Canada Alberta



Northern River Basins Study





















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Prepared for the Northern River Basins Study under Project 3119-B1

by B.A. Barton, C.P. Bjornson, and K.L. Egan Environmental Management Associates

NORTHERN RIVER BASINS STUDY PROJECT REPORT NO. 8 SPECIAL FISH COLLECTIONS UPPER ATHABASCA RIVER MAY, 1992

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PREFACE:

The Northern River Basins Study was initiated through the "Canada-Alberta-Northwest Territories Agreement Respecting the Peace-Athabasca-Slave River Basin Study, Phase II - Technical Studies" which was signed September 27, 1991. The purpose of the Study is to understand and characterize the cumulative effects of development on the water and aquatic environment of the Study Area by coordinating with existing programs and undertaking appropriate new technical studies.

This publication reports the method and findings of particular work conducted as part of the Northern River Basins Study. As such, the work was governed by a specific terms of reference and is expected to contribute information about the Study Area within the context of the overall study as described by the Study Final Report. This report has been reviewed by the Study Science Advisory Committee in regards to scientific content and has been approved by the Study Board of Directors for public release.

It is explicit in the objectives of the Study to report the results of technical work regularly to the public. This objective is served by distributing project reports to an extensive network of libraries, agencies, organizations and interested individuals and by granting universal permission to reproduce the material.

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Whereas the above publication is the result of a project conducted under the Northern River Basins Study and the terms of reference for that project are deemed to be fulfilled, IT IS THEREFORE REQUESTED BY THE STUDY OFFICE THAT:

this publication be subjected to proper and responsible review and be considered for release to the public.

1. WIMA (Dr. F.J. Awrona, Ph.D., Science Director)

June 93

Whereas it is an explicit term of reference of the Science Advisory Committee "to review, for scientific content, material for publication by the Board". IT IS HERE ADVISED BY THE SCIENCE ADVISORY COMMITTEE THAT;

this publication has been reviewed for scientific content and that the scientific practices represented in the report are acceptable given the specific purposes of the project and subject to the field conditions encountered.

SUPPLEMENTAL COMMENTARY HAS BEEN ADDED TO THIS PUBLICATION: [] Yes [] No

liauboin (Dr. P. A. Larkin, Ph.D., Chair)

Whereas it is the duty of the Operations Committee to attend to the day-today management of the Study on behalf of the Study Board, IT IS THEREFORE RECOMMENDED BY THE OPERATIONS COMMITTEE THAT; this publication be released to the public and it is reported that THIS PUBLICATION HAS BEEN REVIEWED BY THE HEALTH ASSESSMENT COMMITTEE AND SUBSEQUENTLY FORWARDED TO APPROPRIATE HEALTH AUTHORITIES: [] Yes [] No

Whereas the Study Board is satisfied that this publication has been reviewed for scientific content and for immediate health implications. IT IS HERE APPROVED BY THE BOARD OF DIRECTORS THAT: this publication be released to the public, and that this publication be designated for: [] STANDARD AVAILABILITY [] EXPANDED AVAILABILITY

(Bev Burns, Co-chair) Jun incluer_ (Peter Melnychuk, Co-Chair

/c/b/93 (Date) <u>22/06/93</u>

SPECIAL FISH COLLECTIONS UPPER ATHABASCA RIVER MAY, 1992

STUDY PERSPECTIVE

abundance The presence and of within contaminants the aquatic "effects" ecosystem, their on ecosystem health, and the manner of contaminant transfer are of primary interest to the Northern River Basins (NRBS). Contaminants Study mav fish accumulate to levels in potentially affecting fish behaviour and health as well as the health of humans who consume them. Knowledge of fish quality, health. fish distribution behaviour and is therefore important.

This report details the 1992 spring collection of fish from the upper Athabasca River, between the boundary of Jasper National Park and the Windfall Bridge crossing (upstream of Newsprint Mi11 the Alberta at Whitecourt). Collections were made of bottom feeding (mountain whitefish) eating (northern and fish pike) from 6 sites. Mountain species

Related Study Questions

- 1a) How has the aquatic ecosystem, including fish and/or other aquatic organisms, been affected by exposure to organochlorines or other toxic compounds?
- 4a) What are the contents and nature of the contaminants entering the system and what is their distribution and toxicity in the aquatic ecosystem with particular reference to water, sediments and biota?
- b) Are toxins such as dioxins, furans, mercury, etc. increasing or decreasing and what is their rate of change?
- 8) Recognizing that people drink water and eat fish from these river systems, what is the current concentration of contaminants in water and edible fish tissue and how are these levels changing through time and by location?

whitefish, having a high level of fatty tissue, are good accumulators of many contaminants. The fish eating species allow consideration of contaminant biomagnification to upper levels of the food chain. Fish tissue collected under this program augment other "mediums" (eg., sediment, water and benthos) sampled and analyzed from the area for a variety of contaminants.

In addition to preserving muscle, liver, gall bladders, bile fluid, blood and stomach contents, investigators also examined specimens for general condition and health. A full complement of mature mountain whitefish tissue was obtained but there were only 29 mature northern pike from a sample size of 60 pike. The populations of burbot and bull trout in the study area were sparse. No abnormalities were noted with the captured fish. Further fish sampling of the Peace, Athabasca and Slave rivers will depend upon the analytical results of the fish collected to date.

It is hoped that this study can integrate with similar work being done by Alberta Pacific Forest Industries Inc. on the Athabasca River near the town of Athabasca and the Weyerhaeuser Canada Ltd. investigations on the Wapiti-Smoky rivers, to provide a larger geographical database. The degree of integration will depend on whether or not the methods and results of the studies are comparable.

EXECUTIVE SUMMARY

A special fish collection was made in the upper Athabasca River in the spring of 1992 to obtain tissue and blood samples for assessing fish exposure to contaminants. Samples were collected from one site upstream and five sites downstream of the Weldwood Mill at Hinton. Fish were collected by electrofishing, immediately anesthetized, and sampled to obtain plasma, livers, gall bladders, gonads, intestinal contents, and muscle tissues for specialized analyses by other laboratories. Appropriate tissues were also taken for fish ageing. Morphometric information and other data on fish health and extent of observed abnormalities were also recorded.

Mountain whitefish (*Prosopium williamsoni*) were collected from all sites in the river (total n = 62) but suitable numbers of northern pike (*Esox lucius*) were only obtained from the two lowermost sites (total n = 29). A higher frequency of skin lesions, particularly multiple lesions per fish, were observed in fish at all sites downstream of Hinton than at the upstream site. Higher levels of body fat and higher condition factors were also recorded in the downstream fish than in those upstream. Fish health/condition profiles indicated that, except for the external lesions noted, the fish appeared to be free of any gross pathological conditions.

Other species captured or observed included: white suckers (*Catostomus commersoni*), longnose suckers (*Catostomus catostomus*), bull trout (*Salvelinus confluentus*), rainbow trout (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*), Arctic grayling (*Thymallus arcticus*), lake whitefish (*Coregonus clupeaformis*), and burbot (*Lota lota*).



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ACKNOWLEDGMENTS

Layne Seely, HydroQual Laboratories Limited, assisted by organizing sampling equipment and preparing fixatives and other reagents for use in the field. The portable centrifuge was provided on loan by Dr. George Iwama, University of British Columbia.

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1.0 **INTRODUCTION**

The Athabasca River, which starts in Jasper National Park and ends at the Peace -Athabasca Delta at Lake Athabasca, is one of the largest river systems in Alberta and comprises a large portion of the McKenzie River drainage. A well-established pulp mill at the Town of Hinton in the upper end of the Athabasca drainage basin provides one of the largest point-source industrial effluent inputs along the river's course.

As part of the Representative Area Program (RAP) of the Northern River Basins Study (NRBS), a special fish collection was made in the spring of 1992 to assess contaminant loading, selected physiological indicators of contaminant exposure and stress, and food web components. Specifically, the objectives of this project were to: (1) collect fish from pre-selected sites in the upper portion of the Athabasca River for specialized fish contaminant and health studies, and (2) prepare blood and tissue samples as required from collected fish for delivery to Alberta Environment for subsequent distribution to selected laboratories. Another objective of the project was to assess the feasibility of conducting this type of collection within the constraints imposed by field sampling conditions.



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2.0 METHODS AND RESULTS

2.1 SAMPLE SITES

Six sample-site vicinities were preselected by NRBS for collection upstream and downstream of the Town of Hinton, and were designated as follows:

Site A - Near Entrance (near Highway 40 bridge upstream of Mosquito Creek)
Site B - Below Weldwood Haul Bridge at Hinton
Site C - Above and below Obed Mountain Coal Bridge
Site D - Above and below Emerson Lakes Bridge
Site E - Below Berland River confluence (bridge crossing)
Site F - Above and below Windfall Bridge (Windfall Junction upstream of Whitecourt)

All of the sites were accessible from boat launch access points, although three of them required travel upstream or downstream on the river for up to 20 km to reach the designated site. All boat launch points were suitable except for that accessing Site D, which may be unsuitable for vehicular travel in very wet weather or when the river stage is very low. Legal and UTM site location coordinates are listed in Table 1; latitudes and longitudes are described in Table 2. Descriptions of amount of river fished at each site and boat launch accesses are provided in Table 3.

2.2 FISH SAMPLING

All fish were collected by electrofishing using a Smith-Root Model SR18 equipped with Yamaha 90 hp outboard jet-drive. Gill nets (20-m x 2-m panels of 64 mm and 89 mm stretched mesh monofilament) and set lines (15 m with 6 hooks each) were also attempted when electrofishing was not successful. Mountain whitefish



LOCATIONS OF SITES USED FOR SPECIAL FISH COLLECTIONS IN THE UPPER ATHABASCA **RIVER IN SPRING 1992**

SITE	ŢM	SW CORNER	448750/5911490	444080/5906370	463550/5920100	463490/5920050	475180/5929000	489480/5946170	485730/5941050	510650/5984480	510650/5984480	557350/6003980	556600/6003950
CK INCORPORATING	5	NE CORNER	453820/5914210	458050/5915600	468690/5923180	469400/5924950	475890/5930100	489410/5949720	489750/5956150	514600/5987900	515110/5991490	564240/6008350	564220/6009010
TION OF AREA BLOG	JAL	SW CORNER	SE/SW 32/50/26/W5	NW/NE 11/50/27/W5	NW/SE 25/51/25/W5	NW/SE 25/51/25/W5	NW/NE 19/52/23/W5	SE/NW 15/54/22/W5	NW/SW 32/53/22/W5	NE/SW 13/58/20/W5	NE/SW 13/58/20/W5	SW/SW 13/60/15/W5	SW/SE 14/60/15/W5
LOCA	TEC	NE CORNER	SW/NE 1/51/26/W5	SW/NW 9/51/25/W5	NW/SE 4/52/24/W5	NW/SW 10/52/24/W5	SW/NW 29/52/23/W5	NE/NW 27/54/22/W5	NW/NE 14/55/22/W5	NE/SE 29/58/19/W5	SW/NW 3/59/19/W5	NE/NW 27/60/14/W5	SE/SW 34/60/14/W5
SPECIES			Ι	II	-	II	-	-	II	-	Ξ	_	II
SITE			A		В		С	D		ш		تتر	

3

LATITUDES AND LONGITUDES OF DOWNSTREAM AND UPSTREAM POINTS ON THE ATHABASCA RIVER DELINEATING SAMPLE SITES FOR SPRING 1992 SPECIAL FISH COLLECTIONS

