRAY***	***UB26***	***6/28/2018***	***185***	***BC1***	***7/21/2018***	***197***	***23***
OR2976	GRAY	W18401	7/2/2018	280	W18401	7/24/2018	285	22
OR2983	GRAY	W18401	7/2/2018	403	W18401	7/24/2018	403	22
OR0960	GRAY	W18204	6/27/2018	211	W18204	7/19/2018	221	22
OR4007	GRAY	W18401	7/2/2018	246	W17401	7/24/2018	260	22
OR0516	GRAY	W18204	6/30/2018	190	W18204	7/22/2018	203	22
OR2446	***GRAY***	***W18401***	***7/2/2018***	***278***	***FC1801***	***7/23/2018***	***283***	***21***
OR2980	GRAY	W18401	7/2/2018	297	W18401	7/23/2018	300	21
OR5981	GRAY	W18401	7/2/2018	290	W18401	7/23/2018	292	21
OR2847	***GRAY***	***W18204***	***6/29/2018***	***330***	***W17201***	***7/20/2018***	***330***	***21***
OR1090	GRAY	W18204	6/29/2018	210	W18204	7/20/2018	222	21
OR1317	GRAY	BC1	6/28/2018	237	BC1	7/19/2018	250	21
OR4006	GRAY	W18401	7/2/2018	210	W18401	7/22/2018	217	20
OR4054	GRAY	W18401	7/2/2018	246	W18401	7/22/2018	255	20
OR2442	GRAY	W18401	7/2/2018	369	W17401	7/22/2018	371	20
OR0934	GRAY	W18204	6/29/2018	196	W18204	7/19/2018	206	20
OR1092	GRAY	W18204	6/29/2018	180	W18204	7/19/2018	195	20
OR0515	GRAY	W18204	6/30/2018	184	W18204	7/20/2018	198	20
OR4056	***GRAY***	***W18401***	***7/2/2018***	***249***	***W17201***	***7/20/2018***	***255***	***18***
OR0579	***GRAY***	***W18402***	***7/19/2018***	***180***	***W18401***	***7/25/2018***	***182***	***6***
OR4536	GRAY	W18401	6/26/2018	334	W18401	7/2/2018	335	6
OR2352	BDWF	BC1	6/22/2018	482	BC1	6/28/2018	482	6
OR0932	***GRAY***	***W17201***	***6/25/2018***	***189***	***W18204***	***6/30/2018***	***191***	***5***
OR5056	***BDWF***	***W18402***	***8/24/2018***	***465***	***W17401***	***8/29/2018***	***463***	***5***
OR0587	LSCS	W17401	7/20/2018	180	W17401	7/25/2018	180	5
OR4596	GRAY	W17201	8/24/2018	261	W17201	8/29/2018	262	5
OR2847	GRAY	W18204	6/24/2018	331	W18204	6/29/2018	330	5
OR2848	***GRAY***	***W18204***	***6/24/2018***	***315***	***W17201***	***6/29/2018***	***313***	***5***
OR0934	***GRAY***	***W17201***	***6/24/2018***	***194***	***W18204***	***6/29/2018***	***196***	***5***
OR5981	GRAY	W18401	6/27/2018	286	W18401	7/2/2018	290	5
OR0565	GRAY	W18204	7/21/2018	210	W18204	7/25/2018	210	4
OR0439	GRAY	W17401	7/21/2018	183	W18401	7/25/2018	269	4
OR4199	GRAY	W18401	7/21/2018	241	W18401	7/25/2018	244	4
OR5317	GRAY	W18401	7/21/2018	289	W18401	7/25/2018	289	4
OR3378	GRAY	W17201	7/20/2018	204	W17201	7/24/2018	204	4
OR0973	GRAY	W17201	6/26/2018	184	W17201	6/30/2018	184	4
OR5644	***GRAY***	***W18204***	***7/19/2018***	***250***	***W17201***	***7/23/2018***	***250***	***4***
