Assessment of lake trout (*Salvelinus namaycush*) stocks and an evaluation of netting and analysis techniques in Chapman, Augier, Pinkut, Taltapin and Doris lakes, BC.

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Abstract

Chapman, Doris, Augier, Pinkut and Taltapin lakes were sampled during the spring (May – June) of 2002 for lake trout (*Salvelinus namaycush*). Various gill netting techniques were applied to capture lake trout and *post hoc* evaluation of netting efficiency was conducted. One hour –to- one and a half hour daytime sets with 90m daytime net sets recorded the highest lake trout per unit catches. Spatial and gear biases were noted for lakes sampled and hindered between lake comparisons for lake trout abundance. Estimates of fishing mortality were calculated for each lake, with Taltapin (F=0.2), Pinkut (F=0.19) and Chapman (F=0.19) lakes being at, or approaching theoretical maximum equilibrium yield (F=0.21). Fishing mortality in Augier Lake (F=0.12) was well below maximum equilibrium, whereas lake trout were not detected in Doris Lake. Current lake trout regulations in Skeena Region are considered to be providing the minimum protection for lake trout populations in lakes greater than 100ha, whereas lakes less than 100ha are vulnerable to over-harvest. Regulation changes are not discussed in this report pending further research on characteristics of BC lake trout life history. Adoption of Ontario Ministry of Natural Resources (OMNR), Spring Littoral Index Netting (SLIN) program is recommended for future lake trout assessments in Skeena Region. Modification of assessment techniques described by deLeeuw et al. (1992) are recommended, as well as, use of abundance estimates and mortality indices described by Lester and Dunlop (2003) and Janoscik and Lester (2002).

Acknowledgments

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HABITAT CONSERVATION TRUST FUND

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Anglers, hunters, trappers and guides contribute to the projects of the Trust Fund through license surcharges. Tax deductible donations to assist in the work of the Trust Fund are also welcomed.

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1.0 Introduction

Lake trout (lake char; *Salvelinus namaycush*) are a popular sport fish and comprise a significant portion of the native subsistence fishery in the upper Babine and Nechako watersheds of the Skeena Region (Mark West, pers. com.). Assessment of lake trout populations has not occurred in BC's Skeena Region since the early 1990's (deLeeuw *et al.* 1991).

deLeeuw *et al.* (1991) developed a Regional lake char management strategy and program with a goal to develop a simple field sampling and stock assessment protocol to ensure wild fish stock conservation, while providing sustainable use of the resource. Qualitative estimates of lake char exploitation, abundance, growth rates, age structure and population trends were the primary outcomes of each sampling event. Standard sinking 90m Ministry of Environment Lands & Parks (MELP) multi-panel mono-filament gill nets, set over a 24 hr period comprised the assessment tool. Possible management prescriptions were suggested to achieve the objective for each lake population (e.g. natural population conservation) based on assessment results (deLeeuw *et al.* 1991). However, the requirement for destructive sampling, low lake char catch rates and qualitative population assessment techniques recommended by deLeeuw *et al.* (1991) resulted in an unacceptable level of uncertainty for management action in most applications. Furthermore, reduced Regional operating budgets, combined with the labour intensive requirement for the assessment and categorization of Regional char lakes, resulted in the deLeeuw *et al.* (1991) strategy not being implemented.

Concomitant with efforts of deLeeuw *et al.* (1991), the Ontario Ministry of Natural Resources (OMNR), Fisheries Research Division was synthesizing lake trout life history and management information in an attempt to develop a lake trout life history model for the management and protection of Ontario's lake char stocks (Payne *et al.* 1990, Olver *et al.* 1990, Evans *et al.* 1991, Lester *et al.* 1991, Shuter *et al.* 1998), as well as, non-destructive, representative lake char sampling technique (Lester *et al.* 1991, Hicks 1999).

Both deLeeuw (1991) and Hicks (1999) lake char assessment techniques are applied, and in the case of deLeeuw *et al.* (1991) modified, in this report. The goal of the 2002 Skeena Region lake char sampling project was to assess the status of small lake (Augier, Chapman, Pinkut, Taltapin and Doris lakes) lake char populations identified as potentially experiencing lake char harvest pressure. Project objectives include: 1) evaluating the effectiveness of various netting techniques; 2) develop regional lake char population assessment techniques and status indices; 3) compare current assessment results to those collected in past assessments; 4) evaluate the sustainability of current lake char harvest regulations; and, 5) recommend strategic regulation changes for the conservation of the Region's lake char stocks.

1.1 Study Area

Chapman, Doris, Augier, Pinkut and Taltapin lakes are small lakes located within the Babine Lake watershed. Augier, Taltapin and Pinkut lakes are located approximately 15km north of the Town of Burns Lake and comprise major waterbodies of the Pinkut Creek watershed (Figure1). Pinkut Creek flows into the southern arm of Babine Lake where the Department of Fisheries & Oceans, Canada (DFO) operates a flow regulation weir at the outlet of Taltapin Lake in order to supply flows to sockeye spawning channels located in the lower reaches of Pinkut Creek.

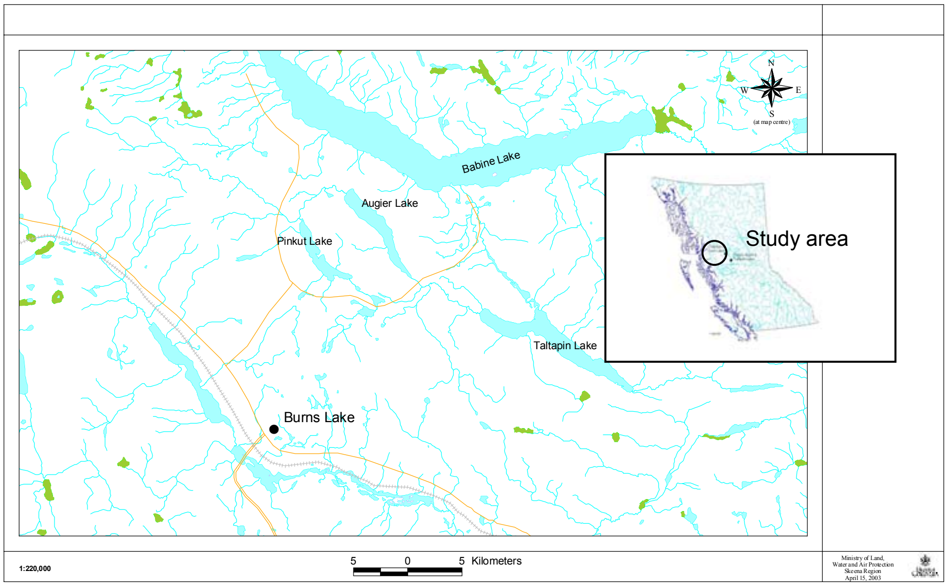

Figure 1: Location of Augier, Pinkut and Taltapin lakes relative to the Town of Burns Lake and Babine Lake. Inset map depicts general location in BC.

Chapman and Doris lakes are located approximately 40km northeast of Smithers, in the headwaters of the Fulton Creek watershed. Fulton Creek drains into north central arm of Babine Lake (Figure 2). Like Pinkut Creek, DFO operates a flow control weir at the outlet of Fulton Lake to supply flows to sockeye spawning channels in the lower reaches of Fulton Creek.

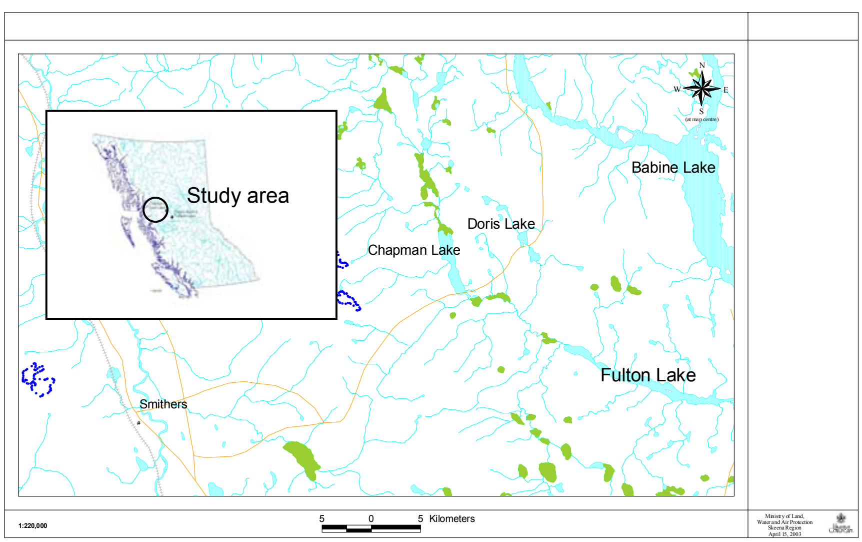

Figure 2: Location of Chapman & Doris lakes relative to Smithers. Inset map depicts general location in BC.

Physical and chemical parameters for the lakes sampled are summarized in Tables 1 and 2 respectively. All lakes were initially sampled in the late 1960's and early 70's by provincial fisheries agency staff. The lakes sampled in 2002 are small; less than 2500 ha and typical of lakes containing lake trout in Skeena Region (DeGisi, in prep.).

Table 1: Summary of study lake physical parameters measured during historical reconnaissance inventories.

Gazetted Name	Survey Date	Agency Name	Surface Area(ha)	Littoral Area(ha)	Perimeter (m)	Volume (m3)	Mean Depth(m)	Max. Depth(m)	Outlets	Permanent Inlets	Watershed Code	Waterbody Identifier
CHAPMAN LAKE	29/07/1952	Other	1018.63		21726	130410820	12.8	26.8	1	1	480-697200	00726BABL
AUGIER LAKE	20/08/1974	MOE - Fisheries Inventory	851.49	123.03	22068	235940430	27.4	60.3	1	2	480-927700	02159BABL
PINKUT LAKE	01/10/1974	MOE - Fisheries Inventory	574.67	229.46	19934	59591972	10.4	31.7	1	13	480-927700-66700	02257BABL
DORIS LAKE	24/08/1969	MOE - Smithers	113.31		6181	7373342	6.5	13.4	1	0	480-697200-33400	00722BABL
TALTAPIN LAKE	21/08/1974	MOE - Fisheries Inventory	2109.7	177.26	38679	833044260	39.6	95.7	1		480-927700	02504BABL

Table 2: Summary of study lakes chemical parameters measured during historical reconnaissance inventories.

Gazetted Name	Region	Survey Date	Agency Name	pH	TDS	Hydrogen Sulfide	Secchi Depth(m)	Cloud Cover (tenths)	Watershed Code	Waterbody Identifier
CHAPMAN LAKE	6	24/08/1968	MOE - Fisheries Inventory	7.2	63		3	7 - 24-Aug-1968	480-697200	00726BABL
AUGIER LAKE	6	20/08/1974	MOE - Fisheries Inventory	7.4	60	0 AT 130 FT	2.4	7 - 20-Aug-1974	480-927700	02159BABL
DORIS LAKE	6	11/08/1970	MOE - Smithers	6.5	47	NIL	1.8	9 - 11-Aug-1970	480-697200-33400	00722BABL
PINKUT LAKE	6	01/10/1974	MOE - Fisheries Inventory	6.7	64	NIL AT 29.6 METRES	2.6	6 - 05-Oct-1974	480-927700-66700	02257BABL
TALTAPIN LAKE	6	21/08/1974	MOE - Fisheries Inventory	7.6	88	NIL AT 32 METRES, NIL AT 53.3 METRES	2.7	5 - 22-Aug-1974, 9 - 22-Aug-1974	480-927700	02504BABL

1.2 Regulations Background

Management of the lake trout fishery has followed a progression of increasing restrictions on harvest beginning in the 1970's (Figure 3). Prior to 1993, lake char were managed and regulated with all trout species. From 1993 on, daily catches of char species were separated from other trout species and reduced to possession of six, rather than ten (Figure 3). In 1976, anglers were limited to one ice fishing line and possession limits were reduced to ten from 15. Trophy lake char (*i.e.* >50cm) limits were also dropped from possession of six to four. Retention of trophy lake char was reduced again to two in possession in 1985 and total possession was reduced to six in 1993. The first lake char specific regulation was introduced in Skeena Region in 1985, where lake trout harvest was closed on Cheslatta Lake due to perceived low lake trout abundances and re-opened in 1993. Tchesinkut Lake was recently changed to one month retention fisheries for each of the ice and open water fisheries; all other periods are lake trout catch and release.

Present regulations limit anglers to one lake char over 50 cm per day and two under 50 cm, with a possession limit of two daily limits. Lake char are to be released, from Skeena and Nass watersheds from September 15th to November 30th. Fall lake char release was initiated for Nass and Skeena watersheds to protect adults during spawning events.

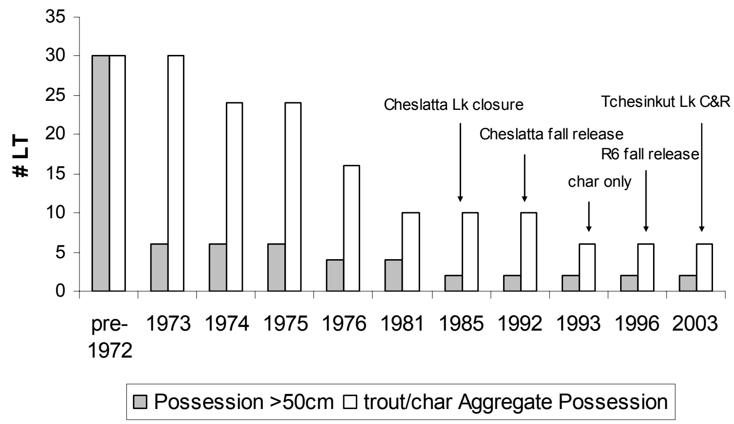

Figure 3 Summary of Skeena Region lake trout regulation history.

2.0 Methods

2.1 Lake Selection

Known lake char lakes that were close to population centres, small in size (less than 5,000ha), and had been sampled previously for lake trout by deLeeuw (1990-92) were identified for sampling. The Conservation Officer Service in Burns Lake was also consulted to determine the popularity of local lakes to lake trout anglers and first nations subsistence fishing.

2.2 Site Selection

Sample sites were selected through two processes: 1) systematic stratified sites were spaced equally along the shoreline at a rate of one site per 0.75km^2 of lake area following methods described by Thompson (1999) for Yukon lakes. Systematic sites were sampled first. Biased sites were established by field crews to increase biological sample size if less than 30 lake trout were captured following completion of systematic sites. Sites were selected based on systematic sampling lake trout catch results and lake bathymetry. Efforts were made to avoid severe sloped shoreline bathymetry and submerged debris. All sites were geo-referenced with hand-held GPS.

2.3 Sampling Gear

2.3.1 Systematic Netting

Systematic sites were sampled with 45m long either green (*n*=4) or grey (*n*=2) sinking mono-filament gill nets comprised of three 15 m panels of 1.5" (381mm), 2" (508mm), and 2.5" (635mm) stretch meshes. Nets were set perpendicular to shore with a shore anchor line that was either 10m or 30m long. The smallest (1.5") mesh panel was set alternately between shore and deep water. Lake depth was measured and recorded at each end of the net using a Lowrance™ Eagle digital depth sounder.

2.3.2 Biased Netting

Net deployment for biased sites followed the same setting routines described for systematic netting. However, in addition to forty-five meter nets, two 45m nets were often deployed ganged together to form 90m gill nets. In addition, an 80m 1.5" light green mesh gill net was also deployed on Taltapin Lake.

2.4 Data Management

Site location, set time, gear type, net configuration and individual fish data was recorded on BC Resource Inventory Committee (RIC), Field Data Inventory System (FDIS) Fish Collection Forms. Field forms were entered by field technicians into mini-FDIS (Microsoft Access vers. 2002) database, suitable for uploading into the Ministry of Sustainable Resource Management's Fisheries Data Warehouse.

Calculations, statistical analysis and graphics generation were performed in Microsoft Excel *v.*2002. Mapping was completed using ArcView.

