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Juvenile Dolly Varden Whole Body Metals Analyses, Red Dog Mine (2002)

by **Alvin G. Ott**
and William A. Morris

Mainstem Red Dog Creek
Photograph by Al Ott 1999

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Alaska Department of Natural Resources
Office of Habitat Management and Permitting

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By

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Table of Contents

Table of Contents (concluded).

List of Tables

List of Figures

List of Figures (concluded).

Acknowledgements

We thank Teck Cominco Alaska Inc. (TCAK) for the financial and logistical support that enabled us to sample juvenile Dolly Varden for whole body metals analyses. Support for this project began in 1993 and has continued since, with a substantial expansion in summer 2002 to address issues associated with the Delong Mountain Transportation System. In particular, we acknowledge the support given by Jim Kulas, Mark Thompson, Wayne Hall, Sam Hill, and Austin Swan Sr. of TCAK. Field work support was provided Phyllis Weber Scannell, Laura Jacobs, Nancy Ihlenfeldt, and Al Townsend of the Alaska Department of Fish and Game (ADF&G).

We want to acknowledge the fact that sampling juvenile Dolly Varden for whole body metals analyses from 1993 through 2002 was done by the ADF&G via a contract with TCAK. The project, along with funding, was transferred from ADF&G to the Alaska Department of Natural Resources (ADNR) when Habitat Division was moved to ADNR in May 2003. We continue to work cooperatively with ADF&G on this project.

Introduction

The Red Dog Mine is located in northwestern Alaska, about 130 km north of Kotzebue and 75 km inland from the coast of the Chukchi Sea (Figure 1). Lead and zinc concentrate is trucked from the mine site 82 km to the coast. The haul road is referred to as the Delong Mountain Transportation System (DMTS) and it provides the main logistical support for the movement of concentrate, equipment, supplies, and fuel between the Port Site and the mine.

Elevated concentrations of cadmium (Cd), lead (Pb), and zinc (Zn) in mosses (*Hylocomium splendens*) proximate to the DMTS near the port site were reported by the National Park Service (Ford and Hasselbach, 2001). In response to the findings by the National Park Service, Teck Cominco Alaska Inc. (TCAK) initiated several projects to mitigate potential sources of metals to the environment and to gather information on metals concentrations proximate to the DMTS (Appendix 1). TCAK also began several field studies along the DMTS that included water quality sampling and collection of juvenile Dolly Varden (*Salvelinus malma*) for whole body analyses for Cd, Pb, Se, and Zn.

Our rational for selecting juvenile Dolly Varden to determine if differences existed upstream and downstream of the DMTS was based on the following: (1) previous work by Weber Scannell et al. (2000) documented differences in metals concentrations in juvenile Dolly Varden among sample sites in the Red Dog area; (2) metals concentrations in juvenile Dolly Varden were related to major differences in water quality; (3) juvenile Dolly Varden are the most common fish species present in all the waterbodies; (4) juvenile Dolly Varden feed mainly on benthic invertebrates and thus should reflect changes that might occur in metals loading; and (5) changes in metals concentrations between years or over time should reflect yearly actual changes since each spring most juvenile Dolly Varden smolt and leave freshwater and thus the sample collected reflects fish that moved into and used the sample site during that sample year.

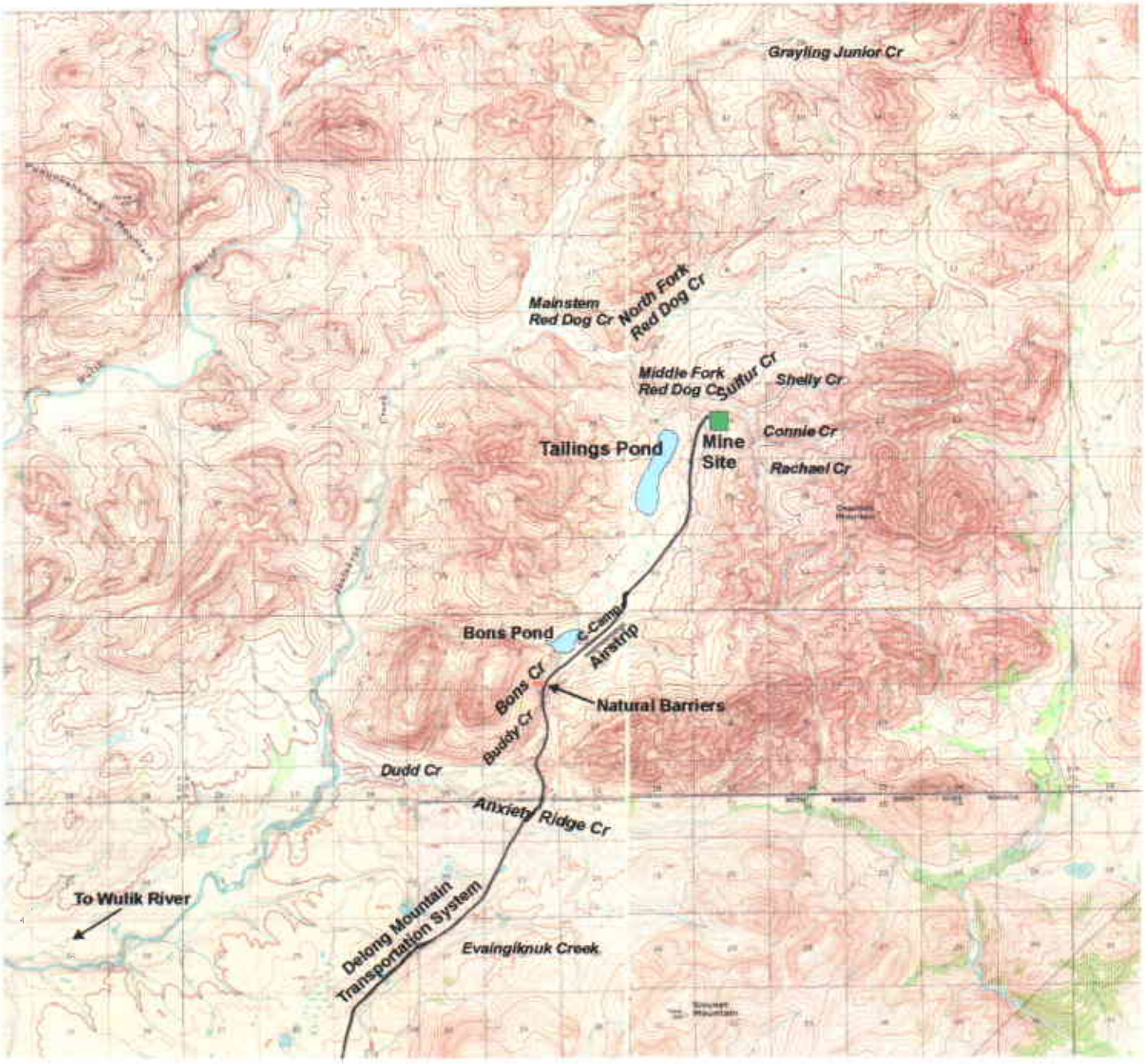

Figure 1. Facilities and waterbodies near the Red Dog Mine in northwest Alaska.

Methods

To capture juvenile Dolly Varden, we fished ten minnow traps baited with salmon roe treated with 1% betadine solution for about 24 hours in each sample reach. In 2002, we set minnow traps in Mainstem Red Dog, North Fork Red Dog, Buddy, Anxiety Ridge, and Aufeis creeks, and in the Omikviorok River (Table 1, Figures 2 and 3).

Table 1. Juvenile Dolly Varden sample sites along the Delong Mountain Transportation System and near the Red Dog Mine (2002).

Stream Name	Location	Distance from Road
South Fork Aufeis Creek	Upstream of Road	1.6 km
North Fork Aufeis Creek	Upstream of Road	1.6 km
Aufeis Creek	Downstream of Road	1.6 km
South Fork Omikviorok River	Upstream of Road	1.6 km
North Fork Omikviorok River	Upstream of Road	1.6 km
Omikviorok River	Downstream of Road	1.6km
Anxiety Ridge Creek	Upstream of Road	1.6 km
Anxiety Ridge Creek	Downstream of Road	1.6 km
Buddy Creek	Downstream of Road	1.6 km
Mainstem Red Dog Creek	Downstream of Confluence with North Fork Red Dog Creek	N/A
North Fork Red Dog Creek	Upstream (6 km) from Confluence with Mainstem Red Dog Creek	N/A

In 2002, we collected 15 juvenile Dolly Varden between 90 and 142 mm fork length from each site listed in Table 1. We followed protocol for clean techniques by wearing new latex gloves at each site for handling fish. Fish were measured to fork length, then double-bagged by placing each fish in a prelabeled, new Zip-Lock bag, then combining all fish from a given site into a larger, new Zip-Lock bag. Sample bags were placed in a

clean (acid-washed) cooler and transported back to the mine site where they were frozen until transported to Fairbanks. Before shipment of the samples to an analytical laboratory, individual fish were weighed. A tare weight for the Zip-Lock bags was determined and fish were weighed in the bag to minimize contamination. Whole fish were analyzed for Cd, Pb, selenium (Se) and Zn on a dry weight basis with percent moisture reported for each fish.

Our field procedures and methods followed our quality assurance and quality control (QA/QC) program (ADF&G 1998). QA/QC also were conducted by the laboratory on all samples. QA/QC procedures included field blanks (of reagent water), laboratory blanks, spike recoveries, and recovery of standard reference materials.

Our results and discussion focus on juvenile Dolly Varden collected in summer 2002. The number of stream reaches sampled (11) and number of fish (15) per sample reach in 2002 represent, to date, our most complete data set for juvenile Dolly Varden whole body metals analyses. Results are presented to compare whole body metals concentrations upstream and downstream from the DMTS, to compare changes in metals concentrations over time at sites with multiple years of sampling, to show the relative relationship among the various sample sites, and to evaluate the correlation between water quality and metals concentrations in juvenile Dolly Varden.

Statistical comparison of metals concentrations among more than two sites, creeks, or years was conducted using the non-parametric Kruskal-Wallis analysis of variance (AOV) (see Appendix 3 for specific results). The procedure is more robust to departures from normality than parametric tests and is more conservative than parametric tests. The corresponding parametric result however, is, presented for each Kruskal-Wallis AOV conducted. This procedure relies on ranking all data and comparing the between group ranked distributions. For all significant Kruskal-Wallis results, pairwise comparisons using alpha = 0.05 are presented. Two reporting formats of the pairwise comparisons are presented for most analyses, the Homogenous Group and the Triangle Matrix. The Triangle Matrix provides more detailed information and is presented in instances with multiple significant results. Entries in the Triangle Matrix with an asterisk indicate a significant difference between the pairs. Wilcoxon Rank Sum tests were used in

comparisons of two groups (i.e., upstream vs downstream, Creek A vs Creek B). The test is used in place of the Two-Sample T Test as it is more robust to departures from normality and nearly as powerful. This test compares the distribution of the ranks of two independent data sets and is the general basis for the Kruskal-Wallis AOV (Analytical Software, 2003). Analyses were conducted using Statistix 8.0 (Analytical Software, 2003).

Method detection limits for Cd, Pb, Se, and Zn were as follows: Cd 0.05; Pb 0.02; Se 1.0; and Zn 0.5 (all in mg/kg dry weight). Data on Cd, Pb, Se, and Zn are presented in Appendix 4.

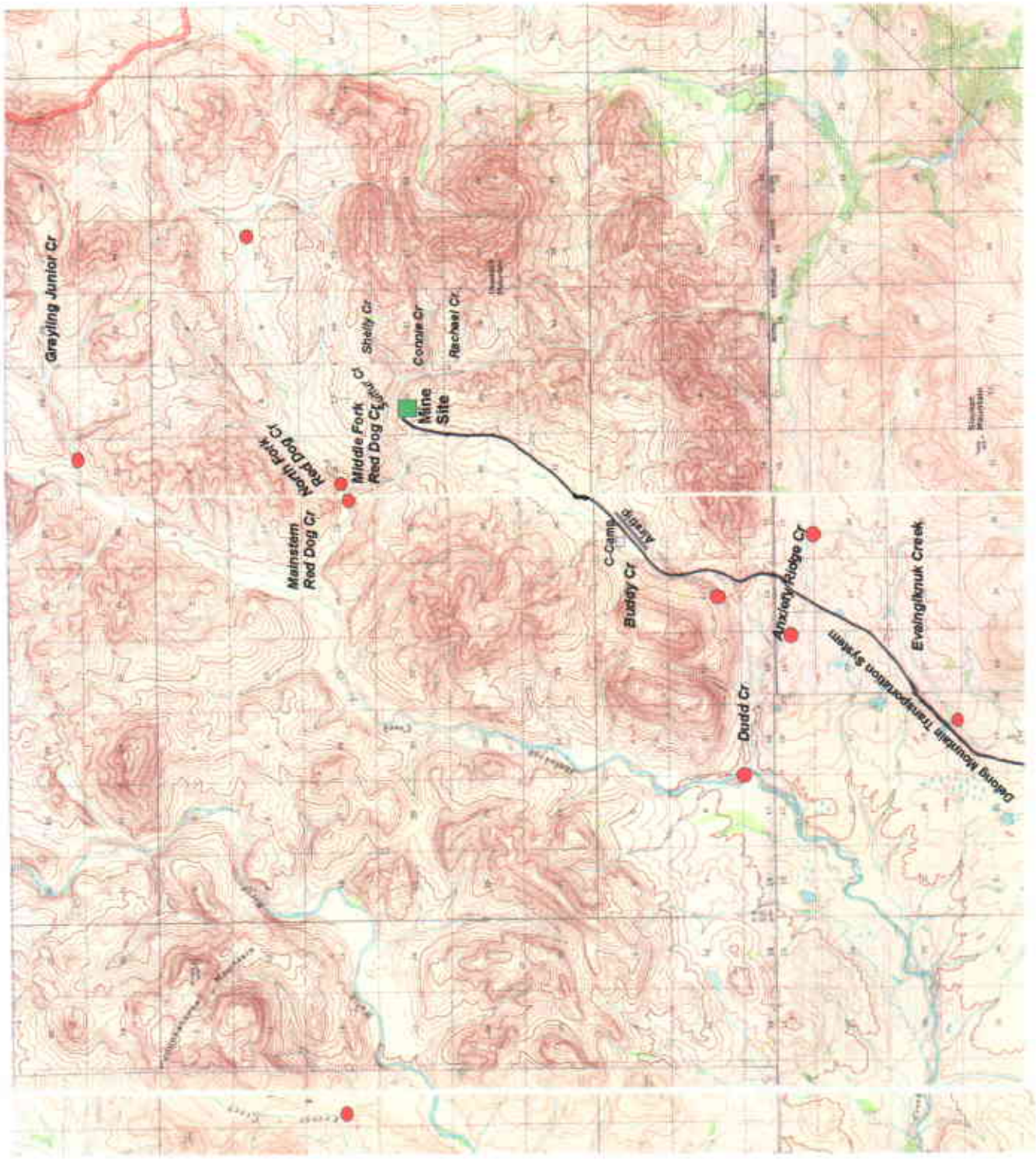

Figure 2. Juvenile Dolly Varden sample sites in the vicinity of Red Dog Mine and along the northern section of DMTS.

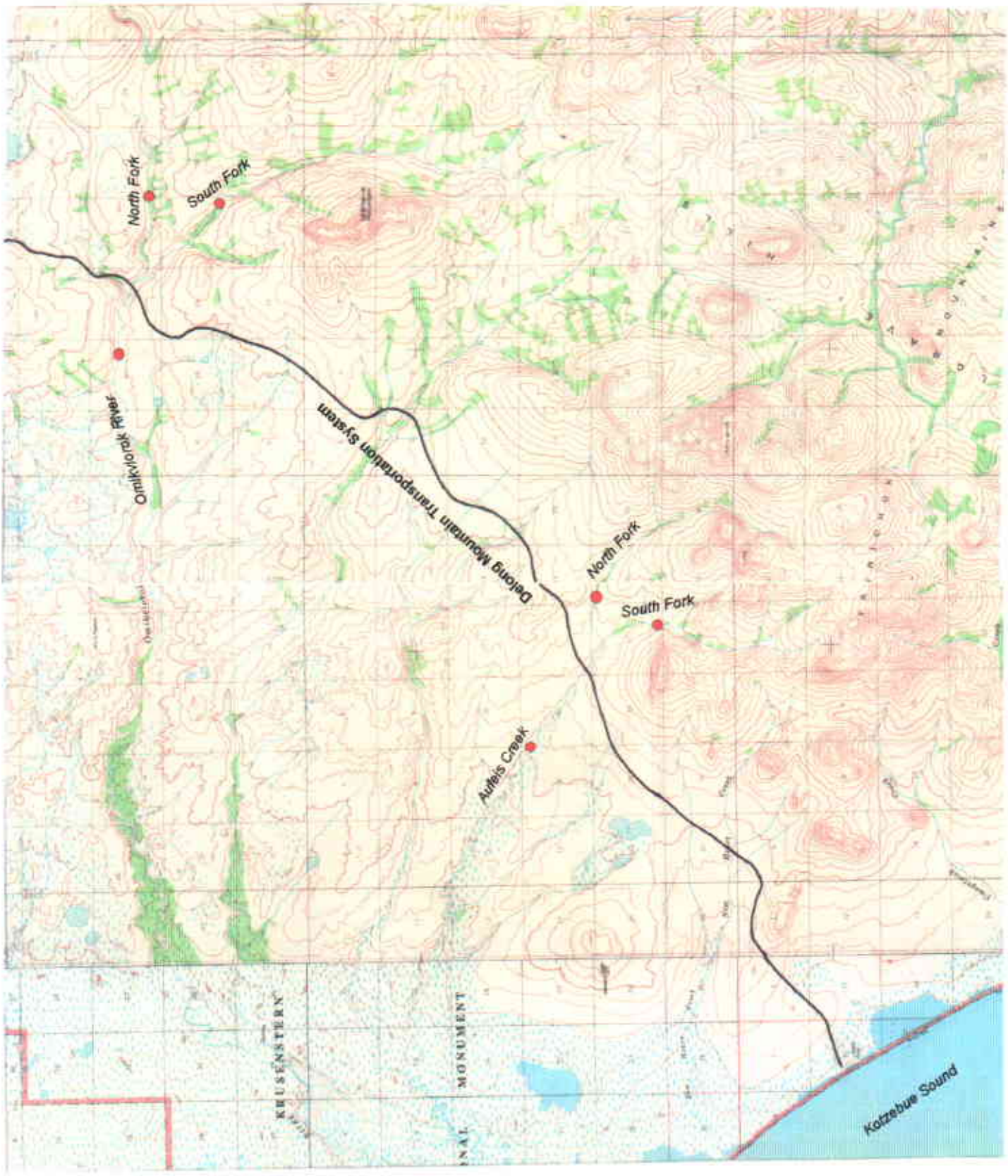

Figure 3. Juvenile Dolly Varden sample sites along the southern section of the DMTS.

Results and Discussion

Whole body metals analyses (Cd, Pb, Se, and Zn) of 165 juvenile Dolly Varden collected from 11 sites in fall 2002 were completed (Appendix 4, metals concentrations and method detection limits). Aufeis, Anxiety Ridge, and Buddy creeks and Omikviorok River (i.e., nine sites) are crossed by the DMTS and will be used to investigate potential changes in metals concentrations that may be related to fugitive dust, erosion of materials from the road, or from parent sources in the drainage. Mainstem Red Dog Creek, although not crossed by the DMTS, also was sampled in 2002.

Movement of metals to receiving waters along the DMTS could be direct by dust entering the waterbody, indirect via transport by water (i.e., erosion of road materials due to runoff), or from natural sources in the drainage. Potential sources of metals entering Mainstem Red Dog Creek include the effluent from the water treatment plant, fugitive dust, and parent sources in the drainage. No mine related facilities directly affect North Fork Red Dog Creek, thus potential sources of metals include fugitive dust and parent materials in the drainage.

Results on Cd, Pb, Se, and Zn concentrations will be presented for each site. Within each analyte, data will be reviewed for the sites along the DMTS. These data will then be compared with Buddy, Mainstem Red Dog, and North Fork Red Dog creeks. Thirdly, we will look at trends over time for those sites where multiple years of data exist. Finally, we will compare fish from streams in the Red Dog Mine area with other streams in Alaska.

Lengths of juvenile Dolly Varden in the sample set from summer 2002 are shown in Figure 4. Ages of the juvenile fish, based on length, probably range from 1 to 3 with most being age 2. Significant differences in fish length among the streams sampled in 2002 were observed (KW = 14.09, p = 0.015) (see Appendix 3 for specific results). Fish from North Fork Red Dog Creek were larger than fish from Anxiety Ridge and Mainstem Red Dog creeks. Analysis of fish length among all sample sites indicated that lengths for all groups were similar (KW = 18.945, p = 0.041). Dolly Varden retained for whole body analyses were selected at random from the sample with the provision that fish were

between 90 and 145 mm fork length. Previous work has shown that there is no correlation between length (90 to 145 mm) and concentrations of the analytes (Morris and Ott 2001).

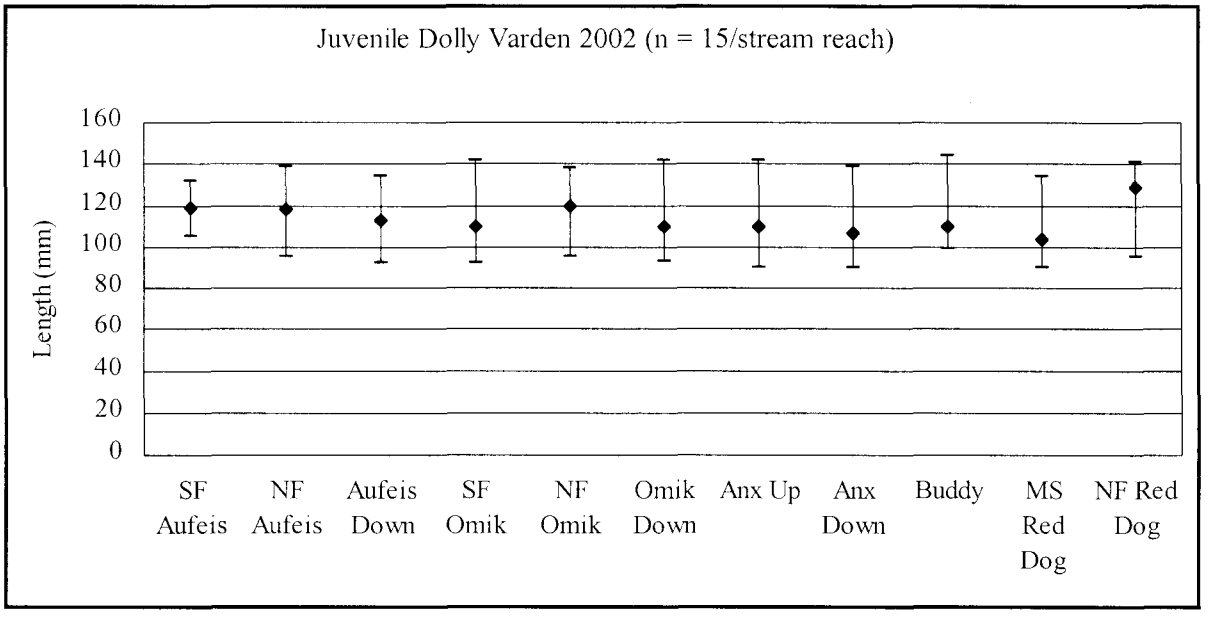

Figure 4. Length (maximum, median, and minimum) of juvenile Dolly Varden collected in South and North Fork Aufeis, South and North Fork Omikviorok and Omikviorok River, and Anxiety Ridge, Buddy, Mainstem Red Dog, and North Fork Red Dog creeks in 2002.

Cadmium Haul Road 2002

With respect to the DMTS sample streams, Cd concentrations in juvenile Dolly Varden were highest in Anxiety Ridge Creek (KW = 84.8723, p <0.0001)(Figure 5). Dolly Varden in the downstream Anxiety Ridge site had significantly higher Cd concentrations, than the upstream Anxiety Ridge Creek sample reach (W = 3.007, p = 0.0026). Rill erosion exists along the road prism in the Anxiety Ridge Creek area, particularly south of the bridge, with direct input of sediments from the road occurring during rainfall events.

Cadmium concentrations in juvenile Dolly Varden from Aufeis Creek were higher downstream of the road when compared with both the North (W = 3.452, p = 0.0006) and South forks of Aufeis Creek (W = 4.307, p <0.0001); both forks are upstream of the road.