OR4606	GRAY	BC1	8/23/2018	314	BC1	8/27/2018	316	4
OR4607	GRAY	BC1	8/23/2018	322	BC1	8/27/2018	325	4

		Release Data			Recapture Data			
Tag Number	**Species**	**Station**	**Date**	**Length**	**Station**	**Date**	**Length**	**Days At Large**
OR1317	GRAY	BC1	6/25/2018	236	BC1	6/28/2018	237	3
OR0582	***BDWF/LSCS***	***W18402***	***7/19/2018***	***187***	***W18401***	***7/22/2018***	***190***	***3***
OR4193	GRAY	W18401	7/21/2018	230	W18401	7/24/2018	226	3
OR2351	GRAY	BC1	6/23/2018	324	BC1	6/26/2018	320	3
OR2859	GRAY	BC1	6/23/2018	305	BC1	6/26/2018	304	3
OR1090	GRAY	W18204	7/22/2018	221	W18204	7/25/2018	221	3
OR0595	GRAY	W18401	7/22/2018	206	W18401	7/25/2018	209	3
OR4602	GRAY	BC1	8/24/2018	278	BC1	8/27/2018	280	3
OR6583	GRAY	W18402	8/24/2018	266	W18402	8/27/2018	264	3
OR1211	***GRAY***	***W18204***	***6/26/2018***	***220***	***W17201***	***6/29/2018***	***220***	***3***
OR0564	GRAY	W18204	7/19/2018	212	W18204	7/22/2018	211	3
OR0569	GRAY	W18204	7/19/2018	187	W18204	7/22/2018	187	3
OR0570	GRAY	W18204	7/19/2018	195	W18204	7/22/2018	196	3
OR0960	GRAY	W18204	7/19/2018	221	W18204	7/22/2018	222	3
OR4182	LSCS	W18401	7/22/2018	183	W17401	7/25/2018	180	3
OR0959	LSCS	W18402	6/27/2018	249	W18402	6/30/2018	249	3
OR2843	GRAY	W18204	6/24/2018	312	W18204	6/27/2018	312	3
OR0933	***GRAY***	***W17201***	***6/24/2018***	***185***	***W18204***	***6/27/2018***	***188***	***3***
OR0563	GRAY	W17201	7/20/2018	202	W17201	7/23/2018	202	3
OR2826	GRAY	W17201	6/24/2018	264	W17201	6/27/2018	264	3
OR1317	GRAY	BC1	6/22/2018	236	BC1	6/25/2018	236	3
OR2293	GRAY	BC1	6/22/2018	280	BC1	6/25/2018	282	3
OR2853	GRAY	BC1	6/22/2018	261	BC1	6/25/2018	261	3
OR5634	***GRAY***	***W18204***	***7/20/2018***	***285***	***W17201***	***7/22/2018***	***286***	***3***
OR0309	***GRAY***	***W17203***	***6/27/2018***	***215***	***W18204***	***6/29/2018***	***251***	***2***
OR4190	***GRAY***	***W17401***	***7/22/2018***	***205***	***W17201***	***7/24/2018***	***199***	***2***
OR0963	GRAY	W17201	6/27/2018	180	W17201	6/29/2018	178	2
OR0971	GRAY	W17201	6/27/2018	233	W17201	6/29/2018	233	2
OR4522	***GRAY***	***W18204***	***6/27/2018***	***279***	***W17201***	***6/29/2018***	***278***	***2***
OR4524	***GRAY***	***W18204***	***6/27/2018***	***324***	***W17201***	***6/29/2018***	***322***	***2***
OR2479	GRAY	W17401	7/23/2018	266	W18401	7/25/2018	270	2
OR5622	GRAY	BC1	6/25/2018	270	BC1	6/27/2018	270	2
OR5498	***BDWF***	***W18402***	***8/27/2018***	***425***	***W17401***	***8/29/2018***	***425***	***2***
