Canada Alberta Northwest Territories

Northern River Basins Study
















Prepared for the
Northern River Basins Study
under Project 3119-B2

by
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NORTHERN RIVER BASINS STUDY PROJECT REPORT NO. 10

SPECIAL FISH COLLECTIONS
UPPER ATHABASCA RIVER
SEPTEMBER AND OCTOBER, 1992

Published by the
Northern River Basins Study
Edmonton, Alberta, Canada
June, 1993

CANADIAN CATALOGUING IN PUBLICATION DATA

Barton, B. A.

Special fish collections, Upper Athabasca River,
September and October, 1992

(Northern River Basins Study project report,
ISSN 1192-3571 ; no. 10)
Includes bibliographical references.
ISBN 0-662-20768-8
DSS cat. no. R71-49/3-10E

1. Fishes -- Environmental aspects -- Alberta --
Athabasca River. 2. Fishes -- Alberta --
Athabasca River -- Effect of water pollution on.
I. Patan, D.J. (Daniel J.) II. Seely, L. (Layne)
III. Northern River Basins Study (Canada)
IV. Title. V. Series.

QL626.5A42B37 1993 597.09712 C93-099606-2

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.

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PROJECT REPORT RELEASE FORM

This publication may be cited as:

Barton, B.A., Patan, D.J., and Seely, L., Environmental Management Associates, *Northern River Basins Study Project Report No. 10, Special Fish Collections, Upper Athabasca River, September and October, 1992*, Edmonton, Alberta, Canada, June, 1993.

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SPECIAL FISH COLLECTIONS
UPPER ATHABASCA RIVER
SEPTEMBER AND OCTOBER, 1992

STUDY PERSPECTIVE

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

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?*

This report chronicles the fall 1992 sampling program on the upper Athabasca River between the boundary of Jasper National Park and the Windfall Bridge crossing (upstream of the Alberta Newsprint Mill at Whitecourt). Fish tissues collected under this program augment other "mediums" (eg. sediment, water and benthos) sampled and analyzed for a variety of contaminants. As a consequence of experiences encountered with the spring program, suckers were also collected in addition to mountain whitefish and northern pike.

Aside from some anecdotal fish life history information, nothing unusual was noted with the condition and health of the collected fish species . Investigators did note a general movement of species downstream into "holding" water areas that exhibit a greater water depth than other riverine habitat.

Future sampling programs on the Athabasca, Peace and Slave rivers depend on the analytical findings of the tissues collected by this and the spring sampling program. This body of work will enable some seasonal comparison to be done as well with some parallel work being done on the mid-Athabasca River by Alberta-Pacific Forest Industries Inc. and on the Wapiti-Smoky rivers by Weyerhaeuser Canada Ltd. Similar studies from other parts of Canada would support efforts in designing future sampling/monitoring programs.

EXECUTIVE SUMMARY

A special fish collection was made in the upper Athabasca River in the fall 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 collected 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 = 23). Similarly, adequate numbers of white suckers (*Catostomus commersoni*) were only obtained from the lowermost sites (total n = 26). As a substitute species for white sucker, longnose suckers (*Catostomus catostomus*) were collected from all sites (total n = 57).

A higher frequency of abnormalities, including skin lesions, was observed in mountain whitefish at some sites downstream of Hinton than at the upstream site but generally, the frequency of abnormalities was lower in the fall than in the spring. Higher levels of body fat were also recorded in downstream mountain whitefish than in those upstream but, overall, fat levels were considerably lower than in spring samples. 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 in relatively low numbers included: bull trout (*Salvelinus confluentus*), rainbow trout (*Oncorhynchus mykiss*), Arctic grayling (*Thymallus arcticus*), lake whitefish (*Coregonus clupeaformis*), and burbot (*Lota lota*).

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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 Reach Specific Studies program of the Northern River Basins Study (NRBS), a special fish collection was made in the fall of 1992 to assess contaminant loading, selected physiological indicators of contaminant exposure and stress, and food web components. This collection was similar in nature to the one made in the spring of 1992 (Barton et al. 1993). 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, (2) autopsy collected fish to determine incidence of abnormalities and other indices of health and condition, and (3) prepare blood and tissue samples as required from collected fish for delivery to NRBS in care of Alberta Environment scientists for subsequent distribution to selected laboratories.

2.0 METHODS AND RESULTS

2.1 SAMPLE SITES

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

- Site G - Near Entrance (near Highway 40 bridge upstream of Mosquito Creek)
- Site H - Below Weldwood Haul Bridge at Hinton
- Site J - Above and below Obed Mountain Coal Bridge
- Site K - Above and below Emerson Lakes Bridge
- Site L - Below Berland River confluence (bridge crossing)
- Site M - Above and below Windfall Bridge (Windfall Junction upstream of Whitecourt)
- Site N - Rock Lake as reference site

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. The river sites were the same as those used in the spring collection (Barton et al. 1993); sites G through M are the same as sites A through F, respectively, and were designated as such to avoid confusion with the spring program. Rock Lake (Site N) is accessible by two well-maintained boat launch sites within an established campground.

All species were collected in the same vicinities as described for mountain whitefish (*Prosopium williamsoni*) in the spring 1992 collection; latitude and longitude, and legal and UTM coordinates of the areas incorporating those sites (i.e., upstream and downstream limits of site) are listed in Table 1 (Site N not included as no fish were collected there).

TABLE 1

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

SITE	LATITUDE - LONGITUDE		LOCATION OF BLOCK INCORPORATING SITES			
	DOWNSTREAM	UPSTREAM	LEGAL		UTM	
			NE CORNER	SW CORNER	NE CORNER	SW CORNER
G	53°23' - 117°42'	53°21' - 117°46'	SW/NE 1/51/26/W5	SE/SW 32/50/26/W5	453820/5914210	448750/5911490
H	53°28' - 117°28'	53°26' - 117°33'	NW/SE 4/52/24/W5	NW/SE 25/51/25/W5	468690/5923180	463550/5920100
J	53°31' - 117°22'	53°31' - 117°23'	SW/NW 29/52/23/W5	NW/NE 19/52/23/W5	475890/5930100	475180/5929000
K	53°42' - 117°10'	53°40' - 117°10'	NE/NW 27/54/22/W5	SE/NW 15/54/22/W5	489410/5949720	489480/5946170
L	54°03' - 116°47'	54°00' - 116°50'	NE/SE 29/58/19/W5	NE/SW 13/58/20/W5	514600/5987900	510650/5984480
M	54°11' - 116°01'	54°13' - 116°07'	NE/NW 27/60/14/W5	SW/SW 13/60/15/W5	564240/6008350	557350/6003980

2.2 FISH SAMPLING

All fish were collected by electrofishing using a Smith-Root Model SR18 equipped with Yamaha 90 hp outboard jet-drive. Mountain whitefish, designated as Species I, were collected at all river sites but were not found in Rock Lake in the areas searched (shallows around mouth and into inlet for >1 km). Dangerous wind conditions prevented sampling Rock Lake itself for other species, although northern pike (*Esox lucius*) were observed; the lake was only visited once. Northern pike, designated as Species II, and white sucker (*Catostomus commersoni*), designated as Species III, were caught at downstream sites but were sparse or not found at upstream sites. As a result of failure to collect sufficient numbers of white suckers, longnose suckers (*Catostomus catostomus*), designated as Species IV, were selected as an alternative species after discussion with NRBS (K. Crutchfield, personal communication). Dates of sampling and actual electrofishing effort are described in Table 2.

Initially, the intent was to capture a sufficient sample (10) of the largest age or size class. However, as in the spring collection, it was 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. Relative abundance and distribution of fishes were similar to what was found in the spring except that northern pike and white suckers appeared to be less common. Thus, sampling focused on collecting mature adults of each species.

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 fish for sampling was obtained. Fish were placed immediately after capture into a 200-mg/L solution of tricaine methanesulphonate (MS222) for blood and tissue sampling (Figure 1). This dosage has been found to be effective for routine sampling of

TABLE 2

SAMPLING DATES AND ELECTROFISHING EFFORT (ACTUAL TIME ELECTRIC CURRENT APPLIED; * - TIMER NOT WORKING) DURING FALL 1992 SPECIAL FISH COLLECTIONS IN THE UPPER ATHABASCA RIVER

SITE	DATE SAMPLED	SPECIES SOUGHT	ELECTROFISHING EFFORT (SEC)
G	26 September	I	*
	8 October	II, III	2 791
	9 October	II, IV	2 307
H	25 September	I	*
	7 October	II, III	3 424
	11 October	II, IV	1 542
J	27 September	I	*
	7 October	II, III	see H
	10 October	II, IV	2 525
K	28 September	I	4 875
	6 October	II, III	5 368
	12 October	II, IV	1 218
L	30 September	I, II	1 891
	3 October	II, III	1 813
	4 October	III	2 397
	14 October	IV	616
M	1 October	I, II	678
	2 October	II, III	1 733
	5 October	III	538
	13 October	IV	1 325
	15 October	IV	2 621
N	29 September	I	2 679

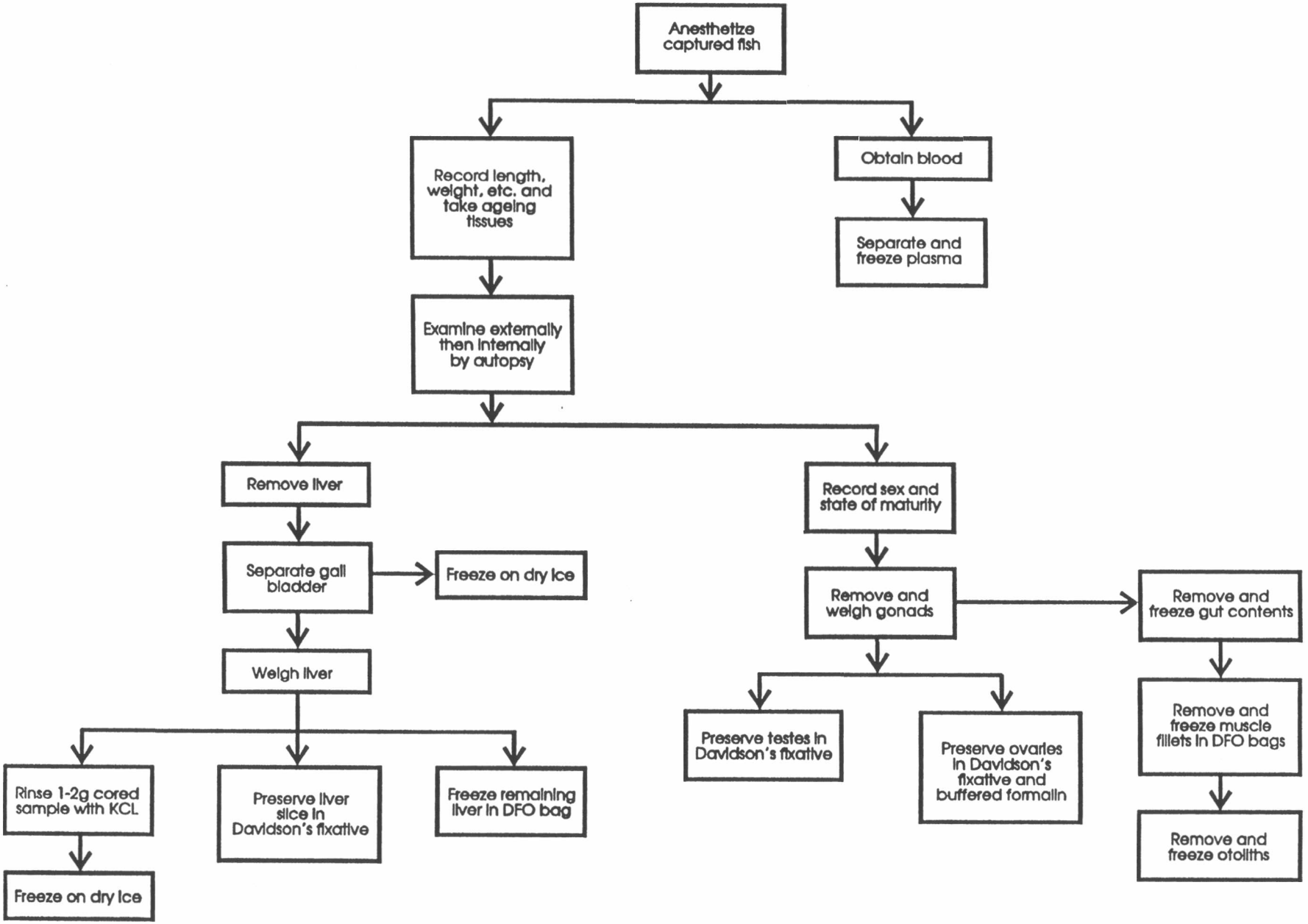


Figure 1. Flow chart describing blood and tissue collection protocol.

blood to measure chemical constituents in stress-related studies (Wedemeyer et al. 1990). 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, gall bladder 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).

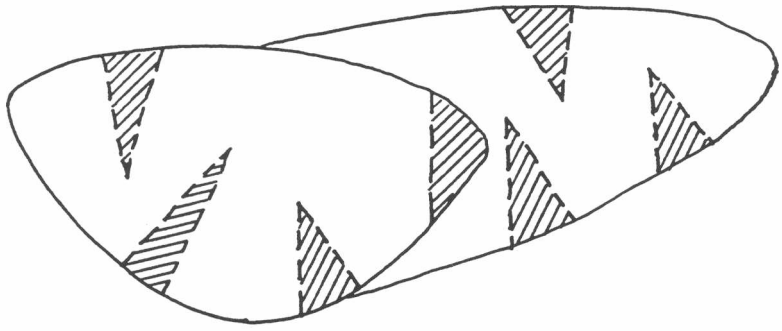
After measuring (fork length) and weighing, about 2 mL of blood was obtained from the caudal vasculature with a 3-mL syringe equipped with a 20-gauge needle inserted ventrally midline posterior to the anal fin (Houston 1990). Syringes and needles were prerinsed with a 4% (w/v) solution of sodium heparin to prevent blood clotting. Within about 15 min of removal, blood was centrifuged using a Millipore Capsule HF-120 portable centrifuge powered by a 1000-W portable Honda generator. About 0.5-1 mL of plasma was extracted from each sample with a Pasteur pipet, stored in a 1.5-mL microfuge tube, and frozen on dry ice.

After blood sampling, the fish was examined externally for lesions and abnormalities and then autopsied externally and internally following a standard procedure (Goede and Barton 1990). The autopsy system used is a simple empirical approach based on a systematic standard set of observations of signal organs and tissues. The method is a population approach and assumes that a normal appearance of vital organ systems in a majority of the fish sampled indicates that the population is healthy or "in harmony" with its environment. This method further assumes that any challenge to the fish has not persisted long enough to result in obvious structural changes. Health/condition summary reports were prepared from autopsy data with Lotus 123-based software developed for that purpose (Goede and Houghton 1987).

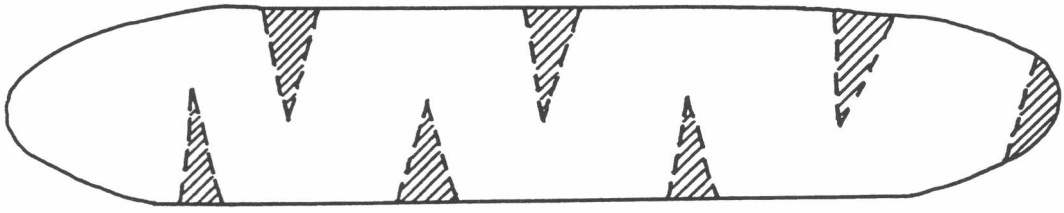
The liver was then removed and the gall bladder carefully separated and frozen on dry ice in either a 4-mL cryovial or, when too large to fit in a cryovial, in a small Whirlpac bag. In some instances, gall bladders were empty of bile likely because the fish had recently fed; although some of these were not kept, many were as trace amounts of bile sufficient for analysis may be present.

