

FINAL

OBJECTIVE 2

Exotic Fish Risk Assessment

Contribution No. 2 to an *Evaluation of an Experimental Re-introduction of Sockeye Salmon into Skaha Lake: YEAR 3 of 3*

Presented to: Colville Confederated Tribes

Date: May 31, 2003

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EXECUTIVE SUMMARY

This report arising from Objective 2 of the three-year study “Evaluation of an experimental re-introduction of sockeye salmon into Skaha Lake” is to explore the possibility of certain undesirable exotic fish, termed “exotic species of concern” gaining access to upstream areas, and eventually colonizing them to the detriment of native species. While a number of exotic species are already quite widely established in the drainage, some exist only below McIntyre Dam. These might extend their range upstream and colonize Vaseux as well as Skaha Lake if the dam were modified or removed in the reintroduction process.

To confirm the ranges of exotic fishes as indicated from a literature review and in a report and recommendations from YEAR 1 and Year 2 sampling, the Okanagan Nation Fisheries Commission (ONFC) used a variety of fish sampling techniques to capture specimens over a range of habitats within the study area from April 15 to November 28, 2002.

Field sampling was by angling, beach seining, boat based electrofishing, backpack electrofishing, gillnetting, minnow trapping, trap netting and from a weed harvester. There were thought to be only five species of exotic fishes of concern, i.e. black bullhead, black crappie, largemouth bass, tench and walleye, until 2001 when a 6th species – bluegill sunfish, was captured by electrofishing in Osoyoos Lake.

Currently, black bullheads are in Skaha Lake and largemouth bass are in Vaseux Lake; but black crappie have not been found above Osoyoos Lake and walleye are in the Okanagan River drainage but not further upriver of Mallot, Washington.

Range extensions would be heavily influenced by availability of suitable food and habitat. Black crappie range widely in open water and feed on a variety of very small fishes and plankton. Largemouth bass are predatory feeders in littoral areas and because smallmouth bass are widely distributed in the Okanagan basin and share some food preferences and behavioral similarities with largemouth they may reflect some of the hazards that the former could constitute for salmonids. Both bass species are piscivorous, but while smallmouth are known to feed on sockeye fry as they coexist in littoral areas during migrations to and from the lakes pelagic zone, largemouth wait at the edge of the littoral zone as territorial ambush predators thus limiting their predation on pelagic salmonids. Tench are carp-like fish with likely some of the same impact on indigenous non-salmonids fish species that carp have – notably competition for food, and turbidity when they spawn. Tench spawn early in summer (May/June) but dependent on water temperatures as is for most fish. Walleye are predators known to travel long distances.

The risks associated with range extension of exotic species of concern into Skaha Lake and other upstream waters were assembled in years 1, 2 and 3 and are summarized in Table 3.

ACKNOWLEDGMENTS

The Okanagan Nation Fisheries Commission would like to acknowledge valuable contributions made by a number of people to Objective 2: Exotic Fish Species Risk Assessment (YEAR 3).

Steve Logan, Owner of Newport Beach R.V Park located on Westside road near Vernon B.C. for the use of their boat launch and parking lot to do bio-sampling. Mr. Logan was very supportive to ONFC and the study undertaken.

We would like to pay special thanks again to Monte Miller and the Colville Confederated Tribes (CCT) for the use of their electrofishing boat. Thanks for completing the electrofishing segment of the study and for sharing some “exotic fish “ photos.

The gillnets and beach seines were loaned by Steve Matthews of the Ministry of Water, Land and Air Protection (Penticton) while Don Ignace and Darby Hewitt of the Skeetcheson Band lent us two of their trap nets and Kanji Tsamura of BC Fisheries also lent us a trap net.

Thank you, Lynnea Wiens, Natasha Audy of Katim Enterprises and Bob Swite, summer student who provided fieldwork and data entry support.

Thanks to our quality control advisor Chris Bull, and to Howard Smith who edited this report.

The YEAR 3 report could not have been completed without the contributions of these resources and experts. Thanks again to everyone involved.

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1.0 INTRODUCTION

1.1 Project Background

This report summarizes the third year of the three-year study “Evaluation of an experimental re-introduction of sockeye salmon into Skaha Lake”. The Okanagan sockeye salmon is one of the last two significant populations in the Columbia River system, the other being the Wenatchee River stock in Washington State. Abundance of this stock has declined and fluctuated dramatically in the last fifty years (Hyatt & Rankin 1999). Anadromous sockeye probably populated many upstream waters at one time and the Okanagan Nation and tribes in the U.S. have proposed re-introducing the species into Skaha and possibly Okanagan Lake, both of which have larger rearing capacities than Osoyoos Lake where juvenile sockeye now spend their first year (see Figure 1). McIntyre Dam is largely impassible for sockeye which is currently the furthest point upstream that they can reach.

The Bonneville Power Authority (BPA) along with the Colville Confederated Tribes (CCT) and the Okanagan Nation Fisheries Commission (ONFC) are evaluating the proposal for a re-introduction of sockeye salmon into Skaha Lake. The ONFC was retained for project management and implementation of the data field collection for this report, which covers YEAR 3 of Objective 2, the ‘Exotic Species Risk Assessment’.

1.2 Objective 2 Scope

The concern implicit in Objective 2 is the possibility of undesirable exotic fish passage to, and colonization of upstream areas. A number of exotic fish not indigenous to the Okanagan have become widely established in the Okanagan system. Some of these are found only below McIntyre Dam, which is generally a barrier to fish migration, but with removal or changes in the dam structure; they could extend their range upstream and colonize waters such as Vaseux, Skaha and Okanagan Lakes. These populations are referred to as the ‘exotic fishes of concern’.

Objective 2 calls for an evaluation of the potential risks through the following tasks:

- ◆ Task A: continue to review available fish inventory information from the Okanagan River system.
- ◆ Task B: repeat the inventory of presence or absence of exotic fish species and habitat use above and below McIntyre Dam.
- ◆ Task C: complete a literature review of habitat requirements of additional exotic species of concern. No new species were found during the 2002 sampling.

1.3 Project Study Area

At the year two BPA review meeting it was decided to expand the study area to include the north arm of Okanagan Lake because this region has likely Exotic Species habitat. The rest of the study area remains the same i.e. below McIntyre Dam encompassing the north and central basin of Osoyoos Lake and the Okanagan River channel; and above McIntyre Dam including Okanagan River, Vaseux Lake, Skaha Lake and the southern portion of Okanagan Lake (see Figure 1). Barriers to fish migration at dams located at the outlets of Skaha and Okanagan Lakes have provisions for fish passage but are not in operation.

[Figure 1. Overview map of the study area](#)

2.0 INVENTORY OF EXOTIC FISH SPECIES

To confirm the extent of exotic fish range and distribution as indicated by the literature review and after one year of sampling, the ONFC used a wide variety of capture techniques and sampled a wide range of habitats within the study areas. The sampling plan was based on the YEAR 2 report and recommendations. ONFC was responsible for field data collections and project management. Glenfir Resources was retained to provide quality control for the program.

The sampling in YEAR 3 targeted the exotic species of concern and areas of their likely habitat as determined in YEAR 1 and 2. These include,

1. Minnow trap, beach seine, electro fish and trap net in the north arm of Okanagan Lake because of its exotic species habitat possibilities.
2. Minnow trap in areas not sampled in 2001, 2002.
3. Beach seine the south end of Okanagan Lake.
4. Sample by angling and trap netting in and above Vaseux Lake to determine how far up the basin largemouth bass and black crappie have migrated,
5. Fish for black bullheads in South Okanagan Lake to measure the rate of colonization.

2.1 Exotic fish inventory methods and results

ONFC conducted the exotic fish inventory in accordance with all required permits from the Ministry of Water, Land and Air Protection (MOWLAP) and Fisheries and Oceans Canada (DFO) as noted in Appendix A.

Sampling was conducted from April 15 to November 28, 2002 with at least one method per week, to cover migrations of fish species utilizing different habitat types during different times of the year. Sampling sites were established in YEAR 1. After Year 2 when several pertinent recommendations were received it was decided to expand the sampling area to include the north arm of Okanagan Lake and to focus on the exotic species of concern by targeting their habitat types, and to double efforts in Skaha Lake. Table 1 outlines the sampling methods used during the four sampling seasons and selected locations. Details of each sampling method and fish caught are outlined in Sections 2.1.1 to 2.1.8. Refer to Fig. 2 through 8 for sites and methods used.

Table 1. Methods and locations for sampling exotic fishes of concern

Method	Months	Locations	Species targeted
Angling	May, September & November	Vaseux lake, Okanagan River, Penticton Oxbows	Black Crappie, Largemouth Bass
Beach seining	May, June, September & November	South Okanagan and Osoyoos Lake, North Okanagan	13 littoral fish species
Electrofishing-boat	April, June, August & November	South Okanagan, Skaha, Osoyoos Lake, North Okanagan Lake	18 littoral fish species
Electrofishing-backpack	July	Okanagan River	Small river fishes (RBT, CH)
Gill netting	August	Osoyoos Lake	Walleye & pelagic species
Minnow trapping	April, May, July, & November	General	Small individuals
Floating trap net	July and September	Vaseux Lake, North Okanagan	Black Crappie and Largemouth bass
Weed Harvester	August	Osoyoos Lake	Sockeye fry

The Catch Efficiency of each kind of sampling gear was recorded. A summary of species caught by each kind of fishing gear is presented in Table 2, and detailed summaries are in Appendices C-H.

2.1.1 Angling

After several attempts at angling without success, it was decided to discontinue this method of sampling. See Appendix B for dates and areas sampled.

2.1.2 Beach seining

Fourteen new beach seine sites were added this year in the north arm of Okanagan Lake. (See Fig. 2). These were in addition to last year's sites in southern part of Okanagan Lake (Photo 1). A large seine net 30 m long, 3 m deep and with mesh sizes (stretch measure) of 3 mm in the bunt end and 10 and 25 mm panels in each wing was used. As anticipated, seines employed from shore over smooth substrate caught species which frequent the littoral zone. In addition to 14 identified species some unidentifiable juvenile fish were caught (see Appendix C for details).

Species caught:

black crappie	black bullhead	peamouth chub
prickly sculpin	common carp	redside shiner
sockeye fry	northern pike minnow	smallmouth bass
yellow perch	whitefish spp.	bluegill
		largemouth bass
		sucker spp.



Photo 1. Beach seining on South Okanagan Lake (BS 4)

2.1.3 Electrofishing

Night surveys with the boat-mounted electrofisher (Photo 3) were conducted in April, June, August and November (Appendix D). See figures 2, 3, 5, and 8 for sites. The boat, equipped with a Smith-root model 7.5 GPP electrofisher, sampled transects parallel to the shoreline, in water depths of less than 3.5 meters. Voltage was kept constant at 500 volts (DC) with the duty cycles varying between 20% and 55%. The majority of electrofishing was undertaken at outputs between 3.8-6.5 Amps. Species caught from the study area are listed below.

Species caught:

black crappie	black bullhead	common carp	rainbow trout
reidside shiner	burbot	prickly sculpin	sockeye
whitefish spp.	yellow perch	bluegill	kokanee
northern pike minnow	largemouth bass	peamouth chub	smallmouth bass
pumpkinseed	sucker spp		



Photo 2. Electrofishing in Osoyoos Lake (EF-b 10)

2.1.4 Backpack Electrofishing

As per the recommendations from Year 2, one day of backpack electrofishing was conducted on the natural section of the Okanagan River, near Oliver, BC. Target species were small river fishes and no new species were found (refer to species caught in Appendix E).

2.1.5 Gillnetting

Gillnets were used to target walleye in Osoyoos Lake (GN 1, 2, and 3) in 3 areas identified in the YEAR 1 recommendations.

Gillnetting was also completed at two sites in Skaha Lake. Gangs were made up of 5-6 nets; gill nets used at all sites ranged from 1" to 5.5" in mesh size (see Appendix F for complete details)

Species caught:

common carp	northern pike minnow	sucker spp.	adult sockeye
whitefish spp.	kokanee	rainbow trout	peamouth chub

2.1.6 Minnow trapping

Minnow traps were distributed throughout much of the study area in April, May, June, August, September and November and fished for 24-hour periods. Several extra sites were included in Year 3 in the north arm of Okanagan Lake as per the recommendations in Year 2. (see Figure 2). The trap mesh was 6 mm and the circular entrance was 2 cm in diameter. The traps were baited with canned sardines or salmon roe. Usually, 3 to 4 minnow traps were set at each site. (Photos 3 and 4).

Species caught:

black bullhead	prickly sculpin	common carp	kokanee
largemouth bass	pumpkin seed	rainbow trout	redside shiner
smallmouth bass	sucker spp.	bluegill	yellow perch
northern pike minnow			



Photo 3. Minnow trapping in the Penticton Oxbows (MT 7a)



Photo 4. Minnow trap set in Vaseux Lake (MT17)

2.1.7 Trap netting

Three floating traps were fished for 48hr periods in Vaseux Lake specifically targeting black crappie. No black crappie was caught but a tench was (Photo 5). There was also 1 site in Osoyoos Lake and 3 sites in Okanagan Lake (Photo 6). Furthermore, trap netting was conducted in the north arm of Okanagan Lake. The net was set in water 1 to 3 m deep, 5 m offshore (see Appendix H for data and Catch Efficiency)

Species caught:

black bullhead	largemouth bass	yellow perch	sucker spp
pumpkinseed	northern pike minnow	tench	



Photo 5. Vaseux Lake Tench (TN 2)



Photo 6. Trap net in the North Arm of Okanagan Lake (TN 4)

2.1.8 Weed Harvester

In August a weed harvester conducted a clean up of Eurasian milfoil near the northern basin, and Haines Provincial Park of Osoyoos Lake. Permission to board the harvester was granted by the North Okanagan Regional District (NORD) to observe any by-catch of sockeye fry. No sockeye fry were observed, but some smallmouth bass were caught up in the grids. (see Appendix I for more details).

2.2 Inventory summary

No new species were discovered this year within the study area, which ranged from the north arm of Okanagan Lake all the way south to Osoyoos Lake. Therefore, to date, the species of concern remain black bullhead, brown bullhead, black crappie, bluegill, largemouth bass, tench and walleye. Of these species black bullhead are found as far as Skaha Lake; and largemouth bass as far upstream as Vaseux Lake. In Year 3 two tench were collected on two separate occasions in Vaseux Lake, -- the first time in this study they have been caught. Black crappie and bluegill have been found only in Osoyoos Lake, and brown bullhead and walleye have not yet been caught in the study area. Table 2 summarizes the fish species caught during 2002 sampling. The catch data and Catch Efficiency are found in Appendices B through I, and the species codes are in Appendix J. Figures 2 through 8 show sampling sites located on composite air photos.

