NOTE TO FILE: 28 Jan 98

The attached report on mercury in slimy sculpins in Wood River, was completed by Carol Outwater, a student biologist under the supervision of the Bristol Bay Native Corporation, Environmental Health Service. Advice and information were provided for the study by Bristol Bay Native Corporation Environmental Health Service, Alaska Department of Fish and Game, US Fish and Wildlife Service, US Geological Survey, and US Bureau of Land Management. Analytical work was completed by the US Geological Survey, Denver, CO.

April 14, 1995

Dear Wayne,

Hi. I have sent you the results to the project I did on the content of Mercury in slimy sculpins of the Wood River. I wanted to thank you for the information you were able to provide for me, it was very much appreciated. I hope these results will be of some use to you. Thanks again.

Sincerely,

Carol Outwater

Carol Outwater

Abstract

The Red Top Mine mill site located two miles southeast of Aleknagik on the east bank of the Wood River served as a Mercury mill site. Mercury can pose a serious health hazard.

The purpose of this experiment is to determine if mercury entered the food chain.

The hypothesis was there would be no dangerous levels of mercury in the Wood River food chain.

Slimy sculpins were caught in minnow traps baited with salmon eggs. Coho salmon fry were caught incidentally.

Slimy sculpins were analyzed using cold vapor-atomic absorption spectrometry to find mercury content. The coho salmon fry were also analyzed.

The results indicated that there was not a potentially dangerous level of mercury in the fish.

Mercury Levels in Wood River Sculpins

Table of Contents

Acknowledgments

The following people need to be commended for the help, hard work, support and information they provided to make this experiment run smoothly: John Gray, Elaine Snyder, Wayne Svejnoha, Mac Minard, Vince Luckhurst and Nicole Strub.

A very big thanks must go to Ward and Helen Jones for the time and effort they put into helping make this project a success. If it were not for them as well as the others, this project would have not been done. Everyone's help is very much appreciated.

Introduction

In Aleknagik, Alaska there is a Mercury Mill site on the east bank of the Wood River. It poses a potential health hazard to anyone exposed to the mercury contaminated structures in the soil. The project being done is to test if the Mercury leaked into the Wood River and contaminated the fish living in it.

The fish tested were slimy sculpins. The slimy sculpin is a tadpole-shaped fish with a broad, flattened head. The sculpins are distributed all across northern North America. The fish is an abundant species within the range they are located. The sculpins inhibit lakes to considerable depths, they are found in streams (particularly those with fairly fast currents and rocky bottoms). They stay at the bottom of the water darting from place to place when being disturbed. There coloration and bottom-dwelling habit make it difficult to see them.

Growth rates of sculpins range from place to place. Growth is rather slow, and most sculpins mature in their first year. The usual age at maturity is 4, and the maximum age record is 7.

Except for probable movements into shallow water for spawning, slimy sculpins do not migrate. They are quite sedentary fish, rarely moving more than a few meters, even when violently disturbed. They have been seen to move considerable distances on the bottoms of lakes.

The slimy sculpin is almost exclusively insectivorous in its food habits. Sculpins are mostly bottom feeders. In most areas, the major items are the larvae of Diptera, Ephemeroptera and Trichoptera. They often devour eggs and young trout and other salmonoids, but they do it

seldomly. Sculpins and sculpin eggs are consumed far more frequently than the sculpin eating the larger fish. The sculpins feeding habits are very similar to that of higher order fish but they do not migrate making them the best fish for the experiment.

Some coho salmon were also caught and analyzed. These fish have pointed snouts, small round eyes, elongated, streamlined bodies, sharp teeth. On their anterior side they are dark metallic blue or greenish in color and silver on their abdomen sides. Coho's are found throughout North America.

Coho salmon fry feed on Diptera and Hymenoptera. The young coho normally spend a year in fresh water before going to sea. The coho caught and analyzed were still coho fry so they never reached adulthood.

Coho are not the best fish to study for this experiment because they are migratory fish and to obtain the best results fish that tend to stay in one spot are desirable. The coho fry caught though, were still young and probably didn't migrate much.