OR4187	LSCS	W18402	7/22/2018	200	W18402	7/24/2018	170	2
OR0590	LSCS	W17401	7/20/2018	190	W18401	7/22/2018	189	2
OR0595	GRAY	W17401	7/20/2018	206	W18401	7/22/2018	206	2
OR0834	GRAY	W18204	7/22/2018	202	W18204	7/24/2018	203	2
OR0858	GRAY	BC1	6/26/2018	211	BC1	6/28/2018	211	2
OR0568	***GRAY***	***W18204***	***7/20/2018***	***230***	***W17201***	***7/22/2018***	***231***	***2***

		Release Data			Recapture Data			
Tag Number	**Species**	**Station**	**Date**	**Length**	**Station**	**Date**	**Length**	**Days At Large**
OR5294	LSCS	W18401	7/23/2018	267	W17401	7/25/2018	269	2
OR1090	GRAY	W18204	7/20/2018	222	W18204	7/22/2018	221	2
OR0931	GRAY	W18204	7/21/2018	205	W18204	7/23/2018	202	2
OR2576	BURB	FC1801	8/25/2018	577	FC1801	8/27/2018	577	2
OR0538	GRAY	W17201	8/25/2018	228	W17201	8/27/2018	231	2
OR2939	GRAY	FT1802	6/24/2018	330	FT1802	6/26/2018	333	2
OR5898	BDWF	W17201	7/22/2018	389	W17201	7/24/2018	391	2
OR5819	BDWF	W17201	7/19/2018	477	W17201	7/21/2018	477	2
OR5891	BDWF	W17201	7/22/2018	353	W17201	7/24/2018	350	2
OR0960	GRAY	W18204	8/24/2018	229	W18204	8/26/2018	229	2
OR1317	GRAY	BC1	7/19/2018	250	BC1	7/21/2018	247	2
OR0937	***GRAY***	***W17201***	***6/24/2018***	***193***	***W18204***	***6/26/2018***	***195***	***2***
OR6600	***BDWF***	***W18401***	***8/24/2018***	***351***	***W18402***	***8/26/2018***	***348***	***2***
OR4071	LSCS	W17201	7/21/2018	247	W17201	7/23/2018	249	2
OR2866	GRAY	BC1	6/22/2018	253	BC1	6/24/2018	250	2
OR0567	GRAY	W18204	7/19/2018	200	W18204	7/21/2018	199	2
OR1092	GRAY	W18204	7/19/2018	195	W18204	7/21/2018	195	2
OR5646	GRAY	W18204	7/19/2018	253	W18204	7/21/2018	254	2
OR0931	GRAY	W18204	7/19/2018	204	W18204	7/21/2018	205	2
OR4582	GRAY	W18401	7/21/2018	281	W18401	7/23/2018	282	2
OR2546	***GRAY***	***UB26***	***6/23/2018***	***246***	***BC1***	***6/25/2018***	***332***	***2***
OR5014	GRAY	W17201	7/20/2018	293	W17201	7/21/2018	295	1
OR3334	GRAY	FT1802	7/23/2018	191	FT1802	7/24/2018	189	1
OR5144	GRAY	FT1802	7/23/2018	266	FT1802	7/24/2018	261	1
OR0509	LSCS	W17201	7/19/2018	221	W17201	7/20/2018	220	1
OR0511	GRAY	W17201	7/19/2018	216	W17201	7/20/2018	216	1
OR0512	LSCS	W17201	7/19/2018	225	W17201	7/20/2018	222	1
OR5823	GRAY	W17201	7/19/2018	282	W17201	7/20/2018	285	1
OR5824	GRAY	W17201	7/19/2018	258	W17201	7/20/2018	258	1
OR5825	GRAY	W17201	7/19/2018	292	W17201	7/20/2018	293	1
OR2729	GRAY	BC1	6/23/2018	318	BC1	6/24/2018	310	1
OR2735	BDWF	BC1	6/23/2018	515	BC1	6/24/2018	519	1
OR0240	GRAY	W17201	7/23/2018	209	W17201	7/24/2018	278	1
