
**2002/2003 Seton and Anderson Lakes Kokanee Assessment -
Feasibility Study and Study Design**

Prepared for:

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EXECUTIVE SUMMARY

In 2002, funds were provided by the Bridge Coastal Fish and Wildlife Restoration Program (BCRP) to the British Columbia Conservation Foundation (BCCF) to ascertain feasibility and develop a technically sound proposal to study kokanee (*Oncorhynchus nerka*) populations within Seton and Anderson Lakes.

The feasibility and study design portions of this project attempted to expand upon the existing information for Seton and Anderson Lake kokanee and further develop methodologies to identify spawning sites, spawn timing and quantification of population sizes through:

- limited field reconnaissance (helicopter overflight, boat surveys and lakeshore walks), and
- consultation with a regional biologist who has specialized expertise in kokanee (Harvey Andrusak, Redfish Consulting Ltd.).

Evidence of spawning activity in Seton and Anderson Lakes has been difficult to determine and so far, is only apparent when the spawned out fish eventually float to the lake surface due to distended swim bladders (some still alive) and are predated on by eagles or harvested by First Nations as they wash onto the beaches. Historical data review, interviews with First Nations and the limited field reconnaissance conducted to date has yet to reveal any actual kokanee spawning areas. However, valuable information has been gathered during the feasibility study with regard to suspected kokanee spawn timing, carcass recovery sites and predatory bird (i.e. eagle) congregations which may indicate general spawning areas and which will guide the more comprehensive field surveys detailed in the study design of this document and proposed to BCRP for 2003/2004.

There study design for the proposed 5 year (beginning 2003/2004) *Seton and Anderson Lakes Kokanee Assessment* was developed to meet four strategic objectives:

1. *Assess and document key kokanee spawning sites in Seton and Anderson Lakes.*
2. *Implement a systematic, standard procedure for enumerating kokanee with the intent of establishing key sites for index of abundance estimates.*
3. *Determine kokanee population estimates for both lakes.*
4. *Develop a kokanee conservation plan for both lakes.*

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1.0 INTRODUCTION

1.1 BACKGROUND

In 2001, funds were provided by the Bridge Coastal Fish and Wildlife Restoration Program (BCRP) to the British Columbia Conservation Foundation (BCCF) to ascertain feasibility and develop a technically sound proposal to study kokanee (*Oncorhynchus nerka*) populations within Seton and Anderson Lakes.

The Seton and Anderson Lakes watershed falls within BC Hydro's Bridge River/Coastal Generation Area, where BC Hydro operates two hydro-electric facilities: the Seton River power dam and the Shalath power generation facility. BC Rail tracks run the length of both lakes on the north side. It is unclear what effect hydro facilities including diversion of Bridge River water have had on kokanee populations in the watershed. The Ministry of Water, Land and Air Protection (WLAP) and BC Hydro require current information on these fish species in order to guide reductions of any adverse impacts or to recover losses in fish production or habitat productive capacity related to hydroelectric development.

Previous work conducted by BCCF and WLAP in the Seton and Anderson Lakes watershed (Morris et al. 2003), indicates that First Nations, WLAP and BC Hydro have placed a high importance on understanding the status of kokanee within the study area. There is very little information on kokanee life history, habitat requirements and population size in either lake. What is known is that the kokanee are culturally significant to First Nations who call them "Gwenis" and they have been an important supplementary component of their diet. Geen and Andrews (1961) noted that First Nations had reported large numbers of kokanee in both lakes, however, First Nations are now concerned that kokanee populations within both lakes are severely depressed. The kokanee or gwenis (First Nation term - pronounced waneesh) population within Seton and Anderson Lakes have a unique black colorization, and display unique spawning behavior and spawning site selection (shore and/or deep water habitats).

Note that the terms kokanee and gwenis are both used in this report to refer to the same fish.

1.2 OBJECTIVES

The primary objectives of the *Seton and Anderson Lakes Kokanee Assessment Feasibility Study* are to:

- Ascertain project feasibility through low level reconnaissance of areas within Seton and Anderson Lakes to identify possible location and timing of kokanee spawning for 2003/2004 project surveys, and, if possible, collect biological samples.
- Develop a comprehensive study design to assess kokanee populations in Seton and Anderson Lakes in 2003/2004.