2.5 Fish Handling

Each lake char was measured for fork length (mm), round weight (g), sex, maturity, and age sampled prior to release. For live lake trout, approximately one cm of the basal portion of the leading ray of the pectoral fin was collected for age analysis using small side-cutter pliers. Scales were collected from lake trout less than 200mm fork length. Fish gender and maturity was estimated through visual inspection of ovi-positor and head shape; however, these data were not considered reliable for analysis. Round fish weight was measured using Accu-Weigh™ spring scales (model T-5c 500 g, T-4 2kg, T-10 5 kg, T-20 10 kg, T-50 25 kg) and ¼ inch mesh bag. Spring scales and wetted bags were calibrated each day. Lake trout that suffered mortality from netting had round weights collected without the use of the net bag, otiliths were collected for age analysis and gender and maturity assessments were completed through internal examination. Gonad development was recorded according to definitions described in the BC Resource Inventory Committee Fish Collection Form manual.

2.6 Lake Trout Data Analysis

Lake trout data was compiled for each lake and exposed to analysis described by deLeeuw (unpublished manuscript), Lester et al. (1991) and Payne et al. (1990).

2.6.1 Net Catch Calibration

Netting effort and catches were calibrated to 100 m of gill net per day (24 hr) using equation 1, developed by deLeeuw (1991).

Equation 1: $$CF = \frac{\left[2400 \times n_y \div \sum Xi\right]}{n_y}$$

where: *CF* = net catch correction factor, n_y = number of nets, *Xi* = *m·net hr (*net length *x* soak time*)*.

2.6.2 Age

Ages derived for lake trout using fin ray structures were corrected using simple linear regression of fin ray age versus corresponding otolith age. Parameter estimates of y-intercept (*a*) and slope (*b)* generated by DeGisi (in prep.) for 13 Skeena Region lake trout lakes were used in the correction. Age structures considered poor by the aging consultant were removed from the analysis . The following formula was applied:

Equation 2: Otolith corrected fin ray age = 0.31 + 1.10(fin ray age)

2.6.3 Growth

von Bertalanffy growth equation and parameters were used to estimate and describe lake trout growth (Equation 3). Growth rate parameter (*K*), the rate at which the gap between L_t and L_∞ is closed each year, was were calculated for mature lake trout (>7yrs) using linear regression (*b*) between fork length at age *n vs.* fork length at age *n*+1measurements from Walford plots (Ricker 1975). Infinite fish length ($L\infty$) was calculated using geometric mean of the longest 5 percent of the lake trout catch, following methods described by Payne *et al.* (1990) for calculating $L\infty'$.

Equation 3: $$L_t = L_\infty(1 - e^{-K(t-to)})$$

Where: L_t is the expected fork length of fish at age t; L_∞ (asymptotic length parameter) - fork length at age infinity; *K* - the rate at which the gap between L_t and L_∞ is closed each year; and, t_o - the theoretical age at which fish length is zero.

2.6.4 Mortality Estimates

Natural mortality (*M*) rates were calculated using Shuter et al's (1998) modification of the Pauly method (Pauly 1980), where *T* = annual mean temperature set to 6^{o}C (Shuter et al. 1998).

Equation 4: $\log_e M = -0.0238 - 0.9326\log_e(1.094L\infty) + 0.6551\log_e(\Omega) + 0.4646\log_e(T)$

Instantaneous mortality (*Z)* was calculated using Beverton-Holt's formula (Beverton and Holt 1956).

Equation 5: $Z = \frac{K(L\infty - \overline{L})}{(\overline{L} - L')}$

where: K and $L\infty$ are growth parameters, $\overline{L}$ = mean length of fish greater than or equal to L'. L' is a length not smaller than the smallest length of fish fully represented in the catch (smallest size of fish susceptible to gear). An L' of 400mm is used to refer to *ML*400 as mean length above 400mm.

*ML*400, or mean length above 400mm, used as an index of adult lake trout mortality rates where age does not exist was calculated by:

Equation 6: $ML400 = \frac{400Z + KL\infty}{Z + K}$ (Lester *et al*. 1991)

Fishing Mortality (*F*) was calculated by:

Equation 7: $F = Z - M$

*A*400 or age at 400mm, an index of early lake trout growth was calculated using:

Equation 8: $A400 = -\log_e(-(400/ L\infty - 1))/ K$ (from: DeGisi in prep.)

Annual Mortality was calculated following estimates described by Lester & Dunlop (2002).

Equation 9: $A = 1 - e^{-Z}$

2.6.5 Condition

Condition factor was calculated for lake trout using Fulton's equation (Ricker 1975), as well as, that suggested by Payne et al (1990).

Equation 10: *Fulton's Condition Factor:* K = weight/length^3

Equation 11: *Payne et al. (1990):* $W = aL^b$

Where W = weight (g), L = length (mm). Parameters a and b were estimated for each lake by least square linear regression of log transformed weight and length using the function:

Equation 12: $\log W = \log a + b \log L$

2.7 Habitat Measurement

Lakes were sampled for dissolved oxygen (mg/l) and temperature using an OxyGuard™ dissolved oxygen/temperature meter, fitted with a graduated 30 m probe cable during the netting as well as high summer (July 29-31, 2002). Thermal habitat volumes (THV) were calculated from each lakes bathymetric map according to procedures described by Payne *et al.* (1990) using a hand-held digital planimeter, bathymetric maps for each lake and the high summer temperature profiles.

3.0 Results

3.1 Temperature & Dissolved Oxygen Profiles

Spring temperature and dissolved oxygen profiles for Chapman and Augier lakes demonstrated little stratification, whereas Doris, Pinkut and Taltapin lakes were significantly warmer to depths of 4m, 10m and 12m respectively (Figure 4).

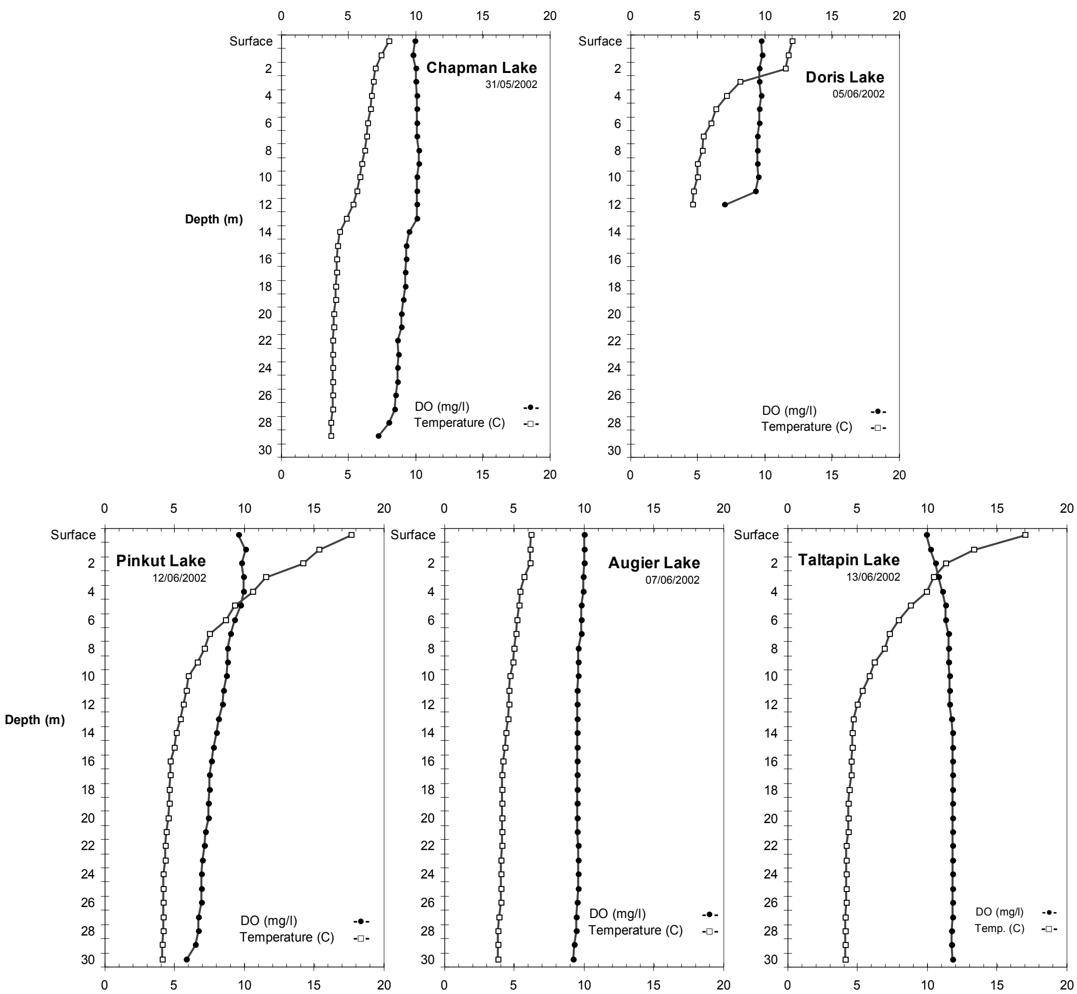

Figure 4: Oxygen (mg/l) and temperature (^{o}C) depth profiles for lakes sampled between May 31 and June 13th, 2002.

It is interesting to note that Chapman and Augier lakes were sampled earlier in the sampling period compared to Pinkut and Taltapin lakes. Air temperatures recorded at Prince George were much cooler early in the sampling period (Figure 5). Cool conditions also preceded high summer DO/temperature sampling (Figure 5).

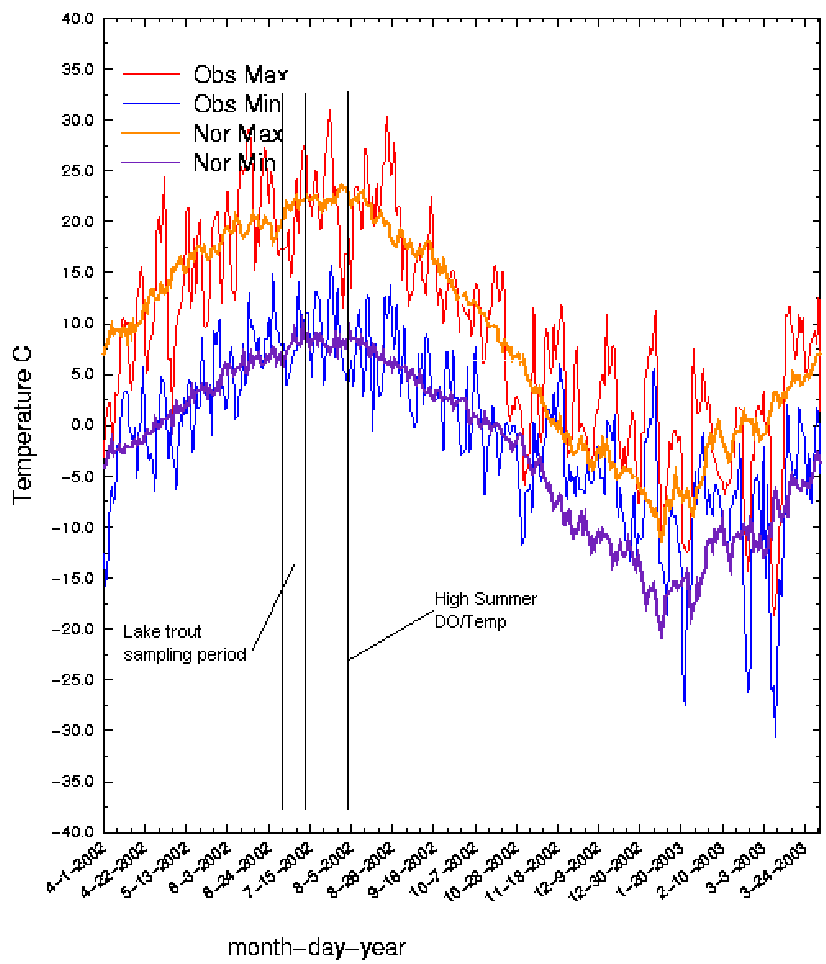

Figure 5: Observed air temperatures in degrees Celsius (^{o}C) at Prince George BC between April 1, 2002 and March 31, 2003. Approximate dates of dissolved oxygen temperature profile sampling conducted in late May/early June for Chapman, Augier, Taltapin and Pinkut lakes are indicated.

High summer temperature/dissolved oxygen profiles (July 30-31, 2002) were also collected for study lakes to facilitate thermal habitat volume estimates (Christie and Regier 1988). All lakes recorded dissolved oxygen concentrations greater than 4 mg/l throughout the 30 m profile with the exception of bottom samples at Doris and Chapman lakes. Pinkut Lake recorded the lowest dissolved oxygen levels to 4.8 mg/l during high summer (Figure 6). Water depth to 8 ^{o}C ranged between 5m (Doris Lake) to 30 m (Taltapin Lake; Figure 6). Also of note was the surface water temperature at Taltapin Lake, which was warmer in early June than late July (Figures 4 & 6). However, warmer water temperatures (>6 ^{o}C) were present to greater depths in July compared to the June sample.

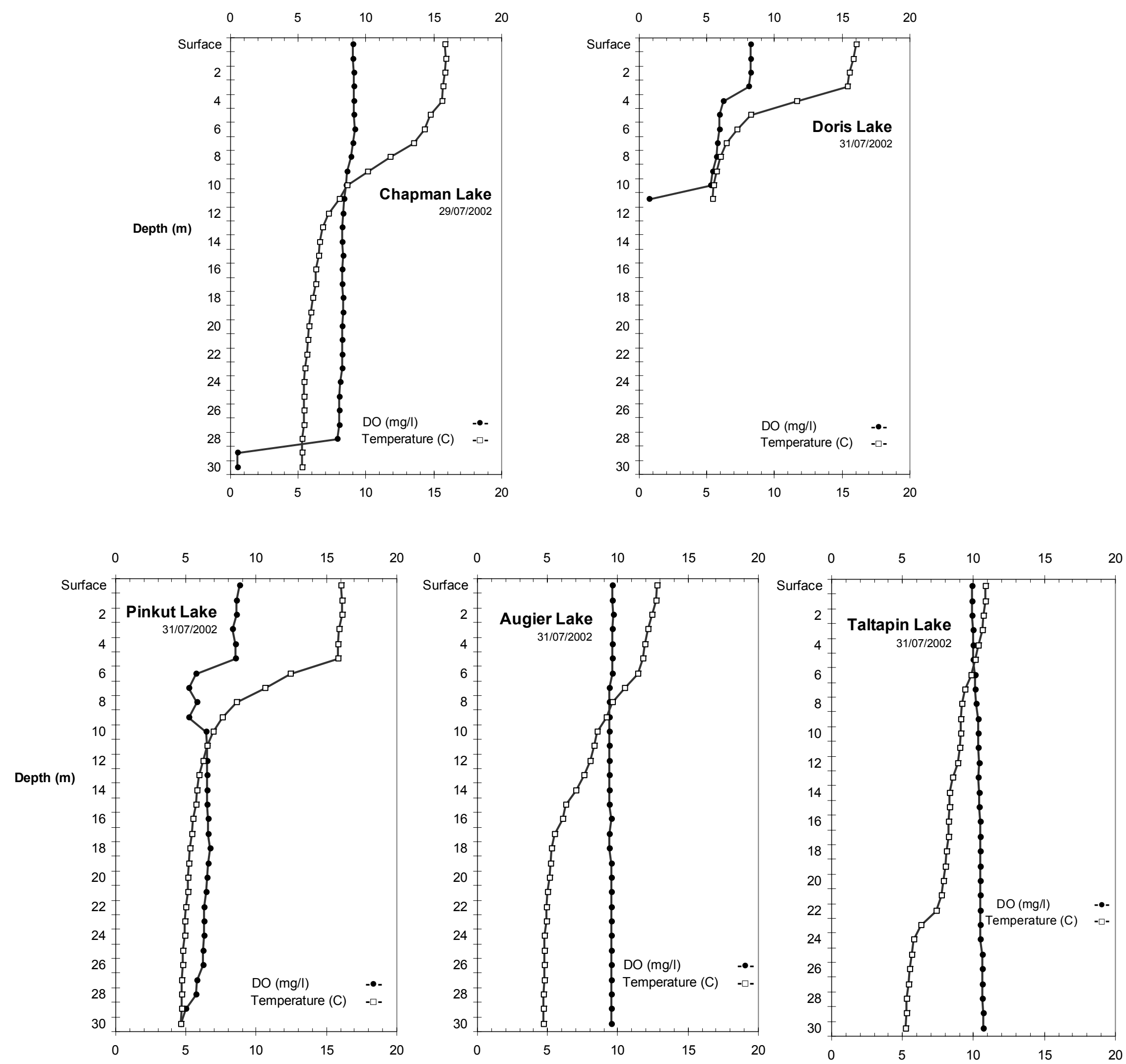

Figure 6: Oxygen (mg/l) and temperature (^{o}C) depth profiles for Chapman, Doris, Pinkut, Augier and Taltapin lakes sampled July 29^{th} and July 31^{st}, 2002.