OR4070	LSCS	W17201	7/21/2018	192	W17201	7/22/2018	191	1
OR5038	GRAY	W17201	7/21/2018	287	W17201	7/22/2018	286	1
OR4208	GRAY	W18401	7/23/2018	220	W18401	7/24/2018	224	1
OR5285	GRAY	W18401	7/23/2018	253	W18401	7/24/2018	254	1
OR5981	GRAY	W18401	7/23/2018	292	W18401	7/24/2018	292	1
OR0588	LSCS	W17401	7/20/2018	187	W18401	7/21/2018	186	1

		Release Data			Recapture Data			
Tag Number	**Species**	**Station**	**Date**	**Length**	**Station**	**Date**	**Length**	**Days At Large**
OR5238	LSCS	W17401	7/20/2018	251	W18401	7/21/2018	254	1
OR0783	LSCS	W17401	7/21/2018	186	W18401	7/22/2018	185	1
OR0786	LSCS	W18402	7/20/2018	180	W18401	7/21/2018	181	1
OR2030	BDWF	W18402	6/24/2018	356	W18402	6/25/2018	356	1
OR2841	***GRAY***	***W18204***	***7/21/2018***	***266***	***W17201***	***7/22/2018***	***263***	***1***
OR4516	***GRAY***	***W18204***	***7/21/2018***	***323***	***W17201***	***7/22/2018***	***323***	***1***
OR5371	***GRAY***	***W18204***	***7/21/2018***	***277***	***W17201***	***7/22/2018***	***275***	***1***
OR0577	LSCS	W17401	7/19/2018	226	W17401	7/20/2018	226	1
OR5250	LSCS	W17401	7/19/2018	260	W17401	7/20/2018	260	1
OR2927	GRAY	FT1802	6/24/2018	283	FT1802	6/25/2018	282	1
OR0845	GRAY	W18204	7/21/2018	192	W18204	7/22/2018	196	1
OR1092	GRAY	W18204	7/21/2018	195	W18204	7/22/2018	193	1
OR5646	GRAY	W18204	7/21/2018	254	W18204	7/22/2018	255	1
OR2397	GRAY	BC1	6/26/2018	280	BC1	6/27/2018	279	1
OR0860	GRAY	BC1	6/26/2018	229	BC1	6/27/2018	228	1
OR0864	GRAY	BC1	6/26/2018	231	BC1	6/27/2018	231	1
OR2332	GRAY	BC1	6/26/2018	336	BC1	6/27/2018	337	1
OR2345	GRAY	BC1	6/26/2018	354	BC1	6/27/2018	355	1
OR2348	GRAY	BC1	6/26/2018	251	BC1	6/27/2018	250	1
OR2380	GRAY	BC1	6/26/2018	301	BC1	6/27/2018	301	1
OR2386	GRAY	BC1	6/26/2018	354	BC1	6/27/2018	353	1
OR2390	GRAY	BC1	6/26/2018	252	BC1	6/27/2018	252	1
OR2951	GRAY	BC1	6/26/2018	334	BC1	6/27/2018	333	1
OR5078	GRAY	BC1	6/26/2018	293	BC1	6/27/2018	293	1
OR0528	GRAY	BC1	6/26/2018	242	BC1	6/27/2018	243	1
OR2345	GRAY	BC1	6/27/2018	355	BC1	6/28/2018	353	1
OR4760	GRAY	BC1	6/27/2018	323	BC1	6/28/2018	324	1
OR4762	GRAY	BC1	6/27/2018	259	BC1	6/28/2018	259	1
OR5907	GRAY	BC1	6/27/2018	350	BC1	6/28/2018	353	1
OR5914	GRAY	BC1	6/27/2018	368	BC1	6/28/2018	365	1
OR5920	GRAY	BC1	6/27/2018	284	BC1	6/28/2018	284	1
OR5958	GRAY	W18401	7/1/2018	367	W18401	7/2/2018	370	1
OR5649	***GRAY***	***W18204***	***7/19/2018***	***288***	***W17201***	***7/20/2018***	***290***	***1***
OR0563	***GRAY***	***W18204***	***7/19/2018***	***202***	***W17201***	***7/20/2018***	***202***	***1***