The liver was weighed (to 0.1 g) on an electronic balance and then subsampled as required for analysis. Pieces of liver tissue up to 1-2 g (or more) were removed from the liver, rinsed with cold 0.15-M potassium chloride (KCl) solution, placed in a labelled 4-mL cryogenic vial, and stored immediately on dry ice.

Initially, attempts were made to obtain random cores of tissue from the liver using a sharp stainless steel corer. This approach was not found to be feasible under the field conditions (sometimes freezing) and time constraints; specifically, we experienced some difficulty extracting sufficient cored tissue from the corer and then cleaning the corer thoroughly for the next sample in a timely way. As liver MFO activity is extremely time sensitive, particularly at temperatures above freezing, a more rapid alternative method was adopted. Five to seven small wedges of tissue were cut from the liver at approximately equidistant locations around the entire organ and/or from the ends, and pooled to form a single sample. We attempted to keep this method consistent throughout the entire sampling program. While this method of liver tissue sampling was effective for mountain whitefish and northern pike (Figure 2), it was not for suckers because of the different anatomical structure of their liver. The liver in suckers tends to be "intertwined" with the anterior part of the intestinal tract, which necessitated removing and uncoiling the entire tract and then teasing the liver tissue from it. Extra care was taken during this process not to slit the intestinal wall because of the visibly high amount of bile present in the gut of actively feeding fish. The removed sucker liver tissue was then collected and small portions "randomly" removed to provide a pooled sample.



A. Mountain Whitefish



B. Northern Pike

Figure 2. Diagrammatic representation of livers from mountain whitefish and northern pike illustrating tissue sample removal for MFO analysis.

Three or four small slices or pieces of liver tissue were placed in a HistoPrep capsule and preserved in Davidson's fixative. The remainder of the liver was stored frozen in a resin-free plastic bag approved by Department of Fisheries and Oceans (DFO) and provided by NRBS for subsequent contaminant analysis.

After sex and state of maturity was assessed, both gonads were removed in their entirety and weighed (to 0.1 g) on an electronic balance. Three sections of the left male or female gonad, were removed from the centre portion of the gonad and stored in separate HistoPrep capsules in Davidson's fixative (subsamples were designated as "a, b, and c" along with sample numbers on capsules). Three similarly sized pieces of ovary were removed from mature females and stored in 5% buffered formalin solution, following the same protocol.

Contents of the digestive tract (esophagus, stomach, and intestine) of each fish was carefully extruded, where possible, into a labelled, plastic Whirlpac bag and stored frozen. (For one sample [M-IV-6], intestinal tissue was included with the gut contents as the entire intestine froze in air before contents could extruded.) When stomachs were too full to extrude the contents (e.g., mountain whitefish, northern pike), stomach walls were slit and the contents removed with the flat side of a clean knife blade. Muscle fillets were removed from each fish with a stainless steel knife, weighed (to 0.1 g), and stored on dry ice in labelled, resin-free, DFO-approved bags. To minimize the risk of contamination, muscle tissue was weighed after being placed in the bag and the bag weight subsequently subtracted. All muscle samples should be re-weighed before analysis as it was often difficult to obtain accurate bag weights because of field conditions (e.g., wind).

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, cleithra from northern pike, and pectoral fin rays from both sucker species. Fish were later aged using the otoliths

for mountain whitefish, cleithra for northern pike, and cross-sections of the proximal end of pectoral fin rays for suckers, prepared using methods described by Mackay et al. (1990). Moutain whitefish and northern pike were aged by Alberta Fish and Wildlife Division, and white and longnose suckers by EMA staff.

Disposable latex gloves were worn for sampling and were changed for each fish. Instruments were washed with water, rinsed with hexane and air-dried between samples except for those used for extracting gut contents; those were rinsed with distilled water only. Cutting boards were washed and rinsed with distilled or chlorinated municipal water between each fish sampling. River water was never used for any washing or rinsing, or allowed to come into contact with fish tissues or sampling equipment.

All samples (except for those fixed in preservative) 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 (at about -20°C) for about two days. Two sample deliveries were made to Alberta Environment (and additional dry ice obtained) during the field collections and remaining samples were delivered upon completion of all sampling.

2.3 FISH COLLECTION RESULTS

The total number of samples collected for each species at each site is summarized in Table 3. A summary of the sample dates, locations, and numbers caught for each species are summarized in Figure 3. The time from initial anaesthetization at capture to blood and liver removal for each sample is recorded in Tables 4 through 7; although the fish were deeply anaesthetized and opercular movement had ceased, in most instances, the heart was still beating at the time livers were removed. Maturity indices used in subsequent tables are those used by the Alberta Fish and

TABLE 3

SUMMARY OF SAMPLE NUMBERS OBTAINED DURING THE FALL 1992 SPECIAL FISH COLLECTION

SITE	MOUNTAIN WHITEFISH (SP.I)	NORTHERN PIKE (SP.II)	WHITE SUCKER (SP.III)	LONGNOSE SUCKER (SP.IV)
G - Hwy. 40 Br.	10	0	0	10
H - Weldwood Br.	11	1	2	10
J - Obed Mtn. Br.	10	0	0	10
K - Emerson Lks. Br.	11	2	4	10
L - Berland R. Br.	10	10	10	10
M - Windfall Br.	10	10	10	7
N - Rock L.	0	0	0	0

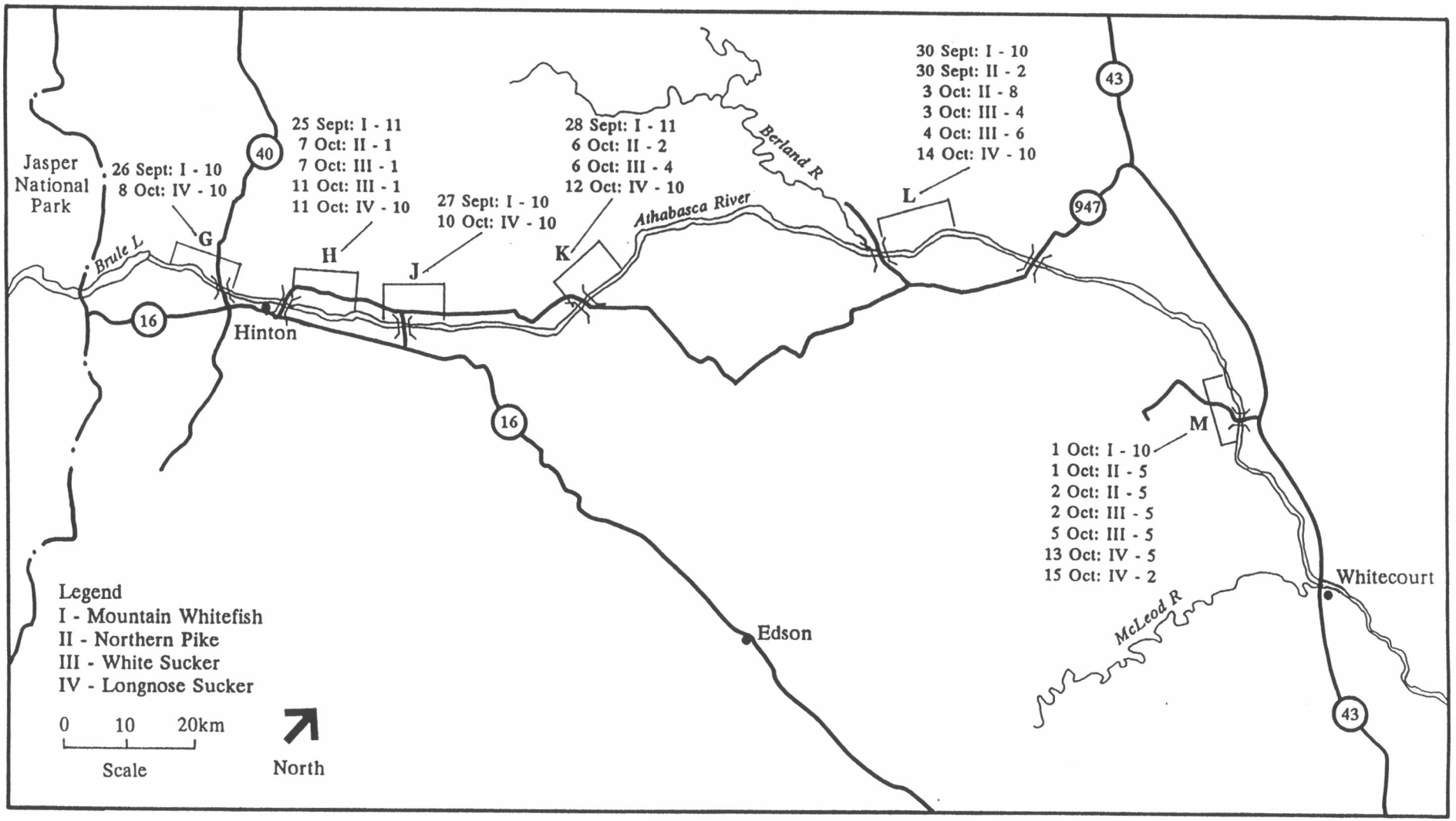


Figure 3 General locations of sample sites in the Athabasca River for the fall 1992 special fish collection indicating sample dates and numbers caught for each species (e.g. date:species - number caught)

TABLE 4

TIME FROM INITIAL CAPTURE OF MOUNTAIN WHITEFISH TO TISSUE REMOVAL

SAMPLE NUMBER	TIME OF DAY (h)	MINUTES TO TISSUE REMOVAL (min)		
		BLOOD	LIVER	GONADS
G-I-1	10:52	9	16	15
G-I-2	10:53	10	26	25
G-I-3	11:56	16	23	21
G-I-4	12:43	4	9	10
G-I-5	12:43	15	10	18
G-I-6	13:54	13	20	17
G-I-7	14:02	22	19	23
G-I-8	14:50	13	18	16
G-I-9	14:59	11	17	16
G-I-10	15:40	8	10	13
AVERAGE		12.1	16.8	17.4
H-I-1	11:40	12	25	20
H-I-2	13:05	13	18	19
H-I-3	13:10	17	20	28
H-I-4	14:35	9	18	26
H-I-5	14:40	10	18	24
H-I-6	15:36	7	12	11
H-I-7	15:38	13	18	19
H-I-8	16:31	8	9	12
H-I-9	16:36	12	16	14
H-I-10	17:13	7	11	13
H-I-11	17:14	15	21	22
AVERAGE		11.2	16.9	18.9

TABLE 4

(PAGE 2 OF 3)

SAMPLE NUMBER	TIME OF DAY (h)	MINUTES TO TISSUE REMOVAL (min)		
		BLOOD	LIVER	GONADS
J-I-1	11:17	18	23	22
J-I-2	12:27	11	15	15
J-I-3	12:30	15	17	20
J-I-4	12:35	10	18	24
J-1-5	13:58	6	8	10
J-I-6	14:01	10	12	15
J-I-7	14:30	7	9	10
J-I-8	14:33	11	18	20
J-I-9	15:11	15	17	18
J-I-10	15:24	9	11	15
AVERAGE		11.1	14.7	16.9
K-I-1	10:51	12	17	16
K-I-2	11:43	9	11	12
K-I-3	11:47	13	16	17
K-I-4	12:28	15	17	18
K-I-5	12:39	11	14	17
K-I-6	14:38	12	14	16
K-I-7	14:46	12	15	17
K-I-8	15:45	10	12	13
K-I-9	15:50	12	15	16
K-I-10	16:26	4	6	6
K-I-11	16:26	11	13	12
AVERAGE		11.0	13.6	14.5

TABLE 4

(PAGE 3 OF 3)

SAMPLE NUMBER	TIME OF DAY (h)	MINUTES TO TISSUE REMOVAL (min)		
		BLOOD	LIVER	GONADS
L-I-1	10:45	8	12	11
L-I-2	10:48	12	15	18
L-I-3	11:28	4	7	9
L-I-4	11:28	12	14	23
L-I-5	12:07	4	8	8
L-I-6	12:05	15	19	20
L-I-7	12:45	9	12	13
L-I-8	12:49	13	15	19
L-I-9	14:17	4	6	9
L-I-10	14:17	13	15	20
AVERAGE		9.4	12.3	15.0
M-I-1	10:45	8	13	13
M-I-2	10:48	17	20	24
M-I-3	11:28	4	7	8
M-I-4	11:28	11	14	19
M-I-5	12:05	3	6	6
M-I-6	12:05	11	14	17
M-I-7	13:27	6	10	11
M-I-8	13:27	18	21	21
M-I-9	14:08	7	9	10
M-I-10	14:11	11	13	17
AVERAGE		9.6	12.7	14.6

TABLE 5

TIME FROM INITIAL CAPTURE OF NORTHERN PIKE TO TISSUE REMOVAL

SAMPLE NUMBER	TIME OF DAY (h)	MINUTES TO TISSUE REMOVAL (min)		
		BLOOD	LIVER	GONADS
H-II-1	09:51	11	16	19
AVERAGE		11.0	16.0	19.0
K-II-1	16:50	5	10	11
K-II-2	16:51	5	17	20
AVERAGE		5.0	13.5	15.5
L-II-1	15:09	3	6	8
L-II-2	15:09	4	16	21
L-II-3	11:05	18	23	27
L-II-4	11:54	4	8	9
L-II-5	11:54	13	18	19
L-II-6	13:13	4	8	10
L-II-7	13:13	15	21	22
L-II-8	14:15	7	11	14
L-II-9	14:19	14	17	21
L-II-10	14:58	10	15	17
AVERAGE		9.2	14.3	16.8
M-II-1	14:46	10	13	16
M-II-2	14:48	7	24	27
M-II-3	15:38	4	7	9
M-II-4	15:38	13	17	20
M-II-5	16:15	6	13	14
M-II-6	10:40	7	11	27
M-II-7	10:40	17	21	44
M-II-8	11:47	7	12	28
M-II-9	11:47	17	21	41
M-II-10	12:48	9	15	22
AVERAGE		9.7	15.4	24.8

TABLE 6

TIME FROM INITIAL CAPTURE OF WHITE SUCKERS TO TISSUE REMOVAL

SAMPLE NUMBER	TIME OF DAY (h)	MINUTES TO TISSUE REMOVAL (min)		
		BLOOD	LIVER	GONADS
H-III-1	13:09	6	14	17
H-III-2	11:46	8	34	36
AVERAGE		7.0	24.0	26.5
K-III-1	11:48	14	20	22
K-III-2	11:57	16	24	25
K-III-3	11:57	17	Immature -	not sampled
K-III-4	15:34	6	14	15
AVERAGE		13.3	19.3	20.7
L-III-1	10:58	14	16	19
L-III-2	15:35	5	11	12
L-III-3	15:36	14	17	22
L-III-4	15:37	14	27	33
L-III-5	11:10	18	24	26
L-III-6	12:09	6	11	11
L-III-7	12:11	14	20	21
L-III-8	13:10	17	21	21
L-III-9	14:06	16	20	23
L-III-10	14:50	3	9	10
AVERAGE		12.1	14.3	19.8

TABLE 6

(PAGE 2 OF 2)

SAMPLE NUMBER	TIME OF DAY (h)	MINUTES TO TISSUE REMOVAL (min)		
		BLOOD	LIVER	GONADS
M-III-1	15:18	15	22	28
M-III-2	16:27	3	9	43
M-III-3	16:27	3	15	54
M-III-4	16:42	4	12	48
M-III-5	16:46	3	16	53
M-III-6	11:25	5	10	11
M-III-7	11:25	17	21	23
M-III-8	12:35	4	8	10
M-III-9	12:35	12	19	22
M-III-10	12:36	13	30	34
AVERAGE		7.9	16.2	32.6