3.2 *Index Netting*

3.2.1 Sample Site Locations

Systematic site netting was conducted as described in Methods section 2.2. Biased sites however, were generally localized to areas where: 1) lake trout capture was noted following systematic site sampling; 2) in areas with gradual bathymetric profiles; or, 3) in areas where logistical efficiencies were realized (e.g. take out locations). Crews generally repeated sets in favourable locations until such a time that lake trout catches were depleted.

Augier Lake received the greatest effort along the north and south western shore the lake. Mid reaches of the lake were avoided due to exposure to heavy southerly winds (Figure 7). The southern basin of Pinkut Lake, and especially the western shore was fished heavily. Pinkut Lake's high site density is evident in Figure 7.

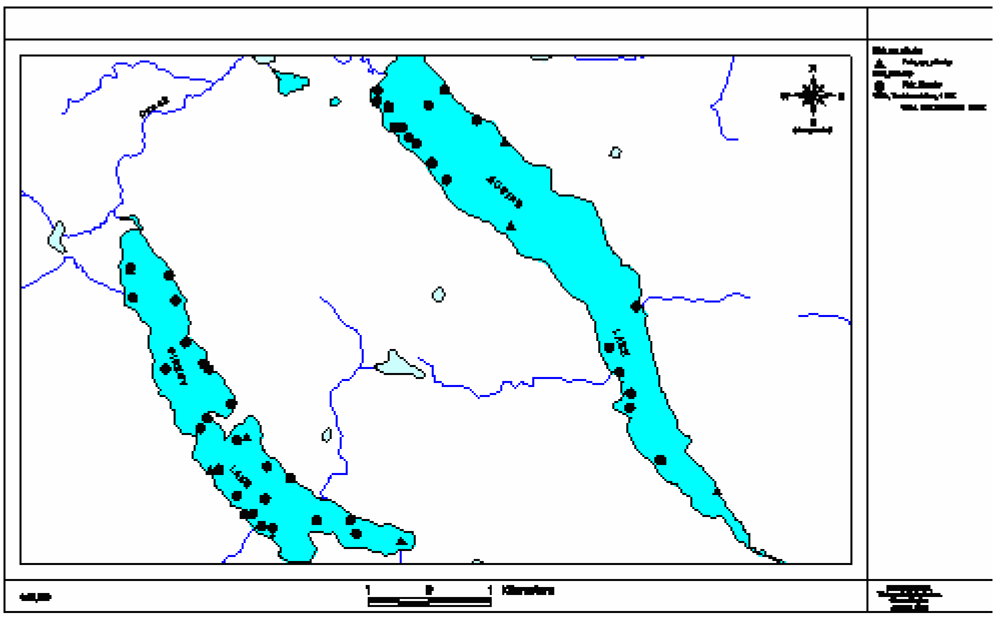

Figure 7: Biased (circles) and systematic (triangles) gill net sample site locations for Augier and Pinkut lakes. Sites sampled June 6-7 (Augier), and June 12-13 (Pinkut), 2002.

Taltapin Lake was fished heaviest along the south-western shore of the lake. Logistical efficiencies were realized by biasing sites towards the western end of the lake as the lake take-out was located at the northwest corner of the lake (Figure 8).

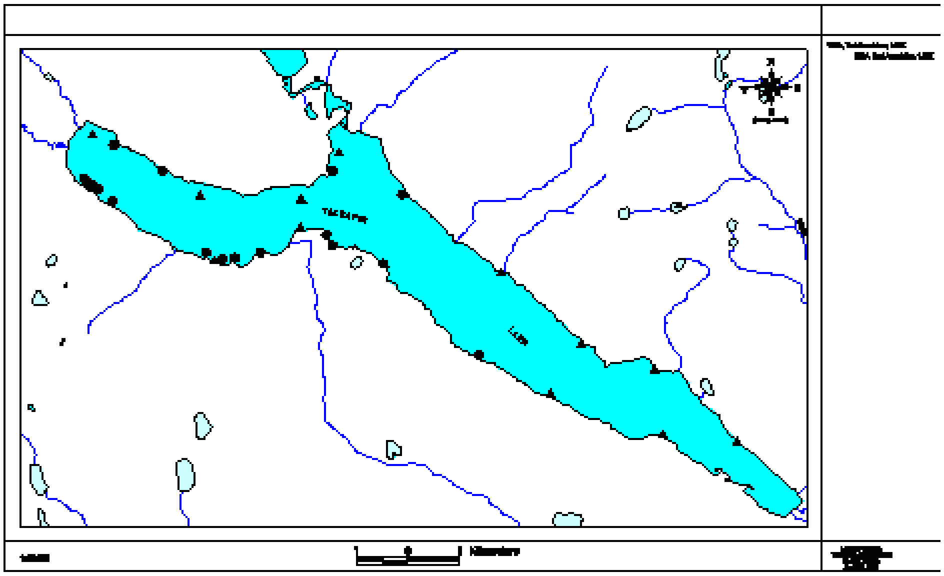

Figure 8: Biased (circles) and systematic (triangles) gill net sample site locations for Taltapin Lake. Sites sampled June 14-16, 2002.

The eastern shore of Chapman Lake received more intense netting (Figure 9), while the south-east corner of Doris Lake was netted with the highest frequency (Figure 10). Doris Lake's sites were selected due to favourable bathymetric profile and presence of lake whitefish.

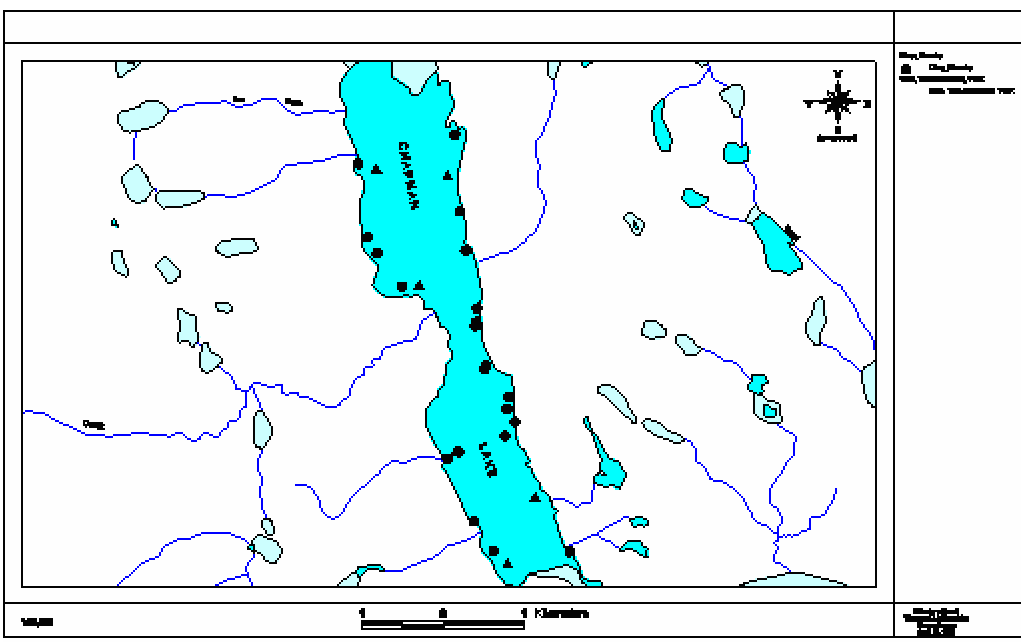

Figure 9: Biased (circles) and systematic (triangles) gill net sample site locations for Chapman Lake. Sites sampled May 24-29, 2002.

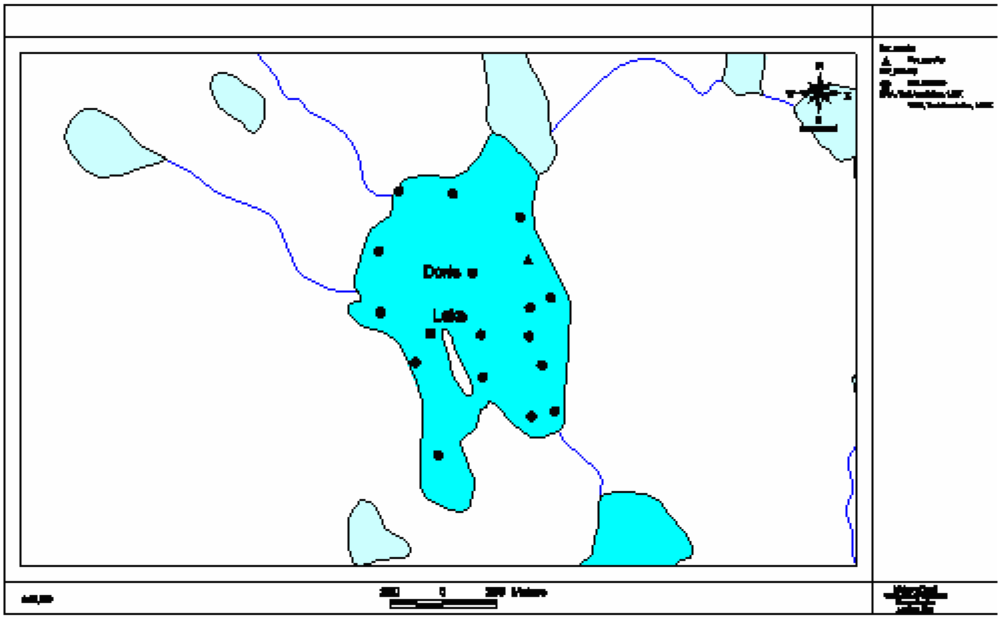

Figure 10: Biased (circles) and systematic (triangles) gill net sample site locations for Doris Lake. Sites sampled June 5, and October 9, 2002.

3.2.2 Net Type and Effort

Ninety meter and 45 m variable mesh sinking gill nets comprised the greatest amount of effort for the lakes sampled (Table 3). Uniform mesh (1.5") 80m nets were used for just 23.9 hours on Taltapin Lake exclusively. Biased netting effort exceeded systematic netting by 274.6 hrs (88% of total effort). This is due in large part to the use of overnight biased sets, which comprised 40% of total effort (hrs), while comprising only 10% of the total number of biased and 8% of the total net sets (Table 4).

Table 3: Summary of netting effort (hours), net type, site types (systematic or biased), overnight and daylight sets for lakes sampled May and June, 2002.

Lake	Net Effort (hrs)				Systematic Effort (hrs)	Biased Set Effort (hrs)				Overnight Set Effort (hrs)				Daytime Set Effort (hrs)			
	45m	90m	80m	Total	45m	45m	90m	80m	Total	45m	90m	80m	Total	45m	90m	80m	Total
Augier	46.1	21.9	0.0	68.0	10.5	35.7	21.9	0	57.5	17.0	17.1	0	34	29.2	4.8	0	33.9
Pinkut	23.1	73.4	0.0	96.6	4.5	18.7	73.4	0	92.1	11.7	37.0	0	49	11	36	0	47.9
Taltapin	20.0	81.3	23.9	125.2	20.0	0	81.3	23.9	105.2	0	50.6	12.9	64	20	15	11	45.9
Chapman	44.6	0.0	0.0	44.6	6.1	38	0	0	38.5	0	0	0	0	44	0	0	43.6
Doris	13.9	10.6	0.0	24.5	1.1	13	10.58	0	23.4	0	0	0	0	14	11	0	24.5
Total	147.7	187.2	23.9	358.7	42.1	105.6	187.2	23.9	316.7	28.7	104.8	12.9	146.3	118.0	66.7	11.0	195.7

Table 4: Summary of the number of gill net sets by net and site type (systematic or biased), overnight and daylight sets for lakes sampled May and June, 2002.

Lake	Total No. of Sets	No. Systematic (45m net)	No. Biased Sets				No. Overnight Sets				No. Daytime Sets			
			45m	90m	80m	Total	45m	90m	80m	Total	45m	90m	80m	Total
Augier	25	7	14	4	0	18	1	1	0	2	22	3	0	23
Pinkut	32	4	4	23	0	28	1	3	0	4	8	20	0	28
Taltapin	33	16	0	11	4	17	0	4	1	5	20	7	3	28
Chapman	29	5	24	0	0	24	0	0	0	0	29	0	0	29
Doris	19	1	12	6	0	18	0	0	0	0	29	6	0	19
Total	138	33	54	44	4	105	2	8	1	11	108	36	3	127

3.2.3 Catch Composition

The greatest number of fish were captured in Chapman Lake, followed by Augier, Pinkut, Taltapin and Doris lakes (Table 5). Lake whitefish (*Coregonus clupeaformis*) were most abundant species encountered in all lakes with the exception of Taltapin Lake, where longnose suckers (*Catastomus catastomus*) were the most abundant fish handled (Table 5). Overnight net sets appeared to influence catch results. Pinkut and Taltapin lakes had the greatest number of overnight sets (Table 4), in addition to the most abundant catches of sucker and burbot (*Lota lota;* Table 5). Doris Lake was the exception to this observation, recording high catches of sucker *sp.* while not having a net set overnight. Doris Lake was also the only lake where high numbers of northern pike-minnow (*Ptychocheilus oregonensis*) were captured and lake trout was absent from the catch. Taltapin Lake also recorded the highest number of kokanee trout (*Oncorhynchus nerka*) and the lowest catch of whitefish *sp*.

Table 5: Summary of catch by species for each lake sampled during spring of 2002. LT = lake trout, LW = lake whitefish, MW = mountain whitefish, BB = burbot, LSU = longnose sucker, CSU = coarsescale sucker, WSU = white sucker, RB = rainbow trout, CT = cutthroat trout, KO = kokanee trout, RSC = redside shiner, NSC = northern pike minnow, PCC = peamouth chub, SU = sucker sp., *Oncor.* = all *oncorhynchus*.

Lake	LT	LW	MW	BB	LSU	CSU	WSU	RB	CT	KO	RSC	NSC	PCC	Total Catch	Total SU	Total *Oncor.*
Augier	31	480	0	2	12	2	0	1	0	2	0	0	0	530	14	3
Pinkut	40	299	0	15	56	5	27	16	0	0	0	0	0	458	88	16
Taltapin	43	27	0	14	65	0	1	3	0	48	0	0	0	201	66	51
Chapman	42	569	1	1	7	11	0	3	0	0	0	6	13	653	18	3
Doris	0	50	0	0	4	41	0	1	11	0	3	33	0	143	45	12
Total	156	1425	1	32	144	59	28	24	11	50	3	39	13	1985	231	85

Lake whitefish comprised 72% of the total catch, suckers *sp.* 12%, lake trout 8%, *oncorhynchus sp.* 4%, burbot and northern pike minnow 2% respectively (Table 6).

Table 6: Summary of percentage of catch by species for each lake sampled during spring of 2002. LT = lake trout, LW = lake whitefish, MW = mountain whitefish, BB = burbot, LSU = longnose sucker, CSU = coarsescale sucker, WSU = white sucker, RB = rainbow trout, CT = cutthroat trout, KO = kokanee trout, RSC = redside shiner, NSC = northern pike minnow, PCC = peamouth chub, SU = sucker sp., *Oncor.* = all *oncorhynchus*.

Lake	LT	LW	MW	BB	LSU	CSU	WSU	RB	CT	KO	RSC	NSC	PCC	Total Catch	Total SU	Total Oncor.
Augier	6%	91%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	100%	3%	1%
Pinkut	9%	65%	0%	3%	12%	1%	6%	3%	0%	0%	0%	0%	0%	100%	19%	3%
Taltapin	21%	13%	0%	7%	32%	0%	0%	1%	0%	24%	0%	0%	0%	100%	33%	25%
Chapman	6%	87%	0%	0%	1%	2%	0%	0%	0%	0%	0%	1%	2%	100%	3%	0%
Doris	0%	35%	0%	0%	3%	29%	0%	1%	8%	0%	2%	23%	0%	100%	31%	8%
Total	8%	72%	0%	2%	7%	3%	1%	1%	1%	3%	0%	2%	1%	100%	12%	4%

3.2.4 Net & Catch Efficiency

Systematic sample site effort was proportionate to lake area and therefore comparable among lakes; however, too few data were generated using this method to permit meaningful comparisons. With the exception of the systematic site netting, the netting program was not specifically designed to evaluate netting efficiency or compare catch abundance between lakes. Bias was present in the catch results due to different applications of net length, site selection, set duration and applications in various lakes. The goal of the bias netting was to increase lake trout sample size through what ever means available and practical. Readers are cautioned to keep the bias in mind while reviewing the catch results presented below.