The Red Top Mine mill sight was used during World War II. In the later months of 1994 the Bureau of Land Management made a report and started clean-up of the Red Top Mine mill site. The mercury from the site had spilled into the soil causing a potential health hazard to anyone near it. Most of the contamination of the soil came from the retort shed holding the mercury. Tests showed that there was no mercury found in the water table or Wood River but it's hard to believe after forty years with the river getting high and spring thaw, the water reaches the banks of the tanks so some mercury had to spill.

Mercury is a metallic, colorless, nonferrous element whose chief ore is cinnabar. It is silvery in color, an extremely heavy liquid with a extremely high surface tension giving it a unique rheological behavior. (ability to change in form and the way it flows embodying elasticity, viscosity, and plasticity). Mercury is derived by heating cinnabar in air or with lime and condensing the vapor. To purify mercury you must distill it. A lot of mercury is recovered by redistilling used mercury.

To separate mercury from the cinnabar ores you heat the ore in an air stream in a rotary kiln or shaft furnace. In this process sulfide ore is roasted. The vapor is carried over with the combustion gases cools and condenses. The liquid mercury that is newly formed is stored in flasks. This process is continued to produce more mercury.

The hazards of all inorganic compounds of mercury are they are highly toxic if ingested, inhaled, or taken in by skin absorption through fumes , vapor or absorbed by the respiratory and intestinal tract. Organic compounds of mercury are also very toxic.

If spillage occurs, the mercury may be a toxic hazard due to the droplets formed that multiply rapidly.

Mercury compounds cause dysfunction of the central nervous system and the kidneys, and are irritants of eyes, mucous membranes, and skin. Once a toxic dose of mercury has been absorbed and retained for a periods of time, damage and functional disturbances occur. Some symptoms of poisoning include numbness and tingling of the lips, hands and feet, constriction of the visual field, impairment of hearing, and emotional disturbance.

Purpose

The purpose of this study is to determine if dangerous levels of mercury is present in the food chain in Wood River.

Hypothesis

On the basis of previous research, it is believed that there will not be dangerous levels of mercury found in the food chain in Wood River.

Procedure

In the experiment performed, tests were made on fish to see if there was any mercury in the food chain of Wood River due to the Red Top Mill site.

The first task was choosing a fish that could be caught easily and used to get the desired results. The slimy sculpin was chosen because it was a smaller fish, which feeds off of the same food as larger orders of fish and does not migrate, thus resulting in a more accurate reading of mercury. A skiff was taken to several sites near the Red Top Mill site on the Wood River to catch the fish.

On October 14, 1994, five minnow traps were set, using salmon eggs as bait. The traps were left out overnight. Each trap was checked on October 15, 1994.

On October 15, eight more traps were set to obtain more sculpins. The eight traps were again left out overnight. The traps were placed in Arcana Creek (which the mine site runs into), at the mouth of Arcana Creek, below the Retort Mine site and near an island about 1 mile below the retort site.

The traps were checked on October 16, 1994, and the sculpins caught were immediately put into zip lock bags and placed in a cooler. Coho salmon fry were also caught and dealt with in the same manner as the sculpins.

Two more traps were set as controls. They were located at Squaw Creek in Dillingham. Each trap was set out overnight and checked the next day. These samples were also bagged and cooled.

Each fish was then weighed (g.) and measured (cm.) then frozen. The fish were sent to John Gray of the U.S. Department of the Interior, Geological Survey in Denver, Colorado, to determine the level of mercury found in the sculpins and coho salmon fry. The lab used the technique originally developed for coal analysis.

First, the fish samples were digested with nitric acid, sulfuric acid, and vanadium pentoxide in a disposable glass test tube. After digestion, each sample was diluted in water until they reached a constant volume. Second, the samples were mixed with air and a solution of sodium chloride, hydroxylamine hydrochloride, and sulfuric acid and the Hg II was reduced to HG with stannous (tin) chloride solution in a continuous flow manifold. The mercury vapor formed was then separated and measured using cold vapor atomic absorption spectrometry.

The cold vapor atomic absorption spectrometry method is as follows:

.150 grams of the fish sample is put into a 16x150-mm test tube. .1 gram of vanadium pentoxide, 3.5 mL 16 M HNO3, and 1.50ml H2SO4 are added to the test tube. The test tube is placed in an aluminum heating block, covered with watch glass, and heated gradually to 150 degrees over a two hour period and

left to heat overnight at this temperature.

