MONITORING FISH POPULATIONS IN THE UBLUTUOCH RIVER DRAINAGE IN EASTERN NPR-A: 2004-2006

Final Report

January 2007

Prepared by:

MJM Research
1012 Shoreland Drive
Lopez Island, WA

Prepared for:
ConocoPhillips Alaska, Inc.
700 G Street
Anchorage, AK

and

Anadarko Petroleum Corp.
1200 Timberloch Place
The Woodlands, TX

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Prepared by:

Lawrence L. Moulton
MJM Research
1012 Shoreland Drive
Lopez Island, WA

and

John Seigle
ABR Environmental Research and Services, Inc.
P.O. Box 80410
Fairbanks, AK 99708

Prepared for:

ConocoPhillips Alaska, Inc.
700 G Street
Anchorage, AK

and

Anadarko Petroleum Corp.
1200 Timberloch Place
The Woodlands, TX

EXECUTIVE SUMMARY

ConocoPhillips Alaska Inc. (CPAI) has been exploring for oil within the eastern portion of the National Petroleum Reserve–Alaska (NPR-A) since the winter of 1999/2000. Oil reserves have been located in the region, and the feasibility of developing a producing field in the area is being investigated. Part of the evaluation process includes assessing the potential environmental impacts. The inventory of fish and fish habitat provides information for assisting permitting decisions regarding road and pipeline routing. In addition, streams in the area may be crossed by ice roads, so an understanding of potential overwintering areas is also desirable. A key element of the study is identifying movements and distribution of fish utilizing the stream systems.

The goal of the present study effort is to develop information needed to monitor fish populations using the Ublutuoch River drainage so that changes, if any, in fish use of the drainage system after field development can be evaluated.

Specific objectives of the 2006 fish survey were to conduct studies on the Tingmiaqsiugvik (Ublutuoch River) drainage system to:

a) describe fish populations and habitat use patterns within the drainage,
b) obtain information on fish movements within the drainage.

METHODS

During summer 2006, fyke nets were used to sample small streams in the eastern NPR-A study area. Sampling was by fyke net so that fish could be released unharmed. Sampling covered late June to evaluate post-breakup movements, late July-early August to evaluate fish use of channels after spring out-migration was complete, and late August to evaluate potential movements to wintering areas. Water chemistry parameters, including water temperature, specific conductance, dissolved oxygen, pH, and turbidity, were measured to assess habitat conditions and provide information on the suitability of the water for domestic and industrial uses. Fish were tagged to reveal movements within the study area and provide estimates of the number of grayling using the study area.

RESULTS

Eight species were captured in small streams in eastern NPR-A during fyke net sampling in 2006. Arctic grayling were again the most abundant species, followed by ninespine stickleback. Bill's Creek and Crea Creek, small tributary streams, produced the greatest number of grayling, followed by the Tingmiaqsiugvik (Ublutuoch River).

As seen in previous years, there was substantial movement of fish in clear water tributaries connected to lake systems. Both Bill's Creek and Crea Creek are connected to lake systems by well-defined streams and there are similar stream/lake systems upstream from the Tingmiaqsiugvik (Ublutuoch River) sampling stations. Other clear water streams without significant lake area, or with ephemeral connecting streams, supported lower densities and diversity. It is clear that

connected lakes with predictable access provide important rearing areas for many fish species during summer.

Catch rates of Arctic grayling in the small streams were lower in July 2006 as compared to July 2004 and 2005, the low catches resulted in part by a reduced catch of juvenile grayling in 2006. A shorter sampling period than usual in July may also have been a factor.

An unusual event during 2005 was the catch of 2 sockeye salmon in the Tingmiaqsiugvik (Ublutuoch River) during August. Sockeye salmon are rarely encountered along the Beaufort Sea coast and are considered strays from streams farther south. No salmon were caught in 2006.

Tags were applied to 290 Arctic grayling in 2006, bringing the total number of tagged grayling in eastern NPRA to 1,934 since 2001. During 2006, 76 tagged grayling were recovered, for a total of 359 recaptured from 2001 to 2006. One moved about 23 miles from Crea Creek to the Nigliq Delta fall harvest area in 97 days, where it was caught in a gill net; the rest were captured within the study area.

Multiple recaptures of the same fish were common, with one fish recaptured four times during the summer and another being captured five times since its original release in 2001. Tag returns indicate that Arctic grayling are wide-ranging within the Fish Ck/Judy Ck drainage system, however, many appear to consistently use the clear water creeks and lakes associated with the Tingmiaqsiugvik (Ublutuoch River).

Tag returns indicated that Arctic grayling were returning to the same feeding areas year after year. Tagged Arctic grayling tended to be caught in the stream in which they had been tagged, even between years.

The estimates of Arctic grayling entering the study area were similar in both 2004 and 2005 for both estimating models, which indicated that between 4,100 and 4,400 grayling in excess of 180 mm likely used the study area. The estimate decreased to between 3,300 to 3,400 fish in 2006. Of these, approximately 1,000 to 2,000 entered Crea Creek in each year. For Bill's Creek, the 2004 and 2005-2006 estimates were quite different, with 2,400-2,700 estimated for 2004 and 920-940 estimated for 2005 and 800-1000 estimated for 2006.

Using the ratio of broad whitefish to grayling catch rates to estimate numbers of broad whitefish, it was estimated that an annual average of 365 broad whitefish (range: 163-506) entered the study area from 2004-2006, with 9 (range: 4-15) entering Crea Creek and 120 (range: 28-172) entering Bill’s Creek.

CONCLUSIONS

Sampling in eastern NPR-A during 2006 indicated, as in previous years, that the Tingmiaqsiugvik (Ublutuoch River) drainage system is heavily used by Arctic grayling and broad whitefish, with humpback whitefish, least cisco and round whitefish also present during summer. Clearwater tributaries to the Tingmiaqsiugvik (Ublutuoch River) that have strong connections to lakes supported high densities of juvenile Arctic grayling, as well as a variety of other species, indicating the importance of these small connected streams as summer feeding areas.

Larger Arctic grayling (in excess of 180 mm) also ascended these small tundra drainages to feed, with individual fish showing fidelity to the same tributary system. It appears that the Tingmiaqsiugvik (Ublutuoch River) functions primarily as a migratory corridor for many of the larger grayling that are heading for specific stream/lake tributary systems. There is likely a portion of the population that remains within the main river through the summer. A similar pattern likely occurs in broad whitefish that are heading for feeding areas in lakes, although tag returns to date have been too low to validate this conclusion.

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INTRODUCTION

ConocoPhillips Alaska Inc. (CPAI) has been exploring for oil within the eastern portion of the National Petroleum Reserve–Alaska (NPR-A) since the winter of 1999/2000. Oil reserves have been located in the region, and the feasibility of developing a producing field in the area is being investigated. Part of the evaluation process includes assessing the potential environmental impacts, which requires information specific to the activity area in order to evaluate the biological sensitivity of streams and lakes in the region. Streams in the area may be crossed by ice roads during winter or by roads and/or pipelines after development. An understanding of the fish populations in these streams is needed to minimize effects to these populations during field development. The inventory of fish and fish habitat provides information for assisting permitting decisions regarding road and pipeline routing.

Streams in the study region have previously been investigated by Netsch et al. (1977), and Bendock and Burr (1984). These surveys consisted of one-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 (Fish Creek) and Iqalliqpiq (Judy Creek) included broad whitefish, Arctic grayling, round whitefish, slimy sculpin and ninespine stickleback. The Tingmiaqsiugvik (Ublutuoch River) was also reported to contain Arctic grayling, slimy sculpin and ninespine stickleback.

The present study was begun in 2001 as the first detailed examination of fish habitats and populations in the eastern NPR-A study area (Moulton 2002, 2003). The study was designed to provide details of fish populations in eastern NPR-A (Figure 1), and the habitats used by those populations, so that oilfield facilities can be sited, designed and constructed in a manner that will avoid or minimize impacts.

The goal of the present study effort is to develop information needed to monitor fish populations using the Ublutuoch River drainage so that changes, if any, in fish use of the drainage system after field development can be evaluated.

Specific objectives of the 2006 fish survey were to conduct studies on the Tingmiaqsiugvik (Ublutuoch River) drainage system to:

a) describe fish populations and habitat use patterns within the drainage,
b) obtain information on fish movements within the drainage.

METHODS

During summer 2004-2006, fyke nets were used to sample smaller drainages within the Tingmiaqsiugvik (Ublutuoch River) study area (Figures 2 and 3). Initial stream sampling begun in 2001 consisted of fyke net stations in lower and upper Uvlutuuq (Fish Creek) (i.e. upstream from the confluence of Uvlutuuq (Fish Creek) and Iqalliqpiq (Judy Creek)), Iqalliqpiq (Judy Creek), and the Tingmiaqsiugvik (Ublutuoch River). In 2002 and 2003, sampling was expanded to smaller tundra stream drainages associated with the greater Uvlutuuq (Fish Creek)/Iqalliqpiq (Judy Creek) system. Additional stations were sampled in lakes throughout the study region.

During summers from 2004 to 2006, the study design was to re-sample small streams in the Tingmiaqsiugvik (Ublutuoch River) study area in the vicinity of potential development (Figure 2). Stream systems selected were two tundra streams, Bill's Creek and Crea Creek, that discharged directly into the Tingmiaqsiugvik (Ublutuoch River).

Sampling was by fyke net so that fish could be released unharmed. Fyke nets used had an opening 0.9 m deep by 1.1 m wide, the trap end was 4.9 m long, made of 9.5 mm mesh. The wings (5 m long) and lead (15 m long) were made of 12.7 mm mesh. The nets were emptied daily. Fish were measured and released, with no fish retained for laboratory analysis. Duration of each set was recorded to allow calculation of catch rates. In 2005, fyke nets were arranged to sample fish moving both upstream and downstream.

In 2004-2006, fish longer than 180 mm were tagged to evaluate movement patterns within the drainage system and to reveal the extent to which fish caught in the study area contribute to the subsistence catch. Floy FD-94 anchor tags (monofilament = 1/2 inch, vinyl = 3/4 inch) were applied to whitefish, cisco, and burbot caught by fyke net. Recapture was monitored in research sampling within Colville Delta and eastern NPR-A study areas and in the Nuiqsut subsistence fishery.

Water Chemistry Sampling

Water chemistry parameters were measured to assess habitat conditions during summer. Water chemistry measurements included surface measures of water temperature, specific conductance, dissolved oxygen, pH, and turbidity. Temperature, specific conductance and dissolved oxygen were *in situ* measurements taken at a depth of approximately 0.5 m near the trap end of the fyke net with a YSI Model 85 meter. A sample obtained from about 15 cm below the surface was returned to the field office to measure pH and turbidity. PH was measured with either a Coning pH meter or an Oaktron pH Tester III. Turbidity was measured with an H.F. Scientific DRT15CE turbidity meter.

Population Estimates

Estimates of the number of Arctic grayling (greater than 180 mm fork length) using the study area from 2004 to 2006 were performed using two different multiple census models: 1) the Schnabel method and 2) the Schumacher-Eschmeyer estimate, as described in Ricker (1975). Estimates of population (N) used the following notations:

m = number of periods, in this case, sample days
M_i = total marked fish in the population at the start of the ith sampling period (i = 1,..., m).
C_i = total sample taken in period i.
R_i = number of recaptures in the sample C_i.
R = (sum of) R_i total recaptures during the experiment.

Method 1: Schnabel (adjusted)

The Schnabel approximation to the maximum likelihood estimator of population, N, from multiple censuses (Ricker 1975) was:

$$N = \sum_{i=1}^{m} \frac{C_i M_i}{R+1}$$

Approximate 95% confidence limits for this estimator were obtained by treating R as a Poisson variable and substituting limits found in Ricker (1975) for R.

Method 2: Schumacher-Eschmeyer

The Schumacher-Eschmeyer method uses the regression slope estimator in the plot of recovery rate versus the number of marked fish to obtain the following estimator:

$$N = \frac{\sum_{i=1}^{m} C_i M_i^2}{\sum_{i=1}^{m} M_i R_i}$$

Approximate 95% confidence limits for N were obtained by first calculating limits for 1/N and then inverting those limits. The confidence limits for 1/N were based on a t-value with m-1 degrees of freedom and the standard error (S.E.) of 1/N.

$$\text{S.E. }(1/N) = \sqrt{\frac{\sum_{i=1}^{m} \frac{R_i^2}{C_i} - \frac{\left(\sum_{i=1}^{m} R_i M_i\right)^2}{\sum_{i=1}^{m} C_i M_i^2}}{(m-1)\sum_{i=1}^{m} C_i M_i^2}}$$

There are three key assumptions on which these estimators depend:

1. marked fish are randomly dispersed into the general population.
2. all fish are equally catchable within each sampling period, including both marked and unmarked fish (not necessarily among sampling periods).
3. the population is closed (i.e., no inmigration or outmigration during the experiment).

RESULTS AND DISCUSSION

Physical Environment

Sampling in 2006, as in previous years, began in June as stream flows were receding from peak break-up flows. At the onset of sampling on June 15, channel ice had melted and water temperatures had reached 12-13^{o}C in study area streams (Figure 3). Subsequently, temperatures decreased rapidly to near 5-6^{o}C before increasing in late June. Water temperatures fluctuated between 10 and 18^{o}C through July, and between 5 to 6^{o}C in late August. In contrast, water temperatures in June and late August 2004 were substantially higher than observed in any other year between 2002 and 2006.

During the period of study, specific conductance rose slowly at all sites through the summer as snow melt and runoff decreased. Bill's Creek exhibits the highest specific conductance, while the Tingmiaqsiugvik (Ublutuoch River) has the lowest (Figure 3). Turbidity in the Tingmiaqsiugvik (Ublutuoch River) and its tributaries was low throughout the summer, generally in the range of 2 NTU or less, indicating consistently clear water (Appendix Table B-1). Highest values were recorded in the Tingmiaqsiugvik (Ublutuoch River) following break-up.