		LATITUDE -	LONGITUDE		
SITE	SPECIES	DOWNSTREAM	UPSTREAM		
	Ι	53°23' - 117°42'	53°21' - 117°46'		
А	II	53°24' - 117°38'	53°18' - 117°51'		
	Ι	53°28' - 117°28'	53°26' - 117°33'		
В	II	53°29' - 117°28'	53°26' - 117°33'		
С	Ι	53°31' - 117°22'	53°31' - 117°23'		
	Ι	53°42' - 117°10'	53°40' - 117°10'		
D	II	53°45' - 117°09'	53°37' - 117°13'		
_	Ι	54°03' - 116°47'	54°00' - 116°50'		
E	II	54°05' - 116°47'	54°00' - 116°50'		
_	Ι	54°11' - 116°01'	54°13' - 116°07'		
F	II	54°11' - 116°01'	54°14' - 116°08'		



DESCRIPTIONS OF SITES USED FOR SPECIAL FISH COLLECTIONS IN THE UPPER ATHABASCA RIVER IN SPRING 1992

SITE	SPECIES	DESCRIPTION	ACCESS
A	Ι	Hwy 40 Bridge near Entrance to 7 km upstream	Travel ca. 15 km upstream by boat from Weldwood Haul Bridge launch site at Hinton; no
	II	Lower portion of Brule Lake to 5 km downstream of Hwy 40 Bridge near Entrance	local access
В	Ι	Weldwood Haul Bridge at Hinton to 7 km downstream	Weldwood Haul Bridge launch site at Hinton
	II	Weldwood Haul Bridge at Hinton to 9 km downstream	
С	Ι	0.5 to 1.5 km upstream of Obed Mountain Coal Bridge	Travel ca. 20 km downstream by boat from Weldwood Haul Bridge launch site at Hinton; no local access
D	Ι	0.5 to 4.5 km upstream of Emerson Lakes Bridge	Travel ca. 10 km downstream by boat from launch site; primitive launch site accessible by dry weather
	II	11 km upstream to 6.5 km downstream of Emerson Lakes Bridge	road north from Obed; no local access
Ш	Ι	Berland River Bridge to 6 km downstream	Launch site at Berland River Bridge
	II	Berland River Bridge to 9.5 km downstream	
Ĺ	-	5.5 km upstream to 4 km downstream of Windfall Bridge	Launch site at Windfall Bridge
	II .	6.5 km upstream to 4 km downstream of Windfall Bridge	

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(*Prosopium williamsoni*), designated as Species I, were collected at all sites as required. Sites E and F were sampled first and the piscivorous species selected based on the relative catch. The representative piscivore selected was northern pike (*Esox lucius*), designated as Species II, as both electrofishing and the use of set lines (Site F) failed to capture burbot (*Lota lota*) or bull trout (*Salvelinus confluentus*). The sample numbering system is based on "Site - Species - Sample Number". For example, Sample D-II-4 would refer to northern pike number 4 sampled from Site D in the vicinity of the Emerson Lakes Bridge. Dates of sampling, water temperatures, and actual electrofishing effort are described in Table 4.

Initially, the intent was to capture a sufficient sample (10) of the largest age or size class. However, it became evident shortly after sampling commenced that this approach would not be feasible within time and budget constraints because of the relatively low abundance of fishes in the river in general (see Section 2.3). Thus, sampling focused on collecting mature adults of each species (note -- all changes to original Terms of Reference were discussed with K. Crutchfield, NRBS, during the field collection period).

The relative paucity of fish in the upper Athabasca River precluded the feasibility of establishing a shore station for sampling because of the distances covered during actual fishing. The adopted approach was to "fish" until a suitably sized sample was obtained. Electrofishing would then continue for up to 10 more minutes and, if an additional sample was not collected, the boat was landed on shore and the fish sample processed. Sufficient flat space was available on the electrofishing boat to set up work stations with the portable equipment for the three-man crew (one person carried out blood and liver processing, the second conducted the gonad, gut content, muscle fillet, and ageing material removal, while the third person recorded data and kept samples organized in their respective containers).



SAMPLING DATES, WATER TEMPERATURES, AND ELECTROFISHING EFFORT (ACTUAL TIME ELECTRIC CURRENT WAS APPLIED) DURING SPECIAL FISH COLLECTIONS IN THE UPPER ATHABASCA RIVER IN

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TE	DATE SAMPLED	WATER TEMPERATURE (°C)	SPECIES SOUGHT	ELECTROFISHING EFFORT (SEC)	OTHER SAMPLE METHOD
-	12 May	6.5	I and II	7509	
	13 May	6.5	I and II	4331	Gill Nets
	17 May	8.0	II	5571	
m	11 May	7.0	I and II	4751	
	14 May	7.0	I and II	4007	
U	· 15 May		I and II	3447	
	16 May	9.0	I and II	3287	
	18 May		=	4031	Gill Nets
[1]	8 May	10.5	I and II	2854	
	10 May	9.0	=	2761	
ĹĿ.	7 May	11.5	I and II	5628	Set Lines
	9 May	10.5	Ш	888	

Captured fish were placed immediately into a 200-mg/L solution of tricaine methanesulphonate (MS222) for blood and tissue sampling (Figure 1) to avoid possible alterations in reproductive steroid hormones due to handling stress. This dosage has been found to be effective for routine sampling of blood to measure chemical constituents in stress-related studies (Wedemeyer et al. 1990). After measuring (fork length) and weighing the fish, about 2-3 mL of blood was obtained from the caudal vasculature with a 3-mL disposable syringe equipped with a 21-gauge needle inserted ventrally midline posterior to the anal fin (Houston 1990). Syringes and needles were prerinsed with a 4% (w/v) solution of sodium heparin to prevent blood clotting. The length of time from initial anesthetization to blood removal for each sample is described in Tables 5 and 6; the average time was less than 10 min. Within about 15 min of removal, blood was centrifuged using a Millipore Capsule HF-120 portable centrifuge powered by a 500-W portable Honda generator. About 1 mL of plasma was extracted from each sample with a Pasteur pipet, stored in a 1.5-mL microcentrifuge tube, and frozen on dry ice.

After blood sampling, the fish was examined externally and internally for evidence of lesions or other abnormalities. Mountain whitefish were also examined using a standard autopsy procedure that provides a health/condition profile for the population (Goede and Barton 1990). Health/condition summary reports were prepared with Lotus 123-based software developed for that purpose (Goede and Houghton 1987). The liver was then removed and the gall bladder carefully separated and frozen on dry ice in either a 4-mL cryovial or, when too large to fit in a cryovial, in a small Whirlpac bag. In some instances, gall bladders were empty of bile likely because the fish had recently fed; these were not kept.

The liver was weighed (to 1 g) on an electronic balance and then subsampled as required for analysis. A 1 to 2-g (or more) subsample of liver was thoroughly rinsed with cold 0.15-M potassium chloride (KCl) solution, sliced, placed in a labelled 4-mL cryogenic vial, and stored immediately on dry ice. The remainder of the liver was





Flow chart describing blood and tissue collection protocol. Figure 1.

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TIME OF REMOVAL AFTER SAMPLE TIME OF ANESTHETIZATION (MIN) NUMBER DAY (h) **GONADS** BLOOD LIVER 10:57 15 17 **A-I-1** 10 20 23 A-I-2 11:00 16 A-I-3 11:47 7 13 17 A-I-4 12:40 14 19 22 9 15 14:37 12 A-I-5 7 13 13 A-I-6 17:47 10 18 A-I-7 10:46 14 11:22 14 18 A-I-8 10 6 15 A-I-9 12:18 13 A-I-10 12:19 17 22 26 Average - Site A 10.6 15.5 18.4 14:22 15 17 **B-I-1** 11 **B-I-2** 15:14 10 15 17 16:43 17 17 **B-I-3** 11 9 **B-I-4** 16:46 25 27 **B-I-5** 17:45 8 15 16 **B-I-6** 17:48 14 17 22 9 **B-I-7** 18:38 13 14 09:17 8 **B-I-**8 13 15 09:18 8 25 **B-I-9** 21 19 10:05 10 **B-I-10** 16 **B-I-11** 14:13 10 14 18 **B-I-12** 14:54 17 11 14 Average - Site B 9.9 16.3 18.7

TIME FROM INITIAL ANESTHETIZATION OF MOUNTAIN WHITEFISH AT CAPTURE TO REMOVAL OF BLOOD, LIVER, AND GONADAL TISSUE

É EMA

Environmental Management Associates

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SAMPLE	TIME OF	TIME O	F REMOVA HETIZATIO	L AFTER N (MIN)
NUMBER	DAY (h)	BLOOD	LIVER	GONADS
C-I-1	11:18	9	11	15
C-I-2	11:19	9	24	27
C-I-3	12:12	10	13	16
C-I-4	12:47	9	15	16
C-I-5	13:32	8	11	13
C-I-6	13:34	15	20	22
C-I-7	15:12	9	13	15
C-I-8	15:46	7	10	12
C-I-9	15:47	4	17	20
C-I-10	16:31	8	10	13
Average - Site C		8.8	14.4	16.9
D-I-1	10:27	10	12	15
D-I-2	10:57	8	13	16
D-I-3	11:00	15	19	21
D-I-4	11:43	11	13	15
D-I-5	12:22	11	15	19
D-I-6	13:13	8	13	16
D-I-7	13:15	17	21	24
D-I-8	14:56	11	14	17
D-I-9	14:58	18	22	24
D-I-10	15:38	8	11	13
Average - Site D		11.7	15.3	18.0

PAGE 3 OF 3

SAMPLE	TIME OF	TIME OF REMOVAL AFTER ANESTHETIZATION (MIN)					
NUMBER	DAY (h)	BLOOD	LIVER	GONADS			
E-I-1	10:33	6	11	15			
E-I-2	10:33	10	27	31			
E-I-3	11:28	7	11	14			
E-I-4	11:29	14	21	25			
E-I-5	13:54	10	14	18			
E-I-6	16:25	10	15	19			
E-I-7	16:29	18	26	30			
E-I-8	17:17	8	12	16			
E-I-9	17:18	16	28	32			
E-I-10	18:06	4	7	9			
Average - Site E		10.3	17.2	20.9			
F-I-1	10:11	11	18	29			
F-I-2	10:12	11	32	43			
F-I-3	10:11	12	41	52			
F-I-4	14:45	8	15	19			
F-I-5	15:57	8	13	17			
F-I-6	16:41	6	11	15			
F-I-7	16:42	6	18	27			
F-I-8	17:25	7	10	15			
F-I-9	17:56	11	14	19			
F-I-10	18:31	6	9	13			
Average - Site F		8.6	18.1	24.9			



SAMPLE	TIME OF	TIME OF REMOVAL AFTER ANESTHETIZATION (MIN)			
NUMBER	DAY (h)	BLOOD	LIVER	GONADS	
A-II-1	12:52	14	21	24	
A-II-2	17:18	5	11	-	
A-II-3	16:24	6	11	13	
A-II-4	13:09	11	18	20	
A-II-5	16:21	13	19	22	
A-II-6	17:41	11	17	20	
Average - Site A		10.0	16.2	19.8	
B-II-1	12:05	5	12	15	
B-II-2	12:05	17	26	32	
Average - Site B		11.0	19.0	23.5	
D-II-1	11:41	14	24	26	
Average - Site D		14.0	24.0	26.0	
E-II-1	12:22	9	15	20	
E-II-2	12:25	19	28	30	
E-II-3	14:43	9	14	17	
E-II-4	15:26	10	17	20	
E-II-5	15:28	22	31	36	
E-II-6	E-II-6 1O:25		15	19	
E-II-7	11:09	5	10	11	
E-II-8	11:47	9	13	14	
E-II-9	13:09	8	13	14	
E-II-10	16:11	6	12	13	
Average - Site E		10.4	16.8	19.4	

TIME FROM INITIAL ANESTHETIZATION OF NORTHERN PIKE AT CAPTURE TO REMOVAL OF BLOOD, LIVER, AND GONADAL TISSUE

PAGE 2 OF 2

SAMPLE NUMBER	TIME OF DAY (h)	TIME OF REMOVAL AFTER ANESTHETIZATION (MIN)				
		BLOOD	LIVER	GONADS		
F-II-1	09:07	13	17	19		
F-II-2	09:08	20	26	28		
F-II-3	10:07	10	15	16		
F-II-4	10:08	18	27	29		
F-II-5	10:08	19	37	39		
F-II-6	11:04	7	14	17		
F-II-7	11:05	15	24	25		
F-II-8	12:00	11	18	20		
F-II-9	13:23	6 12		14		
F-II-10	13:57	7	13	15		
Average - Site F		12.6	20.3	22.2		



frozen and stored on dry ice in a resin-free plastic bag approved by Department of Fisheries and Oceans (DFO) and provided by NRBS for subsequent contaminant analysis. The time from initial anesthetization at capture to liver removal for each sample is recorded in Tables 5 and 6; in most instances, the heart was still beating at this time. It should be noted that the total time included the additional time required to collect a second sample, when required.