Fish from North Fork Aufeis Creek had higher Cd concentrations than fish from South Fork Aufeis Creek (W = 2.951, p = 0.0032).

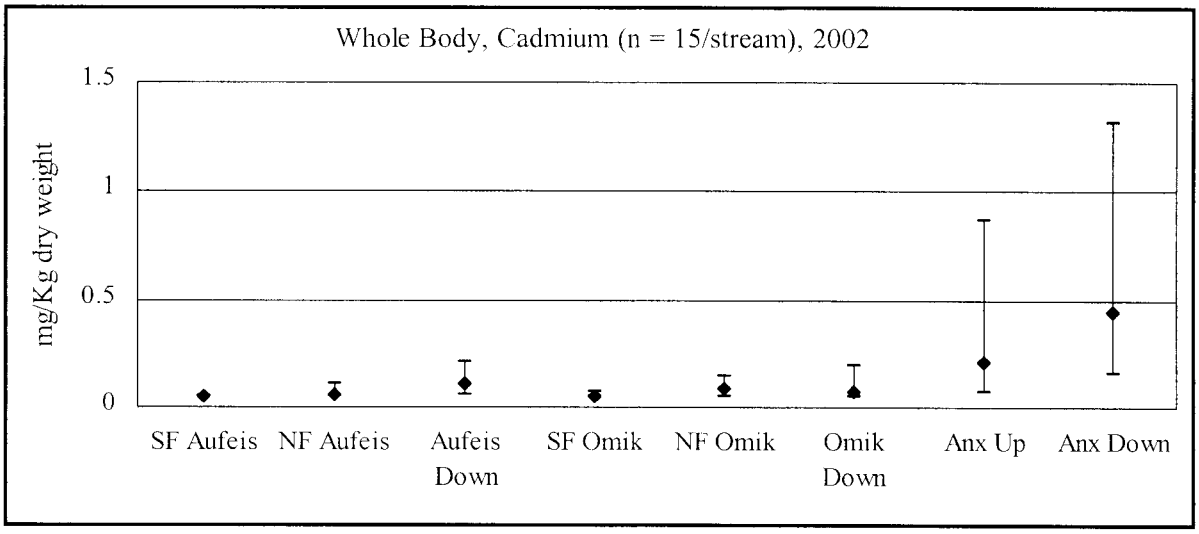

Figure 5. Whole body cadmium concentrations (maximum, median, and minimum) in juvenile Dolly Varden collected from creeks along the DMTS in 2002.

Cadmium concentrations from fish collected from the Omikviorok River were similar downstream of the road relative to the North Fork Omikviorok River upstream of the road (W = 0.884, p = 0.3766); however, concentrations of Cd from fish below the road were higher than those found in fish above the road in the South Fork Omikviorok River (W = 2.268, p = 0.0233). Cadmium concentrations from fish captured at the North Fork Omikviorok River were significantly higher than concentrations found in fish from the South Fork Omikviorok River (W = 3.319, p = 0.0009).

Pairwise comparisons of Dolly Varden sampled from all creeks along the road suggest that five sub-sets of creeks exist with similar cadmium concentrations. However, fish from Anxiety Ridge Creek, both upstream and downstream of the road, and Aufeis Creek downstream of the road, had the highest cadmium concentrations and were grouped together (Appendix 3). Fish collected downstream of the road in Anxiety Ridge Creek had the highest Cd concentrations in their tissues of all fish examined.

Cadmium Haul Road and Mine Site 2002

When all 2002 sample sites are considered, including Mainstem Red Dog, North Fork Red Dog, and Buddy creeks, the concentration of Cd in juvenile Dolly Varden was significantly higher in Mainstem Red Dog Creek (KW = 125.4750, $p < 0.0001$) (Figure 6). Pairwise comparisons of mean ranks indicate that juvenile Dolly Varden from Aufeis Creek and the Omikviorok River have similar Cd concentrations, but are considerably lower than fish from all the other streams sampled (Appendix 3).

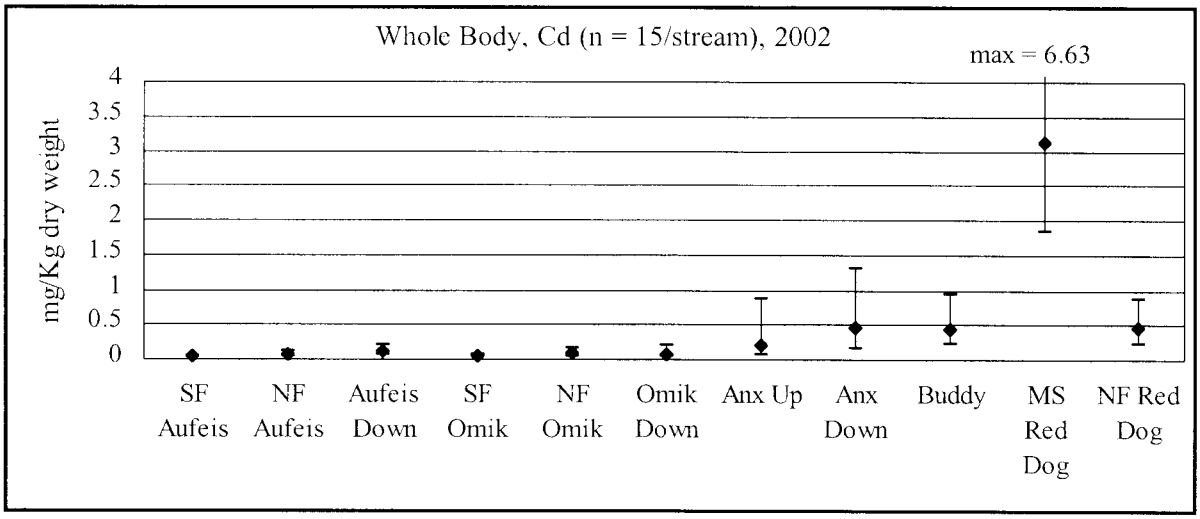

Figure 6. Whole body cadmium concentrations (maximum, median, and minimum) in juvenile Dolly Varden collected from creeks along the DMTS and near the Red Dog Mine in 2002.

Anxiety Ridge Creek Cd concentrations were higher than those observed in fish from Aufeis Creek and the Omikviorok River but similar to concentrations found in fish from Buddy and North Fork Red Dog creeks (Appendix 3). Cd concentrations in juvenile Dolly Varden from Anxiety Ridge Creek were lower than concentrations found in fish from Mainstem Red Dog Creek. Potential sources of Cd to Buddy Creek include rill erosion from the road, natural background levels, and fugitive dust.

Sample sites with the highest concentrations were close to the Red Dog mine. Sources of Cd to Mainstem Red Dog Creek include natural background levels, the wastewater treatment plant effluent, and fugitive dust. It was noted by Weber Scannell et al. (2000), that the major source of Cd in Mainstem Red Dog Creek was water in the clean-water bypass channel, and not the effluent from the water treatment plant.

Cadmium Multi-Year Data Sets

We next compared Cd concentrations in juvenile Dolly Varden collected in Anxiety Ridge, Mainstem Red Dog, and North Fork Red Dog creeks over several years. Our objective was to determine if Cd concentrations were changing with time. Generally, whole body Cd concentrations do not appear to be increasing with time for the juvenile Dolly Varden in these creeks (Figures 7, 8, and 9).

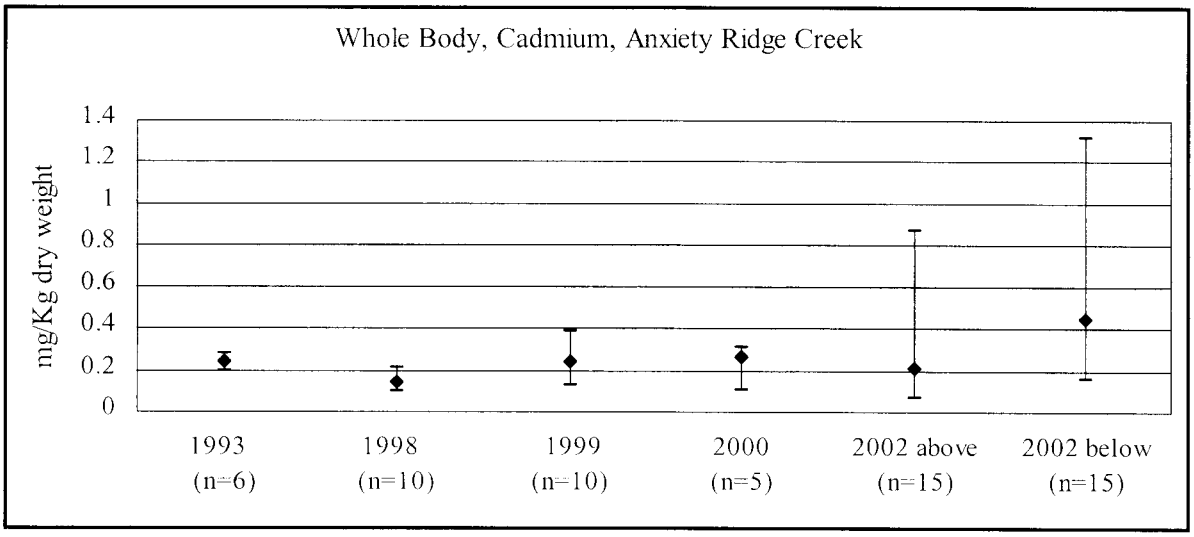

Figure 7. Whole body cadmium concentrations (maximum, median, and minimum) in juvenile Dolly Varden collected in Anxiety Ridge Creek from 1993 to 2002.

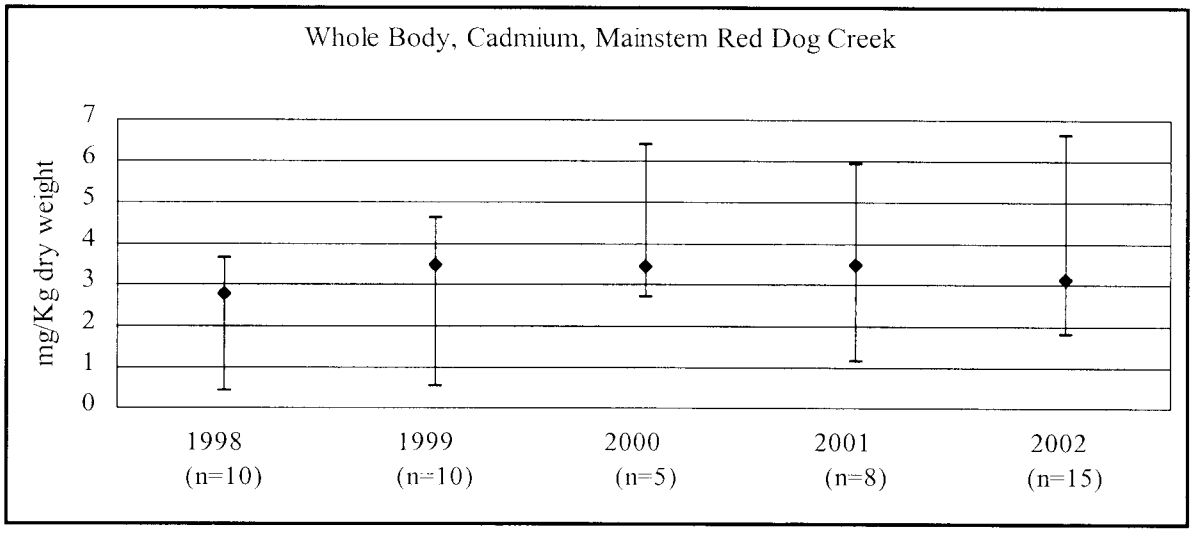

Figure 8. Whole body cadmium concentrations (maximum, median, and minimum) in juvenile Dolly Varden collected in Mainstem Red Dog Creek from 1998 to 2002.

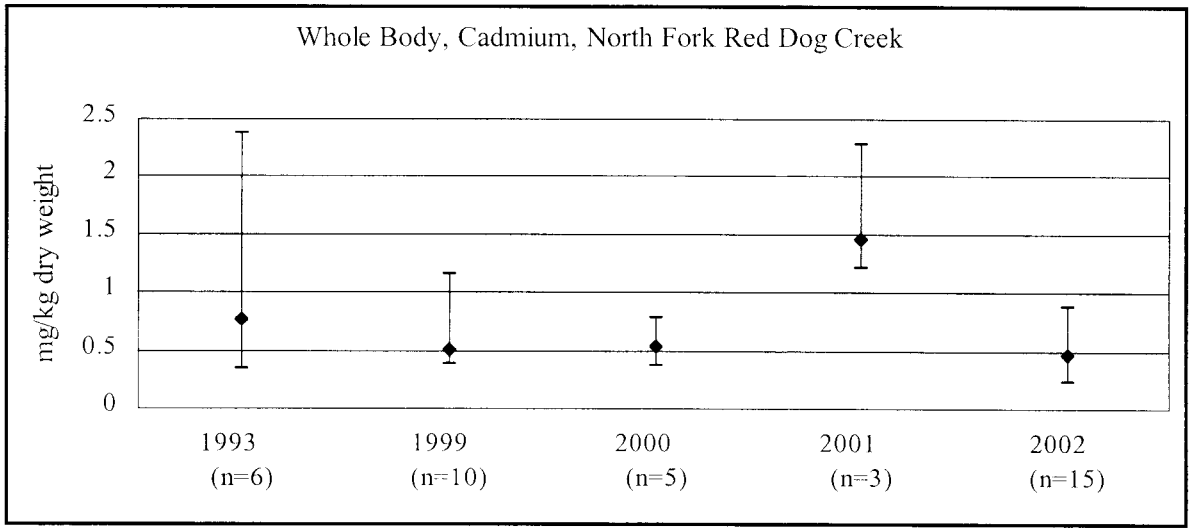

Figure 9. Whole body cadmium concentrations (maximum, median, and minimum) in juvenile Dolly Varden collected in North Fork Red Dog Creek from 1993 to 2002. (Note, different y-axis scales used in Figures 7, 8, and 9).

Significant differences in Cd concentrations from fish sampled from Mainstem Red Dog Creek from 1998 through 2002 were not observed (KW = 5.4319, p = 0.2458). However, juvenile Dolly Varden from North Fork Red Dog Creek, sampled in 1993, 1999, 2000, 2001, and 2002 did exhibit significant differences among some years (KW = 11.3804, p = 0.0226). However, Dolly Varden collected in 2001 in North Fork Red Dog Creek had the highest Cd concentrations in their bodies whereas Dolly Varden sampled in 2002 had the lowest; no annual trend is apparent (Appendix 3). Juvenile Dolly Varden sampled from Anxiety Ridge Creek show no annual trend in Cd concentration (KW = 15.3994, p = 0.0039) (Appendix 3).

Cadmium Comparisons with Other Sample Sites

Cadmium concentrations in juvenile Dolly Varden in selected streams near the Red Dog Mine were compared with fish collected at other sample sites located in Alaska. Sites selected for comparative analyses were streams located in areas with active or proposed hard-rock mines. Juvenile Dolly Varden obtained in 2001 (combination of anadromous and resident fish) from Greens Creek (Sites 6 and 54) (Weber Scannell and Paustian 2002), chinook salmon juveniles collected in 1999 from the Goodpaster River (Morsell 2000), juvenile coho salmon collected in 1995 from Illinois Creek (Winters 1996), and Arctic grayling collected in 1993 (juvenile and adult fish) from upper Fish Creek were selected (Ott and Weber Scannell 1996). Cadmium concentrations were higher in Mainstem Red Dog, Grayling Junior, and Greens creeks (Figure 10). Although mineralized deposits often produce different elements in various amounts into the areas' surface and subsurface ground waters, mine sites are the primary locations where we have data on juvenile fish tissues (whole body) and offer the best for comparison.

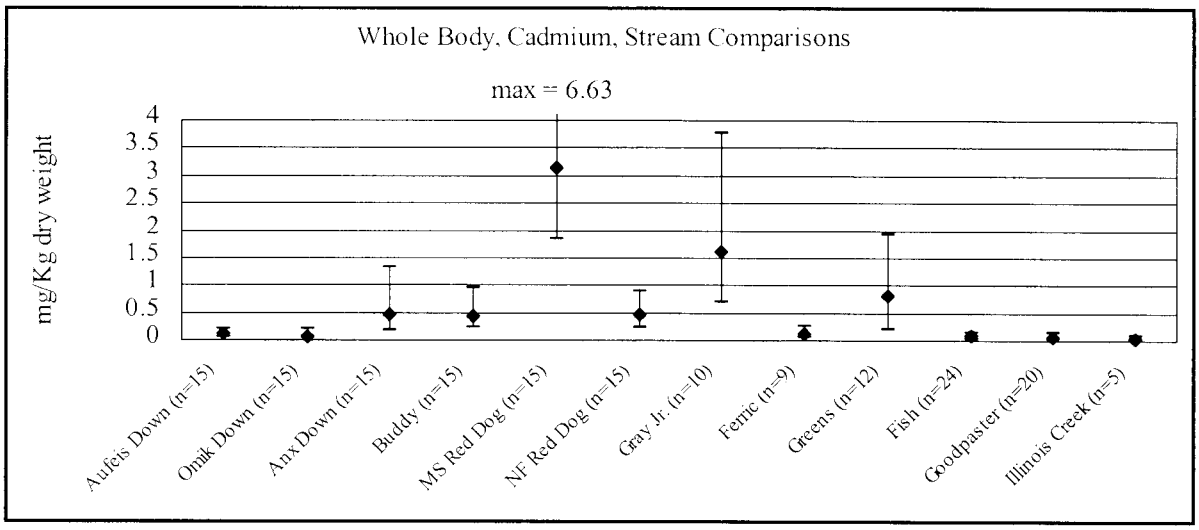

Figure 10. Whole body cadmium concentrations (maximum, median, and minimum) in fish collected from various creeks in Alaska (Aufeis, Omikviorok, Anxiety, Buddy, Mainstem Red Dog, and North Fork Red Dog 2002, Grayling Junior 2001, Ferric 1999, Greens 2001, Fish 1993, Goodpaster 1999, and Illinois 1995).

Lead Haul Road 2002

With respect to the DMTS sample streams, Pb concentrations in juvenile Dolly Varden were highest in Anxiety Ridge Creek (both upstream and downstream of road) and in North Fork Omikviorok River (Appendix 3) (Figure 11). However, North Fork Omikviorok River fish had significantly lower Pb concentrations in their tissues when compared to fish from Anxiety Ridge Creek (both upstream and downstream) (Appendix 3). Dolly Varden in the downstream Anxiety Ridge Creek site were higher in Pb concentrations than the upstream site ($W = 3.570$, $p = 0.0004$). Dolly Varden from Aufeis Creek collected downstream from the road had higher Pb concentrations than fish collected from North Fork Aufeis Creek ($W = 4.720$, $p < 0.0001$), upstream of the road, but similar to fish collected from South Fork Aufeis Creek ($W = 1.4$, $p = 0.1616$), also upstream of road. Concentrations of Pb found in fish in North Fork Aufeis Creek also were significantly lower than concentrations found in fish from South Fork Aufeis Creek ($W = 4.202$, $p < 0.0001$), suggesting that South Fork Aufeis Creek may be the source of

Pb found in fish below the road or that South Fork Aufeis Creek and Aufeis Creek have similar geologic conditions.

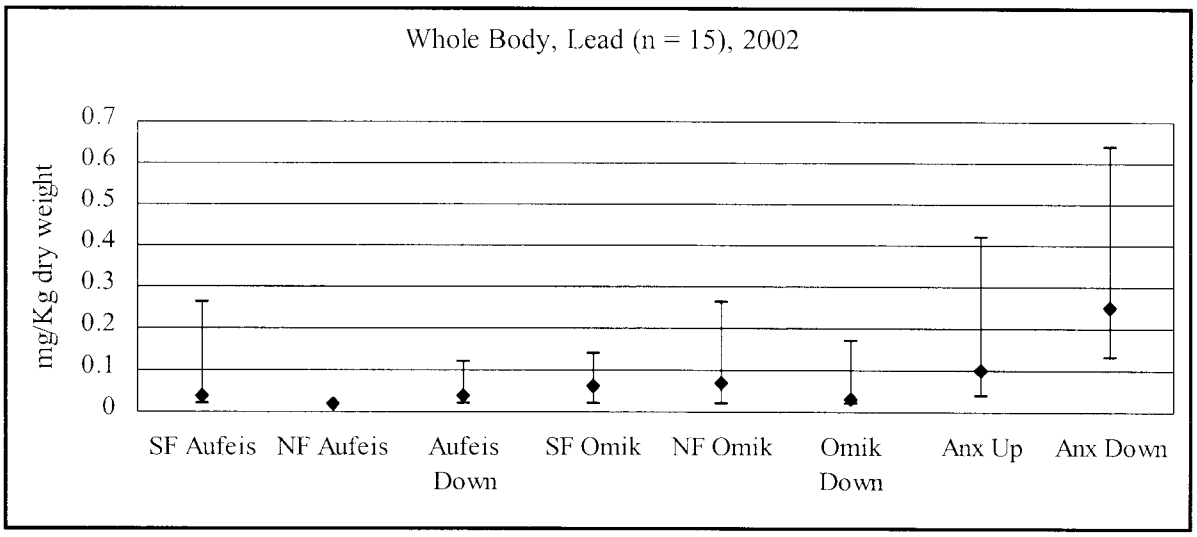

Figure 11. Whole body lead concentrations (maximum, median, and minimum) in juvenile Dolly Varden collected from creeks along the DMTS in 2002.

Juvenile Dolly Varden in the Omikviorok River downstream of the DMTS road had significantly lower Pb concentrations than fish captured in North Fork ($W = 3.064$, $p = 0.0022$) and South Fork ($W = 2.73$, $p = 0.0067$) of the Omikviorok River, above the road. Fish from the two forks of the Omikviorok River had similar Pb concentrations ($W = 1.380$, $p = 0.1677$). For most of the sample streams along the DMTS, median Pb concentrations were less than 0.1 mg/Kg dry weight.

Lead Haul Road and Mine Site 2002

The concentration of Pb in juvenile Dolly Varden is significantly higher in Mainstem Red Dog Creek than in fish from all other creeks sampled (Figures 12 and 13). Comparison of mean ranks suggest that while fish from Mainstem Red Dog Creek typically have the highest concentrations of Pb, mean rank of concentrations are statistically similar to those found in fish from North Fork Red Dog, Buddy, and Anxiety Ridge (downstream) creeks

(Appendix 3). When Mainstem Red Dog Creek is not considered, the Pb concentrations are higher in Anxiety (downstream), North Fork Red Dog, and Buddy creeks (Figure 12).

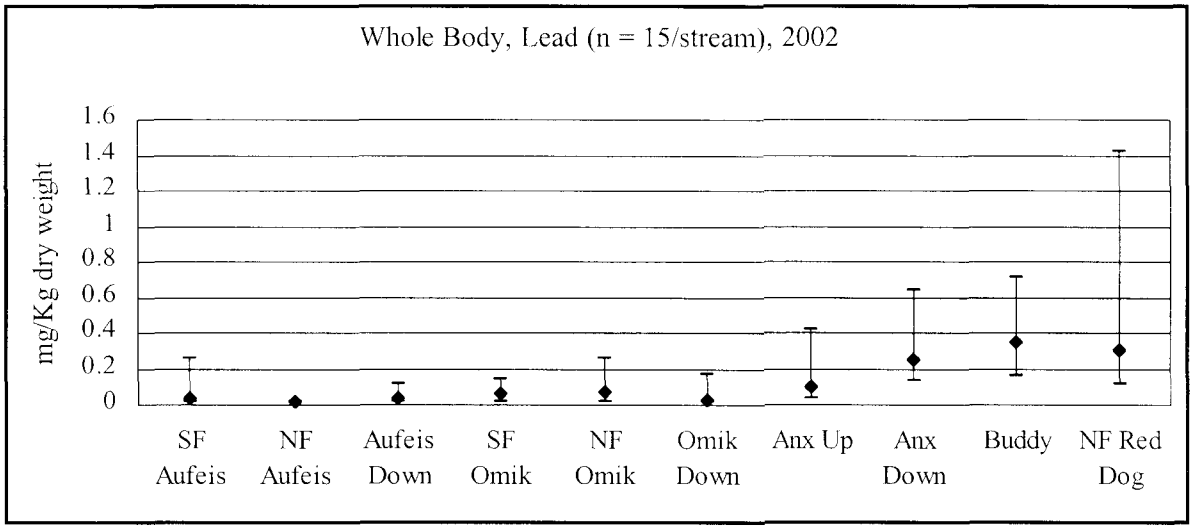

Figure 12. Whole body lead concentrations (maximum, median, and minimum) in juvenile Dolly Varden collected from creeks along the DMTS and near the Red Dog Mine in 2002.