OR5647	***GRAY***	***W18204***	***7/19/2018***	***306***	***W17201***	***7/20/2018***	***303***	***1***
OR0589	LSCS	W17401	7/20/2018	184	W17401	7/21/2018	183	1
OR0591	LSCS	W17401	7/20/2018	220	W17401	7/21/2018	220	1
OR5144	GRAY	FT1802	7/22/2018	265	FT1802	7/23/2018	266	1
OR1288	GRAY	W18401	6/25/2018	229	W18401	6/26/2018	230	1

		Release Data			Recapture Data			
Tag Number	**Species**	**Station**	**Date**	**Length**	**Station**	**Date**	**Length**	**Days At Large**
OR1296	GRAY	W18401	6/25/2018	183	W18401	6/26/2018	186	1
OR0785	RDWF	W18402	7/20/2018	187	W18402	7/21/2018	188	1
OR0565	GRAY	W18204	7/20/2018	209	W18204	7/21/2018	210	1
OR0934	GRAY	W18204	7/20/2018	206	W18204	7/21/2018	205	1
OR5645	GRAY	W18204	7/20/2018	255	W18204	7/21/2018	255	1
OR2932	***GRAY***	***FT1802***	***6/24/2018***	***340***	***FC1801***	***6/25/2018***	***338***	***1***
OR5343	GRAY	W17401	7/21/2018	251	W17401	7/22/2018	253	1
OR0570	GRAY	W18204	7/22/2018	196	W18204	7/23/2018	195	1
OR0624	GRAY	W18204	7/22/2018	182	W18204	7/23/2018	182	1
OR0538	GRAY	W17201	8/24/2018	228	W17201	8/25/2018	228	1
OR2773	GRAY	W17201	8/24/2018	268	W17201	8/25/2018	270	1
OR2586	GRAY	W17201	8/24/2018	284	W17201	8/25/2018	284	1
OR3340	***GRAY***	***W17201***	***7/22/2018***	***208***	***W18204***	***7/23/2018***	***210***	***1***
OR7101	GRAY	BC1	8/26/2018	285	BC1	8/27/2018	285	1
OR1211	GRAY	W18204	8/27/2018	234	W18204	8/28/2018	232	1
OR0260	GRAY	W17201	6/29/2018	182	W17201	6/30/2018	213	1
OR0565	GRAY	W18204	7/19/2018	210	W18204	7/20/2018	209	1
OR0568	GRAY	W18204	7/19/2018	232	W18204	7/20/2018	230	1
OR0934	GRAY	W18204	7/19/2018	206	W18204	7/20/2018	206	1
OR5645	GRAY	W18204	7/19/2018	255	W18204	7/20/2018	255	1
OR4330	GRAY	W18204	8/24/2018	247	W18204	8/25/2018	249	1
OR5253	BDWF	W18401	7/24/2018	375	W17401	7/25/2018	396	1
OR2426	BDWF	FT1802	7/21/2018	550	FT1802	7/22/2018	554	1
OR2427	BDWF	FT1802	7/21/2018	533	FT1802	7/22/2018	537	1
OR2429	BDWF	FT1802	7/21/2018	537	FT1802	7/22/2018	544	1
OR2431	BDWF	FT1802	7/21/2018	518	FT1802	7/22/2018	518	1
OR2432	BDWF	FT1802	7/21/2018	503	FT1802	7/22/2018	505	1
OR2434	BDWF	FT1802	7/21/2018	433	FT1802	7/22/2018	432	1
OR2435	BDWF	FT1802	7/21/2018	422	FT1802	7/22/2018	430	1
OR2437	BDWF	FT1802	7/21/2018	381	FT1802	7/22/2018	384	1
OR4066	BDWF	FT1802	7/21/2018	245	FT1802	7/22/2018	245	1
OR0277	***GRAY***	***W17203***	***6/24/2018***	***201***	***W18204***	***6/25/2018***	***243***	***1***
OR0517	GRAY	W18204	6/30/2018	198	W18204	7/1/2018	198	1
OR0932	GRAY	W18204	6/30/2018	191	W18204	7/1/2018	191	1
