MONITORING FISH POPULATIONS IN THE UBLUTUOCH RIVER DRAINAGE IN EASTERN NPR-A: 2004-2005

Final Report

January 2006

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Prepared for:
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and

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1200 Timberloch Place
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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 2005 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 2005, fyke nets were used to sample small streams and lakes 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

Ten species were captured in small streams in eastern NPR-A during fyke net sampling in 2005. Arctic grayling were 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 higher in July 2005 as compared to July 2004, but the size ranges were similar within each creek in both years. Higher catches in July 2005 may be a result of delayed entry into the small systems because of cooler water temperatures in June. In 2004, the grayling appeared to enter these streams in June, when water temperatures had already exceeded 12^{o}C by the onset of sampling.

Most of the broad whitefish caught during 2005 were moving upstream in Bill's Creek during July. There was an indication of an August downstream movement by broad whitefish in the Tingmiaqsiugvik (Ublutuoch River), but this was based on relatively low numbers of fish. 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.

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.

Tags were applied to 593 Arctic grayling in 2005, bringing the total number of tagged grayling in eastern NPRA to 1,644 since 2001. During 2005, 95 tagged grayling were recovered, with 283 recaptured from 2001 to 2005. 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). 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.

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.

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. Of these, approximately 1,000 to 1,200 entered Crea Creek in each year. For Bill's Creek, the 2004 and 2005 estimates were quite different, with 2,400-2,700 estimated for 2004 and 920-940 estimated for 2005. The high estimate in 2004 results from the low number of recoveries in that year.

CONCLUSIONS

Sampling in eastern NPR-A during 2005 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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MONITORING FISH POPULATIONS IN THE UBLUTUOCH RIVER DRAINAGE IN EASTERN NPR-A: 2004-2005

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 2005 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 2005, 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 summer 2004 and 2005, 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 2004-2005, 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 in 2004 and 2005 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 2005, 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, there was still substantial channel ice and water temperatures were low, around 1.0°C or less in Bill's Creek and the Tingmiaqsiugvik (Ublutuoch River) (Figure 3). Subsequently, temperatures rose rapidly and fluctuated between 8 and 14°C through July, and between 8 to 12°C in late August. In contrast, water temperatures in June and late August 2004 were substantially higher than observed in either 2003 or 2005.

Specific conductance rose slowly at all sites through the summer as snow melt and runoff decreased. Some reversals to this trend were apparent after rain (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. Ten species were captured in small streams in eastern NPR-A during fyke net sampling in 2005, with a total of twelve species identified from Tingmiaqsiugvik (Ublutuoch River) drainage since 2001 (Table 2). Arctic grayling were the most abundant species, followed by ninespine stickleback. Stations B0401/B0402 in Bill's Creek and C0301 in Crea Creek, small tributary streams, produced the greatest number of grayling, followed by Station U0301 on the Tingmiaqsiugvik (Ublutuoch River). While juvenile grayling dominated the catches, adults were also present (Appendix Table C-1).

In 2004 and 2005, 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. There was strong upstream movement by Arctic grayling at all stations during July, with fish apparently moving downstream during late August (Figure 4).

Most of the broad whitefish caught during 2005 were moving upstream in Bill's Creek during July. There was an indication of an August downstream movement by broad whitefish in the Tingmiaqsiugvik (Ublutuoch River), 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), 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 higher in July 2005 as compared to July 2004, but the size ranges were similar within each creek in both years (Figures 9 and 10). As discussed above, the higher catches in July 2005 may be a result of delayed entry into the small systems because of cooler water temperatures in June. In 2004, the grayling appeared to enter these streams in June, when water temperatures had already exceeded 12^{o}C by the onset of sampling.

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).

Tag Returns. Tags were applied to 593 Arctic grayling in 2005, bringing the total number of tagged grayling in eastern NPRA to 1,644 since 2001 (Table 3). During 2005, 95 tagged grayling were recovered, with 283 recaptured from 2001 to 2005. 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.

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). There was no difference in return rates between the two streams (Chi-square = 2.1, 1 df, p=0.15, Table 5). 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. The differences in return rates between the two small streams and the Tingmiaqsiugvik (Ublutuoch River) were highly significant (Chi-square = 30.4, 1 df, $p<0.001$, Table 5). 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 68 broad whitefish in 2005, bringing the total number of tagged broad whitefish in eastern NPRA to 417 since 2001. Only two tagged broad whitefish were recovered during 2005, both at the release station in within 4 days of their release. To date, only 10 have been recaptured, 9 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 38 humpback whitefish in 2005, bringing the total number of tagged humpback whitefish in eastern NPRA to 378 since 2001. As with broad whitefish, only two tagged humpback whitefish were recovered during 2005, both at the release station in within 4 days of their release. To date, only 11 have been recaptured, 9 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 136 least cisco and 78 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 2005, four species (Arctic grayling, broad whitefish, humpback whitefish and least cisco) comprised over 98% of the catch, excluding ninespine stickleback. Ninespine stickleback were 25% 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, only one burbot was caught in 2005.

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 10). Young-of-the-year were caught in small numbers in Bill's Creek, Crea Creek and Tingmiaqsiugvik (Ublutuoch River).

Broad Whitefish. Broad whitefish were the third most abundant fish caught, but were less than 1.5% of the total catch (Table 2). Larger broad whitefish were caught primarily in Bill's Creek during mid-July and the Tingmiaqsiugvik (Ublutuoch River) during the late August sampling period, with only scattered records of larger individuals at other locations and periods (Figures 5 and 8).

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

Humpback Whitefish. Humpback whitefish were fourth in abundance, with the catch recorded from Bill's Creek and 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 Bill's Creek during July sampling (July 10-27), followed by a small downstream movement in the Tingmiaqsiugvik (Ublutuoch River) in late August.

Estimates of Arctic Grayling

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 inmigration or outmigration 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). Of these, approximately 1,000 to 1,200 entered Crea Creek in each year. For Bill's Creek, the 2004 and 2005 estimates were quite different, with 2,400-2,700 estimated for 2004 and 920-940 estimated for 2005. The high estimate in 2004 results from the low number of recoveries in that year.

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

CONCLUSIONS

Sampling in eastern NPR-A during 2005 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.

LITERATURE CITED

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.

Bendock, T.N. and J. Burr. 1985. Freshwater fish distributions in the Central Arctic Coastal Plain (Topagoruk River to Ikpikpuk River). Alaska Department of Fish and Game, Sport Fish Division, Fairbanks, AK. 30p.

Craig, P.C. 1984. Fish use of coastal waters of the Alaskan Beaufort Sea: a review. Transactions of the American Fisheries Society 113:265-282.

Craig, P.C., and L. Haldorson. 1986. Pacific salmon in the North American Arctic. Arctic 39(1):2-7.

MBJ (Michael Baker Jr., Inc). 2003. Recommended lake volume estimation methods and survey procedures for North Slope lakes. Prepared by Michael Baker Jr., Inc. for ConocoPhillips. Anchorage, AK. 12 p+appendices.

McElderry, H.I. and P.C. Craig. 1981. A fish survey in the lower Colville River drainage with an analysis of spawning use by Arctic and least cisco. Appendix 2. Final Report, Simpson Lagoon (Part 4, Fish). In: Environmental Assessment of the Alaskan Continental Shelf, Final Reports (Vol. 7). BLM/NOAA OCSEAP, Boulder, Colorado. p. 657 678.

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. 248 p.

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. 124 p.

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.

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: US Fish and Wildlife Service. Anchorage, AK. 214p.

Power, G. 1997. A review of fish ecology in arctic North America. Pages 13-39 in J. Reynolds, editor. Fish ecology in arctic North America. American Fisheries Society Symposium 19, Bethesda, MD.

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

Table 1. Location of fyke net stations fished in eastern NPRA and Alpine during 2004-2005.

Year	Station	Location	Dates Fished	Latitude (NAD83)	Longitude (NAD83)
2004					
	B0401 (US)	Bill's Creek (trib to Ublutuoch)	Jul 13-Aug 24	70.22592	151.26387
	B0401 (DS)	Bill's Creek (trib to Ublutuoch)	Jul 13-Aug 24	70.22592	151.26387
	C0301 (US)	Crea Creek (trib to Ublutuoch)	Jun 16-Aug 24	70.27969	151.33000
	C0301 (DS)	Crea Creek (trib to Ublutuoch)	Jul 13-Aug 24	70.27969	151.33000
	U0102 (US)	Ublutuoch River	Jul 14-Aug 24	70.24875	151.29120
	U0102 (DS)	Ublutuoch River	Jul 30-Aug 24	70.24875	151.29120
	U0301 (US)	Ublutuoch River	Jun 16-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

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 2001-2005.

Number of fish caught

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

Catch Rate (fish per day)

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

Table 3. Release and recapture locations of Arctic grayling tagged in eastern NPR-A streams from 2003 to 2005.

Number Recaptured

Release Stream	Release Year	Number Released	Number Recaptured in 2003			Number Recaptured in 2004			Number Recaptured in 2005		
			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
	2005	220	--	--	--	--	--	--	25	0	2
Crea CK											
	2003	96	--	3	0	1	11	0	0	4	0
	2004	216	--	--	--	2	25	1	1	12	2
	2005	226	--	--	--	--	--	--	3	21	4
Ublutuoch											
	2001	187	--	2	0	1	0	5	3	1	0
	2002	87	--	0	1	3	0	2	0	1	0
	2003	56	--	1	3	0	1	0	1	0	0
	2004	142	--	--	--	1	1	3	0	2	4
	2005	255	--	--	--	--	--	--	6	1	0

Percent Recaptured

Release Stream	Release Year	Number Released	Percent Recaptured in 2003			Percent Recaptured in 2004			Percent Recaptured in 2005		
			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%
	2005	220	--	--	--	--	--	--	**11.4%**	0	0.9%
Crea CK											
	2003	96	--	3.1%	0	1.0%	**11.5%**	0	0	**4.2%**	0
	2004	216	--	--	--	0.9%	**11.6%**	0.5%	0.5%	**5.6%**	0.9%
	2005	226	--	--	--	--	--	--	1.3%	**9.3%**	1.8%
Ublutuoch											
	2001	187	--	1.1%	0	0.5%	0	2.7%	1.6%	0.5%	0
	2002	87	--	0	1.1%	3.4%	0	2.3%	0	1.1%	0
	2003	56	--	1.8%	5.4%	0	1.8%	0	1.8%	0	0
	2004	142	--	--	--	0.7%	0.7%	2.1%	0	1.4%	2.8%
	2005	255	--	--	--	--	--	--	2.4%	0.4%	0

Table 4. Multiple recaptures of Arctic grayling in eastern NPRA streams, 2001-2005.

Tag	Release			Recapture			
Number	Station	Date	Length	Station	Date	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
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
MJM021325	U0301	6/19/2004	210	C0301	8/2/2004	237	44
	C0301	8/2/2004	237	C0301	8/18/2004	244	16
MJM021374	C0301	6/20/2004	267	C0301	7/15/2004	282	25
	C0301	7/15/2004	282	C0301	7/20/2004	281	5
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

Table 5. Recovery of tagged Arctic grayling within and between small streams in eastern NPR-A, 2004-2005.

Release Location	Number of Tags Released	Within Stream Recoveries	Other Location Recoveries	Percent Within Stream Recoveries	Percent Other Location Recoveries
Bill's Ck	379	36	7	9.5%	1.8%
Crea Ck	442	58	13	13.1%	2.9%
Pooled	821	94	20	8.3%	2.5%
Small Streams	821	94	20	11.4%	2.4%
Ublutuoch R.	397	7	11	1.8%	2.8%
Pooled	1218	101	31	8.3%	2.5%

Chi-square Tests:

Factor	Bill's Ck	Crea Ck	
Observed Recaptures:	36	58	
Expected Recaptures:	43	51	
Chi-square statistic:	2.10	(1 df)	p=0.15 (not significant)

Factor	Small Streams	Ublu. R.	
Observed Recaptures:	94	7	
Expected Recaptures:	68	33	
Chi-square statistic:	30.43	(1 df)	p<0.001

Table 5. Estimates of Arctic grayling using eastern NPR-A study area streams during 2004 and 2005.