3.2.4.1 Net Type

Forty-five meter sinking gill nets produced the highest catch rates of lake trout and whitefish per hour (0.5 LT/hr, 12.0 WF/hr) and per 100 m of net/24hr day (28.5 LT/100m net/day; 380.4 WF/100m net /day; Table 7). Eighty and 90m nets had the highest lake trout catch per set (2.5 LT/set, 1.5 LT/set), however sample sizes were small for 80 m nets (*n*=4; Table 7). Ninety meter nets also captured the highest absolute number for all catch rate estimates of suckers (Table 7). However, net soak time, set length and lake netted appear to have biased the sucker catches.

3.2.4.2 Net & Set Type

Forty-five meter daytime net sets had the greatest lake trout catch rate per 100 m of net/24 hr net day (33.6 LT/100m/24hr), as well as, the greatest number of daytime net sets (*n*=53; Table 7). For net types set greater than five times, 90 m daytime sets recorded he highest lake trout catch per hour (0.7LT/hr) and catch per set (1.2LT/hr) of all net types (Table 7). Eighty meter nets recorded a high catch rate, however sample size was small (*n*=3 sets) and limited to one lake. Forty-five meter nets set during daytime at biased selected sites recorded the highest capture rates of whitefish per set (15.3WF/set), whereas 45 m daytime sets (biased and systematic combined) recorded highest whitefish capture rates per hour and per 100 m of 24 hr netting (Table 7). Chapman Lake, where only 45 m nets were set, appears to have influenced this result. Ninety meter nets in general, but specifically 90 m nets set overnight, captured the greatest number, as well as, the highest capture rate of suckers *sp.* per set, per hour and per 100 m of 24 hr netting (Table 7).

Table 7: Summary of sinking gill nets and set type (syst = systematic 1 hr daytime site, ovr_nt = overnight set, daytime = bias and systematic sites @ 1-3hr/daylight set) catch by species (LT, WF and SU) for netting completed on Augier, Taltapin, Pinkut, Chapman and Doris lakes sampled during spring season, 2002.

Sinking Gill Net & Set Type	# LT	#WF	#SU	Effort (# sets)	Effort (hrs)	LT/set	WF/set	SU/set	LT/hr	WF/hr	SU/hr	m net x hrs	CF = 100m / 24hr net	LT/100m /24hr net	WF/100m /24hr net	SU/100m /24hr net
90m	67	372	210	46	176.6	1.5	8.1	4.6	0.4	2.1	1.2	15894	0.15	10.1	56.2	31.7
80m	10	1	6	4	23.9	2.5	0.3	1.5	0.4	0.0	0.3	1909	1.26	12.6	1.3	7.5
45m	79	1053	55	88	147.65	0.9	12.0	0.6	0.5	7.1	0.4	6644	0.36	28.5	380.4	19.9
total	156	1426	271	138	348.1	1.1	10.3	2.0	0.4	4.1	0.8	24448	0.10	15.3	140.0	26.6
90m bias	67	372	210	46	176.6	1.5	8.1	4.6	0.4	2.1	1.2	15894	0.15	10.1	56.2	31.7
80m bias	10	1	6	4	23.9	2.5	0.3	1.5	0.4	0.0	0.3	1909	1.26	12.6	1.3	7.5
45m syst	25	213	12	33	42.1	0.8	6.5	0.4	0.6	5.1	0.3	1892	1.27	31.7	270.2	15.2
45m bias	54	840	43	55	105.6	1.0	15.3	0.8	0.5	8.0	0.4	4752	0.51	27.3	424.2	21.7
total	156	1426	271	138	348.12	1.1	10.3	2.0	0.4	4.1	0.8	24448	0.10	15.3	140.0	26.6
90m ovr_nt	20	117	129	8	104.8	2.5	14.6	16.1	0.2	1.1	1.2	9428	0.25	5.1	29.8	32.8
80m ovr_nt	4	1	1	1	12.9	4.0	1.0	1.0	0.3	0.1	0.1	1033	2.32	9.3	2.3	2.3
45m ovr_nt	4	43	9	2	28.7	2.0	21.5	4.5	0.1	1.5	0.3	1289	1.86	7.4	80.0	16.8
total	28	161	139	11	146.3	2.5	14.6	12.6	0.2	1.1	0.9	11750	0.20	5.7	32.9	28.4
90m daytime	47	255	81	38	71.9	1.2	6.7	2.1	0.7	3.5	1.1	6467	0.37	17.4	94.6	30.1
80m daytime	6	0	5	3	11.0	2.0	0.0	1.7	0.5	0.0	0.5	876	2.74	16.4	0.0	13.7
45m daytime	75	1010	46	86	119.0	0.9	11.7	0.5	0.6	8.5	0.4	5355	0.45	33.6	452.7	20.6
45m daytime bias	50	797	34	53	76.95	1.0	15.3	0.8	0.5	8.0	0.4	4752.0	0.5	27.3	424.2	21.7
total*	128	1265	132	127	201.8	1.0	10.0	1.0	0.6	6.3	0.7	12698	0.19	24.2	239.1	24.9

3.2.4.3 Among Lake Systematic Netting

Daylight netting conducted at predetermined sites at an intensity of 1 set/0.75 km^2 using 45 m nets produced variable catch rates and results (Table 8). Augier Lake recorded the highest catch rate of lake trout and whitefish *sp.* (Table 8). Pinkut Lake also recorded high lake trout catch rates, as well as, the highest sucker *sp.* catches (Table 8). Doris Lake did not record any fish captured in its one systematic set. This result illustrates that although systematic netting effort addresses bias of net type, indicate that area based effort criteria can significantly limit sample sizes and create substantial spatial bias.

Table 8: Summary of effort and catch of lake trout, whitefish *sp.* and sucker *sp.* at sites chosen systematically (1 net site/0.75 km^2) using 45m sinking gill nets in lakes sampled in the spring of 2002.

Net Type: 45m syst.	# LT	#WF	#SU	# Sets	Effort (hrs)	LT/set	WF/set	SU/set	LT/hr	WF/hr	SU/hr	net m x hrs	CF= 100m / 24hr net	LT/ 100m / 24hr net	WF/ 100m / 24hr net	SU/ 100m / 24hr net
Chapman Lake	2	43	1	5	6.1	0.4	8.6	0.2	0.3	7.1	0.2	273.8	8.8	17.5	377.0	8.8
Taltapin Lake	10	11	4	16	20.0	0.6	0.7	0.3	0.5	0.6	0.2	898.5	2.7	26.7	29.4	10.7
Pinkut Lake	3	20	3	4	4.5	0.8	5.0	0.8	0.7	4.5	0.7	200.3	12.0	36.0	239.7	36.0
Augier Lake	10	139	4	7	10.5	1.0	13.3	0.4	1.0	13.3	0.4	470.3	5.1	51.0	709.4	20.4
Doris Lake	0	0	0	1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	49.5	48.5	0.0	0.0	0.0

Lake area does not appear to require an effort based compensation factor as applied in this study. Although the sample size is small (*n*=4; Doris Lake removed), there is little apparent correlation between lake area and lake trout catch (r^2=0.14; Figure 11).

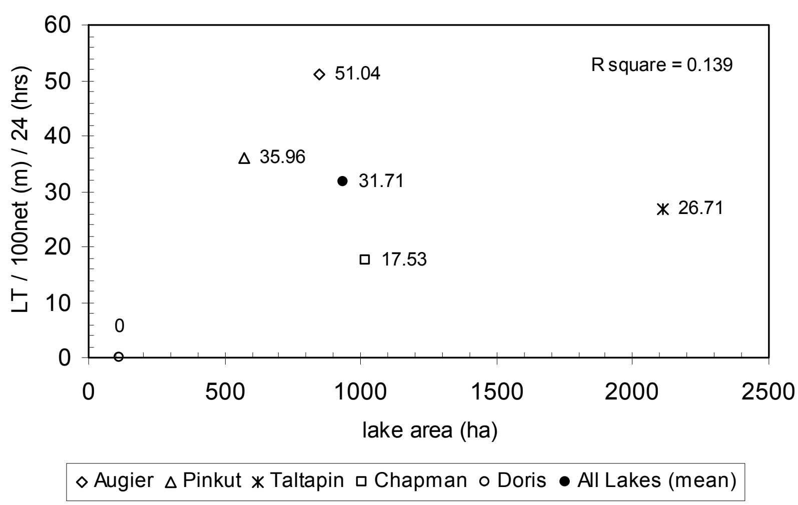

Figure 11: Plot of lake trout catch per 100 m of net over a 24 hour net set period from systematic sample sites using 45m sinking gill nets versus lake area for lakes sampled in the spring of 2002. Displayed point values correspond to the y-axis. Doris Lake result removed from analysis.

3.2.4.4 Among Lake Biased Site Netting

The variation of the intensity of netting and the various combinations of net and site types applied among lakes has likely biased the netting results through processes such as local site depletion, net saturation and habitat differences. Therefore, cross lake comparisons of catch abundances are limited. However, effort required to capture the first 30 lake trout applying various techniques produced results which could provide an indication of population abundance.

Table 9: Summary of total netting effort (hrs), net hrs effort (m net x hrs) and effort (hrs) to capture first 30 lake trout and net hrs effort to capture first 30 lake trout.

	total effort (hrs)	net (m) x effort (hrs)	Effort (hrs) to 1st 30 LT	m x effort to 1st 30 lt
Augier	68.0	4042.5	68.0	4042.5
Pinkut	96.6	7648.5	83.5	6471.3
Taltapin	125.2	10127.8	63.4	4571.8
Chapman	44.6	2004.8	39.1	1757.3
Doris	24.5	1576.5		

There was no correlation between lake area and effort required to capture the first 30 lake trout (r^2=0.01). Chapman Lake required the least effort to capture 30 lake trout, whereas Pinkut Lake required the greatest effort (Table 9). Chapman Lake was sampled with 45 m day time sets exclusively, whereas the other lakes had between one (Taltapin Lake) and three (Pinkut Lake) overnight sets included in the analysis of effort required to capture the first 30 lake trout (Taltapin:*1 overnight set included in effort achieve 1st 30 LT;* Pinkut Lake: *3 overnight sets*; Augier : *2 overnight sets*). Although overnight sets are logistically efficient, the Chapman Lake net effort results demonstrate that overnight sets are inefficient at capturing lake trout compared to daytime one –to-two hour sets. Also apparent in this result is the need to use a consistent netting method to facilitate unbiased between lake evaluations of fish abundance through an index netting program.

3.2.4.5 Net Depth and Catch

In three of the four lakes sampled, 90m nets had the greatest maximum set depth (Figure 12). Maximum net depth of 45m nets exceeded 90m nets on Taltapin Lake only. This is primarily due to the exclusive use of 45m nets in the lakes eastern basin, which has a steeper bathymetric profile than the western basin, where 90m nets were primarily set. Nets were also set deepest on Taltapin Lake, followed by Chapman, Pinkut, Augier and Doris lakes (Figure 12). Differences between lakes maximum net depth were significant (one-way ANOVA; F=6.11, p=0.001).

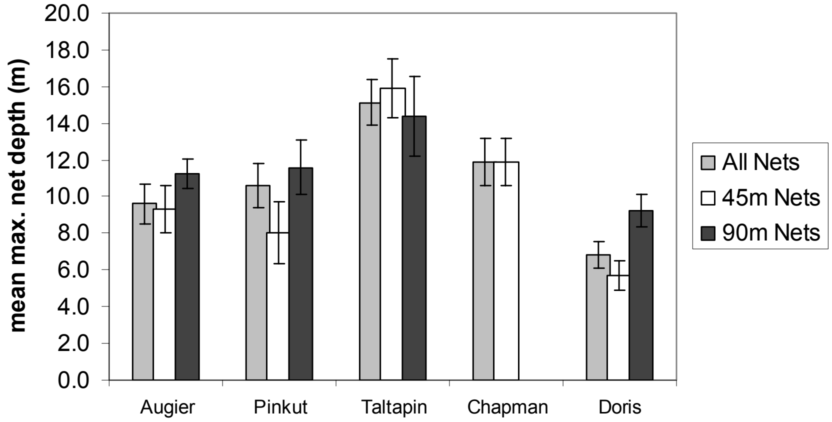

Figure 12: Mean maximum net depths (m) and standard error (bars) of all nets combined (grey bar), 45 m (white bar) and 90 m (black bar) nets in Augier, Pinkut, Taltapin, Chapman and Doris lakes sampled during the spring 2002.

Mean net depth (m) was not correlated with lake trout catch rates (LT/m net x hrs; r^2=0.0002; Figure 13B). Lake trout of all length classes appear in sets less than 20 m deep; however, lake trout longer than 300mm are relatively absent at depths greater than 20 m (Figure 13A). This is likely responsible for the significant, but weak negative correlation between maximum net depth (m) and lake trout fork-length (r^2=0.12; F=9.94, df=70; Figure 13A). Therefore, potential bias towards smaller lake trout may exist for nets set in deeper water (e.g. Taltapin Lake). Hence, some caution must be considered when comparing catches among lakes with significantly different net set depths.

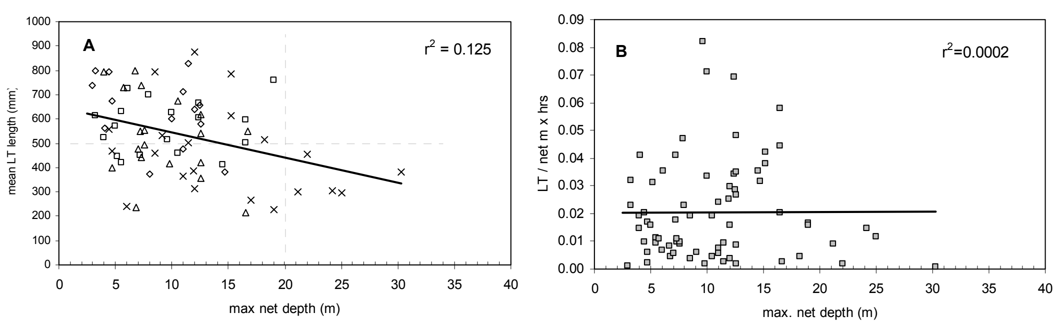

Figure 13: (A) Scatter plot of mean lake trout fork-length (mm) versus maximum net depth (m) for all nets set in Augier (◊), Chapman (□), Taltapin (x) and Pinkut lakes (Δ). Doris Lake results were omitted as lake trout were absent from the catch. (B) Scatter plot of lake trout captured per meter of net hour versus maximum net depth (m) for all sites with lake trout captured.

3.2.4.6 Net Slope and Catch

Lake trout size (r^2 =0.03) and catch rate (r^2=0.08) were not correlated with net slope. Taltapin Lake's net slope was the greatest of lakes sampled, followed by Chapman

Augier, Pinkut and Doris lakes (Figure 14). Taltapin's 45 m nets recorded the greatest average slope. The exclusive use of 45 m nets at systematic sites in Taltapin's eastern basin contributed to the high set slope encountered.

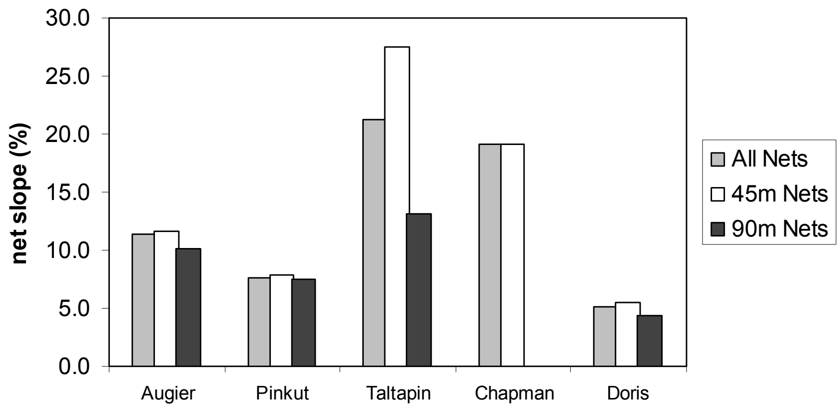

Figure 14: Percent slope for all nets set, 45 m nets and 90 m nets for Augier, Pinkut, Taltapin, Chapman and Doris lakes sampled spring 2002.

