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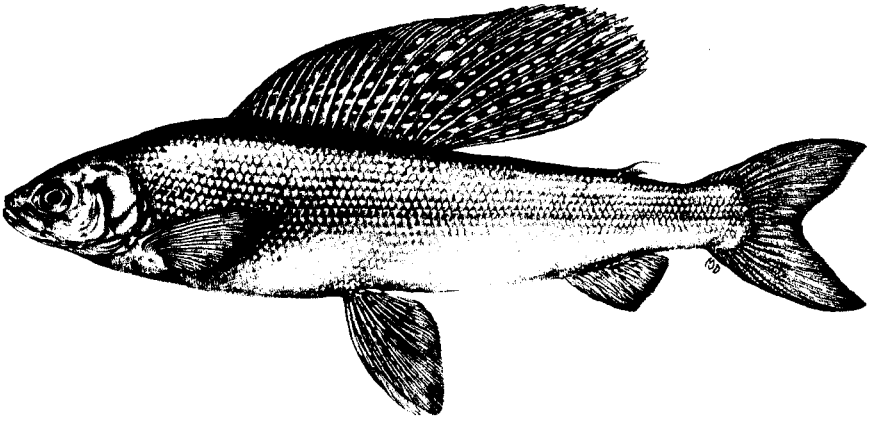
By

Alvin G. Ott and Phyllis Weber Scannell

Technical Report No. 96-2



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ACKNOWLEDGEMENTS

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Ms. Charlotte MacCay, Mr. Jack Winters, Mr. Fred DeCicco, and Mr. Alan Townsend reviewed and provided constructive comments. Mr. Alan Townsend and Ms. Sheree Warner prepared figures.

INTRODUCTION

The Red Dog Mine, operated by Cominco Alaska, Inc., is in remote northwestern Alaska (Figure 1). The mine facility includes a tailing impoundment, freshwater reservoir, airstrip, mill, living quarters, a solid waste site, and an open pit lead-zinc mine (Figure 2).

In 1991, we began a 3-year study in the Wulik River drainage to document short-term changes in fish distribution during mine development. Our study focused on distribution and relative abundance of juvenile Dolly Varden, Arctic grayling use of North Fork Red Dog Creek, metals concentrations in adult Dolly Varden tissues, and the number of adult Dolly Varden wintering in the Wulik River. Results and conclusions of the 3-year study were reported in Ott and Weber Scannell (1994).

A 5-year study design was developed to continue documentation of changes in fish distribution, relative abundance, fish species composition, and metals concentrations in adult Dolly Varden tissues. Results and conclusions for year 1 were reported in Weber Scannell and Ott (1995). This report is divided into 2 parts: Part 1 presents a summary of mine activities and water quality in the Wulik River drainage; and Part 2 presents results from year 2 of our fish study.

Figure 1. Map of location of the Red Dog Mine located in northwestern Alaska.

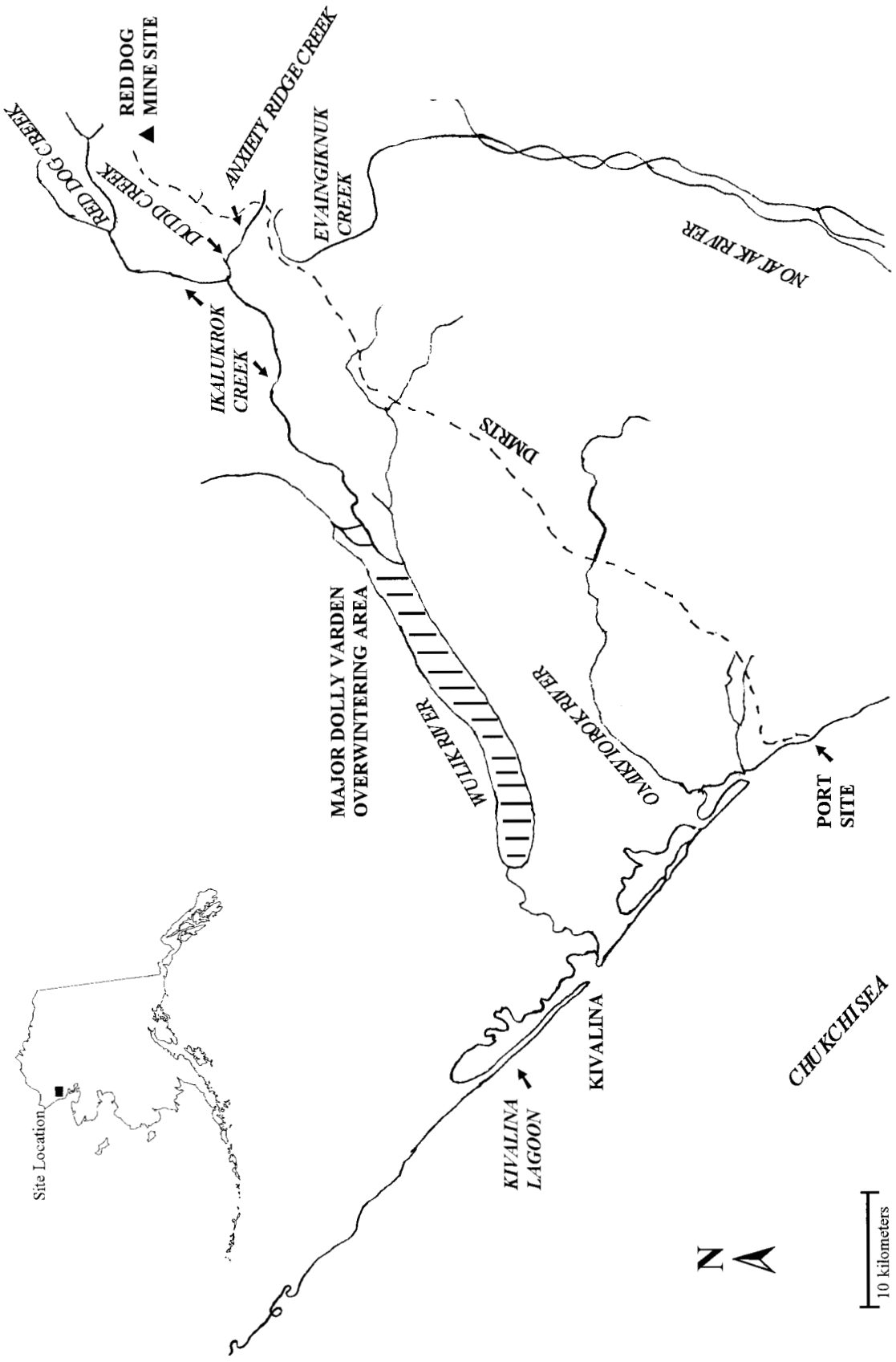
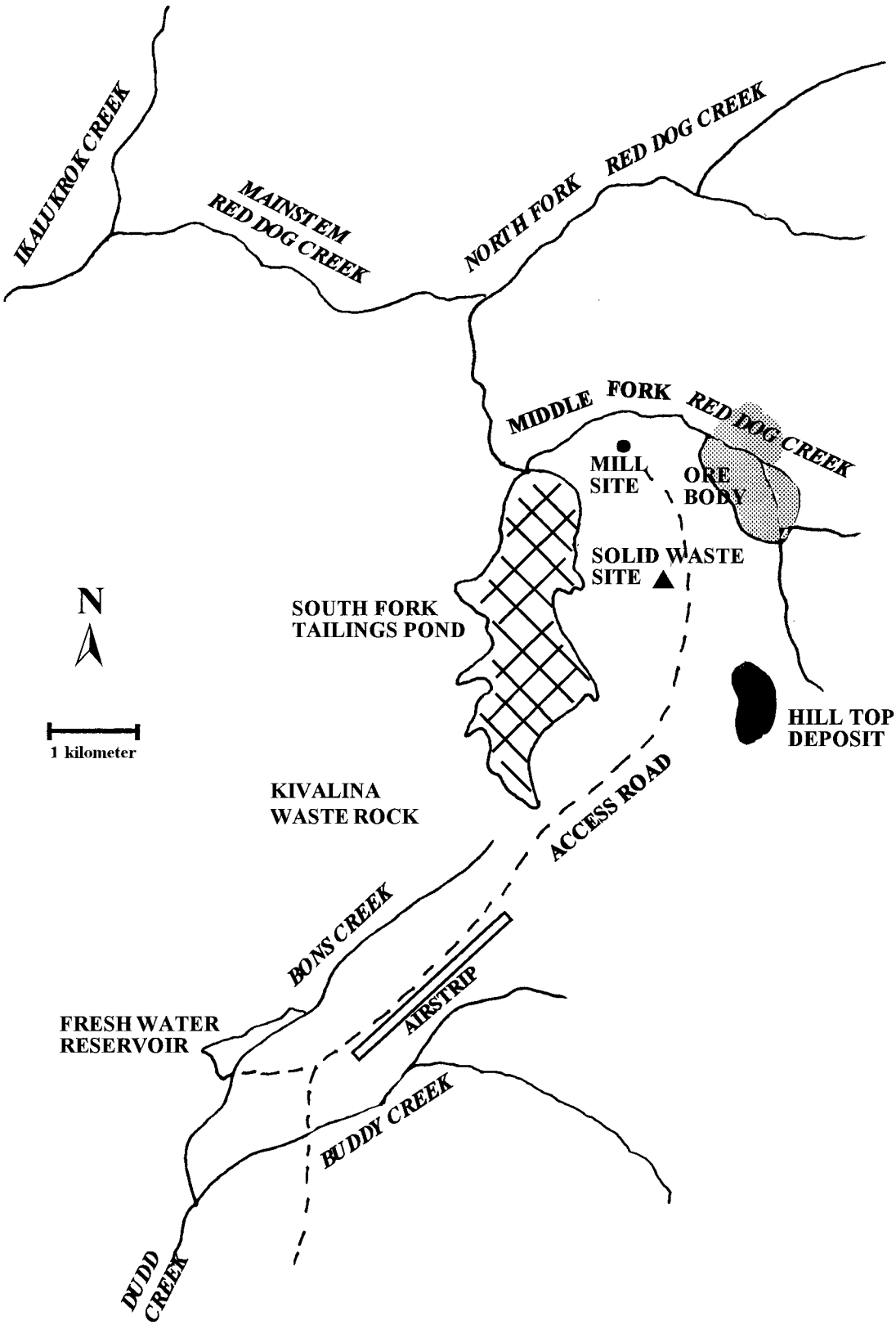


Figure 2. Major facilities, including the mill, airstrip, tailing impoundment, solid waste site, and freshwater impoundment at the Red Dog Mine.



PART I: MINE DEVELOPMENT AND WATER QUALITY

Planning and baseline data collection for the Red Dog Mine began in late 1979 and continued through 1982. The Environmental Impact Statement was finalized in 1983. Overburden stripping started in 1988 and ore processing commenced in 1989. Immediate changes in water quality were observed in summer 1989 (Tables 1 and 2). Concentrations of metals in Middle Fork and Mainstem Red Dog and Ikalukrok Creeks increased considerably in 1989 and 1990 compared with baseline conditions. In 1990, concentrations of zinc (Zn) reached 1510 mg/L in Middle Fork Red Dog Creek below the mine effluent (Station 21)(Figure 3 - Water Quality Sampling Stations). The median Zn concentration in Ikalukrok Creek in 1990 (Station 8) was 18.15 mg/L, with a maximum of 76 mg/L. In comparison, the median baseline Zn concentration at Station 8 in 1982-83 was 1.1 mg/L, with a maximum of 3 mg/L.

Early attempts to control mine seepage water in 1990 had limited success. Surface water control structures were in place but subsurface water was entering Middle Fork Red Dog Creek. Sumps were dug and pumps installed to intercept water, but were largely ineffective.

In March and April 1991, Cominco Alaska Inc. constructed a lined channel to bypass surface stream flowing through the ore body. Surface flows from Shelly, Connie, and Sulfur Creeks were collected in the lined bypass channel. A pump-back system was built to transfer water collected in the mine seepage ditch and pump it to the tailing pond. Water was stored in the tailing pond and then treated and discharged. In summer 1990, median Zn concentration at Station 8 in Ikalukrok Creek was 18.15 mg/L. Following construction of the bypass system, median Zn concentration fell to 1.62 mg/L in 1991 and to 0.865 mg/L in 1992 (Table 2). Decreases in aluminum (Al), cadmium (Cd), and lead (Pb) occurred in Ikalukrok Creek in 1991 and 1992 (Table 2).

Table 1. Concentrations of Al, Cd, Pb, and Zn (median, maximum, and minimum) in Middle Fork Red Dog Creek at Station 20 (below the mine discharge) during the ice-free season (June 1 through October 15). 1982 data are from Dames and Moore (1983); remaining data are from Cominco Alaska Inc.

Year		Al mg/L	Cd mg/L	Pb mg/L	Zn mg/L
1982	median	0.33	0.078	0.11	9.91
	maximum	0.91	0.14	0.36	16.5
	minimum	0.05	0.043	0.002	5.88
	n	28	33	33	33
1991	median	<0.05	0.13	0.161	21.75
	maximum	0.48	0.19	0.295	32.40
	minimum	<0.05	0.06	0.044	8.28
	n	12	12	12	12
1992	median	<0.05	0.045	0.0405	6.38
	maximum	0.226	0.147	0.23	18.7
	minimum	<0.05	0.013	0.015	1.6
	n	30	30	30	30
1993	median	<0.05	0.026	0.049	3.29
	maximum	0.38	0.032	0.348	3.83
	minimum	<0.05	0.013	0.016	1.64
	n	17	17	17	17
1994[1]	median	0.174	0.034	0.1	3.57
	maximum	1.25	0.049	0.345	11.3
	minimum	<0.05	0.03	0.01	2.68
	n	17	17	17	17
1995[2]	median	<0.05	0.03965	0.0384	4.43
	maximum	0.197	0.0559	0.142	8.06
	minimum	<0.05	0.00005	0.00039	0.012
	n	14	38	38	37

[1]Concentrations reported by Weber Scannell and Ott (1995) were changed to include only data collected from June 1 to October 15.

[2]Note that lower detection limits were used in 1995.

Table 2. Median, maximum, and minimum concentrations of Al, Cd, Pb, and Zn in Ikalukrok Creek (Station 8) during the ice-free season (June 1 through October 15). Data for 1993-1994 were collected at Station 73 on Ikalukrok Creek (about 1.6 km downstream of Station 8). 1981-1983 data are from Dames and Moore (1983); remaining data are from Cominco Alaska Inc.

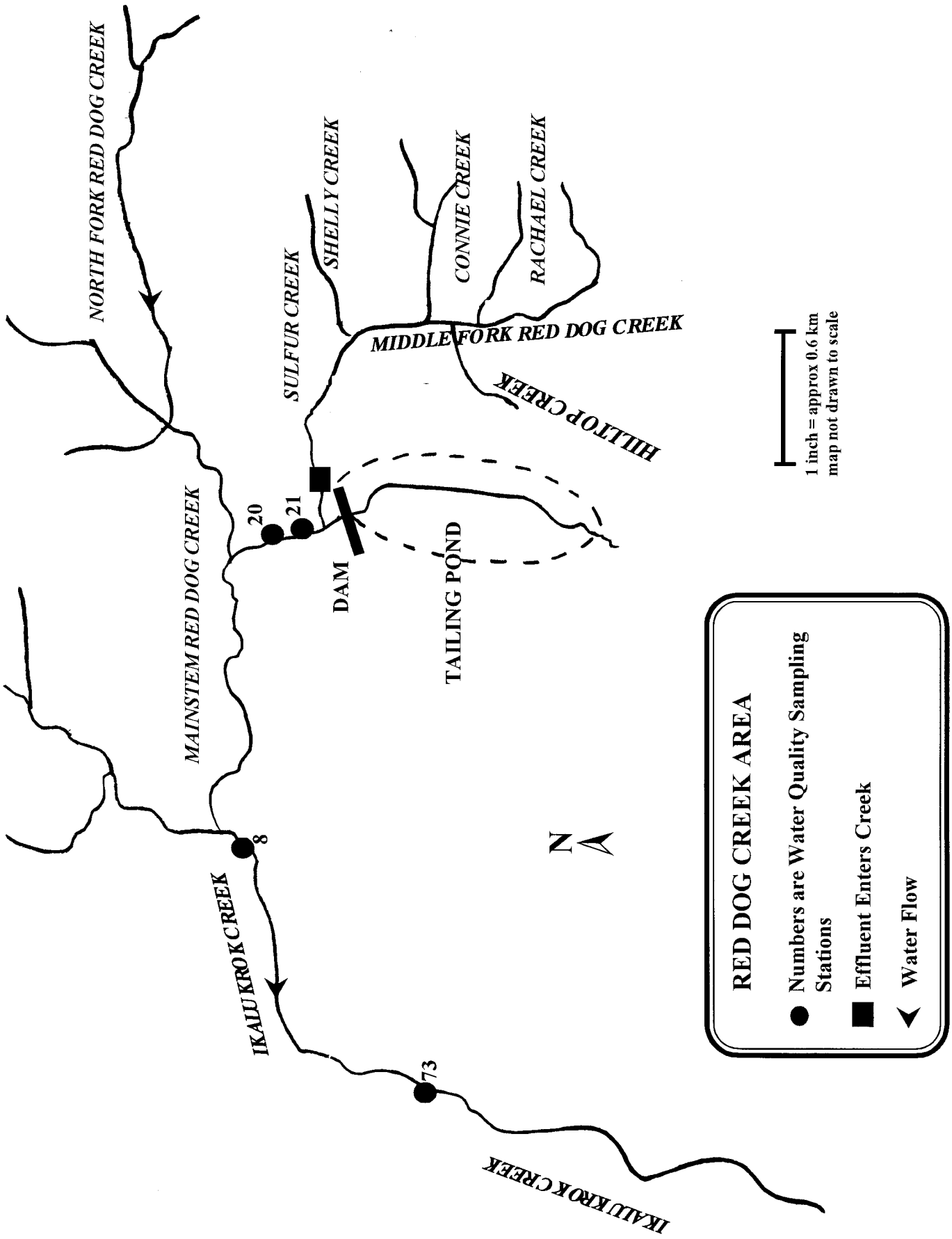
Year (Station)		Al mg/L	Cd mg/L	Pb mg/L	Zn mg/L
1981/83 (73, 8)[1]					
	median	0.04	0.12	0.01	0.86
	maximum	0.17	<0.025	0.08	2.25
	minimum	0.02	<0.002	<0.001	0.26
	n	7	24	24	24
1989	median	0.30	0.02	0.037	3.10
(8)	maximum	3.86	0.10	0.110	10.00
	minimum	0.16	<0.01	0.018	0.94
	n	16	17	17	17
1990	median	0.67	0.080	0.070	18.15
(8)	maximum	1.80	0.410	0.340	76.00
	minimum	0.10	0.040	<0.02	5.46
	n	24	26	23	23
1991	median	<0.05	0.012	0.008	1.62
(8)	maximum	<0.05	0.040	0.023	3.61
	minimum	<0.05	0.007	<0.001	1.07
	n	12	12	12	12
1992	median	<0.05	0.007	<0.002	0.865
(8)	maximum	0.73	0.024	0.094	3.120
	minimum	<0.05	<0.003	<0.002	0.305
	n	28	28	28	28
1993	median	<0.05	<0.003	<0.002	0.203
(73)	maximum	0.28	<0.003	0.009	0.389
	minimum	<0.05	<0.003	<0.002	0.143
	n	17	17	17	17
1994	median	0.085	0.003	0.006	0.282
(73)	maximum	1.02	0.02	0.078	2.62
	minimum	0.05	0.003	0.002	0.098
	n	23	23	23	23

Table 2, concluded.

Year		Al mg/L	Cd mg/L	Pb mg/L	Zn mg/L
1995	median	0.08	0.00722	0.00341	0.704
(73, 8)	maximum	1.06	0.0198	0.106	2.01
	minimum	<0.05	0.00069	0.00058	0.138
	n	35	41	41	41

[1]Concentrations reported by Weber Scannell and Ott (1995) were changed to include data from Stations 73 and 8.

Figure 3. Water quality sampling stations.



In 1993, sand filters were added to remove particulate metals remaining in the effluent. Zinc concentrations (mg/L) at Station 20 (Table 1) were 6.38 (median) in 1992 but decreased in 1993 to 3.29 (median). The concentration of Cd decreased, Al remained at or near detection, and Pb remained unchanged from 1992 to 1993 (Table 1).

In 1994, the mill-feed thickener was converted to an additional water treatment system to augment treatment capacity from about 0.26 m^3s^{-1} (9 cfs) to 0.63 m^3s^{-1} (22 cfs). The Red Dog area received unusually high rainfall in summer 1994. Total precipitation between June 1 and September 30 was 47 cm; the water level in the tailing impoundment increased 2.4 m. Water in the tailing impoundment was sampled by ADF&G in August 1994. Only slight differences in conductivity, pH, temperature, and metals concentrations were found along transects and with depth (Weber Scannell and Ott 1995). Water was acidic (pH 3.7), high in hardness (1510 to 1690 mg/L), high in conductivity (2397 to 2468 uSi/cm), and contained high metals concentrations (e.g., Zn 251 to 259 mg/L). Cominco Alaska Inc.'s treatment system was taking input water containing Zn at 251 to 259 mg/L and discharging water containing Zn from 0.018 to 0.299 mg/L.

In September and October 1994, 2,779 million l (734.11 million gallons) of water were treated and discharged with the new water treatment plant. Water level in the tailing pond decreased by 0.7 m - all discharge water met state and federal limits for metals (Table 3). Water discharge continued until October 30, 1994. However, in 1994, metals concentrations at Stations 20 and 73 (Tables 1 and 2) increased slightly from those found in 1993. Increases were small and may have been due to increased erosion and exposure of mineral deposits outside of the mine area associated with high rainfall events.

Table 3. Concentrations of metals, total dissolved solids, sulfate, and pH in effluent from the Red Dog Mine wastewater treatment facility, 1994-1995.

Year (Analyte)	Median mg/L	Maximum mg/L	Minimum mg/L	n	Maximum Daily Limits[1] mg/L
(1994)					
Hardness	1660	1950	714	49	
TDS	2420	2810	352	63	
Sulfate	1600	2000	200	41	
pH	9.6	10.3	6.8	73	
Cd	<LOD[2]	0.055	<LOD	71	0.1
Cu	<LOD	<LOD	<LOD	71	0.3
Hg	<LOD	<LOD	<LOD	45	
Pb	<LOD	<LOD	<LOD	71	0.6
Zn	0.046	0.299	0.018	71	1.5
total cyanide	<LOD	0.13	<LOD	73	0.1
(1995)					
Hardness	1630	1880	167	44	
TDS	2465	2700	1040	134	
Sulfate	1700	1900	690	53	
pH	9.6	10.5	9.1	150	
Cd	0.0149	0.0675	0.00004	134	0.1
Cu	0.00345	0.071	0.0004	136	0.3
Hg	<0.0001	<0.0005	<0.0001	131	
Pb	0.00097	0.012	0.00012	136	0.6
Zn	0.036	0.34	0.023	134	1.5
total cyanide	<0.01	0.06	<0.01	60	0.1

[1]Maximum Daily Limits for Cd, Cu, Pb, Zn, and total cyanide are from Wastewater Disposal Permit 9332-DB007

[2]LOD=Limit of Detection, in 1995 the LOD was lowered leading to detectable limits although actual concentrations may not have changed

In summer 1995, metals concentrations in the clean water bypass channel increased to levels comparable to baseline conditions. Water quality samples collected by Cominco Alaska Inc. determined that the major source of increased metals, primarily Zn, was Hilltop Creek - a small tributary to Middle Fork Red Dog Creek upstream of the ore body. Only minor surface disturbance and some test drilling for minerals had occurred in the Hilltop drainage over the past 10 years; no activities had taken place in Hilltop Creek. Cominco Alaska Inc. extended the clean water bypass system and mine seepage ditch about 457 m (1500 ft) further upstream in October 1995. Water from Hilltop Creek is now diverted into the dirty water collection system; however, metals are not attributed to mining activities.