Table 2. Summary of 2002 catch by fishing location

Species found during 2002 sampling	Above McIntyre Dam					Below McIntyre Dam	
	Okanagan Lake North	Okanagan Lake South	Skaha Lake	Vaseux Lake	Okanagan River channel & oxbow	Okanagan River channel	Osoyoos Lake
Burbot		EF-b, TN					GN
Black crappie							BS, EF-b
Black bullhead			EF-b, MT	MT, TN	MT	MT	BS
Brown bullhead							
Bluegill sunfish							BS, EF-b
Prickly sculpin	MT	BS, EF-b, MT	EF-b, MT	MT	MT	B-EF, MT	BS, EF-b, MT
Chinook salmon							
Chiselmouth						B-EF	
Common carp	BS, EF-b	EF-b	EF-b	MT			, BS, EF-b, GN
Eastern brook trout							
Longnose dace						B-EF	
Goldfish							
Kokanee			EF-b, GN		MT		GN
Largemouth bass				MT, TN			BS, EF-b, GN
Lake chub							
Northern pike minnow	BS, TN, MT, EF-B	BS, EF-b, MT	EF-b MT, GN	MT	MT	B-EF,	EF-b, GN
Peamouth chub	BS, MT, EF-b	BS, EF-b	EF-b GN		MT		BS, EF-b, GN
Pumpkinseed	BS,	MT	EF-b	MT, TN		B-EF	BS, EF-b
Rainbow trout	EF-b		EF-b, GN			B-EF, MT	EF-b,
Redside shiner	BS, EF-b	BS, EF-b, MT			MT	B-EF	
Sockeye salmon							BS, EF-b, GN
Smallmouth bass		MT	EF-b	MT	MT	B-EF MT	BS, EF-b
Sucker spp.	TN, EF-b	BS, EF-b	EF-b, GN		MT	B-EF	EF-b, GN
Tench				MT			
Whitefish spp.	EF-b	BS, EF-b	EF-b				GN, BS, EF-b
Walleye							
Yellow perch	TN, MT, EF-b		EF-b, MT	MT, TN	MT	MT	BS, EF-b, MT

Fish capture methods and gear codes	EF-b	electrofishing boat
	MT	minnow trapping
	GN	Gillnetting
	AG	Angling
	BS	beach seining
	TN	trap netting
B-EF	Backpack electrofish	

[Figure 2. Map of Okanagan Lake](#)

Figure 3. Sampling sites on South Okanagan Lake

Figure 4. Sampling Sites on Penticton Channel

Figure 5 Sampling sites on Skaha Lake

Figure 6. Sampling sites on Vaseux Lake

Figure 7. Sampling sites on Okanagan River Channel

Figure 8. Sampling sites on Osoyoos Lake

3.0 AVAILABILITY OF SUITABLE HABITAT FOR EXOTIC SPECIES OF CONCERN

The possibility of undesirable exotic fish moving to areas upstream of McIntyre Dam such as Skaha and/or Okanagan Lakes is a concern because if such habitats prove suitable to exotic species they may adapt for long-term colonization. The Skaha Lake littoral zone (Figure 9) has rooted aquatic vegetation along the shallow eastern and western shorelines thus providing habitat for fish that prefer such areas. Given access these exotic species, black crappie, bluegill, largemouth bass and tench could survive in Skaha Lake but not necessarily flourish as well as they do in Osoyoos Lake with its shallow mean depth and extensive littoral area.

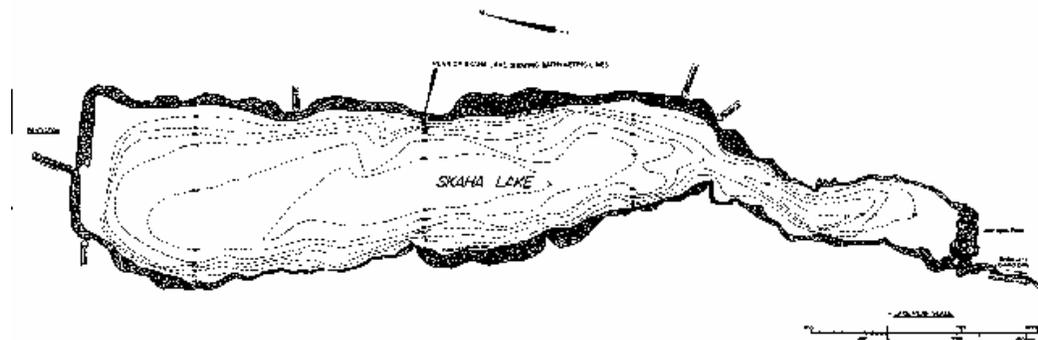


Figure 9. Bathymetric Map of Skaha Lake

Along its large littoral area, Osoyoos Lake (Figure 10) supports many fish species, and is an important nursery ground for young sockeye salmon (Anon, 1972). There is a high density of fish in all habitats of Osoyoos Lake including a large percentage of non-salmonids. Bluegill, found during sampling in YEAR 2, inhabit shallow, weedy, littoral areas as juveniles. but when they reach >50-75mm they move into open-water within the limnetic zone. Black bullheads already exist in Skaha Lake. Black crappie, largemouth bass and tench typically inhabit littoral areas like those found in Osoyoos Lake and could inhabit Skaha Lake. Walleye are found in both the pelagic and littoral areas of lakes; they are also piscivorous and prey heavily on juvenile sockeye when present.

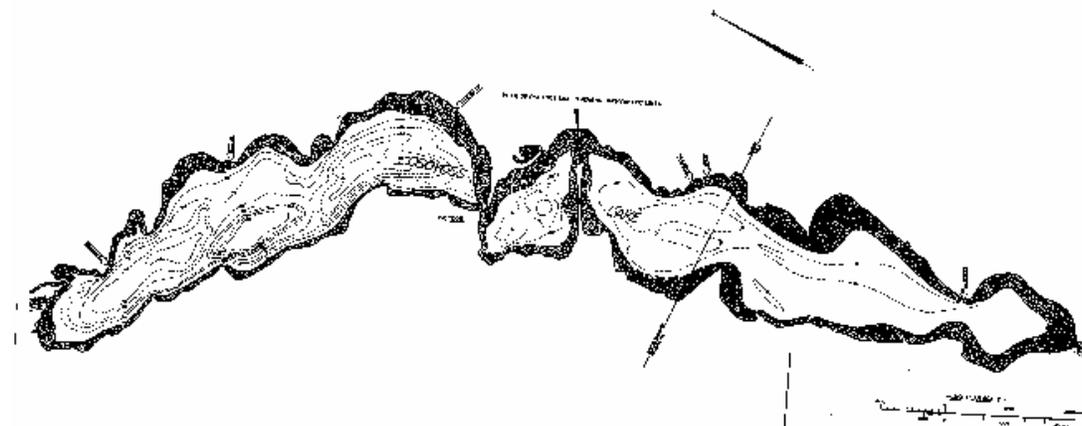


Figure 10. Bathymetric map of Osoyoos Lake

4.0 ASSESSMENT OF THE RISK OF EXOTIC SPECIES INTRODUCTION TO SKAHA LAKE

After a complete review of YEARS 1, 2, and 3, there arise two risks from the possible introduction of exotic species into Skaha Lake:

1. Predation on young salmonids by carnivorous fish species
2. Strong competition for habitat and/or food.

From the three year literature review and sampling it was concluded that there were six exotic species of concern i.e. black crappie, black bullhead, largemouth bass, tench, bluegill and walleye.

Largemouth bass (already found in Vaseux Lake above McIntyre Dam) are a predatory fish that feed in the littoral areas. By studying smallmouth bass (established throughout the Okanagan Basin) it was hoped to extrapolate findings and apply them to the somewhat similar habitats and feeding preferences of largemouth bass (a fish of the same genus). The literature search concluded that the two species use different areas with smallmouth bass using cooler deeper areas (Scott and Crossman 1973; Coble 1975) whereas largemouth bass thrive best in warm, shallow, weedy areas of lakes or river backwaters (Newbury and Gaboury 1993; Scott and Crossman 1973). Both largemouth and smallmouth bass are piscivorous but largemouth bass are described as territorial ambush predators, which behavior would seem likely to make them comparatively less threatening to pelagic salmonids (Naito 2000). Smallmouth feed on sockeye fry primarily in the littoral zone where the young fish are abundant after emergence and on sockeye smolts during their out-migration.

Juvenile bluegills are typically found in littoral zones, but on reaching about 50-75mm they move into open water within the limnetic zone where they feed predominantly on limnetic zooplankton. Fish are rarely eaten so bluegill is of little consequence for deep pelagic species like kokanee, sockeye and rainbow trout.

Walleye are found in the Okanagan River south of the International Border and there is no apparent physical barrier to their movement north. These fish would have an impact on juvenile sockeye and kokanee but this would occur primarily in Osoyoos Lake if they were to extend their range to include it. Walleye are sensitive to light and it appears this photosensitivity maybe what keeps them from colonizing the upper areas of the Okanagan system (Vedan 2003).

There are a number of barriers to fish migration up the Okanagan River. For instance, the control dam at the outlet of Okanagan Lake is a barrier to black bullheads that exist in Skaha Lake and the control dam at the outlet of Skaha Lake is a barrier to largemouth bass that are well established in Vaseux Lake above McIntyre Dam. Since black bullheads have been identified during this study in both Skaha and Osoyoos lakes they are no longer considered an exotic species of concern.

Tench are a carp-like fish that would most likely have the same role in the ecosystem that carp have, such as competition for food with native species. The risks associated

with the upstream migration and colonization of exotic species into Skaha and South Okanagan Lakes from Years 1, 2, and 3 are summarized in Table 3.

In the Okanagan drainage the design of fish passages should be based on the jumping capabilities of the salmonids. There is little information on the jumping capabilities of exotic species, but it is known, that they do not jump very high. With this in mind, the recommendation of this report is that there are some minimum height requirements for the fish passage sections of dams. For instance sockeye salmon can probably ascend drops of 1.5 m or more and depending a great deal on where they are leaping from (Vedan 2003).

Osoyoos and Skaha Lake habitats differ primarily in the amount of littoral area. Skaha Lake contains rooted aquatic vegetation along only the eastern and western shorelines whereas, Osoyoos Lake provides considerable and widely distributed littoral habitat suitable for species such as largemouth bass, black crappie, bullhead, bluegill sunfish and tench. If access was provided to Skaha Lake, exotic species could probably survive there but perhaps not as successfully as they do in Osoyoos Lake.

Studies were conducted on the north arm of Okanagan Lake in Year Three, due to the fact that there is acceptable exotic species habitat in this area. However no species of concern were noted in this area during inspection of catches after the sampling season.

The risks associated with the introduction of all these species are minimal. Sockeye either live in a different zone or pass by them too quickly for carnivorous fish to have a significant impact.

Table 3. Summary of results from YEARS 1, 2 and 3 and perceived risks

Exotic species of concern	Geographical Range of species within South Okanagan Basin	Habitat preferences and species interactions	Skaha Lake areas thought likely to be colonized	Exotic Fish Risk Assessment
Black crappie	Caught in Osoyoos Lake oxbows; not above McIntyre Dam	Lake littoral zone. Adults feed on very small fish.	Littoral	Little interaction with salmonids
Largemouth bass	Vaseux and Osoyoos Lake where they have coexisted with salmonids for 70 years	Warm, shallow, weedy areas. Piscivorous but predation would be minimized on pelagic species except during emergence and smolts.	Littoral	Would feed on salmonids passing through the littoral zones
Tench	Caught in Osoyoos and Vaseux in 2002	Littoral areas of lakes, or swamps, particularly where organic material is substantial	Littoral and backwater oxbows	Rare in Osoyoos Lake & most likely have little interaction with salmonids.
Walleye	Not in Osoyoos, Skaha or South Okanagan lakes; established population in the Columbia mainstem	Littoral and pelagic areas of lakes seasonally inhabit the same areas, and are known to prey on juvenile salmonids.	There is suitable habitat in Skaha & Osoyoos Lake	Would have an impact on resident salmonids if they established themselves in the Okanagan Basin.
Bluegill	In Osoyoos Lake.	Littoral zone; adults move into limnetic open-water; feed predominantly on limnetic zooplankton and rarely eat fish.	Littoral as juveniles and limnetic open water as adults.	Occupy different habitat and feed on zooplankton, which makes them of little consequence to deep pelagic species like kokanee, sockeye and rainbow trout.

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

APPENDIX A

Required Permits



OKANAGAN NATION ALLIANCE

3255 C Shannon Lake Road, Westbank, BC V4T 1V4
Phone (250) 707-0095 Fax (250) 707-0166 www.syilx.org

June 3rd, 2002

Steve Matthews
Senior Fish Biologist
Environmental Stewardship Division
Okanagan Region
Ministry of Water, Land and Air Protection
Suite 201-3547 Skaha Lake Road
Penticton, BC V2A 7K2

COPY

Dear Steve,

Re: Scientific Collection Permit (File: 34770-20)

Thank you for the Scientific Collection Permit File: 34770-20, for our Skaha Lake sampling project to collect fish for scientific purposes. In past permits the Ministry has written in a clause stating "this permit is issued without prejudice to the title and rights of the Okanagan Nation or any member Band of the Okanagan Nation".

The ONFC recognizes the good working relationship that has developed with regional MoWLAP in Penticton and have in the past accepted the permits issued as a courtesy of goodwill amongst government agencies. However, the Okanagan Nation Fisheries Commission (ONFC), care of the Okanagan Nation Alliance (ONA) can not recognize the issued permit without the clause.

Therefore, please accept this letter as notification of our scientific works in Okanagan territory for your records.

Thank you

Deana Machin
Program Manager





COPY

File: 34770-20

Phone: (250) 707-0095

SCIENTIFIC COLLECTION PERMIT

Permittee:

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

is hereby authorized under Section 19(1) of the Wildlife Act, RSBC 1996, and as provided in Section 2(c)(i) Permit Regulation (B.C. Reg. 235/2000), 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 (including oxbows)

**Permitted Areas:
& Times:**

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 15 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 April 1 to July 15 and November 1 to March 31, and no sampling in any streams utilized by kokanee during the period September 1 to April 30.

No lake sampling (with the exception of minnow traps) within 0.5 kilometers of known kokanee shore spawning areas during the period October 1 to April 30.

No seining in littoral zones of Skaha Lake, Vaseux Lake, Vaseux Lake oxbows and Osoyoos Lake during the period March 15 to June 30.