After sex and state of maturity were assessed, both gonads were removed in their entirety and weighed (to 1 g) on an electronic balance. Three sections of the left male or female gonad, about 0.5 cm thick and <1 cm overall, were removed from the centre portion of the gonad and stored in separate HistoPrep capsules in Davidson's fixative according to the protocol described in Schedule B of the Terms of Reference (subsamples were designated as "a, b, and c" along with sample numbers on capsules). Three similarly sized pieces of ovary were removed from females and stored in 5% buffered formalin solution, following the same protocol. Because of the high ratio of female to male fish at some sites, three subsamples were taken from the first five females sampled and two subsamples from the remainder. (An extra sample of male gonad tissue was taken from one fish at Site E that had apparent gonadal constrictions: sample number E-I-10d.)

Contents of the digestive tract (esophagus, stomach, and intestine) of each fish were carefully extruded, where possible, into a labelled, plastic Whirlpac bag and stored frozen. When stomachs were too full to extrude the contents, stomach walls were slit and the contents removed with the flat side of a clean knife blade. Both whole muscle fillets were removed from each fish with a stainless steel knife, weighed (to 1 g), and frozen on dry ice in labelled, resin-free, DFO-approved bags.

Appropriate ageing tissues according to Mackay et al. (1990) were removed from each fish and stored frozen in a labelled, plastic Whirlpac bag; the tissues included both otoliths and scales from mountain whitefish and a single cleithrum and scales from northern pike; ageing was carried out later by Alberta Fish and Wildlife Division using the otoliths and cleithra. All instruments were washed with water and rinsed with hexane between samples except for the knife used for extracting gut contents, which was rinsed with distilled water. Cutting boards were washed and rinsed with distilled water between each fish sampling.

All samples (except for preserved gonadal tissues) were frozen with dry ice at the time of removal from the fish. Samples were subsequently stored on dry ice for the duration except for muscle tissues that, because of the quantity collected relative to available space in the dry ice cooler, were transferred to a standard chest-type deep freezer for about five days. Two batches of liver samples were shipped on dry ice to Alberta Environment during the field collections and all remaining samples were delivered frozen on dry ice to Alberta Environment upon completion of the sampling.

2.3 FISH COLLECTION RESULTS

A summary of the sample dates, locations, and numbers caught for each species is presented in Figure 2. Complete samples of mountain whitefish (10 per site) were obtained from all sites. However, because adult mountain whitefish were not abundant in the system, it was not feasible to capture fish of the same size or age class within the time and budget constraints of the project. Thus, sampling focused on collecting mature adults. Adult mountain whitefish were usually found at current breaks associated with gravel bars along the sides of the river and around islands. An average of about one full day was required at each site to collect and process the complete sample of mountain whitefish. Length, weight, age, and other details of collected mountain whitefish are summarized in Table 7. At Site B, two additional fish (B-I-11 and 12) were collected to replace two fish (B-I-2 and 5) that were considered small at <290 mm; all samples were included. The state of





numbers caught for each species (e.g. date:species - number caught) General locations of sample sites in the Athabasca River for the spring 1992 special fish collection indicating sample dates and Figure 2

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	MPLE LENGTH WEIGHT SEX SM AGE					TISSUE WEIGHTS (g)		
SAMPLE		AGE	LIVER	GONADS	MUSCLE FILLETS			
A-I-1	314	325	F	GR	7	4	3	117
A-I-2	330	381	М	GR	6	8	3	140
A-I-3	446	841	F	GR	12	7	8	253
A-I-4	292	308	F	GR	7	2	3	117
A-I-5	298	290	F	GR	7	3	3	99
A-I-6	366	531	F	GR	10	8	5	196
A-I-7	363	492	M	GR	10	. 5	3	181
A-I-8	413	795	F	GR	10	8	8	268
A-I-9	333	409	M	GR	8	4	2	132
A-I-10	314	360	F	GR	7	4	4	137
B-I-1	292	309	F	GR	6	2	2	98
B-I-2	285	310	F	GR	8	4	3	112
B-I-3	459	1199	F	GR	12	11	15	447
B-I-4	402	819	F	GR	9	9	13	299
B-I-5	283	291	F	GR	7	3	5	200
B-I-6	372	674	F	GR	8	8	10	207
B-I-7	328	472	F	GR	7	5	6	149
B-I-8	314	357	M	GR	8	5	2	121
B-I-9	320	400	F	GR	-1	5	8	154
B-I-10	375	560	F	GR	12	4	7	186
B-I- 11	357	526	F	GR	-	5	8	218
B-I-12	418	961	F	GR	9	8	8	258

LENGTH, WEIGHT, SEX, STATE OF MATURITY (SM), AGE, AND TISSUE WEIGHTS OF SAMPLED MOUNTAIN WHITEFISH (GR = GREEN)



PAGE 2 OF 3

SAMPLE	LENGTH FL mm	WEIGHT g	SEX	SM	AGE	TISSUE WEIGHTS (g)		
						LIVER	GONADS	MUSCLE FILLETS
C-I-1	401	1 029	F	GR	10	9	19	319
C-I-2	420	1030	F	GR	8	10	14	317
C-I-3	421	1030	F	GR	9	10	3	285
C-I-4	393	742	М	GR	6	8	11	206
C-I-5	385	550	F	GR	10	4	7	182
C-I-6	313	435	F	GR	6	5	7	144
C-I-7	297	341	F	GR	6	3	2	125
C-I-8	385	599	F	GR	8	8	8	185
C-I-9	406	692	М	GR	9	8	2	228
C-I-10	414	812	F	GR	7	9	12	264
D-I-1	373	631	М	GR	10	7	2	214
D-I-2	305	361	F	GR	11	3	9	144
D-I-3	329	403	F	GR	8	5	5	138
D-I-4	326	422	М	GR	6	5	2	164
D-I-5	433	920	F	GR	11	14	12	284
D-I-6	433	1038	F	GR	9	15	11	309
D-I-7	320	415	F	GR	8	8	2	156
D-I-8	395	812	F	GR	7	11	10	233
D-I-9	350	602	F	GR	• 7	9	8	202
D-I-10	356	570	F	GR	9	11	8	180
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		WEIGUE	0 EV			TISSUE WEIGHTS (g)			
SAMPLE	FL mm	g	SEX	SM	AGE	LIVER	GONADS	MUSCLE FILLETS	
E-I-1	335	412	М	GR	7	4	2	149	
E-I-2	453	1173	F	GR	9	14	12	377	
E-I-3	342	468	F	GR	7	5	4	178	
E-I-4	392	715	F	GR	8	7	5	212	
E-I-5	354	491	F	GR	10	3	3	143	
E-I-6	369	648	М	GR	8	8	<1	181	
E-I-7	389	748	М	GR	6	10	2	214	
E-I-8	412	932	F	GR	9	11	9	292	
E-I-9	459	952	F	GR	11	15	21	325	
E-I-10	370	611	М	GR	6	7	2	203	
F-I-1	418	891	М	GR	9	8	3	284	
F-I-2	316	428	F	GR	8	3	3	104	
F-I-3	343	502	М	GR	8	5	1	160	
F-I-4	327	395	М	GR	11	6	< 1	178	
F-I-5	333	472	F	GR	10	6	5	158	
F-I-6	347	465	F	GR	10	5	3	149	
F-I-7	338	497	F	GR	10	6	4	149	
F-I-8	302	371	F	GR	9	3	11	137	
F-I-9	414	914	М	GR	12	9	3	293	
F-I-10	384	722	F	GR	9	8	4	247	

¹ Missing data indicate poor or lack of suitable sample



maturity of all mountain whitefish was classed as "green" (GR) indicating that sexual products were clearly evident but in a stage of early development.

The complete complement of samples for northern pike was not obtained. Although northern pike were relatively common at downstream sites (Site E and F), they were not so upstream (Sites A and B) and were not observed at Site C. Northern pike were usually found in backwater areas with little or no flow-through; such sites were more limited in the vicinity of Sites C and D than upstream or downstream. Considerable extra effort was spent fishing Brulé Lake in an attempt to catch additional northern pike for the upstream Site A samples, but none were captured. In general, fish abundance in Brulé Lake was very low. Also, additional effort was spent fishing for northern pike at Site D but with limited success (one sample, D-II-1). Length, weight, age, and other details of northern pike collected are summarized in Table 8. The health/condition profile summaries for mountain whitefish are included in Appendix I.

Except for two immature fish (IM, taken at Site A to increase sample size), northern pike were either in prespawning condition (mature, M, for males and gravid, GA, for females) or had already spawned (spent. SP).

A higher incidence of body surface lesions on mountain whitefish was evident at downstream sites (B to F) than at Site A (Table 9, Figure 3). Very small areas of apparent necrosis at the margin of the gills were also observed on some mountain whitefish samples. However, gill lice were present on some specimens as well, so it is possible that the observed focal damage was caused by these parasites. The tissue normality index (TNI), calculated from the percent normal values of organs and tissues from the health/condition profile, ranged from 0.91 to 0.98 (Figure 4), indicating that apart from the external abnormalities observed, the fish appeared to be absent of any gross pathological condition.

