ENVIRONMENTAL DYNAMICS INC.
Natural Resource Consultants

FISH PRODUCTION AND GROWTH IN EAGLET LAKE

Prepared for:

BC MINISTRY OF ENVIRONMENT, LANDS AND PARKS
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Project Reference Information

MoELP Project Number	COP0023
CLIB Project Number	20065
FDIS Project Number	2412
MELP Region	7A
FW Management Unit	7-7
Forest Region	Prince George Forest Region
Forest District	Prince George Forest District

Watershed Information

Watershed Group	Willow River
Watershed Code	100-596500-03300
Waterbody Identifier	00033WILL
UTM at Mouth of Main Inlet	10.550083.5995797
Order at Mouth of Main Inlet	4
Drainage Area	231.2 km^2
Magnitude	338
Elevation	590 m
NTS Map	93J/01
TRIM Map	93J.009/93J.019
BEC Zone	SBS
Air Photos	15BCB96007:156

Lake Sampling Summary

Lake Survey Type	Secondary
Water Surface Area	831 ha
Max. Depth	9.4 m
Mean Depth	5 m
Secchi Depth	1.4 m
Volume	41 980 800 m^3
Area Above 6m Contour	623 ha
Shoreline Perimeter	23 165 m
Number of Islands	0
Fish Species Captured in Lake	BB, BT, CSU, LSU, NSC, PCC, RB, RSC, WSU
Historic Fish Species Captured in Lake	BB, BT, CC, CSU, LSU, NSC, PCC, RB, RSC

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1.0 INTRODUCTION

First Nations treaty negotiations within the province have increased in scope and complexity in recent years. Information on important features within each area of interest is required to successfully institute the potential transfer of land and resource rights and responsibilities. Gaps in the knowledge base may initiate conflicts or defer discussions, resulting in costly delays and controversial decisions .

1.1 Project Scope and Objectives

In September of 1999, EDI Environmental Dynamics Inc. was retained by the BC Ministry of Environment, Lands and Parks to conduct four lake inventories within the 45,780 km^2 Lheidli T'enneh Statement of Intent (SOI) Area. The fisheries within Eaglet, Hedrick, Naltesby and Stony lakes are high management priorities for both the Province and the Lheidli T'enneh. The lakes are known to support both recreational and Native sustenance fisheries.

Although standard inventories had been conducted on all of the lakes, the Province required a more intensive level of detail before developing and implementing active fisheries management strategies. The present study focused on expanding the existing fish population inventory of each lake so that the current production of certain key species could be assessed. Fish habitat and environmental parameters would also be evaluated in sufficient detail to estimate productive capacity and identify limitations to fish production.

1.2 Location

Eaglet Lake is located approximately 30 km north-east of Prince George, BC (Figure 1). It is situated within the Fraser Basin unit of the Interior Plateau physiographic division. The Fraser Basin is an area of low relief extending from Williams Lake northward to McLeod Lake and from Fraser Lake eastward to Sinclair Mills. The terrain is flat or gently rolling and covered with glacial drift. Exposed bedrock is uncommon, although the northwest side of Eaglet Lake is an exception. Numerous lakes and poorly drained depressions are present (Holland 1976).

Eaglet Lake is also situated within the Sub-Boreal Spruce wet cool biogeoclimatic subzone. Hybrid spruce - Oak fern is the zonal association in the SBSwk (Meidinger and Pojar 1991). Subalpine fir and hybrid white spruce are the climax tree species. The shrub and herb layers are moderately- to well-developed and commonly include oak fern, highbush cranberry, black twinberry, black huckleberry, black gooseberry, thimbleberry and bunchberry. Important ecological features for wildlife in the SBS zone are the long, snowy winters, the dominance of dense spruce-subalpine fir forests on gently rolling terrain, and the abundant riparian habitats.

Eaglet Lake is drained by Hay Creek, which meanders through approximately 9.4 km of low-lying farmland and beaver dams. Hay Creek drains into the Willow River, about 2.5 km upstream from the community of Willow River.

Figure 1. Location of Eaglet Lake in relation to the region and the province.

1.2.1 Access

Eaglet Lake is accessed by paved road by driving approximately 18 km east from Prince George, BC on Highway 16 and turning left onto Upper Fraser Road. Follow Upper Fraser Road then turn right after crossing the Willow River bridge. Several pull-outs allow access to the lake shortly beyond the community of Giscome. The main road turns away from the lake after passing Harold Mann Regional Park.

2.0 RESOURCE INFORMATION

2.1 Development and Land Use

The watershed occupied by Hay Creek and Eaglet Lake supports a number of developments dating back to the early part of the century. Forestry and agriculture are the two most prevalent land use activities within the watershed.

