Evaluation of an Experimental Re-introduction of Sockeye Salmon into Skaha Lake

Year 1 of 3

Technical Report
2000

DOE/BP-00005136-1

June 2001

This Document should be cited as follows:

Hammell, Larry, Deanna Machin, Karilyn Long, Trevor Evelyn, Chris Bull, "Evaluation of an Experimental Re-introduction of Sockeye Salmon into Skaha Lake; Year 1 of 3", 2000 Technical Report, Project No. 200001300, 230 electronic pages, (BPA Report DOE/BP-00005136-1)

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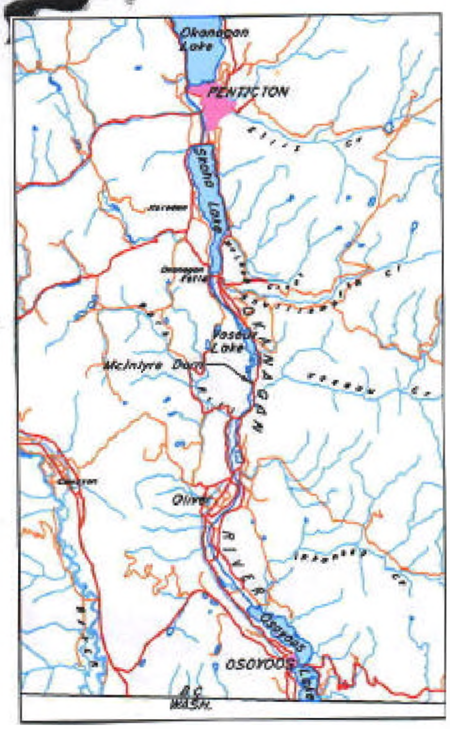
P.O. Box 3621
Portland, OR 97208

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the author's and do not necessarily represent the views of BPA.

Evaluation of an experimental re-introduction of sockeye salmon into Skaha Lake

Year 1 of 3

Submitted to:
Colville Confederated Tribes



Submitted by:
Okanagan Nation
Fisheries Commission

June 2001

OKANAGAN NATION ALLIANCE

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September 20, 2001

Chris Fisher
Anadromous Fisheries Biologist
Colville Confederated tribes
Fish and Wildlife Department
PO Box 862
Omak, Washington 98841

Dear Chris;

Re: Year 1 Report – An Evaluation of an Experimental Re-Introduction of Sockeye Salmon into Skaha Lake

Please find enclosed three copies of the report *An Evaluation of an Experimental Re-Introduction of Sockeye Salmon into Skaha Lake – Year 1 of 3*. The overall project encompasses six objectives over three years. The Year 1 report is a compilation of Objectives 1, 2 and 3: Disease Risk Assessment, Exotic Fish Species Risk Assessment and Sockeye Salmon Habitat Assessment in Okanagan River Upstream of McIntyre Dam.

Please contact our office if you have any questions or comments.

Sincerely,
OKANAGAN NATION FISHERIES COMMISSION

Deana Machin
Program Manager

Evaluation of an Experimental Re-introduction of Sockeye Salmon into Skaha Lake

Objective 1: Disease Risk Assessment

Submitted to:
Okanagan Nation Fisheries Commission

Submitted by:
Trevor Evelyn, Fish Health Consulting Ltd.
Larry Hammell, Atlantic Veterinary College,
University of Prince Edward Island

Reviewed by:
Chris Bull, R.P.Bio
Glenfir Resources

June 2001

EXECUTIVE SUMMARY

The Okanagan Nation and tribes in the U.S. have proposed re-introducing sockeye salmon into Okanagan Lake. To investigate the risks involved, a multi-agency workshop recommended an experimental re-introduction into Skaha Lake. Risks might include competition between sockeye and kokanee, the introduction of exotic species, and the introduction of new diseases. This report summarizes the findings from the first year of a three-year disease risk assessment.

The first task was to compare the disease and infection status of fish above and below McIntyre Dam (the present limit of sockeye migration). Additional tasks included determining if lake conditions would contribute disease risks and assessing whether re-introduced fish were likely to interact with resident fish or extend the range of pathogens.

The disease agents of particular concern are:

- infectious pancreatic necrosis virus (IPNV),
- infectious haematopoietic necrosis virus type 2 (IHNV type2),
- erythrocytic inclusion body syndrome virus (EIBSV),
- the whirling disease agent (*Myxobolus cerebralis*), and
- the ceratomyxosis agent (*Ceratomyxa shasta*).

The Okanagan Nation Fisheries Commission was responsible for collecting fish from above and below McIntyre Dam, and the number of fish collected surpassed the target of 720 fish from each area. A wide variety of species was captured including sockeye, kokanee, whitefish and 15 species of non-salmonids.

Provincial and federal fish health laboratories performed the lab analyses. All of the virus isolates obtained appeared to be IHNV type I. However, IHNV type I is not a concern because it is already found above McIntyre Dam.

There was no indication of IPNV in any of the samples tested. However, another condition, indistinguishable from erythrocytic inclusion body syndrome (EIBS), and indicative of the presence of the EIBS virus, was found. Because EIBS occurred in fish above and below the Dam its causative virus is probably widespread in the Okanagan drainage.

All adult sockeye samples tested for the whirling disease agent (*Myxobolus cerebralis*) and the ceratomyxosis agent (*Ceratomyxa shasta*) proved negative for these pathogens. More conclusive tests to determine whether these agents occur above and below McIntyre Dam will be conducted in 2001 and 2002 by holding rainbow trout, susceptible to both of these agents, in “live boxes” at appropriate sites above and below the Dam.

At this early phase in the sampling, there is no evidence that the fish populations above and below the Dam differ with respect to pathogens of concern.

Limnological data for Okanagan and Skaha Lakes reveal no extraordinary risk of predisposing fish to disease. Both lakes become stratified with a warm epilimnion and a cooler hypolimnion in summer followed by an overturn. Thus salmonids should be able to reside in non-stressful oxygen and temperature conditions all year long. However, Skaha Lake, which is much smaller and shallower than Okanagan Lake, may be slightly stressful to salmonids in very warm years.

Kokanee in Okanagan and Skaha Lakes have declined drastically due to reduced nutrient input and the introduction of mysids which compete with kokanee for zooplankton. There is some speculation that sockeye would add to the competition and could adversely affect the health of kokanee because starving fish are less likely to be robust and disease resistant. However, the decomposing carcasses of the spent sockeye would provide nutrients from the sea which may mitigate any negative effects.

Sockeye progeny will likely have eco-niche requirements and behaviour patterns similar to those of kokanee. Thus cross infections are possible. Cross infections may also be possible between salmonids and non-salmonids. However the important question is whether any new pathogens are likely to be introduced. The present pathogen survey is intended to provide answers to this important question.

ACKNOWLEDGEMENTS

The culmination of this report has been truly a group effort and the Okanagan Nation Fisheries Commission would like to thank all those involved.

Trevor Evelyn and Larry Hammell prepared the sampling plan and reviewed the results. Disease analyses were carried out by Sally Goldes and Sherry Guest of the provincial Ministry of Agriculture, Fisheries and Food (MAFF), Fish Culture Section laboratory and Garth Traxler and Jon Richardson of the federal Pacific Biological Station, Fish Health Laboratory.

Chris Fisher and Monte Miller of the Colville Confederated Tribes generously provided the electrofisher boat available for all the night sampling. Mysis harvestors Lee Granberg and Vince and crews kindly provided the kokanee fry.
Barry Hanslit of the Pacific Biological Station provided the opportunity for us to collect sockeye fry during his trawls of Osoyoos Lake.

Jason Webster and crew, of Chara Consulting were an asset in collecting kokanee spawners for us. And thanks to Blake Kennedy for allowing us to access sections of the river through his property to do our early sockeye disease sampling.

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1.0 INTRODUCTION

1.1 Project Background

Historical records indicate that sockeye salmon were once found in most of the lakes in the Okanagan River Basin. Currently, the only sockeye population within the Okanagan River Basin is found in Osoyoos Lake. Abundance of this stock has declined significantly in the last fifty years. The Okanagan Nation and tribes in the U.S. have proposed re-introducing the species into Okanagan Lake, which has a large rearing capacity. However, assessing the potential benefits and risks associated with a re-introduction of sockeye salmon into Okanagan Lake is difficult because of uncertainties about factors that determine production of Okanagan sockeye, and potential interactions with other species in Okanagan Lake.

Associated with this proposal are the potential risks of re-introduction of sockeye salmon into Okanagan Lake. One of these is the effects of sockeye on the resident Okanagan Lake kokanee population, which has declined significantly in the past several years because of habitat loss due to human encroachment, competition with introduced mysid shrimp, and the reduction of biological productivity in the lake as municipalities have moved to more complete effluent treatment. Another concern is the possibility of the transmission of diseases that are currently not found in Okanagan and Skaha lakes from re-introduced sockeye to resident fish. An additional concern is the risk that exotic species (e.g. tench, largemouth bass), that have become established in southern Okanagan Lakes (principally as a result of purposeful introductions in the US Columbia/Okanagan river system), may be able to extend their range to Skaha and Okanagan Lakes, through fish ladders provided at the outlets of Vaseaux (McIntyre Dam) and Skaha Lakes (Okanagan Falls Dam), for natural upstream migration of sockeye.

A transboundary multi-agency workshop was hosted in November of 1997 to discuss the potential risks and benefits of reintroducing sockeye salmon into Okanagan Lake. These discussions were summarized into a Draft Action Plan that recommended that sockeye be re-introduced to Skaha Lake as an experimental management strategy to resolve some of these uncertainties (Peters et al. 1998).

The purpose of this project is to assess the risks and benefits of an experimental re-introduction of sockeye salmon into Skaha Lake. The assessment will be accomplished by completing the following six objectives over three years:

1. Disease Risk Assessment;
2. Exotic species Re-introduction risk Assessment;
3. Inventory of Existing Habitat and Opportunities for Habitat Enhancement;
4. Development of a life-cycle model of Okanagan salmonids, including interaction with resident kokanee;
5. Development of an experimental design and;
6. Finalize a plan for experimental re-introduction of sockeye salmon into Skaha Lake and associated monitoring programs.

Objectives 1-3 would span over the three year period, objective 4 and 5 implemented and completed in the second year, and objective 6 to be implemented and completed in the third year. These elements will be integrated into an overall experimental management plan through a cooperative multi-agency process that involves U.S. and Canadian agencies.

Re-introducing sockeye salmon into Skaha Lake offers potential rebuilding benefits by increasing the amount of rearing habitat available to Okanagan sockeye that is known to be the present limiting factor (Hyatt 1999, PSARC Report). Perhaps more importantly, a re-introduction of sockeye into Skaha Lake offers an opportunity to implement an experimental management approach to learning about interactions between sockeye salmon and resident species in the Okanagan system of lakes and the relative importance of various factors that influence overall survival. This information will be extremely valuable in future evaluations of re-introduction of sockeye into Okanagan Lake, and for other sockeye rebuilding strategies throughout the basin. Actual implementation of the re-introduction and monitoring programs will be covered in a future proposal to the Fish and Wildlife program. The information contained in this plan, as well as the information gathered from the re-introduction itself, will support future decisions on rebuilding strategies for the Okanagan River sockeye stock and for other sockeye stocks in the Columbia River Basin.

The Okanagan Nation Fisheries Commission (ONFC) was contracted for project management and implementation of the field data collection for Objectives 1, 2 and 3. This report summarizes the inventory and preliminary lab analysis findings of year one of the first objective, Disease Risk Assessment. In addition, difficulties in the sampling design implementation will be discussed.

1.2 Project Area

The first task in the pathogen risk assessment will therefore be to sample fish, both salmonids and non-salmonids, from above and below MacIntyre Dam for certain pathogens and parasites of particular concern (See Figure 1). This sampling should determine whether fish from below the dam are likely to be carrying infectious agents that are not yet present in fish above the dam. It is proposed that the geographic limits for sampling above and below MacIntyre Dam be the northernmost shore of Okanagan Lake and the southernmost shore of Osoyoos Lake (Zosel Dam), respectively. Notwithstanding this, data on fish pathogens routinely collected from sockeye and other salmonids downstream of Osoyoos Lake and held at Cassimer Bar Hatchery will also be taken into account.

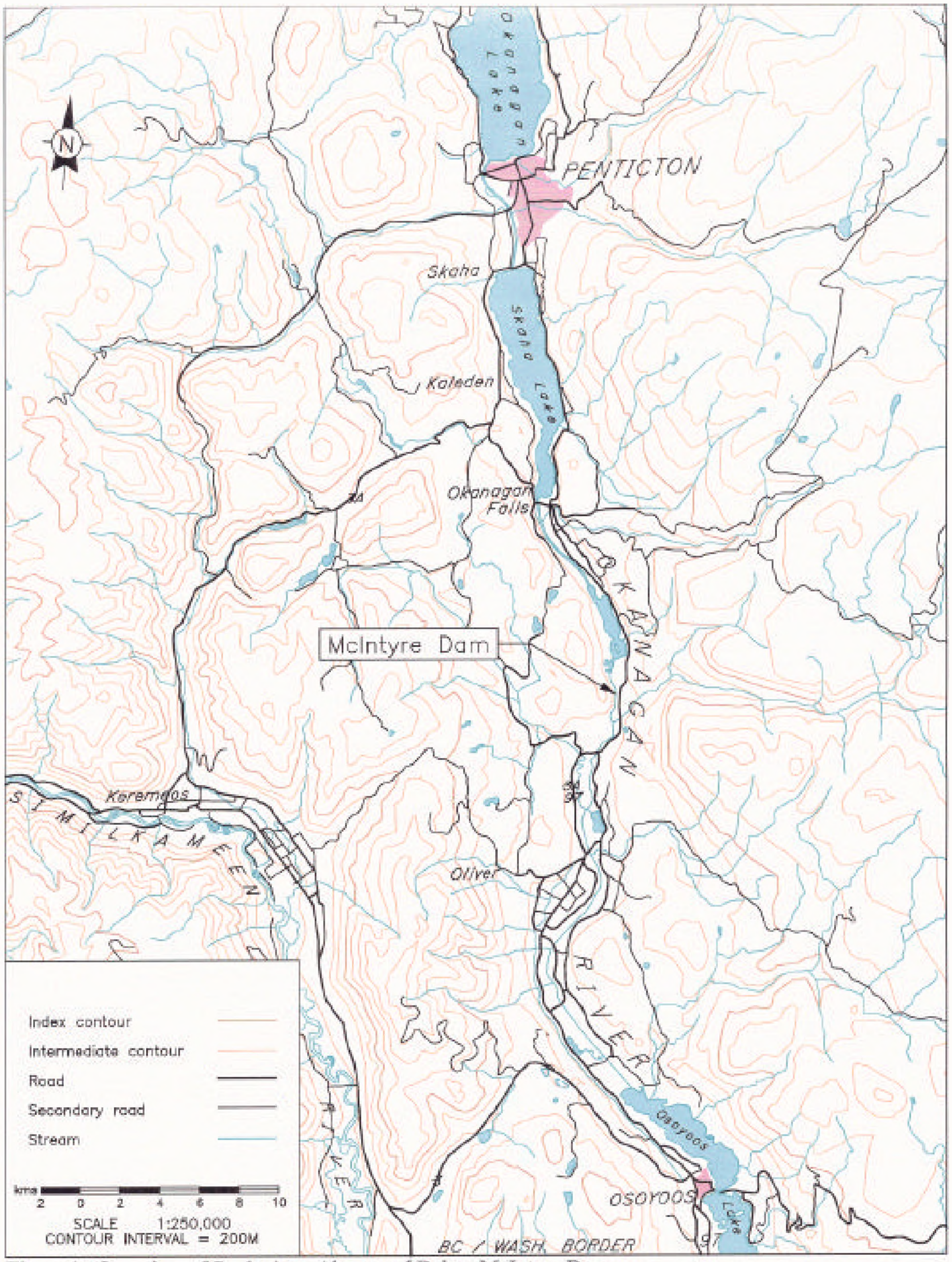

Figure 1 Overview of Study Area Above and Below McIntyre Dam

1.3 Project Objectives

The project objectives are outlined below as described in the original proposal:

1. Compare the disease and infection status of fish above and below the dams,
2. Determine if there are environmental conditions specific to the lakes in question that would either put fish at extraordinary risk for developing disease or that would maintain introduced infectious agents, and,
3. Assess the opportunity for re-introduced fish to interact with susceptible resident fish or to extend the distribution of important pathogens.

The provincial and federal agencies fish health departments (Ministry of Agriculture Food and Fisheries (MAFF) and Department of Fisheries and Oceans (DFO), respectively) were asked to submit recommendations for independent contractors to conduct the Disease Risk Assessment. Dr. Larry Hammel and Dr. Trevor Evelyn were selected to conduct the disease risk assessment.

To develop the sampling design, a multi-agency workshop of people with fish disease expertise was hosted by the ONFC and the Colville Confederated Tribes (CCT). A consensus-based sampling design was developed and summarized by Trevor Evelyn and Larry Hammel (Appendix A).

The purpose of the sampling design is to assess the risk of introducing fish pathogens new to Skaha Lake with the re-introduction of sockeye salmon into the lake. Sockeye may not be the only fish to enter the lake once the barrier to migration (MacIntyre Dam) is removed by the installation of a fish ladder or by dam removal. Other fishes, both salmonids and non-salmonids will also almost certainly be capable of migrat-ing upstream once the barrier is removed.

The disease agents of particular concern to be tested for during the survey are:

- infectious pancreatic necrosis virus (IPNV),
- infectious haematopoietic necrosis virus type 2 (IHNV type2),
- erythrocytic inclusion body syndrome virus (EIBSV),
- the whirling disease agent (*Myxobolus cerebralis*), and
- the ceratomyxosis agent (*Ceratomyxa shasta*).

The Okanagan Nation Fisheries Commission conducted the field sampling with the provincial and federal agencies conducting the lab analyses in accordance with their jurisdiction (provincial, non-anadromous fish; federal, anadromous fish). A sampling protocol developed by the provincial and federal agencies was developed and implemented by the ONFC (see Figure 2).

The first year of sampling was used to learn of any difficulties associated with the sampling program. It is hoped that any difficulties encountered will be corrected during the additional two years of sampling. The three-year sampling period will therefore result in an improved basis for drawing reasonable conclusions about the infection status of the fish populations above and below MacIntyre Dam. (In this connection, and for the purposes of this study, a fish population is considered to consist of both the salmonids and non-salmonids that occur in the geographic region being sampled).

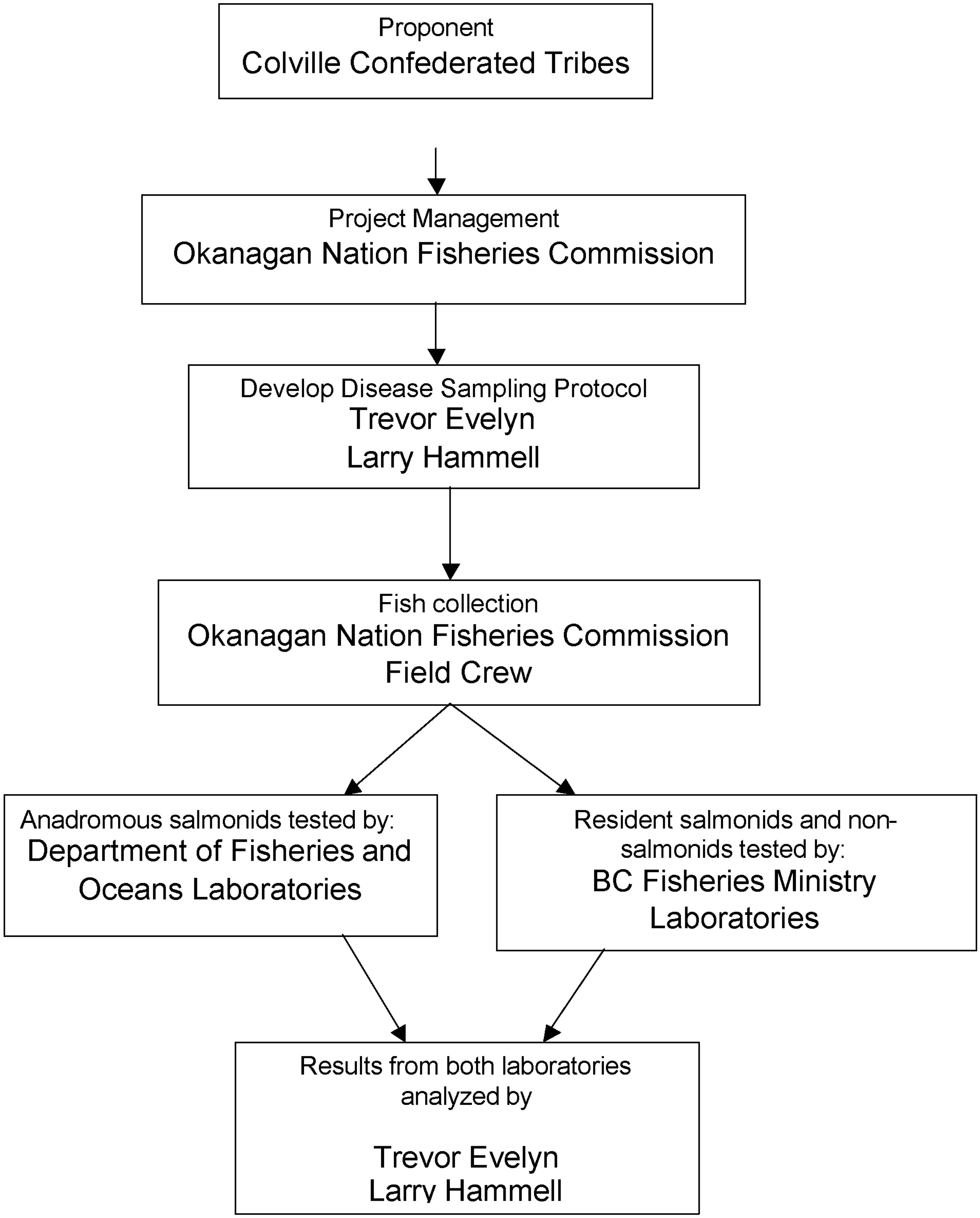

Figure 2. Disease Assessment Team Structure

2.0 METHODS

The aim is to sample fish that are likely to pose the greatest risk of introducing the disease agents of particular concern (see list on page 6) and that are likely to be harbouring these agents in readily detectable numbers.
For this reason, fish that are active migrators, very young fish which lack an effective specific immune system, fish that have gone through the stress of spawning, or fish that may have been immuno-compromised by high water temperatures (e.g., summer) willcomprise the bulk of the samples collected.

The aim is to collect approximately 720 fish per year from each of the two geographic sampling regions, the sample for each geographic region to consist of 360 salmonids and 360 non-salmonids. Salmonids collected above and below MacIntyre Dam would feature kokanee and sockeye salmon, respectively. Non-salmonids collected from each of these regions would represent as many species as possible with no single species accounting for more than 25% of the sample (see Appendix A Pathogen Risk Assessment Protocol for details).

Samples were collected by personnel from the Okanagan Nation Fisheries Commission (ONFC) and sent to the fish health laboratories. All resident salmonids and non-salmonids were sent to the MAFF laboratory and anadromous salmonids were sent to the Pacific Biological Station (DFO). Samples were usually received the day following collection from the field.

2.1 Field sampling methods

All non-salmonids were collected using a boat electroshocker at selected sites in Okanagan, Skaha and Osoyoos Lakes. The boat electroshocker was a Smith-root model 7.5 GPP electrofisher mounted in a Smith-root manufactured aluminum boat, supplied by the Colville Confederated Tribes. Voltage varied between 360-1000 volts with electrical pulse frequencies of 30-120 Hz. Majority of electrofishing was undertaken at outputs between 5.5-7.5 Amps, provided the water temperatures were greater than 4^{o}C and conductivity was above 30 μS/cm (Resource Inventory Committee water chemistry standard for electrofishing). See Table 1, Disease risk assessment sampling plan.

Sockeye spawners were collected on the spawning grounds by dip netting. Samples from the early run of sockeye were collected by angling below McIntyre Dam where they congregate. Sockeye fry were collected by trawling with the DFO trawling boat. Due to the sensitive nature of the kokanee populations, all adult samples were post-spawned fish collected on the spawning grounds. Kokanee fry were caught while surveying the local commercial Mysid shrimp operation.

Table 1. BPA Disease risk assessment sampling plan

ABOVE MCINTYRE DAM

Fish species		**Laboratory Responsible**	**Number of fish recommended**	**Test for**	**Comments**
Salmonids, mostly Kokanee salmon	Recent post-spawners	Ministry of Agriculture, Fisheries and Food (MAFF)	150	IPNV, IHNV, EIBSV and *C.shasta*	Approx. 30 fish per group; make up the total with other salmonids if necessary
	2 month old fry	MAFF	150	IPNV, IHNV, and EIBSV	
	all ages	MAFF	60	IPNV, IHNV, and EIBSV	
Non-salmonids	Migratory & Non-migratory fish	MAFF	360	IPNV, IHNV and EIBSV	Collect as many species and age groups as possible from as many areas as possible, no single species should represent more than 25% of the sample.
TOTAL			**720**		

BELOW MCINTYRE DAM

Fish species		**Laboratory Responsible**	**Number of fish recommended**	**Test for**	**Comments**
Salmonids, mostly Sockeye salmon	Recent post-spawners	Department of Fisheries and Oceans (DFO)	180	IPNV, IHNV, EIBSV, and *C.shasta*	Make up the total with other salmonids if necessary
	2 month old fry	DFO	180	IPNV, IHNV and EIBSV	
Non-salmonids	Migratory & Non-migratory fish	MAFF	360	IPNV, IHNV and EIBSV	Collect as many species and age groups as possible from as many areas as possible, no single species should represent more than 25% of the sample.
TOTAL			**720**		

2.2 Live box testing for *M.cerebralis* and *C. shasta*

Thus far, adult sockeye samples were the only samples tested for the whirling disease agent (*Myxobolus cerebralis*) and the ceratomyxosis agent (*Ceratomyxa shasta*). (Samples collected from adult kokanee are still to be tested.) The testing involved a microscopic examination of appropriate tissues for spores characteristic of these agents (see diagnostic protocols). Testing for the presence of *M. cerebralis* and for *C. shasta* in waters above and below McIntyre Dam will, however, be primarily based on exposing susceptible sentinel fish (rainbow trout), held in "live boxes", to suspect waters above and below McIntyre Dam. The fish will then be examined to determine whether they have picked up *M. cerebralis* and *C. shasta*. This method of testing was postponed in year 2000 due to the need for favourable water temperatures and because a suitable stock of sentinel fish had still to be identified.. The live boxes will be placed in the suspect water after water temperatures have reached 9 C, and the boxes will be located in areas where water flow is sluggish but the oxygen level adequate to satisfy the needs of the live-boxed fish.

We will use 1000 fish from a stock known to be free of *M. cerebralis* and *C. shasta*. One hundred fish in each of 8 cages will be exposed to the test waters and 200 fish will be held as unexposed controls. The fish age should be 3 weeks to 12 weeks post- hatch. Four sites above and four below McIntyre Dam have been selected in low gradient mainstem locations or near the outlet of tributaries that are likely to favour the presence of the alternate hosts of *M. cerebralis* and *C. shasta (Tubifex tubifex and Manayunkia speciosa,* respectively*)* . It is the alternate hosts that produce and shed the life-stages (TAMs) of the two parasites that are infectious for salmonids. Exposures should last 15 to 25 days after which the fish will be grown in Skaha Hatchery for 1600 thermal units until they are processed and sent to the MAFF lab where they will be tested for the presence of *M. cerebralis* and *C. shasta*. . Live-box exposures will begin in 2001.

2.3 Laboratory methods used by the DFO lab

Immediately upon receipt, the samples were (or will be) stored at – 80°C until assays were (or are) conducted. Dates of collection and assay were (or will be) noted for each shipment of samples from the ONFC.

2.3.1 Virology

Sockeye fry were assayed by grinding gill, kidney, spleen, and pyloric caeca tissues in Earle's balanced salt solution to prepare a 2% homogenate. A 10-fold dilution was prepared and 0.1 ml of both the 2% and 0.2% homogenates were inoculated onto separate preformed monolayers of EPC and CHSE-214 cells that were seeded the day before. The cells were incubated at 15°C and observed 2-3 times each week for a period of 3 weeks for CPE. Ovarian fluid and milt were collected from post-spawned adults and 1:2 and 1:20 dilutions, prepared with EBSS, were inoculated onto the monolayers as above.

The indirect fluorescent antibody technique (IFAT) was used to determine if any of the virus isolates were Type II IHNV. Cell cultures infected with virus isolates from individual fish were tested using DiagXotics monoclonal antibodies 14D (universal) and 105B (Type II specific).

2.3.2 Hematology

Blood smears were air-dried and fixed in methanol for 5 min prior to staining with the Leishman-Giemsa technique. A minimum of 50 fields were examined for evidence of the EIBS virus using a 100X oil immersion lens .

2.3.3 Parasitology

Laboratory tests for the detection of *M. cerebralis* and *C. shasta* followed (and will follow) the procedures for the detection of certain myxospordian spores as described in the Canadian Fish Health Protection Regulations. *M. cerebralis* -- the pepsin/trypsin digest method. *C. shasta* - microscopic examination of smears

2.4 Laboratory methods used by the MAFF laboratory

2.4.1 Virology

Fish were dissected in the lab and pooled using fish of the same species, normal with normal and moribund with moribund. A maximum of three fish (majority of fish pooled in 3's or lower) were pooled together. The following tissues were retained for analysis for the different life stages;

- Sac-Fry: Whole fish, after removing the yolk sac,
- Fry (2-4 cm): Retain gills, but discard head anterior to gills and tail posterior to the vent,
- Fingerlings. (4-10 cm): Remove and retain the gills, g-i tract, kidney, spleen, liver,
- Fingerlings. (>10 cm):Remove and retain the gills, spleen, pyloric caeca or liver, kidney (equal amts. ant., cent. and post. kidney),
- Ovarian fluid: Pool females with females and males with males. Post-spawners with post-spawners, etc.

The inoculated plates were incubated for 4 weeks at 15°C and examined at least twice weekly for CPE. Virus confirmation was the same as for ovarian fluids. IHNV and IPNV confirmed by fluorescent antibody test (monoclonal anti-sera from DiagXotics Inc.). All IHNV-positive samples, also tested for IPNV by FAT.

2.4.2 Hematology

The Erythrocyte Inclusion Body Syndrome (EIBS). Detection of causative agent was based on a microscopic examination of blood smears (one blood smear collected per fish), which were stained with Leishman-Giemsa.

2.4.3 Parasitology

Methods for detecting *M. cerebralis* and *C. shasta* will be following in the new year as will the results from stored samples, collected in year 2000.

3.0 RESULTS

The Ministry of Agriculture, Fisheries and Food, Fish Culture Section along with the Department of Fisheries and Oceans laboratory participated in the laboratory epidemiological survey for certain piscine pathogens in the Upper Okanagan drainage. The 2000 field sampling season commenced in late June and continued until late November. Table 2 illustrates the number of fish collected for the analysis and indicates where, how, and when they were collected.

Table 2. BPA Disease risk summary of sampling results

ABOVE MCINTYRE DAM

Fish species		**Number of fish recommended**	**Fish Collected**	**Collection sites**	**Collection times**
Salmonids mostly Kokanee	Recent post-spawners	150	160 & 44 ovarian fluids	collect from the three spawning channels and ovarian fluids from beach spawning groups	October, 2000
	2 month old fry	150	150 & 39 of 4 and 6 month fry	Mysid shrimp harvest boat	June – Aug 2000
	all ages	60	50	Use the whitefish (*Salmonidae* family) of all ages	20 fish-June 20 fish-August 20 fish-Nov.
Non-salmonids	Migratory & Non-migratory fish	360	393	Electrofishing –boat	120 fish-June 120 –August 120 fish-Nov
TOTAL		**720**	**792**		

BELOW MCINTYRE DAM

Fish species		**Number of fish recommended**	**Fish collected**	**Collection sites**	**Collection times**
Salmonids mostly Sockeye	Recent post-spawners	180	39 170	collect from Okanagan River Channel with DFO	Early run: July Post spawn: Oct, Nov 2000
	2 month old fry	180	171 & 121 of 4 to 6 month fry	DFO -shrimp trawler	July 2000 Sept 2000
Non-salmonids	Migratory & Non-migratory fish	360	309	Electrofishing boat	120 fish-June 120 –August 120 fish-Nov.
TOTAL		**720**	**810**		

3.1 Department of Fisheries & Oceans laboratory results

Data were collected by Department of Fisheries and Oceans laboratory, on sockeye fry (248 fish) and adults (208 fish) from the Okanagan River system. Of the 51 IHNV isolates tested by indirect fluorescent labeling all were determined to be IHNV type I (none were IHNV Type II).

There was no indication of erythrocytic inclusion body syndrome (EIBS) virus or erythrocytic necrosis (EN) virus based on the observation of cytoplasmic inclusion bodies in blood smears (see Appendix C for details).

3.2 Ministry of Agriculture, Fisheries and Food laboratory results

The Fish Health Unit of MAFF received approximately 1,200 fish. Tests for IHNV and IPNV have been completed and the results are summarized in Appendix D. Analysis of blood samples for EIBS were also completed. Tissue samples for *Ceratomyxa shasta* have been preserved and will be analyzed with the whirling disease testing during 2001. Laboratory methods used for the detection of IHNV, IPNV and EIBSV are detailed in Appendix B. Sampling for two-month- old kokanee fry was not a possibility as the sampling protocol was received too late. However, we were able to sample four- to six-month-old fry.

4.0 DISCUSSION OF RESULTS

4.1 Pathogen survey

The collection of samples in year 2000 started later than intended because of the time it took to develop the sampling plan. This meant that it was not possible to collect two-month-old salmonid fry. It also contributed to the fact that sampling for the presence of two pathogens (*M.cerebralis* and *C. shasta*), using the live box technique, had to be delayed until 2001. Notwithstanding this, sampling during year 2000 went off rather well. The numbers of samples collected were short of the 360 fish target in only one case (the below McIntyre Dam sample of non-salmonids). In all other cases (i.e., non-salmonids above the Dam, and salmonids above and below the Dam), the sampling target of 360 fish was met and even exceeded (see Tables 1 and 2, Appendix E which summarise the findings to date).

With non-salmonids, 12 species were collected below the Dam and 15 species above (Tables 3 and 4, Appendix E). A goal was to have no single species account for more than 25% of the sample. This goal was met for the species collected above the Dam but in the species collected below the Dam where the specimens collected were short of the 360 fish goal, one species (yellow perch) made up 34.3% of the sample and was thus over-represented. To avoid such an outcome in future sampling, it will be necessary stop collecting a particular species when 90 specimens (i.e., 25% of 360) have been caught.

With the non-salmonid species an unforeseen problem has been in deciding which species are migratory and which are non-migratory (i.e., which species are most likely to migrate up the Okanagan drainage once the barriers to migration have been removed). This is an important consideration, because the sampling plan called for 75% of the non-salmonids collected to fall in the migratory category. Until this question is resolved it will be impossible to satisfy this sampling criterion. However, if the classification used in Tables 3 and 4, Appendix E, is used, the sampling goals based on this criterion were not met. The below-the-Dam sample consisted of about 50/50 migratory/non-migratory fish while the above-the-Dam sample consisted of 68/32 migratory/non-migratory fish. It is hoped that a decision on this matter can be arrived at the March 1-2, 2001 meeting on the Skaha Lake/Sockeye Salmon Project. It may be that the realities of sampling will dictate that one or other of the sampling criteria for non-salmonids (i.e., the 25% or the 75% criterion) be dropped.

A final problem with the non-salmonid sampling program is that species of non-salmonids known or suspected to be present above or below the Dam were not represented in the catch. For example, tench which are reported to occur below the Dam were not captured. It may be that the method of collecting samples and the capture sites will have to be diversified.

Based on the results obtained from the fish samples processed to date, only one known viral fish pathogen (IHNV, probably type I) was isolated (see Tables 1 and 2, Appendix E). The identification protocol indicates that the IHNV isolates were not type II but it did not rule out the possibility that they were type III. This possibility is, however, considered remote as type III is usually found in chinook salmon and its range is in southern Oregon and northern California. IHNV type I is not one of the “pathogens of concern” because it is already known to occur in salmonids above McIntyre Dam. In this survey, it occurred in salmonid samples obtained both below and above McIntyre Dam and was detected, not unexpectedly, in fish at the spawning and post-spawning stage.

Evidence was also obtained that a second agent, possibly EIBSV, was also present. Signs indicating its presence were the existence of inclusion bodies in the red blood cells of a number of fish, both salmonids and non-salmonids (Tables 1 and 2, Appendix E). The inclusion bodies were indistinguishable from those caused by the EIBSV but it is impossible to conclude at this stage whether the etiologic agent is in fact EIBSV. Indeed, because non-salmonids (eight species) as well as salmonids were affected, it is even possible that more than etiological agent is involved. In any event, because the inclusion body syndrome occurred in fish above and below the Dam, it would appear to be already widespread in the Okanagan drainage.

To date, all salmonids tested for *C. shasta* and *M. cerebralis* have proved negative for these pathogens (Table1, Appendix E). A better idea of whether these pathogens occur in the two regions being sampled will, however, have to await the outcome of additional sampling, especially of “live box” fish samples. The intent is to do live box sampling for these pathogens in years 2001 and 2002.

At this early phase in the sampling, there is no evidence to indicate that the fish populations above and below the Dam differ with respect to the “pathogens of concern” that they carry. If the infection status of the populations has not changed by the end of the three years of sampling, a decision on whether to allow the barrier to fish migration to come down will likely be based more on the non-disease impacts that the sockeye (and other unintended) introductions might have.

4.2 Factors in the lakes likely to contribute to disease or that would maintain introduced infectious agents

An examination of limnological data for Okanagan and Skaha lakes reveals no obvious environmental factors likely to pose an extraordinary risk of causing disease in salmonids or non-salmonids. Both lakes appear to undergo the classic stratification cycle for northern lakes, with a warm epilimnion and a cooler hypolimnion in summer followed by an overturn. Temperature regimes in the lakes are such that salmonids should be able to reside in water of non-stressful temperatures all year long. Brief entries into the epilimnion, for feeding, even during its warmest periods (where temperatures may be less than ideal for salmonids), are not likely to be stressful enough to cause disease because they are unlikely to induce chronic stress, the type of stress most conducive to disease. Likewise, oxygen levels in the hypolimnion appear normally to be at levels that are non-stressful to salmonids, although in Skaha Lake, which is much smaller and shallower than Okanagan Lake, oxygen levels in the hypolimnion may decline to levels that may be slightly stressful to salmonids in very warm years.

Populations of kokanee in the above lakes have declined drastically ever since anthropogenic nutrient input into the lakes was reduced and mysids, competitors for zooplankton needed by kokanee, were introduced. One might speculate, therefore, that the introduction of sockeye to these lakes would add to the competition for an already limiting food supply. Because starving fish are not likely to be as robust and disease resistant as well-fed fish, one might predict that the introduced sockeye would contribute to the poor health of kokanee and other fish in the lakes depending on zooplankton for their food. However, introduced sockeye will also be providing the lakes with nutrients brought back from the sea in the form of spawning sockeye adults. These nutrients, released from the decomposing carcasses of the spent sockeye, may mitigate and even neutralise any negative effects resulting from the “extra (sockeye) mouths to be fed”.

It is probably a given that any microbial fish pathogen introduced above the McIntyre Dam with sockeye or other fishes that are allowed to migrate there, will eventually establish infections in resident fish, if not disease. Most microbial pathogens are not highly host-specific, but rather can infect a variety of fish species. In addition, once released from infected fish, most of these pathogens can survive in water for significant periods. The virus responsible for IPN, for example, has a particularly wide host range, and its long-term persistence in water has been well documented. In addition, IPNV is considered to be a vertically transmitted pathogen (i.e., it can be transmitted from parent to progeny via the egg). It thus has the ability to persist in generation after generation of any introduced species, which can then serve as a constant potential source of infection for other fish sharing the same water.

With myxosporidian pathogens such as *M. cerebralis* and *C. shasta,* their persistence in a system following introduction is dependent on whether their alternate hosts are also present in the system. At the moment, it is not known if the alternate hosts for these pathogens occur in the Okanagan drainage. However, in the case of *M. cerebralis* its persistence would not be unexpected as its alternate (non-fish) host is known to be rather ubiquitous. Less is known about the distribution of the alternate host of *C. shasta* and so its chances for persistence following introduction above McIntyre Dam are more difficult to predict.

4.3 Potential interactions between resident and introduced fish and the outcome of this with respect to extending pathogen distributions

It seems very likely that the progeny of introduced sockeye will have the same eco-niche requirements as resident kokanee and that their behaviour patterns will be very similar. It follows, therefore, that this will increase the chances of interactions between these fishes, thus increasing the chances that any pathogens carried by one or other of these fishes will cause cross infections. These factors will likely also hold true for cross infections between introduced and resident non-salmonid species. In addition, because of the survival of many microbial fish pathogens in water, cross infections between salmonids and non-salmonids will also be possible (e.g.,with IPNV). Range extensions of fish pathogens are therefore a distinct possibility when fish carrying exotic pathogens move into new areas. However, in the present study, the important question is whether any new (i.e., exotic) pathogens are likely to be introduced. The present pathogen survey is intended to provide answers to this important question.

5.0 CONCLUSION

At this early phase in the sampling, there is no evidence that the fish populations above and below McIntyre Dam differ with respect to pathogens of concern. Nor is there any indication that Okanagan and Skaha Lakes pose an extraordinary risk of causing disease in fish. Competition between kokanee and sockeye could conceivably add to a starvation problem which would make resident fish less robust and more susceptible to disease, but nutrients from decomposing sockeye carcasses may mitigate any negative effects. More conclusive tests will be conducted in 2001 and 2002.

6.0 REFERENCES

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APPENDIX A

Pathogen Risk Assessment Protocol

Project: Evaluation of Sockeye Salmon Re-introduction into Skaha Lake

Objective 1: Pathogen Risk Assessment

Purpose of Fish Sampling.

The purpose of the following sampling is to assess the risk of introducing fish pathogens new to Skaha Lake with the re-introduction of sockeye salmon into the lake. It is visualised that sockeye will not be the only fish to enter the lake once the barrier to migration (MacIntyre Dam) is removed by the installation of a fish ladder. Other fishes, both salmonids and non-salmonids will also almost certainly be capable of using the fish ladder.

Geographic Zones for Fish Sampling.

The first task in the pathogen risk assessment will therefore be to sample fish, both salmonids and non-salmonids, from above and below MacIntyre Dam for certain pathogens and parasites of particular concern. This sampling should determine whether fish from below the dam are likely to carrying infectious agents that are not yet present in fish above the dam. It is proposed that the geographic limits for sampling above and below MacIntyre Dam be the northernmost shore of Okanogan Lake and the southernmost shore of Osoyoos Lake (Zosel Dam), respectively. Notwithstanding this, data on fish pathogens routinely collected from sockeye and other salmonids downstream of Osoyoos Lake and held at Cassimer Bar Hatchery will also be taken into account.

Disease Agents.

The disease agents of particular concern to be tested for during the survey are: infectious pancreatic necrosis virus (IPNV), infectious haematopoietic necrosis virus type 2 (IHNV type2), erythrocytic inclusion body syndrome virus (EIBSV), the whirling disease agent (*Myxobolus cerebralis*), and the ceratomyxosis agent (*Ceratomyxa shasta*).

Duration of Sampling.

The duration of sampling should be at least two, and preferably, three years. The first year of sampling is likely to point out where difficulties in the sampling program lie. These difficulties are likely to result in gaps in the data collected -- gaps that would be corrected by having an additional two years of sampling. A three-year sampling period is therefore recommended as it is likely to result in an improved basis for drawing reasonable conclusions about the infection status of the fish populations above and below MacIntyre Dam. (In this connection, and for the purposes of this study, a fish population is considered to consist of both the salmonids and non-salmonids that occur in the geographic region being sampled.)

Fish to be Sampled.

The aim is to sample fish that are likely to pose the greatest risk of introducing the above-mentioned disease agents and that are likely to be harbouring the agents of interest in readily detectable numbers. For this reason fish that are active migrators, very young fish which lack an effective specific immune system, fish that have gone through the stress of spawning, or fish that may have been immuno-compromised by high water (e.g., summer) temperatures will comprise the bulk of the samples collected.

Numbers of Fish to be Collected.

The aim is to collect approximately 720 fish per year from each of the two geographic sampling regions, the sample for each geographic region to consist of 360 salmonids and 360 non-salmonids. Salmonids collected above and below MacIntyre Dam should feature kokanee and sockeye salmon, respectively. Non-salmonids collected from each of these regions should represent as many species as possible with no single species accounting for more than 25% of the sample; in addition, the emphasis in the non-salmonids sampled should be placed on the actively migrating species which should constitute approximately 75% of the specimens collected. Details regarding the numbers of fish to be sampled for each particular disease agent are given in Appendix 1 (attached), along with recommendations as to where and when (at what life stage) the sampling is to be done.

Diagnostic Tests.

Detection of each of the two of viruses, IPNV and IHNV, will be based on culture methods using two cell lines: EPC and CHSE-214. Tissues to be used for the detection of IPNV are pyloric caeca, kidney, and spleen. Tissues to be used for detection of IHNV can be the same except that pyloric caeca can be omitted to minimise the chances of non-viral cytopathic effects. Because IHNV is likely to occur in high titre and at high prevalence in certain of the sampled fish (e.g., sockeye and kokanee), there is a chance that IPNV present in such samples will be overlooked. For this reason, samples to be examined for IPNV should first be treated with anti-IHNV serum to neutralise any IHNV present. Identification of IHNV must be accomplished using anti-IHNV serum (e.g., monoclonal antiserum 14D that recognises all IHNV isolates). In addition, however, IHNV isolates should be tested with monoclonal antiserum 105B that reacts only with IHN type 2 isolates). Any IPNV-like isolates obtained should be provisionally identified using anti-IPNV serum. However, because a number of seemingly non-virulent IPNV-like viruses (birnaviruses) cross-react strongly with IPNV, it will be necessary to do virulence testing of such isolates in the laboratory to determine whether the isolates are indeed IPNV (i.e., are capable of causing IPN). For this purpose, the protocols of Reno and Stafford (1995) should be followed using one or more species of juvenile trout (e.g., rainbow trout, brook trout).

Detection of the third virus, EIBSV, will be based on the microscopic examination of Leishman-Giemsa stained blood smears. If, as will often be the case, blood is not available (due to its rapid clotting following the death of captured fish), then imprint smears from kidney (a blood-rich tissue) should be prepared for Leishman-Giemsa staining. The blood or kidney imprint smears should preferably be prepared in the field and stained later in the laboratory. The presence of blue-staining inclusion bodies (0.8 to 3.0 µm in diameter) in the cytoplasm would be presumptive evidence for the infection. Note, however, another viral infection, viral erythrocytic necrosis (VEN), causes very similar inclusions in the cytoplasm of fish erythrocytes and occurs in a wide range of fishes (salmonids and non-salmonids). Because the icosahedral viruses causing these two diseases cannot be cultured, they are best distinguished on the basis of size using electron microscopy: EIBSV averages 74-77 nm in diameter; ENV is much larger (190 nm or more in diameter). However, the infections can be distinguished with reasonable certainty in stained smears because EIBS inclusions tend to be smaller than those of VEN, they stain pale blue instead of pink with the Leishman-Giemsa stain, and unlike VEN inclusions which are often associated with the cell nucleus, they tend to occur free in the cytoplasm. In addition, EIBSV is an RNA virus while VENV is a DNA virus. Thus it may be possible to distinguish between them in erythrocytes using a DNA stain. .

Detection of *Myxosoma cerebralis* (Mc) is usually based on demonstrating the characteristic spores in infected cartilaginous tissues of the head (the caudal ventral portion of the skull and the auditory capsule) using microscopy. However, an alternative diagnostic procedure based on the polymerase chain reaction (PCR) (Andree et al 1998) is now available for detecting Mc in these tissues. The PCR technique is not only specific for Mc but has the advantages over the microscopic method of being faster, more sensitive, and less costly to carry out. Also, the PCR technique has the additional advantage that it can detect the pathogen in tissues while it is still in the pre-spore stages. Thus with the PCR technique, instead of having to wait for two or more months for spore development to occur, infections can be detected within a few days of their occurrence (and certainly within one to three weeks of their occurrence).

Detection of *Ceratomxa shasta* (Cs) has traditionally been based on demonstrating the characteristic spores in tissues such as the intestine and gall bladder using microscopy. However, a new and specific PCR-based technique (Palenzeula et al 1999) has been developed for detecting the agent in intestinal tissue. It has the advantages of speed, cost, and sensitivity mentioned in connection with the Mc PCR technique, and as with the PCR technique for Mc, the Cs PCR has the advantage that the parasite can be detected while it is still in the pre-spore stages. In fact, in experimental infections, intestinal tissue becomes positive for the pathogen within a few days of infection.

Special Techniques for Surveying for the presence of Mc and Cs.

The presence of Mc and Cs in the waters of the two geographic regions to be sampled should be investigated by exposing a susceptible strain of rainbow trout (no more than nine weeks old) to the waters of these regions. Strains of susceptible rainbow trout have been mentioned in the scientific literature but it seems probable that Pennask Lake rainbow trout, which apparently have not been exposed to Mc and Cs, would be susceptible. The exposure should be performed using the live box technique. The live boxes should be placed in the suspect water after water temperatures have reached 9 C, and the boxes should be located in areas where water flow is sluggish but the oxygen level adequate to satisfy the needs of the live-boxed fish. To obviate the need for any subsequent holding of the live-boxed fish in a hatchery or laboratory, it is strongly recommended that the fish be exposed to the suspect water for at least one week, following which they should be shipped, frozen or iced, to the laboratory for PCR testing along with unexposed control fish. Exposed and unexposed (control) fish should be shipped in separate plastic bags.

Tissues for Diagnostic Tests.

Fish samples should be placed on ice as soon as possible after collection. First, however, caudal blood smears (for EIBSV testing) should be prepared from the fish if they are captured alive. Following this, it is best with very small fish (fry and fingerlings) to submit them to the diagnostic laboratory in sealed plastic bags with the body cavity unopened. The bags should then be covered in chipped ice and transported to the laboratory in an insulated container. With larger fish, it is best that the tissues required for cultivable virus testing (kidney, spleen, and pyloric caeca) be aseptically excised from each specimen and placed in a plastic bag (one bag per fish). Tissue required for *Ceratomyxa shasta* testing (posterior intestine) should then be excised and placed in a separate bag. The two bags should then be sealed and shipped to the diagnostic laboratory in chipped ice in an insulated container. The bagged samples should be labelled to indicate the nature of the sample and the date and location of its collection (use an indelible pen), and the diagnostic laboratory should be notified by phone to expect the samples. At this stage, relevant shipping information should be provided to the laboratory (e.g., identity of the carrier, waybill number, etc). With samples to be tested for viruses by culture, every effort should be made to examine them unfrozen. If freezing cannot be avoided, then freezing at –80 C is recommended. With samples to be examined by PCR techniques, samples may be stored frozen (at – 20C but preferably at – 80 C) by the receiving laboratory until they can be processed.