The next day the tube is removed, cooled, and the sample is diluted into 15 mL with water. This diluted sample is then capped and shaken for five minutes. The shaken sample is then centrifuged at 1000 rpm for five minutes. After centrifugation 12 ml of solution is transferred to a 16x100 tube.

The spectrometer is calibrated against the aqueous standard of .00147, .00588, and .0188 ppm Hg. A manifold is used to analyze the digested materials along with aqueous calabration standards. Samples with Hg concentration greater than 1.18 ppm must be diluted and re-analyzed. The calibration curve is checked at the beginning and after every 20 samples.

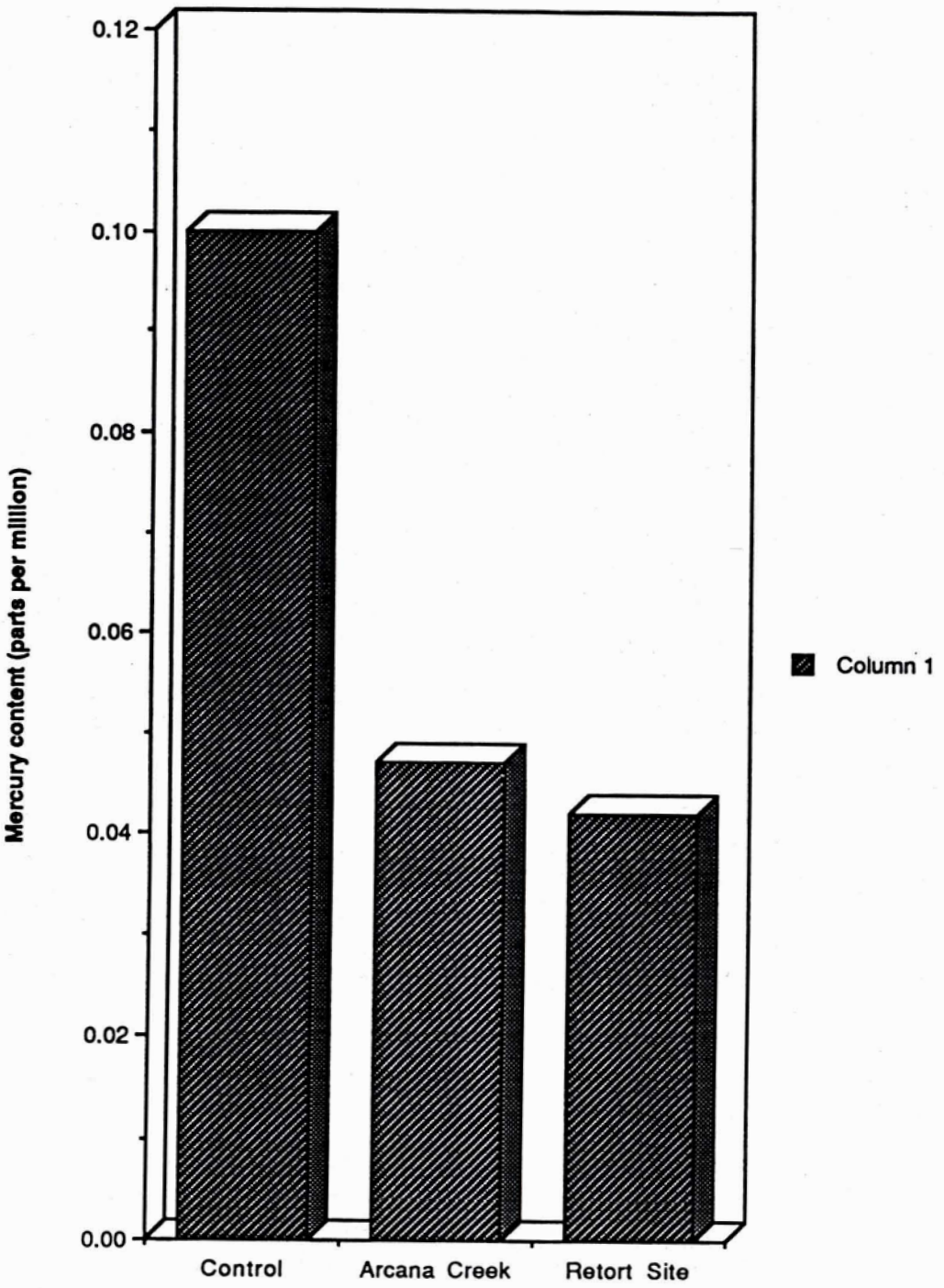
The calculation formula is:

$$\text{ppm} = \frac{\text{calibration std. (mg/mL)}}{\text{peak height of std. (mm)}} \times \frac{\text{final sample volume (mL)}}{\text{sample weight (g)}} \times \text{pk hght. of smpl.}$$