Zinc concentrations in the clean water bypass channel exceeded 10 mg/L from late June through mid-September, and reached a peak of 63.2 mg/L in late July. The median concentration of Zn at Station 20 was 4.43 mg/L, with a maximum of 8.06 mg/L (Table 1). From May through October 1995, the water treatment facility was in operation with discharges ranging from 0.57 m^3s^{-1} (20 cfs) to 0.74 m^3s^{-1} (26 cfs). Treated water was discharged to Middle Fork Red Dog Creek immediately downstream of the clean water bypass channel. Metals in water flowing from the clean water bypass channel were precipitated in the creek when the effluent mixed with the bypass waters due to the high pH effluent (Figure 4).

Total dissolved solids (TDS), sulfate, and pH were monitored at Stations 20, 8, and 73 in 1994 and 1995 (Tables 4 and 5). Limited baseline data exist for these variables. With the higher effluent discharge in 1995, median TDS increased from 509 in 1994 to 2,025 at Station 20 and median TDS increased from 166 in 1994 to 451 at Stations 8 and 73 (Tables 4 and 5). Median pH values of 7.3 in Middle Fork Red Dog Creek and 7.7 in Ikalukrok Creek did not vary from 1994 to 1995.

Figure 4. Middle Fork Red Dog Creek at point where effluent enters creek (note the precipitated metal hydroxides in the creek). Photograph taken in July 1995.

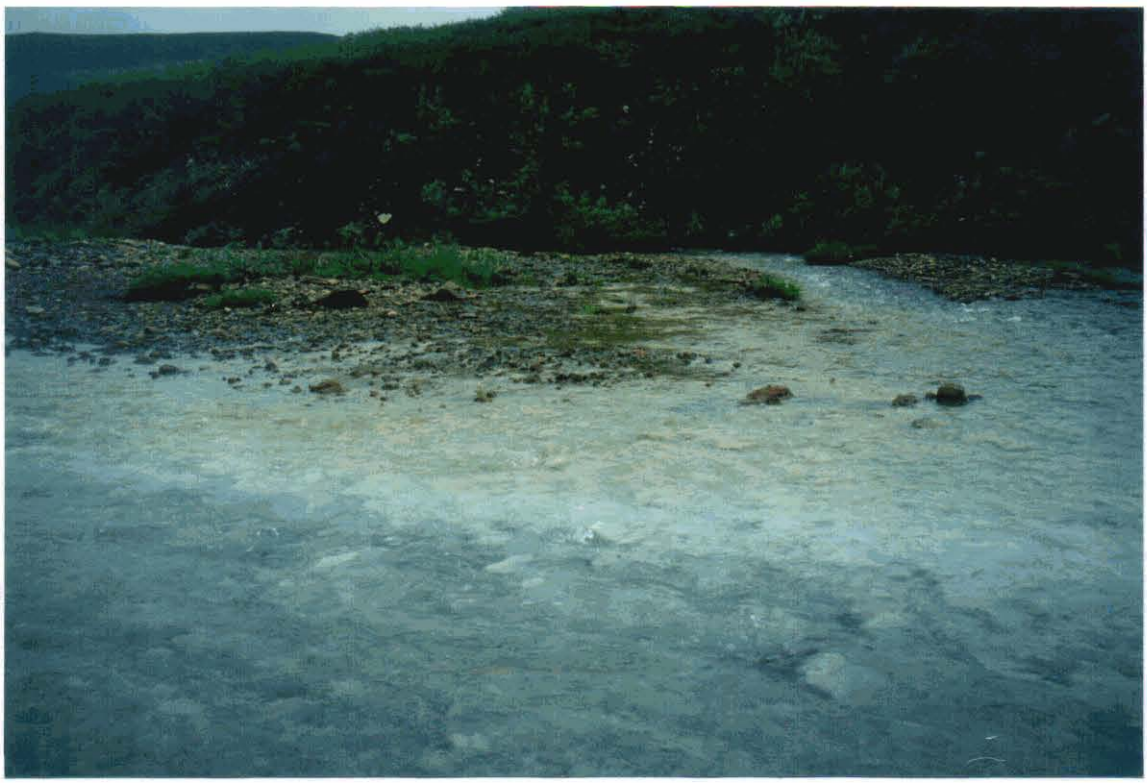


Table 4. Total dissolved solids (TDS), sulfate, and pH at Station 8 (Station 73 in 1994, Station 8 and 73 in 1995).

		TDS mg/L	Sulfate mg/L	pH
1981-1982	median		62	
	maximum	174	72	
	minimum	124	36	
	n	2	3	
1989	median			7.3
	maximum			7.9
	minimum			6.8
	n			16
1990	median			7.1
	maximum			7.8
	minimum			6.5
	n			18
1991	median	271		7.2
	maximum	406		7.5
	minimum	174		6.8
	n	12		12
1992	median	209		7.47
	maximum	548		8.20
	minimum	64		6.15
	n	21		28
1993	median	181		7.7
	maximum	229		8.2
	minimum	68		6.7
	n	17		17
1994 (Station 73)	median	166	58	7.7
	maximum	658	400	8.2
	minimum	72	21	7.2
	n	23	23	23
1995 (Station 8 and 73)	median	451	270	7.8
	maximum	1060	660	8
	minimum	77	29	7.1
	n	39	33	36

Table 5. Total dissolved solids (TDS), sulfate, and pH at Station 20.

		TDS mg/L	Sulfate mg/L	pH
1982	median			
	maximum		108	
	minimum		66	
	n		2	
1991	median	598		
	maximum	1310		
	minimum	346		
	n	12		
1992	median	815		
	maximum	2230		
	minimum	50		
	n	31		
1993	median	235		
	maximum	961		
	minimum	57		
	n	17		
1994	median	509	300	7.3
	maximum	2440	1500	8.7
	minimum	97	55	6.3
	n	18	18	17
1995	median	2025	1200	7.3
	maximum	2570	1600	7.9
	minimum	135	57	6.6
	n	38	15	35

PART II: YEAR 2 OF THE 5-YEAR FISH MONITORING STUDY

Past studies conducted by ADF&G focused on distribution and relative abundance of juvenile Dolly Varden, metals concentrations in selected tissues of adult Dolly Varden, and Arctic grayling use of North Fork Red Dog Creek. Since beginning operation of the Red Dog Mine, Cominco Alaska Inc. has continued to identify new metals contaminant sources. Metals in receiving waters have been controlled or reduced through addition of facilities to treat discharge waters, treatment of higher volumes of metal-laden water, installation of sand filters, control and transfer of seepage water from the ore body to the tailing impoundment, and extension of the clean water bypass channel to reroute Hilltop Creek into the dirty water collection system. Changes in fish distribution and habitat have been observed and appear to coincide with water quality changes in Middle Fork Red Dog Creek.

To determine the effectiveness of facilities, such as the clean water bypass system, it is essential to continue fisheries studies and document changes in fish distribution, relative abundance, and metals content of fish tissues. The 5-year monitoring project was based upon the following objectives.

OBJECTIVES OF THE 5-YEAR FISH MONITORING STUDY

(1) Summarize changes in water quality and fish distribution at the Red Dog Mine from 1981 to 1995.

(2) Determine concentrations of aluminum, cadmium, copper, lead, and zinc in Dolly Varden muscle, gill, liver, and kidney.

(3) Estimate abundance and assess distribution of overwintering Dolly Varden in late September - early October using aerial surveys of the Wulik River from its mouth to about 8 river km (5 mi) upstream of the confluence of Ikalukrok Creek.

(4) Determine relative abundance (catch per unit effort) of juvenile Dolly Varden during the ice-free season in Ikalukrok, Anxiety Ridge, Evaingiknuk, Middle Fork Red Dog, Mainstem Red Dog, and North Fork Red Dog Creeks. Evaingiknuk Creek, tributary to the Noatak River, is a reference stream unaffected by the Red Dog Mine.

(5) Determine Arctic grayling and juvenile Dolly Varden use of North Fork Red Dog Creek.

(6) Determine fish use of Middle Fork and Mainstem Red Dog Creeks.

Another objective added to the scope of work in 1995 was to determine the number of adult chum salmon spawning in Ikalukrok Creek in early August using aerial survey techniques. The survey area covers Ikalukrok Creek from its mouth to its confluence with Dudd Creek.

METHODS

Adult Dolly Varden were obtained from the subsistence fishery in Kivalina by ADF&G Sport Fish Division in spring 1995. The fall 1995 Dolly Varden sample was collected by ADF&G Wildlife Conservation Division. Each Dolly Varden was placed in a clean plastic container and labeled with sample date and location. A minimum sample of six fish was taken. Fish were frozen and shipped to ADF&G in Fairbanks, Alaska. We removed Dolly Varden from the freezer, measured, weighed, recorded sex and spawning condition, and removed otiliths to determine age for each fish. Tissue samples from muscle (muscle was removed below the dorsal fin and above the lateral line), gill, kidney, and liver were removed from partially thawed fish using standard procedures to minimize contamination (Crawford and Luoma 1993). About 10 g of each tissue was placed in pre-cleaned jars (EPA protocol C, Series 300) and refrozen. We cleaned each dissection instrument in ultra-pure nitric acid with a rinse in double distilled water before we began to work on a new tissue. Tissue samples were submitted to a private analytical laboratory. Samples were digested, freeze-dried, and analyzed for Al, Cu, Cd, Pb, and Zn using U.S. Environmental Protection Agency standard methods (Table 6).

Table 6. Method and method detection limit used to analyze fish tissues for various metals. All samples were reported as mg/Kg, dry weight basis.

Metal	Method[1]	Limit of Detection
Al	200.8	0.2
Cd	200.8	0.02
Cu	200.8	0.05
Pb	200.8	0.02
Zn	200.8	0.5

[1]EPA Method 200.8 - "Methods for Chemical Analysis of Water and Wastes" EPA 600/4-79-020

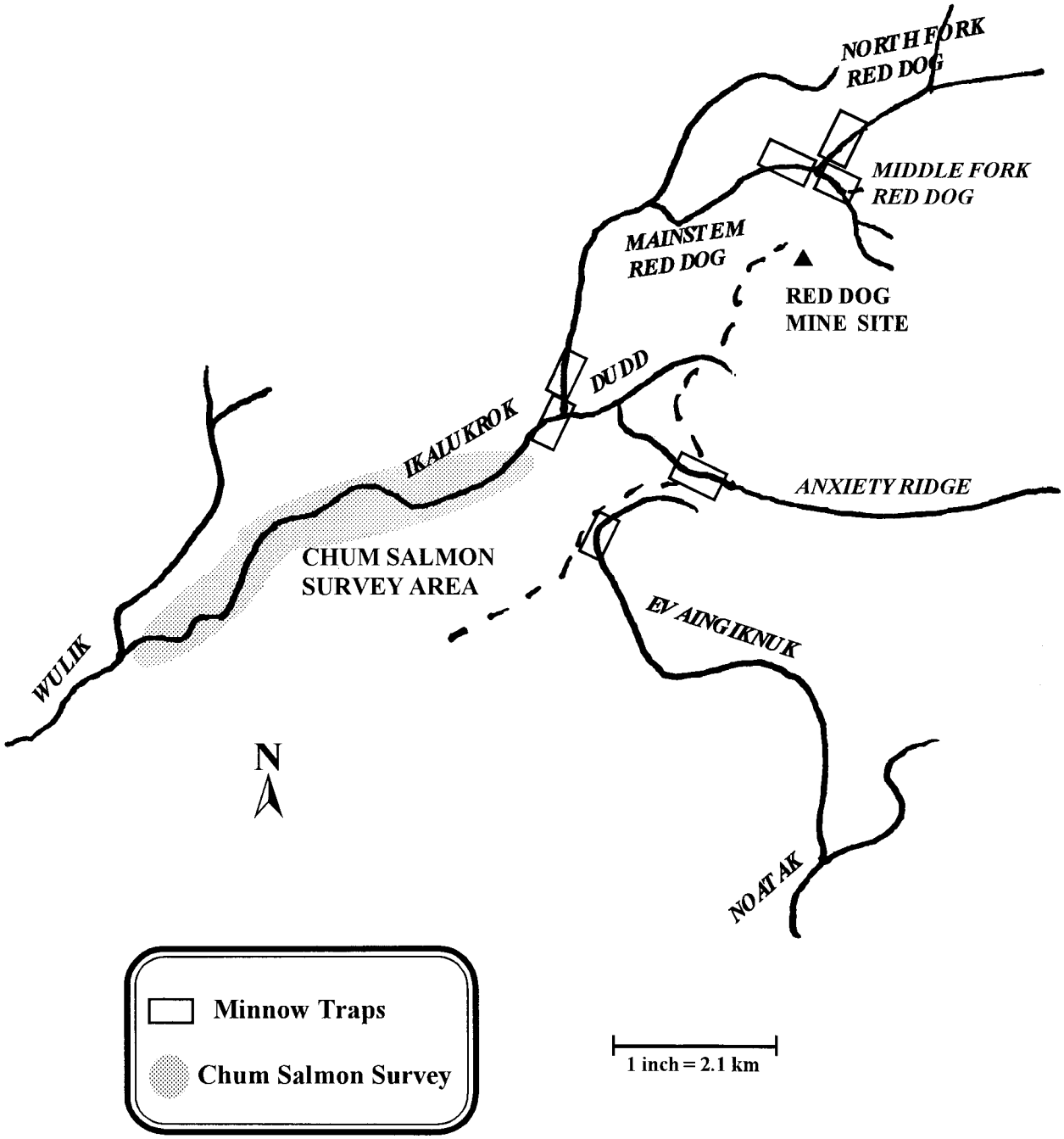
In addition to results, the laboratory provided quality assurance/quality control information for each analyte. Beginning in fall 1994, we required the following quality assurance procedures: matrix spikes, standard reference materials, laboratory calibration data, sample blanks, and sample duplicates. We compared the 1990 through 1995 data on concentrations of Al, Cu, Cd, Pb, and Zn in adult Dolly Varden with baseline data collected by Dames and Moore (1983) and with water quality conditions in the Wulik River.

We flew aerial surveys using fixed-wing aircraft in August over Ikalukrok Creek and in September over the Wulik River. Our August Ikalukrok Creek survey covered the creek from its mouth to Dudd Creek (Figure 5). The September survey included the Wulik River from Kivalina to a point about 8 km (5 mi) upstream of the mouth of Ikalukrok Creek. We counted the number of Dolly Varden in the Wulik River and chum salmon in Ikalukrok Creek.

In 1995, we fished minnow traps in Anxiety Ridge, Evaingiknuk, Ikalukrok, Middle Fork Red Dog, Mainstem Red Dog, and North Fork Red Dog Creeks (Figure 5). Evaingiknuk Creek, a Noatak River tributary, was our control stream. We added a set of 10 traps in Mainstem Red Dog Creek. All other trap sites remained unchanged from previous years. Identification markers and flagging on streambank vegetation were used to designate trap sites. Ten traps were fished for 24 to 72 h periods in each sample reach. Two sample reaches were worked in Middle/Mainstem Red Dog and Ikalukrok Creeks. Minor relocations of trap sites were made where pool/riffle changes had occurred.

Minnow traps were fished in late June, mid-July, and mid-August. Visual surveys of Middle Fork and Mainstem Red Dog Creeks and Buddy Creek also were made. Numbers of Dolly Varden and slimy sculpin captured and fork length (FL) to the

Figure 5. Chum salmon survey area along Ikalukrok Creek and minnow trap sample sites in Ikalukrok, Anxiety Ridge, Evaingiknuk, Middle Fork Red Dog, Mainstem Red Dog, and North Fork Red Dog Creeks.



nearest mm were recorded. Numbers of Dolly Varden per trap (catch) were compared among sample areas and times (Analysis of Variance, $p<0.05$).

Angling was used to collect Dolly Varden and Arctic grayling in North Fork and Mainstem Red Dog, Ikalukrok, and Buddy Creeks. Arctic grayling were marked with an adipose fin clip and those greater than 150 mm FL were tagged with numbered *Fine Fabric Floy-tags*.

RESULTS AND DISCUSSION

Metals in Dolly Varden Tissues

Since 1990, ADF&G has sampled adult Dolly Varden from the Wulik River for metals concentrations (Al, Cd, Cu, Pb, and Zn) in gill, kidney, liver, and muscle (Ott et al. 1992, Ott and Weber Scannell 1993 and 1994, Weber Scannell and Ott 1995) (Appendix 1 and quality control/quality assurance data, Appendix 2). Median, maximum, and minimum concentrations of Al, Cd, Cu, Pb, and Zn for adult Dolly Varden tissues collected in the Wulik River are presented in Figures 6, 7, 8, 9, and 10.

Increased Al concentrations in gill tissue was observed in fall 1994, spring 1995, but not in the fall 1995 sample. Median Al concentrations for Al in kidney, liver, and muscle remained similar to baseline conditions and to fish samples collected from 1990 to 1994 (Figure 6).

Cadmium concentrations in Dolly Varden tissues have steadily decreased since samples were taken in 1990. Cadmium concentrations generally are less than that reported for baseline fish tissue samples (Figure 7).

Copper concentrations in Dolly Varden gill tissue were higher in 1994 samples, but decreased in the 1995 fish. Median copper concentrations in kidney, liver, and muscle remain unchanged (Figure 8).

A slight increase in lead concentrations in gill tissue has been observed in both 1994 and 1995. Median lead concentrations in kidney and liver tissue are unchanged from baseline and tissue samples collected since 1990. A slight increase in lead in muscle tissue occurred in the fall 1995 sample (Figure 9).

Figure 6. Median, maximum, and minimum concentrations of aluminum (mg/Kg dry weight) in adult Dolly Varden tissues (gill, kidney, liver, and muscle) collected in the Wulik River in 1982 and 1990-1995. Median values for 1982 fish were not available; 1982 data are expressed as mean concentration.

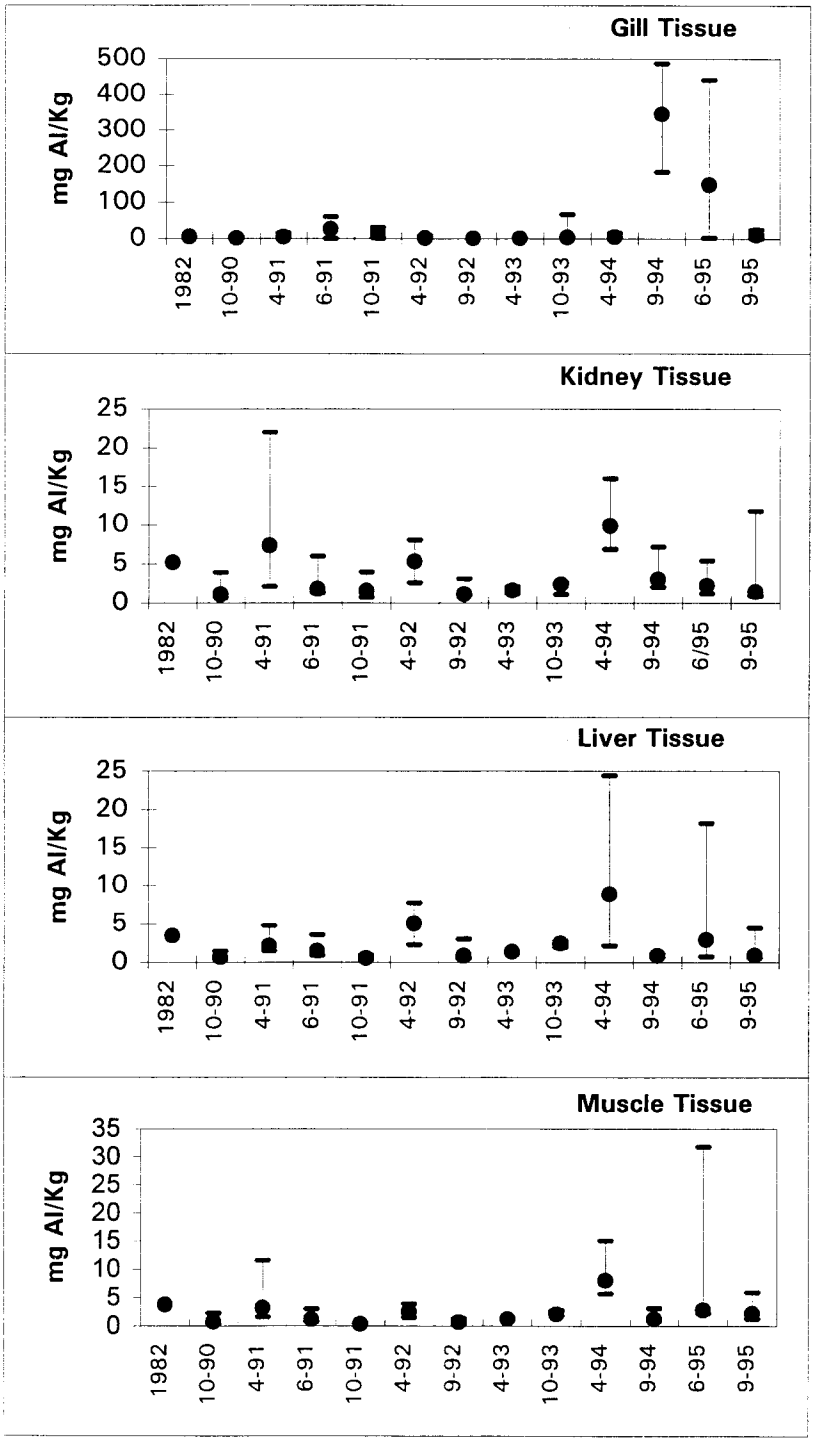


Figure 7. Median, maximum, and minimum concentrations of cadmium (mg/Kg dry weight) in adult Dolly Varden tissues (gill, kidney, liver, and muscle) collected in the Wulik River in 1982 and 1990-1995. Median values for 1982 fish were not available; 1982 data are expressed as mean concentration.

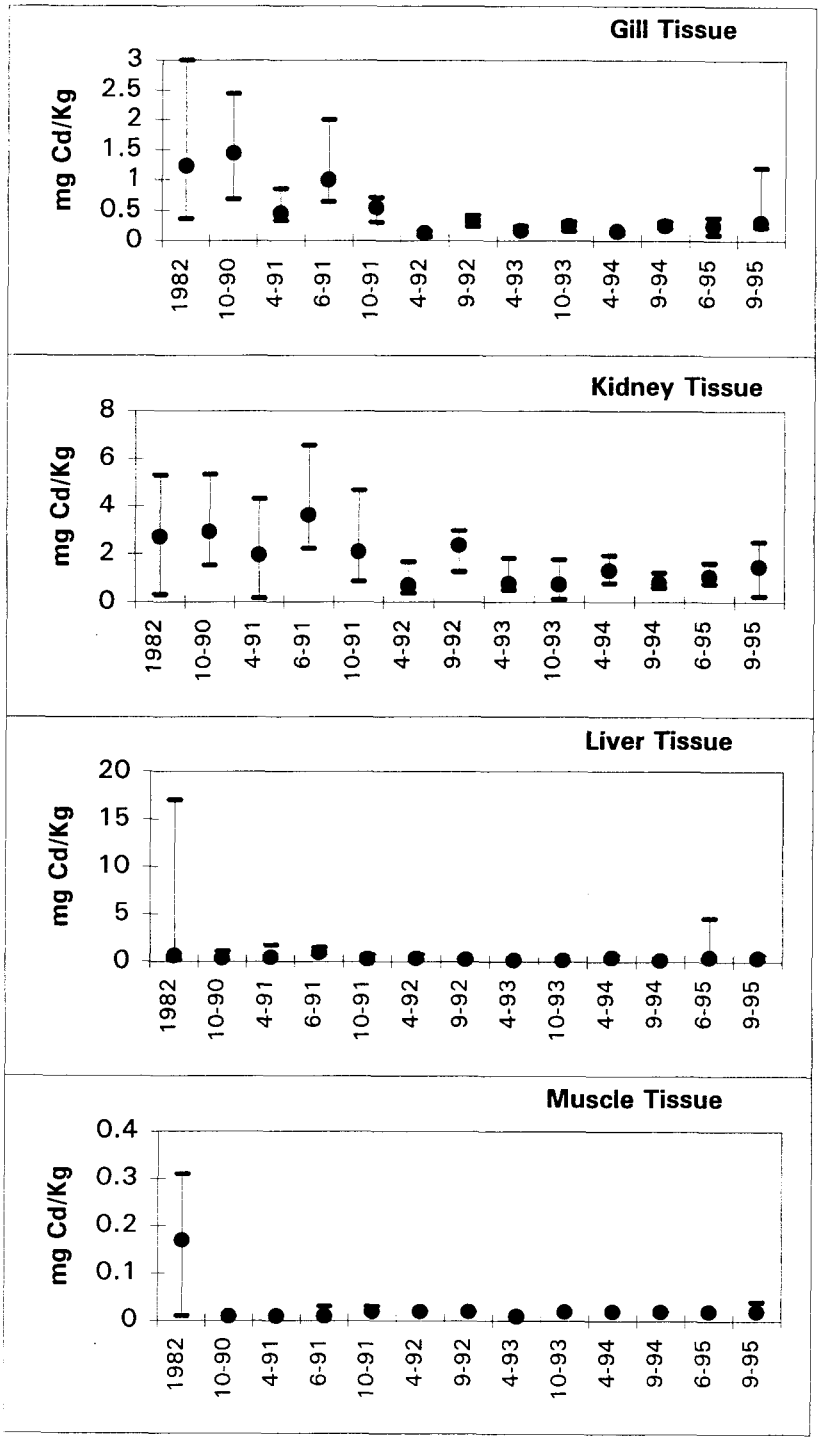


Figure 8. Median, maximum, and minimum concentrations of copper (mg/Kg dry weight) in adult Dolly Varden tissues (gill, kidney, liver, and muscle) collected in the Wulik River in 1982 and 1990-1995. Median values for 1982 fish were not available; 1982 data are expressed as mean concentration.