Biological Observations

Movements Within Drainages

Fyke Net Catches. Substantial differences were found in fish use of small drainages of eastern NPR-A. Eight species were captured in small streams in eastern NPR-A during fyke net sampling in 2006, with a total of twelve species identified from Tingmiaqsiugvik (Ublutuoch River) drainage since 2001 (Table 2). Arctic grayling were the most abundant species (52% of the total catch, 86% of the non-stickleback catch), followed by ninespine stickleback. Stations B0401 in Bill's Creek and C0301 in Crea Creek, small tributary streams, produced the greatest number of grayling, followed by Station U0601 on the Tingmiaqsiugvik (Ublutuoch River). While juvenile grayling dominated the catches, adults were also present (Appendix Table C-1).

From 2004 to 2006, fyke nets were placed to catch fish moving both upstream and downstream in Bill's Creek, Crea Creek, and the Tingmiaqsiugvik (Ublutuoch River). In 2004, most Arctic grayling appeared to be moving downstream in July to early August, with relatively few remaining in late August, while broad whitefish remained in the streams into late August. In 2005, there was little movement into the streams in June, possibly because of the much lower water temperatures as compared to 2004; however this was followed by strong upstream movement by Arctic grayling at all stations during July, with fish apparently moving downstream during late August. In 2006, the relatively high water temperatures, compared to 2005, seemed to stimulate upstream movements into Bills Creek and Crea Creek in June. Moderate activity continued through July, with low catches in both directions during August (Figure 4).

Few broad whitefish were caught during 2006, with most of those caught moving downstream in Bill's Creek and the Tingmiaqsiugvik (Ublutuoch River). There was an indication of an August downstream movement by broad whitefish in both of these streams, but this was based on relatively low numbers of fish (Figure 5). Bill's Creek drains an extensive lake system, which may explain the higher numbers of broad whitefish moving into this system as compared to the Crea Creek system (Figure 6).

It is clear that connected lakes with predictable access provide important rearing areas for many fish species during summer. As seen in previous years, and discussed in Morris (2003) and Moulton (2005), there was substantial movement of fish in clear water tributaries connected to lake systems. Both Bill's Creek and Crea Creek are connected to lake systems by well-defined streams and there are similar stream/lake systems upstream from the Tingmiaqsiugvik (Ublutuoch River) sampling stations (Figure 6). As reported in Moulton (2005, 2006), other clear water streams without significant lake area, or with ephemeral connecting streams, supported lower densities and diversity. In previous sampling, only ninespine stickleback and Alaska blackfish were caught in lakes of the Oil Creek drainage.

Catch rates of Arctic grayling in the small streams were lower in 2006 as compared to 2004 and 2005 (Figure 8). Much of this decrease in catch seems to be related to a lack of small fish during 2006 at all stations (Figure 9). The July sampling period during 2006 was later and shorter than those in previous years and may account for some of the reduction in small grayling observed in 2006.

An unusual event during 2005 was the catch of 2 adult sockeye salmon in the Tingmiaqsiugvik (Ublutuoch River) during August. Sockeye salmon are very rare in North Slope drainages This follows the similarly unusual capture of 4 adult chinook salmon (685-900 mm) from this river in 2004. Chinook and sockeye salmon are rarely encountered along the Beaufort Sea coast and are considered strays from streams farther south (Craig and Haldorson 1986). There were no unusual species encounters in 2006.

Tag Returns. Tags were applied to 290 Arctic grayling in 2006, bringing the total number of tagged grayling in eastern NPRA to 1,934 since 2001 (Table 3). During 2006, 76 tagged grayling were recovered, for a total of 359 recaptured from 2001 to 2006. One moved about 23 miles from Crea Creek to the Nigliq Delta fall harvest area in 97 days, where it was caught in a gill net; the rest were captured within the study area.

Multiple recaptures of the same fish were common (Table 4), with one fish recaptured four times during the summer and another being captured five times since its original release in 2001. Tag returns indicate that Arctic grayling are wide-ranging within the Fish Ck/Judy Ck drainage system, however, many appear to consistently use the clear water creeks and lakes associated with the Tingmiaqsiugvik (Ublutuoch River). One fish demonstrating remarkable consistency was captured at the Tingmiaqsiugvik (Ublutuoch River) site on the following dates:

June 25, 2001

June 25, 2002
June 22, 2003
June 23, 2004

This fish was not encountered in 2005 or 2006.

Tag returns indicated that Arctic grayling were returning to the same feeding areas year after year. Tagged Arctic grayling tended to be caught in the stream in which they had been tagged, even between years. For both Bill's Creek and Crea Creek, the highest tag return rates were within the stream of release in both 2004 and 2005 (Table 3). In 2006, the pattern differed, with tagged fish form Bill's Creek and Crea Creek caught at higher rates in the Tingmiaqsiugvik (Ublutuoch River) than in the stream of release. Return rates within the Tingmiaqsiugvik (Ublutuoch River), however, were lower than in the small side streams, with returns at the tagging site not necessarily higher than at other netting stations. Few grayling tagged in Bill's Creek were caught in Crea Creek, and similarly, few tagged in Crea Creek were captured in Bill's Creek.

Tags were applied to 38 broad whitefish in 2006, bringing the total number of tagged broad whitefish in eastern NPRA to 455 since 2001. Only one tagged broad whitefish were recovered during 2006, recaptured at the release station 1 day after its release. To date, only 11 have been recaptured, 10 within 5 days of release. The remaining broad whitefish was captured in a gill net at Nuiqsut 86 days after being tagged.

Tags were applied to 86 humpback whitefish in 2006, bringing the total number of tagged humpback whitefish in eastern NPRA to 464 since 2001. Only two tagged humpback whitefish were recovered during 2006, both at the release station in within 2 days of their release. To date, only 13 have been recaptured, 11 of those coming within 4 days of release. The remaining 2 humpback whitefish were captured in gill nets in the Nigliq Channel 94 and 97 days after being tagged.

Tagged least cisco and round whitefish have been released in lesser numbers, with 143 least cisco and 86 round whitefish released since 2001. Two least cisco from these releases ended up in gill nets in the Nigliq Channel after 128 and 824 days at large. Eight others were captured near the release site within a week or less at large. There have not been any notable recoveries for round whitefish.

Habitat Use by Dominant Species

During 2006, four species (Arctic grayling, broad whitefish, humpback whitefish and round whitefish) comprised over 98% of the catch, excluding ninespine stickleback. Ninespine stickleback were 39% of the total catch, being most abundant in Crea Creek (Table 2). In previous years, burbot were encountered in several habitats, and while not numerous, were conspicuous because of their large size. However, burbot were not caught in 2006.

Arctic Grayling. Arctic grayling were the most abundant species caught (Table 2). The two clear streams, Bill's Creek and Crea Creek, contained the highest abundance of adult Arctic grayling, with the Tingmiaqsiugvik (Ublutuoch River) third in abundance (Table 2). Rearing juveniles, primarily ages 1 and 2, were particularly abundant in the clear water tributaries to Tingmiaqsiugvik (Ublutuoch River), although larger grayling were also abundant in Bill's Creek and Crea Creek (Figure 9). Young-of-the-year were caught in small numbers in Bill's Creek, Crea Creek and Tingmiaqsiugvik (Ublutuoch River).

Humpback Whitefish. Humpback whitefish were third in abundance, with 74% of the catch recorded from the Tingmiaqsiugvik (Ublutuoch River). Unlike other species, most of the captured humpback whitefish were adults. There was a strong upstream movement of large humpback whitefish in the Tingmiaqsiugvik (Ublutuoch River) during July sampling (July 22-29).

Broad Whitefish. Broad whitefish were the fourth most abundant fish caught, but were less than 2% of the total catch (Table 2). Larger broad whitefish were caught primarily in Bill's Creek and the Tingmiaqsiugvik (Ublutuoch River) July and August sampling, with only scattered records of larger individuals at other locations and periods (Figure 5).

Least Cisco. Least cisco were most abundant in Bill's Creek and Tingmiaqsiugvik (Ublutuoch River), apparently moving upstream to access connected lakes.

Estimates of Arctic Grayling and Broad Whitefish

The consistent and high recapture rates of tagged Arctic grayling allowed estimating the number of fish likely entering the study area during summer. Two estimating models were used, the Schnabel method and the Schumacher-Eschmeyer method. Both estimating models are appropriate when there are multiple release and recapture events through a study period.

There are three key assumptions on which these estimators depend:

1. marked fish are randomly dispersed into the general population.
2. all fish are equally catchable within each sampling period, including both marked and unmarked fish (not necessarily among sampling periods).
3. the population is closed (i.e., no immigration or emigration during the experiment).

These assumptions are generally not met, thus the estimated numbers must be viewed as approximations, however, they may be useful for comparison with future tag recovery trends. Assumption 1 is rarely true for any fish population, as behavioral interactions will likely preclude random mixing. Assumption 2 is also problematic because groups of fish are usually headed in a particular direction (either upstream or downstream) when caught for tagging, and thus are likely to be unavailable for sampling periods immediately after release; recovery is likely to occur when the fish next happen to move past the sampling station, either later in the summer or the following year. The third assumption, i.e. the population is closed, may be the most valid assumption, particularly within Bill's Creek and Crea Creek. Tag returns indicate that

Arctic grayling show a degree of fidelity to these streams, and return year after year to these feeding systems. Although the fish move downstream to winter, they return to the stream/lake systems during summer. It is also clear that there are additional groups moving farther upstream in the Tingmiaqsiugvik (Ublutuoch River) that are rarely encountered again. Thus the estimated numbers are most likely to be useful for the two smaller creeks (Bill's Creek and Crea Creek).

The estimates of Arctic grayling entering the study area were similar in both 2004 and 2005 for both estimating models, which indicated that between 4,100 and 4,400 grayling in excess of 180 mm likely used the study area (Table 5). The estimate decreased to between 3,300 to 3,400 fish in 2006. Of these, approximately 1,000 to 2,000 entered Crea Creek in each year. For Bill's Creek, the 2004 and 2005-2006 estimates were quite different, with 2,400-2,700 estimated for 2004 and 920-940 estimated for 2005 and 800-1000 estimated for 2006. The high estimates in Bill's Creek for 2004 and Crea Creek for 2006 result from the low number of recoveries in those cases.

Both models provided similar estimates and similar confidence intervals. However, the low number of recoveries in Bill's Creek during 2004 and Crea Creek during 2006 resulted in broad confidence intervals for those estimates, particularly with the Schumacher-Eschmeyer model.

A rough estimate can be made of the number of broad whitefish exceeding 180 mm entering the Tingmiaqsiugvik (Ublutuoch River) study area if it is assumed that the ratio of broad whitefish catches to Arctic grayling catches is a reasonable indicator of relative abundance. An insufficient number of anchor tags were returned to make a direct estimate of broad whitefish, but if it is assumed that fish in excess of 180 mm in both species are equally vulnerable to catch by fyke nets, then the ratio of broad whitefish to Arctic grayling can be used to estimate numbers of broad whitefish (Table 6). Using this approach, an annual average of 365 broad whitefish (range: 163-506) entered the study area from 2004-2006, with 9 (range: 4-15) entering Crea Creek and 120 (range: 28-172) entering Bill's Creek. Estimates of broad whitefish from 2004 and 2006 in Bill's Creek and the Tingmiaqsiugvik (Ublutuoch River) study area were similar in magnitude, while estimates form 2005 were considerably lower.

CONCLUSIONS

Sampling in eastern NPR-A during 2006 indicated, as in previous years, that the Tingmiaqsiugvik (Ublutuoch River) drainage system is heavily used by Arctic grayling and broad whitefish, with humpback whitefish, least cisco and round whitefish also present during summer. Clearwater tributaries to the Tingmiaqsiugvik (Ublutuoch River) that have strong connections to lakes supported high densities of juvenile Arctic grayling, as well as a variety of other species, indicating the importance of these small connected streams as summer feeding areas.

Larger Arctic grayling (in excess of 180 mm) also ascended these small tundra drainages to feed, with individual fish showing fidelity to the same tributary system. It appears that the Tingmiaqsiugvik (Ublutuoch River) functions primarily as a migratory corridor for many of the larger grayling that are heading for specific stream/lake tributary systems. There is likely a portion of the population that remains within the main river through the summer. A similar pattern likely occurs in broad whitefish that are heading for feeding areas in lakes, although tag returns to date have been too low to validate this conclusion.

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Table 1. Location of fyke net stations fished in eastern NPRA during 2004-2006.