A white spruce sawmill operated on the shores of Eaglet Lake from the early 1900s until it was shut down in 1972. The sawmill was a small, privately-owned operation that was sold to Northwood Pulp and Timber Ltd. in the late 1960s. The mill was situated directly on the lakeshore and its processing operations relied heavily on the lake outlet near the townsite of Giscome. In 1969, and in the years following, the mill was implicated in the deterioration of water quality and fisheries values in the lake outlet (Pinsent 1969). Major issues identified by the Regional Fisheries Biologist of the time included improper placement and design of a dam across the outlet, and the introduction of excessive organic and woody debris into the stream. The resulting drops in pH and dissolved oxygen created a low quality environment for fish life. The poor conditions were further illustrated by a die-off of suckers in Hay Creek near Giscome in July, 1969.

Logging activity within the watershed over the past hundred years has created a network of clearcuts and roads in various stages of green-up. Northwood Pulp and Timber Ltd. is the largest timber licensee in the area. Northwood recently announced the sale of its assets to Canadian Forest Products Ltd. The Ministry of Forests' Small Business Forest Enterprise Program also administers logging development throughout the watershed.

Cattle farms and associated agricultural and residential developments dominate the northern and eastern portions of the watershed. Private farms occupy a large section of frontage on the north-eastern side of the lake. A community pasture surrounds the headwaters of several tributaries that flow into the north-western side of the lake. Cattle densities are currently relatively low in this area (D. McLean, pers. comm.).

Extensive railway development has also occurred along the lake and its tributaries. A Canadian National Railway (CN) line travels along the majority of the southern shoreline. A CN railyard and gravel quarry is located near the western (outlet) end of the lake. A water license application was filed by CN in 1992 for a ballast wash system in the railyard.

Upper Fraser Road is a paved, two-lane road which serves as the major transportation corridor for industrial traffic, tourists and residents of the Newlands, Aleza Lake, Upper Fraser and Sinclair Mills areas.

2.2 Historical Fisheries and Habitat Information

Eaglet Lake has been sampled on four separate occasions since 1969 using gill nets and minnow traps. Burbot (*Lota lota*), bull trout (*Salvelinus confluentus*), sculpins (*Cottus* sp.), coarsescale sucker (*Catostomus macrocheilus*), longnose sucker (*C. catostomus*), northern squawfish (*Ptychocheilus oregonensis*), peamouth chub (*Mylocheilus caurinus*), rainbow trout (*Oncorhynchus mykiss*) and redside shiner (*Richardsonius balteatus*) were captured. Northern squawfish and peamouth chub comprised the majority of the catch on each occasion. Angler creel surveys conducted in August and September of 1992 estimated catch-per-unit-effort (CPUE) for rainbow trout at 0.19 fish per hour. Conversely, CPUE estimates for northern squawfish and peamouth chub averaged 0.49 and 0.38 fish per hour, respectively.

Electrofishing conducted on Bateman Creek in the early 1980's captured peamouth chub, suckers and rainbow trout. A steep cascade section of Bateman Creek approximately one kilometre long selectively obstructs suckers and cyprinids from the upper portions of Bateman Creek, creating a monoculture of rainbow trout. In 1984, 38 spawning platforms were installed in the upper portion of Bateman Creek, approximately four kilometres upstream from the lake. This enhancement was meant to improve recruitment of rainbow trout to Eaglet Lake and eventually slow or reverse the decline in the recreational fishery. Unfortunately, no consistent effort was made to evaluate the effectiveness of the structures. Funding was reduced and the project gradually deteriorated in the early 1990's. The last recorded inspection in 1991reported only 17 out of 32 structures still in good condition.

Between 1981 and 1994, 10,000 to 30,000 rainbow trout juveniles were stocked into Eaglet Lake annually by the provincial government.

3.0 METHODS

Methods followed the approach described in the project proposal (EDI Environmental Dynamics Inc. 1999) and the field assessment plan (Van Schubert and Newman 1999). Minor modifications were made in the field to the original design where required. An overview of the sampling and analysis methods is described below.