Final Miscellaneous Comments

Tests for Mc and Cs need only be applied to salmonids as non-salmonids are not thought to be infected with these agents. Post-spawned sockeye and post-spawned kokanee should be tested for Cs. Live box-exposed rainbow trout should be tested for both Mc and Cs.

Tests for the cultivable viruses (IPNV and IHNV) should be performed on both the salmonid and non-salmonid species as the viruses are known to affect both types of fish. Tests for EIBSV should also be performed on salmonid and non-salmon species.

On occasion, duplicate samples should be collected in the field and submitted to two diagnostic laboratories to determine whether the findings of the laboratories agree. These submissions should be made without making the laboratories aware of the situation.

References.

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General Sampling Plan

Populations to be sampled:

The purpose of this study is to determine whether certain fish disease agents (identified in the main document) occur in fish populations below MacIntyre Dam but not in those above the Dam and might therefore pose a risk to fish above the Dam if the barrier to fish migration were to be removed. The species and ages of the fishes sampled should bias *toward* detecting the disease agents. For example, if out-migrant stages of salmonids are more likely to contain IHNV-positive individuals, then samples should be weighted so that this stage is represented more frequently than other stages in which the agent is not likely to be detected. Different species and ages may be more or less susceptible to different disease agents. Therefore, sampling for each disease agent will have to take this into account.

Sample sizes:

Sample size requirements are influenced by the following:

- sensitivity of detection
- number of detectable cases in the population
- confidence level of declaring a population free of the disease agent
- access to life stage of species
- availability of lethal samples from small populations sizes.

Assumptions about disease identification in study populations:

- if the disease agent is present at all, it will occur in at least 1% of the population
- the minimum confidence for declaring the population free of the disease agent is 95% but preferably 99%
- some populations do not have sufficient numbers of fish to contribute to lethal samples, but for sample size calculations, each population is assumed to contain more than 3000 individuals
- the sensitivity of detection may be less than 25% in apparently healthy animals (i.e. 25% of the true positive fish will be detected as positive, 75% of the true positive fish will be categorised as negative falsely)

To maximize the ability to detect the disease agents of concern within the constraints of the available fish populations, it was decided that a minimum of 720 individuals would be collected and tested annually from each of the two populations being compared (i.e. 720 from above MacIntyre Dam and 720 from below the dam). From this overall sample size, half are to be salmonids and the other half are to be non-salmonids. Among the salmonids, emphasis is being placed on kokanee above the Dam and on sockeye below the Dam. Among the non-salmonids, emphasis is being placed on migratory species. Details follow in the section below.

Sample size calculations normally use standard formulae (see below, for example) for detecting a disease agent in a population. However, the sample size in this study is more influenced by the availability of species and sampling opportunity than by components of the following formula:

$$n = 1 - (1 - P)^{1/d} * N - ((d - 1) / 2)$$

where n = sample size, P = confidence level, N = population size, and d = number of detectable cases.

Specific Sampling Plan

Above MacIntyre Dam Samples

Total: 720 fish/year

A. 50% (360 fish) salmonids (as many of them as possible, kokanee)
150 of them, recent post-spawners [1]
150 of them, approx. 2 month-old fry [2]
60 of them, all ages [3]

B. 50% (360 fish) non-salmonids (75% of them (270 fish) migratory species and 25% (90 fish) non-migratory species.) [4]

[1] Collect from three spawning channels and from beach–spawning groups (approx. 30 fish per group); make up total with other salmonids if necessary
[2] Collect from three spawning channels or adjacent lake areas
[3] Collect by trawling in Okanagan and Skaha lakes during year-round trawls for mysid shrimp
[4] Collect as many species and age groups as possible from as many areas as possible. No single species should represent more than 25% of the non-salmonid sample.

Test all fish (salmonids and non-salmonids) for IPNV, IHNV, and where possible for EIBSV as outlined in the main document. In addition, test all salmonid post-spawners for *C. shasta* as outlined in the main document.

Below MacIntyre Dam Samples

Total: 720 fish/year

A. 50% (360 fish) salmonids (as many of them as possible, sockeye)
180 of them, recent post-spawners [1]
180 of them, approx. 2 month-old fry [2]

B. 50% (360 fish) non-salmonids (75% of them (270 fish) migratory species and 25% (90 fish) non-migratory species.) [3]

[1] Collect from three spawning channels and any beach–spawning groups; make up total with other salmonids if necessary
[2] Collect from three spawning channels, Osoyoos Lake and Okanagan River
[3] Collect as many species and age groups as possible from as many areas as possible. No single species should represent more than 25% of the non-salmonid sample.

Test all fish (salmonids and non-salmonids) for IPNV, IHNV, and where possible for EIBSV as outlined in the main document. In addition, test all salmonid post-spawners for *C. shasta* as outlined in the main document. To save on costs, samples to be tested for the IPNV and IHNV may be pooled for testing (tissues from up to five fish per pool)

Live-box Exposed Samples

Each year, samples of rainbow trout exposed in live boxes to water for seven and preferably fourteen days at two sites above MacIntyre Dam (outlet of Okanagan Lake and outlet of Skaha Lake) and at two sites below MacIntyre Dam (outlet of Osoyoos lake and Okanagan River) should be tested for the presence of *M. cerebralis* and *C. shasta* according to the methods outlined in the main document. About 25 rainbow trout, of a strain likely to be susceptible to the two disease agents, should be used per live box exposure. Exposures should be made when the water temperatures are 9 to 17C. At each exposure, five additional (negative control) rainbow trout from the test stock should be sampled and tested for the two above disease agents without having been exposed to the test waters. To save on costs, samples may be pooled for testing (tissues from up to five fish per pool).

APPENDIX B

Detailed laboratory methodologies used by the Ministry of Agriculture, Fisheries and Food Laboratories

Laboratory Methods Used to Test for IPN and IHN.

1. Protocol for Virology Assay on Ovarian Fluids

Pooling Samples

1) Keep all tubes in crushed ice.
2) Remove centrifuge tubes from cooler and sort into ice bath. Separate ovarians into two groups:
    a. Clear, colourless fluid (no centrifuging necessary). These samples generally produce the least tissue toxicity.
    b. Cloudy, coloured, turbid, bloody (centrifuging required). These samples usually produce the greatest tissue toxicity.
    c. Discard tubes with whole or broken eggs.
    d. Discard tubes with fecal material.
3) Vortex all tubes to resuspend particulates.
4) Centrifuge those tubes which contain yellow, cloudy or bloody ovarian fluid for 15 min at 3500 rpm in a 4C refrigerated centrifuge.
5) Pool samples up to three per pool.
6) Pool females with females and males with males. Post-spawners with post-spawners etc.
7) Dilute pooled ovarian 1:1 with Hank's Balanced Salt Solution (HBSS), pH 7.75. This produces a 50% dilution.
8) Filter the 50% dilution through a sterile .45 micron Millipore HVLP filter into second sterile 5 ml tube.
9) Make two additional dilutions from the filtered 50% dilution:
    a. Prepare a 1:1 dilution of the 50% solution with HBSS, pH 7.75. This produces a 25% dilution.
    b. Prepare a 1:9 dilution of the 50% solution with HBSS, pH 7.75. This produces a 5% dilution.

Inoculating Plates

1) From this point on, move all work to the disinfected biological safety cabinet.
2) Remove plates from the incubator and label (case number, stock name, inoculation date, cell line and plate number).
3) Add oil to the vacuum motor if below level and then turn on.
4) Work with two or three plates at a time. Vacuum off the media from each well being careful not to touch the monolayer.
5) Add 0.05 mL PEG-MEM-10-HEPES to each of the EPC wells.
6) For negative controls:
    c. Two wells are left untouched. The overlay is left on and no inoculation.
    d. Two wells are inoculated with 0.1 mL of HBSS and treated as other wells.
    e. One set of negative controls per cell line is adequate.
7) For CHSE plates, inoculate 0.1 mL of 50% dilution onto each of the top two wells in the lane.
8) For EPC cells, inoculate 0.1 mL of <u>25%</u> dilution onto each of the top two wells in lane. The dilution was increased to 25% due to the high amount of tissue toxicity with the 50% dilution.
9) For both CHSE and EPC plates, inoculate 0.1 mL of the 5% dilution onto each of the bottom two wells in the lane.
10) Rock the plates to distribute inoculum.
11) Wrap plates in Saran Wrap and place in 15 C incubator for one hour.
12) Using either a sterile, single wrap, plugged 10.0 mL pipet or a cornwall repeater syringe and reservoir, add 1.0 mL of HEPES-MEM-10 to each well
13) Re-wrap the plates with syran wrap and close with tape.
14) Return plates to the incubator.
15) Make sure all information on the virology form is <u>correct</u> and return the form to it's file.
16) Type up an index card with the:
    a. Inoculation date
    b. Case number
    c. Stock name
    d. Type of tubes enclosed (ie 50%/25%/5%)

17) Put the 50% and 25% tubes in a whirl pak bag (where there isn't any of these dilutions left, substitue the 5% tube) with the index card and freeze in the ultracold.
18) Autoclave all remaining tubes, biohazard refuse and contaminated materials.
19) Hold all plates for 4 weeks.
20) Examine plates at least twice/week for cytopathic effect.
21) IHN and IPN confirmed by fluorescent antibody test (monoclonal anti-sera from DiagXotics Inc.). All IHN positive samples, also tested for IPN by FAT.

2. Protocol for Virology Assay on Tissues

Disecting Fish

1) Pooling:
   a. Pool:
      i) Fish of the same species
      ii) Normal with normal
      iii) Moribund with moribund

      Sac-Fry — Remove yolk sac and discard. Grind rest of fish whole.

      Fry (2-4 cm) — Retain gills, but discard head anterior to gills and tail posterior to the vent.

      Fing. (4-10 cm) — Remove: gills
      g-i tract, kidney, spleen, liver (if no pc)

      Fing. (>10 cm) — Remove: gills
      spleen
      pyloric caeca or liver
      kidney (equal amts. ant., cent. and post. kidney)
   b. Pool tissues from a maximum of three fish (majority of fish pooled in 3's or lower). Record the number of fish pooled on the virology record sheet for each pool.
   c. Make sure all information pertaining to the fish is written on the virology sheet (tag number, species, sex, condition (moribund/normal) etc.
   d. Between each pool:
      i) Wipe disecting tools clean with kleenex (to get the organics off).
      ii) Dip in 70% isopropyl.
      iii) Flame.
      iv) Let instruments ***cool***. Heat destroys virus.
   e. Place all pooled tissues into an empty 50 mL centrifuge tube.
   f. Weigh tube and calculate the weight of the tissues.
   g. Using the calculation form calculate parameters for making further dilutions. Two final dilutions will be made: 2% and 0.2%.
2) Homogenizing:
   a) If the tissue weight is greater than 1 gm, add 5 mL of HBSS (just enough fluid to homogenize tissue).
   b) If the tissue weight is less than 1 gm, calculate how much HBSS can be safely added to homogenize the tissue.
   c) Homogenize tissue for approx. 30 sec using a polytron probe.
   d) Wipe organic matter off probe with a clean kleenex.
   e) Rinse the polytron probe by sequentially running it in 2 x 500 mL flasks of sterile, autoclaved tap water.
15) Add sufficient HBSS to each 50 mL tube to achieve the first dilution:
   a. Less than a gram of tissue – 50 x tissue weight = mL of HBSS to be added.
   b. Greater than a gram – fill to 50 mL level with HBSS.
   c. Invert 50 mL tubes several times to completely mix.
16) Diluting into a 15 mL centrifuge tube:

   a. Less than a gram – fill the centrifuge tube to 10 mL with material from the 50 mL centrifuge tube.
   b. Greater than a gram – divide the tissue weight by 10 and add that amount to the 15 mL centrifuge tube from the 50 mL centrifuge tube. Fill to 10 mL by adding HBSS.
   c. Vortex tubes to completely mix.
17) Centrifuge tubes for 15 min @ 3500 rpm @ 4C.
18) Filter supernatant through a Millipore HVLP .45 micron filter (attached to a sterile 10 mL syringe). This is the first dilution (2%).
19) Vortex.
20) Add 0.1 mL of the 2% solution to 0.9 mL of HBSS. This is the second dilution (0.2%)
21) Vortex all tubes.
22) For negative controls:
   a. Two wells are left untouched. The overlay is left on and no inoculation.
   b. Two wells are inoculated with 0.1 mL of HBSS and treated as other wells.
23) Add 0.05 mL of PEG-MEM10-HEPES to each of the EPC wells. Rock plate to distribute.
24) Inoculate 0.1 mL of the 2% solution into each of the two top wells in the lane.
25) Inoculate 0.1 mL of the 0.2% solution into each of the two bottom wells in the lane.
26) Gently rock plate to distribute.
27) Wrap plates in syran wrap and close with tape.
28) Place in 15C incubator for 60 min.
29) Add 1.0 mL of MEM-10-HEPES to each well.
30) Wrap plates in syran wrap and close with tape.
31) Put 2% tubes into whirl-pak bag with typed identification card and place in ultracold freezer.
32) Incubate plates for 4 weeks at 15°C.
33) Examine at least twice weekly for CPE.
34) Virus confirmation same as for ovarian fluids.

Erythrocyte Inclusion Body Syndrome – Detection of Causative Agent

1) One blood smear per fish.
2) Air dry.
3) Fix in methanol for 10 min.
4) Stain with Leishman-Giemsa.
5) Read 60 fields.

APPENDIX C

Data from Ministry of Agriculture, Fisheries and Food Laboratories

Disease risk assessment sampling
Okanagan Nation Fisheries Commission

Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
1	21-Jun	S. Okanagan Lake	CSU	29.4				1	0	
1	21-Jun	S. Okanagan Lake	CSU	29.4				2		
1	21-Jun	S. Okanagan Lake	CSU	29.4				3		
2	21-Jun	S. Okanagan Lake	NSC	56.5				4	0	
3	21-Jun	S. Okanagan Lake	CSU	41.3				5	1	
4	21-Jun	S. Okanagan Lake	PCC	21.5				6	7	
5	21-Jun	S. Okanagan Lake	PCC	12.7				7	1	
6	21-Jun	S. Okanagan Lake	PCC	15.0				8	1	
7	21-Jun	S. Okanagan Lake	PCC	12.0				9	1	
8	21-Jun	S. Okanagan Lake	PCC	18.1				10	0	
9	21-Jun	S. Okanagan Lake	NSC	35.1				11	1	
10	21-Jun	S. Okanagan Lake	CSU	45.4				12	0	
11	21-Jun	S. Okanagan Lake	RSC	17.9				13	0	
12	21-Jun	S. Okanagan Lake	RSC	8.2				14	0	
13	21-Jun	S. Okanagan Lake	NSC	4.3				15	1	
14	21-Jun	S. Okanagan Lake	NSC	4.7				16	0	
15	21-Jun	S. Okanagan Lake	WF					17	2	
16	21-Jun	S. Okanagan Lake	WF					18	1	
17	21-Jun	S. Okanagan Lake	WF	5.2				19	0	
18	21-Jun	S. Okanagan Lake	RSC	8.5				20	0	
19	21-Jun	S. Okanagan Lake	NSC	15.9				21	0	
20	21-Jun	S. Okanagan Lake	WF	8.2				22	1	
21	21-Jun	S. Okanagan Lake	WF	16.0				23	0	
22	21-Jun	S. Okanagan Lake	PCC	22.0				24	0	
23	21-Jun	S. Okanagan Lake	NSC	33.4				25	0	
24	21-Jun	S. Okanagan Lake	SU	39.1				26	0	
25	21-Jun	S. Okanagan Lake	WF	4.8				27	2	
26	21-Jun	S. Okanagan Lake	RSC	21.0				28	0	
27	21-Jun	S. Okanagan Lake	RSC	8.1				29	0	
28	21-Jun	S. Okanagan Lake	PCC	11.7				30	0	
29	21-Jun	S. Okanagan Lake	RSC	9.0				31	0	
30	21-Jun	S. Okanagan Lake	SU	16.0				32	0	
31	21-Jun	S. Okanagan Lake	NSC	37.0				33	0	
32	21-Jun	S. Okanagan Lake	NSC	23.7				34	0	
33	21-Jun	S. Okanagan Lake	NSC	18.7				35	0	
34	21-Jun	S. Okanagan Lake	NSC	22.0				36	0	
35	21-Jun	S. Okanagan Lake	CAS	12.4				37	0	
36	21-Jun	S. Okanagan Lake	CSU	29.2				38	0	
37	21-Jun	S. Okanagan Lake	NSC	39.0				39	0	
38	21-Jun	S. Okanagan Lake	CSU	37.7				40	0	
39	21-Jun	S. Okanagan Lake	NSC	4.0				41	0	
40	21-Jun	S. Okanagan Lake	RSC	8.0				42	0	
41	21-Jun	S. Okanagan Lake	RSC	8.6				43	7	
42	21-Jun	S. Okanagan Lake	WF	16.3				44	0	
43	21-Jun	S. Okanagan Lake	WF	7.0				45	0	
44	21-Jun	S. Okanagan Lake	CSU	15.4				46	0	
45	21-Jun	S. Okanagan Lake	SU	25.2				47	1	
46	21-Jun	S. Okanagan Lake	NSC	28.4				48	0	
47	21-Jun	S. Okanagan Lake	CAS	13.3				49	0	
48	21-Jun	S. Okanagan Lake	CSU	30.9				50	0	
49	21-Jun	S. Okanagan Lake	NSC	51.9				51	0	
50	21-Jun	S. Okanagan Lake	NSC	3.9				52	0	
51	21-Jun	S. Okanagan Lake	lake chub	13.2				53	0	
52	21-Jun	S. Okanagan Lake	PCC	10.4				54	0	
53	21-Jun	S. Okanagan Lake	PCC	11.9				55	0	
54	21-Jun	S. Okanagan Lake	SU	15.5				56	0	
54	21-Jun	S. Okanagan Lake	SU	15.5				57		

Disease risk assessment sampling
Okanagan Nation Fisheries Commission

Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
55	21-Jun	S. Okanagan Lake	PCC	21.8				58	0	
56	21-Jun	S. Okanagan Lake	PCC	17.9				59	0	
57	21-Jun	S. Okanagan Lake	NSC	29.5				60	0	
58	21-Jun	S. Okanagan Lake	CSU	41.3				61	0	
59	21-Jun	S. Okanagan Lake	SU	5.7				62	0	
60	21-Jun	S. Okanagan Lake	PCC	10.5				63	0	
61	21-Jun	S. Okanagan Lake	RSC	6.8				64	12	
62	21-Jun	S. Okanagan Lake	PCC	13.1				65	0	
63	21-Jun	S. Okanagan Lake	PCC	15.4				66	0	
64	21-Jun	S. Okanagan Lake	PCC	19.9				67	0	
65	21-Jun	S. Okanagan Lake	YP	19.4				68	0	
65	21-Jun	S. Okanagan Lake	YP	17.4				69		
66	21-Jun	S. Okanagan Lake	BB	17.2				70	0	
67	21-Jun	S. Okanagan Lake	CAS	8.5				71	0	
68	21-Jun	S. Okanagan Lake	CAS	12.2				72	0	
69	21-Jun	S. Okanagan Lake	CAS	13.9				73	0	
70	21-Jun	S. Okanagan Lake	SU	24.0				74	0	
71	21-Jun	S. Okanagan Lake	CSU	16.6				75	0	
72	21-Jun	S. Okanagan Lake	CAS	13.3				76	0	
73	21-Jun	S. Okanagan Lake	CAS	11.8				77	0	
74	21-Jun	S. Okanagan Lake	CAS	6.1				78	0	
75	21-Jun	S. Okanagan Lake		5.7				79	0	
76	22-Jun	Skaha Lake	SMB	16.1					bad smear	
77	22-Jun	Skaha Lake	SMB	24.6					bad smear	
78	22-Jun	Skaha Lake	SMB	22.7					bad smear	
79	22-Jun	Skaha Lake	SMB	16.3					bad smear	
80	22-Jun	Skaha Lake	SMB	25.0					bad smear	
81	22-Jun	Skaha Lake	CP	33.0					bad smear	
82	22-Jun	Skaha Lake	SMB	24.5					bad smear	
83	22-Jun	Skaha Lake	SMB	17.6					bad smear	
84	22-Jun	Skaha Lake	SMB	15.0					bad smear	
85	22-Jun	Skaha Lake	NSC	28.5					bad smear	
86	22-Jun	Skaha Lake	NSC	15.6					bad smear	
87	22-Jun	Skaha Lake	NSC	19.1					bad smear	
88	22-Jun	Skaha Lake	NSC	19.3					bad smear	
89	22-Jun	Skaha Lake	NSC	13.4					bad smear	
90	22-Jun	Skaha Lake	SMB	23.6					bad smear	
91	22-Jun	Skaha Lake	SMB	22.4					bad smear	
92	22-Jun	Skaha Lake	SMB	15.7					bad smear	
93	22-Jun	Skaha Lake	SMB	7.5					bad smear	
94	22-Jun	Skaha Lake	SMB	16.4					bad smear	
95	22-Jun	Skaha Lake	SMB	21.2					bad smear	
96	22-Jun	Skaha Lake	PMB	8.0					bad smear	
97	22-Jun	Skaha Lake	YP	18.6					bad smear	
98	22-Jun	Skaha Lake	YP	19.6					bad smear	
99	22-Jun	Skaha Lake	SMB	28.8					bad smear	
100	22-Jun	Skaha Lake	SMB	21.4					bad smear	
101	22-Jun	Skaha Lake	SMB	15.7					bad smear	
102	22-Jun	Skaha Lake	BKH	15.3					bad smear	
103	22-Jun	Skaha Lake	SMB	26.6					0	
104	22-Jun	Skaha Lake	NSC	17.9					bad smear	
105	22-Jun	Skaha Lake	PCC	18.5					1	
106	22-Jun	Skaha Lake	PCC	14.9					bad smear	
107	22-Jun	Skaha Lake	PCC	19.4					0	
108	22-Jun	Skaha Lake	SMB	15.9					0	
109	22-Jun	Skaha Lake	SMB	28.2					0	
110	22-Jun	Skaha Lake	SMB	28.8					0	

Disease risk assessment sampling
Okanagan Nation Fisheries Commission

Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
111	22-Jun	Skaha Lake	SMB	24.5					bad smear	
112	22-Jun	Skaha Lake	SMB	44.4					0	
113	22-Jun	Skaha Lake	SMB	30.1					0	
114	22-Jun	Skaha Lake	SMB	6.8					0	
115	22-Jun	Skaha Lake	PCC	17.1					0	
116	22-Jun	Skaha Lake	PCC	22.0					1	
117	22-Jun	Skaha Lake	PCC	22.5					0	
118	22-Jun	Skaha Lake	NSC	19.5					1	
119	22-Jun	Skaha Lake	SMB	8.5					0	
120	22-Jun	Skaha Lake	SMB	17.5					0	
121	22-Jun	Skaha Lake	BKH	12.3					0	
122	22-Jun	Skaha Lake	CAS	7.7					0	
123	22-Jun	Skaha Lake	CAS	9.9					0	
124	22-Jun	Skaha Lake	CSU	34.3					0	
125	22-Jun	Skaha Lake	CSU	35.3					0	
126	22-Jun	Skaha Lake	CSU	36.0					bad smear	
127	22-Jun	Skaha Lake	CSU	36.5					1	anemic
128	22-Jun	Skaha Lake	CSU	40.1					0	
129	22-Jun	Skaha Lake	CSU	31.1					0	
130	22-Jun	Skaha Lake	CSU	30.4					9	
131	22-Jun	Skaha Lake	CSU	36.0					0	anemic
132	22-Jun	Skaha Lake	CSU	36.3					0	
133	22-Jun	Skaha Lake	CSU	36.6					0	
134	22-Jun	Skaha Lake	CAS	6.0					0	
135	22-Jun	Skaha Lake	CAS	6.2					0	
136	22-Jun	Skaha Lake	CAS	8.2					2	
137	22-Jun	Skaha Lake	CAS	6.4					2	
138	22-Jun	Skaha Lake	CAS	6.3					0	
139	22-Jun	Skaha Lake	CAS	5.8					0	
140	22-Jun	Skaha Lake	CAS	8.1					0	
141	22-Jun	Skaha Lake	CAS	7.0					0	
142	22-Jun	Skaha Lake	NSC	24.6					0	
143	22-Jun	Skaha Lake	NSC	29.3					3	
144	22-Jun	Skaha Lake	LSU	35.5					1	
145	22-Jun	Skaha Lake	LSU	37.6					0	anemic
146	22-Jun	Skaha Lake	SMB	19.3					1	
147	22-Jun	Skaha Lake	NSC	18.4					2	
148	22-Jun	Skaha Lake	PCC	20.0					0	
149	22-Jun	Skaha Lake	CAS	5.9					1	
150	22-Jun	Skaha Lake	CAS	6.4					1	
151	23-Jun	Osoyoos Lake	YP	15.0					4	
152	23-Jun	Osoyoos Lake	YP	14.2					1	
153	23-Jun	Osoyoos Lake	WF	14.3					1	
154	23-Jun	Osoyoos Lake	WF	8.6					0	
155	23-Jun	Osoyoos Lake	WF	8.8					0	
156	23-Jun	Osoyoos Lake	WF	8.0					0	
157	23-Jun	Osoyoos Lake	SK	11.9					1	
158	23-Jun	Osoyoos Lake	SK	11.5					2	
159	23-Jun	Osoyoos Lake	SK	16.9					0	
160	23-Jun	Osoyoos Lake	WF	20.2					0	
161	23-Jun	Osoyoos Lake	SMB	7.1					0	
162	23-Jun	Osoyoos Lake	WF	6.7					0	
163	23-Jun	Osoyoos Lake	WF	7.6					0	
164	23-Jun	Osoyoos Lake	WF	6.8					1	
165	23-Jun	Osoyoos Lake	WF	7.7					0	
166	23-Jun	Osoyoos Lake	WF	7.9					4	
167	23-Jun	Osoyoos Lake	WF	8.0					0	

Disease risk assessment sampling
Okanagan Nation Fisheries Commission

Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
168	23-Jun	Osoyoos Lake	WF	7.3					3	
169	23-Jun	Osoyoos Lake	SK	16.7					3	
170	23-Jun	Osoyoos Lake	WF	8.9					0	
171	23-Jun	Osoyoos Lake	WF	8.2					0	
172	23-Jun	Osoyoos Lake	WF	6.2					1	
173	23-Jun	Osoyoos Lake	WF	8.1					2	
174	23-Jun	Osoyoos Lake	WF	6.8					0	
175	23-Jun	Osoyoos Lake	WF	7.6					1	
176	23-Jun	Osoyoos Lake	WF	7.4					0	
177	23-Jun	Osoyoos Lake	WF	8.0					0	
178	23-Jun	Osoyoos Lake	WF	7.6					0	
179	23-Jun	Osoyoos Lake	WF	7.1					1	
180	23-Jun	Osoyoos Lake	YP	10.7					1	
181	23-Jun	Osoyoos Lake	YP	8.3					0	
182	23-Jun	Osoyoos Lake	YP	13.0					1	
183	23-Jun	Osoyoos Lake	YP	8.7					0	
184	23-Jun	Osoyoos Lake	YP	13.2					0	
185	23-Jun	Osoyoos Lake	YP	13.8					2	
186	23-Jun	Osoyoos Lake	YP	12.2					0	
187	23-Jun	Osoyoos Lake	YP	12.4					1	
188	23-Jun	Osoyoos Lake	YP	12.5					1	
189	23-Jun	Osoyoos Lake	YP	14.3					0	
190	23-Jun	Osoyoos Lake	YP	11.7					1	
191	23-Jun	Osoyoos Lake	YP	12.6					0	
192	23-Jun	Osoyoos Lake	YP	12.2					0	
193	23-Jun	Osoyoos Lake	YP	11.8					0	
194	23-Jun	Osoyoos Lake	YP	15.7					0	
195	23-Jun	Osoyoos Lake	YP	15.6					0	
196	23-Jun	Osoyoos Lake	YP	12.2					0	
197	23-Jun	Osoyoos Lake	YP	13.7					0	
198	23-Jun	Osoyoos Lake	YP	12.8					2	
199	23-Jun	Osoyoos Lake	YP	12.3					0	
200	23-Jun	Osoyoos Lake	YP	12.2					0	
201	23-Jun	Osoyoos Lake	YP	9.1					0	
202	23-Jun	Osoyoos Lake	YP	8.3					0	
203	23-Jun	Osoyoos Lake	YP	6.9					1	
204	23-Jun	Osoyoos Lake	YP	7.3					2	
205	23-Jun	Osoyoos Lake	YP	8.6					0	
206	23-Jun	Osoyoos Lake	WF	21.5					0	
207	23-Jun	Osoyoos Lake	WF	20.8					0	
208	23-Jun	Osoyoos Lake	LMB	30.4					0	
209	23-Jun	Osoyoos Lake	SMB	23.0					0	
210	23-Jun	Osoyoos Lake	SMB	23.2					0	
211	23-Jun	Osoyoos Lake	NSC	35.5					0	
212	23-Jun	Osoyoos Lake	NSC	23.9					0	
213	23-Jun	Osoyoos Lake	SMB	28.8					2	
214	23-Jun	Osoyoos Lake	SMB	26.6					0	
215	23-Jun	Osoyoos Lake	LMB	31.5					0	
216	23-Jun	Osoyoos Lake	LMB	27.9					0	
217	23-Jun	Osoyoos Lake	BKH	22.4					0	
218	23-Jun	Osoyoos Lake	LSU	33.4					1	
219	23-Jun	Osoyoos Lake	LSU	32.6					1	
220	23-Jun	Osoyoos Lake	LSU	35.2					0	
221	23-Jun	Osoyoos Lake	LSU	27.6					1	
222	23-Jun	Osoyoos Lake	LSU	42.5					0	
223	23-Jun	Osoyoos Lake	CAS	8.3					1	
224	23-Jun	Osoyoos Lake	CAS	12.2					0	

Disease risk assessment sampling
Okanagan Nation Fisheries Commission

Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
225	23-Jun	Osoyoos Lake	CAS	6.6					0	
226	23-Jun	Osoyoos Lake	CAS	6.5					0	
227	23-Jun	Osoyoos Lake	CAS	6.9					0	
228	23-Jun	Osoyoos Lake	CAS	7.3					0	
229	23-Jun	Osoyoos Lake	CAS	8.6					0	
230	23-Jun	Osoyoos Lake	CAS	7.1					0	
231	23-Jun	Osoyoos Lake	CP	43.4					0	
232	23-Jun	Osoyoos Lake	CP	22.8					0	
233	23-Jun	Osoyoos Lake	CP	42.3					0	
234	6-Jul	Osoyoos Lake	SK/KO	8.9	3-4 mo				?DFO	
235	6-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				?DFO	
236	6-Jul	Osoyoos Lake	SK/KO	7.5	3-4 mo				?DFO	
237	6-Jul	Osoyoos Lake	SK/KO	7.3	3-4 mo				?DFO	
238	6-Jul	Osoyoos Lake	SK/KO	7.6	3-4 mo				?DFO	
239	6-Jul	Osoyoos Lake	SK/KO	7.5	3-4 mo				?DFO	
240	6-Jul	Osoyoos Lake	SK/KO	7.5	3-4 mo				?DFO	
241	6-Jul	Osoyoos Lake	SK/KO	7.7	3-4 mo				?DFO	
242	6-Jul	Osoyoos Lake	SK/KO	6.5	3-4 mo				?DFO	
243	6-Jul	Osoyoos Lake	SK/KO	8.1	3-4 mo				?DFO	
244	6-Jul	Osoyoos Lake	SK/KO	8.4	3-4 mo				?DFO	
245	6-Jul	Osoyoos Lake	SK/KO	5.8	3-4 mo				?DFO	
246	6-Jul	Osoyoos Lake	SK/KO	7.8	3-4 mo				?DFO	
247	6-Jul	Osoyoos Lake	SK/KO	7.0	3-4 mo				?DFO	
248	6-Jul	Osoyoos Lake	SK/KO	5.9	3-4 mo				?DFO	
249	6-Jul	Osoyoos Lake	SK/KO	8.4	3-4 mo				?DFO	
250	6-Jul	Osoyoos Lake	SK/KO	7.6	3-4 mo				?DFO	
251	6-Jul	Osoyoos Lake	SK/KO	5.5	3-4 mo				?DFO	
252	6-Jul	Osoyoos Lake	SK/KO	6.1	3-4 mo				?DFO	
253	6-Jul	Osoyoos Lake	SK/KO	7.7	3-4 mo				?DFO	
254	6-Jul	Osoyoos Lake	SK/KO	6.4	3-4 mo				?DFO	
255	6-Jul	Osoyoos Lake	SK/KO	8.4	3-4 mo				?DFO	
256	6-Jul	Osoyoos Lake	SK/KO	7.3	3-4 mo				?DFO	
257	6-Jul	Osoyoos Lake	SK/KO	6.7	3-4 mo				?DFO	
258	6-Jul	Osoyoos Lake	SK/KO	6.5	3-4 mo				?DFO	
259	6-Jul	Osoyoos Lake	SK/KO	5.8	3-4 mo				?DFO	
260	6-Jul	Osoyoos Lake	SK/KO	6.7	3-4 mo				?DFO	
261	6-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				?DFO	
262	6-Jul	Osoyoos Lake	SK/KO	7.6	3-4 mo				?DFO	
263	6-Jul	Osoyoos Lake	SK/KO	6.5	3-4 mo				?DFO	
264	6-Jul	Osoyoos Lake	SK/KO	6.4	3-4 mo				?DFO	
265	6-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				?DFO	
266	6-Jul	Osoyoos Lake	SK/KO	5.7	3-4 mo				?DFO	
267	6-Jul	Osoyoos Lake	SK/KO	5.7	3-4 mo				?DFO	
268	6-Jul	Osoyoos Lake	SK/KO	6.7	3-4 mo				?DFO	
269	6-Jul	Osoyoos Lake	SK/KO	6.9	3-4 mo				?DFO	
270	6-Jul	Osoyoos Lake	SK/KO	6.7	3-4 mo				?DFO	
271	6-Jul	Osoyoos Lake	SK/KO	5.8	3-4 mo				?DFO	
272	6-Jul	Osoyoos Lake	SK/KO	5.3	3-4 mo				?DFO	
273	6-Jul	Osoyoos Lake	SK/KO	5.7	3-4 mo				?DFO	
274	6-Jul	Osoyoos Lake	SK/KO	5.9	3-4 mo				?DFO	
275	6-Jul	Osoyoos Lake	SK/KO	5.7	3-4 mo				?DFO	
276	6-Jul	Osoyoos Lake	SK/KO	4.8	3-4 mo				?DFO	
277	6-Jul	Osoyoos Lake	SK/KO	4.8	3-4 mo				?DFO	
278	7-Jul	Osoyoos Lake	SK/KO	8.1	3-4 mo				?DFO	
279	7-Jul	Osoyoos Lake	SK/KO	9.2	3-4 mo				?DFO	
280	7-Jul	Osoyoos Lake	SK/KO	8.2	3-4 mo				?DFO	
281	7-Jul	Osoyoos Lake	SK/KO	7.9	3-4 mo				?DFO	

Disease risk assessment sampling
Okanagan Nation Fisheries Commission

Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
282	7-Jul	Osoyoos Lake	SK/KO	8.6	3-4 mo				?DFO	
283	7-Jul	Osoyoos Lake	SK/KO	8.6	3-4 mo				?DFO	
284	7-Jul	Osoyoos Lake	SK/KO	9.4	3-4 mo				?DFO	
285	7-Jul	Osoyoos Lake	SK/KO	6.6	3-4 mo				?DFO	
286	7-Jul	Osoyoos Lake	SK/KO	8.3	3-4 mo				?DFO	
287	7-Jul	Osoyoos Lake	SK/KO	8.4	3-4 mo				?DFO	
288	7-Jul	Osoyoos Lake	SK/KO	8.1	3-4 mo				?DFO	
289	7-Jul	Osoyoos Lake	SK/KO	7.9	3-4 mo				?DFO	
290	7-Jul	Osoyoos Lake	SK/KO	7.6	3-4 mo				?DFO	
291	7-Jul	Osoyoos Lake	SK/KO	9.6	3-4 mo				?DFO	
292	7-Jul	Osoyoos Lake	SK/KO	5.6	3-4 mo				?DFO	
293	7-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				?DFO	
294	7-Jul	Osoyoos Lake	SK/KO	7.0	3-4 mo				?DFO	
295	7-Jul	Osoyoos Lake	SK/KO	6.6	3-4 mo				?DFO	
296	7-Jul	Osoyoos Lake	SK/KO	7.6	3-4 mo				?DFO	
297	7-Jul	Osoyoos Lake	SK/KO	6.8	3-4 mo				?DFO	
298	7-Jul	Osoyoos Lake	SK/KO	7.0	3-4 mo				?DFO	
299	7-Jul	Osoyoos Lake	SK/KO	5.9	3-4 mo				?DFO	
300	7-Jul	Osoyoos Lake	SK/KO	6.4	3-4 mo				?DFO	
301	7-Jul	Osoyoos Lake	SK/KO	5.4	3-4 mo				?DFO	
302	7-Jul	Osoyoos Lake	SK/KO	6.9	3-4 mo				?DFO	
303	7-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				?DFO	
304	7-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				?DFO	
305	7-Jul	Osoyoos Lake	SK/KO	8.1	3-4 mo				?DFO	
306	7-Jul	Osoyoos Lake	SK/KO	9.3	3-4 mo				?DFO	
307	7-Jul	Osoyoos Lake	SK/KO	8.9	3-4 mo				?DFO	
308	7-Jul	Osoyoos Lake	SK/KO	6.4	3-4 mo				?DFO	
309	7-Jul	Osoyoos Lake	SK/KO	8.6	3-4 mo				?DFO	
310	7-Jul	Osoyoos Lake	SK/KO	6.8	3-4 mo				?DFO	anemic
311	7-Jul	Osoyoos Lake	SK/KO	7.0	3-4 mo				?DFO	
312	7-Jul	Osoyoos Lake	SK/KO	5.6	3-4 mo				?DFO	
313	7-Jul	Osoyoos Lake	SK/KO	6.4	3-4 mo				?DFO	
314	7-Jul	Osoyoos Lake	SK/KO	7.9	3-4 mo				?DFO	
315	7-Jul	Osoyoos Lake	SK/KO	7.3	3-4 mo				?DFO	
316	7-Jul	Osoyoos Lake	SK/KO	7.8	3-4 mo				?DFO	
317	7-Jul	Osoyoos Lake	SK/KO	7.2	3-4 mo				?DFO	
318	7-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				?DFO	
319	7-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				?DFO	
320	7-Jul	Osoyoos Lake	SK/KO	8.7	3-4 mo				?DFO	
321	7-Jul	Osoyoos Lake	SK/KO	6.6	3-4 mo				?DFO	clotting
322	7-Jul	Osoyoos Lake	SK/KO	6.8	3-4 mo				?DFO	clotting
323	7-Jul	Osoyoos Lake	SK/KO	6.6	3-4 mo				?DFO	
324	7-Jul	Osoyoos Lake	SK/KO	7.6	3-4 mo				?DFO	
325	7-Jul	Osoyoos Lake	SK/KO	7.0	3-4 mo				?DFO	
326	7-Jul	Osoyoos Lake	SK/KO	7.0	3-4 mo				?DFO	
327	7-Jul	Osoy oos Lake	SK/KO	6.4	3-4 mo				?DFO	
328	7-Jul	Osoyoos Lake	SK/KO	7.6	3-4 mo				?DFO	
329	7-Jul	Osoyoos Lake	SK/KO	5.4	3-4 mo				?DFO	
330	7-Jul	Osoyoos Lake	SK/KO	7.5	3-4 mo				?DFO	
331	7-Jul	Osoyoos Lake	SK/KO	6.8	3-4 mo				?DFO	clotting
332	7-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				?DFO	
333	7-Jul	Osoyoos Lake	SK/KO	5.3	3-4 mo				?DFO	anemic
334	7-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				?DFO	
335	7-Jul	Osoyoos Lake	SK/KO	6.9	3-4 mo				?DFO	
336	7-Jul	Osoyoos Lake	SK/KO	6.3	3-4 mo				?DFO	
337	7-Jul	Osoyoos Lake	SK/KO	9.0	3-4 mo				?DFO	
338	7-Jul	Osoyoos Lake	SK/KO	5.6	3-4 mo				?DFO	

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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
339	7-Jul	Osoyoos Lake	SK/KO	6.4	3-4 mo				?DFO	anemic
340	7-Jul	Osoyoos Lake	SK/KO	6.3	3-4 mo				?DFO	
341	7-Jul	Osoyoos Lake	SK/KO	6.4	3-4 mo				?DFO	
342	7-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				?DFO	
343	7-Jul	Osoyoos Lake	SK/KO	6.5	3-4 mo				?DFO	
344	7-Jul	Osoyoos Lake	SK/KO	6.9	3-4 mo				?DFO	
345	7-Jul	Osoyoos Lake	SK/KO	7.5	3-4 mo				?DFO	
346	7-Jul	Osoyoos Lake	SK/KO	7.8	3-4 mo				?DFO	
347	7-Jul	Osoyoos Lake	SK/KO	7.6	3-4 mo				?DFO	clotting
348	7-Jul	Osoyoos Lake	SK/KO	5.4	3-4 mo				?DFO	clotting
349	7-Jul	Osoyoos Lake	SK/KO	7.5	3-4 mo				?DFO	
350	7-Jul	Osoyoos Lake	SK/KO	7.1	3-4 mo				?DFO	
351	7-Jul	Osoyoos Lake	SK/KO	8.8	3-4 mo				?DFO	
352	7-Jul	Osoyoos Lake	SK/KO	7.8	3-4 mo				?DFO	
353	7-Jul	Osoyoos Lake	SK/KO	6.1	3-4 mo				?DFO	
354	7-Jul	Osoyoos Lake	SK/KO	7.0	3-4 mo				?DFO	
355	7-Jul	Osoyoos Lake	SK/KO	8.3	3-4 mo				?DFO	clotting
356	7-Jul	Osoyoos Lake	SK/KO	8.5	3-4 mo				?DFO	
357	7-Jul	Osoyoos Lake	SK/KO	8.0	3-4 mo				?DFO	
358	7-Jul	Osoyoos Lake	SK/KO	7.9	3-4 mo				?DFO	
359	7-Jul	Osoyoos Lake	SK/KO	8.0	3-4 mo				?DFO	
360	7-Jul	Osoyoos Lake	SK/KO	8.4	3-4 mo				?DFO	
361	7-Jul	Osoyoos Lake	SK/KO	8.4	3-4 mo				?DFO	
362	7-Jul	Osoyoos Lake	SK/KO	7.7	3-4 mo				?DFO	
363	7-Jul	Osoyoos Lake	SK/KO	7.0	3-4 mo				?DFO	
364	7-Jul	Osoyoos Lake	SK/KO	10.0	3-4 mo				?DFO	
365	7-Jul	Osoyoos Lake	SK/KO	8.1	3-4 mo				?DFO	
366	7-Jul	Osoyoos Lake	SK/KO	8.1	3-4 mo				?DFO	
367	7-Jul	Osoyoos Lake	SK/KO	7.0	3-4 mo				?DFO	
368	7-Jul	Osoyoos Lake	SK/KO	8.6	3-4 mo				?DFO	
369	7-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				?DFO	
370	7-Jul	Osoyoos Lake	SK/KO	9.1	3-4 mo				?DFO	
371	7-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				?DFO	
372	7-Jul	Osoyoos Lake	SK/KO	8.7	3-4 mo				?DFO	
373	7-Jul	Osoyoos Lake	SK/KO	8.5	3-4 mo				?DFO	
374	7-Jul	Osoyoos Lake	SK/KO	7.6	3-4 mo				?DFO	
375	7-Jul	Osoyoos Lake	SK/KO	7.0	3-4 mo				?DFO	
376	7-Jul	Osoyoos Lake	SK/KO	7.0	3-4 mo				?DFO	
377	7-Jul	Osoyoos Lake	SK/KO	6.8	3-4 mo				0	
378	7-Jul	Osoyoos Lake	SK/KO	8.4	3-4 mo				0	
379	7-Jul	Osoyoos Lake	SK/KO	7.9	3-4 mo				0	
380	7-Jul	Osoyoos Lake	SK/KO	7.0	3-4 mo				0	
381	7-Jul	Osoyoos Lake	SK/KO	8.3	3-4 mo				0	
382	7-Jul	Osoyoos Lake	SK/KO	6.0	3-4 mo				0	
383	7-Jul	Osoyoos Lake	SK/KO	10.0	3-4 mo				0	
384	7-Jul	Osoyoos Lake	SK/KO	7.6	3-4 mo				0	
385	7-Jul	Osoyoos Lake	SK/KO	9.5	3-4 mo				0	
386	7-Jul	Osoyoos Lake	SK/KO	7.0	3-4 mo				0	
387	7-Jul	Osoyoos Lake	SK/KO	8.3	3-4 mo				0	clotting
388	7-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				0	
389	7-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				0	
390	7-Jul	Osoyoos Lake	SK/KO	7.9	3-4 mo				0	
391	7-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				0	
392	7-Jul	Osoyoos Lake	SK/KO	7.9	3-4 mo				0	
393	7-Jul	Osoyoos Lake	SK/KO	7.9	3-4 mo				0	
394	7-Jul	Osoyoos Lake	SK/KO	7.4	3-4 mo				0	
395	7-Jul	Osoyoos Lake	SK/KO	7.6	3-4 mo				0	

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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
396	7-Jul	Osoyoos Lake	SK/KO	7.7	3-4 mo				0	
397	7-Jul	Osoyoos Lake	SK/KO	7.0	3-4 mo				0	
398	7-Jul	Osoyoos Lake	SK/KO	7.6	3-4 mo				0	
399	7-Jul	Osoyoos Lake	SK/KO	6.5	3-4 mo				0	
400	7-Jul	Osoyoos Lake	SK/KO	8.4	3-4 mo				0	
401	7-Jul	Osoyoos Lake	SK/KO	8.6	3-4 mo				0	
402	7-Jul	Osoyoos Lake	SK/KO	7.1	3-4 mo				0	clotting
403	7-Jul	Osoyoos Lake	SK/KO	7.7	3-4 mo				0	
404	11-Jul	Okanagan Lake	KO	5.4	3-4 mo				0	
404	7-Jul	Osoyoos Lake	SK/KO	8.1	3-4 mo				0	
405	11-Jul	Okanagan Lake	KO	4.1	3-4 mo				0	
406	11-Jul	Okanagan Lake	KO	4.9	3-4 mo				1	
407	11-Jul	Okanagan Lake	KO	4.7	3-4 mo				0	
408	11-Jul	Okanagan Lake	KO	4.6	3-4 mo				0	
409	11-Jul	Okanagan Lake	KO	5.0	3-4 mo				0	
410	11-Jul	Okanagan Lake	KO	4.4	3-4 mo				0	
411	11-Jul	Okanagan Lake	KO	4.5	3-4 mo				0	
412	11-Jul	Okanagan Lake	KO	5.3	3-4 mo				0	
413	11-Jul	Okanagan Lake	KO	5.1	3-4 mo				0	
414	11-Jul	Okanagan Lake	KO	4.9	3-4 mo				0	
415	11-Jul	Okanagan Lake	KO	4.8	3-4 mo				0	
416	11-Jul	Okanagan Lake	KO	4.6	3-4 mo				0	
417	11-Jul	Okanagan Lake	KO	4.1	3-4 mo				0	
418	13-Jul	Okanagan Lake	KO	4.6	3-4 mo				bad smear	clotted
419	13-Jul	Okanagan Lake	KO	3.9	3-4 mo				1	
420	13-Jul	Okanagan Lake	KO	4.4	3-4 mo				0	clotted
421	13-Jul	Okanagan Lake	KO	10.8	1-2 yr				4	
422	13-Jul	Okanagan Lake	KO	4.7	3-4 mo				1	
423	13-Jul	Okanagan Lake	KO	5.3	3-4 mo				2	
424	13-Jul	Okanagan Lake	KO	4.5	3-4 mo				0	
425	13-Jul	Okanagan Lake	KO	4.4	3-4 mo				1	
426	13-Jul	Okanagan Lake	KO	4.0	3-4 mo				bad smear	
427	13-Jul	Okanagan Lake	KO	4.9	3-4 mo				2	
428	13-Jul	Okanagan Lake	KO	4.6	3-4 mo				0	
429	13-Jul	Okanagan Lake	KO	4.4	3-4 mo				0	
430	13-Jul	Okanagan Lake	KO	4.2	3-4 mo				0	clotted
431	13-Jul	Okanagan Lake	KO	3.9	3-4 mo				0	
432	13-Jul	Okanagan Lake	KO	4.6	3-4 mo				0	
433	13-Jul	Okanagan Lake	KO	5.0	3-4 mo				bad smear	
434	13-Jul	Okanagan Lake	KO	4.0	3-4 mo				bad smear	clotted
435	13-Jul	Okanagan Lake	KO	4.6	3-4 mo				bad smear	
436	13-Jul	Okanagan Lake	KO	4.4	3-4 mo				0	clotted
437	13-Jul	Okanagan Lake	KO	5.0	3-4 mo				0	clotted
438	13-Jul	Okanagan Lake	KO	4.0	3-4 mo				0	
439	13-Jul	Okanagan Lake	KO	5.0	3-4 mo				3	clotted
440	13-Jul	Okanagan Lake	KO	5.4	3-4 mo				3	
441	13-Jul	Okanagan Lake	KO	5.4	3-4 mo				1	
442	13-Jul	Okanagan Lake	KO	5.3	3-4 mo				2	clotted
443	20-Jul	McIntyre Dam	SK	50.1	spawner	M			DFO	
444	20-Jul	McIntyre Dam	SK	49.0	spawner	M			DFO	
445	20-Jul	McIntyre Dam	SK	52.0	spawner	F			DFO	
446	20-Jul	McIntyre Dam	SK	44.5	spawner	F			DFO	
447	20-Jul	McIntyre Dam	SK	49.5	spawner	F			DFO	
448	20-Jul	McIntyre Dam	SK	52.0	spawner	M			DFO	
449	20-Jul	McIntyre Dam	SK	50.5	spawner	F			DFO	
450	20-Jul	McIntyre Dam	SK	50.0	spawner	M			DFO	
451	20-Jul	McIntyre Dam	SK	46.0	spawner	M			DFO	