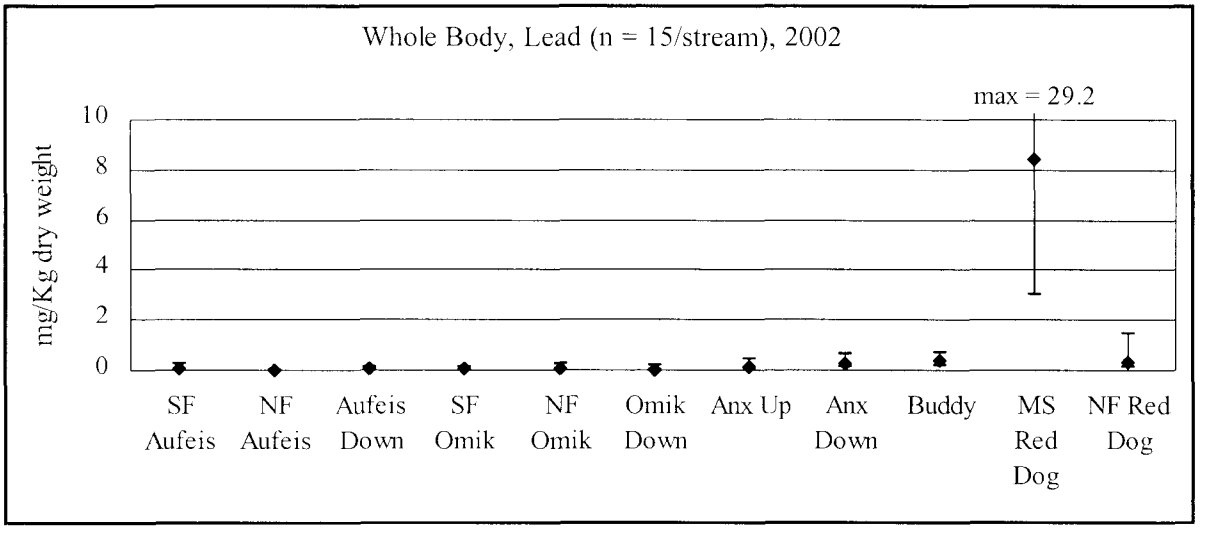

Figure 13. Whole body lead concentrations (maximum, median, and minimum) in juvenile Dolly Varden collected from creeks along the DMTS and near the Red Dog Mine in 2002, including Mainstem Red Dog Creek. (Note, different y-axis scales used in Figures 12 and 13).

Lead Multi-Year Data Sets

Whole body Pb concentrations in juvenile Dolly Varden collected in Anxiety Ridge, Mainstem Red Dog, and North Fork Red Dog creeks do not appear to be following any definitive trends (Figures 14, 15, and 16). Lead concentrations in juvenile Dolly Varden collected in Anxiety Ridge Creek have been similar or decreased among the years of sampling (KW = 45.5162, $p < 0.0001$). Lead concentrations in Mainstem Red Dog Creek have been similar in all years (KW = 4.5207, $p = 0.3401$). Juvenile Dolly Varden sampled from North Fork Red Dog Creek generally have been similar; however, Pb concentrations in 2001 were significantly higher than those observed in 1993 and 2002 (KW = 14.5749, $p = 0.0057$) (Appendix 3).

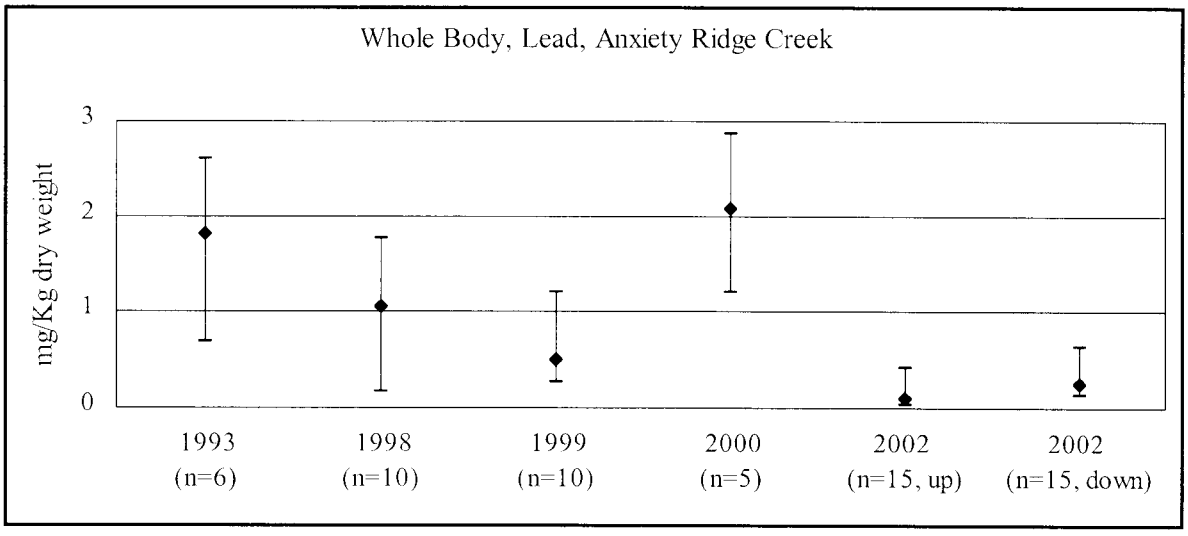

Figure 14. Whole body lead concentrations (maximum, median, and minimum) in juvenile Dolly Varden collected in Anxiety Ridge Creek from 1993 to 2002.

Median Pb concentrations in Mainstem Red Dog Creek have been similar for all sample years since 1998; however, individual fish exhibited higher Pb concentrations in 2001 and 2002 (Figure 15). In North Fork Red Dog Creek an upward trend in Pb concentrations occurred from 1993 to 2001, but median Pb concentrations measured in 2002 were similar to or lower than all previous years of sampling (Figure 16).

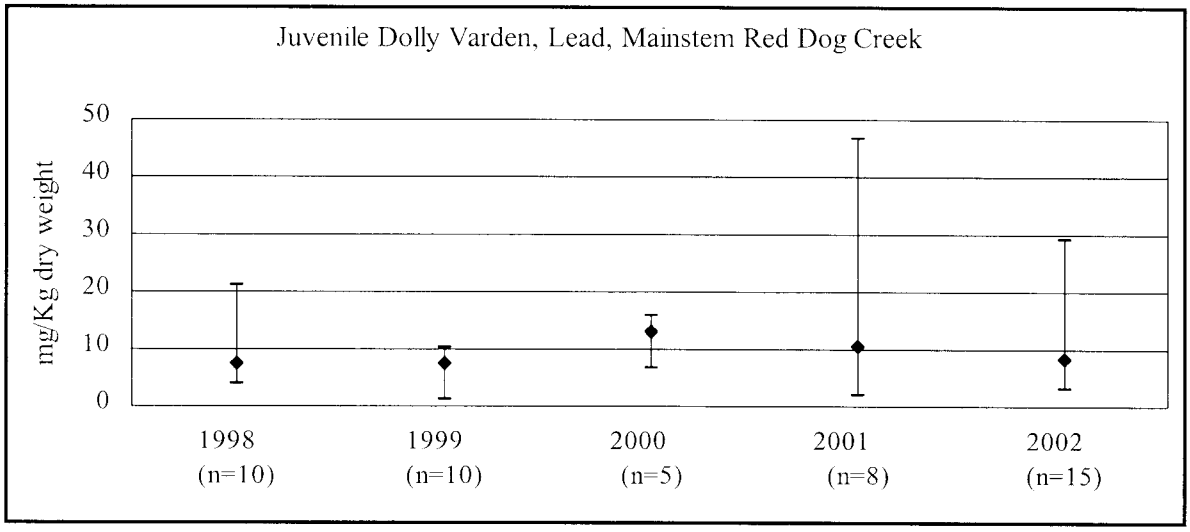

Figure 15. Whole body lead concentrations (maximum, median, and minimum) in juvenile Dolly Varden collected in Mainstem Red Dog Creek from 1998 to 2002.

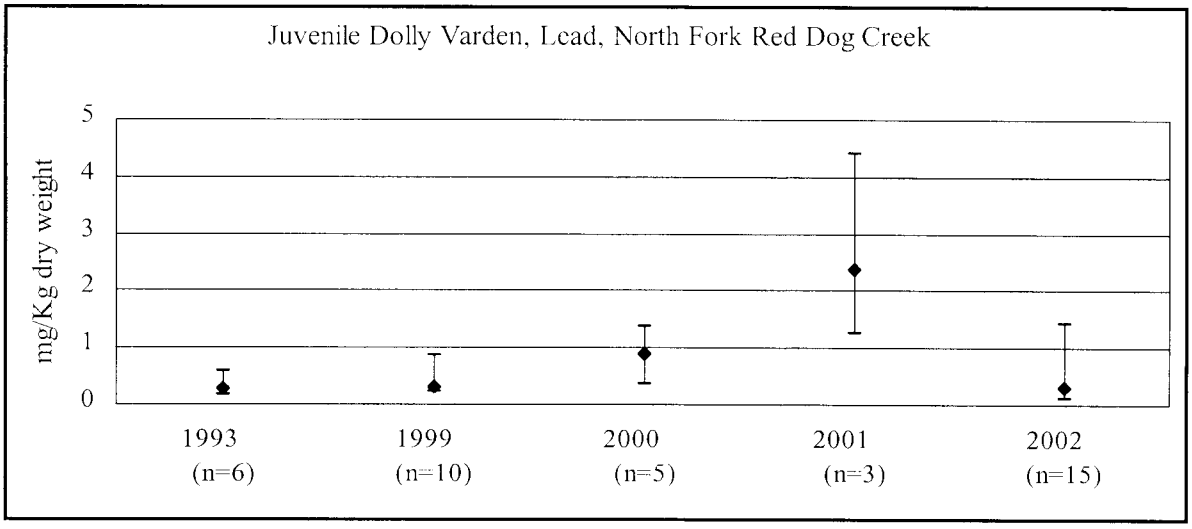

Figure 16. Whole body lead concentrations (maximum, median, and minimum) in juvenile Dolly Varden collected in North Fork Red Dog Creek from 1993 to 2002. (Note, different y-axis used in Figures 15 and 16).

Juvenile Dolly Varden use Mainstem Red Dog and North Fork Red Dog creeks seasonally to migrate in during June to feed and outmigrate prior to freezeup. Juvenile Dolly Varden in North Fork Red Dog Creek must move through Mainstem Red Dog

Creek. Higher Pb concentrations in individual fish may reflect longer time spent in Mainstem Red Dog Creek before entering North Fork Red Dog Creek.

Lead Comparisons with Other Sample Sites

Lead concentrations in juvenile Dolly Varden from streams in the Red Dog Mine area were compared with fish from other streams in Alaska. Sites selected included Greens Creek in southeast Alaska, and the Goodpaster River, and Illinois and Fish creeks in the Interior. Lead concentrations were substantially higher in juvenile Dolly Varden collected in Mainstem Red Dog Creek (Figure 17). At all of the other sites, median Pb concentrations were less than 1 mg/Kg dry weight. Concentrations of Pb were slightly higher in Greens, Grayling Junior, and North Fork Red Dog creek fish. Although Mainstem Red Dog Creek fish indicate the creek contains higher Pb concentrations than other systems, it is still used throughout the ice-free season by juvenile Dolly Varden. In years with high spawning success by Arctic grayling, large numbers of age-0 Arctic grayling rear in shallow backwater areas of Mainstem Red Dog Creek. Juvenile fish tissue (whole body) from mine sites is the best data available to make comparisons.

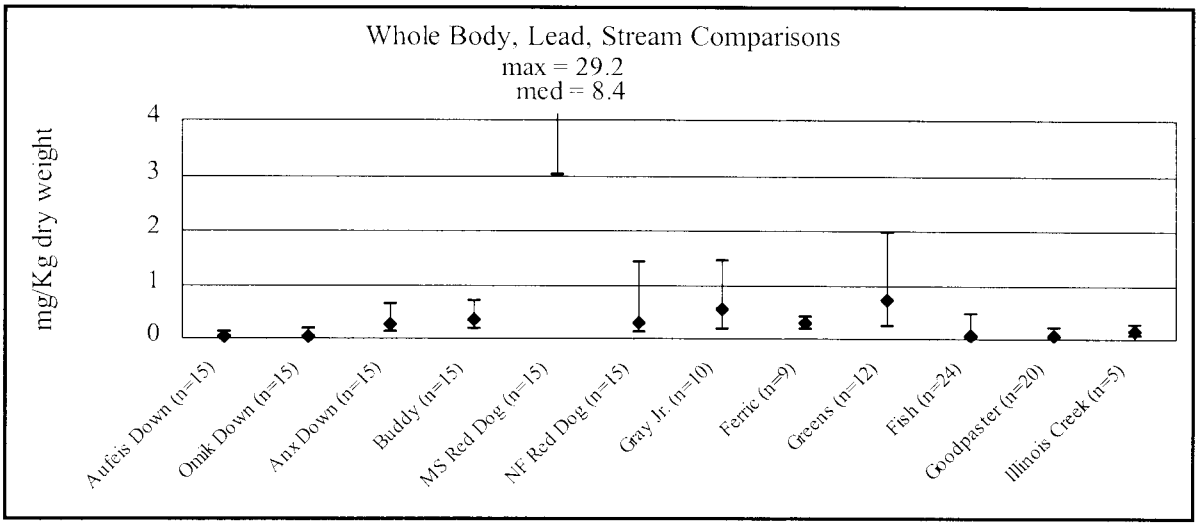

Figure 17. Whole body lead concentrations (maximum, median, and minimum) in fish collected from various creeks in Alaska (Aufeis, Omikviorok, Anxiety, Buddy, Mainstem Red Dog, and North Fork Red Dog 2002, Grayling Junior 2001, Ferric 1999, Greens 2001, Fish 1993, Goodpaster 1999, and Illinois 1995).

Selenium Haul Road 2002

Selenium concentrations differed among fish from sampling sites along the DMTS (KW = 61.6170, $p < 0.0001$) (Appendix 3). Generally, fish from Aufeis Creek downstream of the road, South Fork Aufeis Creek, and Anxiety Ridge Creek downstream of the road had the highest concentrations of Se. Median Se concentrations in juvenile Dolly Varden collected along the DMTS were similar in South Fork Aufeis Creek and Aufeis Creek downstream of the road (W = 0.332, p = 0.7398), but had higher Se concentrations than fish from North Fork Aufeis Creek (W downstream vs North Fork = 4.361, $p < 0.0001$; W North Fork vs South Fork = 4.507, $p < 0.0001$) (Figure 18). Selenium concentrations were similar for sites upstream and downstream of the road for both the Omikviorok River (W South Fork vs downstream = 0.457, p = 0.6476; W North Fork vs downstream = 1.661, p = 0.0966; W North Fork vs South Fork = 1.578, p = 0.1146) and Anxiety Ridge Creek (W = 1.454, p = 0.1460) (Figure 18).

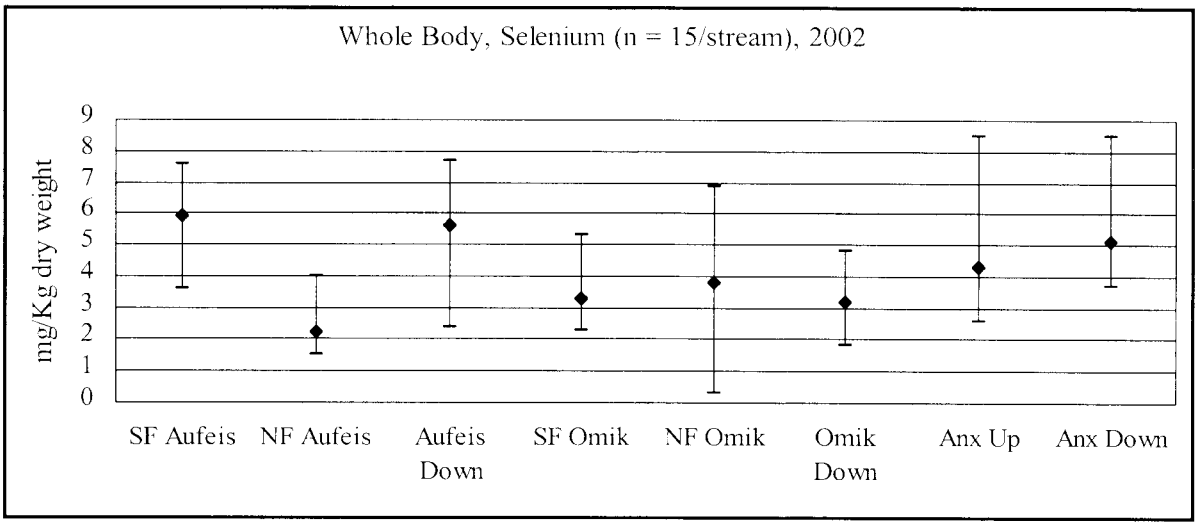

Figure 18. Whole body selenium concentrations (maximum, median, and minimum) in juvenile Dolly Varden collected from creeks along the DMTS in 2002.

Selenium Haul Road and Mine Site 2002

When all 2002 sample sites were compared, the Se concentrations in fish collected from Mainstem Red Dog Creek were significantly higher than in fish collected from all sites except Buddy and North Fork Red Dog creeks (Appendix 3) (Figure 19). Dolly Varden from Buddy Creek exhibited higher Se concentrations than fish from Anxiety Ridge Creek, the Omikviorok River, and Aufeis Creek (Appendix 3).

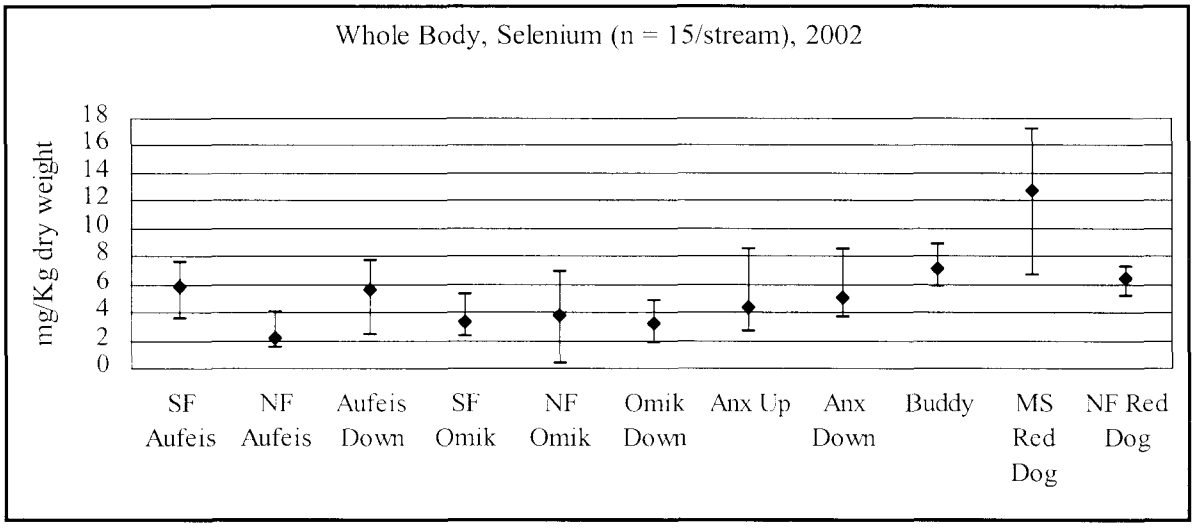

Figure 19. Whole body selenium concentrations (maximum, median, and minimum) in juvenile Dolly Varden collected from creeks along the DMTS and near the Red Dog Mine in 2002.

Selenium Multi-Year Data Sets

Juvenile Dolly Varden samples for Se have been collected in Mainstem Red Dog and North Fork Red Dog creeks for several years, beginning in 1998 for Mainstem Red Dog Creek. In fish collected annually since 1998 from Mainstem Red Dog Creek, there appears to an upward trend for Se (Figure 20). Differences in Se concentrations among years are apparent (KW = 24.6504, p = 0.0001); however, comparison of mean ranks

suggests that when broken down there are two groups of years with different Se concentrations (Appendix 3). Fish sampled in 1998, 1999, and 2000 are similar in Se concentrations but significantly lower than fish collected in 2000, 2001, and 2002. These results suggest an upward shift in Se concentration in fish from Mainstem Red Dog began in 2000 and continued through 2002. The whole body Se concentrations have consistently been lower in North Fork Red Dog Creek than in Mainstem Red Dog Creek, with the exception of 2001 when only three Dolly Varden were captured in North Fork Red Dog Creek (Figures 20 and 21).

Based on findings by Weber Scannell et al. (2000) that juvenile whole body metals concentrations reflect background water quality, it appears that Se sources have increased in Mainstem Red Dog Creek since 2000; however, there is no evidence of increased Se in the water quality data for Station 10 (Mainstem Red Dog Creek).

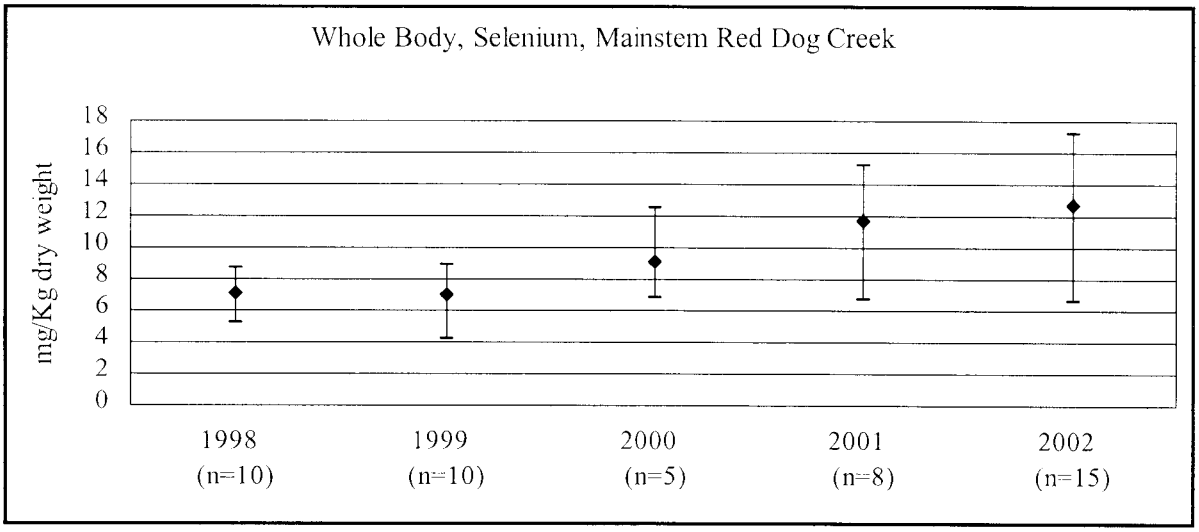

Figure 20. Whole body selenium concentrations in juvenile Dolly Varden collected in Mainstem Red Dog Creek from 1998 to 2002.

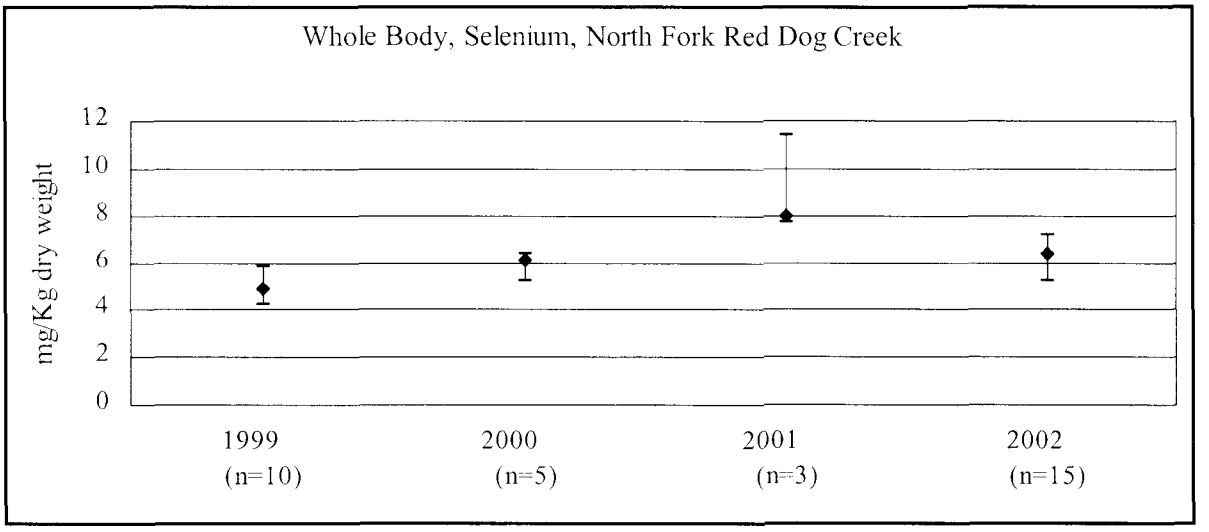

Figure 21. Whole body selenium concentrations in juvenile Dolly Varden collected in North Fork Red Dog Creek from 1999 to 2002.