System		Fish Caught	Tags Released	Tags Recovered	Schnabel Model		Schumacher-Eschmeyer Model	
					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
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
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

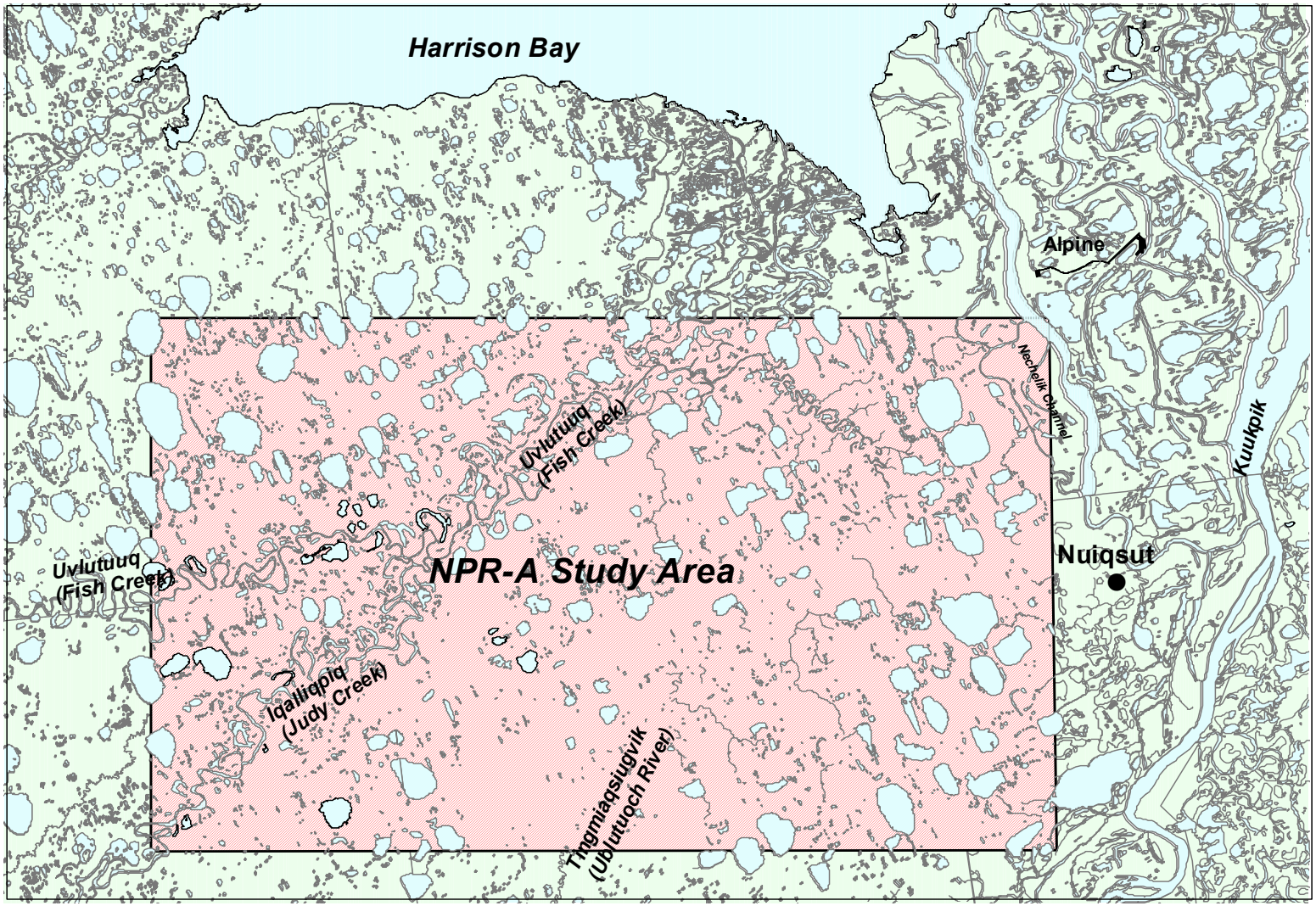

Figure 1. General location of the eastern NPR-A study area, Alaska, 2001-2005.

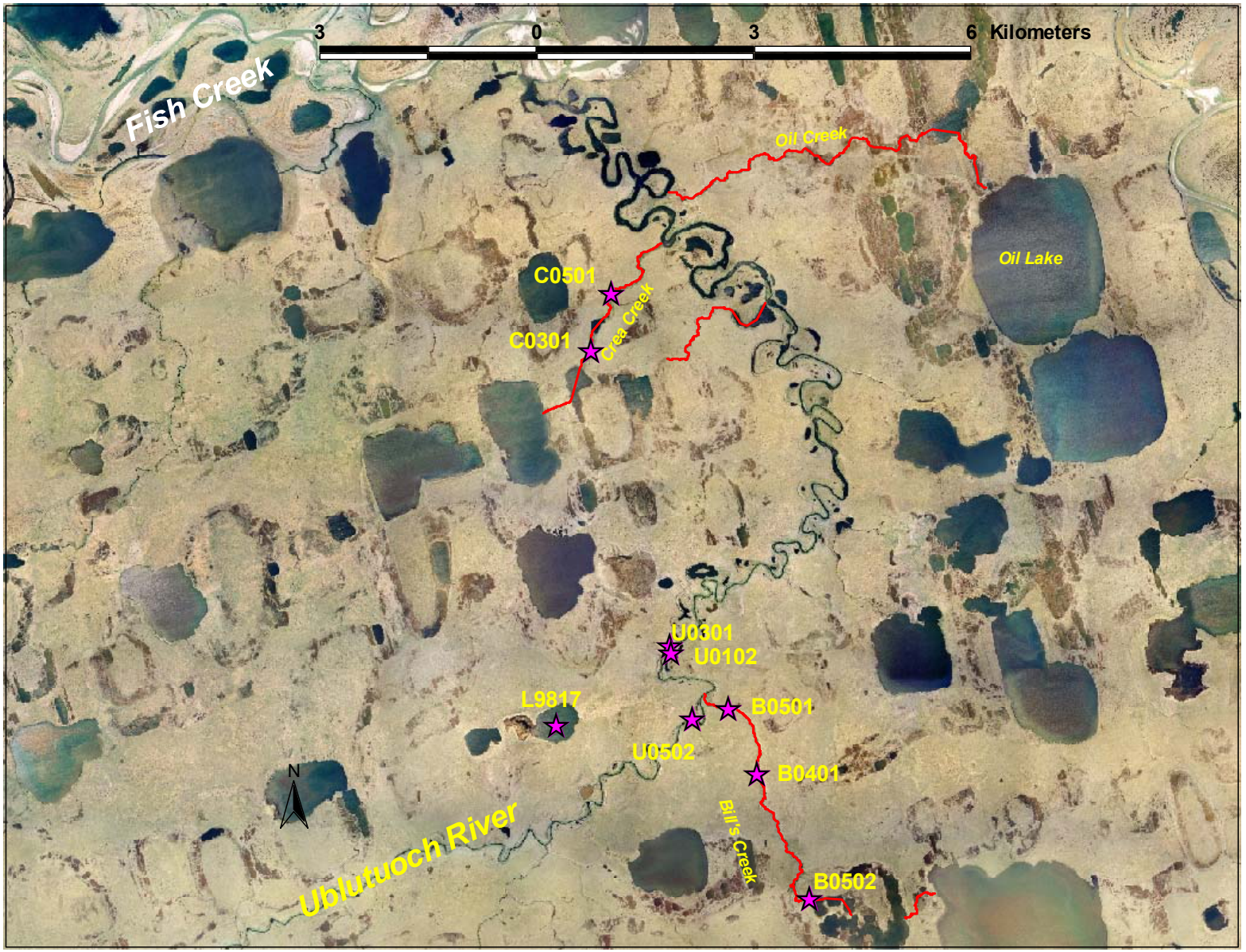

Figure 2. Fyke net locations in streams of eastern NPR-A study area, 2004.

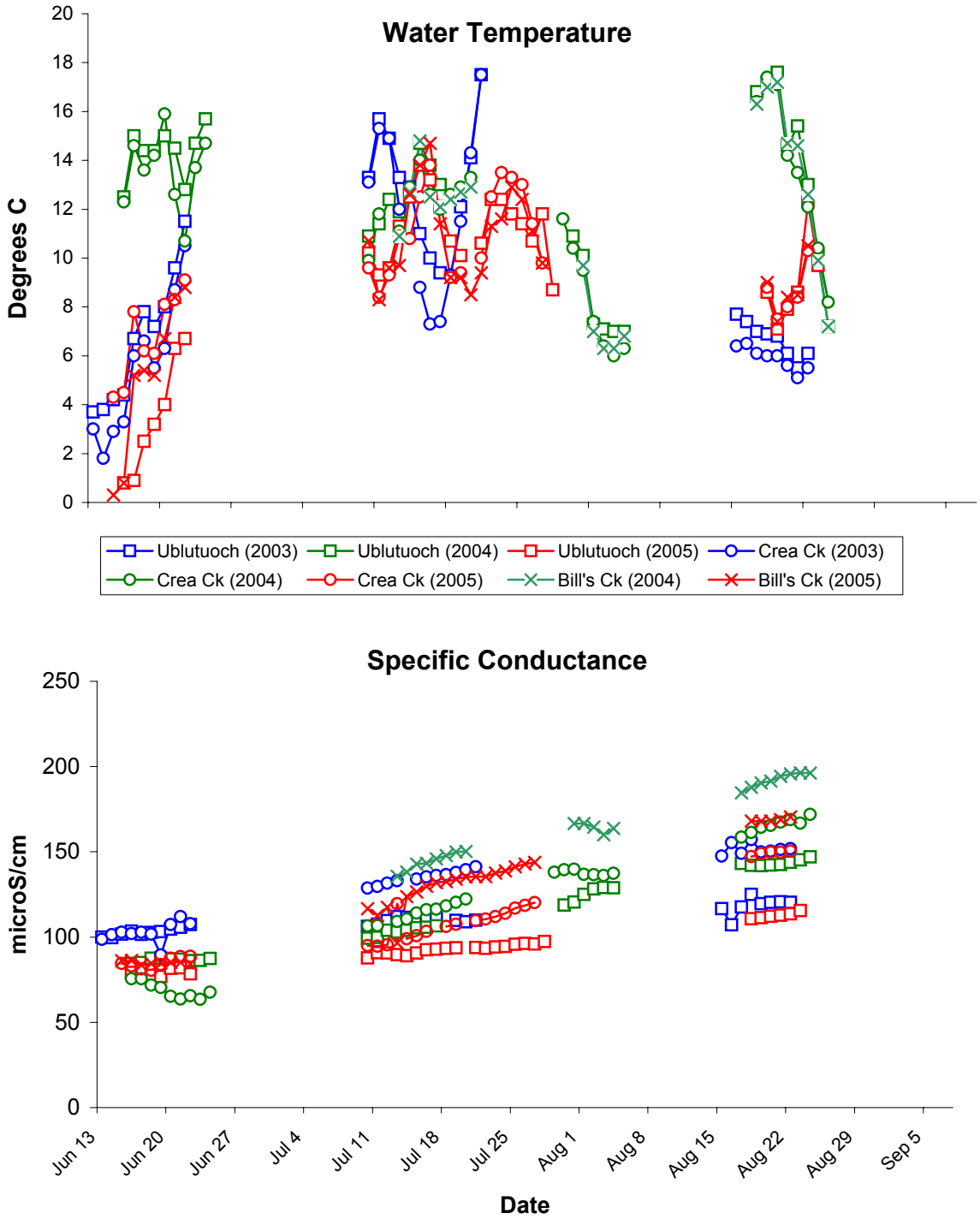

Figure 3. Water temperature and specific conductance at selected stations sampled in the eastern NPR-A study area, 2003-2005 (blue = 2003, green = 2004, red = 2005).

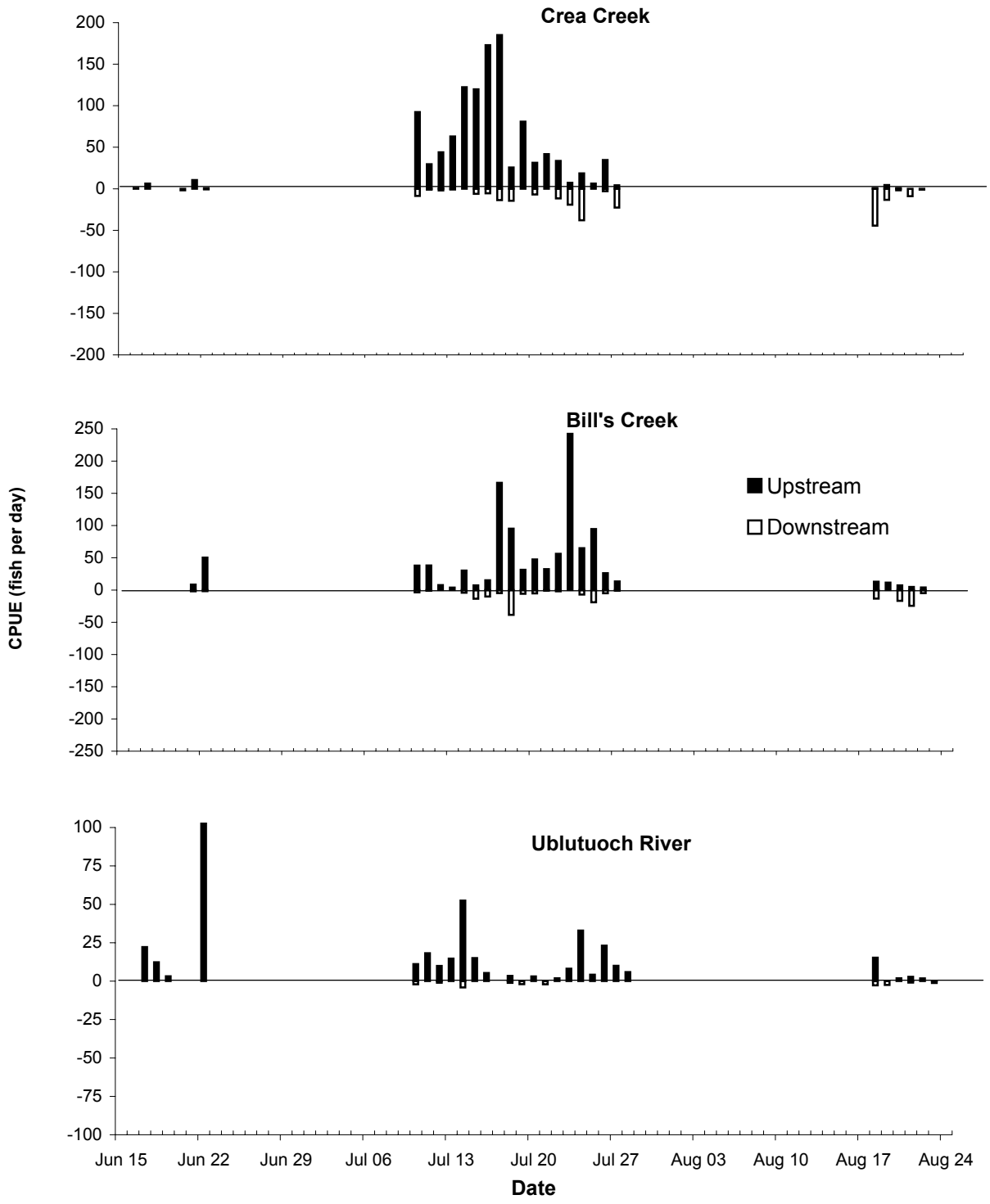

Figure 4. Comparison of Arctic grayling catch rates for fish moving in and out of streams of eastern NPR-A during 2005.
(Downstream = fish moving downstream, Upstream = fish moving upstream)

