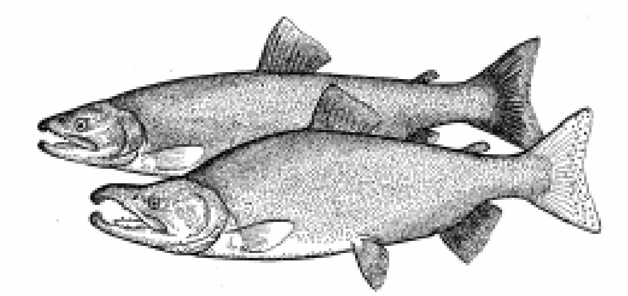
Recovering Lakelse Lake Sockeye Salmon

-Lakelse Lake Sockeye Recovery Plan (LLSRP)



Partnered by:

Lakelse Watershed Society
Kitselas Fisheries
Terrace Salmonid Enhancement Society
Province of B.C. Ministry of Water, Lands and Air Protection
Province of B.C. Ministry of Forests
Fisheries and Oceans Canada

April 2005

Lakelse Lake Sockeye Recovery Plan (LLSRP)

Overview

Lakelse Lake, near Terrace, B.C., is one of 28 sockeye rearing lakes in the Skeena River watershed. Since the mid 1990's, sockeye escapements (spawners) into Lakelse Lake, as well as the number of juveniles rearing in the lake itself, have fallen precipitously. Current information suggests the major problem is poor spawning success in the tributary streams primarily related to degraded spawning habitat. In the fall of 2003, concerned local stakeholders, First Nations, and provincial and federal governmental agencies began to jointly review available information, evaluate options, and identify activities for recovering Lakelse Lake sockeye. This document is the result of that process and is intended as a framework for moving forward. A companion document: Conserving Lakelse Fish and their Habitat: Lakelse Watershed Backgrounder (Skeena Fisheries Commission 2003) should be referenced for further information.

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Summary

- Sockeye escapements to Lakelse Lake have been low in recent years and appear to be depressed relative to historic levels.

- Based on the last 12 years of visual escapement surveys for Lakelse Lake (1992-2003), the Lakelse Lake sockeye stock has experienced a 92% decline over the last three cycles.

- Exploitation rates for Lakelse Lake sockeye have been low to modest since 1970, primarily because of the early timing of this stock through mixed-stock interception fisheries targeting enhanced Babine Lake sockeye. Fisheries exploitation is not believed to be the major factor affecting escapements and subsequent sockeye production from Lakelse Lake.

- Recent lake trophic studies indicate that Lakelse Lake provides a favorable rearing environment for juvenile sockeye. Lakelse Lake has the capacity to rear the progeny from approximately 29,000 spawners.

- In 2003, juvenile sockeye densities in Lakelse Lake were just 9% of estimated lake rearing capacity, representing the progeny from just 750 spawners. In 2004, juvenile sockeye densities were less than 20% of estimated lake rearing capacity.

- Lakelse Lake is fry recruitment limited and is producing sockeye well below potential production. Degraded or limited tributary spawning habitat, relative to historic levels, is believed to be restricting spawner access and spawning success (recruits per spawner).

- Increasing fry recruitment by increasing escapements, combined with spawning habitat restoration and/or fry out planting, has been suggested for improving sockeye production from Lakelse Lake.

BACKGROUND

Lakelse Lake

Lakelse Lake sockeye salmon are one of approximately 28 wild sockeye stocks in the Skeena River drainage. Lakelse Lake is located in northwestern British Columbia, 20 km south of Terrace. The lake basin drains via the 18 km-long Lakelse River into the Skeena River southwest of Terrace.

Biological knowledge of Lakelse Lake sockeye is quite extensive compared to other lakes in the Skeena River watershed. Enhancement activities preceded formal assessments, with hatcheries operating on Coldwater Creek from 1901-1920 and Granite Creek from 1920-1935. From the late 1940's through the mid 1960's, extensive research was conducted on basic sockeye life history dynamics, migrant survivals, and production trends in the lake and in key spawning tributaries (Foerster 1968). As well, hatcheries, fish fences, and spawning facilities were operated on Williams and Scully Creeks from 1962-1967, and a weir across the Lakelse River was used to assess adult escapements and downstream smolt migration. Lake trophic status, sockeye productive capacity, and factors limiting sockeye production were assessed in 1994 and again in 2003 (Shortreed 2003).

Significant human activity in the Lakelse Lake watershed began in the 1950's. These activities included logging, highway construction, creek diversions, and resultant landslides (Skeena Fisheries Commission 2003). The cumulative affect of human activity has likely affected fish production in the watershed (Skeena Fisheries Commission 2003). For example, increased sedimentation and siltation rates in spawning tributary creeks, first identified as a concern in 1986, are still a concern today. Increased sedimentation is also suspected of providing favorable habitat for the recent invasions of the lake shore by the macrophyte *Elodea canadensis*.

Over the past 30 years, numerous assessments of Lakelse Lake water quality and lake habitat have been conducted. These have included studies of sediment loading, tributary changes, landslide dynamics, watershed hydrology, and restorative enhancement options (Skeena Fisheries Commission 2003, WLAP 2003).

The Kalum Land and Resource Management Plan (BC Ministry of Sustainable Resource Management 2002) specifically identified Lakelse Lake as a priority for continued water quality monitoring and assessment. This plan also identified several tributaries for additional study to ensure the protection and rehabilitation of fish populations, fish habitat, water quality and hydrologic stability. These tributaries included Williams, Scully, Furlong and Hatchery (Granite) Creeks.

In recent years, considerable effort has been directed towards actively improving water quality and fish habitat in Lakelse Lake, especially by concerned community stewardship groups such as the Lakelse Lake Watershed Society and the Terrace Salmonid Enhancement Society. Fisheries stock assessment and habitat activities in Lakelse Lake are co-ordinated by the federal Canadian Department of Fisheries and Oceans and the provincial Ministry of Water, Lands, and Air Protection.