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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
452	20-Jul	McIntyre Dam	SK	52.5	spawner	M			DFO	
453	20-Jul	McIntyre Dam	SK	46.5	spawner	F			DFO	
454	20-Jul	McIntyre Dam	SK	47.5	spawner	F			DFO	
455	20-Jul	McIntyre Dam	SK	47.5	spawner	F			DFO	
456	20-Jul	McIntyre Dam	SK	51.5	spawner	M			DFO	
457	20-Jul	McIntyre Dam	SK	54.0	spawner	F			DFO	
458	21-Jul	McIntyre Dam	SK	57.0	spawner	M			DFO	
459	21-Jul	McIntyre Dam	SK	50.0	spawner	M			DFO	
460	21-Jul	McIntyre Dam	SK	51.0	spawner	F			DFO	
461	21-Jul	McIntyre Dam	SK	49.0	spawner	M			DFO	
462	21-Jul	McIntyre Dam	SK	51.0	spawner	M			DFO	
463	21-Jul	McIntyre Dam	SK	51.0	spawner	F			DFO	
464	21-Jul	McIntyre Dam	SK		spawner				DFO	
465	21-Jul	McIntyre Dam	SK	51.0	spawner	M			DFO	
466	21-Jul	McIntyre Dam	SK	50.0	spawner	F			DFO	
467	21-Jul	McIntyre Dam	SK	47.0	spawner	M			DFO	
468	21-Jul	McIntyre Dam	SK	47.0	spawner	F			DFO	
469	21-Jul	McIntyre Dam	SK	51.0	spawner	M			DFO	
470	21-Jul	McIntyre Dam	SK	52.0	spawner	M			DFO	
471	21-Jul	McIntyre Dam	SK	52.0	spawner	M			DFO	clotted
472	21-Jul	McIntyre Dam	SK	49.0	spawner	M			DFO	
473	21-Jul	McIntyre Dam	SK	53.0	spawner	M			DFO	
474	21-Jul	McIntyre Dam	SK	53.0	spawner	M			DFO	
475	21-Jul	McIntyre Dam	SK	51.0	spawner	F			DFO	
476	21-Jul	McIntyre Dam	SK	51.0	spawner	M			DFO	
477	21-Jul	McIntyre Dam	SK	46.0	spawner	F			DFO	
478	21-Jul	McIntyre Dam	SK	49.0	spawner	M			DFO	
479	21-Jul	McIntyre Dam	SK	54.0	spawner	M			DFO	
480	21-Jul	McIntyre Dam	SK	49.0	spawner	M			DFO	no intestine
481	21-Jul	McIntyre Dam	SK	49.0	spawner	F			DFO	no blood
482	21-Aug	Okanagan Lake	WF	11.0	juv				0	
483	21-Aug	Okanagan Lake	WF	10.0					0	
484	21-Aug	Okanagan Lake	WF	11.3					bad smear	
485	21-Aug	Okanagan Lake	WF	9.1					0	
486	21-Aug	Okanagan Lake	WF	9.4					0	
487	21-Aug	Okanagan Lake	WF	10.4					0	
488	21-Aug	Okanagan Lake	WF	11.1					0	
489	21-Aug	Okanagan Lake	NSC	8.8					0	
490	21-Aug	Okanagan Lake	PCC	13.6					0	
491	21-Aug	Okanagan Lake	PCC	13.4					0	
492	21-Aug	Okanagan Lake	WF	19.5	AD				1	
493	21-Aug	Okanagan Lake	PCC	13.2					0	
494	21-Aug	Okanagan Lake	PCC	18.0					1	
495	21-Aug	Okanagan Lake	PCC	12.8					0	
496	21-Aug	Okanagan Lake	RSC	6.2					0	
497	21-Aug	Okanagan Lake	RSC	5.8					0	
498	21-Aug	Okanagan Lake	WF	19.7	AD				1	
499	21-Aug	Okanagan Lake	PCC	19.2					0	
500	21-Aug	Okanagan Lake	SU	6.7					0	
501	21-Aug	Okanagan Lake	RSC	7.4					0	clotted
502	21-Aug	Okanagan Lake	NSC	7.6					0	
503	21-Aug	Okanagan Lake	NSC	7.4					1	
504	21-Aug	Okanagan Lake	PCC	14.4					0	clotted
505	21-Aug	Okanagan Lake	PCC	15.3					0	
506	21-Aug	Okanagan Lake	PCC	17.4					0	
507	21-Aug	Okanagan Lake	PCC	19.0					0	
508	21-Aug	Okanagan Lake	PCC	19.8					0	

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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
509	21-Aug	Okanagan Lake	PCC	19.8					0	
510	21-Aug	Okanagan Lake	PCC	20.0					0	
511	21-Aug	Okanagan Lake	PCC	16.5					0	
512	21-Aug	Okanagan Lake	NSC	25.0					0	
513	21-Aug	Okanagan Lake	NSC	41.7					0	
514	21-Aug	Okanagan Lake	NSC	38.1					0	
515	21-Aug	Okanagan Lake	NSC	37.7					0	
516	21-Aug	Okanagan Lake	NSC	30.2					0	
517	21-Aug	Okanagan Lake	NSC	30.2					1	
518	21-Aug	Okanagan Lake	YP	15.5					0	
519	21-Aug	Okanagan Lake	YP	25.9					0	
520	21-Aug	Okanagan Lake	NSC	19.2					1	
521	21-Aug	Okanagan Lake	NSC	26.0					0	
522	21-Aug	Okanagan Lake	NSC	24.1					0	
523	21-Aug	Okanagan Lake	NSC	29.3					0	
524	21-Aug	Okanagan Lake	PCC	20.9					0	
525	21-Aug	Okanagan Lake	YP	16.0					0	
526	21-Aug	Okanagan Lake	PCC	15.3					0	
527	21-Aug	Okanagan Lake	PCC	17.0					1	
528	21-Aug	Okanagan Lake	RSC	7.7					0	
529	21-Aug	Okanagan Lake	CC	8.5					0	
530	21-Aug	Okanagan Lake	CC	9.1					0	
531	21-Aug	Okanagan Lake	NSC	6.1					0	
532	21-Aug	Okanagan Lake	RSC	8.1					0	
533	21-Aug	Okanagan Lake	SU	16.0					0	
534	21-Aug	Okanagan Lake	PCC	14.5					0	
535	21-Aug	Okanagan Lake	SU	29.0					0	
536	21-Aug	Okanagan Lake	SU	38.5					0	
537	21-Aug	Okanagan Lake	NSC	37.5					0	
538	21-Aug	Okanagan Lake	SU	45.5					0	
539	21-Aug	Okanagan Lake	SU	38.7					1	
540	21-Aug	Okanagan Lake	SU	45.8					0	
541	21-Aug	Okanagan Lake	NSC	22.5					0	
542	21-Aug	Okanagan Lake	PCC	21.4					0	
543	21-Aug	Okanagan Lake	PCC	18.9					0	
544	21-Aug	Okanagan Lake	PCC	18.3					0	
545	21-Aug	Okanagan Lake	SU	26.6					0	
546	21-Aug	Okanagan Lake	SU	34.6					0	
547	21-Aug	Okanagan Lake	SU	40.0					0	
548	21-Aug	Okanagan Lake	SU	41.1					0	
549	21-Aug	Okanagan Lake	SU	41.5					0	
550	21-Aug	Okanagan Lake	SU	43.4					0	
551	21-Aug	Okanagan Lake	SU	39.8					0	
552	21-Aug	Okanagan Lake	CC	8.5					0	
553	21-Aug	Okanagan Lake	CC	8.7					0	
554	21-Aug	Okanagan Lake	CC	7.5					0	
555	21-Aug	Okanagan Lake	PCC	19.4					0	
556	21-Aug	Okanagan Lake	PCC	16.5					0	
557	22-Aug	Skaha Lake	SMB	18.7					0	
558	22-Aug	Skaha Lake	SMB	18.0					0	
559	22-Aug	Skaha Lake	SMB	24.5					0	
560	22-Aug	Skaha Lake	SMB	22.1					0	
561	22-Aug	Skaha Lake	SMB	26.6					0	
562	22-Aug	Skaha Lake	SMB	29.1					0	
563	22-Aug	Skaha Lake	SMB	5.7					0	clotted
564	22-Aug	Skaha Lake	SMB	32.0					0	
565	22-Aug	Skaha Lake	SMB	34.0					0	

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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
566	22-Aug	Skaha Lake	SMB	36.0					0	
567	22-Aug	Skaha Lake	SMB	18.0					0	
568	22-Aug	Skaha Lake	SMB	15.1					0	
569	22-Aug	Skaha Lake	SMB	17.0					0	
570	22-Aug	Skaha Lake	NSC	19.0					1	
571	22-Aug	Skaha Lake	PCC	21.5					0	
572	22-Aug	Skaha Lake	SMB	22.8					0	
573	22-Aug	Skaha Lake	PCC	21.9					0	
574	22-Aug	Skaha Lake	PCC	24.0					0	
575	22-Aug	Skaha Lake	PCC	27.0					0	
576	22-Aug	Skaha Lake	PCC	18.0					0	
577	22-Aug	Skaha Lake	SMB	17.4					0	
578	22-Aug	Skaha Lake	SMB	12.5					0	
579	22-Aug	Skaha Lake	SMB	13.0					0	
580	22-Aug	Skaha Lake	PCC	16.5					0	
581	22-Aug	Skaha Lake	NSC	21.3					0	
582	22-Aug	Skaha Lake	SMB	21.0					0	
583	22-Aug	Skaha Lake	SMB	14.5					0	
584	22-Aug	Skaha Lake	PCC	23.0					0	
585	22-Aug	Skaha Lake	SMB	18.7					0	
586	22-Aug	Skaha Lake	PCC	19.0					0	
587	22-Aug	Skaha Lake	NSSC	25.0					0	
588	22-Aug	Skaha Lake	PCC	21.1					0	
589	22-Aug	Skaha Lake	SMB	14.5					0	
590	22-Aug	Skaha Lake	SU	19.0					0	
591	22-Aug	Skaha Lake	SMB	13.0					0	
592	22-Aug	Skaha Lake	PMB	9.1					0	
593	22-Aug	Skaha Lake	PMB	9.0					0	
594	22-Aug	Skaha Lake	PMB	8.8					0	
595	22-Aug	Skaha Lake	SMB	24.1					0	
596	22-Aug	Skaha Lake	SMB	30.0					0	
597	22-Aug	Skaha Lake	SMB	19.4					2	
598	22-Aug	Skaha Lake	PCC	29.5					0	
599	22-Aug	Skaha Lake	PCC	26.0					0	
600	22-Aug	Skaha Lake	PCC	26.0					0	
601	22-Aug	Skaha Lake	PCC	24.4					0	
602	22-Aug	Skaha Lake	SMB	12.5					3	
603	22-Aug	Skaha Lake	NSC	21.1					0	
604	22-Aug	Skaha Lake	PCC	22.6					0	
605	22-Aug	Skaha Lake	NSC	29.0					0	
606	22-Aug	Skaha Lake	PCC	23.0					0	
607	22-Aug	Skaha Lake	NSC	11.3					0	
608	22-Aug	Skaha Lake	NSC	24.5					0	
609	22-Aug	Skaha Lake	NSC	23.6					0	
610	22-Aug	Skaha Lake	PCC	26.0					1	
611	22-Aug	Skaha Lake	PCC	23.1					0	
612	22-Aug	Skaha Lake	PCC	22.7					0	
613	22-Aug	Skaha Lake	PCC	22.0					0	
614	22-Aug	Skaha Lake	NSC	25.0					0	
615	22-Aug	Skaha Lake	PCC	20.0					0	
616	22-Aug	Skaha Lake	NSC	24.1					0	
617	22-Aug	Skaha Lake	SU	35.0					0	
618	22-Aug	Skaha Lake	CC	6.5					0	
619	22-Aug	Skaha Lake	CC	7.0					0	
620	22-Aug	Skaha Lake	CC	5.5					0	
621	22-Aug	Skaha Lake	CC	4.5					0	
622	22-Aug	Skaha Lake	NSC	18.5					0	

Disease risk assessment sampling
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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
623	22-Aug	Skaha Lake	SU	37.0					0	
624	22-Aug	Skaha Lake	SU	44.0					0	
625	22-Aug	Skaha Lake	SU	28.0					0	
626	22-Aug	Skaha Lake	SU	37.0					0	
627	22-Aug	Skaha Lake	SU	26.5					0	
628	22-Aug	Skaha Lake	SU	23.0					no slide	
629	22-Aug	Skaha Lake	SU	34.5					0	
630	22-Aug	Skaha Lake	SU	34.5					0	
631	22-Aug	Skaha Lake	SU	38.0					0	
631	23-Aug	Osoyoos Lake	SU	38.7						
632	23-Aug	Osoyoos Lake	SU	44.6					0	
633	23-Aug	Osoyoos Lake	SU	40.0					0	
634	23-Aug	Osoyoos Lake	SU	38.8					0	
635	23-Aug	Osoyoos Lake	SU	41.5					0	clotted
636	23-Aug	Osoyoos Lake	SU	44.4					0	
637	23-Aug	Osoyoos Lake	YP	13.4					0	
638	23-Aug	Osoyoos Lake	SU	45.2					0	
639	23-Aug	Osoyoos Lake	YP	18.7					0	
640	23-Aug	Osoyoos Lake	YP	16.0					0	
641	23-Aug	Osoyoos Lake	YP	15.6					1	
642	23-Aug	Osoyoos Lake	YP	17.4					0	
643	23-Aug	Osoyoos Lake	YP	14.3					0	
644	23-Aug	Osoyoos Lake	YP	13.9					0	anemic
645	23-Aug	Osoyoos Lake	YP	14.8					0	anemic
646	23-Aug	Osoyoos Lake	YP	10.0					0	
647	23-Aug	Osoyoos Lake	YP	19.3					0	
648	23-Aug	Osoyoos Lake	YP	14.2					0	
649	23-Aug	Osoyoos Lake	YP	12.0					0	
650	23-Aug	Osoyoos Lake	YP	16.4					0	
651	23-Aug	Osoyoos Lake	YP	17.6					0	
652	23-Aug	Osoyoos Lake	YP	14.2					0	
653	23-Aug	Osoyoos Lake	YP	13.5					0	
654	23-Aug	Osoyoos Lake	YP	14.5					0	
655	23-Aug	Osoyoos Lake	WF	16.4					0	
656	23-Aug	Osoyoos Lake	WF	11.4					0	
657	23-Aug	Osoyoos Lake	WF	11.9					0	
658	23-Aug	Osoyoos Lake	NSC	32.4					0	
659	23-Aug	Osoyoos Lake	SU	17.4					0	clotted
660	23-Aug	Osoyoos Lake	SU	14.4					0	
661	23-Aug	Osoyoos Lake	PMB	12.8					0	
662	23-Aug	Osoyoos Lake	PMB	7.2					0	
663	23-Aug	Osoyoos Lake	PMB	12.2					1	clotted
664	23-Aug	Osoyoos Lake	PMB	8.0					0	
665	23-Aug	Osoyoos Lake	PMB	9.3					0	
666	23-Aug	Osoyoos Lake	PMB	7.1					0	anemic
667	23-Aug	Osoyoos Lake	PMB	8.5					1	
668	23-Aug	Osoyoos Lake	CC	9.0					1	
669	23-Aug	Osoyoos Lake	NSC	9.4					0	
670	23-Aug	Osoyoos Lake	PMB	10.8					0	
671	23-Aug	Osoyoos Lake	SMB	28.1					0	
672	23-Aug	Osoyoos Lake	PMB	16.5					0	
673	23-Aug	Osoyoos Lake	SMB	40.7					1	
674	23-Aug	Osoyoos Lake	SMB	22.5					0	
675	23-Aug	Osoyoos Lake	SMB	20.5					0	
676	23-Aug	Osoyoos Lake	SMB	19.5					0	
677	23-Aug	Osoyoos Lake	LMB	10.0					0	
678	23-Aug	Osoyoos Lake	LMB	10.8					0	anemic

Disease risk assessment sampling
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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
679	23-Aug	Osoyoos Lake	LMB	11.0					0	
680	23-Aug	Osoyoos Lake	LMB	10.5					0	
681	23-Aug	Osoyoos Lake	SMB	8.0					0	
682	23-Aug	Osoyoos Lake	PMB	9.0					0	
683	23-Aug	Osoyoos Lake	LMB	7.5					0	
684	23-Aug	Osoyoos Lake	SMB	7.5					0	
685	23-Aug	Osoyoos Lake	LMB	5.5					0	
686	23-Aug	Osoyoos Lake	SMB	6.5					0	clotted
687	23-Aug	Osoyoos Lake	LMB	9.6					0	
688	23-Aug	Osoyoos Lake	LMB	10.0					0	
689	23-Aug	Osoyoos Lake	LMB	11.0					0	
690	23-Aug	Osoyoos Lake	LMB	8.5					0	
691	23-Aug	Osoyoos Lake	PMB	7.0					0	clotted
692	23-Aug	Osoyoos Lake	SMB	6.5					0	
693	23-Aug	Osoyoos Lake	LMB	7.3					0	
694	23-Aug	Osoyoos Lake	LMB	7.5					0	
695	23-Aug	Osoyoos Lake	LMB	7.4					0	
696	23-Aug	Osoyoos Lake	SMB	7.3					0	
697	23-Aug	Osoyoos Lake	SMB	6.5					0	clotted
698	23-Aug	Osoyoos Lake	SMB	6.5					0	
699	23-Aug	Osoyoos Lake	LMB	6.5					0	
700	23-Aug	Osoyoos Lake	SMB	11.0					0	
701	23-Aug	Osoyoos Lake	SMB	6.4					0	
702	23-Aug	Osoyoos Lake	YP	15.5					1	
703	23-Aug	Osoyoos Lake	YP	18.0					0	
704	23-Aug	Osoyoos Lake	YP	13.0					0	
705	23-Aug	Osoyoos Lake	YP	15.0					0	
706	24-Aug	Osoyoos Lake	SU	41.0					0	
707	24-Aug	Osoyoos Lake	SU	48.0					0	
708	24-Aug	Osoyoos Lake	SU	41.0					0	
709	24-Aug	Osoyoos Lake	SU	45.0					0	
710	24-Aug	Osoyoos Lake	SU	44.0					1	
711	24-Aug	Osoyoos Lake	SU	44.0					0	
712	24-Aug	Osoyoos Lake	SU	36.0					0	
713	24-Aug	Osoyoos Lake	SU	46.3					0	
714	24-Aug	Osoyoos Lake	SU	39.0					0	clotted
715	24-Aug	Osoyoos Lake	NSC	46.0					0	
716	24-Aug	Osoyoos Lake	NSC	52.0					0	
717	24-Aug	Osoyoos Lake	NSC	49.0					0	
718	24-Aug	Osoyoos Lake	NSC	38.0					0	
719	24-Aug	Osoyoos Lake	BCB	7.7					0	
720	24-Aug	Osoyoos Lake	SMB	18.6					0	
721	24-Aug	Osoyoos Lake	SMB	23.5					0	
722	24-Aug	Osoyoos Lake	LMB	7.5					1	
723	24-Aug	Osoyoos Lake	SMB	8.0					0	
724	24-Aug	Osoyoos Lake	LMB	8.0					0	
725	24-Aug	Osoyoos Lake	LMB	8.0					0	
726	24-Aug	Osoyoos Lake	LMB	8.4					0	
727	24-Aug	Osoyoos Lake	LMB	5.6					0	clotted
728	24-Aug	Osoyoos Lake	LMB	7.5					0	clotted
729	24-Aug	Osoyoos Lake	LMB	6.5					0	
730	24-Aug	Osoyoos Lake	SMB	7.0					0	clotted
731	24-Aug	Osoyoos Lake	LMB	6.3					0	clotted
732	24-Aug	Osoyoos Lake	LMB	6.5					0	clotted
733	24-Aug	Osoyoos Lake	SMB	9.0					0	
734	24-Aug	Osoyoos Lake	SMB	7.0					0	
735	24-Aug	Osoyoos Lake	SMB	6.0					0	

Disease risk assessment sampling
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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
736	24-Aug	Osoyoos Lake	LMB	8.0					0	
737	24-Aug	Osoyoos Lake	LMB	7.5					0	
738	24-Aug	Osoyoos Lake	LMB	6.0					0	
739	24-Aug	Osoyoos Lake	LMB	7.7					0	
740	24-Aug	Osoyoos Lake	SMB	6.5					0	
741	24-Aug	Osoyoos Lake	SMB	7.0					0	clotted
742	24-Aug	Osoyoos Lake	LMB	7.0					0	
743	24-Aug	Osoyoos Lake	LMB	7.0					0	
744	24-Aug	Osoyoos Lake	LMB	5.5					0	
745	24-Aug	Osoyoos Lake	LMB	8.0					0	
746	24-Aug	Osoyoos Lake	SMB	8.0					0	
747	24-Aug	Osoyoos Lake	SMB	7.0					0	
748	24-Aug	Osoyoos Lake	PMB	9.0					0	
749	24-Aug	Osoyoos Lake	SMB	6.5					0	
750	24-Aug	Osoyoos Lake	LMB	7.0					0	clotted
751	24-Aug	Osoyoos Lake	LMB	9.0					0	
752	24-Aug	Osoyoos Lake	SMB	7.0					0	clotted
753	24-Aug	Osoyoos Lake	LMB	5.0					0	
754	24-Aug	Osoyoos Lake	SMB	6.5					0	
755	24-Aug	Osoyoos Lake	LMB	6.0					0	clotted
756	24-Aug	Osoyoos Lake	LMB	10.0					0	
757	24-Aug	Osoyoos Lake	SMB	6.0					0	
758	24-Aug	Osoyoos Lake	LMB	5.5					0	
759	24-Aug	Osoyoos Lake	LMB	5.6					0	
760	24-Aug	Osoyoos Lake	LMB	5.5					0	
761	24-Aug	Osoyoos Lake	SMB	6.5					0	
762	24-Aug	Osoyoos Lake	SMB	6.3					bad smear	
763	24-Aug	Osoyoos Lake	LMB	5.5					0	
764	24-Aug	Osoyoos Lake	SMB	5.2					0	
765	24-Aug	Osoyoos Lake	LMB	6.5					0	
766	24-Aug	Osoyoos Lake	YP	17.3					0	
767	24-Aug	Osoyoos Lake	YP	15.0					bad smear	
768	24-Aug	Osoyoos Lake	YP	17.3					0	
769	24-Aug	Osoyoos Lake	YP	16.6					0	
770	24-Aug	Osoyoos Lake	YP	16.0					0	
771	24-Aug	Osoyoos Lake	YP	18.4					0	
772	24-Aug	Osoyoos Lake	YP	14.4					0	
773	24-Aug	Osoyoos Lake	YP	18.0					0	
774	24-Aug	Osoyoos Lake	YP	16.0					0	
775	24-Aug	Osoyoos Lake	YP	17.0					0	
776	24-Aug	Osoyoos Lake	YP	14.5					0	
777	24-Aug	Osoyoos Lake	YP	15.6					0	
778	24-Aug	Osoyoos Lake	YP	14.6					0	
779	24-Aug	Osoyoos Lake	YP	17.0					0	
780	24-Aug	Osoyoos Lake	YP	16.5					0	
800	12-Sep	Okanagan Lake north	KO	6.7	6 mo. Fry				0	
801	12-Sep	Okanagan Lake north	KO	6.9	6 mo. Fry				0	
802	12-Sep	Okanagan Lake north	KO	6.9	6 mo. Fry				0	
803	12-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				0	
804	12-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				0	
805	12-Sep	Okanagan Lake north	KO	5.7	6 mo. Fry				0	clotted
806	12-Sep	Okanagan Lake north	KO	6.9	6 mo. Fry				0	
807	12-Sep	Okanagan Lake north	KO	6.1	6 mo. Fry				0	
808	12-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				0	
809	12-Sep	Okanagan Lake north	KO	6.6	6 mo. Fry				0	
810	12-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				0	
811	12-Sep	Okanagan Lake north	KO	7.1	6 mo. Fry				0	

Disease risk assessment sampling
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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
812	12-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				0	
813	12-Sep	Okanagan Lake north	KO	7.0	6 mo. Fry				0	
814	12-Sep	Okanagan Lake north	KO	6.9	6 mo. Fry				0	
815	12-Sep	Okanagan Lake north	KO	7.2	6 mo. Fry				0	
816	12-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				0	
817	12-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				0	
818	12-Sep	Okanagan Lake north	KO	7.1	6 mo. Fry				0	
819	12-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				0	
820	12-Sep	Okanagan Lake north	KO	5.2	6 mo. Fry				0	
821	12-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				0	
822	12-Sep	Okanagan Lake north	KO	6.3	6 mo. Fry				0	
823	12-Sep	Okanagan Lake north	KO	7.5	6 mo. Fry				0	
824	12-Sep	Okanagan Lake north	KO	7.2	6 mo. Fry				0	
825	12-Sep	Okanagan Lake north	KO	6.9	6 mo. Fry				4	
826	12-Sep	Okanagan Lake north	KO	5.4	6 mo. Fry				0	
827	12-Sep	Okanagan Lake north	KO	6.4	6 mo. Fry				0	
828	12-Sep	Okanagan Lake north	KO	6.6	6 mo. Fry				0	
829	12-Sep	Okanagan Lake north	KO	7.4	6 mo. Fry				0	
830	12-Sep	Okanagan Lake north	KO	7.5	6 mo. Fry				0	
831	12-Sep	Okanagan Lake north	KO	7.7	6 mo. Fry				0	
832	12-Sep	Okanagan Lake north	KO	7.6	6 mo. Fry				0	
833	12-Sep	Okanagan Lake north	KO	6.2	6 mo. Fry				0	
834	12-Sep	Okanagan Lake north	KO	6.7	6 mo. Fry				0	
835	12-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				0	
836	12-Sep	Okanagan Lake north	KO	5.8	6 mo. Fry				0	
837	12-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				0	
838	12-Sep	Okanagan Lake north	KO	7.0	6 mo. Fry				0	
839	12-Sep	Okanagan Lake north	KO	6.6	6 mo. Fry				0	
840	12-Sep	Okanagan Lake north	KO	6.7	6 mo. Fry				0	
841	12-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				0	
842	12-Sep	Okanagan Lake north	KO	6.3	6 mo. Fry				0	
843	12-Sep	Okanagan Lake north	KO	7.0	6 mo. Fry				0	
844	12-Sep	Okanagan Lake north	KO	6.6	6 mo. Fry				0	
845	12-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				0	
846	12-Sep	Okanagan Lake north	KO	6.2	6 mo. Fry				0	
847	12-Sep	Okanagan Lake north	KO	7.2	6 mo. Fry				0	
848	12-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				0	
849	12-Sep	Okanagan Lake north	KO	7.5	6 mo. Fry				0	
850	12-Sep	Okanagan Lake north	KO	6.9	6 mo. Fry				0	
851	12-Sep	Okanagan Lake north	KO	5.6	6 mo. Fry				0	
852	12-Sep	Okanagan Lake north	KO	6.9	6 mo. Fry				0	
853	12-Sep	Okanagan Lake north	KO	6.0	6 mo. Fry				0	
854	12-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				0	
855	12-Sep	Okanagan Lake north	KO	5.5	6 mo. Fry				0	
856	12-Sep	Okanagan Lake north	KO	7.3	6 mo. Fry				0	
857	12-Sep	Okanagan Lake north	KO	7.1	6 mo. Fry				0	
858	12-Sep	Okanagan Lake north	KO	7.0	6 mo. Fry				0	
859	12-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				0	
860	12-Sep	Okanagan Lake north	KO	5.4	6 mo. Fry				0	
861	12-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				0	
862	12-Sep	Okanagan Lake north	KO	6.2	6 mo. Fry				0	
863	12-Sep	Okanagan Lake north	KO	6.7	6 mo. Fry				0	
864	12-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				0	clotting
865	12-Sep	Okanagan Lake north	KO	7.0	6 mo. Fry				0	
866	12-Sep	Okanagan Lake north	KO	7.2	6 mo. Fry				0	
867	12-Sep	Okanagan Lake north	KO	7.6	6 mo. Fry				0	
868	12-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				0	

Disease risk assessment sampling
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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
869	12-Sep	Okanagan Lake north	KO	5.8	6 mo. Fry				0	condensation on slide
870	12-Sep	Okanagan Lake north	KO	6.6	6 mo. Fry				0	condensation on slide
871	12-Sep	Okanagan Lake north	KO	5.7	6 mo. Fry				bad smear	condensation on slide
872	12-Sep	Okanagan Lake north	KO	6.7	6 mo. Fry				0	
873	12-Sep	Okanagan Lake north	KO	6.4	6 mo. Fry				0	
874	12-Sep	Okanagan Lake north	KO	6.3	6 mo. Fry				0	
877	13-Sep	Okanagan Lake north	KO	7.9	6 mo. Fry				0	
878	13-Sep	Okanagan Lake north	KO	7.2	6 mo. Fry				bad smear	
879	13-Sep	Okanagan Lake north	KO	6.4	6 mo. Fry				0	
880	13-Sep	Okanagan Lake north	KO	6.2	6 mo. Fry				0	
881	13-Sep	Okanagan Lake north	KO	7.3	6 mo. Fry				0	
882	13-Sep	Okanagan Lake north	KO	7.0	6 mo. Fry				0	
883	13-Sep	Okanagan Lake north	KO	5.9	6 mo. Fry				0	
884	13-Sep	Okanagan Lake north	KO	7.2	6 mo. Fry				0	
885	13-Sep	Okanagan Lake north	KO	6.4	6 mo. Fry				0	
886	13-Sep	Okanagan Lake north	KO	6.6	6 mo. Fry				0	
887	13-Sep	Okanagan Lake north	KO	4.6	6 mo. Fry				0	anemic
888	13-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				0	
889	13-Sep	Okanagan Lake north	KO	7.7	6 mo. Fry				0	
890	13-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				0	
891	13-Sep	Okanagan Lake north	KO	6.4	6 mo. Fry				0	
892	13-Sep	Okanagan Lake north	KO	7.2	6 mo. Fry				0	
893	13-Sep	Okanagan Lake north	KO	6.9	6 mo. Fry				0	
894	13-Sep	Okanagan Lake north	KO	8.2	6 mo. Fry				0	
895	13-Sep	Okanagan Lake north	KO	7.2	6 mo. Fry				0	
896	13-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				0	
897	13-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				0	
898	13-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				0	
899	13-Sep	Okanagan Lake north	KO	6.0	6 mo. Fry				0	
900	13-Sep	Okanagan Lake north	KO	5.1	6 mo. Fry				0	
901	13-Sep	Okanagan Lake north	KO	6.4	6 mo. Fry				0	
902	13-Sep	Okanagan Lake north	KO	5.9	6 mo. Fry				0	
903	13-Sep	Okanagan Lake north	KO	7.7	6 mo. Fry				0	
904	13-Sep	Okanagan Lake north	KO	6.3	6 mo. Fry				0	
905	13-Sep	Okanagan Lake north	KO	4.6	6 mo. Fry				0	
906	13-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				0	
907	13-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				0	
908	13-Sep	Okanagan Lake north	KO	7.1	6 mo. Fry				0	
909	13-Sep	Okanagan Lake north	KO	6.9	6 mo. Fry				0	
910	13-Sep	Okanagan Lake north	KO	7.2	6 mo. Fry				0	
911	13-Sep	Okanagan Lake north	KO	6.7	6 mo. Fry				0	
912	13-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				0	
913	13-Sep	Okanagan Lake north	KO	6.7	6 mo. Fry				0	
914	13-Sep	Okanagan Lake north	KO	6.6	6 mo. Fry				0	
915	13-Sep	Okanagan Lake north	KO	6.0	6 mo. Fry				0	
916	13-Sep	Okanagan Lake north	KO	6.3	6 mo. Fry				0	
917	13-Sep	Okanagan Lake north	KO	7.2	6 mo. Fry				0	
918	13-Sep	Okanagan Lake north	KO	5.3	6 mo. Fry				0	
919	13-Sep	Okanagan Lake north	KO	6.3	6 mo. Fry				0	
920	13-Sep	Okanagan Lake north	KO	7.0	6 mo. Fry				0	
921	13-Sep	Okanagan Lake north	KO	6.4	6 mo. Fry				0	
922	13-Sep	Okanagan Lake north	KO	6.6	6 mo. Fry				0	anemic
923	13-Sep	Okanagan Lake north	KO	7.3	6 mo. Fry				0	
924	13-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				0	
925	13-Sep	Okanagan Lake north	KO	6.9	6 mo. Fry				0	
926	13-Sep	Okanagan Lake north	KO	6.7	6 mo. Fry				no smear	no blood smear
927	13-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				no smear	no blood smear

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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
928	13-Sep	Okanagan Lake north	KO	6.4	6 mo. Fry				no smear	no blood smear
929	13-Sep	Okanagan Lake north	KO	6.4	6 mo. Fry				no smear	no blood smear
930	13-Sep	Okanagan Lake north	KO	6.6	6 mo. Fry				no smear	no blood smear
931	13-Sep	Okanagan Lake north	KO	6.3	6 mo. Fry				no smear	no blood smear
932	13-Sep	Okanagan Lake north	KO	6.4	6 mo. Fry				no smear	no blood smear
933	13-Sep	Okanagan Lake north	KO	5.8	6 mo. Fry				no smear	no blood smear
934	13-Sep	Okanagan Lake north	KO	6.4	6 mo. Fry				no smear	no blood smear
935	13-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				no smear	no blood smear
936	13-Sep	Okanagan Lake north	KO	6.6	6 mo. Fry				no smear	no blood smear
937	13-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				no smear	no blood smear
938	13-Sep	Okanagan Lake north	KO	6.4	6 mo. Fry				no smear	no blood smear
939	13-Sep	Okanagan Lake north	KO	7.2	6 mo. Fry				no smear	no blood smear
940	13-Sep	Okanagan Lake north	KO	6.6	6 mo. Fry				no smear	no blood smear
941	13-Sep	Okanagan Lake north	KO	6.3	6 mo. Fry				no smear	no blood smear
942	13-Sep	Okanagan Lake north	KO	4.7	6 mo. Fry				no smear	no blood smear
943	13-Sep	Okanagan Lake north	KO	6.9	6 mo. Fry				no smear	no blood smear
944	13-Sep	Okanagan Lake north	KO	6.8	6 mo. Fry				no smear	no blood smear
945	13-Sep	Okanagan Lake north	KO	6.5	6 mo. Fry				no smear	no blood smear
946	13-Sep	Okanagan Lake north	KO	7.3	6 mo. Fry				no smear	no blood smear
947	13-Sep	Okanagan Lake north	KO	7.0	6 mo. Fry				no smear	no blood smear
948	13-Sep	Okanagan Lake north	KO	5.7	6 mo. Fry				no smear	no blood smear
949	13-Sep	Okanagan Lake north	KO	6.4	6 mo. Fry				no smear	no blood smear
950	13-Sep	Okanagan Lake north	KO	5.6	6 mo. Fry				no smear	no blood smear
951	13-Sep	Okanagan Lake north	KO	7.4	6 mo. Fry				no smear	no blood smear
952	19-Sep	Mission Creek	KO	25.5	post-spn	F			no smear	ovarian fluid taken
953	19-Sep	Mission Creek	KO	25.5	post-spn	F			no smear	ovarian fluid taken
954	19-Sep	Mission Creek	KO	26.8	post-spn	M			no smear	
955	19-Sep	Mission Creek	KO	26.2	post-spn	M			no smear	
956	19-Sep	Mission Creek	KO	27.0	post-spn	M			no smear	
957	19-Sep	Mission Creek	KO	26.4	post-spn	F			no smear	
958	19-Sep	Mission Creek	KO	26.0	post-spn	F			no smear	ovarian fluid taken
959	19-Sep	Mission Creek	KO	26.8	post-spn	F			no smear	
960	19-Sep	Mission Creek	KO	27.0	post-spn	F			no smear	ovarian fluid taken
961	19-Sep	Mission Creek	KO	25.8	post-spn	M			no smear	
962	19-Sep	Mission Creek	KO	27.0	post-spn	M			no smear	
963	19-Sep	Mission Creek	KO	27.1	post-spn	M			no smear	
964	19-Sep	Mission Creek	KO	25.9	post-spn	F			no smear	
965	19-Sep	Mission Creek	KO	25.8	post-spn	F			no smear	ovarian fluid taken
966	19-Sep	Mission Creek	KO	25.6	post-spn	F			no smear	ovarian fluid taken
967	19-Sep	Mission Creek	KO	27.1	post-spn	M			no smear	
968	19-Sep	Mission Creek	KO	22.7	post-spn	M			no smear	
969	19-Sep	Mission Creek	KO	27.8	post-spn	M			no smear	
970	19-Sep	Mission Creek	KO	26.7	post-spn	M			no smear	
971	19-Sep	Mission Creek	KO	26.1	post-spn	M			no smear	
972	19-Sep	Mission Creek	KO	25.8	post-spn	F			no smear	
973	19-Sep	Mission Creek	KO	25.0	post-spn	M			no smear	
974	19-Sep	Mission Creek	KO	25.4	post-spn	M			no smear	
975	19-Sep	Mission Creek	KO	25.7	post-spn	M			no smear	
976	19-Sep	Mission Creek	KO	27.1	post-spn	M			no smear	
977	19-Sep	Mission Creek	KO	27.9	post-spn	M			no smear	
978	19-Sep	Mission Creek	KO	26.1	post-spn	M			no smear	
979	19-Sep	Mission Creek	KO	25.4	post-spn	M			no smear	
980	19-Sep	Mission Creek	KO	27.9	post-spn	M			no smear	
981	19-Sep	Mission Creek	KO	25.1	post-spn	M			no smear	
982	19-Sep	Mission Creek	KO	25.0	post-spn	F			no smear	
983	19-Sep	Mission Creek	KO	28.4	post-spn	M			no smear	
984	19-Sep	Mission Creek	KO	25.2	post-spn	M			no smear	

Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
985	19-Sep	Mission Creek	KO	28.4	post-spn	F?			no smear	
986	19-Sep	Mission Creek	KO	26.2	post-spn	F?			no smear	
987	19-Sep	Mission Creek	KO	27.8	post-spn	M			no smear	
988	19-Sep	Mission Creek	KO	27.6	post-spn	F			no smear	ovarian fluid taken
989	19-Sep	Mission Creek	KO	26.4	post-spn	F			no smear	ovarian fluid taken
990	19-Sep	Mission Creek	KO	27.2	post-spn	M			no smear	
991	19-Sep	Mission Creek	KO	27.6	post-spn	F			no smear	
992	19-Sep	Mission Creek	KO	27.0	post-spn	M			no smear	
993	19-Sep	Mission Creek	KO	27.6	post-spn	M			no smear	
994	19-Sep	Mission Creek	KO	25.8	post-spn	M			no smear	
995	19-Sep	Mission Creek	KO	27.4	post-spn	M			no smear	
996	20-Sep	Deep Creek	KO	32.0	post-spn	F	IHNV Pos.		0	spawned out
997	20-Sep	Deep Creek	KO	39.0	post-spn	M	IHNV Pos.		no smear	
998	20-Sep	Deep Creek	KO	31.0	post-spn	M	IHNV Pos.		no smear	
999	20-Sep	Deep Creek	KO	22.0	post-spn	F	IHNV Pos.		0	
1000	20-Sep	Deep Creek	KO	27.0	post-spn	M	IHNV Pos.		0	
1001	20-Sep	Deep Creek	KO	25.0	post-spn	M	IHNV Pos.		0	
1002	20-Sep	Deep Creek	KO	31.0	post-spn	M	IHNV Pos.		0	
1003	20-Sep	Deep Creek	KO	26.0	post-spn	F	IHNV Pos.		0	clotted
1004	20-Sep	Deep Creek	KO	24.0	post-spn	M	IHNV Pos.		0	
1005	20-Sep	Deep Creek	KO	25.0	post-spn	F	IHNV Pos.		0	
1006	20-Sep	Deep Creek	KO	27.0	post-spn	M	IHNV Pos.		0	
1007	20-Sep	Deep Creek	KO	27.0	post-spn	M	IHNV Pos.		0	
1008	20-Sep	Deep Creek	KO	26.5	post-spn	M?	IHNV Pos.		0	
1009	20-Sep	Deep Creek	KO	26.0	post-spn	M	IHNV Pos.		0	
1010	20-Sep	Deep Creek	KO	25.5	post-spn	M	IHNV Pos.		0	
1011	20-Sep	Deep Creek	KO	26.6	post-spn	M	IHNV Pos.		0	
1012	20-Sep	Deep Creek	KO	29.0	post-spn	F	IHNV Pos.		0	
1013	20-Sep	Deep Creek	KO	25.5	post-spn	F	IHNV Pos.		0	
1014									1	we have slides for 1014-1019
1015									0	we have slides for 1014-1019
1016									0	we have slides for 1014-1019
1017									0	we have slides for 1014-1019
1018									0	we have slides for 1014-1019
1019									0	we hav e slides for 1014-1019
1020	21-Sep	Mission Creek	KO	25.9	post-spn	M	IHNV Pos.		0	
1021	21-Sep	Mission Creek	KO	27.2	post-spn	F	IHNV Pos.		0	
1022	21-Sep	Mission Creek	KO	26.7	post-spn	F	IHNV Pos.		0	
1023	21-Sep	Mission Creek	KO	27.2	post-spn	F	IHNV Pos.		0	
1024	21-Sep	Mission Creek	KO	24.8	post-spn	M	IHNV Pos.		0	
1025	21-Sep	Mission Creek	KO	25.4	post-spn	F	IHNV Pos.		0	
1026	21-Sep	Mission Creek	KO	25.5	post-spn	M	IHNV Pos.		0	
1027	21-Sep	Mission Creek	KO	28.6	post-spn	F	IHNV Pos.		0	
1028	21-Sep	Mission Creek	KO	26.1	post-spn	M	IHNV Pos.		0	
1029	21-Sep	Mission Creek	KO	25.0	post-spn	M	IHNV Pos.		0	
1030	21-Sep	Mission Creek	KO	25.2	post-spn	F	IHNV Pos.		0	
1031	21-Sep	Mission Creek	KO	24.5	post-spn	M	IHNV Pos.		0	
1032	21-Sep	Mission Creek	KO	27.5	post-spn	F	IHNV Pos.		0	
1033	21-Sep	Mission Creek	KO	57.0	post-spn	M	IHNV Pos.		0	
1034	21-Sep	Mission Creek	KO	26.0	post-spn	M	IHNV Pos.		0	
1035	21-Sep	Mission Creek	KO	25.8	post-spn	F	IHNV Pos.		0	
1036	21-Sep	Mission Creek	KO	45.0	post-spn	M	IHNV Pos.		0	
1037	21-Sep	Mission Creek	KO	28.0	post-spn	F	IHNV Pos.		0	
1038	21-Sep	Mission Creek	KO	28.1	post-spn	M	IHNV Pos.		0	
1039	21-Sep	Mission Creek	KO	26.0	post-spn	F	IHNV Pos.		0	
1040	21-Sep	Mission Creek	KO	26.5	post-spn	M	IHNV Pos.		0	anemic
1041	21-Sep	Mission Creek	KO	27.0	post-spn	F	IHNV Pos.		0	un spawned

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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
1042	21-Sep	Mission Creek	KO	26.0	post-spn	F	IHNV Pos.		0	
1043	21-Sep	Mission Creek	KO	26.8	post-spn	F	IHNV Pos.		0	
1044	21-Sep	Mission Creek	KO	26.0	post-spn	F	IHNV Pos.		0	
1045	21-Sep	Mission Creek	KO	25.9	post-spn	F	IHNV Pos.		0	
1046	21-Sep	Mission Creek	KO	29.4	post-spn	M	IHNV Pos.		0	
1047	21-Sep	Mission Creek	KO	27.7	post-spn	F	IHNV Pos.		0	
1048	21-Sep	Mission Creek	KO	27.0	post-spn	F	IHNV Pos.		0	
1049	21-Sep	Mission Creek	KO	26.0	post-spn	F	IHNV Pos.		0	
1050	21-Sep	Mission Creek	KO	27.0	post-spn	F	IHNV Pos.		0	
1051	21-Sep	Mission Creek	KO	25.0	post-spn	F	IHNV Pos.		0	no blood
1052	21-Sep	Mission Creek	KO	27.0	post-spn	F	IHNV Pos.		0	
1053	21-Sep	Mission Creek	KO	25.0	post-spn	F	IHNV Pos.		0	anemic
1054	21-Sep	Mission Creek	KO	25.5	post-spn	M	IHNV Pos.		1	
1055	21-Sep	Mission Creek	KO	24.0	post-spn	F	IHNV Pos.		0	
1056	21-Sep	Mission Creek	KO	24.0	post-spn	M	IHNV Pos.		0	
1057	21-Sep	Mission Creek	KO	26.5	post-spn	M	IHNV Pos.		0	
1058	21-Sep	Mission Creek	KO	24.0	post-spn	M	IHNV Pos.		0	
1059	21-Sep	Mission Creek	KO	26.0	post-spn	M	IHNV Pos.		0	
1060	21-Sep	Mission Creek	KO	26.0	post-spn	F	IHNV Pos.		0	
1061	21-Sep	Mission Creek	KO	26.5	post-spn	F	IHNV Pos.		0	
1062	21-Sep	Mission Creek	KO	26.0	post-spn	F	IHNV Pos.		0	
1063	21-Sep	Mission Creek	KO	25.0	post-spn	F	IHNV Pos.		0	anemic
1064	21-Sep	Mission Creek	KO	27.0	post-spn	F	IHNV Pos.		0	
1065	21-Sep	Mission Creek	KO	25.0	post-spn	M	IHNV Pos.		0	
1066	21-Sep	Mission Creek	KO	23.5	post-spn	F	IHNV Pos.		0	
1067	21-Sep	Mission Creek	KO	25.0	post-spn	F	IHNV Pos.		0	
1068	21-Sep	Mission Creek	KO	24.5	post-spn	M	IHNV Pos.		0	
1069	21-Sep	Mission Creek	KO	25.0	post-spn	F	IHNV Pos.		0	
1070	21-Sep	Mission Creek	KO	27.0	post-spn	M	IHNV Pos.		0	
1071	21-Sep	Mission Creek	KO	24.5	post-spn	F	IHNV Pos.		0	
1072	21-Sep	Mission Creek	KO	23.0	post-spn	F	IHNV Pos.		0	
1073	21-Sep	Mission Creek	KO	26.0	post-spn	F	IHNV Pos.		0	2 eggs left
1074	21-Sep	Mission Creek	KO	30.0	post-spn	F	IHNV Pos.		0	anemic
1075	21-Sep	Mission Creek	KO	27.5	post-spn	M	IHNV Pos.		0	
1076	21-Sep	Mission Creek	KO	25.0	post-spn	F	IHNV Pos.		0	
1077	21-Sep	Mission Creek	KO	26.0	post-spn	F	IHNV Pos.		0	
1078	21-Sep	Mission Creek	KO	25.5	post-spn	F	IHNV Pos.		0	spawned out
1079	21-Sep	Mission Creek	KO	26.0	post-spn	M	IHNV Pos.		0	
1080	21-Sep	Mission Creek	KO	28.4	post-spn	M	IHNV Pos.		0	
1081	21-Sep	Mission Creek	KO	25.9	post-spn	M	IHNV Pos.		0	anemic
1082	21-Sep	Mission Creek	KO	26.4	post-spn	M	IHNV Pos.		0	
1083	21-Sep	Mission Creek	KO	25.4	post-spn	M	IHNV Pos.		0	
1084	21-Sep	Mission Creek	KO	37.4	post-spn	M	IHNV Pos.		0	
1085	21-Sep	Mission Creek	KO	24.9	post-spn	F	IHNV Pos.		1	
1086	21-Sep	Mission Creek	KO	28.0	post-spn	F	IHNV Pos.		0	spawned out
1087	21-Sep	Mission Creek	KO	25.6	post-spn	F	IHNV Pos.		0	2 eggs left
1088	26-Sep	Deep Creek	KO	31.5	post-spn	F	IHNV Pos.		0	ovarian fluid taken (OV)
1089	26-Sep	Deep Creek	KO	43.4	post-spn	M	IHNV Pos.		0	anemic/clotted
1090	26-Sep	Deep Creek	KO	57.0	post-spn	M	IHNV Pos.		0	anemic
1091	26-Sep	Deep Creek	KO	40.0	post-spn	F	IHNV Pos.		0	ovarian fluid taken (OV)
1092	26-Sep	Deep Creek	KO	32.4	post-spn	M	IHNV Pos.		0	anemic
1093	26-Sep	Deep Creek	KO	26.0	post-spn	M	IHNV Pos.		0	
1094	26-Sep	Deep Creek	KO	30.5	post-spn	M	IHNV Pos.		0	
1095	26-Sep	Deep Creek	KO	25.0	post-spn	M	IHNV Pos.		0	
1096	26-Sep	Deep Creek	KO	34.0	post-spn	F	IHNV Pos.		0	spawned out
1097	26-Sep	Deep Creek	KO	26.0	post-spn	F	IHNV Pos.		0	
1098	26-Sep	Deep Creek	KO	26.0	post-spn	F	IHNV Pos.		0	ovarian fluid taken