3.2.5 Length Frequency of Catch

3.2.5.1 Lake trout

A bi-modal distribution pattern, centered on 400-450 mm and 700-750 mm length classes was observed for lake trout captured in all lakes using all net types (Figure 15). The lake trout length class distribution for Taltapin and Pinkut lakes was largely skewed towards lake trout less than 500 mm, whereas Chapman and Augier lakes was evenly distributed and similar to the length frequency pattern for all lakes (Figure 15).

Lake trout lengths were significantly different among lakes, with Augier and Chapman recording greater lake trout lengths than Pinkut and Taltapin (one-way ANOVA p=0.001; Table 10; Figure 17).

3.2.5.2 Lake whitefish

Lake whitefish lengths for all lakes combined were normally distributed around the mean (307.6 mm ± 3.04; Figure 16). Doris and Chapman lakes had little length variation within the whitefish catch, whereas the catch in the remaining lakes was distributed through all size classes represented (Figure 16).

Lake whitefish lengths were significantly different among lakes, with Taltapin, Doris and Pinkut recording greater lengths, than Augier and Chapman (one-way ANOVA p=0.001; Table 11; Figure 17).

Mean lake whitefish and lake trout lengths also appear to exhibit an interaction (Figure 17). Lake whitefish lengths in lakes with mean lake trout length greater than 500 mm were significantly less than lakes with mean lake trout lengths less than 500 mm (one-way ANOVA, p=0.001; Table 13). This suggests that lake whitefish are experiencing growth compensation where lake trout are smaller or in low abundances.

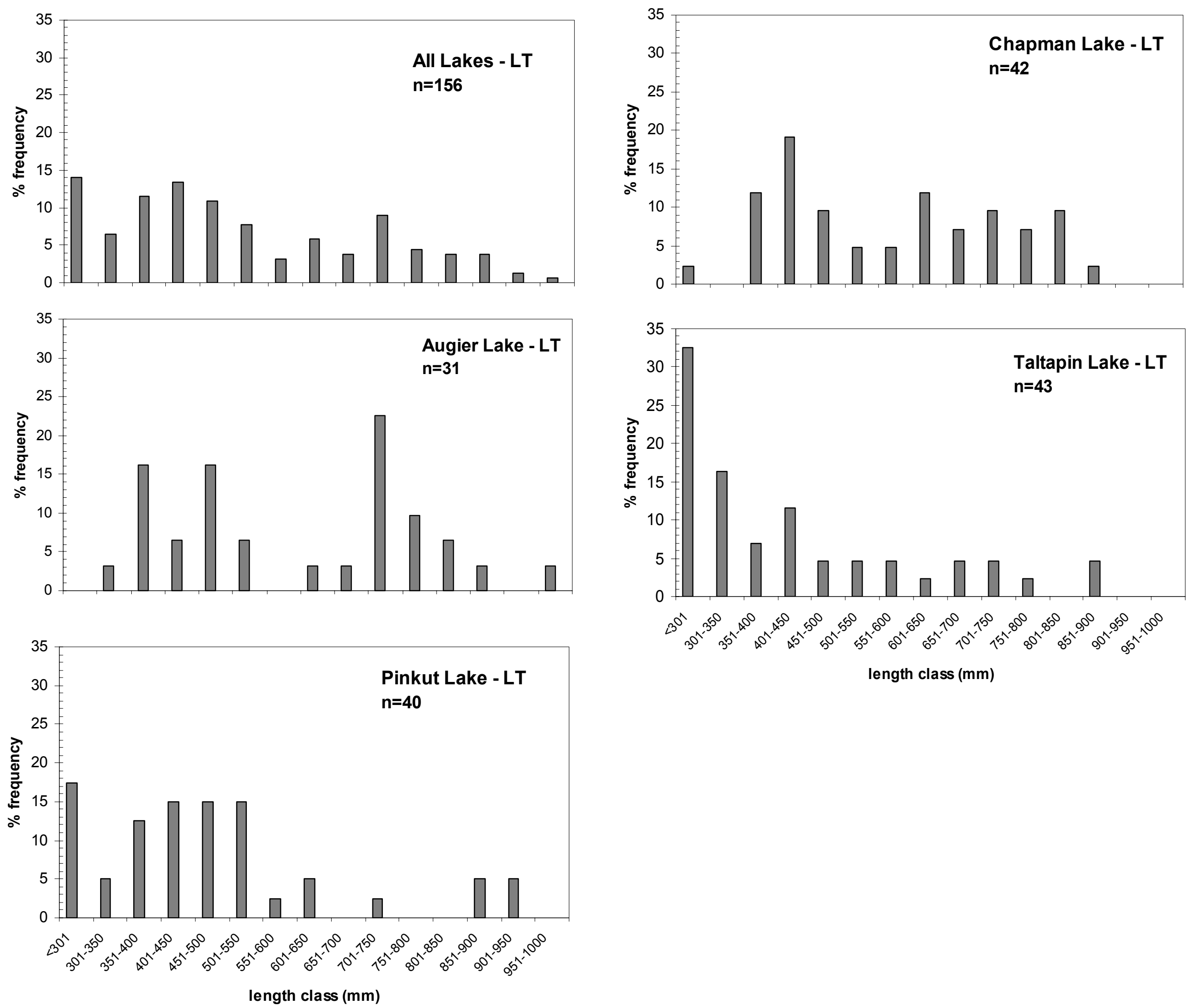

Figure 15: Length frequency (%) histograms of lake trout catches for all lakes combined, Augier, Chapman, Pinkut and Taltapin lakes sampled spring, 2002. Doris Lake is omitted as lake trout were not captured.

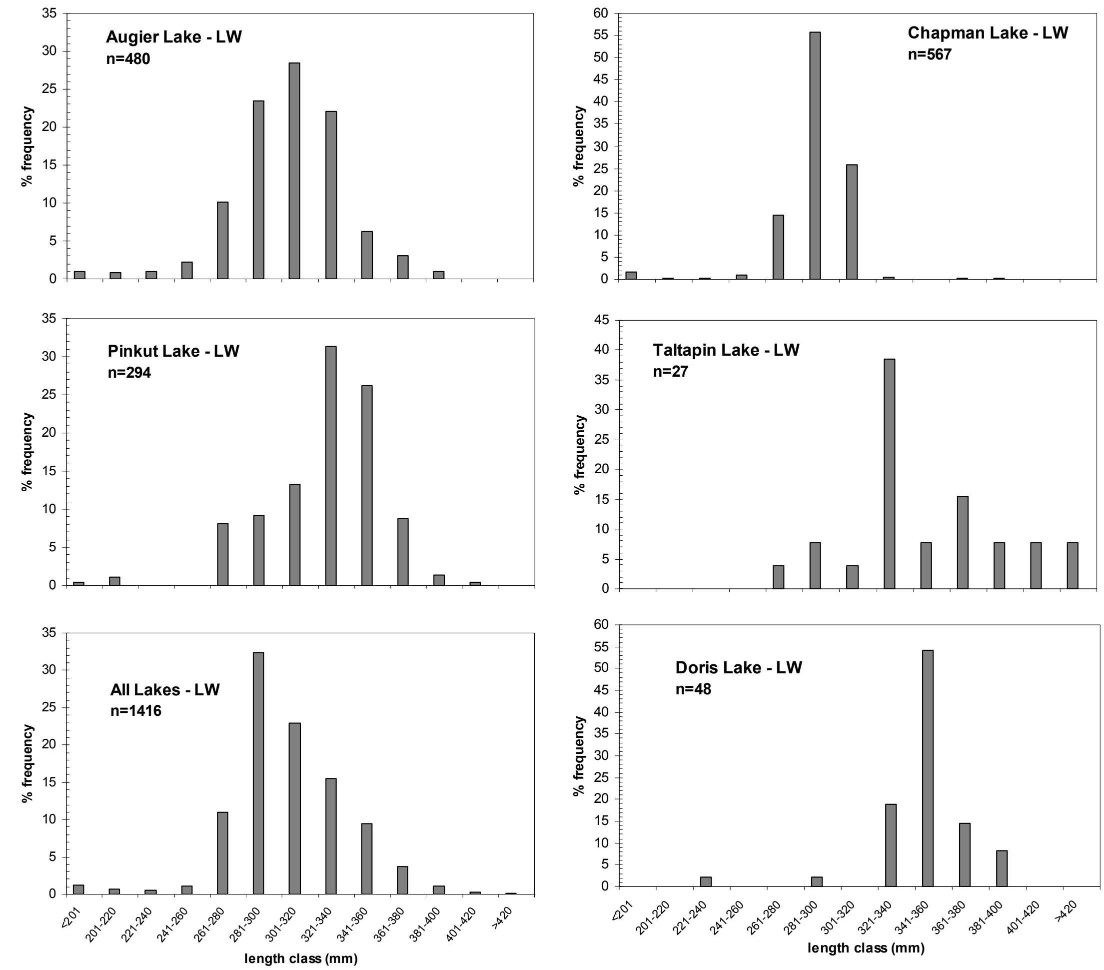

Figure 16: Length frequency histograms of lake whitefish captured in all nets from Augier, Pinkut, Chapman, Taltalpin, all lakes combined, and Doris lakes, during the spring of 2002.

Table 10: Descriptive statistics for lake trout captured in Augier, Pinkut, Taltapin, Chapman and Doris lakes in the spring of 2002.

Lake	Mean Length (mm)	SE	Median (mm)	Min. (mm)	Max. (mm)	n
Augier	609.03	32.44	645	350	970	31
Pinkut	472.58	30.39	449.5	194	932	40
Taltapin	426.42	28.36	381	194	888	43
Chapman	580.95	24.46	570	300	890	42
Doris						0
All Lakes	516.15	15.45	475	194	970	156

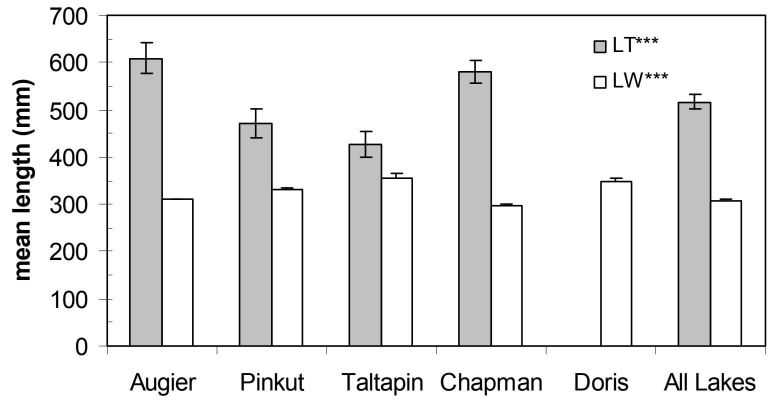

Figure 17: Mean length of lake trout and lake whitefish catch between lakes. Standard error bars are plotted. *** indicates significant differences between lakes (*p*=0.001 one-way ANOVA). Note: Combined (all lakes) lake trout lengths not included in ANOVA analysis.

Table 11: ANOVA (one-way) test results for lake trout length (mm) among Augier, Chapman, Pinkut and Taltapin lakes.

Group	*df*	*MS*	*F*	*P*
Among Lakes	3	288662.8	8.95	0.001
Within Lakes	152	32257.61		

Table 12: ANOVA (one-way) test results for lake whitefish length (mm) among Augier, Chapman, Pinkut, Doris and Taltapin lakes.

Group	*df*	*MS*	*F*	*P*
Among Lakes	5	656846.65	412.47	0.001
Within Lakes	1452	1592.47		

Table 13: ANOVA (one-way) test results for pooled lake whitefish lengths (mm) from lakes with mean lake trout length < 500 mm (Taltapin & Pinkut lakes) or no lake trout (Doris Lake) and lakes with mean lake trout > 500 mm (Augier & Chapman lakes).

Group	*df*	*MS*	*F*	*P*
Among Lakes	1	270370.92	284.45	0.001
Within Lakes	1414	950.51		

3.2.5.3 Non-Game sp.

Because non-game species were generally enumerated, but not measured, length data is not suitable for among lake comparisons.

3.3 Age & Growth

3.3.1 Lake Trout

Age and length classes included in the Walford growth estimates varied by lake and did not represent all age classes (Figure 18). In some instances, age classes were removed to best describe growth, using visual inspection of the vonBertalanffy growth curve (Figure 19). Pinkut Lake for example, had two old, (>25yrs) large lake trout removed as they upwardly biased vonBertalanffy growth parameter estimates considerably. The largest char were separated by as much as 400 mm from adjacent age classes. A greater number of lake trout samples per lake would improve the certainty of this estimate.

Lake trout from Chapman Lake (L_∞=700mm) and Augier Lake (L_∞=600mm) had the greatest asymptotic length estimated by Walford's method, whereas Pinkut Lake (L_∞'=928.5mm) had the greatest L_∞' (5% of geometric mean; Payne et al. 1991; Table 13). Chapman and Augier lakes recorded the greatest growth rates prior to age seven (Ω) followed by Taltapin and Pinkut using the Walford method for L_∞, whereas Chapman and Taltapin had the greatest Ω using L_∞' (Table 13). Chapman Lake has the highest overall growth rates (k=0.132) and omega using L' method (Ω =113.3) followed by Taltapin Lake (k=0.119; Ω =104.66), whereas Augier (k=0.089; ω =82.38) and Pinkut (k=0.083; Ω =77.23) growth rates were similar (Table 13).

Table 14: Summary of asymptotic length (L_∞), vonBertalanffy growth rate (k) and early growth (Ω) statistics for lake trout from Doris, Taltapin, Pinkut, Augier and Chapman lakes results using Walford's method (Ricker 1958) and L_∞' (Payne et al. 1990).

Lake	Walford Method			L∞′ (Payne et al. 1990)		
	L∞ (mm)	k	Omega (Ω) (mm)	L∞' (mm)	k	Omega (Ω) (mm)
Doris						
Taltapin	450	0.119	53.43	881.5	0.119	104.66
Pinkut	550	0.083	45.75	928.5	0.083	77.23
Augier	600	0.089	53.50	923.9	0.089	82.38
Chapman	700	0.132	92.28	859.5	0.132	113.30

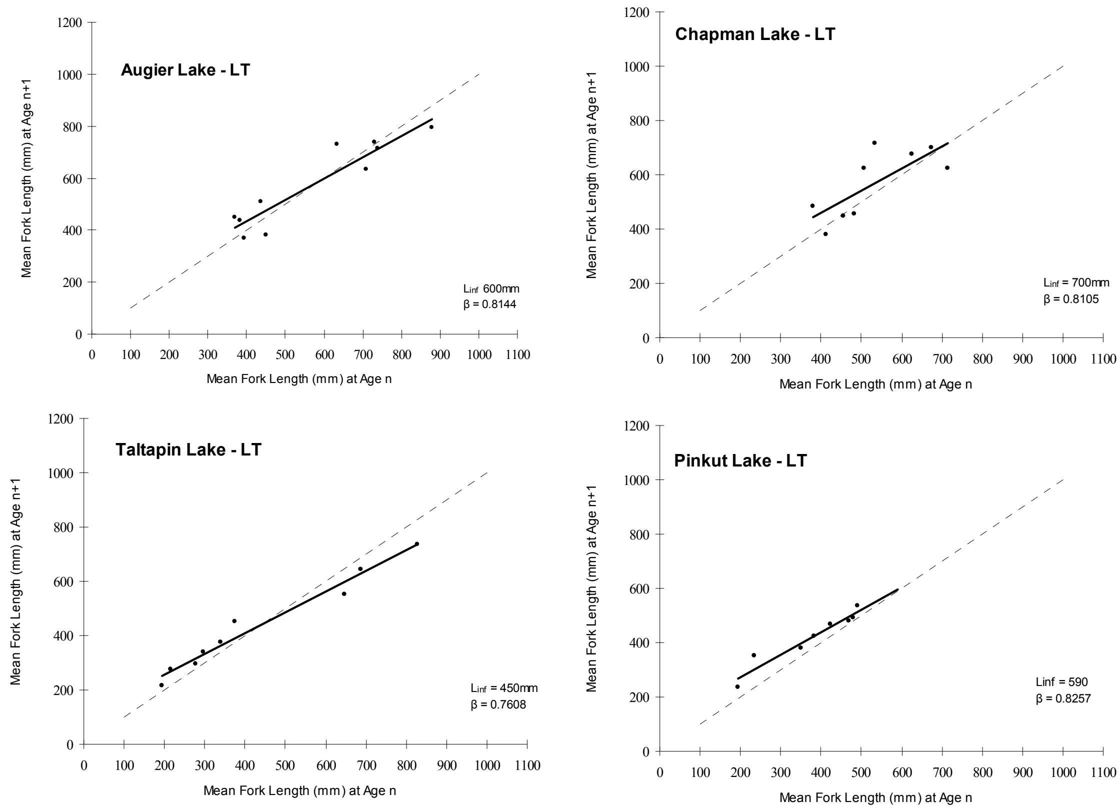

Figure 18: Walford plots for lake trout age classes used to estimate growth rates ($K = \log \beta$) in the vonBertalanffy growth curves. Lake trout were sampled from Augier, Pinkut, Chapman and Taltapin lakes, May & June, 2002.

vonBertalanffy growth curves generated using Walford's method for $L\infty$ generally under predicted growth rates and asymptotic length for lake trout, whereas $L\infty'$ provided a more representative fit and hence, accurate prediction of lake trout growth (Figure 19).