In the fall of 2003, concerned local stakeholders, First Nations, and provincial and federal governmental agencies formed a steering committee to begin reviewing available information, evaluating options, and identifying activities for recovering Lakelse Lake sockeye. Representatives from the following organizations have been participating in the recovery planning process.

<u>LLSRP Steering Committee Partners</u>

Lakelse Watershed Society
Kitselas Fisheries
Terrace Salmonid Enhancement Society
Province of British Columbia
- Min. of Water, Lands, and Air Protection
- Ministry of Forests
Fisheries and Oceans Canada

Stock Status

Species Biology

Lakelse Lake sockeye spawn from late August through October in tributary creeks to Lakelse Lake. Thirteen tributaries feed into Lakelse Lake with the three largest also being the principal sockeye spawning tributaries (Williams, Hatchery, and Schulbuckhand creeks, Figure 1). Unlike most other Skeena River sockeye lakes, lakeshore spawning does not appear to be significant in Lakelse Lake (Ken Shortreed, Cultus Lake Laboratory, Pers. Comm.)

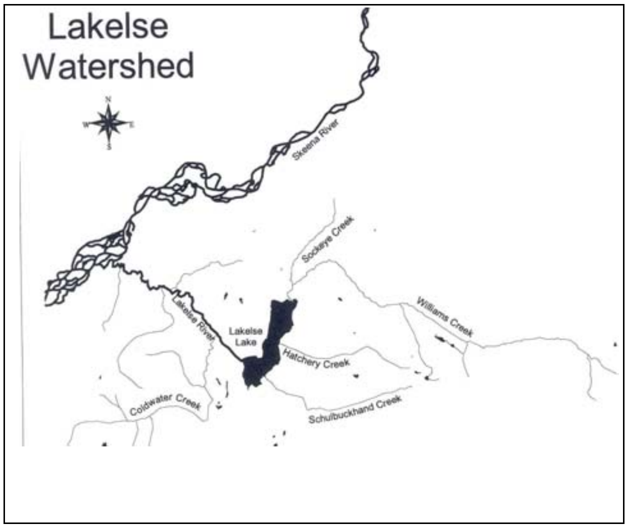

***Figure 1**: Map of Lakelse Lake showing the major spawning tributaries.*

Like other sockeye salmon, Lakelse Lake sockeye die soon after spawning. Fry emerge from the gravels in early spring and subsequently school into deeper lake waters soon after. After one year of lake rearing, the smolts migrate to sea in late April and move northward from the Skeena River estuary along the coast and offshore into the North Pacific Ocean. Most Lakelse River sockeye mature at age 4 or 5, although males (“jacks”) also commonly mature at age 3. The maturing fish return from offshore waters of the North Pacific Ocean through Southeast Alaska and northern British Columbia and enter the Skeena terminal fishing areas from mid-June through early July. Based on tagging data (Aro and McDonald 1966) and recent DNA analyses from the Tyee Test fishery on the lower Skeena River (Cox-Rogers et al 2004, Beacham et al 2005) the return typically peaks in Canadian waters during the last week of June.

Fisheries

Lakelse Lake sockeye migrate through a complex array of mixed-stock fishing areas in southern southeast Alaska, northern British Columbia (Statistical Areas 1 through 5), and in First Nations food, social, and ceremonial fisheries (FSC) within the lower Skeena River itself (Wood 1999).

First Nations Fisheries

The Kitselas Band of the Tsimshian First Nation (lower Skeena River and adjacent ocean areas) harvest Lakelse Lake sockeye in mixed-stock food, social, and ceremonial fisheries in the Skeena River mainstem below the confluence of the Lakelse and Skeena Rivers. First Nations exploitation of Lakelse Lake sockeye is believed to be quite low as the stock migrates into the Skeena River when river levels are high and when First Nations fishing is minimal. Terminal sockeye fishing by First Nations has not occurred on the Lakelse River or at Lakelse Lake for many years (Wilfred McKenzie, Kitselas Band, Pers. Comm.), although historic terminal fisheries are well documented (Skeena Fisheries Commission 2003).

Alaskan Commercial Fisheries

Lakelse Lake sockeye migrate homeward through Southeast Alaska and a proportion of the total run is harvested in Alaska gillnet and seine fisheries. Given the early run-timing of this stock, Alaskan commercial fisheries are not believed to be exerting high exploitation rates on Lakelse Lake sockeye. The Pacific Salmon Treaty limits catch in some Alaskan fisheries directed at Skeena sockeye salmon, but other interceptions occur as incidental harvests in Alaskan pink and chum fisheries.

Canadian Commercial Fisheries

The commercial fishery on Skeena River sockeye began with the first cannery operations in

1877. (Wood 1999, 2001). Sockeye salmon were harvested predominantly by gillnets in the Skeena River until the 1930's when powered vessels moved out to ocean fishing areas. A seine fishery was introduced in the 1950's and grew rapidly through the next two decades. The fishery typically ran from late-June through mid-August but in recent years, the fishery has been confined to the mid-July to early August time period to reduce incidental catches of coho, steelhead, and earlier migrating non-Babine sockeye. Effort levels in recent years, from gillnet and seine boat-days, are substantially reduced compared to historic levels. As with fisheries in Southeast Alaska, commercial fishing in Canada is not believed to exert high exploitation rates on Lakelse Lake sockeye because of the early run-timing of this stock.

Resource Status

Lakelse Lake Abundance and Exploitation

Annual catch data for Lakelse Lake sockeye are not available and annual escapement records are incomplete. As such, exploitation rates on this stock cannot be directly calculated. Instead, exploitation rates are modeled using weekly sockeye harvest rates in Canadian fisheries, run-timing curves for the wild stocks, and add-on exploitation for U.S. and in-river First Nations fisheries (Cox-Rogers et al 2003). Figure 2 summarizes estimated exploitation rates for Lakelse Lake sockeye since 1970. Decadal mean exploitation is estimated to have been 0.262 from 1970-79, 0.245 from 1980-89, 0.338 from 1990-99, and 0.279 from 2000 through 2002. These exploitation rates are considered maximums and may be biased high because a) exploitation rates for the Skeena River aggregate stock caught in Southeast Alaska have been used as a surrogate for the earlier-timed Lakelse Lake sockeye stock, and b) FSC exploitation rates within the Skeena River are for the aggregate stock captured below Terrace which may not apply to the earlier-timed Lakelse Lake sockeye stock. Future DNA-based stock identification analyses of commercial and FSC fisheries may help to quantify exploitation rates on Lakelse Lake sockeye.