TISSUE WEIGHTS (g) SAMPLE LENGTH WEIGHT SEX SM AGE LIVER GONADS MUSCLE FL mm g FILLETS 470 785 A-II-1 M M 3 10 4 285 467 712 A-II-2 UN IM 3 234 12 -A-II-3 659 1792 F SP 5 45 27 351 590 1399 Μ 5 A-II-4 Μ 3 12 340 A-II-5 440 632 F 3 IM 10 3 218 F A-II-6 483 910 GA 3 13 32 345 B-II-1 477 781 F GA 3 8 223 18 B-II-2 395 415 M Μ 3 <1 137 -D-II-1 698 2596 F SP 6 480 33 31 E-II-1 699 2152 F GA 6 20 287 459 E-II-2 405 543 M M 2 7 2 177 612 1693 5 E-II-3 M Μ 22 465 14 835 F 7 E-II-4 5409 GA 40 532 1024 F E-II-5 665 GA 5 2413 40 697 174 F E-II-6 667 2212 SP 5 18 370 13 E-II-7 650 1680 Μ M 6 12 21 322 E-II-8 548 1110 Μ M 3 10 279 11 507 1093 9 294 E-II-9 M M 4 12 E-II-10 631 720 F SP 5 19 413 15

LENGTH, WEIGHT, SEX, STATE OF MATURITY (SM), AGE, AND TISSUE WEIGHTS OF SAMPLED NORTHERN PIKE (ABBREVIATIONS EXPLAINED IN TEXT, UN = UNABLE TO DETERMINE ACCURATELY)



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			CT-N	CN (TISSUE WEIGHTS (g)			
SAMPLE	LENGTH FL mm	GTH WEIGHT SEX SM mm g		SM	AGE	LIVER	GONADS	MUSCLE FILLETS	
F-II-1	455	632	F	GA	4	5	21	202	
F-II-2	465	674	М	М	4	8	9	224	
F-II-3	540	1 129	М	М	4	5	13	338	
F-II-4	537	1100	М	М	5	10	10	308	
F-II-5	538	1084	М	М	4	13	4	290	
F-II-6	530	970	М	М	4	8	22	239	
F-II-7	546	1118	М	М	5	8	8	370	
F-II-8	792	3735	F	SP	8	28	38	441	
F-II-9	521	1045	F	SP	4	13	5	257	
F-II-10	637	2045	F	GA	5	33	219	388	

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OBSERVED ABNORMALITIES IN SAMPLED MOUNTAIN WHITEFISH

SAMPLE	ABNORMALITIES
A-I-1	gill lice
A-I-2	none
A-I-3	"coffee" - coloured liver; thin blood
A-I-4	kidney appeared slightly swollen
A-I-5	none
A-I-6	a few pinpoint white nodules in liver
A-I-7	none
A-I-8	1 small lesion - caudal peduncle
A-I-9	1 small lesion - right side
A-I-10	1 small lesion - base of left pelvic fin; gill lice
B-I-1	none
B-I-2	none
B-I-3	multiple (9+) lesions on body surface (photos)
B-I-4	multiple cysts; pinpoint white nodules in liver (photo)
B-I-5	1 lesion - belly
B-I-6	5 lesions - belly; slight focal necrosis on gill margin
B-I-7	slight focal necrosis on gill margin (margination)
B-I-8	slight focal necrosis on gill margin
B-I-9	gill lice; "raspberry" spleen
B-I-10	slight focal necrosis on gill margin; damage to opercle (photo)
B-I-11	thin blood
B-I-12	none



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SAMPLE	ABNORMALITIES
C-I-1	1 lesion - behind left pectoral fin; gill lice
C-I-2	2 lesions - belly (photo)
C-I-3	blister on right opercle (photo)
C-I-4	1 lesion by anal fin; 1 hemorrhagic lesion by left pelvic fin; mottled liver
C-I-5	deformity - missing maxilla; "raspberry" spleen
C-I-6	1 very small lesion near anus
C-I-7	none
C-I-8	none
C-I-9	slight focal necrosis on gill margin
C-I-10	2 large hemorrhagic lesions; 2 small lesions; slight focal necrosis on gill margin
D-I-1	none
D-I-2	none
D-I-3	2 small lesions - belly; slight gill margination: gill lice: "rasberry" spleen
D-I-4	1 hemorrhagic lesion - right side (photo)
D-I-5	1 hemorrhagic lesion - left side; multiple lesions - belly (photo)
D-I-6	very small lesions - belly
D-I-7	2 small lesions - belly
D-I-8	2 lesions - base of each pectoral fin; 1 lesion - base of left pelvic fin (photo)
D-I-9	none
D-I-10	1 hemorrhagic lesion - belly; 1 hemorrhagic lesion - right pelvic fin (photo)

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SAMPLE	ABNORMALITIES
E-I-1	none
E-I-2	slight focal necrosis on gill margin
E-I-3	none
E-I-4	slight focal necrosis on gill margin
E-I-5	none
E-I-6	few small lesions; slight gill margination
E-I-7	3 lesions - belly; 1 lesion behind right opercle (photo)
E-I-8	1 lesion - base of right pectoral fin
E-I-9	2 small lesions - belly
E-I-10	apparent gonadal constrictions (photo); slight gill margination
F-I-1	none
F-I-2	2 small lesions - belly
F-I-3	none
F-I-4	none
F-I-5	none
F-I-6	none
F-I-7	none
F-I-8	none
F-I-9	1 lesion - left side of belly; 1 lesion near anus
F-I-10	none





Figure 3. Frequency of occurrence of single (S) and multiple (M) lesions on mountain whitefish sampled from the Athabasca River in spring 1992.



Figure 4. Tissue normality index (TNI) from autopsy examination of mountain whitefish sampled from the Athabasca River in spring 1992.



Mountain whitefish at all sites downstream of Hinton (Sites B through F) had noticeably higher levels of abdominal fat deposits around the pyloric caeca and intestines in the body cavity than those upstream at Site A. Using the fat index system of Goede and Barton (1990) that assigns unit values from 0 (no fat present) to 4 (complete coverage of caeca by fat), the average fat index of mountain whitefish at Site A was 1.4 compared with average indices of 2.5 to 2.7 for downstream sites (Figure 5). Bile colour/fullness indices (ratings range from 0 to 3) were between 1 and 2 indicating that all fish were feeding at about the same level of activity (Figure 5). Condition factors (K_n) were slightly higher at Sites B to F than at Site A, which may reflect the higher levels of fat deposits in those fish (Figure 6).

Except for 100% incidence of intestinal tapeworms (species unknown), northern pike captured upstream were free of abnormalities, whereas those downstream had skin and fin lesions, particularly at Site F (Table 10).

Other species observed during the sampling program included juvenile and adult bull trout, burbot, rainbow trout (*Oncorhynchus mykiss*), juvenile brook trout (*Salvelinus fontinalis*), Arctic grayling (*Thymallus arcticus*), lake whitefish (*Coregonus clupeaformis*), white suckers (*Catostomus commersoni*), longnose suckers (*Catostomus catostomus*), and sculpins (*Cottus* sp.) (Table 11). Electrofishing caught all the fish sampled for the special collections. Gill nets yielded only two suckers and one mountain whitefish in 6 h of effort at Site A and one Arctic grayling at Site D in 5 h of effort; set lines at Site F caught no fish in 5-6 h of effort.



Figure 5. Mean visceral fat (F) and bile colour/fullness (B) indices of mountain whitefish sampled from the Athabasca River in spring 1992.





Figure 6. Mean condition factor $(K_{fl} + SE)$ of mountain whitefish sampled from the Athabasca River in spring 1992.

OBSERVED ABNORMALITIES IN SAMPLED NORTHERN PIKE

SAMPLE	ABNORMALITIES
A-II-1	intestinal tapeworms
A-II-2	intestinal tapeworms
A-II-3	intestinal tapeworms
A-II-4	intestinal tapeworms
A-II-5	intestinal tapeworms
A-II-6	intestinal tapeworms
B-II-1	intestinal tapeworms
B-II-2	exophthalmia and cataract in right eye; eroded caudal fin; intestinal tapeworms
D-II-1	slight fin fraying; intestinal tapeworms
E-II-1	1 small lesion
E-II-2	none
E-II-3	1 small lesion
E-II-4	apparent fatty liver (normal?)
E-II-5	apparent fatty liver
E-II-6	intestinal parasites
E-II-7	intestinal parasites
E-II-8	1 small lesion - left side
E-II-9	intestinal parasites
E-II-10	intestinal parasites



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SAMPLE	ABNORMALITIES
F-II-1	open wound behind left pectoral fin (photo)
F-II-2	none
F-II-3	eroded lower caudal lobe (or clip?)
F-II-4	none
F-II-5	none
F-II-6	2 cysts - lower caudal lobe; extremely enlarged gail bladder - yellow bile (photo); anal fin erosion or clip(?)
F-II-7	1 lesion - top of head; 1 lesion - anal fin; 1 hemorrhagic lesion - left side; 1 cyst
F-II-8	12 lesions over body (photo); 1 large liver cyst (photo); intestinal parasites
F-II-9	intestinal tapeworms
F-II-10	2 lesions - right side; 1 lesion - left side; minor scale loss: intestinal parasites

APPROXIMATE RELATIVE ABUNDANCE OF FISH SPECIES OBSERVED DURING SPECIAL FISH COLLECTIONS IN THE ATHABASCA RIVER IN SPRING 1992 (A - ABUNDANT, ABOUT 50 OR MORE PER DAY; C - COMMON, ABOUT 10 PER DAY; U - UNCOMMON, A FEW PER DAY; O - OCCASIONAL, ONLY ONE PER DAY; N - NONE OBSERVED)

SPECIES (STAGE)	SITE							
	A	В	C	D	E	F		
Mountain whitefish (juvenile)	A	A	A	A	A	А		
Mountain whitefish (adult)	C	C	С	С	С	С		
Northern pike (juvenile)	U	U	N	0	С	С		
Northern pike (adult)	U	U	N	0	С	С		
Bull trout (juvenile)	N	U	N	N	N	Ν		
Bull trout (adult)	0	U	0	U	N	Ν		
Rainbow trout	C	U	0	А	N	Ν		
Brook trout (juvenile)	0	0	Ν	Ν	Ν	Ν		
Arctic grayling	N	N	Ν	С	А	Ν		
Lake whitefish	U	N	N	Ν	N	0		
Burbot	U	U	U	U	U	U		
White and longnose suckers	A	А	А	А	А	А		
Sculpin (sp.)	0	Ν	Ν	Ν	Ν	Ν		

3.0 <u>RECOMMENDATIONS</u>

Because of the relative paucity of fish fauna in the upper Athabasca River compared to other, more productive systems, a minimum of one day per site for each species should be allotted for special fish collections in order to obtain the required samples. More time may be necessary if sampling is to be selective for fish of all one size or age class.

Selection of a piscivorous species for special fish collections should be restricted to northern pike or burbot as bull trout, although present, do not appear to be common in the system. Northern pike and burbot appeared to be present in similar numbers, although this observation may be a function of the fishing method used rather than actual relative abundance. If northern pike are selected, more effort may be required to collect sufficient numbers from upstream sites. Also, Talbot Lake in Jasper National Park should be considered as a possible site to obtain northern pike for control samples. If burbot are selected, intensive use of set lines will likely be needed as burbot appear to detect the peripheral field from the electrofishing unit and manage to escape before becoming immobilized.

The use of a shore station to process samples will not likely be feasible in this system because of the relatively low abundance of fish. Because of the distance of river needed to cover to obtain the required samples, it would not be possible to collect the fish and return them to the shore station for sampling within the time restrictions of the sampling protocol. In the present collection, three persons processed the samples using portable equipment and the flat decks of the electrofishing boat as work space. In this way, fish were collected and then the boat moored at shore to process the samples as needed. Following this protocol, no more than two fish at a time are recommended; initially, three fish were tried but resulted in too long a time period between initial anesthetization and tissue collection from the third fish (e.g., F-I-3, Table 4).



Three people are adequate to collect and process the samples -- two to measure, weigh, and remove tissues, and one to record data and keep sample containers organized during processing.

If high quality coolers are used, four blocks of dry ice would be sufficient for freezing and storing samples for one week. If longer times are planned for field collections, arrangements may have to be made for procuring additional dry ice and for local storage of muscle tissue for contaminant analysis because of their volume.

4.0 <u>REFERENCES</u>

- Goede, R.W., and B.A. Barton. 1990. Organismic indicators and an autopsy-based assessment as indicators of health and condition of fish. Pages 93-108 in S.M. Adams, editor. Biological indicators of stress in fish. American Fisheries Society Symposium 8.
- Goede, R.W., and S. Houghton. 1987. AUSUM: a computer program for the autopsy-based fish health/condition system. Utah Natural Resources, Division of Wildlife Resources, Logan, UT. 31 p.
- Houston, A.H. 1990. Blood and circulation. Chapter 9, pages 273-334 in C.B. Schreck and P.B. Moyle, editors. Methods for fish biology. American Fisheries Society, Bethesda, MD.
- Mackay, W.C., G.R. Ash, and H.J. Norris, editors. 1990. Fish ageing methods for Alberta. R.L. & L. Environmental Services Limited, in association with Alberta Fish and Wildlife Division and University of Alberta, Edmonton. 113 p.
- Wedemeyer, G.A., B.A. Barton, and D.J. McLeay. 1990. Stress and acclimation.Chapter 14, pages 451-489 in C.B. Schreck and P.B. Moyle, editors.Methods for fish biology. American Fisheries Society, Bethesda, MD.