Selenium Comparisons with Other Sample Sites

Selenium concentrations in juvenile Dolly Varden from streams in the vicinity of the Red Dog Mine were compared with Dolly Varden from Greens Creek and chinook salmon juveniles from the Goodpaster River. Highest concentrations of Se occurred in juvenile Dolly Varden collected from Mainstem Red Dog Creek (Figure 22). Concentrations of Se were similar in the other sample sites except for the Goodpaster River where Se was much lower (at or lower than the detection limit of one mg/Kg dry weight) in juvenile chinook salmon (Figure 22). Juvenile fish tissue (whole body) from mine sites is the best data available to make these comparisons.

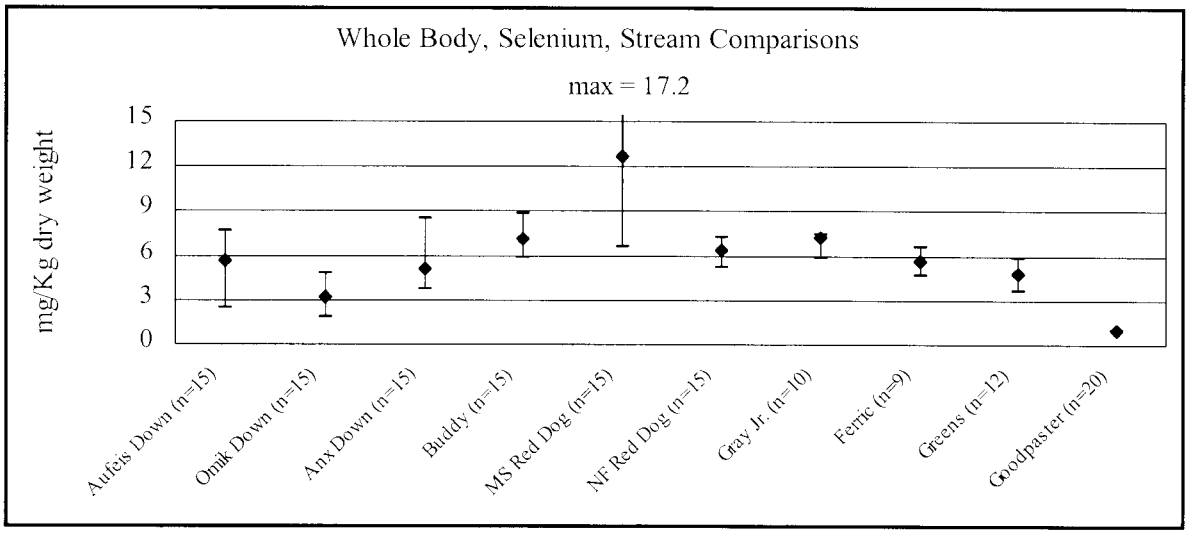

Figure 22. Whole body selenium concentrations in fish collected from various creeks in Alaska (Aufeis, Omikviorok, Anxiety, Buddy, Mainstem Red Dog, and North Fork Red Dog 2002, Grayling Junior 2001, Ferric 1999, Greens 2001, and Goodpaster 1999).

Zinc Haul Road 2002

Zinc concentrations in juvenile Dolly Varden collected along the DMTS in 2002 are presented in Figure 23. The only significant difference in Zn concentrations from fish sampled from road sites was the significantly lower concentration found in fish from Aufeis Creek (KW = 67.3724, $p < 0.0001$, Appendix 3). There is no significant difference in the zinc concentrations among the remaining streams. Zinc concentrations in Anxiety Ridge Creek upstream and downstream (W = 0.166, p = 0.8681) and the Omikviorok River upstream and downstream (W South Fork vs downstream = 0.125, p = 0.9009; W North Fork vs downstream = 0.021, p = 0.9834) of the DMTS were nearly identical. Zinc concentrations were higher in fish from Aufeis Creek downstream of the road than from fish from South Fork Aufeis Creek (W = 1.970, p = 0.488), but similar to concentrations in fish from North Fork Aufeis Creek (W = 1.514, p = 0.1300). Zinc concentrations were higher in fish from North Fork Aufeis Creek than in fish from South Fork Aufeis Creek (W = 2.510, p = 0.0121). The uniformity of Zn concentrations in fish along the DMTS would support the conclusion that the source of Zn is not fugitive dust or sediment from the road.

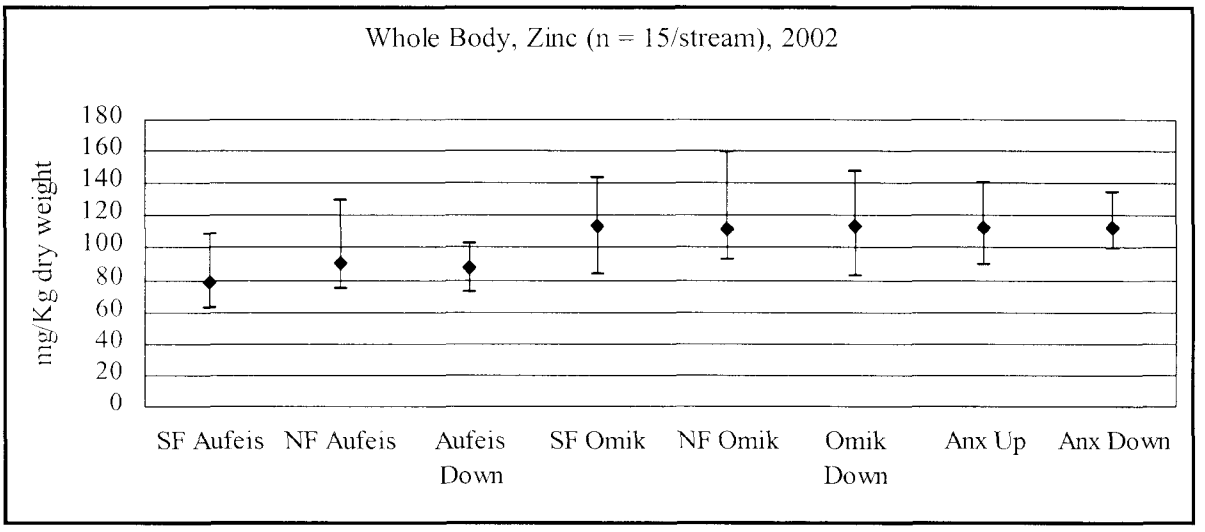

Figure 23. Whole body zinc concentrations in juvenile Dolly Varden collected from creeks along the DMTS in 2002.

Zinc Haul Road and Mine Site 2002

Zinc concentrations for juvenile Dolly Varden for all 2002 sample sites, including creeks near the Red Dog Mine, are presented in Figure 24. Concentrations of Zn in fish collected from Mainstem Red Dog Creek are significantly higher than all sites but ranked similarly to Buddy and North Fork Red Dog creeks.

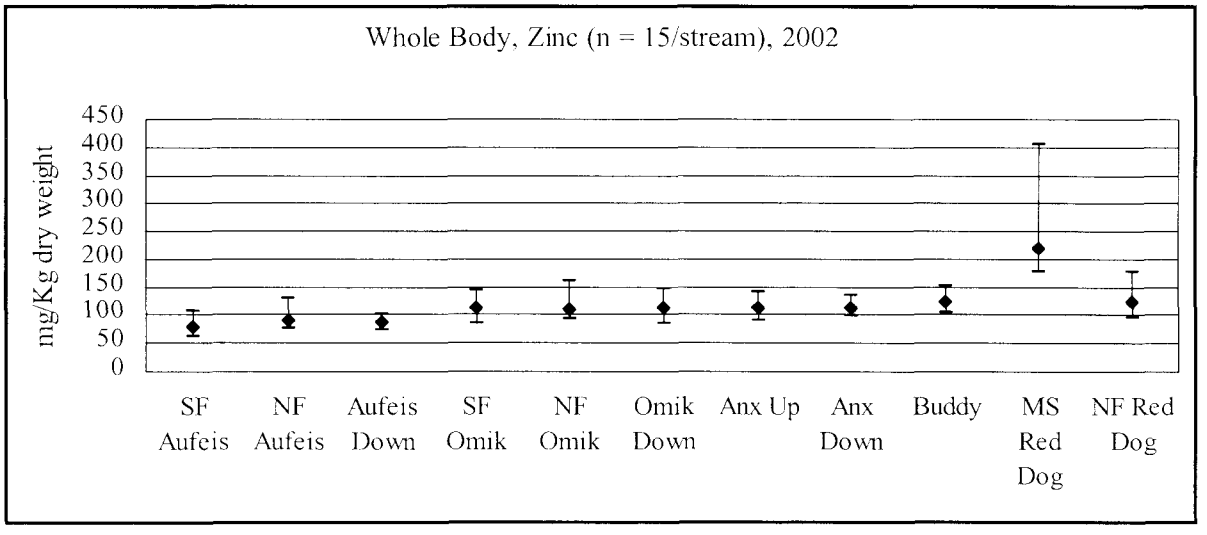

Figure 24. Whole body zinc concentrations in juvenile Dolly Varden collected from creeks along the DMTS and near the Red Dog Mine in 2002.

Zinc concentrations for all remaining sites are similar (Figure 24) with the exception of Aufeis Creek where Zn concentrations in juvenile Dolly Varden were the lowest among all the drainages (Appendix 3, Figure 24).

Zinc, Multi-Year Data Sets

Until recently, we had no juvenile Dolly Varden whole body analyses for Zn. Only two years (2001 and 2002) of Zn concentrations are available for fish from Mainstem Red Dog Creek. Median Zn concentrations did not change from 2001 to 2002 (W = 0.226, Exact p = 0.7295) (Figure 25).

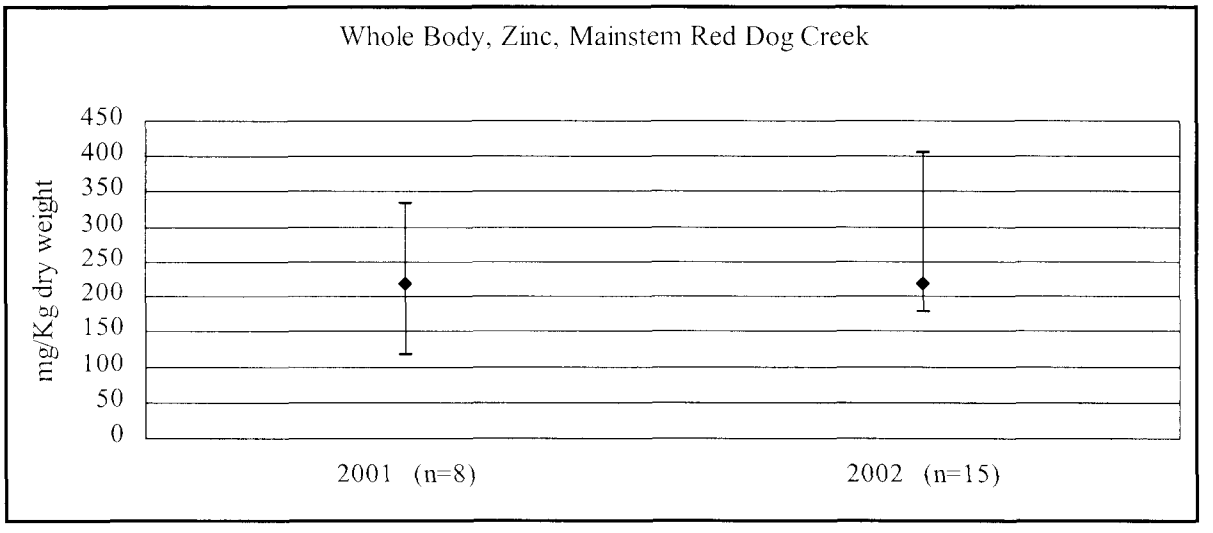

Figure 25. Whole body zinc concentrations in juvenile Dolly Varden collected in Mainstem Red Dog Creek from 2001 to 2002.

Zinc Comparisons with Other Sample Sites

Zinc concentrations in juvenile Dolly Varden from streams near the Red Dog Mine were compared with Dolly Varden (resident and anadromous) from Greens Creek. The Zn concentrations were highest in fish from Grayling Junior Creek, followed by fish from Mainstem Red Dog (Figure 26). Mainstem Red Dog Creek is located immediately downstream of the main ore deposits at the Red Dog Mine. Grayling Junior Creek, a tributary to Ikalukrok Creek, is located to the north and is not affected by activities

associated with the Red Dog Mine. Evidence of mineralization (substrate stained red) is apparent in the upper part of Grayling Junior Creek. Zinc concentrations in fish at the remaining sites were similar, with higher median concentrations found in fish in Greens Creek. Juvenile fish tissue (whole body) from mine sites is the best data available to make these comparisons.

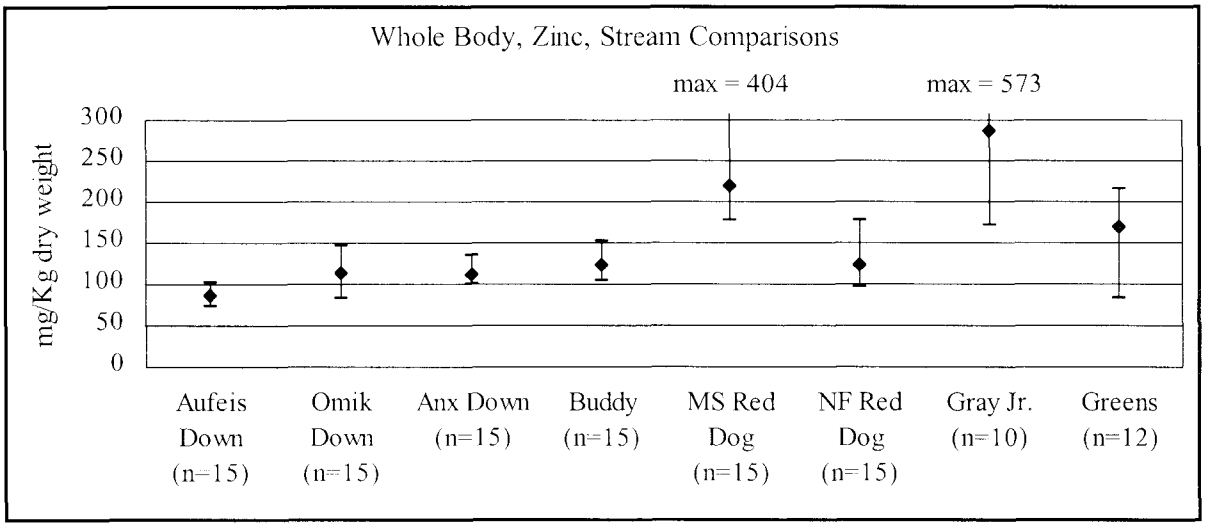

Figure 26. Whole body zinc concentrations in fish collected from various creeks in Alaska.

Summary

It should be recognized that each of the streams sampled is unique in terms of geology, water quality, and fish species use. Streams in the vicinity of the Red Dog and Greens Creek Mines are in areas known to have mineralized sulfide deposits whereas the Fort Knox and Illinois Creek ore bodies are not sulfide deposits. The Pogo ore body located near the Goodpaster River is a sulfide deposit, but it appears that the belowground deposit does not have effects on surface and subsurface waters in the Goodpaster River due to permafrost soils. Our comparisons of fish among these sites must be viewed in light of the very different geological conditions through which the streams flow.

For our comparisons among sample sites for juvenile Dolly Varden in the Red Dog Mine area, it is important to understand that there is no way to determine what length of time an individual fish spent at the capture site. We do know, however, that for most of our sites the juveniles leave the area to overwinter in lower portions of the drainages. They return to these rearing areas in mid-June, with peak abundance occurring during late July to mid-August. Our sample time each year is in late July to early August to capture fish after individuals have spent the most time in the sample reach. Therefore, the minimum and maximum values for any given sample set probably reflect in some manner the length of time spent in the sample reach. We believe our sample size (15 per sample reach) is sufficient to factor out variability due to time spent in the sample area. Our research is not intended to determine whether the metals concentrations found in juveniles have a direct impact to the fish. The primary purpose of the data collection is to determine existing conditions and to monitor trends that may occur over time. In fact, all our work on juvenile Dolly Varden in these sample sites at the Red Dog Mine suggest that the populations are healthy and fluctuations in numbers among sample years are related to environmental conditions.

Haul Road 2002

The highest concentrations of Cd and Pb in Dolly Varden were found in Anxiety Ridge Creek and in both cases concentrations were higher in fish from the sample site below the

road. Based on sediment data provided by TCAK, there are several reaches of Anxiety Ridge Creek below and above the DMTS with high concentrations of Pb and Cd. Selenium concentrations in Dolly Varden were higher in South Fork Aufeis Creek and Aufeis Creek below the road and Zn concentrations were lowest in the Aufeis Creek drainage. There is no indication that concentrations of Se or Zn are related to upstream versus downstream locations from the DMTS.

Haul Road and Mine Site

The highest concentrations of Cd, Pb, Se, and Zn in Dolly Varden occurred in Mainstem Red Dog Creek. Both Cd and Pb were lowest at the sites on Aufeis Creek and the Omikviorok River located on the southern end of the DMTS. The Se concentrations were high in South Fork Aufeis Creek and also in Aufeis Creek below the road. Zinc was highest in Mainstem Red Dog Creek fish and lower at all the other sites near the Red Dog Mine and along the DMTS. Metals concentrations in juvenile Dolly Varden from Buddy Creek were statistically similar to those found in Mainstem Red Dog Creek for all metals, and often similar to or higher in concentration to those found in Anxiety Ridge Creek.

Multi-Year Data Sets

Multi-year data sets are only available for Se, Cd and Pb and there are no apparent trends up or down in fish from Anxiety, Mainstem Red Dog, or North Fork Red Dog creeks. Selenium in fish from Mainstem Red Dog Creek appears to have shifted upwards in 2000 and has remained high. Only two years of data are available for Zn concentrations in Mainstem Red Dog Creek and no difference between years was noted.

Comparisons with Other Sample Sites

We compared Cd, Pb, Se, and Zn concentrations in whole body fish samples from streams in the Red Dog Mine area with other waterbodies in Alaska. We selected streams from mining areas and sites where whole body metals concentrations data in juvenile salmonids were available. Analyses for each analyte were not necessarily available for all the sites. Relative comparisons (low, medium, and high) of the analytes were made based on the available data (Table 2).

Mainstem Red Dog Creek ranked high for all the analytes and Grayling Junior and Greens creeks ranked high for Cd and Zn. Higher concentrations of Cd, Pb, Se, and Zn in fish from these systems probably are related to background conditions. Mainstem Red Dog is located below the largest known lead-zinc mine in the world. Greens Creek is proximate to an active subsurface silver mine in southeast Alaska. Grayling Junior Creek has no current mining activity in the watershed, but according to information from TCAK there was a geophysical anomaly in the watershed that was slated for exploration several years ago.

Table 2. Relative comparisons (low, medium, and high) of the concentrations of cadmium, lead, selenium, and zinc in juvenile fish Red Dog and other selected streams in Alaska (N/D = no data available for analyte for specific waterbody).

Red Dog Area	Cadmium	Lead	Selenium	Zinc
South Fork Aufeis	Low	Low	Medium	Low
North Fork Aufeis	Low	Low	Medium	Low
Aufeis	Low	Low	Medium	Low
South Fork Omikviorok	Low	Low	Medium	Medium
North Fork Omikviorok	Low	Low	Medium	Medium
Omikviorok Downstream	Low	Low	Medium	Medium
Anxiety Upstream	Low	Low	Medium	Medium
Anxiety Downstream	Medium	Medium	Medium	Medium
Buddy	Medium	Medium	Medium	Medium
Mainstem Red Dog	High	High	High	High
North Fork Red Dog	Medium	Medium	Medium	Medium
Grayling Junior	High	Medium	Medium	High
Ferric	Low	Low	Medium	N/D
Statewide				
Greens	High	Medium	Medium	High
Fish	Low	Low	N/D	N/D
Goodpaster	Low	Low	Low	N/D
Illinois	Low	Low	N/D	N/D
Low (mg/kg)	0.03 to 0.21	0.02 to 0.18	1	78.6 to 90.4
Medium (mg/Kg)	0.44 to 0.47	0.25 to 0.73	2.2 to 7.2	111 to 124
High (mg/Kg)	0.80 to 3.13	8.4	12.7	170 to 286

Recommendations for Future Studies

Results obtained to date from whole body analyses of juvenile Dolly Varden for selected analytes have been extremely useful in comparing different streams and in tracking changes over time. In addition, whole body concentrations of selected metals have been related to measurement of various water quality conditions. Sampling conducted in summer 2002 represents the largest sample collected to date in terms of number of sites (11) and the number of fish per site (15). The sample size of 15 fish per site has provided us with a much higher degree of confidence in the individual data sets.

Our highest priority for continued work is to sample, annually, Anxiety Ridge (upstream and downstream of the DMTS), Buddy, Mainstem Red Dog, North Fork Red Dog, and Grayling Junior Creek. We recommend that the sample size per site be at least 10 fish, but preferably 15. Analytes to be measured should be Cd, Pb, Se, and Zn. Data on these sites will provide a database to address issues in the future. These data may be used to address the following topics: (a) effects from the proposed backdam for the tailing impoundment; (b) effects of the DMTS; (c) changes in selected analytes with time; (d) differences among sample streams; and (e) changes in streams as affected by future exploration and development activities.

We recommend that sampling of juvenile Dolly Varden from Aufeis Creek and Omikviorok River be discontinued at this time. Our rationale for ending this program at this time is that Cd, Pb, Se, and Zn concentrations in fish from these creeks is low by comparison with sites located near the Red Dog Mine. While there are differences upstream and downstream of the DMTS, there is no clear evidence that the source of metals is related to the DMTS.

Consideration should be given to sampling fish in other selected sites near known ore deposits in the vicinity of the Red Dog Mine. Streams suggested for sampling include Competition located near the Anarraaq prospect and Oak, Square, and Sunday creeks located near the Lik Deposit.

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Appendix 1. Teck Cominco Alaska Inc. projects to minimize escapement of ore concentrate, Red Dog Mine

Summer 2001 – Instituted new operational controls with the truck unloading building that included improved housekeeping methods and the reduction of air lancing.

Summers 2000, 2001 and 2002 – Initiated summer truck washing of the concentrate haulage fleet after loading and after dumping.

July to November 2001 – Replaced the entire concentrate haulage fleet from A-Train units that had tarpaulin covers and side doors to more robust B-Train units that have steel lids and solid truck boxes. Additionally, the B-Train units provide greater stability, reducing the risk of spills.

July/August 2001 and November 2001 – Installed stilling curtains over the hopper in the truck unloading building and additional modifications to control and contain dust while unloading the trucks.

October 2001 – Completed an extension of the truck unloading building to accommodate the longer B-Train units.

February and November 2002 – A temporary baghouse was installed to control dust in the truck unloading building in early 2002. This temporary system was replaced by a much larger permanent facility that was commissioned in November 2002.

June 2002 – Completed a redesign and modification to the port site surge bin (silo) improving its baghouse operation and containment of emissions from this facility.

June 2002 – Repaired and/or replaced the entire cover on loadout conveyor belts (P7 and P10) at the port.

June 2002 – Improved barge loading system by modifying the hood over a key conveyor transfer point and improving the dust and carry-back control on conveyor P11.

July 2002 – Completed a five-mile test section of high float on the south end of the port road. Prior to applying this hard surface treatment, contaminated sections were identified and removed for recycling through the mill.

Summer 2002 – Modified the mobile hoppers in the port concentrate storage building to reduce dust during belt loading.

Summer 2002 – Installed diesel particulate filter to reduce emissions from the concentrate storage building loadout equipment.