Year	Station	Location	Dates Fished	Latitude (NAD83)	Longitude (NAD83)
2004					
	B0401 (US)	Bill's Creek (trib to Ublutuoch)	Jul 13-20; Jul 31-Aug 4; Aug 18-24	70.22592	151.26387
	B0401 (DS)	Bill's Creek (trib to Ublutuoch)	Jul 13-20; Jul 31-Aug 4; Aug 18-24	70.22592	151.26387
	C0301 (US)	Crea Creek (trib to Ublutuoch)	Jun 16-24; Jul 10-20; Jul 29-Aug 4; Aug 18-24	70.27969	151.33000
	C0301 (DS)	Crea Creek (trib to Ublutuoch)	Jul 13-20; Jul 29-Aug 4; Aug 18-24	70.27969	151.33000
	U0102 (US)	Ublutuoch River	Jul 14-17; Jul 30-Aug 4; Aug 18-24	70.24875	151.29120
	U0102 (DS)	Ublutuoch River	Jul 30-Aug 4; Aug 18-24	70.24875	151.29120
	U0301 (US)	Ublutuoch River	Jun 16-24; Jul 13	70.23952	151.30293
2005					
	B0401 (US)	Bill's Creek (trib to Ublutuoch)	Jul 10-27; Aug 18-22	70.22592	151.26387
	B0401 (DS)	Bill's Creek (trib to Ublutuoch)	Jul 10-27; Aug 18-22	70.22592	151.26387
	B0501 (US)	Bill's Creek (trib to Ublutuoch)	Jun 16-22	70.23563	151.27713
	B0501 (DS)	Bill's Creek (trib to Ublutuoch)	Jun 16-22	70.23563	151.27713
	B0502 (US)	Bills' Creek at Lake Outlet	Jul 15-26	70.21218	151.24599
	C0301 (US)	Crea Creek (trib to Ublutuoch)	Jul 10-27; Aug 18-22	70.27969	151.33000
	C0301 (DS)	Crea Creek (trib to Ublutuoch)	Jul 10-27; Aug 18-22	70.27969	151.33000
	C0501 (DS)	Crea Creek (trib to Ublutuoch)	Jun 15-21	70.28680	151.32316
	C0501 (US)	Crea Creek (trib to Ublutuoch)	Jun 15-21	70.28680	151.32316
	U0102 (US)	Ublutuoch River	Jul 10-28; Aug 18-23	70.24875	151.29120
	U0102 (DS)	Ublutuoch River	Jul 10-28; Aug 18-23	70.24875	151.29120
	U0501 (US)	Ublutuoch River	Jun 17	70.25358	151.26657
	U0502 (US)	Ublutuoch River	Jun 17-22	70.23415	151.29025
2006					
	B0401 (US)	Bill's Creek (trib to Ublutuoch)	Jun 15-22; Jul 21-29; Aug 17-23	70.22592	151.26387
	B0401 (DS)	Bill's Creek (trib to Ublutuoch)	Jun 16-22; Jul 21-29; Aug 17-23	70.22592	151.26387
	C0301 (US)	Crea Creek (trib to Ublutuoch)	Jun 15-22; Jul 21-29; Aug 17-23	70.27969	151.33000
	C0301 (DS)	Crea Creek (trib to Ublutuoch)	Jun 15-22; Jul 21-29; Aug 17-23	70.27969	151.33000
	U0502 (US)	Ublutuoch River	Jun 15-22; Jul 21-29; Aug 17-23	70.23374	151.28735
	U0502 (DS)	Ublutuoch River	Jul 22-29; Aug 17-23	70.23385	151.28803

DS = net catching fish moving downstream
US = net catching fish moving upstream

Table 2. Comparison of fish catches in small streams of eastern NPRA during 2004-2006.

Number of fish caught

	Bill's Ck			Crea Ck				Ublutuoch River					
Species	2004	2005	2006	2003	2004	2005	2006	2001	2002	2003	2004	2005	2006
Chinook salmon											4		
Chum salmon								1				1	
Sockeye salmon												2	
Broad whitefish	122	38	15	3	8	5	1	121	155	6	76	26	23
Humpback whitefish	24	9	23				1	192	5	1		26	67
Least cisco	12	4	3	3	1	1		37	66	2	13	24	8
Round whitefish	3	4	9				5	70	11	2		18	20
Arctic grayling	1,837	1,266	532	1,394	1,175	1,381	267	660	630	222	749	705	265
Burbot				1	3	1							
Alaska blackfish	2			2	5		1						
Ninespine stickleback	938	213	132	391	1,213	901	562	52	15	305	296	92	93
Slimy sculpin	17	14	1	15	5	5		7	7	9	5	1	2
Total catch	2,955	1,548	715	1,809	2,410	2,294	837	1,140	889	547	1,143	895	478
Number of Species	8	7	7	7	7	6	6	8	7	7	6	9	7
Effort (hours)	933.1	1,735.9	1,026.2	634.8	1,331.3	1,462.1	1,049.6	653.7	590.3	645.7	987.3	1,347.8	859.5

Catch Rate (fish per day)

	Bill's Ck			Crea Ck				Ublutuoch River					
Species	2004	2005	2006	2003	2004	2005	2006	2001	2002	2003	2004	2005	2006
Chinook salmon											0.10		
Chum salmon								0.04				0.02	
Sockeye salmon												0.04	
Broad whitefish	3.1	0.53	0.35	0.11	0.14	0.08	0.02	4.4	6.3	0.22	1.8	0.46	0.64
Humpback whitefish	0.62	0.12	0.54				0.02	7.0	0.20	0.04		0.46	1.87
Least cisco	0.31	0.06	0.07	0.11	0.02	0.02		1.4	2.7	0.07	0.32	0.43	0.22
Round whitefish	0.08	0.06	0.21				0.11	2.6	0.4	0.07		0.32	0.56
Arctic grayling	47.2	17.5	12.44	52.7	21.2	22.7	6.11	24.2	25.6	8.3	18.2	12.6	7.40
Burbot				0.04	0.05	0.02							
Alaska blackfish	0.05			0.08	0.09		0.02						
Ninespine stickleback	24.1	2.9	3.09	14.8	21.9	14.8	12.85	1.9	0.61	11.3	7.2	1.6	2.60
Slimy sculpin	0.44	0.19	0.02	0.57	0.09	0.08		0.26	0.28	0.33	0.12	0.02	0.06
Total CPUE	76.0	21.4	16.7	68.4	43.4	37.7	19.1	41.9	36.1	20.3	27.8	15.9	13.3
Number of Species	8	7	7	7	7	6	6	8	7	7	6	9	7

Table 3. Release and recapture locations of Arctic grayling tagged in eastern NPR-A streams from 2003 to 2006.

Number Recaptured

Release Stream	Release Year	Number Released	Number Recaptured in 2003			Number Recaptured in 2004			Number Recaptured in 2005			Number Recaptured in 2006		
			Bill's Ck	Crea Ck	Ublutuoch	Bill's Ck	Crea Ck	Ublutuoch	Bill's Ck	Crea Ck	Ublutuoch	Bill's Ck	Crea Ck	Ublutuoch
Bill's Ck														
	2004	159	--	--	--	6	0	1	5	2	2	3	0	0
	2005	220	--	--	--	--	--	--	25	0	2	7	0	2
	2006	121	--	--	--	--	--	--	--	--	--	7	1	9
Crea CK														
	2003	96	--	3	0	1	11	0	0	4	0	0	2	0
	2004	216	--	--	--	2	25	1	1	12	2	0	6	0
	2005	226	--	--	--	--	--	--	3	21	4	1	11	0
	2006	86	--	--	--	--	--	--	--	--	--	1	1	2
Ublutuoch R.														
	2001	187	--	2	0	1	0	5	3	1	0	1	1	1
	2002	87	--	0	1	3	0	2	0	1	0	0	0	0
	2003	56	--	1	3	0	1	0	1	0	0	0	0	0
	2004	142	--	--	--	1	1	3	0	2	4	1	1	3
	2005	255	--	--	--	--	--	--	6	1	0	2	0	1
	2006	83	--	--	--	--	--	--	--	--	--	2	0	1

Percent Recaptured

Release Stream	Release Year	Number Released	Percent Recaptured in 2003			Percent Recaptured in 2004			Percent Recaptured in 2005			Percent Recaptured in 2006		
			Bill's Ck	Crea Ck	Ublutuoch	Bill's Ck	Crea Ck	Ublutuoch	Bill's Ck	Crea Ck	Ublutuoch	Bill's Ck	Crea Ck	Ublutuoch
Bill's Ck														
	2004	159	--	--	--	**3.8%**	0	0.6%	**3.1%**	1.3%	1.3%	**1.9%**	0.0%	0.0%
	2005	220	--	--	--	--	--	--	**11.4%**	0	0.9%	**3.2%**	0.0%	0.9%
	2006	121	--	--	--	--	--	--	--	--	--	5.8%	0.8%	**7.4%**
Crea CK														
	2003	96	--	3.1%	0	1.0%	**11.5%**	0	0	**4.2%**	0	0.0%	**2.1%**	0.0%
	2004	216	--	--	--	0.9%	**11.6%**	0.5%	0.5%	**5.6%**	0.9%	0.0%	**2.8%**	0.0%
	2005	226	--	--	--	--	--	--	1.3%	**9.3%**	1.8%	0.4%	**4.9%**	0.0%
	2006	86	--	--	--	--	--	--	--	--	--	1.2%	1.2%	**2.3%**
Ublutuoch R.														
	2001	187	--	1.1%	0	0.5%	0	2.7%	1.6%	0.5%	0	0.5%	0.5%	0.5%
	2002	87	--	0	1.1%	3.4%	0	2.3%	0	1.1%	0	0.0%	0.0%	0.0%
	2003	56	--	1.8%	5.4%	0	1.8%	0	1.8%	0	0	0.0%	0.0%	0.0%
	2004	142	--	--	--	0.7%	0.7%	2.1%	0	1.4%	2.8%	0.7%	0.7%	**2.1%**
	2005	255	--	--	--	--	--	--	2.4%	0.4%	0	**0.8%**	0.0%	0.4%
	2006	83	--	--	--	--	--	--	--	--	--	**2.4%**	0.0%	1.2%

Table 4. Multiple recaptures of Arctic grayling in eastern NPRA streams, 2001-2006.

Tag Number	Release Station	Release Date	Release Length	Recapture Station	Recapture Date	Recapture Length	Days Out
MJM0100118	U0101	6/25/2001	309	U0102	6/25/2002	319	365
	U0102	6/25/2002	319	U0301	6/22/2003	338	362
	U0301	6/22/2003	338	U0301	7/13/2003	336	21
	U0301	7/13/2003	336	U0301	7/16/2003	337	3
	U0301	7/16/2003	337	C0301	6/23/2004	347	343
MJM0100835	MC7916C	7/25/2001	332	MC7916C	7/28/2001	332	3
	MC7916A	7/28/2001	332	CK17A	6/23/2002	341	330
MJM0101817	B0401	8/19/2004	349	B0401	7/17/2005	351	332
	B0401	7/17/2005	351	B0401	8/19/2005	350	33
MJM0101392	U0102	9/1/2001	356	C0301	7/12/2005	385	1410
	C0301	7/12/2005	385	C0301	6/15/2006	383	338
MJM020027	U0102	6/21/2002	211	B0401	7/15/2004	273	755
	B0401	7/15/2004	273	U0102	8/4/2004	281	20
MJM020490	U0102	7/31/2002	295	C0301	7/11/2005	330	1076
	C0301	7/11/2005	330	C0301	7/21/2005	330	10
MJM020730	C0301	6/18/2003	218	C0301	6/19/2004	263	367
	C0301	6/19/2004	263	C0301	7/24/2005	310	400
MJM020859	C0301	7/19/2003	233	C0301	7/14/2004	268	361
	C0301	7/14/2004	268	C0301	7/14/2005	310	365
MJM021211	C0301	8/17/2003	188	C0301	7/18/2004	222	336
	C0301	7/18/2004	222	C0301	7/29/2004	220	11
MJM021264	C0301	7/12/2004	227	C0301	7/29/2004	228	17
	C0301	7/29/2004	228	C0301	8/2/2004	231	4
MJM021266	C0301	7/12/2004	361	C0301	7/12/2005	362	365
	C0301	7/12/2005	362	C0301	7/14/2005	365	2
	C0301	7/14/2005	365	C0301	7/16/2005	360	2
MJM021299	C0301	6/24/2004	191	C0301	7/13/2004	205	19
	C0301	7/14/2004	205	C0301	7/20/2004	207	6
	C0301	7/20/2004	207	C0301	8/23/2004	215	34
MJM021307	U0301	6/19/2004	387	U0102	7/23/2005	380	399
	U0102	7/23/2005	380	B0401	7/26/2006	383	368
MJM021325	U0301	6/19/2004	210	C0301	8/2/2004	237	44
	C0301	8/2/2004	237	C0301	8/18/2004	244	16
MJM021369	U0301	6/20/2004	384	U0502	6/20/2006	379	730
	U0502	6/20/2006	379	U0502	7/22/2006	374	32
MJM021374	C0301	6/20/2004	267	C0301	7/15/2004	282	25
	C0301	7/15/2004	282	C0301	7/20/2004	281	5
	C0301	7/20/2004	281	C0301	6/20/2006	314	700

Table 4. Multiple recaptures of Arctic grayling in eastern NPRA streams, 2001-2006.

Tag Number	Release Station	Release Date	Release Length	Recapture Station	Recapture Date	Recapture Length	Days Out
MJM021480	C0301	7/12/2003	198	C0301	6/19/2004	235	343
	C0301	6/19/2004	235	C0301	8/4/2004	274	46
	C0301	8/4/2004	274	C0301	8/18/2004	276	14
	C0301	8/18/2004	276	C0301	8/21/2004	278	3
MJM021489	C0301	7/12/2003	235	C0301	7/29/2004	281	383
	C0301	7/29/2004	281	C0301	8/2/2004	283	4
MJM021993	U0102	7/31/2004	339	U0102	8/2/2004	340	2
	U0102	8/2/2004	340	C0301	7/12/2005	352	344
	C0301	7/12/2005	352	C0301	7/15/2005	365	3
MJM022572	B0401	7/15/2005	187	B0401	7/23/2005	190	8
	B0401	7/23/2005	190	B0502	7/27/2005	191	4
MJM022610	B0401	7/16/2005	246	B0401	8/18/2005	260	33
	B0401	8/18/2005	260	B0401	8/21/2005	260	3
MJM022797	B0401	8/20/2005	327	B0401	6/18/2006	327	302
	B0401	6/18/2006	327	B0401	7/24/2006	347	36

Table 5. Estimates of Arctic grayling using eastern NPR-A study area streams from 2004 to 2006.