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APPENDIX I

AUTOPSY-BASED FISH HEALTH/CONDITION PROFILE SUMMARY REPORTS FOR MOUNTAIN WHITEFISH

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SUMMARY OF AUTOPSY

LC	CATION:	Athaba	asca Riv	er, Sit	e A		QUALITY	CONTRO	DL NO.:	NA	
Sp St Ma Ur Fi Eg Ha Re	Decies: crain: ark/Lot: hit: NA ish Source: og Source: atching Date marks:	MNWH (NA NA L NA	(A) /ild IA IA	Auto Age: Wate Vate Inve Rease	osy Date NA r Temp.: r Hardne: stigator on for An	: 05-13- NA NA ss: N/ : Barton utopsy:	92 Tissue (Dise: Ca: A ppm Health	Sampl Collecti ase Surv se Histo Custo Purpos Assessm	le Size: ion No.: vey No.: ory No.: ody No.: se Code: ment	10 NA NA NA NA	
== W K C H L	.ength Weight (tl* :tl** Hematocrit .eucocrit Vlasma Prote	1 340 473 1 4	IEAN 5.900 mm 5.200 gr 1.130 5.082 NA NA NA		STAI DEV 47 187 0	NDARD IATION .82 mm .29 gr .07 NA NA NA		COEFFI OF VAR 14 40 7 NA NA	ICIENT RIATION		
*Expr	essed as Kt	l times	10 to t	he fift	power			NP	`		
**Conv	verted from	Ktl; exp	ressed	as Ctl 1	times 10	to the	fourth po	wer =======		=======	
		VA	LUES AS	PERCENT	OF TOT	AL SAMPLE	E				
EYES N 100 B1 0 E1 0 E2 0 H1 0 H2 0 M1 0 M2 0 OT 0	F 0% GILLS B 1% N 100% 7 F 0% 1% C 0% 1% M 0% S 1% OT 0% 0 1% 1% OT 0% 0 1% 1% OT 0% 1% 1% OT 0% 1% 1% OT 0% 1% 1% OT 0% 1% 1% OT 0% 1% OT 0% 1% OT 0% 1% OT 0% 1% OT 0% 1% OT 0% 1% OT 0% 1% OT 0% 1% OT 0% 1% O	SEUDO- RANCHS N 100% S 0% L 0% L 0% I 0% T 0%	THYMUS 0 100% 1 0% 2 0% x 0.0	MESEN. FAT 0 0% 1 70% 2 20% 3 10% 4 0% × 1.4	SPLEEN B 90% R 0% G 10% NO 0% E 0% OT 0%	HIND GUT 0 100% 1 0% 2 0% x 0.0	KIDNEY N 90% S 10% M 0% G 0% U 0% OT 0%	LIVER A 20% B 60% C 20% D 0% E 0% F 0% OT 0%	BILE 0 0% 1 60% 2 40% 3 0% x 1.4	FIN 0 100% 1 0% 2 0% X 0	OPERCLE 0 100% 1 0% 2 0% x 0
			Summ	ary of M	lormals						
100	100%	100%	100%	xxxxxx	100%	100%	90%	80%	xxxxxx	100%	100%
			Sum	mary of	Means						
*****	× ××××××× ×	******	0.0	1.4	*****	0.0	*****	*****	1.4	0	0
SEX:	M: 30% F	: 70%	U: 0%								
122223	**********	******		19999199	Inde	ex Summar	.À				
Tissue	Normality I	ndex:	TX	0	.97						
Fat Ind	ex:		FX	1	.40						
Bile In	dex:		BX	1	.40				=======		
FINS	NA		GEI	NERAL RE	MARKS						
SKIN	Single les	ions - F	ish 8,9	,10							
GONADS	NA										
OTHER	Fish 3 - l	ow hemat	ocrit								

SN 1 2 3 4 5 6 7 8 9 10 11 10 10 10 10 10 10 10 10 10 10 10	LGH 314 292 298 366 363 413 333 314	WGT 325 381 308 290 531 492 795 409 360	Ktl 1.05 1.06 0.95 1.24 1.10 1.08 1.03 1.13 1.11 1.16	EYE N N N N N N N N N N N N	GILL N N N N N N	PSBR N N N N N N N N	THY 0 0 0 0 0 0 0 0 0	FAT 2 1 1 1 1 1 1 1 1 2 1 3	SPL B B B B B B B B B B B B B B B B B B B	GUT 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	KID N N N N N N N N	LIV B C B C A B A B B	BILE 1 2 1 1 2 2 2 1 2	SEX F F F F F M F F	HEM	LEU	PLPR	FIN OP 0 0 0 0 0 0 0 0 0 0	
20 22 22 22 22 22 22 22 22 22 22 22 22 2																			
43 44 56 47 48 95 15 25 35 45 55 57 8 50 50 50 50 50 50 50 50 50 50 50 50 50																			

Qual. Control No. NA

LOCATION:	Athabasca River	, Site B	G	QUALITY CONTROL	NO.:	NA	
Species:	MNWH (B)	Autopsy Date:	05-11-92	Sample	Size:	12	
Strain:	NA	Age: NA	11	SSUE LOLLECTIC	NO.:	NA	
Mark/LUL.		Water Tomp :		Case Histor	NO.		
Fish Source:	Hild	Water Hardnes		vom Custor	V No ·	NA	
Fog Source:	NA	Investigators	Barton	Purpose	Code	NA	
Hatching Date:	NA	Reason for AL	topsv:	lealth Assessme	nt	30	
Remarks:	NA			rearen Assessin			
N GINAT KOT							
		STAN	DARD	COEFFIC	IENT		
	MEAN	DEVI	ATION	OF VARI	ATION		
Length	350.420 mm	54	.1 mm	152	4		
Weight	573.170 gr	276.	99 gr	482			
Ktl*	1.330	0.	08	62			
Ctl**	4.805				_		
Hematocrit	NA		NA	NA			
Leucocrit	NA		NA	NA			
Plasma Protei	n NA		NA	NA			
*Expressed as Ktl	times 10 to the	fifth power					
**Converted from K	tl; expressed as	Ctl times 10	to the fou	irth power			
	VALUES AS PI	ERCENT OF TOTA	L SAMPLE				
PSI	EUDO- MI	ESEN.	HIND				
EYES GILLS BR	ANCHS THYMUS	FAT SPLEEN	GUT K	IDNEY LIVER	BILE	FIN	OPERCLE
N 100% N 67% N	100% 0 92% 0	0% B 58%	0 100% N	100% A 25%	0 0%	0 100%	0 92%
B1 0% F 0% S	0% 1 8% 1	8% R 33%	1 0% s	0% B 67%	1 33%	1 0%	1 8%
B2 0% C 0% L	0% 2 0% 2	25% G 8%	2 0% M	0% C 0%	2 67%	2 0%	2 0%
E1 0% M 33% S&I	L 0% x 0.1 3	67% NO 0%	x 0.0 G	0% D 0%	3 0%	x 0	x 0.0

N 100 B1 0 B2 0 E1 0 E2 0 H1 0 H2 0 M1 0 M2 0 OT 0	0% N 0% F 0% C 0% M 0% P 0% OT 0% 07	67% 0% 0% 33% 0%	N S L S&L I OT	100% 0% 0% 0%	0 1 2 x	92% 8% 0% 0.1	0 1 2 3 4 x	0% 8% 25% 67% 0% 2.6	B R G NO E OT	58% 33% 8% 0% 0%	0 1 2 x	100% 0% 0% 0.0	N S G U OT	100% 0% 0% 0% 0%	A B C D F OT	25% 67% 0% 0% 8% 0%	0 1 2 3 x	0% 33% 67% 0% 1.7	0 1 2 x	10	0% 0% 0% 0	0 1 2 x	92% 8% 0%	
						Summ	nary	of	Norn	nals														
100	0%	67%		100%		92%	xxx	xxxx		100%		100%		100%		92%	xxx	xxxx		10	0%		92%	
						Sur	nmar	y of	Mea	ins			1		1									
xxxxxx	x xxx	xxxx	xxx>	xxxx		0.1		2.6	xxx	xxxx		0.0	xx	xxxxx	xx>	xxx		1.7			0		0.0	
SEX:	M:	8%	F:	92%	U:	0%					==:									===	===	===:		
Tissue	Norma	lity	Inde	ex:	т	x			0.91	Inde	x	Summa	гу											
Fat Inc	lex:	,			F	x			2.58	1														
Bile Ir	ndex:				в	x			1.67	,			÷											
		=====			:22	=====		====		=====	===						===	=====	.===:	===	===	===:		:==
FINS	NA					GE	ENER	AL RI	EMAR	KS														
SKIN	Sing	le le	esior	n - Fi	sh	5; M	lul t	iple	les	ions	- F	ish 3	3,6											

GONADS NA

OTHER Fish 11 - low hematocrit

Qual. Control No. NA

S 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3	LGH 2922 283 372 283 372 328 314 320 375 357 418	WGT 309 310 1199 291 674 472 357 400 566 961	Ktl 1.24 1.34 1.26 1.28 1.31 1.34 1.15 1.22 1.06 1.16 1.32	EYE N N N N N N N N N N N N N	GILL N N M M M N N N N	PSBR N N N N N N N N N N		FAT 3 3 2 3 3 3 3 2 3 3 1 3 2 2 3 1 3 2 2	SPL R R R B B B B B B B B B B B B B B B B	GUT 0 0 0 0 0 0 0 0 0 0 0		LIV B B A B B B B B B B B B B B B B B B B	BILE 1 2 2 2 2 2 2 2 2 2 2 2 2 2	SEX FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF	HEM	LEU	PLPR	FIN 0 0 0 0 0 0 0 0 0 0 0 0 0	DPCL 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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SUMMARY OF AUTOPSY

LO	CATION:	Athab	asca Ri	ver, Sit	e C		QUALITY	CONTRO	DL NO.:	NA	
Sp St Un Fi Eg Ha Re	pecies: rain: rk/Lot: hit: NA sh Source: Ig Source: Ig Source: tching Date marks:	MNWH NA NA	(C) Wild NA NA	Auto Age: Wate Wate Inve Reas	psy Date NA r Temp.: r Hardne: stigator on for An	NA NA SS: N/ Barton utopsy:	92 Tissue (Dise: Ca: A ppm Health	Sampl Collecti ase Surv se Histo Custo Purpos Assessm	le Size: ion No.: vey No.: ory No.: ody No.: se Code: ment	10 NA NA NA NA	
==			******		STA	NDARD		COEFFI	CIENT		
L W K C H	ength Weight tl* tl** Wematocrit	38 72	MEAN 4.170 m 8.920 g 1.290 4.660 NA	n	DEV 30 234 0	IATION 9.7 mm .62 gr .18 NA		OF VAR 10 32 14 N/	RIATION 0% 2% 4%		
P	lasma Prote	ein	NA			NA NA		N#	A A		
*Expr **Conv	essed as Kt erted from	tl times Ktl; ex	10 to pressed	the fift as Ctl	h power times 10	to the	fourth p	ower			
******		V.	ALUES A	S PERCEN	T OF TOT	AL SAMPLI					
EYES N 100 B1 0 E1 0 E1 0 E2 0 H1 0 H2 0 M1 0 M1 0 OT 0	GILLS P GILLS 8 % N 83% % F 0% % C 0% % M 17% S % P 0% % OT 0% C %	PSEUDO- BRANCHS N 100% S 0% L 0% S&L 0% I 0% DT 0%	THYMUS 0 100% 1 0% 2 0% × 0.0	MESEN. FAT 0 0% 1 17% 2 17% 3 67% 4 0% x 2.5	SPLEEN B 92% R 0% G 8% NO 0% E 0% OT 0%	HIND GUT 0 100% 1 0% 2 0% × 0.0	KIDNEY N 100% S 0% M 0% G 0% U 0% OT 0%	LIVER A 17% B 75% C 0% D 0% E 8% F 0% OT 0%	BILE 0 8% 1 58% 2 33% 3 0% x 1.3	FIN 0 100%1 1 0% 2 0% X 0	OPERCLE 0 92% 1 8% 2 0% x 0.0
			Sumr	mary of I	Normals						'
100	83%	100%	100%	xxxxxxx	100%	100%	100%	92%	*****	100%	92%
			Sur	nmary of	Means						
xxxxxx	x xxxxxx x	*****	0.0	2.5	xxxxxxx	0.0	*****	xxxxxx	1.3	0	0.0
SEX:	M: 20% F	: 100%	U: 0%								
	Normality I				Inde	ex Summai	ry				
Issue	Normality 1	naex:	TX		0.95						
Fat Ind	ex:		FX		2.50						
	dex:										
FINS	NA		GE	ENERAL RE	EMARKS						
SKIN	Single les	ions -	Fish 1,3	8,6; Muli	tiple les	sions - A	ish 2,4	.10			
GONADS	NA										
OTHER	NA										

Qual. Control No.