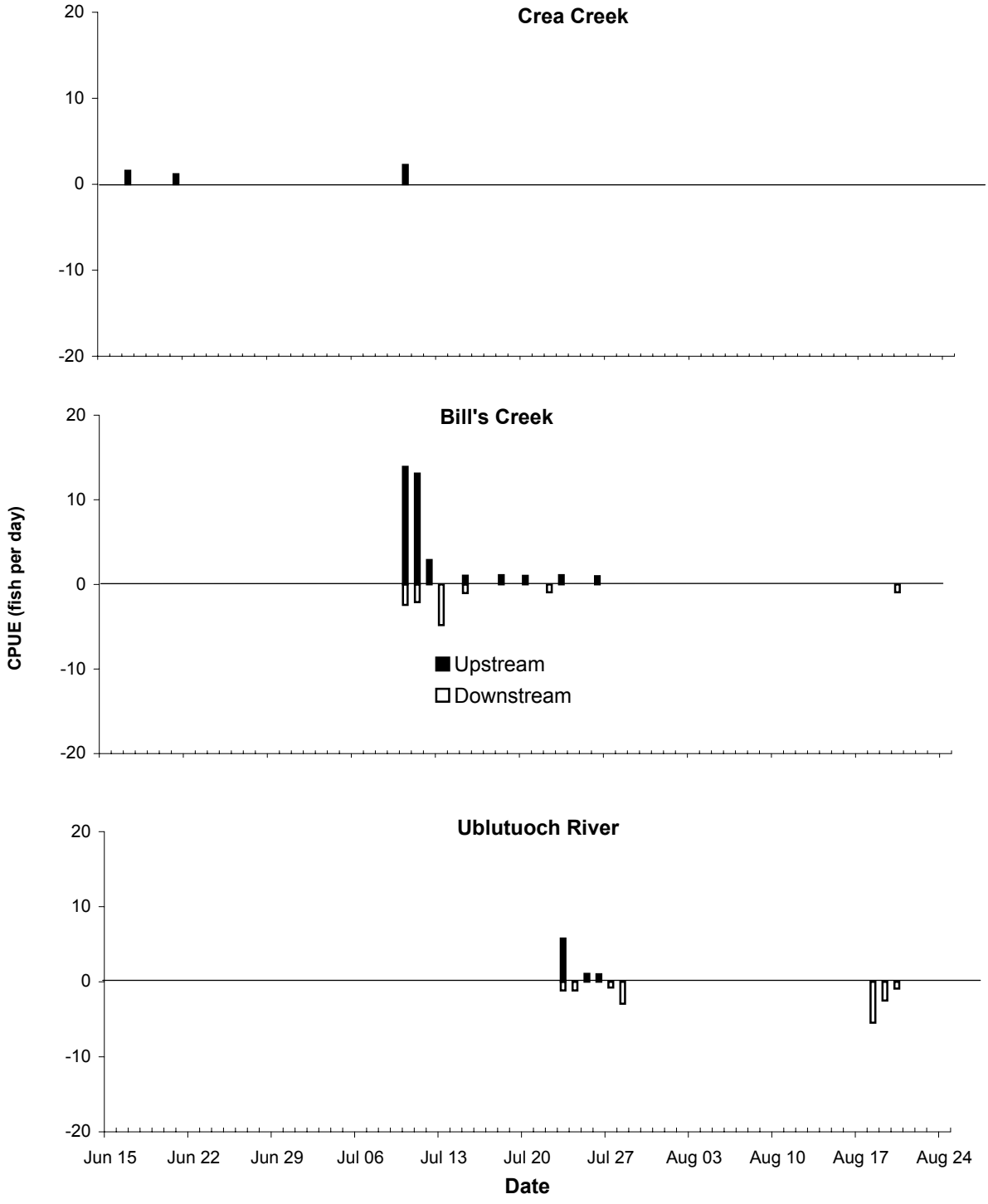

Figure 5. Comparison of broad whitefish catch rates for fish moving in and out of streams of eastern NPR-A during 2005.
(Downstream = fish moving downstream, Upstream = fish moving upstream)

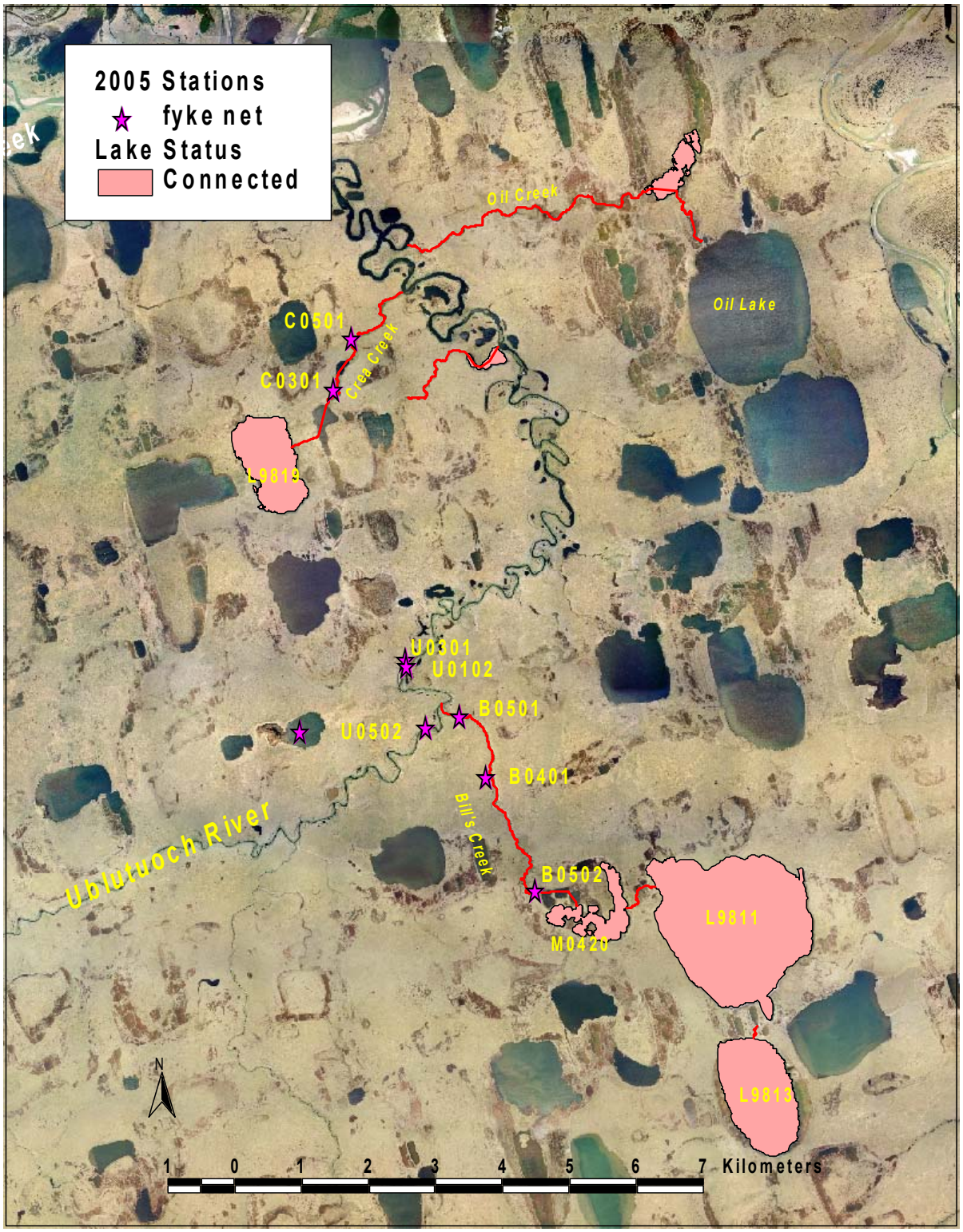

Figure 6. Small streams with connected lake systems investigated in 2003-2005 (red stars ndicate fyke net stations).

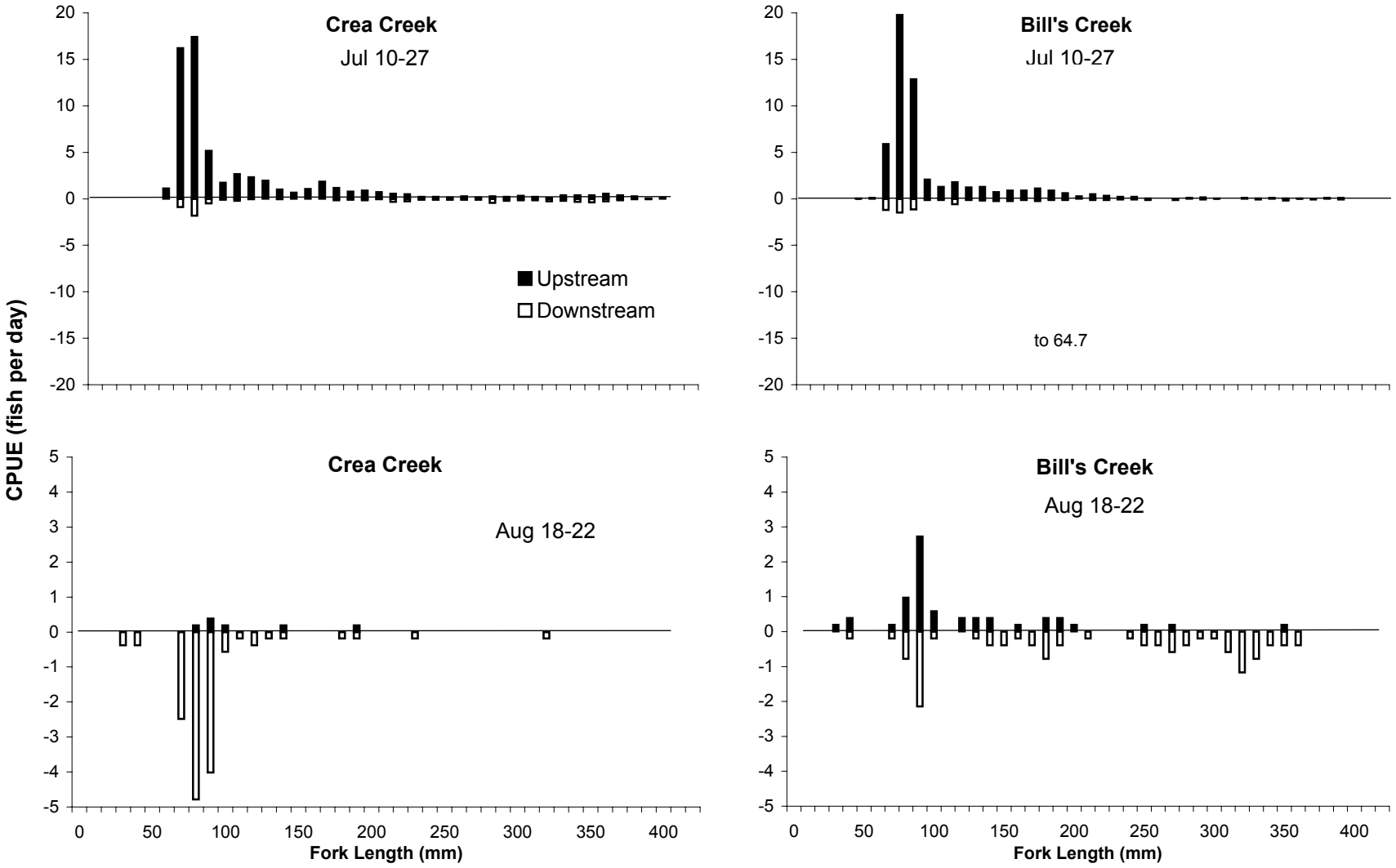

Figure 7. Length frequencies of Arctic grayling moving upstream and downstream in Crea Creek and Bill's Creek, 2005
(note change of scale between July and August sampling periods)