				Schnabel Model		Schumacher-Eschmeyer Model	
System	Fish Caught	Tags Released	Tags Recovered	**Population Estimate**	95% Confidence Interval	**Population Estimate**	95% Confidence Interval
Ublutuoch Study Area							
2004	617	557	43	**4,212**	3,145-5,769	**4,122**	2,860-7,376
2005	741	704	63	**4,408**	3,457-5,710	**4,086**	3,216-5,601
2006	369	366	21	**3,267**	2,171-5,133	**3,359**	2,096-8,456
Crea Ck							
2004	253	216	29	**1,008**	709-1,480	**960**	704-1,506
2005	243	226	28	**1,010**	706-1,494	**1,159**	866-1,753
2006	111	108	3	**1,680**	688-4,151	**2,574**	849-NA
Bill's Ck							
2004	221	199	9	**2,401**	1,327-4,693	**2,741**	1,613-9,105
2005	234	223	29	**936**	658-1,375	**920**	695-1,362
2006	153	153	15	**797**	496-1,358	**1,005**	571-4,163

Table 6. Estimates of broad whitefish using northeast NPR-A study area streams, 2004 to 2006. (based on ratio of broad whitefish to grayling catch rates)

System	Year	**Population Estimate**	95% Confidence Interval
Ublutuoch Stuy Area			
	2004	**427**	319-585
	2005	**163**	127-211
	2006	**506**	337-797
Crea Ck			
	2004	**7**	5-10
	2005	**4**	3-5
	2006	**15**	6-37
Bill's Ck			
	2004	**159**	88-312
	2005	**28**	20-41
	2006	**172**	107-293

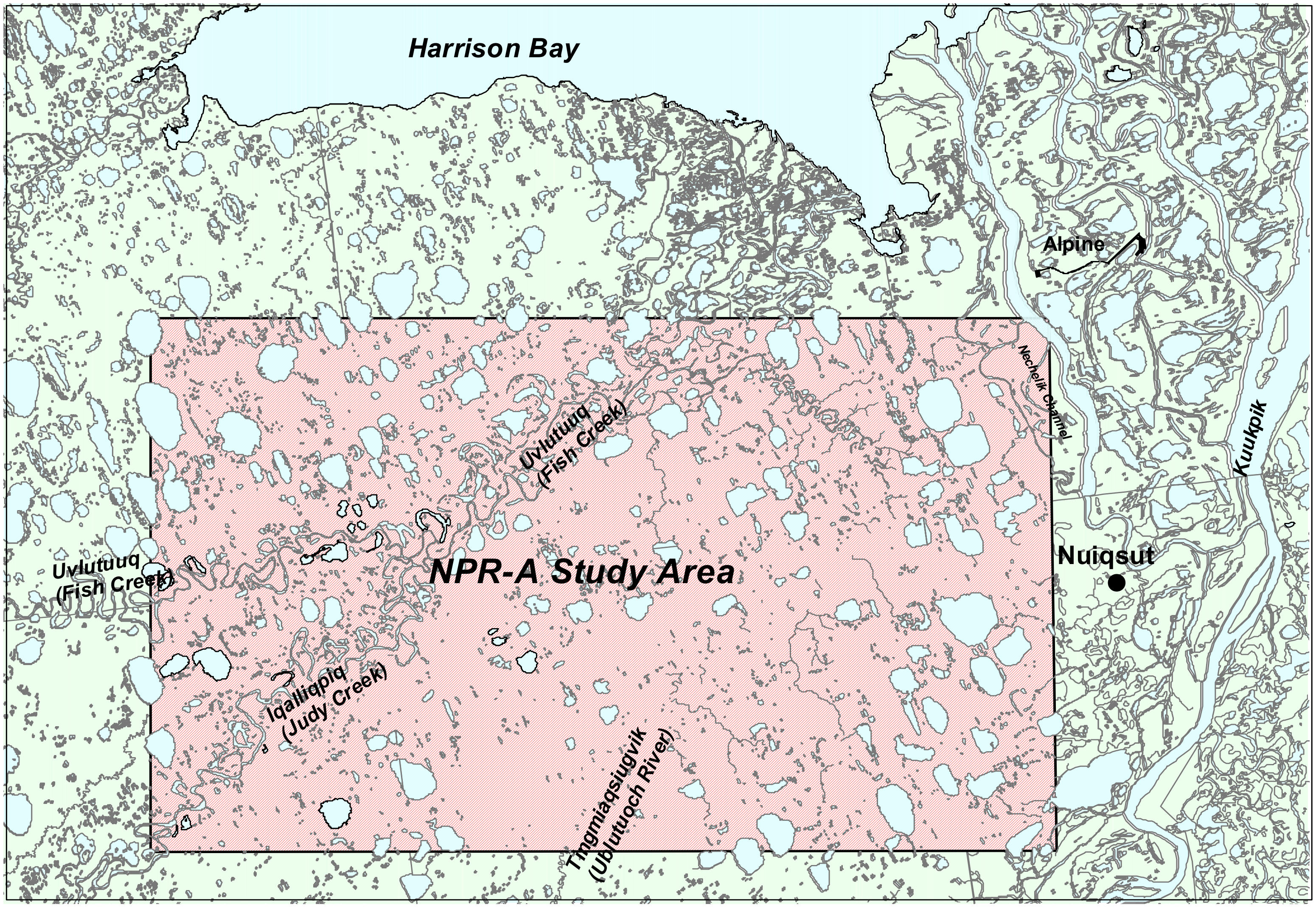

Figure 1. General location of the eastern NPR-A study area, Alaska, 2001-2006.

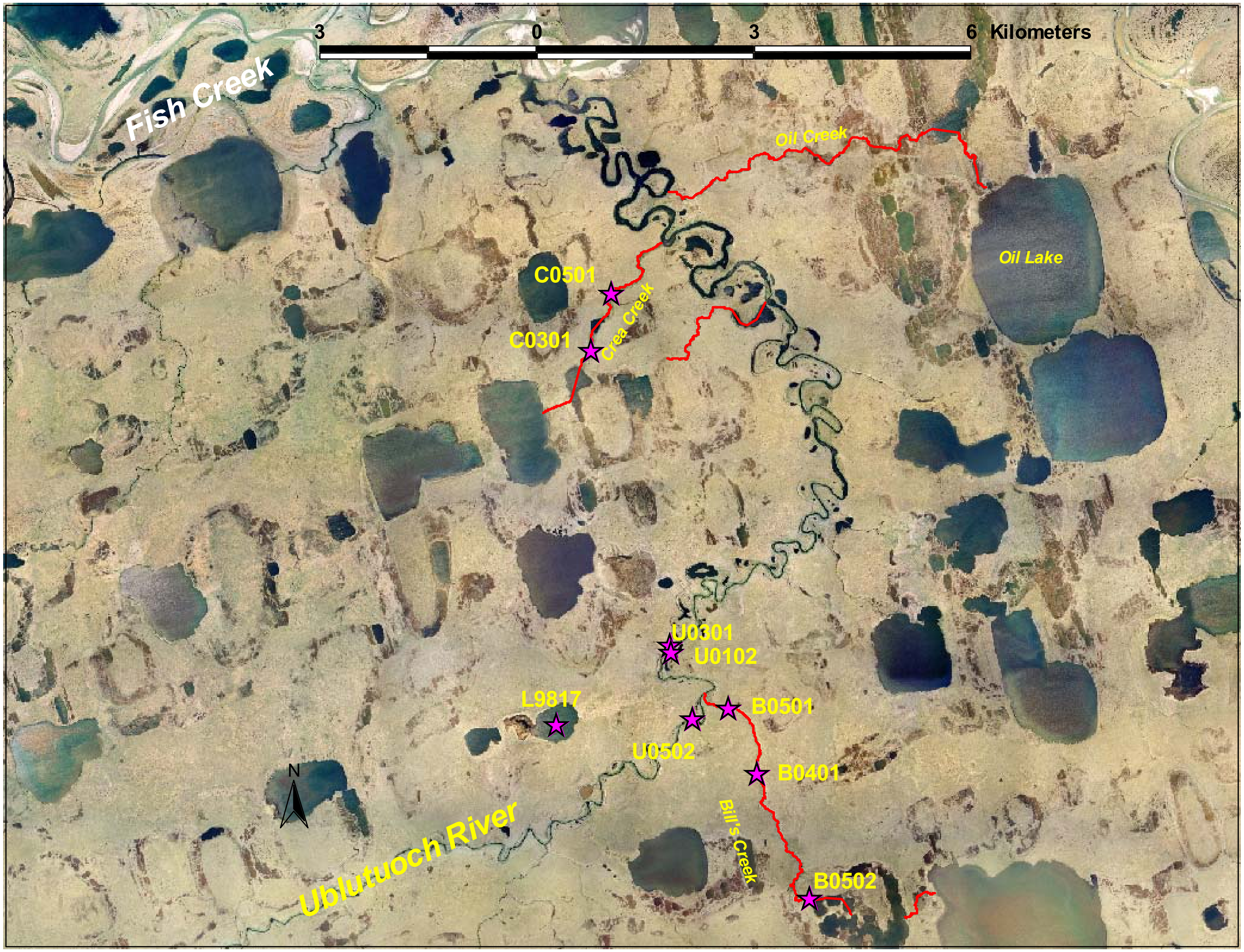

Figure 2. Fyke net locations in streams of eastern NPR-A study area, 2004-2006.

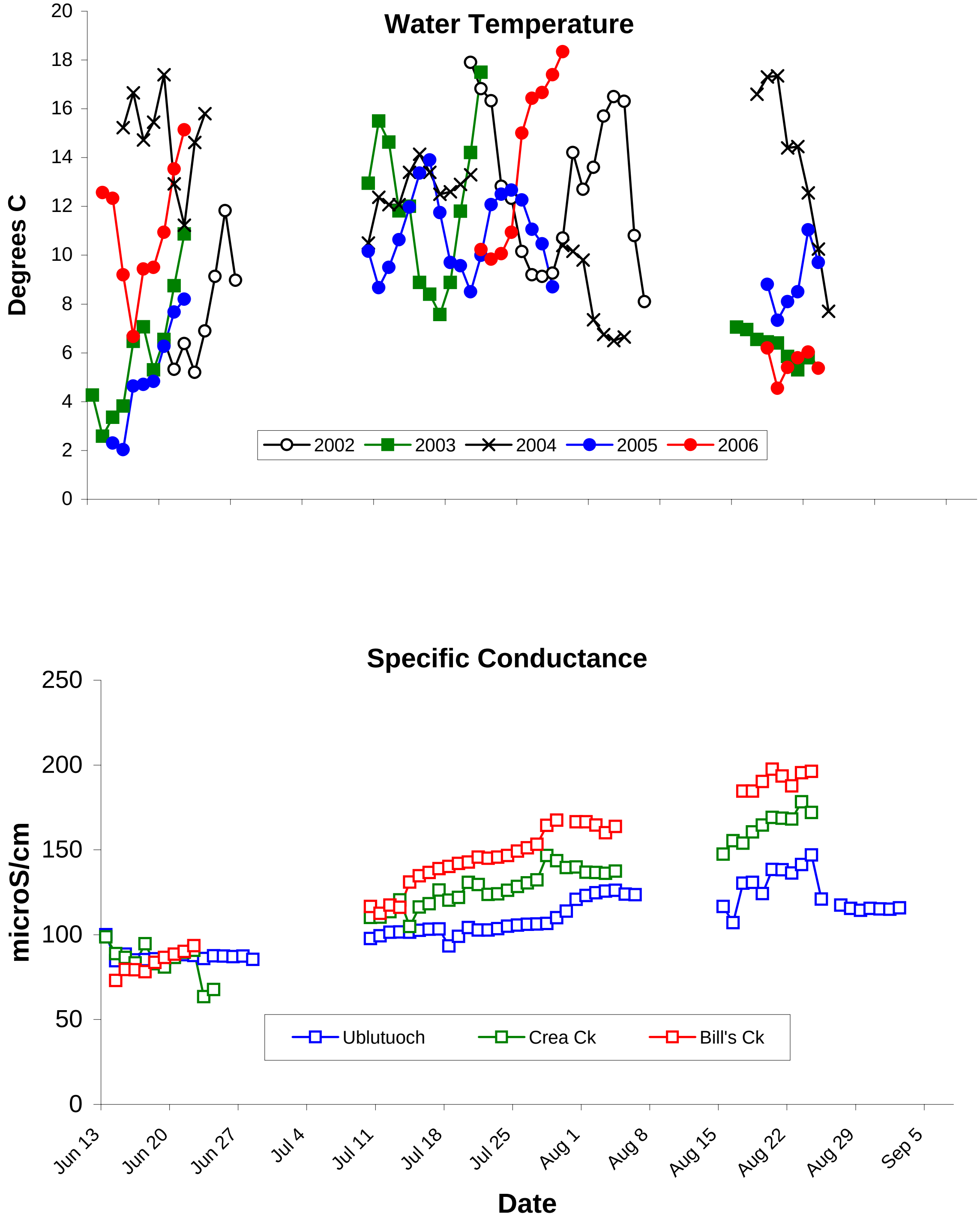

Figure 3. Mean water temperature and specific conductance at streams sampled in the eastern NPR-A study area, 2002-2006.