NA

LC	CATION	:	At	haba	asca Ri	ver	, Sit	e D				QL	JALIT	YC	ONTR	OL I	NO.:	NA	ι.				
SF St Ur Fi Eg Ha Re	Decies: train: ark/Lot: hit: ish Sour gg Sourc atching emarks:	NA ce: Dat	MN NA NA :e: NA	WH ((D) Vild IA IA		Auto Age: Wate Wate Inve Reas	psy NA r Te r Ha stig on f	Date mp.: ardne: gator for Au	N/ SS: Bato	5-16- A NA Na arton psy:	92 Тіз Арр Ин	Dise Ca Dise Ca Dise Ca	Coll ase se f (Pu Ass	Samp lect Sur list Cust urpos	le ion vey ory ody se men	Size: No.: No.: No.: Code: t	NA NA NA NA		10			
== L W K C H L P *Expr *Conv	ength Weight (tl* tl** Hematocri eucocri blasma P ressed a verted f	it t rot	ein (tl ti (tl;	==== 366 638 1 4	EAN 5.250 m 3.420 g 1.300 5.697 NA NA NA 10 to pressed	m ir the i as	fift Ctl	h po	STAI DEV 42 227 0	NDAR IATI 64 48 08 NA NA NA NA	RD ION mm gr	four	•••••		DEFF VAI 12 30 0 0 0 0	ICII RIA 2% 6% 6%	ENT						
222222				==== VA	LUES A	S PI	ERCEN	T OF	TOT	AL 9	SAMPL	iss: E				===	=====		===	====			
EYES N 100 B1 0 E1 0 E1 0 H1 0 H2 0 M1 0 M2 0 OT 0	GILL 3% N 9 3% F 5% C 5% M 5% P 5% OT 5% OT 5% 5% 5% 5% 5% 5% 5% 5% 5% 5%	MI 1 2 3 4 x	ESEN. FAT 0% 33% 67% 0% 2.7	SP B R G NO E OT	PLEEN 83% 0% 17% 0% 0%	0 1 2 x	HIND GUT 100% 0% 0% 0.0	KI N G U OT	DNEY 100% 0% 0% 0% 0%	LIN A C D F OT	/ER 17% 75% 0% 0% 8% 0%	B 0 1 2 3 x	ILE 07 257 757 07 1.8	x0 x0 x0 x0	FI 0 1 1 2 x	N 100% 0% 0% 0	OPE 0 1 2 x	RCLE 100% 0% 0%					
					Sun	mary	y of I	Norm	als														
100	1% 9	2%	1	00%	100%	xx	xxxx		100%		100%		100%		92%	xx	xxxx)		1	100%		100%	
					Su	mma	rv of	Mea	ns								• • • • •			·			
xxxxxx	x xxxxx	xx	xxxxx	xxx	0.0		2.7	xxx	xxxx		0.0	xxx	xxxx	xxx	xxx		1.8			0		0	
SEX:	M: 2	0%	F: 1	00%	U: 0%	===:				.==:		.==:	====										
Ticcuc	Normali	***	Index		TV		,		Inde	ex s	Summan	гy											
TISSUE	NOTINALI	LY	Index	•	57				,														
Bile In	iex: idex:				BX			2.07 1.75															
		===	=====			===:				====				====	===:	.==:		===	===		====	====	.==
FINS	NA				G	ENEF	RAL RE	MAR	KS														
SKIN	Single	le	sion	- Fi	sh 4;	Muli	tiple	les	ions	- F	ish 3	3,5,	6,7,8	3,10)								
GONADS	NA																						
OTHER	NA																						

Qual. Control No. NA

s 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	LGH 373 305 329 326 433 320 355 350 355 357 418	WGT 631 403 422 920 1038 415 570 526 961	Ktl 1.22 1.13 1.28 1.27 1.32 1.40 1.26 1.16 1.32	EYE N N N N N N N N N N N N N N N N N N	GILL N N N N N N N N	PSBR N N N N N N N N N N	THY 0 0 0 0 0 0 0 0 0 0 0 0 0	FAT 2 3 2 2 2 3 3 3 3 3 3 3 3 2 2 3 3 3 3 2 2 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	SPL 8 8 6 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	GUT 000000000000000000000000000000000000	LIV B B B B B B B B B B B B B B B B B B B	BILE 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	SEX M F F M F F F F F F F F F F F F F F F	HEM	LEU	PLPR	FIN 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	OPCL 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
45 46 47 49 51 55 55 55 57 58 50																		

	LOCATION:		Athab	asca Ri	ver,	Sit	еE			(QUALIT	Y C	ONTR	OL I	10.:	NA					
	Species: Strain: Mark/Lot: Unit: N Fish Source Egg Source Hatching D Remarks:	A e: e: bate:	MNWH NA NA	(E) Wild NA NA		Auto Age: Wate Wate Inve Reas	psy NA r Te r Ha stig on f	mp.: rdne: ator or Au	NA N SS: Barto Jtopsy:	-92 T NA 1	issue Dise Ca ppm Health	Col ase se l Pi As:	Samp lect Sur Hist Cust urpo sess	le s ion vey ory ody se (ment	Size: No.: No.: No.: No.: Code:	NA NA NA NA		10			
	Length Weight Ktl* Ctl** Hematocrit Leucocrit	t	38 71	MEAN 7.500 m 9.750 g 1.240 4.480 NA NA				STAI DEV 39 228	NDARD IATION .25 mm .83 gr D.1 NA NA			==== C(DEFF F VA 1 3 N, N,	==== ICIE RIAT 0% 2% 8% A A	ENT TION	===:					
*Ex	pressed as	Ktl	times	10 to	the	fift	h po	wer	NA	<i>f</i> ~	unth m		N.	A							
====	nverted fr		======	Pressed ======= ALLIES A	as ==== s ps				to the		urtn p ======	====	r ====	===:	.====	===:	===:				
EYE N 1 B1 E2 E1 E2 H1 H2 M1 M2 OT	S GILLS 00% N 67 0% F 0 0% C 0 0% M 33 0% P 0 0% OT 0 0% 0% 0% 0%	PSE BRA % N % S % L % S&L % I % OT	UDO- NCHS 100% 0% 0% 0%	THYMUS 0 92% 1 8% 2 0% x 0.1	ME F 0 1 2 3 4 x	SEN. AT 0% 0% 33% 67% 0% 2.7	SP B R G NO E OT	LEEN 58% 33% 0% 0% 0%	HIND GUT 0 100 1 0 2 0 X 0.0		KIDNEY N 92% S 0% M 0% G 0% U 0% T 0%	LI A C D F OT	VER 17% 75% 0% 0% 0%	B1 0 1 2 3 x	LE 0% 8% 92% 0% 1.9		FIN 0 10 1 2 x	0% 0% 0%	0 PE 0 1 2 x	RCLE 100% 0% 0	
	1	I		Sum	mary 	of	Norm 	als		I		1		1		1		I			1
1	00% 67	%	100%	92%	xxx	××××		100%	100	6	92%	<u> </u>	92%	xxx	(XXXX		10	00%		100%	
XXXX	xxx xxxxxx	x xxx	XXXXX	Su 0.1	mmar 	y of 2.7	Mear xxx	ns xxxx	0.0	x)	*****	xx	<xxx< td=""><td> </td><td>1.9</td><td> </td><td></td><td>0</td><td></td><td>0</td><td></td></xxx<>		1.9			0		0	
====	M: 40	=====	=====		====	====:		Inde				===:	====	===:		===:					
Tissu	e Normalit	y Ind	ex:	ТХ		(0.91	Inde	s Summ	ar y											
Fat I	ndex:			FX		â	2.67														
Bile	Index:			BX			1.92														
FINS	NA			G	ENER	AL RE	EMARI	KS									~ ~				
SKIN	Single	lesio	n - F	ish 8; 1	Mult	iple	les	ions	- Fish	6,7	7,9										
GONAD	S Apparen	t tes	ticula	ar cons	tric	tions	5 - 1	Fish	10												

OTHER NA

GILL PSBR THY FAT SPL GUT KID LIV BILE SEX SN LGH WGT Ktl EYE HEM LEU PLPR FIN OPCL 3 335 412 1.10 N 0 В 0 Ν В 2 0 0 N Μ N 3 Ν 2 2 453 3 342 Ν 0 В 0 В F 0 453 1173 1.26 N Μ 0 23 0 R 0 Ν В 2 F 468 1.17 Ν N 0 0 N 0 N F 0 R 392 715 1.19 N Μ N В 1 0 0 5 354 N 0 23 R 0 N A 2 F 0 0 491 1.11 N Ν Ν Ε 2 Ν 0 G 0 Μ 0 369 648 1.29 Ν М 0 23 389 Ν 1 R 0 N В 2 2 M F 748 1.27 N N 0 0 0 0 Ν В 412 932 1.33 Ν Ν N В 0 0 3 3 22 459 952 0.98 N N N 0 В 0 L В F 0 0 0 0 N Ν В А 10 370 611 1.21 N Μ Μ 0 0 22 526 1.16 3 0 N N 357 N N N 0 В В F 0 0 11 12 418 961 1.32 N N N 0 2 В 0 В F 0 0

1

4

6

7

8

9

Qual. Control No.