Gillnetting is permitted on a trial basis on Skaha Lake only (see Permitted Gear Section for more details).

Permitted Species:

All non native fish species to specified limits indicated on Sampling Plan.

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

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Okanagan Nation Alliance

requirements for each fish species.

Permitted Gear:

(a) Equipment

Angling, gillnetting, electroshockers (backpack and boat mounted), minnow traps, seine nets, dip nets as per the Sampling Plan submitted by permittee.

(b) 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 health condition. If there is a bycatch of non-target species, particularly salmonid species, collection methods must be modified prior to resuming sampling operations.

Gillnets are permitted on a trial basis only. Capture methodologies (mesh size, net location, fishing times and duration) must be designed to minimize capture of non-target species as indicated above. Gillnets must be checked a minimum of once per hour to assess bycatch.

Monitoring of Operation:

The Permittee will allow Ministry of Water, Land and Air Protection observers to inspect the collection procedure at any time without advance notice being given.

Permitted Personnel:

Howie Wright, Shayla Lawrence, Herb Alex, Fabian Alexis, Alfred Snow, Keith Lewis, Kari Long and any additional qualified personnel as authorized by the ONFC. Qualified fish sampling personnel must be present during all sampling activities.

Permit Period:

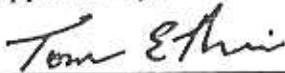
April 15, 2002 to March 31, 2003.

Expiry Date:

April 1, 2003.

See reverse side of General Conditions

Approved by:



Tom Ethier
Acting Section Head

Date: April 15, 2002

Cc: Rick Hildebrand, Conservation Officer Service, Kamloops
Steve Matthews, Fisheries Program, Penticton

Any contravention or failure to comply with the terms and conditions of this permit is an offence under the Wildlife Act, RSBC 1996 and B.C. Reg. 253/2000. Section 2(c)(i) Permit Regulation.

GENERAL CONDITIONS

This permit is issued without prejudice to the title and rights of the Okanagan Nation.

1. This collecting permit is not valid
 - (a) in national parks,
 - (b) in provincial parks unless approved in writing 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 possess 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 Permittee must notify the district conservation officer(s) of the permittee's schedule for collection activities in their areas prior to the commencement of those activities.
4. This permit must be carried by the permittee while engaged in fish collecting and produced for inspection upon request of a conservation officer, fishery officer or constable.
5. 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.
6. 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.
7. Fish collected under authority of this permit shall not 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.
8. 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 Committee on live fish permits.
9. The permittee shall submit to the Regional Fisheries Section Head for the area under consideration the fish collection data within 90 days of completion of the collecting activity. Interim reports and/or sample data cards will be provided upon request to the requesting officer.
10. This collecting 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.
11. Ensure staff are always working in water that is 5°C or greater if sampling for presence or absence of fish.

To:

- ◆ Conservation Officer Service – Ministry of Environment, Lands and Parks, Penticton FAX 492-1314
- ◆ Penticton RCMP Detachment – Atten. Watch Commander FAX 492-4851
- ◆ Osoyoos RCMP Detachment – Atten. Officer in Charge FAX 495-7416

April 17, 2001

Dear Sir or Madam:

The Okanagan Nation Fisheries Commission will be conducting fisheries research on Okanagan, Skaha and Osoyoos Lakes and the rivers between these lakes. Similar to last years sampling we will be fishing along shorelines at night from a large boat with many lights, setting nets etc. at various times. We wanted you to know about our operations in advance since persons observing these operations may report illegal fishing or criminal activity. Our tentative schedule is as follows,

- ◆ electrofishing from the boat in the evenings from April 22nd to 26th, 2001
- ◆ minnow trapping during the day April 17th to May 11th, 2001
- ◆ beach seining various sampling during the day between May 1st and 18th
- ◆ gill netting during the evenings between May 1st and 18th, 2001
- ◆ angling sampling during the day for the Month of May 2001.

All our activities are legitimate fisheries research and both Fisheries and Oceans Canada (a.k.a. Department of Fisheries and Oceans or DFO) and the Fisheries Section of the Ministry of Environment are fully informed.

Should you require further information please contact, Kari Long or Dawn Machin with the Okanagan Nation Fisheries Commission (250) 707 0095.

Yours truly,

Kari Long
Okanagan Nation Fisheries Commission
FAX 707 0166

APPENDIX B

Angling Data

BPA Angling - 2002

Date	Location description	Site	Species Caught					Fishing Effort				Bait & Tackle
			SMB	YP	NSC	CP	LMB	Start Time	Stop Time	Hours Fished	No. of fishers	
07-May-02	VDS # 1							7:15	9:00	1:45	3	Worms, spinners, jiggers
14-May-02	Vaseaux L - OK R. mouth	3						10:15	10:35	0.34	2	Spinners, Roe
14-May-02	Vaseaux L - wildlife viewing	4						11:00	11:20	0.34	2	Spinners, Roe
14-May-02	Vaseaux L - along Hwy	5						12:30	13:15	0.67	2	Spinners, Roe
14-May-02	Osoyoos L - Rattlesnake	8						14:45	15:30	0.67	3	Spinners, Roe
16-May-02	Vaseaux L - OK R. mouth	3						10:00	10:25	0.42	3	Spinners, Jiggers, Roe
16-May-02	Vaseaux L - along Hwy	5						11:35	12:10	0.58	2	Spinners, Jiggers, Worms
16-May-02	Osoyoos L - Rattlesnake	8						13:45	14:30	0.67	3	Spinners, Jiggers, Worms

APPENDIX C

Beach Seining Data

Date	Lake	Site	Location	Species Caught																	Fishing Effort				Comments	
				BGB	BCB	BH	CAS	CP	RSC	LMB	NSC	PCC	PMB	RBT	SK	SMB	SU	YP	WF	UNK	No. of hauls	Net Depth (m)	Net Length (m)	Mesh size (mm)		
April 8, 2002	OSOYOOS	1	N. Basin, W of river mouth				10										25			3		1	3 m	35 m	3, 10, 25 mm	
April 8, 2002	OSOYOOS	2	River mouth														7				1	1	3 m	35 m	3, 10, 25 mm	
April 8, 2002	OSOYOOS	3	E. of river mouth														3					1	3 m	35 m	3, 10, 25 mm	
May 2, 2002	OK LK - NA	22	Old pole wharf				27													2		1	3 m	35 m	3, 10, 25 mm	
May 2, 2002	OK LK - NA	21	North of Mudhole				32													18		1	3 m	35 m	3, 10, 25 mm	
May 2, 2002	OK LK - NA	23	Eastside of lake				13													1		1	3 m	35 m	3, 10, 25 mm	
May 2, 2002	OK LK - NA	20	Komasket park (S. of wharf)				6													4	1	1	3 m	35 m	3, 10, 25 mm	
May 2, 2002	OK LK - NA	19	Komasket park (below daycare)				6														1	1	3 m	35 m	3, 10, 25 mm	Substrate consists of fine mud - poor site to work
May 2, 2002	OK LK - NA	18	Below S. Joe property																			0	3 m	35 m	3, 10, 25 mm	Possible electrofishing site
May 2, 2002	OK LK - NA	16	Louie Property																			0	3 m	35 m	3, 10, 25 mm	Possible electrofishing site
May 2, 2002	OK LK - NA	17	C.Louis Property				5															6	3 m	35 m	3, 10, 25 mm	
May 3, 2002	OSOYOOS	7	Ok River mouth				6													3		1	3 m	35 m	3, 10, 25 mm	
May 3, 2002	OSOYOOS	8	Eastside of river mouth				2													25		1	3 m	35 m	3, 10, 25 mm	
May 3, 2002	OSOYOOS	10	Whitesands																	8		1	3 m	35 m	3, 10, 25 mm	
May 3, 2002	OSOYOOS	11	Inlet @ Central Basin				2	3			2	1									3	12	3 m	35 m	3, 10, 25 mm	
May 3, 2002	OSOYOOS	12	Haynes point Campground				4													3			3 m	35 m	3, 10, 25 mm	
May 17, 2002	OSOYOOS	11	Inlet @ Central Basin			16	13	2	1													6	3 m	35 m	3, 10, 25 mm	
May 17, 2002	OSOYOOS	13	Westside of Central basin						1														3 m	35 m	3, 10, 25 mm	
May 17, 2002	OSOYOOS	12	Haynes point Campground				7													34			3 m	35 m	3, 10, 25 mm	
May 17, 2002	OSOYOOS	7	Ok River mouth				20													21			3 m	35 m	3, 10, 25 mm	
May 17, 2002	OSOYOOS	10	Whitesands				1													16			3 m	35 m	3, 10, 25 mm	
June 3, 2002	OSOYOOS	11	Inlet @ Central Basin			1	4														1	6	3 m	35 m	3, 10, 25 mm	
June 3, 2002	OSOYOOS	12	Haynes point Campground					2															3 m	35 m	3, 10, 25 mm	
June 3, 2002	OSOYOOS	10	Whitesands																	1			3 m	35 m	3, 10, 25 mm	
June 3, 2002	OSOYOOS	8	Eastside of river mouth																				3 m	35 m	3, 10, 25 mm	
June 3, 2002	OSOYOOS	1	N. Basin, W of river mouth				4															2	3 m	35 m	3, 10, 25 mm	
June 13, 2002	OK LK - NA	17	C.Louis Property				1				9	1											3 m	35 m	3, 10, 25 mm	Sunny, clear, calm waters
June 13, 2002	OK LK - NA	16	Louie Property				29															1	3 m	35 m	3, 10, 25 mm	
June 13, 2002	OK LK - NA	15	Irish Creek				2	4			21	115										3	3 m	35 m	3, 10, 25 mm	Six CMC
June 13, 2002	OK LK - NA	14	Deep Creek				3	1														1	3 m	35 m	3, 10, 25 mm	One snail
June 13, 2002	OK LK - NA	27	Gregoire Property [barn]								13	12											3 m	35 m	3, 10, 25 mm	
June 13, 2002	OK LK - NA	26	Spider Ranch				4				2	99										3	3 m	35 m	3, 10, 25 mm	
June 13, 2002	OK LK - NA	25	South of Spider Ranch					1	29		25	10											3 m	35 m	3, 10, 25 mm	
June 13, 2002	OK LK - NA	24	Bonneau Property				1		98		15	326	5									22	3 m	35 m	3, 10, 25 mm	
June 13, 2002	OK LK - NA	22	Old pole wharf						25%		15%	55%											3 m	35 m	3, 10, 25 mm	Mostly PCC, then RSC, NSC, YP
June 13, 2002	OK LK - NA	21	North of Mudhole						20%		15%	60%	5%										3 m	35 m	3, 10, 25 mm	Mostly PCC, then RSC; PMB - approx. 3480 in total
June 13, 2002	OK LK - NA	21 A	Alexis Beach								1												3 m	35 m	3, 10, 25 mm	
June 13, 2002	OK LK - NA	20	Komasket park(S. of wharf)					9			2	4										1	3 m	35 m	3, 10, 25 mm	
June 13, 2002	OK LK - NA	19	Komasket park (below daycare)																				3 m	35 m	3, 10, 25 mm	No longer a site(omit)
June 13, 2002	OK LK - NA	18	Below S. Joe property						35%		15%	50%											3 m	35 m	3, 10, 25 mm	Mostly PCC, then RSC, NSC - approx. 2960 in total

June 14, 2002	Osoyoos	7	Ok River mouth															yes			1	3 m	35 m	3, 10, 25 mm	YP juveniles present				
June 14, 2002	Osoyoos	10	Whitesands																		1	3 m	35 m	3, 10, 25 mm	No fish				
June 14, 2002	Osoyoos	8	Eastside of river mouth																		1	3 m	35 m	3, 10, 25 mm					
June 14, 2002	Osoyoos	9	Rattlesnake			5															1	3 m	35 m	3, 10, 25 mm					
June 14, 2002	Osoyoos	10	Whitesands																		1	3 m	35 m	3, 10, 25 mm	No fish				
June 14, 2002	Osoyoos	11	Inlet @ Central Basin				2			3	6										7	1	3 m	35 m	3, 10, 25 mm	Lots of green algae & slime\ Lots of mud & silt (21 BNH present)			
June 14, 2002	Osoyoos	12	Haynes point Campground			1															1	3 m	35 m	3, 10, 25 mm					
July 4, 2002	OK LK - NA	22	Old pole wharf			1	1	17													1	1	1	3 m	35 m	3, 10, 25 mm			
July 4, 2002	OK LK - NA	21	North of Mudhole			7	68	29	3	1											35	2	10	1	3 m	35 m	3, 10, 25 mm	One painted turtle	
July 4, 2002	OK LK - NA	21 A	Alexis Beach			17																	100	1	3 m	35 m	3, 10, 25 mm		
July 4, 2002	OK LK - NA	24	Bonneau Property			12	630	42	10	40											22	69		1	3 m	35 m	3, 10, 25 mm		
July 4, 2002	OK LK - NA	20	Komasket park (S. of wharf)			2	4	30	27															1	3 m	35 m	3, 10, 25 mm		
July 4, 2002	OK LK - NA	18	Below S. Joe property				75%	15%	5%															1	3 m	35 m	3, 10, 25 mm	Mostly RSC, then NSC, SU, and PCC	
July 4, 2002	OK LK - NA	11	South of Spider Ranch				50%	15%	5%															1	3 m	35 m	3, 10, 25 mm	Mostly RSC, then NSC, SU, and PCC	
July 4, 2002	OK LK - NA	10	Spider Ranch			4	28	2	2												11	22		1	3 m	35 m	3, 10, 25 mm		
July 4, 2002	OK LK - NA	16	Louie Property			27	2	28	47															1	3 m	35 m	3, 10, 25 mm		
July 4, 2002	OK LK - NA	17	C Louis Property					1																1	3 m	35 m	3, 10, 25 mm		
July 4, 2002	OK LK - NA	7	Head of the lake			1		40	1															1	3 m	35 m	3, 10, 25 mm		
July 4, 2002	OK LK - NA	8	Deep creek					10	1												1			1	3 m	35 m	3, 10, 25 mm	One CP	
July 4, 2002	OK LK - NA	23	Eastside of lake			3	21	4													6	25		1	3 m	35 m	3, 10, 25 mm		
July 5, 2002	Osoyoos	11	Inlet @ Central Basin					500	1	4														2	1	3 m	35 m	3, 10, 25 mm	One BCB, no adult fish, construction, noise pollution 10m from shore
July 5, 2002	Osoyoos	13	Westside of Central basin			5		3	1															2	1	3 m	35 m	3, 10, 25 mm	
July 5, 2002	Osoyoos	7	N. Basin, W of river mouth			1		2																1	3 m	35 m	3, 10, 25 mm		
July 5, 2002	Osoyoos	8	East of river mouth			1			1																1	3 m	35 m	3, 10, 25 mm	
July 5, 2002	Osoyoos	10	Whitesands						1															1	3 m	35 m	3, 10, 25 mm		
September 16, 2002	Osoyoos	11	Lagoon	3	16			12													1	1		1	3 m	35 m	3, 10, 25 mm		
September 16, 2002	Osoyoos	12	Haines Point																					3	1	3 m	35 m	3, 10, 25 mm	
September 16, 2002	Osoyoos	3	WS river mouth			6		1																2	1	3 m	35 m	3, 10, 25 mm	
September 16, 2002	OK LK - NA	17	C Louis Property			23																		1	1	3 m	35 m	3, 10, 25 mm	
September 16, 2002	OK LK - NA	16	Louie Property			8																			1	3 m	35 m	3, 10, 25 mm	
September 16, 2002	OK LK - NA	15	Irish Cr. - HOL Site																					0	3 m	35 m	3, 10, 25 mm	Water levels to low	
September 16, 2002	OK LK - NA	14	Deep Cr.			25	1																	3	1	3 m	35 m	3, 10, 25 mm	
September 16, 2002	OK LK - NA	27	Gregoire Property [barn]			2			1	1														1	1	3 m	35 m	3, 10, 25 mm	
September 16, 2002	OK LK - NA	26	Spider Ranch			7			1	1														1	1	3 m	35 m	3, 10, 25 mm	
September 16, 2002	OK LK - NA	25	South of Spyder Ranch																					0	3 m	36 m	3, 10, 25 mm	Water levels to low	
September 16, 2002	OK LK - NA	22	Old pole wharf			17																		1	3 m	35 m	3, 10, 25 mm		
September 16, 2002	OK LK - NA	21	Mud Hole			6																		1	3 m	35 m	3, 10, 25 mm		
September 16, 2002	OK LK - NA	23	near OKIB boundary					172		16														1	3 m	35 m	3, 10, 25 mm		
September 16, 2002	OK LK - NA	20	Komasket - south of wharf			4																		1	3 m	35 m	3, 10, 25 mm		
September 16, 2002	OK LK - NA	18	Below S. Joe Property			3	3		6															1	3 m	35 m	3, 10, 25 mm		