Exploitation to achieve maximum sustained yield (MSY) has been estimated at 0.432 for Lakelse Lake sockeye based on adjusted (for Mysid competition) lake trophic status assessments, However, this calculation assumes lake rearing capacity alone limits sockeye production (Cox-Rogers et al 2003). Sustainable exploitation may actually be reduced for this stock if spawning habitat limitation is occurring.

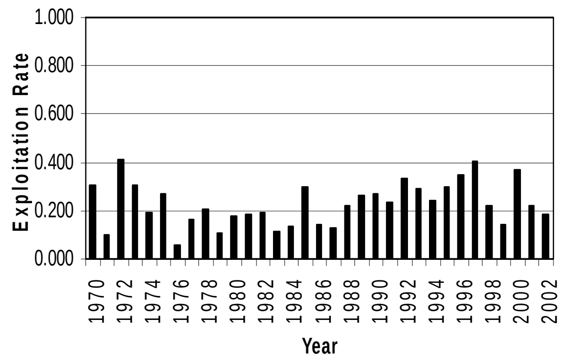

Figure 2: *Estimated (all fisheries) fisheries exploitation rates on Lakelse Lake sockeye salmon: 1970-2002.*

Spawning Escapements

Escapement trends for Lakelse Lake sockeye are somewhat difficult to assess because the counts represent data from a diverse series of surveys with decreasing coverage over time. Since the late 1990's, stream walks have been sporadic but those that have been conducted have indicated lower escapements to key tributary streams than in past years (Mitch Drewes, DFO, Pers. Comm.). Figure 3 shows estimated sockeye escapements into Lakelse Lake based on the available data from 1950- 2003 (B.C. 16's). The records indicate that Lakelse Lake sockeye escapements were generally above 5000 fish in most years (range 1000-41000) with peak years of abundance in the 1960's, early 1980's, and mid 1990's, and very low abundance in recent years. Note that the visual escapement records are considered under-estimates of actual escapement except for the 1960's time period when fence counts and calibrated visual estimates were used to derive the annual escapements (Forester 1968).

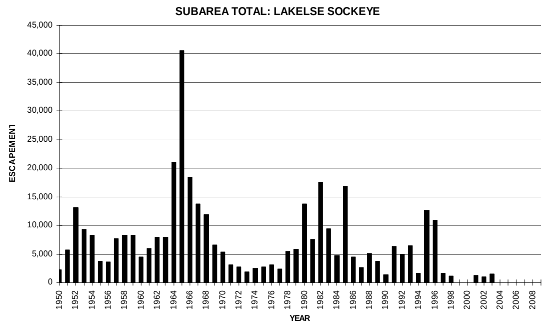

Figure 3: *Estimated sockeye salmon escapements to Lakelse Lake (B.C. 16 visual estimates): 1950-2003.*

Limnological and juvenile surveys

Ongoing analyses of limnological and juvenile acoustic data for Lakelse Lake sockeye indicate that spawning escapements are much too low to fully utilize lake rearing habitat and maximize smolt production (Shortreed et al 1998, 2001). Highlights of lake trophic and acoustic surveys conducted in 2003 are summarized below:

- The lake was thermally stratified from June to September, and thermocline depths were unusually deep (usually greater than 20 m) for a relatively small lake. This is no doubt due to the frequent winds. The lake is relatively clear, with an average euphotic zone depth (the depth to which plants can grow) of 8.2 m.
- Lakelse Lake water has a near-neutral pH averaging 7.1, a relatively low average conductivity of 54 µS/cm, and a total alkalinity of 22.5 mg $CaCO_3$/L. These values are near the middle of the range seen for a number of other lakes in the Skeena River system.
- Total phosphorus concentrations averaged 5.4 µg/L. Spring nitrate concentrations were approximately 50 µg N/L and although epilimnetic nitrate did not become completely depleted, it was <6 µg N/L from June to September. Bacteria numbers averaged 1.5 million/mL and average chlorophyll concentrations were 1.4 µg/L. Photosynthetic rates averaged 144 mg $C \cdot m^{-2} \cdot d^{-1}$.
- These data all indicate that Lakelse is a relatively unproductive lake and is in the middle of the oligotrophic range.
- The data indicate that for much of the growing season, lake productivity is limited by the availability of both nitrogen and phosphorus. In other words, an increased supply of both nitrogen and phosphorus would stimulate lake productivity.
- Lakelse Lake has a somewhat unusual zooplankton community in that the preferred food item (*Daphnia*) of juvenile sockeye is abundant only in July. The rapid decline of *Daphnia* numbers from July to August is likely due to the high numbers of the mysid shrimp *N. mercedis*, which was most abundant (360/m²) in August.
- In the fall of 1994 it was estimated there were 450,000 sockeye juveniles in the lake but the fall estimate in 2003 found only 100,000 sockeye fry. It would require approximately 750 sockeye spawners in the previous year to produce this number of fry in the fall of 2003.
- Every sockeye nursery lake has a rearing capacity for juvenile sockeye that is controlled by a number of factors, some of which are surface area, nutrient loading, productivity, and presence of competitors. The large mysid population in Lakelse Lake reduces its sockeye rearing capacity by 40%. Taking this into account, Lakelse Lake has the capacity to effectively rear the sockeye fry from 29,000 spawning adults. Data collected in 2003 and 2004 showed that just 9% and 20% of the lake's sockeye rearing capacity was being utilized in each year respectively.
- Increasing fry recruitment by increasing escapements, escapement success (recruits per spawner), and/or fry stocking may be the best way to enhance this population.