2.0 STUDY AREA

The Seton and Anderson Lakes watershed encompasses an area of approximately 1039 km² within the WLAP Southern Interior Region and within the Lillooet Forest District of the Kamloops Forest Region and the Squamish Forest District of the Vancouver Forest Region. The Seton River (WSC 100-1235900-000 UTM 10.576204.5613960) is a fifth order tributary to the Fraser River with its confluence with the Fraser located in the village of Lillooet, B.C. The watershed contains two large water bodies, Anderson Lake and Seton Lake Reservoir. Seton Lake is within semi-arid climate zone while Anderson Lake is transitional to a coastal climate. The project study area encompasses only that area of the Seton and Anderson Lakes watershed located upstream of Seton Dam (Figure 1).

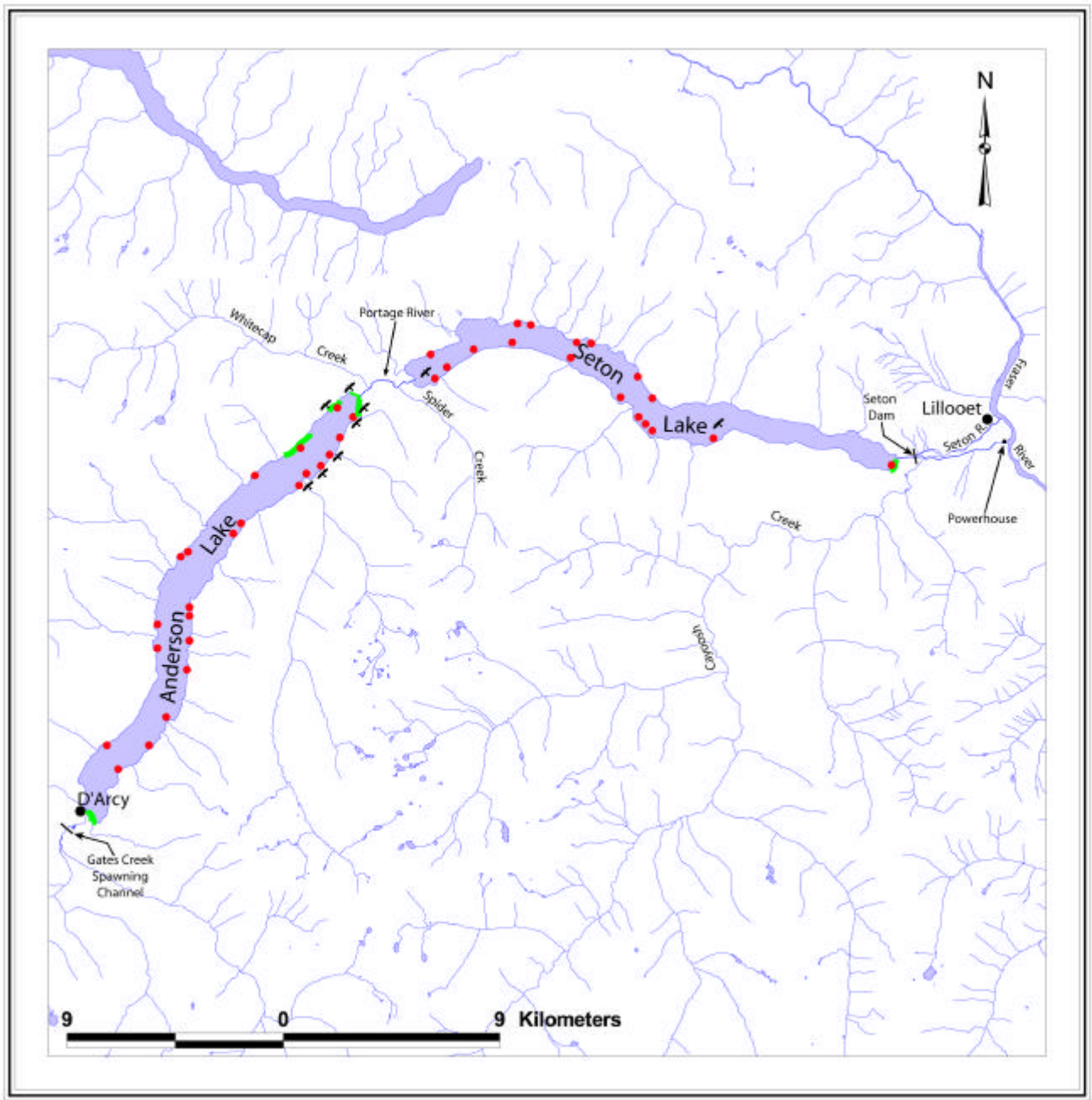
3.0 METHODS

3.1 PROJECT FEASIBILITY

The feasibility portion of this project attempted to expand upon the existing information for Seton and Anderson Lake kokanee and further develop methodologies to identify spawning sites, spawn timing and quantification of population sizes through:

- limited field reconnaissance (helicopter overflight, boat surveys and lakeshore walks), and
- consultation with a regional biologist who has specialized expertise in kokanee (Harvey Andrusak, Redfish Consulting Ltd.).

During the field reconnaissance, potential kokanee shore spawning sites (based on habitat descriptions of known kokanee shore spawning sites in Adams, Okanagan, Kootenay and Arrow Lakes, carcass recovery beaches (with funding assistance from WLAP), as well as, the presence of predatory birds (i.e. eagles) were noted and later recorded on NTS maps for subsequent mapping using Arcview (Figure 1).



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- Potential Kokanee Shore Spawning Site
- Kokanee Carcass Recovery Site
- Predatory Bird Locations



Study Area Within The Southern Interior Region Of British Columbia

Figure 1. Project area and survey sites for the 2002/2003 Seton and Anderson Lakes Kokanee Assessment - Feasibility Study and Study Design

Post-spawn kokanee mortalities were collected from Anderson Lake in the winter of 2003 by personnel from BCCF, WLAP and First Nations. Samples are in storage at WLAP in Kamloops for future collection of basic biological information from individual fish, including:

- Length (mm)
- Weight (g)
- Sex (m/f)
- Aging structures (scale, otolith, fin ray)

3.2 STUDY DESIGN

The study design portion of this project was completed through additional consultation with Harvey Andrusak of Redfish Consulting Ltd. Mr. Andrusak, was a professional fisheries biologist for the province of British Columbia for 30 years and now provides professional fisheries consulting services. He has extensive knowledge of kokanee populations in the Kootenays and was key in the development of a scientifically and technically sound study design for the Seton and Anderson Lakes kokanee assessment.

4.0 RESULTS

4.1 PROJECT FEASIBILITY

On October 16, 2002 a helicopter overflight was conducted on Seton and Anderson Lakes by Al Caverly (WLAP) and Harvey Andrusak (Redfish Consulting Ltd.) to assess the geography of the study area and scope project feasibility. A secondary task was to identify potential kokanee shore spawning habitat. Potential kokanee shore spawning sites were identified in Anderson Lake based on similar shore spawning habitat for kokanee populations in other lakes. The most suitable kokanee spawning shorelines were at the west half Anderson Lake, where sections of both the north and south shores have sloping gravel to boulder substrates. Similar sites exist in Seton Lake but are less common.

On October 31, 2002, a shoreline reconnaissance via boat was conducted on Seton Lake by Al Caverly (WLAP) and the Lillooet Conservation Officer Service, following a First Nations report of kokanee carcasses ("floaters") in Seton Lake a week prior. No kokanee, live or mortalities were observed. A large flock of inactive gulls was noted at the east end of the lake, where water depths were approximately 75 meters depth, however few targets were observed with a fish finder. No concentrations of fish were apparent on the sounder along the shorelines (10 -20 meters of water) just east of the Bridge turbine outfall at

Shalath. No eagle perching or feeding activity was obvious. Water surface temperature was 10° C on October 31. It appeared that, kokanee had not yet spawned. In 2001, floaters were present at the east end of Seton Lake within two weeks (mid November) of the October 31, 2002 survey. A second boat reconnaissance of Seton Lake on December 5 had identical results and no kokanee were found.

A third field reconnaissance was conducted on Anderson Lake on January 8, 2003 following reports (January 3) from local residents of kokanee carcasses near the outlet of Anderson Lake and the increased presence of raptors (eagles) at various points along the shoreline. Personnel from BCCF and WLAP conducted a boat survey on the eastern portion of the lake (approximately 1/3 of the total length of the lake), on both the northern and southern shorelines. Weather at the time of the survey was calm and clear with a surface water temperature of 6.4° C. Two kokanee carcasses (both male) were recovered from the beach along the northern shore (Figure 2) and numerous congregations of eagles were noted at various points along both shorelines.