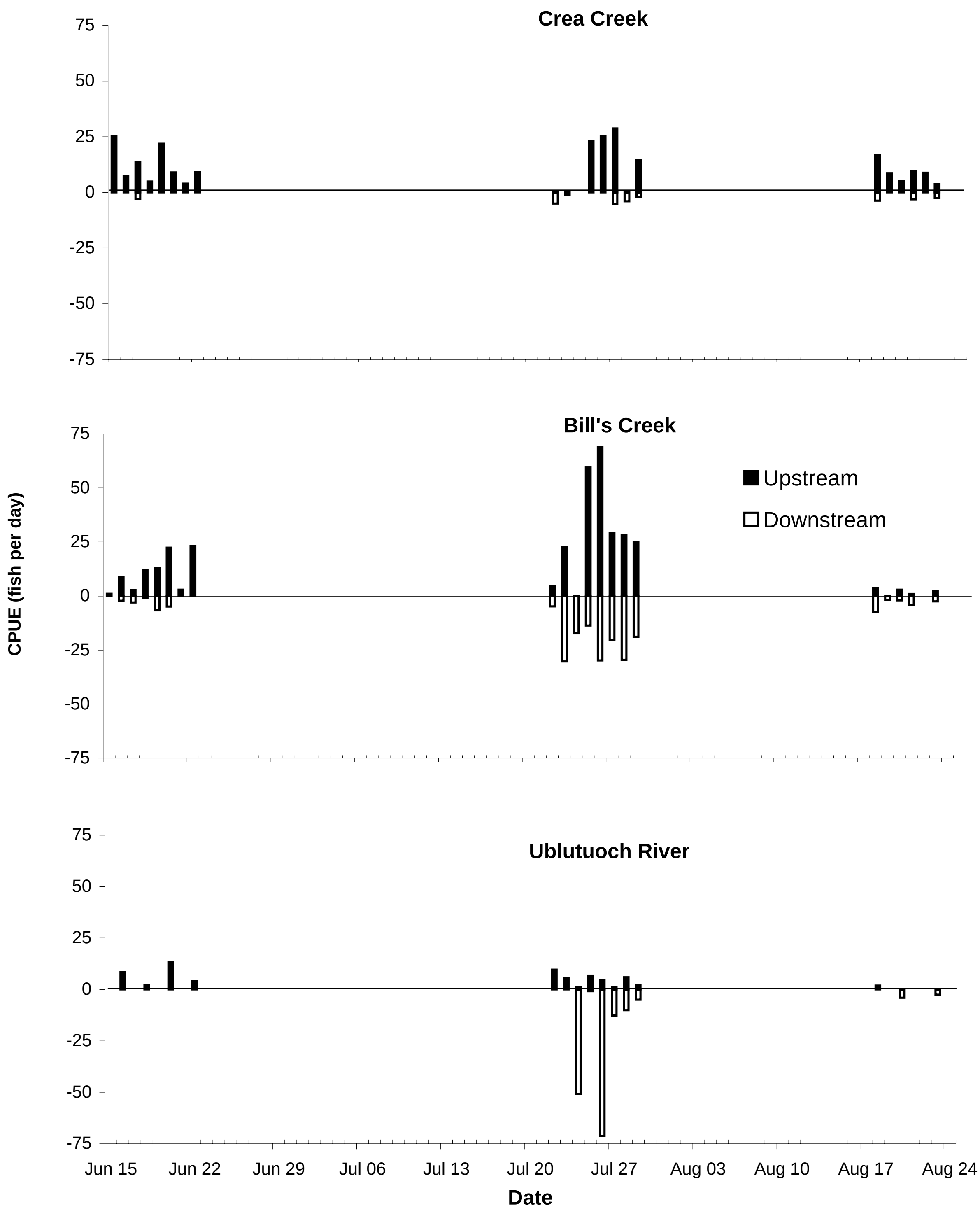

Figure 4. Comparison of Arctic grayling catch rates for fish moving in and out of streams of eastern NPR-A during 2006.
(Downstream = fish moving downstream, Upstream = fish moving upstream)

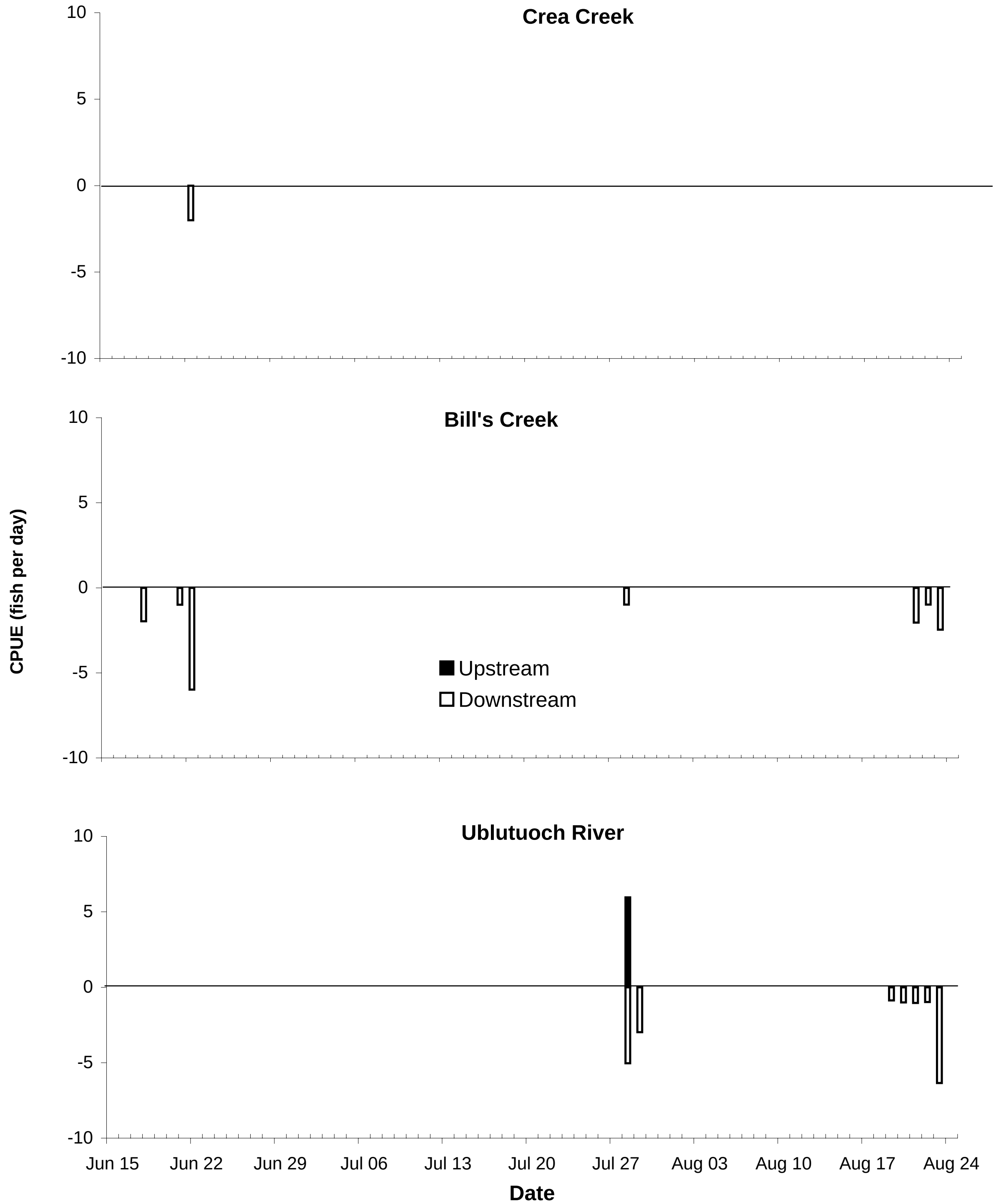

Figure 5. Comparison of broad whitefish catch rates for fish moving in and out of streams of eastern NPR-A during 2006.
(Downstream = fish moving downstream, Upstream = fish moving upstream)

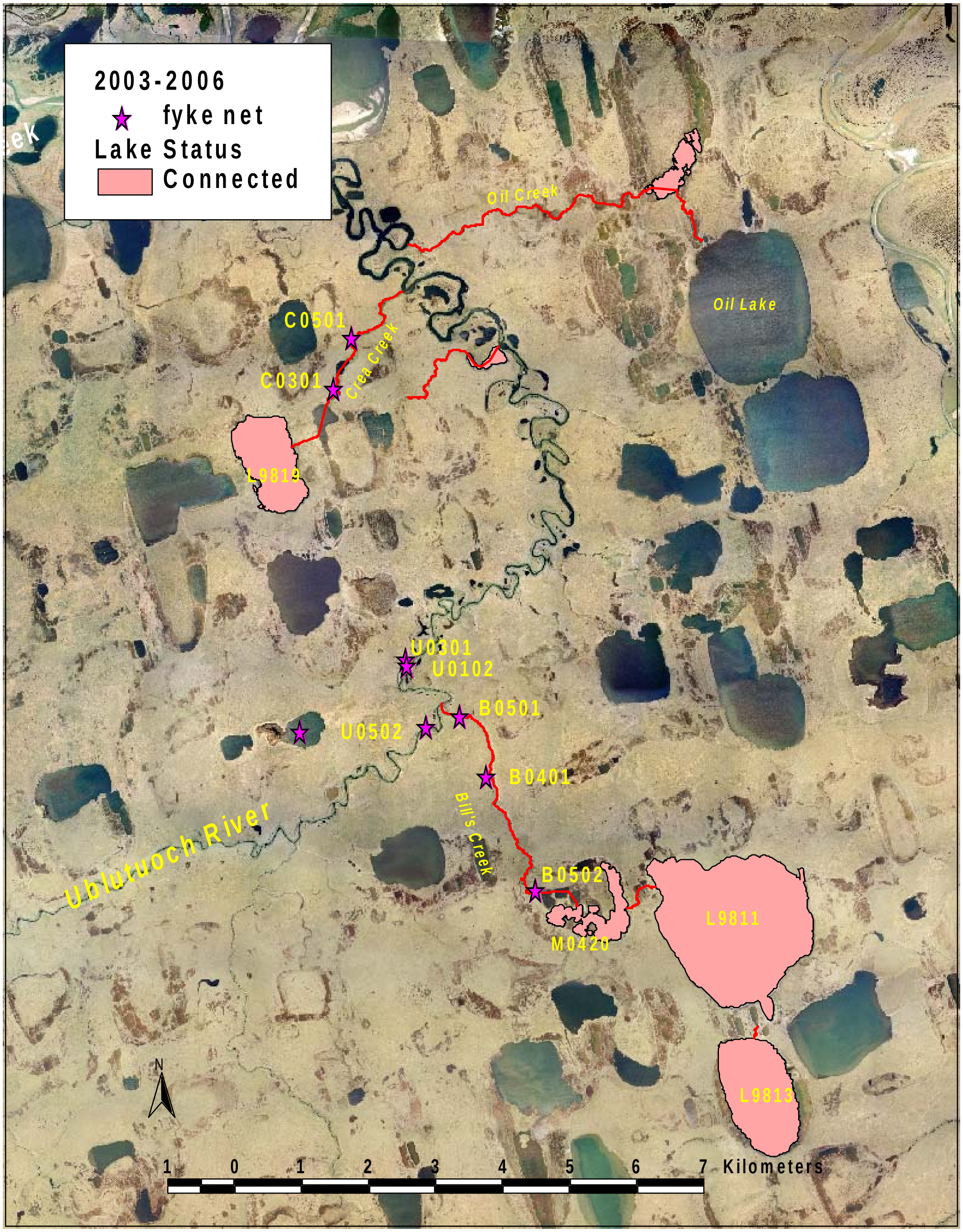

Figure 6. Small streams with connected lake systems investigated in 2003-2006 (red stars indicate fyke net stations).

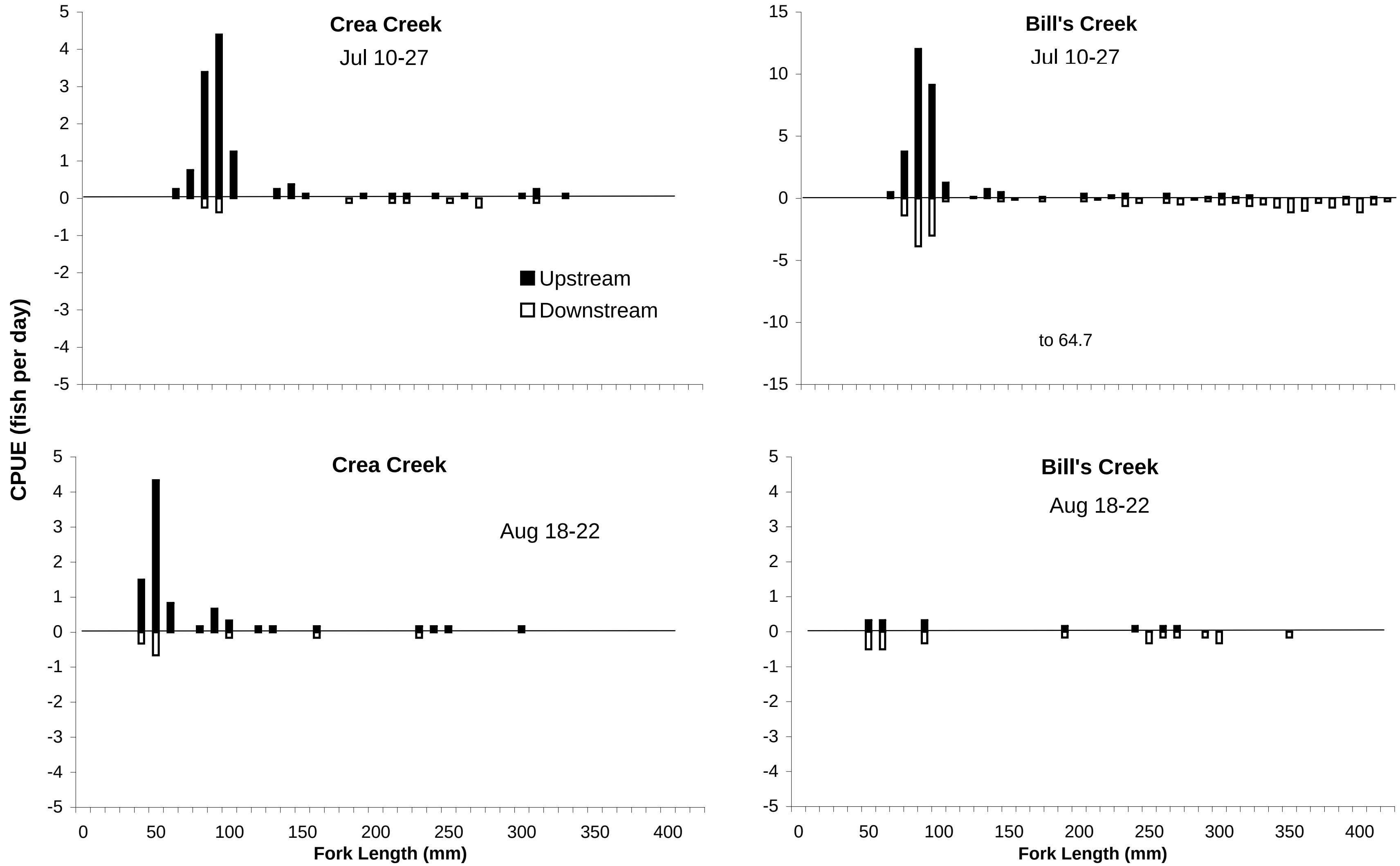

Figure 7. Length frequencies of Arctic grayling moving upstream and downstream in Crea Creek and Bill's Creek, 2006
(note change of scale between Bill's Ck July and August sampling periods)