Stock Status Outlook

Based on the last 12 years of available visual escapement data for Lakelse Lake (1992-2003), and assuming these data are representative, then the Lakelse Lake sockeye stock has declined by 92% over the last three cycles (Figure 4). Although the accuracy of the escapement data is not known, recent juvenile surveys in the lake confirm low escapement levels and escapement surveys since the late 1990's have noticed reduced escapements in the major spawning tributaries relative to historic levels.

If low escapements continue and if fry recruitment into the lake is not improved, preliminary analyses suggest the Lakelse Lake sockeye could be at biological risk even at currently low levels of exploitation (Cox-Rogers, in prep, 2004).

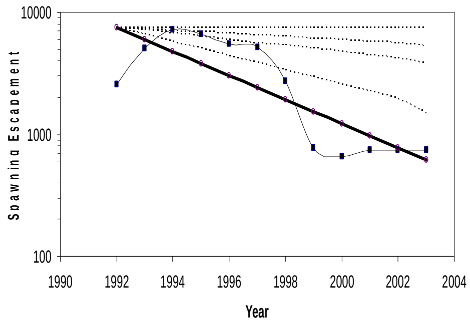

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***Figure 4**. Estimated 3 generation (last 12 years) escapement decline rate (92%) for Lakelse Lake sockeye salmon (solid line). Also shown are the smoothed escapement data (curved line) and COSEWIC conservation criteria thresholds corresponding to decline rates of 0%, 30%, 50%, and 80% (dashed lines). Note the y-axis is plotted on a logarithmic scale.*

Habitat Status

Habitat Setting

The Lakelse watershed lies in a basin with mountains to the east and west that rise to 1845 m presenting considerable relief. The basin floor is low gradient, but the watershed as a whole has a moderately high response from water input due to the steep topography of the major tributaries. Coastal weather systems have easy access to the watershed, leading to heavy snow packs and precipitation in the mid and upper elevations of the drainage.

Cleugh *et al* (1978) estimate that the greatest discharge from Lakelse River occurs in May and June due to snowmelt. Decreased stream flow in July and August is followed by an increase in September and October. Typical fall rain on snow events often generate peak discharges.

Lakelse Lake is the predominant feature of the upper watershed. It covers an area of 14.5 km^2 (14,516 ha), with the majority of watershed tributary streams feeding directly into the lake. Lakelse Lake is approximately 8.7 km long with an average width of 1.2 km. The average flushing rate of the lake is four times during the six-month spring and summer seasons and once during the fall and winter (Kokelj, 2003). It has a maximum depth of 32 m and a mean depth of 7.8 m; a large portion (42%) of the lake is littoral. This extensive littoral zone affects temperature, dissolved oxygen, aquatic plants, and overall productivity of the lake (Cleugh *et al* 1978). Lakelse Lake water quality studies are reported in Brett (1950), Abelson (1976), Cleugh *et al* (1978), McKean (1986), Wilkes and Lloyd (1990), Shortreed (1998) and Kokelj (2003). McMahon (1954) reported on Lakelse plankton and Warrington (1986) documented aquatic vegetation.

Lakelse Lake is considered to have been oligotrophic to slightly mesotrophic throughout the last several hundred years (Cummings, 2002). This is due to its low phosphorous concentrations, the low oxygen depletion rates of its bottom waters, and low chlorophyll *a* concentrations. These attributes, together with the lake's high water quality, determine the recreational and fisheries importance of the lake. Physics (light, climate and thermo regime) and chemistry levels (nitrogen and phosphorous) suggest that increased nutrient loading would quickly increase lake productivity and phytoplankton biomass in Lakelse Lake. Further, already low Nitrogen:Phosphorous ratios indicate that increases in phosphorous loading without concomitant increases in nitrogen loading could result in the development of undesirable blue-green algal blooms or eutrophication (Remington 1996). The lake has been experiencing a steady increase in aquatic plant growth, *Elodea Canadensis*, since 2002 (Kokelj 2003).

Williams, Hatchery and Schulbuckhand (Scully) Creeks are the major tributary streams of the thirteen tributaries feeding Lakelse Lake, as well as being the principal sockeye spawning streams (Skeena Fisheries Commission, 2003). These steeply graded creeks originating in the mountains to the east are fed from large areas of alpine mountain slopes. Brett (1950) indicated that water level fluctuations within Lakelse Lake reflect the fluctuations in volume of Williams Creek discharge.

Williams Creek and its three main tributaries, Sockeye, Myron and Llewellyn Creeks, comprise approximately 25% of the total stream length in the Lakelse Watershed. Within Williams

Creek, the first three lower reaches are low gradient at 2% or less, and form a large alluvial fan that is shared by Sockeye and Blackwater Creeks (Reese-Hansen 2001). Streamflow connectivity is high and avulsions are common. On Williams Creek, upstream of reach three, the hillslopes are coupled to the creek with headwater streams that largely originate from small cirque glaciers and snowpacks. Williams Creek sub-basin typically receives 80% of Lakelse Lake sockeye spawners.

Sockeye Habitat Requirements

Lakelse Lake sockeye are anadromous, dividing their life cycle into fresh water and ocean habitats that have different geographical and environmental variables. Freshwater habitats provide spawning, egg incubation, fry rearing and smolt migration, while the marine habitat accommodates the young migrants' physiological adaptation to salinity and allows ocean rearing and in-out migration corridors common to northeast Pacific sockeye.

This sockeye recovery plan relates to freshwater and estuarine habitats, particularly habitats that are critical to the sustenance and survival of Lakelse Lake sockeye. Critical habitat is defined as *"the minimum extent and arrangement of habitat elements throughout the estuarine and freshwater life history of Lakelse Lake sockeye that are necessary to provide an acceptable probability for the survival or recovery and that are identified as critical habitat in this recovery plan."* Critical habitats for sustaining and recovering Lakelse Lake sockeye populations include:

- Migratory routes from the ocean to Lakelse Lake for smolt and pre-spawning adults. This critical habitat requires a route clear of obstructions, appropriate water temperatures, flows, cover and healthy conditions in the estuary, Skeena River, and Lakelse River.