Results

The results of this study show that the mercury concentrations found in the slimy sculpins and coho salmon fry are considered average. As shown by the concentration levels, each fish sample was between 0.01 ppm (parts per million) to 0.14 ppm. Concentrations of 0.1 ppm are slightly elevated, but 1 ppm concentration for edible fish is the level established by the Food and Drug Administration. In conclusion, this study shows that the mercury has not entered the Wood River food chain at dangerous levels.

Average Mercury Content of Sculpins



1 ppm is dangerous level of Mercury

Average Mercury Level in Sculpins

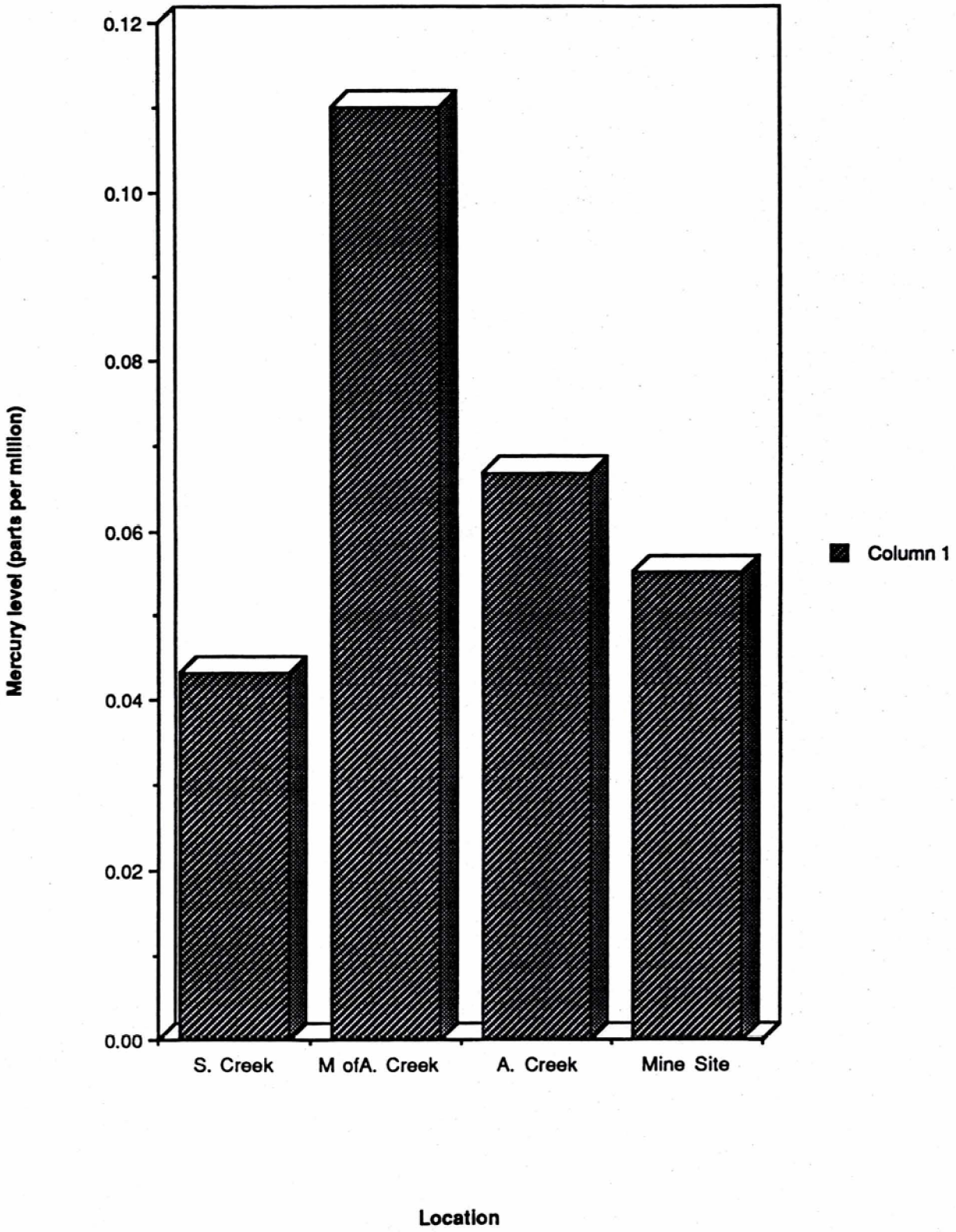
(Parts per Million)