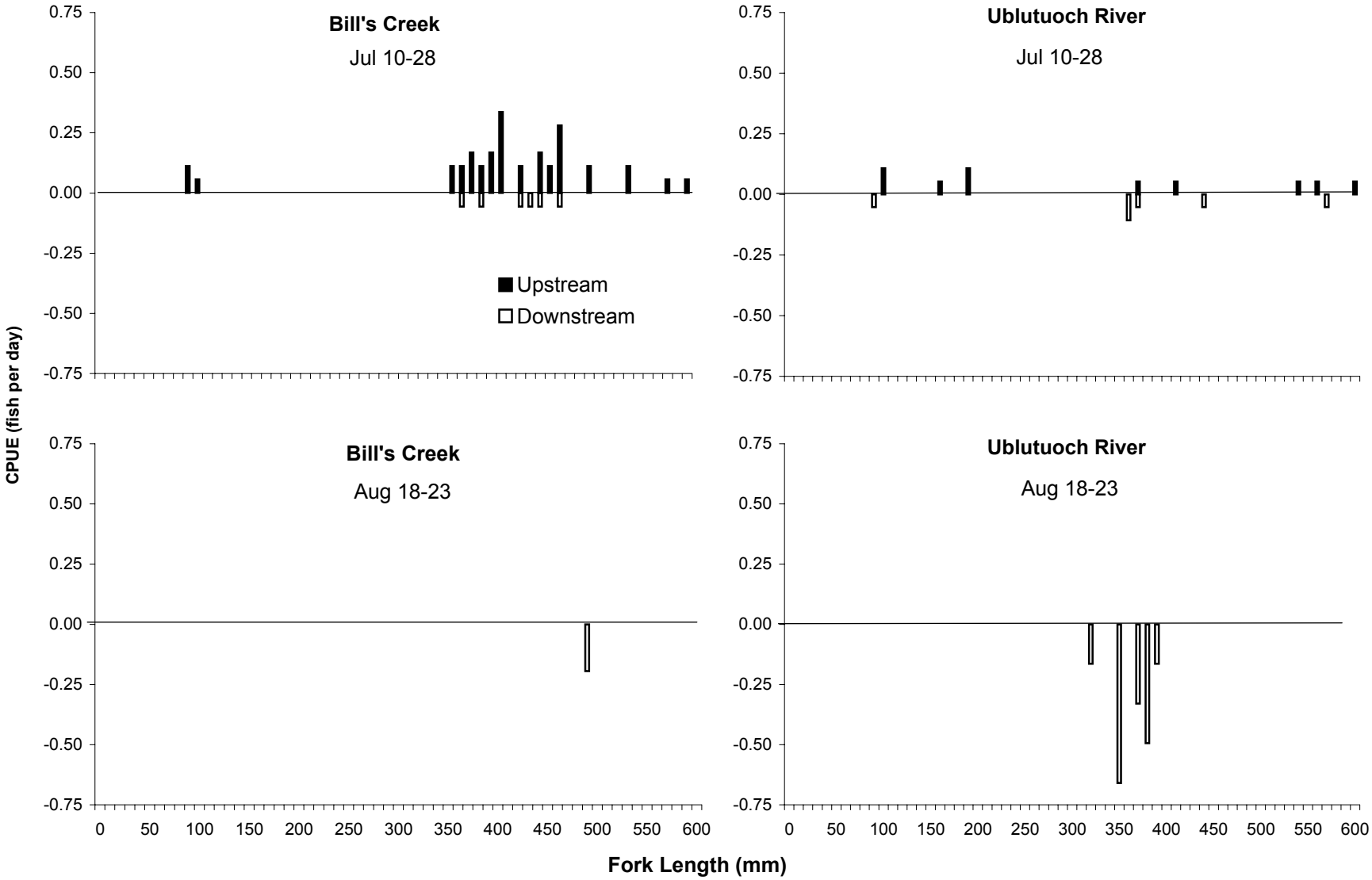

Figure 8. Length frequencies of broad whitefish moving upstream and downstream in Ublutuoch River and Bill's Creek, 2005.

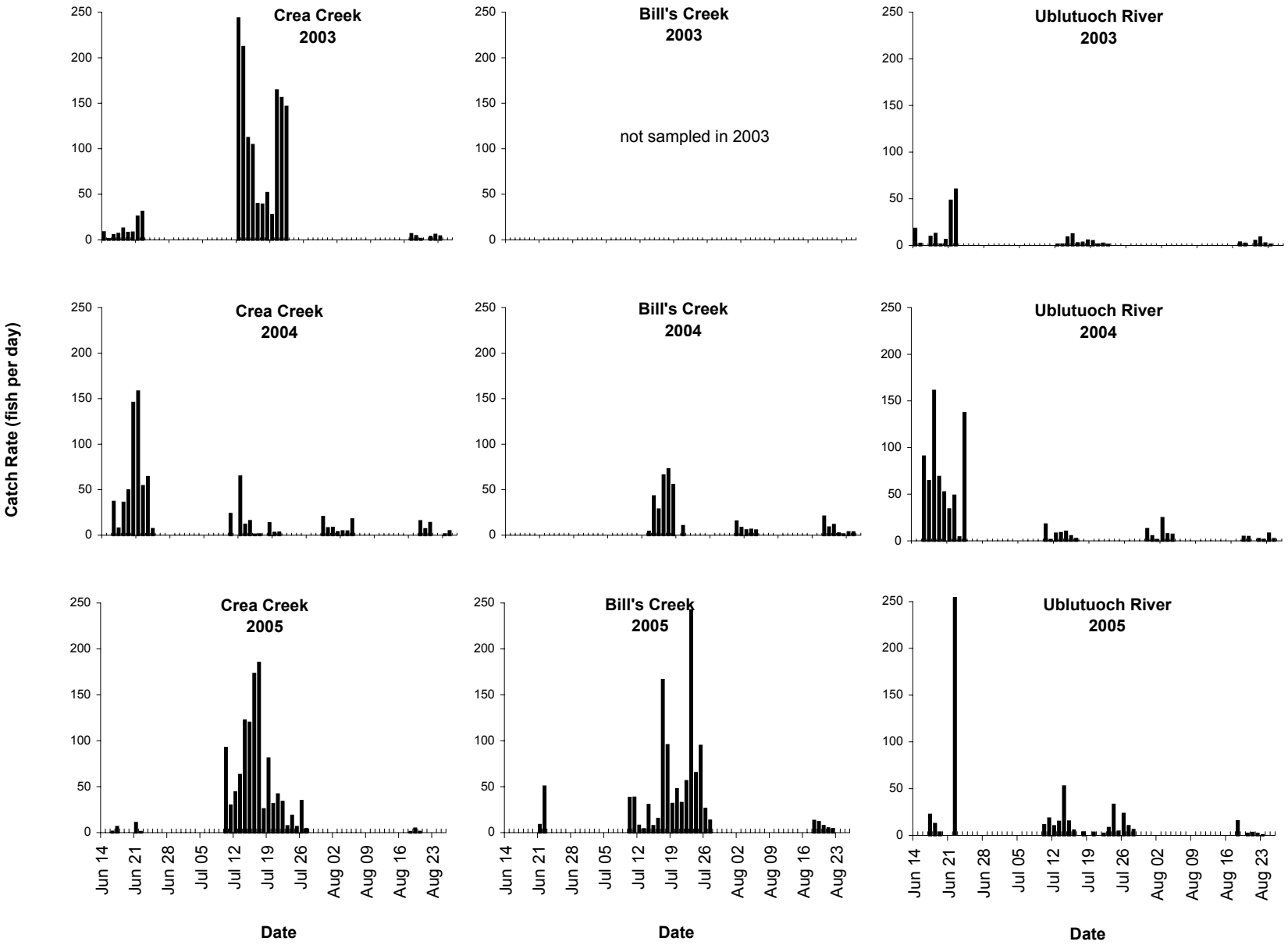

Figure 9. Comparison of Arctic grayling daily catch rates in 3 eastern NPR-A streams sampled in 2003-2005.

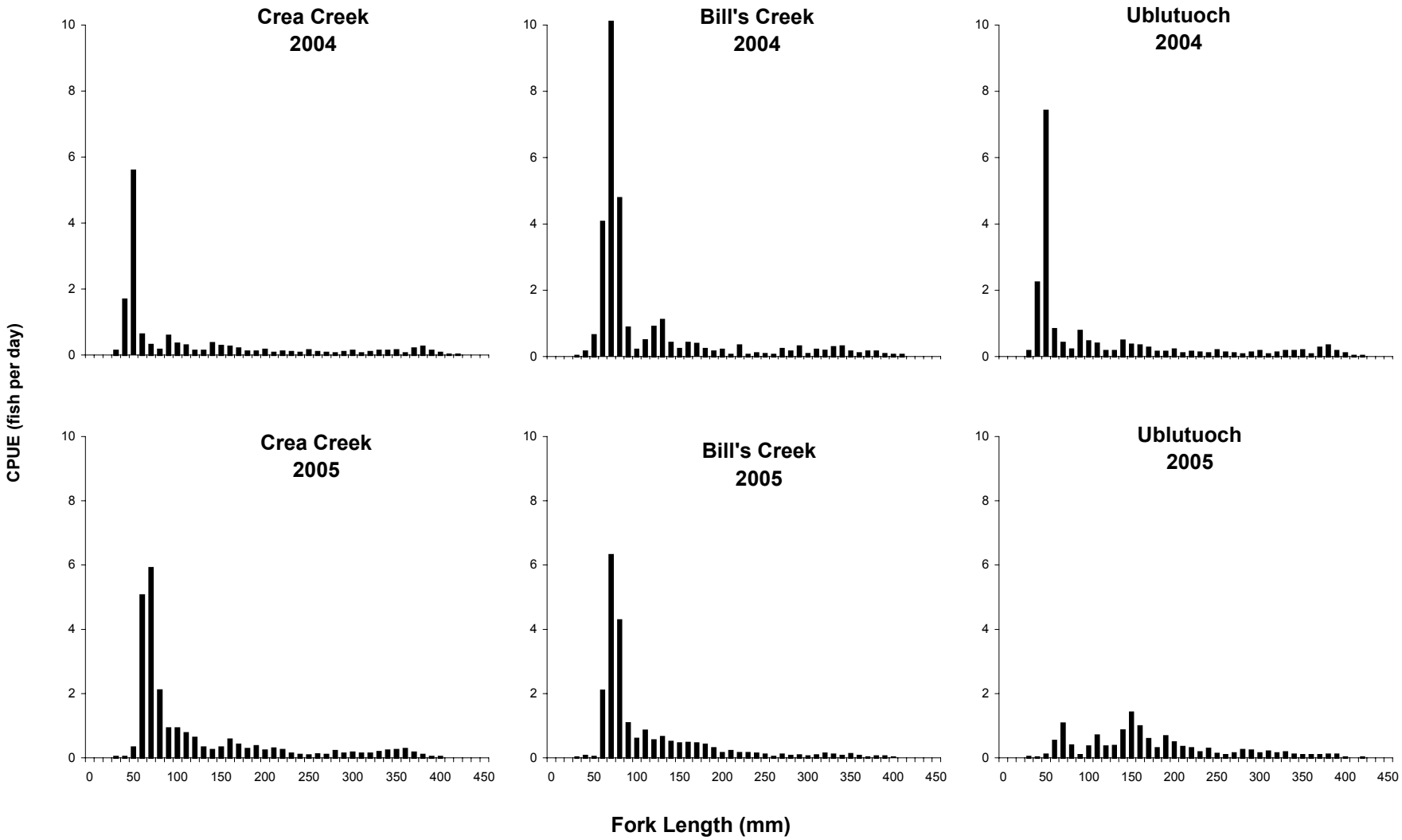

Figure 10. Comparison of Arctic grayling lengths at 3 streams in eastern NPR-A in both 2004 and 2005.

APPENDIX A

Water chemistry from fyke net stations in eastern NPR-A during 2005

Appendix Table A-1. Means and ranges of water chemistry parameters measured at NPRA fyke net sampling sites, 2005.