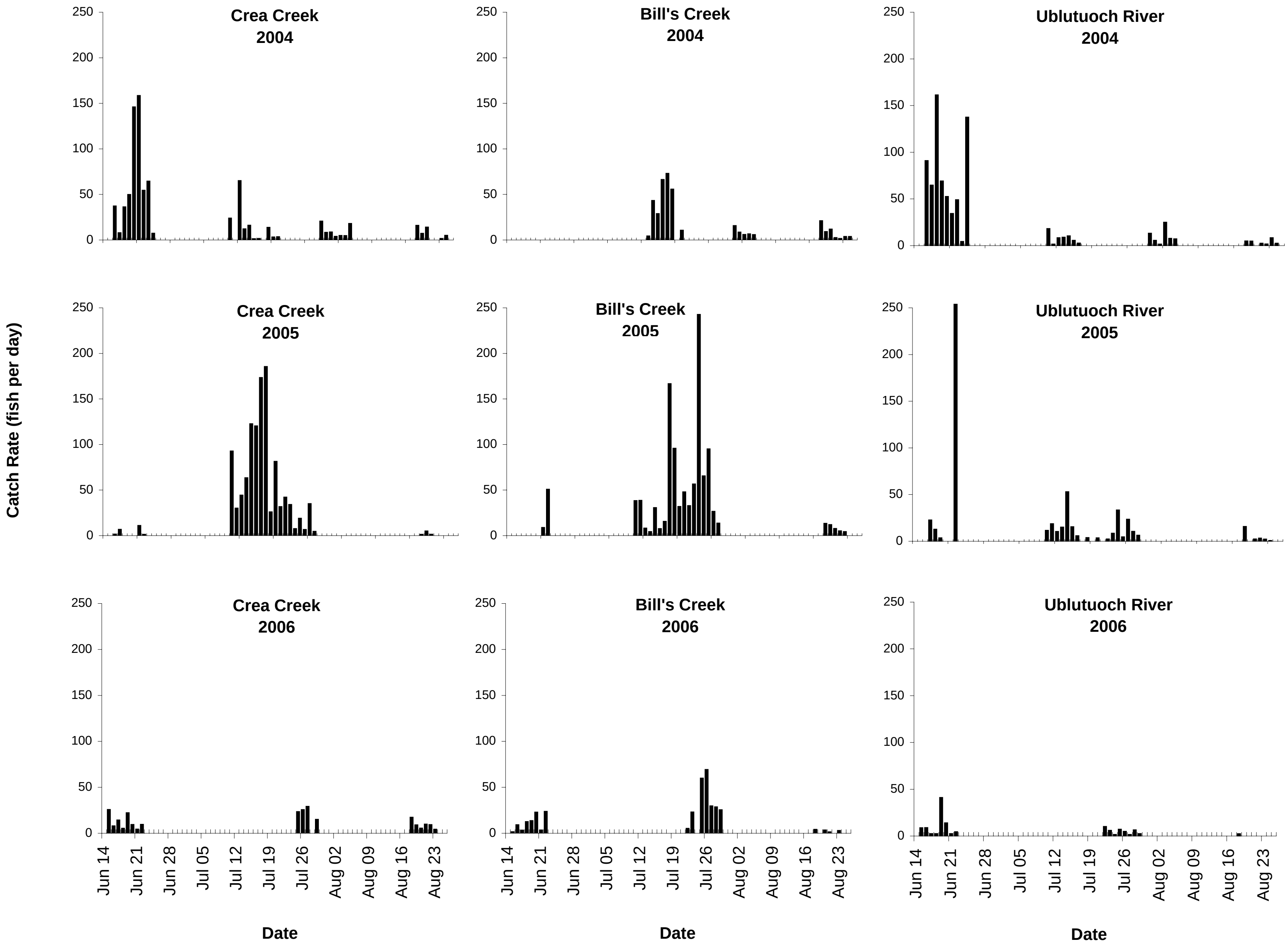

Figure 8. Comparison of Arctic grayling daily catch rates in 3 eastern NPR-A streams sampled in 2004-2006.

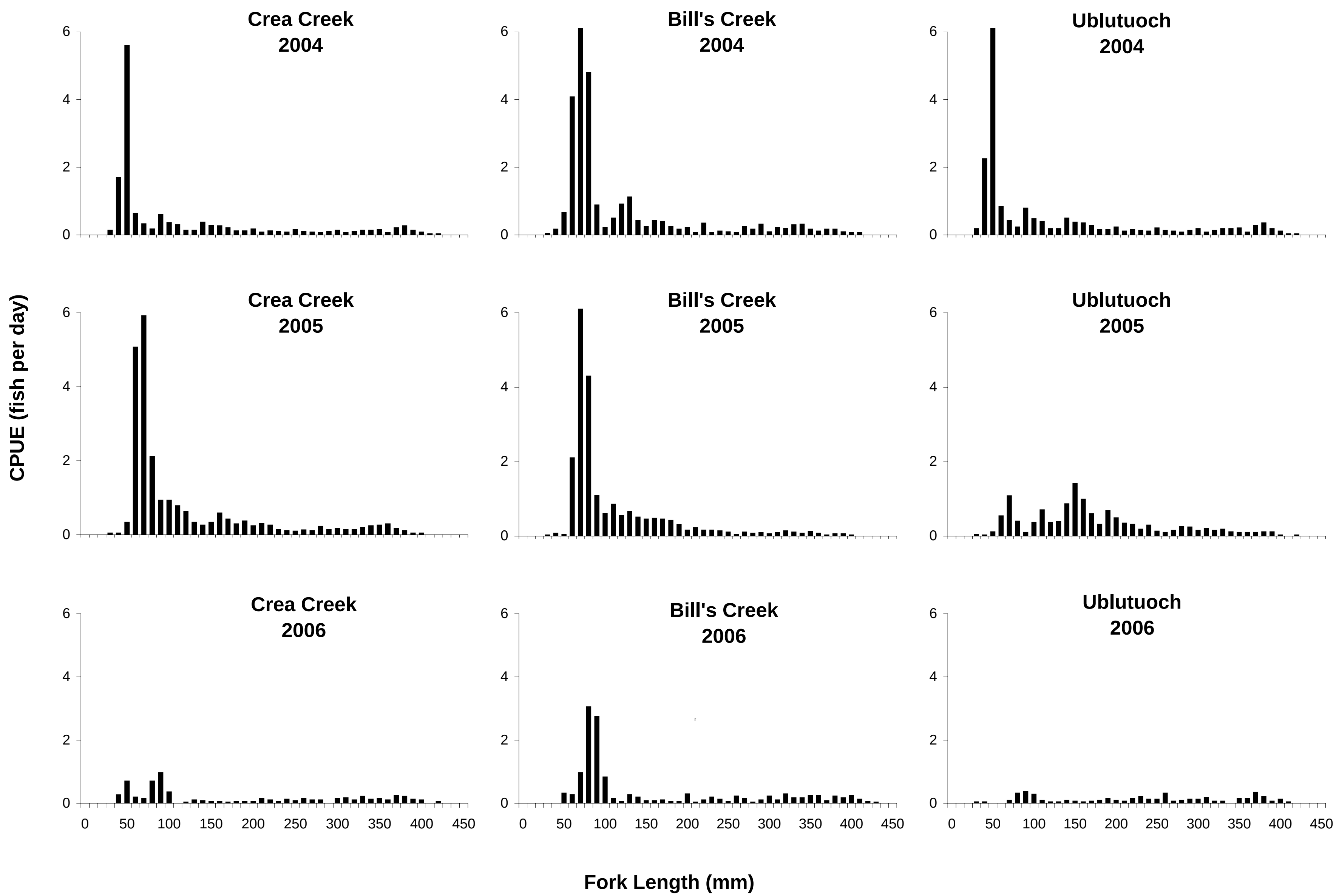

Figure 9. Comparison of Arctic grayling lengths at 3 streams in eastern NPR-A from 2004 to 2006.

APPENDIX A

Water chemistry from fyke net stations in eastern NPR-A during 2006

Appendix Table A-1. Water chemistry parameters measured at NPRA fyke net sampling sites, 2006.

Station	Date	Temp (^{o}C)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (%)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH
B0401	6/14/2006	13.4	9.72	93.1	73.0	0.8	7.20
B0401	6/15/2006	12.2	9.55	89.1	72.8	0.6	7.57
B0401	6/16/2006	8.2	9.98	84.7	72.4	0.5	7.58
B0401	6/17/2006	6.5	11.44	93.2	72.7	0.5	7.22
B0401	6/18/2006	10.1	10.86	96.8	82.6	0.4	7.73
B0401	6/19/2006	9.2	9.67	84.1	88.4	0.6	7.48
B0401	6/20/2006	11.7	10.28	95.1	92.0	0.5	7.32
B0401	6/21/2006	14.9	8.79	86.5	95.2	0.4	7.40
B0401	6/22/2006	16.0	8.33	84.5	102.9	0.4	7.42
B0401	7/21/2006	10.0	10.63	94.3	156.0	1.2	7.78
B0401	7/22/2006	9.8	11.08	98.1	154.7	0.9	7.57
B0401	7/23/2006	9.6	10.83	95.5	153.7	0.9	7.55
B0401	7/24/2006	11.0	10.53	95.7	154.5	0.8	7.59
B0401	7/25/2006	15.5	9.76	98.7	157.2	0.8	7.75
B0401	7/26/2006	17.1	9.25	96.3	159.5	0.8	7.75
B0401	7/27/2006	16.6	8.85	91.2	162.8	0.8	7.76
B0401	7/28/2006	17.6	8.76	92.6	164.4	0.9	7.71
B0401	7/29/2006	18.4	8.78	93.7	167.5	1.0	7.56
B0401	8/18/2006	6.3			197.7		
B0401	8/19/2006	4.5			212.3		
B0401	8/20/2006	5.3			232.6		
B0401	8/21/2006	6.0			217.4		
B0401	8/22/2006	6.1			196.7		
B0401	8/23/2006	5.2			194.6		
C0301	6/14/2006	11.8	9.68	89.7	76.3	0.9	7.18
C0301	6/15/2006	12.0	11.03	102.5	72.5	1.2	7.70
C0301	6/16/2006	9.1	9.93	86.0	73.1	0.7	7.32
C0301	6/17/2006	5.5	11.51	91.5	119.0	0.6	7.14
C0301	6/18/2006	8.6	11.25	96.6	77.3	0.5	7.98
C0301	6/19/2006	9.5	10.52	92.4	79.8	0.6	7.42
C0301	6/20/2006	10.1	10.43	92.7	85.8	0.5	7.47
C0301	6/21/2006	12.5	10.02	94.2	94.6	0.5	7.62
C0301	6/22/2006	14.6	9.50	92.5	100.6	0.6	7.52
C0301	7/21/2006	10.3	9.87		137.5	3.0	7.81
C0301	7/22/2006	9.4	10.28	93.3	136.9	2.7	7.53
C0301	7/23/2006	10.2	10.34	91.7	136.2	1.4	7.56
C0301	7/24/2006	10.6	9.76	84.7	138.2	1.2	7.56
C0301	7/25/2006	14.4	9.30	92.0	139.8	1.3	7.63
C0301	7/26/2006	16.4	9.26	95.6	142.3	1.5	7.68
C0301	7/27/2006	16.8	8.49	88.0	144.3	1.4	7.66
C0301	7/28/2006	17.6	8.38	88.2	146.6	1.7	7.59
C0301	7/29/2006	18.3	7.74	82.3	149.2	1.8	7.48

Appendix Table A-1. Water chemistry parameters measured at NPRA fyke net sampling sites, 2006.

Station	Date	Temp (^oC)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (%)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH
C0301	8/18/2006	6.0			176.6		
C0301	8/19/2006	4.6			195.0		
C0301	8/20/2006	5.1			210.5		
C0301	8/21/2006	5.3			206.0		
C0301	8/22/2006	5.5			201.4		
C0301	8/23/2006	5.2			189.9		
U0502	6/14/2006	12.5	9.60	90.1	69.8	1.7	7.22
U0502	6/15/2006	12.8	9.15	86.6	75.2	1.5	7.55
U0502	6/16/2006	10.3	9.43	84.2	73.4	1.6	7.64
U0502	6/17/2006	8.0	10.61	89.8	73.7	1.3	7.20
U0502	6/18/2006	9.6	11.21	98.7	75.2	1.2	7.84
U0502	6/19/2006	9.8	10.18	89.9	78.3	1.3	7.52
U0502	6/20/2006	11.0	10.41	94.5	79.9	1.1	7.45
U0502	6/21/2006	13.2	10.05	95.9	81.8	1.1	7.50
U0502	6/22/2006	14.8	9.66	95.5	83.2	1.1	7.47
U0502	7/21/2006	10.4	10.44	93.9	105.7	1.0	7.87
U0502	7/22/2006	10.3	10.81	96.9	111.1	1.1	7.60
U0502	7/23/2006	10.4	10.97	98.4	111.4	0.9	7.62
U0502	7/24/2006	11.2	10.24	96.0	113.4	0.9	7.60
U0502	7/25/2006	15.1	9.20	95.3	113.2	1.0	7.74
U0502	7/26/2006	15.8	9.69	98.5	112.5	1.0	7.78
U0502	7/27/2006	16.6	8.96	92.2	111.2	1.1	7.79
U0502	7/28/2006	17.0	9.18	94.8	109.7	1.0	7.73
U0502	7/29/2006	18.3	8.90	95.2	108.6	1.0	7.62
U0502	8/18/2006	6.3			145.8		
U0502	8/19/2006						
U0502	8/20/2006	5.8			179.1		
U0502	8/21/2006	6.1			177.0		
U0502	8/22/2006	6.5			167.6		
U0502	8/23/2006	5.7			163.1		

APPENDIX B

Fish caught by fyke net in eastern NPR-A during 2006

Appendix Table B-1. Daily catches of fish and effort at fyke net stations in eastern NPRA streams during 2006.