3.1 Fish Sampling

Fish were captured using gill nets and set lines over the months of September and October, 1999. Two gill nets were used composed of 6-panel and 5-panel gangs of 38 mm monofilament mesh. Each panel was 15 m long and 2.4 m tall with cumulative lengths of 90 m and 75 m. The mesh size of the nets was constant throughout the length of each gang. The nets were attached to shore by a lead line that was adjusted to suit the off shore water depth. All net sets were set perpendicular to shore and were soaked for 20 to 50 min. To increase the lake sampling efficiency some net sets were overlapped when weather was

permitting. Nets were pulled from shore to attain more evenly distributed soak times for consecutive panels. Ten individual sites were distributed throughout the perimeter of the lake (Figure 2). Throughout each day a net was set at five of these 10 sites. Two full days were required to complete one full pass of the lake. In total, two passes were made of Eaglet Lake.

Because burbot primarily inhabit the hypolimnion of lakes (Scott and Crossman 1973), set lines and deep water gill net sets were utilized to target this species. The set line was set three times overnight. The set line consisted of seven hooks (2.5 cm gap) evenly distributed along a piece of cord baited with peamouth chub, northern squawfish and red-side shiner carcasses. At each end of this cord were 454 g lead weights attached to float lines and floats. Two deep water gill net sets were conducted, each of which consisted of the 6 panel 38 mm mesh gill net, set out in water greater than 7 m for a period of 40 min.

Captured fish were put into a 60 L cooler of lake water. Water was replaced for each net fished and was agitated to increase oxygen saturation. Adipose fin clips were the chosen marking method to minimize harm to the fish (Guy, et al. 1996). Salmonid scales were removed from above the lateral line, anterior to the dorsal fin on the left side of the fish. Fin rays were also removed from bull trout for more reliable aging (RIC 1997), since scale aging for these fish is not considered as accurate. Two fin rays were removed from the leading edge of the pelvic fin on the left side of the fish (RIC 1997). Otoliths were also used for aging but were only taken from dead fish. All aging structures were assigned a structure number that corresponds with a fish species, length and other information or comments (Appendix 3). Fish fork lengths were measured in mm. Fish weights were measured in grams using an Accuweigh drop scale. Mortalities were sampled for otoliths, sex, maturity and stomach contents.

3.2 Tributary Sampling

Stream reaches identified during the planning phase as potential production areas were visited. At each site, RIC-standard Site Cards were completed to provide an overview source of information including channel size and morphology, cover types and abundance, fish habitat quality, water chemistry and representative photographs. Inventory procedures followed standards described in BC Ministry of Fisheries (1998).

Watershed Restoration Program Level 1 Fish Habitat Assessment Procedures (FHAP) were conducted on selected tributaries (Johnston and Slaney 1996). Johnston and Slaney (1996) recommend that assessment and restoration procedures be applied to third to fourth order basins based on 1:50,000 National Topographic Series (NTS) maps. In interior locations, larger watersheds are normally considered. To simplify the selection process for this study, streams with average channel widths over 5 m were considered candidates for FHAP. However, criteria influencing the decision to complete an FHAP on a particular reach also included morphology and relative importance to the lake's fish populations. At sites where an FHAP was conducted, detailed information on habitat units was measured using a systematic subsampling design. Sites of arbitrary length were delimited. Each habitat unit within the site was systematically measured for characteristics such as width, depth, cover and substrate. Data were recorded on standard FHAP data collection sheets.

3.3 Water Chemistry Sampling

One water quality site was established at the deepest point on the lake. Water samples were collected by Van Dorn bottle from two depths, one metre from the surface and one metre from the bottom. Labeled water samples were kept cool and sent by courier to Philip Analytical Laboratories in Burnaby, BC immediately after collection. In addition to water samples collected for laboratory analysis (Table 1), field measurements were also collected. Dissolved oxygen/temperature profiles were collected using a YSI analog meter. Weather conditions and Secchi depth were also noted.

Table 1. Water quality parameters for laboratory analysis.

pH	Nitrogen: Nitrate
Alkalinity	Nitrogen: Nitrite
Specific Conductance	Nitrogen: Total
Residue: Filterable (TDS)	Phosphorus: Total Dissolved
Nitrogen: Ammonia	Phosphorus: Total

3.4 Data Analysis and Reporting

Scale samples and otoliths were aged by Birkenhead Scale Analyses, Lone Butte, BC while fin rays were aged by North-South Consultants, Winnipeg, MB. All mark-recapture and population parameter information was entered into Microsoft Excel workbooks to simplify and standardize statistical analyses and the creation of graphical displays. Data analyses included calculation of mean fork lengths, weights and associated statistics. Fulton's condition factor was calculated for key species (Ricker 1975). Population sizes and biomass could not be estimated, since no recaptures were obtained.

Reconnaissance inventory Site Cards were entered into the Field Data Information System (FDIS v7.2), a provincial database designed to capture fish and fish habitat inventory data. FHAP results were entered into an Excel spreadsheet for analysis and presentation.