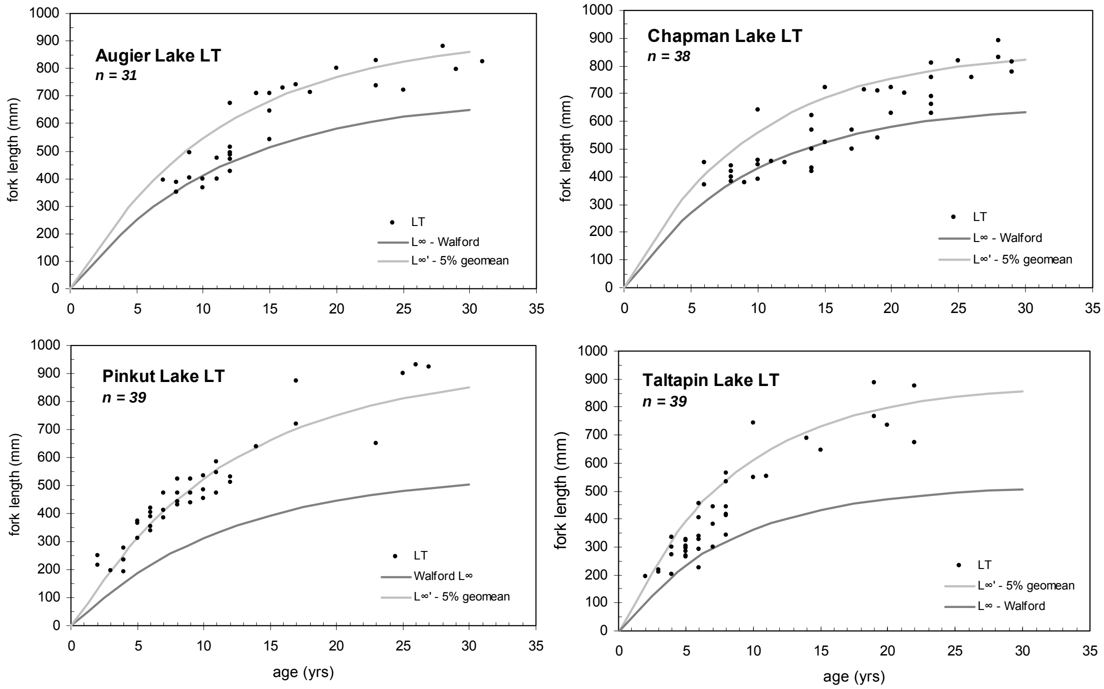

Figure 19: vonBertalanffy growth curves for lake trout from Augier, Chapman, Pinkut and Taltapin lakes, sampled in the spring of 2002. L_∞ (Walford plot estimates) and L_∞' plotted for each lake.

Age at 400 mm (*A*400) for lake trout was described by Lester et al. (1991) as a method to evaluate growth rates of populations where age data was not available. DeGisi (in prep.) adapted the approach as a means of classifying lake populations into either large of small bodied, or rapid or slow growth populations. DeGisi chose 750 mm as the criteria for body size based on literature and provincial standards for trophy size lake trout. He also chose nine years as the criteria defining slow versus rapid growth populations after reviewing literature and criteria established by deLeeuw et al. (1991). Applying the average growth slope for Skeena Region lake trout populations developed by DeGisi (β = 80.1), the populations sampled during the 2002 season fall into the rapid / large bodied category (Figure 20).

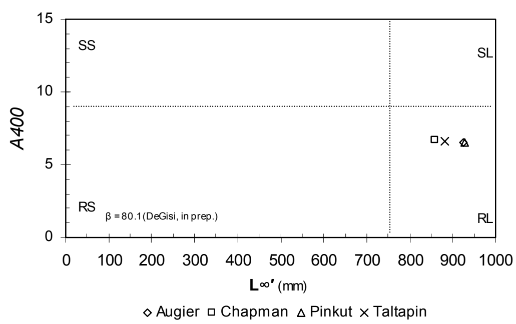

Figure 20: Plot of *A*400 (age at 400mm) against L_∞' for lake trout sampled in Augier, Chapman, Pinkut and Taltapin lakes. The plot is divided into quadrants following life history growth characteristics criteria described by DeGisi (in prep.) for slow small (SS), slow large (SL), rapid small (RS) and rapid large (RL) lake trout populations.

3.3.2 Lake Whitefish

Lake whitefish L_∞ and $L\infty'$ estimates were similar (Table 15). However, estimates for *K*, and Ω were generally higher using $L\infty'$. Taltapin Lake had the greatest asymptotic length regardless of method, whereas growth rate estimates (*K* and Ω) were greatest for Pinkut Lake whitefish using Walford's method and Augier using $L\infty'$ (Table 15).

Table 15: Summary of asymptotic length (*L*∞), vonBertalanffy growth rate (*k*) and early growth (Ω) statistics for lake whitefish from Taltapin, Pinkut, Augier and Chapman lakes results using Walford's method (Ricker 1954) and $L\infty'$ (Payne et al. 1990).

Lake	Walford Method			L∞′ (Payne et al. 1990)		
	L∞ (mm)	k	Omega (Ω) (mm)	L∞' (mm)	k	Omega (Ω) (mm)
Taltapin	550	0.046	25.17	443	0.173	141.20
Pinkut	350	0.293	102.59	405	0.108	118.63
Augier	415	0.131	54.17	397	0.451	179.07
Chapman	320	0.118	37.68	377	0.106	112.93

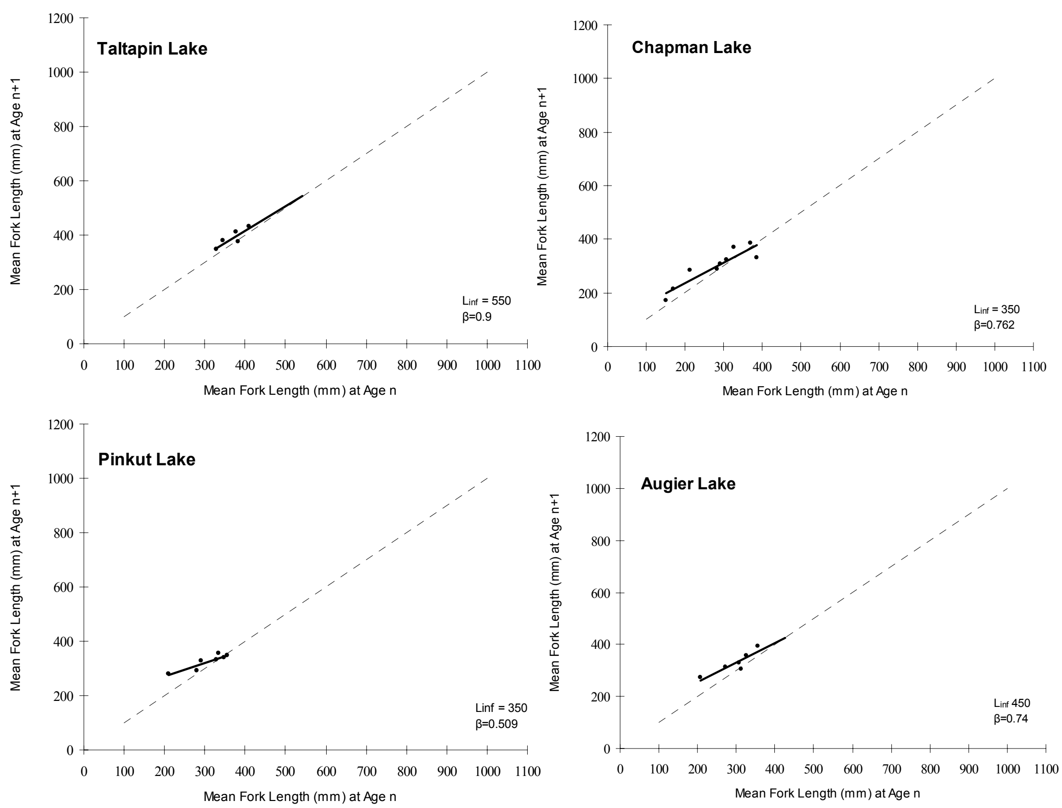

Figure 21: Walford plots for lake whitefish sampled from Augier, Pinkut, Chapman and Taltapin lakes, May & June, 2002.

Walford plots tended to under estimate lake whitefish asymptotic length and growth rates (Figures 21 and 22), whereas calculation of geometric mean of the largest 5% of the whitefish catch produced more accurate asymptotic lengths (L_∞'). Growth estimates however, required the use of selected age classes to best approximate observed growth patterns (Figure 22).

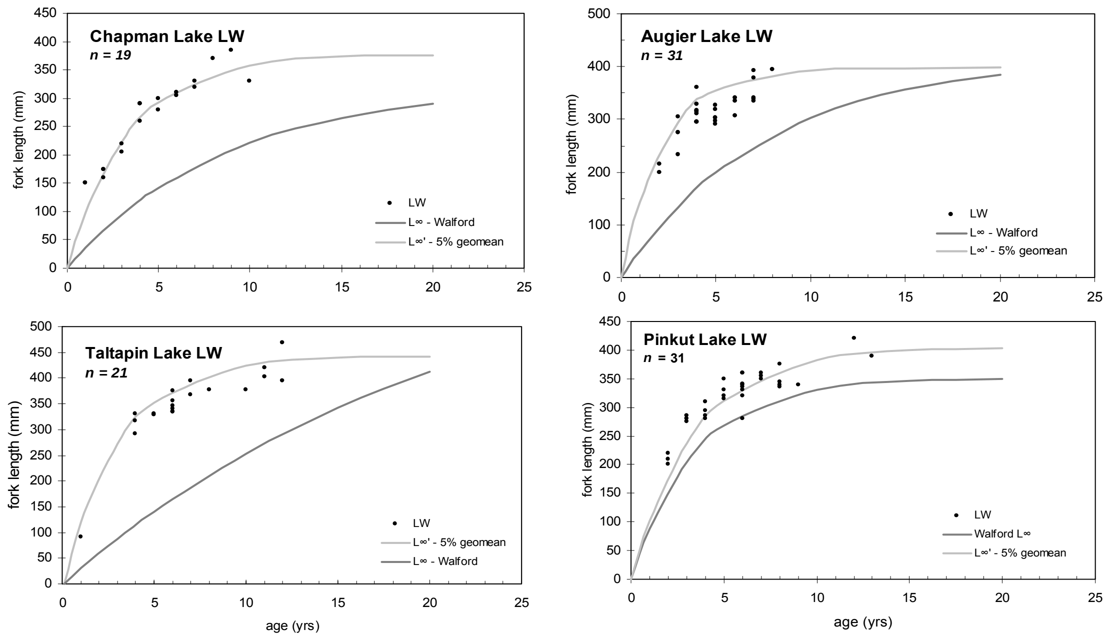

Figure 22: vonBertalanffy growth curves for lake whitefish from Augier, Chapman, Pinkut and Taltapin lakes, sampled in the spring of 2002. L_∞ (Walford plot estimates) and L_∞' plotted for each lake.

3.3.3 Condition

Lake trout captured in Pinkut and Augier lakes had the greatest mean Fulton's condition factor (*K*), followed by Taltapin and Chapman lakes (Table 16).

Table 16: Summary of mean and standard error of weight, length and Fulton's condition factor (K) for lake trout captured in Augier, Pinkut, Taltapin and Chapman lakes, spring 2002.

Lake	n	Mean Weight (g)	±SE	Mean Length (mm)	±SE	Mean Fulton's K	±SE
Augier	30	3317.83	524.4	612.83	33.3	1.05	0.03
Pinkut	40	1991.03	458.4	472.58	30.4	1.06	0.04
Taltapin	43	1456.22	324.1	426.42	28.4	1.01	0.03
Chapman	42	2610.39	330.9	580.95	24.5	0.95	0.05

Length weight relationship plotted using equation 11, using parameters derived from equation 12, produced similar curves for each lake. However, the noted differences in *K* were not significant (one-way ANOVA, p= 0.95). Of note, is the growth for each lake assessed lies below the Ontario Standard (Figure 23). Parameters used to generate length weight curves are presented in Table 17.

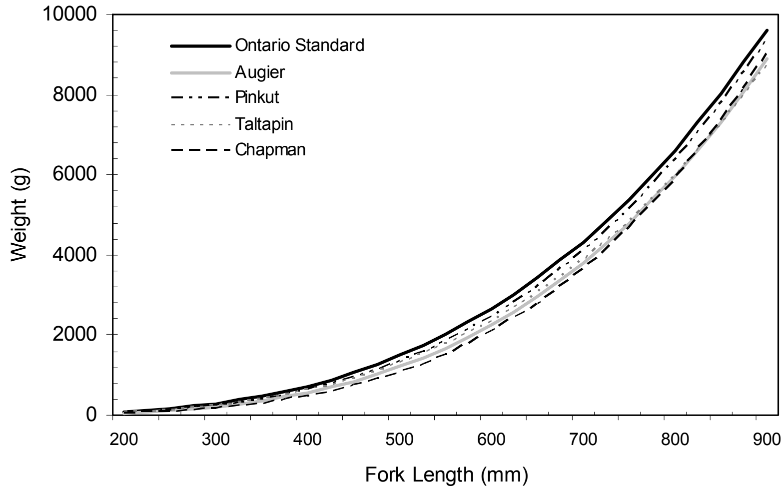

Figure 23: Length weight (condition) relationship for lake trout from Augier, Pinkut, Taltapin and Chapman lakes. Ontario standard condition ($W=3.88x10^{-6}L^{3.18}$) included for reference. Refer to Table 17 for a summary of intercept (*a)* and slope (*b)* parameters applied for individual lakes.

Table 17: Slope (b) and intercept (a) parameters used in lake trout weight prediction ($W=aL^{b}$; $a=10^{a'}$). b and a' derived from $_{log}$length, $_{log}$weight regression.

Lake	n	b	a'	a
Augier	30	3.39	-6.06	8.71E-07
Pinkut	40	3.30	-5.78	1.64E-06
Taltapin	43	3.24	-5.64	2.3E-06
Chapman	42	3.62	-6.73	1.85E-07

3.4 Mortality

Lake trout mortality estimates generated using Pauly's method modified by Shuter et al. 1998 (Equation 4) and Beverton-Holt method (Equation 5) provide parameters fundamental in the assessment of lake trout populations. Chapman and Taltapin lakes reported the highest estimated natural mortality rate (*M*) followed by Augier and Pinkut lakes (Table 18). Taltapin Lake and Chapman Lake reported the highest instantaneous mortality estimate (*Z*) at 0.29 and 0.28 respectively, whereas Pinkut Lake recorded 0.26 and Augier Lake 0.19 (Table 18). Fishing mortality was estimated using Equation 7. Pinkut (*F*=0.20) and Chapman (*F*=0.19) lakes are experiencing similar levels of fishing mortality, whereas Taltapin Lake has the highest *F* at 0.21. Augier Lake's fishing mortality is considerably lower (0.12; Table 18). Lester and Dunlop (2002) describe *F=0.*21 as the maximum *F* to maintain equilibrium yield.

Estimates of annual mortality for fish vulnerable to the sampling gear range from 25% (Taltapin) to 17% (Augier Lake; Table 18).