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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
1099	26-Sep	Deep Creek	KO	25.9	post-spn	F	IHNV Pos.		0	ovarian fluid taken
1100	26-Sep	Deep Creek	KO	33.8	post-spn	M	IHNV Pos.		0	
1101	26-Sep	Deep Creek	KO	28.5	post-spn	F	IHNV Pos.		0	ovarian fluid taken
1102	26-Sep	Deep Creek	KO	46.1	post-spn	M	IHNV Pos.		0	anemic
1103	26-Sep	Deep Creek	KO	49.5	post-spn	M	IHNV Pos.		0	
1104	26-Sep	Deep Creek	KO	33.0	post-spn	F	IHNV Pos.		0	ovarian fluid taken
1105	26-Sep	Deep Creek	KO	28.0	post-spn	F	IHNV Pos.		0	ovarian fluid taken
1106	26-Sep	Deep Creek	KO	30.3	post-spn	F	IHNV Pos.		0	
1107	26-Sep	Deep Creek	KO	26.0	post-spn	M	IHNV Pos.		0	
1108	26-Sep	Deep Creek	KO	26.9	post-spn	M	IHNV Pos.		0	
1109	26-Sep	Deep Creek	KO	26.3	post-spn	?	IHNV Pos.		0	
1110	26-Sep	Deep Creek	KO	26.0	post-spn	M	IHNV Pos.		0	anemic
1111	26-Sep	Deep Creek	KO	27.5	post-spn	F	IHNV Pos.		0	
1112	26-Sep	Deep Creek	KO	33.2	post-spn	F	IHNV Pos.		0	ovarian fluid taken
1113	26-Sep	Deep Creek	KO	25.8	post-spn	F	IHNV Pos.		0	spawned out
1114	26-Sep	Deep Creek	KO	27.5	post-spn	F	IHNV Pos.		0	ovarian fluid taken
1115	26-Sep	Deep Creek	KO	23.5	post-spn	F	IHNV Pos.		0	ovarian fluid taken
1116	26-Sep	Deep Creek	KO	31.3	post-spn	M	IHNV Pos.		0	
1117	26-Sep	Deep Creek	KO	34.3	post-spn	F	IHNV Pos.		0	ovarian fluid taken
1120	28-Sep	Osoyoos Lake	SK/KO	7.1	6 month					
1121	28-Sep	Osoyoos Lake	SK/KO	10.1	6 month					
1122	28-Sep	Osoyoos Lake	SK/KO	9.2	6 month					
1123	28-Sep	Osoyoos Lake	SK/KO	9.5	6 month					
1124	28-Sep	Osoyoos Lake	SK/KO	8.8	6 month					
1125	28-Sep	Osoyoos Lake	SK/KO	9.6	6 month					
1126	28-Sep	Osoyoos Lake	SK/KO	9.2	6 month					clotted
1127	28-Sep	Osoyoos Lake	SK/KO	9.7	6 month					
1128	28-Sep	Osoyoos Lake	SK/KO	8.4	6 month					clotted
1129	28-Sep	Osoyoos Lake	SK/KO	8.0	6 month					clotted
1130	28-Sep	Osoyoos Lake	SK/KO	7.9	6 month					
1131	28-Sep	Osoyoos Lake	SK/KO	8.0	6 month					
1132	28-Sep	Osoyoos Lake	SK/KO	8.4	6 month					clotted
1133	28-Sep	Osoyoos Lake	SK/KO	8.8	6 month					
1134	28-Sep	Osoyoos Lake	SK/KO	8.0	6 month					
1135	28-Sep	Osoyoos Lake	SK/KO	9.0	6 month					
1136	28-Sep	Osoyoos Lake	SK/KO	8.5	6 month					
1137	28-Sep	Osoyoos Lake	SK/KO	8.5	6 month					no blood
1138	28-Sep	Osoyoos Lake	SK/KO	9.5	6 month					
1139	28-Sep	Osoyoos Lake	SK/KO	9.4	6 month					
1140	28-Sep	Osoyoos Lake	SK/KO	7.8	6 month					
1141	28-Sep	Osoyoos Lake	SK/KO	8.0	6 month					
1142	28-Sep	Osoyoos Lake	SK/KO	8.5	6 month					no blood
1143	28-Sep	Osoyoos Lake	SK/KO	8.4	6 month					
1144	28-Sep	Osoyoos Lake	SK/KO	8.5	6 month					
1145	28-Sep	Osoyoos Lake	SK/KO	8.8	6 month					
1146	28-Sep	Osoyoos Lake	SK/KO	9.1	6 month					
1147	28-Sep	Osoyoos Lake	SK/KO	8.7	6 month					
1148	28-Sep	Osoyoos Lake	SK/KO	7.8	6 month					
1149	28-Sep	Osoyoos Lake	SK/KO	7.6	6 month					
1150	28-Sep	Osoyoos Lake	SK/KO	8.0	6 month					
1151	28-Sep	Osoyoos Lake	SK/KO	9.5	6 month					
1152	28-Sep	Osoyoos Lake	SK/KO	8.0	6 month					
1153	28-Sep	Osoyoos Lake	SK/KO	7.4	6 month					
1154	28-Sep	Osoyoos Lake	SK/KO	8.1	6 month					
1155	28-Sep	Osoyoos Lake	SK/KO	10.5	6 month					
1156	28-Sep	Osoyoos Lake	SK/KO	7.4	6 month					
1157	28-Sep	Osoyoos Lake	SK/KO	9.1	6 month					

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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
1158	28-Sep	Osoyoos Lake	SK/KO	10.0	6 month					
1159	28-Sep	Osoyoos Lake	SK/KO	9.6	6 month					
1160	28-Sep	Osoyoos Lake	SK/KO	8.5	6 month					
1161	28-Sep	Osoyoos Lake	SK/KO	7.4	6 month					
1162	28-Sep	Osoyoos Lake	SK/KO	8.6	6 month					
1163	28-Sep	Osoyoos Lake	SK/KO	9.1	6 month					
1164	28-Sep	Osoyoos Lake	SK/KO	9.6	6 month					
1165	28-Sep	Osoyoos Lake	SK/KO	9.3	6 month					
1166	28-Sep	Osoyoos Lake	SK/KO	9.6	6 month					
1167	28-Sep	Osoyoos Lake	SK/KO	8.4	6 month					
1168	28-Sep	Osoyoos Lake	SK/KO	10.8	6 month					
1169	28-Sep	Osoyoos Lake	SK/KO	8.7	6 month					
1170	28-Sep	Osoyoos Lake	SK/KO	9.7	6 month					
1171	28-Sep	Osoyoos Lake	SK/KO	8.7	6 month					clotted
1172	28-Sep	Osoyoos Lake	SK/KO	7.7	6 month					
1173	28-Sep	Osoyoos Lake	SK/KO	7.1	6 month					
1174	28-Sep	Osoyoos Lake	SK/KO	8.4	6 month					
1175	28-Sep	Osoyoos Lake	SK/KO	8.1	6 month					
1176	28-Sep	Osoyoos Lake	SK/KO	8.7	6 month					clotted
1177	28-Sep	Osoyoos Lake	SK/KO	8.8	6 month					
1178	28-Sep	Osoyoos Lake	SK/KO	8.6	6 month					
1179	28-Sep	Osoyoos Lake	SK/KO	7.8	6 month					
1180	28-Sep	Osoyoos Lake	SK/KO	8.4	6 month					
1181	28-Sep	Osoyoos Lake	SK/KO	8.0	6 month					
1182	28-Sep	Osoyoos Lake	SK/KO	9.5	6 month					
1183	28-Sep	Osoyoos Lake	SK/KO	8.9	6 month					
1184	28-Sep	Osoyoos Lake	SK/KO	8.4	6 month					clotted
1185	28-Sep	Osoyoos Lake	SK/KO	8.4	6 month					
1186	28-Sep	Osoyoos Lake	SK/KO	9.1	6 month					
1187	28-Sep	Osoyoos Lake	SK/KO	9.0	6 month					
1188	28-Sep	Osoyoos Lake	SK/KO	7.8	6 month					
1189	28-Sep	Osoyoos Lake	SK/KO	6.5	6 month					
1190	28-Sep	Osoyoos Lake	SK/KO	6.4	6 month					
1191	28-Sep	Osoyoos Lake	SK/KO	7.9	6 month					
1192	28-Sep	Osoyoos Lake	SK/KO	6.6	6 month					
1193	28-Sep	Osoyoos Lake	SK/KO	8.6	6 month					
1194	28-Sep	Osoyoos Lake	SK/KO	8.0	6 month					
1195	28-Sep	Osoyoos Lake	SK/KO	8.4	6 month					
1196	28-Sep	Osoyoos Lake	SK/KO	8.0	6 month					
1197	28-Sep	Osoyoos Lake	SK/KO	7.7	6 month					
1198	28-Sep	Osoyoos Lake	SK/KO	10.0	6 month					
1199	28-Sep	Osoyoos Lake	SK/KO	7.6	6 month					
1200	28-Sep	Osoyoos Lake	SK/KO	8.3	6 month					
1201	28-Sep	Osoyoos Lake	SK/KO	8.8	6 month					
1202	28-Sep	Osoyoos Lake	SK/KO	8.6	6 month					
1203	28-Sep	Osoyoos Lake	SK/KO	9.2	6 month					
1204	28-Sep	Osoyoos Lake	SK/KO	9.8	6 month					
1205	28-Sep	Osoyoos Lake	SK/KO	9.7	6 month					
1206	28-Sep	Osoyoos Lake	SK/KO	9.6	6 month					
1207	28-Sep	Osoyoos Lake	SK/KO	8.8	6 month					
1208	28-Sep	Osoyoos Lake	SK/KO	9.7	6 month					
1209	28-Sep	Osoyoos Lake	SK/KO	9.4	6 month					clotted
1210	28-Sep	Osoyoos Lake	SK/KO	9.7	6 month					
1211	28-Sep	Osoyoos Lake	SK/KO	11.4	6 month					
1212	28-Sep	Osoyoos Lake	SK/KO	7.7	6 month					
1213	28-Sep	Osoyoos Lake	SK/KO	7.4	6 month					
1214	28-Sep	Osoyoos Lake	SK/KO	9.2	6 month					

Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
1215	28-Sep	Osoyoos Lake	SK/KO	7.9	6 month					
1216	28-Sep	Osoyoos Lake	SK/KO	9.0	6 month					
1217	28-Sep	Osoyoos Lake	SK/KO	7.8	6 month					
1218	28-Sep	Osoyoos Lake	SK/KO	8.4	6 month					
1219	28-Sep	Osoyoos Lake	SK/KO	7.1	6 month					
1220	28-Sep	Osoyoos Lake	SK/KO	8.3	6 month					
1221	28-Sep	Osoyoos Lake	SK/KO	7.1	6 month					
1222	28-Sep	Osoyoos Lake	SK/KO	10.6	6 month					
1223	28-Sep	Osoyoos Lake	SK/KO	7.4	6 month					no blood
1224	28-Sep	Osoyoos Lake	SK/KO	10.1	6 month					no blood
1225	28-Sep	Osoyoos Lake	SK/KO	10.0	6 month					no blood
1226	28-Sep	Osoyoos Lake	SK/KO	10.4	6 month					no blood
1227	28-Sep	Osoyoos Lake	SK/KO	9.1	6 month					no blood
1228	28-Sep	Osoyoos Lake	SK/KO	7.9	6 month					no blood
1229	28-Sep	Osoyoos Lake	SK/KO	7.8	6 month					no blood
1230	28-Sep	Osoyoos Lake	SK/KO	8.4	6 month					no blood
1231	28-Sep	Osoyoos Lake	SK/KO	8.3	6 month					no blood
1232	28-Sep	Osoyoos Lake	SK/KO	8.3	6 month					no blood
1233	28-Sep	Osoyoos Lake	SK/KO	6.8	6 month					no blood
1234	28-Sep	Osoyoos Lake	SK/KO	7.9	6 month					no blood
1235	28-Sep	Osoyoos Lake	SK/KO	6.7	6 month					no blood
1236	28-Sep	Osoyoos Lake	SK/KO	8.2	6 month					no blood
1237	28-Sep	Osoyoos Lake	SK/KO	8.1	6 month					no blood
1238	28-Sep	Osoyoos Lake	SK/KO	8.1	6 month					no blood
1239	28-Sep	Osoyoos Lake	SK/KO	7.9	6 month					no blood
1240	28-Sep	Osoyoos Lake	SK/KO	7.4	6 month				no slide	no blood
1241	10-Oct	Okanagan Lake	KO-beach	24.7	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1242	10-Oct	Okanagan Lake	KO-beach	25.6	post-spn	F			no slide	only ovarian fluid taken
1243	10-Oct	Okanagan Lake	KO-beach	24.6	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1244	10-Oct	Okanagan Lake	KO-beach	25.4	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1245	10-Oct	Okanagan Lake	KO-beach	23.3	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1246	10-Oct	Okanagan Lake	KO-beach	25.1	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1247	10-Oct	Okanagan Lake	KO-beach	26.0	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1248	10-Oct	Okanagan Lake	KO-beach	25.7	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1249	10-Oct	Okanagan Lake	KO-beach	25.9	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1250	10-Oct	Okanagan Lake	KO-beach	25.5	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1251	10-Oct	Okanagan Lake	KO-beach	26.8	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1253	10-Oct	Okanagan Lake	KO-beach	24.4	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1254	10-Oct	Okanagan Lake	KO-beach	24.6	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1255	10-Oct	Okanagan Lake	KO-beach	24.9	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1256	10-Oct	Okanagan Lake	KO-beach	24.7	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1258	10-Oct	Okanagan Lake	KO-beach	25.5	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1260	10-Oct	Okanagan Lake	KO-beach	25.4	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1261	10-Oct	Okanagan Lake	KO-beach	25.1	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1262	10-Oct	Okanagan Lake	KO-beach	25.0	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1263	10-Oct	Okanagan Lake	KO-beach	24.9	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1264	10-Oct	Okanagan Lake	KO-beach	25.3	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1266	10-Oct	Okanagan Lake	KO-beach	23.9	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1267	10-Oct	Okanagan Lake	KO-beach	24.9	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1268	10-Oct	Okanagan Lake	KO-beach	23.0	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1269	10-Oct	Okanagan Lake	KO-beach	23.6	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1270	10-Oct	Okanagan Lake	KO-beach	26.8	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1271	10-Oct	Okanagan Lake	KO-beach	24.3	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1272	10-Oct	Okanagan Lake	KO-beach	23.6	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1273	10-Oct	Okanagan Lake	KO-beach	26.2	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1274	10-Oct	Okanagan Lake	KO-beach	24.5	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1275	10-Oct	Okanagan Lake	KO-beach	24.0	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken

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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
1276	10-Oct	Okanagan Lake	KO-beach	25.9	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1277	10-Oct	Okanagan Lake	KO-beach	24.6	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1278	10-Oct	Okanagan Lake	KO-beach	23.9	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1279	10-Oct	Okanagan Lake	KO-beach	24.9	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1280	10-Oct	Okanagan Lake	KO-beach	23.8	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1282	10-Oct	Okanagan Lake	KO-beach	24.3	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1283	10-Oct	Okanagan Lake	KO-beach	25.5	post-spn	F	IHNV Pos.		no slide	only ovarian fluid taken
1300	22-Nov	Osoyoos Lake	YP	8.8					bad smear	
1301	22-Nov	Osoyoos Lake	YP	12.6					bad smear	
1302	22-Nov	Osoyoos Lake	YP	6.8					bad smear	
1303	22-Nov	Osoyoos Lake	YP	6.1					bad smear	anemic
1304	22-Nov	Osoyoos Lake	YP	7.3					bad smear	photo 11
1305	22-Nov	Osoyoos Lake	YP	7.3					bad smear	clotted
1306	22-Nov	Osoyoos Lake	YP	6.1					bad smear	
1307	22-Nov	Osoyoos Lake	YP	6.0					bad smear	
1308	22-Nov	Osoyoos Lake	YP	6.2					bad smear	clotted/ frozen
1309	22-Nov	Osoyoos Lake	YP	6.7					bad smear	
1310	22-Nov	Osoyoos Lake	YP	6.5					bad smear	frozen
1311	22-Nov	Osoyoos Lake	YP	6.6					bad smear	
1312	22-Nov	Osoyoos Lake	LMB	8.1					bad smear	
1313	22-Nov	Osoyoos Lake	CAS	8.0					bad smear	frozen
1314	22-Nov	Osoyoos Lake	PMB	9.4					bad smear	photo 12
1315	22-Nov	Osoyoos Lake	YP	7.8					bad smear	
1316	22-Nov	Osoyoos Lake	PMB	7.8					bad smear	
1317	22-Nov	Osoyoos Lake	YP	6.5					bad smear	
1318	22-Nov	Osoyoos Lake	YP	5.5					bad smear	
1319	22-Nov	Osoyoos Lake	YP	6.4					bad smear	frozen
1320	22-Nov	Osoyoos Lake	YP	7.6					bad smear	
1321	22-Nov	Osoyoos Lake	PMB	7.9					bad smear	
1322	22-Nov	Osoyoos Lake	PMB	6.4					bad smear	
1323	22-Nov	Osoyoos Lake	PMB	7.6					bad smear	
1324	22-Nov	Osoyoos Lake	PMB	7.7					bad smear	
1325	22-Nov	Osoyoos Lake	YP	6.6					bad smear	
1326	22-Nov	Osoyoos Lake	WF	13.3					bad smear	
1327	22-Nov	Osoyoos Lake	SU	13.4					bad smear	photo 13
1328	22-Nov	Osoyoos Lake	CAS	5.0					bad smear	
1329	22-Nov	Osoyoos Lake	CAS	5.5					bad smear	
1330	22-Nov	Osoyoos Lake	CAS	7.0					bad smear	
1331	22-Nov	Osoyoos Lake	CAS	7.8					bad smear	
1332	22-Nov	Osoyoos Lake	CAS	8.7					bad smear	
1333	22-Nov	Osoyoos Lake	LSU	44.0					bad smear	
1334	22-Nov	Osoyoos Lake	LSU	44.8					bad smear	
1335	22-Nov	Osoyoos Lake	SU	43.6					bad smear	photo 14, frozen
1336	22-Nov	Osoyoos Lake	WF	46.2					bad smear	photo 15
1337	22-Nov	Osoyoos Lake	SMB	6.4					bad smear	frozen
1338	22-Nov	Osoyoos Lake	YP	7.3					bad smear	
1339	22-Nov	Osoyoos Lake	CAS	7.2					bad smear	
1340	22-Nov	Osoyoos Lake	CAS	6.9					bad smear	
1345	23-Nov	Osoyoos Lake	LMB	7.2					bad smear	
1346	23-Nov	Osoyoos Lake	LMB	8.6					bad smear	
1347	23-Nov	Osoyoos Lake	LMB	8.1					bad smear	
1348	23-Nov	Osoyoos Lake	YP	7.8					bad smear	
1349	23-Nov	Osoyoos Lake	YP	6.8					bad smear	
1350	23-Nov	Osoyoos Lake	PMB	7.9					bad smear	
1351	23-Nov	Osoyoos Lake	PMB	6.8					bad smear	
1352	23-Nov	Osoyoos Lake	PMB	7.7					bad smear	
1353	23-Nov	Osoyoos Lake	YP	7.3					bad smear	

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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
1354	23-Nov	Osoyoos Lake	YP	8.4					bad smear	photo 16/ frozen/ clotted
1355	23-Nov	Osoyoos Lake	LMB	7.2					bad smear	photo 17
1356	23-Nov	Osoyoos Lake	LMB	6.4					bad smear	photo 17
1357	23-Nov	Osoyoos Lake	LMB	6.1					bad smear	anemic
1358	23-Nov	Osoyoos Lake	LMB	6.4					bad smear	
1359	23-Nov	Osoyoos Lake	YP	6.9					bad smear	
1360	23-Nov	Osoyoos Lake	YP	6.6					bad smear	frozen
1361	23-Nov	Osoyoos Lake	YP	5.5					bad smear	
1362	23-Nov	Osoyoos Lake	PMB	7.0					bad smear	frozen
1363	23-Nov	Osoyoos Lake	CAS	6.4					bad smear	photo 18
1364	23-Nov	Osoyoos Lake	LSU	44.1					bad smear	
1365	23-Nov	Osoyoos Lake	CAS	7.1					bad smear	
1366	23-Nov	Osoyoos Lake	CAS	7.3					bad smear	
1367	23-Nov	Osoyoos Lake	PMB	17.4					bad smear	photo 19 / frozen
1368	23-Nov	Osoyoos Lake	PMB	17.6					bad smear	photo 20
1369	23-Nov	Osoyoos Lake	YP	7.9					bad smear	clotting
1370	23-Nov	Osoyoos Lake	YP	16.2					bad smear	photo 21 / clotting
1371	23-Nov	Osoyoos Lake	YP	16.7					bad smear	
1372	23-Nov	Osoyoos Lake	YP	7.2					bad smear	frozen
1373	23-Nov	Osoyoos Lake	YP	15.8					bad smear	
1374	23-Nov	Osoyoos Lake	YP	17.2					bad smear	
1375	23-Nov	Osoyoos Lake	YP	19.6					bad smear	
1376	23-Nov	Osoyoos Lake	CAS	6.9					bad smear	frozen
1377	23-Nov	Osoyoos Lake	CAS	8.6					bad smear	frozen
1378	23-Nov	Osoyoos Lake	YP	6.5					bad smear	frozen
1379	23-Nov	Osoyoos Lake	WF	28.4					bad smear	photo 22
1380	23-Nov	Osoyoos Lake	WF	36.0					bad smear	frozen
1381	23-Nov	Osoyoos Lake	YP	13.8					bad smear	
1382	23-Nov	Osoyoos Lake	LSU	25.1					bad smear	
1383	23-Nov	Osoyoos Lake	LSU	35.1					bad smear	
1384	23-Nov	Osoyoos Lake	LSU	22.5					bad smear	
1385	23-Nov	Osoyoos Lake	LSU	43.5					bad smear	
1386	23-Nov	Osoyoos Lake	LSU	41.4					bad smear	
1387	23-Nov	Osoyoos Lake	LSU	40.5					bad smear	
1388	23-Nov	Osoyoos Lake	LSU	41.6					bad smear	
1389	23-Nov	Osoyoos Lake	LSU	45.5					bad smear	
1390	23-Nov	Osoyoos Lake	LSU	46.5					bad smear	
1391	23-Nov	Osoyoos Lake	LSU	47.5					bad smear	
1392	23-Nov	Osoyoos Lake	LSU	41.3					bad smear	
1393	23-Nov	Osoyoos Lake	LSU	39.8					bad smear	
1394	23-Nov	Osoyoos Lake	CP	39.5					bad smear	
2000	6-Nov	Okanagan Lake South	WF	13.5			WHITEFISH ISOLATE STILL		bad smear	
2001	6-Nov	Okanagan Lake South	WF	14.0					bad smear	
2002	6-Nov	Okanagan Lake South	WF	13.5					bad smear	
2003	6-Nov	Okanagan Lake South	WF	13.0					0	
2004	6-Nov	Okanagan Lake South	WF	10.9					0	
2005	6-Nov	Okanagan Lake South	WF	13.8					0	
2006	6-Nov	Okanagan Lake South	WF	14.0					0	
2007	6-Nov	Okanagan Lake South	WF	13.8					0	photo 9
2008	6-Nov	Okanagan Lake South	WF	13.6					1	
2009	6-Nov	Okanagan Lake South	WF	12.9					0	
2010	6-Nov	Okanagan Lake South	WF	14.0					1	
2011	6-Nov	Okanagan Lake South	WF	13.9					0	
2012	6-Nov	Okanagan Lake South	WF	25.1					1	
2013	6-Nov	Okanagan Lake South	WF	20.5					0	
2014	6-Nov	Okanagan Lake South	WF	13.7					0	
2015	6-Nov	Okanagan Lake South	WF	13.5					0	

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Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex		EIBS Slide Number	Number of EIBS-like Inclusions	Comments
2016	6-Nov	Okanagan Lake South	WF	14.1					1	
2017	6-Nov	Okanagan Lake South	WF	14.8			UNDER INVESTIGATION		0	
2018	6-Nov	Okanagan Lake South	WF	14.5					0	
2019	6-Nov	Okanagan Lake South	WF	13.9					0	
2020	6-Nov	Okanagan Lake South	WF	21.5					0	
2021	6-Nov	Okanagan Lake South	WF	13.3					0	
2022	6-Nov	Okanagan Lake South	WF	14.3					0	
2023	6-Nov	Okanagan Lake South	WF	13.9					0	
2024	6-Nov	Okanagan Lake South	WF	13.5					0	
2025	6-Nov	Okanagan Lake South	WF	12.9					bad smear	
2026	6-Nov	Okanagan Lake South	WF	27.2					bad smear	
2027	6-Nov	Okanagan Lake South	WF	30.2					0	
2028	6-Nov	Okanagan Lake South	WF	28.2					0	
2029	6-Nov	Okanagan Lake South	WF	27.4					0	
2030	6-Nov	Okanagan Lake South	CAS	21.8					0	
2031	6-Nov	Okanagan Lake South	CAS	8.5					0	anemic, photo 20
2032	6-Nov	Okanagan Lake South	CAS	9.4					0	
2033	6-Nov	Okanagan Lake South	CAS	8.5					0	
2034	6-Nov	Okanagan Lake South	CAS	6.4					bad smear	
2035	6-Nov	Okanagan Lake South	CAS	9.6					0	
2036	6-Nov	Okanagan Lake South	CAS	7.7					0	
2037	6-Nov	Okanagan Lake South	CAS	9.9					0	
2038	6-Nov	Okanagan Lake South	CAS	6.9					0	
2039	6-Nov	Okanagan Lake South	CAS	6.6					0	
2040	6-Nov	Okanagan Lake South	SU	13.1					0	photot 21
2041	6-Nov	Okanagan Lake South	SU	13.7					0	
2042	6-Nov	Okanagan Lake South	SU	23.5					0	
2043	6-Nov	Okanagan Lake South	SU	38.0					0	
2044	6-Nov	Okanagan Lake South	SU	24.5					0	
2045	6-Nov	Okanagan Lake South	SU	40.0					0	
2046	6-Nov	Okanagan Lake South	SU	20.5					0	anemic
2047	6-Nov	Okanagan Lake South	SU	27.0					0	anemic
2048	6-Nov	Okanagan Lake South	SU	25.0					0	
2049	6-Nov	Okanagan Lake South	SU	24.0					0	
2050	6-Nov	Okanagan Lake South	PCC	21.5					0	
2051	6-Nov	Okanagan Lake South	NSC	33.0					0	
2052	6-Nov	Okanagan Lake South	PCC	17.5					0	
2053	6-Nov	Okanagan Lake South	NSC	27.0					0	anemic
2054	6-Nov	Okanagan Lake South	NSC	31.0					0	photo 22
2055	6-Nov	Okanagan Lake South	PCC	22.5					0	photo 23
2056	6-Nov	Okanagan Lake South	NSC	20.0					0	
2057	6-Nov	Okanagan Lake South	PCC	12.0					0	
2058	6-Nov	Okanagan Lake South	NSC	14.1					bad smear	
2059	6-Nov	Okanagan Lake South	PCC	16.0					bad smear	
2060	6-Nov	Okanagan Lake South	PCC	10.4					0	
2061	6-Nov	Okanagan Lake South	RSC	10.0					0	
2062	6-Nov	Okanagan Lake South	RSC	8.0					0	photo 24
2063	6-Nov	Okanagan Lake South	RSC	9.7					0	
2064	6-Nov	Okanagan Lake South	RSC	9.1					0	
2065	6-Nov	Okanagan Lake South	RSC	11.8					0	
2066	6-Nov	Okanagan Lake South	RSC	7.9					0	
2067	6-Nov	Okanagan Lake South	RSC	8.5					0	
2068	6-Nov	Okanagan Lake South	RSC	10.7					0	
2069	6-Nov	Okanagan Lake South	RSC	8.2					0	
2070	6-Nov	Okanagan Lake South	RSC	7.4					0	
2071	6-Nov	Okanagan Lake South	RSC	7.5					0	
2072	6-Nov	Okanagan Lake South	RSC	8.3					0	

Disease risk assessment sampling
Okanagan Nation Fisheries Commission

Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
2073	6-Nov	Okanagan Lake South	RSC	7.3					1	
2074	6-Nov	Okanagan Lake South	RSC	8.2					0	
2075	7-Nov	Skaha Lake	SMB	23.1					0	
2076	7-Nov	Skaha Lake	SMB	14.7					0	
2077	7-Nov	Skaha Lake	SMB	17.3					0	
2078	7-Nov	Skaha Lake	SMB	20.2					1	
2079	7-Nov	Skaha Lake	SMB	15.7					0	
2080	7-Nov	Skaha Lake	SMB	20.5					0	
2081	7-Nov	Skaha Lake	SMB	21.5					0	photo 25
2082	7-Nov	Skaha Lake	SMB	16.4					0	
2083	7-Nov	Skaha Lake	SMB	16.6					0	
2084	7-Nov	Skaha Lake	SMB	8.0					0	anemic
2085	7-Nov	Skaha Lake	SMB	15.1					0	
2086	7-Nov	Skaha Lake	SMB	8.2					0	
2087	7-Nov	Skaha Lake	SMB	8.1					0	anemic
2088	7-Nov	Skaha Lake	SMB	20.4					0	
2089	7-Nov	Skaha Lake	SMB	28.8					0	
2090	7-Nov	Skaha Lake	SMB	20.9					0	
2091	7-Nov	Skaha Lake	SMB	19.1					0	
2092	7-Nov	Skaha Lake	SMB	15.4					0	
2093	7-Nov	Skaha Lake	SMB	14.4					0	
2094	7-Nov	Skaha Lake	SMB	13.5					0	
2095	7-Nov	Skaha Lake	SMB	7.2					1	
2096	7-Nov	Skaha Lake	SMB	9.4					0	
2097	7-Nov	Skaha Lake	SMB	9.9					0	
2098	7-Nov	Skaha Lake	SMB	16.5					0	
2099	7-Nov	Skaha Lake	SMB	15.9					0	
2100	7-Nov	Skaha Lake	PMB	14.1					0	photo 26
2101	7-Nov	Skaha Lake	PMB	12.7					0	
2102	7-Nov	Skaha Lake	PMB	10.6					0	
2103	7-Nov	Skaha Lake	PMB	10.5					bad smear	
2104	7-Nov	Skaha Lake	PMB	10.2					0	
2105	7-Nov	Skaha Lake	PMB	7.9					0	
2106	7-Nov	Skaha Lake	PMB	7.9					0	anemic
2107	7-Nov	Skaha Lake	PMB	6.4					0	anemic
2108	7-Nov	Skaha Lake	WF	11.1					1	
2109	7-Nov	Skaha Lake	WF	12.5					0	
2110	7-Nov	Skaha Lake	NSC	31.5					0	
2111	7-Nov	Skaha Lake	NSC	29.5					0	
2112	7-Nov	Skaha Lake	NSC	32.5					0	
2113	7-Nov	Skaha Lake	NSC	30.4					0	
2114	7-Nov	Skaha Lake	NSC	31.1					0	
2115	7-Nov	Skaha Lake	NSC	29.2					0	anemic
2116	7-Nov	Skaha Lake	WF	13.4					0	
2117	7-Nov	Skaha Lake	NSC	24.8					0	
2118	7-Nov	Skaha Lake	NSC	32.5					0	
2119	7-Nov	Skaha Lake	NSC	37.0					0	
2120	7-Nov	Skaha Lake	NSC	31.4					0	
2121	7-Nov	Skaha Lake	SU	36.2					0	anemic
2122	7-Nov	Skaha Lake	SU	37.0					0	anemic
2123	7-Nov	Skaha Lake	SU	36.0					0	
2124	7-Nov	Skaha Lake	SU	34.5					0	
2125	7-Nov	Skaha Lake	SU	37.5					0	
2126	7-Nov	Skaha Lake	SU	36.5					0	
2127	7-Nov	Skaha Lake	SU	36.0					0	
2128	7-Nov	Skaha Lake	SU	18.0					bad smear	
2129	7-Nov	Skaha Lake	SU	36.5					0	

Disease risk assessment sampling
Okanagan Nation Fisheries Commission

Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
2130	7-Nov	Skaha Lake	SU	28.4					bad smear	
2131	7-Nov	Skaha Lake	SMB	19.5					bad smear	
2132	7-Nov	Skaha Lake	SMB	21.7					0	
2133	7-Nov	Skaha Lake	SMB	21.2					bad smear	
2134	7-Nov	Skaha Lake	SMB	22.5					bad smear	
2135	7-Nov	Skaha Lake	SMB	17.3					bad smear	
2136	7-Nov	Skaha Lake	SMB	14.5					bad smear	
2137	7-Nov	Skaha Lake	SMB	7.5					bad smear	anemic
2138	7-Nov	Skaha Lake	SMB	8.5					bad smear	
2139	7-Nov	Skaha Lake	SMB	7.6					bad smear	
2140	7-Nov	Skaha Lake	SMB	8.4					0	anemic
		* missing data for DFO 1 - 108 sockeye post - spawner from Okanagan River								
DFO 109	19-Oct	Okanagan River	SK	47.5	post-spn	F				
DFO 110	19-Oct	Okanagan River	SK	43.0	post-spn	F				
DFO 111	19-Oct	Okanagan River	SK	49.5	post-spn	F				
DFO 112	19-Oct	Okanagan River	SK	46.0	post-spn	F				
DFO 113	19-Oct	Okanagan River	SK	51.0	post-spn	F				
DFO 114	19-Oct	Okanagan River	SK	47.5	post-spn	F				
DFO 115	19-Oct	Okanagan River	SK	49.5	post-spn	F				
DFO 116	19-Oct	Okanagan River	SK	44.0	post-spn	F				
DFO 117	19-Oct	Okanagan River	SK	47.5	post-spn	F				
DFO 118	19-Oct	Okanagan River	SK	49.5	post-spn	F				
DFO 119	19-Oct	Okanagan River	SK	51.5	post-spn	F				
DFO 120	19-Oct	Okanagan River	SK	48.0	post-spn	F				
DFO 121	19-Oct	Okanagan River	SK	49.0	post-spn	F				
DFO 122	19-Oct	Okanagan River	SK	49.0	post-spn	F				
DFO 123	19-Oct	Okanagan River	SK	45.0	post-spn	F				
DFO 124	19-Oct	Okanagan River	SK	50.0	post-spn	F				
DFO 125	19-Oct	Okanagan River	SK	47.0	post-spn	F				
DFO 126	19-Oct	Okanagan River	SK	47.5	post-spn	F				
DFO 127	19-Oct	Okanagan River	SK	53.5	post-spn	F				
DFO 128	19-Oct	Okanagan River	SK	43.5	post-spn	F				
DFO 129	19-Oct	Okanagan River	SK	49.0	post-spn	F				
DFO 130	19-Oct	Okanagan River	SK	49.5	post-spn	F				
DFO 131	19-Oct	Okanagan River	SK	50.0	post-spn	M				
DFO 132	19-Oct	Okanagan River	SK	50.0	post-spn	M				
DFO 133	19-Oct	Okanagan River	SK	47.5	post-spn	M				
DFO 134	19-Oct	Okanagan River	SK	50.5	post-spn	M				
DFO 135	19-Oct	Okanagan River	SK	47.0	post-spn	M				
DFO 136	19-Oct	Okanagan River	SK	52.5	post-spn	M				
DFO 137	19-Oct	Okanagan River	SK	49.5	post-spn	M				
DFO 138	19-Oct	Okanagan River	SK	50.5	post-spn	M				
DFO 139	19-Oct	Okanagan River	SK	51.0	post-spn	M				
DFO 140	19-Oct	Okanagan River	SK	55.0	post-spn	M				
DFO 141	19-Oct	Okanagan River	SK	41.0	post-spn	M				
DFO 142	19-Oct	Okanagan River	SK	48.0	post-spn	F				
DFO 143	19-Oct	Okanagan River	SK	45.5	post-spn	F				
DFO 144	19-Oct	Okanagan River	SK	51.0	post-spn	F				
DFO 145	19-Oct	Okanagan River	SK	48.0	post-spn	F				
DFO 146	19-Oct	Okanagan River	SK	47.0	post-spn	F				
DFO 147	19-Oct	Okanagan River	SK	47.5	post-spn	F				
DFO 148	19-Oct	Okanagan River	SK	50.5	post-spn	M				
DFO 149	19-Oct	Okanagan River	SK	45.5	post-spn	F				
DFO 150	19-Oct	Okanagan River	SK		post-spn	F				no data
DFO 151	19-Oct	Okanagan River	SK	51.5	post-spn	F				
DFO 152	19-Oct	Okanagan River	SK	51.0	post-spn	F				
DFO 153	19-Oct	Okanagan River	SK	49.5	post-spn	F				

Disease risk assessment sampling
Okanagan Nation Fisheries Commission

Fish number	Date 2000	Location caught	Species	Length (cm)	Age	Sex	IHNV Positive Fish	EIBS Slide Number	Number of EIBS-like Inclusions	Comments
DFO 154	19-Oct	Okanagan River	SK	-	post-spn	F				post orb is 36.5
DFO 155	19-Oct	Okanagan River	SK	50.0	post-spn	F				
DFO 156	19-Oct	Okanagan River	SK	-	post-spn	F				post orb is 36.5
DFO 157	19-Oct	Okanagan River	SK	50.5	post-spn	M				
DFO 158	19-Oct	Okanagan River	SK	48.0	post-spn	M				
DFO 159	19-Oct	Okanagan River	SK	47.0	post-spn	M				
DFO 160	19-Oct	Okanagan River	SK	47.5	post-spn	M				
DFO 161	19-Oct	Okanagan River	SK	52.5	post-spn	M				
DFO 162	19-Oct	Okanagan River	SK	56.5	post-spn	M				
DFO 163	19-Oct	Okanagan River	SK	48.5	post-spn	M				
DFO 164	19-Oct	Okanagan River	SK	51.5	post-spn	M				
DFO 165	19-Oct	Okanagan River	SK	51.5	post-spn	M				
DFO 166	19-Oct	Okanagan River	SK	50.5	post-spn	M				
DFO 167	19-Oct	Okanagan River	SK	52.5	post-spn	M				
DFO 168	19-Oct	Okanagan River	SK	50.0	post-spn	M				
DFO 169	19-Oct	Okanagan River	SK	54.0	post-spn	M				
DFO 170	19-Oct	Okanagan River	SK	51.5	post-spn	M				
DFO 171	19-Oct	Okanagan River	SK	49.5	post-spn	M				
DFO 172	19-Oct	Okanagan River	SK	52.5	post-spn	M				

APPENDIX D

Data from Department of Fisheries and Oceans Laboratories

Disease Risk Assessment results from the Department of Fisheries and Oceans, pacific biological Station, Fish health Laboratories

Assay Date – July 11, 2000 (samples frozen)

Pool Number	Number of fish/pool	Weight of tissue (g)	Virology Results	Blood Smears
1	3	0.37	nvd*	Negative
2	3	0.37	nvd	Negative
3	3	0.42	nvd	Negative
4	3	0.37	nvd	Negative
5	3	0.39	nvd	Negative
6	3	0.52	nvd	Negative
7	3	0.4	nvd	Negative
8	3	0.44	nvd	Negative
9	3	0.34	nvd	Negative
10	3	0.35	nvd	Negative
11	3	0.27	nvd	Negative
12	2	0.26	nvd	Negative
13	2	0.45	nvd	Negative
14	2	0.19	nvd	Negative
15	2	0.17	nvd	Negative
16	3	0.37	nvd	Negative
Total	44 fish		0/44	44 fish

* no virus detected

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Disease Risk Assessment results from the Department of Fisheries and Oceans, pacific biological Station, Fish health Laboratories

Collection Site-Osoyoos Lake
Collection Date-July 7/2000
Sample-87 Sockeye Fry # 278-334, 350-380
Assay Date-July11/2000 (samples frozen)

Pool Number	Number of fish/pool	Weight of tissue (g)	Virology Results	Blood Smear
17	3	0.34	nvd*	no blood smears received for this group
18	3	0.35	nvd	
19	3	0.2	nvd	
20	3	0.29	nvd	
21	3	0.37	nvd	
22	3	0.23	nvd	
23	3	0.27	nvd	
24	3	0.19	nvd	
25	3	0.3	nvd	
26	3	0.33	nvd	
27	3	0.41	nvd	
28	3	0.15	nvd	
29	3	0.23	nvd	
30	3	0.33	nvd	
31	3	0.27	nvd	
32	3	0.22	nvd	
33	3	0.24	nvd	
34	3	0.19	nvd	
35	3	0.19	nvd	
41	3	0.3	nvd	
42	3	0.32	nvd	
43	3	0.43	nvd	
44	3	0.49	nvd	
45	3	0.56	nvd	
46	3	0.5	nvd	
47	3	0.47	nvd	
48	3	0.59	nvd	
49	3	0.5	nvd	
50	3	0.5	nvd	
Total	87 fish		0/87	

* no virus detected

Disease Risk Assessment results from the Department of Fisheries and Oceans, pacific biological Station, Fish health Laboratories

Assay Date-July22/2000 (samples not frozen)

Virology Fish Number	Number of fish/pool	Weight of tissue (g)	Virology Results	Blood Smear
1	1	0.46	nvd*	Negative
2	1	0.47	nvd	Negative
3	1	0.23	nvd	Negative
4	1	0.47	nvd	Negative
5	1	0.61	nvd	Negative
6	1	0.52	nvd	Negative
7	1	0.35	nvd	Negative
8	1	0.62	nvd	Negative
9	1	0.69	nvd	Negative
10	1	0.72	nvd	Negative
11	1	0.53	nvd	Negative
12	1	0.52	nvd	Negative
13	1	0.51	nvd	Negative
14	1	0.63	nvd	Negative
15	1	0.6	nvd	Negative
Total	15 fish		0/15	0/15

* no virus detected

Disease Risk Assessment results from the Department of Fisheries and Oceans, pacific biological Station, Fish health Laboratories

Collection Site-McIntyre Dam
Collection Date-July 21/2000
Sample-24 Sockeye Adults # 458-481 early run
Assay Date-Aug 17/2000 (samples frozen)

Virology Fish Number	Number of fish/pool	Weight of tissue (g)	Virology Results	Blood Smear
16	1	0.59	nvd*	Negative
17	1	0.39	nvd	Negative
18	1	0.5	nvd	Negative
19	1	0.58	nvd	Negative
20	1	0.67	nvd	Negative
21	1	0.66	nvd	Negative
22	1	0.59	nvd	Negative
23	1	0.6	nvd	Negative
24	1	0.39	nvd	Negative
25	1	0.59	nvd	Negative
26	1	0.57	nvd	Negative
27	1	0.75	nvd	Negative
28	1	0.51	nvd	Negative
29	1	0.62	nvd	Negative
30	1	0.47	nvd	Negative
31	1	0.68	nvd	Negative
32	1	0.65	nvd	Negative
33	1	0.7	nvd	Negative
34	1	0.52	nvd	Negative
35	1	0.47	nvd	Negative
36	1	0.5	nvd	Negative
37	1	0.62	nvd	Negative
38	1	0.72	nvd	Negative
39	1	0.65	nvd	No sample
Total	24 fish		0/24	0/23

* no virus detected

Disease Risk Assessment results from the Department of Fisheries and Oceans, pacific biological Station, Fish health Laboratories

Collection Site-Osoyoos Lake
Collection Date-Sept 28/2000
Sample-120 Sockeye Fry # 1120-1240
Assay Date-Nov 28/2000 (samples frozen)

Virology Fish Number	Number of fish/pool	Weight of tissue (g)	Virology Results	Blood Smear
1	1	single fish	nvd*	Negative
2	1	pools	nvd	Negative
3	1	tissue wt.	nvd	Negative
4	1	0.1 to	nvd	Negative
5	1	0.15 g	nvd	Negative
6	1	per fish	nvd	Negative
7	1		nvd	no sample
8	1		nvd	Negative
9	1		nvd	Negative
10	1		nvd	Negative
11	1		nvd	Negative
12	1		nvd	Negative
13	1		nvd	Negative
14	1		nvd	Negative
15	1		nvd	Negative
16	1		nvd	Negative
17	1		nvd	Negative
18	1		nvd	Negative
19	1		nvd	Negative
20	1		nvd	Negative
21	1		nvd	Negative
22	1		nvd	Negative
23	1		nvd	Negative
24	1		nvd	Negative
25	1		nvd	Negative
26	1		nvd	Negative
27	1		nvd	Negative
28	1		nvd	Negative
29	1		nvd	Negative
30	1		nvd	Negative
31	1		nvd	Negative
32	1		nvd	no sample
33	1		nvd	Negative
34	1		nvd	Negative
35	1		nvd	Negative
36	1		nvd	Negative
37	1		nvd	Negative
38	1		nvd	no sample
39	1		nvd	Negative
40	1		nvd	Negative
41	1		nvd	Negative
42	1		nvd	Negative
43	1		nvd	Negative
44	1		nvd	Negative
45	1		nvd	Negative
46	1		nvd	Negative
47	1		nvd	Negative
48	1		nvd	Negative
Sub-Total	48		0/48	0/45

Assay Date-December 13, 2000

Virology Fish Number	Number of fish/pool	Weight of tissue (g)	Virology Results	Blood Smear
49	2	0.27		Negative
50	2	0.3		Negative
51	2	0.33		Negative
52	2	0.23		Negative
53	2	0.31		Negative
54	2	0.22		Negative
55	2	0.26		Negative
56	2	0.3		Negative
57	2	0.31		Negative
58	2	0.26		Negative
59	2	0.2		Negative
60	2	0.33		Negative
61	2	0.31		Negative
62	2	0.24		Negative
63	2	0.27		Negative
64	2	0.34		Negative
65	2	0.32		Negative
66	2	0.39		Negative
67	1	0.14		Negative
68	1	0.15		Negative
69	1	0.15		
70	1	0.2		
71	1	0.16		
72	1	0.26		
73	1	0.11		
74	1	0.1		
75	1	0.19		
76	1	0.15		
77	1	0.19		
78	1	0.12		
79	1	0.12		
80	1	0.09		
81	1	0.17		
82	1	0.28		
83	1	0.16		
84	1	0.26		
85	1	0.23		
86	1	0.16		
87	1	0.22		
88	1	0.11		
89	1	0.13		
90	1	0.14		
91	2	0.31		
92	1	0.13		
93	1	0.13		
94	1	0.25		
95	2	0.25		
96	2	0.26		
Sub-Total	69 fish			

Disease Risk Assessment results from the Department of Fisheries and Oceans, pacific biological Station, Fish health Laboratories

Collection Site-Okanagan River

Collection Date-Oct 17-19/2000

Sample-170 Sockeye Adults post-spawners

Assay Date-Nov 7/2000 (samples frozen)

Virology Fish Number	Number of fish/pool	Sex Ovarian Fl or Milt	Virology Results PFU/ml	Blood Smear
1	1	F	10^{2}	Negative
2	1	F	10^{4}	Negative
3	1	F	10^{2}	Negative
4	1	F	10^{2}	Negative
5	1	F	10^{2}	Negative
6	1	F	10^{4}	Negative
7	1	F	10^{5}	Negative
8	1	F	10^{3}	Negative
9	1	F	10^{4}	Negative
10	1	F	10^{4}	Negative
11	1	M	nvd*	Negative
12	1	M	nvd	Negative
13	1	M	nvd	Negative
14	1	M	nvd	Negative
15	1	M	nvd	Negative
16	1	F	10^{3}	not sampled
17	1	F	10^{6}	not sampled
18	1	F	10^{3}	not sampled
19	1	F	10^{3}	not sampled
20	1	F	10^{4}	not sampled
21	1	F	10^{4}	not sampled
22	1	F	10^{3}	not sampled
23	1	F	10^{2}	not sampled
24	1	F	10^{4}	not sampled
25	1	F	nvd	not sampled
26	1	F	nvd	not sampled
27	1	F	10^{3}	not sampled
28	1	F	10^{5}	not sampled
29	1	M	nvd	not sampled
30	1	M	nvd	not sampled
31	1	M	nvd	not sampled
32	1	M	10^{4}	not sampled
33	1	M	nvd	not sampled
34	1	M	nvd	not sampled
35	1	F	10^{4}	not sampled
36	1	F	10^{2}	not sampled
37	1	F	10^{4}	not sampled
38	1	F	nvd	not sampled
39	1	F	10^{5}	not sampled
40	1	F	10^{3}	not sampled
41	1	M	10^{4}	not sampled
42	1	M	10^{3}	not sampled
43	1	M	nvd	not sampled
44	1	M	nvd	not sampled
45	1	M	10^{3}	not sampled
46	1	M	nvd	not sampled
47	1	M	nvd	not sampled
48	1	M	10^{2}	not sampled
49	1	M	10^{2}	not sampled
50	1	F	10^{3}	Negative
51	1	F	10^{2}	Negative
52	1	F	10^{3}	Negative
53	1	F	10^{4}	Negative

Virology Fish Number	Number of fish/pool	Sex Ovarian Fl or Milt	Virology Results PFU/ml	Blood Smear
54	1	F	10^{3}	Negative
55	1	M	nvd	Negative
56	1	M	nvd	not sampled
57	1	F	10^{2}	not sampled
58	1	F	10^{3}	not sampled
59	1	F	nvd	not sampled
60	1	F	nvd	not sampled
61	1	F	10^{5}	not sampled
62	1	F	10^{4}	not sampled
63	1	F	10^{4}	not sampled
64	1	F	10^{4}	not sampled
65	1	M	10^{4}	not sampled
66	1	M	nvd	not sampled
67	1	M	nvd	not sampled
68	1	M	nvd	not sampled
69	1	M	10^{3}	not sampled
70	1	F	10^{3}	not sampled
71	1	F	10^{4}	not sampled
72	1	F	10^{3}	not sampled
73	1	F	10^{3}	not sampled
74	1	F	10^{4}	not sampled
75	1	F	10^{3}	not sampled
76	1	F	10^{3}	not sampled
77	1	F	10^{5}	not sampled
78	1	M	nvd	not sampled
79	1	M	nvd	not sampled
80	1	M	nvd	not sampled
81	1	F	nvd	not sampled
82	1	M	nvd	not sampled
83	1	M	nvd	not sampled
84	1	M	10^{2}	not sampled
85	1	F	nvd	not sampled
86	1	F	10^{5}	not sampled
87	1	F	10^{3}	not sampled
88	1	F	10^{4}	not sampled
89	1	F	10^{6}	not sampled
90	1	F	10^{3}	not sampled
91	1	M	nvd	not sampled
92	1	M	10^{4}	not sampled
93	1	M	nvd	not sampled
94	1	M	nvd	not sampled
95	1	M	nvd	not sampled
96	1	M	10^{4}	not sampled
97	1	M	nvd	not sampled
98	1	M	nvd	not sampled
99	1	F	10^{2}	not sampled
100	1	F	10^{3}	not sampled
101	1	F	10^{2}	not sampled
102	1	F	nvd	not sampled
103	1	F	10^{3}	not sampled
104	1	F	10^{3}	not sampled
105	1	F	nvd	not sampled
106	1	F	nvd	not sampled
107	1	F	10^{3}	not sampled
108	1	F	10^{4}	not sampled
109	1	F	10^{6}	not sampled
110	1	F	nvd	not sampled
111	1	F	10^{2}	not sampled
112	1	F	10^{4}	not sampled
113	1	F	10^{2}	not sampled
114	1	F	10^{2}	not sampled
115	1	F	10^{6}	not sampled

Virology Fish Number	Number of fish/pool	Sex Ovarian Fl or Milt	Virology Results PFU/ml	Blood Smear
116	1	F	10^5	not sampled
117	1	F	nvd	not sampled
118	1	F	10^3	not sampled
119	1	F	10^2	not sampled
120	1	F	10^4	not sampled
121	1	F	10^4	not sampled
122	1	F	10^5	not sampled
123	1	F	10^3	not sampled
124	1	F	10^6	not sampled
125	1	F	10^3	not sampled
126	1	F	10^3	not sampled
127	1	F	10^4	not sampled
128	1	F	10^2	not sampled
129	1	F	nvd	not sampled
130	1	F	10^4	not sampled
131	1	M	10^5	not sampled
132	1	M	10^3	not sampled
133	1	M	nvd	not sampled
134	1	M	nvd	not sampled
135	1	M	nvd	not sampled
136	1	M	10^2	not sampled
137	1	M	nvd	not sampled
138	1	M	10^3	not sampled
139	1	M	10^3	not sampled
140	1	M	nvd	not sampled
141	1	M	nvd	not sampled
142	1	F	10^4	not sampled
143	1	F	nvd	not sampled
144	1	F	10^4	not sampled
145	1	F	10^5	not sampled
146	1	F	10^4	not sampled
147	1	F	10^3	not sampled
148	1	M	nvd	not sampled
149	1	F	10^2	not sampled
150	1	F	10^3	not sampled
151	1	F	10^4	not sampled
152	1	F	10^3	not sampled
153	1	F	10^5	not sampled
154	1	F	10^4	not sampled
155	1	F	10^4	not sampled
156	1	F	10^3	not sampled
157	1	M	No sample	not sampled
158	1	M	10^2	not sampled
159	1	F	10^6	not sampled
160	1	M	10^4	not sampled
161	1	M	nvd	not sampled
162	1	M	10^3	not sampled
163	1	F	10^4	not sampled
164	1	M	nvd	not sampled
165	1	F	10^3	not sampled
166	1	M	nvd	not sampled
167	1	F	10^3	not sampled
168	1	F	10^2	not sampled
169	1	M	10^2	not sampled
170	1	F	nvd	not sampled
* no virus detected				

Summary

	Females	Males
nvd	15	40
10^{2}	17	6
10^{3}	32	7
10^{4}	29	6
10^{5}	10	1
10^{6}	6	0
	94/109	20/60
Prevalence	86.2%	33.3%
Total	114/169 (67.5%)	

Dec 11/00
The following 14 isolates were tested by IFAT and all reacted with monoclonal antisera 14D (universal) and did not react with 105B (type II specific)
Isolates (1, 7, 17, 20, 53, 65, 100, 109, 115, 120, 121, 124, 131, 144)

Jan 19/01
The following 23 isolates were tested by IFAT and all reacted with monoclonal antisera 14D (universal) and did not react with 105B (type II specific)
Isolates (6, 10, 11, 12, 14, 19, 22, 24, 27, 30, 31, 34, 54, 55, 57, 63, 64, 66, 68, 69, 70, 72, 73)

Feb 1/01
The following14 isolates were tested by IFAT and all reacted with monoclonal antisera 14D (unuversal) and did not react with 105B (type II specific)
Isolates (77, 86, 108, 126, 127, 138, 142, 145, 151, 155, 159, 160, 163, 167)

A total of 51 isolates were tested for Type II using monoclonal antibodies

APPENDIX E

Data summarizing pathogen survey results

Table 1. Samples Collected and Processed in Year 2000*

Below McIntyre Dam

Fish Species	No. Collected	Cult. Virus	EIBSV	Cs	Mc
Salmonids					
Sockeye	208 adults	114/207	0/44	0/158	0/207
Sockeye?	208 fry/fingerlings	0/208	1/131	NT	NT
Whitefish	31 various ages	0/25	3/27	NT	NT
Total salmonids	447				
Non-salmonids					
12 species	289 various ages	0/225	5/196	NT	NT
Total non-salmonids	289#				

*Symbols: NT = not tested; fractions = no. fish positive/no. available for testing or tested (all virus isolates were IHNV, probably type 1; < 1 inclusions = positive EIBSV result).