Bill's Creek

	Jun 15		Jun 16		Jun 17		Jun 18		Jun 19		Jun 20		Jun 21		Jun 22		Jul 22		Jul 23		Jul 24	
Species	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
Broad whitefish							2						1		6							
Arctic grayling		1	2	8	3	3	1	12	6	12	5	23		3		23	5	5	27	21	17	
Humpback whitefish		1	2		7		2						1		2		1	1				
Least cisco			1													1						
Ninespine stickleback		12		17		1	2	1		6		6		21		5					3	
Round whitefish																	2	6				
Slimy sculpin														1								
Effort (hrs)		22.5	22.2	22.2	24.6	24.7	24.4	23.9	21.7	21.9	24.6	24.6	24.1	24.3	24.1	23.8	25.1	25.0	21.4	22.3	23.6	23.3

Bill's Creek (continued)

	Jul 25		Jul 26		Jul 27		Jul 28		Jul 29		Aug 18		Aug 19		Aug 20		Aug 21		Aug 22		Aug 23	
Species	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
Broad whitefish							1										2		1		2	
Arctic grayling	16	70	28	65	19	27	30	28	19	25	8	4	2		2	3	4	1			2	2
Humpback whitefish	4		1						1													
Least cisco			1																			
Ninespine stickleback				1	3	3	13	10	12	7			2					1	5			1
Round whitefish		1																				
Slimy sculpin																						
Effort (hrs)	28.3	28.2	22.6	22.7	22.3	22.2	24.4	23.8	24.3	24.0	25.8	26.0	27.4	27.3	24.0	24.2	23.5	23.7	24.3	24.1	19.5	19.3

Crea Creek

	Jun 15		Jun 16		Jun 17		Jun 18		Jun 19		Jun 20		Jun 21		Jun 22		Jul 22		Jul 23		Jul 24	
Species	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
Broad whitefish															1							
Alaska blackfish				1																		
Arctic grayling		25		7	3	14		5		20		9		4		9	5		1			
Humpback whitefish																	1					
Ninespine stickleback	1							1				1		1			1		4			
Round whitefish																	3		2			
Effort (hrs)	24.0	23.7	22.7	22.7	24.8	24.3	24.6	24.7	22.4	22.0	24.4	24.0	24.5	24.3	24.0	23.6	24.2	24.8	22.3	22.3	23.9	24.0

Appendix Table B-1. Daily catches of fish and effort at fyke net stations in eastern NPRA streams during 2006.

Crea Creek (continued)

	Jul 25		Jul 26		Jul 27		Jul 28		Jul 29		Aug 18		Aug 19		Aug 20		Aug 21		Aug 22		Aug 23	
Species	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
Broad whitefish																						
Alaska blackfish																						
Arctic grayling		27		23	5	27	4		2	14	4	18		10		5	3	9		9	2	3
Humpback whitefish																						
Ninespine stickleback	3	1		1	244		41	2	84	34	2	3	1	2	3		27	21	9	25	37	13
Round whitefish																						
Effort (hrs)	28.1	28.2	21.8	22.0	22.7	22.6	24.0	24.0	23.3	23.2	25.8	25.6	27.8	27.8	23.6	23.9	23.3	22.9	24.2	24.5	19.2	19.2

Ublutuoch

	Jun 15		Jun 16		Jun 17		Jun 18		Jun 19		Jun 20		Jun 21		Jun 22		Jul 22		Jul 23		Jul 24	
Species	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
Broad whitefish																						
Humpback whitefish										1												
Least cisco		1								1				3		1	1	5	5	4	6	
Round whitefish										2				1		1		5	3		1	
Arctic grayling		8		8		2		2		37		14		2		4		10		5	50	1
Ninespine stickleback				1		1								1		38						
Slimy sculpin				1		1																
Effort (hrs)	0.0	23.3	0.0	22.7	0.0	24.6	0.0	23.9	0.0	21.9	0.0	24.8	0.0	24.1	0.0	23.8	24.7	24.8	22.2	21.9	23.7	23.8

Ublutuoch (continued)

	Jul 25		Jul 26		Jul 27		Jul 28		Jul 29		Aug 18		Aug 19		Aug 20		Aug 21		Aug 22		Aug 23	
Species	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
Broad whitefish							5	6	3				1		1		1		1		5	
Humpback whitefish		2			3		1												1			
Least cisco	7	1	4		12		8		7												1	
Round whitefish	1										1		4		1							
Arctic grayling	1	8	65	4	12	1	10	6	5	2		2			4						2	
Ninespine stickleback																					52	
Slimy sculpin																						
Effort (hrs)	28.2	28.5	21.9	22.0	22.7	22.8	23.8	24.2	24.2	23.3	25.7	25.6	27.7	27.7	23.9	24.0	23.2	23.2	24.5	24.4	18.9	19.2

APPENDIX C

Length frequencies of fish caught by fyke net in eastern NPR-A during 2006

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2006.

Fork Length (mm)	Bill's Creek Jun15		Jun16		Jun17		Jun18		Jun19		Jun20		Jun21		Jun22	
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0																
10																
20																
30																
40																
50				1		1				1						5
60																2
70																
80																3
90				2	1			2		1		2		1		7
100				2	1	1				3		12		1		3
110		1	1							1		2		1		
120				1												
130								1	1			1				2
140										1		1				
150									1	1						
160										2	1					
170												1				
180				1				1								
190																
200				1				3				3				
210																
220								1		1						
230																
240												1				
250																
260									1							
270																
280																
290																
300																
310																
320								2	2		1					
330					1		1									1
340										1						
350																
360						1					1					
370																
380								2			1					
390			1						1							
400											1					
410																
420																
430																
440																
450																
460																
470																
480																
490																
500																
Total:	0	1	2	8	3	3	1	12	6	12	5	23	0	3	0	23

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2006.

Fork Length (mm)	Crea Creek															
	Jun15		Jun16		Jun17		Jun18		Jun19		Jun20		Jun21		Jun22	
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0																
10																
20																
30																
40																
50																
60																1
70																
80																
90																
100												1				1
110																
120																
130						1										
140																
150				1												
160																
170		1														
180																1
190				1												
200								1		1						
210		2		1								1				
220								1								1
230																
240				1				2								
250												1				
260				1						1		1		1		1
270										1		1				
280		1				1						1				1
290																
300		1				1						1		1		
310		1								2		1				
320				1		1				1				1		
330		2				2		1		1						2
340		3								2						
350		3			1	1								1		
360		1		1		2										
370		3				2				4		1				
380		3								6						
390		2			1	2										
400		1			1	1				1						
410																
420		1														1
430																
440																
450																
460																
470																
480																
490																
500																
Total:	0	25	0	7	3	14	0	5	0	20	0	9	0	4	0	9

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2006.

Fork Length (mm)	**Ublutuoch River** Jun15		Jun16		Jun17		Jun18		Jun19		Jun20		Jun21		Jun22	
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0																
10																
20																
30																
40																
50																
60																
70																
80																
90				2				1		2						
100		2		3		1				3						1
110		1		1		1										
120								1								
130										1						
140										3						
150										2						
160										1						
170										2						
180				1								1				1
190												1				2
200				1						1						
210										2						
220										1						
230										2		1				
240		1								1		1				
250												1				
260										2						
270										1		1				
280										2						
290		1								1				1		
300		1								1		1				
310												2				
320		1														
330										1						
340																
350										1		1		1		
360										2						
370												3				
380										3						
390																
400										1		1				
410		1														
420																
430																
440																
450																
460																
470																
480																
490																
500																
Total:	0	8	0	8	0	2	0	2	0	36	0	14	0	2	0	4

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2006.

Fork Length (mm)	**Bill's Creek** Jul 22		Jul 23		Jul 24		Jul 25		Jul 26		Jul 27		Jul 28		Jul 29	
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0																
10																
20																
30																
40																
50																
60								1		2		1				
70				1				7	2	10	3	4	5	2	1	6
80			2	5	3		1	31	5	26	8	16	7	12	5	6
90			1	10	3		2	20	4	17	3	8	6	10	5	8
100			1	1	1			3				1		3		2
110																
120								1								
130		1		1				1		3						
140					1			1		1			1			2
150															1	
160																
170										1					2	
180																
190																
200		1		1	1									1	1	
210							1									
220								1		1						
230										2	3	1	1		1	
240			1						1				1			
250																
260		1	1					1		1	1		1			
270									1				1		2	
280									1							
290					1			1	1							
300		1		1					1				3			1
310			1				2					1				
320	1		1	1	1		1	1	1							
330			2		1				1							
340					2				2		1		1			
350			2		2		4		1							
360			3						3				2			
370			2				1									
380	1		2				1		2							
390	1				1		1	1					1			
400	1		6				1		1							
410	1	1	2												1	
420							1		1							
430																
440																
450																
460																
470																
480																
490																
500																
Total:	5	5	27	21	17	0	16	70	28	64	19	32	30	28	19	25

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2006.

Fork Length (mm)	**Crea Creek** Jul 22		Jul 23		Jul 24		Jul 25		Jul 26		Jul 27		Jul 28		Jul 29	
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0																
10																
20																
30																
40																
50																
60												1				1
70								2		1		2				1
80								6		9	2	9				3
90								11		9	2	9	1			6
100								4		2		2				2
110																
120																
130								1		1						
140								2				1				
150												1				
160																
170																
180											1					
190												1				
200																
210										1			1			
220												1	1			
230																
240								1								
250															1	
260																1
270													1		1	
280																
290																
300		1														
310		2	1													
320																
330		1														
340																
350																
360																
370																
380																
390																
400																
410																
420																
430																
440																
450																
460																
470																
480																
490																
500																
Total:	0	4	1	0	0	0	0	27	0	23	5	27	4	0	2	14

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2006.

Fork Length (mm)	Ublutuoch River															
	Jul 22		Jul 23		Jul 24		Jul 25		Jul 26		Jul 27		Jul 28		Jul 29	
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0																
10																
20																
30																
40																
50																
60																
70		1									1		1			
80		4							1		2		2	1	1	
90								1	2	1	1			2		
100																
110																
120																
130																
140																
150																
160																
170																
180																
190														1	1	
200													1			
210																
220								2		2						
230									1		1		1		1	
240																1
250				1							1		1			
260								1			2	1		2	1	1
270																
280																
290											1					
300											1					
310								1					2			
320																
330						1										
340																
350		1									1					
360		1		1				1								
370		1		2			1	1			1		1		1	
380		2						1		1						
390													1			
400				1					1							
410																
420																
430																
440																
450																
460																
470																
480																
490																
500																
Total:	0	10	0	5	0	1	1	8	5	4	12	1	10	6	5	2

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2006.

Fork Length (mm)	**Bill's Creek** Aug 18		Aug 19		Aug 20		Aug 21		Aug 22		Aug 23	
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0												
10												
20												
30												
40												
50	2	2			1							
60	2					1		1			1	
70												
80												
90	2	1				1						
100												
110												
120												
130												
140												
150												
160												
170												
180												
190						1	1					
200												
210												
220												
230												
240		1										
250			1		1							
260			1									1
270	1											1
280												
290							1					
300							1				1	
310												
320												
330												
340												
350	1											
360												
370												
380												
390												
400												
410												
420												
430							1					
440												
450												
460												
470												
480												
490												
500												
Total:	8	4	2	0	2	3	4	1	0	0	2	2

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2006.

Fork Length (mm)	**Crea Creek** Aug 18		Aug 19		Aug 20		Aug 21		Aug 22		Aug 23	
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0												
10												
20												
30												
40	2	5		1		1		1				1
50	2	7		4		2		5		7	2	1
60		1		1				1		1		1
70												
80				1								
90		2						1		1		
100				1		1	1					
110												
120		1										
130		1										
140												
150												
160		1					1					
170												
180												
190												
200												
210												
220												
230				1			1					
240				1								
250								1				
260												
270												
280												
290												
300						1						
310												
320												
330												
340												
350												
360												
370												
380												
390												
400												
410												
420												
430												
440												
450												
460												
470												
480												
490												
500												
Total:	4	18	0	10	0	5	3	9	0	9	2	3

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2006.

Fork Length (mm)	Ublutuoch River Aug 18		Aug 19		Aug 20		Aug 21		Aug 22		Aug 23	
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0												
10												
20												
30											1	
40											1	
50												
60												
70												
80												
90					1							
100												
110												
120												
130												
140												
150												
160												
170												
180												
190												
200												
210												
220												
230												
240												
250												
260					1							
270												
280									1			
290												
300												
310					1							
320		1										
330												
340												
350												
360												
370		1										
380												
390					1							
400												
410												
420												
430												
440												
450												
460												
470												
480												
490												
500												
Total:	0	2	0	0	4	0	0	0	1	0	2	0

Appendix Table C-2. Length frequencies of broad whitefish caught by fyke net in eastern NPR-A, 2006.