Figure 2. Northern shore of Anderson Lake where kokanee carcasses were recovered in January 2003.

A final field survey was conducted on January 21, 2003 on Anderson Lake. Personnel from BCCF (Eric Braumandl) and local First Nations (Larry Green) again surveyed the eastern portion of the lake (approximately 1/3 of the total length of the lake), this time concentrating on the northern shore. Sixty carcasses (36 males, 24 females) were recovered from this shoreline. The majority of these specimens were assessed as recent mortalities (based on lack of decay or predation). Approximately 10 % of the specimens were still alive when recovered. These fish were noted struggling within the surface layer just off the shoreline (swim bladders full). The majority of females recovered noted frayed tails, presumably as a result of redd digging. General findings (no measurements) concluded that male fork length was greater than female fork length (males approximately 25 cm and females approximately 20 cm). All specimens noted expanded swim bladders and a few had external parasitic worms. All specimens are in storage at WLAP in Kamloops and will be sampled for length, weight and age structures at a later date.

During the January 21, 2003 field survey, the field crew discussed kokanee with a First Nations resident who surveys this shoreline on a regular basis and still utilizes these fish as a food source. This person indicated that few fish had been found prior to this survey. He believed that the main kokanee spawning activity was just starting and that it was coinciding with high winds, which had been lacking up to this time. Weather at the time of survey was overcast and mild (2° C) with strong southwesterly winds (whitecaps). The resident indicated that he had observed one kokanee “floater” on December 15, 2002. He also noted that the week prior (mid January), he observed 103 eagles, which seemed to indicate that kokanee spawning or spawning mortality had yet to peak. Approximately 50 eagles were noted during the January 8, 2003 survey. Only a few eagles were noted near the lake surface (presumed searching for or recovering floaters) on the January 21, 2003 survey, likely due to the high winds at the time of the survey masking any kokanee surface activity that would attract these birds.

4.2 STUDY DESIGN

There are four strategic objectives associated with the *Seton and Anderson Lakes Kokanee Assessment* study design:

1. *Assess and document key kokanee spawning sites in Seton and Anderson Lakes.*

Field technicians (herein named field crew) will be located on site periodically from mid summer to late fall to conduct some basic sampling procedures to obtain some biological data. Gill nets set in the evening in open water sites prior to thermal stratification (June) will provide samples for age analysis and growth. Although shore spawning is predominant, the larger inflowing streams will be

assessed in the fall to document any stream spawner numbers. (If any numbers are identified a sample of 50 fish will be taken for length and fecundity). Based on information obtained in 2002/2003, the field crew would check both lakes approximately every two weeks from mid-October until the end of January. A boat will be used to access the shoal areas. Initially the crew would observe suspected shore spawning sites based on information gained from First Nations and local residents. Sample methods will adapt to current conditions in the field. The field crew will also have some knowledge of such sites from the completed *Seton and Anderson Lakes Kokanee and Char Assessment* (Morris et al. 2003), from data collected for this report, as well as, the on-going WLAP kokanee project in the Thompson watershed and from some recent observations of deep water shore spawning kokanee in Alouette Reservoir (Wilson 2000). Key observations would also be made on predatory bird activity and appearance and location of carcasses.

Note: In years 2-5 an underwater camera may be used to further define shore spawning sites once the sites are identified. It may be possible to quantify spawner numbers through a combination of camera and diver observations. Night time observations using a light from a boat may also be possible. If stream spawning is identified then the standard assessment methods described by Sebastian et al. (2000) will be employed.

- 2. Implement a systematic, standard procedure for enumerating kokanee with the intent of establishing key sites for index of abundance estimates.*

This work would be scheduled for years 2-5 in an attempt to establish some baseline data that over the long term would provide insight into year class variability and relative abundance estimates. It is expected that only 2-3 sites per lake would be necessary. A spawning stream and a shoreline site would be ideal. Further detail on methods would be described once several sites are identified. Habitat attributes and condition would provide a foundation for restoration options.