TABLE 7

TIME FROM INTIAL CAPTURE OF LONGNOSE SUCKERS TO TISSUE REMOVAL

SAMPLE NUMBER	TIME OF DAY (h)	MINUTES TO TISSUE REMOVAL (min)		
		BLOOD	LIVER	GONADS
G-IV-1	15:48	8	13	14
G-IV-2	15:51	6	23	28
G-IV-3	11:15	11	19	20
G-IV-4	11:19	9	28	30
G-IV-5	12:24	15	20	22
G-IV-6	13:42	7	13	15
G-IV-7	13:43	6	24	26
G-IV-8	14:40	4	10	11
G-IV-9	14:40	5	21	23
G-IV-10	15:31	7	12	13
AVERAGE		7.8	18.3	20.2
H-IV-1	09:46	14	23	22
H-IV-2	09:53	8	28	29
H-IV-3	10:50	15	22	24
H-IV-4	10:57	9	18	20
H-IV-5	11:44	9	15	17
H-IV-6	11:47	6	22	24
H-IV-7	13:19	5	11	12
H-IV-8	13:20	5	22	23
H-IV-9	14:01	5	11	12
H-IV-10	14:01	7	25	26
AVERAGE		8.3	19.7	20.9

TABLE 7

(PAGE 2 OF 3)

SAMPLE NUMBER	TIME OF DAY (h)	MINUTES TO TISSUE REMOVAL (min)		
		BLOOD	LIVER	GONADS
J-IV-1	10:23	9	15	16
J-IV-2	10:24	8	25	26
J-IV-3	11:16	4	9	9
J-IV-4	11:48	12	18	20
J-IV-5	12:30	9	14	16
J-IV-6	12:30	10	26	28
J-IV-7	13:50	15	19	22
J-IV-8	14:26	11	18	20
J-IV-9	14:27	11	27	28
J-IV-10	15:18	4	10	12
AVERAGE		9.3	18.1	19.7
K-IV-1	11:15	12	19	20
K-IV-2	11:16	12	29	30
K-IV-3	12:05	7	17	19
K-IV-4	12:06	8	26	27
K-IV-5	12:07	9	35	36
K-IV-6	13:22	6	12	13
K-IV-7	13:22	7	22	23
K-IV-8	13:22	7	35	39
K-IV-9	14:15	11	18	19
K-IV-10	14:17	11	25	26
AVERAGE		9.0	23.8	25.2

TABLE 7

(PAGE 3 OF 3)

SAMPLE NUMBER	TIME OF DAY (h)	MINUTES TO TISSUE REMOVAL (min)		
		BLOOD	LIVER	GONADS
L-IV-1	11:14	9	17	19
L-IV-2	11:16	8	25	26
L-IV-3	12:04	6	11	13
L-IV-4	12:06	14	20	21
L-IV-5	12:43	5	13	15
L-IV-6	12:43	6	24	25
L-IV-7	14:19	3	7	9
L-IV-8	14:19	12	18	20
L-IV-9	14:57	4	12	13
L-IV-10	14:57	5	24	25
AVERAGE		7.2	17.1	18.6
M-IV-1	15:06	9	16	18
M-IV-2	15:07	9	27	29
M-IV-3	16:01	14	22	23
M-IV-4	16:13	5	20	21
M-IV-5	16:53	10	16	17
M-IV-6	10:24	6	13	14
M-IV-7	10:24	19	24	25
AVERAGE		10.3	19.7	21.0

Wildlife Division and are as follows (fish too immature to confidently distinguish sex were not coded):

Females:

1 - Immature; no gonadal development
2 - Maturing; only partial gonadal development
3 - Mature; gravid, gonads fully developed
4 - Ripe; eggs easily expressed with slight pressure
5 - Spent; post-spawning condition

Males:

6 - Immature; no gonadal development
7 - Maturing; only partial gonadal development
8 - Mature; gonads fully developed
9 - Ripe; sperm easily expressed with slight pressure
10 - Spent; post-spawning condition

Complete samples of mountain whitefish (10 per site) were obtained from all sites except Rock Lake (Table 3). 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. At the two lowermost sites, mountain whitefish had started to spawn and were most often found in deeper areas with moderate current just downstream or upstream of shallow, high current velocity riffle zones. Spawning mountain whitefish were abundant throughout these two sites at this time. An average of about one full day was required for 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 8.

TABLE 8

FORK LENGTH, WEIGHT, SEX, STATE OF MATURITY (SM), AGE AND TISSUE WEIGHTS OF SAMPLED MOUTAIN WHITEFISH

SAMPLE	FL (mm)	WT (g)	SEX	SM	AGE	TISSUE WEIGHTS (g)		
						LIVER	GONAD	MUSCLE
G-I-1	323	380	M	9	7	2.4	11.9	62.7
G-I-2	322	380	M	8	6	2.4	16.4	60.6
G-I-3	383	740	F	3	8	9.0	117.1	113.6
G-I-4	350	435	M	8	-[1]	2.8	20.8	41.2
G-I-5	360	510	F	3	8	7.2	53.7	80.2
G-I-6	366	580	F	3	9	6.9	73.0	95.6
G-I-7	326	390	M	8	8	2.4	20.3	80.0
G-I-8	325	390	F	3	6	4.8	56.3	67.0
G-I-9	405	695	F	3	11	9.7	75.6	121.0
G-I-10	370	575	M	8	-	4.4	36.7	108.4
H-I-1	382	720	F	3	9	13.4	161.7	29.2
H-I-2	401	790	F	3	8	12.4	59.2	50.9
H-I-3	440	1100	F	3	6	16.5	158.4	67.4
H-I-4	413	820	F	3	8	9.3	111.4	63.9
H-I-5	402	870	F	3	9	13.9	109.0	89.1
H-I-6	314	360	F	3	6	5.3	4.9	71.0
H-I-7	321	375	F	1	5	3.0	0.7	48.8
H-I-8	315	360	F	1	6	3.1	2.1	49.3
H-I-9	341	485	M	9	7	3.5	18.3	57.2
H-I-10	469	1220	F	1	10	11.2	3.9	114.2
H-I-11	334	420	M	9	9	3.0	6.8	56.2

TABLE 8

PAGE 2 OF 3

SAMPLE	FL (mm)	WT (g)	SEX	SM	AGE	TISSUE WEIGHTS (g)		
						LIVER	GONAD	MUSCLE
J-I-1	316	385	M	8	7	2.9	23.2	70.2
J-I-2	377	675	F	3	6	5.4	99.9	113.2
J-I-3	306	345	M	8	7	2.5	20.7	77.1
J-I-4	385	745	F	3	8	8.3	110.9	136.7
J-I-5	358	570	F	3	8	7.0	67.9	101.1
J-I-6	353	580	F	3	9	4.2	36.5	92.9
J-I-7	344	480	F	3	6	4.2	46.1	92.0
J-I-8	416	900	F	3	5	13.2	110.6	138.2
J-I-9	315	365	F	3	5	5.4	40.1	69.2
J-I-10	340	510	F	3	6	5.4	56.7	125.5
K-I-1	381	740	F	3	8	6.7	85.1	124.8
K-I-2	329	430	F	3	6	3.2	55.6	76.9
K-I-3	324	380	F	1	7	2.7	1.4	76.2
K-I-4	379	640	F	1	8	6.2	1.8	148.0
K-I-5	322	425	F	3	6	6.1	56.7	102.4
K-I-6	444	1160	F	3	10	11.5	192.2	225.0
K-I-7	358	530	F	1	8	4.6	1.7	132.8
K-I-8	337	425	M	9	7	2.7	18.9	93.2
K-I-9	346	540	F	3	6	5.2	89.0	101.9
K-I-10	332	345	M	9	6	2.4	25.5	81.4
K-I-11	352	600	F	3	-	4.9	72.3	107.9

TABLE 8

PAGE 3 OF 3

SAMPLE	FL (mm)	WT (g)	SEX	SM	AGE	TISSUE WEIGHTS (g)		
						LIVER	GONAD	MUSCLE
L-I-1	332	390	M	9	6	2.1	12.9	88.7
L-I-2	319	450	F	4	8	2.6	41.9	95.7
L-I-3	382	710	F	4	8	3.4	74.6	157.5
L-I-4	423	860	F	4	9	6.2	104.9	170.6
L-I-5	379	720	F	3	6	5.1	111.5	117.1
L-I-6	415	805	F	4	7	6.0	58.6	184.4
L-I-7	426	1010	F	3	9	7.9	110.5	204.9
L-I-8	407	790	F	3	6	6.8	109.9	161.5
L-I-9	409	860	F	4	9	6.1	124.8	182.0
L-I-10	338	485	F	4	7	3.0	55.7	93.1
M-I-1	431	960	M	9	13	5.7	40.1	211.6
M-I-2	378	560	F	4	11	3.2	33.0	127.8
M-I-3	359	435	M	9	5	2.9	13.7	118.2
M-I-4	399	680	F	4	9	4.2	40.0	149.5
M-I-5	363	585	M	9	7	3.8	21.3	153.4
M-I-6	389	720	M	9	13	3.8	38.2	184.7
M-I-7	400	840	F	3	12	7.9	131.2	165.3
M-I-8	450	1280	F	3	11	12.5	211.1	264.5
M-I-9	362	625	F	3	6	4.8	72.6	151.7
M-I-10	347	510	M	9	5	2.6	20.4	138.9

[1] Missing data indicate poor or lack of suitable sample

The complete complement of samples for northern pike was not obtained. Although northern pike were present at downstream sites (Sites L and M), they were scarce (Sites H and K) or were not observed (Sites G and J) upstream (Table 3). Northern pike were usually found in backwater areas with little or no flow-through; such sites were more limited upstream than downstream. Length, weight, age, and other details of northern pike collected are summarized in Table 9.

Similarly, while white suckers were present at downstream sites, they were either scarce or not found upstream (Table 3). Longnose suckers, however, were relatively common throughout the system and a full complement of samples was obtained from all sites except Site M (Table 3). We suspect the difficulty in obtaining 10 longnose suckers at the lowermost site was related to the declining water temperature (Figure 4); by this time, suckers and whitefish appeared to have ceased active feeding and moved to overwinter areas. Longnose suckers were usually found in similar habitats as mountain whitefish, although in less current. White suckers were usually found in still water areas of pools, but often close to the current breaks. Length, weight, age, and other details of white and longnose suckers collected are summarized in Tables 10 and 11, respectively.

A summary of abnormalities observed is presented on Tables 12, 13, 14 and 15; note that this list reports *all* abnormalities including physical damage that may have been caused by predation, spawning, or other factor. The term, lesion, was used to describe those external abnormalities that appear as sores or areas of "redness" or hemorrhage on the skin that may be indicative of chronic stress or generally poor health. Such lesions ranged from being usually fairly mild to occasionally severe. Although hematocrit was not measured, the "apparent low hematocrit" was based on a subjective evaluation of the packed cell volume remaining in the microfuge tube after plasma was removed from blood samples; the low hematocrit assessment was estimated to be less than about 20%.

TABLE 9

FORK LENGTH, WEIGHT, SEX, STATE OF MATURITY (SM), AGE AND TISSUE WEIGHTS OF SAMPLED NORTHERN PIKE

SAMPLE	FL (mm)	WT (g)	SEX	SM	AGE	TISSUE WEIGHTS (g)		
						LIVER	GONAD	MUSCLE
H-II-1	485	825	F	1	4	10.8	2.8	146.5
K-II-1	491	925	M	8	5	19.5	8.5	96.3
K-II-2	565	1260	F	3	4	15.6	43.3	153.1
L-II-1	438	620	F	1	3	10.2	2.4	148.2
L-II-2	441	600	M	8	3	9.5	6.9	196.4
L-II-3	876	5135	F	3	6	150.8	286.4	423.3
L-II-4	538	1050	M	8	3	14.0	10.8	134.9
L-II-5	643	2150	M	8	8	36.6	42.0	283.4
L-II-6	499	930	M	8	4	10.6	11.6	145.4
L-II-7	636	2090	F	3	5	39.4	66.5	208.0
L-II-8	562	1370	F	3	3	18.9	35.4	222.1
L-II-9	573	1340	M	8	4	14.9	15.3	240.7
L-II-10	549	1450	M	8	5	15.8	14.5	242.8
M-II-1	558	1280	F	3	4	26.0	55.4	225.9
M-II-2	766	3450	F	3	8	42.3	111.7	360.9
M-II-3	471	765	M	8	4	11.9	11.3	187.3
M-II-4	603	1610	F	3	4	14.8	55.4	289.6
M-II-5	677	2540	M	8	8	44.8	64.1	499.8
M-II-6	700	2650	F	3	8	36.1	84.7	449.4
M-II-7	730	2860	F	3	8	62.4	123.1	380.1
M-II-8	706	2780	F	3	8	71.5	87.2	493.4
M-II-9	667	2340	M	8	8	42.5	54.6	339.4
M-II-10	770	3715	M	8	10	67.1	65.8	461.5

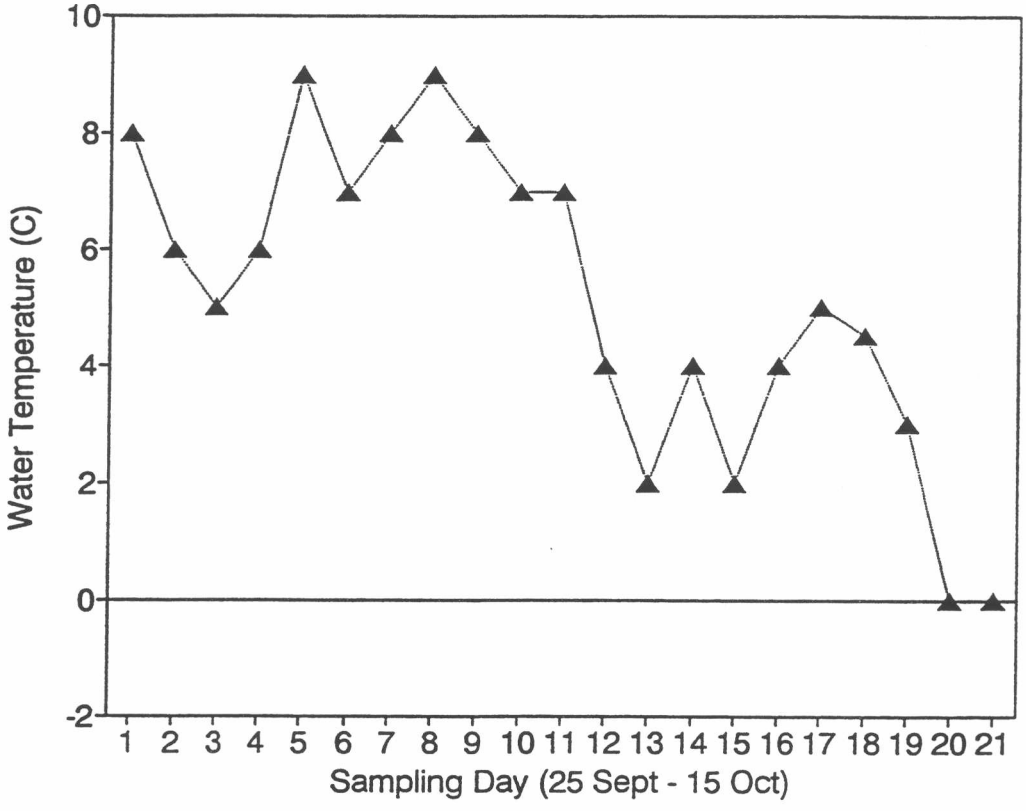


Figure 4. Daily water temperature of the upper Athabasca River from 25 September to 15 October 1992, inclusive.