APPENDIX D

Electrofishing boat Data

Date	Lake	Site	Species Caught																	Fishing Effort					Comments			
			BC	BG	BH	BB	CP	KO	LB	NSC	PCC	MB	RSC	CAS	SMB	SU	SK	WF	YP	SEC.	Volts	Amps	Duty Cycle	Temp.				
April 15/02	Skaha	EF-b 8a																	1612	500 60pps	3.3	35%	5.6-5.9					
April 15/02	Skaha	EF-b 8b					1			3	1				1			2	2	1016	500 60pps	330%	33%	5.0				
April 15/02	Skaha	EF-b 8c									1						1	1	750	500 60pps	3.3	33-35%	5.2					
15-Apr-02	Skaha	EF-b 7					2					1						9	1025	500 60pps	4.0	30%	5.8-6.0					
15-Apr-02	Skaha	EF-b 6					1	14										1	5	1025	500 60pps	3.1	20%	6.0				
15-Apr-02	Skaha	EF-b 8					2				1	7			1	##	2		>600	500 60pps	3.1	20%	5.6					
15-Apr-02	Skaha	EF-b 8d																	610	500 60pps	3.1	20%	5.9	No fish caught				
15-Apr-02	Skaha	EF-b 5									1							9	1	850	500 60pps	3.1	30%	5.2				
17-Apr-02	Osoyoos	EF-b 9						2		3	1							3	6	##	1530	500 60pps	2.7-3.0	15-20%	9.1	Water is turbid		
17-Apr-02	Osoyoos	EF-b 10						19			2				1	2	5	5	52	1720	500 60pps	3.1	20%	8.6				
17-Apr-02	Osoyoos	EF-b 11									1							3	3	12	1050	500 60pps	2.7	15-18%	7.3			
17-Apr-02	Osoyoos	EF-b 12																	50	18	500 60pps	2.6	10-20%	8.9				
17-Apr-02	Osoyoos	EF-b 9-ef-b 10										11						10	25	30	5040	500 60pps	3	20%	8.1-8.5	Observed carp and emergent sockeye fry in littoral zone		
16-Jun-02	Okanagan - North Arm	EF-b-17					2			3	2							11	7	814	500 60pps	3-4.0	40%	19.5	Shallow water			
16-Jun-02	Okanagan - North Arm	EF-b-16					10			6	2							6	2	661	500 60pps	4	40%	19.5	Tules			
16-Jun-02	Okanagan - North Arm	EF-b-21									1								1	224	500 60pps	4	40%	21.2				
16-Jun-02	Okanagan - North Arm	EF-b-20						30		1	1								1	1866	500 60pps	4	40%	21.3	Clay Bottom			
16-Jun-02	Okanagan - North Arm	EF-b-19					1	1			6	8	1		1			21	2	2106	500 60pps	4	40	15.7	Sporadic Reeds			
17-Jun-02	Skaha	Site 6					1			4	2	1						1	16	5	4	1117	500 60pps	4.5	40%	19		
17-Jun-02	Skaha	Site 7					2	1										1	39	9		1510	500 60pps	4	40%	18.9		
17-Jun-02	Skaha	Site 8																29	16		1060	500 60pps	4	40%	19.4			
17-Jun-02	Skaha	Site 5						2			1								50		900	500 60pps	4.5	40	16.9	Heavy Curent into lake		
19-Jun-02	Osoyoos	Site 9					2	14			4	2		2				3	15	7	12	##	1805	500 60pps	4	40%	19.8	
19-Jun-02	Osoyoos	Site10					1	1	27		1	1	1	1	1	3	4	1	9	##	2262	500 60pps	4	40%	20			
19-Jun-02	Osoyoos	Site11																	3	35	730	500 60pps	4	40%	18.6			
19-Jun-02	Osoyoos	Site 12																	1	8	930	500 60pps	4	40%	19.3			
19-Jun-02	Osoyoos	Site13						5											2	35	900	500 60pps	4	40%	19.9			
20-Jun-02	Osoyoos	Site 9						6			3								5	11	10	##	1788	500 60pps	4	40%	20.6	
20-Jun-02	Osoyoos	Site10					1	39	1		2				2	5	6		9	##	2160	500 60pps	4	40%	22.1			
20-Jun-02	Osoyoos	Site11						3							1	1				34	630	500 60pps	4	40%	22.1			
20-Jun-02	Osoyoos	Site 12						1					1	1					21	725	500 60pps	4	40%	21.1				
24-Jun-02	Osoyoos	Site 5						1		8	10	2		11				38	22	2400	500 60pps	4.2	40%	19.2				
24-Jun-02	Osoyoos	Site 6						10		11	60	13		8				16	1	27	1500	500 60pps	4.2	35%	21.4			
26-Aug-02	Okan. Lk. - South	Site A Trout Creek						1			1	2							3		1500	500 60pps	3.9	30%	22.6			
26-Aug-02	Okan. Lk. - South	Site B West of Trout Creek						1		4	33			3	2	3			2	482	500 60pps	40	30%	22.6-22.9				
26-Aug-02	Okan. Lk. - South	Site T1						1		3	2			13					9	1	1660	500 60pps	4	30%	23.1	Made two EF passes of this site		
26-Aug-02	Skaha	Site T1								30	24			8				1	15	1	810	500 60pps	4	30%	22.8			
26-Aug-02	Skaha	Site 5								1	3	1	1	1	13	25	10			750	500 60pps	4.3	30%	22.3				
26-Aug-02	Skaha	Site 8a						1							1	2	15			966	500 60pps	4.3	30%	22				
27-Aug-02	Skaha	Site 8d						4			2								8	1320	500 60pps	4.4	40%	21.2				
27-Aug-02	Skaha	Site 6						2				3							4	8	998	500 60pps	4.3	40%	21.8			
27-Aug-02	Skaha	Site 7						22			2								8	6	950	500 60pps	4.3	40%	22			
27-Aug-02	Osoyoos	El Site b9						11	10		20		10	1	1	6		1	36	4	##	1635	500 60pps	3.5	30%	24.4		
27-Aug-02	Osoyoos	Site Ef b-10						5				6	4						25	6	4	13	1200	500 60pps	3.9	30%	24.6	
27-Aug-02	Osoyoos	Site Ef-B-10a						11	4		23	37							3	69	##	1260	500 60pps	4	30%	24.9		
28-Aug-02	Osoyoos	Site Ef-b11 Rattlesnake						5	1	10	12				2	9				51	900	500 60pps	4.1	40%	24.8			
28-Aug-02	Osoyoos	SiteEf-b12						1		2	5				14	1				26	860	500 60pps	4.1	30%	24.4			
04-Sep-02	Osoyoos	Site Ef B-9						15	12		##	1	2		2	35	2			96	1700	500 60pps	2.2-4.0	30-35	20.9			
04-Sep-02	Osoyoos	Site 9						2	3	1	2		36	1					1	37	3	48	1320	500 60pps	3	35%	20.7	
28-Oct-02	Okanagan - North Arm	EF-b-19									3	##		1	1					12	8	2400	500 60pps	3.6	30%	11.1		
28-Oct-02	Okanagan - North Arm	EF-b-18								18	6	13							13	2	13	1570	500 60pps	3.6	30%	10.1		
29-Oct-02	Skaha	Site 5						3	2	50	11			1	1	1	19			49	1500	500 60pps	3.4	35%	10.1	Nsc 520 mm Ate ko. 220mm		
29-Oct-02	Skaha	Site 8a								2	11	1	3						6	17	12	2530	500 60pps	3.3	35%	10.8-10.4		
29-Oct-02	Skaha	Site 8						2	1		1	1	17						##	5	1	1080	500 60pps	3.2	40%	11.2		
29-Oct-02	Skaha	Site 6						2	1	1			3						6	5	880	500 60pps	3.4	30%	10.7			
29-Oct-02	Skaha	Site 7								1	22	3							3	22	840	500 60pps	3.5	30%	10.8			
29-Oct-02	Skaha	Site 8D						2	3	8	8	9		1	2	14	4	1		2345	500 60pps	4	35%	10.8				
31-Oct-02	Osoyoos	Site 9						2		1	1	2		2	1	1	2	65	880	500 60pps	3.2	25%	10.3					
31-Oct-02	Osoyoos	Site 10						23	1			5	1		1	1	8		16	960	500 60pps	4.5/3.2	25/30%	10.1(10.3-10.4)				
31-Oct-02	Osoyoos	Site11													1				10	2	14	900	500 60pps	3.2	30%	10.6		
31-Oct-02	Osoyoos	Site 12									1				1		6				660	500 60pps	3.8	40%	9.7			

APPENDIX E

Backpack Electrofishing Data

BPA Backpack Electrofishing - 2002

Date	Location	Site #	Cond.	Temp.	Sec.	Setting	Voltage	Species caught	Numbers of fish	Crew	Weather	Comments
July11/02	Okanagan River											
July11/02	Deer park	1	224	22	206	L4	200	pumpkinseed	3	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Deer park	1						smallmouth bass	1	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Deer park	1						prickley sculpin	2	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Vaseux Creek	2			204	J5	400	longnose dase	1	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Vaseux Creek	2						salmonid fry	1	Hwright/Halex/Klong	Sunny/Clear	
July11/02		3			337	J5	400	rainbow trout	6	Hwright/Halex/Klong	Sunny/Clear	
July11/02		3						smallmouth bass	2	Hwright/Halex/Klong	Sunny/Clear	
July11/02		3						longnose dase	6	Hwright/Halex/Klong	Sunny/Clear	kept 1 longnose dace
July11/02		3						sucker	3	Hwright/Halex/Klong	Sunny/Clear	kept 1 SU
July11/02	SC at first island	3a			209	J5	200	sucker	2	Hwright/Halex/Klong	Sunny/Clear	
July11/02	SC opposite Transect # 1	4			62	J5	200	none	0	Hwright/Halex/Klong	Sunny/Clear	
July11/02		5			175	J5	200	prickley sculpin	1	Hwright/Halex/Klong	Sunny/Clear	
July11/02		5						smallmouth bass	1	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Transect # 3	6			269	J5	200	rainbow trout	1	Hwright/Halex/Klong	Sunny/Clear	kept possible other
July11/02	The island	7			227	L4	600	red side shiner	2	Hwright/Halex/Klong	Sunny/Clear	
July11/02	The island	7						longnose dase	4	Hwright/Halex/Klong	Sunny/Clear	UNK-possible PMB
July11/02	Pool below island	8				D3	600	none	0	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Around isle upstream of Oasis gas station	9				L4	100	none	0	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Side-channel near Oasis gas station	10			621	L5	200	longnose dase	1	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Side-channel near Oasis gas bar	10						rainbow trout	5	Hwright/Halex/Klong	Sunny/Clear	kept RB
July11/02	Gravel bar below Hwy bridge	11			411	L5	200	red side shiner	1	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Gravel bar below Hwy bridge	11						smallmouth bass	4	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Gravel bar below Hwy bridge	11						chiselmouth chub	4	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Gravel bar below Hwy bridge	11						northern pike minnow	1	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Gravel bar below Hwy bridge	11						rainbow trout	1	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Gravel bar below Hwy bridge	11						sucker	2	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Oxbow RL below Hwy bridge	12			240	L5		pumpkinseed	1	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Oxbow RL below Hwy bridge	12						smallmouth bass	1	Hwright/Halex/Klong	Sunny/Clear	
July11/02	SC near Transect # 4	13		24	431		200	longnose dase	1	Hwright/Halex/Klong	Sunny/Clear	
July11/02	SC near Transect # 4	13						sucker	4	Hwright/Halex/Klong	Sunny/Clear	
July11/02	Island below Transect # 5	14			174	15	200	northern pike minnow	1	Hwright/Halex/Klong	Sunny/Clear	