Summer 2002 – Installed cab filter units to provide for improved air quality in the concentrate storage building equipment cabs allowing for tighter control on building enclosures.

Winter and Spring 2003 – Evaluate emission areas related to barge loading and off-loading. This information will be used to design and modify the barge loader and the barges ship loader prior to the 2003-shipping season.

Appendix 2. Juvenile Dolly Varden collected for whole body analyses of metals in the creeks near the Red Dog Mine (1993-2001).

Stream Name	Location	Year Sampled
Anxiety Ridge	Immediately upstream and downstream of road	1993, 1998, 1999, 2000
North Fork Red Dog	Just upstream of confluence with Middle Fork Red Dog	1993, 1999, 2000
Mainstem	Immediately downstream of confluence with North Fork	1998, 1999, 2000, 2001, 2002
North Fork Red Dog	6 km upstream of confluence with Middle Fork Red Dog	2001, 2002
Ferric	2 km upstream of confluence with Wulik	1999
Grayling Junior	Immediately upstream of confluence with Ikalukrok	2001
Evaingiknuk	Proximate to DMTS	2001
Ikalukrok	Upstream and downstream of Dudd Creek	2001
SF Aufeis	1.6 km upstream of DMTS	2001, 2002
NF Aufeis	1.6 km upstream of DMTS	2002
Aufeis	1.6 km downstream of DMTS	2001, 2002
NF Omikviorok	1.6 km upstream of DMTS	2001, 2002
SF Omikviorok	1.6 km upstream of DMTS	2002
Omikviorok	1.6 km downstream of DMTS	2001, 2002
Anxiety Ridge	1.6 km upstream of DMTS	2002
Anxiety Ridge	1.6 km downstream of DMTS	2002

Appendix 3. Pairwise Comparisons of Dolly Varden Whole Body Analyses

Dolly Varden Length Comparisons

Kruskal-Wallis One-Way Nonparametric AOV for LENGTH by RIVER

RIVER	Mean Rank	Sample Size
Anxiety	69.0	30
Aufeis	92.2	45
Buddy	75.3	15
Main Stem	60.8	15
North Fork	113.7	15
Omikviorok	82.8	45
Total	83.0	165

Kruskal-Wallis Statistic 14.0903
P-Value, Using Chi-Squared Approximation 0.0150

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	5	32133	6426.68	2.99	0.0132
Within	159	341874	2150.15		
Total	164	374007			

Total number of values that were tied 159
Max. diff. allowed between ties 0.00001

Cases Included 165 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of LENGTH by RIVER

RIVER	Mean	Anxiety	Aufeis	Buddy	Main Stem
Anxiety	68.983				
Aufeis	92.211	23.23			
Buddy	75.333	6.35	16.88		
Main Stem	60.833	8.15	31.38	14.50	
North Fork	113.73	44.75*	21.52	38.40	52.90*
Omikviorok	82.833	13.85	9.38	7.50	22.00

RIVER	Mean	North Fork
North Fork	113.73	
Omikviorok	82.833	30.90

Alpha 0.05
Critical Z Value 2.935

Kruskal-Wallis One-Way Nonparametric AOV for LENGTH by SAMPLE SITE

SAMPLE	Mean Rank	Sample Size
080102MSRD	60.8	15
080102NFUS	113.7	15
080302BUDV	75.3	15
080402AUDS	75.9	15
080402AUNF	96.5	15
080402AUSF	104.3	15
080402AXDS	67.4	15
080402AXUS	70.6	15
080402OMDS	74.8	15
080402OMNF	97.0	15
080402OMSF	76.7	15
Total	83.0	165

Kruskal-Wallis Statistic 18.9452
P-Value, Using Chi-Squared Approximation 0.0410

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	10	43205	4320.51	2.01	0.0356
Within	154	330802	2148.06		
Total	164	374007			

Total number of values that were tied 159
Max. diff. allowed between ties 0.00001

Cases Included 165 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of LENGTH by SAMPLE SITE

SAMPLE	Mean	Homogeneous Groups
080102NFUS	113.73	A
080402AUSF	104.30	A
080402OMNF	96.967	A
080402AUNF	96.467	A
080402OMSF	76.733	A
080402AUDS	75.867	A
080302BUDV	75.333	A
080402OMDS	74.800	A
080402AXUS	70.600	A
080402AXDS	67.367	A
080102MSRD	60.833	A

Alpha 0.05
Critical Z Value 3.317 Critical Value for Comparison 57.870
There are no significant pairwise differences among the means.

Dolly Varden Cadmium Concentration Analyses - Road Sites

Kruskal-Wallis One-Way Nonparametric AOV for CD by Road SAMPLE SITE

SAMPLE	Mean Rank	Sample Size
080402AUDS	73.2	15
080402AUNF	38.9	15
080402AUSF	20.5	15
080402AXDS	110.2	15
080402AXUS	94.3	15
080402OMDS	53.3	15
080402OMNF	60.9	15
080402OMSF	32.7	15
Total	60.5	120

Kruskal-Wallis Statistic 84.8723
P-Value, Using Chi-Squared Approximation 0.0000

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	7	100056	14293.7	39.8	0.0000
Within	112	40233	359.2		
Total	119	140289			

Total number of values that were tied 96
Max. diff. allowed between ties 0.00001

Cases Included 120 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of CD by Road SAMPLE SITE

SAMPLE	Mean	Homogeneous Groups
080402AXDS	110.23	A
080402AXUS	94.300	AB
080402AUDS	73.200	ABC
080402OMNF	60.900	BCD
080402OMDS	53.300	CDE
080402AUNF	38.900	CDE
080402OMSF	32.667	DE
080402AUSF	20.500	E

Alpha 0.05
Critical Z Value 3.124 Critical Value for Comparison 39.677
There are 5 groups (A, B, etc.) in which the means
are not significantly different from one another.

Kruskal-Wallis All-Pairwise Comparisons Test of CD by SAMPLE

SAMPLE	Mean	080402AUDS	080402AUNF	080402AUSF	080402AXDS
080402AUDS	73.200				
080402AUNF	38.900	34.30			
080402AUSF	20.500	52.70*	18.40		
080402AXDS	110.23	37.03	71.33*	89.73*	
080402AXUS	94.300	21.10	55.40*	73.80*	15.93
080402OMDS	53.300	19.90	14.40	32.80	56.93*
080402OMNF	60.900	12.30	22.00	40.40*	49.33*
080402OMSF	32.667	40.53*	6.23	12.17	77.57*

SAMPLE	Mean	080402AXUS	080402OMDS	080402OMNF
080402AXUS	94.300			
080402OMDS	53.300	41.00*		
080402OMNF	60.900	33.40	7.60	
080402OMSF	32.667	61.63*	20.63	28.23

Alpha 0.05
Critical Z Value 3.124 Critical Value for Comparison 39.677

Dolly Varden Cadmium Concentration Analyses - Road Sites and Mine Sites

Kruskal-Wallis One-Way Nonparametric AOV for CD by RIVER

RIVER	Mean Rank	Sample Size
Anxiety	113.2	30
Aufeis	44.2	45
Buddy	126.2	15
Main Stem	158.0	15
North Fork	123.0	15
Omikviorok	49.0	45
Total	83.0	165

Kruskal-Wallis Statistic 125.475
P-Value, Using Chi-Squared Approximation 0.0000

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	5	283561	56712.1	104	0.0000
Within	159	87062	547.6		
Total	164	370623			

Total number of values that were tied 115
Max. diff. allowed between ties 0.00001

Cases Included 165 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of CD by RIVER

RIVER	Mean	Homogeneous Groups
Main Stem	158.00	A
Buddy	126.20	AB
North Fork	122.97	AB
Anxiety	113.18	B
Omikviorok	48.956	C
Aufeis	44.200	C

Alpha 0.05
Critical Z Value 2.935
There are 3 groups (A, B, etc.) in which the means are not significantly different from one another.

Kruskal-Wallis All-Pairwise Comparisons Test of CD by RIVER

RIVER	Mean	Anxiety	Aufeis	Buddy	Main Stem
Anxiety	113.18				
Aufeis	44.200	68.98*			
Buddy	126.20	13.02	82.00*		
Main Stem	158.00	44.82*	113.80*	31.80	
North Fork	122.97	9.78	78.77*	3.23	35.03
Omikviorok	48.956	64.23*	4.76	77.24*	109.04*

RIVER	Mean	North Fork
North Fork	122.97	
Omikviorok	48.956	74.01*

Alpha 0.05
Critical Z Value 2.935

Dolly Varden Cadmium Concentration Analyses – Trends with Time

Kruskal-Wallis One-Way Nonparametric AOV for CD by YEAR - North Fork Red Dog Creek

YEAR	Mean Rank	Sample Size
1993	26.5	6
1999	18.5	10
2000	19.1	5
2001	37.0	3
2002	15.3	15
Total	20.0	39

Kruskal-Wallis Statistic 11.3804
P-Value, Using Chi-Squared Approximation 0.0226

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	4	1478.40	369.600	3.63	0.0143
Within	34	3458.10	101.709		
Total	38	4936.50			

Total number of values that were tied 9

Max. diff. allowed between ties 0.00001

Cases Included 39 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of CD by YEAR - North Fork Red Dog Creek

YEAR	Mean	Homogeneous Groups
2001	37.000	A
1993	26.500	AB
2000	19.100	AB
1999	18.500	AB
2002	15.300	B

Alpha 0.05
Critical Z Value 2.807
There are 2 groups (A and B) in which the means
are not significantly different from one another.

Kruskal-Wallis All-Pairwise Comparisons Test of CD by YEAR - North Fork Red Dog Creek

YEAR	Mean	1993	1999	2000	2001
1993	26.500				
1999	18.500	8.000			
2000	19.100	7.400	0.600		
2001	37.000	10.500	18.500	17.900	
2002	15.300	11.200	3.200	3.800	21.700*

Alpha 0.05
Critical Z Value 2.807

Kruskal-Wallis One-Way Nonparametric AOV for CD by DATE - Anxiety Ridge Creek

DATE	Mean Rank	Sample Size
08/25/93	30.6	6
08/10/98	12.6	10
08/11/99	30.1	10
08/01/00	28.9	5
08/04/02	37.9	30
Total	31.0	61

Kruskal-Wallis Statistic 15.3994
P-Value, Using Chi-Squared Approximation 0.0039

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	4	4848.9	1212.22	4.83	0.0020
Within	56	14043.6	250.78		
Total	60	18892.5			

Total number of values that were tied 34
Max. diff. allowed between ties 0.00001
Cases Included 61 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of CD by DATE - Anxiety Ridge Creek

DATE	Mean	Homogeneous Groups
08/04/02	37.867	A
08/25/93	30.583	AB
08/11/99	30.150	AB
08/01/00	28.900	AB
08/10/98	12.550	B

Alpha	0.05
Critical Z Value	2.807

There are 2 groups (A and B) in which the means are not significantly different from one another.

Kruskal-Wallis All-Pairwise Comparisons Test of CD by YEAR - Anxiety Ridge Creek

YEAR	Mean	1993	1998	1999	2000
1993	30.583				
1998	12.550	18.033			
1999	30.150	0.433	17.600		
2000	28.900	1.683	16.350	1.250	
2002	37.867	7.283	25.317*	7.717	8.967

Alpha	0.05
Critical Z Value	2.807

Dolly Varden Lead Concentration Analyses - Road Sites

Kruskal-Wallis One-Way Nonparametric AOV for PB by SAMPLE SITE

SAMPLE	Mean Rank	Sample Size
080402AUDS	55.1	15
080402AUNF	14.5	15
080402AUSF	45.0	15
080402AXDS	109.5	15
080402AXUS	83.8	15
080402OMDS	36.8	15
080402OMNF	74.7	15
080402OMSF	64.7	15
Total	60.5	120

Kruskal-Wallis Statistic	77.0911
P-Value, Using Chi-Squared Approximation	0.0000

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	7	91753	13107.5	29.4	0.0000
Within	112	49879	445.4		
Total	119	141632			

Total number of values that were tied 111

Max. diff. allowed between ties 0.00001

Cases Included 120 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of PB by SAMPLE SITE

SAMPLE	Mean	Homogeneous Groups
080402AXDS	109.53	A
080402AXUS	83.833	AB
080402OMNF	74.667	ABC
080402OMSF	64.667	BC
080402AUDS	55.067	BC
080402AUSF	44.967	BCD
080402OMDS	36.767	CD
080402AUNF	14.500	D

Alpha 0.05
Critical Z Value 3.124 Critical Value for Comparison 39.677
There are 4 groups (A, B, etc.) in which the means
are not significantly different from one another.

Kruskal-Wallis All-Pairwise Comparisons Test of PB by SAMPLE SITE

SAMPLE	Mean	080402AUDS	080402AUNF	080402AUSF	080402AXDS
080402AUDS	55.067				
080402AUNF	14.500	40.57*			
080402AUSF	44.967	10.10	30.47		
080402AXDS	109.53	54.47*	95.03*	64.57*	
080402AXUS	83.833	28.77	69.33*	38.87	25.70
080402OMDS	36.767	18.30	22.27	8.20	72.77*
080402OMNF	74.667	19.60	60.17*	29.70	34.87
080402OMSF	64.667	9.60	50.17*	19.70	44.87*
SAMPLE	**Mean**	**080402AXUS**	**080402OMDS**	**080402OMNF**	
080402AXUS	83.833				
080402OMDS	36.767	47.07*			
080402OMNF	74.667	9.17	37.90		
080402OMSF	64.667	19.17	27.90	10.00	

Alpha 0.05
Critical Z Value 3.124 Critical Value for Comparison 39.677

Dolly Varden Lead Concentration Analyses - Road Sites and Mine Sites

Kruskal-Wallis One-Way Nonparametric AOV for PB by SAMPLE SITE

SAMPLE	Mean Rank	Sample Size
080102MSRD	158.0	15
080102NFUS	125.5	15
080302BUDV	127.1	15
080402AUDS	55.1	15
080402AUNF	14.5	15
080402AUSF	45.8	15
080402AXDS	121.7	15
080402AXUS	87.1	15

080402OMDS	37.1	15
080402OMNF	76.3	15
080402OMSF	64.9	15
Total	83.0	165

Kruskal-Wallis Statistic 133.786
P-Value, Using Chi-Squared Approximation 0.0000

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	10	303424	30342.4	68.2	0.0000
Within	154	68526	445.0		
Total	164	371950			

Total number of values that were tied 133
Max. diff. allowed between ties 0.00001

Cases Included 165 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of PB by SAMPLE SITE

SAMPLE	Mean	Homogeneous Groups
080102MSRD	158.00	A
080302BUDV	127.07	AB
080102NFUS	125.53	AB
080402AXDS	121.70	ABC
080402AXUS	87.067	BCD
080402OMNF	76.300	BCD
080402OMSF	64.867	CDE
080402AUDS	55.100	DE
080402AUSF	45.800	DE
080402OMDS	37.067	DE
080402AUNF	14.500	E

Alpha 0.05
Critical Z Value 3.317 Critical Value for Comparison 57.870
There are 5 groups (A, B, etc.) in which the means
are not significantly different from one another.

Kruskal-Wallis All-Pairwise Comparisons Test of PB by SAMPLE SITE

SAMPLE	Mean	080102MSRD	080102NFUS	080302BUDV	080402AUDS
080102MSRD	158.00				
080102NFUS	125.53	32.47			
080302BUDV	127.07	30.93	1.53		
080402AUDS	55.100	102.90*	70.43*	71.97*	
080402AUNF	14.500	143.50*	111.03*	112.57*	40.60
080402AUSF	45.800	112.20*	79.73*	81.27*	9.30
080402AXDS	121.70	36.30	3.83	5.37	66.60*
080402AXUS	87.067	70.93*	38.47	40.00	31.97
080402OMDS	37.067	120.93*	88.47*	90.00*	18.03
080402OMNF	76.300	81.70*	49.23	50.77	21.20
080402OMSF	64.867	93.13*	60.67*	62.20*	9.77

SAMPLE	Mean	080402AUNF	080402AUSF	080402AXDS	080402AXUS
080402AUNF	14.500				
080402AUSF	45.800	31.30			
080402AXDS	121.70	107.20*	75.90*		
080402AXUS	87.067	72.57*	41.27	34.63	
080402OMDS	37.067	22.57	8.73	84.63*	50.00
080402OMNF	76.300	61.80*	30.50	45.40	10.77
080402OMSF	64.867	50.37	19.07	56.83	22.20

SAMPLE	Mean	080402OMDS	080402OMNF
080402OMDS	37.067		
080402OMNF	76.300	39.23	
080402OMSF	64.867	27.80	11.43

Alpha 0.05
Critical Z Value 3.317 Critical Value for Comparison 57.870

Dolly Varden Lead Concentration Analyses – Trends with Time

Kruskal-Wallis One-Way Nonparametric AOV for PB by YEAR - North Fork Red Dog Creek

YEAR	Mean Rank	Sample Size
1993	14.4	6
1999	18.4	10
2000	30.7	5
2001	37.3	3
2002	16.3	15
Total	20.0	39

Kruskal-Wallis Statistic 14.5749
P-Value, Using Chi-Squared Approximation 0.0057

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	4	1893.40	473.350	5.29	0.0020
Within	34	3043.10	89.503		
Total	38	4936.50			

Total number of values that were tied 14
Max. diff. allowed between ties 0.00001
Cases Included 39 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of PB by YEAR - North Fork Red Dog Creek

YEAR	Mean	1993	1999	2000	2001
1993	14.417				
1999	18.350	3.933			
2000	30.700	16.283	12.350		
2001	37.333	22.917*	18.983	6.633	
2002	16.300	1.883	2.050	14.400	21.033*

Alpha 0.05
Critical Z Value 2.807

Kruskal-Wallis One-Way Nonparametric AOV for PB by DATE - Anxiety Ridge Creek

DATE	Mean Rank	Sample Size
08/25/93	54.2	6
08/10/98	41.9	10
08/11/99	36.3	10
08/01/00	54.9	5
08/04/02	17.0	30
Total	31.0	61

Kruskal-Wallis Statistic 42.5162
P-Value, Using Chi-Squared Approximation 0.0000

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	4	13395.1	3348.77	34.0	0.0000
Within	56	5508.4	98.36		
Total	60	18903.5			

Total number of values that were tied 21
Max. diff. allowed between ties 0.00001
Cases Included 61 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of PB by DATE - Anxiety Ridge Creek

DATE	Mean	Homogeneous Groups
08/01/00	54.900	A
08/25/93	54.167	A
08/10/98	41.850	A
08/11/99	36.250	A
08/04/02	17.017	B

Alpha 0.05
Critical Z Value 2.807
There are 2 groups (A and B) in which the means are not significantly different from one another.

Dolly Varden Selenium Concentration Analyses - Road Sites

Kruskal-Wallis One-Way Nonparametric AOV for SE by SAMPLE SITE

SAMPLE	Mean Rank	Sample Size
080402AUDS	90.7	15
080402AUNF	18.6	15
080402AUSF	88.1	15
080402AXDS	84.5	15
080402AXUS	68.2	15
080402OMDS	37.9	15
080402OMNF	54.1	15
080402OMSF	41.8	15
Total	60.5	120

Kruskal-Wallis Statistic 61.6170
P-Value, Using Chi-Squared Approximation 0.0000

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	7	74508	10644.0	17.2	0.0000
Within	112	69388	619.5		
Total	119	143896			

Total number of values that were tied 93
Max. diff. allowed between ties 0.00001
Cases Included 120 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of SE by SAMPLE SITE

SAMPLE	Mean	Homogeneous Groups
080402AUDS	90.733	A
080402AUSF	88.100	A
080402AXDS	84.533	A
080402AXUS	68.200	AB
080402OMNF	54.100	ABC
080402OMSF	41.833	BC
080402OMDS	37.867	BC
080402AUNF	18.633	C

Alpha 0.05
Critical Z Value 3.124 Critical Value for Comparison 39.677
There are 3 groups (A, B, etc.) in which the means
are not significantly different from one another.

Kruskal-Wallis All-Pairwise Comparisons Test of SE by SAMPLE SITE

SAMPLE	Mean	080402AUDS	080402AUNF	080402AUSF	080402AXDS
080402AUDS	90.733				
080402AUNF	18.633	72.100*			
080402AUSF	88.100	2.633	69.467*		
080402AXDS	84.533	6.200	65.900*	3.567	
080402AXUS	68.200	22.533	49.567*	19.900	16.333
080402OMDS	37.867	52.867*	19.233	50.233*	46.667*
080402OMNF	54.100	36.633	35.467	34.000	30.433
080402OMSF	41.833	48.900*	23.200	46.267*	42.700*

SAMPLE	Mean	080402AXUS	080402OMDS	080402OMNF
080402AXUS	68.200			
080402OMDS	37.867	30.333		
080402OMNF	54.100	14.100	16.233	
080402OMSF	41.833	26.367	3.967	12.267

Alpha 0.05
Critical Z Value 3.124 Critical Value for Comparison 39.677

Dolly Varden Selenium Concentration Analyses - Road Sites and Mine Sites

Kruskal-Wallis One-Way Nonparametric AOV for SE by SAMPLE SITE

SAMPLE	Mean Rank	Sample Size
080102MSRD	155.6	15
080102NFUS	115.0	15
080302BUDV	132.0	15
080402AUDS	99.1	15
080402AUNF	18.6	15
080402AUSF	94.4	15
080402AXDS	89.9	15
080402AXUS	73.2	15
080402OMDS	37.9	15
080402OMNF	55.3	15
080402OMSF	41.9	15
Total	83.0	165

Kruskal-Wallis Statistic 117.424
P-Value, Using Chi-Squared Approximation 0.0000

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	10	267919	26791.9	38.8	0.0000
Within	154	106270	690.1		
Total	164	374189			

Total number of values that were tied 128
Max. diff. allowed between ties 0.00001
Cases Included 165 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of SE by SAMPLE SITE

SAMPLE	Mean	Homogeneous Groups
080102MSRD	155.60	A
080302BUDV	132.00	AB
080102NFUS	115.03	ABC
080402AUDS	99.067	ABCD
080402AUSF	94.433	BCDE
080402AXDS	89.867	BCDE
080402AXUS	73.233	CDEF
080402OMNF	55.333	DEF
080402OMSF	41.933	DEF
080402OMDS	37.867	EF
080402AUNF	18.633	F

Alpha 0.05
Critical Z Value 3.317 Critical Value for Comparison 57.870
There are 6 groups (A, B, etc.) in which the means
are not significantly different from one another.

Kruskal-Wallis All-Pairwise Comparisons Test of SE by SAMPLE SITE

SAMPLE	Mean	080102MSRD	080102NFUS	080302BUDV	080402AUDS
080102MSRD	155.60				
080102NFUS	115.03	40.57			
080302BUDV	132.00	23.60	16.97		
080402AUDS	99.067	56.53	15.97	32.93	
080402AUNF	18.633	136.97*	96.40*	113.37*	80.43*
080402AUSF	94.433	61.17*	20.60	37.57	4.63
080402AXDS	89.867	65.73*	25.17	42.13	9.20
080402AXUS	73.233	82.37*	41.80	58.77*	25.83
080402OMDS	37.867	117.73*	77.17*	94.13*	61.20*
080402OMNF	55.333	100.27*	59.70*	76.67*	43.73
080402OMSF	41.933	113.67*	73.10*	90.07*	57.13
SAMPLE	**Mean**	**080402AUNF**	**080402AUSF**	**080402AXDS**	**080402AXUS**
080402AUNF	18.633				
080402AUSF	94.433	75.80*			
080402AXDS	89.867	71.23*	4.57		
080402AXUS	73.233	54.60	21.20	16.63	
080402OMDS	37.867	19.23	56.57	52.00	35.37
080402OMNF	55.333	36.70	39.10	34.53	17.90
080402OMSF	41.933	23.30	52.50	47.93	31.30
SAMPLE	**Mean**	**080402OMDS**	**080402OMNF**		
080402OMDS	37.867				
080402OMNF	55.333	17.47			
080402OMSF	41.933	4.07	13.40		

Alpha 0.05
Critical Z Value 3.317 Critical Value for Comparison 57.870

Kruskal-Wallis One-Way Nonparametric AOV for SE by RIVER

RIVER	Mean Rank	Sample Size
Anxiety	81.5	30
Aufeis	70.7	45
Buddy	132.0	15
Main Stem	155.6	15
North Fork	115.0	15
Omikviorok	45.0	45
Total	83.0	165

Kruskal-Wallis Statistic 88.6008
P-Value, Using Chi-Squared Approximation 0.0000

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	5	202155	40431.1	37.4	0.0000
Within	159	172034	1082.0		
Total	164	374189			

Total number of values that were tied 128
Max. diff. allowed between ties 0.00001
Cases Included 165 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of SE by RIVER

RIVER	Mean	Homogeneous Groups
Main Stem	155.60	A
Buddy	132.00	A
North Fork	115.03	AB
Anxiety	81.550	BC
Aufeis	70.711	CD
Omikviorok	45.044	D

Alpha 0.05
Critical Z Value 2.935
There are 4 groups (A, B, etc.) in which the means are not significantly different from one another.