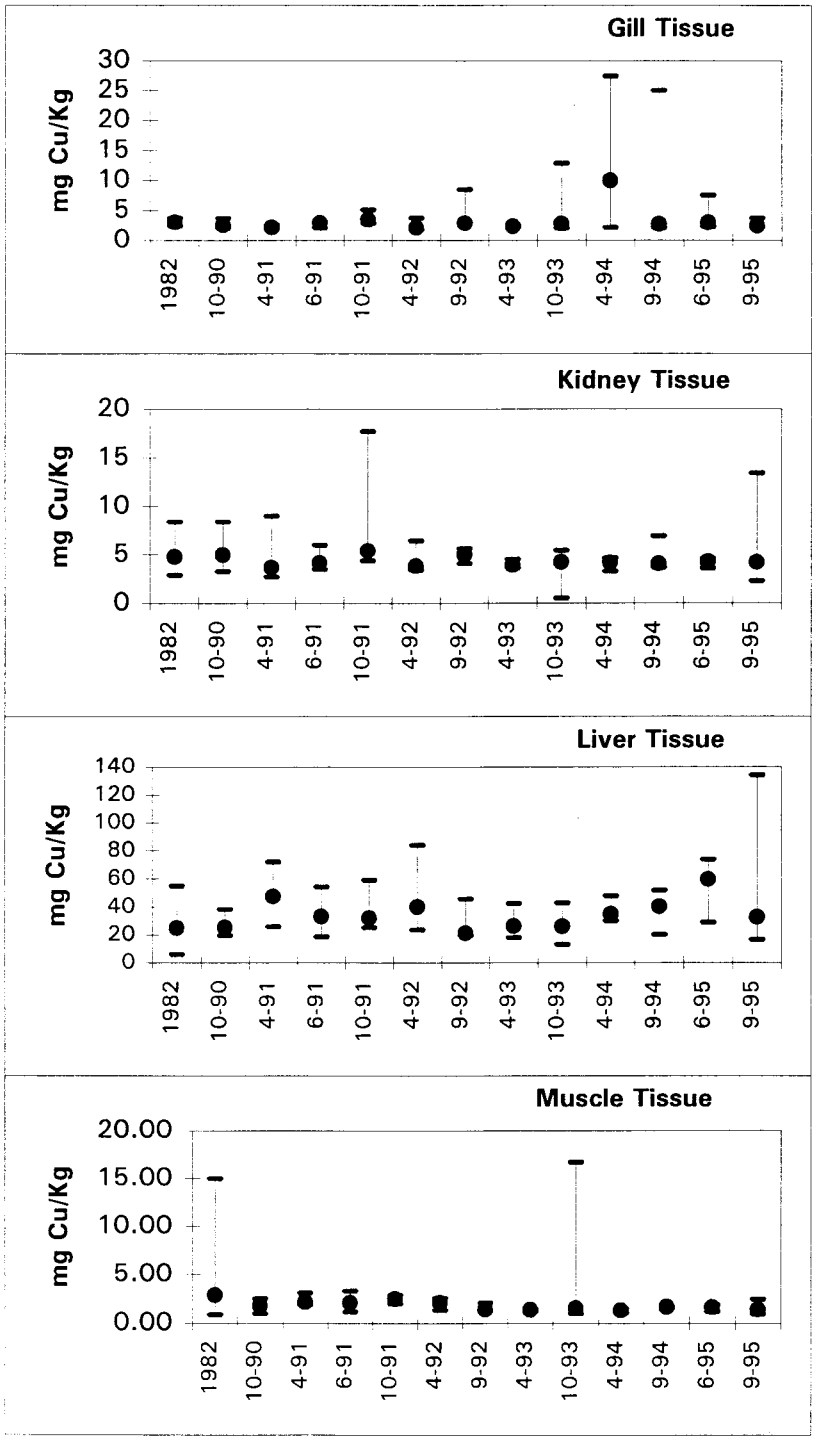


Figure 9. Median, maximum, and minimum concentrations of lead (mg/Kg dry weight) in adult Dolly Varden tissues (gill, kidney, liver, and muscle) collected in the Wulik River in 1982 and 1990-1995. Median values for 1982 fish were not available; 1982 data are expressed as mean concentration.

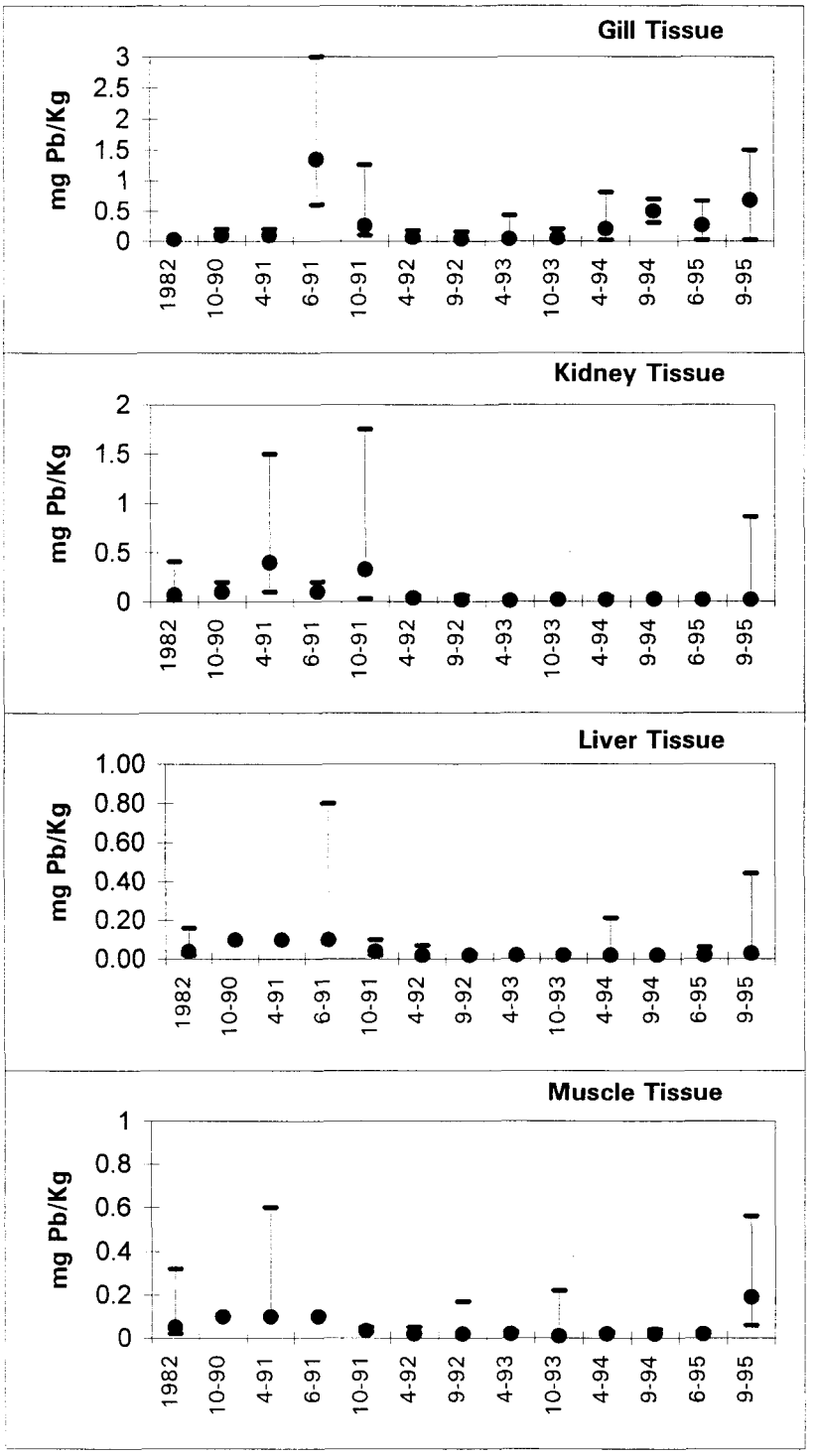
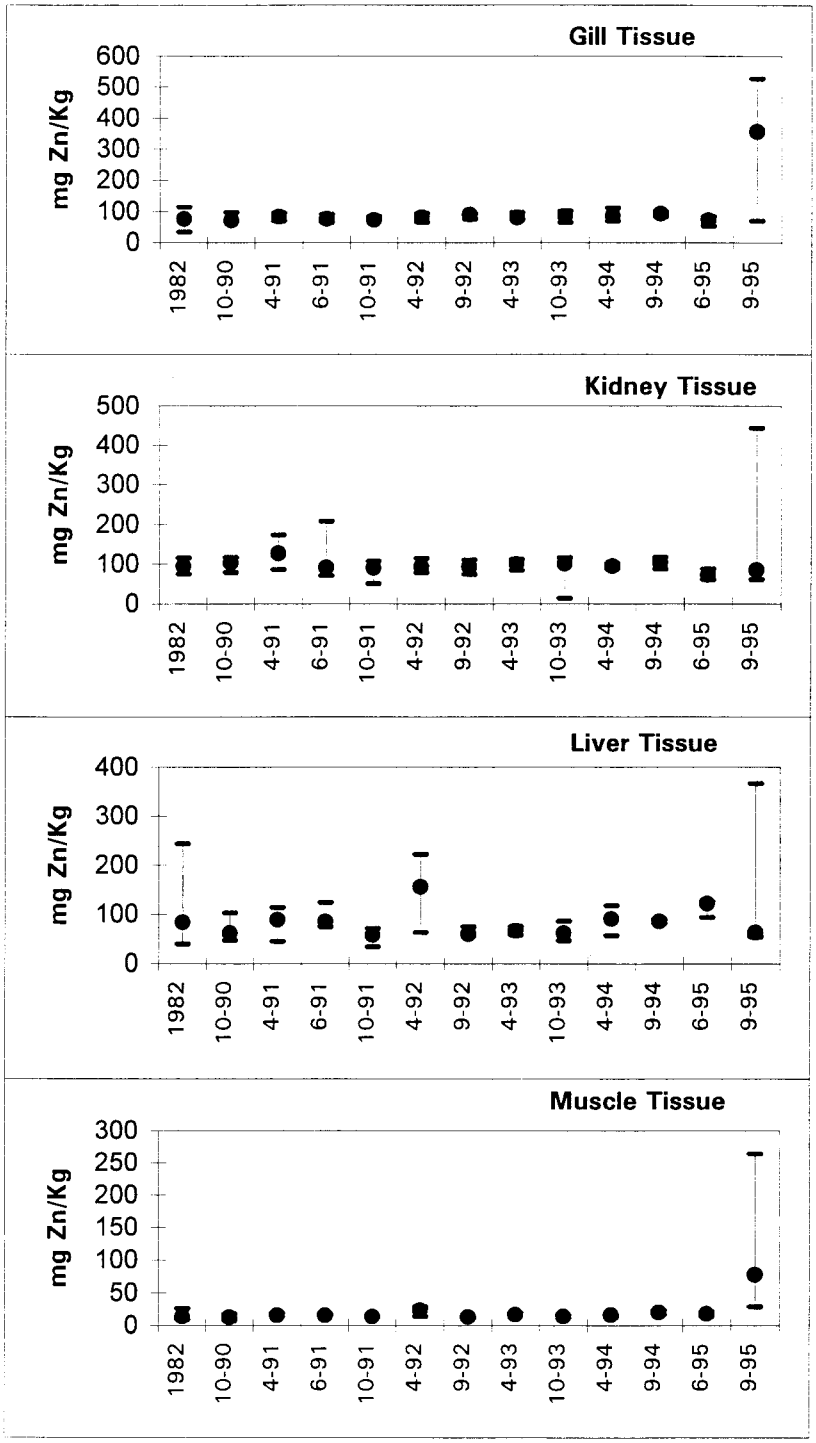


Figure 10. Median, maximum, and minimum concentrations of zinc (mg/Kg dry weight) in adult Dolly Varden tissues (gill, kidney, liver, and muscle) collected in the Wulik River in 1982 and 1990-1995. Median values for 1982 fish were not available; 1982 data are expressed as mean concentration.



Zinc concentrations (median) did increase in gill and muscle tissue in the fall 1995 sample (Figure 10). Median Zn concentrations in kidney and liver remained unchanged from baseline conditions and for tissue samples collected since 1990.

Overwintering Dolly Varden, Wulik River

In early October 1995, ADF&G conducted its annual aerial survey to count overwintering Dolly Varden in the Wulik River. Similar surveys have been made annually since 1979 except in 1983, 1985, 1986, and 1990 when conditions were not favorable. Prior to mining at Red Dog, with the exception of 1980, 90% of the Dolly Varden were observed downstream of the mouth of Ikalukrok Creek during fall surveys (Table 7). In 1991 through 1994, over 90% of the fish were seen in the Wulik River below Ikalukrok Creek (Weber Scannell and Ott 1995). A population estimate for Dolly Varden >399 mm was made by DeCicco (1995) for the 1994-1995 overwintering population in the Wulik River. Fish were marked in fall 1994 and recaptured during the 1995 spring subsistence fishery in Kivalina. An estimated 361,599 Dolly Varden used the Wulik River in winter 1994-1995. The 1994-1995 population estimate exceeded the aerial count because Dolly Varden entered the Wulik River late in fall 1994 after the aerial survey was done.

The number of Dolly Varden counted in fall 1995 was 128,705 (DeCicco 1995). Over 90% of the Dolly Varden continue to use the Wulik River below the mouth of Ikalukrok Creek for overwintering. Since mining began at Red Dog, the number of Dolly Varden using the Wulik River for overwintering has been equal to or greater than numbers estimated for pre-mining with the exception of 1989 (Table 7).

Table 7. Number of overwintering adult Dolly Varden in the Wulik River before freezeup. Surveys conducted by ADF&G (DeCicco 1989, 1991, 1992, 1993, 1994, and 1995).

Year	Wulik River upstream of Ikalukrok Creek	Wulik River downstream of Ikalukrok Creek	Total Fish	Percent of Fish downstream of Ikalukrok Creek
1979	3,305	51,725	55,030	94
1980	12,486	101,067	113,553	89
1981	4,125	97,136	101,261	96
1982	2,300	63,197	65,497	97
1984	370	30,483	30,853	99
1987	893	60,397	61,290	99
1988	1,500	78,644	[1]80,144	98
1989	2,110	54,274	56,384	96
1991	7,930	119,055	126,985	94
1992	750	134,385	135,135	99
1993	7,650	136,488	144,138	95
1994	415	66,337	[2]66,752	99
1995	240	128,465	128,705	99

[1]The population estimate (mark/recapture) for winter 1988/1989 for fish >400 mm was 76,892 (DeCicco 1990a).
[2]The population estimate (mark/recapture) for winter 1994/1995 for fish >400 mm was 361,599.

Chum Salmon, Ikalukrok Creek

Our objective was to count and assess distribution of adult chum salmon in Ikalukrok Creek downstream of Dudd Creek using aerial surveys (Table 8). The estimated number of chum salmon in September 1981 ranged from 3,520 to 6,960 (Houghton and Hilgert 1983). In August and September of 1982, chum salmon were estimated at 353 and 1,400 (Houghton and Hilgert 1983). DeCicco (1990b) documented 994 and 1,975 adult chum salmon in Ikalukrok Creek in August 1984 and August 1986. In 1990 and 1991, less than 70 chum salmon were seen (Ott et al. 1992). Surveys were not done from 1992 to 1994.

We flew two aerial surveys in 1995. On August 16 we counted 48 live and one dead chum salmon and estimated that 50% of the creek was surveyed (Townsend and Lunderstadt 1995). DeCicco (1995) estimated between 300 and 400 chum salmon on August 20, 1995. Chum salmon continue to use Ikalukrok Creek for spawning but numbers are substantially lower than premining. Water quality conditions were degraded in Ikalukrok Creek during summer 1989 and 1990 and into spring 1991 as a result of non-point pollution from the Red Dog ore body. Elevated metals concentrations probably adversely affected three age groups (progeny of adults that spawned in fall 1988 and adults returning to Ikalukrok Creek in 1989 and 1990). Chum salmon adults vary from 3 to 6 years with most fish age 4 when they return to spawn. Thus adult returns to Ikalukrok Creek would be depressed for at least three years following improvements in water quality which occurred by fall 1991. If water quality conditions remain improved, adult chum salmon numbers should begin to increase in Ikalukrok Creek.

Table 8. Number of adult chum salmon in Ikalukrok Creek downstream of Dudd Creek.

Survey Time	Number of Chum Salmon	Reference
September 1981	3,520 to 6,960	Houghton and Hilgert 1983
August/September 1982	353 and 1,400	Houghton and Hilgert 1983
August 1984	994	DeCicco 1990b
August 1986	1,985	DeCicco 1990b
August 1990	<70	Ott et al. 1992
August 1991	<70	Ott et al. 1992
August 1995	49	Townsend and Lunderstadt 1995
August 1995	300 to 400	DeCicco 1995

Juvenile Dolly Varden, Relative Abundance and Distribution

Our objective was to assess relative abundance (catch per unit of effort) of juvenile Dolly Varden during the ice-free season in Ikalukrok, Anxiety Ridge, Evaingiknuk, Red Dog (Middle Fork and Mainstem), and North Fork Red Dog Creeks. The most productive creek for juvenile Dolly Varden during baseline surveys in 1983 was Anxiety Ridge Creek in the vicinity of the Haul Road crossing (Dames and Moore 1984).

In 1995, we fished minnow traps in Evaingiknuk, Anxiety Ridge, Ikalukrok, Red Dog (Middle Fork and Mainstem), and North Fork Red Dog Creeks. Number of Dolly Varden captured, their length (range and average), and the number of fish (average, standard deviation) per trap were recorded (Appendices 4 through 10).

Dolly Varden captured per minnow trap were compared for sample creeks. Comparisons in catch/trap were made for each sample period (June 26-29, July 17-20, and August 11-14). Significant differences among creeks in catch per trap of juvenile Dolly Varden were determined for late June ($F = 21.11$; $df = 5,54$; $P < 0.05$), mid-July ($F = 5.34$; $df = 5,54$; $P < 0.05$), and mid-August ($F = 17.23$; $df = 5,54$; $P < 0.05$).

The highest catch of juvenile Dolly Varden occurred in Anxiety Ridge Creek in mid-August 1995. Since our study began in 1990, the highest catch each year consistently has occurred in Anxiety Ridge Creek during August. Earlier in summer, catch rates in Evaingiknuk Creek sometimes exceed the catch in Anxiety Ridge Creek. We believe that overwintering areas for Anxiety Ridge Creek Dolly Varden are located in lower Ikalukrok Creek and the Wulik River whereas overwintering habitat exists in Evaingiknuk Creek near our summer sample area. Dolly Varden using Anxiety Ridge Creek do not reach the upper creek until later

in summer. Our findings continue to support Houghton and Hilgert's (1983) assessment that the most productive stream for summer rearing in this area is Anxiety Ridge Creek.

Fish sampling of Buddy Creek which joins Anxiety Ridge Creek to form Dudd Creek had not been conducted before 1995. In 1995, we made visual observations and caught, by angling, juvenile Dolly Varden. Juvenile Dolly Varden were common in Buddy Creek and abundance appeared higher than in Anxiety Ridge Creek. Fish use Buddy Creek up to a falls which is located about 1.5 km below the Red Dog Haul Road. The waterfall and an associated chute below the falls prohibit fish movement upstream (Figure 11).

Year to year variability in Dolly Varden use of Anxiety Ridge and Evaingiknuk Creeks also is significant. Fish use of Anxiety Ridge Creek can be affected by activities at the Red Dog Mine whereas Evaingiknuk Creek, a Noatak River tributary, is not affected. Comparisons in catch for each creek were made for August, the period of highest use by juvenile Dolly Varden. The number of Dolly Varden captured in Anxiety Ridge Creek in August 1992, 1993, 1994, and 1995 was 334, 295, 26, and 154. Significant differences were noted among sample years ($F = 16.5$; $df = 3,36$; $P < 0.05$). Total catch of juvenile Dolly Varden in Evaingiknuk Creek was 111, 26, 3, and 38 in August of 1992, 1993, 1994, and 1995. Significant differences were noted among sample years ($F = 8.4$; $df = 3,36$; $P < 0.05$). Low catches during 1994 in both drainages suggest that natural environmental conditions in the region influenced juvenile fish distribution.

In 1995, the catch of juvenile Dolly Varden in Ikalukrok Creek increased from June to August (Appendix 8). The average catch and standard deviation (SD) for the June, July, and August samples were 0.0, 0.8 ± 1.3, and 2.1 ± 3.5. The increase in

Figure 11. Natural fish barrier in Buddy Creek. Photographs taken in August 1995.

use with time during summer represents gradual movement into the sample area by juvenile fish. We also compared catches in Ikalukrok Creek among the 1992 through 1995 sample years. A significant difference among years was not found ($F = 2.51$; $df = 3, 36$; $P < 0.05$) for the late July to August samples. The lowest catch was recorded in the same year catches were low in Evaingiknuk and Anxiety Ridge Creeks supporting the observation that areawide environmental conditions likely influenced juvenile fish distribution in 1994.

Arctic Grayling, North Fork Red Dog Creek

Our objective was to determine current Arctic grayling use of North Fork of Red Dog Creek. On July 6, 1982, spawned-out Arctic grayling were abundant in North Fork Red Dog Creek and on July 9, 1982, numerous young-of-the-year Arctic grayling were observed (Dames and Moore 1983).

In 1995, mature Arctic grayling were present in late June, young-of-the-year (<25 mm) were observed on July 17, and in mid-August, fry (40 - 47 mm) were present but not numerous. In all prior sample years (1991 to 1994), we found mature fish in late June and young-of-the-year in July (Ott et al. 1992; Ott and Weber Scannell 1993; Ott and Weber Scannell 1994; Weber Scannell and Ott 1995). Fry were numerous in backwater areas and along stream margins in 1991, 1992, and 1993, but not in 1994, probably due to high-water events immediately following spawning. Total rainfall in 1995 was similar to 1994 but was more evenly distributed. Our results indicate the Arctic grayling use of North Fork Red Dog Creek is similar to pre-mining use.

The average size of Arctic grayling in North Fork Red Dog Creek in 1995 increased slightly from June to August (Table 9). On August 15, 1995, Arctic grayling were observed in large schools (30 to 60 fish) actively moving

Table 9. Average size of Arctic grayling collected, by angling, in North Fork Red Dog Creek (1993-1995).