4.0 RESULTS

4.1 Logistics

Overlapping net sets were rarely conducted due to the large lake area and the abundance of cyprinids in the gill net. The size of the cyprinids enabled them to become gilled and in turn slowed down the net picking process. In order to limit fish mortality and increase the efficiency of the survey, soak times were kept short. This did not substantially affect the net yield but allowed a more consistent number of net sets throughout the day.

Initially, no burbot were captured because nets were set in relatively shallow water for short time periods during daylight hours. When burbot were targeted by deep water gill net sets and set lines they were readily captured.

4.2 Immediate Shoreline

The majority of the shoreline of Eaglet Lake was forested to the water's edge by hybrid white spruce and trembling aspen. The remainder of the shoreline was divided between wetland and low rocky types. Wetlands were situated at each end of the lake and in bays toward the east side. Low rocky shoreline was most common along the north side of the lake.

A variety of land uses dominated the immediate shoreline. Linear development is present in the form of Upper Fraser Road and the CN rail line. Agricultural development and associated residences are also visible from the lake.

4.3 Terrain

The surrounding country consisted of gently rolling terrain primarily vegetated with coniferous forest. The north-west side of the lake exhibited a short section of steep, rocky bluffs on the north side of Upper Fraser Road. This area was dominated by aspen and birch forest.

4.4 Aquatic Flora

Abundant aquatic vegetation was evident throughout the lake, particularly on the south shore associated with the adjacent farm land. The aquatic flora appeared to be dominated by submergent *Potomageton* sp. but detailed species inventories were not determined.

4.5 Site Summary

Eaglet Lake was divided into ten sites for the mark-recapture study (Figure 2). Each site was sampled twice with a short gill net set on alternate days. Twelve tributary sample sites were surveyed (Figure 2). Site Cards were completed for each reach. FHAP datasheets and triple-pass electrofishing were completed for two reaches.

4.6 Bathymetry

No bathymetric surveys were conducted for the current project. Historical bathymetric data were used for locating limnological sites and selecting fish sample sites.

4.7 Limnological Sampling

One limnological station was established at the deepest part of the lake. Field-tested parameters are listed on the Lake Survey Form in Appendix 1. Dissolved oxygen was near 100% saturation and temperature was constant throughout the water column (Figure 3). The absence of a thermocline suggested fall overturn had already occurred.

Two water samples were collected from the lake and were later analyzed for a variety of chemical parameters (Appendix 2). Results for nutrients and inorganic indicators of water quality will be used as a baseline for monitoring future trends related to lake productivity.

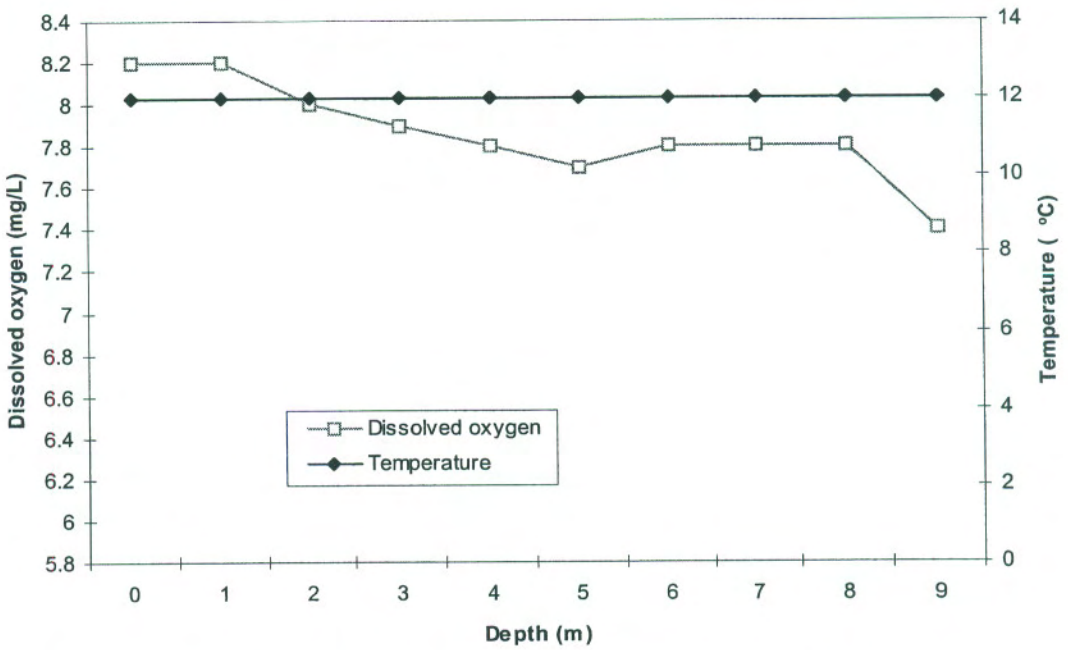

Figure 3. Oxygen/temperature profile for Eaglet Lake on September 28, 1999.