- Lakelse Lake, as pre-spawning sockeye hold for their prolonged residency before ascending spawning streams. Lakelse Lake sockeye fry and parr rear in the lake for one year utilizing a variety of the lacustrine habitats.

- The lower reaches of Williams, Sockeye, Hatchery, and Scully Creeks that support spawning, egg incubation and downstream fry migration habitat. This critical habitat requires adequate flows (depth and velocity), high water quality, suitable substrate, and holding grounds. It is spawning and incubation habitat that is considered most limiting for sockeye production in the Lakelse watershed.

Sockeye Habitat Status

Until recently, Lakelse Lake was one of the most productive sockeye rearing lakes in the Skeena Watershed (Skeena Fisheries Commission 2003). The very high sockeye values within the Lakelse watershed stem from the superb spawning and rearing habitat. Habitats critical to Lakelse Lake sockeye life histories have been impacted principally by forest development, settlement and housing, and transportation and utility corridors.

Significant human activities in the watershed began to occur in the 1950s and included a sawmill operation on the north end of the lake, increased logging activity, linear development, creek diversions, and raised wastewater effluent. Sediment cores obtained from Lakelse Lake in 2002 were analyzed by Cumming (2002), who noted that sedimentation rates in the north and south lake basins corresponded with significant development in the watershed.

Forestry

The Lakelse Watershed was impacted by large-scale industrial logging, particularly in the mid 1960's to mid 1980's. Overall, 87% of the operable timber in the watershed has been logged. Over the last four to five decades, the Williams Creek sub-basin, which includes Williams, Llewellyn, Sockeye, and Blackwater Creeks, has seen extensive forest harvesting development, concentrated on stands on the valley lower slopes.

The alluvial fan of Williams Creek has a somewhat unstable channel that receives large amounts of sediments from the unconfined reach three and the large amounts of bank erosion in reach four. The recent avulsion (2001) of

Williams Creek into Sockeye Creek has left three km of creek bed dry at times of low flow (Culp 2002). Recent watershed assessments reviewed the Williams Creek sub-basin overall habitat components. Channel, fish habitat, riparian, hillslope, and road conditions are rated as poor (Reese-Hansen 2001).

Forestry activities have occurred within the Scully Creek watershed since 1975 with development concentrated on the alluvial fan until 1980 (Triton 1998), followed by logging in the upper watershed until the present. In addition to logging, the lower Scully Creek watershed has undergone extensive development and alteration since the early 1900s (Brown and Williams, 1998). This development includes settlement, transportation and utility corridors which have all incrementally contributed to channelization, channel diversion, bank instability, amplified sediment contribution, and lack of instream habitat complexity.

Schulbuckhand Creek, flowing into the southeast end of Lakelse Lake, has received restoration works in reach 1. In reach 2, large quantities of bedload are being deposited from upstream failures and the flow is sometimes subsurface. Logging and the “Cat Fire” above the Scully Creek fan apex have exacerbated problems associated with levels of sediment and bedload mobilization. Instability of the fan due to logging and linear development has led to the complete diversion of surface water flows from the south channel (original mainstem) to the constructed channels that flow through the Mt. Layton Hotsprings property for the lowest kilometer, before entering the lake. The southern channel is currently fed only by sub-surface flows.

Development activities within the lower reach of Hatchery Creek (downstream of Highway 37 South) include logging, settlement, transportation and utility corridors. Streamflow across the fan is channelized, and with large amounts of bedload movement, aggradation has caused variable sections of the stream to flow subterranean. Cumulative impacts to the fisheries resource are rated very high (Gordon *et al*, 1996). Hatchery Creek is a designated Community Watershed where water quality, quantity, and flow timing are the principal values under the Forest Practices Code.

Smaller 1st Avenue streams that support sockeye populations such as Mountain Creek, Salmon Creek and Hatchery Creek have been impacted by channelization, flow diversions, and road crossings.

Some of the post-logging impacts to fish habitat within the Lakelse Watershed have been mitigated by time. Lasting impacts of timber harvesting are primarily to tributary riparian zones and stream structure/stability. Increased bedload movement has lead to channel destabilization and aggradation on moderate to steep gradient stream fans. Many tributary riparian zones have seen an expansion of beaver habitat into areas that historically provided sockeye spawning habitat. Fish access is now problematic and backwatering of these areas has decreased the quality of this habitat for spawning. The degraded habitat poses a major rehabilitation effort in relation to sockeye spawning and egg incubation habitat.

Linear Development

Transportation and utility systems are extensive in the Lakelse Watershed. Linear development includes Highway 37 South, a major north-south transportation route connecting Terrace and Highway 16 with Kitimat and tidewater to the south. In addition to the highway are PNG’s natural gas pipeline and a BC Hydro major transmission line. This linear development has caused fish passage problems and destabilization of stream channel integrity.

Residential Development

The Lakelse basin supports seasonal and full-time residences providing a variety of lifestyles for a population of 360 people (RDKS 2002). Mount Layton Hotsprings Resort operates water-based recreation, a restaurant, and a motel on the east shore of Lakelse Lake. There are two Provincial Parks located on the east side of the lake and at the northeast corner, which are popular stopping off points for local and non-local water-based recreation, picnics, and camping. Lakelse Lake is believed to be the most heavily utilized recreational lake in the region.

In 1974, Sinclair (1974) and Schouwenburg (1974) noted that enrichment of Lakelse from nutrient-rich sewage would destroy the lake from a fish producing and recreational standpoint. They recommended that the only alternative available was to divert the sewage away from the lake. The Regional District of Kitimat Stikine has expressed concerns about impacts of the current sewage disposal systems on water quality and fish habitat around the lake (Stantec 2000).