Sample Period	Number of Fish	Average Length (mm)	Range (mm)	Standard Deviation
6/28-7/2/93	25	214	130-410	68.2
6/27-29/94	48	257	194-325	31.2
7/25-30/94	54	216	158-269	23.0
8/30/94	0[1]			
6/26-30/95	95	257	180-395	36.3
7/17-21/95	100	263	171-377	32.6
8/11-15/95	107	264	147-383	35.2

[1]Arctic grayling juveniles and adults were not observed or collected.

downstream, presumably to overwintering habitat. In previous sample years, larger Arctic grayling appeared to leave the creek immediately after spawning. In 1994, average size decreased from 257 to 216 mm FL from June to July (Table 9) when more small fish were captured. Smaller Arctic grayling also enter North Fork Red Dog Creek as summer progresses. In 1995, more of the larger Arctic grayling remained in North Fork Red Dog Creek.

Tagging of Arctic grayling began in 1994 and continued in 1995 (Appendix 11) (Figure 12). Eleven Arctic grayling tagged in summer 1994 were recaptured in summer 1995. Growth ranged from 37 to 66 mm per year (Table 10). Six Arctic grayling tagged and recaptured in North Fork Red Dog Creek in summer 1995 exhibited a 12 to 34 mm growth from late June to mid-August (Table 11).

Juvenile Dolly Varden, North Fork Red Dog Creek

Our objective was to determine current juvenile Dolly Varden use of North Fork Red Dog Creek. Houghton and Hilgert (1983) repeatedly sampled North Fork Red Dog Creek in 1981-1982 and reported finding only one Dolly Varden near the headwaters of the creek. They assumed the Dolly Varden was a non-migratory resident. Juvenile Dolly Varden were first documented by ADF&G in North Fork Red Dog Creek during summer 1992 (Ott and Weber Scannell 1993). Juvenile Dolly Varden use of North Fork Red Dog Creek also occurred in summer 1993 (Ott and Weber Scannell 1994) and 1994 (Weber Scannell and Ott 1995).

In 1995, we fished ten minnow traps in North Fork Red Dog Creek in June, July, and August. We caught one juvenile Dolly Varden during each sample period (Appendix 10). In mid-August 1995, we caught five Dolly Varden by angling. Four were silvery without parr marks and ranged in size from 169 to 247 mm FL (average size 204 mm, SD = 35.6). We believe these fish were in saltwater during

Figure 12. Arctic grayling sample areas in the North Fork of Red Dog Creek.

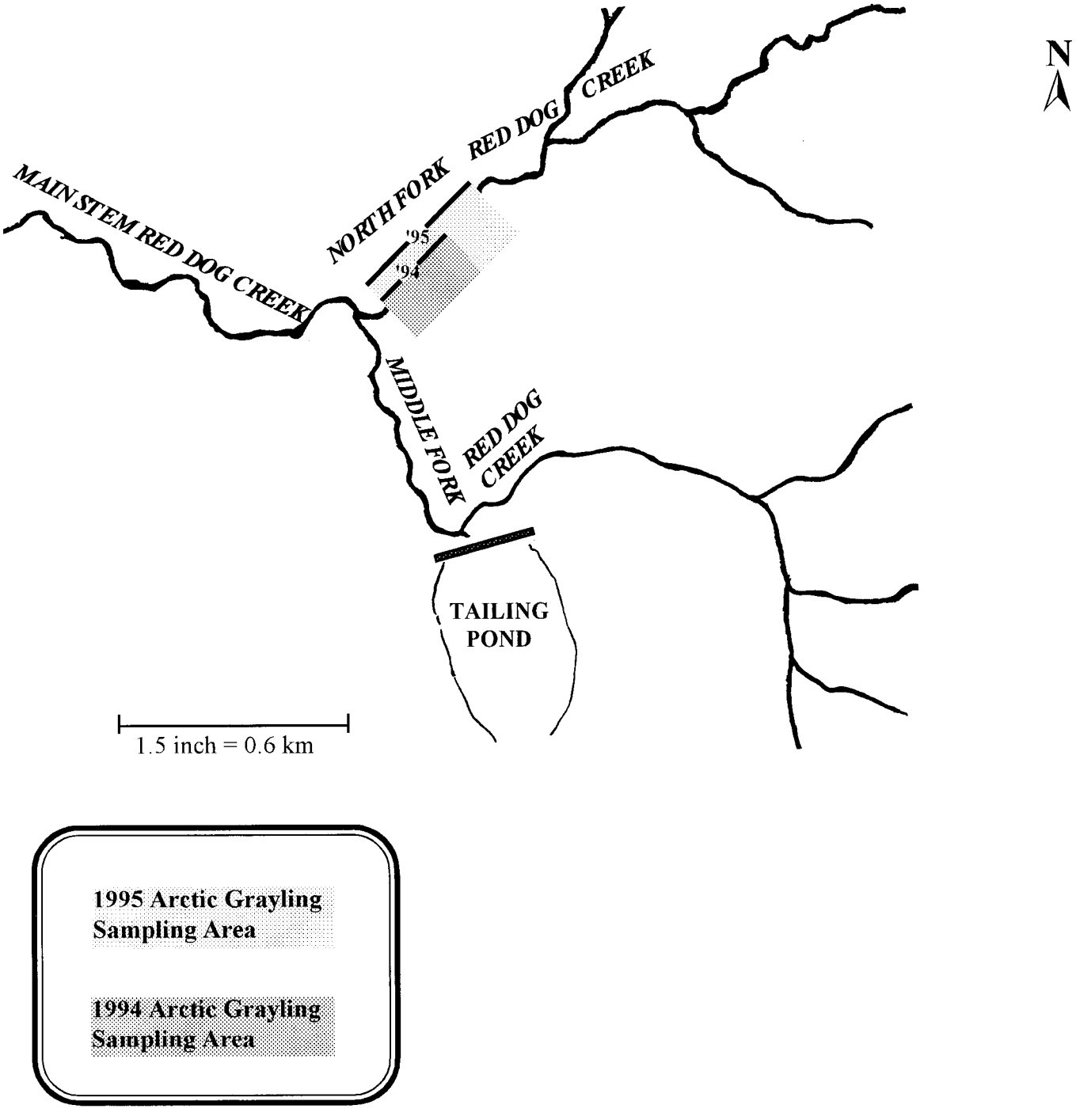


Table 10. Growth of Arctic grayling collected in North Fork Red Dog Creek (1994-1995).

Tag Number/Color Length at Marking (mm)	Time at Large (Days)	Growth (mm)	Growth /Year (mm)
3114 Y[1] (200)	359	36	37
3124 Y (200)	338	37	40
3137 Y (203)	384	69	66
3426 Y (205)	364	60	60
3411 Y (210)	384	68	65
3122 Y (211)	385	55	52
3110 Y (222)	356	43	44
3449 Y (235)	366	53	53
3417 Y (238)	363	52	52
3107 Y (255)	384	47	45
3419 Y (270)	384	44	42

[1]Y=Yellow

Table 11. Growth of Arctic grayling in North Fork Red Dog Creek (1995).

Tag Number/Color Length at Marking (mm)	Time at Large (Days)	Growth (mm)
1588 W (227)	47	23
1579 W (228)	43	29
1573 W (241)	46	34
1565 W (243)	47	28
1539 W (270)	46	20
1507 W[1] (320)	46	12

[1]W=White

early summer 1995 and returned to freshwater. Houghton and Hilgert (1983) observed a large school of uniform-sized small Dolly Varden in September 1982 in Dudd Creek. They saw several hundred Dolly Varden (235 to 257 mm) and concluded that the fish appeared to be those that have spent their first or second summer feeding in salt water. We believe that Dolly Varden after one season of saltwater feeding used North Fork Red Dog Creek in a manner similar to that described by Houghton and Hilgert for Dudd Creek in 1982. The continued use of North Fork Red Dog Creek by rearing Dolly Varden and the first documentation of use by Dolly Varden after saltwater migration probably is related to the continued operation of the clean water bypass system and reduced metals concentrations in Mainstem Red Dog Creek.

Dolly Varden and Arctic Grayling, Middle Fork and Mainstem Red Dog Creek

Our objective was to determine Dolly Varden and Arctic grayling use of the Mainstem and Middle Fork Red Dog Creek. Historical data indicate that fish use was limited to migration in Mainstem Red Dog Creek and that fish did not use Middle Fork Red Dog Creek. However, fish were observed in Mainstem Red Dog Creek within the influence of the North Fork Red Dog Creek (Dames and Moore 1983) and fish mortalities were documented in Mainstem Red Dog Creek (EVS Consultants Ltd. 1983). Fish were not seen in Middle Fork Red Dog Creek in 1992, 1993, and 1994. Minnow traps fished in Middle Fork and Mainstem Red Dog Creeks in 1994 yielded no fish (Appendices 6 and 7). One Dolly Varden and two adult Arctic grayling were seen in Mainstem Red Dog Creek in the influence of North Fork Red Dog Creek in 1994 (Weber Scannell and Ott 1995).

Minnow traps, visual surveys, and angling were used to assess fish presence in Mainstem and Middle Fork Red Dog Creeks in 1995. In 1995, juvenile Dolly

Varden were not captured in Middle Fork Red Dog Creek but were present during all sample periods in Mainstem Red Dog Creek (Appendices 6 and 7). During four field trips in summer 1995, adult Arctic grayling were present in Mainstem Red Dog Creek. We observed adult and young-of-the-year Arctic grayling in a large scour pool and side channel of Mainstem Red Dog Creek about 1.2 km below North Fork Red Dog Creek. On August 14, 1995, we collected 11 Arctic grayling (290 to 336 mm FL) from the scour pool, two of which we had marked in North Fork Red Dog Creek: one in summer 1994 and one in summer 1995. Arctic grayling were observed actively feeding in the scour pool.

The presence of rearing juvenile Dolly Varden and adult Arctic grayling in Mainstem Red Dog Creek represents a change in fish use from baseline conditions. We believe that general improvements in water quality since fall 1991 have resulted in fish now using Mainstem Red Dog Creek for rearing habitat.

Slimy Sculpin, Mainstem Red Dog Creek

Houghton and Hilgert (1983) found slimy sculpin in all of the regularly sampled stations on Ikalukrok Creek and in Dudd Creek but none were ever collected in the Red Dog Creek drainage. Minnow bucket sampling in Mainstem, Middle Fork, and North Fork Red Dog Creeks began in 1992 and continued in 1993 and 1994. No slimy sculpin were captured during these years (Appendix 12).

In 1995, we collected one slimy sculpin in Mainstem Red Dog Creek and one in North Fork Red Dog Creek, but none were collected in Middle Fork Red Dog Creek. It appears that slimy sculpin are now using the Red Dog Creek drainage. Use of the system probably is related to improvement in water quality since fall 1991.

CONCLUSIONS

In 1995, we observed no adverse effects on fisheries resources from the existing wastewater discharge 0.57 m^3s^{-1} to 0.74 m^3s^{-1} (20 to 26 cfs) at the Red Dog Mine. Actions taken by Cominco Alaska Inc. since 1991 have tended to reduce metals concentrations and increase TDS and sulfate in streams below the ore body throughout the summer. The reduced metals content in the water also have occurred during low flow conditions in contrast to pre-mining conditions when adverse, toxic concentrations of metals and low pH occurred and fish mortalities were observed. The substantial increases in TDS and sulfate in downstream waters do not appear to adversely affect fish use. A summary of our fisheries findings to date follows:

(1) Arctic grayling returned to North Fork Red Dog Creek in spring 1995 in numbers comparable to previous years of survey (1992 through 1995). Arctic grayling have continued to spawn successfully in North Fork Red Dog Creek since mine development.

(2) Dolly Varden juveniles returned to North Fork Red Dog Creek in spring 1995. Prior to development of the mine, anadromous Dolly Varden were not found in North Fork Red Dog Creek. Dolly Varden juveniles have been observed in North Fork Red Dog Creek in 1992, 1993, 1994, and 1995. In 1995, 4 Dolly Varden without parr marks ranging in size from 169 to 247 mm were caught in North Fork Red Dog Creek. Based on size and coloration, these Dolly Varden spent part of summer 1995 in salt water.

(3) Arctic grayling adults were observed, collected, or marked in Mainstem Red Dog Creek during the weeks of June 20 to 30, July 10 to 14, and July 17 to

21, 1995. Prior to development of the mine, adult Arctic grayling were not known to use Mainstem Red Dog Creek for summer rearing.

(4) Dolly Varden juveniles were collected in Mainstem Red Dog Creek during the weeks of June 26 to 30 and July 17 to 21, 1995. Prior to development of the mine, juvenile Dolly Varden were not known to use Mainstem Red Dog Creek for rearing or migration.

(5) Slimy sculpin were documented in Mainstem Red Dog Creek and North Fork Red Dog Creek in 1995. Prior to mine development, slimy sculpin were not found in the entire Red Dog Creek drainage.

(6) No fish were collected or observed in Middle Fork Red Dog Creek. Visual observations have been made each year since 1991 and minnow traps were fished in 1994 and 1995.

(7) Juvenile Dolly Varden use of Anxiety Ridge Creek has varied among sample years, but for all sample years, the highest use of sampled creeks by juvenile Dolly Varden has occurred in Anxiety Ridge Creek. Similar findings were reported in premining studies.

(8) Juvenile Dolly Varden continue to rear in Ikalukrok Creek immediately upstream and downstream of Dudd Creek. Significant differences in use among years by juvenile Dolly Varden in Ikalukrok Creek have not occurred since 1992.

(9) The number of overwintering Dolly Varden in the Wulik River before freezeup has ranged from 66,752 to 144,138 from 1991 to 1994 (aerial survey data). The actual population estimate for winter 1994/1995 was 361,599.

Distribution of overwintering fish in the Wulik River upstream and downstream of Ikalukrok Creek has not changed since 1979.

(10) The number of chum salmon using Ikalukrok Creek in 1990, 1991, and 1994 remains well below pre-mining numbers. Decreased numbers of adult chum salmon are likely the result of poor water quality in 1989 and 1990 which adversely impacted developing fry and adult spawners prior to construction of the clean water bypass system.

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Appendix 1. Concentrations of Al, Cd, Cu, Pb, and Zn in adult Dolly Varden tissues, 1990 through 1995, from the Wulik River. Baseline fish tissue data from Dames and Moore (1983) are included. All concentrations expressed as mg/Kg, dry weight basis. See Appendix 3 for explanation of the sample groups.

				Muscle Tissue												
Sample	Collector	Date	Location	Sex	Weight	Length	age									
Group					grams	mm	(fresh	Al		Cd		Cu		Pb	Zn	%
							salt)	mg/kg		mg/kg		mg/kg		mg/kg	mg/kg	Solids
E	Cominco	10/5/91	Wulik	F	1162	480		0.55	<	0.020		2.55		0.03	14.90	27.70
E	Cominco	10/5/91	Wulik	M	1262	480		0.66	<	0.020		2.85		0.03	13.90	26.90
E	Cominco	10/5/91	Wulik	M	2551	614		0.43	<	0.020		2.02		0.04	14.50	27.40
E	Cominco	10/5/91	Wulik	F	2188	589		0.13		0.030		2.68		0.04	13.10	30.40
E	Cominco	10/5/91	Wulik	F	1616	525		0.22	<	0.020		2.03		0.03	12.80	27.50
E	Cominco	10/5/91	Wulik	M	2233	563		0.32	<	0.020		2.42		0.05	12.20	29.10
F	ADF&G	4/29/92	Wulik	F	180	291		2.50	<	0.020		2.27	<	0.05	16.50	24.70
F	ADF&G	4/29/92	Wulik	F	670	424	(2+2)	2.20	<	0.020		1.460		0.02	14.60	24.40
F	ADF&G	4/29/92	Wulik	F	1420	530	(2+3)?	1.80	<	0.020		1.35	<	0.02	14.10	25.90
F	ADF&G	4/29/92	Wulik	U	180	294	(2+1)?	2.60	<	0.020		2.12		0.03	25.90	23.60
F	ADF&G	4/29/92	Wulik	F	140	275	(3+1)	1.50	<	0.020		2.08	<	0.02	28.70	20.50
F	ADF&G	4/29/92	Wulik	M	160	276		2.60	<	0.020		2.38		0.02	22.90	22.60
F	ADF&G	4/29/92	Wulik	M	140	264	(4+1)	3.00	<	0.020		2.57	<	0.02	24.30	21.80
F	ADF&G	4/29/92	Wulik	F	150	259	(3+1)	3.90	<	0.020		1.99		0.02	26.10	22.80
G	ADF&G	9/30/92	Wulik	F	2820	620	9	1.35	<	0.020		1.74	<	0.02	14.00	23.50
G	ADF&G	9/30/92	Wulik	M	3410	674	(3+4)	0.47	<	0.020		1.27	<	0.02	11.00	31.70
G	ADF&G	9/30/92	Wulik	F	2630	600	(3+5)	0.72	<	0.020		1.27	<	0.02	13.00	34.40
G	ADF&G	9/30/92	Wulik	M	2110	564	(4+4)	0.74	<	0.020		1.26		0.03	13.00	26.20
G	ADF&G	9/30/92	Wulik	F	2920	595	(3+4)	0.42	<	0.020		1.59	<	0.02	14.00	30.70
G	ADF&G	9/30/92	Wulik	M	673	407	(2+4)	1.26	<	0.020		2.08		0.17	14.00	35.50
H	ADF&G	4/21/93	Wulik R.		1032	480		1.000	<	0.0100		1.380		0.02	16.000	25.400
H	ADF&G	4/21/93	Wulik R.		717	414	(2+3)	1.400	<	0.0100		1.450		0.03	18.000	27.400
H	ADF&G	4/21/93	Wulik R.		701	421	(4+2)	1.300	<	0.0100		1.490		0.02	20.000	27.400
H	ADF&G	4/21/93	Wulik R.		685	398	(3+2)	1.300	<	0.0100		1.380		0.02	16.000	26.500
H	ADF&G	4/21/93	Wulik R.		611	407	6	1.200	<	0.0100		1.230		0.02	18.000	24.800
H	ADF&G	4/21/93	Wulik R.		2168	575	(2+3)	1.300	<	0.0100		1.270		0.07	15.000	25.800
I	ADF&G	10/20/93	Wulik R.		2168	575	(3+3)	2.70	<	0.020		16.700		0.22	14.60	36.700
I	ADF&G	10/20/93	Wulik R.		1352	491	(4+3)	2.60	<	0.020		1.570	<	0.01	14.50	29.600
I	ADF&G	10/20/93	Wulik R.		1551	498	(3+3)	2.10	<	0.020		1.510	<	0.01	14.00	31.100
I	ADF&G	10/20/93	Wulik R.		1188	456	(3+3)	1.90	<	0.020		1.910	<	0.01	16.10	31.300
I	ADF&G	10/20/93	Wulik R.		1324	473	(3+3)	2.10	<	0.020		1.370	<	0.01	14.70	31.400
I	ADF&G	10/20/93	Wulik R.		2204	556	(3+4)	1.80	<	0.020		1.000	<	0.01	11.70	33.100
J	ADF&G	4/7/94	Wulik R.	M	245	297		7.80	<	0.020		1.380	<	0.02	16.70	23.000
J	ADF&G	4/7/94	Wulik R.	F	572	380		8.80	<	0.020		1.350		0.02	15.80	25.800
J	ADF&G	4/7/94	Wulik R.	M	526	390		6.60	<	0.020		1.480		0.03	16.50	24.300
J	ADF&G	4/7/94	Wulik R.	M	499	385		5.70	<	0.020		1.090	<	0.02	17.00	22.800
J	ADF&G	4/7/94	Wulik R.	M	590	386		8.20	<	0.020		1.390		0.02	16.40	24.300
J	ADF&G	4/7/94	Wulik R.	F	1651	521		15.00	<	0.020		1.250		0.02	12.90	28.000

Appendix 1, continued.

Muscle Tissue																
Sample Group	Collector	Date	Location	Sex	Weight grams	Length mm	age (fresh salt)	Al mg/kg		Cd mg/kg		Cu mg/kg		Pb mg/kg	Zn mg/kg	% Solids
k	ADF&G	9/23/94	Wulik R.	F	844	420		3.10	<	0.02		1.74		0.04	16.90	29.1
k	ADF&G	9/23/94	Wulik R.	M	690	420		0.90	<	0.02		1.53	<	0.02	23.70	31.3
k	ADF&G	9/23/94	Wulik R.	M	826	425		1.00	<	0.02		1.64	<	0.02	19.60	30.5
k	ADF&G	9/23/94	Wulik R.	M	890	435		1.2	<	0.02		1.73	<	0.02	21.4	31
k	ADF&G	9/23/94	Wulik R.	F	681	405		1.4	<	0.02		1.48	<	0.02	20.3	30
k	ADF&G	9/23/94	Wulik R.	F	726	420		2.1	<	0.02		1.7	<	0.02	20.8	27.6
L	ADF&G	6/14/95	Wulik R.	M	916.25	443	3/3	31.8	<	0.02		1.82		0.03	21.3	25.2
L	ADF&G	6/14/95	Wulik R.	F	1007	454	3/3	12.8	<	0.02		1.49	<	0.02	16.4	25.2
L	ADF&G	6/14/95	Wulik R.	M	762.03	419	3/2	2.2	<	0.02		1.9	<	0.02	20.5	25.2
L	ADF&G	6/14/95	Wulik R.	F	907.18	455	3/3	2.2	<	0.02		1.21	<	0.02	14.6	24.5
L	ADF&G	6/14/95	Wulik R.	F	925.32	462	3/3	2.4	<	0.02		1.76	<	0.02	19.5	25.2
L	ADF&G	6/14/95	Wulik R.	F	916.25	448	3/3	3.3	<	0.02		1.44	<	0.02	17.4	27.7
N	ADF&G	9/9/95	Wulik R.	F	816.46	434	3/3	5.9	<	0.04		2.43	<	0.56	264	8.6
N	ADF&G	9/9/95	Wulik R.	M	1170.3	482	3/3	4.2	<	0.02		1.66	<	0.42	160	10.8
N	ADF&G	9/9/95	Wulik R.	F	1451.5	475	4/3	1.8	<	0.02		1.23		0.18	88.5	12.3
N	ADF&G	9/9/95	Wulik R.	M	1097.7	457	2/3	2.2	<	0.02		1.52		0.16	67.1	11.4
N	ADF&G	9/9/95	Wulik R.	F	1977.7	530	2/3	2.3	<	0.02		1.34		0.19	64.7	12.5
N	ADF&G	9/9/95	Wulik R.	U	1778.1	555	7	1.3	<	0.02		0.97		0.06	28.5	15.8
A=Adult, U= undetermined, F=female, M=male.																

Appendix 1, continued.