TABLE 10

FORK LENGTH, WEIGHT, SEX, STATE OF MATURITY (SM), AGE AND TISSUE WEIGHTS OF SAMPLED WHITE SUCKERS

SAMPLE	FL (mm)	WT (g)	SEX	SM	AGE	TISSUE WEIGHTS (g)		
						LIVER	GONAD	MUSCLE
H-III-1	370	730	M	6	6	23.7	-	107.2
H-III-2	388	960	F	3	7	14.4	56.2	86.7
K-III-1	393	825	F	3	8	15.4	52.6	128.7
K-III-2	340	550	F	3	6	12.1	36.8	80.2
K-III-3	333	470	U	-	-	-	-	-
K-III-4	370	650	F	3	8	11.6	43.5	104.5
L-III-1	352	636	M	8	6	6.9	37.4	116.1
L-III-2	397	820	F	3	7	15.9	49.5	98.5
L-III-3	389	820	F	3	8	21.5	55.2	122.2
L-III-4	425	1105	F	3	11	28.7	48.4	111.4
L-III-5	360	570	M	8	6	-	35.4	98.9
L-III-6	410	950	F	3	8	18.9	57.2	135.7
L-III-7	377	720	M	8	7	19.9	38.3	137.7
L-III-8	395	800	F	3	7	16.0	57.2	114.2
L-III-9	390	820	F	3	7	17.0	57.9	124.4
L-III-10	435	1090	F	3	8?	18.2	54.7	139.5
M-III-1	430	1110	F	3	11	17.6	76.7	123.3
M-III-2	408	920	F	3	9	19.6	59.8	145.1
M-III-3	399	835	F	3	8	-	39.3	153.3
M-III-4	380	710	F	3	9	12.8	47.2	125.9
M-III-5	406	980	F	3	7?	23.8	69.0	171.7
M-III-6	350	570	M	8	6	6.9	25.9	91.3
M-III-7	389	750	M	8	7	14.4	46.1	100.5
M-III-8	431	1020	F	3	8	23.1	74.3	108.0
M-III-9	406	960	F	3	8	22.0	67.8	126.4
M-III-10	446	1170	F	3	8	27.8	103.2	160.8

TABLE 11

FORK LENGTH, WEIGHT, SEX, STATE OF MATURITY (SM), AGE AND TISSUE WEIGHTS OF SAMPLED LONGNOSE SUCKERS

SAMPLE	FL (mm)	WT (g)	SEX	SM	AGE	TISSUE WEIGHTS (g)		
						LIVER	GONAD	MUSCLE
G-IV-1	375	690	F	3	9	14.2	53.7	90.2
G-IV-2	416	820	F	3	9	11.3	58.8	112.2
G-IV-3	362	570	M	6	7	8.3	2.5	101.3
G-IV-4	375	470	M	6	8	5.9	2.8	87.5
G-IV-5	412	870	F	3	9	16.8	84.6	106.2
G-IV-6	426	940	F	3	10	15.0	54.8	122.4
G-IV-7	378	670	M	8	9	10.3	7.1	120.4
G-IV-8	388	760	F	3	8?	10.0	54.8	106.9
G-IV-9	400	870	F	3	10	14.9	79.2	85.9
G-IV-10	378	630	F	3	9	11.7	45.9	131.0
H-IV-1	414	880	F	2	10	12.8	19.0	113.6
H-IV-2	393	760	M	8	9	13.9	29.2	68.8
H-IV-3	411	820	M	8	10	8.9	31.5	66.3
H-IV-4	374	670	M	7	8	9.6	3.5	91.0
H-IV-5	412	960	F	3	9?	14.8	74.1	115.7
H-IV-6	400	800	M	7	9	18.6	33.2	74.4
H-IV-7	400	710	F	3	8	11.4	50.5	76.5
H-IV-8	400	830	F	3	8	14.5	60.9	96.1
H-IV-9	402	850	M	8	8	15.0	31.2	88.1
H-IV-10	386	700	M	8	8	9.4	25.4	91.1

TABLE 11

PAGE 2 OF 3

SAMPLE	FL (mm)	WT (g)	SEX	SM	AGE	TISSUE WEIGHTS (g)		
						LIVER	GONAD	MUSCLE
J-IV-1	376	680	F	3	8	10.6	54.4	80.2
J-IV-2	406	835	F	3	9	12.9	76.9	79.5
J-IV-3	352	580	M	8	6	10.2	27.8	79.1
J-IV-4	361	650	M	8	6	12.1	N/D	101.4
J-IV-5	381	780	M	8	9	13.0	34.4	97.7
J-IV-6	386	750	F	3	8	12.5	48.4	82.0
J-IV-7	398	870	F	8	10	13.2	47.4	119.1
J-IV-8	397	715	M	8	8	10.2	28.5	100.9
J-IV-9	397	720	M	8	9	11.6	39.2	77.3
J-IV-10	408	810	M	3	10	15.0	75.4	110.0
K-IV-1	377	600	F	8	7	9.2	32.2	57.7
K-IV-2	348	560	M	8	7	9.0	20.8	70.0
K-IV-3	411	825	M	8	8	18.8	34.8	111.2
K-IV-4	356	555	M	8	6	9.3	22.2	71.2
K-IV-5	384	660	M	8	7	11.9	35.3	100.0
K-IV-6	357	590	M	8	7	12.6	19.3	75.0
K-IV-7	372	650	F	3	7	12.7	48.8	99.6
K-IV-8	374	640	F	2	8	10.4	9.7	74.8
K-IV-9	376	670	M	8	10	14.2	20.3	87.6
K-IV-10	356	590	M	7	7	10.4	2.5	130.5

TABLE 11

PAGE 3 OF 3

SAMPLE	FL (mm)	WT (g)	SEX	SM	AGE	TISSUE WEIGHTS (g)		
						LIVER	GONAD	MUSCLE
L-IV-1	384	690	F	3	8	9.6	46.1	111.8
L-IV-2	442	1060	F	3	11	19.1	80.4	118.5
L-IV-3	380	620	F	2	8	10.7	6.6	98.5
L-IV-4	423	910	F	3	10	12.7	72.3	127.5
L-IV-5	358	540	M	8	8	9.3	17.5	84.3
L-IV-6	392	765	M	8	9	13.3	31.4	79.1
L-IV-7	385	680	F	2	10	9.8	7.8	100.9
L-IV-8	399	760	F	3	9	14.2	49.5	83.0
L-IV-9	412	800	F	3	9?	15.0	46.8	132.2
L-IV-10	414	810	F	3	10	10.5	41.4	115.9
M-IV-1	407	830	F	2	9	17.3	7.2	136.3
M-IV-2	383	690	M	7	7	11.2	4.7	67.1
M-IV-3	409	880	F	2	9	17.3	11.7	156.6
M-IV-4	403	940	F	3	8	18.5	77.9	102.8
M-IV-5	417	840	F	3	10	20.6	55.2	96.5
M-IV-6	376	730	F	3	7	13.2	53.4	122.2
M-IV-7	427	975	F	3	10	20.7	99.1	77.0

TABLE 12

OBSERVED ABNORMALITIES IN SAMPLED MOUNTAIN WHITEFISH

SAMPLE	ABNORMALITIES
G-I-1	none
G-I-2	"raspberry" spleen
G-I-3	1 lesion near anal fin; small nodules in liver
G-I-4	none
G-I-5	none
G-I-6	none
G-I-7	none
G-I-8	none
G-I-9	none
G-I-10	1 large belly lesion; 1 small nodule in liver
H-I-1	kidney somewhat swollen
H-I-2	2 belly lesions
H-I-3	1 large lesion by left pelvic fin; 2 belly lesions; swollen kidney
H-I-4	"raspberry" spleen
H-I-5	1 lesion at pelvic fin base; swollen kidney; gill lice
H-I-6	none
H-I-7	none
H-I-8	immature, but traces of previous year's eggs present
H-I-9	2 lesions at bases of pectoral and pelvic fins
H-I-10	immature, but traces of previous year's eggs present; "raspberry" spleen
H-I-11	none

TABLE 12

(PAGE 2 OF 3)

SAMPLE	ABNORMALITIES
J-I-1	none
J-I-2	none
J-I-3	none
J-I-4	none
J-I-5	none
J-I-6	none
J-I-7	healed abrasion on right side
J-I-8	1 large belly lesion
J-I-9	"raspberry" spleen
J-I-10	"raspberry" spleen
K-I-1	none
K-I-2	none
K-I-3	1 small lesion by pectoral fin; "raspberry" spleen
K-I-4	none
K-I-5	kidney somewhat swollen
K-I-6	none
K-I-7	kidney somewhat swollen
K-I-8	none
K-I-9	none
K-I-10	none
K-I-11	none

TABLE 12

(PAGE 3 OF 3)

SAMPLE	ABNORMALITIES
L-I-1	none
L-I-2	none
L-I-3	very slight hemorrhaging in tail
L-I-4	1 small belly lesion; slight redness in anal fin
L-I-5	none
L-I-6	none
L-I-7	none
L-I-8	none
L-I-9	none
L-I-10	"raspberry" spleen
M-I-1	1 small nodule in liver
M-I-2	none
M-I-3	none
M-I-4	none
M-I-5	healed wound on left side
M-I-6	none
M-I-7	slight redness in pelvic fins; small nodules in liver
M-I-8	none
M-I-9	apparent low hematocrit
M-I-10	none

TABLE 13

OBSERVED ABNORMALITIES IN SAMPLED NORTHERN PIKE

SAMPLE	ABNORMALITIES
H-II-1	1 small lesion on right side
K-II-1	none
K-II-2	none
L-II-1	none
L-II-2	none
L-II-3	none
L-II-4	none
L-II-5	none
L-II-6	none
L-II-7	none
L-II-8	none
L-II-9	none
L-II-10	none
M-II-1	none
M-II-2	1 small lesion on side; eroded lower lobe caudal fin
M-II-3	none
M-II-4	none
M-II-5	none
M-II-6	none
M-II-7	none
M-II-8	none
M-II-9	none
M-II-10	none

TABLE 14

OBSERVED ABNORMALITIES IN SAMPLED WHITE SUCKERS

SAMPLE	ABNORMALITIES
H-III-1	1 lesion on side; excessive fat deposits; immaturity unusual for fish of this size
H-III-2	none
K-III-1	none
K-III-2	none
K-III-3	none
K-III-4	apparent low hematocrit
L-III-1	none
L-III-2	apparent low hematocrit; intestinal cyst
L-III-3	none
L-III-4	none
L-III-5	none
L-III-6	frayed caudal fin; intestinal cysts
L-III-7	intestinal cysts
L-III-8	intestinal cysts
L-III-9	intestinal cysts
L-III-10	1 small lesion on underside of lower jaw
M-III-1	none
M-III-2	none
M-III-3	none
M-III-4	none
M-III-5	none
M-III-6	healed wound on one side
M-III-7	cataracts in both eyes
M-III-8	intestinal cysts
M-III-9	intestinal cysts
M-III-10	intestinal cysts

TABLE 15

OBSERVED ABNORMALITIES IN SAMPLED LONGNOSE SUCKERS

SAMPLE	ABNORMALITIES
G-IV-1	1 very small lesion on left side
G-IV-2	none
G-IV-3	none
G-IV-4	large open ulcer on side; apparent low hematocrit
G-IV-5	none
G-IV-6	none
G-IV-7	none
G-IV-8	none
G-IV-9	none
G-IV-10	none
H-IV-1	partial gonadal development
H-IV-2	eroded caudal fin
H-IV-3	none
H-IV-4	partial gonadal development
H-IV-5	none
H-IV-6	partial gonadal development
H-IV-7	minor hemorrhage around lips
H-IV-8	none
H-IV-9	none
H-IV-10	"coffee" - coloured liver; apparent low hematocrit

TABLE 15

(PAGE 2 OF 3)

SAMPLE	ABNORMALITIES
J-IV-1	none
J-IV-2	frayed tissue on first gill on one side
J-IV-3	none
J-IV-4	none
J-IV-5	none
J-IV-6	first gills on both sides badly eroded; eroded caudal fin
J-IV-7	none
J-IV-8	none
J-IV-9	none
J-IV-10	none
K-IV-1	first gill on one side badly eroded
K-IV-2	healed wound on one side
K-IV-3	none
K-IV-4	none
K-IV-5	eroded tissue on first gill on one side
K-IV-6	none
K-IV-7	none
K-IV-8	dark area on dorsal skin surface; partial gonadal development
K-IV-9	gill tissue frayed
K-IV-10	partial gondal development

TABLE 15

(PAGE 3 OF 3)

SAMPLE	ABNORMALITIES
L-IV-1	none
L-IV-2	slight inflammation in hind gut
L-IV-3	partial gonadal development
L-IV-4	none
L-IV-5	none
L-IV-6	none
L-IV-7	partial gonadal development; deformed upper caudal lobe
L-IV-8	slight inflammation in hind gut
L-IV-9	gills on one side badly eroded
L-IV-10	none
M-IV-1	1 small lesion on left side; partial gonadal development
M-IV-2	partial gonadal development
M-IV-3	partial gonadal development; 1 very small lesion on cheek
M-IV-4	none
M-IV-5	1 very small "blister" on belly; area of one gill eroded with some necrosis present
M-IV-6	1 small lesion on ventral surface
M-IV-7	none

A higher incidence of abnormalities on mountain whitefish was evident at Site H than either upstream or further downstream, although the abnormalities generally were fewer and less severe than in the spring (Figure 5). Mountain whitefish at all sites downstream of Hinton had noticeably higher levels of abdominal fat deposits around the pyloric caeca and intestines in the body cavity, as determined from the mean fat index, than those upstream although fat levels were lower in the fall than in the spring (Figure 6). The mean fat index is based on an observed qualitative rating of 0 (no fat) to 4 (complete fat coverage of pyloric caeca) and is explained in detail in Goede and Barton (1990). This difference is understandable as mountain whitefish, being fall spawners, would shift energy reserves towards gametic growth during the summer rather than to fat deposition.

A number of longnose suckers collected had only partial gonadal development even though these fish were sufficiently large to be mature adults. Similarly, two female mountain whitefish sampled at Site H had immature gonads but also had remnants of reabsorbed eggs from the previous year. Although this failure to mature in 1992 may be a natural phenomenon (alternate year spawning?), it is worth noting that this did not occur for either species upstream at Site G.

Limited bile samples were available from a number of fish, especially the longnose suckers, although gall bladders were still collected. During most of the sampling period, fish were actively feeding resulting in gall bladders that were generally empty or with only a small amount of bile present. At the end of the sampling period, feeding appeared to cease as water temperature declined (Figure 4), which was reflected in the accumulation of bile in the gall bladder in the latter samples.