Kruskal-Wallis All-Pairwise Comparisons Test of SE by RIVER

RIVER	Mean	Anxiety	Aufeis	Buddy	Main Stem
Anxiety	81.550				
Aufeis	70.711	10.84			
Buddy	132.00	50.45*	61.29*		
Main Stem	155.60	74.05*	84.89*	23.60	
North Fork	115.03	33.48	44.32*	16.97	40.57
Omikviorok	45.044	36.51*	25.67	86.96*	110.56*

RIVER	Mean	North Fork
North Fork	115.03	
Omikviorok	45.044	69.99*

Alpha 0.05
Critical Z Value 2.935

Dolly Varden Selenium Concentration Analyses – Trends with Time

Kruskal-Wallis One-Way Nonparametric AOV for SE by YEAR - Mainstem Red Dog Creek

YEAR	Mean Rank	Sample Size
1998	12.5	10
1999	13.3	10
2000	26.9	5
2001	32.6	8
2002	34.8	15
Total	24.5	48

Kruskal-Wallis Statistic 24.6504
P-Value, Using Chi-Squared Approximation 0.0001

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	4	4830.70	1207.68	11.9	0.0000
Within	43	4379.80	101.86		
Total	47	9210.50			

Total number of values that were tied 6

Max. diff. allowed between ties 0.00001
Cases Included 48 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of SE by YEAR - Mainstem Red Dog Creek

YEAR	Mean	Homogeneous Groups
2002	34.800	A
2001	32.625	A
2000	26.900	AB
1999	13.300	B
1998	12.550	B

Alpha 0.05
Critical Z Value 2.807
There are 2 groups (A and B) in which the means
are not significantly different from one another.

Kruskal-Wallis One-Way Nonparametric AOV for SE by DATE - Anxiety Ridge creek

DATE	Mean Rank	Sample Size
08/10/98	14.5	10
08/11/99	32.6	10
08/01/00	20.6	5
08/04/02	32.2	30
Total	28.0	55

Kruskal-Wallis Statistic 11.0588
P-Value, Using Chi-Squared Approximation 0.0114

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	3	2837.1	945.700	4.38	0.0081
Within	51	11016.4	216.008		
Total	54	13853.5			

Total number of values that were tied 16
Max. diff. allowed between ties 0.00001
Cases Included 55 Missing Cases 6

Kruskal-Wallis All-Pairwise Comparisons Test of SE by DATE - Anxiety Ridge Creek

DATE	Mean	08/10/98	08/11/99	08/01/00
08/10/98	14.500			
08/11/99	32.600	18.100		
08/01/00	20.600	6.100	12.000	
08/04/02	32.200	17.700*	0.400	11.600

Alpha 0.05
Critical Z Value 2.638

Kruskal-Wallis One-Way Nonparametric AOV for SE by YEAR - North Fork Red Dog Creek

YEAR	Mean Rank	Sample Size
1999	6.7	10
2000	15.8	5
2001	32.0	3
2002	21.3	15
Total	17.0	33

Kruskal-Wallis Statistic	21.5958
P-Value, Using Chi-Squared Approximation	0.0001

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	3	2016.17	672.056	20.1	0.0000
Within	29	971.33	33.494		
Total	32	2987.50			

Total number of values that were tied 13
Max. diff. allowed between ties 0.00001

Cases Included 33 Missing Cases 6

Kruskal-Wallis All-Pairwise Comparisons Test of SE by YEAR - North Fork Red Dog Creek

YEAR	Mean	1999	2000	2001
1999	6.7000			
2000	15.800	9.100		
2001	32.000	25.300*	16.200	
2002	21.267	14.567*	5.467	10.733

Alpha	0.05
Critical Z Value	2.638

Kruskal-Wallis All-Pairwise Comparisons Test of SE by YEAR - North Fork Red Dog Creek

YEAR	Mean	Homogeneous Groups
2001	32.000	A
2002	21.267	A
2000	15.800	AB
1999	6.7000	B

Alpha	0.05
Critical Z Value	2.638

There are 2 groups (A and B) in which the means
are not significantly different from one another.

Dolly Varden Zinc Concentration Analyses - Road Sites

Kruskal-Wallis One-Way Nonparametric AOV for ZN by SAMPLE SITE

SAMPLE	Mean Rank	Sample Size
080402AUDS	26.0	15
080402AUNF	38.6	15
080402AUSF	18.0	15
080402AXDS	80.5	15
080402AXUS	80.7	15
080402OMDS	80.4	15
080402OMNF	80.9	15
080402OMSF	78.8	15
Total	60.5	120

Kruskal-Wallis Statistic 67.3724
P-Value, Using Chi-Squared Approximation 0.0000

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	7	81493	11641.8	20.9	0.0000
Within	112	62448	557.6		
Total	119	143941			

Total number of values that were tied 59
Max. diff. allowed between ties 0.00001

Cases Included 120 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of ZN by SAMPLE SITE

SAMPLE	Mean	Homogeneous Groups
080402OMNF	80.933	A
080402AXUS	80.667	A
080402AXDS	80.533	A
080402OMDS	80.400	A
080402OMSF	78.833	A
080402AUNF	38.633	B
080402AUDS	26.033	B
080402AUSF	17.967	B

Alpha 0.05
Critical Z Value 3.124 Critical Value for Comparison 39.677
There are 2 groups (A and B) in which the means
are not significantly different from one another.

Dolly Varden Zinc Concentration Analyses - Road Sites and Mine Sites

Kruskal-Wallis One-Way Nonparametric AOV for ZN by RIVER

RIVER	Mean Rank	Sample Size
Anxiety	88.9	30
Aufeis	28.3	45
Buddy	113.5	15

Main Stem	158.0	15
North Fork	111.5	15
Omikviorok	89.0	45
Total	83.0	165

Kruskal-Wallis Statistic 108.576
P-Value, Using Chi-Squared Approximation 0.0000

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	5	247776	49555.2	62.3	0.0000
Within	159	126479	795.5		
Total	164	374255			

Total number of values that were tied 84
Max. diff. allowed between ties 0.00001
Cases Included 165 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of ZN by RIVER

RIVER	Mean	Homogeneous Groups
Main Stem	158.00	A
Buddy	113.50	AB
North Fork	111.53	AB
Omikviorok	89.033	B
Anxiety	88.950	B
Aufeis	28.322	C

Alpha 0.05
Critical Z Value 2.935
There are 3 groups (A, B, etc.) in which the means
are not significantly different from one another.

Kruskal-Wallis All-Pairwise Comparisons Test of ZN by RIVER

RIVER	Mean	Anxiety	Aufeis	Buddy	Main Stem
Anxiety	88.950				
Aufeis	28.322	60.63*			
Buddy	113.50	24.55	85.18*		
Main Stem	158.00	69.05*	129.68*	44.50	
North Fork	111.53	22.58	83.21*	1.97	46.47
Omikviorok	89.033	0.08	60.71*	24.47	68.97*

RIVER	Mean	North Fork
North Fork	111.53	
Omikviorok	89.033	22.50

Alpha 0.05
Critical Z Value 2.935

Kruskal-Wallis One-Way Nonparametric AOV for ZN by SAMPLE SITES

SAMPLE	Mean Rank	Sample Size
080102MSRD	158.0	15
080102NFUS	111.5	15
080302BUDV	113.5	15
080402AUDS	26.2	15
080402AUNF	40.6	15
080402AUSF	18.2	15
080402AXDS	88.5	15
080402AXUS	89.4	15
080402OMDS	89.1	15
080402OMNF	90.9	15
080402OMSF	87.1	15
Total	83.0	165

Kruskal-Wallis Statistic 110.331
P-Value, Using Chi-Squared Approximation 0.0000

Parametric AOV Applied to Ranks

Source	DF	SS	MS	F	P
Between	10	251780	25178.0	31.7	0.0000
Within	154	122475	795.3		
Total	164	374255			

Total number of values that were tied 84
Max. diff. allowed between ties 0.00001
Cases Included 165 Missing Cases 0

Kruskal-Wallis All-Pairwise Comparisons Test of ZN by SAMPLE SITES

SAMPLE	Mean	Homogeneous Groups
080102MSRD	158.00	A
080302BUDV	113.50	AB
080102NFUS	111.53	AB
080402OMNF	90.900	BC
080402AXUS	89.400	BC
080402OMDS	89.100	BC
080402AXDS	88.500	BC
080402OMSF	87.100	BC
080402AUNF	40.633	CD
080402AUDS	26.167	D
080402AUSF	18.167	D

Alpha 0.05
Critical Z Value 3.317 Critical Value for Comparison 57.870
There are 4 groups (A, B, etc.) in which the means
are not significantly different from one another.

Kruskal-Wallis All-Pairwise Comparisons Test of ZN by SAMPLE SITES

SAMPLE	Mean	080102MSRD	080102NFUS	080302BUDV	080402AUDS
080102MSRD	158.00				
080102NFUS	111.53	46.47			
080302BUDV	113.50	44.50	1.97		
080402AUDS	26.167	131.83*	85.37*	87.33*	
080402AUNF	40.633	117.37*	70.90*	72.87*	14.47
080402AUSF	18.167	139.83*	93.37*	95.33*	8.00
080402AXDS	88.500	69.50*	23.03	25.00	62.33*
080402AXUS	89.400	68.60*	22.13	24.10	63.23*
080402OMDS	89.100	68.90*	22.43	24.40	62.93*
080402OMNF	90.900	67.10*	20.63	22.60	64.73*
080402OMSF	87.100	70.90*	24.43	26.40	60.93*

SAMPLE	Mean	080402AUNF	080402AUSF	080402AXDS	080402AXUS
080402AUNF	40.633				
080402AUSF	18.167	22.47			
080402AXDS	88.500	47.87	70.33*		
080402AXUS	89.400	48.77	71.23*	0.90	
080402OMDS	89.100	48.47	70.93*	0.60	0.30
080402OMNF	90.900	50.27	72.73*	2.40	1.50
080402OMSF	87.100	46.47	68.93*	1.40	2.30

SAMPLE	Mean	080402OMDS	080402OMNF
080402OMDS	89.100		
080402OMNF	90.900	1.80	
080402OMSF	87.100	2.00	3.80

Alpha 0.05
Critical Z Value 3.317 Critical Value for Comparison 57.870

Appendix 4. Cd, Pb, Se, and Zn (mg/Kg dry weight) juvenile Dolly Varden (whole body).

Collector	Sample Number	Stream	Site	Date Collected	Fish Spp	Length (mm)	Weight (g)	Method analyte MRL		200.80 Cd total 0.05		200.8 Pb total 0.02		7740.0 Se total 1.0		200.8 Zn total 0.5	% Solids
Anxiety Ridge Creek																	
ADF&G	082593ARDVJ1	Anxiety	at Haul Road	8/25/93	DV	131	20	Juvenile		0.26		1.52					22.3
ADF&G	082593ARDVJ2	Anxiety	at Haul Road	8/25/93	DV	136	21	Juvenile		0.24		2.12					24.4
ADF&G	082593ARDVJ3	Anxiety	at Haul Road	8/25/93	DV	122	17	Juvenile		0.28		2.51					24.4
ADF&G	082593ARDVJ4	Anxiety	at Haul Road	8/25/93	DV	124	19	Juvenile		0.24		1.52					24.3
ADF&G	082593ARDVJ5	Anxiety	at Haul Road	8/25/93	DV	126	18	Juvenile		0.20		0.69					24.9
ADF&G	082593ARDVJ6	Anxiety	at Haul Road	8/25/93	DV	122	16	Juvenile		0.24		2.60					23.3
ADF&G	081098AXDVJ01	Anxiety	at Haul Road	8/10/98	DV	120		Juvenile		0.14		1.03		2.9			24
ADF&G	081098AXDVJ02	Anxiety	at Haul Road	8/10/98	DV	120		Juvenile		0.10		0.72		2.5			21.6
ADF&G	081098AXDVJ03	Anxiety	at Haul Road	8/10/98	DV	118		Juvenile		0.18		1.33		5.2			21.3
ADF&G	081098AXDVJ04	Anxiety	at Haul Road	8/10/98	DV	133		Juvenile		0.21		1.45		2.8			23.2
ADF&G	081098AXDVJ05	Anxiety	at Haul Road	8/10/98	DV	142		Juvenile		0.15		1.77		3.1			22.7
ADF&G	081098AXDVJ06	Anxiety	at Haul Road	8/10/98	DV	126		Juvenile		0.16		0.62		3.0			21.9
ADF&G	081098AXDVJ07	Anxiety	at Haul Road	8/10/98	DV	140		Juvenile		0.11		0.17		5.1			23.9
ADF&G	081098AXDVJ08	Anxiety	at Haul Road	8/10/98	DV	128		Juvenile		0.11		1.07		3.5			22.1
ADF&G	081098AXDVJ09	Anxiety	at Haul Road	8/10/98	DV	132		Juvenile		0.15		0.41		3.6			18.6
ADF&G	081098AXDVJ10	Anxiety	at Haul Road	8/10/98	DV	111		Juvenile		0.13		1.15		4.3			22.4
ADF&G	081299AXDVJ01	Anxiety	at Haul Road	8/12/99	DV	125		Juvenile		0.22		0.42		5.6			23.2
ADF&G	081299AXDVJ02	Anxiety	at Haul Road	8/12/99	DV	134		Juvenile		0.39		0.51		5.9			23.0
ADF&G	081299AXDVJ03	Anxiety	at Haul Road	8/12/99	DV	135		Juvenile		0.18		0.48		4.6			23.3
ADF&G	081299AXDVJ04	Anxiety	at Haul Road	8/12/99	DV	131		Juvenile		0.37		1.20		4.2			22.9
ADF&G	081299AXDVJ05	Anxiety	at Haul Road	8/12/99	DV	137		Juvenile		0.13		0.27		4.0			17.6
ADF&G	081299AXDVJ06	Anxiety	at Haul Road	8/12/99	DV	130		Juvenile		0.26		0.36		4.3			22.2
ADF&G	081299AXDVJ07	Anxiety	at Haul Road	8/12/99	DV	123		Juvenile		0.34		1.10		5.2			20.4
ADF&G	081299AXDVJ08	Anxiety	at Haul Road	8/12/99	DV	127		Juvenile		0.14		0.43		4.9			23.4
ADF&G	081299AXDVJ09	Anxiety	at Haul Road	8/12/99	DV	123		Juvenile		0.23		0.68		4.5			21.9

Appendix 4, juvenile Dolly Varden continued.

Collector	Sample Number	Stream	Site	Date Collected	Fish Spp	Length (mm)	Weight (g)	Method analyte MRL		200.80 Cd total 0.05		200.8 Pb total 0.02		7740.0 Se total 1.0		200.8 Zn total 0.5	% Solids
ADF&G	081299AXDVJ10	Anxiety	at Haul Road	8/12/99	DV	126		Juvenile		0.27		0.56		5.5			25.0
ADF&G	080100AXDV01	Anxiety	at Haul Road	8/1/00	DV	125	16.1	Juvenile		0.21		1.36		3.4			21.9
ADF&G	080100AXDV02	Anxiety	at Haul Road	8/1/00	DV	117	12.4	Juvenile		0.31		2.86		5.4			21.4
ADF&G	080100AXDV03	Anxiety	at Haul Road	8/1/00	DV	124	14.2	Juvenile		0.31		2.09		3.9			19.8
ADF&G	080100AXDV04	Anxiety	at Haul Road	8/1/00	DV	133	21.9	Juvenile		0.11		2.30		3.9			25.2
ADF&G	080100AXDV05	Anxiety	at Haul Road	8/1/00	DV	134	18.7	Juvenile		0.27		1.20		4.1			24.3
ADFG	080402AXUSDVJ01	Anxiety	Upstream	8/4/02	DV	142	28.02	Juvenile		0.07		0.07		2.9		91.6	24.8
ADFG	080402AXUSDVJ02	Anxiety	Upstream	8/4/02	DV	134	22.87	Juvenile		0.13		0.23		4.3		110	24.7
ADFG	080402AXUSDVJ03	Anxiety	Upstream	8/4/02	DV	125	18.68	Juvenile		0.12		0.04		3.7		116	23.7
ADFG	080402AXUSDVJ04	Anxiety	Upstream	8/4/02	DV	98	8.26	Juvenile		0.33		0.08		5.9		89.2	25.2
ADFG	080402AXUSDVJ05	Anxiety	Upstream	8/4/02	DV	110	11.6	Juvenile		0.87		0.12		8.5		135	25.7
ADFG	080402AXUSDVJ06	Anxiety	Upstream	8/4/02	DV	132	23.65	Juvenile		0.17		0.42		2.6		115	24
ADFG	080402AXUSDVJ07	Anxiety	Upstream	8/4/02	DV	129	18.89	Juvenile		0.21		0.22		3.7		139	23.1
ADFG	080402AXUSDVJ08	Anxiety	Upstream	8/4/02	DV	122	15.55	Juvenile		0.11		0.06		2.8		135	22.7
ADFG	080402AXUSDVJ09	Anxiety	Upstream	8/4/02	DV	98	8.34	Juvenile		0.32		0.1		4.6		119	22
ADFG	080402AXUSDVJ10	Anxiety	Upstream	8/4/02	DV	95	8.08	Juvenile		0.09		0.05		4.2		112	21.7
ADFG	080402AXUSDVJ11	Anxiety	Upstream	8/4/02	DV	110	11.51	Juvenile		0.43		0.2		6.3		102	24.8
ADFG	080402AXUSDVJ12	Anxiety	Upstream	8/4/02	DV	97	7.24	Juvenile		0.19		0.16		6.2		108	22.2
ADFG	080402AXUSDVJ13	Anxiety	Upstream	8/4/02	DV	93	7.06	Juvenile		0.27		0.08		5.0		107	23.7
ADFG	080402AXUSDVJ14	Anxiety	Upstream	8/4/02	DV	90	6.33	Juvenile		0.22		0.05		3.8		103	21.2
ADFG	080402AXUSDVJ15	Anxiety	Upstream	8/4/02	DV	98	8.39	Juvenile		0.62		0.11		7.8		140	25.8
ADFG	080402AXDSDVJ01	Anxiety	Downstream	8/4/02	DV	139	26.42	Juvenile		0.36		0.21		4.3		107	23.9
ADFG	080402AXDSDVJ02	Anxiety	Downstream	8/4/02	DV	114	14.25	Juvenile		0.54		0.23		8.5		102	23.7
ADFG	080402AXDSDVJ03	Anxiety	Downstream	8/4/02	DV	107	12.06	Juvenile		0.81		0.32		5.2		120	22.2
ADFG	080402AXDSDVJ04	Anxiety	Downstream	8/4/02	DV	135	22.88	Juvenile		0.25		0.32		4.4		113	23.3
ADFG	080402AXDSDVJ05	Anxiety	Downstream	8/4/02	DV	95	9.89	Juvenile		0.37		0.24		5.0		99.4	22.1
ADFG	080402AXDSDVJ06	Anxiety	Downstream	8/4/02	DV	90	8.71	Juvenile		1.32		0.35		5.8		121	23.3

Appendix 4, juvenile Dolly Varden continued.

Collector	Sample Number	Stream	Site	Date Collected	Fish Spp	Length (mm)	Weight (g)	Method analyte MRL		200.80 Cd total 0.05		200.8 Pb total 0.02		7740.0 Se total 1.0		200.8 Zn total 0.5	% Solids
ADFG	080402AXDSDVJ07	Anxiety	Downstream	8/4/02	DV	96	9.01	Juvenile		0.62		0.42		5.0		134	24.3
ADFG	080402AXDSDVJ08	Anxiety	Downstream	8/4/02	DV	97	9.36	Juvenile		0.45		0.22		5.1		114	21.7
ADFG	080402AXDSDVJ09	Anxiety	Downstream	8/4/02	DV	114	13.25	Juvenile		0.42		0.17		4.7		103	22.5
ADFG	080402AXDSDVJ10	Anxiety	Downstream	8/4/02	DV	136	24	Juvenile		0.16		0.13		3.7		127	24.2
ADFG	080402AXDSDVJ11	Anxiety	Downstream	8/4/02	DV	116	14.98	Juvenile		0.41		0.28		5.5		107	24.9
ADFG	080402AXDSDVJ12	Anxiety	Downstream	8/4/02	DV	114	13.28	Juvenile		0.44		0.2		5.1		111	24.5
ADFG	080402AXDSDVJ13	Anxiety	Downstream	8/4/02	DV	105	10.54	Juvenile		0.82		0.61		8.1		112	22.6
ADFG	080402AXDSDVJ14	Anxiety	Downstream	8/4/02	DV	104	10.41	Juvenile		0.61		0.64		6.8		134	21.6
ADFG	080402AXDSDVJ15	Anxiety	Downstream	8/4/02	DV	96	8.03	Juvenile		1.13		0.25		4.7		108	22.1
North Fork Red Dog Creek																	
ADF&G	082593NFDVJ1	Red Dog	North Fork 12	8/25/93	DV	136	24	Juvenile		0.80		0.26					26.8
ADF&G	082593NFDVJ2	Red Dog	North Fork 12	8/25/93	DV	133	24	Juvenile		0.79		0.18					27.9
ADF&G	082593NFDVJ3	Red Dog	North Fork 12	8/25/93	DV	117	15	Juvenile		0.35		0.25					27.8
ADF&G	082593NFDVJ4	Red Dog	North Fork 12	8/25/93	DV	119	15	Juvenile		2.37		0.32					26.8
ADF&G	082593NFDVJ5	Red Dog	North Fork 12	8/25/93	DV	130	21	Juvenile		0.67		0.34					28.4
ADF&G	082593NFDVJ6	Red Dog	North Fork 12	8/25/93	DV	131	19	Juvenile		0.75		0.58					28.1
ADF&G	081299NFDVJ01	Red Dog	North Fork 12	8/12/99	DV	140		Juvenile		0.42		0.52		4.7			24.8
ADF&G	081299NFDVJ02	Red Dog	North Fork 12	8/12/99	DV	123		Juvenile		0.88		0.86		5.2			25.9
ADF&G	081299NFDVJ03	Red Dog	North Fork 12	8/12/99	DV	128		Juvenile		0.56		0.22		4.4			28.0
ADF&G	081299NFDVJ04	Red Dog	North Fork 12	8/12/99	DV	128		Juvenile		0.58		0.57		4.2			24.5
ADF&G	081299NFDVJ05	Red Dog	North Fork 12	8/12/99	DV	125		Juvenile		0.43		0.31		5.5			23.2
ADF&G	081299NFDVJ06	Red Dog	North Fork 12	8/12/99	DV	134		Juvenile		0.42		0.28		5.8			24.1
ADF&G	081299NFDVJ07	Red Dog	North Fork 12	8/12/99	DV	146		Juvenile		0.52		0.57		4.3			26.1
ADF&G	081299NFDVJ08	Red Dog	North Fork 12	8/12/99	DV	119		Juvenile		0.50		0.30		4.6			42.0
ADF&G	081299NFDVJ09	Red Dog	North Fork 12	8/12/99	DV	126		Juvenile		1.15		0.29		5.7			23.7
ADF&G	081299NFDVJ10	Red Dog	North Fork 12	8/12/99	DV	126		Juvenile		0.38		0.32		5.1			27.4

Appendix 4, juvenile Dolly Varden continued.