APPENDIX F

Gill Netting Data

BPA Gill Netting - 2002

Date	Lake	Site	Mesh size (cm)	Species Caught									Fishing Effort				Area Description
				CP	NSC	SK Adult	RBT	KO	PCC	MWF	WF	SU	Depth of Lake at set	Depth of GN	Time Set	Time Picked	
23-Apr-02	Skaha	one	2.0, 2.5, 3.5, 4.0, 4.5		3			1	13	2		1	30 metre	20m		21:50	10 m from shoreline 30 feet to 90 feet
23-Apr-02	Skaha	two	2.0, 2.5, 3.0, 4.5, 5.5											20m		23:08	200 m from shoreline and 50 m north of transect
25-Jun-02	Osoyoos	one	2.0, 2.5, 3.0, 3.5, 4.5,									5	North 50FT South 100	20m	18:10	4:37	South End Osoyoos. East of river mouth
25-Jun-02	Osoyoos	Two	2.5, 3.5, 4.5									22	South 20ft North 60	20m	18:45	6:20	South of Acoustic transect site
27-Jun-02	Osoyoos	One	2.0, 2.5, 3.5, 4.5, 5.5,					1					20m	20m	1:15		200m north of transect
27-Jun-02	Osoyoos	Two	2.0, 2.5, 3.0, 3.5, 4.0, 4.5					1				1	20m.	20m	21:15	5:15	500m South of transect
15-Jul-02	Osoyoos	one	2.0, 2.5, 3.0, 3.5, 4.0, 5.5			3						12	100ft	20m	7:34	5:50	North end of Osoyoos Lk.
17-Jul-02	Osoyoos	one	2.0, 2.5, 3.0, 3.5, 4.5, 5.5					1	9				65ft South 90 North	20m	6:30	5:30	Set 50m South of transect
17-Jul-02	Osoyoos	Two	2.0, 2.5, 3.5, 3.5, 5.0									1	100ft	20m	9:00	5:45	50m North of transect
25-Nov-02	Osoyoos	One	1.0, 1.5, 2.0, 3.0, 3.5, 4.0, 5.0, 5.5	1									30m	20m	17:15	7:45	North of Acoustic transect
28-Nov-02	Skaha	One	1.5, 3.0, 3.5, 4.0, 5.0				1	1					30m	20m	2.15	7:47	Below saddle of Howies transect
28-Nov-02	Skaha	Two	2.0, 3.0, 3.5, 4.0, 4.5, 5.0,					1					30m	20m	2.55	7:47	Below saddle of Howies transect

APPENDIX G

Minnow Trapping Data

Location	MT site #	Species Caught													Fishing Effort				Comments		
		SU	SM B	CAS	NSC	PM B	RSC	RBT	YP	BB	LM B	CP	PC C	BKH	TC	Date set	Time set	No of trap s		Date picked	Time picked
Inlet of Penticton channel	6			4					2							04-Apr-02	9:50	3	05-Apr-02	9:57	
Bridge of Penticton channel	7			3	1											04-Apr-02	10:05	3	05-Apr-02	9:40	
Penticton Oxbow 1	7a															04-Apr-02	10:30	3	05-Apr-02	10:15	one salamander
Penticton Oxbow 2	7b				12					1						04-Apr-02	10:40	3	05-Apr-02	10:25	
Outlet of Penticton channel	8			3				1								04-Apr-02	10:50	3	05-Apr-02	10:36	
VDS 17	13			2												04-Apr-02	11:15	3	05-Apr-02	11:00	
VDS 16	14															04-Apr-02	11:20	3	05-Apr-02	11:04	
VDS 15	15			3												04-Apr-02	11:25	3	05-Apr-02	11:08	
VDS 14	16			4												04-Apr-02	11:30	3	05-Apr-02	11:15	
Vaseux Lake Wildlife Park	18															04-Apr-02	11:55	3	05-Apr-02		
Okanagan River - Vincor sign	23a															04-Apr-02	12:05	3	05-Apr-02	11:37	
Okanagan River	24															04-Apr-02	13:10	3	05-Apr-02	11:54	
Okanagan River	25															04-Apr-02	13:45	3	05-Apr-02	13:11	
Okanagan River	27															04-Apr-02	14:00	3	05-Apr-02	13:20	
Okanagan River	28a															04-Apr-02	14:40	3	05-Apr-02	13:33	
Okanagan River	28b															04-Apr-02	14:50	3	05-Apr-02	13:44	
Okanagan River -VDS 1 & Oxbows	28c															04-Apr-02	14:55	3	05-Apr-02		
Osoyoos Lake	29															30-Apr-02	10:15	3	01-May-02	10:00	
Osoyoos Lake	30								8							30-Apr-02	10:20	3	01-May-02	10:11	
Osoyoos Lake	30a								70							30-Apr-02	10:25	3	01-May-02	10:16	
Osoyoos Lake	32a															30-Apr-02	10:40	3	01-May-02	10:32	
Osoyoos Lake	32								6							30-Apr-02	11:00	3	01-May-02	10:40	
Okanagan Lake - South	1			9												30-Apr-02	4:40	3	01-May-02	4:22	
Okanagan Lake - South	2															30-Apr-02	5:18	3	01-May-02	4:36	
Okanagan Lake - South	3															30-Apr-02			01-May-02		Note: There were not enough trap snaps to complete site areas.
Okanagan Lake - South	4			4												30-Apr-02	5:03	5	01-May-02	4:50	Put five traps instead of three because not enough traps snaps for other sites
Okanagan Lake - South	5			5												30-Apr-02	4:54	3	01-May-02	4:58	
Vaseux Lake	20				5											30-Apr-02	13:25	3	01-May-02	12:35	
Vaseux Lake	21			1		1										30-Apr-02	13:35	3	01-May-02	12:45	
Vaseux Lake	22			3												30-Apr-02	13:40	3	01-May-02	13:00	
Skaha Lake	9			1												30-Apr-02	15:15	3	01-May-02	15:00	
Skaha Lake	10			2												30-Apr-02	15:20	3	01-May-02	15:10	
Skaha Lake	11															30-Apr-02	15:30	3	01-May-02	15:17	
Skaha Lake	12			9												30-Apr-02	15:40	3	01-May-02	15:30	
Okanagan Lake																30-Apr-02	16:40	3	01-May-02	16:22	
Okanagan Lake																30-Apr-02	17:18	3	01-May-02	16:36	
Okanagan Lake				4												30-Apr-02	17:03	5	01-May-02	16:50	
Okanagan Lake				5												30-Apr-02	16:54	3	01-May-02	16:58	
Okanagan Lake																30-Apr-02	9:42	3	01-May-02	9:15	
Okanagan Lake																30-Apr-02	9:55	3	01-May-02	9:25	1 trap opened / photo 1 lagoon
Okanagan Lake																30-Apr-02	10:03	3	01-May-02	9:30	
Okanagan Lake																30-Apr-02	10:09	3	01-May-02	9:35	lilly pad
Okanagan Lake																30-Apr-02	10:24	3	01-May-02		traps not found / traps found @ later date
Okanagan Lake																30-Apr-02	10:32	3	01-May-02	10:30	
Okanagan Lake																30-Apr-02	11:00	3	01-May-02	10:55	
Okanagan Lake																30-Apr-02	11:17	3	01-May-02	11:10	photo site 2
Okanagan Lake																30-Apr-02	11:50	3	01-May-02	11:35	
Okanagan Lake																30-Apr-02	12:00	3	01-May-02	11:45	28 unk. #10 jar / flagged site
Okanagan Lake																30-Apr-02	12:25	3	01-May-02	13:05	3 unk.
Okanagan Lake																30-Apr-02	12:45	3	01-May-02	13:20	
Okanagan Lake																30-Apr-02	13:13	3	01-May-02	13:45	photo 3-4 site 13
Okanagan Lake																30-Apr-02	13:35	3	01-May-02	14:00	lg willow Joe property
Inlet of Penticton Channel	6			1	1			6								04-Jun-02	9:43	3	05-Jun-02	9:47	positive ID @ office
Bridge of Penticton channel	7			2												04-Jun-02	9:58	3	05-Jun-02	10:00	
Penticton oxbow 1	7a															04-Jun-02	10:05	3	05-Jun-02	10:15	1 garter snake
Penticton oxbow 2	7b				2	17										04-Jun-02	10:17	3	05-Jun-02	10:25	

Location	MT site #	Species Caught													Fishing Effort				Comments		
		SU	SM	CAS	NSC	PM	RSC	RBT	YP	BB	LM	CP	PC	BKH	TC	Date set	Time set	No of trap s		Date picked	Time picked
Outlet of Penticton channel	8		8	10												04-Jun-02	10:28	3	05-Jun-02	10:38	
VDS 17	13															04-Jun-02	10:43	3	05-Jun-02	11:13	
VDS 16	14						1									04-Jun-02	11:03	3	05-Jun-02	11:17	
VDS 15	15			5		3		1								04-Jun-02	11:12	3	05-Jun-02	11:23	
VDS 14	16			1												04-Jun-02	11:17	3	05-Jun-02	11:28	
Vaseux Lake Wildlife Park	18			2		18										04-Jun-02	11:41	6	05-Jun-02	11:50	
Okanagan River - Vincor sign	23a	2	1	1				1								04-Jun-02	11:58	3	05-Jun-02	12:05	
Okanagan River	24															04-Jun-02	13:00	3	05-Jun-02	12:27	
Okanagan River	25															04-Jun-02	13:35	3	05-Jun-02	13:16	
Okanagan River	26	3					1									04-Jun-02	13:46	3	05-Jun-02	13:23	
Okanagan River	27															04-Jun-02	14:00	3	05-Jun-02	13:30	
Okanagan River	28a															04-Jun-02	14:25	3	05-Jun-02	14:00	
Okanagan River	28b			4												04-Jun-02	14:30	3	05-Jun-02	13:55	
Okanagan River	28c															04-Jun-02	14:34	3	05-Jun-02	13:51	
Osoyoos Lake- North weedbed	29															11-Jun-02	15:00	3	12-Jun-02	13:09	
Osoyoos Lake - West River Mouth	30															11-Jun-02	15:05	3	12-Jun-02	13:15	
Osoyoos Lake - Rattlesnake Point	31			3												11-Jun-02	15:15	3	12-Jun-02	13:28	
Osoyoos Lake - Whitesands	32															11-Jun-02	15:19	3	12-Jun-02	13:34	
Skaha Lake	9			1												11-Jun-02	10:00	4	12-Jun-02		photo 11-12
Skaha Lake	10															11-Jun-02	10:10	4	12-Jun-02		photo 10
Skaha Lake	11			1												11-Jun-02	10:30	4	12-Jun-02		photo 7 & 9
Skaha Lake	11a		5	2												11-Jun-02	10:36	4	12-Jun-02		
Skaha Lake	12		1	1												11-Jun-02	11:20	3	12-Jun-02		
Inlet of Penticton Channel	6		7													12-Aug-02	10:15	3	13-Aug-02	9:40	
Bridge of Penticton Channel	7			3												12-Aug-02	10:45	4	13-Aug-02	10:02	one trap missing
Penticton Oxbow 1	7a															12-Aug-02	10:50	4	13-Aug-02	10:10	
Penticton Oxbow 2	7b															12-Aug-02	10:56	4	13-Aug-02	10:21	
Outlet of Penticton Channel	8		2	12												12-Aug-02	11:05	4	13-Aug-02	10:39	
VDS 17	13															12-Aug-02	11:25	3	13-Aug-02	11:00	
VDS 16	14		1	2												12-Aug-02	11:40	3	13-Aug-02	11:06	
VDS 15	15															12-Aug-02	11:45	3	13-Aug-02	11:15	
VDS 14	16		1	2												12-Aug-02	11:50	3	13-Aug-02	11:22	
Vaseux Lake Wildlife Park	18			3		16				7	1			1		12-Aug-02	12:15	6	13-Aug-02	11:47	
Okanagan River - Vincor sign	23a															12-Aug-02	12:32	3	13-Aug-02	12:09	
Okanagan River	24							1								12-Aug-02	13:32	3	13-Aug-02	12:45	stuck in mouth of trap
Okanagan River	25		2													12-Aug-02	14:00	3	13-Aug-02	13:40	
Okanagan River	26				1											12-Aug-02	14:10	3	13-Aug-02	13:49	
Okanagan River	27															12-Aug-02	14:18	3	13-Aug-02	14:00	
Okanagan River	28a															12-Aug-02	14:35	3	13-Aug-02	14:20	
Osoyoos Lake - North weedbed	29															09-Sep-02	10:23	3	10-Sep-02	12:40	
Osoyoos Lake River - West River Mouth	30															09-Sep-02	10:28	3	10-Sep-02	12:45	
Osoyoos Lake - Rattlesnake Point	31															09-Sep-02	10:46	3	10-Sep-02	13:06	
Osoyoos Lake - Whitesands	32															09-Sep-02	11:00	3	10-Sep-02	13:36	
Skaha Lake	9			3												09-Sep-02	12:55	3	10-Sep-02	15:54	
Skaha Lake	10				1					1						09-Sep-02	13:05	3	10-Sep-02	16:09	
Skaha Lake	11		2													09-Sep-02	13:13	3	10-Sep-02	16:15	
Skaha Lake	11a		1													09-Sep-02	13:20	3	10-Sep-02	16:40	
Skaha Lake	12		2													09-Sep-02	13:34	3	10-Sep-02	16:34	
Okanagan Lake - South	s1			3	7											09-Sep-02	14:25	3	12-Sep-02	12:13	boat trouble caused 3day delay in pu of traps
Okanagan Lake - South	s5															09-Sep-02	14:54	3	12-Sep-02	12:20	1 trap opened
Okanagan Lake - South	s4			7	5	1	2									09-Sep-02	15:07	4	12-Sep-02	12:30	
Okanagan Lake - South	s2			1	4											09-Sep-02	15:15	3	12-Sep-02	11:15	
Okanagan Lake - South	3			9	4											09-Sep-02	15:23	3	12-Sep-02	12:05	
Okanagan Lake - NA - (Westside) Old Pole Wharf	43			1									1			06-Nov-02	9:26	3	07-Nov-02	9:05	
Okanagan Lake - NA - (Westside) OKIB Rec. Area	42			1	1											06-Nov-02	9:36	3	07-Nov-02	9:17	
Okanagan Lake - NA - (Eastside) near Band boundary line	44			2												06-Nov-02	9:52	3	07-Nov-02	9:33	
Okanagan Lake - NA - (Eastside)				7												06-Nov-02	10:07	3	07-Nov-02	9:44	
Okanagan Lake - NA - (Westside) Komasket Rec. Park																06-Nov-02	13:36	3	07-Nov-02	10:00	