In some mountain whitefish, swollen kidneys were observed. The explanation for this phenomenon is not apparent as the fish appeared otherwise healthy, but may have been caused by electrofishing. A number of suckers captured had freshly ruptured kidneys, which was considered to be damage directly resulting from the

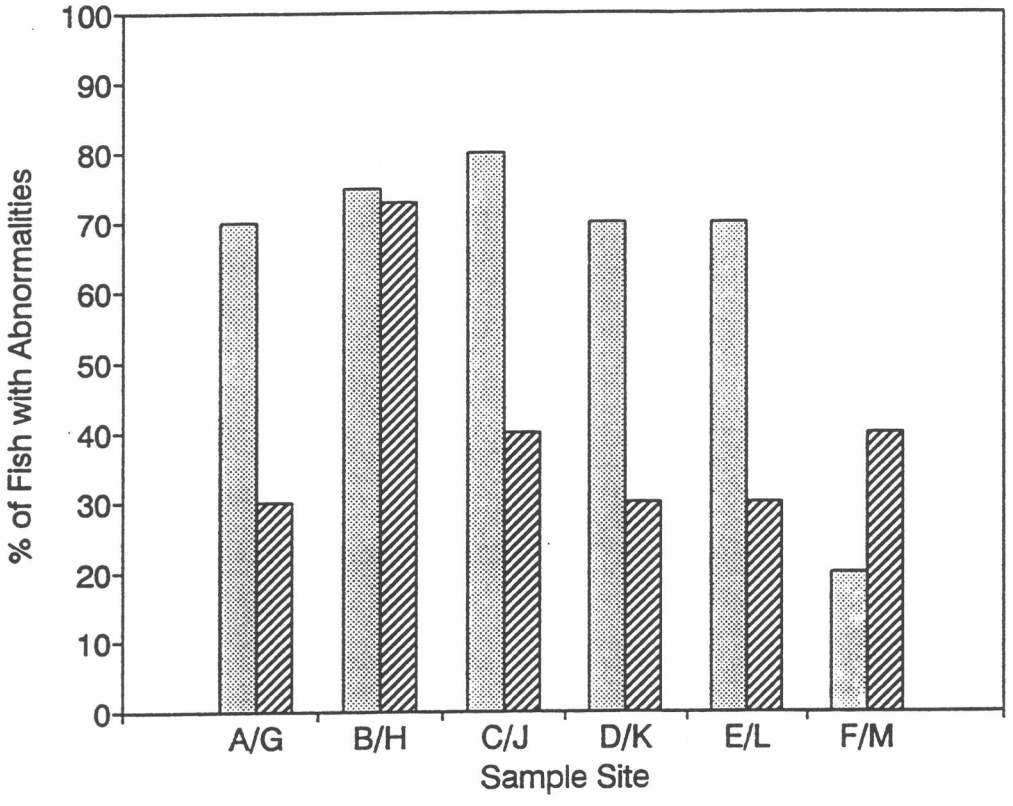


Figure 5. Frequency (%) of mountain whitefish from the upper Athabasca River with observed abnormalities in the spring (shaded bars) and fall (cross-hatched bars) 1992 special fish collections.

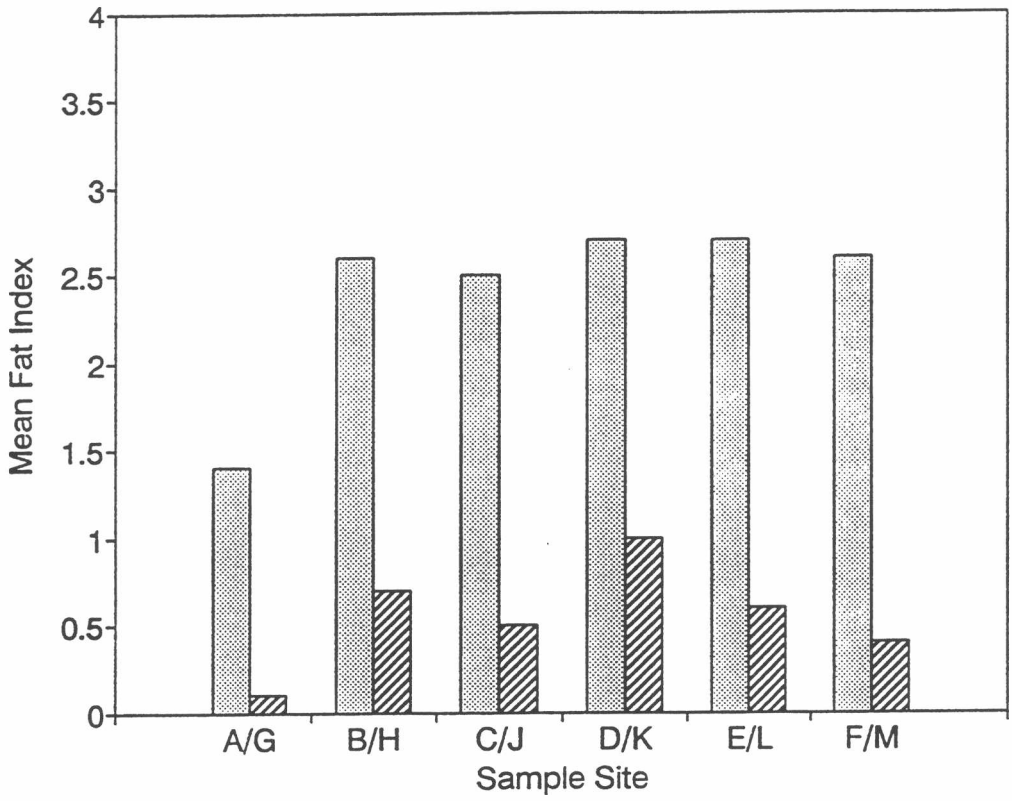


Figure 6. Mean fat indices of mountain whitefish from the upper Athabasca River in the spring (shaded bars) and fall (cross-hatched bars) 1992 special fish collections.

electrofishing; the frequency of this occurrence was 19% in white suckers and 3.5% in longnose suckers examined.

Summaries of the autopsies conducted on all species are presented in Appendices I to IV, inclusive. A description of the codes used in the autopsies is in Appendix V and are explained in detail in Goede and Barton (1990). The tissue normality index (TNI) is automatically calculated from the percent normal values of organs and tissues when the health/condition profile summaries (Appendices I-IV) are generated from the autopsy data. The TNI represents the sum of the *average* percent normal values for each signal organ or tissue in the sample, expressed as an index between 0 and 1 (e.g., if all signal organs were classed as normal in all fish of the sample, TNI would be 1.00). The TNI ranged from 0.92 to 0.99 in mountain whitefish and longnose suckers (Figure 7), the major species found in the river, indicating that apart from the external abnormalities observed, the fish were relatively free of any gross pathological condition.

Other species observed during the sampling program included juvenile and adult bull trout (*Salvelinus confluentus*), burbot (*Lota lota*), rainbow trout (*Oncorhynchus mykiss*), Arctic grayling (*Thymallus arcticus*), and lake whitefish (*Coregonus clupeaformis*). All of these species were present only in very low numbers except Arctic grayling, which were common only at Site L below the Berland River confluence. Two fish caught were tagged: one mountain whitefish (Tag No. 03080; Sample No. G-I-10) upstream of Highway 40 bridge and one adult bull trout (Tag No. 03098) about 2-3 km downstream of the Hinton mill. The bull trout also contained a radio-tag and was released.

A summary of estimated relative abundance of fishes observed while sampling is presented in Table 16. Generally, it was not possible to collect additional information about abundance or movements of fish as the overall low density of fish in the river required all field time to be focused towards obtaining the specified

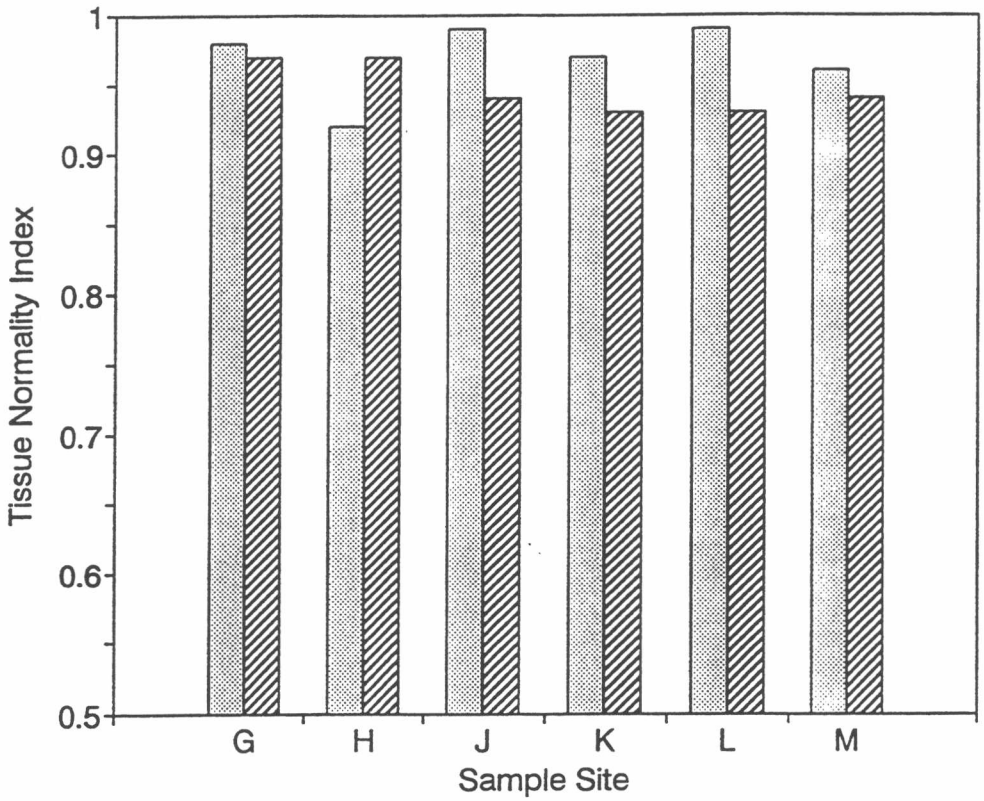


Figure 7. Tissue abnormality indices of mountain whitefish (shaded bars) and longnose suckers (cross-hatched bars) in the fall 1992 special fish collection.

TABLE 16

APPROXIMATE RELATIVE ABUNDANCE OF FISH SPECIES OBSERVED DURING SPECIAL FISH COLLECTIONS IN THE ATHABASCA RIVER (AND ROCK LAKE) IN FALL 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						
	G	H	J	K	L	M	N[1]
Mountain Whitefish (J)	A	A	A	A	A	A	C
Mountain Whitefish (A)	C	C	C	C	A	A	N
Northern Pike (J)	N	N	N	O	U	U	C
Northern Pike (A)	N	O	N	U	U	C	C
White Sucker	N	U	U	U	U	U	N
Longnose Sucker	C	C	C	C	C	U	N
Bull Trout (J)	N	N	O	N	U	N	O
Bull Trout (A)	N	O	N	N	N	N	N
Rainbow Trout	O	N	N	N	U	N	N
Cutthroat Trout	N	N	N	N	N	N	O
Arctic Grayling	N	N	N	U	U	N	N
Lake Whitefish	N	N	N	N	N	O	N
Burbot	O	O	U	N	O	U	N

[1] Rock Lake

samples. Such would also likely be the case in future monitoring programs unless additional resources are specifically included for collecting ancillary data. Exceptions in 1992 were the observations that: (1) mountain whitefish commenced spawning about the end of September and were more concentrated in suitable habitats downstream than upstream, and (2) both mountain whitefish and suckers appeared to have ceased feeding and moved to overwinter areas by mid-October with the rapid drop in water temperature. Thus, it appears that the spawning "window" for mountain whitefish in 1992 was relatively short (ca. two weeks).

3.0 RECOMMENDATIONS

The two most common species in the system appear to be mountain whitefish and longnose suckers. Although white suckers are also present throughout the system, longnose suckers would be a preferred species for monitoring because of their higher abundance.

Selection of a piscivorous species for special fish collections in future years will be difficult because of their relatively low abundance. In this regard, northern pike may still be the preferred species although collections may have to be restricted to the spring and more effort may be required to collect sufficient sample sizes upstream.

In future, fall collections should be conducted about one month earlier in the season than in 1992. Mountain whitefish began spawning during the 1992 collection period, thus precluding the ability to discern differences in reproductive steroid hormones as peak pre-spawning titres would have likely declined to minimal concentrations. Also, as water temperatures declined to near-zero levels, fish appeared to move from their normal habitats either to overwinter areas or out of the system, which made them difficult to locate.

Tissues weighed in the field and submitted intact for analysis (e.g., muscle) should be re-weighed to ensure accuracy and eliminate a possible source of error, as field conditions (e.g., wind) sometimes make obtaining accurate weights to 0.1 g difficult. Subsequent special fish collections should provide for field-testing of non-standard tissue collection methods (e.g., livers) and preparation of equipment accordingly.

Autopsies conducted in future studies using the same protocol as in 1992 will allow for the establishment of a long-term database that may be useful for detecting trends through time or departures from normal in the populations.

4.0 REFERENCES

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APPENDIX I

AUTOPSY SUMMARY REPORTS FOR MOUNTAIN WHITEFISH

SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site G QUALITY CONTROL NO.: 12-111

Species: MNWH (G) Autopsy Date: 09-26-92 Sample Size: 10
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: 6 C Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	353.000 mm	27.38 mm	8%
Weight	507.500 gr	128.22 gr	25%
Ktl*	1.150	0.08	7%
Ctl**	4.155		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 100%	0 100%	0 90%	B 40%	0 100%	N 100%	A 80%	0 0%	0 100%	0 100%
B1 0%	F 0%	S 0%	1 0%	1 10%	R 40%	1 0%	S 0%	B 0%	1 30%	1 0%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 0%	G 20%	2 0%	M 0%	C 0%	2 70%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.0	3 0%	NO 0%	x 0.0	G 0%	D 20%	3 0%	x 0	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 1.7		
H1 0%	OT 0%	OT 0%		x 0.1	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	100%	100%	xxxxxxx	100%	100%	100%	80%	xxxxxxx	100%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.0	0.1	xxxxxxx	0.0	xxxxxxx	xxxxxx	1.7	0	0

SEX: M: 50% F: 50% U: 0%

Index Summary

Tissue Normality Index: TX 0.98

Fat Index: FX 0.10

Bile Index: BX 1.70

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	323	380	1.13	N	N	N	0	0	R	0	N	A	2	M				0	0
2	322	380	1.14	N	N	N	0	0	G	0	N	A	2	M				0	0
3	383	740	1.32	N	N	N	0	0	B	0	N	D	1	F				0	0
4	350	435	1.01	N	N	N	0	0	R	0	N	A	1	M				0	0
5	360	510	1.09	N	N	N	0	0	R	0	N	A	2	F				0	0
6	366	580	1.18	N	N	N	0	0	B	0	N	A	1	F				0	0
7	326	390	1.13	N	N	N	0	0	B	0	N	A	2	M				0	0
8	325	390	1.14	N	N	N	0	0	B	0	N	A	2	F				0	0
9	405	695	1.05	N	N	N	0	1	R	0	N	A	2	F				0	0
10	370	575	1.14	N	N	N	0	0	G	0	N	D	2	M				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site H QUALITY CONTROL NO.: 12-111

Species: MNWH (H) Autopsy Date: 09-25-92 Sample Size: 11
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	375.640 mm	51.37 mm	14%
Weight	683.640 gr	292.44 gr	43%
Ktl*	1.290	0.07	5%
Ctl**	4.660		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 91%	N 100%	0 73%	0 45%	B 73%	0 100%	N 73%	A 64%	0 0%	0 100%	0 100%
B1 0%	F 0%	S 0%	1 27%	1 36%	R 9%	1 0%	S 27%	B 27%	1 18%	1 0%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 18%	G 18%	2 0%	M 0%	C 0%	2 82%	2 0%	2 0%
E1 0%	M 9%	S&L 0%	x 0.3	3 0%	NO 0%	x 0.0	G 0%	D 0%	3 0%	x 0	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 1.8		
H1 0%	OT 0%	OT 0%		x 0.7	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	91%	100%	73%	xxxxxxx	100%	100%	73%	91%	xxxxxxx	100%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.3	0.7	xxxxxxx	0.0	xxxxxxx	xxxxxx	1.8	0	0

SEX: M: 18% F: 82% U: 0%

Index Summary

Tissue Normality Index:	TX	0.92
Fat Index:	FX	0.73
Bile Index:	BX	1.82

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	382	720	1.29	N	N	N	1	2	B	0	S	R	2	F				0	0
2	401	790	1.23	N	N	N	0	1	G	0	N	A	2	F				0	0
3	440	1100	1.29	N	N	N	1	1	B	0	S	B	2	F				0	0
4	413	820	1.16	N	N	N	0	0	B	0	N	A	2	F				0	0
5	402	870	1.34	N	M	N	1	0	B	0	S	A	1	F				0	0
6	314	360	1.16	N	N	N	0	0	B	0	N	B	2	F				0	0
7	321	375	1.13	N	N	N	0	2	B	0	N	B	2	F				0	0
8	315	360	1.15	N	N	N	0	0	R	0	N	A	2	F				0	0
9	341	485	1.22	N	N	N	0	0	B	0	N	A	1	M				0	0
10	469	1220	1.18	N	N	N	0	1	G	0	N	A	2	F				0	0
11	334	420	1.13	N	N	N	0	1	B	0	N	A	2	M				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site J QUALITY CONTROL NO.: 12-111