Collector	Sample Number	Stream	Site	Date Collected	Fish Spp	Length (mm)	Weight (g)	Method analyte MRL		200.80 Cd total 0.05		200.8 Pb total 0.02		7740.0 Se total 1.0		200.8 Zn total 0.5	% Solids
ADF&G	072800NFDV01	Red Dog	North Fork 12	7/28/00	DV	136	21.2	Juvenile		0.78		1.38		6.4			23.3
ADF&G	072800NFDV02	Red Dog	North Fork 12	7/28/00	DV	142	24.1	Juvenile		0.37		0.36		5.2			22.5
ADF&G	072800NFDV03	Red Dog	North Fork 12	7/28/00	DV	132	17.4	Juvenile		0.73		0.99		6.2			21.1
ADF&G	072800NFDV04	Red Dog	North Fork 12	7/28/00	DV	132	17.6	Juvenile		0.54		0.90		5.7			19.7
ADF&G	072800NFDV05	Red Dog	North Fork 12	7/28/00	DV	137	22.1	Juvenile		0.43		0.89		6.1			22.8
ADF&G	080501NFUSDVJ01	Red Dog	North Fork U/S	8/1/01	DV	113	11.39	Juvenile		1.21		1.27		7.70		183	24.0
ADF&G	080501NFUSDVJ02	Red Dog	North Fork U/S	8/1/01	DV	130	15.87	Juvenile		1.45		2.37		8.00		154	23.7
ADF&G	080501NFUSDVJ03	Red Dog	North Fork U/S	8/1/01	DV	138	25.42	Juvenile		2.28		4.41		11.4		236	22.9
ADFG	080102NFUSDVJ01	Red Dog	North Fork U/S	8/2/02	DV	139	27.1	Juvenile		0.24		0.66		6.6		113	28
ADFG	080102NFUSDVJ02	Red Dog	North Fork U/S	8/2/02	DV	133	22.42	Juvenile		0.29		0.55		6.4		114	26.4
ADFG	080102NFUSDVJ03	Red Dog	North Fork U/S	8/2/02	DV	128	20.42	Juvenile		0.59		0.98		6.5		131	24.9
ADFG	080102NFUSDVJ04	Red Dog	North Fork U/S	8/2/02	DV	95	8.12	Juvenile		0.47		0.21		6.3		146	24.4
ADFG	080102NFUSDVJ05	Red Dog	North Fork U/S	8/2/02	DV	129	18.62	Juvenile		0.6		0.25		5.5		127	24.2
ADFG	080102NFUSDVJ06	Red Dog	North Fork U/S	8/2/02	DV	133	21.02	Juvenile		0.23		0.17		5.2		124	24.9
ADFG	080102NFUSDVJ07	Red Dog	North Fork U/S	8/2/02	DV	116	19.18	Juvenile		0.69		0.36		6		118	25.9
ADFG	080102NFUSDVJ08	Red Dog	North Fork U/S	8/2/02	DV	136	22.87	Juvenile		0.24		0.18		6		116	25.5
ADFG	080102NFUSDVJ09	Red Dog	North Fork U/S	8/3/02	DV	141	30.31	Juvenile		0.71		0.79		7.2		156	27.6
ADFG	080102NFUSDVJ10	Red Dog	North Fork U/S	8/3/02	DV	120	18.54	Juvenile		0.86		0.12		6.9		96.2	27.8
ADFG	080102NFUSDVJ11	Red Dog	North Fork U/S	8/3/02	DV	115	14.05	Juvenile		0.42		0.3		7		115	26.4
ADFG	080102NFUSDVJ12	Red Dog	North Fork U/S	8/3/02	DV	130	21.31	Juvenile		0.88		1.42		7.2		176	27.9
ADFG	080102NFUSDVJ13	Red Dog	North Fork U/S	8/3/02	DV	130	19.33	Juvenile		0.32		0.28		6		168	21.4
ADFG	080102NFUSDVJ14	Red Dog	North Fork U/S	8/3/02	DV	98	11.4	Juvenile		0.65		0.38		6.5		168	26
ADFG	080102NFUSDVJ15	Red Dog	North Fork U/S	8/3/02	DV	113	15.94	Juvenile		0.27		0.16		6.3		98.5	27
Mainstem Red Dog Creek																	
ADF&G	080798MSDVJ1	Red Dog	Mainstem	8/7/98	DV	132		Juvenile		1.97		5.04		6.46			25.5
ADF&G	080798MSDVJ2	Red Dog	Mainstem	8/7/98	DV	145		Juvenile		3.62		15.00		7.27			26.8

Appendix 4, juvenile Dolly Varden continued.

Collector	Sample Number	Stream	Site	Date Collected	Fish Spp	Length (mm)	Weight (g)	Method analyte MRL		200.80 Cd total 0.05		200.8 Pb total 0.02		7740.0 Se total 1.0		200.8 Zn total 0.5	% Solids
ADF&G	080798MSDVJ3	Red Dog	Mainstem	8/7/98	DV	124		Juvenile		3.62		16.20		6.40			23.8
ADF&G	080798MSDVJ4	Red Dog	Mainstem	8/7/98	DV	124		Juvenile		3.04		10.60		5.23			23.7
ADF&G	080798MSDVJ5	Red Dog	Mainstem	8/7/98	DV	110		Juvenile		3.07		6.97		5.73			24.3
ADF&G	080798MSDVJ6	Red Dog	Mainstem	8/7/98	DV	130		Juvenile		1.89		4.17		7.29			24.1
ADF&G	080798MSDVJ7	Red Dog	Mainstem	8/7/98	DV	143		Juvenile		0.42		3.95		6.88			25.6
ADF&G	080798MSDVJ8	Red Dog	Mainstem	8/7/98	DV	130		Juvenile		2.54		21.20		8.68			23.3
ADF&G	080798MSDVJ9	Red Dog	Mainstem	8/7/98	DV	132		Juvenile		3.08		6.48		7.26			23.3
ADF&G	080798MSDVJ10	Red Dog	Mainstem	8/7/98	DV	132		Juvenile		1.04		7.97		7.62			24.2
ADF&G	081299MSDVJ01	Red Dog	Mainstem	8/10/99	DV	140		Juvenile		4.62		8.91		6.89			23.9
ADF&G	081299MSDVJ02	Red Dog	Mainstem	8/10/99	DV	121		Juvenile		3.90		8.78		7.13			22.6
ADF&G	081299MSDVJ03	Red Dog	Mainstem	8/10/99	DV	125		Juvenile		3.75		8.68		8.90			22.2
ADF&G	081299MSDVJ04	Red Dog	Mainstem	8/10/99	DV	127		Juvenile		4.14		3.11		7.26			24.1
ADF&G	081299MSDVJ05	Red Dog	Mainstem	8/10/99	DV	130		Juvenile		3.19		4.97		6.87			20.8
ADF&G	081299MSDVJ06	Red Dog	Mainstem	8/10/99	DV	134		Juvenile		1.28		3.18		7.30			24.1
ADF&G	081299MSDVJ07	Red Dog	Mainstem	8/10/99	DV	139		Juvenile		3.84		6.52		8.89			22.8
ADF&G	081299MSDVJ08	Red Dog	Mainstem	8/10/99	DV	145		Juvenile		3.17		10.40		6.30			23.3
ADF&G	081299MSDVJ09	Red Dog	Mainstem	8/10/99	DV	143		Juvenile		0.54		1.09		5.66			26.0
ADF&G	081299MSDVJ10	Red Dog	Mainstem	8/10/99	DV	120		Juvenile		2.47		9.94		4.24			23.2
ADF&G	072800MSDVJ01	Red Dog	Mainstem	7/28/00	DV	131	17.9	Juvenile		2.69		6.80		6.8			22.5
ADF&G	072800MSDVJ02	Red Dog	Mainstem	7/28/00	DV	117	12.3	Juvenile		3.45		13.0		10.8			25.1
ADF&G	072800MSDVJ03	Red Dog	Mainstem	7/28/00	DV	140	21.8	Juvenile		4.75		9.75		9.1			22.7
ADF&G	072800MSDVJ04	Red Dog	Mainstem	7/28/00	DV	110	11.2	Juvenile		2.91		13.4		12.5			24.6
ADF&G	072800MSDVJ05	Red Dog	Mainstem	7/28/00	DV	125	16	Juvenile		6.40		15.8		8.9			20.9
ADF&G	080501MSRDDVJ01	Red Dog	Mainstem	7/31/01	DV	92	6.93	Juvenile		5.92		46.6		12.3		333	22.0
ADF&G	080501MSRDDVJ02	Red Dog	Mainstem	7/31/01	DV	133	16.11	Juvenile		3.88		16.8		7.6		244	20.8
ADF&G	080501MSRDDVJ03	Red Dog	Mainstem	7/31/01	DV	94	6.22	Juvenile		3.42		25.0		15.2		327	24.9
ADF&G	080501MSRDDVJ04	Red Dog	Mainstem	7/31/01	DV	132	15.98	Juvenile		1.15		1.95		6.7		117	21.4

Appendix 4, juvenile Dolly Varden continued.

Collector	Sample Number	Stream	Site	Date Collected	Fish Spp	Length (mm)	Weight (g)	Method analyte MRL	200.80 Cd total 0.05	200.8 Pb total 0.02	7740.0 Se total 1.0	200.8 Zn total 0.5	% Solids
ADF&G	080501MSRDDVJ05	Red Dog	Mainstem	7/31/01	DV	134	21.74	Juvenile	3.83	9.79	14.4	210	22.8
ADF&G	080501MSRDDVJ06	Red Dog	Mainstem	7/31/01	DV	117	12.7	Juvenile	2.78	4.43	10.5	226	20.7
ADF&G	080501MSRDDVJ07	Red Dog	Mainstem	7/31/01	DV	106	9.69	Juvenile	2.80	5.62	11.1	210	21.5
ADF&G	080501MSRDDVJ08	Red Dog	Mainstem	7/31/01	DV	106	9.3	Juvenile	3.52	11.4	13.1	188	23.2
ADFG	081002MSRDDV01	Red Dog	Mainstem	7/28/02	DV	112	13.99	Juvenile	6.63	20.7	9.4	271	23.8
ADFG	081002MSRDDV02	Red Dog	Mainstem	7/28/02	DV	100	11.75	Juvenile	5.62	8.89	13	276	25.1
ADFG	081002MSRDDV03	Red Dog	Mainstem	7/28/02	DV	127	20.25	Juvenile	6.16	14.6	16.1	404	25.4
ADFG	081002MSRDDV04	Red Dog	Mainstem	7/28/02	DV	128	20.53	Juvenile	6.17	29.2	12.7	402	23.6
ADFG	081002MSRDDV05	Red Dog	Mainstem	7/28/02	DV	90	6.22	Juvenile	1.83	6.77	6.6	195	22.9
ADFG	081002MSRDDV06	Red Dog	Mainstem	7/28/02	DV	106	10.88	Juvenile	3.39	9.33	13	230	25.1
ADFG	081002MSRDDV07	Red Dog	Mainstem	7/28/02	DV	104	10.93	Juvenile	4.82	8.39	17.2	314	24.9
ADFG	081002MSRDDV08	Red Dog	Mainstem	7/28/02	DV	98	8.74	Juvenile	3.13	6.42	17	210	24.2
ADFG	081002MSRDDV09	Red Dog	Mainstem	7/28/02	DV	119	16.71	Juvenile	2.82	5	14.2	205	26.1
ADFG	081002MSRDDV10	Red Dog	Mainstem	7/28/02	DV	95	9.04	Juvenile	3.65	16.9	9.2	218	23.4
ADFG	081002MSRDDV11	Red Dog	Mainstem	7/29/02	DV	134	23.22	Juvenile	3.05	8.4	9.8	219	24.7
ADFG	081002MSRDDV12	Red Dog	Mainstem	7/29/02	DV	116	13.21	Juvenile	2.31	5.26	8.7	180	20.5
ADFG	081002MSRDDV13	Red Dog	Mainstem	7/29/02	DV	99	9.67	Juvenile	2.64	3.02	11.2	218	25.3
ADFG	081002MSRDDV14	Red Dog	Mainstem	7/29/02	DV	100	10.6	Juvenile	3.11	8.12	13.3	221	24
ADFG	081002MSRDDV15	Red Dog	Mainstem	7/29/02	DV	96	8.36	Juvenile	2.04	10.1	8.2	177	24
ADNR	080803MSDVJ01	Red Dog	Mainstem	8/8/03	DV	150	30	Juvenile	4.98	10.7	11.8	233	25.4
ADNR	080803MSDVJ02	Red Dog	Mainstem	8/8/03	DV	128	16.7	Juvenile	5.48	8.4	11.5	208	24.5
ADNR	081003MSDVJ03	Red Dog	Mainstem	8/10/03	DV	112	13.5	Juvenile	6.56	15.2	10.1	271	23.2
ADNR	081003MSDVJ04	Red Dog	Mainstem	8/10/03	DV	111	13.6	Juvenile	3.86	2.42	10.0	220	25.2
ADNR	081003MSDVJ05	Red Dog	Mainstem	8/10/03	DV	119	15.5	Juvenile	3.41	1.72	10.1	166	24.2
ADNR	081003MSDVJ06	Red Dog	Mainstem	8/10/03	DV	108	12	Juvenile	2.82	3.41	10.0	197	23
ADNR	081003MSDVJ07	Red Dog	Mainstem	8/10/03	DV	106	11.3	Juvenile	5.92	9.26	10.4	331	23.3
ADNR	081003MSDVJ08	Red Dog	Mainstem	8/10/03	DV	108	11.2	Juvenile	4.65	4.51	11.0	212	24.6
ADNR	081003MSDVJ09	Red Dog	Mainstem	8/10/03	DV	112	12.3	Juvenile	2.96	4.66	8.5	185	24.6

Appendix 4, juvenile Dolly Varden continued.

Collector	Sample Number	Stream	Site	Date Collected	Fish Spp	Length (mm)	Weight (g)	Method analyte MRL		200.80 Cd total 0.05		200.8 Pb total 0.02		7740.0 Se total 1.0		200.8 Zn total 0.5	% Solids
ADNR	081003MSDVJ10	Red Dog	Mainstem	8/10/03	DV	118	16.3	Juvenile		5.15		16.3		12.7		258	24.3
ADNR	081003MSDVJ11	Red Dog	Mainstem	8/10/03	DV	111	11.9	Juvenile		4.37		12.7		9.6		234	24.7
ADNR	081003MSDVJ12	Red Dog	Mainstem	8/10/03	DV	109	11.6	Juvenile		1.29		1.87		10.1		153	24.7
ADNR	081003MSDVJ13	Red Dog	Mainstem	8/10/03	DV	106	15.5	Juvenile		1.86		0.97		8.2		140	24.9
ADNR	081003MSDVJ14	Red Dog	Mainstem	8/10/03	DV	110	12.8	Juvenile		3.53		4.42		13.7		249	25.5
Buddy Creek																	
ADFG	080302BUDVJ01	Buddy Creek	D/S Road	7/29/02	DV	108	13.38	Juvenile		0.5		0.4		7.8		110	25.2
ADFG	080302BUDVJ02	Buddy Creek	D/S Road	7/29/02	DV	100	9.93	Juvenile		0.56		0.41		7.9		122	24.7
ADFG	080302BUDVJ03	Buddy Creek	D/S Road	7/29/02	DV	99	9.6	Juvenile		0.7		0.19		5.9		152	22.8
ADFG	080302BUDVJ04	Buddy Creek	D/S Road	7/29/02	DV	100	10.14	Juvenile		0.6		0.19		7.5		127	22.8
ADFG	080302BUDVJ05	Buddy Creek	D/S Road	7/29/02	DV	104	12.83	Juvenile		0.95		0.71		8.4		150	24.7
ADFG	080302BUDVJ06	Buddy Creek	D/S Road	7/29/02	DV	102	11.59	Juvenile		0.74		0.55		6.3		121	27.7
ADFG	080302BUDVJ07	Buddy Creek	D/S Road	7/29/02	DV	117	15.07	Juvenile		0.39		0.37		5.9		141	22.9
ADFG	080302BUDVJ08	Buddy Creek	D/S Road	7/29/02	DV	106	10.78	Juvenile		0.43		0.25		7		128	24.5
ADFG	080302BUDVJ09	Buddy Creek	D/S Road	7/29/02	DV	110	13.26	Juvenile		0.93		0.23		7.1		132	25
ADFG	080302BUDVJ10	Buddy Creek	D/S Road	7/29/02	DV	110	13.75	Juvenile		0.28		0.16		7.1		117	24.8
ADFG	080302BUDVJ11	Buddy Creek	D/S Road	7/29/02	DV	112	14.48	Juvenile		0.31		0.65		8.8		120	31.1
ADFG	080302BUDVJ12	Buddy Creek	D/S Road	7/29/02	DV	136	23.85	Juvenile		0.24		0.35		6.8		125	26.3
ADFG	080302BUDVJ13	Buddy Creek	D/S Road	7/29/02	DV	112	13.8	Juvenile		0.44		0.23		7.8		103	26.4
ADFG	080302BUDVJ14	Buddy Creek	D/S Road	7/29/02	DV	144	28.25	Juvenile		0.39		0.39		6.6		123	24.4
ADFG	080302BUDVJ15	Buddy Creek	D/S Road	7/29/02	DV	144	28.6	Juvenile		0.29		0.35		8.1		117	24.5
ADNR	080903BUDVJ01	Buddy Creek	D/S Road	8/9/03	DV	108	12.3	Juvenile		0.72		1.18		8.4		160	23.7
ADNR	080903BUDVJ02	Buddy Creek	D/S Road	8/9/03	DV	118	15.4	Juvenile		0.50		1.44		6.0		130	25.9
ADNR	080903BUDVJ03	Buddy Creek	D/S Road	8/9/03	DV	122	18.5	Juvenile		0.54		0.49		6.1		125	25.1
ADNR	080903BUDVJ04	Buddy Creek	D/S Road	8/9/03	DV	106	11.8	Juvenile		0.77		0.44		6.8		138	25.4
ADNR	080903BUDVJ05	Buddy Creek	D/S Road	8/9/03	DV	134	20.7	Juvenile		0.57		0.52		7.6		125	22.5
ADNR	080903BUDVJ06	Buddy Creek	D/S Road	8/9/03	DV	118	14	Juvenile		0.39		1.37		7.0		130	24.6

Appendix 4, juvenile Dolly Varden continued.

Collector	Sample Number	Stream	Site	Date Collected	Fish Spp	Length (mm)	Weight (g)	Method analyte MRL		200.80 Cd total 0.05		200.8 Pb total 0.02		7740.0 Se total 1.0		200.8 Zn total 0.5	% Solids
ADNR	080903BUDVJ07	Buddy Creek	D/S Road	8/9/03	DV	120	15.1	Juvenile		0.77		0.6		7.1		138	25.3
ADNR	080903BUDVJ08	Buddy Creek	D/S Road	8/9/03	DV	102	8.8	Juvenile		1.75		0.58		6.7		165	26.1
ADNR	080903BUDVJ09	Buddy Creek	D/S Road	8/9/03	DV	102	8.8	Juvenile		0.35		0.18		8.5		122	24.9
ADNR	080903BUDVJ10	Buddy Creek	D/S Road	8/9/03	DV	109	11.2	Juvenile		0.42		0.41		6.9		118	24.9
ADNR	080903BUDVJ11	Buddy Creek	D/S Road	8/9/03	DV	104	9.9	Juvenile		0.62		0.46		6.9		143	25
ADNR	080903BUDVJ12	Buddy Creek	D/S Road	8/9/03	DV	115	15	Juvenile		0.43		0.17		7.1		130	26.3
ADNR	080903BUDVJ13	Buddy Creek	D/S Road	8/9/03	DV	90	5.4	Juvenile		0.48		0.53		5.0		180	24.6
ADNR	080903BUDVJ14	Buddy Creek	D/S Road	8/9/03	DV	110	11	Juvenile		1.12		0.59		6.6		154	26.8
ADNR	080903BUDVJ15	Buddy Creek	D/S Road	8/9/03	DV	102	9.7	Juvenile		0.94		0.46		5.5		167	26.9
Ferric Creek																	
ADF&G	081299FEDVJ01	Ferric	Above Seep	8/12/99	DV	123		Juvenile		0.09		0.36		5.27			25.2
ADF&G	081299FEDVJ02	Ferric	Above Seep	8/12/99	DV	125		Juvenile		0.21		0.37		5.20			25.4
ADF&G	081299FEDVJ03	Ferric	Above Seep	8/12/99	DV	149		Juvenile		0.06		0.22		6.32			26.3
ADF&G	081299FEDVJ04	Ferric	Above Seep	8/12/99	DV	141		Juvenile		0.06		0.33		5.58			24.3
ADF&G	081299FEDVJ05	Ferric	Above Seep	8/12/99	DV	123		Juvenile		0.26		0.42		6.19			24.0
ADF&G	081299FEDVJ06	Ferric	Above Seep	8/12/99	DV	141		Juvenile		0.11		0.18		6.46			24.4
ADF&G	081299FEDVJ07	Ferric	Above Seep	8/12/99	DV	115		Juvenile		0.27		0.30		6.64			27.8
ADF&G	081299FEDVJ08	Ferric	Above Seep	8/12/99	DV	116		Juvenile		0.16		0.22		5.69			25.9
ADF&G	081299FEDVJ09	Ferric	Above Seep	8/12/99	DV	107		Juvenile		0.07		0.21		4.66			26.0
Evaingiknuk Creek																	
ADF&G	080501EV00DVJ01	Eva	near Haul Road	7/30/01	DV	89	5.09	Juvenile		0.29		0.82		2.1		160	21.5
ADF&G	080501EV00DVJ02	Eva	near Haul Road	7/30/01	DV	78	3.07	Juvenile		0.17		0.36		3.4		137	19.4
ADF&G	080501EV00DVJ03	Eva	near Haul Road	7/30/01	DV	130	17.15	Juvenile		0.16		0.23		2.0		124	24.5
ADF&G	080501EV00DVJ04	Eva	near Haul Road	7/30/01	DV	81	4.11	Juvenile		0.19		0.31		2.8		111	19.6
ADF&G	080501EV00DVJ05	Eva	near Haul Road	7/30/01	DV	90	5.06	Juvenile		0.16		0.31		4.4		138	20.4
ADF&G	080501EV00DVJ06	Eva	near Haul Road	7/30/01	DV	100	7.74	Juvenile		0.22		0.55		2.7		129	20.4

Appendix 4, juvenile Dolly Varden continued.

Collector	Sample Number	Stream	Site	Date Collected	Fish Spp	Length (mm)	Weight (g)	Method analyte MRL		200.80 Cd total 0.05		200.8 Pb total 0.02		7740.0 Se total 1.0		200.8 Zn total 0.5	% Solids
ADF&G	080501EV00DVJ07	Eva	near Haul Road	7/30/01	DV	126	17.63	Juvenile		0.14		0.17		5.7		119	22.4
ADF&G	080501EV00DVJ08	Eva	near Haul Road	7/30/01	DV	117	14.4	Juvenile		0.30		0.13		2.2		130	23.1
ADF&G	080501EV00DVJ09	Eva	near Haul Road	7/30/01	DV	87	4.26	Juvenile		0.13		0.15		2.6		120	19.2
ADNR	080803EVDVJ01	Eva	near Haul Road	8/8/03	DV	99	11.4	Juvenile		0.35		0.31		1.3		170	25.2
ADNR	080803EVDVJ02	Eva	near Haul Road	8/8/03	DV	104	10	Juvenile		0.27		0.08		1.2		125	24.1
ADNR	080803EVDVJ03	Eva	near Haul Road	8/8/03	DV	100	10.8	Juvenile		0.31		0.15		1.3		156	25.8
ADNR	080803EVDVJ04	Eva	near Haul Road	8/8/03	DV	96	8.1	Juvenile		0.37		0.08		1.9		164	23.6
ADNR	080803EVDVJ05	Eva	near Haul Road	8/8/03	DV	106	10.8	Juvenile		0.31		0.09		1.7		151	24.5
ADNR	080803EVDVJ06	Eva	near Haul Road	8/8/03	DV	94	9.2	Juvenile		0.34		0.1		1.3		161	23.5
ADNR	080803EVDVJ07	Eva	near Haul Road	8/8/03	DV	109	12.2	Juvenile		0.30		0.12	<	1.0		139	25.2
ADNR	080803EVDVJ08	Eva	near Haul Road	8/8/03	DV	117	11.9	Juvenile		0.66		0.07		1.8		139	25.6
ADNR	080803EVDVJ09	Eva	near Haul Road	8/8/03	DV	100	10.1	Juvenile		0.64		0.12		1.4		153	24
ADNR	080803EVDVJ10	Eva	near Haul Road	8/8/03	DV	99	10	Juvenile		0.36		0.18		1.3		154	24.7
ADNR	080803EVDVJ11	Eva	near Haul Road	8/8/03	DV	95	7.8	Juvenile		0.34		0.16		1.4		139	25
ADNR	080803EVDVJ12	Eva	near Haul Road	8/8/03	DV	100	9.1	Juvenile		0.28		0.06		1.6		151	25.8
ADNR	080803EVDVJ13	Eva	near Haul Road	8/8/03	DV	100	8.7	Juvenile		0.33		0.11		2.6		141	23.6
ADNR	080803EVDVJ14	Eva	near Haul Road	8/8/03	DV	103	9.2	Juvenile		0.33		0.09		1.6		167	23.2
ADNR	080803EVDVJ15	Eva	near Haul Road	8/8/03	DV	96	8.3	Juvenile		0.20		0.09		4.1		150	23.2
Ikalukrok Creek																	
ADF&G	080501IK07DVJ01	Ikalukrok	Sta 7	8/5/01	DV	122	15.57	Juvenile		1.81		1.75		5.1		333	20.4
ADF&G	080501IK07DVJ02	Ikalukrok	Sta 7	8/5/01	DV	77	3.52	Juvenile		1.47		1.83		4.2		242	20.6
ADF&G	080501IK07DVJ03	Ikalukrok	Sta 7	8/5/01	DV	99	7.38	Juvenile		0.48		0.80		4.6		146	20.4
ADF&G	080501IK07DVJ04	Ikalukrok	Sta 7	8/5/01	DV	93	4.77	Juvenile		0.77		1.82		5.0		170	19.2
ADF&G	080501IK07DVJ05	Ikalukrok	Sta 7	8/5/01	DV	96	6.52	Juvenile		1.03		0.35		4.8		159	25.9
ADF&G	080501IK07DVJ06	Ikalukrok	Sta 7	8/5/01	DV	91	5.47	Juvenile		1.06		0.67		5.2		217	26.0

Appendix 4, juvenile Dolly Varden continued.