Station	Date	Temp (°C)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (%)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH
B0501	6/15/2005	0.3	14.02	97.2	86.1	1.5	7.32
B0501	6/16/2005	0.8	12.97	91.0	86.3	2.5	7.22
B0501	6/17/2005	5.2	12.29	98.2	83.6	1.7	7.08
B0501	6/18/2005	5.4	11.53	91.6	84.6	1.0	7.18
B0501	6/19/2005	5.2	11.77	92.9	84.9	1.4	7.20
B0501	6/20/2005	6.7	11.66	96.7	85.2	1.1	6.96
B0501	6/21/2005	8.4	10.13	86.5	85.2	1.0	7.07
B0501	6/22/2005	8.8	10.18	87.7	84.1	0.7	7.13
B0401	7/10/2005	9.7	10.51	93.3	166.6	1.4	7.65
B0401	7/11/2005	7.0	11.35	93.5	166.6	2.3	7.60
B0401	7/12/2005	6.3	11.55	93.7	164.6	1.5	7.59
B0401	7/13/2005	6.3	12.07	97.8	160.1	1.9	7.64
B0401	7/14/2005	6.8	11.96	97.9	163.7	2.8	7.61
B0401	7/15/2005	16.3	9.80	100.2	184.6	1.4	7.44
B0401	7/16/2005	17.0	8.65	89.2	187.8	1.8	7.48
B0401	7/17/2005	17.2	9.70	101.0	190.4	1.7	7.71
B0401	7/18/2005	14.7	9.58	94.6	191.6	1.9	7.65
B0401	7/19/2005	14.6	10.33	101.2	194.2	2.0	7.71
B0401	7/20/2005	12.6	10.63	100.1	195.6	1.9	7.67
B0401	7/21/2005	9.9	10.13	89.3	196.3	1.8	7.59
B0401	7/22/2005	7.2	11.06	91.6	196.2	1.7	7.61
B0401	7/23/2005	7.2	11.06	91.6	196.2	1.7	7.61
B0401	7/24/2005	7.2	11.06	91.6	196.2	1.7	7.61
B0401	7/25/2005	7.2	11.06	91.6	196.2	1.7	7.61
B0401	7/26/2005	7.2	11.06	91.6	196.2	1.7	7.61
B0401	7/27/2005	7.2	11.06	91.6	196.2	1.7	7.61
B0401	8/18/2005	9.0	11.49	100.0	168.1	1.1	8.01
B0401	8/19/2005	7.4	11.64	96.9	168.0	1.1	7.93
B0401	8/20/2005	8.4	12.16	103.5	168.1	1.8	8.09
B0401	8/21/2005	8.5	12.55	107.3	168.8	1.1	8.12
B0401	8/22/2005	10.5	11.80	106.3	170.5	0.9	8.09
C0501	6/15/2005	4.3	12.80	98.8	84.5	2.3	6.88
C0501	6/16/2005	4.5	11.32	88.1	83.0	0.9	6.98
C0501	6/17/2005	7.8	10.76	91.6	81.3	0.7	6.99
C0501	6/18/2005	6.2	12.07	98.0	80.5	0.9	7.07
C0501	6/19/2005	6.1	11.31	91.3	83.9	1.2	7.11
C0501	6/20/2005	8.1	10.85	93.0	87.6	1.9	6.86
C0501	6/21/2005	8.3	10.43	89.3	88.5	2.0	7.07
C0501	6/22/2005	9.1	10.05	86.8	88.8	1.1	7.00
C0301	7/10/2005	9.6	9.92	88.6	94.9	1.0	7.55
C0301	7/11/2005	8.4	10.25	88.7	94.6	1.0	7.86
C0301	7/12/2005	9.3	11.07	98.4	95.4	0.8	8.12
C0301	7/13/2005	10.9	10.85	98.9	119.5	0.4	7.70
C0301	7/14/2005	10.8	10.26	92.7	98.9	1.4	7.40
C0301	7/15/2005	12.5	9.40	88.3	100.8	0.9	7.44

Appendix Table A-1. Means and ranges of water chemistry parameters measured at NPRA fyke net sampling sites, 2005.

Station	Date	Temp (°C)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (%)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH
C0301	7/16/2005	13.8	9.47	92.8	103.3	1.0	7.60
C0301	7/17/2005					1.2	7.66
C0301	7/18/2005	9.2	11.01	96.7	106.3	1.2	7.60
C0301	7/19/2005	9.4	10.24	89.9	107.5	1.4	7.59
C0301	7/20/2005					1.3	7.60
C0301	7/21/2005	10.0	11.12	97.8	109.6	1.3	7.58
C0301	7/22/2005	12.5	10.74	99.3	110.5	1.3	7.58
C0301	7/23/2005	13.5	10.39	99.9	112.0	1.5	7.59
C0301	7/24/2005	13.3	10.63	101.9	114.0	1.4	7.72
C0301	7/25/2005	13.0	10.80	102.5	116.9	1.1	7.73
C0301	7/26/2005	11.4	10.54	97.6	118.6	1.6	7.64
C0301	7/27/2005	9.8	10.60	94.3	120.2	1.5	7.76
C0301	8/18/2005	8.8	11.23	97.1	147.1	1.6	7.74
C0301	8/19/2005	7.5	10.74	89.6	149.0	1.5	7.74
C0301	8/20/2005	8.0	11.84	101.1	149.7	1.7	7.87
C0301	8/21/2005	8.4	12.59	107.1	149.8	1.8	7.95
C0301	8/22/2005	10.3	12.04	108.2	150.4	1.6	7.70
U0501	6/16/2005	0.8	14.01	98.4	79.2	3.8	7.29
U0501	6/17/2005	0.9	13.63	95.7	80.4	4.2	7.84
U0501	6/18/2005	2.5	13.20	99.3	77.5	2.6	7.97
U0501	6/19/2005	3.2	13.16	98.5	76.8	2.5	7.43
U0501	6/20/2005	4.0	13.15	100.5	81.6	2.4	7.24
U0501	6/21/2005	6.3	12.61	102.6	82.0	2.3	7.22
U0501	6/22/2005	6.7	12.45	102.1	78.4	1.7	7.38
U0102	7/10/2005	10.2	10.13	91.0	87.7	0.9	7.40
U0102	7/11/2005	9.3	10.94	95.8	90.7	0.9	7.52
U0102	7/12/2005	9.6	10.90	95.7	90.7	0.7	7.50
U0102	7/13/2005	11.3	10.95	101.6	89.7	0.7	7.45
U0102	7/14/2005	12.5	10.50	99.6	88.9	1.0	7.45
U0102	7/15/2005	13.8	10.45	101.2	90.6	0.7	7.51
U0102	7/16/2005	13.2	10.23	97.7	92.6	0.7	7.63
U0102	7/17/2005	112.1	10.02	92.7	26.3	0.8	7.70
U0102	7/18/2005	10.7	10.60	95.4	93.3	0.8	7.64
U0102	7/19/2005	10.1	10.57	93.6	93.7	1.0	7.67
U0102	7/20/2005				0.0	0.8	7.66
U0102	7/21/2005	10.6	11.03	99.5	93.8	0.8	7.78
U0102	7/22/2005	12.4	11.08	104.0	93.4	0.9	7.74
U0102	7/23/2005	12.4	10.45	99.2	94.2	1.0	7.70
U0102	7/24/2005	11.8	11.02	101.7	94.5	1.3	7.88
U0102	7/25/2005	11.4	10.45	95.4	95.8	0.9	7.75
U0102	7/26/2005	10.7	10.66	96.5	96.3	1.2	7.72
U0102	7/27/2005	11.8	11.20	104.0	95.9	0.9	7.93
U0102	7/28/2005	8.7	11.04	95.2	97.3	3.1	7.78
U0102	8/18/2005	8.6	11.74	100.4	110.7	1.0	7.92
U0102	8/19/2005	7.1	12.35	102.0	111.4	1.2	7.86

Appendix Table A-1. Means and ranges of water chemistry parameters measured at NPRA fyke net sampling sites, 2005.

Station	Date	Temp (°C)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (%)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH
U0102	8/21/2005	8.6	12.93	111.4	112.8	1.0	8.05
U0102	8/22/2005	12.3	11.50	107.9	113.5	1.7	7.92
U0102	8/23/2005	9.7	12.53	110.5	115.6	1.8	7.84
B0502	7/16/2005	13.5	10.20	99.3	134.3	0.5	8.02
B0502	7/17/2005	9.9	10.92	97.1	135.5	0.6	8.01
B0502	7/18/2005	8.0	11.50	97.3	136.5	0.5	8.10
B0502	7/19/2005	8.1	11.18	95.6	136.7	0.5	7.92
B0502	7/20/2005	7.1	11.21	93.2	136.8	0.5	7.90
B0502	7/21/2005	8.8	11.97	103.5	137.4	0.5	7.96
B0502	7/22/2005	10.4	10.80	99.5	138.6	0.4	8.02
B0502	7/23/2005	11.0	10.19	93.8	139.0	0.6	7.88
B0502	7/24/2005	11.7	10.98	101.2	140.5	1.2	8.00
B0502	7/25/2005	11.0	10.84	98.5	142.1	0.6	7.94
B0502	7/26/2005	9.4	10.70	93.8	144.3	1.3	7.88
B0502	7/27/2005	7.7	12.24	102.9	144.9	0.8	8.00

APPENDIX B

Fish caught by fyke net in eastern NPR-A during 2005

Appendix Table B-1. Daily catches of fish and effort at fyke net stations in eastern NPRA streams during 2005.

Bill's Creek

	Jun 16		Jun 17		Jun 18		Jun 19		Jun 20		Jun 21		Jun 22		Jul 10		Jul 11		Jul 12		Jul 13	
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	11	2	12		3	5	
Arctic grayling											2	8	2	59	3	30	1	35		8		4
Humpback whitefish																3		2		2		
Least cisco																						
Ninespine stickleback				2			1	4	1	93	5	4	14					1				
Round whitefish																						
Slimy sculpin																						
Effort (hrs)	23.3	24.2	30.8	30.0	18.6	18.5	23.6	23.2	25.3	25.4	23.7	22.9	27.3	28.2	19.8	19.0	22.8	22.0	25.8	25.0	24.9	25.1

Bill's Creek (continued)

	Jul 14		Jul 15		Jul 16		Jul 17		Jul 18		Jul 19		Jul 20		Jul 21		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	1						1				1			1			1		
Arctic grayling	4	30	13	7	11	17	4	146	35	87	6	32	5	47	1	32	2	60		222	8	74
Humpback whitefish								1					1									
Least cisco			2																			
Ninespine stickleback		1		3	2	4		5	1	2		8		23		33		2				2
Round whitefish		1												1				1				1
Slimy sculpin					1			3				2		2		1						1
Effort (hrs)	23.5	23.8	23.3	23.5	26.3	27.1	19.9	21.1	21.8	21.9	24.6	24.4	23.5	23.8	23.8	23.7	25.7	25.7	21.9	22.0	27.2	27.3

Bill's Creek (continued)

	Jul 25		Jul 26		Jul 27		Aug 18		Aug 19		Aug 20		Aug 21		Aug 22	
Species	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
Broad whitefish				1							1					
Arctic grayling	19	91	5	27	1	13	15	15		9	18	8	26	5	5	4
Humpback whitefish																
Least cisco						1	1									
Ninespine stickleback		1														
Round whitefish																
Slimy sculpin							1									
Effort (hrs)	23.9	23.1	24.0	24.9	23.7	23.6	27.3	27.9	19.3	18.7	25.9	26.3	25.4	25.5	25.3	24.8

Appendix Table B-1. Daily catches of fish and effort at fyke net stations in eastern NPRA streams during 2005.

Bill's Creek at Lake M0420 Outlet

	Jul 16	Jul 17	Jul 18	Jul 19	Jul 20	Jul 21	Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	Jul 27
Species	US	US	US	US	US	US	US	US	US	US	US	US
Broad whitefish	5			1				2				
Arctic grayling	44	33	8	15	1	12	46	30	102	51	151	10
Humpback whitefish	2	2		1								
Least cisco	1		1									
Ninespine stickleback					1	7	5	2	1	7	6	
Round whitefish									1			
Slimy sculpin									1		1	
Effort (hrs)	29.1	21.5	21.3	24.8	24.0	23.8	24.8	23.0	26.7	23.3	24.7	24.2

Crea Creek

	Jun 16		Jun 17		Jun 18		Jun 19		Jun 20		Jun 21		Jun 22		Jul 10		Jul 11		Jul 12		Jul 13	
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				2						
Arctic grayling		1		8					2			9	1	1	8	82	1	30	2	45	1	66
Least cisco																						
Ninespine stickleback									2	6			8		1		4		4	1		1
Slimy sculpin																						
Effort (hrs)	23.0	22.7	30.6	30.7	18.3	18.3	23.1	23.1	25.8	25.8	20.4	20.5	30.8	30.8	22.5	21.3	23.1	24.3	23.8	24.6	25.9	25.2

Crea Creek (continued)

	Jul 14		Jul 15		Jul 16		Jul 17		Jul 18		Jul 19		Jul 20		Jul 21		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																						
Arctic grayling		118	6	114	7	218	13	169	13	23		80	7	32		41	13	38	19	7	36	18
Least cisco								1														
Burbot				1																		
Ninespine stickleback					315	6	122	8	2	20	12	40	116	56				15	3	8	3	
Slimy sculpin						1				1										1		1
Effort (hrs)	23.2	23.2	23.7	22.8	30.6	30.2	22.8	21.9	21.6	21.6	23.9	23.8	24.4	24.6	23.8	23.6	26.8	27.2	23.7	23.6	22.8	23.3

Crea Creek (continued)

	Jul 25		Jul 26		Jul 27		Aug 18		Aug 19		Aug 20		Aug 21		Aug 22	
Species	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
Broad whitefish																
Arctic grayling		6	3	36	22	4	50	1	12	4	2	1	10		1	
Least cisco																
Ninespine stickleback	35	25	18	13	35	6	1	6	1			2	3		3	
Slimy sculpin															1	
Effort (hrs)	23.8	23.2	24.8	25.0	23.3	23.3	27.1	27.3	21.7	21.4	25.8	26.0	27.2	27.2	23.6	23.7

Appendix Table B-1. Daily catches of fish and effort at fyke net stations in eastern NPRA streams during 2005.