NA

LC	OCATION	:	,	Athab	asc	a Ri	ver,	Sit	e F				QL	JALIT	r co	DNTR	DL I	NO.:	N	A				
SP S1 Ma Ur Fi Eg Ha Re	pecies: train: ark/Lot nit: ish Sou gg Sour atching emarks:	NA rce: Dat	N N N N N	ANWH NA NA	(F) Vil NA	d		Auto Age: Wate Wate Inve Reas	psy NA r Te r Ha stig on f	Date	: 0 N/ ss: : B uto	5-07- A NA Na arton Dsy:	92 Тіз Арр Не	ssue (Disea Cas math	Soll ase Se H Pu Ass	ect Sur list ust sess	le s ion vey ory ody se (nent	No. No. No. No. Code	: N : N : N : N	A A A A	10			
==		2321			.==				8222	STAI	NDA	===== RD			CC	DEFF		ENT		===	====			
L k C	ength Weight (tl* Ctl**			35/ 59	HEA 3.0 5.3 1.3	N 80 mr 30 gi 00 97	n			DEV: 38. 206. 0.	IAT .99 .67 .08	ION mm gr			OF	VAI 1 3	RIA1 1% 5% 5%	TION						
L L	eucocr	rit it				NA NA					NA NA					N/	4 4							
P *Expr	lasma i	Prot as k	tein (tl t	imes	10	NA to 1	the	fift	h no	wer	NA					N	4							
**Conv	verted	fron	n Ktl	; exp	ore	ssed	as	Ctl	time	s 10	to	the	four	th po	wer									
		====		V/	LU	ES AS	S PE	RCEN	T OF	TOT	AL 9	SAMPLI	==== E			===:	.==:		===	===	====			
EYES N 100 B1 0 E1 0 E1 0 H1 0 H2 0 M1 0 M2 0 OT 0	GILI 0% N (1% F 0% C 0% M 0% OT 0% 0% 0% 0% 0% 0% 0%	YMUS 92% 8% 0% 0.1	ME F 0 1 2 3 4 X	SEN. AT 0% 25% 67% 0% 2.6	SP B G NO E OT	LEEN 25% 75% 0% 0% 0%	0 1 2 x	11 ND SUT 100% 0% 0%	KI N G U OT	DNEY 92% 0% 0% 0%	LIV A B C D E F OT	ER 17% 83% 0% 0% 0% 0%	B1 0 1 2 3 x	LE 17 50 33 0 1.2	%	F 0 1 2 x	IN 100% 0% 0	OPE 0 1 2 x	RCLE 100% 0% 0%					
	1	1				Summ	nary	of	Norm	als														
100)%	92%		100%		92%	xxx	xxxx		100%		100%		92%	1	00%	xxx	(XXX)	x		100%		100%	
						Sun	nmar	y of	Mea	ns														
*****		xxx	xxxx	xxxx	(0.1		2.6	xxx	xxxx		0.0	xxx	xxxx	xxx	xxx		1.2			0		0	
SEX:	M: 4	40%	F:	80%	U:	0%																		
					==:			====:		Inde	ex S	ummar	==== ^у	====:		===:		===:	===:				====	
Tissue	Normali	ity	Inde	x:	T)	<		(0.97															
Fat Ind	lex:				F)	(1	2.58															
Bile In	dex:			=====	B)	(1.17															
FINS	NA					GE	NER	AL RE	MARI	KS														
SKIN	Multip	ole	lesi	ons -	Fi	ish 2	,9																	
GONADS	NA																							

OTHER NA

Qual. Control No. NA

SN L 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 9 20 21 22	GH 418 316 343 327 333 347 338 418 418	WGT 891 428 502 395 472 465 472 465 477 371 914 722 526 961	Ktl 1.22 1.36 1.24 1.13 1.29 1.35 1.29 1.28 1.16 1.32	EYE N N N N N N N N N N N N N	GILL N F N N N N N N N N	P S B R N N N N N N N N N N N N N N N N N N	THY 1 0 0 0 0 0 0 0 0 0 0 0 0 0	FAT 3 2 3 1 2 3 3 3 3 3 2 2	SPL R R R R R R R R B B B	GUT 0 0 0 0 0 0 0 0 0 0 0 0 0 0	KID N L N N N N N N N	LIV A B B B B B B B B B B B B B B B B B B	BILE 2 1 0 1 2 1 1 1 1 2 2	SEX F M F F F F F F	HEM	LEU	PLPR	FIN OPC	
23 24 25 26 27 8 29 30 31 32 33 34 56 37 8 9 40 41 23 44 45 46 47 88 95 51 52 53 54 55 67 58 960																			

APPENDIX II

CODING SYSTEM USED FOR AUTOPSY FEATURES SUMMARY PROGRAM DATA ENTRY


APPENDIX II

CODING SYSTEM USED FOR AUTOPSY FEATURES SUMMARY PROGRAM DATA ENTRY

- Eyes: Normal (N), Exophthalmia (E1, E2), Hemorrhagic (H1, H2), Blind (B1, B2), Missing (M1, M2), Other (OT)
- <u>Gills</u>: Normal (N), Frayed (F), Clubbed (C), Marginate (M), Pale (P), Other (OT)
- <u>Pseudo-</u> <u>Branch:</u> Normal (N), Swollen (S), Lithic (L), Swollen and Lithic (S&L), Inflamed (I), Other (OT)
- <u>Thymus</u>: No hemorrhage (0), Mild hemorrhage (1), Severe hemorrhage (2)
- Mesentery Internal body fat expressed with regard to amount present; Fat:

0 - None

- 1 Little, where less than 50% of each caecum is covered
- 2 50% of each caecum is covered
- 3 More than 50% of each caecum is covered
- 4 Caeca are completely covered by large amount of fat
- Spleen: Black (B), Red (R), Granular (G), Nodular (NO), Enlarged (E), Other (OT)
- <u>Hind Gut</u>: No inflammation (0), Mild inflammation (1), Severe inflammation (2)
- Kidney: Normal (N), Swollen (S), Mottled (M), Granular (G), Urolithic (U), Other (OT)
- Liver: Red (A), Light red (B), "Fatty" liver; "coffee with cream" colour (C), Nodules in liver (D), Focal discolouration (E), General discolouration (F), Other (OT)
- <u>Bile</u>: 0 Yellow or straw colour; bladder empty or partially full
 - 1 Yellow or straw colour; bladder full, distended
 - 2 Light green to "grass" green colour
 - 3 Dark green to dark blue-green colour
- <u>Fins</u>: No active erosion or previous erosion healed over (0), Mild active erosion with no bleeding (1), Severe active erosion with hemorrhage and/or secondary infection (2)
- <u>Opercles</u>: No shortening (0), Mild shortening (1), Severe shortening (2)

APPENDIX III

LEGEND FOR PHOTOGRAPHIC SLIDES SUBMITTED TO NRBS OFFICE

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APPENDIX III SPRING 1992 SPECIAL FISH COLLECTIONS ATHABASCA RIVER LEGEND FOR PHOTOGRAPHIC SLIDES SUBMITTED TO NRBS OFFICE

I-1	Site F - launch site looking downstream		
I-2	Site F - launch site looking upstream		
I-4	Site F		
I-5	Sampling equipment and layout - boat deck		
I-6	Tissue sampling		
I-7	SR-18 Sampling boat		
I-8	F-I-9 - lesion		
I-9	F-I-9 - lesion		
I-10	Site E - launch site looking downstream		
I-11	Site E - launch site looking upstream		
I-12	E-I-4 - gill margination/focal necrosis		
I-13	Tissue sampling - gut		
I-14	Site E		
I-15	E-II-1 - lesion on side		
I-16	Sampling equipment and layout - deck		
I-17	Sampling equipment and layout - live well		
I-18	E-I-10 - lesions		
I-19	E-I-10 - gonadal abnormality/constrictions?		
I-21	F-II-1 - open lesion or wound		
I-22	F-II-6 - extremely enlarged gall bladder		
I-23	F-II-8 - multiple open lesions		
I-24	F-II-8 - open lesion		
I-25	F-II-8 - liver cyst		
I-27	Site F - backwater		
I-29	B-I-3 - multiple lesions		
I-30	B-I-3 - multiple lesions		

I-31	B-I-5 - belly lesion	
I-32	Site B	
I-33	Site B	
I-34	Site B	
I-35	Site B - launch site looking upstream	
I-36	River between sites A & B, upstream of Hinton	
I-37	Site A - Hwy 40 Bridge	
II-2	Tissue sampling - muscle fillets	
II-3	Site A near Brulé Lake	
II-5	Sampling equipment - boat	
II-6	Sampling equipment - boat deck layout	
II-7	Sampling equipment - live well layout	
II-9	B-I-10 - opercle ulcer or damage	
II-10	B-II-2 - eye abnormality/exopthalmia and cataract	
II-12	C-I-2 - belly lesions	
II-13	C-I-3 - blister on right opercle	
II-14	Site C - Obed Mtn. Coal Bridge	
II-15	Site C	
II-16	C-I-10 - hemorrhagic lesion	
II-17	C-I-10 - hemorrhagic lesion	
II-19	Site C	
II-20	Site C - Obed Mtn. Coal Bridge	
II-21	D-I-5 - multiple belly lesions	
II-22	D-I-5 - multiple belly lesions	
II-23	Site D	
II-24	Site D - Emerson Lakes Bridge	
II-25	D-I-8 - lesion at pelvic fin base	
II-26	D-I-10 - lesion at pelvic fin base	
II-29	Site A - Brulé Lake	
II-30	Site A	

II-31 Site A

The following numbers did not turn out and were discarded:

I - 3, 20, 26, 28 II - 1, 4, 8, 11, 18, 27, 28

Original slides are being retained for reference by the NRBS office.

APPENDIX IV

TERMS OF REFERENCE

NORTHERN RIVER BASINS STUDY

SCHEDULE OF TERMS OF REFERENCE

PROJECT 3119 - RAP - SPECIAL FISH COLLECTION

GENERAL OBJECTIVES

- A. To collect 120 fish from the upper reach of the Athabasca River (near Hinton) to meet the specialized fish sample requirements of other directed contaminant and fish health studies as follows:
 - a) Selected chemical contaminants in fish:
 - samples for 120 analyses of fish muscle and liver tissues.
 - b) Contaminant induced stress in fish:
 - 120 samples for assessment of Mixed Function Oxidase (MFO) enzyme induction.
 - 120 samples for assessment of Gonads and sex steroids.
 - c) Food web and fish migrations based on stable isotopes.
 - 120 samples for assessment of stable isotopes in sample tissue and gut contents.
 - 120 samples for gut content identification.
- B. To prepare collected fish samples in accordance with prescribed protocols, and to deliver to Alberta Environment for temporary storage and subsequent distribution to selected laboratories.

Contractor will:

- 1. Have the field crew members assigned the responsibility for sub-sampling captured fish, demonstrate their techniques, in accordance with the protocols described in schedule B to Study Office staff prior to initiation of the field program.
- 2. Collect fish samples of the species, in the quantities and at the locations described in Schedule A.
- 3. Sub-sample, preserve, label and transport the samples in accordance with the protocols outlined in Schedule B. These samples are required for the Representative Area Program (RAP) investigations listed below:
 - Chemical contaminants in fish.
 - Contaminant induced stress in fish.
 - Food web and fish migrations based on stable isotopes.

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- 4. Collect fish using capture methods and equipment required to honour the protocols described in Schedule B.
- 5. Transport and deliver in a timely and competent manner, fish samples, according to procedures outlined in Schedule B, all the while ensuring the integrity and continuity (i.e., document possession and transfer) of the samples are safeguarded.
- 6. Complete field collection prior to the onset of historical high spring flows and endeavour to complete the collections in the shortest interval of time practical.
- 7. Prepare DRAFT and FINAL reports in a generally accepted format for reporting a project of this kind. The reports are to include among other things:
 - a) methods used to capture, process and transport samples;
 - b) specifics on each sample taken as to date, location (legal land, latitude and longitude), method of capture, species, length of time to process a specific sample from time to capture, length-weight and age of fish, general condition of fish (externally and internally) making note of any abnormalities;
 - c) analysis of field collections, with recommendations on the method and direction of future collections;
 - d) photographic documentation of methods, equipment and processing setup.

Ten copies of the draft report are to be received by the Northern River Basins Study office by June 15, 1992.

Ten copies of the final report are to be received by the Northern River Basins Study office two weeks after the receipt of comments on the DRAFT report.

8. Subject to prior approval from the Department, payment will be made based on monthly invoices submitted up to the maximum contract amount of \$40,045.