Note: Non-salmonid sample is 71 short of required 360.

Table 2. Samples Collected and Processed in Year 2000*

Above McIntyre Dam

Fish Species	No. Collected	Cult. Virus	EIBSV	Cs	Mc
Salmonids					
Kokanee	215 adults	109/215	0/120	?	NT
Kokanee	189 fry/fingerlings	0/189	7/174		
Whitefish	50 various ages	0/16	2/44		
Total salmonids	454				
Non-salmonids					
15 species	391 various ages	0/391	10/344	NT	NT
Total non-salmonids	391				

*Symbols: ? = awaiting results; NT = not tested; fractions = no. fish positive/no. available for testing or tested (with cult. virus, result is an average based on pooled fish samples; all viral isolates were IHNV, probably type 1; < 2 inclusions = EIBSV positive result).

Table 3. Details re Non-salmonids Collected below McIntyre Dam, Year 2000

Fish Species	Migratory	No. Collected	% of Total	% M or NM
Northern Pike Minnow	Yes?	8	2.8	
Smallmouth Bass	Yes?	39	13.5	50.5
Yellow Perch	Yes?	99	34.3	
Black Catfish	No?	1	0.3	
Black Crappie	No?	1	0.3	
Carp	No?	4	1.4	
Largemouth bass	No?	52	18.0	49.5
Pumpkinseed	No?	24	8.3	
Sculpins (2 species?)	No?	22	7.6	
Suckers (2 species?)	No?	39	13.4	

Note: Yellow perch are too highly represented (max. % per species should be 25%). Also, if migratory (M)/non-migratory (NM) classification is valid, %M representation should be increased to 75

Table 4. Details re Non-salmonids Collected above McIntyre Dam, Year 2000

Fish Species	Migratory	No. Collected	% of Total	% M or NM
Burbot	Yes?	1	0.3	
Lake Chub	Yes?	1	0.3	
Northern Pike Minnow	Yes?	68	17.4	
Peamouth Chub	Yes?	71	18.2	67.5
Redside Shiner	Yes?	28	7.2	
Smallmouth Bass	Yes?	89	22.8	
Yellow Perch	Yes?	6	1.5	
Black Bullhead	No?	2	0.5	
Carp	No?	1	0.2	
Pumpkinseed	No?	12	3.1	32.5
Sculpins (2 spccies?)	No?	40	10.2	
Suckers (3 species?)	No?	72	18.4	

Evaluation of an Experimental Re-introduction of Sockeye Salmon into Skaha Lake

Year 1 of 3

Objective 2: Exotic Fish Species Risk Assessment

Submitted to:
Colville Confederated Tribes

Prepared by:
Karilyn Long
Okanagan Nation Fisheries Commission

Reviewed by:
Chris Bull, R.P.Bio
Glenfir Resources

June 2001

EXECUTIVE SUMMARY

A transboundary multi-agency workshop was hosted in November 1997 to discuss the potential risks and benefits of re-introducing sockeye salmon into Okanagan Lake. These discussions were summarized in a Draft Action Plan that recommended sockeye be re-introduced to Skaha Lake as an experiment designed to resolve some of these uncertainties (Peters et al., 1998).

One of the concerns regarding re-establishing sockeye salmon runs is the possibility of exotic fish colonizing upstream areas, which may have a negative impact on the ecosystem. In the Okanagan Basin, the present barrier to fish migration is McIntyre Dam, located immediately downstream from Vaseux Lake. It normally prevents sockeye as well as resident and exotic fish from migrating upstream and colonizing areas in Vaseux, Skaha and Okanagan Lakes.

Objective 2 researches the potential risks of the upstream migration and colonization of exotic species into Skaha Lake. The exotic species in question are black crappie, black and brown bullheads, goldfish, largemouth bass, tench and walleye.

Based on the results from year one of the study, there are few risks associated with any upstream migration and colonization by exotic species into Skaha and South Okanagan Lakes. Among species of concern black bullhead already exist in Skaha Lake but not South Okanagan Lake and largemouth bass have been established in Vaseux Lake above McIntyre Dam since 1918 (Appendix B) but not further upstream in Skaha Lake.

Despite extensive sampling efforts, brown bullhead and tench were not caught anywhere in the study area. Considering that their presence has been noted by only one reference during the literature review (Appendix B), it is suspected that they are not aggressive colonizers.

Black crappie, black bullhead, largemouth bass and tench typically inhabit eutrophic systems like Osoyoos Lake, where they find requisite littoral areas with shallow water and aquatic vegetation. Interactions of these species with resident species such as kokanee are minimal in that littoral species are seldom found in the pelagic zone where salmonids feed.

Walleye are found in both the pelagic and littoral areas of lakes. They were not caught within the study area during the present study nor have they been caught in the past. However, walleye do exist in the Columbia River mainstem and lower Okanagan River. During the angling survey, expert fisherman Roger Patton, found that Osoyoos Lake has acceptable habitat for walleye and also has suitable areas for spawning within the main lake. Walleye are of concern as they are piscivorous, and have been found to prey on juvenile sockeye in lakes where they coexist.

ACKNOWLEDGMENTS

The Okanagan Nation Fisheries Commission would like to acknowledge the following people and organizations for their valuable contributions to Objective 2: Exotic Fish Species Risk Assessment.

Special thanks go to Monte Miller of the Colville Confederated Tribes (CCT) who spent many hours counting and recounting fish. Thanks to the CCT for letting us use Monte and the extremely effective electrofishing boat.

Gillnets and beach seines were borrowed from Steve Matthews of the Ministry of Water, Land and Air Protection. The trap net was provided by Paul Rankin of the Pacific Biological Station and installed and demonstrated by Chris Fisher of CCT.

Thanks to Milfoil weed harvester Gordon Greer and the Okanagan Basin Water Board who facilitated the collection and identification of fish. Sorry we brought you such bad luck.

Thanks also to our quality control advisor, Chris Bull.

Taxonomist Dr. Don McPhail, of the University of British Columbia helped immensely with the identification of fish.

The year 1 report could not have been completed without this assemblage of resources and expertise. Thanks again to everyone involved.

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1.0 INTRODUCTION

1.1 Project Background

A transboundary multi-agency workshop was hosted in November 1997 to discuss the potential risks and benefits of re-introducing sockeye salmon into Okanagan Lake. These discussions were summarized in a Draft Action Plan that recommended sockeye be re-introduced to Skaha Lake as an interim test to resolve some of these uncertainties (Peters et al. 1998).

Re-introducing sockeye salmon into Skaha Lake offers potential rebuilding benefits by increasing the amount of available rearing habitat. At present, rearing habitat is known to be a limiting factor for Okanagan sockeye salmon (Hyatt & Rankin, 1999). The Skaha Lake re-introduction would also provide an opportunity to assess survival and interactions between sockeye and the resident fish community. The information gathered during this project, and the re-introduction will help investigators reach future decisions on rebuilding strategies for the Okanagan River sockeye stock and for other sockeye stocks in the Columbia River Basin.

Currently, juvenile sockeye within the Okanagan River Basin can only access Osoyoos Lake for rearing. This is one of the last two significant sockeye populations that exist in the Columbia River system. Abundance of this stock has declined and fluctuated dramatically in the last fifty years. The Okanagan Nation and tribes in the U.S. have proposed re-introducing the species into Skaha and possibly Okanagan Lake, which have much larger rearing capacities.

The occurrence of kokanee in Okanagan Lake suggests that sockeye salmon probably spawned in Vaseux, Skaha and Okanagan lake basins in the past. However, some argue that the original Okanagan Falls, located in the outlet of Skaha Lake, has been an impassable barrier to sockeye in recent historic times (Ernst, 1999).

The Bonneville Power Authority (BPA) along with the Colville Confederated Tribes (CCT) and the Okanagan Nation Fisheries Commission (ONFC) is evaluating the proposal to re-introduce sockeye salmon into Skaha Lake. This will be accomplished by completing the following six objectives over three years:

1. disease risk assessment;
2. exotic fish species risk assessment;
3. inventory of existing habitat and opportunities for habitat enhancement;
4. development of a life-cycle model of Okanagan salmonids, including interaction with resident kokanee;
5. development of an experimental design and;
6. finalize a plan for experimental re-introduction of sockeye salmon into Skaha Lake and associated monitoring programs.

Objectives 1-3 would span the three year period, objectives 4 and 5 would be implemented and completed in the second year, and objective 6 would be completed in the third year. These elements will be integrated in an overall experimental management plan through a cooperative multi-agency process that involves U.S. and Canadian agencies.

The ONFC was contracted for project management and data collection for Objectives 1, 2 and 3. This report covers Year 1 of Objective 2: 'Exotic fish species risk assessment'.

1.2 Objective 2 Tasks

The concern implicit in Objective 2 is the possibility of undesirable exotic fish passage and colonization of upstream areas.

A number of exotic fish species introduced into the Okanagan have become widely established. However, some of these are found only below McIntyre Dam, and with removal or changes in the dam, these could extend their range upstream and colonize Vaseux, Skaha and Okanagan Lakes. These populations are referred to as the 'exotic fish species of concern'. McIntyre Dam is generally a barrier to all fish migration, except in a number of recent instances where the dam has been open for short periods of time.

Objective 2 examines potential risks as follows:

- Review available fish inventory information above and below McIntyre Dam;
- Determine exotic fish species presence/absence and habitat use above and below McIntyre Dam;
- Review literature on habitat requirements for exotic species of concern;
- Assess the availability of suitable habitat for species of concern above McIntyre Dam.

During 'Year 1' of Objective 2, the first year of fish collections, literature reviews and habitat assessment were completed.

1.3 Project Study Area

The study area below McIntyre Dam encompasses the north basin of Osoyoos Lake and the Okanagan River channel. The areas above McIntyre Dam within the study area include Vaseux Lake, Skaha Lake and the southern portion of Okanagan Lake (Figure 1). There are additional barriers to fish migration at dams located at the outlets of Skaha and Okanagan Lakes. These dams have provisions for fish passage but they are not currently in operation.

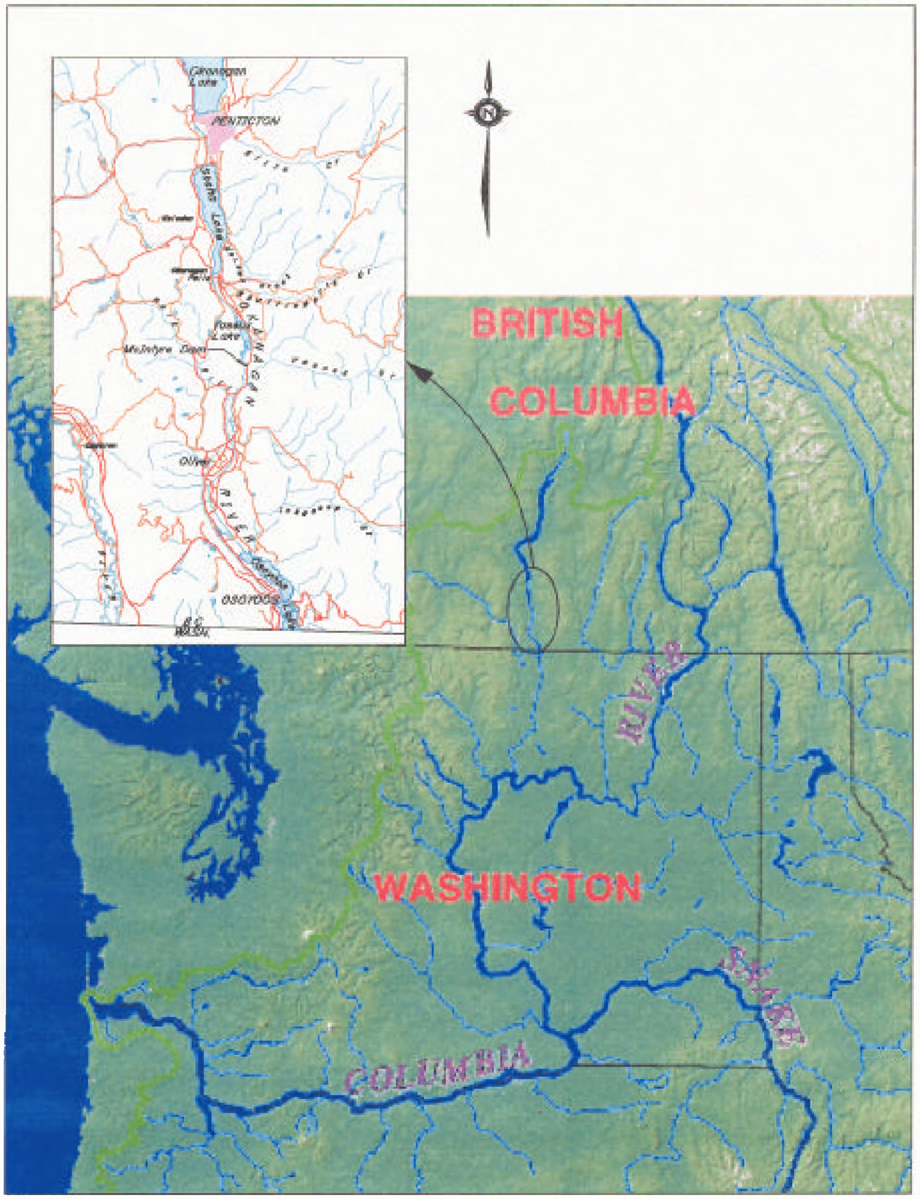

Figure 1:
Exotic Fish Species Risk Assessment - Overview Map of the Study Area

2.0 LITERATURE REVIEW OF AVAILABLE FISH INVENTORY INFORMATION

The literature review identifies all known fish inventory information within the study area and will be used to direct field sampling. The complete report is provided in Appendix B.

The exotic fish species found below but not above McIntyre Dam (i.e. not in Skaha or Okanagan Lake) include;

- black bullhead
- brown bullhead
- black crappie
- goldfish
- largemouth bass
- tench
- walleye.

A concern related to the potential re-introduction of sockeye salmon is the possible concurrent passage by exotic fish. Aggressive species could successfully colonize new areas and adversely affect native fish habitat and productivity.

Among the exotic species, tench and goldfish are only briefly mentioned in the literature. Goldfish most likely originated in private collections and are unlikely to be numerous enough to establish themselves as a population and for the purposes of this report are not included in the risk analysis. Tench would most likely have the same habits as carp such as competing for food with native species. Largemouth bass are predatory, but feed primarily in the littoral areas. Bullheads are bottom-feeding, shallow water dwellers.

There are unconfirmed reports of black crappie being found above McIntyre Dam. Black crappie are known to be able to travel in open waters and feed on a variety of very small fishes as well as plankton.

Walleye have not been reported in the Canadian portion of the Okanagan system but they do exist downstream in the Columbia River mainstem and could conceivably extend their range into Okanagan Valley waters. They can travel long distances and are piscivorous. A complete review of habitat requirements for the above exotic species is found in Section 4.0 of this report.

3.0 INVENTORY OF EXOTIC FISH SPECIES

To confirm the extent of exotic fish presence and distribution reported in the literature review, the ONFC used a wide variety of capture techniques and sampled a wide range of habitats within the study areas. The sampling plan was developed in consultation with both the provincial Ministry of Environment, Lands and Parks (MELP) and the federal Department of Fisheries and Oceans (DFO). ONFC was responsible for field data collections and project management. Glenfir Resources was retained to monitor quality and to prepare the sampling procedures with Columbia Environmental Consultants.

3.1 Exotic fish inventory methods and results

ONFC conducted the exotic fish inventory in accordance with all the stipulations of required permits from MELP and DFO. Notification of sampling was given to the local police.

Sampling was conducted during four seasons to help describe migrations of various fish species. The four sampling seasons were spring (April and May), early summer (June), late summer (August) and fall (October and November). Sampling sites were chosen by stratifying the habitat types typically found within the study area (Appendix D), then confirming their presence. Habitat selection was based on substrate type (cobble, silt, sand or bedrock) aquatic vegetation (emergent and submergent), water depth, and channel velocities (inlet and outlet velocities). Table 1 outlines the sampling methods used during the four sampling seasons and suitable locations. Details of each sampling method are outlined in Sections 3.1.1 to 3.1.7. Sampling sites are shown on air photo composites (Figures 2 through 7).

Table 1. Sampling methods and locations for exotic fish of concern

Method	Date/Season 2000	Areas	Targeted species
Angling	April (Spring)	Osoyoos Lake	Walleye
Gill netting	July (Early summer) November (Fall)	Osoyoos & Skaha Lakes	Walleye
Beach seining	August (Late summer)	Osoyoos & Skaha Lakes	Black crappie
Minnow trapping	April (Spring) June & August (Early and late summer) November (Fall)	Entire study area	River and lake small, bottom feeding fish.
Electrofishing-boat	April (Spring) June & August (Early and late summer) November (Fall)	South Okanagan, Skaha & Osoyoos Lakes	Littoral fish species
Trap netting	September (Late summer)	Osoyoos Lake	Walleye
Weed harvester	August (Late summer)	Osoyoos Lake	Juvenile fish

For each of the sampling methods, fish presence/absence was noted along with the catch-per-unit-effort (CPUE). Detailed summaries can be found in Appendices F through K. In cases where the fish species were unknown they were either collected and preserved in formaldahyde or photographed for later verification. Dr. Don McPhail and Mr. Gerry Taylor were retained as taxonomic advisors. (see Appendix N for resumes).

3.1.1 Angling

An experienced walleye angler, Roger Patton, President of the Western Walleye Council, was retained to fish in Osoyoos Lake in the spring. Mr. Patton completed an assessment of the potential walleye habitat and their likely presence or absence (Photos 1 to 4). No walleye were caught, but northern pike minnow, carp and smallmouth bass were taken. Mr. Patton concluded that there is suitable walleye rearing habitat along the west side of Osoyoos Lake as well as spawning areas within the main lake but not at the river inlet. In his opinion, there is not an established walleye population in Osoyoos Lake. The report produced by Mr. Patton is found in Appendix F.

3.1.2 Beach seining

Beach seining was undertaken at four sites in Osoyoos Lake and six sites in Skaha Lake in late summer (details found in Appendix I). In Osoyoos Lake, the ONFC crew used both a large and a small beach seine. The large net was 35 m in length, 3.5 m depth with 10 mm mesh size. The small seine was 15 m in length, and 2.3 m in depth with mesh sizes of 2 mm in the bunt end and 5 mm in each wing. One to three hauls (Photos 5 & 6) were conducted at each site in August, 2000. As expected, beach seining caught littoral zone fish holding over smooth substrate. Beach seining was most effective in Osoyoos Lake with its large littoral zones and sand-silt substrate. The species caught include black crappie, sculpins, carp, pumpkinseed, and smallmouth bass.

3.1.3 Electrofishing

Night surveys with the electroshocker boat (Photos 8 & 9) were completed in all sampling seasons over different littoral substrate types (silt, sand, cobble, reef, and rip rap). The electrofishing boat fished transects parallel to the shoreline, in water depths of less than 3.5 meters. A Smith-root model 7.5 GPP electrofisher was mounted in a Smith-root manufactured aluminum boat. The cathode of the electrofishing boat is the hull with a curtain of rat-tail on the bow of the boat. The boat is also equipped with two 36 inch six dropper umbrella anodes on 7’11” booms. Voltage varied between 360-1000 volts (DC) with electrical pulse frequencies of 30-120 Hz. The majority of electrofishing was undertaken at outputs between 5.5-7.5 Amps, provided the water temperatures were greater than 4°C and conductivity was above 30 *u*S/cm (BC Resource Inventory Committee water chemistry standard for electrofishing). During the first three sampling seasons, fish were caught in the littoral zone. In November, during the fall sampling season the catch consisted of mostly juvenile sockeye/kokanee. The electrofishing boat captured the majority of fish species (see Table 2) during the spring and summer sampling seasons(Appendix G).

3.1.4 Gillnetting

Gillnetting was selected to target walleye in Osoyoos Lake and other exotic fish species of concern in Skaha Lake (Appendix H). The sites in Osoyoos Lake were areas identified by Mr. Patton as potential walleye habitat. Skaha and Osoyoos Lake were gillnetted at night in early summer (July) using 3 to 5 standard gangs (1.8 X 2.4 m) of varied mesh (6.35 to 12.7 cm), with soak times of approximately 2 hours. Sinking nets were set on the bottom at depths ranging from 8 to 16 feet. During fall sampling (November), Osoyoos Lake was fished overnight using 6 standard gangs of varied mesh sizes (6.35 to 12.7 cm). Gill netting was not conducted during late summer (August) because of the concern that adult sockeye were likely schooled in Osoyoos Lake. The catch was chiefly adult suckers, northern pike minnow, smallmouth bass and whitefish.

3.1.5 Minnow trapping

Minnow traps were placed in lake, channel and oxbow habitats (Appendix I) in all four sampling seasons (Photos 10 to 20). Soak times were 24 hours. Trap mesh was 6 mm with 2 cm diameter openings. The traps were baited with canned sardines. Usually, 3 to 4 minnow traps were set at each site. The catch included prickley sculpins, northern pike minnow, redside shiner, suckers, yellow perch, pumpkinseed, smallmouth bass, and carp.

3.1.6 Trap netting

A Canada Department of Fisheries and Oceans trap net (see diagram in Appendix J) was set in late summer (September) to expand the catch effort for potential walleye. It was soaked for a 24 hour period near Rattlesnake Point on Osoyoos Lake. The net was set in 1 to 3 m deep water, floating 5 m offshore. Fish caught during trap netting were yellow perch, smallmouth bass, largemouth bass, and black crappie.

3.1.7 Weed harvester sampling

During the annual milfoil weed harvest in Osoyoos Lake conducted by the Okanagan Basin Water Board (OBWB) in August, two ONFC crew members counted and collected by-catch (Photo 21). The paddle wheel motored weed harvester collects eurasian milfoil, an aquatic weed species. During the harvest, juvenile and very small fish that were too slow to escape the moving belt of the harvester were caught. The ONFC crew counted all fish from above the water line of the weed harvester and collected a sample of each species for later verification (see Appendix K). Yellow perch, largemouth bass and black crappie were caught.

3.2 Results of the exotic fish species inventory

The six exotic fish species identified as species of concern are black and brown bullheads, black crappie, largemouth bass, tench and walleye. Of these, black bullheads (awaiting verification) were caught during sampling above the dam as far north as Skaha Lake. Local anglers catch largemouth bass in Vaseux Lake just above McIntyre Dam. We were not able to verify this as sampling in Vaseux Lake is not permitted because part of the lake is in a wildlife preserve. However MELP has verified the angler reports (C.Bull, personal communication)

Table 2 summarizes the fish species caught during the year 2000 sampling. The catch data and CPUE are found in Appendices F through K. Figures 2 through 7 are composite air-photos of the study area.

Table 2. Summary of fish species caught in all four sampling seasons

Species found during 2000 sampling	Above McIntyre Dam: Okanagan Lake South	Above McIntyre Dam: Skaha Lake	Above McIntyre Dam: Vaseux Lake	Above McIntyre Dam: Okanagan River channel	Below McIntyre Dam: Okanagan River channel	Below McIntyre Dam: Osoyoos Lake
Burbot	EF	EF	-	-	-	-
Black crappie	-	-	-	-	-	BS, TN, EF, WH
Black bullhead	-	EF, MT	MT	-	-	EF
Brown bullhead	-	-	-	-	-	-
Prickley sculpin	EF, MT	EF, MT, BS	MT	MT	MT	EF, MT, BS
Chinook salmon	-	-	-	-	AG	-
Carp	EF	EF, BS	-	-	-	EF, MT, AG
Eastern brook trout	-	-	-	-	-	-
Goldfish	-	-	-	-	-	-
Kokanee	EF	EF	-	-	-	-
Largescale sucker	EF	EF	-	-	-	EF, GN
Largemouth bass	-	-	-	-	-	EF, TN, WH
Lake chub	EF, MT	-	-	-	-	-
Northern pike minnow	EF, MT	EF, GN, MT	MT	MT	-	EF, GN, MT, AG
Peamouth chub	EF, MT	EF	-	-	-	EF
Pumpkinseed	-	EF, BS	MT	MT	-	EF, MT
Rainbow trout	-	EF	-	-	MT	EF, MT
Redside shiner	EF, MT	-	-	MT	-	-
Sockeye salmon	-	-	-	-	AG	EF, GN
Smallmouth bass	-	EF, BS, MT	-	MT	MT	EF, BS, GN, TN, AG
Sucker, general	EF	EF, GN	-	MT	-	EF
Tench	-	-	-	-	-	-
Mountain whitefish	EF	EF	-	-	-	EF
Whitefish, general	EF	-	-	-	-	EF, GN
Walleye	-	-	-	-	-	-
Yellow perch	EF	EF	MT	MT	MT	EF, BS, TN, WH

Fish capture methods		
	EF	electrofishing boat
	MT	minnow trapping
	GN	gillnetting
	AG	angling
	BS	beach seining
	WH	milfoil weed harvester
	TN	trap netting

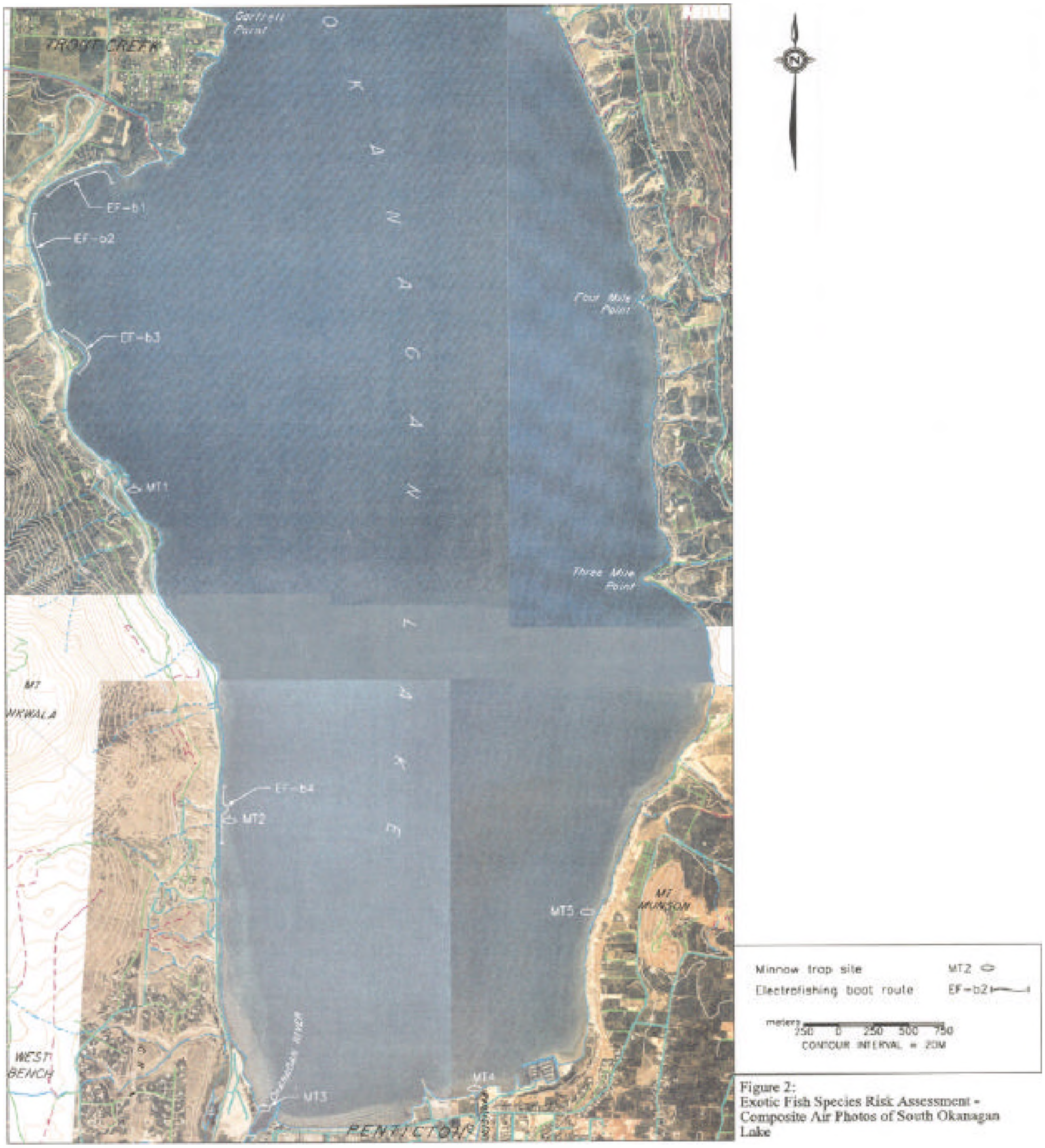

Figure 2:
Exotic Fish Species Risk Assessment - Composite Air Photos of South Okanagan Lake

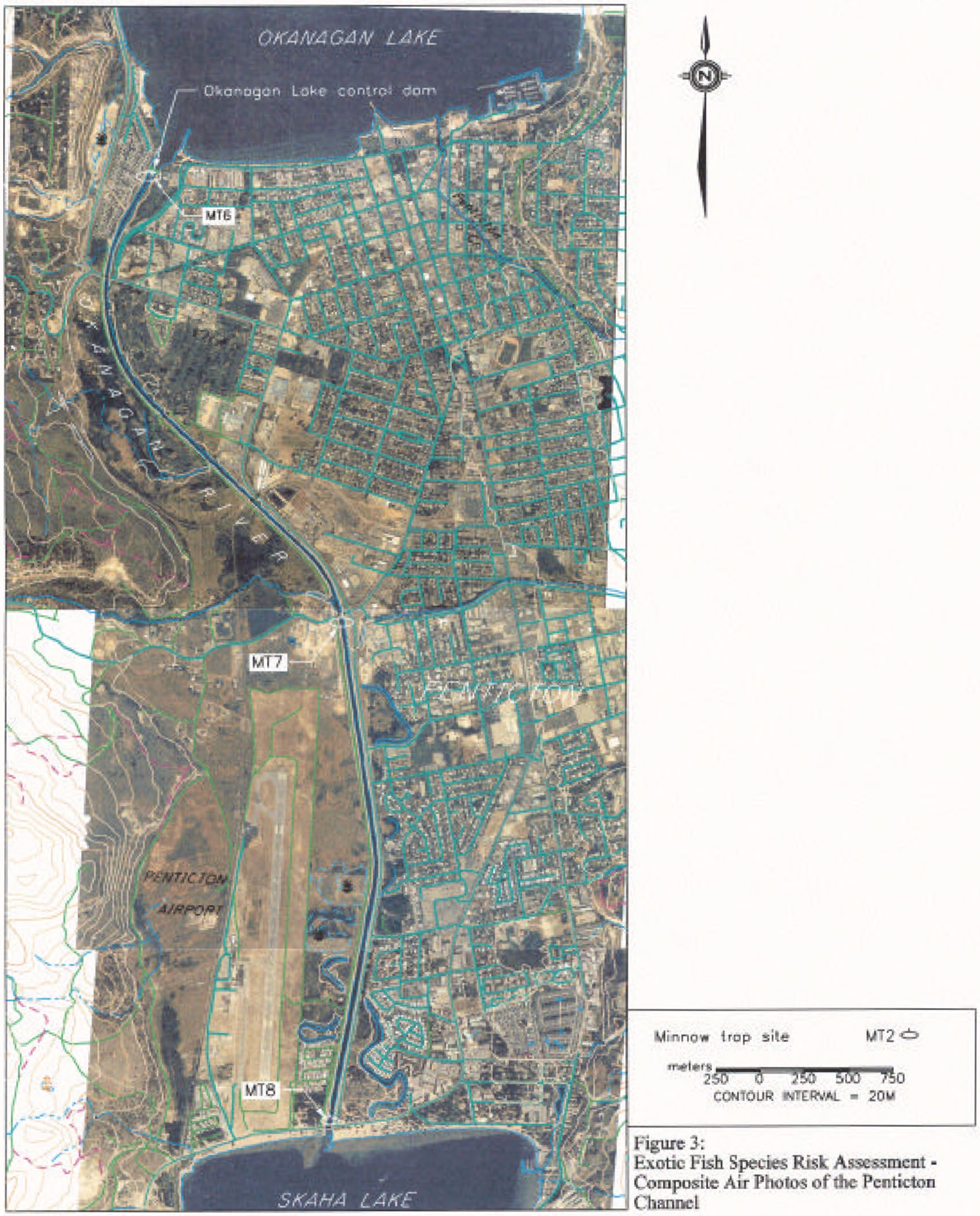

Figure 3:
Exotic Fish Species Risk Assessment - Composite Air Photos of the Penticton Channel

Figure 4:
Exotic Fish Species Risk Assessment - Composite Air Photos of Skaha Lake

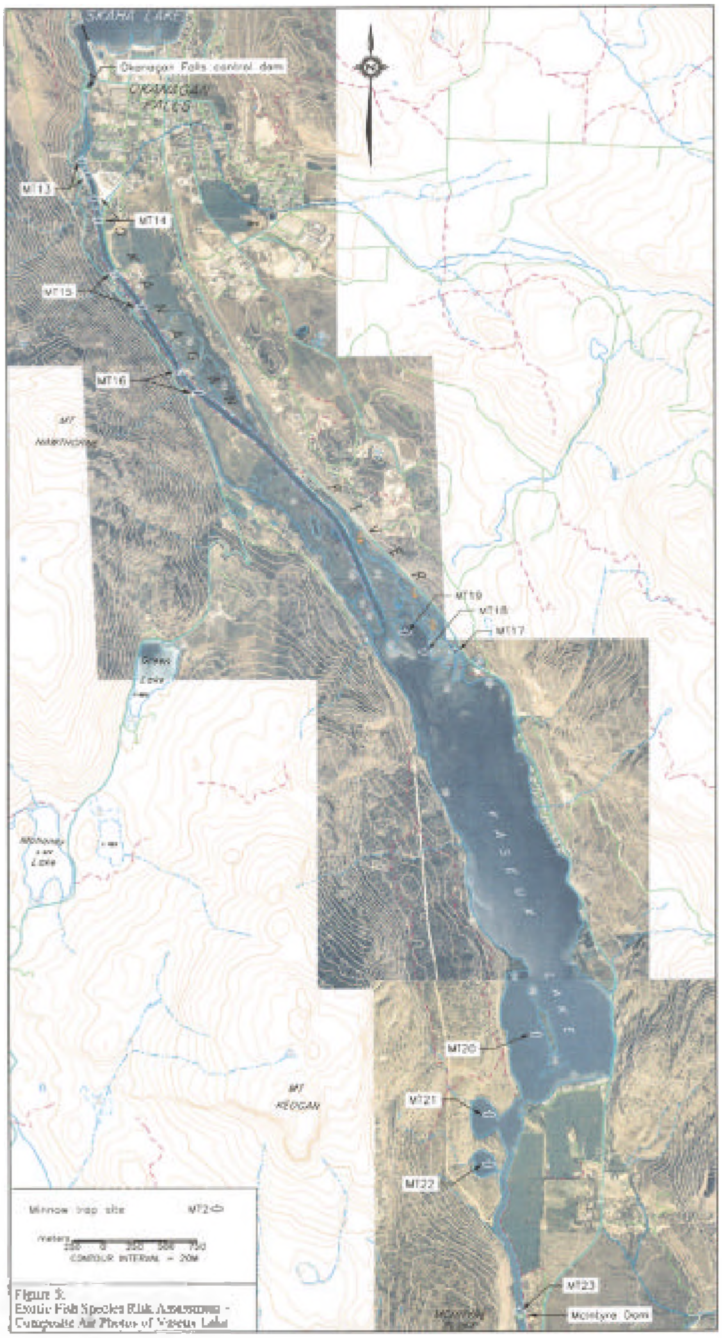

Figure 5:
Exotic Fish Species Risk Assessment -
Composite Air Photos of Vaseux Lake

Figure 6:
Exotic Fish Species Risk Assessment - Composite Air Photos of the Okanagan River Channel

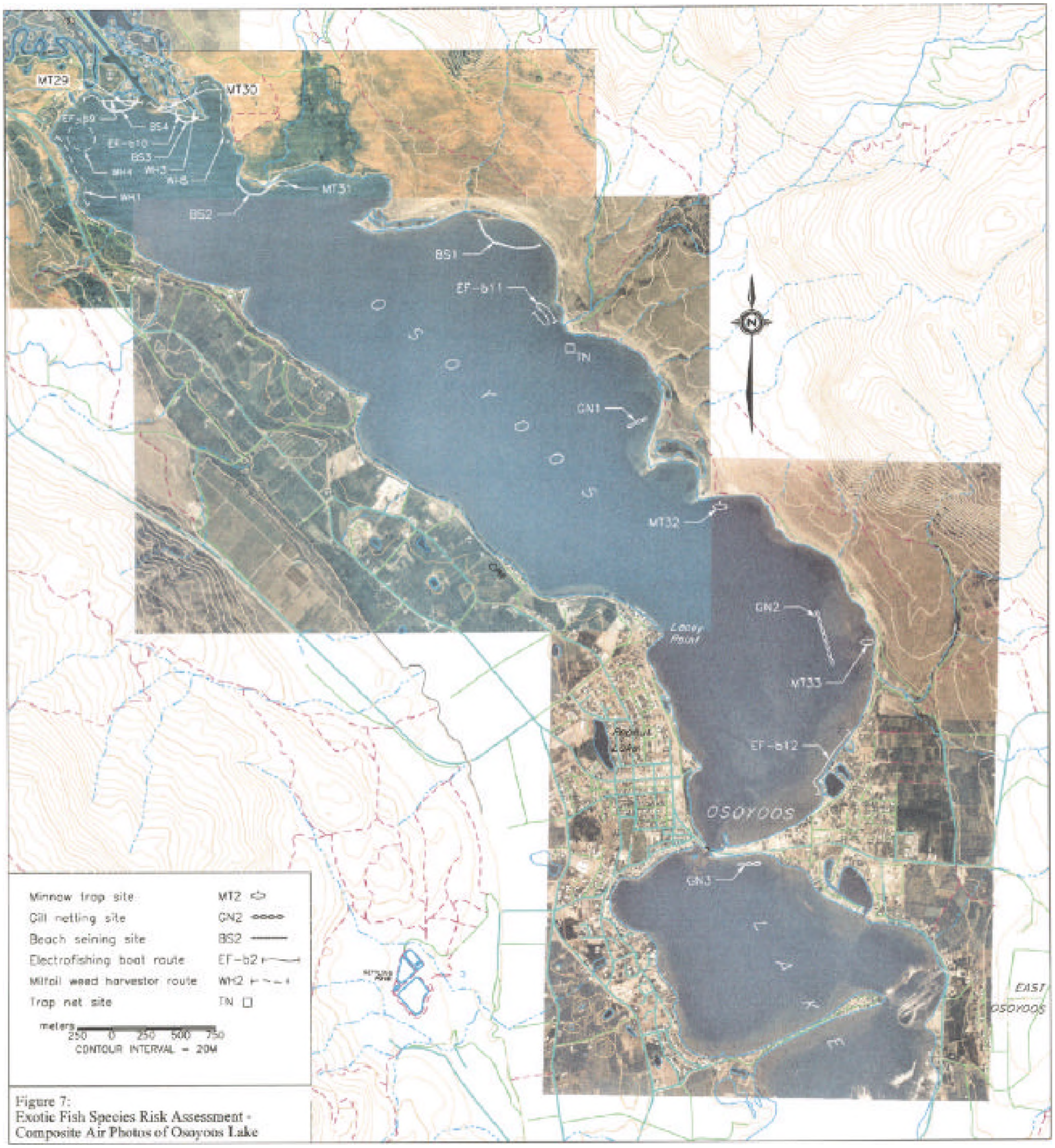

Figure 7:
Exotic Fish Species Risk Assessment - Composite Air Photos of Osoyoos Lake

4.0 LITERATURE REVIEW OF HABITAT REQUIREMENTS FOR EXOTIC SPECIES OF CONCERN

Providing sockeye salmon access to Skaha Lake may also inadvertently allow exotic fish species to enter and colonize the lake and this could affect the existing indigenous fish populations. The literature review was undertaken to determine whether the type of habitat that exists in Skaha Lake and other South Okanagan Lakes is suitable for colonization by the species of concern. Walleye have been added to the list of species because of their aggressive colonization habits and their presence in the Columbia River mainstem. Table 3 summarizes the preferred habitat requirements of exotic fish (the full report is found in Appendix C).

Table 3. Exotic fish species preferred habitat requirements

Exotic fish species	Preferred habitat
Black crappie	Black crappie inhabit low gradient, low flow, shallow, littoral waters. They feed on larvae until they are 160mm in length, then switch to a variety of small fishes.
Black & brown bullhead	Black and brown bullheads prefer quiet, murky, soft bottomed areas and are primarily bottom-feeding scavengers which compete with other bottom-feeders.
Largemouth bass	Largemouth bass inhabit the warm epilimnion in lakes generally avoided by sockeye juveniles, which keep to the colder deeper waters in lakes. Adult bass are piscivorous ambush predators. This tends to minimize their predatory impact on pelagic species such as kokanee.
Tench	Tench are mostly sluggish bottom feeding fish, which inhabit the littoral zone of lakes and other swampy waters. Impacts of tench may include competition for food with native species and the creation of turbid conditions created when they spawn.
Walleye	Walleye are found in the pelagic and littoral areas of lakes and progress from a predominantly invertebrate diet in the spring to a predominantly fish diet in the late summer and fall. Walleye are found to prey on juvenile sockeye in lakes (Appendix C).

5.0 AVAILABILITY OF SUITABLE HABITAT IN SKAHA LAKE FOR SPECIES OF CONCERN

Osoyoos Lake is eutrophic. The rate of eutrophication was increasing steadily from about 1900, as a cumulative effect of years of nutrient enrichment due primarily to agriculture (Stockner and Buchanan, 1974), and from the City of Oliver sewage treatment plant. Over the last seven years, as both sewage treatment and land practices have improved there has been a reduction in spring phosphorus values and an improved trophic status. (E.V. Jensen, personal communication).

There is a high density of fish including a large percentage of non-salmonids, in all habitats of Osoyoos Lake. The lake serves as an important nursery ground for young sockeye salmon (Anon, 1972), though the abundance of this species has declined dramatically in the last fifty years. Hyatt & Rankin (1999) concluded that the rearing habitat in Osoyoos Lake is a limiting factor and that eutrophication, if it continues, has the potential to reduce rearing habitat to critical levels. Re-introducing sockeye salmon into Skaha Lake provides them with more rearing habitat.

Skaha Lake is a medium-sized two basin lake in the middle of the main valley lake system. Inflow is from Okanagan Lake via the Okanagan River. With a mean depth of 26 meters, Skaha Lake is considered to be oligotrophic (Stockner and Buchanan, 1974). Twenty-five years ago, the City of Penticton discharged treated effluent into the Okanagan River, approximately 1.5 km above Skaha Lake. The lake was very productive with an annual blue-green algal bloom in August/ September (Nordin et al, 1990). In 1972, Penticton introduced tertiary sewage treatment, greatly reducing phosphorus (P) inputs from municipal discharge. Like Osoyoos Lake, there has been an improved trophic status as spring phosphorus levels have been reduced over the last seven years (E.V. Jensen, Personal communication).

A large number of both sport and coarse fishes are found in the lake and their growth is the highest recorded in any of the Okanagan mainstem lakes. Oxygen depletion in the hypolimnion of Skaha was noted at the height of summer stratification, but was not low enough to seriously limit fish distribution (Nordin et al, 1990).

Skaha Lake littoral zone has rooted aquatic vegetation along its shorelines that could provide habitat for most of exotic species, which prefer productive shallow littoral zones. Walleye are an exception since they are also found in pelagic regions. If access for fish were provided, exotic species could survive in Skaha Lake but would not necessarily flourish as well as they do in Osoyoos Lake, which is shallow and has a large littoral area.

6.0 ASSESSMENT OF THE RISK OF INTRODUCING EXOTIC SPECIES TO SKAHA LAKE AND RECOMMENDATIONS FOR YEAR 2

A concern with re-establishing sockeye salmon is possible colonization of areas upstream of McIntyre Dam by exotic fish, including black crappie, black bullhead, brown bullhead, goldfish, largemouth bass, tench, and walleye. Table 4 addresses the risk of exotic fish species introductions into Skaha and Okanagan Lakes.

Table 4. Summary of Exotic fish risk assessment.

Species of concern (Section 2.0)	**Exotic species field sampling (Section 3.0)**	**Habitat preferences and species interactions (Section 4.0)**	**Areas likely to colonize in Skaha Lake (Section 5.0)**	**Exotic Risk Assessment (Section 6.0)**
Black crappie	Caught in Osoyoos Lake oxbows, not caught above McIntyre Dam	Lake littoral zone associated with low flows. Adult crappies can feed on very small fish.	South Okanagan Lake does not have the extent of littoral zone of Skaha, Osoyoos and Vaseux Lakes.	There is habitat for crappie but the exotic fish would have little interaction with salmonids.
Black & Brown Bullhead	Found above Skaha Lake. Not found in South Okanagan Lake.	Soft bottomed littoral areas of lakes. Competes with other bottom feeders.	Bullheads already coexist with resident species in Skaha Lake.	They already coexist with resident species in Skaha Lake.
Largemouth bass	Not found in Skaha or Okanagan Lake but has become established in Vaseux Lake & Osoyoos Lake.	Littoral lake zones with soft bottoms and aquatic vegetation. Generally do not compete with salmonids because of habitat differences.	South Okanagan Lake does not have the extent of littoral zone of Skaha, Osoyoos and Vaseux Lakes.	Largemouth bass and salmonids have coexisted in Osoyoos Lake for at least 70 years.
Tench	Not found in Osoyoos, Skaha or South Okanagan Lakes.	Inhabitat littoral areas of lakes, or swamps, particularly areas polluted with organic materials.	Already coexist with resident species in Osoyoos Lake.	Tench are very rare in Osoyoos Lake & have little interaction with salmonids.
Walleye	Not found in Osoyoos, Skaha or South Okanagan Lakes. There is an established population in the Columbia mainstem.	Littoral and pelagic areas of lakes. They seasonally inhabit the same areas as salmonids and are known to prey on juvenile salmonids.	There is suitable habitat in Osoyoos Lake and most likely in Skaha Lake for walleye to establish a population.	Walleye would have an impact on resident salmonids if they move up the Columbia and establish themselves in the Okanagan Basin.

Based on the results from Year 1, there are few risks associated with the upstream migration and colonization of exotic species into Skaha and South Okanagan Lakes. Among the species of concern black bullhead already exist in Skaha Lake but not South Okanagan Lake and largemouth bass have been established in Vaseux Lake above McIntyre Dam since 1918 (Appendix B) but not further upstream in Skaha Lake.

Despite extensive sampling, brown bullhead and tench were not caught anywhere in the study area. Considering that their presence has been noted by only one reference during the literature review (Appendix B), it is suspected that these fish are not aggressive colonizers.

Black crappie, black bullhead, largemouth bass and tench typically inhabit eutrophic systems like Osoyoos Lake, because they require littoral areas with shallow water and aquatic vegetation. They do not compete for space or food of salmonids such as kokanee which inhabit the pelagic zone of lakes.

Walleye are found in both the pelagic and littoral areas of lakes. They were not caught in this study nor have they been caught in the past (Appendix B). They do, however, exist in the Columbia River mainstem and lower Okanogan River. During the angling survey, walleye fisherman Roger Patton, found that Osoyoos Lake has suitable habitat for walleye (particularly the west-side) and also has suitable areas for spawning within the main lake. Walleye are a concern as they are piscivorous, and prey on juvenile sockeye in lakes where they coexist (Appendix C).

Recommendations for Year 2 sampling include focusing on areas and species that were found to be of concern during Year 1. These include,

1. Sampling in the oxbows of Penticton channel and the Okanagan River Channel to determine if this unique habitat harbors exotic fish species other than those currently found,
2. Minnow trapping and beach seining on areas not covered in year one,
3. Gill netting and beach seining in South Okanagan Lake,
4. Angling and trap netting in and above Vaseux Lake to determine the upper limit of largemouth bass and black crappie,
5. Sampling for black bullheads in South Okanagan Lake to assess the rate of spreading,
6. Review literature on the movement and colonization of new areas by walleye,
7. Review literature on the interactions between kokanee and rainbow trout and the exotic fish species of concern.

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[1] Reference used to produce literature reviews listed within the appendisized literature reviews

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Stockner, J.G. and R.J. Buchanan. 1974. The Limnology of the Major Okanagan Basin Lakes – Technical Supplement V. BC Okanagan Basin Agreement. Penticton, B

APPENDIX A

REQUIRED SAMPLING PERMITS

COPY

BRITISH COLUMBIA

File: 34770-25

SCIENTIFIC COLLECTION PERMIT

Permittee:
Okanagan Nation Fisheries Commission
3255 C Shannon Lake Road
Westbank, BC
V4T 1V4
(250) 707-0095

is hereby authorized under Section 102 of the Wildlife Act, SBC 57/82, and as provided in Section 18 of B.C. Reg. 125/90, to collect fish for scientific purposes from nontidal waters subject to the conditions set forth herein:

Permitted Waters: Okanagan Lake, Skaha Lake, Vaseux Lake, Osoyoos Lake, and Okanagan River

Permitted Areas: No lake sampling (with the exception of minnow traps) within .5 kilometers of any streams utilized by rainbow trout (with the exception of Okanagan River using electroshocker only) during the period March 15 to June 20 and within .5 kilometers of any streams utilized by kokanee during the period September 1 to October 31.
No sampling (with the exception of minnow traps) in any streams utilized by rainbow trout during the periods March 15 to July 15 and November 1 to March 31, and no sampling in any streams utilized by kokanee during the period September 1 to March 31.
No lake sampling (with the exception of minnow traps) within .5 kilometers of known kokanee shore spawning areas during the period October 1 to March 31.
No seining in littoral zones of Skaha Lake, Vaseux Lake, Vaseux Lake oxbows and Osoyoos Lake during the period March 15 to June 30.