Fork Length (mm)	**Bill's Creek**							**Crea Creek**
	Jun18	Jun21	Jun22	Jul 28	Aug 21	Aug 22	Aug 23	Jun22
	DS	DS	DS	DS	DS	DS	DS	DS
0								
10								
20								
30								
40								
50								
60								
70								
80								
90								
100								
110								
120								
130								
140								
150								
160								
170								
180								
190								
200								
210								
220								
230								
240								
250								
260								
270								
280								
290								
300				1				
310								
320						1		
330								
340								
350								
360					1			
370								
380								
390			2					1
400								
410								
420								
430			2					
440								
450								
460		1						
470							2	
480			1					
490								
500								
510								
520								
530								
540			1					
550								
560								
570					1			
580	2							
590								
Total:	2	1	6	1	2	1	2	1

Appendix Table C-2. Length frequencies of broad whitefish caught by fyke net in eastern NPR-A, 2006.

Fork Length (mm)	**Ublutuoch Creek** Jul 28 DS	Jul 28 US	Jul 29 DS	Aug 19 DS	Aug 20 DS	Aug 21 DS	Aug 22 DS	Aug 23 DS
0								
10								
20								
30								
40								
50								
60								
70								
80								
90								
100								
110								
120								
130								
140								
150								
160								
170								
180								
190								
200								
210								
220								
230								
240								
250								
260								
270		1						
280								
290								
300								
310		1	1					
320		1						
330	1	1						
340								
350		1						1
360	2							
370				1				1
380								1
390	1	1						
400			1			1	1	
410			1					
420								
430								
440								
450								1
460								
470								
480					1			
490								
500	1							1
510								
520								
530								
540								
550								
560								
570								
580								
590								
Total:	5	6	3	1	1	1	1	5

Appendix Table C-3. Length frequencies of humpback caught by fyke net in eastern NPR-A, 2006.

Fork	**Bill's Creek**											**Crea Creek**
Length	Jun15	Jun16	Jun17	Jun18	Jun21	Jun22	Jul 22	Jul 22	Jul 25	Jul 26	Jul 29	Jun22
(mm)	US	DS	DS	DS	DS	DS	DS	US	DS	DS	DS	US
0												
10												
20												
30												
40												
50												
60												
70												
80												
90												
100								1				
110												
120												
130												
140												1
150												
160												
170												
180												
190												
200												
210									1			
220												
230												
240												
250												
260												
270												
280												
290												
300									1			
310												1
320												
330												
340									1			
350												
360	1				1							
370			1	1								
380			3			1						
390			1						1			
400		2										
410			2			1					1	
420				1								
430										1		
440							1					
450												
460												
470												
480												
490												
500												
Total:	1	2	7	2	1	2	1	1	4	1	1	2

Appendix Table C-3. Length frequencies of humpback caught by fyke net in eastern NPR-A, 2006.

Fork	**Ublutuoch River**														
Length	Jun15	Jun19	Jun21	Jun22	Jul 22	Jul 23	Jul 23	Jul 24	Jul 25	Jul 25	Jul 26	Jul 27	Jul 28	Jul 29	Aug 23
(mm)	US	US	US	US	US	DS	US	DS	DS	US	DS	DS	DS	DS	DS
0															
10															
20															
30															
40															
50															
60															
70															
80															
90															
100															
110															
120															
130					1										
140															
150					1		1								
160															
170															
180															
190															
200															
210															
220															
230															
240															
250															
260															
270															
280															
290															
300															
310													1		
320															
330															
340		1													
350				1			1				1	1			
360						1	1		1			1			
370										1					
380								2							
390			1		1	1		1	2			2			
400							1				2	3	1		
410	1				1			3	1			1	2		1
420			1						1			1		2	
430			1			1			1			1	2	2	
440					1						1	1	1		
450						1							1		
460						1			1					2	
470															
480															
490												1			
500															
Total:	1	1	3	1	5	5	4	6	7	1	4	12	8	6	1

Appendix Table C-4. Length frequencies of least cisco caught by fyke net in eastern NPR-A, 2006.

Fork Length (mm)	**Bill's Creek**		**Ublutuoch River**											
	Jun16		Jun22		Jul 26		Jun19		Jul 26		Jul 27		Jul 28	
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0														
10														
20														
30														
40														
50														
60														
70														
80														
90														
100														
110														
120														
130											1			
140											1			
150											1			
160														
170														
180														
190														
200														
210													1	
220														
230					1									
240														
250									2					
260														
270														
280				1										
290														
300														
310														
320	1													
330														
340														
350								1						
Total:	1	0	0	1	1	0	0	1	2	0	3	0	1	0

Appendix Table C-5. Length frequencies of round whitefish caught by fyke net in eastern NPR-A, 2006.

Fork Length (mm)	Bill's Creek				Crea Creek				Ublutuoch River							
	Jul 22		Jul 25		Jul 22		Jul 23		Jun19		Jun21		Jun22		Jul 22	
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0																
10																
20																
30																
40																
50																
60																
70	1	3														
80	1	2														
90		1				2										2
100																
110																
120																
130																
140				1			2									1
150																
160																
170										1						1
180																
190																
200																
210																
220																
230																1
240																
250																
260																
270																
280						1										
290																
300																
310																
320																
330																
340																
350																
360																
370														1		
380																
390										1		1				
400																
410																
420																
430																
440																
450																
Total:	2	6	0	1	0	3	2	0	0	2	0	1	0	1	0	5

Appendix Table C-5. Length frequencies of round whitefish caught by fyke net in eastern NPR-A, 2006.

Fork Length (mm)	Ublutuoch River Jul 24		Jul 25		Aug 18		Aug 19		Aug 20	
	DS	US	DS	US	DS	US	DS	US	DS	US
0										
10										
20										
30										
40										
50										
60										
70										
80										
90	1									
100										
110										
120										
130										
140							1			
150										
160					1		1			
170										
180										
190										
200										
210										
220										
230										
240										
250										
260										
270										
280										
290										
300										
310										
320										
330										
340										
350										
360									1	
370							2			
380										
390										
400										
410										
420			1							
430										
440										
450										
Total:	1	0	1	0	1	0	4	0	1	0

Appendix C-6. Length frequencies of slimy sculpin and Alaska blackfish caught by fyke net in eastern NPR-A, 2006.

Slimy Sculpin

Fork Length (mm)	Bill's Creek Jun21		Ublutuoch River Jun16		Ublutuoch River Jun17	
	DS	US	DS	US	DS	US
0						
10						
20						
30						
40						
50						
60						
70						
80		1				
90				1		1
100						
110						
120						
130						
140						
150						
160						
170						
180						
190						
200						
Total:	0	1	0	1	0	1

Alaska Blackfish

Fork Length (mm)	Crea Creek Jun16	
	DS	US
0		
10		
20		
30		
40		
50		
60		
70		1
80		
90		
100		
110		
120		
130		
140		
150		
160		
170		
180		
190		
200		
Total:	0	1

APPENDIX D

Population estimates for Arctic grayling based on tag recaptures, 2006

Appendix Table D-1. Population estimates of Arctic grayling (180 mm or longer) using the Schnabel and Schumacher-Eshmeyer estimators.

Ublutuoch drainage - 2006

	C_i		M_i	R_i					
	Number	Tags	Cum	Tags	Schnabel	Schumacher-Eschmeyer			
Date	Caught	Released	Released	Recapped	Est.	C_iM_i	M_iR_i	CM^2	R^2/C
6/15/2006	29	29	29		38	841	0	24,389	0.000
6/16/2006	11	11	40	1	20	440	40	17,600	0.091
6/17/2006	18	18	58		47	1,044	0	60,552	0.000
6/18/2006	15	15	73		50	1,095	0	79,935	0.000
6/19/2006	48	47	120	1	262	5,760	120	691,200	0.021
6/20/2006	30	30	150		205	4,500	0	675,000	0.000
6/21/2006	6	6	156		43	936	0	146,016	0.000
6/22/2006	11	11	167		84	1,837	0	306,779	0.000
7/22/2006	19	19	186	1	161	3,534	186	657,324	0.053
7/23/2006	32	32	218	4	317	6,976	872	1,520,768	0.500
7/24/2006	10	10	228	4	104	2,280	912	519,840	1.600
7/25/2006	27	27	255		313	6,885	0	1,755,675	0.000
7/26/2006	27	27	282	3	346	7,614	846	2,147,148	0.333
7/27/2006	19	19	301		260	5,719	0	1,721,419	0.000
7/28/2006	25	25	326	3	370	8,150	978	2,656,900	0.360
7/29/2006	15	15	341	2	233	5,115	682	1,744,215	0.267
8/18/2006	5	5	346		79	1,730	0	598,580	0.000
8/19/2006	4	4	350	2	64	1,400	700	490,000	1.000
8/20/2006	6	6	356		97	2,136	0	760,416	0.000
8/21/2006	6	6	362		99	2,172	0	786,264	0.000
8/22/2006	1	1	363		17	363	0	131,769	0.000
8/23/2006	3	3	366		50	1,098	0	401,868	0.000
Totals:	367	366		21		71,625	5,336	17,893,657	4.224

Schnabel Estimate:		3,256
-95%	32.1007	2,171
+95%	12.9993	5,133

from Poisson dist. Table at:
http://statpages.org/confint.html

Schumacher-Eschmeyer Estimate:		3,353
-95%	0.000478	2,093
+95%	0.000119	8,428
s^2=	0.1254	
s 1/n =	0.00008	
df	21	
t.95, 14df	2.145	

Appendix Table D-2. Population estimates of Arctic grayling (180 mm or longer) using the Schnabel and Schumacher-Eshmeyer estimators.

Bill's Ck - 2006

Date	C_i Number Caught	Tags Released	M_i Cum Released	R_i Tags Recapped	Schnabel Est.	Schumacher-Eschmeyer C_iM_i	M_iR_i	CM^2	R^2/C
6/15/2006			0		0	0	0	0	
6/16/2006	3	3	3		1	9	0	27	0.000
6/17/2006	2	2	5		1	10	0	50	0.000
6/18/2006	10	10	15		9	150	0	2,250	0.000
6/19/2006	6	6	21		8	126	0	2,646	0.000
6/20/2006	8	8	29		15	232	0	6,728	0.000
6/21/2006			29		0	0	0	0	
6/22/2006	1	1	30		2	30	0	900	0.000
7/22/2006	10	10	40	3	25	400	120	16,000	0.900
7/23/2006	26	26	66	4	107	1,716	264	113,256	0.615
7/24/2006	9	9	75		42	675	0	50,625	0.000
7/25/2006	18	18	93	2	105	1,674	186	155,682	0.222
7/26/2006	21	21	114		150	2,394	0	272,916	0.000
7/27/2006	7	7	121	3	53	847	363	102,487	1.286
7/28/2006	12	12	133	1	100	1,596	133	212,268	0.083
7/29/2006	6	6	139		52	834	0	115,926	0.000
8/18/2006	3	3	142	2	27	426	284	60,492	1.333
8/19/2006	2	2	144		18	288	0	41,472	0.000
8/20/2006	2	2	146		18	292	0	42,632	0.000
8/21/2006	4	4	150		38	600	0	90,000	0.000
8/22/2006			150		0	0	0	0	
8/23/2006	3	3	153		29	459	0	70,227	0.000
Totals:	153	153		15	797	12,758	1,350	1,356,584	4.440

Schnabel Estimate:		797
-95%	24.7402	496
+95%	8.3954	1,358

from Poisson dist. Table at:
http://statpages.org/confint.html

Schumacher-Eschmeyer Estimate:		1,005
-95%	0.001750	571
+95%	0.000240	4,163
s^2=	0.1720	
s 1/n =	0.00036	
df	18	
t.95, 16df	2.12	

Appendix Table D-3. Population estimates of Arctic grayling (180 mm or longer) using the Schnabel and Schumacher-Eshmeyer estimators.

Crea Ck - 2006

Date	C_i Number Caught	Tags Released	M_i Cum Released	R_i Tags Recapped	Schnabel Est.	Schumacher-Eschmeyer C_iM_i	M_iR_i	CM^2	R^2/C
6/15/2006	24	24	24		144	576	0	13,824	0.000
6/16/2006	6	6	30	1	45	180	30	5,400	0.167
6/17/2006	16	16	46		184	736	0	33,856	0.000
6/18/2006	5	5	51		64	255	0	13,005	0.000
6/19/2006	20	19	70	1	350	1,400	70	98,000	0.050
6/20/2006	8	8	78		156	624	0	48,672	0.000
6/21/2006	4	4	82		82	328	0	26,896	0.000
6/22/2006	7	7	89		156	623	0	55,447	0.000
7/22/2006	4	4	93		93	372	0	34,596	0.000
7/23/2006	1	1	94	1	24	94	94	8,836	1.000
7/24/2006			94		0	0	0	0	
7/25/2006	1	1	95		24	95	0	9,025	0.000
7/26/2006	1	1	96		24	96	0	9,216	0.000
7/27/2006	3	3	99		74	297	0	29,403	0.000
7/28/2006	3	3	102		77	306	0	31,212	0.000
7/29/2006	3	3	105		79	315	0	33,075	0.000
8/18/2006			105		0	0	0	0	
8/19/2006	2	2	107		54	214	0	22,898	0.000
8/20/2006	1	1	108		27	108	0	11,664	0.000
8/21/2006	2	2	110		55	220	0	24,200	0.000
8/22/2006			110		0	0	0	0	
8/23/2006			110		0	0	0	0	
Totals:	111	110		3		6,839	194	509,225	1.217

Schnabel Estimate:		1,710
-95%	8.7673	688
+95%	0.6187	4,151

from Poisson dist. Table at:
http://statpages.org/confint.html

Schumacher-Eschmeyer Estimate:		2,625
-95%	0.001155	866
+95%	#######	-2,543
s^2=	0.0672	
s 1/n =	0.00036	0.000363
df	17	
t.95, 15df	2.131	