NORTHERN RIVER BASINS STUDY

PROJECT 3119 - RAP - SPECIAL

SCHEDULE A LOCATION AND QUANTITY OF FISH TO BE COLLECTED

- 1. The study area stretches from the outfall of Jasper Lake to Windfall bridge west of Whitecourt. See attached Northern River Basins Study map of the upper Athabasca River. Sampling sites should be chosen for their suitability, but should be located in the vicinity of the following six sites:
 - near, Entrance (near Highway #40 Bridge)
 - Weldwood Haul Bridge
 - Obed Mountain Coal Bridge
 - Emerson Lakes Bridge
 - near Berland River
 - Windfall Bridge

Sampling should be conducted in early April before river flows increase in mid-spring (normally before late April - early May).

- 2. It is essential that the same two fish species be sampled at all six sampling sites. Both a bottom feeder and a piscivorous fish species are required. Mountain whitefish has been selected as the bottom feeding species. The piscivorous species has not been selected, however, one of bull trout, northern pike or burbot must be utilized. Data and information collected during the general fish surveys, in the upper reach of the Athabasca River, are to be used in selecting the piscivorous species. This information will be made available by the contractor responsible for this portion of the general survey.
- 3. At each of the six sites, ten (10) individuals of the largest size class (adult) of mountain whitefish and ten (10) individuals of the largest size class (adult) of the selected piscivorous fish species are to be collected (a total of 120 fish), and sub-sampled in accordance with Schedule B.
- 4. In the event that difficulty is experienced in collecting the desired species and size class at the stipulated six sites, the contractor is to consult (e.g., by phone) with the study office. Any deviation from the above requirements must be approved in advance.

NORTHERN RIVER BASINS STUDY

SUB-PROJECT 3119 - RAD - SPECIAL FISH COLLECTION

SCHEDULE B COLLECTION PROTOCOL

STANDARD OPERATING PROCEDURES REPRESENTATIVE AREA PROGRAM PROJECTS

- 1. Fish may be collected using a variety of techniques including:
 - Electro-fishing
 - Trap nets
 - Gill nets
 - Seines
 - Set lines
 - Angling

2. It is important to obtain blood and tissue sub-samples for analyses from <u>live fish only</u>, which have experienced minimum handling stress. This requirement places certain restrictions on the use of the various collection techniques, namely

i) Electro-fishing:

Blood samples must be taken within 15 to 20 minutes, immediately followed by the remaining sub-sampling as described below.

ii) Overnight trap net sets:

With the exception of whitefish, it is acceptable to obtain blood samples from live fish caught in overnight sets.

iii) Gill nets, seines and set lines:

When nets and set lines are used, they are to be set when the desired species are most active (one hour before and after sunset for many species). They must be lifted or checked every 30 minutes to remove fish while they are still alive.

iv) Angling:

Angling is acceptable as long as fish are rapidly landed.

- 3. A sample numbering system must be designed and used to facilitate tracking of sub-samples from the same fish.
- 4. Captured fish must be immediately anaesthetized in the boat using MS222.

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- 5. Immediately remove blood from the caudal vessels of the anaesthetized fish using a separate heparinized needle for each fish.
- 6. Transfer each blood sample to an appropriate stoppered centrifuge tube, label and store it and fish together on ice until they are transported to shore. Within 15 minutes after blood removal, transport fish and blood to shore.
- 7. On shore centrifuge blood, aspirate plasma into appropriate labelled storage tubes and freeze on dry ice within 15 minutes.
- 8. Record the fish length and weight.
- 9. Examine fish for external lesions and record any abnormalities. Complete the Gross Pathology Sheet (Appendix 1).
- 10. Open fish ventrally and examine fish for internal lesions and record any abnormalities.
- 11. Remove liver, weigh and record weight. Livers must be sub-sampled immediately. Mixed-function oxidase (MFO) activity decreases and the variability increases within 15 minutes of death, depending on external temperatures. Remove gall bladder and store in cryovial, specifically labelled and frozen. Livers must be removed carefully, avoiding the rupture of the gall bladder and avoiding contact with bile.
 - a) Take a 1.0g sample (if liver 5.0 g or larger increase sample size to 2.0g) of the liver for MFO analysis.
 - b) Each sample must be rinsed with cold 0.15m KCl to remove traces of blood and bile.
 - c) Each sample must then be placed in a cryovial, specifically labelled and frozen on dry ice.

For tissue storage, all MFO samples must be stored and maintained at -60° C or lower; storage at -20° C is not acceptable.

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- 12. Score each fish for gender and for state of sexual development.
- 13. Remove gonads, weigh and record the weight. Each gonad sample must then be prepared and stored as follows:

<u>Materials</u>

HistoPrep Tissue Capsules (disposable polypropylene) 38 x 8 mm (Dia XH) are used in preserving and processing tissues. Pertinent information (e.g., fish sample number) and identification of the specimen should be written on each capsule with an HB pencil. The capsules are available from Fisher Scientific, product number 15-182-218.

Nalgene Square Polyethylene wide mouth bottles (Ngle 2114) of 1 litre capacity have proven to be excellent for field sampling simply because they do not leak. Bottles containing about 750 ml of Davidson's solution are packed (2 to a bag) in plastic bags (14" \times 22") and secured with masking tape for transportation. The bottles are available from Fisher Scientific, product number 03-3120.

Davidson's fixative is used to preserve the pieces of gonads that have been removed from fish within 15 minutes of being brought ashore. Tissue capsules containing gonad samples are immersed in this solution for at least 24 hours and can be stored for several weeks. The Davidson solution can be prepared as follows:

95% ethyl alcohol	300.0 mL
formaldehyde	200.0 mL
glacial acetic acid	100.0 mL
distilled water	300.0 mL
glycerine	100.0 mL

These ingredients should be adequately stirred.

A 5% buffered formalin solution is also used to preserve pieces of ovary. When fresh eggs are placed directly into 5% buffered formalin, there is no significant alteration in egg weight. Labelled tissue capsules are used to hold and identify each sample. The formalin is made up as follows:

formaldehyde	50.0	mL
sodium phosphate monobasic		g
sodium phosphate dibasic	6.5	g
distilled water add to make 1 litre		

Procedure for Fixation:

One litre Nalgene bottles containing 750 mL Davidson's and 5% formalin solutions are readied. After weighing the gonads, pieces are dissected out with a scalpel. Generally, the mid-region of the gonad from one side, i.e., the left gonad is used from each fish (Burbot - take what is available). It is important that the tissue pieces do not exceed 0.5 cm in thickness but may be slightly larger (usually not greater than 1.0 cm) in the other dimensions. The tissue pieces should easily fit into the tissue capsules without being squashed, and should not take up more than half the capsule space. If a sensitive analytical balance is available, the piece of tissue to be placed in formalin can be weighed and the weight recorded (two decimal places) in a notebook and on the capsule. A capsule containing tissue should be placed into each of the fixatives and with forceps, momentarily submersed (the tissue capsules tend to float in the fixatives). No more than 24 tissue capsules are placed in each 1 litre bottle to ensure adequate fixative volume. If the eggs in an ovary are large (>3.0mm), additional samples can be taken from the same fish to ensure an adequate number of these eggs will be taken.

- 14. The remaining portion of the liver with gall bladder removed is to be saved for contaminant analysis. The sample should be placed in a specifically labelled Fisheries and Oceans recommended contaminant free plastic bag. Then frozen on dry ice.
- 15. Gut contents from each fish are to be saved. Samples are to be placed in clean labelled containers (e.g. whirlpak bags) and frozen at -20°C. Each sample will subsequently be used to determine stable carbon, nitrogen and sulphur isotopes so contamination must be avoided. Formaldehyde and ethyl alcohol or liquids high in nitrogen, carbon and sulphur must not be used.
- 16. Take whole muscle fillets for contaminant and stable isotope analysis. The whole fillets are to be weighed and then placed in a specifically labelled Fisheries and Oceans recommended contaminant free plastic bag and then frozen on dry ice. Record the weight.
- 17. Remove the otolith for subsequent ageing. Place each sample in a specifically labelled whirlpak bag and freeze.
- 18. The use of dry ice for initial freezing and shipping is mandatory.
- 19. The use of sturdy styrofoam coolers is most practical and is recommended. Styrofoam coolers of weak construction may not assure constant freezing and may break down during shipping. Coleman type coolers may be used but not necessarily be returned immediately for repetitive use. The Contractor is responsible for picking up coolers when notified by Alberta Environment.
- 20. Place dry ice both on top and bottom of coolers to assure that no freezethaw cycles will occur during transport.
 - N.B.: Any freeze-thaw, however moderate it may be, will cause contaminant migration within a sample and this may affect contaminant concentration levels in tissues.

21. Ship frozen samples and this may affect contaminant concentration levels in tissues as soon as possible or, if not possible, the majority of samples must be kept frozen in a freezer at -20°C until shipping. Samples of liver tissue for MFO analysis must be stored at -60°C or colder. Samples should be shipped to:

> Alberta Environment c/o Sub Ramamoorthy or E. Baddaloo Standards Development Office Oxbridge Place 9820 - 106 Street Edmonton, Alberta T5K 2J6 (403) 427-6102

- 22. Any deviation from the above established protocol/procedure should be justified and accounted for in writing and a detailed description of what was done is to be submitted with the fish sample; this is to assure credibility and validity of results.
- 23. Develop a photographic record of equipment and techniques to capture and process fish samples. As appropriate, take close-up photographs of fish exhibiting internal and/or external abnormalities. Use 35 mm, 200 ASA Fuji slide film in a camera having a 50-55 mm lens. Maintain records to associate photographs with sample material.

Appendix 1

NORTHERN RIVER BASINS STUDY EXAMINATION SHEETS GROSS PATHOLOGY

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		DATE:
SAMPLE	E NO.:	LOCATION:
SPECIES	ES: C.	APTURE METHOD:
CAPTURI	RE TIME: E	XAMINATION TIME:
GROSS 1	EXTERNAL EXAMINATION	
Skin:	 () Normal () Excessive mucus () Lesions () Single () Open () Haemorrhagic () Blister () Tumour) Abnormal Colour) Multiple () Closed) Necrotic () Ulcer) Lost Scales () Abrasions
	Location:	
	Wet mount/smear:	
Eyes:	() Normal () Exophthalmia (() Opaque cornea () Lens lost () Cataract () Haemorrhagic) Parasites () Bilateral
Fins:	() Normal () Frayed(() Eroded () Deformed
	Wet mount/smear:	· · · · · · · · · · · · · · · · · · ·
Gills:	: () Normal () Pale (() Necrotic () Excessive mucus () Telangiectasia () Gas emboli (() Large Parasites () Mottled () Haemorrhagic () Hyperplasia) Cysts) Fungus Visible
	Wet amount/smear:	
GROSS I	INTERNAL EXAMINATION	
Adipose	se Tissue: () Normal () Excessive () Red () Colour () Cys	duced () Petechial Haemorrhagic sts
Liver:	: () Normal () Enlarge () Red () Other Texture: () Lesions: () Single () Multiple () Necrotic () Haemorrhagic () Cys	duced Colour: () Pale () Mottled () Tumour st (parasite) () Cyst (Fluid)
Spleen:	a:	
	() Normal () Enlarged (() Cyst(parasite) () Cyst (fluid) () Reduced () Raspberry surface) Colour
	Stained smear:	
Intesti	tines: () Normal () Distended (fluid) (() Flaccid () Haemorrhagic () Distended (mucoid)) Cysts(parasite) () Tumour
Kidney,	7, Posterior: () Normal () Enlarge () Les () Multiple () Gritty, white () Cys () Tumour	sions () Single st (parasite) () Cyst (fluid)
	Stained smear:	
OTHER:		
N.B.	In the event that a significant number of spe contractor is asked to immediately notify t	ecimen at any site have abnormalities, the the Study Office.

contractor is asked to immediately notify Phone: 427-1742 or fab to 422-3055 3 1510 00135 2823