Table 18: Summary of von Bertalanffy growth parameters (L_∞', *K*) and estimates of natural mortality (*M*; Pauly 1980, Shuter et al. 1998), instantaneous mortality (Z; Beverton-Holt) fishing mortality (*F*) and annual mortality (*A*, Lester & Dunlop 2002) for lakes sampled during spring, 2002.

Lake	L_∞' (mm)	*K*	*Z*	*M*	*F*	*A*
Augier	924	0.09	0.19	0.06	0.12	0.17
Chapman	859	0.13	0.28	0.08	0.19	0.24
Doris						
Pinkut	928	0.08	0.26	0.06	0.20	0.23
Taltapin	881	0.12	0.29	0.08	0.21	0.25

3.4.1 Mortality Index: *Mean length above 400mm (ML400)*

Lester et al. (1991) present the use of mean length of catch above 400mm (ML400; Equation 6) as an index of lake trout mortality for individual lakes. Lester *et al.* (1991) discuss the bias associated with the use of L_∞ on the x-axis and suggest that although the A400 growth index is not precise, it provides less bias than L_∞. They also, recommend that ML400 and A400 not be used to assess individual lakes, but rather to gain an understanding of proportion of lakes that approach or exceed 50% annual mortality rate. The Ontario Min. of Natural Resources (OMNR) has established 50% annual mortality as the critical annual mortality level. Skeena Region lakes assessed in 2002 all fell well below the 50% threshold, with Pinkut Lake recording the lowest ML400 (595mm) and the highest L_∞ placing it in a higher annual mortality classification (Figure 24). The remaining lakes recorded similar ML400 values (Figure 24). The relatively high ML400 scores for Skeena lakes and slow growth rates placed it well below the 20% annual mortality threshold when compared against A400 (Figure 24).

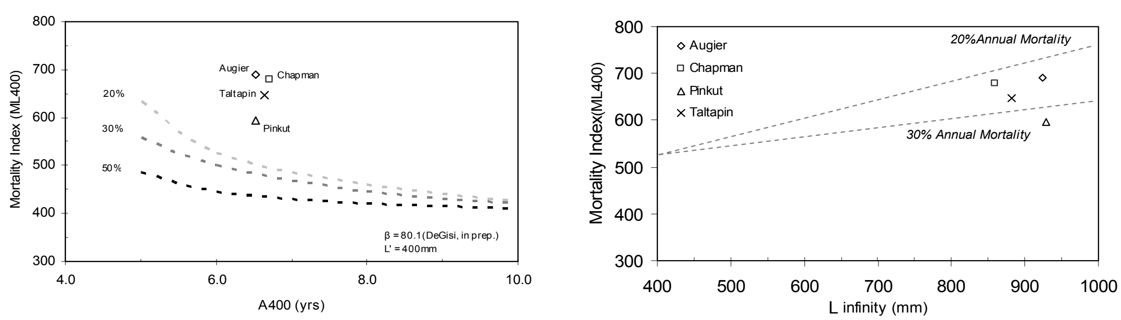

Figure 24: Plots of ML400 (mean length above 400mm) index of mortality for Augier (diamond), Chapman (square), Pinkut (triangle) and Taltapin (x) lakes against L_∞ (right plot) and *A*400 (age at 400mm; left plot). Annual mortality reference lines from Lester *et al.* (1991) plotted for 20, 30% (ML400 *vs.* L_∞) and 20-50% for ML400 *vs. A*400.

ML400 index was devised for use when adequate age data was not available. When adequate age data is available, Lester (pers. comm.) suggested ML400 be avoided as a means by which to assess lake trout mortality in lieu of other mortality measures.

3.5 Lake Trout Yield

Lake trout yield (kg/ha/yr) was not directly measured for any of the lakes sampled during the 2002 field season. However, maximum potential yield estimates were calculated using Christie and Regier's (1988) thermal habitat volume (THV) as described in Payne et al. (1990), as well as, applying maximum sustainable yield estimates (Payne et al. 1990). With the exception of Doris Lake, thermal habitat volume (THV) yield estimates were considerably higher to yield estimates using Payne et al. (1990; Table 19). Yield estimates are area based models, therefore the largest lakes (e.g. Taltapin) have the greatest predicted maximum sustainable yield (MSY) of lake trout, whereas smaller lakes (e.g. Doris) has the lowest MSY (Table 19).

Table 19: Summary of life history parameters for lake trout from Shuter et al. (1998) and maximum equilibrium yield estimates (Payne et al. 1990) on lakes sampled in 2002 field season. Tchesinkut Lake is included for perspective, due to its recent creel survey (Maniwa et al. 2001).

Lake	Lake Area (ha)	TDS (mg/l)	*L∞ (cm)*	*Omega (Ω) (cm)*	*Lm (cm)*	*Lm* 50 (cm)	*M*	*Lc (cm)*	*Bo*	*LT Yield (kg/ha/yr)*	*THV Yield (kg/ha/yr)*	*Creel Estimated LT Yield (kg/ha/yr)*
Tchesinkut	3382.7	10.9	66.15	8.25	45.94	43.58	0.16	34.25	135.23	0.535	1.81	0.640
Doris	113	47.9	51.97	10.48	37.16	39.48	0.24	32.24	85.14	0.343	0.06	
Taltapin	2105.1	88	63.96	11.57	45.99	46.48	0.21	38.61	123.91	0.513	1.57	
Pinkut	585.9	64	58.41	10.98	41.86	43.18	0.22	35.55	101.56	0.447	0.91	
Augier	906.2	60	60.25	10.87	43.11	43.96	0.22	36.14	108.03	0.470	1.13	
Chapman	670.6	63	58.97	10.96	42.25	43.43	0.22	35.74	103.45	0.454	0.98	

Note: TDS = total dissolved solids, Lm = predicted length at maturity, Lm 50 = length at which 50% of LT are mature, M = natural mortality, Lc = length at capture, Bo = recruitment rate, THV = thermal habitat volume yield estimate.

Lester and Dunlop (2002) present predicted response of lake trout maximum equilibrium yield (MEY) to fishing stress (*F*) for a 1000 ha lake with TDS = 26 $mg.^{L-1}$ (based on Shuter et al. 1998). The curve in Figure 25 represents the expected MEY for lakes in Ontario with limiting habitat (Lester and Dunlop, 2003). The vertical reference line (F=0.21) bisects the curve at critical maximum equilibrium yield (MEY). Points to the right of the line are exceeding sustainable fishing mortalities (F) and points outside of the curve exceed yield.

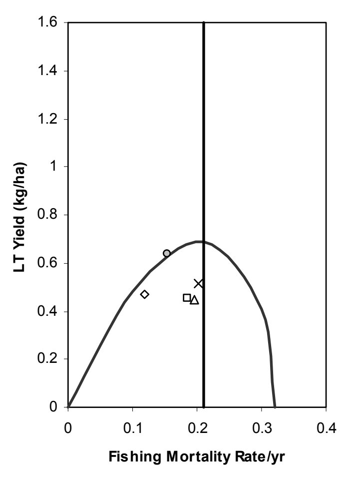

Figure 25: Plot of theoretical (Payne et al. 1990) maximum equilibrium lake trout yield (kg/ha/yr) against estimated fishing mortality (*F*) for Taltapin (x), Augier (diamond), Pinkut (triangle) and Chapman (square). Tchesinkut Lake (grey filled circle) creel estimated yield is also presented.

Curve presented from Lester and Dunlop (2003) of predicted response of fishing stress on lake trout yield (based on Shuter et al. 1998).

Lakes sampled in this report have their theoretical maximum equilibrium yield values based on Payne et al. (1990) and the estimated *F* parameters (Figure 25). Taltapin, Chapman and Pinkut lakes are approaching the recommended F_{max}, whereas Augier Lake appears to be experiencing sustainable harvest pressure (Figure 25). Tchesinkut Lake is plotted as reference for it is the only lake in Skeena Region with current lake trout harvest information. The plot indicates that Tchesinkut's lake trout are being harvested at slightly above its maximum equilibrium yield and cannot support higher harvest levels.

4.0 Discussion

4.1 Index Netting Evaluation and Recommendations

deLeeuw (1991) determined criteria for capturing lake trout using standard BC Min. of Environment (now referred to as standard Resource Inventory Standards Committee;(*RISC*)), multi-paneled 90 m overnight gill net sets in Skeena Region lakes. Lester et al. (1991) also developed day-time littoral lake trout netting standards and procedures for Ontario lakes. These standards were later described by Hicks et al. (1999). Although not designed specifically to evaluate netting method efficiency, the results of netting effort and catch of lake trout in this study support the findings of Lester et al. (1991); that short (1-1.5 hr), day time sets are the most efficient at capturing lake trout (Table 7). Although, overnight sets captured almost twice the number of lake trout per set, the number of trout captured on average (n=2.5), would require 15-20 sets to achieve a minimum sample size of lake trout to complete cursory stock assessment (n> 30). In addition, the mortality associated with overnight net sets is not acceptable considering the program's goals.

Daytime one -to- one and a half hour, 90m net sets recorded the highest lake trout capture rate (0.7 LT/hr). Applying this capture rate, thirty sets at 1.5 hrs/set would achieve a sample size of 31.5 lake trout on average for lakes with lake trout densities similar to those studied in this report, regardless of lake area. These results support the adoption of the SLIN program (Hicks 1999), which suggests 30-60 sites per lake be sampled using 90m nets. Thirty sites would be the minimum number of sets used to monitor a population, whilst 60 sites would provide greater confidence in the interpretation of the results and may be required when populations are suspected to be suffering excessive exploitation. Another advantage to the application of the SLIN is the ability to apply lake trout abundance estimates from netting CUE as described by Janoscik and Lester (2002) and placed in context to MEY (Lester and Dunlop 2003). It is, therefore recommended that the SLIN (Hicks, 1999) netting program be applied for future lake trout assessments in Skeena Region.

4.2 Assessment Techniques

deLeeuw (1991) and deLeeuw et al. (1991) designed a lake trout assessment program that would rapidly assess populations through the utilization of age-at-length plots, percent catch age, survival to 20 years and maturity to categorize lake trout populations into either slow or fast growing and exploitation level. Abundance was measured through catch per unit effort. Once categorized, management objectives for each lake trout population could be assigned (deLeeuw et al. 1991). deLeeuw et al. (1991) addressed post categorization assessment through monitoring changes in population parameters used in categorization. However, deLeeuw (1991) described that sample sizes required to detect changes in age and size at the 80% confidence level would require 37 lake trout to detect an average change of one age class and 24 lake trout for a 5 cm change in average population length. Catch per unit effort was used to monitor abundance.

The assessment protocol's described by deLeeuw et al. (1991) do not however, provide quantitative standards from which each lake trout population category is to be measured against. Rather, assessment relies on visual comparisons of historic sampling events. Netting bias, which deLeeuw (1991) does not discuss, is also a concern in the suggested assessment procedures.

Net site selection or netting intensity are not examined in detail by deLeeuw (1991) but, it is recommended that the same site or sites be selected from year-to-year. However, because of the small number of net sites, all habitats and therefore size classes of lake trout may not be exposed to the gear. The bias introduced to the catch from a low number of sites and compounded through possible variation in habitat, temporal, or thermal changes may significantly alter the catch and the resultant evaluation. This is a significant factor to consider, given that assessments may only be completed once a decade.

The net site selection procedures described by Hicks (1999) for OMNR SLIN procedures offer less spatial bias within each lake. With relatively equal lake trout abundances found in the lakes sampled in this report being common in other Skeena Region lakes, adequate sample sizes should be encountered to detect changes in age, growth and abundance. Continued use of deLeeuw's (1991) criteria with additional use of mortality estimates (M, F, and Z) abundance estimates following Hicks (1999), Janoscik and Lester (2002) and Lester and Dunlop (2003) will provide quantitative measures of change. Application of OMNR's biological reference points (e.g. MEY for yield and abundance; Lester and Dunlop (2003) may also be used until such a time that BC develops its own.

4.3 Lake Assessments

4.3.1 Doris Lake

deLeeuw and Hatlevik (1992) recorded the last confirmed record of lake trout in Doris Lake, capturing six and live releasing four (appendix 1e-5e). Maximum lake trout length was 84 cm. Doris Lake appeared to have a large bodied, low natural mortality population of lake trout. However, after 19 one-hour, 45m and 90m daytime littoral zone net sets, followed by another eight 90m sets completed in the fall, lake trout presence remains unconfirmed. Considering these results, this population of lake trout is at very low abundances and may be extirpated. Doris Lake provides marginal lake trout habitat, with a maximum depth of 13 m, and limited thermally suitable habitat during high summer (Figure 6). Combined with marginal habitat, depensatory effects are likely in effect contributing to the decline of the population (Walters and Kitchell 2001, Post et al. 2003). There are high numbers of competing fish species that may prey on lake trout eggs, fry or juveniles. Reduced abundance of lake trout adults due to fishing mortality may decrease predation of competing species, which in turn allows for an increase in the abundance of competing species. In all likelihood, this has contributed to subsequent lake trout recruitment failure and possible extirpation. There are no other known records of lake trout extirpations in BC lakes. Immediate non-retention angler regulations are required for Doris Lake to protect the fish that may remain in the lake. A monitoring plan will be required for this population to confirm lake trout presence and record any response to the closure.

4.3.2 Pinkut Lake

On June 4th, 1991, deLeeuw and Hatlevik captured three lake trout in Pinkut Lake after two overnight 91.4 m six-panelled RIC standard sinking gill nets (2691 m/net hrs), at the north end of the lake(appendix 1b-5b). Two of the three lake trout escaped from a damaged net and were estimated to be over 60cm and 80cm each, whereas one was measured at 55 cm and estimated to be six years of age. The catch of lake trout was considered to be extremely poor. The cause of the poor catch was concluded to be over fishing. Catch and release regulation changes for a period of ten years are recommended (deLeeuw and Hatlevik 1991). High catches of longnose and coarse scale suckers (n=241) as well as [lake] whitefish (n=54) may have contributed to net saturation and subsequent reduced catch of lake trout. The choice of netting sites was also proximal to Pinkut Creek inlet. Suckers were likely congregated at the north end of the lake in preparation for spawning.

Catch and release measures were not put in place as a result of the 1991 survey. In 2002, considerably more netting effort (7648 m/net hrs) was expended to capture 40 lake trout. Using criteria and methods of classification established by deLeeuw (1991) Pinkut Lake had moderate classed abundance (12.6 LT/100m net/day), moderate survival to maturity (71.8%), moderate survival to 20 yrs (10%) and its lake trout population was classed as a young / rapid growth for 2002 data. The difference in the catch results from the netting methods employed by deLeeuw and Hatlevik (1991) and this study, demonstrates the potential bias associated with seasonal sampling, employing limited netting sites and the use of overnight sets as a sole stock assessment measure.

Applying methods of analysis and categorization described by Payne et al. (1990), DeGisi (in-prep) and Lester and Dunlop (2003), Pinkut Lake is a rapidly growing, large bodied lake trout population that has low natural mortalities, but high instantaneous, annual and fishing mortality. It's fishing mortality estimate (F=0.20) places it at the maximum equilibrium level (Lester and Dunlop 2003) whereas its annual mortality (A=0.23) estimate places it well below the critical measure used in Ontario for fishery closure (*i.e.* A=50%). High mortality estimates result from the fact that the majority of the lake trout catch was less than 55 cm fork length.

It is unfortunate that a more complete historical data set does not exist for Pinkut Lake's lake trout population to assist in evaluating its state of equilibrium (*i.e.* abundance trend). However, it is likely that harvest pressure from sport angling and first nations netting has remained relatively constant over the past decade due to the lakes close proximity to the town of Burns Lake and its large and popular recreational camp site (estimated 2000-3500 annual users; Alex Bergen, pers. comm.). Based on the current catch and analysis information, Pinkut Lake's lake trout population is existing on the "knife's edge" of sustainability, as it is experiencing its maximum sustainable fishing mortality. Further review of Regional lake trout populations will assist in determining if Pinkut Lake is unique in its mortality rate or if it warrants special regulation consideration. The complex fish community and high abundance of suckers indicate that Pinkut's lake trout population may not recover should it be harvested to collapse. Therefore, regulation changes reducing angler harvest should be considered for Pinkut Lake.