Permitted Species: All non native fish species.
Moribund or dead kokanee samples collected as part of any ongoing Fisheries Program research projects (kokanee trawling or *Mysis relicta* Test Fishery) can be utilized for disease analysis provided they are surplus to the project requirements.
Additional fish species may be added to this Permit upon receipt of a detailed list of target species and the sample size requirements for each fish species.

Permitted Gear:

(a) **Equipment** – Angling, gillnetting, electoshockers (backpack and boat mounted), minnow traps, seine nets, dip nets as per the Sampling Plan submitted by the permittee.

Operational Strategy - The collection operation must be designed to avoid the bycatch of non-target organisms. Ideally, all non-target organisms that are captured will be released alive in healthy condition. If there is bycatch of salmonid species, collection methods must be modified prior to resuming sampling operations.
Gillnets must be checked every hour to ensure bycatch of non target species is minimized.

Monitoring of Operation: The Permittee will allow BC Environment observers to inspect the collection procedure at any time without advance notice being given.

Permitted Personnel: Howie Wright, Chris Bull, Dwight Shanner, Graham Martens, and any additional qualified personnel as authorized by the ONFC. Qualified fish sampling personnel must be present during all sampling activities.

Permit Period: April 17 to March 31, 2001

Expiry Date: April 1, 2001

See reverse side for General Conditions

Approved by:

per [signature]
Ian McGregor
Fisheries Program Section Head
Southern Interior Region

Date:

cc: Rick Hildebrand, Conservation Officer Service, Kamloops
Ian McGregor, Fisheries Program, Kamloops
Steve Matthews, Fisheries Program, Penticton
Val Bergren, Processing, Kamloops

Any contravention or failure to comply with the terms and conditions of this permit is an offence under the Wildlife Act, SBC 57/82 and B.C. Reg. 337/82. Sec. 8.

GENERAL CONDITIONS

1. This collecting permit is not valid

   (a) in national parks,
   (b) - in provincial parks unless approved by regional staff of BC Parks,
   (c) for salmon other than kokanee, or
   (d) for collecting fish by angling unless the permittee and crew members possesses a valid angling licence.

2. This permit is valid only for the activities approved on the application form and in accordance with any restrictions set out therein.

3. The project supervisor named on the application for a scientific collection permit will carry a copy of this permit while engaged in fish collecting and produce it upon request of a conservation officer, fishery officer or constable.

4. This permit is valid only for trained, qualified staff named in the Application. The permittee will comply with all Worker's Compensation Board requirements and other regulatory requirements.

5. Any specimens surplus to scientific requirements and any species not authorized for collection shall be immediately and carefully released alive at the point of capture.

6. No fish collected under authority of this permit shall be used for food or any purpose other than the objectives set out in the approved application for a scientific collection permit. The permittee shall not sell, barter, trade, or give away, or offer to sell, barter, trade, or give away fish collected under authority of this permit. Dead fish shall be disposed of in a manner that will not constitute a health hazard, nuisance or a threat to wildlife.

7. No fish collected under authority of this permit shall be transported alive or transplanted to another body of water unless separately authorized by the Federal/Provincial Fish Transplant Committee on a live fish permit.

8. The permittee shall submit to the Regional Fisheries Section Head for the area under consideration a summary report of collecting activities within 90 days of completion of the collecting activity. Interim reports will be provided upon request to the requesting office. A copy of the full report, for which the fish sampling data were used, is also requested. Should the report not be available, the permittee is to explain why and should provide excerpts of all relevant fish and habitat inventory data collected incidental to the sampling authorized in this Permit.

9. This collection permit may be cancelled at any time and shall be surrendered to a Conservation Officer on demand or to the issuer immediately upon receipt of written notice of its cancellation.

Appendix 1 Reporting Requirements

Submission of Fish Collection Permit Data

When the permit has been issued and sampling is completed, the results must be submitted to the ministry within the time limit specified on the permit. Results must be submitted even if no fish were captured for the entire study. Fish collection permit data must be submitted in hardcopy using the Fish Collection Form (Appendix 2 provides a sample Fish Collection Form) or an acceptable alternate form. Instructions for completing the Fish Collection Form are available on the web sites listed below. The copy of the form provided with the permit may be used for initial data recording, but an original form must be used in the report submitted to the ministry. The form is available from the Queens Printers for approximately $26.00 a gross (red card on duks back paper) Acceptable alternate formats must be agreed to in writing by the Regional Fisheries Inventory Specialist. Data submissions must also be accompanied with a hardcopy cover letter that explains who collected the data, the purpose of the data collection and where the data came from. You should indicate in the cover letter, the name of someone who can be contacted in the event there is a problem with your data submission. Maps showing the locations of your sampling sites will also be accepted if the maps help to clarify your data.

All submissions of fish collection permit data should be addressed to the appropriate fisheries section (either Kamloops or Penticton) and the permit number should be indicated on the outside of the envelope.

Electronic Submission of Fish Collection Permit Data

An electronic data entry tool is now available that is compatible with the current fish collection forms and the ministry's corporate database. Through the use of this tool, electronic submission of your fish collection permit data is now possible. Electronic submission of the fish collection permit data is not mandatory and contractors wishing to submit their data electronically do so voluntarily. Even though the data is submitted electronically, hardcopy submissions of the data are still required. However, acceptable printouts of the data can be created from the data entry tool.

If you would like to use the data entry tool or learn more about it, information and downloads are available from the Fisheries Inventory Section - Field Data Information System webpage at: http://www.elp.gov.bc.ca/fsh/ids/invent/tools/FDIS.HTM.

More details on the Fish Collection Permit application process, data submission, sample forms and user manuals are available on the Southern Interior Region - Fisheries Section webpage at: http://www.elp.gov.bc.ca/sir/fsh

APPENDIX B

LITERATURE REVIEW OF AVAILABLE FISH INVENTORY INFORMATION

Literature Review (Task 2a):

Review available fish inventory information in the Okanagan River system below Skaha Lake, and in Skaha and the southern portion of Okanagan Lake.

Submitted to: Chris Bull, Glenfir Resources &
Okanagan Nation Fisheries Commission

Submitted by: Karilyn Long

Date: September 1st, 2000

1.0 Introduction

The Okanagan Nation Fisheries Commission (ONFC) is completing a feasibility study on the re-introduction of sockeye salmon (*Oncorhynchus nerka*, Walbaum) into Skaha Lake, where they historically ranged. Objective 2 of the study requires an exotic species re-introduction risk assessment, including a review of available fish inventory information in the Okanagan River system below Skaha Lake, in Skaha Lake and the southern portion of Okanagan Lake. The following literature review covers both native and exotic fish species presence and distribution in the Okanagan Basin.

2.0 Literature review methods

Research methods of the ONFC commissioned report titled "Presence and distribution of exotic fish species in the Okanagan Watershed" (25) consisted primarily of conducting telephone or personal interviews. These interviews were with the staff of fishing tackle retail shops from Vernon to Osoyoos, the Ministry of Environment, Lands and Parks (MELP) in Penticton biologists, staff of the Summerland Trout hatchery and local Okanagan anglers. Due to funding limitations the report focused on exotic species only. Along with the results from the above-mentioned report, the following search areas were covered for available literature and fish collections in the study area.

- Okanagan Nation Fisheries Commission (ONFC)
- Okanagan University College (OUC)
- Department of Fisheries and Oceans, Pacific Biological Station
- Fisheries Information Summary System (FISS)
- University of Victoria libraries
- University of Washington libraries
- Utah State University
- Royal BC Museum
- Provincial Museum of Alberta, Edmonton
- University of Alberta, Edmonton Museum of Zoology
- Ministry of Environment, Lands and Parks - Regional Penticton Office
- Ministry of Environment, Lands and Parks - BC Headquarters, Victoria
- Central Okanagan Regional District

3.0 Results - Summary of fish distribution

Species Code	Common name	Present below Skaha Lake	Present in Skaha and Okanagan Lake	References
BB	Burbot	✓	✓	12, 13, 36, 8, 35, 39, 6
*BCB	black crappie	✓	Unconfirmed	5, 25, 6, 36, 38, 8
*BKH	black bullhead	✓		26, 25, 6, 38, 8
*BNH	brown bullhead	Unconfirmed		25
BSU	bridgelip sucker		✓	10, 17
CAS	prickly sculpin	✓	✓	26, 12, 13, 17, 8, 35, 6
CCG	slimy sculpin	✓	✓	17, 8, 6
CMC	chiselmouth chub		✓	26, 18, 8, 35, 37
*CP	Carp	✓	✓	26, 25, 12, 13, 8, 36, 39, 1, 6, 38, 27, 40
CSU	largescale sucker	✓	✓	13, 17, 8, 35, 6, 36, 38
*EB	eastern brook trout	✓	✓	15, 26, 8, 55, 56, 30
*GC	Goldfish	✓		25, 36, 38, 8
KO	Kokanee	✓	✓	57, 15, 12, 13, 17, 47, 19, 36, 34, 18, 33, 53, 8, 39, 35, 52, 6
LDC	leopard dace		✓	8
*LMB	largemouth bass	✓		5, 26, 25, 1, 6, 24, 36, 38,8
LNC	longnose dace	✓	✓	26, 13, 8, 48
LSU	longnose sucker	✓	✓	8, 48
*LT	lake trout		✓	15, 25, 36, 8
*LW	lake whitefish	✓	✓	25, 35, 8, 6, 36, 38, 27
MW	mountian whitefish	✓	✓	57, 8, 36, 35, 39, 6, 38, 36
NSC	northern pike minnow (formerly squawfish)	✓	✓	6, 35, 57, 29, 12, 13, 21, 8, 39, 27, 40
PCC	peamouth chub	✓	✓	57, 34, 8, 39, 6, 40
*PMB	pumpkinseed, sunfish	✓	✓	26, 25, 8, 6, 35, 36, 38
PW	pygmy whitefish	✓	✓	6, 8
RB	rainbow trout, (formerly Kamloops trout)	✓	✓	6, 36, 38, 55, 56, 30, 26, 12, 13, 34, 35, 8, 39, 40
RSC	redside shiner	✓	✓	26, 12, 13, 8, 27
SK	sockeye salmon	✓		52, 22, 28, 48, 45
*SMB	smallmouth bass	✓	✓	7,25, 36, 39, 1, 6, 28, 38, 8
ST	steelhead (summer run)	✓		8, 36, 38, 40
*TC	Tench	Unconfirmed		25, 48, 6
WF	whitefish; general		✓	12, 13, 36, 39, 8, 40
*WP	Walleye	Unconfirmed		15, 25
*YP	yellow perch	✓	✓	5, 26, 25, 8, 1, 48, 50, 6, 35, 36

* Exotic species

4.0 Summary of results

Of concern to the feasibility of re-establishing sockeye salmon is exotic fish passage and colonization of upstream areas, which may have a negative effect on the lakes ecosystem. Where the aggressive exotic fish from downstream colonize and alter native fish abundance, fauna as well as wildlife species and the sport fishery.

The original Okanagan Falls, located between Skaha and Okanagan Lake was historically known as a selective fish passage structure, which sockeye could migrate past into Skaha Lake (photo available from the National Archives of Canada # PA 32416). Any fish passage structures constructed to make Skaha and Okanagan Lakes accessible to sockeye may need to be selective to allow passage by sockeye salmon and take into account exotic fish not found in Skaha Lake but in Osoyoos Lake.

Sockeye and steelhead are the native fish species, which are present below Skaha Lake but not in Skaha or the southern portion of Okanagan Lake. The following exotic species are also present below Osoyoos Lake but not in Skaha or the southern portion of Okanagan Lake,

- black bullhead
- brown bullhead
- black crappie
- goldfish
- largemouth bass
- tench
- walleye.

There are unconfirmed reports of walleye below Skaha Lake, however due to their capability to swim against a current and travel long distances they potentially pose the greatest threat to the ecosystem as a predatory fish (43). Washington Department of Fish and Wildlife during the 1950's stocked walleye and a fishery was established in the 1970's (58). Largemouth bass are predatory fish that feed in the littoral areas, which may make them competitors for food with sport fish, and they may prey on juvenile salmonids (11). Bullheads are bottom-feeding, shallow water dwellers which the impacts on the ecology and other fish are unknown (46). Black crappie are known to travel in open waters and feed on a variety of small fish as well as plankton (46). Tench is a carp-like fish that would most likely have the same effect on the ecosystem that carp have, such as competition for food with native species (54). Further literature review of the impact of the above exotic fish on native fish and the ecosystem will follow in a separate literature review.

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APPENDIX a - (Task 2a) Review available fish inventory information.

Review available fish inventory information in the Okanagan River system below Skaha Lake, and in Skaha and the southern portion of Okanagan Lake. Available fish inventory information has been compiled into the following table, which has been organized by study area then by date.

Area	**Date**	**Study**	**Species noted**	**Ref**	**Available from**
British Columbia	1998	Rare fish of British Columbia.	BSU among others	10	UBC
Okanagan Basin	1973	General limnology of the mainstem lakes. Identifying dominant fish species.	Osoyoos:KO, MW Vaseux: NSC, PCC Skaha: NSC, PCC Okanagan: KO, PCC, MW	57	ONFC
Okanagan Basin	1985	Warmwater gamefish management plan	Osoy:LMB, SMB, BCB, YP Vaseux:LMB, YP Okanagan lk=YP	5	MELP - Penticton
Okanagan Basin	1987	Investigations of black bass in the Okanagan sub-unit.	BS	21	MELP-Pent Columbia Env
Okanagan Basin	1994	A general fish inventory of the streams in the south Okanagan and Similkameen watersheds. The survey included 33 streams and 4 oxbows, from Kelowna to Osoyoos.	Osoyoos:CP, NSC, CAS, RB, EB, PMB, BKH, RSC, LMB, YP. Skaha: LNC, RB Okanagan:RSC, LNC, CMC, RB, CP	26	ONFC
Okanagan Basin	1995	Literature Reviews of the Life History, Habitat Requirements and Mitigation/Compensation Strategies for Selected Fish Species	Spp. of interest include KO, WP, LT, RB, BT	15	ONFC

Area	Date	Study	Species noted	Ref	Available from
Okanagan Basin	2000	Presence and distribution of exotic fish species in the Okanagan watershed	LMB, SMB, LT, PMB, BCB, WP, YP, BKH, BNH, TC, CP, GC, EB	25	ONFC
Okanagan Lake	1939	The fishes of Okanagan Lake and nearby waters. Ministry of Environment	BB, WF, KO, RB, CP, RSC, NSC, CAS	12	MELP – Penticton
Okanagan Lake	1939	Biological survey of Okanagan Lake. MELP	BB, WF, KO, RB, CBC, CSU, BSU, CP, RSC, NSC, LNC, CAS	13	MELP – Penticton
Okanagan Lake	1970	Heavy metal content of some freshwater fishes in BC.	KO, CAS, CCG, DC, CMC, NSC, CSU	17	BC Fisheries, Victoria
Okanagan Lake	1974	Bibliography on kokanee spawning, large lake management, winter kill, stream stocking, bass biology & inland commercial fishing	KO	3	MELP – Penticton
Okanagan Lake	1977	Lake Survey and Stocking Records for the Okanagan Region of British Columbia	RB, KO, LW, EB, CAS, RSC, BB, CP, NSC	27	MELP – Penticton
Okanagan Lake	1990	Okanagan Lake management plans 1990-1995	KO	47	MELP – Victoria
Okanagan Lake tributaries	1994	Migration of Kokanee Salmon Adults into Mission Creek Spawning Channel and Estimate of Egg Deposition.	KO	19	ONFC & OUC
Okanagan Lake	1995	Lake plans of Okanagan Watershed	LT, BB, KO	36	MELP – Penticton
Okanagan Lake	1995	Okanagan Lake File #34020-20-02	KO, PCC, RB	34	MELP-Penticton
Okanagan Lake	1995	BC Lakes database	RB	35	MELP – Victoria
Okanagan Lake	1998	Okanagan Kokanee Stream Escapements	KO	53	ONFC
Okanagan Lake	1999	BC Environment, Fisheries Program, 1999. Fisheries Information Summary System (FISS) DFO Web-site	BB, CAS, CCG, CMC, CP, CSU, DC, EB, KO, LDC, LNC, LT, MW, PW, RB, ST, LSU, YP, NSC, PCC, RSC	8	FISS

Area	Date	Study	Species noted	Ref	Available from
Okanagan Lake	1999	Ministry of Environment Lands and Parks. Okanagan Kokanee Spawning Summary for 1999.	KO	33	ONFC & MELP - Penticton
Okanagan Lake	1998/1999	Okanagan Lake floating bridge proposed upgrade project	CAS, CP,LSU, NSC, RSC, PCC, PMB, LW, PMB, KO	14	Coast River Env. Serv.
Okanagan Lake	2000	Okanagan River - Rainbow/Steelhead geneetic sampling 2000	ST, RB, NSC, PCC, WF, CP	40	MELP - Penticton
Skaha Lake	1977	Lake survey and stocjking records for the Okanagan Region of British Columbia	MW, LW, KO, RB, CP, NSC, BB, PCC, SU	27	MELP - Penticton
Skaha Lake	1991	Summary of small lakes index management aerial angler count for 1991.	N/A	37	MELP - Penticton
Skaha Lake	1995	Lake plans of Okanagan Watershed	KO, SMB, RB, BB, WF, CP, MW	36	MELP - Penticton
Skaha Lake	1995	BC Lakes database	BB, CAS, CMC, CSU, LW, MW, RB, KO	35	MELP - Victoria
Skaha Lake	1995	Skaha Lake. File #: 34020-20-(02).	KO, BB, CBC, CC, CMC, CP, WF, MW, NSC, PCC, RB, SMB, SU	39	MELP - Penticton
Skaha Lake	1999	BC Environment, Fisheries Program, 1999. Fisheries Information Summary System (FISS) DFO Web-site	BB, CAS, CBC, CC, SU, CMC, CP, CSU, KO, LW, MW, NSC, SMB, PCC, RB, RSC, WF	8	FISS
Okanagan River	1954	The salmon problems associated with the proposed flood control project on the Okanagan River in British Columbia.	SK, KO	52	ONFC
Okanagan River	1966	Influence of rocky reach dam and temperature of the Okanagan River on upstream migration of sockeye salmon.	SK	31	Trumbley Env. Consul.
Okanagan River oxbows	1975	Warmwater fish inventory of Okanagan River Oxbows adjacent to Osoyoos Lake	LMB, SMB, YP, CP, BS, BH	1	ONFC, MELP - Penticton
Okanagan River	1994	1993 Okanagan River sockeye spawning ground population study.	SK	22	Trumbley Env. Consul.

Area	Date	Study	Species noted	Ref	Available from
Okanagan River	1995	Okanagan River sockeye salmon spawning ground escapement	SK	28	Trumbley Env. Consul.
Okanagan River	1995	Sockeye and Kokanee fry migration study – Okanagan River above Osoyoos Lake	SK/KO fry, WF fry and minor catches of LSU, YP, LNC and TC	48	MELP - Penticton
Okanagan River	1996	Evaluation of 1995 Okanagan River sockeye abundance estimation	SK	49	Trumbley Env. Consul.
Okanagan River	1997	Okanagan River Sockeye Escapement to Spawning Grounds Study	SK	51	ONFC
Okanagan River	1999	Fisheries Habitat in the Okanagan River Phase 1: Options for Protection and Restoration.	LW, CP, BKH, TC, SMB, LMB, BCB, PMB, YP, RB, KO, MW, CSU, PW, NSC, PCC, CAS, CCG, BB	6	ONFC & Glenfir Res.
Osoyoos Lake	1977	Lake survey and stocking records for the Okanagan Region of British Columbia	MW, LW, CP, RB, KO, SK, NSC, YP	27	MELP – Penticton
Osoyoos Lake	1982	Osoyoos Bass project report. Ministry of Environment	BS	23	ONFC
Osoyoos Lake	1982	Technical Report: Habitat Bass - Improvement. Osoyoos Bass Project.	SMB, LMB	24	MELP – Penticton
Osoyoos Lake	1991	Summary of small lakes index management aerial angler count for 1991.	N/A	37	MELP – Penticton
Osoyoos Lake	1995	Provincial Museum of Alberta, Edmonton: Collections	YP	50	Museum of Alberta
Osoyoos Lake	1996	Limnology of lake Osoyoos and sockeye salmon rearing conditions	SK	45	ONFC
Osoyoos Lake	1995	BC Lakes database	MW, NSC, PMB, RB, SP, YP	35	MELP – Victoria

Area	Date	Study	Species noted	Ref	Available from
Osoyoos Lake	1995	Lake plans of Okanagan Watershed	RB, YP, BCB, PMB, MW, CSU, SMB, BKH, GC, ST, CP, KO, LMB, LW	36	MELP - Penticton
Osoyoos Lake	1995	Osoyoos Lake File #: 34020-20-02.	RB, YP, BCB, PMB, MW, CSU, SMB, BKH, GC, ST, CP, KO, LMB, LW	38	MELP - Penticton
Osoyoos Lake	1999	BC Environment, Fisheries Program, 1999. Fisheries Information Summary System (FISS) DFO Web-site	BCB, BKH, CP, GC, PMB, KO, LMB, LW, RB, MW, SMB, NSC, ST, YP	8	FISS
Osoyoos Lake tributaries	1997	Fish inventory and stream classification for CP 55.	EB, RB	55	ONFC & Wildstone
Osoyoos Lake tributaries	1997	Fish inventory and stream classification: Tributaries to Inkaneep, Vaseux and Damfino Creeks.	EB, RB	55	ONFC & Wildstone
Osoyoos Lake tributaries	2000	Inkaneep Creek Fish Inventory and Fish Habitat Assessment	LMB, EB, RB	30	ONFC

APPENDIX b - List of Species Codes

The following species codes were used in the tables listing the species inventoried in the Okanagan Basin. The codes are based on Fisheries Information Summary System (FISS) BC fish species codes (18).

Species Code	Common name	Scientific name
BB	burbot	*Lota lota*
BCB	black crappie	*Pomoxis nigromaculatus*
BH	bullhead, catfish; general	*Ameiurus* spp.
BKH	black bullhead	*Ameiurus melas* (formerly *Ictalurus melas)*
BNH	brown bullhead	*Ameiurus nebulosus (formerly Ictalurus nebulosus)*
BS	bass, sunfish; general	*Micropterus* spp., *Lepomis* spp., *Pomoxis* spp.
BSU	bridgelip sucker	*Catostomus columbianus*
CAS	prickly sculpin	*Cottus asper*
CBC	chub; general	
CC	sculpin; general	Primarily *Cottus* spp.
CCG	slimy sculpin	*Cottus cognatus*
CMC	chiselmouth	*Acrochelius alutaceus*
CP	carp	*Cyprinus carpio*
CSU	largescale sucker	*Catostomus macrocheilus*
DC	dace; general	*Rhinichthys* spp., *Phoxinus* spp.
EB	eastern brook trout	*Salvelinus fontinalis*
GC	goldfish	*Carassius auratus*
KO	kokanee	*Oncorhynchus nerka*
LDC	leopard dace	*Rhinichthys falcatus*
LMB	largemouth bass	*Micropterus salmoides*
LNC	longnose dace	*Rhinichthys cataractae*
LSU	longnose sucker	*Catostomus catostomus*
LT	lake trout	*Salvelinus namaycush*
LW	lake whitefish	*Coregonus clupeaformis*
MW	mountian whitefish	*Prosopium williansoni*
NSC	northern pike minnow (formerly squawfish)	*Ptycheilus oregonensis*
PCC	peamouth chub	*Mylocheilus caurinus*
PMB	pumpkinseed, sunfish	*Lepomis gibbosus*
PW	pygmy whitefish	*Prosopium coulteri*
RB	rainbow trout, (formerly Kamloops trout)	*Oncorhynchus mykiss* (formerly *Salmo gairdneri)*
RSC	redside shiner	*Richardsonius balteatus*
SK	sockeye salmon	*Oncorhynchus nerka*
SMB	smallmouth bass	*Micropteruus dolomieui*
SP	not identified	
ST	steelhead (summer run)	*Oncorhynchus mykiss*
SU	sucker; general	*Catostomus* spp.
TC	tench	*Tinca tinca*
WF	whitefish; general	*Prosopium* spp., *Coregonus* spp., *Stenodus* spp.
WP	walleye	*Stizostedion vitreum*
YP	yellow perch	*Perca flavescens*

APPENDIX C

LITERATURE REVIEW OF HABITAT REQUIREMENTS FOR EXOTIC SPECIES OF CONCERN

Literature review (Task 2c):

Habitat requirements for exotic species identified as being present in the Okanagan System below Skaha Lake but not in Skaha or Okanagan Lake.

Submitted to: Chris Bull, Glenfir Resources &
Okanagan Nation Fisheries Commission

Submitted by: Karilyn Long

Date: September 1st, 2000

1.0 Introductions

Since their extirpation due to a series of dams on the Okanagan River that inhibit upstream migration, sockeye salmon (*Oncorhynchus nerka*, Walbaum) access as far as McIntyre Dam below Vaseux Lake. Improving fish passage for sockeye to access Skaha Lake may also allow exotic fish species passage into the lake where they could potentially colonize Skaha Lake and affect the existing fish populations.

Part of Objective 2, of the sockeye re-introduction risk assessment is to identify habitat requirements for the exotic species present in the Okanagan system below Skaha Lake. This project is managed by the Okanagan Nation Fisheries Commission.

2.0 Methods

This literature review covers the exotic species which were identified in task 2a, the review of available fish inventory information in the Okanagan River system. Walleye has been added to the list because of its aggressive colonization and its presence in the Columbia River mainstem.

Table 1. Names and distribution of exotic species reported in Okanagan basin

Exotic Species	**Scientific name**	**Distribution**	**Included in review**
Tench	*Tinca tinca*	unconfirmed reports from Kalamalka Lake (45)	*
Black crappie	*Pomoxis nigromaculatus*	reports from Okanagan Lake (45)	*
Brown bullhead	*Ameriurus nebulosis*	Uncertain distribution	*
Black bullhead	*Ameriurus melas*	reports form Duck Lake(45)	*
Yellow perch	*Perca fluviatilis*	Established throughout	
Walleye	*Stizostedion vitreum*	unconfirmed reports from Okanagan Lake	*
Largemouth bass	*Micropterus salmoides*	established south of Okanagan Falls (45)	*
smallmouth bass	*Micropteris dolomieui*	established in Okanagan Lake and valley lakes (45)	
pumpkinseed	*Lepomis gibbosus*	established throughout(45)	
carp	*Cyprinus carpio*	established throughout(45)	
goldfish	*Carassius auratus*	reports below Skaha Lake	*

3.0 Results - Task 2c

The following series of tables (Table 2) summarizes the literature reviewed. The Literature concerning how these particular species affect salmonids is sparse.

Table 2. (Task 2c). Literature review on habitat requirements for exotic species identified as being present in the Okanagan system below Skaha Lake but not in Skaha or Okanagan Lake.

3.1 Tench *Tinca tinca*

Tench *Tinca tinca*	Lake habitat	Littoral: Tench most commonly exist in littoral zone of lakes (12). Tench also exist in swamps, weedy ponds, river backwaters and waters which, were heavily polluted with organic materials (67).
	Biology	Sluggish carp-like fish (15). Tench prefer mud-bottom ponds or the still waters where rooted aquatic plants grow (57). Tench are said to have a life expectancy of 20 to 30 years (57). Spawning usually occurs during early summer, in weedy shallow waters (57).
	Velocity tolerance	Tench are regarded as a slow moving sluggish fish (57). Evidence of spreading: Introduced in North America from Europe in 1936 during Seattle's World Fair; they have moved into Osoyoos Lake via the Columbia River (57).
	Competition & Predation	Competition: Impacts of tench invasion might be similar to those presently caused by carp, which is food competition with native species (45). Tench (like carp) also increase water turbidity and destory aquatic vegetation that is essential for cover, food and spawning sites the survival of native species (57). Predation: They are preyed upon by predatory fish like the northern pike, but large tench probably have few enemies except man (33). Feeding: Tench are mainly bottom feeders (61). Feeding mainly on vegetation, but also on small aquatic life on the bottom. Tench feed on zooplankton as juveniles but then switch to feeding on a broad range of benthic macroinvertebrates (54). They feed mainly early morning and late evening (57 & 61).
	Physio / chemical tolerances	Oxygen: 0.4ppm dissolved oxygen is at the lowest concentration that tench can survive (67). Tench are able to live in poorly oxygenated water (68). Turbidity: Tolerance to turbidity must be high as tench have been observed in hatchery troughs buried in the mud bottom during winter where they remained torpid (67). Temperature: Tench live comfortably between 15 and 32 °C (67).

3.2 Black crappie, *Pomoxis nigromaculatus*

Black crappie *Pomoxis Nigromaculatus*	Lake habitat	Littoral: Black crappie are found in large ponds, small lakes, bays and shallower areas of larger lakes and areas of low flow of larger rivers (57).
	Biology	They are almost always associated with abundant growths of aquatic vegetation; sandy to mucky bottoms. They are less often found in turbid conditions. They are usually found in discrete, moderately large schools (57). Spawning: Black crappie spawns in late spring and early summer starting when water temperature is 19-20°C (57). They spawn up to 6 feet deep (44).
	Velocity tolerance	Black crappie are associated with low flows and quiet waters (57). Evidence of spreading: Native in the backwaters and tributaries of the Columbia River (57).
	Competition & predation	Competition: Crappie may compete with walleye to some degree because their habits are similar. Both species travel open water in schools, feeding on similar foods at night, dusk and dawn (44). Predation: Juvenile black crappie are probably prey of a variety of warmwater predaceous fish such as largemouth and smallmouth bass. The spines of the adults probably make predation negligible (57). Feeding: The diet of crappies change with size and age with younger crappies feeding on planktonic crustacea and free-swimming, nocturnal larvae until they are 160mm in length (3). Beyond that size a variety of very small fishes make up an increasing proportion of the diet (57). Adults can continue to feed on plankton but primarily eat small fish (44). Perch, which share their open water habitat were most often eaten. Crappies are active and feed all winter. Feeding is most active in open water mass in the early morning and between midnight and 2 am (57).
	Physio / chemical tolerances	Turbidity: prefer clear water areas (57). Temperature: The black crappie are usually found in warmwater areas (57).

3.3 Black bullhead, *Ameriurus melas*

Black bullhead *Ameriurus melas*	Lake habitat	Littoral: The habitat of this species is usually considered to be lower sections of small to medium sized streams of low gradient, ponds, and backwaters of larger rivers and silty, soft-bottomed areas of lakes or impoundment's (57).
	Biology	The adults of this species are almost entirely nocturnal. The young feed most actively just before dawn and again after dark (57). Spawning: Considered a spring spawner or when the water temperature reaches 21 °C. Spawning takes place in areas of moderate to heavy submerged vegetation, in shallow water (57).
	Velocity tolerance	Usually found in low gradient areas. Evidence of spreading: Introductions into the Columbia River resulted in spreading to Oregon, Idaho and BC (57).
	Competition & Predation	Competition: Black bullhead is a competitor of sunfishes and some other bottom feeders (57). It does not inhabit the areas in which brown and yellow bullheads usually occur but seems to replace these species if the habitat deteriorates (57). Predation on black bullhead is low (57). Feeding: Food is sought along the bottom on immature insects, clams, snails, crustaceans, plant material, leeches and fishers (57).
	Physio / chemical tolerances	The black bullhead is apparently more tolerant of pollutants than yellow or brown bullheads. Oxygen: Tolerant of warm water and low levels of dissolved oxygen (25). Temperature: This species can withstand extremely high temperatures. Upper lethal limit for temperature is 35 °C (57).

3.4 Brown bullhead, *Ameriurus nebulosus*

Brown bullhead *Ameriurus nebulosus*	Lake habitat	Littoral: Brown bullheads usually occur near or on the bottom in shallow, warmwater situations, in ponds, small lakes, shallow bays or larger lakes and slow-moving streams with abundant aquatic vegetation (57). They are sometimes are found as deep as 40 feet (57).
	Biology	Brown bullheads prefer quiet, murky waters, soft bottoms and rarely found in clear rocky-bottomed habitats. Brown bullheads are primarily scavengers (62). Spawning occurs in the late spring and summer, when water temperature reaches 21 ^{o}C. Spawning sites are mud-bottomed or sand or among the roots of aquatic vegetation, usually near the protection of a stump, rock or tree. Brown bullheads will also nest in hollow stumps and even inside vehicle tires. Nesting depth vary from 150 mm to as deep as a metre and are usually found around the shores of lakes or in coves, bays or creek mouths (57).
	Velocity tolerance	Present in primarily slow-moving streams. Evidence of spreading: Its occurs as a result of introductions in BC (57).
	Competition & Predation	Competition: Brown bullheads probably compete quantitatively for bottom organisms with a wide variety of bottom-feeding fishes (57). Predation: Brown bullheads especially the young are eaten by a variety of predatory fishes which include northern pike and walleye (57). Feeding: Adults are omnivorous, their food is composed of waste, mollusks, immature insects, terrestrial insects, leeches, crustaceans (crayfish and plankton), worms algae, plant material, fishes and fish eggs. Brown bullheads have been noted to eat the eggs of trout and cisco, however incidence of this has been noted as minor (18). Feeds on or near the bottom mainly at night (57).
	Physio / chemical tolerances	They are very tolerant of conditions of temperature, oxygen and pollution which might be limiting for other species (57). Oxygen: Survive high CO and low oxygen concentrations. In winter they can live at 0.2ppm oxygen (57). Turbidity: Tolerance to turbidity must be high as Brown bullhead have been known to burrow in the bottom mud to avoid adverse conditions (57). Temperature: The upper lethal limit temperature is 29-38^{o}C (57).

3.5 Largemouth bass, *Micropterus salmoides*

Largemouth bass *Micropterus salmoides*	Lake habitat	Littoral: Habitat of the largemouth bass is the upper warmwater levels in lakes and more rarely large slow rivers. This species is rarely caught at depths over 6 metres (57). Generally bass feed in the shallows at night (48 & 30). Largemouth bass move to the lake bottom in winter and are active (57).
	Biology	Adult: Bass is almost universally found in association with soft bottoms, stumps and extensive growths of a variety of emergent and sub-emergent vegetation (5 & 57). They thrive best in shallow, weedy lakes or in river backwaters (25 & 48). Spawning: Bass spawns from late spring (10) to mid-summer usually when the water temperature reaches 15.5°C (57). Largemouth bass prefer to nest in quiet, more vegetated areas, but will use any substrate (25).
	Velocity tolerance	Movement is not extensive, usually less than 5 miles (57). Evidence of spreading: Bass were found in Osoyoos and Vaseux Lakes as early as 1920, but there were concerns even then that they might migrate further, eventually getting into the Fraser System where they would prey on salmon (14).
	Competition & predation	Competition: Juvenile largemouth bass compete for food with a wide variety of other bottom-feeding warmwater fishes. At 5 cm fry become active predators (25). Adults compete for food with all other shallow-water predaceous fishes in their habitat and with other sunfishes for spawning sites (57). They may compete indirectly with sport species such as rainbow trout, but generally do not compete for food because of habitat differences (55 & 66). Bass tend to be territorial ambush predators, which would tend to minimize their predation impact on a pelagic species such as KO (45). Predation: Egg/fry predators include crayfish, sunfishes,dragonfly/beetle larvae(57). Feeding: Adult largemouth bass are largely fish-eating predators but food type changes with size from plankton, insects to fish and frogs (15, 21, 25, 58 & 57). Food is taken at the surface (morning and evening) in the water mass (during the day) and from the bottom. Largemouth bass is a sight feeder often schooling near shore and close to vegetation (57 & 66). Fry feed primarily on zooplankton and insect larvae (51 & 62).
	Physio / chemical tolerances	Oxygen: optimal 5 mb/L (41). Turbidity: prefer clear water with cover (48). Temperature: optimal temperature 27-28 °C, lethal temperature 30-32 °C (41 & 57).

3.6 Walleye, *Stizostedion vitreum*

Walleye *Stizostedion vitreum*	Lake habitat	Pelagic: Larvae are photo-positive and probably pelagic in lakes until about 2.5 - 4.0 cm in length (38), where they occupy waters 0.3 - 1.2 m deep (50). Adults are found in lakes above the thermocline - often occurring in deep water during the summer and move inshore in the fall, as adults walleye are negatively phototaxic (59). Littoral: In the fall walleye use shallow to moderate depths, extensive littoral areas, moderate turbitities and extensive areas of clean rocky substrate (20). Usually found at < 15 m depths (66); most abundant in water between 1.2 and 3.7 m deep (17). There are daily movements (16) in response to light intensity (22).
	Biology	Larvae: Larvae drift passively to the lake rearing habitats after hatching from tributaries; after becoming photo-sensitive walleye seek shelter from light in areas such as deep or turbid water and cover habitats (66). Adult: Walleye tolerate a wide range of environmental conditions but are generally more abundant in moderate to large mesotrophic lakes or riverine systems characterized by cool temperatures, moderate turbitities and extensive areas of clean rocky substrate (20 & 24). Found under cover during the day, move inshore to feed at night (38); tend to school (17). Walleye will use sunken trees, boulder shoals, weed beds, and thick ice and snow as shelter from sunlight (38). Spawning: Walleye spawn in shallow shoals of lakes, streams and rivers shortly after ice break up (20). Spawning grounds are the rocky areas in white water below impassable falls and dams in rivers, or boulder, to coarse-gravel shoals of lakes (57). Spawning sites also include shoals and shorelines of lakes and streams; at lake depths of 0.05-4.6m (4 & 17); and river depths of 0.2 - 0.9m (17). Walleye also utilize dense mats of vegetation (38). There is evidence of homing to spawning grounds year after year (57) and spawning migrations of up to 100km (43).

cont. Walleye	Velocity tolerance	Critical velocity is from 0.6 m/sec to 0.74m/sec. Fry can handle only slight currents (38). Walleye is an active swimmer that is capable of traveling long distances (15). Evidence of spreading: Reports of walleye are unconfirmed in Okanagan Lake, it is likely only a matter of time before they become established south of Okanagan Falls, as they have already successfully colonized other BC rivers from the south (45). It is their aversion to light which probably explains why walleye have not yet been able to reach Osoyoos Lake via the Okanagan River even though the lower Okanagan supports good numbers of walleye (24).
	Competition & predation	Competition: Yellow perch, smallmouth bass and lake whitefish compete with walleye for food (57). Predation: Adult perch and walleye prey on juvenile walleye, as probably do a wide variety of predatory fishes (57). Feeding: Both adult and juvenile walleye follow a similar seasonal feeding pattern, progressing from a predominantly invertebrate diet in the spring and early summer to a predominantly fish diet in the late summer and fall (20, 57 & 59). Walleye are found to prey on juvenile sockeye salmon in lakes (10). Walleye is probably the greatest threat to Okanagan kokanee (45).
	Physio / chemical tolerances	Oxygen: adult lethal <1 mg/L; optimal fry > 5 mg/L (38). Temperature: fry lethal 31-31 °C; adult optimal 20 - 24 °C; adult lethal 29-32 °C (38) Turbidity: walleye survive and grow at a wide range of turbitities (38) but moderate turbidity is preferred. Maximum feeding for walleye occurs at 1-2 m secchi, poor feeding at < 1 or > 5 m (38).

3.7 Goldfish, *Carassius auratus*

Goldfish *Carassius auratus*	Lake habitat	Littoral: Goldfish prefer littoral zones such as ponds and even colder-water lakes (10).
	Biology	They are most successful in small water bodies such as ponds where there is a good growth of aquatic plants (57). Spawning: Goldfish is a spring-spawner in weedy shallows (57). They are able to reproduce if aquatic vegetation is present (10).
	Velocity tolerance	Evidence of spreading: Goldfish have not been as successful as carp in natural waters in establishing themselves. Goldfish were brought to America by 1889 and occur only sporadically in Canada (57).
	Competition & Predation	Competition: They are prolific and probably as dangerous to native fish as carp (31). Carp are considered detrimental to native fish populations because they increase the turbidity of the water and uproot and destroy submerged aquatic vegetation that is essential for the survival of native species, since such growth provides cover, food and sometimes spawning sites. They also affect duck populations by destroying rooted aquatic plants in marshes (57). Predation: Young goldfish fall prey to a variety of predaceous fishes and birds (57). Feeding: Goldfish are omnivorous feeders consuming a variety of larvae and adult aquatic insects, mollusks, crustaceans, polycheates and aquatic vegetation (10 & 57).

4.0 Summary of results

4.1 Sockeye fry lake-rearing habitat and behavior

Juvenile sockeye typically exhibit diel feeding migrations during their lake residence, which in British Columbia is usually only one year (57). Upon entering the nursery lake, sockeye fry tend to feed in the shallow littoral areas for a few weeks before moving into deeper water where they concentrate initially at depths of 10 to 20m (limnetic zone). Juveniles in the limnetic zone are visual predators and are at this time vulnerable to piscivore predators. Upon transition to pelagic feeding, the juveniles target zooplankton. The pelagic feeding period of freshwater residence lasts ten or eleven months (26).

The native non-salmonid species that overlap with the juvenile sockeye in their lake distribution and food habits are, threespine stickleback, ninespine stickleback, pond smelt, pygmy whitefish and lake whitefish. Native lake rearing predators have been noted as being, rainbow trout, cutthroat trout, Dolly Varden char (bull trout is absent from the Okanagan system), and sculpins (*Cottus asper*) and northern pikeminnnow (26). Along with the native species, there are several exotic species such as yellow perch and smallmouth bass, which currently prey upon the resident kokanee and rainbow trout.

4.2 Exotic fish species – sockeye interactions

The following exotic species were identified in Task 2a as exotic species found below McIntyre Dam that may potentially migrate into Skaha Lake,

- tench
- black crappie
- black bullhead
- brown bullhead
- largemouth bass
- goldfish and
- walleye.

Tench are mostly sluggish bottom feeding fish, which inhabit the littoral zone of lakes and other swampy waters. It impacts would most likely be competition for food with native species.

Black crappie are found to inhabit low gradient, shallow waters. Beyond 160mm in length black crappie a variety of small fishes make up an increasing proportion of the diet. Adults can continue to feed on plankton but primarily eat small fish. Crappies are native in the backwaters and tributaries of the Columbia River.

Black and brown bullheads prefer quiet, murky, soft bottomed areas and are primarily bottom-feeding scavengers. Both bullheads compete with other bottom feeders for food but probably have little interaction with sockeye salmon.

Largemouth bass inhabit the upper warm water levels in lakes generally avoided by sockeye juveniles which keep to the colder deeper waters in lakes. They may compete indirectly with sport species. Bass tend to be ambush predators which tend to minimize their predation impact on pelagic species such as sockeye and kokanee. Bass resemble walleye in that most of the predation occurs from small fish not subject to recreational harvesting (8).

Walleye are found in the pelagic and littoral areas of lakes and progress from a predominantly invertebrate diet in the spring to a predominantly fish diet in the late summer and fall. Walleye are found to prey heavily on juvenile sockeye in lakes (10), however they have been found to eat fewer fry as they age (8). Due to the similar habitat and that walleye feed on kokanee and potentially sockeye salmon, walleye is probably the greatest threat to Okanagan kokanee populations and potential sockeye population's (45). Walleye predation is significant and difficult to manage, as walleye eat fewer smolts as they get older and most smolts are eaten by walleye smaller than those caught by anglers, so removal of walleye by angling has little (6).

Goldfish are most successful in small water bodies with a good growth of aquatic plants (57). Like carp they are prolific and dangerous to native fish because they increase water turbidity, uproot and destroy submerged vegetation which would provide cover, food and spawning sites for native species.

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APPENDIX D

HABITAT STRATIFICATION SAMPLING PLAN

		Habitat types		Sampling technique					
Site location	TRIM Map #	Substrate	Cover	Beach seine	Gill netting	Electrofishing boat	Minnow trapping	Trap netting	Weed harvestor
Okanagan Lake	82E052	Sandy beach	Submergent vegetation			EF-b #1			
Okanagan Lake	82E052	Silt near rip rap from the highway	Submergent vegetation			EF-b #2	MT1		
Okanagan Lake	82E052	Cobble substrate with some silt bottom	None			EF-b #3			
Okanagan Lake	82E052	Silt substrate	Emergent vegetation			EF-b #4	MT2		
Okanagan Lake	82E052	Sandy beach	Submergent vegetation				MT3		
Okanagan Lake	82E052	Silt	None				MT4		
Okanagan Lake	82E052	Cobble and rock substrate	None				MT5		
Penticton Channel	82E042	Cobble	None				MT6		
Penticton Channel	82E042	Cobble and submergent vegetation	None				MT7		
Penticton Channel	82E043	Cobble and silt	None				MT8		
Skaha Lake	82E033	Gravel and sand substrate	None	BS		EF-b #5			
Skaha Lake	82E033	Railway tresle pilings with silt substrate	None		GN	EF-b #6			
Skaha Lake	82E033	Silt substrate near riprap from the highway.	Submergent vegetation	BS		EF-b #7	MT10		
Skaha Lake	82E033	Cobble and rock reef	Surrounded by aquatic vegetation		GN	EF-b #8	MT9		
Skaha Lake	82E033	Sand	Emergent vegetation				MT11		
Skaha Lake	82E033	Rock	Beaver dam				MT12		
Okanagan River	82E033	Silt	Woody debris				MT13		
Okanagan River	82E033	cobble	Submergent vegetation				MT14 MT 15		
Okanagan River	82E033	Silt	Submergent vegetation				MT16		
Vaseux Lake	82E033	Silt	Overhanging bank vegetation				MT17		
Vaseux Lake	82E033	Sand and silt	Lily pad cover				MT18		
Vaseux Lake	82E033	Sand and silt	None				MT19		
Vaseux Lake	82E023	Rock	Rock				MT20		

		Habitat types		Sampling technique					
Site location	**TRIM Map #**	**Substrate**	**Cover**	**Beach seine**	**Gill netting**	**Electrofishing boat**	**Minnow trapping**	**Trap netting**	**Weed harvestor**
Vaseux Lake	82E023	cobble	Shore vegetation				MT21		
Vaseux Lake	82E023	Gravel	Shore vegetation				MT22		
Okanagan River Channel	82E023	Large rock	Rock cover				MT23		
Okanagan River Channel	82E023	Rip rap	Deep pool cover				MT24		
Okanagan River Channel	82E013	Gravel & cobble	None				MT25 MT26		
Okanagan River Channel	82E013	Cobble & rip-rap	None				MT27		
Okanagan River Channel	82E013	Cobble	None				MT28		
Osoyoos Lake	82E.03	Sand	Submergent vegetation & bullrushes	BS		EF-b #9	MT29		WH1
Osoyoos Lake	82E.03	Sand	Submergent vegetation & bullrushes			EF-b #10	MT30		WH4
Osoyoos Lake	82E.03	Silt	Submergent vegetation & bullrushes	BS		EF-b #11		TN	
Osoyoos Lake	82E.03	Rip rap and sand	Sparse bullrushes			EF-b #12			
Osoyoos Lake	82E.03	Sand and silt	None				MT31		
Osoyoos Lake	82E.03	Sand and silt	None		GN		MT32		
Osoyoos Lake	82E.03	Sand and silt	Submergent vegetation		GN		MT33		

APPENDIX E

WALLEYE ANGLING CONTRACTORS REPORT

Howie Wright
Okanagan Nation Fisheries Commission
3255 C Shannon Lake Road,
Westbank BC V4T 1V4

Dear Howie,

Re Walleye Angling at Osoyoos Lake

Studied information sent to me from Chris Bull Marked points and current areas as possible locations for Walleye.

Arrived at Osoyoos Lake May 29,2000 Monday afternoon. Talked to four different local businesses on fishing at Osoyoos Lake, no one had any information except printed material on different species in the lake. I was told that most of the locals do not fish Osoyoos Lake and those that fish, mainly fish for trout. Mainly tourists fish the lake during the summer.

Monday evening I spent five hours sonaring areas marked on the hydrographic map and fishing likely spots for Walleye. The only fish I caught were squawfish.

Tuesday May 30 2000 met Neil with Okanagan Fisheries Commission at 6:00 AM. We went to the Okanagan River and up to the drop structure to see if it would be a suitable area for Walleye to spawn. I feel that in the spring if the amount of water passing over the drop structure was the same as May 30 there is far to much current for Walleye to spawn here. We sonared the mouth of the river and marked some fish, the only fish we got were squawflsh. We then moved to a couple of areas Neil said they Electro-fished and got perch. We sonared and looked for fish in these shallow areas and seen none, we fished them and no fish were caught. We then move to the bridge in town and sonared this area and marked some fish again the only fish we caught were squawflsh. Neil informed me the proper name for squawfish is northern pike minnow. We moved on to Haynes Point and fished a couple of likely areas and no fish were caught. A storm moved in and it was time to drop Neil off. By this time I had fished the points and current areas on the east side of the lake. I picked up my dad and fished a few points on the west side of the lake. The west side of the lake has more typical walleye structure, slower tapering drop-off with rocks and weeds. After 12 hours on the water I called it a day.

Wednesday May 31 2000 started fishing at 7:00 AM and went to the current areas again but only caught squawfish. Dropped my dad off and picked up Howie at 10:30 AM. I spent a few hours with Howie explaining about sonar's, Walleye presentations and showed him how the under water camera worked as a good tool for finding out the sub-straight and some times identifying fish species. I dropped off Howie and continued to fish areas on the west side. I found another good area and fished it, I got small mouth bass and I think a carp and of course squawfish. I spent 10 hours fishing on Wednesday.

Thursday June 1 2000 in the morning we sonared and fished the rest of the likely areas for Walleye and only caught bass and squawfish. In the afternoon I went back over the best areas and fished them again and no Walleye were caught only squawfish and small bass. I spent 10 hours fishing on Thursday.

Surface temperatures:
Monday 59 to 60 degrees F
Tuesday 57 to 59 degrees F
Wednesday 58 to 60 degrees F
Thursday 60 to 62 degrees F

Method of presentation used with pictures:
Bottom bouncer and blades
Lindy rigs
Jigs
Jigging Spoons
Slip bobbers

Type of bait used:
Dew worms
Leeches

Type of equipment used:
LMS 350 with GPS
Flasher
Under water camera
Electric trolling motor
Gas motor

Conclusion:

Osoyoos Lake has suitable habitat for Walleye particular the west side and also has suitable areas for spawning success within the main lake.

After spending 37 hours on Osoyoos Lake fishing likely areas for Walleye with different types of presentations, in my opinion there is not an established Walleye population in Osoyoos Lake.