4.8 Inlets and Outlets

Out of 31 mapped inlets to Eaglet Lake, six were investigated during this survey. In addition, one site on the outlet and several sites on secondary tributaries were sampled. Fish population sizes were estimated on the first reach of Hay Creek and the fourth reach of Bateman Creek to compare actual fish production to available habitat. Summaries of the results for each sample site are given below. Site Cards, Fish Collection Forms and photographs may be found in Appendix 4.

4.8.1 Hay Creek (WSC 100-596500-03300)

The outlet of Eaglet Lake was investigated from its mouth at the Willow River to the Upper Fraser Road culvert crossing. Average channel width was 10.2 m, average gradient was 2 % and morphology was riffle-pool dominated by gravels. Good quality spawning and rearing habitat for resident fish was observed. Deep pools, undercut banks and overhanging vegetation provided good quality rearing habitat. Large woody debris was not abundant, but was still considered a sub-dominant cover type.

Triple-pass electrofishing with removal was conducted within a fully enclosed site. One juvenile burbot, one adult prickly sculpin, one leopard dace and two juvenile rainbow trout were captured. Rainbow trout population density was estimated to be 0.01 fish/m^2. At this density, approximately 62 rainbow trout would inhabit the first reach of Hay Creek (using mean wetted width calculated from the FHAP).

A second electrofishing site was established upstream from Upper Fraser Road to verify the low densities of fish observed in the first site. Enclosures were not utilized, but instead only prospective lies were sampled as the crew worked upstream. An additional 350 m of stream length was sampled, with only seven additional fish captured. Three new species, mountain whitefish, redside shiner, and coarsescale sucker, were identified. Only one additional rainbow trout was captured. Curiously, the two most abundant species captured in the lake, peamouth chub and northern squawfish, did not appear in the catch for Hay Creek. These results indicate severe under-utilization of available habitat in the outlet of Eaglet Lake. Typically productive areas, such as undercut banks and tertiary pools, did not contain fish but appeared physically suitable to support fish life.

4.8.2 Bateman Creek (WSC 100-596500-03300-32100)

Bateman Creek was investigated at two sites upstream from the suspected coarse fish barrier in Reach 3. The site in Reach 4 was chosen because it was historically identified as a highly productive area for rainbow trout. Average channel width was 5.6 m, average gradient was 1 %, and morphology was riffle-pool dominated by gravels. Good quality spawning and rearing habitat for resident fish was observed. Large woody debris and deep pools provided the majority of cover. Due to the long distance from Eaglet Lake, the presence of steep cascades in the reach below, and the high quality habitat, there is a high potential for Bateman Creek to support a resident population of rainbow trout.

Triple-pass electrofishing with removal was conducted within a fully enclosed site. Nineteen rainbow trout fry, 4 juveniles and three adults were captured. Rainbow trout population density was estimated to be 0.18 fish/m^2. At this density, approximately 4,931 rainbow trout would inhabit the fourth reach of Bateman Creek (using mean wetted width calculated from the FHAP). At present, it is unknown what proportion, if any, would exhibit resident behaviour as opposed to individuals that migrate to Eaglet Lake.

Reach 5 contained an average channel width of 3.6 m, an average gradient of 1 %, and a riffle-pool morphology dominated by fine bed material. No spawning habitat was observed within this reach. However, good quality rearing habitat was provided by a diversity of cover types. Fish which incubate and hatch in the lower reach could readily migrate to this reach to find rearing or overwintering sites.

4.8.3 FHAP Results

Fish Habitat Assessment Procedures were conducted on the first reach of the outlet and on the fourth reach of Bateman Creek. Field data collection forms are located with the corresponding Site Cards in Appendix 4. Table 2 contains channel characteristics averaged over each sample site. Mean Bankfull Width (Wb), Mean Wetted Width (Ww), Mean Bankfull Depth (dWb), Mean Residual Pool Depth (Rp), and Mean Gradient (G) were calculated based on an average weighted by habitat unit length. Figures for Reach Length (RL), Estimated Total Channel Area (TCA) and Estimated Total Wetted Area (TWA) are also given. The latter two figures are extrapolated to the entire reach, based on the assumption that the sample site is representative of the reach as a whole.