Liver Tissue																
Sample Group*	Collector	Date	Location	Sex	Weight grams	Length mm	age (fresh salt)	Al mg/kg		Cd mg/kg		Cu mg/kg		Pb mg/kg	Zn mg/kg	% Solids
DM	D&M	6/1/81	Sta 1	A						0.580		33.00	<	0.02	72.3	
DM	D&M	6/1/81	Sta 1	A						0.540		16.50	<	0.02	50.8	
DM	D&M	8/1/81	Sta 1	A						0.770		11.00	<	0.02	91.0	
DM	D&M	9/1/81	Sta 1	A						0.970		18.00		0.02	78.2	
DM	D&M	9/1/81	Mid-Ikaluk	A						1.200		7.90	<	0.03	243.0	
DM	D&M	6/1/82		A				2.50		0.670		27.75		0.03	69.6	
A	ADF&G	10/5/90	Wulik R.	F		538		1.50		1.110		25.60		0.10	103.0	26.1
A	ADF&G	10/5/90	Wulik R.	F		615		0.70		0.250		19.70	<	0.10	46.6	46.6
A	ADF&G	10/5/90	Wulik R.	M		608		0.70		0.190		38.40	<	0.10	58.7	50.9
A	ADF&G	10/5/90	Wulik R.	F		430		0.80		0.460		22.60	<	0.10	79.3	29.0
A	ADF&G	10/5/90	Wulik R.	F		452		0.70		0.400		24.20	<	0.10	74.6	34.6
A	ADF&G	10/5/90	Wulik R.	F		528		0.40		0.370		29.90	<	0.10	61.8	55.9
B	Cominco	3/9/91	Wulik R.					1.50		1.810		40.30	<	0.10	164.0	27.1
B	Cominco	3/9/91	Wulik R.					3.10		0.530		30.70	<	0.10	65.8	44.4
B	Cominco	3/9/91	Wulik R.					2.00		0.730		46.60	<	0.10	84.8	38.8
B	KIVALINA	4/6/91	Wulik R.	M		300		4.80		1.730		51.90	<	0.10	88.8	33.8
B	KIVALINA	4/6/91	Wulik R.	M	197	294		1.50		0.290		47.70	<	0.10	87.2	34.9
B	KIVALINA	4/6/91	Wulik R.	F	201	303		1.80		0.450		41.10	<	0.10	95.8	33.1
B	KIVALINA	4/6/91	Wulik R.	F	237	355		2.20		0.630		72.00	<	0.10	114.0	25.2
B	KIVALINA	4/6/91	Wulik R.	F	751	434		2.90		0.380		25.90		0.10	44.6	35.0
B	Cominco	4/26/91	Wulik R.	F	1279	518		1.30		0.760		25.40	<	0.10	56.1	38.2
C	Noatak	4/15/91	Noatak R.	F	274	323		10.00		0.210		26.90		0.20	70.3	36.3
C	Noatak	4/15/91	Noatak R.	F	283	324		2.60		0.430		44.40	<	0.10	110.0	28.5
C	Noatak	4/15/91	Noatak R.	M	714	416		6.70		0.270		29.80	<	0.10	88.1	44.3
C	Noatak	4/15/91	Noatak R.	F	730	443		1.20		0.270		26.80	<	0.10	49.0	44.2
C	Noatak	4/15/91	Noatak R.	F	449	401		3.70		0.680		65.10	<	0.10	137.0	28.3
D	Cominco	6/16/91	Wulik R.	M	962	489		1.30		1.250		32.40	<	0.10	74.0	31.9
D	Cominco	6/16/91	Wulik R.	F	1426	538		1.80		0.710		18.70	<	0.10	75.2	30.8
D	Cominco	6/16/91	Wulik R.	M	1361	541		3.60		0.860		37.50	<	0.10	83.2	33.7
D	Cominco	6/16/91	Wulik R.	F	762	461		2.00		1.180		34.10	<	0.10	96.6	27.4
D	Cominco	6/16/91	Wulik R.	F	672	417		1.80		1.480		38.30		0.80	124.0	24.0
D	Cominco	6/16/91	Wulik R.	F	745	430		1.20		0.690		54.20	<	0.10	85.4	28.9
D	Cominco	6/16/91	Wulik R.	F	680	443		1.20		1.040		26.00	<	0.10	84.3	33.3
D	Cominco	6/16/91	Wulik R.	F	654	430		0.90		0.840		31.00	<	0.10	88.0	30.1
E	Cominco	10/5/91	Wulik R.	F	1162	480		0.94		0.290		33.60		0.04	70.8	45.6
E	Cominco	10/5/91	Wulik R.	M	1262	480		0.34		0.210		27.40		0.02	50.2	43.1
E	Cominco	10/5/91	Wulik R.	M	2551	614		0.44		0.720		39.00		0.10	61.7	37.7
E	Cominco	10/5/91	Wulik R.	F	2188	589		0.87		0.320		59.00		0.05	65.6	45.7
E	Cominco	10/5/91	Wulik R.	F	1616	525		0.40		0.530		25.40		0.04	55.1	41.5
E	Cominco	10/5/91	Wulik R.	M	2233	563		0.70		0.210		30.60		0.04	33.8	47.6
F	ADF&G	4/29/92	Wulik R.	F	180	291		3.20		0.410		40.30	<	0.02	152.0	27.0
F	ADF&G	4/29/92	Wulik R.	F	670	424	(2+2)	7.20		0.310		23.80	<	0.02	62.8	46.7
F	ADF&G	4/29/92	Wulik R.	F	1420	530	(2+3)?	4.70		0.260		47.80		0.02	66.2	39.6
F	ADF&G	4/29/92	Wulik R.	U	180	294	(2+1)?	7.60		0.370		32.40		0.03	142.0	27.7
F	ADF&G	4/29/92	Wulik R.	F	140	275	(3+1)	7.80		0.210		71.80		0.07	222.0	26.4
F	ADF&G	4/29/92	Wulik R.	M	160	276		2.30		0.740		39.90	<	0.02	162.0	26.5
F	ADF&G	4/29/92	Wulik R.	M	140	264	(4+1)	5.50		0.450		84.10		0.04	176.0	27.0

Appendix 1, continued.

Liver Tissue																
Sample Group*	Collector	Date	Location	Sex	Weight grams	Length mm	age (fresh salt)	Al mg/kg		Cd mg/kg		Cu mg/kg		Pb mg/kg	Zn mg/kg	% Solids
F	ADF&G	4/29/92	Wulik R.	F	150	259	(3+1)	4.50		0.350		36.20		0.02	160.0	25.3
G	ADF&G	9/30/92	Wulik R.	F	4120	706	9	1.64		0.270		21.50		0.02	60.0	45.0
G	ADF&G	9/30/92	Wulik R.	M	2820	620	(3+4)	3.07		0.370		19.50		0.03	67.0	41.8
G	ADF&G	9/30/92	Wulik R.	F	3410	674	(3+5)	0.92		0.240		19.70		0.02	56.0	50.1
G	ADF&G	9/30/92	Wulik R.	M	2630	600	(4+4)	0.51		0.160		40.20	<	0.02	60.0	48.1
G	ADF&G	9/30/92	Wulik R.	F	2110	564	(3+4)	0.61		0.320		45.60		0.02	74.0	41.4
G	ADF&G	9/30/92	Wulik R.	M	2920	595	(2+4)	0.55		0.150		20.00	<	0.02	59.0	41.4
H	ADF&G	4/21/93	Wulik R.		673	407		1.200		0.2400		29.80	<	0.01	75.0	39.5
H	ADF&G	4/21/93	Wulik R.		1032	480	(2+3)	1.400		0.1600		37.30		0.02	73.0	37.4
H	ADF&G	4/21/93	Wulik R.		717	414	(4+2)	1.400		0.1900		42.30	<	0.01	63.0	46.0
H	ADF&G	4/21/93	Wulik R.		701	421	(3+2)	1.400		0.1300		23.00		0.02	58.0	42.2
H	ADF&G	4/21/93	Wulik R.		685	398	6	1.400		0.1500		21.00		0.01	66.0	38.7
H	ADF&G	4/21/93	Wulik R.		611	407	(2+3)	1.100		0.1800		18.10		0.02	67.0	36.8
I	ADF&G	10/20/93	Wulik R.		2168	575	(3+3)	2.800		0.1800		23.60	<	0.02	46.5	48.4
I	ADF&G	10/20/93	Wulik R.		1352	491	(4+3)	2.800		0.2300		22.10		0.03	67.6	41.4
I	ADF&G	10/20/93	Wulik R.		1551	498	(3+3)	2.000		0.1200		13.20	<	0.02	51.0	46.3
I	ADF&G	10/20/93	Wulik R.		1188	456	(3+3)	2.300		0.2300		42.90	<	0.02	86.0	37.4
I	ADF&G	10/20/93	Wulik R.		1324	473	(3+3)	2.600		0.1400		28.90	<	0.02	60.9	44.4
I	ADF&G	10/20/93	Wulik R.		2204	556	(3+4)	2.400		0.2700		35.20	<	0.02	62.4	35.6
J	ADF&G	4/7/94	Wulik R.	M	245	297		24.40		0.270		34.50		0.21	88.5	35.0
J	ADF&G	4/7/94	Wulik R.	F	572	380		10.10		0.550		42.80	<	0.02	118.0	32.4
J	ADF&G	4/7/94	Wulik R.	M	526	390		4.70		0.630		47.80	<	0.02	93.3	32.9
J	ADF&G	4/7/94	Wulik R.	M	499	385		7.80		0.480		35.00	<	0.02	110.0	30.1
J	ADF&G	4/7/94	Wulik R.	M	590	386		2.20		0.400		35.20	<	0.02	86.0	35.4
J	ADF&G	4/7/94	Wulik R.	F	1651	521		10.20		0.270		30.00		0.02	56.5	37.6
k	ADF&G	9/23/94	Wulik R.	F	844	420		0.70		0.17		20.30	<	0.02	85.3	44.7
k	ADF&G	9/23/94	Wulik R.	M	690	420		0.80		0.20		41.10	<	0.02	87.0	42.1
k	ADF&G	9/23/94	Wulik R.	M	826	425		1.10		0.18		51.70	<	0.02	87.2	45.8
k	ADF&G	9/23/94	Wulik R.	M	890	435		0.9		0.18		39.60	<	0.02	81.4	46.4
k	ADF&G	9/23/94	Wulik R.	F	681	405		0.9		0.17		48.00	<	0.02	82.0	50.5
k	ADF&G	9/23/94	Wulik R.	F	726	420		0.9		0.34		28.90	<	0.02	89.9	43.1
L	ADF&G	6/14/95	Wulik R.	M	916.25	443	3/3	7.4		4.58		61.7	<	0.02	125	25.5
L	ADF&G	6/14/95	Wulik R.	F	1007	454	3/3	3.2		0.32		53	<	0.02	93.6	33.6
L	ADF&G	6/14/95	Wulik R.	M	762.03	419	3/2	0.8		0.52		57.6	<	0.02	124	25.6
L	ADF&G	6/14/95	Wulik R.	F	907.18	455	3/3	1.4		0.54		65.7	<	0.02	121	24.4
L	ADF&G	6/14/95	Wulik R.	F	925.32	462	3/3	2.8		0.44		73.9		0.04	126	25.3
L	ADF&G	6/14/95	Wulik R.	F	916.25	448	3/3	18.2		0.24		29		0.06	98.9	29.9
N	ADF&G	9/9/95	Wulik R.	F	816.46	434	3/3	2.1		0.62		34.5		0.02	103.0	14.5
N	ADF&G	9/9/95	Wulik R.	M	1170.3	482	3/3	4.5		0.65		134		0.44	366	13.1
N	ADF&G	9/9/95	Wulik R.	F	1451.5	475	4/3	0.6		0.4		16.6	<	0.02	61	13.8
N	ADF&G	9/9/95	Wulik R.	M	1097.7	457	2/3	1		0.4		27.3		0.03	65.8	13.6
N	ADF&G	9/9/95	Wulik R.	F	1977.7	530	2/3	0.6		0.21		31		0.08	54.6	15.2
N	ADF&G	9/9/95	Wulik R.	U	1778.1	555	7	0.9		0.19		39.4	<	0.02	55.4	15.0
A=Adult, U= undetermined, F=female, M=male.																

Appendix 1, continued.

Kidney Tissue																
Sample	Collector	Date	Location	Sex	Weight	Length	age									
Group*					grams	mm	(fresh/	Al		Cd		Cu		Pb	Zn	%
							salt)	mg/kg		mg/kg		mg/kg		mg/kg	mg/kg	Solids
DM	D&M	6/1/81	Sta 1	A						0.32		4.90		0.02	80.10	
DM	D&M	6/1/81	Sta 2	A						5.30		4.00	<	0.02	75.90	
DM	D&M	8/1/81	Sta 1	A						2.90		5.20	<	0.05	74.60	
DM	D&M	9/1/81	Sta 1	A						3.00		5.80	<	0.03	109.00	
DM	D&M	6/1/82		A				3.0		2.53		5.28		0.03	94.43	
A	ADF&G	10/5/90	Wulik R.	F		538		1.5		5.34		3.30		0.20	117.00	21.4
A	ADF&G	10/5/90	Wulik R.	F		615		1.1		2.22		4.80	<	0.10	96.40	21.9
A	ADF&G	10/5/90	Wulik R.	M		608		0.7		1.53		4.80	<	0.10	79.30	24.0
A	ADF&G	10/5/90	Wulik R.	F		430		3.0		2.93		5.20	<	0.10	100.00	23.7
A	ADF&G	10/5/90	Wulik R.	F		452		0.9		3.30		5.00	<	0.10	106.00	21.9
A	ADF&G	10/5/90	Wulik R.	F		528		1.1		2.63		5.30	<	0.10	103.00	18.5
B	Cominco	3/9/91	Wulik R.					2.3		3.59		4.80	<	0.10	143.00	23.1
B	Cominco	3/9/91	Wulik R.					4.7		3.48		5.20	<	0.10	103.00	22.9
B	Cominco	3/9/91	Wulik R.					2.1		3.20		4.90	<	0.10	118.00	23.6
B	KIVALINA	4/6/91	Wulik R.	M		300		2.4		4.31		3.70	<	0.20	127.00	20.3
B	KIVALINA	4/6/91	Wulik R.	M	197	294		8.8		0.85		2.70	<	0.40	85.60	23.4
B	KIVALINA	4/6/91	Wulik R.	F	201	303		22.0		1.96		4.10		1.50	173.00	23.7
B	KIVALINA	4/6/91	Wulik R.	F	237	355		7.4		0.17		9.00		0.40	139.00	21.8
B	KIVALINA	4/6/91	Wulik R.	F	751	434		2.1		2.79		3.50	<	0.10	102.00	22.4
C	Noatak	4/15/91	Noatak R	F	274	323		2.1		0.93		3.20	<	0.10	112.00	23.1
C	Noatak	4/15/91	Noatak R	F	283	324		4.6		0.57		2.90	<	0.10	79.80	22.0
C	Noatak	4/15/91	Noatak R	M	714	416		2.2		2.01		3.20	<	0.10	93.40	26.5
C	Noatak	4/15/91	Noatak R	F	730	443		4.1		2.06		3.30	<	0.10	106.00	23.2
C	Noatak	4/15/91	Noatak R	F	449	401		5.0		1.82		3.70		0.10	108.00	18.0
B	Cominco	4/26/91	Wulik R.	F	1279	518		1.0		5.40		6.20		0.20	112.00	21.0
D	Cominco	6/16/91	Wulik R.	M	962	489		6.0		6.56		6.00		0.10	83.30	18.3
D	Cominco	6/16/91	Wulik R.	F	1426	538		2.4		4.87		4.10	<	0.10	89.20	23.0
D	Cominco	6/16/91	Wulik R.	M	1361	541		1.7		4.14		4.00		0.20	76.60	22.3
D	Cominco	6/16/91	Wulik R.	F	762	461		2.1		3.09		4.50	<	0.10	94.50	22.4
D	Cominco	6/16/91	Wulik R.	F	672	417		1.5		2.47		3.50	<	0.10	208.00	15.2
D	Cominco	6/16/91	Wulik R.	F	745	430		1.6		2.23		4.20	<	0.10	71.10	21.9
D	Cominco	6/16/91	Wulik R.	F	680	443		1.9		4.01		4.90	<	0.10	108.00	22.5
D	Cominco	6/16/91	Wulik R.	F	654	430		1.3		3.23		4.10	<	0.10	95.90	21.2
E	Cominco	10/5/91	Wulik R.	F	1162	480		1.0		1.27		4.54		0.06	87.10	22.7
E	Cominco	10/5/91	Wulik R.	M	1262	480		1.9		1.66		4.89		0.62	92.40	22.8
E	Cominco	10/5/91	Wulik R.	M	2551	614		3.9		0.87		17.70		1.75	51.20	23.0
E	Cominco	10/5/91	Wulik R.	F	2188	589		1.3		2.54		6.18		0.03	104.00	22.3
E	Cominco	10/5/91	Wulik R.	F	1616	525		1.9		4.68		5.94		0.04	107.00	21.5
E	Cominco	10/5/91	Wulik R.	M	2233	563		0.8		2.81		4.37		0.06	86.40	22.9
F	ADF&G	4/29/92	Wulik R.	F	180	291		6.6		0.62		5.04		0.04	114.00	36.4
F	ADF&G	4/29/92	Wulik R.	F	670	424	(2+2)	5.0		1.51		3.570		0.04	78.10	24.2
F	ADF&G	4/29/92	Wulik R.	F	1420	530	(2+3)?	5.7		1.28		3.43		0.02	86.60	24.5
F	ADF&G	4/29/92	Wulik R.	U	180	294	(2+1)?	4.7		0.53		3.83		0.04	91.70	20.8
F	ADF&G	4/29/92	Wulik R.	F	140	275	(3+1)	4.3		0.38		6.43		0.06	99.70	21.4
F	ADF&G	4/29/92	Wulik R.	M	160	276		8.1		1.67		3.88		0.05	95.50	19.8
F	ADF&G	4/29/92	Wulik R.	M	140	264	(4+1)	2.6		0.40		3.50		0.04	82.20	17.4
F	ADF&G	4/29/92	Wulik R.	F	150	259	(3+1)	5.9		0.80		4.22		0.03	114.00	21.3

Appendix 1, continued.

Kidney Tissue

Sample Group*	Collector	Date	Location	Sex	Weight grams	Length mm	age (fresh/ salt)	Al mg/kg		Cd mg/kg		Cu mg/kg		Pb mg/kg	Zn mg/kg	% Solids
G	ADF&G	9/30/92	Wulik R.	F	4120	706	9	3.1		2.74		4.49	<	0.02	85.00	22.5
G	ADF&G	9/30/92	Wulik R.	M	2820	620	(3+4)	2.3		2.97		5.00	<	0.02	110.00	22.6
G	ADF&G	9/30/92	Wulik R.	F	3410	674	(3+5)	1.1		2.37		4.09	<	0.02	74.00	28.0
G	ADF&G	9/30/92	Wulik R.	M	2630	600	(4+4)	1.0		1.26		5.64	<	0.02	93.00	24.2
G	ADF&G	9/30/92	Wulik R.	F	2110	564	(3+4)	1.0		2.14		5.24		0.06	105.00	24.3
G	ADF&G	9/30/92	Wulik R.	M	2920	595	(2+4)	1.7		1.64		3.69		0.24	81.00	24.1
H	ADF&G	4/21/93	Wulik R.	F	673	407		1.4		0.76		3.850		0.02	88.00	23.8
H	ADF&G	4/21/93	Wulik R.		1032	480	(2+3)	1.7		1.33		4.530		0.02	106.00	23.5
H	ADF&G	4/21/93	Wulik R.		717	414	(4+2)	1.5		1.82		4.440		0.01	112.00	24.8
H	ADF&G	4/21/93	Wulik R.		701	421	(3+2)	1.2		0.79		3.660		0.01	84.00	26.9
H	ADF&G	4/21/93	Wulik R.		685	398	6	2.1		0.51		4.050	<	0.01	100.00	22.9
H	ADF&G	4/21/93	Wulik R.		611	407	(2+3)	4.1		0.53		3.610	<	0.01	99.00	22.3
I	ADF&G	10/20/93	Wulik R.		2168	575	(3+3)	2.3		1.37		4.67	<	0.02	103	25.6
I	ADF&G	10/20/93	Wulik R.		1352	491	(4+3)	1.1		0.13		0.54	<	0.02	13.8	24.6
I	ADF&G	10/20/93	Wulik R.		1551	498	(3+3)	2.3		0.77		4.51	<	0.02	110	23.0
I	ADF&G	10/20/93	Wulik R.		1188	456	(3+3)	2.6		0.73		4.01	<	0.02	95.5	24.0
I	ADF&G	10/20/93	Wulik R.		1324	473	(3+3)	2.6		0.71		3.93	<	0.02	116	23.5
I	ADF&G	10/20/93	Wulik R.		2204	556	(3+4)	2.5		1.76		5.45	<	0.02	98.9	22.7
J	ADF&G	4/7/94	Wulik R.	M	245	297		16.0		0.79		4.660		0.03	97.60	25.7
J	ADF&G	4/7/94	Wulik R.	F	572	380		10.2		0.88		3.280	<	0.02	88.50	23.1
J	ADF&G	4/7/94	Wulik R.	M	526	390		6.9		1.20		3.300	<	0.02	87.40	21.2
J	ADF&G	4/7/94	Wulik R.	M	499	385		9.6		1.94		4.190		0.05	102.00	20.7
J	ADF&G	4/7/94	Wulik R.	M	590	386		8.9		1.47		4.190		0.02	98.20	20.6
J	ADF&G	4/7/94	Wulik R.	F	1651	521		10.4		1.43		4.370	<	0.02	92.40	21.3
k	ADF&G	9/23/94	Wulik R.	F	844	420		5.7		0.92		4.34		0.04	106.00	23.0
k	ADF&G	9/23/94	Wulik R.	M	690	420		3.1		1.17		6.93		0.03	117.00	22.9
k	ADF&G	9/23/94	Wulik R.	M	826	425		2.9		0.60		3.70	<	0.02	101.00	23.6
k	ADF&G	9/23/94	Wulik R.	M	890	435		7.2		0.63		3.69		0.03	86.6	25.9
k	ADF&G	9/23/94	Wulik R.	F	681	405		2.6		0.71		4.37	<	0.02	114	24.7
k	ADF&G	9/23/94	Wulik R.	F	726	420		2.0		1.23		3.83		0.02	91.3	25.7
L	ADF&G	6/14/95	Wulik R.	M	916.25	443	3/3	3.5		1.18		4.58	<	0.02	88	22.1
L	ADF&G	6/14/95	Wulik R.	F	1007	454	3/3	5.4		1.62		4.31	<	0.02	71.8	24.4
L	ADF&G	6/14/95	Wulik R.	M	762.03	419	3/2	2.5		1.22		4.59	<	0.02	83.5	22.6
L	ADF&G	6/14/95	Wulik R.	F	907.18	455	3/3	1.2		0.95		4.28	<	0.02	74.3	23.5
L	ADF&G	6/14/95	Wulik R.	F	925.32	462	3/3	1.9		0.8		3.59	<	0.02	61.2	22.9
L	ADF&G	6/14/95	Wulik R.	F	916.25	448	3/3	1.3		0.76		3.58	<	0.02	65.9	22.1
N	ADF&G	9/9/95	Wulik R.	F	816.46	434	3/3	1.3		2.36		4.94	<	0.02	89.4	5.4
N	ADF&G	9/9/95	Wulik R.	M	1170.3	482	3/3	1		2.5		13.4	<	0.02	89.6	6.4
N	ADF&G	9/9/95	Wulik R.	F	1451.5	475	4/3	1.6		1.86		4.47	<	0.02	75.1	6.9
N	ADF&G	9/9/95	Wulik R.	M	1097.7	457	2/3	11.8		0.25		2.27		0.86	444	5.8
N	ADF&G	9/9/95	Wulik R.	F	1977.7	530	2/3	3.4		1.08		3.88	<	0.02	80.5	8.9
N	ADF&G	9/9/95	Wulik R.	U	1778.1	555	7	0.9		0.85		3.98		0.06	61.4	9.6

A=Adult, U= undetermined, F=female, M=male.

Appendix 1, continued.