Yours truly,

Roger Patton

PHOTO #1 Walleye angling contractor, boat set-up

PHOTO #2 Jigs used by Walleye angler

PHOTO #3 Jigging spoon used by Walleye angler in Osoyoos Lake

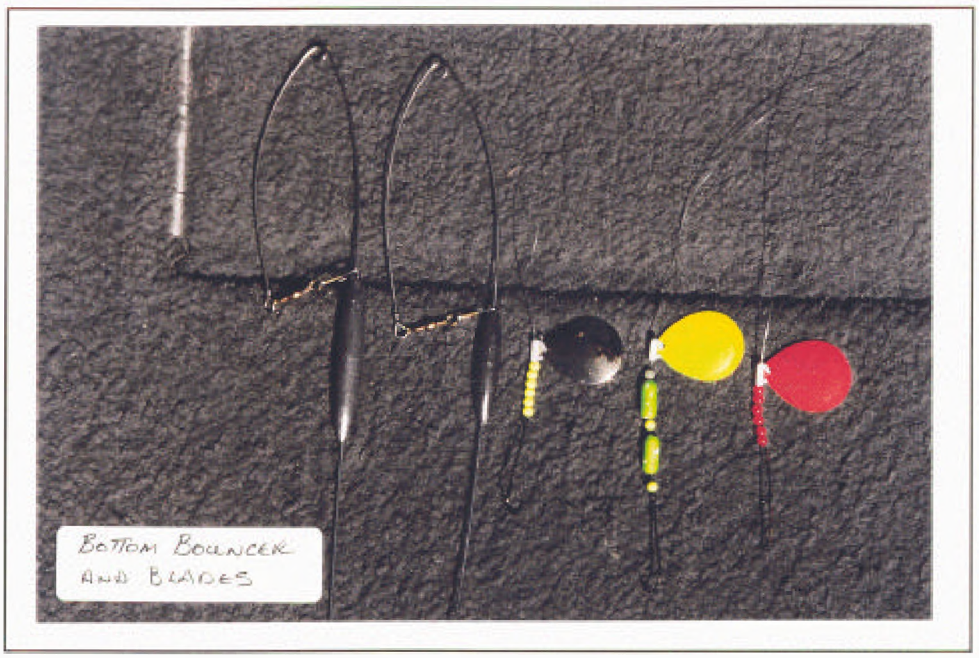


PHOTO #4 Bottom bouncers and blades used by walleye angler in Osoyoos Lake

APPENDIX F

DATA AND CPUE FOR BEACH SEINING

BPA – Exotic fish assessment
August 28, 29th, 2000 Beach Seine

		Fish Species Caught									CPUE				
Area	**Site #**	**LMB**	**SMB**	**BCB**	**CC**	**YP**	**PMB**	**CP**	**UNK**	**Total fish caught**	**No. of hauls**	**Net depth (m)**	**Net length (m)**	**Mesh size (mm)**	**Comments**
Osoyoos Lake	1		10		1					**11**	1	3.5	35	10	Hole size 20mm
	2		8			120				**128**	1	3.5	35	10	Painted turtle, hole size 10mm
	3			206						**206**	1	2.3	15	2 bunt 5 wings	Holes along edges 5mm and 2mm
	4									**0**	1	3.5	35	10	Negative-incomplete
Skaha Lake	1				8				1	**9**	3	2.3	15	2 bunt 5 wings	Substrate – cobble
	2									**0**	1	2.3	15	2 bunt 5 wings	Mud and boulders
	3				3					**3**	2	2.3	15	2 bunt 5 wings	
	4									**0**	2	2.3	15	2 bunt 5 wings	Negative
	5		15		3			1	1	**20**	3	2.3	15	2 bunt 5 wings	
	6		5		4		3			**12**	1	2.3	15	2 bunt 5 wings	
Total fish caught		**0**	**38**	**206**	**19**	**120**	**3**	**1**	**2**						

Fish species Codes

LMB	largemouth bass
SMB	smallmouth bass
BCB	black crappie
CC	sculpin, general
YP	yellow perch
PMB	pumpkinseed
CP	carp
UNK	unknown

PHOTO #5 Beach seining in Osoyoos Lake (BS-site#1)

PHOTO #6 Beach seining in Osoyoos Lake (BS-site#3)

PHOTO #7 Fish caught from beach seining in Osoyoos Lake

APPENDIX G

DATA AND CPUE FOR ELECTROFISHING BOAT

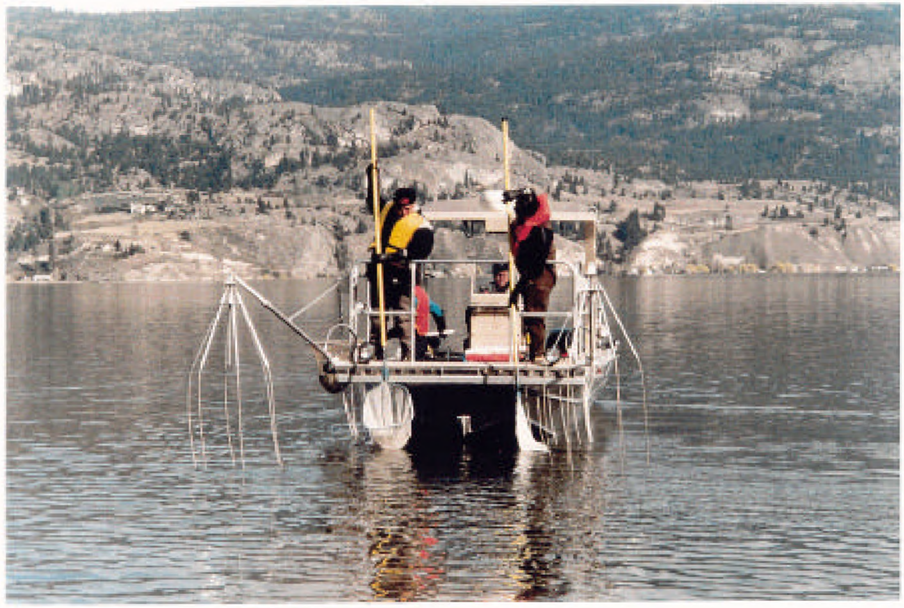


PHOTO #8 Boat Electrofishing in Skaha Lake (EF-b, site#8)

PHOTO #9 Boat Electrofishing in Skaha Lake (EF-b, site#8)

		South Okanagan Lake				Skaha Lake				Total no. of fish found above McIntyre Dam	Osoyoos Lake				Total no. of fish found below McIntyre Dam
Sampling season	Fish species	EF-b #1	EF-b #2	EF-b #3	EF-b #4	EF-b #5	EF-b #6	EF-b #7	EF-b #8		EF-b #9	EF-b #10	EF-b #11	EF-b #12	
April	Black bullhead								15	15	1				1
April	Burbot			1			1			2					0
April	Carp				1	1				2	4				4
April	Kokanee	3								3					0
April	Largemouth bass									0	2				2
April	Largescale sucker	5	31		5	28	6	1	7	83	9	2		2	13
April	Mountain whitefish		2			2				4	4				4
April	Northern pike minnow	1	3	5	5	1				15	2	7			9
April	Peamouth chub	1	1	1						3	2				2
April	Pumpkinseed								11	11					0
April	Redside shiner		13		15					28					0
April	Sculpin, general							6		6		3		4	7
April	Prickley sculpin		5		21					26					0
April	Smallmouth bass							2	39	41				4	4
April	Sockeye									0	1	1	1	1	4
April	Yellow perch							1	3	4	151	16	34	14	215

		South Okanagan Lake				Skaha Lake				Total no. of fish found above McIntyre Dam	Osoyoos Lake				Total no. of fish found below McIntyre Dam
Sampling season	**Fish species**	**EF-b #1**	**EF-b #2**	**EF-b #3**	**EF-b #4**	**EF-b #5**	**EF-b #6**	**EF-b #7**	**EF-b #8**		**EF-b #9**	**EF-b #10**	**EF-b #11**	**EF-b #12**	
June	Black bullhead					3	11	2	3	19			1	1	2
June	Burbot		2							2					0
June	Carp		1		2		1			4	3	5	3	7	18
June	Lake chub			1						1					0
June	Largemouth bass									0	1	2			3
June	Largescale sucker	13	7	8	3		14			45					0
June	Northern pike minnow	2	1	5	5	12	5	8	2	40				1	1
June	Peamouth chub					12		7		19	1			2	3
June	Prickley sculpin	3	14	1	1					19		3	1		4
June	Pumpkinseed								1	1					0
June	Rainbow trout						1	2		3	1				1
June	Redside shiner	4	17	2	3					26					0
June	Smallmouth bass					25	7	40	36	108		1	1	3	5
June	Sockeye									0		2	1		3
June	Sucker, general	4	3	3	10	14		14	20	68	3	2		2	7
June	Whitefish, general	17								17	3	20	1		24
June	Yellow perch				1	2	2			5	101	24	22	6	153

		South Okanagan Lake				Skaha Lake				Total no. of fish found above McIntyre Dam	Osoyoos Lake				Total no. of fish found below McIntyre Dam
Sampling season	**Fish species**	**EF-b #1**	**EF-b #2**	**EF-b #3**	**EF-b #4**	**EF-b #5**	**EF-b #6**	**EF-b #7**	**EF-b #8**		**EF-b #9**	**EF-b #10**	**EF-b #11**	**EF-b #12**	
August	Black bullhead							1		1				1	1
August	Carp		3	1		6	3	1	1	15	5	10		3	18
August	Kokanee					1				1					0
August	Largemouth bass									0		6	14		20
August	Northern pike minnow	6	10	6	1	1		9	2	35		1	1		2
August	Peamouth chub	9	11	7		4	3	1	18	53	1				1
August	Prickley sculpin	2			2			1		5			1	1	2
August	Pumpkinseed								3	3	4	7	2	1	14
August	Redside shiner		2		4					6					0
August	Smallmouth bass					8	4	4	16	32	11	10	4	4	29
August	Sucker, general	8	19	7	2	14	2	9	21	82	4	4	1	3	12
August	Whitefish, general	7	2	1						10		3			3
August	Yellow perch	3							1	4	17	20	16	19	72

		South Okanagan Lake				Skaha Lake				Total no. of fish found above McIntyre Dam	Osoyoos Lake				Total no. of fish found below McIntyre Dam
Sampling season	**Fish species**	**EF-b #1**	**EF-b #2**	**EF-b #3**	**EF-b #4**	**EF-b #5**	**EF-b #6**	**EF-b #7**	**EF-b #8**		**EF-b #9**	**EF-b #10**	**EF-b #11**	**EF-b #12**	
November	Black bullhead							4	18	22					0
November	Black crappie									0		4	1		5
November	Carp				1					1		2			2
November	Largemouth bass									0			1		1
November	Largescale sucker	9		4	9					22	2	1	10		13
November	Northern pike minnow	2	1	1	6	2	1	8		21					0
November	Peamouth chub	4	1	1					1	7					0
November	Prickley sculpin		12	3	1					16		6	2	1	9
November	Pumpkinseed								8	8					0
November	Rainbow trout		1							1			1		1
November	Redside shiner	1	8		5					14					0
November	Smallmouth bass					2	3	13	71	89			1		1
November	Sockeye									0		8	24	73	105
November	Sucker, general			2	5	4	17	17	3	48					0
November	Whitefish, general	27	18	28	1	2				76		1	1		2
November	Yellow perch						1	1		2	6	4	9		19

BPA – Exotic Fish Assessment
Electrofishing boat CPUE 2000

Lake	Site	Date	EF seconds	No. of fish caught	Volts (V)	Output (Amps)	Duty cycle	Temp. oC
Okanagan South	EF-b #1	17-Apr-00	1095	10	944	5.7	40%	9.7
Okanagan South	EF-b #2	17-Apr-00	1188	55	818	7.0	35%	9.7
Okanagan South	EF-b #3	17-Apr-00	530	7	437	6.5	55%	9.7
Okanagan South	EF-b #4	17-Apr-00	570	47	437	6.5	55%	9.7
Skaha Lake	EF-b #5	18-Apr-00	1177	32	427	6.2	55%	10.0
Skaha Lake	EF-b #6	18-Apr-00	461	7	423	6.2	55%	10.0
Skaha Lake	EF-b #7	18-Apr-00	1262	10	430	7.0	55%	10.0
Skaha Lake	EF-b #8	18-Apr-00	1177	75	430	6.0	55%	10.0
Osoyoos Lake	EF-b #9	19-Apr-00	1619	176	409	6.0 to 7.5	40%	11.5
Osoyoos Lake	EF-b #10	19-Apr-00	808	29	413	5.5	38%	11.5
Osoyoos Lake	EF-b #11	19-Apr-00	1572	35	416	6.5 to 7.0	40%	11.5
Osoyoos Lake	EF-b #12	19-Apr-00	823	25	409	5.5	35%	11.5
Okanagan South	EF-b #1	20-Jun-00	2104	43	1000	7.1	35%	
Okanagan South	EF-b #2	20-Jun-00	2222	45	1000	7.1	35%	
Okanagan South	EF-b #3	20-Jun-00	744	20	1000	7.1	35%	
Okanagan South	EF-b #4	20-Jun-00	1750	25	1000	7.1	35%	
Skaha Lake	EF-b #5	21-Jun-00	1800	64	1000	6.8 to 7.0	30%	
Skaha Lake	EF-b #6	21-Jun-00	1189	41	1000	6.8 to 7.0	30%	
Skaha Lake	EF-b #7	21-Jun-00	1218	73	1000	6.7	30%	
Skaha Lake	EF-b #8	21-Jun-00	1053	62	1000	6.8 to 6.9	30%	
Osoyoos Lake	EF-b #9	22-Jun-00	1075	113	1000	5.8	30%	
Osoyoos Lake	EF-b #10	22-Jun-00	1215	57	1000	5.8	30%	
Osoyoos Lake	EF-b #11	22-Jun-00	1000	32	1000	6.8	30%	
Osoyoos Lake	EF-b #12	22-Jun-00	600	22	1000	6.8	30%	
Okanagan South	EF-b #1	21-Aug-00	1200	15	1000	7.1 to 7.5	30%	21.8
Okanagan South	EF-b #2	21-Aug-00	1800	45	1000	6.3	30%	22.0
Okanagan South	EF-b #3	21-Aug-00	1200	22	1000	7.0	30%	22.1
Okanagan South	EF-b #4	21-Aug-00	900	9	1000	7.0	30%	21.9
Skaha Lake	EF-b #5	22-Aug-00	1500	34	500	6.6	30%	
Skaha Lake	EF-b #6	22-Aug-00	1140	17	500	6.5	30%	21.4
Skaha Lake	EF-b #7	22-Aug-00	1320	27	500	6.5	30%	21.2
Skaha Lake	EF-b #8	22-Aug-00	840	62	500	6.5	30%	21.6
Osoyoos Lake	EF-b #9	23-Aug-00	660	42	500	6.5	30%	23.2
Osoyoos Lake	EF-b #10	23-Aug-00	1260	61	500	6.5	30%	
Osoyoos Lake	EF-b #11	23-Aug-00	1200	39	500	6.5	30%	23.5
Osoyoos Lake	EF-b #12	23-Aug-00	1080	32	500	6.1	30%	
Okanagan South	EF-b #1	6-Nov-00	2460	43	500	6.0 to 6.8	30%	8.8
Okanagan South	EF-b #2	6-Nov-00	1500	41	500	6.0 to 6.8	30%	8.9
Okanagan South	EF-b #3	6-Nov-00	840	39	500	6.0	30%	9.0
Okanagan South	EF-b #4	6-Nov-00	1260	28	500	6.3	38%	8.6
Skaha Lake	EF-b #5	7-Nov-00	1140	15	500	6.0	10%	9.1
Skaha Lake	EF-b #6	7-Nov-00	1500	22	500	7.0	40%	9.2
Skaha Lake	EF-b #7	7-Nov-00	1240	43	500	7.0	40%	9.1
Skaha Lake	EF-b #8	7-Nov-00	1020	101	500	6.8	40%	
Osoyoos Lake	EF-b #9	21-Nov-00	900	8	500	4.5	30%	6.8
Osoyoos Lake	EF-b #10	21-Nov-00	1080	26	500	4.4	30%	7.7
Osoyoos Lake	EF-b #11	21-Nov-00	900	50	500	3.0 to 3.5	25%	8.1
Osoyoos Lake	EF-b #12	21-Nov-00	600	74	500	3.5 to 5.0	25 to 40%	6.8

APPENDIX H

DATA AND CPUE FOR GILLNETTING

				Fish species caught						CPUE		
Date 2000	**Lake**	**Site**	**Mesh size (inches)**	**CSU**	**NSC**	**SK adult**	**SMB**	**SU**	**WF**	**Depth of Lake at set**	**Time set**	**Time picked**
5-Jul	Osoyoos Lake	1	2.5		2					9 feet	9:35pm	11:30pm
			3		1					13 feet	9:00pm	11:15pm
			5							14 feet	9:30pm	11:20pm
		2	2.5		1				1	10 feet	10:45pm	12:00am
			3							14 feet	10:00pm	12:15am
			4.5			3				8 feet	10:15pm	12:20am
14-Nov	Osoyoos Lake	3	5.5, 5.0, 4.5, 3.5, 3.0, 2.5, 2.0	1	2	1	1		7	15 feet	14 Nov 00 3:00pm	15 Nov 00 10:00 am
6-Jul	Skaha Lake SW	4	2, 2.5, 3, 3.5, 4		1			3			9:00pm	9:20pm
											9:20pm	12:15am
								2			12:15pm	12:30am
		5	3, 2, 3								9:60pm	9:45pm
	Total number of fish			1	7	4	1	5	8			

APPENDIX I

DATA AND CPUE FOR MINNOW TRAPPING

Completed by:		Columbia Environmental Consultants	Fish species caught							CPUE	
Sampling season	**MT site #**	**Location**	**CCG***	**BKH***	**NSC**	**PCC**	**PMB**	**RCS**	**YP**	**No. of traps**	**Access**
April	1	Okanagan Lake South	2							2	boat
April	2	Okanagan Lake South	1							2	boat
April	3	Okanagan Lake South	1							2	boat
April	4	Okanagan Lake South		1						2	boat
April	5	Okanagan Lake South	1							2	boat
April	6	Penticton Channel	1							1	road
April	7	Penticton Channel								2	road
April	8	Penticton Channel	3							2	road
April	9	Skaha Lake								2	boat
April	10	Skaha Lake								2	boat
April	11	Skaha Lake								2	boat
April	12	Skaha Lake		1						2	boat
April	13	Okanagan River - Ok Falls								2	road
April	14	Okanagan River - Ok Falls								2	road
April	15	Okanagan River - Ok Falls	1							2	road
April	16	Okanagan River - Ok Falls	3							2	road
April	17	Vaseux Lake - north end								1	raft
April	18	Vaseux Lake - north end	1							2	raft
April	19	Vaseux Lake - north end	1							2	raft
April	20	Vaseux Lake - south end								1	raft
April	21	Vaseux Lake - south end								2	raft
April	22	Vaseux Lake - south end								2	raft
Total number of fish above McIntyre Dam			**15**	**2**	**0**	**0**	**0**	**0**	**0**		
April	23	Okanagan River Channel – Oliver	1							1	road
April	24	Okanagan River Channel – Oliver								1 -stolen	road
April	25	Okanagan River Channel – Oliver								2	road
April	26	Okanagan River Channel – Oliver								2	road
April	27	Okanagan River Channel – Oliver								2	road
April	28	Okanagan River Channel – Oliver								2	road
April	29	Osoyoos Lake								2	boat
April	30	Osoyoos Lake								2	boat
April	31	Osoyoos Lake								2	boat
April	32	Osoyoos Lake								2	boat
April	33	Osoyoos Lake								2	boat
Total number of fish below McIntyre Dam			**1**	**0**	**0**	**0**	**0**	**0**	**0**		

Completed by the		Okanagan Nation Fisheries Commission	Fish species caught							CPUE				
Sampling season	**MT site #**	**Location**	**CAS ***	**BKH ***	**NSC**	**PCC**	**PMB**	**RCS**	**YP**	**Date set**	**Time set**	**No. of traps**	**Date picked**	**Time picked**
June	1	Okanagan Lake South	10		1	1				27-Jun	11:50	4	28-Jun	10:25
June	2	Okanagan Lake South	7		2			2		27-Jun	11:35	4	28-Jun	9:45
June	3	Okanagan Lake South	2		2					27-Jun	11:20	4	28-Jun	9:25
June	4	Okanagan Lake South	15							27-Jun	11:00	4	28-Jun	9:00
June	5	Okanagan Lake South	5							27-Jun	10:45	4	28-Jun	8:45
June	6	Penticton Channel	1					7		28-Jun	16:00	4	29-Jun	9:25
June	7	Penticton Channel								28-Jun	15:30	4	29-Jun	10:00
June	8	Penticton Channel	3							28-Jun	11:15	4	29-Jun	10:40
June	9	Skaha Lake								27-Jun	14:00	4	28-Jun	12:10
June	10	Skaha Lake	2							27-Jun	14:10	4	28-Jun	12:20
June	11	Skaha Lake								27-Jun	14:30	4	28-Jun	12:35
June	12	Skaha Lake								27-Jun	13:30	4	28-Jun	11:55
June	13	Okanagan River - Ok Falls						1		28-Jun	13:30	4	29-Jun	11:05
June	14	Okanagan River - Ok Falls	3							28-Jun	13:40	4	29-Jun	11:15
June	15	Okanagan River - Ok Falls	1							28-Jun	13:50	4	29-Jun	11:25
June	16	Okanagan River - Ok Falls	1							28-Jun	14:00	4	29-Jun	11:35
June	17	Vaseux Lake - north end								4-Jul	15:00	1	5-Jul	14:15
June	17	Vaseux Lake - north end	1		2		5		18	5-Jul	14:20	12	6-Jul	17:45
June	18	Vaseux Lake - north end	3							4-Jul	14:35	2	5-Jul	14:00
June	19	Vaseux Lake - north end								4-Jul	14:45	2	5-Jul	14:05
June	20	Vaseux Lake - south end								4-Jul	14:00	3	5-Jul	13:15
June	21	Vaseux Lake - south end								4-Jul	13:00	3	5-Jul	12:30
June	22	Vaseux Lake - south end	2							4-Jul	13:15	3	5-Jul	12:40
Total number of fish above McIntyre Dam			**56**		**7**	**1**	**5**	**10**	**18**					
June	23	Okanagan River Channel - Oliver	1							28-Jun	14:30	4	29-Jun	12:00
June	24	Okanagan River Channel - Oliver								28-Jun	15:00	4	29-Jun	12:10
June	25	Okanagan River Channel - Oliver								29-Jun	13:40	4	30-Jun	14:45
June	26	Okanagan River Channel - Oliver								29-Jun	13:15	4	30-Jun	14:30
June	27	Okanagan River Channel - Oliver								29-Jun	13:00	4	30-Jun	13:58
June	28	Okanagan River Channel - Oliver								29-Jun	12:45	4	30-Jun	13:30
June	29	Osoyoos Lake								4-Jul	9:30	3	5-Jul	9:15
June	30	Osoyoos Lake								4-Jul	9:45	3	5-Jul	9:30
June	31	Osoyoos Lake	2							4-Jul	10:00	3	5-Jul	9:45
June	32	Osoyoos Lake								4-Jul	10:20	3	5-Jul	missing
June	33	Osoyoos Lake								4-Jul	10:30	3	5-Jul	10:45
Total number of fish below McIntyre Dam			**3**		**0**	**0**	**0**	**0**	**18**					

Completed by the		Okanagan Nation Fisheries Commission	Fish Species Caught							CPUE				
Sampling season	**MT site #**	**Location**	**CAS ***	**BKH ***	**LDC**	**NSC**	**PMB**	**SMB**	**YP**	**Date set**	**Time set**	**No. of traps**	**Date picked**	**Time picked**
August	1	Okanagan Lake South								14-Aug	10:20	3	15-Aug	10:30
August	2	Okanagan Lake South	1							14-Aug	10:10	3	15-Aug	10:20
August	3	Okanagan Lake South	1			1				14-Aug	9:50	3	15-Aug	10:00
August	4	Okanagan Lake South	5							14-Aug	9:40	3	15-Aug	9:30
August	5	Okanagan Lake South	1		2					14-Aug	9:30	3	15-Aug	9:20
August	6	Penticton Channel	Not sampled due to heavy pedestrian traffic											
August	7	Penticton Channel												
August	8	Penticton Channel												
August	9	Skaha Lake								14-Aug	12:00	3	15-Aug	12:15
August	10	Skaha Lake				1		1		14-Aug	11:50	3	15-Aug	12:05
August	11	Skaha Lake	1							14-Aug	11:40	3	15-Aug	11:50
August	12	Skaha Lake						2		14-Aug	11:30	3	15-Aug	11:40
August	13	Okanagan River - Ok Falls							1	17-Aug	14:00	3	18-Aug	11:35
August	14	Okanagan River - Ok Falls	3							17-Aug	14:02	3	18-Aug	11:40
August	15	Okanagan River - Ok Falls							1	17-Aug	14:06	3	18-Aug	11:45
August	16	Okanagan River - Ok Falls	13				2	5		17-Aug	14:10	3	18-Aug	11:57
August	17	Vaseux Lake - north end				3	3			17-Aug	13:24	4	18-Aug	11:14
August	18	Vaseux Lake - north end		1			1			17-Aug	13:20	4	18-Aug	11:10
August	20	Vaseux Lake - south end								17-Aug	13:05	3	18-Aug	10:30
August	21	Vaseux Lake - south end							5	17-Aug	12:21	3	18-Aug	10:10
August	22	Vaseux Lake - south end								17-Aug	12:30	3	18-Aug	9:50
Total number of fish above McIntyre Dam			**25**	**1**	**2**	**5**	**6**	**8**	**7**					
August	23	Okanagan River Channel - Oliver	1							16-Aug	12:10	3	17-Aug	11:24
August	24	Okanagan River Channel - Oliver								16-Aug	12:06	3	17-Aug	11:18
August	25	Okanagan River Channel - Oliver							1	16-Aug	11:35	3	17-Aug	11:06
August	26	Okanagan River Channel - Oliver								16-Aug	11:27	3	17-Aug	10:45
August	27	Okanagan River Channel - Oliver						1		16-Aug	11:10	3	17-Aug	10:18
August	28	Okanagan River Channel - Oliver								16-Aug	10:30	3	17-Aug	10:04
August	29	Osoyoos Lake								14-Aug	13:30	3	15-Aug	13:35
August	30	Osoyoos Lake								14-Aug	13:45	3	15-Aug	13:45
August	31	Osoyoos Lake	1							14-Aug	13:55	3	15-Aug	13:50
August	32	Osoyoos Lake								14-Aug	14:05	3	15-Aug	14:00
August	33	Osoyoos Lake								14-Aug	14:15	3	15-Aug	14:15
Total number of fish below McIntyre Dam			**2**	**0**	**0**	**0**	**0**	**1**	**1**					

Completed by the		Okanagan Nation Fisheries Commission	Fish species caught							CPUE				
Sampling season	**MT site #**	**Location**	**CAS ***	**NSC**	**PMB**	**RBT**	**RCS**	**SMB**	**SU**	**Date set**	**Time set**	**No. of traps**	**Date picked**	**Time picked**
November	1	Okanagan Lake South	11	1			1			1-Nov	11:30	3	2-Nov	10:30
November	2	Okanagan Lake South	15							1-Nov	11:10	3	2-Nov	10:20
November	3	Okanagan Lake South	24							1-Nov	11:00	3	2-Nov	10:10
November	4	Okanagan Lake South	6				2			1-Nov	10:30	3	2-Nov	9:50
November	5	Okanagan Lake South	11							1-Nov	10:15	3	2-Nov	9:40
November	6	Penticton Creek	7							1-Nov	12:28	4	2-Nov	10:50
November	7	Penticton Creek	16						1	1-Nov	12:37	4	2-Nov	11:10
November	8	Penticton Creek	18							1-Nov	12:50	4	2-Nov	11:30
November	9	Skaha Lake								1-Nov	13:30	3	2-Nov	12:15
November	10	Skaha Lake	2							1-Nov	13:15	3	2-Nov	12L:10
November	11	Skaha Lake	9							1-Nov	12:45	3	2-Nov	12:05
November	12	Skaha Lake	2					1		1-Nov	12:30	3	2-Nov	12:00
November	13	Okanagan River - Ok Falls	1							31-Oct	10:59	4	1-Nov	11:09
November	14	Okanagan River - Ok Falls								31-Oct	11:08	4	1-Nov	11:15
November	15	Okanagan River - Ok Falls	7							31-Oct	11:21	4	1-Nov	11:20
November	16	Okanagan River - Ok Falls	35	1						31-Oct	11:30	4	1-Nov	11:26
November	17	Vaseux Lake - north end								1-Nov	10:45	4	2-Nov	10:15
November	17	Vaseux Lake - north end								1-Nov	10:48	4	2-Nov	10:20
November	18	Vaseux Lake - north end								1-Nov	10:55	4	2-Nov	10:25
November	20	Vaseux Lake - south end	2							1-Nov	14:48	4	2-Nov	9:15
November	21	Vaseux Lake - south end								1-Nov	14:59	4	2-Nov	9:35
November	22	Vaseux Lake - south end	1							1-Nov	15:14	4	2-Nov	9:57
Total number of fish above McIntyre Dam			**167**	**2**	**0**	**0**	**3**	**1**	**1**					
November	23	Okanagan River Channel - Oliver	1							31-Oct	10:15	4	1-Nov	10:26
November	24	Okanagan River Channel - Oliver				1				31-Oct	10:01	4	1-Nov	10:15
November	25	Okanagan River Channel - Oliver								31-Oct	9:31	4	1-Nov	9:57
November	26	Okanagan River Channel - Oliver								31-Oct	9:24	4	1-Nov	9:45
November	27	Okanagan River Channel - Oliver								31-Oct	9:14	4	1-Nov	9:37
November	28	Okanagan River Channel - Oliver				1				31-Oct	9:05	4	1-Nov	9:20
November	29	Osoyoos Lake		1						1-Nov	15:00	3	2-Nov	13:30
November	30	Osoyoos Lake	3		1					1-Nov	15:15	2	2-Nov	13:40
November	31	Osoyoos Lake	2							1-Nov	15:30	3	2-Nov	13:45
November	32	Osoyoos Lake	4	1						1-Nov	15:45	3	2-Nov	14:00
November	33	Osoyoos Lake	1							1-Nov	16:00	3	2-Nov	14:05
Total number of fish below McIntyre Dam			**11**	**2**	**1**	**2**	**0**	**0**	**0**					

PHOTO #10 Minnow trapping in Okanagan Lake (MT #4)

PHOTO #11 Minnow trapping in Okanagan Lake (MT #5)

PHOTO #12 Minnow trapping in Skaha Lake (MT #9)

PHOTO #13 Minnow trapping in Skaha Lake (MT #11)

PHOTO #14 Minnow trapping in Okanagan River Channel (MT#16)

PHOTO #15 Minnow trapping in Okanagan River Channel oxbow below Vaseux Lake (MT#22)

PHOTO #16 Minnow trapping in Okanagan River Channel (MT#24)
McIntyre Dam in the background

PHOTO #17 Minnow trapping in Okanagan River Channel (MT #25)

PHOTO #18 Minnow trapping in Okanagan River Channel (MT #25)
Looking below the Vertical drop structure

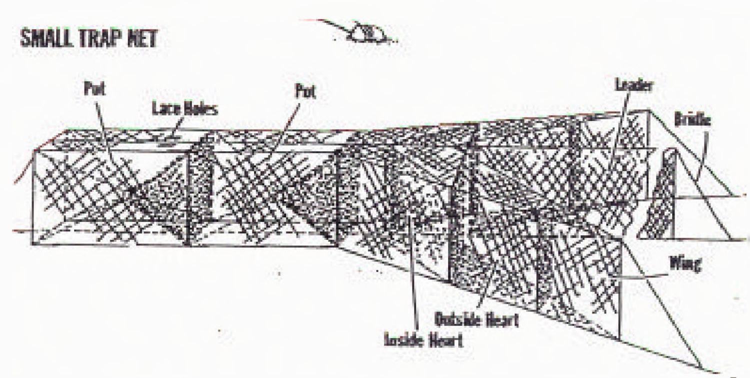
PHOTO #19 Minnow trapping in Osoyoos Lake (MT #29)

PHOTO #20 Minnow trapping in Osoyoos Lake (MT #30)

APPENDIX J

DATA AND CPUE FOR TRAP NETTING

		Fish species caught				CPUE		
Area	**Site #**	**BCB**	**LMB**	**SMB**	**YP**	**Set**	**Picked**	**Depth set**
Osoyoos Lake	Site TN #1, Same as EF-b #11	4	5	1	5	Sept. 28 13:00	Sept. 29 11:00	1.5 to 2.5 meters



APPENDIX K

DATA AND CPUE FOR MILFOIL WEED HARVESTOR

BPA Exotics Risk Assessment
Weed Harvester 2000

Date 2000	Area	Fish species caught					CPUE
		LMB juvenile	PMB juvenile	SMB juvenile	YP juvenile	Other species caught	Number of sweeps
7-Aug	WH1		3	1	101		5
7-Aug	WH4				61		4
17-Aug	WH1	65	32	161	16		24
17-Aug	WH3	5	2	13	1	painted turtle	2
17-Aug	WH4						5
17-Aug	W5H	17	9	43	4	freshwater clam	6

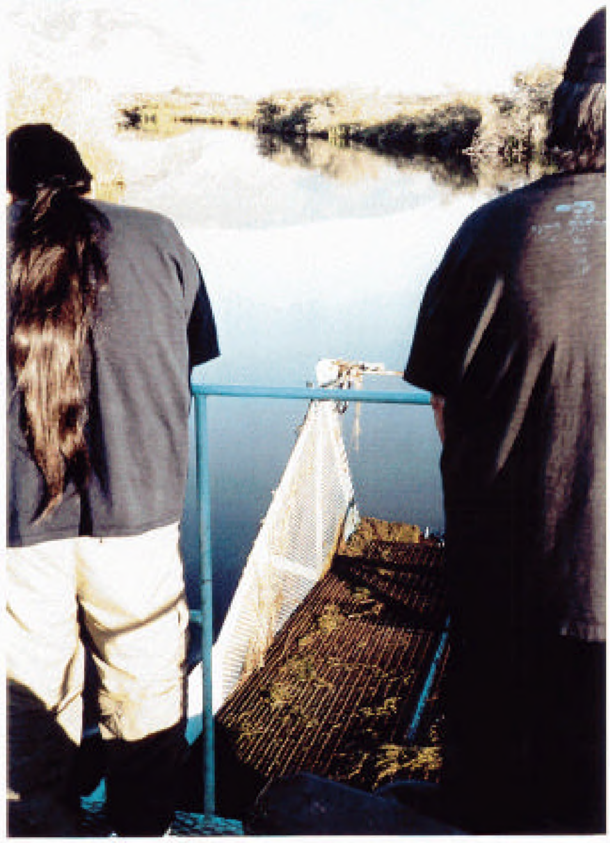


PHOTO #21 Milfoil weed harvestor not in operation, moving to site WH #3

APPENDIX L

2000 SAMPLING
QUARTERLY REPORTS

August 2000 – Quarterly Report
Evaluate an experimental re-introduction of sockeye salmon into Skaha Lake

Objective 1-a Disease Risk Assessment

Methods: Set by T.Evelyn and L. Hammell and approved by S.Goldes, MELP and G.Traxler, DFO. See Table 1 for Disease sampling plan of IPN, IHN, EIBSV and C. shasta.
Whirling disease sampling plans are currently being organized. The rainbow trout needed are available from Spring Valley Trout Hatchery. We have confirmed the use of the Skaha Hatchery for grow-out. Live box exposures will commence in January 2001 and hatchery grow-out will follow until June 2001. Eight sites with 100 fish at each site, will be selected, four above and four below McIntyre Dam with 200 fish held as control in Skaha Hatchery.
Results: Okanagan Lake kokanee assay's are now complete and are negative for IPNV, IHNV, VHS, according to MELP labs. Also of the 225 non-salmonids sampled for disease in June 2000, the IPNV, IHNV, VHS assays are complete and negative at 4 weeks incubation. MELP staff are starting to read the blood smears for EIBSV.
Status: The ONFC has one more sampling season for non-salmonids. We are organizing to collect for post-spawners with the next 2 months and are collecting additional sockeye fry and kokanee fry within the next 3 weeks.

Objective 2-a Review available fish inventory

Results: See table 2 for the Summary of fish distribution
Status: Final draft

Objective 2-b Inventory exotic fish species

Methods: Methods used by sampling season summarized below
The four sampling seasons are

1. Spring May/April
2. Summer June
3. Summer August
4. Fall October/November

Methods	Sampling season	Comments
Electrofishing boat	All	Stratified by habitat types
Minnow trapping	All	Stratified by habitat types
Gill netting	Summer(june) and Fall	Not completed in August to minimize impacts on adult sockeye holding in Osoyoos Lake
Beach seining	Summer (August)	Target for black crappie & walleye
Angling for walleye	Spring	Sub-contracted to a professional walleye fisherman.
Trap netting for walleye	Summer (September) and Fall	To be completed next week, targetting for walleye
Milfoil weed harvestor	Summer (August)	Osoyoos Lake to target juvenile fish species

Results: see results to date in Table 3, Summary of fish species caught
The Walleye angling in Osoyoos Lake sub-contract was completed by Roger Patton, President of the Western Walleye Council
Mr. Patton fished and sonard the lake for 3 days totaling 37 hours and caught northern pike minnow, carp and smallmouth bass.
His conclusions include that there is walleye suitable habitat along the west side of Osoyoos Lake and suitable areas for spawning success within the main lake but not at the river inlet, however there is not an established walleye population in Osoyoos Lake.
Status: Three of the four proposed sampling seasons are complete, the final sampling season will occur end of October to mid-November 2000.

Objective 2-c Literature review of habitat requirements

Results: The summary of habitat requirements for the following exotic fish have been completed;

- Tench, *Tinca tinca*
- Black crappie, *Pomoxis nigromaculatus*
- Black bullhead, *Ameriurus melas*
- Brown bullhead, *Ameriurus nebulosus*
- Largemouth bass, *Micropterus salmoides*
- Walleye, *Stizostedion vitreum*
- Goldfish, *Carassius auratus*

Status: Final draft

Objective 2-d Habitat Assessment

Status: scheduled for assessment October 2000 by Chris Bull

Objective 3-a Literature review of sockeye spawning and incubation habitat and evidence of spawning plasticity

Status: Final draft

Objective 3-b,c,dIdentification, assessment and field inventory of sockeye spawning incubation habitat and potential beach-spawning habitat on Skaha lake

Status: scheduled for assessment October 2000 by Chris Bull

Table 1. BPA Disease risk assessment, sampling plan

ABOVE MCINTYRE DAM

Fish species		**Number of fish**	**Fish Collected**	**Collection sites**	**Collection times**	**Test for**	**Comments**
Salmonids mostly KO Total 360 fish	recent post-spawners	150	0	collect from the three spawning channels and from beach spawning groups	October, November 2000	IPNV, IHNV, EIBSV and *C.shasta*	Approx. 30 fish per group; make up the total with other salmonids if necessary
	2 month old fry	150	38	Mysid shrimp harvest boat	June - Aug 2000	IPNV, IHNV, EIBSV and C. shasta	
	all ages	60	1	collect by trawling in Okanagan and Skaha Lakes on mysid shrimp trawls	20 fish-June 20 fish-August 20 fish-Fall	IPNV, IHNV, And EIBSV	
Non-salmonids Total 360 fish	migratory fish (ie walleye, smallmouth bass, yellow perch, squawfish, northern pike minnow)	270	209	EF-boat	90 fish-June 90 fish-august 90 fish-Fall	IPNV, IHNV and EIBSV	Collect as many species and age groups as possible from as many areas as possible, no single species should represent more than 25% of the sample
	non-migratory fish (largemouth bass, bullheads, carp, tench,pumpkinseed)	90	92	EF-boat	30 fish-June 30 fish-August 30 fish-Fall	IPNV, IHNV and EIBSV	
TOTAL		**720**	**340**				

BELOW MCINTYRE DAM

Fish species		**Number of fish**	**Fish collected**	**Collection sites**	**Collection times**	**Test for**	**Comments**
Salmonids mostly SK Total 360 fish	recent post-spawners	180	39	collect from the three spawning channels and from beach spawning groups	July (early run) Oct, Nov 2000	IPNV, IHNV, EIBSV and *C.shasta*	Make up the total with other salmonids if necessary
	2 month old fry	180 100	171	DFO -shrimp trawler	july 2000 sept 2000	IPNV, IHNV and EIBSV	
Non-salmonids Total 360 fish	migratory fish (ie walleye, smallmouth bass, yellow perch, northern pike minnow)	270	179	EF-boat	90 fish-June 90 fish-august 90 fish-Fall	IPNV, IHNV and EIBSV	Collect as many species and age groups as possible from as many areas as possible, no single species should represent more than 25% of the sample
	non-migratory fish (largemouth bass, bullheads,tench, carp,pumpkinseed	90	49	EF-boat	30 fish-June 30 fish-August 30 fish-Fall	IPNV, IHNV and EIBSV	
TOTAL		**720**	**438**				

Table 2. Summary of fish distribution based on literature review

Species Code	Common name	Present below Skaha Lake	Present in Skaha and Okanagan Lake
BB	Burbot	√	√
*BCB	black crappie	√	Unconfirmed
*BKH	black bullhead	√	
*BNH	brown bullhead	Unconfirmed	
BSU	bridgelip sucker		√
CAS	prickly sculpin	√	√
CCG	slimy sculpin	√	√
CMC	chiselmouth chub		√
*CP	Carp	√	√
CSU	largescale sucker	√	√
*EB	eastern brook trout	√	√
*GC	Goldfish	√	
KO	Kokanee	√	√
LDC	leopard dace		√
*LMB	largemouth bass	√	
LNC	longnose dace	√	√
LSU	longnose sucker	√	√
*LT	lake trout		√
*LW	lake whitefish	√	√
MW	mountian whitefish	√	√
NSC	northern pike minnow (formerly squawfish)	√	√
PCC	peamouth chub	√	√
*PMB	pumpkinseed, sunfish	√	√
PW	pygmy whitefish	√	√
RB	rainbow trout, (formerly Kamloops trout)	√	√
RSC	redside shiner	√	√
SK	sockeye salmon	√	
*SMB	smallmouth bass	√	√
ST	steelhead (summer run)	√	
*TC	Tench	Unconfirmed	
WF	whitefish; general		√
*WP	Walleye	Unconfirmed	
*YP	yellow perch	√	√

* Exotic species

Table 3, Summary of fish species caught

Species found during June/July sampling	Above McIntyre Dam: Okanagan Lake South	Skaha Lake	Vaseux Lake	Okanagan River channel	Below McIntyre Dam: Okanagan River channel	Osoyoos Lake
burbot	EF-boat					
black crappie						BS, WH
black bullhead		EF-boat				EF-boat
brown bullhead						
prickley sculpin	EF-boat, MT	MT	MT	MT	MT	EF-boat, MT
chinook salmon					AG	
carp	EF-boat	EF-boat				EF-boat
eastern brook trout						
goldfish						
kokanee						EF-boat
largescale sucker	EF-boat	EF-boat				
largemouth bass						EF-boat, WH
lake chub	EF-boat					
northern pike minnow	EF-boat, MT	EF-boat, GN	MT			EF-boat, GN
peamouth chub	MT	EF-boat				EF-boat
pumpkinseed		EF-boat	MT			
rainbow trout		EF-boat				EF-boat
redside shiner	EF-boat, MT			MT		
sockeye salmon						EF-boat, GN
smallmouth bass		EF-boat				EF-boat, WH
sucker, general	EF-boat	EF-boat, GN				EF-boat
tench						
whitefish, general	EF-boat					EF-boat
walleye						
yellow perch	EF-boat	EF-boat	MT			EF-boat, WH

Fish capture methods		
	EF-boat	electrofishing boat
	MT	minnow trapping
	GN	gillnetting
	AG	angling
	BS	beach seining
	WH	milfoil weed harvestor
	TN	trap netting

November 2000 – Quarterly Report
Evaluate an experimental re-introduction of sockeye salmon into Skaha Lake

Objective 1-a Disease Risk Assessment

Methods: Whirling disease sampling plans are currently being organized between the ONFC and the MELP. Live box exposures are still set to begin in January 2001 and hatchery grow-out will follow until June 2001.

Results: To date all assays from MELP have turned up negative except for Okanagan Lake Kokanee which are virus positive. The MELP lab is in the process of identifying the virus. DFO labs are working on producing results by the end of November. See Table 1 for the updated sampling plan.

Status: The ONFC has collected all sampling quotas but the salmonids of varying age classes. We have tentatively scheduled a Disease meeting in February/March, to discuss the 2000 sampling plan and results.

Objective 2-a Review available fish inventory

Status: Final draft complete.

Objective 2-b Inventory exotic fish species

Methods: Methods used by sampling season summarized below
The four sampling seasons are

5. Spring May/April
6. Summer June
7. Summer August
8. Fall October/November

Methods	Sampling season	Comments
Electrofishing boat	1-4	Stratified by habitat types
Minnow trapping	1-4	Stratified by habitat types
Gill netting	2 & 4	Not completed in August to minimize impacts on adult sockeye holding in Osoyoos Lake
Beach seining	3	Target for black crappie & walleye
Angling for walleye	1	Sub-contracted to a professional walleye fisherman.
Trap netting for walleye	3	Targetted for walleye
Milfoil weed harvestor	3	Osoyoos Lake to target juvenile fish species

Results: see results to date in Table 2, Summary of fish species caught. The bullheads and sculpins have been sent to specialists for species verification.

Status: The four proposed sampling seasons are complete.

Objective 2-c Literature review of habitat requirements

Status: Final draft complete.

Objective 2-d Habitat Assessment

Status: Aerial and ground based assess of entire system between Okanagan Lake and McIntyre Dam conducted October 18th, 2000 by ONFC (H. Wright), DFO (K. Hyatt) and Glenfir Resources (C. Bull).

Objective 3-a Literature review of sockeye spawning and incubation habitat and evidence of spawning plasticity

Status: Final draft complete.

Objective 3-b,c,dIdentification, assessment and field inventory of sockeye spawning incubation habitat and potential beach-spawning habitat on Skaha lake

Status: Aerial and ground based assess of entire system between Okanagan Lake and McIntyre Dam conducted October 18th, 2000 by ONFC (H. Wright), DFO (K. Hyatt) and Glenfir Resources (C. Bull).

Report Write-ups
Tentative due dates for reports set.

Objective 1 Disease Risk Assessment

What	Who	Date due
Lab methods and results	from MELP lab, DFO lab & WELLS	Dec 15
Draft to specialists	T.Evelyn & L. Hammell	Dec 22
Discussion from specialists	T.Evelyn & L. Hammell	Jan 30
Disease meeting	T.Evelyn & L. Hammell ONFC, Glenfir Resources, MELP, DFO, CCT	Feb ?

Objective 2 Exotic fish species assessment

What	Who	Date due
Introduction, methods and results with maps	ONFC	Dec 8
Discussion meeting	ONFC, CCT, Glenfir Resources	Dec 15
Draft report	ONFC, Glenfir Resources	Dec 20
Final draft report	ONFC, Glenfir Resources	Dec 22

Objective 3. Sockeye habitat assessment

What	Who	Date due
Field work complete	Glenfir Resources	Nov
Draft report	ONFC, Glenfir Resources	Dec 15

Final Reports by ONFC due February 28th, 2000

Table 1. BPA Disease risk assessment, sampling plan

ABOVE MCINTYRE DAM

Fish species		**Number of fish**	**Fish Collected**	**Collection sites**	**Collection times**	**Test for**	**Comments**
Salmonids mostly KO Total 360 fish	recent post-spawners	150	160	collect from the three spawning channels and from beach spawning groups	October, November 2000	IPNV, IHNV, EIBSV and *C.shasta*	Approx. 30 fish per group; make up the total with other salmonids if necessary
	2 month old fry	150	188	Mysid shrimp harvest boat	June - Aug 2000	IPNV, IHNV, EIBSV and C. shasta	
	all ages	60	1	Use the whitefish of all ages	20 fish-June 20 fish-August 20 fish-Fall	IPNV, IHNV, And EIBSV	
Non-salmonids Total 360 fish	migratory fish (ie walleye, smallmouth bass, yellow perch, squawfish, northern pike minnow)	270	312	EF-boat	90 fish-June 90 fish-august 90 fish-Fall	IPNV, IHNV and EIBSV	Collect as many species and age groups as possible from as many areas as possible, no single species
	non-migratory fish (largemouth bass, bullheads, carp, tench,pumpkinseed)	90	130	EF-boat	30 fish-June 30 fish-August 30 fish-Fall	IPNV, IHNV and EIBSV	should represent more than 25% of the sample
TOTAL		**720**	**791**				

BELOW MCINTYRE DAM

Fish species		**Number of fish**	**Fish collected**	**Collection sites**	**Collection times**	**Test for**	**Comments**
Salmonids mostly SK Total 360 fish	recent post-spawners	180	39 170	collect from Okanagan River Channel with DFO	July (early run) Oct, Nov 2000	IPNV, IHNV, EIBSV and *C.shasta*	Make up the total with other salmonids if necessary
	2 month old fry	180 100	171 121	DFO -shrimp trawler	july 2000 sept 2000	IPNV, IHNV and EIBSV	
Non-salmonids Total 360 fish	migratory fish (ie walleye, smallmouth bass, yellow perch, northern pike minnow)	270	179	EF-boat	90 fish-June 90 fish-august 90 fish-Fall	IPNV, IHNV and EIBSV	Collect as many species and age groups as possible from as many areas as possible, no single species
	non-migratory fish (largemouth bass, bullheads,tench, carp,pumpkinseed	90	49	EF-boat	30 fish-June 30 fish-August 30 fish-Fall	IPNV, IHNV and EIBSV	should represent more than 25% of the sample
TOTAL		**720**	**729**				

Table 2, Summary of fish species caught during the Exotic Species Assessment

Species found during June/July sampling	Above McIntyre Dam: Okanagan Lake South	Above McIntyre Dam: Skaha Lake	Above McIntyre Dam: Vaseux Lake	Above McIntyre Dam: Okanagan River channel	Below McIntyre Dam: Okanagan River channel	Below McIntyre Dam: Osoyoos Lake
Burbot	EF-boat					
black crappie *						BS, WH
black bullhead *		EF-boat				EF-boat
brown bullhead *						
prickley sculpin	EF-boat, MT	MT	MT	MT	MT	EF-boat, MT
chinook salmon					AG	
Carp *	EF-boat	EF-boat				EF-boat
eastern brook trout *						
Goldfish *						
Kokanee						EF-boat
Largescale sucker	EF-boat	EF-boat				
largemouth bass *						EF-boat, WH
lake chub	EF-boat					
northern pike minnow	EF-boat, MT	EF-boat, GN	MT			EF-boat, GN, MT
peamouth chub	EF-boat, MT	EF-boat				EF-boat
Pumpkinseed *		EF-boat	MT			MT
rainbow trout	EF-boat	EF-boat			MT	EF-boat
redside shiner	EF-boat, MT			MT		
sockeye salmon						EF-boat, GN
smallmouth bass *		EF-boat				EF-boat, WH
sucker, general	EF-boat	EF-boat, GN				EF-boat
tench *						
whitefish, general	EF-boat					EF-boat
Walleye *						
yellow perch *	EF-boat	EF-boat	MT			EF-boat, WH

* Exotic fish species

Fish capture methods			
	EF-boat	electrofishing boat	*
	MT	minnow trapping	
	GN	gillnetting	*
	AG	angling	
	BS	beach seining	
	WH	milfoil weed harvestor	*
	TN	trap netting	

APPENDIX M

SPECIES CODES

The folllowing speces codes were used in the tables listing the species inventoried in the Okanagan Basin. The codes are based on Fisheries Information Summary System (FISS) BC fish species codes.