Location	MT site #	Species Caught													Fishing Effort					Comments
		SU	SM B	CAS	NSC	PM B	RSC	RBT	YP	BB	LM B	CP	PC C	BKH	TC	Date set	Time set	No of traps	Date picked	
Okanagan Lake - NA - (Westside) Joe Property				3												06-Nov-02	10:54	3	07-Nov-02	10:13
Okanagan Lake - NA - (Eastside) Spyder ranch																06-Nov-02	11:07	3	07-Nov-02	10:38
Okanagan Lake - NA - (Eastside) Gregoire property																06-Nov-02	11:40	3	07-Nov-02	10:58
Okanagan Lake - NA - (Head of the Lake) Rose Louis property																06-Nov-02	11:50	3	07-Nov-02	11:15
Okanagan Lake - NA - (Head of the Lake) Lewis property				1	1											06-Nov-02	12:30	3	07-Nov-02	11:30
Okanagan Lake - NA - (Head of the Lake) Irish Creek				1	4				2							06-Nov-02	12:42	3	07-Nov-02	11:45
Okanagan Lake - NA - Lagoon				2												06-Nov-02	13:10	3	07-Nov-02	12:15
Okanagan Lake - NA - Lawrence property				2												06-Nov-02	13:25	3	07-Nov-02	12:25
Okanagan Lake - NA - Cecil Louis property																06-Nov-02	13:38	3	07-Nov-02	12:35
Skaha Lake	9			1												21-Nov-02	10:40	3	22-Nov-02	10:13
Skaha Lake	10			1										3		21-Nov-02	10:51	3	22-Nov-02	10:24
Skaha Lake	11			3												21-Nov-02	11:04	3	22-Nov-02	10:36
Skaha Lake	11a			1												21-Nov-02	11:14	3	22-Nov-02	10:46
Skaha Lake	12			1												21-Nov-02	11:23	3	22-Nov-02	10:55
Osoyoos Lake - North weedbed	29															21-Nov-02	12:43	3	22-Nov-02	12:36
Osoyoos Lake - West River Mouth	30			7												21-Nov-02	12:56	3	22-Nov-02	12:42
Osoyoos Lake - East of River Mouth (north)	30a															21-Nov-02	13:01	3	22-Nov-02	12:47
Osoyoos Lake - Rattlesnake Point	32a			7												21-Nov-02	13:08	3	22-Nov-02	12:56
Osoyoos Lake - Whitesands	32															21-Nov-02	13:16	3	22-Nov-02	13:07
Osoyoos Lake - South	33 A															21-Nov-02	13:22	3	22-Nov-02	13:14

APPENDIX H

Trap Netting Data

BPA Trap Netting - 2002

Date Net Set	Lake	Site #	Species Caught														Fishing Effort	
			BNH	CAS	LMB	SU	PMB	YP	SMB	LMB	NSC	SK	BH	CP	Other	Date Net Checked	Depth Set	
May 14/02 10:30	Vaseaux	TN 1	1	2	1			3									May 16/02 @ 10:15 am	two metre
May 14/02 12:30	Vaseaux	TN 2					1	1								1 tench	May 16/02 @ 11:39 am	two metre
May 14/02 15:00	Osoyoos	TN 3		1				3								1 SK smolt	May 16/02 @ 13:15 pm	two metre
July 10, 2002 @ 11:45 am	Okanagan North Arm	TN 5				4	1					2				4 Aquarium Turtles	July 12, 2002 @ 9:16 am	two metre
July 10, 2002 @ 2:05 pm	Okanagan North Arm	TN 4	0	0	0	0	0	0				0				0	July 12, 2002 @ 10:20 am	1.5 metre
July 10, 2002 @ 3:35 pm	Okanagan North Arm	TN 6					1	1				3				1 Garter Snake	July 12, 2002 @ 12:02 pm	two metre
July 29, 2002 @ 11:05 am	Vaseaux	TN 1		1						2							July 31, 2002 @ 2:00 pm	two metre
July 29, 2002 @ 11:05 am	Vaseaux	TN 2		1			4	3	2								July 31, 2002 @ 12:40 pm	two metre
July 29, 2002 @ 11:05 am	Osoyoos	TN 3				1			4					1			July 31, 2002 @ 10:35 am	two metre
August 13, 2002 @ 9:57 am	Okanagan North Arm	TN 5						2				9					August 15, 2002 @ 9:30 am	two metre
August 13, 2002 @ 1:49 pm	Okanagan North Arm	TN 4				1	4	9				13				5 aquari um turtles	August 15, 2002 @ 11:11 am	1.5 metre
August 13, 2002 @ 10:57 am	Okanagan North Arm	TN 6	0	0	0	0	0	0	0			0		0	0		August 15, 2002 @ 10:09 am	two metre
November 18, 2002 @ 3:14 pm	Vaseaux	TN 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	November 20, 2002 @ 11:08 am	two metre
Windy weather	Vaseaux	TN 2	Not done due to very windy weather															
November 18, 2002 @ 12:10 pm	Osoyoos	TN 3								1	1		2				November 20, 2002 @ 1:04 pm	two metre

APPENDIX I

Weed Harvester Data

BPA Weed Harvester - 2002

Date	Lake	Site	Species Caught						Fishing Effort		Crew	Comments
			PMB	SMB	YP	NSC	CP	LMB	Start Time	Stop Time		
07-Aug-02	Osoyoos Lake	Willow Beach		49					7:20 AM	7:55 AM	F. Alexis B. Swite	see note below
07-Aug-02	Osoyoos Lake	Willow Beach		53					8:11 AM	8:46 AM	F. Alexis B. Swite	see note below
07-Aug-02	Osoyoos Lake	Willow Beach		31					10:01 AM	10:31 AM	F. Alexis B. Swite	Fish samples and photos taken
07-Aug-02	Osoyoos Lake	Willow Beach	1	43	1				10:47 AM	11:16 AM	F. Alexis B. Swite	
14-Aug-02	Osoyoos Lake	Willow Beach (Weed Piles)	0	0	0	0	0	0	9:45 AM	11:00 AM	F. Alexis S. Lawrence	Weather was too windy for weed harvester to operate and therefore, crew shifted through the weed piles.
14-Aug-02	Osoyoos Lake	Haines Prov. Park (Weed Piles)	0	0	0	0	0	0	12:00 PM	1:00 PM		Sifted through Eurasia milfoil piles and found no evidence of juvenile fish. Also for the milfoil piles at time of search it was very hot and decomposing rapidly. Observed three small schools of juvenile black bull head along beach shore.

Note: While on the harvester it was observed that although fish did get caught up in the weeds, most fish did escape through the grids. More importantly, no sockeye fry observed in weeds.

APPENDIX J

Species codes

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

FINAL

OBJECTIVE 2 Task B1
Results of sockeye fry predator sampling in
Osoyoos Lake

Contribution No. 3 to an *Evaluation of an Experimental Re-introduction of
Sockeye Salmon into Skaha Lake: YEAR 3 of 3*

Presented to: Colville Confederated Tribes

Date: May 31, 2003

Author: Karilyn Long, BSc.

Reviewed by: Chris Bull, R.P. Bio

Edited by: Howard Smith

1.0 Introduction

As part of the *“Evaluation of an experimental re-introduction of sockeye salmon into Skaha Lake”* (Bonneville Power Authority #20124), a life cycle model of sockeye is being produced. This model requires an estimate of fry survival from emergence to smolting and so it is important to know the extent of predation which occurs as newly emerged sockeye fry migrate from the river to lake rearing areas. To supply this information, the Okanagan Nation Fisheries Commission (ONFC) examined the stomach contents of specimens from the predator community during late May of 2002, when emergent sockeye fry were known to be holding in the littoral zones of Osoyoos Lake.

2.0 Study Area

Sampling was limited to Osoyoos Lake, the only rearing lake presently accessible to sockeye fry. Okanagan River empties into the north end of Osoyoos Lake which contains abundant littoral areas where sampling was done.

3.0 Methods

Fyke netting conducted 18 km upstream from the confluence of Okanagan River and Osoyoos Lake showed that sockeye fry emerged from their redds in April. Furthermore beach seining in Osoyoos Lake during April and June 2002 confirmed the presence of fry in the littoral zones (Long, 2002).

Fishing for predators was concentrated in the littoral zones since sockeye fry seem to spend several weeks in these areas after emerging from the river and before moving into the pelagic zones (Alexis, 2003).

ONFC electrofished the north end of Osoyoos Lake on April 17, 2002 (at the onset of emergent sockeye fry migration), however the boat was too large to access the shallows (<2 m) which were thought to be prime areas for predators. Many sockeye fry, but very few large predators were caught (mostly small spawning yellow perch).

Because the shallow bottomed electrofishing boat was often unavailable, angling for predator fish was carried out at Vertical Drop Structure 1, about 1km above the mouth of Okanagan River. Angling occurred May 7th, May 14th and May 16th, (to coincide with the peak out-migration of sockeye fry), but no predators were captured.

On May 21st, 2002 the Colville Confederated Tribes (CCT) shallow-bottomed electrofishing boat became available and was used to sample the north end of Osoyoos Lake, the mouth of Okanagan River and Rattlesnake Point (located approximately 3 km south of the river mouth on the east side of Osoyoos Lake). Two hours of electrofishing was conducted at the river mouth using 30volts, and 4 Amps setting. An additional 30 minutes was spent fishing the lake at Rattlesnake Point using the same settings and fishing at depths of 0.5 to 2 metres.

4.0 Results

Fyke netting in the Okanagan River showed that sockeye fry began to emerge as early as April 4th, peaked about April 22 and were fully emerged by May 14th, 2002 (Long, 2002).

Following emergence Okanagan sockeye fry tend to hold in the littoral zone of Osoyoos Lake prior to migrating into pelagic areas (Alexis, 2003). As early as April 8th, sockeye fry were caught by beach seining but the highest numbers were captured on May 17th and fry were still being caught in seines on June 3rd.

Electrofishing (May 21st) was timed to coincide with the period when both fry and predators were using the littoral zone, however no fry were caught or observed. During the 2.5 hours of electrofishing, 24 fish were caught including: largemouth bass (2), smallmouth bass (4), suckers (5), whitefish (7), and one each of; black crappie, northern pike minnow, chub and yellow perch (Table 1).

Table 1. List of species and stomach contents of fish caught on May 21st, 2002

Fish number	Species	Length (cm)	Weight (g)	Location	Stomach contents
1	Largemouth bass	32.5	750	Osoyoos Lake river mouth	1 sculpin and 1 Unidentifiable fish
2	Sucker	47.0	1200	Osoyoos Lake river mouth	all digested, mostly plant material
3	Whitefish	17.5	100	Osoyoos Lake river mouth	undiscernibly, digested material
4	Largemouth bass	40.5	1300	Osoyoos Lake river mouth	4 sculpin
5	Smallmouth bass	32.5	650	Osoyoos Lake river mouth	1 sculpin
6	Black crappie	34.1	850	Osoyoos Lake river mouth	2 unknown & 1 sculpin
7	Smallmouth bass	26.9	350	Osoyoos Lake river mouth	1 unidentifiable fish
8	Smallmouth bass	39.5	1100	Osoyoos Lake river mouth	1 unidentifiable fish
9	Northern pike minnow	34.1	650	Osoyoos Lake river mouth	empty – tapeworm
10	Tench	35.5	700	Osoyoos Lake river mouth	digested vegetation
11	Sucker	43.5	1050	Osoyoos Lake river mouth	empty – tapeworm
12	Sucker	36.5	650	Osoyoos Lake river mouth	Vegetation
13	Smallmouth bass	20.3	150	Osoyoos Lake river mouth	empty
14	Chub	29.5	400	Osoyoos Lake river mouth	empty – digested
15	Sucker	36.5	700	Osoyoos Lake river mouth	Vegetation, digested
16	Whitefish	24.6	250	Osoyoos Lake river mouth	Earthworm and vegetation
17	Whitefish	27.1	300	Osoyoos Lake river mouth	Vegetation
18	Whitefish	27.0	350	Osoyoos Lake river mouth	Vegetation and chironomids
19	Whitefish	24.4	250	Osoyoos Lake river mouth	Bugs
20	Whitefish	24.0	250	Osoyoos Lake river mouth	Vegetation
21	Whitefish	20.0	200	Osoyoos Lake river mouth	Empty
22	Yellow perch	17.1	100	Osoyoos Lake river mouth	Oligochaetes & chironomids
23	Sucker	43.5	850	Rattlesnake point	Vegetation
24	Whitefish	35.3	500	Rattlesnake point	chironomids & vegetation

Six of the 24 fish caught were found to have fish in their stomachs. The six piscivorous fish included largemouth bass (photo 1), smallmouth bass and black crappie. The fish which had been eaten were prickly sculpins plus several unidentifiable fish.

ONFC caught neither prickly sculpin nor sockeye fry by electrofishing. This is believed to be due to turbidity caused by the high flows in Okanagan River which made it difficult to see and capture the smaller fish. It is therefore difficult to determine if the predators were not eating sockeye fry because few fry were present or because fry were not encountered by the predators.



Photo 1. Largemouth bass with 4 prickly sculpin removed from its stomach.

5.0 Discussion

Although piscivorous fish such as black crappie, and large and smallmouth bass were found to prey upon sculpins, the sampling was not adequate to determine the extent of predation on emerging sockeye fry. Increased sampling of potential sockeye predators is recommended for the future. Electrofishing should be conducted at the river mouth during fry migration and beach seining should also be conducted in the littoral zones along the north side of the lake.

6.0 References

Alexis, F. 2003. Exotic Fish Assessment. As part of the Year 3, Evaluation of an experimental re-introduction of sockeye salmon into Skaha Lake. Submitted by the Okanagan Nation Fisheries Commission.

Long, K. 2002. Okanagan River sockeye egg & alevin development summary. Submitted by Okanagan Nation Fisheries Commission: Westbank, BC. Submitted to Douglas County Public Utility District: East Wenatchee, Washington.

FINAL

OBJECTIVE 2 Task B1
Results of sockeye smolt predator sampling
in the forebay and tailrace of Zosel Dam
2002

Contribution No. 4 to an *Evaluation of an Experimental Re-introduction of
Sockeye Salmon into Skaha Lake: YEAR 3 of 3*

Presented to: Colville Confederated Tribes

Date: May 31, 2003

Author: Chris Fisher

Reviewed by: Chris Bull, R.P. Bio

Edited by: Howard Smith

1.0 INTRODUCTION

The second year of field sampling was a part of the study to evaluate an experimental re-introduction of sockeye salmon (*Oncorhynchus nerka*) into Skaha Lake (Bonneville Power Administration #20124). To provide a better estimate of smolt survival, predator sampling occurred during suspected peak outmigration, May 2002. Fish collection was targeted towards known or potential predators of sockeye smolts including, northern pike minnow (*Ptychocheilus oregonensis*), smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), adult yellow perch (*Perca flavescens*) and walleye (*Stizostedion vitreum*).