Kokelj (2003) notes that the rate of non-point source nutrients entering a lake from septic systems increases when there is no buffer of natural vegetation. In the case of Lakelse Lake this is significant, as 86% of the urban development lie within landforms considered poor to moderate for removing septic effluent (McKean, 1986). These settlement and urban developments with their associated septic systems, lack of riparian vegetation and occasional stream diversions have enriched nutrients in the lake and have had adverse impacts on fish habitat.

In 2004 a Liquid Waste Management Plan for the Lakelse Lake area was initiated by the regional district in partnership with local community associations and agencies such as WLAP and DFO. Potential sources of contaminants have been identified and the committee is now working towards identifying, evaluating and implementing options to resolve these issues.

Development activities since the 1950's have been related to the observed increase in sediment delivery from 1950 to 1990 (Kokelj 2003). In 1962, a significant slide of glaciofluvial marine clays occurred in the northeast region of the lake (Septer and Schwab 1995). This was partially a result of highway construction that intercepted groundwater flows (Kerby 1984). Increased sedimentation in the lake may have contributed to the creation of favorable habitat for *Elodea canadensis* colonization (Kokelj 2003). Growth of *Elodea canadensis* in the lake over the last several years has reached levels that seasonally occludes beaches and shorelines and currently occupies most of the volume of several shallow bays and patches of shorelines. This aquatic invasive plant has the potential to severely change fish habitat with increasing colonization of the littoral zone.

Decline of the sockeye stock in the watershed has resulted from the cumulative effects of land use practices, fish harvest management, and natural fluctuations in environmental conditions. Because of the linear nature of river and stream ecosystems, the accrual of effects is significant along both stresses. Similarly, activities that have occurred in the past may influence current habitat conditions through residual effects.

Sockeye Habitat Trends

Habitat trends revolve around the three critical habitat components: smolt and pre-spawning adults' migratory routes between the ocean and Lakelse Lake, Lakelse Lake for pre-spawning adults and rearing sockeye fry and parr, and the lower reaches of the main sockeye spawning creeks.

Habitat trends involving smolt and pre-spawning adult migratory passage need to consider the uncertainties revolving around proposed coastal finfish farm operations, the mixed stock fishery exploitation at the mouth of the Skeena River, potential increased stream temperatures affected by global climatic change and proposed coastal development such as oil and gas.

Given the documented effects of past harvesting and that most commercially available stands have been logged, it is unlikely that future forest development activities in the Lakelse Watershed will continue at similar levels/rates to past activities. As immature forests stands become commercially viable, the nature and extent of logging of second growth forests will become an issue.

The probability and extent of future impacts relating to past logging, for example, elevated stream temperatures or lateral channel movement that increases sediment delivery, is unknown. Potential increases to beaver impoundments are unknown.

The growth of *Elodea canadensis* in Lakelse Lake has recently been noted and it appears to be steadily increasing. Lakelse Lake residents and regulatory agencies are concerned about how *Elodea* growth will affect water quality and the fisheries value of the lake. Factors affecting *Elodea* growth are not well known, and the exact link between the *Elodea* infestation and sediment and nutrient inputs to the lake is currently unclear.

The relationship between *Elodea* and sockeye is not well understood, so the possibility that excessive plant growth may inhibit sockeye production should be considered. An *Elodea* infestation can affect the food chain in the lake by displacing algal primary producers and potentially limit sockeye production (A. Smith cited in Kokelj, 2003). As well, decomposition of *Elodea* during the winter may cause harmful oxygen deficits.

Population and settlement issues will potentially increase due to the fact that approximately 55% of the available lots in the Lakelse area are currently developed. The Lakelse Lake area is made up of approximately 480 parcels of land, of which only 280 lots have been developed as single family dwellings (Associated Engineering, 2004).

Habitat restoration or rehabilitation of degraded spawning and egg incubation areas will depend on the availability of committed funding. In addition, it is generally unknown how existing and proposed strategic policies, programs, and regulations will affect the Lakelse Lake sockeye recovery approach.

RECOVERY STRATEGY

Feasibility of Recovery

The Lakelse Lake sockeye population is depressed but recovery appears to be both biologically and technically feasible if certain threats to its viability can be addressed. The intent of recovery is to bring this population back to viable status by targeting the threats that have contributed to its decline. For Lakelse Lake, the available assessment data indicates that degraded spawning habitat is a *major* threat affecting sockeye recruitment into the lake and so recovery efforts should focus on this threat. Other threats, such as *Elodea* infestation, juvenile predation, and juvenile competition for food could also be limiting production and will need further evaluation. Fisheries exploitation, although believed low for this population, may also require additional evaluation. The list of threats potentially affecting recovery of Lakelse Lake Sockeye can be summarized as follows:

Life Stage: Egg to Alevin

- Random loss of genetic variation due to low spawning abundance in the Lakelse Lake spawning tributaries (known threat, high risk)
- Past, current, and continued human activity, development, and encroachment in and around the Lakelse Lake spawning tributaries (known threat, high risk)
- Animal activity (beavers) and habitat alteration in and around the Lakelse Lake spawning tributaries (presumed threat, moderate risk)

Life Stage: Fry/Parr

- In-lake predation (presumed threat, low risk)
- In-lake food competition (presumed threat, low risk)
- In-lake macrophyte infestation (potential threat, unknown risk)
- Altered lake water quality due to human activity, development, and encroachment in and around the Lakelse Lake (known threat, moderate risk)
- Altered lake productivity, including that resulting from climate change (potential threat, unknown risk)

Life Stage: Smolt

- In-river predation (presumed threat, low risk)
- Estuarine predation (presumed threat, low risk)
- Estuarine development (potential threat, unknown risk)

Life Stage: Marine Growth

- Altered ocean productivity, including that resulting from climate change (potential threat, unknown risk)
- Finfish aquaculture (potential threat, unknown risk)
- Predation (presumed threat, low risk)
- Fisheries mortality (known threat, moderate risk)

Life Stage: Spawner

- Reduced access to Lakelse Lake spawning tributaries due to tributary fan dynamics (known threat, moderate risk)
- Elevated water temperatures in Lakelse Lake spawning tributaries during low water years (presumed threat, moderate risk)
- Flood or slide events in Lakelse Lake spawning tributaries with loss of spawning habitat and subsequent tributary production (known threat, high risk)
- Bear predation (presumed threat, low risk).
- Disease (presumed threat, low risk)

In the sections below, goals and objectives are identified and various recovery approaches for meeting objectives are established. For each recovery approach, a list of specific projects is presented and prioritized from most urgent to least urgent to ensure resources are directed to where they are needed most. Finally, an action plan showing how and when each recovery project will be implemented, what each project will cost, and how each project will be monitored, is presented.