					Gill Tissue											
Sample	Collector	Date	Location	Sex	Weight	Length	age									
Group*					grams	mm	(fresh	Al		Cd		Cu		Pb	Zn	%
							salt)	mg/kg		mg/kg		mg/kg		mg/kg	mg/kg	Solids
DM	D&M	6/1/81	Sta 1	A						0.770		3.00	<	0.03	67.20	
DM	D&M	6/1/81	Sta 2	A						1.200		3.20	<	0.02	68.60	
DM	D&M	8/1/81	Sta 1	A						0.360		3.20	<	0.04	34.10	
DM	D&M	9/1/81	Sta 1	A						0.790		3.10	<	0.04	67.40	
DM	D&M	9/1/81	Mid-Ikaluk	A						1.400		3.10	<	0.03	52.70	
DM	ADF&G	6/1/82		A						5.750		0.75		3.18	0.03	24.8
A	ADF&G	10/5/90	Wulik	F		538		1.8		1.630		2.20		0.20	90.40	22.3
A	ADF&G	10/5/90	Wulik	F		615		1.3		0.680		3.10	<	0.10	70.90	25.8
A	ADF&G	10/5/90	Wulik	M		608		1.4		1.440		2.60	<	0.10	68.70	24.0
A	ADF&G	10/5/90	Wulik	F		430		2.0		1.200		3.30		0.10	70.50	26.2
A	ADF&G	10/5/90	Wulik	F		452		0.6		1.220		2.10	<	0.10	70.20	21.6
A	Cominco	10/5/90	Wulik	F		528		2.2		2.440		2.60		0.20	96.60	24.1
B	Cominco	3/9/91	Wulik					6.1		0.390		2.30	<	0.10	87.40	19.2
B	Cominco	3/9/91	Wulik					7.8		0.660		2.30	<	0.10	87.60	22.0
B	Cominco	3/9/91	Wulik					10.8		1.020		2.30	<	0.10	77.80	22.1
B	KIVALINA	4/6/91	WULIK	M		300		5.0		0.450		2.60	<	0.10	94.80	19.5
B	KIVALINA	4/6/91	WULIK	M	197	294		13.9		0.360		1.90	<	0.10	74.40	18.6
B	KIVALINA	4/6/91	WULIK	F	201	303		3.4		0.820		2.20	<	0.10	88.40	19.3
B	KIVALINA	4/6/91	WULIK	F	237	355		4.2		0.330		2.50		0.20	70.30	19.0
B	KIVALINA	4/6/91	WULIK	F	751	434		16.1		0.850		1.90	<	0.10	83.00	19.8
C	Noatak	4/15/91	Noatak	F	274	323		27.6		0.050		1.80		0.20	105.00	20.3
C	Noatak	4/15/91	Noatak	F	283	324		15.6		0.060		1.60		0.10	79.80	22.3
C	Noatak	4/15/91	Noatak	M	714	416		3.5		0.070		2.20		0.10	81.20	20.5
C	Noatak	4/15/91	Noatak	F	730	443		6.7		0.100		1.50	<	0.10	76.60	21.3
C	Noatak	4/15/91	Noatak	F	449	401		10.5		0.040		2.20	<	0.10	84.00	20.3
B	Cominco	4/26/91	Wulik	F	1279	518		3.2		0.790		1.7		1.10	79.80	20.4
D	Cominco	6/16/91	Wulik	M	962	489		36.6		1.510		3.10		1.00	75.60	18.2
D	Cominco	6/16/91	Wulik	F	1426	538		56.3		0.780		3.00		3.00	79.30	21.1
D	Cominco	6/16/91	Wulik	M	1361	541		21.2		1.150		2.70		0.60	75.50	18.8
D	Cominco	6/16/91	Wulik	F	762	461		18.4		2.000		3.10		1.50	89.60	22.2
D	Cominco	6/16/91	Wulik	F	672	417		20.5		0.640		2.10		0.80	64.70	21.4
D	Cominco	6/16/91	Wulik	F	745	430		33.3		0.830		2.80		1.50	75.30	20.8
D	Cominco	6/16/91	Wulik	F	680	443		60.2		0.850		2.90		2.40	67.70	21.5
D	Cominco	6/16/91	Wulik	F	654	430		1.2		1.820		3.10		1.20	78.50	20.2
E	Cominco	10/5/91	Wulik	F	1162	480		1.6		0.550		3.39		0.10	70.80	21.0
E	Cominco	10/5/91	Wulik	M	1262	480		23.4		0.300		2.92		0.16	75.20	19.3
E	Cominco	10/5/91	Wulik	M	2551	614		10.6		0.630		2.82		0.29	71.40	20.3
E	Cominco	10/5/91	Wulik	F	2188	589		2.1		0.540		3.64		0.23	72.30	23.0
E	Cominco	10/5/91	Wulik	F	1616	525		22.1		0.500		4.23		1.26	73.60	19.8
E	Cominco	10/5/91	Wulik	M	2233	563		31.7		0.710		5.10		0.33	84.10	21.7
F	ADF&G	4/29/92	Wulik	F	180	291		3.1		0.130		3.34		0.18	93.30	20.8
F	ADF&G	4/29/92	Wulik	F	670	424	(2+2)	2.1		0.160		1.780		0.07	65.50	25.9
F	ADF&G	4/29/92	Wulik	F	1420	530	(2+3)?	9.0		0.070		1.79		0.11	65.70	27.8
F	ADF&G	4/29/92	Wulik	U	180	294	(2+1)?	2.3		0.130		1.92		0.07	84.20	21.0
F	ADF&G	4/29/92	Wulik	F	140	275	(3+1)	2.7		0.120		3.73		0.04	93.70	19.9
F	ADF&G	4/29/92	Wulik	M	160	276		4.4		0.140		2.21		0.02	81.30	19.2
F	ADF&G	4/29/92	Wulik	M	140	264	(4+1)	5.9		0.080		2.24		0.06	80.20	20.3

Appendix 1, concluded.

Gill Tissue																
Sample Group*	Collector	Date	Location	Sex	Weight grams	Length mm	age (fresh salt)	Al mg/kg		Cd mg/kg		Cu mg/kg		Pb mg/kg	Zn mg/kg	% Solids
F	ADF&G	4/29/92	Wulik	F	150	259	(3+1)	1.7		0.090		2.13		0.03	77.70	19.9
G	ADF&G	9/30/92	Wulik	F	4120	706	9	2.8		0.240		3.22		0.04	76.00	21.2
G	ADF&G	9/30/92	Wulik	M	2820	620	(3+4)	2.3		0.420		8.50		0.16	90.00	18.8
G	ADF&G	9/30/92	Wulik	F	3410	674	(3+5)	1.3		0.410		2.92	<	0.02	86.00	19.8
G	ADF&G	9/30/92	Wulik	M	2630	600	(4+4)	1.3		0.330		2.90		0.04	91.00	20.3
G	ADF&G	9/30/92	Wulik	F	2110	564	(3+4)	1.4		0.330		2.92	<	0.02	94.00	19.8
G	ADF&G	9/30/92	Wulik	M	2920	595	(2+4)	1.0		0.360		2.34		0.04	73.00	21.6
H	ADF&G	4/21/93	Wulik R.		673	407		1.8		0.240		2.420		0.36	87.00	20.2
H	ADF&G	4/21/93	Wulik R.		1032	480	(2+3)	1.6		0.150		2.500		0.03	97.00	20.7
H	ADF&G	4/21/93	Wulik R.		717	414	(4+2)	2.5		0.180		2.350		0.43	84.00	20.8
H	ADF&G	4/21/93	Wulik R.		701	421	(3+2)	3.7		0.140		2.330		0.04	74.00	21.7
H	ADF&G	4/21/93	Wulik R.		685	398	6	3.1		0.160		2.190		0.04	75.00	22.4
H	ADF&G	4/21/93	Wulik R.		611	407	(2+3)	1.4		0.170		2.310		0.03	77.00	22.8
I	ADF&G	10/20/93	Wulik R.	F	2168	575	(3+3)	42.4		0.180		2.680		0.06	101.00	25.5
I	ADF&G	10/20/93	Wulik R.	M	1352	491	(4+3)	3.9		0.260		12.800		0.20	88.50	24.8
I	ADF&G	10/20/93	Wulik R.	M	1551	498	(3+3)	3.7		0.310		3.930	<	0.02	80.10	22.2
I	ADF&G	10/20/93	Wulik R.	F	1188	456	(3+3)	66.7		0.280		2.900		0.08	88.50	25.8
I	ADF&G	10/20/93	Wulik R.	M	1324	473	(3+3)	2.9		0.160		2.640		0.03	81.20	21.7
I	ADF&G	10/20/93	Wulik R.	M	2204	556	(3+4)	4.3		0.230		2.020		0.02	64.70	24.8
J	ADF&G	4/7/94	Wulik R.	M	245	297		15.9		0.110		2.150		0.04	83.10	20.8
J	ADF&G	4/7/94	Wulik R.	F	572	380		14.5		0.160		16.300		0.81	78.30	25.1
J	ADF&G	4/7/94	Wulik R.	M	526	390		5.2		0.170		23.100		0.43	66.00	21.2
J	ADF&G	4/7/94	Wulik R.	M	499	385		3.5		0.120		2.910		0.04	111.00	15.2
J	ADF&G	4/7/94	Wulik R.	M	590	386		3.9		0.160		3.640	<	0.02	103.00	19.1
J	ADF&G	4/7/94	Wulik R.	F	1651	521		5.5		0.150		27.400		0.38	88.50	19.0
k	ADF&G	9/23/94	Wulik R.	F	844	420		487.0		0.25		3.41		0.65	99.10	27.3
k	ADF&G	9/23/94	Wulik R.	M	690	420		379.0		0.21		2.95		0.55	99.40	25.8
k	ADF&G	9/23/94	Wulik R.	M	826	425		452.0		0.25		2.52		0.70	94.60	26.3
k	ADF&G	9/23/94	Wulik R.	M	890	435		184.0		0.25		2.09		0.32	83.5	27.5
k	ADF&G	9/23/94	Wulik R.	F	681	405		308.0		0.26		25		0.46	87.2	25.9
k	ADF&G	9/23/94	Wulik R.	F	726	420		212.0		0.32		2.35		0.31	91.4	24.6
L	ADF&G	6/14/95	Wulik R.	M	916.25	443	3/3	4.4		0.26		2.37		0.04	68.8	21.6
L	ADF&G	6/14/95	Wulik R.	F	1007	454	3/3	2.3		0.1		2.3	<	0.02	53	23.8
L	ADF&G	6/14/95	Wulik R.	M	762.03	419	3/2	441		0.23		3.26		0.67	70.3	19.6
L	ADF&G	6/14/95	Wulik R.	F	907.18	455	3/3	5.4		0.24		3.05	<	0.02	83.5	19.5
L	ADF&G	6/14/95	Wulik R.	F	925.32	462	3/3	294		0.29		7.51		0.5	74.7	20.0
L	ADF&G	6/14/95	Wulik R.	F	916.25	448	3/3	388		0.38		2.95		0.56	78.9	18.9
N	ADF&G	9/9/95	Wulik R.	F	816.46	434	3/3	11.8		0.43		3.71		1.5	362	7.9
N	ADF&G	9/9/95	Wulik R.	M	1170.3	482	3/3	7.1		0.3		2.47		1.08	527	8.5
N	ADF&G	9/9/95	Wulik R.	F	1451.5	475	4/3	11.1		0.23		2.43		0.63	351	8.0
N	ADF&G	9/9/95	Wulik R.	M	1097.7	457	2/3	0.9		1.2		3.29		0.02	70.3	7.8
N	ADF&G	9/9/95	Wulik R.	F	1977.7	530	2/3	24.6		0.25		2.34		0.73	375	8.0
N	ADF&G	9/9/95	Wulik R.	U	1778.1	555	7	12.1		0.3		2.25		0.58	315	8.2
A=Adult, U= undetermined, F=female, M=male.																

Appendix 2. Quality control/quality assurance data for concentrations of metals in Dolly Varden tissues collected from 1989 through 1995. (Metals concentrations data presented in Appendix 1.)

			Method Blank Summary			
	Sample Group	Metal	US EPA Method	MB1 mg/L	MB2 Mg/L	MB3 Mg/L
10/5/90	A	Al	202.2	ND		
		Cd	7131	ND		
		Cu	6010	ND		
		Pb	7412	ND		
		Zn	6010	ND		
3/9/91	B	Al	202.2	0.2		
		Cd	7131	ND		
		Cu	6010	ND		
		Pb	7412	ND		
		Zn	6010	ND		
4/6/91	B	Al	202.2	0.2	0.2	0.2
4/15/91	C	Cd	7131	ND	ND	ND
		Cu	6010	ND	ND	ND
		Pb	7412	ND	ND	ND
		Zn	6010	ND	ND	ND
4/26/91	B	Al	202.2	0.3	0.3	
6/16/91	C	Cd	7131	ND	ND	
		Cu	6010	ND	ND	
		Pb	7412	ND	ND	
		Zn	6010	ND	ND	
4/26/91	B	Al	202.2	0.4	0.2	
6/16/91	D	Cd	7131	ND	ND	
continued		Cu	6010	ND	ND	
		Pb	7412	ND	ND	
		Zn	6010	ND	ND	
10/5/91	B	Al	200.8	0.5	0.56	0.51
	D	Cd	200.8	ND	ND	ND
		Cu	200.8	0.08	ND	ND
		Pb	200.8	0.04	ND	ND
		Zn	200.8	0.9	0.41	0.31
4/29/92	E	Al	200.8	ND	ND	
		Cd	7131	ND	ND	
		Cu	200.8	ND	ND	
		Pb	200.8	ND	ND	
		Zn	200.8	ND	ND	

Appendix 2, continued.

Method Blank Summary

	Sample Group	Metal	US EPA Method	MB1 mg/L	MB2 Mg/L	MB3 Mg/L
9/30/92	E	Al	200.8	0.36	0.227	
		Cd	200.8	ND	ND	
		Cu	200.8	ND	ND	
		Pb	200.8	ND	ND	
		Zn	7950	ND	ND	
4/21/93	F	Al	200.8	0.8	0.6	
		Cd	200.8	ND	ND	
		Cu	200.8	ND	ND	
		Pb	200.8	ND	ND	
		Zn	7950	ND	ND	
10/20/93	F	Al	200.8	0.7	0.7	
		Cd	200.8	ND	ND	
		Cu	200.8	ND	ND	
		Pb	200.8	ND	ND	
		Zn	200.8	ND	0.6	
4/7/94	G	Al	200.8	0.7	ND	
		Cd	200.8	ND	ND	
		Cu	200.8	ND	ND	
		Pb	200.8	ND	ND	
		Zn	200.8	ND	ND	
9/23/94	G	Al	200.8	ND		
		Cd	200.8	ND		
		Cu	200.8	ND		
		Pb	200.8	ND		
		Zn	200.8	ND		
6/14/95	H	Al	200.8	0.3	0.4	
		Cd	200.8	ND	ND	
		Cu	200.8	ND	ND	
		Pb	200.8	ND	ND	
		Zn	200.8	ND	ND	
9/9/95	H	Al	200.8	0.3	0.7	
		Cd	200.8	ND	ND	
		Cu	200.8	ND	0.5	
		Pb	200.8	ND	ND	
		Zn	200.8	ND	ND	

ND = not detected at the method detection limit.

Appendix 2, continued.

Matrix Spike Results

	Sample Group	Metal	Method	Method Detection Limit	Spike Level	Sample Result	Spiked Sample Result	% Recovery
10/5/90	A	Al	202.2	0.10	4.70	1.50	6.80	113
		Cd	7131	0.01	0.95	1.11	1.93	86
		Cu	6010	0.40	4.70	25.60	32.60	NC
		Pb	7412	0.10	0.90	0.10	0.90	89
		Zn	6010	0.40	23.70	103.00	129.00	NC
3/9/91	B	Al	202.2	0.10	10.40	2.20	10.20	77
		Cd	7131	0.01	1.04	nd	1.14	110
		Cu	6010	0.50	41.50	3.50	47.30	106
		Pb	7412	0.10	4.20	nd	4.30	102
		Zn	6010	0.50	104.00	18.60	126.00	103
4/6/91	B	Al	202.2	0.10	9.60	6.40	16.10	101
4/15/91	C	Cd	7131	0.01	0.96	0.04	1.10	110
		Cu	6010	0.50	38.50	2.40	43.40	106
		Pb	7412	0.10	3.90	ND	4.10	105
		Zn	6010	0.50	96.30	16.10	113.00	101
4/6/91	B	Al	202.2	0.10	9.70	4.10	14.70	109
4/15/91	C	Cd	7131	0.01	0.97	0.01	1.07	109
continued		Cu	6010	0.50	38.40	1.20	42.70	108
		Pb	7412	0.10	3.90	ND	4.00	103
		Zn	6010	0.50	96.00	17.00	116.00	103
4/26/91	B	Al	202.2	0.10	6.70	1.20	6.40	78
6/16/91	D	Cd	7131	0.01	0.67	ND	0.67	100
		Cu	6010	0.50	26.90	1.70	28.80	101
		Pb	7412	0.10	2.70	ND	2.70	100
		Zn	6010	0.50	67.30	14.10	78.40	96
4/26/91	B	Al	202.2	0.10	9.20	2.10	12.20	110
6/16/91	D	Cd	7131	0.01	0.92	3.09	4.01	100
continued		Cu	6010	0.50	36.70	4.50	39.70	96
		Pb	7412	0.10	3.70	ND	3.90	105
		Zn	6010	0.50	91.70	94.50	178.00	91

Appendix 2, continued.

Matrix Spike Results

	Sample Group	Metal	Method	Method Detection Limit	Spike Level	Sample Result	Spiked Sample Result	% Recovery
10/5/91	E	Al	200.8	0.05	4.06	0.55	3.97	84
		Cd	200.8	0.02	0.81	ND	0.88	109
		Cu	200.8	0.05	16.20	2.55	18.20	97
		Pb	200.8	0.02	1.62	0.03	1.81	110
		Zn	200.8	0.05	40.60	14.90	51.60	90
10/5/91 continued	E	Al	200.8	0.05	4.48	0.32	5.42	114
		Cd	200.8	0.02	0.90	ND	0.97	108
		Cu	200.8	0.05	17.90	2.42	21.40	106
		Pb	200.8	0.02	1.79	0.05	2.13	116
		Zn	200.8	0.05	44.80	12.20	56.40	99
4/29/92	F	Al	200.8	0.5	4.8	2.5	8	115
		Cd	7131	0.02	4.8	ND	5.08	106
		Cu	200.8	0.05	19	2.27	20.5	96
		Pb	200.8	0.02	4.8	ND	4.83	101
		Zn	200.8	0.2	48	16.5	63.3	98
4/29/92 continued	F	Al	200.8	0.5	4.6	2.6	5.5	63
		Cd	7131	0.02	4.6	ND	4.58	100
		Cu	200.8	0.05	18	2.38	19.4	95
		Pb	200.8	0.02	4.6	0.02	4.57	99
		Zn	200.8	0.2	46	22.9	66.5	95
9/30/92	G	Al	200.8	0.5	4.6	0.47	4.9	96
		Cd	200.8	0.02	0.92	ND	0.89	97
		Cu	200.8	0.05	18	1.27	18.3	95
		Pb	200.8	0.02	1.8	ND	1.93	107
		Zn	7950	0.2	46	11	59	104
9/30/92 continued	G	Al	200.8	0.05	4.8	0.42	5.2	100
		Cd	200.8	0.02	0.95	ND	0.94	99
		Cu	200.8	0.05	19	1.59	19.3	93
		Pb	200.8	0.02	1.9	ND	1.97	104
		Zn	7950	1	48	14	63	102
4/21/93	H	Al	200.8	0.05	8.6	1.4	12.9	134
		Cd	200.8	0.02	4.3	ND	4.28	100
		Cu	200.8	0.05	8.6	1.45	9.76	97
		Pb	200.8	0.02	4.4	0.03	4.26	96
		Zn	7950	1	43	18	59	95

Appendix 2, continued.

Matrix Spike Results

	Sample Group	Metal	Method	Method Detection Limit	Spike Level	Sample Result	Spiked Sample Result	% Recovery
4/21/93	H	Al	200.8	0.2	8.4	1.3	9.1	93
		Cd	200.8	0.01	4.2	ND	4.17	99
		Cu	200.8	0.05	8.4	1.24	9.46	98
		Pb	200.8	0.01	4.2	0.07	4.35	105
		Zn	7950	1	42	15	58	102
10/20/93	I	Al	200.8	0.2	9.4	2.6	11	89
		Cd	200.8	0.01	4.7	ND	4.41	94
		Cu	200.8	0.05	9.4	1.57	10.3	93
		Pb	200.8	0.01	4.7	ND	4.43	94
		Zn	200.8	1	47	14.5	56.8	90
10/20/93	I	Al	200.8	0.2	10	1.8	10.9	91
		Cd	200.8	0.02	5	ND	4.89	98
		Cu	200.8	0.05	10	1	10.1	91
		Pb	200.8	0.02	5	ND	4.72	94
		Zn	200.8	0.5	50	11.7	60.1	97
4/7/94	J	Al	200.8	0.2	4.9	7.8	13	106
		Cd	200.8	0.02	0.98	ND	0.99	101
		Cu	200.8	0.05	20	1.38	19	88
		Pb	200.8	0.02	2	ND	1.99	100
		Zn	200.8	0.5	49	16.7	65.8	100
4/7/94	J	Al	200.8	0.2	4.7	15	20.9	126
		Cd	200.8	0.02	0.94	ND	0.97	103
		Cu	200.8	0.05	19	1.25	18.4	90
		Pb	200.8	0.02	1.9	0.02	1.91	99
		Zn	200.8	0.5	47	12.9	60.5	101
9/23/94	K	Al	200.8	0.2	200	3.1	206	101
		Cd	200.8	0.02	4.9	ND	5.16	105
		Cu	200.8	0.05	24	1.74	27.6	108
		Pb	200.8	0.02	49	0.04	47.5	97
		Zn	200.8	0.5	49	16.9	72.9	114

Appendix 2, continued.

Matrix Spike Results

	Sample Group	Metal	Method	Method Detection Limit	Spike Level	Sample Result	Spiked Sample Result	% Recovery
9/23/94	K	Al	200.8	0.2	200	2.1	197	97
		Cd	200.8	0.02	4.9	ND	4.89	100
		Cu	200.8	0.05	24	1.7	26.1	98
		Pb	200.8	0.02	49	ND	46.6	95
		Zn	200.8	0.5	49	20.8	70.8	102
6/14/95	L	Al	200.8	0.2	160	31.8	194	101
		Cd	200.8	0.02	4	ND	4.3	108
		Cu	200.8	0.05	20	1.82	23.8	110
		Pb	200.8	0.02	40	0.03	44.8	112
		Zn	200.8	0.5	40	21.3	64.1	107
6/14/95	L	Al	200.8	0.2	190	18.2	192	91
		Cd	200.8	0.02	4.6	0.24	4.67	96
		Cu	200.8	0.05	23	29	44.7	68
		Pb	200.8	0.02	46	0.06	46.7	101
		Zn	200.8	0.5	46	98.9	144	98
9/9/95	N	Al	200.8	0.2	200	5.9	188	91
		Cd	200.8	0.02	5	0.04	4.65	92
		Cu	200.8	0.05	25	2.43	25.4	92
		Pb	200.8	0.02	50	0.56	54.7	108
		Zn	200.8	0.5	50	264	299	NC
9/9/95	N	Al	200.8	0.2	200	1.3	179	89
		Cd	200.8	0.02	5	ND	4.79	96
		Cu	200.8	0.05	25	0.97	24.3	93
		Pb	200.8	0.02	50	0.06	53.5	107
		Zn	200.8	0.5	50	28.5	73.6	90

Sample Group: For a description of sample groups, refer to Appendix 3.
NC = not calculated because the sample concentration was greater than 4 times the amount spiked.
ND = not detected at stated method detection limit.

Appendix 2, continued.

Dates of Samples QA/QC applies to	Sample Group	Metal	Method	Method Reporting Limit	Duplicate Samples Sample A	Sample B	%Relative Difference
10/5/90	A	Al	202.2	0.10	1.50	1.00	38
		Cd	7131	0.01	1.11	1.14	3
		Cu	6010	0.40	25.60	27.00	5
		Pb	7412	0.10	0.10	ND	
		Zn	6010	0.40	103.00	105.00	2
3/9/91	B	Al	202.2	0.10	2.20	2.30	4
		Cd	7131	0.01	ND	ND	
		Cu	6010	0.50	3.50	3.70	6
		Pb	7412	0.10	ND	ND	
		Zn	6010	0.50	18.60	17.60	6
4/6/91	B	Al	202.2	0.10	6.40	6.80	6
4/15/91	C	Cd	7131	0.01	0.04	0.04	<1
		Cu	6010	0.50	2.40	2.20	9
		Pb	7412	0.10	ND	ND	
		Zn	6010	0.50	16.10	16.40	2
4/6/91	B	Al	202.2	0.10	4.10	3.80	8
4/15/91	C	Cd	7131	0.01	0.01	ND	
continued		Cu	6010	0.50	1.20	1.20	<1
		Pb	7412	0.10	ND	ND	
		Zn	6010	0.50	17.00	16.90	<1
4/26/91	B	Al	202.2	0.10	1.20	1.30	8
6/16/91	D	Cd	7131	0.01	ND	ND	
		Cu	6010	0.50	1.70	1.50	12
		Pb	7412	0.10	ND	ND	
		Zn	6010	0.50	13.60	13.80	4
4/26/91	B	Al	202.2	0.10	2.10	2.20	4
6/16/91	D	Cd	7131	0.01	3.09	3.12	<1
continued		Cu	6010	0.50	4.50	4.30	5
		Pb	7412	0.10	ND	ND	
		Zn	6010	0.50	94.50	90.70	4
10/5/91	E	Al	200.8	0.05	0.55	0.59	7
		Cd	200.8	0.02	ND	ND	--
		Cu	200.8	0.05	2.55	2.15	17
		Pb	200.8	0.02	0.03	0.04	25
		Zn	200.8	0.05	14.90	14.00	6

Appendix 2, continued.