Species Code	Common name	Scientific name
BB	Burbot	*Lota lota*
BCB	black crappie	*Pomoxis nigromaculatus*
BH	bullhead, catfish; general	*Ameiurus* spp.
BKH	black bullhead	*Ameiurus melas* (formerly *Ictalurus melas)*
BNH	brown bullhead	*Ameiurus nebulosus (formerly Ictalurus nebulosus)*
BS	bass, sunfish; general	*Micropterus* spp., *Lepomis* spp., *Pomoxis* spp.
BSU	bridgelip sucker	*Catostomus columbianus*
CAS	prickly sculpin	*Cottus asper*
CBC	chub; general	
CC	sculpin; general	primarily *Cottus* spp.
CCG	slimy sculpin	*Cottus cognatus*
CMC	Chiselmouth	*Acrochelius alutaceus*
CP	Carp	*Cyprinus carpio*
CSU	largescale sucker	*Catostomus macrocheilus*
DC	dace; general	*Rhinichthys* spp., *Phoxinus* spp.
EB	eastern brook trout	*Salvelinus fontinalis*
GC	Goldfish	*Carassius auratus*
KO	Kokanee	*Oncorhynchus nerka*
LDC	leopard dace	*Rhinichthys falcatus*
LMB	largemouth bass	*Micropterus salmoides*
LNC	longnose dace	*Rhinichthys cataractae*
LSU	longnose sucker	*Catostomus catostomus*
LT	lake trout	*Salvelinus namaycush*
LW	lake whitefish	*Coregonus clupeaformis*
MW	mountian whitefish	*Prosopium williansoni*
NSC	northern pike minnow (formerly squawfish)	*Ptycheilus oregonensis*
PCC	peamouth chub	*Mylocheilus caurinus*
PMB	pumpkinseed, sunfish	*Lepomis gibbosus*
PW	pygmy whitefish	*Prosopium coulteri*
RB	rainbow trout, (formerly Kamloops trout)	*Oncorhynchus mykiss* (formerly *Salmo gairdneri)*
RSC	redside shiner	*Richardsonius balteatus*
SK	sockeye salmon	*Oncorhynchus nerka*
SMB	smallmouth bass	*Micropteruus dolomieui*
SP	not identified	
ST	steelhead (summer run)	*Oncorhynchus mykiss*
SU	sucker; general	*Catostomus* spp.
TC	Tench	*Tinca tinca*
WF	whitefish; general	*Prosopium* spp., *Coregonus* spp., *Stenodus* spp.
WP	Walleye	*Stizostedion vitreum*
YP	yellow perch	*Perca flavescens*

APPENDIX N

TAXONOMIST SPECIALISTS RESUMES

CURRICULUM VITAE

(Short version to establish credentials relevant to fish identification)

J. D. McPhail, Professor Emeritus, Department of Zoology, University Of British Columbia, 6270 University Blvd., Vancouver, BC, V6T 1Z4

[redacted]

EDUCATION

a) Undergraduate

University of British Columbia	1952-57	B.A.

c) Graduate:

University of British Columbia	1958-60	M.Sc.
McGill University	1960-63	Ph.D.

PROFESSIONAL EMPLOYMENT RECORD

1963-66 Assistant Professor, University of Washington -- Taught undergraduate and graduate courses in the Ichthyology

1966-72 Associate Professor, University of British Columbia -- Taught undergraduate and graduate courses Ichthyology.

1972-99 Full Professor and Curator of the Fish Museum, University of British Columbia

PROFESSIONAL ACTIVITIES

a) Membership in professional and learned societies (including any offices held, committee memberships, etc.):

American Fisheries Society
American Society of Ichthyology and Herpetology - Governor (1966-70)
Society for the Study of Evolution
American Society of Naturalists
Canadian Society of Zoologists - Executive (1973-75)
Canadian Committee for Freshwater Fisheries Research (President 1993)

b) Academic or professional awards and distinctions

1971-72 Smithsonian Fellowship in Tropical Biology

1971 Wildlife Society of America Award for the Outstanding Publication on Fishes

1988-89 Killam Senior Fellowship

1993 Silver Medal for best university level educational video (San Franscico National Awards).

1999 M. A. Newman Award for life-time achievement in Aquatic Research

c) Professional service and experience (consultancies, professional committees, commissions):

Consultancies

1974-75 - Dolemage Campbell Ltd. - Carbon Creek Coal Development
1977-78 - Arrow Reservoir Study for B.C. Fish & Wildlife and B.C. Hydro
1981-82 - Reviewer (Aquatic Studies) for B.C. Public Utilities Commission, Site C hearings
1983-99 - Reports to committee on the Status of Endangered Wildlife in Canada (COSEWIC)
1991-99 - B.C. Ministry of Environment - advisor on management and conservation of non-game species
1995-96 – Reports to Department of Fisheries and Oceans on vulnerable BC freshwater fish.
1997-98 – Reports to Environment Canada (Fraser River Action plan)
1998-99 - Reports to BCHydro on threatened species affected by hydroelectric projects
1999 - Report to the ecological monitoring and assessment network (EMAN) Environment Canada and Agriculture Canada

Editorships

1983-93 - Associate Editor, Canadian Journal of Zoology

Lectureships

1993 - Salo Memorial Lecturer, University of Washington.

RESEARCH AND PROFESSIONALLY RELATED SCHOLARLY AND CREATIVE ACTIVITIES

a) Areas of special interest and accomplishment in discipline:

Fish and fisheries - Arctic and tropical freshwaters
Evolutionary biology of fishes
Conservation of native species

b) Experience with eels --- I collected, and became familiar with, two species of *Anguilla* during a sabbatical year in New Zealand.

REFEREED PUBLICATIONS

85 journal articles and book chapters

NON-REFEREED PUBLICATIONS

12 Reports to government agencies

Books:

McPhail, J. D., and C. C. Lindsey. 1970. Fishes of northwestern Canada and Alaska. Fisheries Res. Bd. Canada, Bulletin 173, 400 pp.

Videos:

Wrote, and appeared in, a half hour educational video (Evolution in Action) for the Open Learning Agency

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G.D.T. Nat. Res. Consltn. Serv.

January 10, 2001

Howie Wright:

Dear Howie:

As requested here is a brief C.v. relative to the recent sculpin work.

Gerry Taylor, BSc., MSc.----Freshwater fisheries management experience gained while employed by B.C. provincial fish agencies from 1957-97. Activities in hatcheries, research and monitoring programs, lake and stream inventories, and habitat restoration and improvement projects while focussed on salmonids always considered all other species, particularly in relation to competition and/or predation. Sculpins are very widespread in Pacific drainages and my Masters thesis(1966) was focussed on the spatial and temporal distribution of Cottus asper and Cottus aleuticus in a small coastal stream. In the subsequent building of spawning channels,fishways and artificial in-stream barriers some of my management implications were incorporated. Collection and identification of sculpins has been a life-time interest. Particular concern must now be directed toward those sculpin species with disjunct distributions and possibly subject to hybridization and more subtley, introgression. DNA profiling should be occurring to judge future project effects or the "natural" changes that might occur due to climate-habitat related activities.

Yours sincerely,

G.D. Taylor, RPBio

Date Rec'd: 01-15-01
Directed: ONA
XC: Exec Dir & H. Wright
File #
Filed Date

An Experimental Re-introduction of Sockeye Salmon into Skaha Lake

Objective 3: Sockeye Salmon Habitat Assessment In Okanagan River Upstream of McIntyre Dam

Submitted to: Chris Fisher
Colville Confederated Tribes

by:
Okanagan Nation Fisheries Commission

Prepared by:
C. J. Bull, R. P. Bio.
Glenfir Resources

July 2001

EXECUTIVE SUMMARY

The migratory range of Okanagan River sockeye salmon may be extended past McIntyre Dam to the upper portions of Okanagan River and to Skaha Lake. This study identifies the habitat available in these areas and recommends improvements. Sockeye have been known to spawn along lake shorelines in either gravel substrate or in large angular rock. These habitats are not found in Skaha Lake. The shoreline is generally silty with occasional large boulders and sockeye are unlikely to spawn there. Tributary streams are also unsuitable for sockeye spawning.

Eleven kilometers of mainstem river are available between McIntyre Dam and Okanagan Lake, but less than two kilometers are suitable for spawning. Below Skaha Lake gradients are low and vertical drop structures lower the riverbed profile even more. Channelization in every reach of the river has eradicated most of the characteristics that make up good fish habitat. Despite this the river will support some spawning for about 9,000 pairs, particularly in the upper reaches. Egg to fry survival rates are unknown and should be compared with survival rates in the river reaches below McIntyre Dam.

Run extension could benefit juvenile rearing to a greater extent than adult spawning. There is sufficient good quality spawning habitat below McIntyre Dam to accommodate many more adults than are presently found there. However, juvenile rearing and adult holding conditions in Osoyoos Lake are precarious, and will get worse if present warming trends continue. From this viewpoint run extension could be very beneficial. More detailed assessment of holding and rearing conditions in both Osoyoos and Skaha Lakes is recommended.

If the decision is made to extend the sockeye run, improvement of spawning habitat in the main river should be considered. Below Skaha Lake vertical drop structures could be replaced with a series of natural rock riffles. In the upper reaches of the river, substrate could be scarified and supplementary gravel could be added. A spawning channel could be constructed and would increase egg to fry survival provided it was regularly cleaned and occasionally relined with gravel. Such improvement initiatives would require feasibility studies and agreement from provincial and federal governments and the Okanagan First Nation.

In conclusion, although there is little potential for sockeye salmon to spawn on the shoreline of Skaha Lake or in the minor tributary streams, spawning habitat is available in the mainstem of the Okanagan River above McIntyre Dam. This could be particularly beneficial in providing access to new adult holding and juvenile rearing areas in Skaha Lake. Further work should quantify the spawning habitat more precisely, and determine the extent and quality of the rearing areas within Skaha Lake.

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1.0 INTRODUCTION

This study is part of a series that examines the feasibility of reintroducing sockeye salmon to Skaha Lake. The present task reviews the quantity and quality of available habitat should the migration route of sockeye be extended. In addition, we suggest ways of increasing that habitat through river restoration and improvement.

Okanagan Nation Fisheries Commission (ONFC) has undertaken this task through a contract with the Colville Confederated Tribes. Further information regarding this project is available from H. Wright or C. Fisher (personal communication).

2.0 LITERATURE REVIEW OF SOCKEYE SALMON SPAWNING AND INCUBATION HABITAT

As early as the 1900's, there have been numerous attempts and considerable effort to transplant sockeye salmon. Anadromous runs have only been established at three sites, all within the species' natural range. In each case, the successful transplants involved donor populations only 15 to 90 km from the transplant site and in many ways the transplant resembled natural colonization of adjacent habitat.

Among the Pacific salmon, sockeye exhibit the greatest plasticity and diversity in adaptation to a wide variety of spawning habitats. However, there are genetic differences between river spawning and lake spawning sockeye which may limit colonization depending on habitat available in Skaha Lake and the stock of the strays for colonizing the area (most likely from the Okanagan River).

Given that sockeye salmon display spawning plasticity and that there exists suitable habitat above McIntyre Dam, the opportunity exists to re-establish a sockeye population with the ability to effectively colonize for the long term. Please see Appendix A for the full report.

3.0 IDENTIFICATION AND ASSESSMENT OF POTENTIAL AREAS OF SPAWNING HABITAT IN SKAHA LAKE

3.1 Methods

The study area lies between McIntyre Dam(the present limit of migration) immediately downstream of Vaseux Lake and Okanagan Lake Dam (the limit of migration if the run is extended). This 27 km section includes 11 km of mainstem river and 16 km of lakes (Figure 1). For the present purposes Okanagan River was divided into 8 reaches (Figure 2). Reaches number 14 – 17 follow Bull (1999). Reaches 18 – 21 are added. The reaches were chosen based upon similarity of slope, substrate and habitat types (riffles, pools and glides) and by obvious boundaries such as drop structures, dams or tributaries.

Areas were surveyed by walking, by boat, and by helicopter. Information was recorded in field books, and in photographs and on videotape. Conclusions were reached after discussion and consensus among the following biologists:

- Dr. K. Hyatt – Head Sockeye Assessment, Fisheries & Oceans Canada
- Chris Bull – CEO Glenfir Resources
- Howie Wright –Biologist in charge - Salmon Extension Project, ONFC

Assessments were based upon:
- Substrate type, size and quality
- Maximum, minimum and mean stream flows
- Water depth and velocity
- Channel slope and topography
- Watershed size, geomorphometry and resource use

Generally good spawning habitat was considered to have the following characteristics:
- Water depth > 0.3 m
- Water velocity - 25 – 70 cm/sec
- Substrate – gravel 1.2 – 10 cm with:
    - limited fines (less than 30% material under 3 mm in diameter),
    - limited compaction
    - limited weed (milfoil) growth.

These ranges are supported by Reiser and Bjornn (1979). Tolerable variation at these ranges was discussed on a case-by-case basis by the biologists, who were experienced with conditions found in other systems.

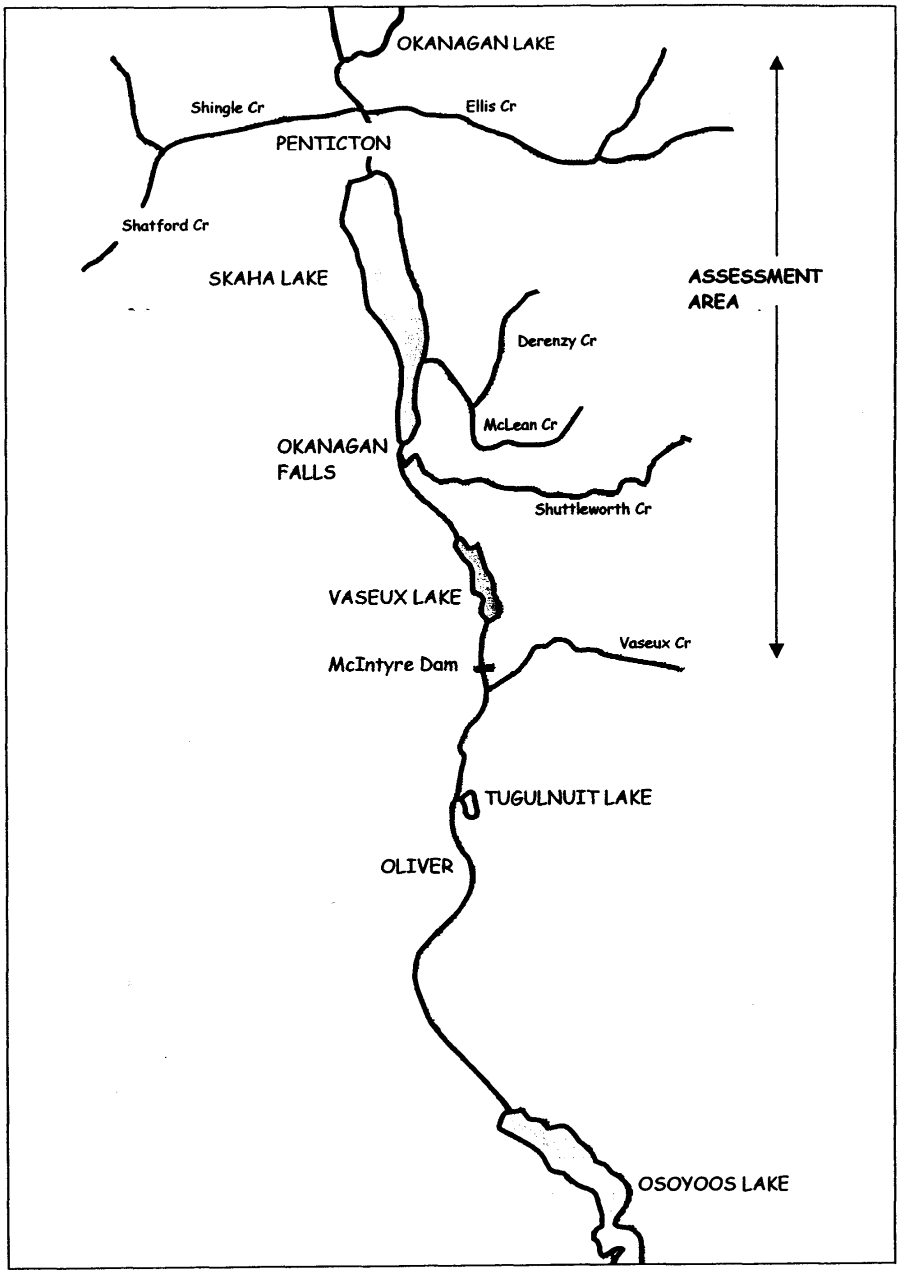

Figure 1 – Assessment Area

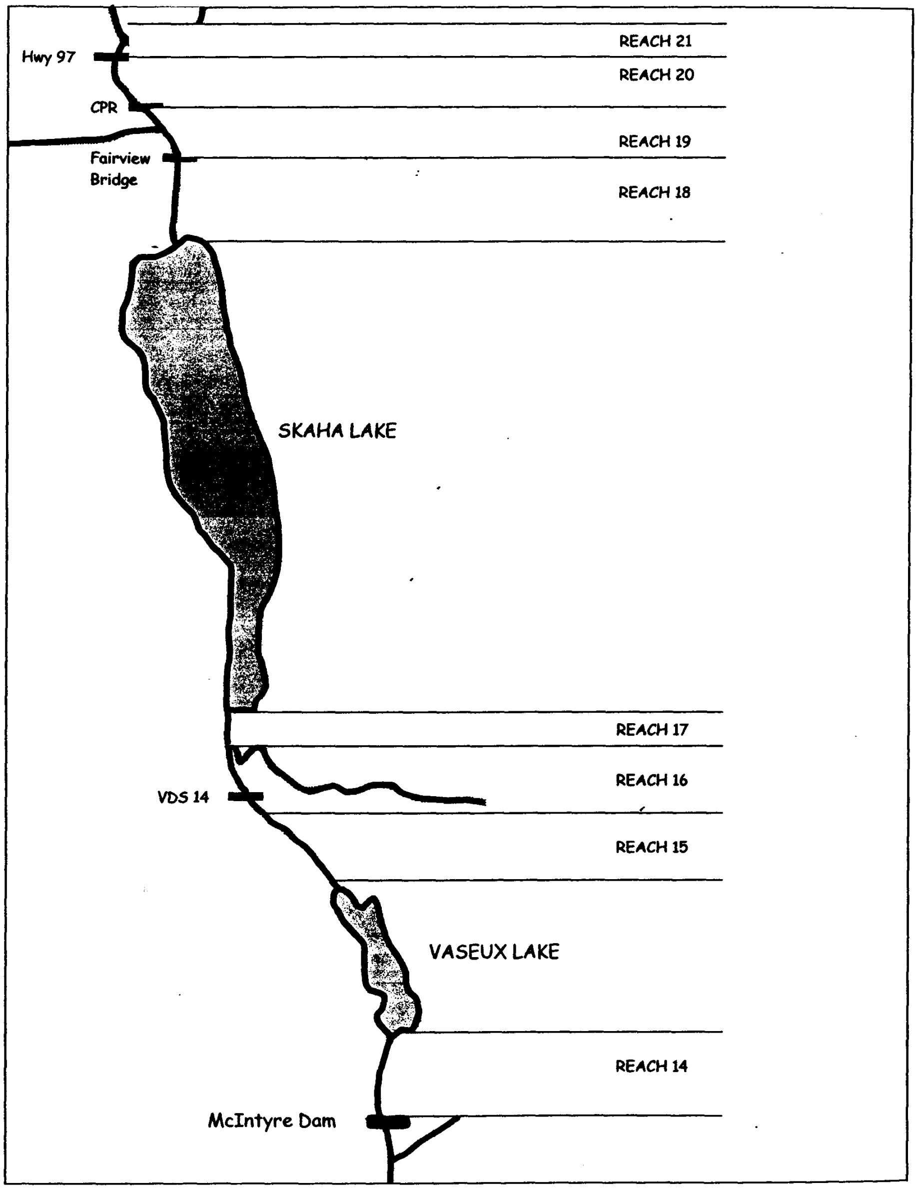

Figure 2 – Reaches in the Study Area

3.2 Results

3.2.1 Shoreline Spawning Sites

Suitable shore spawning habitat for sockeye may be found over either gravel or angular rock substrate. Gravel shoreline is usually associated with windswept beaches. When sockeye spawn in this type of habitat they dig redds as they do in streams. When they spawn in large angular rock they do not dig. Instead, they broadcast spawn into the spaces between the rocks.

Both gravel and angular rock shorelines are found in Okanagan Lake and are used by spawning kokanee. However, neither type of habitat was observed in Skaha Lake. The shoreline consists primarily of silt with occasional large boulders (Figure 3). Skaha Lake is a linear water body 8 km in length lined by mountains on each side. There are no windswept gravel beaches as found in Okanagan Lake.

Our observations that no sockeye spawning habitat is available in Skaha Lake are supported by BC Ministry of Environment staff who report that all the kokanee from Skaha lake spawn in Okanagan river rather than along the lakeshore (Steve Matthews, personal communication).

3.2.2 Tributary Stream Spawning Sites

Many tributaries to the Okanagan River, Vaseux Lake and Skaha Lake are small ephemeral streams that only flow during the spring. Tributaries that frequently flow year round and were considered worthy of assessment included:

- Shuttleworth Creek
- McLean Creek
- Ellis Creek
- Shingle Creek
- Shatford Creek

The location of these creeks is shown in Figure 1. After closer examination, none of the creeks were considered to have potential as sockeye spawning areas. Shuttleworth Creek carries an extreme sediment load as a result of both natural and man induced mass wasting in the watershed. McLean Creek is small and intermittent and has been both channellized and concreted near the mouth. Ellis Creek has an impassible barrier near the mouth, is steep and boulder lined, and receives stormwaters from surrounding urban areas. Shingle and Shatford Creeks support populations of rainbow and occasional kokanee but are considered too small and limited for sockeye (less than 30cm deep).

In comparison with the mainstem, the tributaries have little potential. If sockeye are allowed past McIntyre Dam they will likely spawn exclusively in the main river.

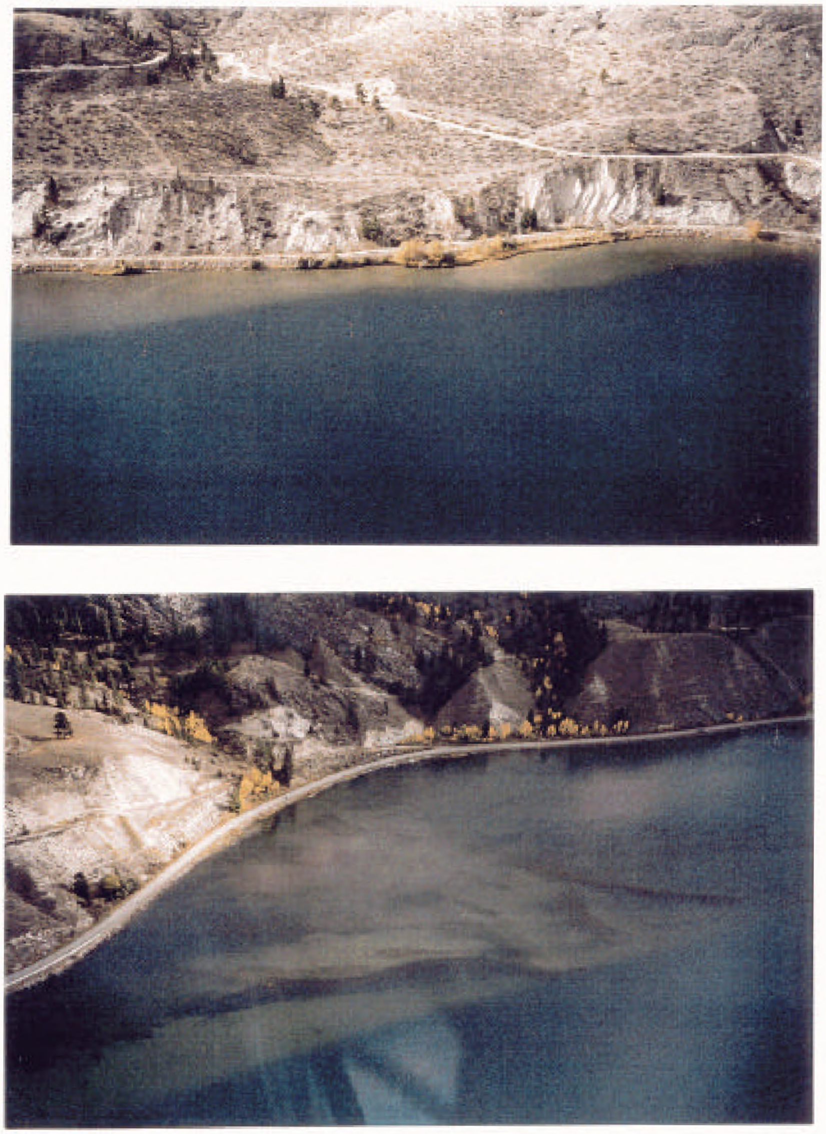

Figure 3 – Typical Shoreline on Skaha lake

3.2.3 Okanagan River Spawning Sites

By migrating to Skaha Lake sockeye will access an additional 11 km of river. In its present state most of the river is too flat to be suitable for spawning (0.03% slope). This problem is aggravated in reaches 14 – 17 by 4 vertical drop structures (VDSs) that lower the riverbed profile.

The entire river from Okanagan Lake to McIntyre was channellized for flood control in the mid 1950's. This eliminated meanders, pools and riffles, cover, and hydraulic diversity (Figure 4). Furthermore it eliminated the floodplain that would normally receive much of the sediment loading. Egg to fry survival will probably be lower than in the more natural areas downstream from McIntyre Dam. Egg and fry survival rates should be compared in the two areas.

The portions of Okanagan River that appear suitable for spawning include:

- A small area at the outlet of Vaseux lake.
- Several small down-welling areas in the vicinity of drop structures 14, 15, 16 and 17 (in 2000 some sockeye migrated past an open gate in McIntyre Dam and spawned in these reaches).
- The upper portion of the river between the CPR Bridge abutments and Okanagan Dam.

The dimensions of these areas should be measured in 2001.

Roughly 2 km of river above McIntyre Dam are suitable for spawning (Figure 5). The river is about 30 m wide (Schubert, 1980) and so approximately 60,000 m^2 of potential area would be available. Burner (1951) recommends that 6.7 m^2 be allowed for each spawning pair. Consequently the area above McIntyre could support about 9,000 pairs of sockeye presently. In the future, restoration work could increase both the quantity and quality of substrate.

Figure 4 – Channelled Section (above)
And Natural Habitat (below)

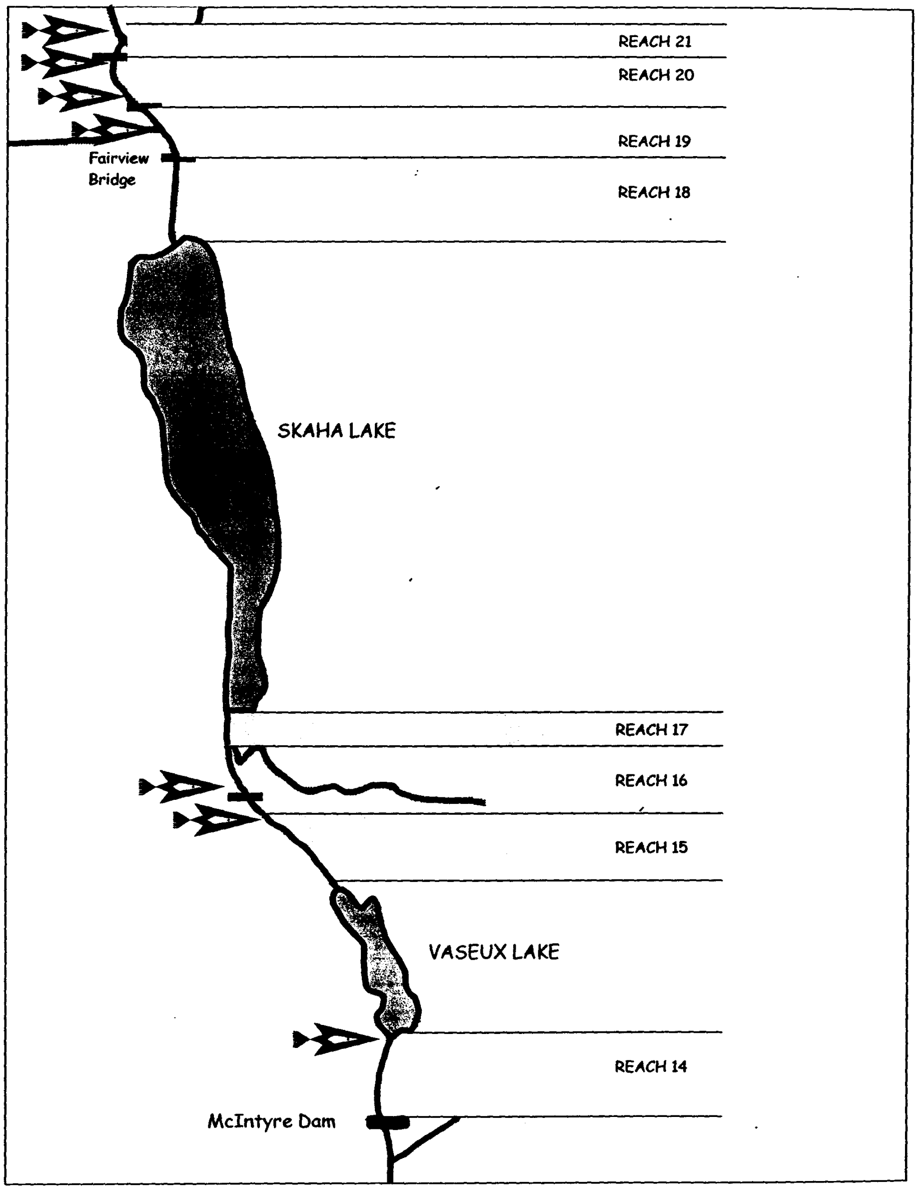

Figure 5 – Potential Sockeye Spawning Areas

4.0 IDENTIFICATION OF RIVER RESTORATION AND OPPORTUNITIES FOR SOCKEYE HABITAT ENHANCEMENT AND DEVELOPMENT

Sockeye spawning habitat in the main river could be improved. In the section between Vaseux Lake and Skaha Lake (Reaches 15 -17) one possibility would be to replace the vertical drop structures with natural rock riffles. This would distribute the drop over a greater run and would provide pool tailouts and down-welling areas conducive to successful spawning. Engineering designs for riffle construction are outlined in Slaney and Zaldokas (1997) and in Newbury and Gaboury, (1993). Engineering drawings for riffles are available for sites in lower reaches of the river (Gaboury and Mould, 1999).

Restoration of floodplains and more natural meanders should also be considered as recommended in the lower reaches by Bull, Gaboury and Newbury (2000).

Reaches 19 – 21, between Skaha and Okanagan Lake, have sections that are sufficiently deep and fast flowing but lack adequate amounts of spawning substrate. Gravel recruitment is limited because this part of the system is lake headed and without tributaries. Here, the river could be improved by substrate scarification and the addition of more gravel. This method was used in reach 20 to improve kokanee spawning. Results have been excellent and now, 20 years after the project was initiated, kokanee still prefer to use the improved area (Steve Matthews, personal communication). Engineering plans are available from Ministry of Environment.

Finally, a spawning channel could be constructed. Optimal conditions of substrate and water flow would maximize egg to fry survival. Existing sockeye channels are very successful (Cooper et. al., 1977) and some consistently produce survival rates of 60 – 70% (M. Flynn, personal communication). However, annual gravel cleaning and complete replacement every few years is necessary to maintain very high survival rates. Furthermore, continual maintenance of headgates and other structures is required. There are several possible channel locations but these would require further site evaluation and consultation with landowners.

Any improvement initiatives in the new section will require much more extensive planning and consultation. The first step is to get approval from provincial and federal fisheries agencies as well as the Okanagan Nation Fisheries Commission. This can be accomplished through the Okanagan Basin Technical Working Group (Elmer Fast, personal communication). Extensive feasibility studies would be required after the concept is approved.

4.1 Adult Holding and Juvenile Rearing

The greatest benefits from extending the run will be achieved through increasing holding and rearing habitat. Adequate spawning habitat is found below McIntyre Dam, and it can accommodate substantially more fish than arrive in most years (Hyatt and Rankin, 1999). Adult holding and juvenile rearing habitat is also available but is not secure. Hyatt (personal communication) warns that sockeye adult holding and juvenile rearing in Osoyoos Lake are “squeezed” into a small meta-limnetic region in the North Basin of Osoyoos Lake which, is bounded by excessive temperature in the epilimnion and low oxygen in the hypolimnion. This small refuge is in danger of decreasing and perhaps disappearing altogether if climate warming continues. Therefore efforts to increase or improve current rearing and holding habitat should be a priority.

Skaha Lake receives water from Okanagan Lake which, is large (26.2 billion cubic metres), deep (242m), and oligotrophic. Based upon limnological conditions it should be a more dependable rearing and holding area than Osoyoos Lake.

The colonization of areas above McIntyre Dam should be allowed to happen naturally by removing the obstructions that man has placed in the way rather than by forcible transport. This will minimize handling of fish which have completed a very long migration through warm water. Since natural colonization may take some time, it would be best to remove the migratory blockages prior to further degradation of holding and rearing habitat in Osoyoos Lake.

5.0 CONCLUSION AND RECOMMENDATIONS

Above McIntyre Dam, two kilometers of river are suitable for spawning. These areas should support about 18,000 sockeye (9,000 spawning pairs). While there is sufficient high quality spawning area below McIntyre Dam, rearing and holding areas in Osoyoos Lake are tenuous. Sockeye should be allowed to naturally migrate back to historical spawning areas higher in the system where adults are able to hold in Skaha Lake prior to spawning and juveniles will be able to rear.

The benefits of extending the run can be increased further by restoring and improving fish habitat in the newly accessed portions of Okanagan River. This can be accomplished by replacing VDSs with natural riffles; restoring natural floodplains and meanders as well as adding new gravel.

Further work is needed to:

- Examine holding and rearing abilities in both Skaha and Osoyoos Lakes
- Compare egg survival rates in areas above and below McIntyre Dam
- Design a habitat restoration and improvement plan for Okanagan River above McIntyre Dam.

6.0 REFERENCES AND PERSONAL COMMUNICATIONS CITED

Bull, C. J., 1999. Fisheries habitat in the Okanagan River. Phase 2: Investigation of Selected Options. Public Utility District 1 of Douglas County Washington.

Bull, C. J., M. Gaboury, and R. Newbury, 2000. Setback dyke and meander restoration designs for the Okanagan River. Submitted to Ministry of Environment, Lands and Parks.

Burner, C. J., 1951. Characteristics of spawning nests of Columbia River salmon. U. S. Fish and Wildlife Service Bulletin 61 (52): 97-110.

Cooper, A. C., D.R. Johnson, W. R. Hourston, W. G. Saletic, R. A. Simmonds, and D. W. Moos, 1977. Evaluation of the production of sockeye and pink salmon at spawning and incubation channels in the Fraser River System. International Pacific Salmon Fisheries Commission Progress Report No. 36. 79p.

Fast, Elmer – Fisheries Manager, Upper Fraser River, Department of Fisheries and Oceans. (Personal Communication, 2000).

Fisher, Chris – Anadromous Fisheries Biologist, Colville Confederated Tribes, Omak, Washington. (Personal Communication, 2000)

Flynn, Mike – Biologist, Habitat and Enhancement Branch, Department of Fisheries and Oceans (Personal Communication, 2000).

Hyatt, Kim – Fisheries Biologist, Stock Assessment Branch, Canada Fisheries and Oceans, Nanaimo, British Columbia. (Personal Communication, 2000).

Hyatt, K.D. and D.P. Rankin. 1999. An evaluation of Okanagan Sockeye salmon Escapement Objectives. Pacific Stock Assessment Review Committee, working Paper S99-18.

Matthews, Steve – Head, Okanagan Fisheries Unit, BC Ministry of Environment. (Personal Communication, 2000).

Mould Engineering, Newbury Hydraulics, Ltd., and Glenfir Resources, 2000. Okanagan River Vertical Drop Structure repairs and fish habitat restoration. MS prepared for BC Ministry of Water Land and Air Protection, Penticton BC.

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Reiser, D. W., and T. C. Bjornn, 1979. Habitat requirements of anadromous salmonids. USDA Forest Service Andromous Fish Habitat Program. 54 p.

Schubert, B., 1980. Okanagan Flood Control System: plan, profile and cross sections of Okanagan River. BC Water Management Branch. 19 Sheets.

Slaney, P. A. & D. Zaldokas, 1997. Fish habitat rehabilitation procedures. Watershed Restoration Circular No. 9. Min. Environment, Vancouver BC.

Wright, Howie – Fisheries Biologist, Okanagan Nation Fisheries Commission, Westbank, British Columbia. (Personal Communication, 2000)

APPENDIX A

Literature Review (Task 3a): Evidence of beach-stream spawning plasticity in sockeye salmon populations and to determine attributes of sockeye spawning and incubation habitat.

Literature Review (Task 3a):
Evidence of beach-stream spawning plasticity in sockeye salmon populations and attributes of sockeye spawning and incubation habitat.

Submitted to: Chris Bull, Glenfir Resources &
Okanagan Nation Fisheries Commission
Submitted by: Karilyn Long
Date submitted: September 1st, 2000

Table of Contents

1.0 Introduction

Sockeye salmon in the Okanagan River once migrated upstream at least as far as Okanagan Lake. Osoyoos, Okanagan and Skaha lakes were probably rearing basins for sockeye salmon, having a rich supply of plankton (14). In 1915, a dam was built at the outlet of Okanagan Lake, which likely rendered the river impassable to salmon migration. Then in 1921, McIntyre Dam was constructed at the outlet of Vaseux Lake to form an impassable barrier to salmon. Currently, the only lake in the Okanagan basin accessible to sockeye is Osoyoos Lake (15).

As part of Objective 3, of the sockeye re-introduction feasibility study, the Okanagan Nation Fisheries Commission (ONFC) completed a literature review of the adaptability of sockeye salmon populations to new spawning habitat and the attributes of sockeye spawning and incubation habitat.

2.0 Literature review methods

The research methods consisted of reviewing literature and conducting interviews. The following search areas were utilized.

- Okanagan University College
- Okanagan Nation Fisheries Commission
- University of Victoria library
- Fisheries Science Centre, University of Washington
- Pacific Biological Station, Department of Fisheries and Oceans
- Sockeye stock assessment, Department of Fisheries and Oceans
- Westwater Research, University of British Columbia
- Malaspina University College
- Ministry of Environment, Lands and Parks, Regional Penticton Office
- Alaska Department of Fish and Game, FRED Division.

Information available on the attributes of sockeye spawning and incubation habitats was comprehensive. While information on beach-stream spawning in Okanagan sockeye was limited, there is sufficient information on sockeye spawning from Alaska, Russia and Northern British Columbia.

3.0 Attributes of sockeye spawning and incubation habitats

In the typical life history, sockeye salmon spawn in creeks where there is a lake in the system. After emergence, sockeye fry migrate to lakes from spawning areas that may be either upstream or downstream from the lake. They rear for one to three years within the lake. The juveniles migrate downstream to the ocean as smolts in the spring and after spending three or four summers at sea, sockeye salmon return to their natal stream to spawn and die. However, sockeye exhibit remarkable variation in life history associated with differences in spawning and freshwater rearing behavior (44).

3.1 Spawning habitat

Characteristically, sockeye spawning areas are adjacent to lake rearing areas (35). Spawning areas selected by sockeye adults may include (see figure 1),

1. rivers or tributary creeks, which flow into or between lakes,
2. the creek mouth at a lake shore where there is subterranean flow during low flow periods (40),
3. the upper sections of the lake's outlet river (13 & 26),
4. shores of the lake where seepage outflows, springs or lake upwelling occurs,
5. shores of a lake where naturally clean, high oxygenated areas exposed to wave action to aerate and clean substrate, usually in large oligotrophic lakes (40),
6. spring-fed ponds and side channels (4).

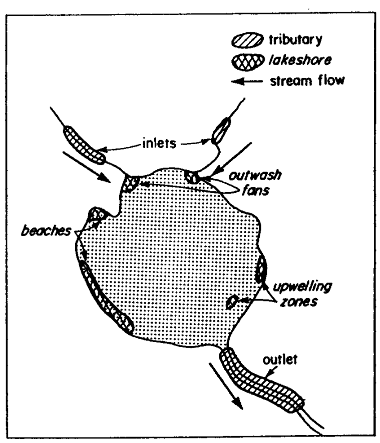

Figure 1. Spawning areas selected by sockeye adults (44).

The character and suitability of areas utilized for spawning depend on geology, topography, climate, water chemistry and runoff patterns (4). More specifically, that the habitat characteristics which determine suitable spawning habitat include substrate, temperature, dissolved oxygen, current velocity and sufficient area per spawning pair (see summary Table 1).

The composition of spawning substrate utilized by sockeye salmon varies widely. Kokanee and sockeye have been known to spawn at considerable depths. Deep spawning to 30 m has been reported in Iliamna Lake, Alaska (6). Most commonly, medium to small-sized gravel (1.3 to 10.2 cm) is utilized for redd production (30).

Preferred water temperature ranges between 10.6-12.2 °C (30). Elevated water temperatures during upstream spawning migration create severe and acute stress (8), which could lead to pre-spawn mortality.

Spawning sites (redds) are selected in areas where there is sufficient water flow through the gravel to provide developing eggs and embryos with dissolved oxygen and to remove the waste products of metabolism (13 & 26). Sockeye spawning areas usually are situated where water is moving 21-101 cm/s (30). Moving water and associated intragravel dissolved oxygen levels are the main limiting factor for beach spawning sockeye (42). Spawning adults avoid marginal areas with intragravel dissolved oxygen levels below 3.0 mg/L. Survival rate is affected when levels drop below 4.0 mg/L (8), and for optimal conditions oxygen concentrations should be greater than 7.88 mg/L (9).

Table 1. Summary spawning habitat requirements.

Parameter	**Requirement**	**Reference**
Preferred spawning substrate size	medium to small gravel 13 to 102 mm 2 to 64 mm	30 38 8
Preferred water temperature	10.6-12.2 °C	30
Preferred current velocity	21-101 cm/s	30
Intragravel DO	> 3.0 mg/L	8
Optimum oxygen concentration	> 7.88 mg/L	9
Optimum depth for spawning	0.3-0.5 m	30
Mean redd area	1.8 m^2	38
Required areas per spawning pair	6.7 m^2	38

3.2 Incubation habitat

Very little is known about the incubation and emergence of sockeye in the mid-Columbia basin, however studies from other areas can be relied on (see summary Table 2). The rate at which sockeye eggs and alevins develop in the redd depends primarily on the water temperature (6) which ranges from 4 to 14 ^{o}C (30 & 32). Egg concentrations occur at depths of 15 to 22.5 cm below the gravel surface (26) with the mean gravel depth at 20 cm (8).

The optimum dissolved oxygen level for incubation is >5.0 mg/L (8 & 30). Davis (9), suggested that the lower lethal concentration of oxygen for salmonids eggs and larvae is 3.98 mg/L with the optimum concentration being greater than 9.75 mg/L. This agrees with Canadian Council of Resources and Environment Ministers (CCREM) (1987) guidelines of 9.5 mg/L for salmonid incubation habitats. The Babine Lake study (42) showed that dissolved oxygen within the substrate was directly related to the survival rates of incubating eggs. The preferred current velocity for incubating eggs is 21-101 cm/s (30).

Table 2. Summary of egg and incubation habitat requirements.

Parameter	Requirement	Reference
Temperature tolerance range	4-14 ^{o}C	30, 32
Optimal gravel depth	mean 20 cm	8
Lower lethal DO	3.98 mg/L	9
Optimum dissolved oxygen	>5.0 mg/L 6.5-9.75 mg/L	8, 30 9
Preferred current velocity	21-101 cm/s	30

4.0 Evidence of beach-stream spawning plasticity in sockeye salmon populations

Among the species of Pacific salmon, sockeye exhibit the greatest diversity in adaptation to a wide variety of spawning habitats. The evolutionary adaptations of sockeye to lake environments appears to require more precise homing to spawning areas, both as to time and location, than is found in the other Pacific salmon (44). The precision in homing behavior promotes reproductive isolation, which shapes the population by facilitating adaptation to local environmental conditions. Precise homing is probably more important to sockeye salmon because it ensures that juvenile sockeye have access to a suitable lake rearing areas (44).

Variations in spawning behavior often require adaptations in fry behavior or egg incubation. In autumn, lakes cool more slowly than small streams, therefore eggs deposited in lake water or outlet tributaries will remain warmer longer than eggs deposited in small inlet tributaries. The difference in the thermal regimes produce adaptations in egg size, development rate and spawning time between lake and stream spawners, which are required to synchronize fry emergence with the availability of food in the spring (44). Presumably, this explains why inlet tributary spawners typically spawn earlier than lakeshore or outlet tributary spawners (4).

Differences have been noted between river spawning and lake spawning sockeye (6). The differences in spawning and incubation habitat were found to promote different traits that led to reproductive success. The two main limiting factors for river-spawners colonizing beach-spawning areas are temperature regime and dissolved oxygen required for egg incubation. Genetic stocks may be adapted exclusively to either river or beach spawning. The temperature in the rivers differ from the lakes as the tributaries cool more quickly in the fall than the lake which maintains heat, and it is the first month temperature that is the most critical for incubating eggs (42).

Spawners also need to be site selective in the tributary and lakeshore incubation habitats, because redds in lake-shore habitat without upwelling may be affected by reductions in water level and scouring by ice over winter if they are too shallow and by low dissolved oxygen concentrations if they are too deep (44).

4.1 Examples of beach-stream spawning sockeye habitat

Burgner (4) found that the relative importance of each type of spawning area varied greatly among lake systems and by year within systems. Three spawning types were examined in the four main lakes in the Wood River system, Alaska. The differences in spawning distribution reflected the relative availability of the spawning area types. In spite of the differences in the areas and variation from year to year, the number of spawners per hectare of lake nursery area was similar among the four lakes (4). These findings plus the following examples support the notion of a high plasticity in sockeye populations.

Lake-beach spawning is important in most sockeye lakes in Bristol Bay, Kodiak Island and the Alaska Peninsula. On the Kamchatka Peninsula, lake beaches accommodate the major portion of the spawning population. Beach spawning is less important in the major lakes of the Fraser and Babine River systems in British Columbia (BC) (4).

There is extensive spawning around islands in Iliamna Lake, Alaska, where spawning occurs in coarse rubble material and circulation around the eggs and alevins is dependent on wind-driven lake currents (4). Sockeye that spawn around these islands do so over large angular rubble too large to move. The spawned eggs settle in crevices (6).

On Babine Lake, beaches utilized for spawning, have suitable gravely bottoms and a strong flow of spring or ground water (42). Such areas may be small or may extend for miles along the shore. Spawning may occur in water only a few inches deep but often extend to depths beyond the vision of a surface observer (16).

Rivers between lakes are utilized for spawning in the Bristol Bay area because they provide more stable flow and temperatures than headwater drainage streams unbuffered by lake reservoirs. In the larger abraided rivers, spawning tends to occur in the finer gravel of side channels (4).

Spring fed ponds and channels are utilized by spawning sockeye in Kamchatka and Bristol Bay. In some Bristol Bay areas, nest digging enlarges the spring pond area by cutting into gravel banks. Spawning in glacial-fed rivers is generally avoided, probably because survival of eggs and alevins would be low in the silt-clogged gravel substrate. However, there is river spawning in the Stikine River and its tributary, the Iskut River, which is highly turbid due to glaciation (4). The majority of progeny remain and overwinter in the river but some migrate at age 0 to the estuaries after spending several months feeding in the stream (4).

In the Fraser and Skeena rivers in BC, most spawning takes place in tributary streams, trunk streams between lakes and lake outlets. Russian investigators reported some Kamchatkan spawning areas where there is no lake access. This situation also occurs in the lower Harrison River, BC and the East Alsek River, Alaska, where juveniles either overwinter in non-freezing springs and creeks or migrate directly to sea after emergence (4).

4.2 Genetic research related to sockeye spawning plasticity

Surveys reveal that genetic diversity in sockeye salmon is extensively divided among major geographic regions and among different lake systems. It is the nursery lake which defines distinct populations, however sub-populations have been identified within many lakes. The genetic surveys by Wood (1995) suggest that reproductively isolated populations are typically adapted to local conditions and are in some sense evolutionarily significant (44).

Estimates of gene flow indicate that on average less than 10 migrants are exchanged per generation between lake and tributary sub-populations or between inlet and outlet tributary sub-populations in most lakes (44).

Winans et al (40) found no discernible pattern in geographic variation, which indicates that the nearest geographic neighbors of sockeye populations are not necessarily the most genetically similar. Whereas other Pacific salmon species (i.e. chum, chinook and pink salmon) exhibit regional patterns of geographic differentiation. Therefore the now extinct Skaha Lake stock may have been genetically different than the established Okanagan River stock.

5.0 Summary of results

As early as the 1900's, there have been numerous attempts and considerable effort to transplant sockeye salmon. Anadromous runs have only been established at three sites, all within the species' natural range. In each case, the successful transplants involved donor populations only 15, 20 and 90 km distances from the transplant site and in many ways the transplant resembled natural colonization of adjacent habitat (44).

Among the Pacific salmon, sockeye exhibit the greatest plasticity and diversity in adaptation to a wide variety of spawning habitats. However, there are genetic differences between river spawning and lake spawning sockeye which may limit colonization depending on habitat available in Skaha Lake and the stock of the strays for colonizing the area (most likely from the Okanagan River).

Kokanee residing in Skaha Lake spawn in the Okanagan River Channel (25). Ministry of Environment, Lands and Parks (MELP) recorded that kokanee spawner numbers were significantly higher in 1999, than the average for the past 10 years (25). MELP fisheries staff attributes the increase to the habitat enhancement. Given that sockeye salmon display spawning plasticity and that Skaha Lake contains suitable habitat, the opportunity exists to re-establish a sockeye population and to effectively colonize for the long term. The status of existing sockeye habitat and opportunities for enhancement will be inventoried as outlined in tasks 3B through 3E, as part of Objective 3, of the sockeye re-introduction feasibility study.

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