OR5964	GRAY	W18204	6/30/2018	263	W18204	7/1/2018	263	1
OR4339	GRAY	W17401	8/28/2018	247	W17401	8/29/2018	247	1
OR5171	GRAY	W17401	8/28/2018	306	W17401	8/29/2018	305	1
OR5484	GRAY	W17401	8/28/2018	311	W17401	8/29/2018	306	1
OR5485	GRAY	W17401	8/28/2018	334	W17401	8/29/2018	339	1

		Release Data			Recapture Data			
Tag Number	**Species**	**Station**	**Date**	**Length**	**Station**	**Date**	**Length**	**Days At Large**
OR5486	GRAY	W17401	8/28/2018	331	W17401	8/29/2018	332	1
OR5489	GRAY	W17401	8/28/2018	310	W17401	8/29/2018	309	1
OR5483	GRAY	W17401	8/28/2018	329	W17401	8/29/2018	330	1
OR0941	***GRAY***	***W17201***	***6/24/2018***	***241***	***W18204***	***6/25/2018***	***241***	***1***
OR4048	LSCS	FT1802	7/19/2018	202	FT1802	7/20/2018	*	1
OR5014	GRAY	W17201	8/23/2018	297	W17201	8/24/2018	295	1
OR5047	GRAY	W17201	8/23/2018	318	W17201	8/24/2018	317	1
OR2629	GRAY	BC1	6/24/2018	257	BC1	6/25/2018	257	1
OR2642	GRAY	BC1	6/24/2018	383	BC1	6/25/2018	380	1
OR5555	GRAY	BC1	6/24/2018	298	BC1	6/25/2018	296	1
OR5557	GRAY	BC1	6/24/2018	375	BC1	6/25/2018	376	1
OR5563	GRAY	BC1	6/24/2018	279	BC1	6/25/2018	280	1
OR0617	***GRAY***	***W18204***	***7/22/2018***	***182***	***W17201***	***7/23/2018***	***183***	***1***
OR1210	***GRAY***	***W18204***	***7/22/2018***	***213***	***W17201***	***7/23/2018***	***212***	***1***
OR0960	***GRAY***	***W18204***	***7/22/2018***	***222***	***W17201***	***7/23/2018***	***222***	***1***
OR3377	GRAY	W17201	7/20/2018	227	W17201	7/21/2018	221	1
OR3400	LSCS	W17201	7/20/2018	216	W17201	7/21/2018	215	1
OR5012	RDWF	W17201	7/20/2018	297	W17201	7/21/2018	295	1
OR5013	LSCS	W17201	7/20/2018	266	W17201	7/21/2018	267	1
OR0128	***GRAY***	***W17203***	***7/20/2018***	***203***	***W17201***	***7/21/2018***	***262***	***1***
OR5892	GRAY	W17201	7/22/2018	264	W17201	7/23/2018	270	1
OR5894	GRAY	W17201	7/22/2018	303	W17201	7/23/2018	304	1
OR5895	GRAY	W17201	7/22/2018	271	W17201	7/23/2018	273	1
OR5896	GRAY	W17201	7/22/2018	287	W17201	7/23/2018	289	1
OR5897	GRAY	W17201	7/22/2018	281	W17201	7/23/2018	283	1
OR1219	GRAY	W17201	6/26/2018	200	W17201	6/27/2018	200	1
OR1220	GRAY	W17201	6/26/2018	194	W17201	6/27/2018	194	1
OR2290	GRAY	BC1	6/22/2018	311	BC1	6/23/2018	310	1
OR2351	GRAY	BC1	6/22/2018	324	BC1	6/23/2018	324	1
OR2742	GRAY	BC1	6/22/2018	281	BC1	6/23/2018	284	1
OR2855	GRAY	BC1	6/22/2018	340	BC1	6/23/2018	340	1
OR2859	GRAY	BC1	6/22/2018	305	BC1	6/23/2018	305	1
OR2861	GRAY	BC1	6/22/2018	319	BC1	6/23/2018	317	1
OR2978	GRAY	W18401	7/2/2018	288	W18401	7/3/2018	288	1