Collector	Sample Number	Stream	Site	Date Collected	Fish Spp	Length (mm)	Weight (g)	Method analyte MRL		200.80 Cd total 0.05		200.8 Pb total 0.02		7740.0 Se total 1.0		200.8 Zn total 0.5	% Solids
Grayling Junior Creek																	
ADFG	080501GJ01DVJ01	Grayling Junior	Station 209	8/1/01	DV	137	20.99	Juvenile		0.69		0.16		7.4		171	22.4
ADFG	080501GJ01DVJ02	Grayling Junior	Station 209	8/1/01	DV	109	11.27	Juvenile		3.78		1.44		7.2		573	21.9
ADFG	080501GJ01DVJ03	Grayling Junior	Station 209	8/1/01	DV	85	5.17	Juvenile		1.64		0.48		6.4		235	20.1
ADFG	080501GJ01DVJ04	Grayling Junior	Station 209	8/1/01	DV	108	9.90	Juvenile		2.3		0.89		6.6		344	19.7
ADFG	080501GJ01DVJ05	Grayling Junior	Station 209	8/1/01	DV	90	6.09	Juvenile		0.71		0.28		5.9		202	21.3
ADFG	080501GJ01DVJ06	Grayling Junior	Station 209	8/1/01	DV	90	5.77	Juvenile		1.27		0.55		7.5		250	19.1
ADFG	080501GJ01DVJ07	Grayling Junior	Station 209	8/1/01	DV	87	5.14	Juvenile		1.66		0.45		7.4		273	19.9
ADFG	080501GJ01DVJ08	Grayling Junior	Station 209	8/1/01	DV	87	4.63	Juvenile		1.48		0.59		6		299	18.8
ADFG	080501GJ01DVJ09	Grayling Junior	Station 209	8/1/01	DV	94	6.08	Juvenile		1.6		0.57		7.2		328	19.2
ADFG	080501GJ01DVJ10	Grayling Junior	Station 209	8/1/01	DV	81	3.93	Juvenile		1.96		0.93		7.5		499	18.6
North Fork Omikviorok River																	
ADFG	080501OMUSDVJ01	Omikviorok	North Fork	8/6/01	DV	123	13.45	Juvenile		0.09		3.03		3.1		107	22
ADFG	080501OMUSDVJ02	Omikviorok	North Fork	8/6/01	DV	83	4.23	Juvenile		0.11		0.34		3.1		120	19.1
ADFG	080501OMUSDVJ03	Omikviorok	North Fork	8/6/01	DV	131	18.66	Juvenile		0.12		0.17		3.2		94.4	22.9
ADFG	080501OMUSDVJ04	Omikviorok	North Fork	8/6/01	DV	132	18.21	Juvenile		0.08		0.19		2.6		106	22.1
ADFG	080501OMUSDVJ05	Omikviorok	North Fork	8/6/01	DV	134	19.74	Juvenile		0.08		0.06		2.5		105	21.6
ADFG	080501OMUSDVJ06	Omikviorok	North Fork	8/6/01	DV	133	18.74	Juvenile		0.14		0.07		2.7		85.4	22.4
ADFG	080501OMUSDVJ07	Omikviorok	North Fork	8/6/01	DV	95	6.79	Juvenile		0.04		0.04		2.1		92.4	21.7
ADFG	080501OMUSDVJ08	Omikviorok	North Fork	8/6/01	DV	87	4.65	Juvenile		0.09		0.06		2.6		71.7	21.9
ADFG	080501OMUSDVJ09	Omikviorok	North Fork	8/6/01	DV	111	10.73	Juvenile		0.08		0.11		2.1		155	23.2
ADFG	080501OMUSDVJ10	Omikviorok	North Fork	8/6/01	DV	105	9.13	Juvenile		0.10		0.08		2.8		144	22.1
ADFG	080402OMNFDVJ01	Omniviorik R	North Fork	8/4/02	DV	122	15.78	Juvenile		0.08		0.21		5.4		110	24.6
ADFG	080402OMNFDVJ02	Omniviorik R	North Fork	8/4/02	DV	130	17.84	Juvenile		0.09		0.06		4.5		102	23.9
ADFG	080402OMNFDVJ03	Omniviorik R	North Fork	8/4/02	DV	138	21.52	Juvenile		0.10		0.07		6.9		98.2	24.8

Appendix 4, juvenile Dolly Varden continued.

Collector	Sample Number	Stream	Site	Date Collected	Fish Spp	Length (mm)	Weight (g)	Method analyte MRL		200.80 Cd total 0.05		200.8 Pb total 0.02		7740.0 Sc total 1.0		200.8 Zn total 0.5	% Solids
ADFG	080402OMNFDVJ04	Omniviorik R	North Fork	8/4/02	DV	119	11.76	Juvenile		0.09		0.26		4.4		159	20.9
ADFG	080402OMNFDVJ05	Omniviorik R	North Fork	8/4/02	DV	105	9.3	Juvenile		0.09		0.06		4.0		92.3	24.4
ADFG	080402OMNFDVJ06	Omniviorik R	North Fork	8/4/02	DV	124	15.21	Juvenile		0.11		0.05		3.1		127	20.3
ADFG	080402OMNFDVJ07	Omniviorik R	North Fork	8/4/02	DV	120	13.63	Juvenile		0.15		0.1		3.5		128	24.6
ADFG	080402OMNFDVJ08	Omniviorik R	North Fork	8/4/02	DV	95	6.44	Juvenile		0.09		0.06		3.8		142	24.8
ADFG	080402OMNFDVJ09	Omniviorik R	North Fork	8/5/02	DV	124	15.73	Juvenile		0.08		0.07		0.3		107	24.5
ADFG	080402OMNFDVJ10	Omniviorik R	North Fork	8/5/02	DV	112	10.78	Juvenile		0.06		0.17		3.1		111	25.3
ADFG	080402OMNFDVJ11	Omniviorik R	North Fork	8/5/02	DV	119	13.95	Juvenile	<	0.05		0.03		4.7		129	24.4
ADFG	080402OMNFDVJ12	Omniviorik R	North Fork	8/5/02	DV	123	16.14	Juvenile		0.08		0.13		3.4		95.3	23.3
ADFG	080402OMNFDVJ13	Omniviorik R	North Fork	8/5/02	DV	116	12.22	Juvenile		0.09		0.07		3.8		125	21
ADFG	080402OMNFDVJ14	Omniviorik R	North Fork	8/5/02	DV	121	13.79	Juvenile		0.06	<	0.02		3.6		117	21.5
ADFG	080402OMNFDVJ15	Omniviorik R	North Fork	8/5/02	DV	102	9.84	Juvenile		0.14		0.12		3.8		107	24.1
South Fork Omikviorok River																	
ADFG	080402OMSFDVJ01	Omniviorik R	South Fork	8/4/02	DV	95	6.81	Juvenile		0.05		0.06		5.1		112	26.4
ADFG	080402OMSFDVJ02	Omniviorik R	South Fork	8/4/02	DV	129	18.02	Juvenile	<	0.05		0.04		3.2		83.6	26.9
ADFG	080402OMSFDVJ03	Omniviorik R	South Fork	8/4/02	DV	135	20.81	Juvenile	<	0.05		0.13		3.0		93.9	26.3
ADFG	080402OMSFDVJ04	Omniviorik R	South Fork	8/4/02	DV	142	23.68	Juvenile		0.06		0.06		2.8		131	25.3
ADFG	080402OMSFDVJ05	Omniviorik R	South Fork	8/4/02	DV	106	12.08	Juvenile		0.06		0.05		2.8		105	28.4
ADFG	080402OMSFDVJ06	Omniviorik R	South Fork	8/4/02	DV	129	17.9	Juvenile	<	0.05		0.05		2.9		143	23.5
ADFG	080402OMSFDVJ07	Omniviorik R	South Fork	8/4/02	DV	114	14.08	Juvenile		0.06		0.13		2.7		116	24.3
ADFG	080402OMSFDVJ08	Omniviorik R	South Fork	8/4/02	DV	97	8.19	Juvenile		0.06		0.03		5.2		122	24.1
ADFG	080402OMSFDVJ09	Omniviorik R	South Fork	8/4/02	DV	110	11.97	Juvenile		0.06		0.05		3.4		120	25
ADFG	080402OMSFDVJ10	Omniviorik R	South Fork	8/4/02	DV	128	17.61	Juvenile	<	0.05		0.05		3.3		104	24.7
ADFG	080402OMSFDVJ11	Omniviorik R	South Fork	8/4/02	DV	110	10.99	Juvenile	<	0.05		0.07		2.3		115	22.5
ADFG	080402OMSFDVJ12	Omniviorik R	South Fork	8/4/02	DV	110	10.65	Juvenile	<	0.05		0.08		3.6		99.8	22.7
ADFG	080402OMSFDVJ13	Omniviorik R	South Fork	8/4/02	DV	101	8.44	Juvenile	<	0.05	<	0.02		3.5		113	23
ADFG	080402OMSFDVJ14	Omniviorik R	South Fork	8/4/02	DV	92	6.76	Juvenile		0.07		0.06		5.3		137	23.1
ADFG	080402OMSFDVJ15	Omniviorik R	South Fork	8/4/02	DV	105	9.93	Juvenile		0.06		0.14		4.0		107	22.6

Appendix 4, juvenile Dolly Varden continued.

Collector	Sample Number	Stream	Site	Date Collected	Fish Spp	Length (mm)	Weight (g)	Method analyte MRL		200.80 Cd total 0.05		200.8 Pb total 0.02		7740.0 Se total 1.0		200.8 Zn total 0.5	% Solids
Omikviorok River Downstream of Road																	
ADFG	080501OMDSDVJ01	Omikviorok	Downstream	8/6/01	DV	138	20.96	Juvenile		0.10		0.21		3.1		118	21.6
ADFG	080501OMDSDVJ02	Omikviorok	Downstream	8/6/01	DV	139	20.42	Juvenile		0.08		0.09		2.6		111	23.9
ADFG	080501OMDSDVJ03	Omikviorok	Downstream	8/6/01	DV	104	8.43	Juvenile		0.05		0.13		3.4		99.1	23.8
ADFG	080501OMDSDVJ04	Omikviorok	Downstream	8/6/01	DV	87	4.58	Juvenile		0.09		0.41		2.7		131	17.4
ADFG	080501OMDSDVJ05	Omikviorok	Downstream	8/6/01	DV	87	5.18	Juvenile		0.07		0.08		2.6		97.7	22.3
ADFG	080501OMDSDVJ06	Omikviorok	Downstream	8/6/01	DV	91	5.15	Juvenile		0.07		0.51		2.9		121	21.9
ADFG	080501OMDSDVJ07	Omikviorok	Downstream	8/6/01	DV	133	22.81	Juvenile		0.10		1.05		2.8		100	21.6
ADFG	080501OMDSDVJ08	Omikviorok	Downstream	8/6/01	DV	134	20.28	Juvenile		0.06		0.22		3.3		116	23.1
ADFG	080501OMDSDVJ09	Omikviorok	Downstream	8/6/01	DV	100	8	Juvenile		0.06		0.27		3.4		106	22
ADFG	080501OMDSDVJ10	Omikviorok	Downstream	8/6/01	DV	98	7.16	Juvenile		0.05		0.21		2.1		107	22.3
ADFG	080402OMDSDVJ01	Omniviorik R	Downstream	8/4/02	DV	128	19.68	Juvenile		0.06		0.17		3.0		114	27.5
ADFG	080402OMDSDVJ02	Omniviorik R	Downstream	8/4/02	DV	124	18.79	Juvenile	<	0.05	<	0.02		4.7		105	26.3
ADFG	080402OMDSDVJ03	Omniviorik R	Downstream	8/4/02	DV	103	10.09	Juvenile		0.09		0.02		4.0		113	24.1
ADFG	080402OMDSDVJ04	Omniviorik R	Downstream	8/4/02	DV	119	17.18	Juvenile	<	0.05		0.02		2.3		134	21.6
ADFG	080402OMDSDVJ05	Omniviorik R	Downstream	8/4/02	DV	99	8.94	Juvenile	<	0.05	<	0.02		2.9		109	23.6
ADFG	080402OMDSDVJ06	Omniviorik R	Downstream	8/4/02	DV	110	11.74	Juvenile	<	0.05		0.04		3.3		114	23.4
ADFG	080402OMDSDVJ07	Omniviorik R	Downstream	8/4/02	DV	98	9.21	Juvenile		0.20	<	0.02		4.1		120	23.2
ADFG	080402OMDSDVJ08	Omniviorik R	Downstream	8/4/02	DV	114	16.15	Juvenile		0.14		0.14		3.1		91.1	24.8
ADFG	080402OMDSDVJ09	Omniviorik R	Downstream	8/4/02	DV	93	8.26	Juvenile		0.14		0.03		4.8		128	22.5
ADFG	080402OMDSDVJ10	Omniviorik R	Downstream	8/4/02	DV	142	24.69	Juvenile	<	0.05		0.03		2.3		112	27.7
ADFG	080402OMDSDVJ11	Omniviorik R	Downstream	8/4/02	DV	107	12.11	Juvenile		0.07		0.02		1.8		106	25.2
ADFG	080402OMDSDVJ12	Omniviorik R	Downstream	8/4/02	DV	105	11.74	Juvenile		0.09		0.04		4.3		133	25.6
ADFG	080402OMDSDVJ13	Omniviorik R	Downstream	8/4/02	DV	102	10.44	Juvenile		0.07		0.05		2.8		108	22.7
ADFG	080402OMDSDVJ14	Omniviorik R	Downstream	8/4/02	DV	112	13.79	Juvenile		0.09	<	0.02		3.3		83	28.1
ADFG	080402OMDSDVJ15	Omniviorik R	Downstream	8/4/02	DV	135	20.58	Juvenile		0.08		0.03		3.2		147	23.3

Appendix 4, juvenile Dolly Varden continued.

Collector	Sample Number	Stream	Site	Date Collected	Fish Spp	Length (mm)	Weight (g)	Method analyte MRL		200.80 Cd total 0.05		200.8 Pb total 0.02		7740.0 Se total 1.0		200.8 Zn total 0.5	% Solids
North Fork Aufeis Creek																	
ADFG	080501AUUSDVJ01	Aufeis Cr	North Fork	8/7/01	DV	140	22.82	Juvenile		0.11		0.17		3.5		106	22.3
ADFG	080501AUUSDVJ02	Aufeis Cr	North Fork	8/7/01	DV	99	8.07	Juvenile		0.16		6.00		7.0		85.4	25.4
ADFG	080501AUUSDVJ03	Aufeis Cr	North Fork	8/7/01	DV	92	7.23	Juvenile		0.12		1.55		2.6		84.5	22.8
ADFG	080501AUUSDVJ04	Aufeis Cr	North Fork	8/7/01	DV	99	8.14	Juvenile		0.11		0.36		3.1		84.6	23.2
ADFG	080501AUUSDVJ05	Aufeis Cr	North Fork	8/7/01	DV	84	4.72	Juvenile		0.17		0.13		5.0		121	19.7
ADFG	080402AUNFDVJ01	Aufeis Cr	North Fork	8/5/02	DV	121	16.93	Juvenile		0.11	<	0.02		1.9		74.9	24.7
ADFG	080402AUNFDVJ02	Aufeis Cr	North Fork	8/5/02	DV	139	26.9	Juvenile		0.06		0.02		2.2		77.2	25.5
ADFG	080402AUNFDVJ03	Aufeis Cr	North Fork	8/5/02	DV	103	10.79	Juvenile		0.11	<	0.02		3.7		90.4	24.1
ADFG	080402AUNFDVJ04	Aufeis Cr	North Fork	8/5/02	DV	118	15.33	Juvenile		0.08	<	0.02		2.5		83.7	24.4
ADFG	080402AUNFDVJ05	Aufeis Cr	North Fork	8/5/02	DV	118	16	Juvenile		0.06		0.02		4.0		104	26.1
ADFG	080402AUNFDVJ06	Aufeis Cr	North Fork	8/5/02	DV	122	18.64	Juvenile	<	0.05	<	0.02		2.1		75.1	26.4
ADFG	080402AUNFDVJ07	Aufeis Cr	North Fork	8/5/02	DV	128	19.44	Juvenile		0.06	<	0.02		1.6		97.3	26.3
ADFG	080402AUNFDVJ08	Aufeis Cr	North Fork	8/5/02	DV	128	21.28	Juvenile		0.06	<	0.02		2.2		87	26.7
ADFG	080402AUNFDVJ09	Aufeis Cr	North Fork	8/5/02	DV	95	8.76	Juvenile		0.05	<	0.02		3.0		129	23.9
ADFG	080402AUNFDVJ10	Aufeis Cr	North Fork	8/5/02	DV	110	12.72	Juvenile		0.07	<	0.02		2.2		94.4	24.6
ADFG	080402AUNFDVJ11	Aufeis Cr	North Fork	8/5/02	DV	129	20.26	Juvenile	<	0.05	<	0.02		1.5		82.4	26
ADFG	080402AUNFDVJ12	Aufeis Cr	North Fork	8/5/02	DV	115	14.85	Juvenile		0.06		0.02		3.1		100	25.2
ADFG	080402AUNFDVJ13	Aufeis Cr	North Fork	8/5/02	DV	112	12.99	Juvenile	<	0.05	<	0.02		2.9		84.9	25.8
ADFG	080402AUNFDVJ14	Aufeis Cr	North Fork	8/5/02	DV	115	15.52	Juvenile		0.07	<	0.02		3.0		96.7	24.9
ADFG	080402AUNFDVJ15	Aufeis Cr	North Fork	8/5/02	DV	122	17.58	Juvenile	<	0.05	<	0.02		2.2		104	25.8
South Fork Aufeis Creek																	
ADFG	080402AUSFDVJ01	Aufeis Cr	South Fork	8/5/02	DV	116	16.19	Juvenile	<	0.05		0.04		6.8		78.6	26.8
ADFG	080402AUSFDVJ02	Aufeis Cr	South Fork	8/5/02	DV	118	16.24	Juvenile	<	0.05		0.04		5.7		72.5	24.3
ADFG	080402AUSFDVJ03	Aufeis Cr	South Fork	8/5/02	DV	118	18.42	Juvenile		0.05		0.04		4.1		86.2	25.9
ADFG	080402AUSFDVJ04	Aufeis Cr	South Fork	8/5/02	DV	130	21.63	Juvenile	<	0.05		0.05		3.7		83.7	26.1

Appendix 4, juvenile Dolly Varden concluded.

Collector	Sample Number	Stream	Site	Date Collected	Fish Spp	Length (mm)	Weight (g)	Method analyte MRL		200.80 Cd total 0.05		200.8 Pb total 0.02		7740.0 Se total 1.0		200.8 Zn total 0.5	% Solids
ADFG	080402AUSFDVJ05	Aufeis Cr	South Fork	8/5/02	DV	111	12.46	Juvenile	<	0.05		0.04		3.6		108	25.4
ADFG	080402AUSFDVJ06	Aufeis Cr	South Fork	8/5/02	DV	124	19.91	Juvenile	<	0.05		0.04		4.7		80.2	26.6
ADFG	080402AUSFDVJ07	Aufeis Cr	South Fork	8/5/02	DV	124	18.76	Juvenile	<	0.05		0.26		6.8		78.1	25.4
ADFG	080402AUSFDVJ08	Aufeis Cr	South Fork	8/5/02	DV	132	24.86	Juvenile	<	0.05	<	0.02		6.1		68.5	29.4
ADFG	080402AUSFDVJ09	Aufeis Cr	South Fork	8/5/02	DV	125	19.69	Juvenile		0.05		0.03		5.9		77.3	27.2
ADFG	080402AUSFDVJ10	Aufeis Cr	South Fork	8/5/02	DV	127	19.63	Juvenile	<	0.05		0.02		6.6		69.2	26.1
ADFG	080402AUSFDVJ11	Aufeis Cr	South Fork	8/5/02	DV	119	17.92	Juvenile	<	0.05	<	0.02		6.0		76.6	27.5
ADFG	080402AUSFDVJ12	Aufeis Cr	South Fork	8/5/02	DV	118	17.17	Juvenile	<	0.05		0.03		5.8		62.4	26.3
ADFG	080402AUSFDVJ13	Aufeis Cr	South Fork	8/5/02	DV	120	18.33	Juvenile	<	0.05		0.03		7.6		80.5	26.5
ADFG	080402AUSFDVJ14	Aufeis Cr	South Fork	8/5/02	DV	105	10.7	Juvenile	<	0.05		0.03		5.9		79.3	24.4
ADFG	080402AUSFDVJ15	Aufeis Cr	South Fork	8/5/02	DV	113	15.3	Juvenile		0.05		0.12		4.5		87.9	25
Aufeis Creek Downstream of Road																	
ADFG	080402AUDSDVJ01	Aufeis Cr	Downstream	8/5/02	DV	115	15.22	Juvenile		0.10		0.06		7.0		74.7	27.1
ADFG	080402AUDSDVJ02	Aufeis Cr	Downstream	8/5/02	DV	122	19.97	Juvenile		0.11		0.07		5.9		76.6	27.3
ADFG	080402AUDSDVJ03	Aufeis Cr	Downstream	8/5/02	DV	118	17	Juvenile		0.07		0.03		6.9		89.5	26.3
ADFG	080402AUDSDVJ04	Aufeis Cr	Downstream	8/5/02	DV	113	14.71	Juvenile		0.11		0.03		5.4		81.3	26.5
ADFG	080402AUDSDVJ05	Aufeis Cr	Downstream	8/5/02	DV	92	7.06	Juvenile		0.06		0.04		6.7		89	25.6
ADFG	080402AUDSDVJ06	Aufeis Cr	Downstream	8/5/02	DV	111	13.56	Juvenile		0.10		0.04		5.6		87.4	26.3
ADFG	080402AUDSDVJ07	Aufeis Cr	Downstream	8/5/02	DV	112	14.44	Juvenile		0.15		0.04		2.4		88.1	26.2
ADFG	080402AUDSDVJ08	Aufeis Cr	Downstream	8/5/02	DV	104	10.58	Juvenile		0.10		0.06		4.7		102	24.5
ADFG	080402AUDSDVJ09	Aufeis Cr	Downstream	8/5/02	DV	134	23.64	Juvenile		0.15		0.02		5.0		72.3	26.2
ADFG	080402AUDSDVJ10	Aufeis Cr	Downstream	8/5/02	DV	130	22.11	Juvenile		0.11		0.03		7.7		80.7	26
ADFG	080402AUDSDVJ11	Aufeis Cr	Downstream	8/5/02	DV	114	16.02	Juvenile		0.15		0.12		5.4		93.3	25.3
ADFG	080402AUDSDVJ12	Aufeis Cr	Downstream	8/5/02	DV	100	10.43	Juvenile		0.10		0.06		6.6		88	17.6
ADFG	080402AUDSDVJ13	Aufeis Cr	Downstream	8/5/02	DV	115	15.13	Juvenile		0.09		0.09		7.5		74.9	27
ADFG	080402AUDSDVJ14	Aufeis Cr	Downstream	8/5/02	DV	106	12.11	Juvenile		0.21		0.06		4.4		90	22.5
ADFG	080402AUDSDVJ15	Aufeis Cr	Downstream	8/5/02	DV	100	9.13	Juvenile		0.13		0.04		5.5		84.7	21