Ublutuoch

	Jun 16		Jun 17		Jun 18		Jun 19		Jun 20		Jun 21		Jun 22		Jul 10		Jul 11		Jul 12		Jul 13	
Species	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
Chum salmon																						
Sockeye salmon																						
Broad whitefish																						
Humpback whitefish															1				1			
Least cisco																	2					
Round whitefish														1			3					
Arctic grayling				47		8		3						388	2	11		18	1	10		15
Ninespine stickleback				9						37		13		19								
Slimy sculpin																						
Effort (hrs)	0.0	0.0	0.0	50.9	0.0	15.7	0.0	22.9	0.0	24.7	0.0	25.0	0.0	21.7	23.8	23.8	23.9	23.7	24.1	24.3	24.4	24.6

Ublutuoch

	Jul 14		Jul 15		Jul 16		Jul 17		Jul 18		Jul 19		Jul 20		Jul 21		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
Chum salmon																						
Sockeye salmon																						
Broad whitefish																			1	5	1	
Humpback whitefish		1																	2	1		
Least cisco																			1	5	1	
Round whitefish				1																1		
Arctic grayling	4	51		15		5			1	3	2			3	2			2		7		28
Ninespine stickleback						3	4	4		1			1	1								
Slimy sculpin																						
Effort (hrs)	23.5	23.3	23.6	24.0	23.0	22.6	25.6	25.8	21.2	21.2	24.5	24.4	23.8	23.7	23.8	23.8	25.7	25.7	20.8	20.8	20.8	20.4

Ublutuoch

	Jul 25		Jul 26		Jul 27		Jul 28		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
Chum salmon											1									
Sockeye salmon										1		1								
Broad whitefish		1		1	1		2		6		2		1							
Humpback whitefish	5				1		2		6		3		1		1				1	
Least cisco		5				3	1	2					1		2					
Round whitefish	1	1				2		1	1				1				2		3	
Arctic grayling		4		23		13		4	3	17	2			2	1	3		2	1	4
Ninespine stickleback																				
Slimy sculpin											1									
Effort (hrs)	23.8	22.9	23.3	23.9	31.4	31.2	16.4	16.3	26.4	26.8	19.2	19.7	26.4	26.0	25.7	25.8	27.3	27.0	20.4	20.5

APPENDIX C

Length frequencies of fish caught by fyke net in eastern NPR-A during 2005

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	**Bill's Creek** Jun 20 US	Jun 21 DS	Jun 21 US	Jun 22 DS	Jun 22 US	Jul 10 DS	Jul 10 US	Jul 11 DS	Jul 11 US	Jul 12 DS	Jul 12 US	Jul 13 DS	Jul 13 US	Jul 14 DS	Jul 14 US	Jul 15 DS	Jul 15 US	Jul 16 DS	Jul 16 US
0																			
10																			
20																			
30																			
40																			
50																			
60															8	4	2	1	7
70												2	3	2	13	1	4		6
80												1			3				1
90					1										1				
100	1		1		5									1				1	
110					9			1					1		1	2		2	
120					7										1			1	1
130	1			1	8										1				
140					9											1		1	
150	1				4							1			1				
160					8													1	
170				1														2	
180					1												1		
190					1													2	1
200		1	1		1														
210	1															1			
220					1							1				1			
230	1		2		1									1					
240			1		1											1			1
250																1			
260																			
270																1			
280																			
290																			
300					1														
310		1	1																
320															1				
330						1													
340																			
350						1													
360			1																
370						1													
380			1																
390																			
400					1														
410																			
420																			
430																			
440																			
450																			
460																			
470																			
480																			
490																			
500																			
Total:	5	2	8	2	59	3	0	1	0							13	7	11	17

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	**Bill's Creek** Jul 17		Jul 18		Jul 19		Jul 20		Jul 21		Jul 22		Jul 23		Jul 24		Jul 25		Jul 26	
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0																				
10																				
20																				
30																				
40																		1		
50				1				1												
60		36	9	12	2	4	1	10		1		1		17	3	2		3		
70	2	63	14	37	1	12	1	20		11		30		88	2	27		20	1	7
80		22	4	10		2	1	9		8		22		77	1	30	10	24	4	8
90		5	1	1				1		2		1		11		5	1	7		1
100		1		3		1		1				1		5		2		2		1
110		3	1	2				1	1			1		7		3	3	6		1
120		2				1		2		2		1		3			1	2		
130		1		2		3				2		1				2	3	6		
140		1	1	2		1								2			1	3		1
150		1	2	1		2	1							1				6		2
160					1	1		1		1				3		1		3		2
170		1	2	4				1		3				3				4		
180	1			3						1		1		1		1		2		2
190		4				1								1				1		1
200		1		2		1														
210		1	1	2						1										1
220				2										2						
230		1		1		1												1		
240						1														
250	1			1																
260																				
270															1					
280																				
290						1	1					1								
300		1																		
310																				
320														1						
330																				
340		1																		
350		1			1										1					
360																				
370																				
380																1				
390				1	1															
400																				
410																				
420																				
430																				
440																				
450																				
460																				
470																				
480																				
490																				
500																				
Total:	4	146	35	87	6	32	5	47	1	32	0	60	0	222	8	74	19	91	5	27

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	**Bill's Creek** Jul 27 DS	Jul 27 US	Aug 18 DS	Aug 18 US	Aug 19 DS	Aug 19 US	Aug 20 DS	Aug 20 US	Aug 21 DS	Aug 21 US	Aug 22 DS	Aug 22 US
0												
10												
20												
30				1								
40			1	2								
50												
60												
70		3	1	1								
80		8	2	3		1	1	1	1			
90			3	4				4	5	4	3	2
100				1			1	1				1
110												
120		1		1		1						
130			1			1				1		
140				1			1		1			1
150									2			
160			1			1						
170							2					
180	1		2			2	1				1	
190			1			1		1	1			
200				1								
210		1					1					
220												
230												
240							1					
250						1	2					
260			1						1			
270								1	3			
280									2			
290									1			
300									1			
310			1				1		1			
320			1				3		1		1	
330							2		2			
340									2			
350						1	1		1			
360							1		1			
370												
380												
390												
400												
410												
420												
430												
440												
450												
460												
470												
480												
490												
500												
Total:	1	13	15	15	0	9	18	8	26	5	5	4

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	**Bill's Creek at Lake Outlet**											
	Jul 16	Jul 17	Jul 18	Jul 19	Jul 20	Jul 21	Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	Jul 27
	US	US	US	US	US	US	US	US	US	US	US	US
0												
10												
20												
30												
40												
50												
60	1	1	1				2	3	2		2	
70	5	4	2				5	3	34	7	20	
80	1	2	2				10	4	29	9	42	2
90	1	1				1	4	1	13	4	7	1
100	2	3		1		1	2		2		2	
110	2	6	1	3		3	3	4	6	1	13	
120	3	4		1		1	5	3	7	9	19	
130	1	2	1				3	3	1	6	16	
140	1	1				2	2	1	2	2	8	
150	2	1		1			1	2		2	3	
160	2	2					1	1	3		6	2
170	1						2			2	8	1
180	3	1					2			4	2	1
190	1	1				2	2			3	2	1
200	1	1		2								
210	4		1			2		1		1		
220	3	1							1		1	2
230		1		1								
240	1			1			1	1		1		
250	1											
260				1			1		1			
270	3			2								
280					1							
290												
300	1	1						1	1			
310				1								
320	1											
330								1				
340												
350												
360	1											
370				1								
380												
390								1				
400	1											
410												
420												
430												
440	1											
450												
460												
470												
480												
490												
500												
Total:	44	33	8	15	1	12	46	30	102	51	151	10

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	**Crea Creek** Jun 16 US	Jun 17 US	Jun 20 DS	Jun 21 US	Jun 22 DS	Jun 22 US	Jul 10 DS	Jul 10 US	Jul 11 DS	Jul 11 US	Jul 12 DS	Jul 12 US	Jul 13 DS	Jul 13 US
0														
10														
20														
30														
40														
50														3
60								3		2	1	6		17
70								5		2		9		13
80								1				3		5
90								4				2		1
100							1	6		4		3		4
110		1		2				4	1	3		2		4
120		1						3				6		1
130								2				2		2
140		1						4		1				
150			1					2						1
160			1		1			9		2		2		4
170	1							5		1				3
180								1		1		1		2
190				1				3				1		2
200								4						1
210		2						1						1
220				1				1				2		
230		1						1		1				
240							1			1				1
250								1				1		
260								2		1				
270				1				1						
280								2						
290														
300				1				1						1
310				1										1
320										1				
330								3		1		2		
340		1								3		1		
350						1		2		1	1			
360				2				2		1		1	1	
370							1	4		1				
380								1		2		1		
390							1			1				
400								2						
410														
420														
430														
440														
450														
460														
470														
480														
490														
500														
Total:	1	7	2	9	1	1	4	80	1	30	2	45	1	67

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	**Crea Creek** Jul 14 DS	Jul 14 US	Jul 15 DS	Jul 15 US	Jul 16 DS	Jul 16 US	Jul 17 DS	Jul 17 US	Jul 18 DS	Jul 18 US	Jul 19 DS	Jul 19 US	Jul 20 DS	Jul 20 US	Jul 21 DS	Jul 21 US	Jul 22 DS	Jul 22 US	Jul 23 DS	Jul 23 US
0																				
10																				
20																				
30																				
40																				
50		2		1		6		5				2		1						
60		22		21	1	69	4	71	4	6		30	2	9		10		12	1	3
70		32	4	36	1	69	6	52	2	7		28	3	7		12	1	12	11	2
80		16	1	9	1	17		11	1	2		6		5		3		3		1
90		1		6		5		6				1						3	2	
100		5		4		10		5	2	1		2		2				1		
110		4		6		12				3		1		1						
120		4		3		2		4		1		2		1		5		2		
130		4		1		2		1		1		1				1				1
140				2		1		1				2								
150		3		5		3		1								1		1		
160		4		1		5		2								1		2		
170		3				4	1	1				1				1	1			
180		1				3		2						2		1			1	
190		2		1		1				2		2	1			1		1		
200		2		2		2						1								
210				2	1	2								2		1		1		
220		2		1		2										1	1		1	
230														1						
240								2									1			
250						1														
260				1									1			1				
270		1										1								
280		2							1					1			1		1	
290		1		3	1															
300		1		3													1			
310		1				1		1											1	
320				1					1											
330			1													1	1			
340				2												1	3			
350		2		1	1			1	2										1	
360		2		1	1	1	1	2									2			
370		1		1			1													
380								1									1			
390																				
400																				
410																				
420																				
430																				
440																				
450																				
460																				
470																				
480																				
490																				
500																				
Total:	0	118	6	114	7	218	13	169	13	23	0	80	7	32	0	41	13	38	19	7

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	**Crea Creek** Jul 24		Jul 25		Jul 26		Jul 27		Aug 18		Aug 19		Aug 20		Aug 21		Aug 22	
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0																		
10																		
20																		
30									1		1							
40											1				1			
50																		
60	1	4				5	2	2										
70	1	8		3		16	4	1	11		1				1			
80	3	3		3		5	3		15		5	1			5			
90						2			19			2			2			
100						1	1		3			1						
110		1				1					1							
120								1					1		1			
130							1		1									
140		1									1			1				
150		1				1												
160						1												
170	1					2												
180							1				1							
190	2									1	1							
200	1					1												
210	3				1		1											
220	2						1											
230	2					1											1	
240																		
250	1						1											
260	1																	
270	1						1											
280	4						1											
290	2						1											
300	2																	
310	1						1											
320	3						1						1					
330	2																	
340	3																	
350					1		1											
360																		
370					1													
380																		
390																		
400																		
410																		
420																		
430																		
440																		
450																		
460																		
470																		
480																		
490																		
500																		
Total:	36	18	0	6	3	36	21	4	50	1	12	4	2	1	10	0	1	0

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	**Ublutuoch River**																	
	Jun 17	Jun 18	Jun 19	Jun 20	Jun 21	Jun 22	Jul 10		Jul 11		Jul 12		Jul 13		Jul 14		Jul 15	
	US	US	US	US	US	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0																		
10																		
20																		
30																		
40																		
50								1		1					1	2		
60										3		3		3		5		5
70								2		2		2		4		13		4
80										1						1		
90								1			1							
100						13								1		5		
110						22		1		1				2		9		
120						14						1		2		1		
130						15	1			2		1		1		1		
140						39		2		1		1				2		1
150						72				1						4		
160						44		1				1		1	1	1		3
170						26						1		1		3		1
180						15												
190		1				28		1		2					1			
200						24		1										
210						16									1	1		
220						15												
230		2				6												
240	1	2	3			8										1		
250	1					2				1								
260	1					3												
270	3	1				3										1		
280	7	1				2				1						1		
290	10					2												
300	6																	
310	3					5												
320	2					3				1								
330	3					4												
340	3																	
350	2					1												
360		1								1								1
370	1							1										
380						4												
390	2					2	1											
400																		
410																		
420	1																	
430																		
440																		
450																		
460																		
470																		
480																		
490																		
500																		
Total:	46	8	3	0	0	388	2	11	0	18	1	10	0	15	4	51	0	15

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	**Ublutuoch River**																			
	Jul 16		Jul 17		Jul 18		Jul 19		Jul 20		Jul 21		Jul 22		Jul 23		Aug 18		Aug 19	
	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS	US
0																				
10																				
20																				
30																				
40																				
50		1																		
60		2				1				1										
70										2								2		
80					1	1														
90																		2	1	
100																			1	
110		1									1									
120																		1		
130																				
140																				
150															1					
160															1					
170																	1			
180																				
190		1															1	2		
200																				
210																				
220																	1			
230							1											1		
240																		1		
250																		2		
260																				
270																				
280						1												1		
290																				
300																		1		
310																				
320																		2		
330																		2		
340							1							1		1				
350																1				
360																1				
370														1						
380																1				
390																1				
400											1									
410																				
420																				
430																				
440																				
450																				
460																				
470																				
480																				
490																				
500																				
Total:	0	5	0	0	1	3	2	0	0	3	2	0	0	2	0	7	3	17	2	0

Appendix Table C-1. Length frequencies of Arctic grayling caught by fyke net in eastern NPR-A, 2005.