- 3. Determine kokanee population estimates for both lakes.*

There are several methods that can be used to estimate kokanee population size. Hydro acoustics and trawl techniques have been used extensively by Sebastian and Scholten (*in* Andrusak et al. 2002; Pieters et al 2001; Ashley et al. 1999) on Okanagan, Arrow and Kootenay Lakes to estimate total kokanee numbers. This work is proposed to be conducted on Seton and Anderson Lakes for the next five years. It should be noted that there is an opportunity to partner with DFO who already conduct similar work periodically on these two lakes. (Previous DFO

work summarized by Shortreed et al. (2001) indicates most *O. nerka* in Anderson Lake were kokanee, so this information will provide some excellent background data). The hydro acoustics data obtained from the two lakes can then be compared to other lakes surveyed by the same methods. *O. nerka* samples from both lakes obtained by trawl catches can be analyzed for Sr/Ca (Strontium/Calcium) ratios to differentiate sockeye from kokanee. The ratio can then be applied against DFO sockeye estimates to generate estimates of kokanee age class abundance.

Crude estimates of theoretical carrying capacity can also be generated using provincial large lakes biostandards (Anon 1987), as well as, the morphoedaphic index (MEI) described by Redfish Consulting Ltd (2002). These two methods to estimate potential population size would be compared, as well as, comparisons made with similar lakes studied elsewhere in southern BC.

4. Develop a kokanee conservation plan for both lakes.

First Nations and public concern for Seton and Anderson Lakes kokanee are centered on three inter-related issues:

- conservation of these unique, wild populations;
- harvest by First Nations and continued sport fish harvest, and;
- resource stewardship.

To address these interests and concerns it is suggested that a conservation plan needs to be developed that provides some direction for fisheries managers, First Nations and the public. The goal of such a plan would be to conserve the kokanee. Strategic objectives would probably include:

- habitat protection, restoration and management of the kokanee populations;
- provide provision for continued First Nation harvest and public angling opportunities; and
- promote public awareness and stewardship of the resource.

Based on the five years of results of this project the conservation plan(s) would be written up towards the end of the fifth year. The plan would provide an overview of all findings and outline a set of restoration activities and or habitat improvement projects if applicable. The timing of a conservation plan (five years hence) does not preclude the earlier initiation of a restoration activity if it clearly obvious that it would benefit the kokanee population (e.g. stream or shoreline restoration involving gravel platforms).

An annual report will be completed each year that summarizes the progress to date. Data analysis and interpretation will be included, as well as, recommendations for any changes to the project with appropriate rationale.



5.0 DISCUSSION

5.1 PROJECT FEASIBILITY

Evidence of spawning activity in Seton and Anderson Lakes has been difficult to determine and so far, is only apparent when the spawned out fish eventually float to the lake surface due to distended swim bladders (some still alive) and are predated on by eagles or harvested by First Nations as they wash onto the beaches. Historical data review, interviews with First Nations and the limited field reconnaissance conducted to date has yet to reveal any actual kokanee spawning areas. However, valuable information has been gathered with regard to suspected spawn timing (Table 1), carcass recovery sites and predatory bird congregation which may indicate general spawning areas and which will guide the more comprehensive field surveys detailed in the study design of this document and proposed to BCRP for 2003/2004.

Table 1. Suspected spawn timing for Seton and Anderson Lake kokanee.

	October	November	December	January
Seton Lake		P		
Anderson Lake				P

 Suspected duration of kokanee spawning
 Suspected peak of kokanee spawning

5.2 STUDY DESIGN

The development of a study design for a project such as this, where there is a great deal of uncertainty, requires an adaptive management approach with planned change made in response to new information. The project objectives detailed in this study design will not change, but the methods used to achieve them could. The progress of this project can also be evaluated and compared to

that of the parallel WLAP project underway in the Thompson watershed and other kokanee projects in British Columbia.

6.0 RECOMMENDATIONS

This feasibility study and study design detailed in this document represents Year 1 of a proposed 5 year project. Application for funding for Years 2-5 will be made to BCRP in subsequent years. It is recommended that this work continue for years 2-5 in an attempt to establish some baseline data that, over the long term, would provide insight into year class variability and relative abundance estimates. Further detail on methodology and budgets would be described in subsequent funding applications once sites are identified.

7.0 ACKNOWLEDGEMENTS

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APPENDIX A: FINANCIAL STATEMENT