Species: MNWH (J) Autopsy Date: 09-27-92 Sample Size: 10
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: 5 C Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	351.000 mm	32.9 mm	9%
Weight	555.500 gr	169.45 gr	31%
Ktl*	1.280	0.05	4%
Ctl**	4.624		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 100%	0 90%	0 50%	B 60%	0 100%	N 100%	A 70%	0 10%	0 100%	0 100%
B1 0%	F 0%	S 0%	1 10%	1 50%	R 20%	1 0%	S 0%	B 30%	1 40%	1 0%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 0%	G 20%	2 0%	M 0%	C 0%	2 50%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.1	3 0%	NO 0%	x 0.0	G 0%	D 0%	3 0%	x 0	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 1.4		
H1 0%	OT 0%	OT 0%		x 0.5	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	100%	90%	xxxxxxx	100%	100%	100%	100%	xxxxxxx	100%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.1	0.5	xxxxxxx	0.0	xxxxxxx	xxxxxx	1.4	0	0

SEX: M: 20% F: 80% U: 0%

Index Summary

Tissue Normality Index:	TX	0.99
Fat Index:	FX	0.50
Bile Index:	BX	1.40

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	316	385	1.22	N	N	N	0	1	B	0	N	A	1	M				0	0
2	377	675	1.26	N	N	N	0	0	B	0	N	A	2	F				0	0
3	306	345	1.20	N	N	N	0	1	B	0	N	A	1	M				0	0
4	385	745	1.31	N	N	N	0	0	B	0	N	A	2	F				0	0
5	358	570	1.24	N	N	N	0	1	R	0	N	B	2	F				0	0
6	353	580	1.32	N	N	N	0	0	R	0	N	A	2	F				0	0
7	344	480	1.18	N	N	N	0	0	B	0	N	B	0	F				0	0
8	416	900	1.25	N	N	N	1	1	B	0	N	A	1	F				0	0
9	315	365	1.17	N	N	N	0	1	G	0	N	B	1	F				0	0
10	340	510	1.30	N	N	N	0	0	G	0	N	A	2	F				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site K QUALITY CONTROL NO.: 12-111

Species: MNWH (K) Autopsy Date: 09-28-92 Sample Size: 11
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: 6 C Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	354.910 mm	34.18 mm	10%
Weight	565.000 gr	220.21 gr	39%
Ktl*	1.260	0.12	10%
Ctl**	4.552		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 100%	0 91%	0 27%	B 91%	0 100%	N 82%	A 91%	0 27%	0 100%	0 100%
B1 0%	F 0%	S 0%	1 9%	1 55%	R 0%	1 0%	S 18%	B 9%	1 27%	1 0%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 9%	G 9%	2 0%	M 0%	C 0%	2 45%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.1	3 9%	NO 0%	x 0.0	G 0%	D 0%	3 0%	x 0	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 1.2		
H1 0%	OT 0%	OT 0%		x 1.0	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	100%	91%	xxxxxxx	100%	100%	82%	100%	xxxxxxx	100%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.1	1.0	xxxxxxx	0.0	xxxxxxx	xxxxxx	1.2	0	0

SEX: M: 18% F: 82% U: 0%

Index Summary

Tissue Normality Index:	TX	0.97
Fat Index:	FX	1.00
Bile Index:	BX	1.18

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER Additional juvenile fish captured had severe hemorrhagic lesions around pelvic fin

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	381	740	1.34	N	N	N	0	1	B	0	N	A	2	F				0	0
2	329	430	1.21	N	N	N	0	1	B	0	N	A	1	F				0	0
3	324	380	1.12	N	N	N	0	1	G	0	N	A	2	F				0	0
4	379	640	1.18	N	N	N	0	1	B	0	N	A	2	F				0	0
5	322	425	1.27	N	N	N	0	0	B	0	S	B	0	F				0	0
6	444	1160	1.33	N	N	N	0	0	B	0	N	A	1	F				0	0
7	358	530	1.16	N	N	N	0	3	B	0	S	A	0	F				0	0
8	337	425	1.11	N	N	N	0	1	B	0	N	A	2	M				0	0
9	346	540	1.30	N	N	N	1	0	B	0	N	A	1	F				0	0
10	332	345	0.94	N	N	N	0	1	B	0	N	A	0	M				0	0
11	352	600	1.38	N	N	N	0	2	B	0	N	A	2	F				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site L QUALITY CONTROL NO.: 12-111

Species: MNWH (L) Autopsy Date: 09-30-92 Sample Size: 10
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	382.800 mm	37.9 mm	10%
Weight	617.100 gr	237.85 gr	39%
Ktl*	1.100	0.34	31%
Ctl**	3.974		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 100%	0 100%	0 50%	B 90%	0 100%	N 100%	A100%	0 20%	0 90%	0 100%
B1 0%	F 0%	S 0%	1 0%	1 40%	R 0%	1 0%	S 0%	B 0%	1 10%	1 10%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 10%	G 10%	2 0%	M 0%	C 0%	2 40%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.0	3 0%	NO 0%	x 0.0	G 0%	D 0%	3 30%	x 0.1	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 1.8		
H1 0%	OT 0%	OT 0%		x 0.6	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	100%	100%	xxxxxxx	100%	100%	100%	100%	xxxxxxx	90%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.0	0.6	xxxxxxx	0.0	xxxxxxx	xxxxxx	1.8	0.1	0

SEX: M: 10% F: 90% U: 0%

Index Summary

Tissue Normality Index:	TX	0.99
Fat Index:	FX	0.60
Bile Index:	BX	1.80

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	332	390	1.07	N	N	N	0	1	B	0	N	A	2	M				0	0
2	319	450	1.39	N	N	N	0	0	B	0	N	A	3	F				0	0
3	382	710	1.27	N	N	N	0	0	B	0	N	A	2	F				1	0
4	423	860	1.14	N	N	N	0	0	B	0	N	A	3	F				0	0
5	379	720	1.32	N	N	N	0	0	B	0	N	A	1	F				0	0
6	415	805	1.13	N	N	N	0	1	B	0	N	A	3	F				0	0
7	426	101	0.13	N	N	N	0	1	B	0	N	A	0	F				0	0
8	407	790	1.17	N	N	N	0	0	B	0	N	A	2	F				0	0
9	407	860	1.28	N	N	N	0	1	B	0	N	A	2	F				0	0
10	338	485	1.26	N	N	N	0	2	G	0	N	A	0	F				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site M QUALITY CONTROL NO.: 12-111

Species: MNWH (M) Autopsy Date: 10-01-92 Sample Size: 10
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	387.800 mm	31.44 mm	8%
Weight	619.500 gr	185.57 gr	30%
Ktl*	1.060	0.28	27%
Ctl**	3.830		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 100%	0 100%	0 60%	B 90%	0 100%	N 100%	A 70%	0 20%	0 90%	0 100%
B1 0%	F 0%	S 0%	1 0%	1 40%	R 0%	1 0%	S 0%	B 10%	1 30%	1 10%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 0%	G 0%	2 0%	M 0%	C 0%	2 40%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.0	3 0%	NO 0%	x 0.0	G 0%	D 20%	3 10%	x 0.1	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 1.4		
H1 0%	OT 0%	OT 0%		x 0.4	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	100%	100%	xxxxxxx	90%	100%	100%	80%	xxxxxxx	90%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.0	0.4	xxxxxxx	0.0	xxxxxxx	xxxxxx	1.4	0.1	0

SEX: M: 50% F: 50% U: 0%

Index Summary

Tissue Normality Index:	TX	0.96
Fat Index:	FX	0.40
Bile Index:	BX	1.40

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	431	960	1.20	N	N	N	0	1	B	0	N	D	2	M				0	0
2	378	560	1.04	N	N	N	0	0	B	0	N	A	2	F				0	0
3	359	435	0.94	N	N	N	0	1	B	0	N	A	0	M				0	0
4	399	680	1.07	N	N	N	0	0	B	0	N	A	3	F				0	0
5	363	585	1.22	N	N	N	0	0	B	0	N	A	1	M				0	0
6	389	720	1.22	N	N	N	0	1	B	0	N	A	0	M				0	0
7	400	840	1.31	N	N	N	0	0	N	0	N	D	1	F				1	0
8	450	280	0.31	N	N	N	0	0	B	0	N	A	2	F				0	0
9	362	625	1.32	N	N	N	0	0	B	0	N	B	1	F				0	0
10	347	510	1.22	N	N	N	0	1	B	0	N	A	2	M				0	0
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APPENDIX II

AUTOPSY SUMMARY REPORTS FOR NORTHERN PIKE

SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site H QUALITY CONTROL NO.: 12-111

Species: NRPK (H) Autopsy Date: 10-07-92 Sample Size: 1
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	485.000 mm	NA mm	NA
Weight	825.000 gr	NA gr	NA
Ktl*	0.723	NA	NA
Ctl**	2.613		
Hematocrit	0.000	NA	NA
Leucocrit	0.000	NA	NA
Plasma Protein	0.000	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 100%	0 100%	0 0%	B 100%	0 100%	N 100%	A 0%	0 0%	0 100%	0 100%
B1 0%	F 0%	S 0%	1 0%	1 0%	R 0%	1 0%	S 0%	B100%	1 100%	1 0%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 0%	G 0%	2 0%	M 0%	C 0%	2 0%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.0	3 100%	NO 0%	x 0.0	G 0%	D 0%	3 0%	x 0	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 1.0		
H1 0%	OT 0%	OT 0%		x 3.0	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	100%	100%	xxxxxxx	100%	100%	100%	100%	xxxxxxx	100%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.0	3.0	xxxxxxx	0.0	xxxxxxx	xxxxxx	1.0	0	0

SEX: M: 0% F: 100% U: 0%

Index Summary

Tissue Normality Index: TX 1.00

Fat Index: FX 3.00

Bile Index: BX 1.00

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	485	825	0.72	N	N	N	0	3	B	0	N	B	1	F				0	0
2																			
3																			
4																			
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site K QUALITY CONTROL NO.: 12-111

Species: NRPK (K) Autopsy Date: 10-06-92 Sample Size: 2
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	528.000 mm	37 mm	7%
Weight	********gr	167.5 gr	15%
Ktl*	0.740	0.04	6%
Ctl**	2.673		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 100%	0 100%	0 0%	B 100%	0 100%	N 100%	A 50%	0 100%	0 100%	0 100%
B1 0%	F 0%	S 0%	1 0%	1 100%	R 0%	1 0%	S 0%	B 50%	1 0%	1 0%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 0%	G 0%	2 0%	M 0%	C 0%	2 0%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.0	3 0%	NO 0%	x 0.0	G 0%	D 0%	3 0%	x 0	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 0.0		
H1 0%	OT 0%	OT 0%		x 1.0	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	100%	100%	xxxxxxx	100%	100%	100%	100%	xxxxxxx	100%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.0	1.0	xxxxxxx	0.0	xxxxxxx	xxxxxx	0.0	0	0

SEX: M: 50% F: 50% U: 0%

Index Summary

Tissue Normality Index:	TX	1.00
Fat Index:	FX	1.00
Bile Index:	BX	0.00

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER Gall bladder completly empty, fish #2

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	491	925	0.78	N	N	N	0	1	B	0	N	B	0	M				0	0
2	565	1260	0.70	N	N	N	0	1	B	0	N	A	0	F				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site L QUALITY CONTROL NO.: 12-111

Species: NRPK (L) Autopsy Date: 09-30-92 Sample Size: 10
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	575.500 mm	119.86 mm	21%
Weight	********gr	1192.29 gr	67%
Ktl*	0.930	0.23	24%
Ctl**	3.360		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 100%	0 80%	0 0%	B 90%	0 100%	N 100%	A 50%	0 30%	0 100%	0 100%
B1 0%	F 0%	S 0%	1 10%	1 30%	R 10%	1 0%	S 0%	B 50%	1 20%	1 0%	1 0%
B2 0%	C 0%	L 0%	2 10%	2 40%	G 0%	2 0%	M 0%	C 0%	2 40%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.3	3 30%	NO 0%	x 0.0	G 0%	D 0%	3 10%	x 0	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 1.3		
H1 0%	OT 0%	OT 0%		x 2.0	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	100%	80%	xxxxxxx	100%	100%	100%	100%	xxxxxxx	100%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.3	2.0	xxxxxxx	0.0	xxxxxxx	xxxxxx	1.3	0	0

SEX: M: 60% F: 40% U: 0%

Index Summary

Tissue Normality Index: TX 0.98

Fat Index: FX 2.00

Bile Index: BX 1.30

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	438	925	1.10	N	N	N	0	1	B	0	N	B	2	F				0	0
2	441	1260	1.47	N	N	N	1	1	B	0	N	B	1	M				0	0
3	876	5135	0.76	N	N	N	0	3	B	0	N	A	3	F				0	0
4	538	1050	0.67	N	N	N	0	2	B	0	N	B	1	M				0	0
5	643	2150	0.81	N	N	N	0	3	R	0	N	B	0	M				0	0
6	499	930	0.75	N	N	N	0	3	B	0	N	B	2	M				0	0
7	636	2090	0.81	N	N	N	2	2	B	0	N	A	0	F				0	0
8	562	1370	0.77	N	N	N	0	2	B	0	N	A	2	F				0	0
9	573	1340	0.71	N	N	N	0	2	B	0	N	A	2	M				0	0
10	549	1450	0.88	N	N	N	0	1	B	0	N	A	0	M				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site M QUALITY CONTROL NO.: 12-111

Species: NRPK (M) Autopsy Date: 10-02-92 Sample Size: 10
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	664.800 mm	90.24 mm	14%
Weight	********gr	884.6 gr	37%
Ktl*	0.820	0.03	4%
Ctl**	2.962		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 100%	0 100%	0 20%	B 90%	0 100%	N 100%	A 80%	0 30%	0 80%	0 100%
B1 0%	F 0%	S 0%	1 0%	1 20%	R 10%	1 0%	S 0%	B 20%	1 40%	1 20%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 30%	G 0%	2 0%	M 0%	C 0%	2 30%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.0	3 30%	NO 0%	x 0.0	G 0%	D 0%	3 0%	x 0.2	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 1.0		
H1 0%	OT 0%	OT 0%		x 1.7	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	100%	100%	xxxxxxx	100%	100%	100%	100%	xxxxxxx	80%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.0	1.7	xxxxxxx	0.0	xxxxxxx	xxxxxx	1.0	0.2	0

SEX: M: 40% F: 60% U: 0%

Index Summary

Tissue Normality Index:	TX	0.98
Fat Index:	FX	1.70
Bile Index:	BX	1.00

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	558	1280	0.74	N	N	N	0	2	B	0	N	A	2	F				0	0
2	766	3450	0.77	N	N	N	0	0	B	0	N	A	0	F				1	0
3	471	765	0.73	N	N	N	0	1	B	0	N	B	1	M				0	0
4	603	1610	0.73	N	N	N	0	1	B	0	N	A	0	F				0	0
5	677	2540	0.82	N	N	N	0	3	B	0	N	A	2	M				0	0
6	700	2650	0.77	N	N	N	0	0	R	0	N	A	0	F				0	0
7	730	2860	0.74	N	N	N	0	2	B	0	N	A	1	F				0	0
8	706	2780	0.79	N	N	N	0	3	B	0	N	B	2	F				0	0
9	667	2340	0.79	N	N	N	0	2	B	0	N	A	1	M				0	0
10	770	3715	0.81	N	N	N	0	3	B	0	N	A	1	M				1	0
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APPENDIX III