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

Appendix Table C-2. Length frequencies of broad whitefish caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	**Bill's Creek** Jul 10		Jul 11		Jul 12		Jul 15		Jul 18		Jul 20		Jul 22		Jul 23		Jul 26		Aug 20	
	DS	US	DS	US	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												1								
100								1												
110																				
120																				
130																				
140																				
150																				
160																				
170																				
180																				
190																				
200																				
210																				
220																				
230																				
240																				
250																				
260																				
270																				
280																				
290																				
300																				
310																				
320																				
330																				
340																				
350																				
360		1																		
370				1										1		1				
380		1																		
390		1						1												
400		1				1												1		
410				5		1														
420																				
430	1			1																
440	1																			
450		2	1	1																
460		1		1																
470		3	1	1		1														
480																				
490																			1	
500				2																
510																				
520																				
530																				
540										1										
550																				
560																				
570																				
580		1																		
590																				
Total:	2	11	2	12	0	3	1	1	0	1	0	1	0	1	0	1	0	1	1	0

Appendix Table C-2. Length frequencies of broad whitefish caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	Bill's Creek at Lake Outlet			Crea Creek		
	Jul 16	Jul 19	Jul 23	Jun 17	Jun 21	Jul 10
	US	US	US	US	US	US
0						
10						
20						
30						
40						
50						
60						
70						
80						
90	1					
100						
110						
120						
130						
140						
150						
160						
170						
180						
190						
200						
210						
220						
230						
240						
250						
260						
270						
280						
290						
300						
310						
320						
330						
340						
350						
360	1					
370						
380	1		1			
390			1			
400						
410						
420						
430	1					
440						
450						
460				1	1	
470						
480						1
490						1
500						
510						
520						
530						
540	1					
550						
560						
570						
580				1		
590		1				
Total:	5	1	2	2	1	2

Appendix Table C-2. Length frequencies of broad whitefish caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	**Ublutuoch River** Jul 15		Jul 21		Jul 23		Jul 24		Jul 25		Jul 26		Jul 27		Jul 28	
	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			1													
100										1		1				
110																
120																
130																
140																
150																
160		1														
170																
180																
190		2														
200																
210																
220																
230																
240																
250																
260																
270																
280																
290																
300																
310																
320																
330																
340																
350																
360					1		1									
370						1							1			
380																
390																
400																
410						1										
420																
430																
440															1	
450																
460																
470																
480																
490																
500																
510																
520																
530																
540						1										
550																
560						1										
570															1	
580																
590						1										
Total:	0	3	1	0	1	2	1	0	0	1	0	1	1	0	1	0

Appendix Table C-2. Length frequencies of broad whitefish caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	**Ublutuoch River** Aug 18 DS	Aug 18 US	Aug 19 DS	Aug 19 US	Aug 20 DS	Aug 20 US	Aug 22 DS	Aug 22 US
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								
310								
320					1			
330								
340								
350	3		1					
360								
370	1						1	
380	3							
390			1					
400								
410								
420								
430								
440								
450								
460								
470								
480								
490								
500								
510								
520								
530								
540								
550								
560								
570								
580								
590								
Total:	7	0	2	0	1	0	1	0

Appendix Table C-3. Length frequencies of humpback caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	Bill's Creek						Bill's Creek at Lake Outlet		
	Jul 10 US	Jul 11 US	Jul 12 US	Jul 14 US	Jul 17 US	Jul 20 DS	Jul 16 US	Jul 17 US	Jul 19 US
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									
310									
320									
330									
340									
350					1				
360	1								1
370			1					1	
380			1					1	
390	1			1					
400						1	1		
410	1								
420		1					1		
430									
440									
450		1							
460									
470									
480									
490									
500									
Total:	3	2	2	1	1	1	2	2	1

Appendix Table C-3. Length frequencies of humpback caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	**Ublutuoch River**											
	Jul 10 DS	Jul 12 DS	Jul 23 DS	Jul 23 US	Jul 25 DS	Jul 27 DS	Jul 28 DS	Aug 18 DS	Aug 19 DS	Aug 20 DS	Aug 21 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												
280												
290												
300												
310												
320												
330												
340												
350			1									
360					1		1	1				
370	1			1								
380								1	1		1	
390		1			1	1		1				
400					1				1			
410									1			
420					2		1					
430								1				1
440			1					2				
450										1		
460												
470												
480												
490												
500												
Total:	1	1	2	1	5	1	2	6	3	1	1	1

Appendix Table C-4. Length frequencies of least cisco caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	**Bill's Creek** Jul 15 DS	Jul 16 DS	Jul 16 US	Jul 18 US	Jul 27 US	Aug 18 DS	**Crea Creek** Jul 17 US	**Ublutuoch River** Jul 11 US	Jul 23 DS	Jul 23 US	Jul 24 DS	Jul 25 US	Jul 27 US
0													
10													
20													
30													
40													
50													
60													
70													
80													
90													
100													
110													
120													
130													
140													
150								1					
160		1		1			1			3		1	
170													1
180								1		1		1	
190						1					1		1
200												1	
210	1												
220													
230												1	
240			1										
250									1	1	1		
260													
270													
280													
290													
300												1	
310					1								
320													
330	1												
340													
350													1
360													
370													
380													
390													
400													
410													
420													
430													
440													
450													
460													
470													
480													
490													
500													
Total:	2	1	1	1	1	1	0	1	0	2	1	5	2	5	3

Appendix Table C-4. Length frequencies of least cisco caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	**Ublutuoch River** Jul 28 DS	Jul 28 US	Aug 18 DS	Aug 20 DS	Aug 21 DS
0					
10					
20					
30					
40					
50					
60					
70					
80					
90					
100					
110		1			
120					
130					
140					
150					
160					
170		1			
180					
190	1			1	
200			1		1
210					
220					
230					
240					
250					
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:	1	2	1	1	2

Appendix Table C-5. Length frequencies of round whitefish caught by fyke net in eastern NPR-A, 2005.

Round Whitefish

Fork	**Bill's Creek**			**Ublutuoch River**												
Length	Jul 20	Jul 22	Jul 24	Jun 22	Jul 11	Jul 14	Jul 15	Jul 23	Jul 25	Jul 25	Jul 27	Jul 28	Aug 18	Aug 20	Aug 22	Aug 23
(mm)	US	US	US	US	US	US	US	US	DS	US	US	US	DS	DS	DS	DS
0																
10																
20																
30																
40																
50																
60																
70																
80																
90																
100																
110	1										1					
120										1						
130		1	2													
140						1	1				1					
150				1				1	1						1	
160					1											
170												1	1			
180					2											
190																
200																
210																
220																
230																
240																
250																
260																
270																
280																
290																
300																
310																
320																
330																
340														1		
350																
360																1
370																1
380																1
390																
400															1	
410																
420																
430																
440																
450																
460																
470																
480																
490																
500																
Total:	1	1	2	1	3	1	1	1	1	1	2	1	1	1	2	3

Appendix Table C-6. Length frequencies of slimy sculpin caught by fyke net in eastern NPR-A, 2005.

Fork Length (mm)	Bill's Creek								Crea Creek			Ublutuoch River
	Jul 13	Jul 20	Jul 21	Jul 24	Jul 25	Jul 26	Jul 27	Aug 18	Jul 23	Jul 24	Aug 22	Aug 19
	US	US	US	US	US	US	US	DS	US	US	DS	DS
0												
10												
20												
30												
40										1		
50									1			
60			1		1							
70	1			1		1	1					
80												1
90				1				1			1	
100		1					1					
110		1										
120												
130												
140												
150												
160												
170												
180												
190												
200												
210												
220												
230												
240												
250												
Total:	1	2	1	2	1	1	2	1	1	1	1	1

APPENDIX D

Population estimates for Arctic grayling based on tag recaptures, 2004-2005

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

2004 - Ublutuoch Study Area

	C_i		M_i	R_i					
	Number	Tags	Cum	Tags	Schnabel	Schumacher-Eschmeyer			
Date	Caught	Released	Released	Recapped	Est.	$C_i M_i$	$M_i R_i$	$C_i M_i^2$	R_i^2/C_i
6/16/2004	41	41	41		38	1,681	0	68,921	0.000
6/17/2004	9	9	50		10	450	0	22,500	0.000
6/18/2004	14	14	64		20	896	0	57,344	0.000
6/19/2004	49	46	110		123	5,390	0	592,900	0.000
6/20/2004	24	23	133		73	3,192	0	424,536	0.000
6/21/2004	13	13	146		43	1,898	0	277,108	0.000
6/22/2004	1	1	147		3	147	0	21,609	0.000
6/23/2004	4	3	150		14	600	0	90,000	0.000
6/24/2004	7	7	157	2	25	1,099	314	172,543	0.571
7/10/2004	8	8	165		30	1,320	0	217,800	0.000
7/11/2004	1	1	166		4	166	0	27,556	0.000
7/12/2004	8	5	171		31	1,368	0	233,928	0.000
7/13/2004	16	12	183	2	67	2,928	366	535,824	0.250
7/14/2004	22	21	204		102	4,488	0	915,552	0.000
7/15/2004	16	15	219	1	80	3,504	219	767,376	0.063
7/16/2004	38	36	255	1	220	9,690	255	2,470,950	0.026
7/17/2004	25	20	275	4	156	6,875	1,100	1,890,625	0.640
7/18/2004	11	9	284	3	71	3,124	852	887,216	0.818
7/19/2004	16	15	299		109	4,784	0	1,430,416	0.000
7/20/2004	54	53	352	2	432	19,008	704	6,690,816	0.074
7/21/2004	27	26	378	1	232	10,206	378	3,857,868	0.037
7/22/2004	18	17	395		162	7,110	0	2,808,450	0.000
7/23/2004	18	17	412	1	169	7,416	412	3,055,392	0.056
7/29/2004	10	4	416	3	95	4,160	1,248	1,730,560	0.900
7/30/2004	13	13	429	3	127	5,577	1,287	2,392,533	0.692
7/31/2004	5	5	434		49	2,170	0	941,780	0.000
8/1/2004	18	15	449	2	184	8,082	898	3,628,818	0.222
8/2/2004	41	40	489	6	456	20,049	2,934	9,803,961	0.878
8/3/2004	12	12	501		137	6,012	0	3,012,012	0.000
8/4/2004	20	20	521	5	237	10,420	2,605	5,428,820	1.250
8/18/2004	7	6	527	2	84	3,689	1,054	1,944,103	0.571
8/19/2004	19	12	539	1	233	10,241	539	5,519,899	0.053
8/20/2004	17	7	546	1	211	9,282	546	5,067,972	0.059
8/21/2004	5	2	548		62	2,740	0	1,501,520	0.000
8/22/2004	1		548	2	12	548	1,096	300,304	4.000
8/23/2004	7	7	555	1	88	3,885	555	2,156,175	0.143
8/24/2004	2	2	557		25	1,114	0	620,498	0.000
Totals:	617	557		43		185,309	17,362	71,566,185	11.303

Schnabel Estimate:		4,212	**Schumacher-Eschmeyer Estimate:**		4,122
-95%	57.921	3,145	-95%	0.000350	2,860
+95%	31.119	5,769	+95%	0.000136	7,376
(from Poisson dist. table)					
			s^2=	0.1970	
			$s_{(1/N)}$ =	0.00005	
			df	36	
			t.95, 30df	2.04	

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

2005 - Ublutuoch Study Area

	C_i		M_i	R_i					
	Number	Tags	Cum	Tags	Schnabel	Schumacher-Eschmeyer			
Date	Caught	Released	Released	Recapped	Est.	$C_i M_i$	$M_i R_i$	$C_i M_i^2$	R_i^2/C_i
6/17/2005	50	48	48		38	2,400	0	115,200	0.000
6/18/2005	8	8	56		7	448	0	25,088	0.000
6/19/2005	3	3	59		3	177	0	10,443	0.000
6/20/2005	2	2	61		2	122	0	7,442	0.000
6/21/2005	16	16	77		19	1,232	0	94,864	0.000
6/22/2005	152	149	226	1	537	34,352	226	7,763,552	0.007
7/10/2005	57	54	280	1	249	15,960	280	4,468,800	0.018
7/11/2005	29	27	307		139	8,903	0	2,733,221	0.000
7/12/2005	11	11	318	2	55	3,498	636	1,112,364	0.364
7/13/2005	11	9	327	1	56	3,597	327	1,176,219	0.091
7/14/2005	26	24	351	4	143	9,126	1,404	3,203,226	0.615
7/15/2005	27	24	375	4	158	10,125	1,500	3,796,875	0.593
7/16/2005	44	38	413	4	284	18,172	1,652	7,505,036	0.364
7/17/2005	29	29	442	4	200	12,818	1,768	5,665,556	0.552
7/18/2005	21	21	463		152	9,723	0	4,501,749	0.000
7/19/2005	22	19	482	4	166	10,604	1,928	5,111,128	0.727
7/20/2005	10	9	491	1	77	4,910	491	2,410,810	0.100
7/21/2005	14	14	505	2	110	7,070	1,010	3,570,350	0.286
7/22/2005	23	23	528	1	190	12,144	528	6,412,032	0.043
7/23/2005	20	20	548	6	171	10,960	3,288	6,006,080	1.800
7/24/2005	39	37	585	5	356	22,815	2,925	13,346,775	0.641
7/25/2005	13	13	598	5	121	7,774	2,990	4,648,852	1.923
7/26/2005	19	18	616	6	183	11,704	3,696	7,209,664	1.895
7/27/2005	19	19	635	3	189	12,065	1,905	7,661,275	0.474
7/28/2005	1	1	636		10	636	0	404,496	0.000
8/18/2005	22	19	655	2	225	14,410	1,310	9,438,550	0.182
8/19/2005	7	7	662	2	72	4,634	1,324	3,067,708	0.571
8/20/2005	18	16	678	2	191	12,204	1,356	8,274,312	0.222
8/21/2005	20	18	696	2	218	13,920	1,392	9,688,320	0.200
8/22/2005	5	5	701		55	3,505	0	2,457,005	0.000
8/23/2005	3	3	704	1	33	2,112	704	1,486,848	0.333
Totals:	741	704		63		282,120	32,640	133,373,840	12.000