2.0 METHODS

Sampling was conducted in the tailrace area of Zosel Dam (from the base of the dam to 50 m downstream on May 20, beginning at approximately 9:00 p.m. PST. Electro-fishing gear was used for 30 minutes. Upon capture predatory fish were immediately subdued to reduce the possibility of regurgitation. Gut contents were examined via dissection on site once electro-fishing was completed.

3.0 RESULTS

A total of 50 predators were collected in the tailrace area (Table 1, Figure 1). The most abundant species collected were northern pike minnow (29), followed by smallmouth bass (17), and largemouth bass (3).

Table 1. Stomach contents of collected fish predators from electro-fishing sampling in tailrace of Zosel Dam during May 20th 2002.

SPECIES	LENGTH (MM)	SEX	STOMACH CONTENTS
Northern Pike Minnow	495	Female	Empty
Northern Pike Minnow	560	Female	Empty
Northern Pike Minnow	530	Female	Empty
Northern Pike Minnow	513	Female	Empty
Northern Pike Minnow	520	Female	Empty
Northern Pike Minnow	527	Female	Empty
Northern Pike Minnow	494	Female	Empty
Northern Pike Minnow	475	Female	Empty
Northern Pike Minnow	475	Female	Empty
Northern Pike Minnow	415	Male	Empty

Table 1. continued

SPECIES	LENGTH (MM)	SEX	STOMACH CONTENTS
Northern Pike Minnow	405	Female	Empty
Northern Pike Minnow	560	Female	Unidentified fish
Northern Pike Minnow	436	Female	Empty
Northern Pike Minnow	448	Female	Empty
Northern Pike Minnow	520	Female	Empty
Northern Pike Minnow	550	Female	Empty
Northern Pike Minnow	427	Male	Empty
Northern Pike Minnow	446	Female	Empty
Small mouth bass	439	Female	1 smolt 150mm
Small mouth bass	247	male	1 fish unidentified 90mm
Small mouth bass	340	Female	1 sculpin - 80mm
Small mouth bass	362	Male	Empty
Large mouth bass	300	Male	Empty
Large mouth bass	218	Female	1 unidentified fish
Northern Pike Minnow	560	Female	1 Yellow perch - 106mm
Northern Pike Minnow	416	Male	Empty
Northern Pike Minnow	533	Female	1 Yellow perch - 106mm
Northern Pike Minnow	395	Male	1 smolt - 104mm
Northern Pike Minnow	412	Female	Empty
Northern Pike Minnow	510	Female	Empty
Northern Pike Minnow	542	Female	1 unidentified fish 175 mm (spiny ray)
Northern Pike Minnow	471	Female	Empty
Northern Pike Minnow	465	Female	Empty
Northern Pike Minnow	462	Female	1 Yellow perch -70mm
Northern Pike Minnow	426	Male	1 unidentified fish
Small mouth bass	323	Male	Empty
Small mouth bass	317	Male	Empty
Small mouth bass	319	Male	1 Yellow perch 110mm
Small mouth bass	318	Female	Empty
Small mouth bass	276	Male	1 unidentified fish
Small mouth bass	345	Female	Empty
Small mouth bass	328	Male	1 sculpin
Small mouth bass	319	Male	Empty
Small mouth bass	286	Female	2 unidentified fish (non-smolt)
Small mouth bass	302	Female	Empty
Small mouth bass	280	Female	1 unidentified fish (non-smolt)
Small mouth bass	395	Male	Empty
Small mouth bass	329	Male	Empty
Large mouth bass	249	Male	Empty

Twenty-four percent or 7 of the twenty-nine northern pike minnow collected contained fish. Of the 7 northern pike minnow containing fish, one was positively identified as a sockeye salmon smolt. The gut contents of three other northern pike minnow containing fish were too decomposed to positively identify, however, one of the fish was determined to be a “spiny-ray” fish i.e. a non-salmonid. The gut contents of the remaining three northern pike minnows included yellow perch.



Figure 1. Collection basin on electro-fishing boat during predation sampling in the tailrace area of Zosel Dam, May 2002.

Eight of the 17 smallmouth bass collected contained fish in their stomachs. One of the eight smallmouth bass stomachs contained a positively identified sockeye smolt (Figure 2). Five smallmouth bass had unidentifiable fish in their stomachs, of which two were determined not to be salmonids. Two sculpins and one yellow perch were found in the stomachs of the three remaining smallmouth bass.

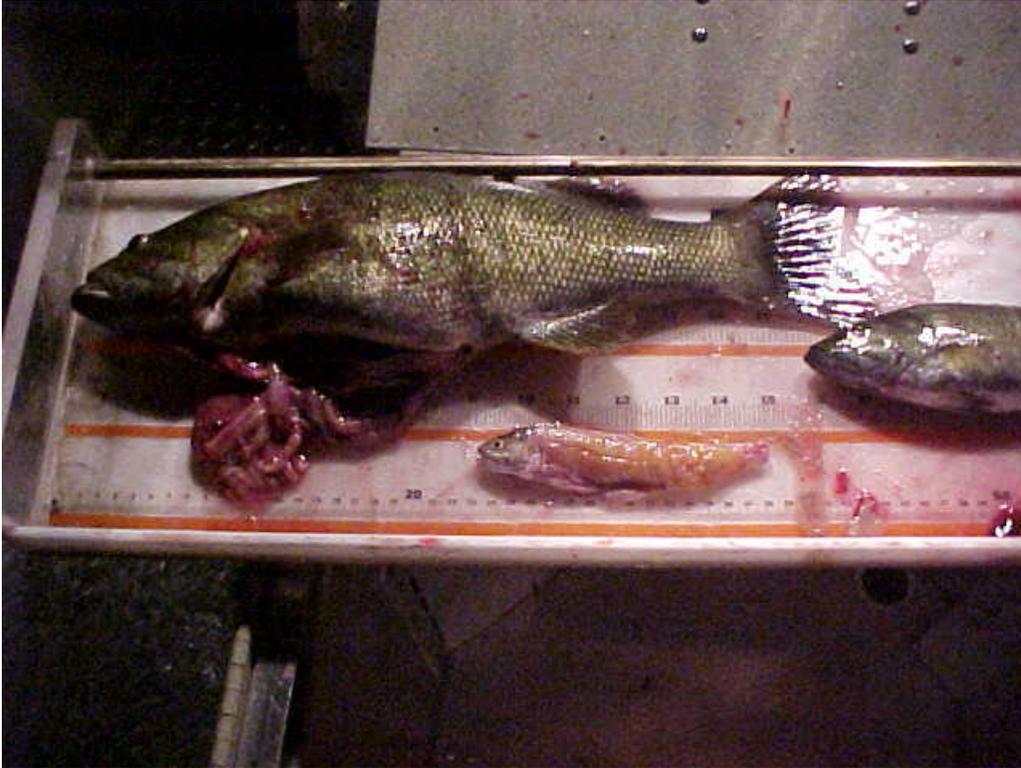


Figure 2. Smallmouth bass collected by electro-fishing in the tailrace of Zosel Dam during May 2002. One sockeye smolt was found in its stomach.

Three largemouth bass were collected, one of which contained unidentifiable fish in its stomach.

4.0 SUMMARY

A total of 50 piscivorous predators (29 northern pike minnow, 17 smallmouth bass and 3 largemouth bass) were collected and their stomachs were examined. Smallmouth bass had the greatest occurrence of fish in their diet (50%), with 1 (5.6%) of the smallmouth bass containing a positively identified sockeye smolt. Twenty-four percent of the northern pike minnow contained fish in the gut, with one (3%) northern pike minnow containing a positively identified sockeye smolt. Three of the northern pike minnow contained yellow perch. Three largemouth bass were sampled of which one contained an unidentified fish.

Electro-fishing occurred on May 20th. However, because few sockeye smolts were observed while electro-fishing, and conversations with Tom Scott, Oroville/Tonasket Irrigation District manager, indicated that he had observed large numbers of sockeye smolts moving through the dam the previous week, it is likely that most of the sockeye smolts had migrated from Osoyoos Lake before May 20th. Therefore, it is likely the frequency of sockeye smolts in the stomachs

of predators, particularly northern pike minnow and smallmouth bass, in the Zosel Dam tailrace area is greater than the 3% and 5.6%, respectively that were observed. Based on sampling conducted during 2002 and the results from 2001 (frequency of occurrence in smallmouth bass 7.1%; and in northern pike minnow 6%), it appears that fish are a more common component in the diet of smallmouth bass than they are in other fish predators and consequently may be the principal piscivorous predator on sockeye smolts in the tailrace area of Zosel Dam.

To quantify the predation rate on the sockeye population in the Okanogan River, particularly during smolt out-migration, a study which involves a known number of sockeye smolts released in Lake Osoyoos and recaptured downstream of Zosel Dam should be considered.

FINAL

OBJECTIVE 2 TASK C
Historical habitat of salmon of the Okanagan
River

Contribution No. 7 to an *Evaluation of an Experimental Re-introduction of Sockeye Salmon into Skaha Lake: YEAR 3 of 3*

Presented to: Colville Confederated Tribes

Date: May 31, 2003

Author: Adrienne Vedan

Reviewed by : Chris Bull, R.P. Bio

Edited by: Howard Smith

1.0 INTRODUCTION

The Okanagan River is known to support: sockeye, chinook, and steelhead and there is historical accounts of possibly coho, chum and pink (Vedan 2002). Objective 2 of the re-introduction of sockeye salmon into Skaha Lake examines the historical habitat of salmon of the Okanagan River in order to provide a framework for restoration work. In order to sustain salmonids along with other fish species, the habitat needed to include areas where there were waters of suitable depth and velocity along with trees and shrubs along the banks to provide nutrients or stability. The following excerpts are from observations and comments on the historical habitat of the Okanagan River.

2.0 SOURCES

The following search areas were utilized:

- Okanagan Nation Fisheries Commission
- Okanagan University College
- University of British Columbia
- Oliver and District Archives
- South Okanagan Similkameen Conservation Program
- British Columbia Archives
- Internet

3.0 HISTORICAL PHOTO DOCUMENTATION

The following photographs show features of the Okanagan River before modification of the channel, circa 1930.



Photo 1. Illustrating the meandering the Okanagan River near Oliver.

Photo 1 illustrates the meandering that characterized portions of the river. Edith Rinehart captured this photo just south of the town of Oliver in 1945. Some portions of the river were at that time narrow and lined by brush. This photo is courtesy of the Oliver and District Archives.



Photo 2. Okanagan River north of the town of Oliver showing the meandering.

The river from the town of Oliver looking northward and showing meanders. It also shows vegetation closely following the meanders. This photo circa 1920 is courtesy of the Oliver and District Archives.



Photo 3. Okanagan River at the town of Oliver showing the width of the river.

Okanagan River in the town of Oliver at a location known as the “swimming hole”, showing how wide portions of the river could be lined with vegetation. The photo circa 1930’s is courtesy of the Oliver and District Archives.



Photo 4. Okanagan River near the city of Penticton, South of Skaha Lake.

Okanagan River through Penticton near Skaha Lake. This portion of the river contained oxbows lined with trees and shrubs. Photo is courtesy of the South Okanagan Similkameen Conservation Program.



Photo 5. Ellis Creek during spring run-off showing the amount of riparian habitat present.

Ellis Creek during high water in the spring as seen from a location in today's downtown Penticton. This creek runs into Okanagan River and illustrates the characteristic riparian habitat, which was common along the Okanagan River and most tributary creeks. In *Historical Souvenir of Penticton* it is noted that this was a great area for spawning. Photo courtesy of the South Okanagan Similkameen Conservation Program

4.0 HISTORICAL ACCOUNTS

The following are excerpts from historical descriptions and accounts of the Okanagan River.

A.L. Fortune's Biography (Ormsby 1951)

- "At Okanagan Falls there is a small Fishing Reserve for the Inkameep Indians. This is isolated from their home Reserve, but the northern boundary of the latter was surveyed just to include the rocky rapids a little way below McIntyre Bluff, for this was an old time fishing spot for the Indians. Here they camped when the runs were on, spearing the salmon as they made their way up the shallows..."
- "...in the Okanagan River near the bridge at Oliver where there is good spawning gravel"

Maggie Victor – Wha-hul-kin-malks: An Okanagan (1966)

- “Salmon were speared along the Okanagan River through the Reserve and on the gravel bars below McIntyre Bluff.”

Atkinson R.N. 1967 - Historical Souvenir of Penticton

- “The Huth Avenue village was chosen for several reasons, but chiefly because the river at that point had a gravel bottom, low banks and was shallow, permitting a safe ford and it was the easiest point between the two lakes at which to harvest the spring and fall runs of fish, the most important species of which were the spring spawning Kamloops trout which would use Ellis and Shingle Creeks both of which join the river close at hand, and the fall spawning Humpback and Chum (Dog) salmon from the sea, and the land-locked Kokanee.”

Barlee, N.L. - The Sagebrush Country

- “Okanagan River still flows hard by the base of McIntyre’s Bluff, here, in the past, the Okanagan Indians paused to spear the Redfish and Salmon as they swam upriver to spawn, for the channel narrows considerably at this spot.”
- “Ancient Okanagan River Channel (before Flood Control dredged the canal through the river now flows) – the original river channel meandered back and forth across the lowlands to provide exceptional bird hunting and fishing in the early days”

Joe Pierre (Ernst2000)

- “Here at the river today it is called a river channel it was called ox bows before. It used to be rich in fish. Steelhead, Coho, and sockeye and the King Salmon.”

Raymond George (Ernst 2000)

- “...they would just fish everywhere. Down in Oliver below the bridge.”

Vernon News (1914)

- “For about a mile the river glides and twists calmly and quietly between low banks covered, for the most part, with reeds, or (as they are locally known) tullies.”
- “After passing this interesting stretch the new bridge of the Kettle Valley Railway is approached and just below this the water quickens and for nearly two miles we dash around turns, each seemingly a little harder than the last to negotiate. Such twists as would break a snake’s back and here – first east, then south, then west and (though we are bound south) sometimes almost due south.”

5.0 Summary

The banks of the Okanagan River appear to have once supported a good riparian habitat, which included shrubs and trees. This habitat would have acted as a temperature buffer by providing shade along with cover for sockeye. Furthermore, this vegetation would have restricted erosion of the riverbanks and streambeds because the soil would have been bound together by the roots. The historical accounts of the river

also describe the gravel beds used for spawning. The notes about gravel refer to the river near McIntyre Dam and also between Skaha and Okanagan Lake.