AUTOPSY SUMMARY REPORTS FOR WHITE SUCKER

SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site H QUALITY CONTROL NO.: 12-111

Species: WHSC (H) Autopsy Date: 10-07-92 Sample Size: 2
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	379.000 mm	9 mm	2%
Weight	845.000 gr	115 gr	14%
Ktl*	1.550	0.1	7%
Ctl**	5.600		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 100%	0 100%	0 0%	B 0%	0 100%	N 100%	A 50%	0 50%	0 100%	0 100%
B1 0%	F 0%	S 0%	1 0%	1 50%	R 100%	1 0%	S 0%	B 50%	1 50%	1 0%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 0%	G 0%	2 0%	M 0%	C 0%	2 0%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.0	3 50%	NO 0%	x 0.0	G 0%	D 0%	3 0%	x 0	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 0.5		
H1 0%	OT 0%	OT 0%		x 2.0	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	100%	100%	xxxxxxx	100%	100%	100%	100%	xxxxxxx	100%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.0	2.0	xxxxxxx	0.0	xxxxxxx	xxxxxx	0.5	0	0

SEX: M: 50% F: 50% U: 0%

Index Summary

Tissue Normality Index:	TX	1.00
Fat Index:	FX	2.00
Bile Index:	BX	0.50

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	370	730	1.44	N	N	N	0	3	R	0	N	B	1	M				0	0
2	388	960	1.64	N	N	N	0	1	R	0	N	A	0	F				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site K QUALITY CONTROL NO.: 12-111

Species: WHSC (K) Autopsy Date: 10-06-92 Sample Size: 4
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	359.000 mm	24.05 mm	7%
Weight	623.750 gr	132.54 gr	21%
Ktl*	1.350	0.05	4%
Ctl**	4.877		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 100%	0 100%	0 25%	B 0%	0 100%	N 100%	A 25%	0 100%	0 100%	0 100%
B1 0%	F 0%	S 0%	1 0%	1 75%	R 100%	1 0%	S 0%	B 75%	1 0%	1 0%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 0%	G 0%	2 0%	M 0%	C 0%	2 0%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.0	3 0%	NO 0%	x 0.0	G 0%	D 0%	3 0%	x 0	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 0.0		
H1 0%	OT 0%	OT 0%		x 0.8	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	100%	100%	xxxxxxx	100%	100%	100%	100%	xxxxxxx	100%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.0	0.8	xxxxxxx	0.0	xxxxxxx	xxxxxx	0.0	0	0

SEX: M: 0% F: 75% U: 25%

Index Summary

Tissue Normality Index:	TX	1.00
Fat Index:	FX	0.75
Bile Index:	BX	0.00

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	393	825	1.36	N	N	N	0	1	R	0	N	A	0	F				0	0
2	340	550	1.40	N	N	N	0	1	R	0	N	B	0	F				0	0
3	333	470	1.27	N	N	N	0	1	R	0	N	B		U				0	0
4	370	650	1.28	N	N	N	0	0	R	0	N	B		F				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site L QUALITY CONTROL NO.: 12-111

Species: WHSC (L) Autopsy Date: 10-03-92 Sample Size: 10
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	393.000 mm	24.8 mm	6%
Weight	833.100 gr	166.15 gr	20%
Ktl*	1.370	0.07	5%
Ctl**	4.950		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 100%	0 100%	0 20%	B 10%	0 100%	N 100%	A 80%	0 20%	0 80%	0 100%
B1 0%	F 0%	S 0%	1 0%	1 70%	R 90%	1 0%	S 0%	B 20%	1 80%	1 20%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 10%	G 0%	2 0%	M 0%	C 0%	2 0%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.0	3 0%	NO 0%	x 0.0	G 0%	D 0%	3 0%	x 0.2	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 0.8		
H1 0%	OT 0%	OT 0%		x 0.9	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	100%	100%	xxxxxxx	100%	100%	100%	100%	xxxxxxx	80%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.0	0.9	xxxxxxx	0.0	xxxxxxx	xxxxxx	0.8	0.2	0

SEX: M: 30% F: 70% U: 0%

Index Summary

Tissue Normality Index:	TX	0.98
Fat Index:	FX	0.90
Bile Index:	BX	0.80

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	352	636	1.46	N	N	N	0	1	R	0	N	A	1	M				0	0
2	397	820	1.31	N	N	N	0	1	R	0	N	A	1	F				1	0
3	389	820	1.39	N	N	N	0	1	R	0	N	A	1	F				0	0
4	425	1105	1.44	N	N	N	0	2	R	0	N	A	1	F				0	0
5	360	570	1.22	N	N	N	0	0	R	0	N	B	0	M				0	0
6	410	950	1.38	N	N	N	0	1	R	0	N	A	1	F				1	0
7	377	720	1.34	N	N	N	0	1	R	0	N	B	1	M				0	0
8	395	800	1.30	N	N	N	0	1	B	0	N	A	0	F				0	0
9	390	820	1.38	N	N	N	0	1	R	0	N	A	1	F				0	0
10	435	1090	1.32	N	N	N	0	0	R	0	N	A	1	F				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site M QUALITY CONTROL NO.: 12-111

Species: WHSC (M) Autopsy Date: 10-02-92 Sample Size: 10
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	404.500 mm	26.33 mm	7%
Weight	902.500 gr	177.05 gr	20%
Ktl*	1.360	0.06	5%
Ctl**	4.913		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 90%	N 100%	N 100%	0 90%	0 10%	B 10%	0 100%	N 100%	A100%	0 30%	0 100%	0 100%
B1 0%	F 0%	S 0%	1 10%	1 80%	R 90%	1 0%	S 0%	B 0%	1 50%	1 0%	1 0%
B2 10%	C 0%	L 0%	2 0%	2 0%	G 0%	2 0%	M 0%	C 0%	2 10%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.1	3 10%	NO 0%	x 0.0	G 0%	D 0%	3 10%	x 0	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 1.0		
H1 0%	OT 0%	OT 0%		x 1.1	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

90%	100%	100%	90%	xxxxxxx	100%	100%	100%	100%	xxxxxxx	100%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.1	1.1	xxxxxxx	0.0	xxxxxxx	xxxxxx	1.0	0	0

SEX: M: 20% F: 80% U: 0%

Index Summary

Tissue Normality Index:	TX	0.99
Fat Index:	FX	1.10
Bile Index:	BX	1.00

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	430	1110	1.40	N	N	N	0	1	R	0	N	A	0	F				0	0
2	408	920	1.35	N	N	N	0	1	R	0	N	A	1	F				0	0
3	399	835	1.31	N	N	N	0	1	R	0	N	A	0	F				0	0
4	380	710	1.29	N	N	N	0	1	B	0	N	A	1	F				0	0
5	406	980	1.46	N	N	N	0	1	R	0	N	A	2	F				0	0
6	350	570	1.33	N	N	N	0	0	R	0	N	A	0	M				0	0
7	389	750	1.27	B2	N	N	0	1	R	0	N	A	1	M				0	0
8	431	1020	1.27	N	N	N	0	1	R	0	N	A	1	F				0	0
9	406	960	1.43	N	N	N	1	1	R	0	N	A	3	F				0	0
10	446	1170	1.32	N	N	N	0	3	R	0	N	A	1	F				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site G QUALITY CONTROL NO.: 12-111

Species: LNSC (G) Autopsy Date: 10-08-92 Sample Size: 10
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	391.000 mm	20.18 mm	5%
Weight	729.000 gr	141.67 gr	19%
Ktl*	1.220	0.12	10%
Ctl**	4.408		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 90%	N 90%	N 100%	0 100%	0 20%	B 10%	0 90%	N 100%	A 70%	0 78%	0 100%	0 100%
B1 0%	F 0%	S 0%	1 0%	1 40%	R 90%	1 10%	S 0%	B 30%	1 11%	1 0%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 20%	G 0%	2 0%	M 0%	C 0%	2 11%	2 0%	2 0%
E1 0%	M 10%	S&L 0%	x 0.0	3 10%	NO 0%	x 0.1	G 0%	D 0%	3 0%	x 0	x 0
E2 0%	P 0%	I 0%		4 10%	E 0%		U 0%	E 0%	x 0.3		
H1 0%	OT 0%	OT 0%		x 1.5	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 10%											
M2 0%											
OT 0%											

Summary of Normals

90%	90%	100%	100%	xxxxxxx	100%	90%	100%	100%	xxxxxxx	100%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.0	1.5	xxxxxxx	0.1	xxxxxxx	xxxxxx	0.3	0	0

SEX: M: 30% F: 70% U: 0%

Index Summary

Tissue Normality Index: TX 0.97

Fat Index: FX 1.50

Bile Index: BX 0.33

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	375	690	1.31	N	N	N	0	1	R	0	N	A	0	F				0	0
2	416	820	1.14	M1	N	N	0	0	R	0	N	A	0	F				0	0
3	362	570	1.20	N	N	N	0	1	B	0	N	B	0	M				0	0
4	375	470	0.89	N	M	N	0	0	R	0	N	A	0	M				0	0
5	412	870	1.24	N	N	N	0	3	R	0	N	A	1	F				0	0
6	426	940	1.22	N	N	N	0	1	R	0	N	A	2	F				0	0
7	378	670	1.24	N	N	N	0	4	R	0	N	B		M				0	0
8	388	760	1.30	N	N	N	0	1	R	0	N	A	0	F				0	0
9	400	870	1.36	N	N	N	0	2	R	1	N	A	0	F				0	0
10	378	630	1.17	N	N	N	0	2	R	0	N	B	0	F				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site H QUALITY CONTROL NO.: 12-111

Species: LNSC (H) Autopsy Date: 10-11-92 Sample Size: 10
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	399.200 mm	11.75 mm	3%
Weight	798.000 gr	85.06 gr	11%
Ktl*	1.250	0.07	6%
Ctl**	4.516		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 100%	N 100%	0 100%	0 30%	B 30%	0 90%	N 100%	A 60%	0 100%	0 90%	0 100%
B1 0%	F 0%	S 0%	1 0%	1 50%	R 70%	1 10%	S 0%	B 30%	1 0%	1 10%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 20%	G 0%	2 0%	M 0%	C 10%	2 0%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.0	3 0%	NO 0%	x 0.1	G 0%	D 0%	3 0%	x 0.1	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 0.0		
H1 0%	OT 0%	OT 0%		x 0.9	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	100%	100%	100%	xxxxxxx	100%	90%	100%	90%	xxxxxxx	90%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.0	0.9	xxxxxxx	0.1	xxxxxxx	xxxxxx	0.0	0.1	0

SEX: M: 60% F: 40% U: 0%

Index Summary

Tissue Normality Index:	TX	0.97
Fat Index:	FX	0.90
Bile Index:	BX	0.00

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	414	880	1.24	N	N	N	0	1	R	0	N	A	0	F				0	0
2	393	760	1.25	N	N	N	0	1	B	1	N	B	0	M				1	0
3	411	820	1.18	N	N	N	0	0	R	0	N	A	0	M				0	0
4	374	670	1.28	N	N	N	0	1	R	0	N	A	0	M				0	0
5	412	960	1.37	N	N	N	0	1	B	0	N	A	0	F				0	0
6	400	800	1.25	N	N	N	0	1	R	0	N	B	0	M				0	0
7	400	710	1.11	N	N	N	0	0	R	0	N	B	0	F				0	0
8	400	830	1.30	N	N	N	0	2	R	0	N	A	0	F				0	0
9	402	850	1.31	N	N	N	0	2	R	0	N	A	0	M				0	0
10	386	700	1.22	N	N	N	0	0	B	0	N	C	0	M				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site J QUALITY CONTROL NO.: 12-111

Species: LNSC (J) Autopsy Date: 10-10-92 Sample Size: 10
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	386.200 mm	17.82 mm	5%
Weight	739.000 gr	84.17 gr	11%
Ktl*	1.280	0.09	7%
Ctl**	4.624		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 80%	N 100%	0 100%	0 0%	B 50%	0 90%	N 100%	A 80%	0 90%	0 90%	0 100%
B1 0%	F 20%	S 0%	1 0%	1 60%	R 50%	1 10%	S 0%	B 20%	1 0%	1 10%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 30%	G 0%	2 0%	M 0%	C 0%	2 0%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.0	3 10%	NO 0%	x 0.1	G 0%	D 0%	3 10%	x 0.1	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 0.3		
H1 0%	OT 0%	OT 0%		x 1.5	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	80%	100%	100%	xxxxxxx	100%	90%	100%	100%	xxxxxxx	90%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.0	1.5	xxxxxxx	0.1	xxxxxxx	xxxxxx	0.3	0.1	0

SEX: M: 60% F: 40% U: 0%

Index Summary

Tissue Normality Index:	TX	0.94
Fat Index:	FX	1.50
Bile Index:	BX	0.30

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	376	680	1.28	N	N	N	0	1	R	0	N	A	0	F				0	0
2	406	835	1.25	N	F	N	0	2	R	0	N	A	0	F				0	0
3	352	580	1.33	N	N	N	0	2	R	0	N	A	0	M				0	0
4	361	650	1.38	N	N	N	0	1	B	0	N	A	0	M				0	0
5	381	780	1.41	N	N	N	0	2	B	0	N	B	0	M				0	0
6	386	750	1.30	N	F	N	0	1	R	0	N	A	0	F				1	0
7	398	870	1.38	N	N	N	0	1	B	1	N	A	0	M				0	0
8	397	715	1.14	N	N	N	0	1	R	0	N	A	0	M				0	0
9	397	720	1.15	N	N	N	0	1	B	0	N	A	0	M				0	0
10	408	810	1.19	N	N	N	0	3	B	0	N	B	3	F				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site K QUALITY CONTROL NO.: 12-111

Species: LNSC (K) Autopsy Date: 10-12-92 Sample Size: 10
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	371.100 mm	17.36 mm	5%
Weight	634.000 gr	74.49 gr	12%
Ktl*	1.240	0.06	5%
Ctl**	4.480		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 70%	N 100%	0 100%	0 0%	B 10%	0 90%	N 100%	A 70%	0 70%	0 100%	0 100%
B1 0%	F 30%	S 0%	1 0%	1 80%	R 90%	1 10%	S 0%	B 30%	1 30%	1 0%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 10%	G 0%	2 0%	M 0%	C 0%	2 0%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.0	3 0%	NO 0%	x 0.1	G 0%	D 0%	3 0%	x 0	x 0
E2 0%	P 0%	I 0%		4 10%	E 0%		U 0%	E 0%	x 0.3		
H1 0%	OT 0%	OT 0%		x 1.4	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	70%	100%	100%	xxxxxxx	100%	90%	100%	100%	xxxxxxx	100%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.0	1.4	xxxxxxx	0.1	xxxxxxx	xxxxxx	0.3	0	0

SEX: M: 80% F: 20% U: 0%

Index Summary

Tissue Normality Index: TX 0.93

Fat Index: FX 1.40

Bile Index: BX 0.30

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	377	600	1.12	N	F	N	0	1	R	0	N	A	0	M				0	0
2	348	560	1.33	N	N	N	0	1	R	0	N	A	0	M				0	0
3	411	825	1.19	N	N	N	0	1	R	0	N	A	0	M				0	0
4	356	555	1.23	N	N	N	0	1	R	1	N	B	0	M				0	0
5	384	660	1.17	N	N	N	0	1	B	0	N	A	0	M				0	0
6	357	590	1.30	N	F	N	0	1	R	0	N	B	1	M				0	0
7	372	650	1.26	N	N	N	0	2	R	0	N	A	0	F				0	0
8	374	640	1.22	N	N	N	0	4	R	0	N	A	1	F				0	0
9	376	670	1.26	N	F	N	0	1	R	0	N	A	1	M				0	0
10	356	590	1.31	N	N	N	0	1	R	0	N	B	0	M				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site L QUALITY CONTROL NO.: 12-111