Goals and Objectives

The biological goals, objectives, and approaches for recovery of Lakelse Lake sockeye need to be both realistic and feasible. As Lakelse Lake is fry-recruitment limited and is producing sockeye well below capacity, the most immediate biological need is to reverse this trend by improving *natural* production. The ***goals*** of Lakelse Lake sockeye recovery are to therefore:

1) *Stop and reverse the decline of Lakelse Lake sockeye salmon.*

2) *Ensure that the natural bio-diversity and genetic integrity of this population is maintained.*

Recovery *objectives* to meet these goals need to consider the nature of the various threats affecting sockeye production in Lakelse Lake as well as the watershed's current and future capacity to support increased salmon production. An additional consideration is the time frame for recovery given that some threats can be addressed now and some may require further assessment. As such, the *immediate* and *long-term* **objectives** of Lakelse Lake sockeye recovery are to:

Immediate (within 1 cycle or 4 years)

1) *reduce the biological risk to the Lakelse Lake sockeye population by improving fry-recruitment into Lakelse Lake as quickly as possible, while maintaining the diversity of production among spawning tributaries.*

2) *halt further loss of critical (major) sockeye spawning habitat in Lakelse Lake spawning tributaries.*

3) *identify and, where feasible, begin restoring lost critical (major) sockeye spawning habitat in Lakelse Lake spawning tributaries.*

Long Term (within 3 cycles or 12 years)

4) *examine and, where feasible, reduce potential threats to sockeye recruitment into Lakelse Lake caused by other factors (macrophyte loading, juvenile predation, food competition, fisheries exploitation, etc).*

5) *achieve upward and sustained growth in annual sockeye fry-recruitment into Lakelse Lake relative to lake-rearing capacity*.

6) *achieve upward and sustained growth in annual adult sockeye returns into Lakelse Lake relative to* spawning capacity.

7) *monitor, and where feasible, reduce potential threats to critical rearing habitat for Lakelse Lake sockeye outside of the Lakelse Lake watershed.*

Recovery Approaches

Recovery of Lakelse Lake sockeye will focus on four coincident recovery approaches to achieve the above objectives:

1) *maintenance and restoration of critical spawning habitat.*

2) *strategic enhancement (fry outplanting) in key spawning tributaries.*

3) *assessments of juvenile and adult stock status coupled with population viability analysis (PVA).*

4) *assessments of other factors affecting Lakelse Lake sockeye production.*

Some of the projects associated with each recovery approach could provide results rather quickly (e.g. strategic enhancement) and will be important for enhancing remaining habitats and stabilizing the population. Other projects will produce results over the long term and will support population recovery over time (e.g. habitat restoration). As resources may be limited and the time and effort needed to implement some projects could be substantial, it is important to establish priorities.

To date, technical evaluations by federal and provincial agencies have determined which protection and restoration projects have the greatest potential to contribute to recovery of Lakelse Lake sockeye. Priorities have been assigned based on the information contained and referenced in this report as well as on the success or failure of similar conservation efforts in other watersheds.

Prioritized Project List

Appendix Tables 1 through 3 outline the prioritized habitat, enhancement, and stock assessment projects designed to recover Lakelse Lake sockeye salmon. Recovery of Lakelse Lake sockeye will be a feed-back learning process starting with the smaller, logistically tractable projects and moving towards the larger, logistically difficult projects over time. To meet the most *immediate* objective of improving fry recruitment as quickly as possible, the fry outplanting pilot projects have good potential and are highly recommended for implementation starting in 2005. Several of the longer-term habitat restoration projects on the major spawning tributaries can also be started in 2005. Stock assessment activities are essentially on-going and will be maintained through 2005 and beyond. One ongoing and key stock assessment activity will be modeling future population size given the range of recovery approaches being considered (PVA).

As recovery proceeds, the duration and scope of each recovery project will need to remain flexible to changing priorities as project results and new information becomes available. For example, habitat degradation of Williams Creek is known to be severe and it may prove difficult to reverse past or future disturbances without substantial cost, effort, additional resources, and/or different approaches. For this reason, the initial schedule and sequence of recovery projects will require commitment to adjusting and supplementing approaches and projects as needed over time.

A final but important component of recovery implementation will be informing and educating the local community and other stakeholders about the recovery planning process and encouraging them to become involved. It is anticipated that local stewardship groups, such as the Lakelse Watershed Society, as well as local First Nations (Kitselas Band) will play a key role in this regard.

ACTION PLAN

This section of the recovery plan details how the recovery projects listed in Appendix Tables 1 through 3 will be implemented, what the proposed timelines are, and how each project will be monitored and evaluated.

Implementation

Specific details for implementation of this recovery plan are now being developed (April 2005). In the interim, projects have begun that address some of the known threats to this population (Appendix Tables 1 through 3).

Monitoring and Evaluation

Monitoring will be critical for detecting and evaluating the response of Lakelse Lake sockeye to recovery activities. The success of this recovery strategy will be dependent upon the measures implemented and a review will be conducted every subsequent 5-year period. Monitoring and Evaluation will incorporate, where appropriate, the following components into all recovery of the projects listed in Appendix Tables 1-3.