Location	Average
Island	0.1 ppm
Arcana Creek	0.047 ppm
Retort Site	0.042 ppm

* 1 ppm is level set by the Food and Drug Administration

Sample	Location	Length	Weight	tissue analyzed	Hg (ppm)
sculpin	Island	6.3 cm	2.7 g	whole body	0.02
sculpin	control	6.7 cm	3.4 g	whole body	0.1
coho	control	8.5 cm	5.3 g	muscle	0.06
coho	control	9.5 cm	6.9 g	muscle	0.03
coho	control	9.3 cm	6.4 g	muscle	0.04
blackfish	control	9.8 cm	8.3 g	whole body	0.06
brachiopod	control	4.3 cm	1.2 g	whole body	0.02
coho	Mth. Arcna Crk	11.0 cm	10.5 g	muscle	0.14
coho	Mth. Arcna Crk.	11.0 cm	12.1 g	muscle	0.08
sculpin	Arcana Creek	8.0 cm	6.9 g	whole body	0.06
sculpin	Arcana Creek	8.5 cm	8.6 g	whole body	0.06
sculpin	Arcana Creek	7.7 cm	6.2 g	whole body	0.02
coho	Arcana Creek	13.0 cm	20.5 g	muscle	0.08
coho	Arcana Creek	11.1 cm	10.8 g	muscle	0.06
coho	Arcana Creek	10.2 cm	8.4 g	muscle	0.06
sculpin	Mine sight	8.1 cm	6.2 g	whole body	0.05
sculpin	Mine sight	8.6 cm	7.3 g	whole body	0.02
sculpin	Mine sight	9.0 cm	8.2 g	whole body	0.03
sculpin	Mine sight	8.4 cm	8.1 g	whole body	0.03
sculpin	Mine sight	8.0 cm	5.2 g	whole body	0.02
sculpin	Mine sight	7.9 cm	5.9 g	whole body	0.01
sculpin	Mine sight	8.0 cm	6.9 g	whole body	0.02
sculpin	Mine sight	7.4 cm	5.4 g	whole body	0.02
sculpin	Mine sight	7.8 cm	5.3 g	whole body	0.05
sculpin	Mine sight	6.3 cm	2.8 g	whole body	0.09
sculpin	Mine sight	7.9 cm	6.7 g	whole body	0.05
sculpin	Mine sight	6.8 cm	3.6 g	whole body	0.04
sculpin	Mine sight	6.2 cm	3.2 g	whole body	0.06
sculpin	Mine sight	7.1 cm	3.3 g	whole body	0.12
sculpin	Mine sight	7.2 cm	4.1 g	whole body	0.02
coho	Mine sight	10.1 cm	9.3 g	muscle	0.08
coho	Mine sight	9.8 cm	8.0 g	muscle	0.03

Average Mercury Content of Coho



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To Wayne Svetkov	From W. Jones
Co. BLM	Co. RBAHC.
Dept.	Phone # 842-9413
Fax # 271-5479	Fax #

UNITED STATES DEI
U.S. (
P.O. I
Denve
Denver, Colorado 80225
(303) 236-2446

MEMORANDUM **DATE:** November 22, 1994

To : Carol Outwater

From : John Gray, USGS

Subject: Mercury data for fish samples collected near Red Top mine

Your mercury results are as follows.