Species: LNSC (L) Autopsy Date: 10-14-92 Sample Size: 10
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	398.900 mm	23.09 mm	6%
Weight	763.500 gr	139.93 gr	18%
Ktl*	1.200	0.04	3%
Ctl**	4.335		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 80%	N 100%	0 90%	0 0%	B 10%	0 80%	N 100%	A 50%	0 10%	0 100%	0 100%
B1 0%	F 10%	S 0%	1 10%	1 30%	R 90%	1 20%	S 0%	B 50%	1 80%	1 0%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 60%	G 0%	2 0%	M 0%	C 0%	2 0%	2 0%	2 0%
E1 0%	M 10%	S&L 0%	x 0.1	3 10%	NO 0%	x 0.2	G 0%	D 0%	3 10%	x 0	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 1.1		
H1 0%	OT 0%	OT 0%		x 1.8	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	80%	100%	90%	xxxxxxx	100%	80%	100%	100%	xxxxxxx	100%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.1	1.8	xxxxxxx	0.2	xxxxxxx	xxxxxx	1.1	0	0

SEX: M: 20% F: 80% U: 0%

Index Summary

Tissue Normality Index: TX 0.93

Fat Index: FX 1.80

Bile Index: BX 1.10

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER NA

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	384	690	1.22	N	N	N	0	1	R	0	N	A	0	F				0	0
2	442	1060	1.23	N	N	N	0	2	R	1	N	A	1	F				0	0
3	380	620	1.13	N	N	N	0	3	R	0	N	B	1	F				0	0
4	423	910	1.20	N	N	N	0	2	R	0	N	A	3	F				0	0
5	358	540	1.18	N	N	N	0	2	R	0	N	B	1	M				0	0
6	392	765	1.27	N	M	N	0	1	R	0	N	A	1	M				0	0
7	385	680	1.19	N	N	N	0	2	B	0	N	B	1	F				0	0
8	399	760	1.20	N	N	N	0	2	R	1	N	B	1	F				0	0
9	412	800	1.14	N	F	N	1	2	R	0	N	A	1	F				0	0
10	414	810	1.14	N	N	N	0	1	R	0	N	B	1	F				0	0
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SUMMARY OF AUTOPSY

LOCATION: Athabasca River, Site M QUALITY CONTROL NO.: 12-111

Species: LNSC (M) Autopsy Date: 10-13-92 Sample Size: 7
Strain: NA Age: NA Tissue Collection No.: NA
Mark/Lot: NA Disease Survey No.: NA
Unit: NA Water Temp.: NA NA Case History No.: NA
Fish Source: Wild Water Hardness: NA ppm Custody No.: NA
Egg Source: NA Investigator: Barton, Purpose Code: D
Hatching Date: NA Reason for Autopsy: Health Assessment
Remarks: NA

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Length	403.140 mm	16.7 mm	4%
Weight	840.710 gr	96.01 gr	11%
Ktl*	1.280	0.09	7%
Ctl**	4.624		
Hematocrit	NA	NA	NA
Leucocrit	NA	NA	NA
Plasma Protein	NA	NA	NA

*Expressed as Ktl times 10 to the fifth power
**Converted from Ktl; expressed as Ctl times 10 to the fourth power

VALUES AS PERCENT OF TOTAL SAMPLE

EYES	GILLS	PSEUDO-BRANCHS	THYMUS	MESEN. FAT	SPLEEN	HIND GUT	KIDNEY	LIVER	BILE	FIN	OPERCLE
N 100%	N 86%	N 100%	0 86%	0 0%	B 29%	0 100%	N 100%	A 43%	0 71%	0 86%	0 100%
B1 0%	F 14%	S 0%	1 14%	1 43%	R 71%	1 0%	S 0%	B 57%	1 29%	1 14%	1 0%
B2 0%	C 0%	L 0%	2 0%	2 14%	G 0%	2 0%	M 0%	C 0%	2 0%	2 0%	2 0%
E1 0%	M 0%	S&L 0%	x 0.1	3 43%	NO 0%	x 0.0	G 0%	D 0%	3 0%	x 0.1	x 0
E2 0%	P 0%	I 0%		4 0%	E 0%		U 0%	E 0%	x 0.3		
H1 0%	OT 0%	OT 0%		x 2.0	OT 0%		OT 0%	F 0%			
H2 0%								OT 0%			
M1 0%											
M2 0%											
OT 0%											

Summary of Normals

100%	86%	100%	86%	xxxxxxx	100%	100%	100%	100%	xxxxxxx	86%	100%

Summary of Means

xxxxxxx	xxxxxxx	xxxxxxxx	0.1	2.0	xxxxxxx	0.0	xxxxxxx	xxxxxx	0.3	0.1	0

SEX: M: 14% F: 86% U: 0%

Index Summary

Tissue Normality Index:	TX	0.94
Fat Index:	FX	2.00
Bile Index:	BX	0.29

GENERAL REMARKS

FINS NA

SKIN NA

GONADS NA

OTHER Fish #6, gut samples include intestines (frozen together)

Qual. Control No. 12-111

SN	LGH	WGT	Ktl	EYE	GILL	PSBR	THY	FAT	SPL	GUT	KID	LIV	BILE	SEX	HEM	LEU	PLPR	FIN	OPCL
1	407	830	1.23	N	N	N	0	3	R	0	N	B	1	F				0	0
2	383	690	1.23	N	N	N	0	3	B	0	N	B	0	M				0	0
3	409	880	1.29	N	N	N	0	1	B	0	N	B	0	F				0	0
4	403	940	1.44	N	N	N	0	1	R	0	N	A	0	F				0	0
5	417	840	1.16	N	F	N	1	1	R	0	N	B	0	F				1	0
6	376	730	1.37	N	N	N	0	2	R	0	N	A	0	F				0	0
7	427	975	1.25	N	N	N	0	3	R	0	N	A	1	F				0	0
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APPENDIX V

CODING SYSTEM USED FOR AUTOPSY FEATURES SUMMARY PROGRAM DATA ENTRY

APPENDIX V

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)

Gills: Normal (N), Frayed (F), Clubbed (C), Marginate (M), Pale (P), Other (OT)

Pseudo-Branch: Normal (N), Swollen (S), Lithic (L), Swollen and Lithic (S&L), Inflamed (I), Other (OT)

Thymus: No hemorrhage (0), Mild hemorrhage (1), Severe hemorrhage (2)

Mesentery Fat: Internal body fat expressed with regard to amount present;

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)

Hind Gut: 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)

Bile:
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

Fins: 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)

Opercles: No shortening (0), Mild shortening (1), Severe shortening (2)

APPENDIX VI

LEGEND FOR PHOTOGRAPHIC SLIDES SUBMITTED TO NRBS OFFICE

APPENDIX VI
FALL 1992 SPECIAL FISH COLLECTIONS
ATHABASCA RIVER
LEGEND FOR PHOTOGRAPHIC SLIDES
SUBMITTED TO NRBS OFFICE

III-2	Sampling equipment - boat dock layout
III-3	Sampling equipment - live well layout
III-4	H-I-3 - lesion
III-5	Site H
III-6	Site H
III-7	Site G
III-8	Site G
III-9	Site G
III-10	G-I-10 - lesion
III-12	Site J
III-13	Site J - Obed Mtn. Coal Bridge
III-14	Site J - electrofishing boat
III-15	J-I-8 - lesion
III-16	Site J
III-17	K-I-3 - lesion
III-18	Site K - juvenile MNWH with multiple lesions
III-19	Rock Lake
III-20	Rock Lake
III-21	Inlet into Rock Lake
III-22	Rock Lake
III-23	Rock Lake
III-25	Site L
III-26	Site M - Windfall Bridge
III-27	Site M - unsampled MNWH with lesion
III-28	M-II-2 - eroded caudal fin
III-29	M-II-2 - lesion/surface hemorrhage

III-30	M-II-2 - cyst in skin surface
III-32	Site K
III-33	K-III-4 - ruptured kidney from electrofishing
III-35	H-III-1 - lesion
III-36	Site G
III-37	G-IV-4 - ulcerative lesion
III-38	K-IV-8 - darkening on dorsal surface
III-39	M-IV-5 - cyst on belly (faint)
III-40	Site M
III-41	Site M

The following numbers did not turn out and were discarded:

III - 1, 11, 24, 31, 34

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

APPENDIX VII

TERMS OF REFERENCE

NORTHERN RIVER BASINS STUDY

SCHEDULE OF TERMS OF REFERENCE

PROJECT 3119-B2 - RSS - SPECIAL FISH COLLECTION

GENERAL OBJECTIVES

A. To collect 180 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 180 analyses of fish muscle and liver tissues.
- samples for 180 analyses of fish bile.

b) Contaminant induced stress in fish:

- 180 samples for assessment of Mixed Function Oxidase (MFO) enzyme induction.
- 180 samples for assessment of Gonad morphology and steroid hormones.

c) Food web and fish migrations based on stable isotopes.

- 180 samples for assessment of stable isotopes in sample tissue and gut contents.
- 180 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.

Contractor will:

1. Obtain the necessary collection permits from the regulatory authorities.

2. Collect fish samples of the species, in the quantities and at the locations described in Schedule A1.

3. Sub-sample, preserve, label and transport the samples in accordance with the protocols outlined in Schedule A2. These samples are required for the Reach Specific Studies (RSS) investigations listed below:

- Chemical contaminants in fish.
- Contaminant induced stress in fish.
- Food web and fish migrations based on stable isotopes.

4. Collect fish using capture methods and equipment required to honour the protocols described in Schedule A2.

5. Transport and deliver in a timely and competent manner, fish samples, according to procedures outlined in Schedule A2, 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 fall spawning and endeavour to complete the collections in the shortest interval of time practical.

7. Age fish samples including 89 samples from spring collection.

8. Prepare DRAFT and FINAL reports to include among other things (Schedule B):

   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 set-up.

   Ten (10) copies of the draft report are to be received by the Northern River Basins Study office by October 23, 1992.

   Thirty (30) 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.

NORTHERN RIVER BASINS STUDY

PROJECT 3119-B2 - RSS - SPECIAL FISH COLLECTION

SCHEDULE A1
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. Sampling sites should be closely approximate to the spring collection sites which are in proximity to:

   - Entrance (near Highway #40 Bridge)
   - Weldwood Haul Bridge
   - Obed Mountain Coal Bridge
   - Emerson Lakes Bridge
   - near Berland River
   - Windfall Bridge
   - Remote Reference Site (Rock lake 52-1-W6)

   Sampling is to be conducted in September before mountain whitefish begin to spawn.

2. It is essential that mountain whitefish and northern pike be sampled at all six sampling sites.

3. At each of the six sites, ten (10) individuals of the largest adult size class of mountain whitefish and northern pike are to be collected and as opportunity avails the same of white suckers (a total of 180 fish), and sub-sampled in accordance with Schedule A2.

4. In the event that difficulty is experienced in collecting the desired species and size class at the stipulated seven 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

PROJECT 3119-B2 - RSS - SPECIAL FISH COLLECTION

SCHEDULE A2
COLLECTION PROTOCOL

STANDARD OPERATING PROCEDURES
REACH SPECIFIC STUDIES

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 live fish only, 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.

SCHEDULE A2

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 centrifuge blood, aspirate plasma into appropriate labelled storage tubes and freeze on dry ice within 15 minutes.

7. Record the fish length and weight to nearest mm and 0.1 gm, respectively.

8. Examine fish for external lesions and record any abnormalities. Complete the Gross Pathology Sheet (Appendix 1).

9. Open fish ventrally and examine fish for internal lesions and record any abnormalities.

10. Remove liver, weigh and record weight to nearest 0.1 gm. 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) Remove and place some of the liver tissue into an appropriately sized and labelled HistoPrep Tissue Capsule. Place this in a Nalgene Square polyethylene wide mouth bottle containing Davidson's fixative.

    b) Take a 1.0 g sample (if liver 5.0 g or larger increase sample size to 2.0 g) of the liver for MFO analysis. To obtain a more uniform and ultimately homogeneous sample of liver for all determinations take small cores from across the liver based on a statistical sampling grid and then combine them to form the 1-2 g sample for enzyme analysis. Either well-cleaned cork borers, available from any scientific equipment supplier, or very wide-gauge syringe needles could be used to take these sub-samples. The latter may be best, as you could pre-load the syringe with the KCl rinse solution and by pushing on the plunger expel the sample into a cryo-vial and pour off the rinse solution.

    c) Each sample must be rinsed with cold 0.15 m KCl to remove traces of blood and bile.

    d) 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.

11. Score each fish for gender and for state of sexual development.

SCHEDULE A2

12. Remove gonads, weigh and record the weight to nearest 0.1 gm. Each gonad sample must then be prepared and stored as follows:

Materials

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" x 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	4.0 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. 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

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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.

13. 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.

14. 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.**

15. 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 to the nearest 0.1 gm.

16. Retain, store and label the appropriate ageing structure[1] of all sampled fish.

17. The use of dry ice for initial freezing and shipping is mandatory.

18. 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.

19. Place dry ice both on top and bottom of coolers to assure that no freeze-thaw 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.

[1] MacKay, W.C., G.R. Ash and J.J. Norris (eds.) 1990. Fish Ageing Methods for Alberta. R.L. & L. Environmental Services Ltd. in association with Alberta Fish and Wildlife Division and University of Alberta, Edmonton. 113 pp.

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20. Ship frozen samples as soon as possible or, if not possible, 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.

Any contractor/consultant or government personnel that is transporting fish to Edmonton must contact one of the following people before leaving place of origin:

Earle Baddaloo	Work:	(403) 427-6102
	Home:	(403) 434-8967
Sub Ramamoorthy	Work:	(403) 427-6102
	Home:	(403) 435-8137

<u>If the above personnel are not in</u>, a message indicating fish is on its way and approximate time of arrival in Edmonton <u>must</u> be left with the secretary (in office) between 8:15 a.m. and 4:30 p.m., or on an answering machine (home) after 4:30 p.m., before leaving place of origin.

Upon arrival in Edmonton with specimens from Northern River Basins Study projects, contractor(s) or consultant(s) should contact one of the above personnel again.

If the above personnel cannot be contacted on a weekday (Monday to Friday), contractor(s)/consultant(s) should proceed directly to **VERSACOLD only between 8:00 a.m. and 4:00 p.m. Drop cargo (fish) off at VERSACOLD under the name of Earle Baddaloo, Alberta Environment.** <u>**DO NOT LEAVE FISH OUTSIDE OF VERSACOLD!!**</u>

<u>**VERSACOLD IS OPEN BETWEEN 0800 AND 1600 HOURS, MONDAY THROUGH FRIDAY.**</u>

ADDRESS: 9002 - 20 Street
Edmonton, Alberta

TELEPHONE: (403) 464-1770
CONTACT: Mr. Merve Permann

If fish tissue arrive after 4:00, contractor(s)/consultant(s) must make <u>every effort</u> to contact Mr. Baddaloo or Dr. Ramamoorthy so that alternate storage for the night or weekend may be found.

It is, therefore, imperative to call contacts before leaving place of origin so that they (contacts) will be aware of the transport activity and can make arrangements for the arrival of the specimens.

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WEEKEND TRANSPORT

If fish has to be transported to Edmonton on the weekend (Saturday, Sunday or public holiday), the contractor(s)/consultant(s) or government personnel should contact Mr. Baddaloo or Dr. Ramamoorthy on the last working day before the weekend or public holiday. (If contacts are not available, messages must be left with the secretary.) Again, before leaving place of origin, please call contacts at home and leave a message if they are not there; and upon arrival in Edmonton, please call contact again.

21. 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.

22. 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.