- statistical designs for gathering data
- specific indicators of recovery that can be measured over time
- standardized sampling protocols
- logistic procedures for data collection that are consistent (quality control)
- generation of data that is accessible and can be shared.
- stable and appropriate funding.
- summary analyses that will help integrate monitoring information into the recovery process.
- inclusion of the public through stewardship initiatives that help protect critical habitats and restore impacted habitats.
- community awareness through information programs developed with local stakeholder and community groups
- partnerships with public and industry for specific stewardship projects.

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APPENDIX TABLE 1. Prioritized list of HABITAT restoration projects for sockeye recovery in the Lakelse Lake Watershed

Objective	Approach	Project Description and Priority	Status	Ann. Cost	Start	Finish
		Highest Priority				
1,2,3	1	**Sockeye & Williams Creeks Fish Passage Improvement** Immediate beaver dam passage for spawners and long term beaver management plan	Underway			
1,2,3	1	**Scully South Fish Passage Improvement** Immediate beaver dam passage for spawners and long term beaver management plan	Underway			
1,2,3	1	**Williams Creek Sediment Study** and prescription for upslope stabilization of roads and other potential sediment sources	Proposed			
1,2,3	1	**Williams/Sockeye/Blackwater Creek Fan Assessment and Prescriptions** Channel stability, riparian assessment, habitat restoration feasibility (including distributary channels, groundwater channel opp.)	Proposed			
1,2,3	1	**Hatchery Creek Spawning Restoration** Design and installation of gravel and large woody debris	Proposed			
1,2,3	1	**Salmon Creek Spawning Restoration** Culvert replacement, gravel nourishment, small woody debris removal and large woody debris placement	Proposed			
1,2,3	1	**Scully Creek Flow Augmentation/Off-channel Spawning Habitat** Groundwater channel construction	Underway			
1,2,3	1	**Scully Creek Sediment Study** and prescription for upslope stabilization of roads and other potential sediment sources	Proposed			
1,2,3	1	**Williams Creek Off-channel Spawning Habitat** Reconnaissance and Feasibility Study	Proposed			
all	all	**Community Consultation and Awareness** Community liason with the recovery process, co-ordinated by government and key stakeholders.	Underway			
		Moderate Priority				
1,2,3	1	**Scully South pilot gravel nourishment** Improve spawning substrate in lower reaches	Proposed			
1,2,3	1	**Salmon Creek Habitat Improvement** Reduce number of bridges, culverts and retaining walls downstream of 1st Avenue and upstream in Park	Proposed			
1,2,3	1	**Scully South Fish Passage Improvement and Habitat Restoration** Scully South replacement of highway culvert with open-bottom structure for fish passage and habitat	Proposed			
		Lower Priority				
1,2,3	1	**Scully South riparian assessment and prescriptions** Accelerate conifer growth	Proposed			
1,2,3	1	**North/Center and Parallel Channels (Hotspring channels)** Spawning habitat improvements in the Hotsprings channels on Scully Mainstem. A small experimental pilot project for gravel and large woody debris placement, bank stabilization and riparian planting is proposed. This "test reach" could be monitored for a pre-determined length of time before additional works are attempted.	Proposed			
1,2,3	1	**Furlong groundwater channel development** Private land ownership. Feasibility study/recon necessary.	Proposed			
1,2,3	1	**Granite Creek Groundwater channel** Test pits completed and feasibility study underway	Underway			
1,2,3	1	**Andalas Creek Fish Passage Improvement** - beaver Management; fish ladders/beaver bafflers; beaver harvesting.	Proposed			

APPENDIX TABLE 2. Prioritized list of ENHANCEMENT restoration projects for sockeye recovery in the Lakelse Lake Watershed

Objective	Approach	Project Description and Priority	Status	Ann. Cost	Start	Finish
		Highest Priority				
1	2	**Pilot Satellite Sockeye fry-outplanting utilizing an existing Enhancement Facility** -co-operative fry planting program for Scully and Williams Creek with Fulton River staff/facility	Proposed			
1	2	Moderate Priority				
		Pilot Satellite Sockeye Fry-outplanting utilizing 1) a locally developed enhancement site and 2) trial incubation boxes in groundwater-fed sites	Proposed			
1	2	Lower Priority **Formal Spawning Channel(s): locations to be determined** Control of water flows and fish densities: backup option to stream rehabilitation	Proposed			

APPENDIX TABLE 3. Prioritized list of ASSESSMENT projects for sockeye recovery in the Lakelse Lake Watershed

Objective	Approach	Project Description and Priority	Status	Ann. Cost	Start	Finish
		Highest Priority				
5	3	**Annual Juvenile Fry Density Monitoring in Lakelse Lake** -acoustic survey program for estimating fall-fry abundance	Underway			
6	3	**Annual Adult Enumeration Escapement Counts and Mapping** AUC stream-walk sockeye escapement surveys of Lakelse Lake spawning tributaries	Underway			
1	3	**Annual (over winter) egg incubation and survival assessments** Incubation and egg survival assessment in Williams, Sockeye, Schulbuckhand and possibly others.	Underway			
		Moderate Priority				
4	3	**Sockeye lake spawning survey/lakeshore utilization mapping** -mapping and distributional surveys of potential sockeye lake spawning sites	Proposed			
4	3	**Sockeye predation monitoring in Lakelse Lake** -assessment of juvenile sockeye predation rates in Lakelse Lake	Proposed			
4	3	**Sockeye food competition studies in Lakelse Lake** -evaluations of fish fauna and zooplankton competition (N. Mercedis)	Proposed			
4	3	**Exploitation rate assessment updates for Lakelse Lake sockeye** -Historic review and updated modeling of recent fisheries exploitation rates eg. Population viability analysis (PVA)	Underway			
		Lower Priority				
5,6	3	**Sockeye Smolt Program** -spring smolt surveys to assess smolt out-migration from Lakelse Lake or one of the major spawning tributaries.	Proposed			
6	3	**Adult sockeye counting fence feasibility study** -assessment of establishing a Lakelse River or tributary adult counting fence	Proposed			