sample	tissue analyzed	Hg µg/g (ppm) wet weight
Sculpin A	whole body	0.06
Sculpin B	whole body	0.06
Sculpin C	whole body	0.02
Sculpin D – Near Red Top mine site	whole body	0.05
Coho E	muscle (fillet)	0.08
Sculpin F	whole body	0.02
Sculpin G	whole body	0.02
Sculpin H	whole body	0.03
Sculpin I	whole body	0.03
Sculpin J	whole body	0.02
Sculpin K	whole body	0.01
Sculpin L	whole body	0.02
Sculpin M	whole body	0.02
Sculpin N	whole body	0.05
Sculpin O	whole body	0.09
Sculpin P	whole body	0.05
Sculpin Q	whole body	0.04
Sculpin R	whole body	0.06
Sculpin S	whole body	0.12
Sculpin T	whole body	0.02
Sculpin U	whole body	0.10 ← Near. Dly.
[redacted]	muscle (fillet)	0.14
[redacted]	muscle (fillet)	0.08
Coho 1C	muscle (fillet)	0.08
Coho 1D	muscle (fillet)	0.03

½ up arcana creek	Coho 1E	muscle (fillet)	0.06
	Coho 1F	muscle (fillet)	0.06
Nerka	Coho 1G	muscle (fillet)	0.06
	Coho 1H	muscle (fillet)	0.03
	Coho 1I	muscle (fillet)	0.04
Nerka	Black fish	whole body	0.06
	Brachiopod	whole body	0.02

(this organism looked like a freshwater crustacean--a branchiopod?)

These mercury concentrations would probably be considered average for freshwater fish. Mercury concentrations of about 0.1 ppm might be slightly elevated, but I do not have other mercury data for Alaskan sculpin for comparison. A 1 ppm mercury concentration for edible fish is the level established by the Food and Drug Administration requiring regulation. You could also compare your mercury values to those cited in my paper that I sent you. Your results suggest one or both of the following 1) the fish analyzed were small and probably also very young, and any available mercury has not had time to accumulate, or 2) that mercury in the streams near the mine are not in a form that is available to biota, specifically fish, and thus, mercury has not accumulated in the sculpin and coho at concentrations high enough to be of concern. The mercury concentrations are slightly higher in the coho samples, but it is difficult to determine if there are any trends in your data because I do not know much about the sample collection sites or which samples are from control sites.

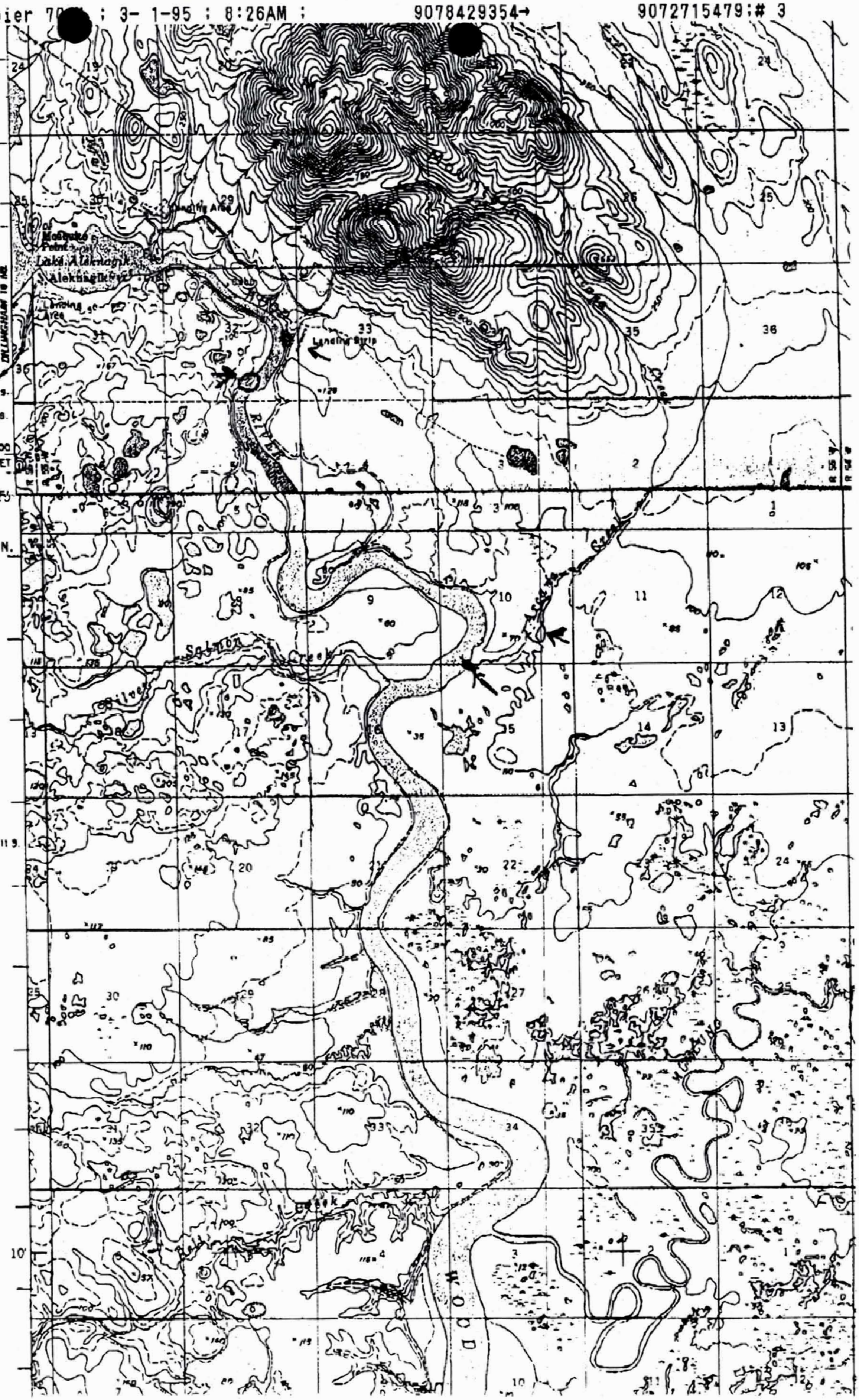
If you have interest in pursuing these studies further, I might suggest trying to sample higher order fish, such as grayling, dolly varden, pike, or even larger salmon near the mine site and several miles downstream. The possibility for elevated mercury concentrations would be greater for such higher order fish. Also, sampling of such fish, more closely approximates direct impact to humans because these fish are commonly consumed.