Schnabel Estimate:		4,408	**Schumacher-Eschmeyer Estimate:**		4,086
-95%	80.604	3,457	-95%	0.000311	3,216
+95%	48.411	5,710	+95%	0.000179	5,601
(from Poisson dist. table)					
			s^2=	0.1337	
			$s_{(1/N)}$ =	0.00003	
			df	30	
			t.95, 36df	2.09	

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

2004 Crea Creek

	C_i		M_i	R_i					
	Number	Tags	Cum	Tags	Schnabel	Schumacher-Eschmeyer			
Date	Caught	Released	Released	Recapped	Est.	$C_i M_i$	$M_i R_i$	$C_i M_i^2$	R_i^2/C_i
6/16/2004	12	12	12		5	144	0	1,728	0.000
6/17/2004	3	3	15		2	45	0	675	0.000
6/18/2004	9	9	24		7	216	0	5,184	0.000
6/19/2004	24	21	45		36	1,080	0	48,600	0.000
6/20/2004	11	10	55		20	605	0	33,275	0.000
6/21/2004	11	11	66		24	726	0	47,916	0.000
6/22/2004	1	1	67		2	67	0	4,489	0.000
6/23/2004	4	3	70		9	280	0	19,600	0.000
6/24/2004	4	4	74	2	10	296	148	21,904	1.000
7/10/2004	6	6	80		16	480	0	38,400	0.000
7/11/2004			80		0	0	0	0	
7/12/2004	8	5	85		23	680	0	57,800	0.000
7/13/2004	11	8	93	2	34	1,023	186	95,139	0.364
7/14/2004	11	10	103		38	1,133	0	116,699	0.000
7/15/2004	12	11	114	1	46	1,368	114	155,952	0.083
7/16/2004	13	13	127		55	1,651	0	209,677	0.000
7/17/2004		1	128	2	0	0	256	0	
7/18/2004	7	5	133	2	31	931	266	123,823	0.571
7/19/2004	8	7	140		37	1,120	0	156,800	0.000
7/20/2004	27	26	166	2	149	4,482	332	744,012	0.148
7/21/2004	10	9	175	1	58	1,750	175	306,250	0.100
7/22/2004			175		0	0	0	0	
7/23/2004			175		0	0	0	0	
7/29/2004	10	4	179	3	60	1,790	537	320,410	0.900
7/30/2004	9	9	188	3	56	1,692	564	318,096	1.000
7/31/2004			188		0	0	0	0	
8/1/2004	3	2	190	2	19	570	380	108,300	1.333
8/2/2004	11	10	200	3	73	2,200	600	440,000	0.818
8/3/2004	2	2	202		13	404	0	81,608	0.000
8/4/2004	3	4	206	2	21	618	412	127,308	1.333
8/18/2004	4	3	209	2	28	836	418	174,724	1.000
8/19/2004	4	1	210		28	840	0	176,400	0.000
8/20/2004	8	3	213	1	57	1,704	213	362,952	0.125
8/21/2004	4	1	214		29	856	0	183,184	0.000
8/22/2004	1		214	1	7	214	214	45,796	1.000
8/23/2004	2	2	216		14	432	0	93,312	0.000
8/24/2004			216		0	0	0	0	
Totals:	253	216		29		30,233	4,815	4,620,013	9.776

Schnabel Estimate: 1,008

-95% 57.9207 709

+95% 31.1193 1,480

(from Poisson dist. table)

Schumacher-Eschmeyer Estimate: 960

-95% 0.001420 704

+95% 0.000664 1,506

s^2= 0.1586

$s_{(1/N)}$ = 0.00019

df 30

t.95, 30df 2.04

Appendix Table D-4. Population estimates of Arctic grayling (180 mm or longer) using the Schnabel and Schumacher-Eshmeyer estimators.

2005 Crea Creek

	C_i		M_i	R_i					
	Number	Tags	Cum	Tags	Schnabel	Schumacher-Eschmeyer			
Date	Caught	Released	Released	Recapped	Est.	$C_i M_i$	$M_i R_i$	$C_i M_i^2$	R_i^2/C_i
6/17/2005	4	4	4		1	16	0	64	0.000
6/18/2005			4		0	0	0	0	
6/19/2005			4		0	0	0	0	
6/20/2005			4		0	0	0	0	
6/21/2005	7	7	11		3	77	0	847	0.000
6/22/2005	1	1	12		0	12	0	144	0.000
7/10/2005	36	33	45	1	56	1,620	45	72,900	0.028
7/11/2005	15	13	58		30	870	0	50,460	0.000
7/12/2005	11	11	69	2	26	759	138	52,371	0.364
7/13/2005	10	8	77	1	27	770	77	59,290	0.100
7/14/2005	18	17	94	4	58	1,692	376	159,048	0.889
7/15/2005	20	18	112	3	77	2,240	336	250,880	0.450
7/16/2005	17	14	126	3	74	2,142	378	269,892	0.529
7/17/2005	11	12	138	2	52	1,518	276	209,484	0.364
7/18/2005	6	6	144		30	864	0	124,416	0.000
7/19/2005	4	3	147	1	20	588	147	86,436	0.250
7/20/2005	8	7	154	1	42	1,232	154	189,728	0.125
7/21/2005	7	7	161	1	39	1,127	161	181,447	0.143
7/22/2005	13	13	174		78	2,262	0	393,588	0.000
7/23/2005	5	5	179	3	31	895	537	160,205	1.800
7/24/2005	30	28	207	3	214	6,210	621	1,285,470	0.300
7/25/2005			207		0	0	0	0	
7/26/2005	5	5	212	2	37	1,060	424	224,720	0.800
7/27/2005	10	10	222		77	2,220	0	492,840	0.000
7/28/2005			222		0	0	0	0	
8/18/2005	1		222		8	222	0	49,284	0.000
8/19/2005	2	2	224		15	448	0	100,352	0.000
8/20/2005	1	1	225		8	225	0	50,625	0.000
8/21/2005			225		0	0	0	0	
8/22/2005	1	1	226		8	226	0	51,076	0.000
8/23/2005			226	1	0	0	226	0	
Totals:	243	226		28		29,295	3,896	4,515,567	6.141

Schnabel Estimate:		1,010	**Schumacher-Eschmeyer Estimate:**			1,159
-95%	40.468	706		-95%	0.001155	866
+95%	18.606	1,494		+95%	0.000571	1,753
(from Poisson dist. table)						
				s^2=	0.0927	
				$s_{(1/N)}$ =	0.00014	
				df	30	
				t.95, 30df	2.04	

Appendix Table D-5. Population estimates of Arctic grayling (180 mm or longer) using the Schnabel and Schumacher-Eshmeyer estimators.

2004 Bill's Creek

	C_i		M_i	R_i					
	Number	Tags	Cum	Tags	Schnabel	Schumacher-Eschmeyer			
Date	Caught	Released	Released	Recapped	Est.	$C_i M_i$	$M_i R_i$	$C_i M_i^2$	R_i^2/C_i
6/16/2004			0		0	0	0	0	
6/17/2004			0		0	0	0	0	
6/18/2004			0		0	0	0	0	
6/19/2004			0		0	0	0	0	
6/20/2004			0		0	0	0	0	
6/21/2004			0		0	0	0	0	
6/22/2004			0		0	0	0	0	
6/23/2004			0		0	0	0	0	
6/24/2004			0		0	0	0	0	
7/10/2004			0		0	0	0	0	
7/11/2004			0		0	0	0	0	
7/12/2004			0		0	0	0	0	
7/13/2004	5	4	4		2	20	0	80	0.000
7/14/2004	6	6	10		6	60	0	600	0.000
7/15/2004	2	2	12		2	24	0	288	0.000
7/16/2004	24	22	34		82	816	0	27,744	0.000
7/17/2004	25	19	53	2	133	1,325	106	70,225	0.160
7/18/2004	4	4	57	1	23	228	57	12,996	0.250
7/19/2004	8	8	65		52	520	0	33,800	0.000
7/20/2004	27	27	92		248	2,484	0	228,528	0.000
7/21/2004	17	17	109		185	1,853	0	201,977	0.000
7/22/2004	18	17	126		227	2,268	0	285,768	0.000
7/23/2004	18	17	143	1	257	2,574	143	368,082	0.056
7/29/2004			143		0	0	0	0	
7/30/2004			143		0	0	0	0	
7/31/2004	1	1	144		14	144	0	20,736	0.000
8/1/2004	14	12	156		218	2,184	0	340,704	0.000
8/2/2004	6	6	162		97	972	0	157,464	0.000
8/3/2004	4	4	166		66	664	0	110,224	0.000
8/4/2004	10	10	176	3	176	1,760	528	309,760	0.900
8/18/2004	3	3	179		54	537	0	96,123	0.000
8/19/2004	14	10	189	1	265	2,646	189	500,094	0.071
8/20/2004	9	4	193		174	1,737	0	335,241	0.000
8/21/2004	1	1	194		19	194	0	37,636	0.000
8/22/2004			194	1	0	0	194	0	
8/23/2004	5	5	199		100	995	0	198,005	0.000
8/24/2004			199		0	0	0	0	
Totals:	221	199		9		24,005	1,217	3,336,075	1.437

Schnabel Estimate:		2,401	**Schumacher-Eschmeyer Estimate:**			2,741
-95%	17.085	1,327		-95%	0.000620	1,613
+95%	4.115	4,693		+95%	0.000110	9,105
(from Poisson dist. table)						
				s^2=	0.0497	
				$s_{(1/N)}$ =	0.00012	
				df	20	
				t.95, 20df	2.09	

Appendix Table D-6. Population estimates of Arctic grayling (180 mm or longer) using the Schnabel and Schumacher-Eshmeyer estimators.

2005 Bill's Creek

	C_i		M_i	R_i					
	Number	Tags	Cum	Tags	Schnabel	Schumacher-Eschmeyer			
Date	Caught	Released	Released	Recapped	Est.	$C_i M_i$	$M_i R_i$	$C_i M_i^2$	R_i^2/C_i
6/17/2005			0		0	0	0	0	
6/18/2005			0		0	0	0	0	
6/19/2005			0		0	0	0	0	
6/20/2005	2	2	2		0	4	0	8	0.000
6/21/2005	9	9	11		3	99	0	1,089	0.000
6/22/2005	8	8	19		5	152	0	2,888	0.000
7/10/2005	17	18	37		21	629	0	23,273	0.000
7/11/2005	8	8	45		12	360	0	16,200	0.000
7/12/2005			45						
7/13/2005	1	1	46		2	46	0	2,116	0.000
7/14/2005	2	2	48		3	96	0	4,608	0.000
7/15/2005	6	6	54	1	11	324	54	17,496	0.167
7/16/2005	26	23	77	1	67	2,002	77	154,154	0.038
7/17/2005	18	17	94	1	56	1,692	94	159,048	0.056
7/18/2005	14	14	108		50	1,512	0	163,296	0.000
7/19/2005	16	15	123	2	66	1,968	246	242,064	0.250
7/20/2005	2	2	125		8	250	0	31,250	0.000
7/21/2005	6	6	131		26	786	0	102,966	0.000
7/22/2005	8	8	139	1	37	1,112	139	154,568	0.125
7/23/2005	10	10	149	3	50	1,490	447	222,010	0.900
7/24/2005	7	7	156	2	36	1,092	312	170,352	0.571
7/25/2005	13	13	169	5	73	2,197	845	371,293	1.923
7/26/2005	9	8	177	4	53	1,593	708	281,961	1.778
7/27/2005	6	6	183	2	37	1,098	366	200,934	0.667
7/28/2005			183						
8/18/2005	7	5	188	2	44	1,316	376	247,408	0.571
8/19/2005	5	5	193	2	32	965	386	186,245	0.800
8/20/2005	15	13	206	1	103	3,090	206	636,540	0.067
8/21/2005	17	15	221	2	125	3,757	442	830,297	0.235
8/22/2005	2	2	223		15	446	0	99,458	0.000
8/23/2005			223						
Totals:	234	223		29		28,076	4,698	4,321,522	8.148

Schnabel Estimate:		936	**Schumacher-Eschmeyer Estimate:**			920
-95%	41.649	658		-95%	0.001440	695
+95%	19.422	1,375		+95%	0.000734	1,362
(from Poisson dist. table)						
				s^2=	0.1267	
				$s_{(1/N)}$ =	0.00017	
				df	24	
				t.95, 24df	2.06	