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FINAL

OBJECTIVE 2 TASK C
North American Lakes where Kokanee, Rainbow
Trout and Sockeye occur with Exotic Species

Contribution No. 8 to an *Evaluation of an Experimental Re-introduction of Sockeye Salmon
into Skaha Lake: YEAR 3 of 3*

Presented to: Colville Confederated Tribes

Date: May 31, 2003

Author:	Adrienne Vedan
Reviewed by:	Chris Bull, R.P. Bio
Edited by:	Howard Smith

1.0 INTRODUCTION

The Okanagan Nation Fisheries Commission (ONFC) is working towards re-introducing sockeye into Skaha Lake, and part of the evaluation of this project includes looking at the possibility of exotic species moving into upstream waters and adversely affecting resident kokanee and rainbow trout populations. A compilation of articles is provided dealing with some North American Lakes where kokanee, rainbow trout or sockeye occur with the following non-salmonids: black bullhead, black crappie, bluegill, smallmouth bass, largemouth bass, tench, carp, yellow perch, pumpkinseed and walleye. The above listed non-salmonids are considered exotic species of concern where they might negatively affect some part of the life cycle of either kokanee, sockeye or rainbow trout. This list will be useful in examining how exotic species interact with salmonids in other systems and in helping to predict what could occur in the Okanagan.

2.0 SOURCES

Literature in the following places was searched for information:

- Okanagan Nation Fisheries Commission
- Okanagan University College
- University of British Columbia
- National Research Council
- Great Lakes Fishery Commission
- Fisheries Information Summary System (FISS)

The information on species within lakes was mostly gathered from FISS and corresponding reports were then sought.

3.0 RESULTS

A partial list of lakes having one or more of sockeye, kokanee or rainbow trout plus one or more exotic species of concern.

Lake	Kokanee	Rainbow Trout	Sockeye	Black Bullhead	Black Crappie	Bluegill	Smallmouth Bass	Largemouth Bass	Tench	Carp	Yellow Perch	Pumpkinseed	Walleye	Lake Description
Lake Ozette, WA	x		x					x	x					Mesotrophic, warm, low elevation
Lake Washington, WA		x	x				x	x	x					Mesotrophic
Christina Lake, BC	x	X		x			x	x	x	x		x		Oligotrophic, warm water
Lower Arrow Lake, BC	x	X		x			x	x	x	x		x		Ultra-oligotrophic
Kootenay Lake, BC	x	X						x			x	x		Oligotrophic
Duck Lake, (Kootenay), BC		X		x				x			x	x		Oligotrophic
Mara Lake, BC	x	X	x							x				Oligotrophic
Pitt Lake, BC		X	x		x					x				Oligotrophic
Osoyoos Lake, BC	x	X	x	x	x		x	x	x	x	x	x		Mesotrophic
Flathead Lake, MO	x							x			x			Oligomesotrophic
Lake Tahoe, CA	x	X					x	x			x			High elevation, Ultra-oligotrophic
Western Lake Erie, Ont		X		x	x	x	x	x			x	x	X	Mesotrophic

The lakes that would be most useful when looking at predation and interaction of exotic species with salmonids would be those that are physically and chemically similar to Osoyoos Lake. The mesotrophic lakes listed with Osoyoos Lake are: Lake Ozette, Lake Washington and Lake Erie.

Studies of the interaction of sockeye and kokanee with predators like yellow perch and largemouth bass in Lake Ozette showed that predation rather than food supply or competition from other fish was the limiting factor in *O. nerka* production (1). In Lake Washington, studies have shown that considerable predation occurs during smolt out-migration (3). The lake has smallmouth bass and juvenile salmonids present; therefore, it is possible that the sockeye population is affected.

From 1969 to 1988, the dominant predator, walleye, shaped the fish community structure of Lake Erie. During this period, walleye greatly influenced the fish community structure as their abundance increased. Lake Erie walleye selectively prey on soft-rayed fishes and during this time records indicate that there was a decline in the abundance of soft-rayed fishes but not of spiny rayed-fishes. It was found that other changes in the nutrient load, loss of spawning habitat, exploitation and introduction of more exotic species changed the structure of the fish community (10).

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FINAL

OBJECTIVE 2 Task C

Leaping Abilities of Exotic Species of Concern

Contribution No. 9 to an *Evaluation of an Experimental Re-introduction of Sockeye Salmon into Skaha Lake: YEAR 3 of 3*

Presented to: Colville Confederated Tribes

Date: May 31, 2003

Author:	Adrienne Vedan
Reviewed by:	Chris Bull, R.P. Bio
Edited by:	Howard Smith

1.0 INTRODUCTION

The Okanagan Nation Fisheries Commission (ONFC) is carrying out a feasibility study on the re-introduction of sockeye salmon (*Oncorhynchus nerka*) into Skaha Lake. In objective 2 of this study we examine the interaction and impact of exotic species of concern with sockeye. One effective means of managing the impact of exotic species is to restrict their access. This literature review looks at the swimming and leaping abilities of exotic species of concern as an aid to developing and or refining fish passage ladders for sockeye salmon at McIntyre Dam.

2.0 SOURCES

The following sources were utilized:

- Okanagan Nation Fisheries Commission
- Okanagan University College
- University of British Columbia
- National Research Council
- Department of Fisheries and Oceans WAVES library
- Internet

Information on the leaping abilities of the exotic species of concern was extremely limited. There was some information regarding their swimming ability but this information was also sparse.

3.0 MOVEMENT

Anadromous and other migratory fish species often need to travel long distances and cross areas of high water velocity in order to reach spawning grounds or other critical habitat. These ordeals are often intensified by dams or other man made obstacles. Therefore, the swimming ability of a fish affects its life history (6.)

Species, smaller than adult salmonids, often cannot swim as fast and usually have a difficult time negotiating obstacles under high flows. Not only do salmonids have great swimming ability but they also have the ability to jump. Depending on the salmonid species the ability to jump makes many falls on streams or rivers passable rather than an impediment depending on the height (12).

Swimming performance may include: burst speed, highest speed attainable and maintainable for less than 15 seconds; prolonged speed, a moderate speed that can be maintained for up to 200 minutes; and sustained speed, a speed that can be maintained indefinitely. Sustained and prolonged speeds are generally used when fish are migrating upstream and burst speeds are used to overcome high velocity areas like rapids (7).

4.0 RESULTS

The following table outlines the swimming and jumping capabilities of various fish species.

Table 1 Swimming and jumping capabilities of some Salmonids and Exotic Species

Species	Lifestage	Maximum Swimming Speed (m/s)			Swimming (m/s)	Maximum Jump Height (m)	Comments	Reference
		Sustained	Prolonged	Burst				
Coho/chinook	Adult	2.7	3.2	6.6		2.4		13
Sockeye	Adult	1.0	3.1	6.3		2.1		13
Chum/Pink	Adult	1.0	2.3	4.6		1.5		13
Steelhead	Adult	1.4	4.2	8.1		3.4		13
Cutthroat/rainbow	Adult	.9	1.8	4.3		1.5		13
Common carp	Adult	.590		1.638				5
Walleye	Adult		0.0-1.1					7
Largemouth Bass	Adult				.340 - .589		Sample size test of 15, swimming with an increasing velocity (can maintain speed for 3 minutes)	7
Yellow Perch	Adult				.313 - .537		Swimming with an increasing velocity (can maintain speed for 3 minutes)	7
Pumpkinseed	Adult	.27						2

5.0 SUMMARY

Information regarding the characteristics of how a particular fish can swim in a specific velocity of water either is limited or not available for most fish species (7.) Nevertheless, the information in Table 1 illustrates the poor swimming abilities of several non-salmonid species. It is unlikely that if a fish is a member of a species with a poor swimming ability it will have much jumping capability.

Efforts to prevent exotic species from populating upstream areas of the Okanagan River may best be expended in setting barriers high or swift enough to only allow passage of salmonids, thereby excluding smaller, usually less capable swimmers.

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FINAL

OBJECTIVE 2 Task C

Movement and Colonization of Walleye

Contribution No. 10 to an *Evaluation of an Experimental Re-introduction of Sockeye Salmon into Skaha Lake: YEAR 3 of 3*

Presented to: Colville Confederated Tribes

Date: May 31, 2003

Author: Adrienne Vedan

Reviewed by: Chris Bull, R.P. Bio

Edited by: Howard Smith

1.0 INTRODUCTION

The Okanagan Nation Fisheries Commission (ONFC) is completing a feasibility study of the re-introduction of sockeye salmon *Oncorhynchus nerka*, into Skaha Lake, which is within the species historic range. Objective 2 of this study includes an assessment of possible unwanted introductions of exotic fish. Walleye are a possible threat to the upper Okanagan River and this literature review will examine walleye habitat, reproduction and movement in order to see how these characteristics may determine where walleye colonize.

Walleye are not native to Washington State and the circumstances of their introduction are unknown. The first verification of a walleye in Washington State was in 1962, from Banks Lake in eastern Washington. Soon afterwards, they appeared in Franklin Roosevelt Lake (connected to Banks Lake through a huge pipe.). Since then they have spread from these original sites to the remainder of the mainstem Columbia River, from near the mouth to the Canadian border. This species is known to be a predator and to colonize quickly (8).

2.0 SOURCES

The research methods consisted of reviewing literature. The following search areas were utilized:

- Okanagan Nation Fisheries Commission
- Okanagan University College
- University of British Columbia
- National Research Council

Information available on walleye movement, reproduction, and habitat preference was extensive but information was limited in regards to methods of stopping walleye range extensions.

3.0 WALLEYE HABITAT

Walleye can withstand a wide variety of environmental conditions: however, they prefer moderate to large lacustrine or riverine systems characterized by: cool temperatures, shallow to moderate depths, extensive littoral areas, moderate turbidities, extensive areas of clean rocky substrate and mesotrophic lakes. The littoral and sublittoral areas that walleye occupy in lakes are comparable to extensions of suitable riverine habitat into the lacustrine environment.

Demersal fry, juveniles and adults are very photosensitive. During the day they seek shelter that has dim light and are usually found in deep or turbid water or in contact with the substrate under the cover of boulders, log piles, brush, or dense beds of submerged vegetation.

Adult walleye prefer temperatures between 20 degrees Celsius and 24 degrees Celsius. Growth in adults stops when temperatures are less than 12 degrees Celsius and temperatures above 29 degrees Celsius are considered lethal (13).

4.0 REPRODUCTION

Walleye reproductive success is dependant on water temperature and quality. They spawn during the spring when there is sudden warming and spawning usually occurs when temperatures are between 6-11 degrees Celsius. Spawning habitat consists of: shallow shoreline areas, shoals and riffles, and having good water circulation from wave action or currents to provide well oxygenated water.

They are nocturnal spawners and eggs are distributed freely over the substrate and fall into cracks. Walleye do not provide any parental care. Current velocities in spawning areas must be sufficient to carry fry downstream to lakes within a period of 3-5 days, after yolk-sac absorption or they will die from a lack of food. Fry will not begin to feed when water temperatures are below 15 degrees Celsius. Juvenile walleye have similar habitat requirements to those of adults.

The heavy Columbia River flows draw most sexually mature walleye to tailrace areas “and away from the Okanogan River when conditions (maximum turbidity and discharge) are most accommodating” (17). “The absence of suitable rearing habitat and food (in the Okanogan River)” is a limiting factor in walleye colonization of the Okanogan system (17).

5.0 MOVEMENT

Studies regarding the swimming performance (15) of walleye have shown that they have a narrow scope for activity compared to species like the sockeye salmon. Walleye are generally considered not to be strong swimmers or to occupy fast water areas which could explain why walleye have a poor performance record when it comes to passing fishways (15, 17). Nevertheless, walleye are well known for expanding into new systems and becoming a dominant species because they are effective predators. Although walleye are nocturnal, they are not restricted to particular areas and often travel long distances. One factor, which limits the movement and behaviour of walleye, is light, since their eyes are extremely sensitive.

The aversion to light probably explains why walleye have been unable to reach Osoyoos Lake through the Okanogan River although the lower Okanogan River supports walleye (17).

6.0 SUMMARY OF RESULTS

If walleye made their way in to the Canadian portion of the Okanagan River they could cause great damage to salmonid populations. Walleye are great predators and colonize quickly. The most important environmental factor which influences walleye movement is light since they are extremely photosensitive and it appears that the Canadian portion of the river is too bright for walleye to enter or remain in. Another limiting factor in walleye movement is that the Okanagan River does not provide walleye with suitable spawning conditions.

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FINAL

OBJECTIVE 2 Task C
Consumption of incubating salmon eggs by
black bullheads (*Ameriurus melas*)

Contribution No. 11 to an *Evaluation of an Experimental Re-introduction of Sockeye Salmon into Skaha Lake: YEAR 3 of 3*

Presented to: Colville Confederated Tribes

Date: May 31, 2003

Author: Adrienne Vedan

Reviewed by: Chris Bull, R.P. Bio

Edited by: Howard Smith

1.0 INTRODUCTION

Species from external ecosystems have invaded the Okanagan basin via the Columbia and Okanogan Rivers. One of the species that is now present in the Okanagan basin is the black bullhead, *Ameiurus melas*, which was first recorded in 1941 as an invasion from the United States. Currently, it is found south of Okanagan Lake Dam (12).

As part of Objective 2, of the sockeye re-introduction to Skaha Lake project, the Okanagan Nation Fisheries Commission (ONFC) completed a literature review of the impacts of black bullheads on incubating salmonid eggs.

2.0 SOURCES

The following sources were searched:

- Okanagan Nation Fisheries Commission
- Okanagan University College
- University of British Columbia
- Pacific Regional Information Services for Education
- National Research Council Canada
- Internet

3.0 SUMMARY OF RESULTS

The information on food habits of the species was extensive, but not much was found on fish eggs in the diet.

The black bullhead is omnivorous, feeding on whatever it can find, including dead things. Midge and mayfly make up a considerable portion of the diet but bullheads also feed on other insects and their larvae, small crayfish, worms, small molluscs, crustaceans and plant material. Adults sometimes eat small fish, including other bullheads but fish play a very small part in their diet. Bullheads have also been known to eat the eggs of other fishes (13,9,3,6,4,11,8,5,10).

Black bullheads inhabit pools, backwaters, and slow-moving sections of creeks and both small and large rivers. They can also be found in impoundments, oxbows and ponds. They prefer turbid water and soft mud bottoms and can tolerate a pH as low as 3.4. The species is usually found in regions of pools having vegetative cover but will move into riffle areas to feed (13, 4,101,8,11,7).

During the day, bullheads remain inactive and stay within the vegetative beds until night falls. Adults feed primarily at night while the young are most active at dawn and dusk. They often destroy vegetation while stirring up the bottom in search of food (8, 9, 6).

Black bullheads are omnivorous and have been reported to eat fish eggs so there is a possibility that they may eat incubating salmon eggs also. However, an estimate of such losses is not possible on the basis of the literature reviewed.

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