Please let me know where I can help further. If you would like, I can look over any of your project write-up. I am very much impressed with your study and you are to be congratulated on putting this project together. Would you be interested in including these data in a paper I will be writing for a USGS publication? You could be a coauthor. The paper would be similar to the one I sent a few weeks ago. It would not interfere with your project because the USGS paper would not be published until about December 1995. Please let me know, either way is fine.

Sincerely,

John E. Gray

John E. Gray



● Mouth of Arcana Creek
C Up Arcana Creek
✱ Near Point Alrine Sight
O Island

FYI

TO: Darrel Richardson, COO

FROM: Ward Jones, Program Director, EHS

DATE: October 17, 1994

SUBJ: Trip Report, Aleknagik, Oct. 14, 15, 16, 1994

OBJECTIVE:

I. Sample food chain in Wood River below Red Top Mine retort site to determine if mercury has entered food chain
   - A. BLM has completed clean up of site and does not believe Hg. has entered the food chain
   - B. Resources were available to assist in sampling, therefore it seems a prudent thing to do

FINDINGS AND ACCOMPLISHMENTS:

I. Resources mobilized
   - A. Equipment and technical advice, Alaska Dept. Fish and Game
   - B. Technical advice, Bureau of Land Management
   - C. Technical advice, U.S. Fish and Wildlife Service
   - D. Testing of specimens for mercury, U.S. Geological Survey
   - E. Docking, Mark and Ivy Smith
   - F. Phone calls BBAHC
   - G. Write up will be provided by Carol Outwater as part of Science Fair project
   - H. Milage and skiff were provided by Ward Jones as assistance for Science Fair project

II. Program
   - A. Capture and analyze organism from food chain for Hg. in wood river adjacent to Red Top Mine retort site and on Arcana Creek
     1. Arcana Creek drains mine site
   - B. Slimy skulpins were deemed to be appropriate organisms
     1. Food much same as grayling
     2. Nonmigratory

III. 18 slimy skulpins captured
   1. 15 Wood River
   2. 3 Arcana Creek

IV. Coho fry captured incidentally will also be analyzed

V. Results will be compiled and distributed after background data is gathered and samples are analyzed

cc. Kevin Meeks, District Injury Prevention Specialist
Jeff Smith, Deputy Director OEH
Aleknagik Village Council
City of Aleknagik