Dates of Samples QA/QC applies to	Sample Group	Metal	Method	Method Reporting Limit	Duplicate Samples Sample A	Sample B	%Relative Difference
10/5/91	E	Al	200.8	0.05	0.32	0.28	13
Continued		Cd	200.8	0.02	ND	ND	--
		Cu	200.8	0.05	2.42	2.35	3
		Pb	200.8	0.02	0.05	0.03	50
		Zn	200.8	0.05	12.20	12.20	<1
4/29/92	F	Al	200.8	0.5	2.5	6.9	94
		Cd	7131	0.02	ND	ND	---
		Cu	200.8	0.05	2.27	2.51	10
		Pb	200.8	0.02	ND	0.08	NC
		Zn	200.8	0.2	16.5	16.5	<1
4/29/92	F	Al	200.8	0.5	2.6	2.4	8
(continued)		Cd	7131	0.02	ND	ND	---
		Cu	200.8	0.05	2.38	2.27	5
		Pb	200.8	0.02	0.02	ND	---
		Zn	200.8	0.2	22.9	22.3	3
9/30/92	G	Al	200.8	0.05	0.47	0.47	<1
		Cd	200.8	0.02	ND	ND	---
		Cu	200.8	0.05	1.27	1.23	3
		Pb	200.8	0.02	ND	ND	---
		Zn	7950	1	11	12	8
9/30/92	G	Al	200.8	0.05	0.42	0.56	29
continued		Cd	200.8	0.02	ND	ND	---
		Cu	200.8	0.05	1.59	1.42	11
		Pb	200.8	0.02	ND	0.02	NC
		Zn	7950	1	14	13	7
4/21/93	H	Al	200.8	0.2	1.4	1.6	13
		Cd	200.8	0.01	ND	ND	<1
		Cu	200.8	0.05	1.45	1.47	1
		Pb	200.8	0.01	0.03	0.01	100
		Zn	7950	1	18	18	<1
4/21/93	H	Al	200.8	0.2	1.3	1	25
		Cd	200.8	0.01	ND	ND	<1
		Cu	200.8	0.05	1.24	1.3	5
		Pb	200.8	0.01	0.07	0.02	125
		Zn	7950	1	15	15	<1

Appendix 2, continued.

Dates of Samples QA/QC applies to	Sample Group	Metal	Method	Method Reporting Limit	Duplicate Samples Sample A	Duplicate Samples Sample B	Duplicate Samples %Relative Difference
10/20/93	I	Al	200.8	0.2	2.6	2.2	17
		Cd	200.8	0.02	ND	ND	<1
		Cu	200.8	0.05	1.57	1.78	12
		Pb	200.8	0.02	ND	0.3	--
		Zn	200.8	0.5	14.5	13.2	9
10/20/93	I	Al	200.8	0.2	1.8	1.5	19
		Cd	200.8	0.02	ND	ND	--
		Cu	200.8	0.05	1	1.12	11
		Pb	200.8	0.02	ND	ND	--
		Zn	200.8	0.5	11.7	12.9	10
4/7/94	J	Al	200.8	0.2	7.8	8.6	10
		Cd	200.8	0.02	ND	ND	
		Cu	200.8	0.05	1.38	1.4	1
		Pb	200.8	0.02	ND	ND	
		Zn	200.8	0.5	17.4	17	4
4/7/94	J	Al	200.8	0.2	15	13.4	14.2
		Cd	200.8	0.02	ND	ND	NC
		Cu	200.8	0.05	1.25	1.21	1.23
		Pb	200.8	0.02	0.02	ND	NC
		Zn	200.8	0.5	12.9	12.5	12.7
9/23/94	K	Al	200.8	0.2	3.1	3.3	6
		Cd	200.8	0.02	ND	ND	NC
		Cu	200.8	0.05	1.74	1.68	4
		Pb	200.8	0.02	0.04	0.04	<1
		Zn	200.8	0.5	16.9	16.1	5

Appendix 2, continued.

					Duplicate Samples		
Dates of Samples QA/QC applies to	Sample Group	Metal	Method	Method Reporting Limit	Sample A	Sample B	%Relative Difference
9/23/94	K	Al	200.8	0.2	2.1	1.4	39
		Cd	200.8	0.02	ND	ND	NC
		Cu	200.8	0.05	1.7	1.68	1
		Pb	200.8	0.02	ND	ND	NC
		Zn	200.8	0.5	20.8	20.6	1
6/14/95	L	Al	200.8	0.2	31.8	37.9	18
		Cd	200.8	0.02	ND	ND	
		Cu	200.8	0.05	1.82	1.88	3
		Pb	200.8	0.02	0.03	0.02	50
		Zn	200.8	0.5	21.3	21.6	1
6/14/95	L	Al	200.8	0.2	18.2	25.4	33
		Cd	200.8	0.02	0.24	0.24	<1
		Cu	200.8	0.05	29	21.7	29
		Pb	200.8	0.02	0.06	0.02	100
		Zn	200.8	0.5	98.9	99.3	<1
9/9/95	N	Al	200.8	0.2	1.3	1.2	8
		Cd	200.8	0.02	ND	ND	
		Cu	200.8	0.05	0.97	0.94	3
		Pb	200.8	0.02	0.06	0.05	17
		Zn	200.8	0.5	28.5	27.3	4
9/9/95	N	Al	200.8	0.2	12.1	13.1	8
		Cd	200.8	0.02	0.3	0.3	<1
		Cu	200.8	0.05	2.25	2.18	3
		Pb	200.8	0.02	0.58	0.54	7
		Zn	200.8	0.5	315	308	2

Appendix 2, concluded.

Recovery of Standard Reference Material

	Sample Group	Metal	Method	Method Detection Limit	TRUE Value mg/kg	Laboratory Result mg/kg	TRUE Value mg/kg	Laboratory Result mg/kg
4/7/94	J	Cd	200.8	0.02	26.3	24.8	26.3	25
		Cu	200.8	0.05	439	414	439	422
		Pb	200.8	0.02	10.4	9.6	10.4	10.8
		Zn	200.8	0.50	177	155	177	157
9/23/94	K	Al	200.8	0.20	10.9 ± 1.7	8.1	10.9 ± 1.7	9
		Cd	200.8	0.02	0.043 ± 0.008	0.047	0.043 ± 0.008	0.049
		Cu	200.8	0.05	2.34 ± 0.16	3.02	2.34 ± 0.16	2.51
		Pb	200.8	0.02	0.065 ± 0.007	0.074	0.065 ± 0.007	0.062
		Zn	200.8	0.50	25.6 ± 2.3	27	25.6 ± 2.3	27.3
9/23/94	K	Al	200.8	0.20				
		Cd	200.8	0.02	26.3 ± 2.1	25.4	26.3 ± 2.1	24.9
		Cu	200.8	0.05	439 ± 22	466	439 ± 22	466
		Pb	200.8	0.02	10.4 ± 2.0	10.1	10.4 ± 2.0	10
		Zn	200.8	0.50	177 ± 10	206	177 ± 10	204
6/14/95	L	Al	200.8	0.20	10.9 ± 1.7	11.2	10.9 ± 1.7	9.4
		Cd	200.8	0.02	0.43 ± 0.008	0.37	0.43 ± 0.008	0.033
		Cu	200.8	0.05	2.34 ± 0.16	2.55	2.34 ± 0.16	2.33
		Pb	200.8	0.02	0.065 ± 0.007	0.056	0.065 ± 0.007	0.056
		Zn	200.8	0.50	25.6 ± 2.3	25.7	25.6 ± 2.3	22.1
9/9/95	N	Al	200.8	0.20	10.9 ± 1.7	10.7	10.9 ± 1.7	10.5
		Cd	200.8	0.02	0.43 ± 0.008	0.047	0.43 ± 0.008	0.05
		Cu	200.8	0.05	2.34 ± 0.16	2.62	2.34 ± 0.16	2.71
		Pb	200.8	0.02	0.065 ± 0.007	0.082	0.065 ± 0.007	0.087
		Zn	200.8	0.50	25.6 ± 2.3	22.4	25.6 ± 2.3	21.9

Appendix 3. Description of fish sample groups for determinations of concentrations of Al, Cd, Cu, Pb, and Zn.

Date Collected	Site	No. of Fish	Collector
1982	Wulik River	Varies with tissue	Dames and Moore
[1]October 1990	Wulik River	6	ADF&G
[2]April 1991	Wulik River	4	Cominco
[2]April 1991	Wulik River	5	Kivalina
[3]April 1991	Noatak River	5	ADF&G
[4]June 1991	Wulik River	8	Cominco
[5]October 1991	Wulik River	6	Cominco and ADF&G
[6]April 1992	Wulik River	8	Cominco and ADF&G
[7]September 1992	Wulik River	6	ADF&G
[8]April 1993	Wulik River	6	Cominco and ADF&G
[9]October 1993	Wulik River	6	ADF&G
[10]April 1994	Wulik River	6	ADF&G
[11]October 1994	Wulik River	6	ADF&G
[12]June 1995	Wulik River	6	ADF&G
[13]September 1995	Wulik River	6	ADF&G

[1]Sample Group A - Six adult Dolly Varden collected from the Wulik River (downstream of the mouth of Ikalukrok Creek) by Fred DeCicco (ADF&G) on October 3, 1990, before freezeup.

[2]Sample Group B - Nine adult Dolly Varden collected from the Wulik River (three by Cominco on 3/9/91, five by Kivalina on 4/6/91, one by Cominco on 4/26/91) between Driver's Camp (Station 2) and Umiivaq (lower Wulik River) during late winter before breakup.

[3]Sample Group C - Five adult Dolly Varden collected from the Noatak River by local residents during winter 1990/1991. Date and exact location in the Noatak River are unknown.

[4]Sample Group D - Eight adult Dolly Varden collected from the Wulik River (lower Wulik River immediately upstream of Kivalina) by Cominco and local residents from Kivalina on 6/16/91, immediately following breakup.

[5]Sample Group E - Six adult Dolly Varden collected from the Wulik River (Station 2) by Matt Robus (ADF&G) and Hank Brown and John Martinesko (Cominco) on 10/5/91, before freezeup.

Appendix 3, fish sample groups concluded.

[6]Sample Group F - Eight adult Dolly Varden collected from the Wulik River (about 5 miles upstream of Kivalina) between 4/28 and 4/30/92, by Al Townsend (ADF&G) and Hank Brown (Cominco) during late winter before breakup.

[7]Sample Group G - Six adult Dolly Varden collected from the Wulik River (Station 2) by Al Townsend (ADF&G) on 9/29/92, before freezeup.

[8]Sample Group H - Six adult Dolly Varden collected from the Wulik River (about five miles upstream of Kivalina) between 4/19 and 4/23/93, by Al Townsend (ADF&G) and Jake Wells (Cominco) during late winter before breakup.

[9]Sample Group I - Six adult Dolly Varden collected from the Wulik River (Station 2) by Al Townsend (ADF&G) on 10/20/93, before freezeup.

[10]Sample Group J - Six adult Dolly Varden collected from the Wulik River (Station 2) by Al Townsend (ADF&G) on 4/7/94, during late winter before breakup.

[11]Sample Group K - Six adult Dolly Varden collected from the Wulik River (Station 2) by Al Townsend (ADF&G) on 9/23/94, before freezeup.

[12]Sample Group L - Six adult Dolly Varden collected from the Wulik River (lower Wulik River near Kivalina) by Fred DeCicco (ADF&G) on 6/10/95 after breakup.

[13]Sample Group N - Six adult Dolly Varden collected from the Wulik River (Station 2) by Randy Zarnke (ADF&G) on 9/9/95, before freezeup.

Appendix 4. Dolly Varden collected in Evaingiknuk Creek using minnow traps baited with salmon roe, 1990-1995.

Sample Time	Number of Traps	Hours Fished/ Trap	Total Number DV	Length Range (mm), (Average)	DV/Trap ±SD
7/27-28/90	5	30	38	58-153(99)	7.6±7.2
8/23-24/90	5	24	23	56-174(101)	4.6±5.9
6/17-18/91	5	24	27	69-129(80)	5.4±8.2
6/18-19/91	5	25	34	66-110(77)	6.8±6.4
6/19-20/91	5	23	25	69-127(77)	5.0±3.6
7/20-21/91	2	24	15	90-107(98)	7.5±10.7
7/21-22/91	2	23	16	83-115(96)	8.0±1.4
8/5-6/91	5	18	34	62-136(97)	6.8±3.5
8/27-28/91	5	20	16	64-135(96)	3.2±2.3
8/28-29/91	5	25	14	59-113(88)	2.8±1.8
8/29-30/91	5	18	20	54-116(93)	4.0±3.4
10/2-3/91	5	24	0		0.0
10/3-4/91	5	24	1	64	0.2±0.4
10/4-5/91	5	26	1	62	0.2±0.4
6/30-7/1/92	10	24	39	64-112(80)	3.9±3.7
7/28-29/92	10	24	63	70-125(90)	6.3±3.2
8/25-26/92	10	24	111	73-143(90)	11.1±9.0
6/29-30/93	10	24	29	70-114(94)	2.9±2.1
8/24-25/93	10	22	26	59-118(93)	2.6±3.1
6/27-28/94	10	24	11	79-110(96)	1.1±0.7
7/25-26/94	10	29	37	78-121(95)	3.7±2.7

Appendix 4 Evaingiknuk, concluded.

Sample Time	Number of Traps	Hours Fished/ Trap	Total Number DV	Length Range (mm), (Average)	DV/Trap ±SD
8/30-31/94	10	25	3	94-118(107)	0.3±0.5
6/27-29/95	10	48	28	79-123(97)	2.8±2.3
7/18-20/95	10	48	35	76-129(102)	3.5±3.2
8/12-14/95	10	50	38	54-138(100)	3.8±3.6

Appendix 5. Dolly Varden collected in Anxiety Ridge Creek using minnow traps baited with salmon roe, 1990-1995.

Sample Time	Number of Traps	Hours Fished/ Trap	Total Number DV	Length Range (mm), (Average)	DV/Trap ±SD
7/27-28/90	5	27.5	7	104-152(133)	1.4±2.1
7/28-29/90	5	23	3	89-128(108)	0.6±0.9
7/29-30/90	5	16.5	9	107-146(132)	1.8±2.0
8/24-25/90	5	17	14	78-166(135)	3.5±1.9
8/25-26/90	5	22	10	75-160(140)	2.0±3.5
9/14-15/90	3	22	1	82	0.3±0.6
5/23-24/91	5	18	0		0.0
6/17-18/91	5	24	2	90,95	0.4±0.6
6/18-19/91	5	25	0		0.0
6/19-20/91	5	22	2	85,137	0.4±0.6
7/20-21/91	5	24	25	99-153(114)	5.0±8.0
7/21-22/91	5	24	18	60-131(100)	3.6±5.9
7/22-23/91	5	13	11	62-155(109)	2.2±3.8
8/5-6/91	5	19	75	88-147(118)	15.0±15.3
8/6-7/91	5	24	79	88-148(118)	15.8±11.3
8/7-8/91	5	20	81	99-147(117)	16.2±10.6
8/27-28/91	5	24	34	71-143(111)	6.8±8.8
8/28-29/91	5	25	3	71-126(90)	0.6±0.9
8/29-30/91	5	17	27	68-135(115)	5.4±4.8
10/2-3/91	4	24	6	108-137(121)	1.5±0.6
10/3-4/91	5	21	7	87-136(123)	1.4±2.6

Appendix 5 Anxiety Ridge, concluded.

Sample Time	Number of Traps	Hours Fished/ Trap	Total Number DV	Length Range (mm), (Average)	DV/Trap ±SD
10/4-5/91	5	26	4	78-133(117)	0.8±0.8
6/30-7/1/92	10	23	11	89-131(113)	1.1±1.7
7/28-29/92	10	24	223	82-144(101)	22.3±13.4
8/25-26/92	10	24	334	60-162(102)	33.4±17.4
6/29-30/93	10	24	55	74-161(109)	5.5±6.8
8/24-25/93	10	22	295	58-159(113)	29.5±8.5
6/27-28/94	10	24	9	72-124(104)	0.9±1.9
7/25-26/94	10	29	22	74-138(108)	2.2±1.6
8/30-31/94	10	25	26	61-146(113)	2.6±3.0
6/27-29/95	10	48	17	76-118(95)	1.7±1.7
7/18-20/95	10	48	27	62-141(96)	2.7±2.9
8/12-14/95	10	51	154	60-135(101)	15.4±9.8

Appendix 6. Dolly Varden collected in Middle Fork Red Dog Creek immediately upstream of North Fork Red Dog Creek using minnow traps baited with salmon roe, 1994-1995.

Sample Time	Number of Traps	Hours Fished/ Trap	Total Number DV	Length Range (mm), (Average)	DV/Trap ±SD
6/27-28/94	5	23	0		
7/26-27/94	5	22	0		
8/30-31/94	5	25	0		
6/26-29/95	5	72	0		
7/17-20/95	5	63	0		
8/11-14/95	5	68	0		

Appendix 7. Dolly Varden collected in Mainstem Red Dog Creek downstream of North Fork Red Dog Creek using minnow traps baited with salmon roe, 1994-1995.

Sample Time	Number of Traps	Hours Fished/ Trap	Total Number DV	Length Range (mm), (Average)	DV/Trap ±SD
6/27-28/94	5	23	0		
7/26-27/94	5	22	0		
8/30-31/94	5	25	0		
6/26-29/95	15	72	5	111-132(120)	0.3±0.8
7/17-20/95	15	63	10	77-114(88)	0.7±1.3
8/11-14/95	15	68	7	85-144(107)	0.3±0.7

Appendix 8. Dolly Varden collected in Ikalukrok Creek using minnow traps baited with salmon roe, 1990-1995. Minnow trap sample sites included Ikalukrok Creek from upstream of the mouth of Red Dog Creek to the lower portion of Ikalukrok Creek about 20 km downstream of the mouth of Dudd Creek. Sample stations (#1 - #5) in Ikalukrok Creek at Dudd Creek were the same with five additional sites established and run in 1992, 1993, 1994, and 1995.

Sample Time	Number of Traps	Hours Fished/ Trap	Total Number DV	Length Range (mm), (Average)	DV/Trap ±SD
[a]7/27-28/90	5	19	0		0.0
[b]7/27-28/90	5	23	1	107	0.2±0.4
[c]7/28-29/90	5	23	0		0.0
[d]7/28-29/90	5	22	0		0.0
[d]8/23-24/90	5	24	0		0.0
[e]8/23-24/90	5	24	0		0.0
[e]8/24-26/90	5	48	0		0.0
[f]8/24-29/90	5	120	0		0.0
[d]9/12-13/90	4	24	0		0.0
[d]9/13-14/90	4	20	0		0.0
[d]9/14-15/90	4	23	0		0.0
[f]9/13-14/90	5	24	0		0.0
[f]9/14-15/90	4	25	0		0.0
[e]9/13-14/90	5	22	0		0.0
[e]9/14-15/90	5	23	0		0.0
[e]7/17-18/91	5	23	6	53-61(57)	1.2±1.1
[e]7/18-19/91	5	23	4	52-109(72)	0.8±0.8
[e]7/19-20/91	5	21	9	82-140(112)	1.8±1.9
[e]8/5-8/91	5	65	10	60-105(66)	2.0±2.5

Appendix 8 Ikalukrok, concluded.

Sample Time	Number of Traps	Hours Fished/ Trap	Total Number DV	Length Range (mm), (Average)	DV/Trap ±SD
[e]8/27-30/91	5	65	0		0.0
[e]10/2-5/91	5	73	0		0.0
[g]6/30-7/1/92	10	24	0		
[g]7/28-29/92	10	24	6	56-104(76)	0.6±1.3
[g]8/25-26/92	10	24	58	60-155(102)	5.8±5.8
[g]6/29-30/93	10	24	8	76-93(83)	0.8±1.0
[g]8/24-25/93	10	22	38	62-137(82)	3.8±3.8
[g]7/27-28/94	10	20	12	56-97(81)	1.2±2.3
[g]6/27-28/95	10	24	0		
[g]7/18-19/95	10	21	8	68-114(88)	0.8±1.3
[g]8/12-13/95	10	21	21	63-135(107)	2.1±3.5

[a]Ikalukrok Creek - 7 km upstream of Dudd Creek
[b]Ikalukrok Creek - 10 km downstream of Dudd Creek
[c]Ikalukrok Creek - 10 km downstream of Dudd Creek, clear back-water
[d]Ikalukrok Creek - 20 km downstream of Dudd Creek
[e]Ikalukrok Creek - Immediately upstream of Dudd Creek
[f]Ikalukrok Creek - Immediately upstream of Red Dog Creek
[g]Ikalukrok Creek - Immediately upstream and downstream of Dudd Creek

Appendix 9. Dolly Varden collected in Ikalukrok Creek using minnow traps baited with salmon roe using 20 traps, 1994-1995. Sample stations (#1 - #10) in Ikalukrok Creek at Dudd Creek were the same with 10 sites added in 1994.

Sample Time	Number of Traps	Hours Fished/ Trap	Total Number DV	Length Range (mm), (Average)	DV/Trap ±SD
7/27-28/94	20	20	20	53-97(80)	1.0±2.0
6/27-28/95	20	24	3	46-99(75)	0.15±0.5
7/18-19/95	20	21	16	68-114(83)	0.8±1.2
8/12-13/95	20	21	28	64-135(106)	1.4±2.5

Appendix 10. Dolly Varden collected in the North Fork Red Dog Creek using minnow traps baited with salmon roe, 1992-1995.

Sample Time	Number of Traps	Hours Fished/ Trap	Total Number DV	Length Range (mm), (Average)	DV/Trap ±SD
7/27-30/92	5	72	2	124,133	0.4±0.9
8/24-25/92	5	22	1	168	0.2±0.4
6/28-29/93	10	24	0		0.0
8/23-25/93	10	48	31	74-148(113)	3.1±3.1
6/27-28/94	10	23	0		
7/26-27/94	10	22	0		
8/30-31/94	10	25	0		
6/26-29/95	10	72	1	136	0.1±0.3
7/17-20/95	10	64	1	85	0.1±0.3
8/11-14/95	10	67	1	116	0.1±0.3

Appendix 11. Arctic grayling collected, tagged, released, and recaptured in North Fork Red Dog, Anxiety Ridge, and Ikalukrok Creeks (1994 - 1995).

Tag Number	Color	Length (mm)	Date Captured	Site Captured	Recapture Date	Recapture Site	Length (mm)
		130	6/29/93	North Fork			
		140	6/29/93	North Fork			
		152	6/29/93	North Fork			
		152	6/29/93	North Fork			
		159	6/29/93	North Fork			
		162	6/29/93	North Fork			
		180	6/29/93	North Fork			
		186	6/29/93	North Fork			
		188	6/29/93	North Fork			
		194	6/29/93	North Fork			
		195	6/29/93	North Fork			
		197	6/29/93	North Fork			
		204	6/29/93	North Fork			
		205	6/29/93	North Fork			
		214	6/29/93	North Fork			
		215	6/29/93	North Fork			
		218	6/29/93	North Fork			
		218	6/29/93	North Fork			
		222	6/29/93	North Fork			
		228	6/29/93	North Fork			
		255	6/29/93	North Fork			
		264	6/29/93	North Fork			
		265	6/29/93	North Fork			
		405	6/29/93	North Fork			
		410	6/29/93	North Fork			
3401	Y	248	6/28/94	North Fork			
3402	Y	270	6/28/94	North Fork			
3403	Y	281	6/28/94	North Fork			
3404	Y	268	6/28/94	North Fork			
3405	Y	248	6/28/94	North Fork			
3406	Y	245	6/28/94	North Fork			
3407	Y	263	6/28/94	North Fork			
3408	Y	270	6/28/94	North Fork			
3409	Y	248	6/28/94	North Fork			
3411	Y	210	6/28/94	North Fork	7/17/95	North Fork	278
3413	Y	270	6/28/94	North Fork			
3414	Y	295	6/28/94	North Fork			
3415	Y	280	6/28/94	North Fork			
3416	Y	325	6/28/94	North Fork			
3417	Y	238	6/28/94	North Fork	6/26/95	North Fork	290
3418	Y	257	6/28/94	North Fork			
3419	Y	270	6/28/94	North Fork	7/17/95	North Fork	314
3420	Y	275	6/28/94	North Fork			
3421	Y	316	6/28/94	North Fork			

Appendix 11, continued.

Tag Number	Color	Length (mm)	Date Captured	Site Captured	Recapture Date	Recapture Site	Length (mm)
3422	Y	260	6/28/94	North Fork			
3423	Y	230	6/28/94	North Fork			
3424	Y	241	6/28/94	North Fork			
3425	Y	258	6/28/94	North Fork			
3426	Y	205	6/27/94	North Fork	6/26/95	North Fork	265
3427	Y	227	6/27/94	North Fork			
3428	Y	205	6/27/94	North Fork			
3429	Y	194	6/27/94	North Fork			
3430	Y	245	6/27/94	North Fork			
3431	Y	200	6/27/94	North Fork			
3432	Y	243	6/27/94	North Fork			
3433	Y	238	6/27/94	North Fork			
3434	Y	207	6/27/94	North Fork			
3435	Y	221	6/27/94	North Fork			
3436	Y	265	6/28/94	North Fork			
3437	Y	295	6/28/94	North Fork			
3438	Y	320	6/28/94	North Fork			
3439	Y	295	6/28/94	North Fork			
3440	Y	260	6/28/94	North Fork			
3441	Y	262	6/28/94	North Fork			
3442	Y	273	6/28/94	North Fork			
3443	Y	240	6/28/94	North Fork			
3444	Y	247	6/28/94	North Fork			
3445	Y	271	6/28/94	North Fork			
3446	Y	268	6/28/94	North Fork			
3447	Y	255	6/28/94	North Fork			
3448	Y	317	6/28/94	North Fork			
3449	Y	235	6/28/94	North Fork	6/29/95	North Fork	288
3450	Y	260	6/28/94	North Fork			
3101	Y	238	7/26/94	North Fork			
3102	Y	228	7/26/94	North Fork			
3103	Y	215	7/26/94	North Fork			
3104	Y	204	7/26/94	North Fork			
3105	Y	254	7/26/94	North Fork			
3106	Y	268	7/26/94	North Fork			
3107	Y	255	7/26/94	North Fork	8/14/95	Mainstem	302
3108	Y	183	7/26/94	North Fork			
3109	Y	255	7/26/94	North Fork			
3110	Y	222	7/26/94	North Fork	7/17/95	North Fork	265
3111	Y	220	7/26/94	North Fork			
3112	Y	213	7/26/94	North Fork			
3113	Y	190	7/26/94	North Fork			
3114	Y	200	7/26/94	North Fork	7/20/95	North Fork	236
3115	Y	198	7/26/94	North Fork			

Appendix 11, continued.

Tag Number	Color	Length (mm)	Date Captured	Site Captured	Recapture Date	Recapture Site	Length (mm)
3116	Y	255	7/26/94	North Fork			
3117	Y	210	7/26/94	North Fork			
3118	Y	198	7/26/94	North Fork			
3119	Y	209	7/26/94	North Fork			
3120	Y	214	7/26/94	North Fork			
3121	Y	218	7/26/94	North Fork			
3122	Y	211	7/26/94	North Fork	6/29/95	North Fork	248
					8/15/95	North Fork	266
3123	Y	196	7/26/94	North Fork			
3124	Y	200	7/26/94	North Fork	6/29/95	North Fork	237
3125	Y	206	7/26/94	North Fork			
3126	Y	205	7/26/94	North Fork			
3127	Y	200	7/26/94	North Fork			
3128	Y	256	7/26/94	North Fork			
3129	Y	207	7/26/94	North Fork			
3130	Y	217	7/27/94	North Fork			
3131	Y	190	7/27/94	North Fork			
3132	Y	220	7/27/94	North Fork			
3133	Y	210	7/27/94	North Fork			
3134	Y	200	7/27/94	North Fork			
3135	Y	212	7/27/94	North Fork			
3136	Y	214	7/27/94	North Fork			
3137	Y	203	7/27/94	North Fork	8/15/95	North Fork	272
3138	Y	260	7/27/94	North Fork			
3139	Y	210	7/27/94	North Fork			
3140	Y	227	7/27/94	North Fork			
3141	Y	201	7/27/94	North Fork			
3142	Y	248	7/27/94	North Fork			
3143	Y	269	7/27/94	North Fork			
3144	Y	218	7/27/94	North Fork			
3145	Y	217	7/27/94	North Fork			
3146	Y	211	7/27/94	North Fork			
3147	Y	158	7/27/94	North Fork			
3148	Y	215	7/27/94	North Fork			
3149	Y	196	7/27/94	North Fork			
3150	Y	225	7/27/94	North Fork			
		225	7/27/94	North Fork			
		183	7/27/94	North Fork			
		196	7/27/94	North Fork			
		210	7/27/94	North Fork			
1501	W	390	6/26/95	North Fork			
1502	W	315	6/26/95	North Fork			
1503	W	265	6/26/95	North Fork	7/17/95	North Fork	279
1504	W	254	6/26/95	North Fork	7/17/95	North Fork	265

Appendix 11, continued.

Tag Number	Color	Length (mm)	Date Captured	Site Captured	Recapture Date	Recapture Site	Length (mm)
1505	W	240	6/26/95	North Fork			
1506	W	237	6/26/95	North Fork			
1507	W	320	6/26/95	North Fork	7/17/95	North Fork	324
					8/11/95	North Fork	332
1508	W	281	6/26/95	North Fork			
1509	W	229	6/26/95	North Fork	7/17/95	North Fork	237
1510	W	262	6/26/95	North Fork			
1511	W	323	6/26/95	North Fork			
1512	W	297	6/26/95	North Fork	7/20/95	North Fork	309
1513	W	220	6/26/95	North Fork			
1514	W	259	6/26/95	North Fork			
1515	W	278	6/26/95	North Fork			
1516	W	283	6/26/95	North Fork	7/20/95	North Fork	291
1517	W	237	6/26/95	North Fork	7/17/95	North Fork	245
1518	W	240	6/26/95	North Fork			
1519	W	218	6/26/95	North Fork			
1520	W	223	6/26/95	North Fork			
1527	W	395	6/29/95	North Fork			
1528	W	266	6/29/95	North Fork			
1529	W	274	6/29/95	North Fork	7/20/95	North Fork	281
1530	W	254	6/29/95	North Fork	7/20/95	North Fork	261
1531	W	241	6/29/95	North Fork			
1532	W	251	6/29/95	North Fork			
1533	W	232	6/29/95	North Fork			
1534	W	291	6/29/95	North Fork			
1535	W	240	6/29/95	North Fork			
1536	W	236	6/29/95	North Fork			
1537	W	230	6/29/95	North Fork			
1538	W	242	6/29/95	North Fork			
1539	W	270	6/29/95	North Fork	8/14/95	Mainstem	290
1540	W	304	6/29/95	North Fork			
1541	W	289	6/29/95	North Fork	7/17/95	North Fork	298
1542	W	273	6/29/95	North Fork			
1543	W	263	6/29/95	North Fork			
1544	W	228	6/29/95	North Fork	7/20/95	North Fork	240
1545	W	228	6/29/95	North Fork			
1546	W	227	6/29/95	North Fork			
1547	W	254	6/29/95	North Fork			
1548	W	236	6/29/95	North Fork			
1549	W	256	6/29/95	North Fork	7/17/95	North Fork	268
1550	W	270	6/29/95	North Fork	7/20/95	North Fork	276
1551	W	253	6/29/95	North Fork			
1552	W	270	6/29/95	North Fork			
1553	W	249	6/29/95	North Fork			
1554	W	315	6/29/95	North Fork			

Appendix 11, continued.

Tag Number	Color	Length (mm)	Date Captured	Site Captured	Recapture Date	Recapture Site	Length (mm)
1555	W	264	6/29/95	North Fork	7/20/95	North Fork	278
1556	W	233	6/29/95	North Fork			
1557	W	280	6/29/95	North Fork			
1558	W	261	6/29/95	North Fork			
1559	W	251	6/29/95	North Fork			
1560	W	235	6/29/95	North Fork			
1561	W	232	6/29/95	North Fork			
1562	W	234	6/29/95	North Fork	7/17/95	North Fork	244
1563	W	275	6/29/95	North Fork			
1564	W	228	6/29/95	North Fork			
1565	W	243	6/29/95	North Fork	8/15/95	North Fork	271
1566	W	296	6/29/95	North Fork			
1567	W	244	6/29/95	North Fork	7/20/95	North Fork	255
1568	W	255	6/29/95	North Fork			
1569	W	234	6/29/95	North Fork			
1570	W	232	6/29/95	North Fork			
1571	W	211	6/29/95	North Fork			
1572	W	225	6/29/95	North Fork			
1573	W	241	6/29/95	North Fork	7/20/95	North Fork	257
					8/14/95	North Fork	275
1574	W	226	6/29/95	North Fork			
1575	W	255	6/29/95	North Fork			
1576	W	234	6/29/95	North Fork			
1577	W	253	6/29/95	North Fork			
1578	W	293	6/29/95	North Fork			
1579	W	228	6/29/95	North Fork	8/11/95	North Fork	257
1580	W	240	6/29/95	North Fork			
1581	W	253	6/29/95	North Fork	7/17/95	North Fork	266
1582	W	222	6/29/95	North Fork			
1583	W	224	6/29/95	North Fork			
1584	W	226	6/29/95	North Fork			
1585	W	235	6/29/95	North Fork			
1586	W	228	6/29/95	North Fork	7/20/95	North Fork	243
1587	W	180	6/29/95	North Fork			
1588	W	227	6/29/95	North Fork	8/15/95	North Fork	250
1589	W	322	6/29/95	North Fork			
1590	W	276	6/29/95	North Fork	7/20/95	North Fork	280
1591	W	252	6/29/95	North Fork			
1592	W	235	6/29/95	North Fork	7/20/95	North Fork	248
1593	W	232	6/29/95	North Fork			
1594	W	237	6/29/95	North Fork			
1595	W	228	6/29/95	North Fork			
1596	W	383	6/29/95	North Fork			
3122	Y	248	6/29/95	North Fork			
3124	Y	237	6/29/95	North Fork			

Appendix 11, continued.

Tag Number	Color	Length (mm)	Date Captured	Site Captured	Recapture Date	Recapture Site	Length (mm)
3417	Y	290	6/26/95	North Fork			
3426	Y	265	6/26/95	North Fork			
3449	Y	288	6/29/95	North Fork			
1521	W	298	6/28/95	Anxiety			
1522	W	298	6/28/95	Anxiety			
1523	W	267	6/28/95	Anxiety			
1524	W	306	6/28/95	Anxiety			
1525	W	251	6/28/95	Anxiety			
1503	W	279	7/17/95	North Fork			
1504	W	265	7/17/95	North Fork			
1507	W	324	7/17/95	North Fork			
1509	W	237	7/17/95	North Fork			
1516	W	291	7/20/95	North Fork			
1517	W	245	7/17/95	North Fork			
1529	W	281	7/20/95	North Fork			
1530	W	261	7/20/95	North Fork			
1541	W	298	7/17/95	North Fork			
1544	W	240	7/20/95	North Fork			
1549	W	268	7/17/95	North Fork			
1550	W	276	7/20/95	North Fork			
1555	W	278	7/20/95	North Fork			
1562	W	244	7/17/95	North Fork			
1567	W	255	7/20/95	North Fork			
1573	W	257	7/20/95	North Fork			
1581	W	266	7/17/95	North Fork			
1586	W	243	7/20/95	North Fork			
1590	W	280	7/20/95	North Fork			
1592	W	248	7/20/95	North Fork			
1599	W	377	7/17/95	North Fork	8/11/95	North Fork	383
1600	W	238	7/17/95	North Fork			
1701	W	249	7/17/95	North Fork			
1702	W	264	7/17/95	North Fork	8/14/95	North Fork	280
1703	W	240	7/17/95	North Fork			
1704	W	256	7/17/95	North Fork	8/14/95	North Fork	269
1705	W	250	7/20/95	North Fork			
1706	W	241	7/17/95	North Fork			
1707	W	233	7/17/95	North Fork			
1708	W	348	7/17/95	North Fork			
1709	W	297	7/17/95	North Fork			
1710	W	296	7/17/95	North Fork			
1711	W	222	7/17/95	North Fork			
1712	W	171	7/17/95	North Fork			
1713	W	262	7/17/95	North Fork			

Appendix 11, continued.

Tag Number	Color	Length (mm)	Date Captured	Site Captured	Recapture Date	Recapture Site	Length (mm)
1714	W	235	7/17/95	North Fork			
1715	W	253	7/17/95	North Fork			
1716	W	241	7/17/95	North Fork			
1717	W	234	7/17/95	North Fork			
1719	W	290	7/20/95	North Fork			
1720	W	269	7/20/95	North Fork			
1721	W	284	7/20/95	North Fork			
1722	W	236	7/20/95	North Fork			
1723	W	251	7/20/95	North Fork			
1724	W	254	7/20/95	North Fork			
1726	W	248	7/20/95	North Fork			
1727	W	247	7/20/95	North Fork			
1728	W	265	7/20/95	North Fork			
1729	W	267	7/20/95	North Fork			
1730	W	294	7/20/95	North Fork			
1731	W	244	7/20/95	North Fork			
1732	W	240	7/20/95	North Fork			
1733	W	247	7/20/95	North Fork			
1734	W	262	7/20/95	North Fork			
1735	W	262	7/20/95	North Fork			
1736	W	241	7/20/95	North Fork			
1737	W	235	7/20/95	North Fork			
1738	W	295	7/20/95	North Fork			
1739	W	252	7/20/95	North Fork			
1740	W	241	7/20/95	North Fork			
1741	W	267	7/20/95	North Fork	8/14/95	North Fork	282
1742	W	234	7/20/95	North Fork			
1743	W	235	7/20/95	North Fork			
1744	W	216	7/20/95	North Fork	8/15/95	North Fork	233
1745	W	238	7/20/95	North Fork			
1746	W	280	7/20/95	North Fork			
1747	W	295	7/20/95	North Fork			
1748	W	242	7/20/95	North Fork			
1749	W	225	7/20/95	North Fork	8/14/95	North Fork	246
1750	W	255	7/20/95	North Fork			
1751	W	231	7/20/95	North Fork			
1752	W	242	7/20/95	North Fork	8/14/95	North Fork	258
1753	W	366	7/20/95	North Fork			
1754	W	291	7/20/95	North Fork			
1755	W	257	7/20/95	North Fork			
1756	W	238	7/20/95	North Fork	8/15/95	North Fork	260
1757	W	225	7/20/95	North Fork			
1758	W	247	7/20/95	North Fork			
1759	W	261	7/20/95	North Fork			
1760	W	267	7/20/95	North Fork			

Appendix 11, continued.

Tag Number	Color	Length (mm)	Date Captured	Site Captured	Recapture Date	Recapture Site	Length (mm)
1761	W	272	7/20/95	North Fork			
1762	W	277	7/20/95	North Fork			
1763	W	373	7/20/95	North Fork			
1764	W	301	7/20/95	North Fork			
1765	W	253	7/20/95	North Fork			
1766	W	246	7/20/95	North Fork	8/14/95	North Fork	262
1767	W	240	7/20/95	North Fork			
1768	W	294	7/20/95	North Fork			
1769	W	259	7/20/95	North Fork			
1770	W	280	7/20/95	North Fork			
1771	W	302	7/20/95	North Fork	8/11/95	North Fork	307
1772	W	282	7/20/95	North Fork			
1773	W	321	7/20/95	North Fork			
1774	W	240	7/20/95	North Fork			
1775	W	231	7/20/95	North Fork			
1776	W	240	7/20/95	North Fork			
3110	Y	265	7/17/95	North Fork			
3114	Y	236	7/20/95	North Fork			
3411	Y	278	7/17/95	North Fork			
3419	Y	314	7/17/95	North Fork			
1718	W	258	7/20/95	North Fork			
1507	W	332	8/11/95	North Fork			
1565	W	271	8/15/95	North Fork			
1573	W	275	8/14/95	North Fork			
1579	W	257	8/11/95	North Fork			
1588	W	250	8/15/95	North Fork			
1599	W	383	8/11/95	North Fork			
1702	W	280	8/14/95	North Fork			
1704	W	269	8/14/95	North Fork			
1741	W	282	8/14/95	North Fork			
1744	W	233	8/15/95	North Fork			
1749	W	246	8/14/95	North Fork			
1752	W	258	8/14/95	North Fork			
1756	W	260	8/15/95	North Fork			
1766	W	262	8/14/95	North Fork			
1771	W	307	8/11/95	North Fork			
1777	W	300	8/11/95	North Fork			
1778	W	275	8/11/95	North Fork			
1779	W	250	8/11/95	North Fork			
1781	W	286	8/11/95	North Fork			
1782	W	293	8/11/95	North Fork			
1783	W	336	8/11/95	North Fork			
1784	W	233	8/11/95	North Fork			

Appendix 11, continued.

Tag Number	Color	Length (mm)	Date Captured	Site Captured	Recapture Date	Recapture Site	Length (mm)
1785	W	246	8/11/95	North Fork			
1786	W	246	8/11/95	North Fork			
1787	W	318	8/11/95	North Fork			
1788	W	278	8/11/95	North Fork			
1789	W	275	8/11/95	North Fork			
1790	W	210	8/11/95	North Fork			
1791	W	270	8/11/95	North Fork			
1792	W	237	8/11/95	North Fork			
1793	W	271	8/11/95	North Fork			
1794	W	269	8/11/95	North Fork			
1807	W	274	8/14/95	North Fork			
1808	W	241	8/14/95	North Fork			
1809	W	261	8/14/95	North Fork			
1810	W	274	8/14/95	North Fork			
1811	W	292	8/14/95	North Fork			
1812	W	252	8/14/95	North Fork			
1813	W	264	8/14/95	North Fork			
1814	W	265	8/14/95	North Fork			
1815	W	242	8/14/95	North Fork			
1816	W	255	8/14/95	North Fork			
1817	W	265	8/14/95	North Fork			
1818	W	260	8/14/95	North Fork			
1819	W	261	8/14/95	North Fork			
1820	W	237	8/14/95	North Fork			
1821	W	236	8/14/95	North Fork			
1822	W	152	8/14/95	North Fork			
1826	W	237	8/14/95	North Fork			
1827	W	236	8/14/95	North Fork			
1828	W	263	8/14/95	North Fork			
1829	W	253	8/14/95	North Fork			
1830	W	149	8/14/95	North Fork			
1831	W	154	8/14/95	North Fork			
1833	W	282	8/14/95	North Fork			
1834	W	249	8/14/95	North Fork			
1835	W	243	8/14/95	North Fork			
1836	W	314	8/14/95	North Fork			
1837	W	300	8/14/95	North Fork			
1838	W	256	8/14/95	North Fork			
1839	W	260	8/14/95	North Fork			
1840	W	300	8/14/95	North Fork			
1841	W	268	8/14/95	North Fork			
1842	W	258	8/14/95	North Fork			
1843	W	286	8/14/95	North Fork			
1844	W	262	8/14/95	North Fork			
1845	W	236	8/15/95	North Fork			

Appendix 11, continued.

Tag Number	Color	Length (mm)	Date Captured	Site Captured	Recapture Date	Recapture Site	Length (mm)
1846	W	147	8/15/95	North Fork			
1847	W	293	8/15/95	North Fork			
1848	W	291	8/15/95	North Fork			
1849	W	234	8/15/95	North Fork			
1850	W	277	8/15/95	North Fork			
1851	W	318	8/15/95	North Fork			
1852	W	260	8/15/95	North Fork			
1853	W	260	8/15/95	North Fork			
1854	W	292	8/15/95	North Fork			
1855	W	272	8/15/95	North Fork			
1856	W	280	8/15/95	North Fork			
1857	W	280	8/15/95	North Fork			
1858	W	259	8/15/95	North Fork			
1859	W	325	8/15/95	North Fork			
1860	W	255	8/15/95	North Fork			
1861	W	301	8/15/95	North Fork			
1862	W	262	8/15/95	North Fork			
1863	W	264	8/15/95	North Fork			
1864	W	274	8/15/95	North Fork			
1865	W	278	8/15/95	North Fork			
1866	W	261	8/15/95	North Fork			
1867	W	275	8/15/95	North Fork			
1868	W	280	8/15/95	North Fork			
1869	W	280	8/15/95	North Fork			
1870	W	264	8/15/95	North Fork			
1871	W	260	8/15/95	North Fork			
1872	W	193	8/15/95	North Fork			
1873	W	205	8/15/95	North Fork			
1874	W	240	8/15/95	North Fork			
1875	W	254	8/15/95	North Fork			
1876	W	277	8/15/95	North Fork			
1877	W	303	8/15/95	North Fork			
1878	W	310	8/15/95	North Fork			
1879	W	262	8/15/95	North Fork			
1880	W	276	8/15/95	North Fork			
1881	W	269	8/15/95	North Fork			
1882	W	284	8/15/95	North Fork			
1883	W	242	8/15/95	North Fork			
3122	Y	266	8/15/95	North Fork			
3137	Y	272	8/15/95	North Fork			
1795	W	373	8/12/95	Ikalukrok			
1796	W	356	8/12/95	Ikalukrok			
1797	W	318	8/12/95	Ikalukrok			
1798	W	337	8/12/95	Ikalukrok			

Appendix 11, concluded.

Tag Number	Color	Length (mm)	Date Captured	Site Captured	Recapture Date	Recapture Site	Length (mm)
1539	W	290	8/14/95	Main Stem			
1783	W	335	8/14/95	Main Stem			
1799	W	335	8/14/95	Main Stem			
1800	W	330	8/14/95	Main Stem			
1801	W	340	8/14/95	Main Stem			
1802	W	290	8/14/95	Main Stem			
1803	W	327	8/14/95	Main Stem			
1804	W	319	8/14/95	Main Stem			
1805	W	336	8/14/95	Main Stem			
1806	W	300	8/14/95	Main Stem			
3107	Y	302	8/14/95	Main Stem			

Appendix 12. Slimy sculpin collected in Anxiety Ridge, Dudd, Ikalukrok (at mouth of Dudd Creek), Middle Fork Red Dog, Mainstem Red Dog, and North Fork Red Dog Creeks using minnow traps baited with salmon roe, 1990-1995.

Creek	Year	No. Sample Periods	No. Traps Deployed	No. Slimy Sculpin
Ikalukrok	1990	3	5	0
	1991	4	5	3
	1992	3	10	3
	1993	2	10	2
	1994	1	20	8
	1995	3	20	8
Dudd	1990	2	10	1
	1991	4	10	2
	1992	3	10	1
	1993	2	10	3
Anxiety	1990	3	5	0
	1991	6	5	0
	1992	3	10	0
	1993	2	10	0
	1994	3	10	1
	1995	3	10	2
North Fork	1992	2	5	0
	1993	2	10	0
	1994	3	10	0
	1995	3	10	1
Mainstem[a]	1994	3	5	0
	1995	3	15	1
Middle Fork[b]	1994	3	5	0
	1995	3	5	0

[a]Mainstem Red Dog Creek - sample area downstream of North Fork Red Dog Creek

[b]Middle Fork Red Dog Creek - sample area upstream of North Fork Red Dog Creek