4.3.3 Chapman Lake

In 1989, deLeeuw and Hatlevik captured 28 lake trout after 15766 m·net hrs of effort, corrected to 3 LT/100 m of net/day (Appendix 1d-5d). Netting occurred on May 28th (n= 4 sets), June 15 (n=1) and August 31 (n=4). Mean soak time was 20.6hrs/set. deLeeuw and Hatlevik (1989) concluded that the abundance for lake trout was poor (3 lt/100m net/day), survival to maturity was poor (82% immature), survival to age 20 yrs was moderate (6% catch >20yrs) and categorized as a moderate growth and age lake trout population. Catch and release regulations for lake trout for 5-10 years is recommended, with overfishing suggested as the cause for the fisheries depressed state.

Applying the same analysis methodology for sampling conducted in 2002 using a modified SLIN technique, 41 lake trout were captured after 1950 m·net hrs of effort (n=38, 45 m nets over 44.5 hrs), corrected to 50.5 LT/100m net/day. Lake trout survival to maturity was classed as good (54% LT immature), survival to age 20 was classed as good (28% catch >20ys), and categorized as a moderately (LT < 60 cm) rapid (LT> 60 cm) growing, moderate (50% catch) –to- old population. Compared to other lakes assessed in 2002, Chapman required the least amount of effort to capture 30 lake trout.

Chapman Lakes lake trout A400 to L_∞ plot place it in the rapid growing-large bodied population type. Low natural mortalities with fishing mortalities (*F*=.19) approaching maximum sustainable levels indicate that Chapman Lakes lake trout is experiencing high harvest levels. Immediate regulation changes are not essential, however; it does indicate that present regulations can leave populations vulnerable to overharvest.

4.3.4 Taltapin Lake

Past sampling of Taltapin Lake has limited value for comparative evaluations due to small sample size or incomplete data. Burns and Grosjean (1974) captured 12 lake trout after 9003 m·net hrs. The catch's mean fork length was 48.3cm (±SE 45.5). Age data was not presented in their summary report. Using the same six panelled sinking gill nets, deLeeuw and Hatlevik (1991; appendix 1c-5c) captured five small (all <39cm) lake trout after one overnight set (1919.4 m·net hrs). In their summary report, low netting effort and net placement was identified as biasing catch results. Conclusions or recommendations on the condition of the fishery were not presented.

In 2002, 43 lake trout were captured following 9004 m·net hrs, using short-set, small mesh daytime sampling, plus overnight sets. Applying deLeeuw's criteria for abundance, Taltapin's 11.5 LT/100 m net/day was ranked moderate (10-15 LT/100m net/day) and its catch of 1.33 LT/ 100 m net/day greater than70cm for length was classed as good. Fifty three percent of the catch was estimated to survive to maturity and was classed good (<60% immature), however, 40% of the catch was classed as unknown maturity. This assessment is however, based primarily on external maturity assessments (75%), and therefore should be interpreted with caution. Just five percent of the catch was 20 years or older and classed poor (<5%) –to- moderate (5- 10%). The lake trout catch from Taltapin was also categorized as a rapid growing – young population (88% of catch in young age classification).

Taltapin Lakes lake trout population has the highest *F* mortality estimate for all the lakes sampled in 2002 (Table 18). Of particular concern is the fishing mortality rate estimate (*F*=0.21), which places it at MEY (Lester and Dunlop 2003). Like the other lakes assessed in 2002 and identified with higher *F* estimates, immediate drastic measures for stock protection do not appear necessary. However, the results do indicate that Taltapin Lakes lake trout population is experiencing mortalities that may not be sustainable over the long term. Lake trout of Taltapin Lake may benefit from more conservative lake trout harvest regulations and could be a candidate for long term sampling to determine if recovery is measurable following regulation changes. Regulation changes that reduce angler harvest of lake trout should be considered for Taltapin Lake.

4.3.5 Augier Lake

Augier Lake was sampled August 20th, 1974 with two floating gill nets (2,925 m·net hrs) where one 51.5 cm lake trout was captured (Tredger and Caw 1975). deLeeuw and Hatlevik (1991; appendix 1a-5a) sampled Augier Lake May 5th, 1991 with one net set over 16 hrs (1462 m·net hrs) and captured six lake trout. Their CUE/abundance estimate (10 LT /100m net/day) classed Augier Lake as moderate (5-15 LT/100m net/day). Maturity was not assessed, as all the lake trout were live released. Sixteen percent of the catch was over the age of 20 years and therefore classed as *good* survival to 20 yrs (+10%). The lake trout population fell within the moderate aged, rapid growth categories.

High lake trout abundance estimates (CUE of 18.4 LT/100m net/day) resulted from the 2002 sampling of systematic short net sets and biased netting. Survival to maturity and age –to- 20 years parameters also fall within deLeeuw's (1991) *Good* categories. The catch of lake trout in 2002 from Augier Lake were primarily moderate aged (76%), with the remainder being within the *old age* class. Lake trout in Augier Lake remained within the rapid growth category. The results of the *A*400 *vs.* L_∞ plot indicate that Augier Lake's lake trout were classed as rapid growing-large bodied. Natural mortality was low (M = 0.06), as was fishing mortality (F=0.12) and annual mortality (A=17). These results are consistent with the observations (moderate aged population = low mortality & rapid growing) of deLeeuw and Hatlevik (1991) and the deLeeuw (1991) assessment techniques.

Augier Lake appears to have the lowest mortality/highest survival rates of all the lakes sampled in 2002. By all indications, exploitation of this lake appears to be having relatively little impact on the population. Based on the above results, Augier Lake appears to receive less angler and native harvest than the other lakes within the Pinkut Creek watershed. Should the majority of the lakes present populations of this sort, changes to the lake char regulations would not be necessary.

4.4 Regulations

Yield estimates are not available for the lakes surveyed in this report. However, fishing mortality estimates indicate that most accessible lake trout populations are being harvested just below the maximum equilibrium yield presented by Lester and Dunlop (2003). This indicates that under present effort and harvest regimes, the regulations are providing the minimum level of protection for the many of Skeena Region's small lake lake trout stocks. This is supported by the creel assessment completed on Tchesinkut Lake (Maniwa et al. 2001) where harvest rates were found to be slightly above MEY (Figure 25) while, fishing mortality was below MEY. Bustard (1989) found similar catch and harvest rates for Tchesinkut in his 1988 creel survey of Tchesinkut, indicating that this fishery may be at equilibrium. Unfortunately, harvest data is not available for the majority of Skeena's small lake trout lakes. With only fishing mortality estimates to use as an index of exploitation, Augier Lake is the only lake sampled that is not exhibiting fishing mortalities close to the MEY maximum.

The sample size of lakes in this report is inadequate to complete a responsible Region wide review of lake trout angling regulation effectiveness. However, it appears that small lake trout populations in small lakes (100 ha) are vulnerable to over-harvest and extirpation under current regulations. Lakes greater than 100 ha and smaller than 500 ha, can also be over-exploited if they are popular with anglers and the risk is enhanced should the lake also support a First Nations food fishery. However, a greater number of lakes require assessment and sampling prior to making recommendations for regulation changes. Furthermore, much of the assessment and benchmark tools are comprised of data collected in Ontario populations, which appear to have higher growth rates when compared to those in Skeena Region (DeGisi, in –prep). Development of exploitation limits for BC populations would assist greatly in determining sustainable yields and regulations.

Lake by lake regulation changes are also not recommended at this time to avoid piece-meal consultation with interest groups, unless emergency order circumstances exist. A coordinated and scientifically justifiable approach to lake trout regulation adjustments should be adopted and developed.

5.0 Conclusions

5.1 Methodology

5.1.1 Field Sampling

The high number of net sets, potential for spatial and gear types bias combined with the potential for destructive sampling of overnight RIC standard 90m sinking gill nets to assess lake trout populations renders them less effective and less desirable as an assessment technique. Non-destructive, short set (1.5hrs) day-time netting, with site selection procedures described by Hicks (1999) appear to provide the methodology that will provide the adequate number of lake trout for evaluation of abundance trends and life history characterization of individual populations; especially in a between lake landscape comparative perspective. Lake physical parameters such as, dissolved oxygen and temperature profiles, surface TDS and secchi depth should be measured at each SLIN sampling event.

5.1.2 Data Management, Analysis & Reporting

Data should be entered into the MSRM, FDIS database for capture into Fisheries Data Warehouse. Consideration should be given to the development of a visual basic module tool built from the FDIS database that could run biological analysis to generate figures and reports for Regional Biologists. Use of mortality based estimates and models appear to hold the greatest promise as a repeatable and quantitative assessment tool (Lester and Dunlop 2003) and will be adopted for Regional applications. deLeeuw's (1991) original notion of creating a simple report, supported with brief descriptions of each population will be maintained and modified. deLeeuw's (1991) population classification methods will be modified and incorporated into the report with the addition of mortality, vonBertalanffy growth parameters, Walford plots and SLIN abundance indices.

5.2 Regulations

Current lake trout regulations do not appear to provide adequate protection for small, and small –to- moderate sized lakes in BC. A project should be initiated to review the life history characteristics of BC's lake trout populations and consider generating models predicting biological reference points. Reference points could then be applied against various regulation scenarios, as well as, assisting in the interpretation of field based assessments. Also, small lakes (<100ha) with large bodied, long-lived populations should be considered for non-retention regulations Region wide.

5.3 Lake Assessments

Of the lake trout populations evaluated under this study, Augier Lake was the only population that appeared to be classed as healthy. The remaining lakes were either being exploited at or near the maximum sustainable levels. Doris Lakes lake trout population appears to be extirpated or experiencing very low abundances. Recovery of the population considering community effects may not be possible. Regardless of this, immediate non-retention of lake trout for Doris Lake is recommended as is further sampling in both spring and fall seasons to determine lake trout presence or absence. If determined absent, Doris Lake may be a candidate for a recovery/transplant experiment.

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Appendix 1: Skeena Region Lake Trout Assessment Reports

APPENDIX 1a

SKEENA REGION LAKE TROUT ASSESSMENT REPORT: AUGIER LAKE

LAKE NAME: Gazetted Augier Lake, Alias Auger .

LAKE LOCATION: Nearest Town: Burns Lake , Drainage Taltapin Lake → Babine Lake → Babine River → Skeena River.
Accessed by: Road ☒ Air ☐ (note Appendix 1, page 3)

LAKE TROUT MANAGEMENT OBJECTIVE: (Definition & Methods, Note Appendix 2, page 4 & 5)

Objective 1.	Maintain natural population.	☒
Objective 2.	Develop population of small fish.	☐
Objective 3.	Develop/maintain population of large fish.	☐

MANAGEMENT/SURVEY HISTORY: (Note Appendix 3, page 6)
Previous surveys: Yes ☒ No ☐
Previous lake trout assessment: Yes ☒ No ☐

SURVEY METHODS: (note Appendix 4, page 7 & 8)

Method			Date (YY.MM.DD)	Person
Fish	Gillnet	☒	June 6-7, 2002	P.Giroux/M.Jessop
Chem.	Water Samp.	☒	June 7, July 30 2002	P.Giroux/M.Jessop
Physical	No	☐		
Temp.	Yes	☒	June 7, July 30 2002	P.Giroux/M.Jessop

SURVEY RESULTS: (Note Appendix 5)

Fish caught: lake trout Y , other species LSU ,BB,CSU,LW, KO, RB, .

Adequate for further analysis: Yes ☒ No ☐

Lake Trout Abundance and Survival Analysis

	Poor	Moderate	Good	
Abundance of fish total.	☐	☐	☒	Page 9
Abundance of fish over 70 cm.	☐	☐	☒	Page 9
Survival to maturity.	☐	☐	☒	Page 10
Survival to age 20 years.	☐	☐	☒	Page 11

APPENDIX 1a

Lake Trout Age and Growth Analysis

Age.	Old ☒	Moderate ☒	Young ☐	Page 12
Growth. .	Slow ☐	Moderate ☐	Rapid ☒	Page 13

	Yes	No	
Survey location.	☒	☐	Page 14
Catch and survey information.	☒	☐	Page __
Photo documentation.	☒	☐	Page __

SURVEY CONCLUSIONS:

Objective	Objectives Achieved: Yes	No	Unknown	Reason
1. Natural population.	☒	☐	☐	Low angling pressure
2. Small fish.	☐	☐	☐	
3. Large fish.	☐	☐	☐	

RECOMMENDATIONS:

A. Assessment. Re-assess Augier Lake lake trout population in 5 – 10 years. Creel survey results would assist in determining harvest levels of LT.

B. Other. No regulation changes recommened.

COMMENTS:

Survey methods employed do not correspond directly to those described by deLeeuw (1990; see page 9 for details).

REPORT BY : Paul Giroux, DATE (YY-MM-DD): 03-01-08 .

APPENDIX 1a

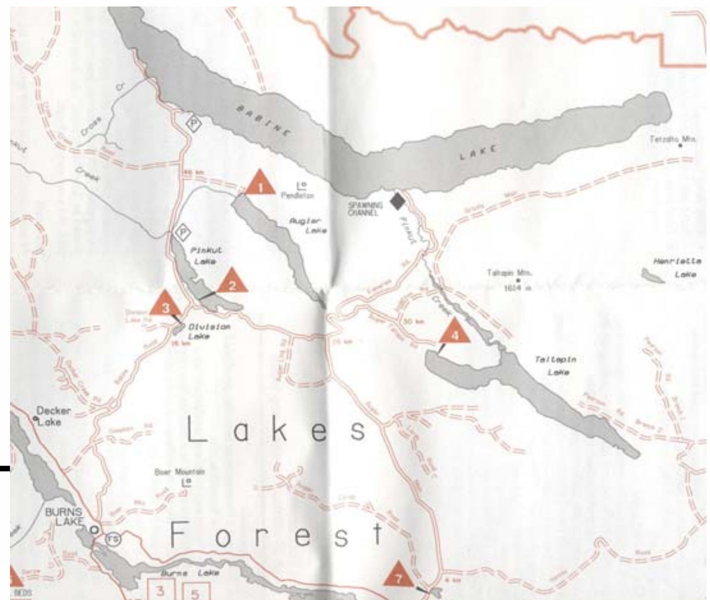
LAKE LOCATION

LAKE NAME: Augier Lake

DRAINAGE: BABL

MAP NUMBER: 104N / 04

ACCESS DIRECTIONS: HWY 16 → North on Babine Rd from Burns Lake → left on Augier/Taltapin Lake Rd → right on Auger Road



APPENDIX 2a

LAKE TROUT MANAGEMENT OBJECTIVE

In addition to province wide fisheries goals, strategic objectives of lake trout management in northern British Columbia will be to promote the maintenance and development of three types of lake trout populations and their associated fisheries. Strategic objectives for lake trout include the following:

STRATEGIC OBJECTIVE 1: Maintain natural populations.

Definition: The majority of lake trout lakes will fall into this category including those for which there is no information. Management intent will be to maintain the natural size and age distribution as well as population abundance of char. These lakes will generally receive low to moderate angling pressure. In some very accessible popular lakes where over harvest of lake trout has occurred, management for this objective will be required in order to restore such lake trout populations to natural levels.

Method: Methods to obtain this objective will include conservative region wide angler regulations and required habitat maintenance measures. This objective allows for the future implementation of objectives 2 and 3 below. In overfished lakes, catch and release regulations may have to be implemented.

STRATEGIC OBJECTIVE 2: Develop populations of small fish.

Definition: A few productive, generally very accessible and heavily angled lakes will be managed to obtain large numbers of primarily small, uniform sized lake trout.

Method: Methods to achieve this objective will include, in addition to habitat maintenance, the implementation of more liberal catch and minimum size restrictions on a few specified lakes. Once implemented the future option of providing large lake trout will very likely not be possible.

APPENDIX 2a

STRATEGIC OBJECTIVE 3: Develop/maintain populations of large fish.

Definition : In a few lakes it will be desirable to maintain/develop trophy size lake trout. These fish will always be "rare" and somewhat dependent on lake size and available forage base.

Method: Very likely the only possible method to achieve this objective will be severely restricted catch quotas or catch and release fisheries. This objective allows for the future implementation of objectives 1 and 2.

APPENDIX 3a

MANAGEMENT/SURVEY HISTORY

MANAGEMENT HISTORY:

Augier Lake has not had any specific management activity to date. Angling regulations have been 3 LT/day, 1 over 50cm, with a possession limit of two daily limits. Harvest of lake trout is closed annually from September 15 – November 15. A Forest Service recreation site (8 sites) is actively maintained at the north end of the lake and is noted as being popular with locals on the weekends.

Additional information on pages NA.

SURVEY HISTORY AND ADDITION INFORMATION:

This assessment report was completed as part of a HCTF funded project to develop a non-destructive assessment methodology for LT populations in small lakes of Region 6.

Additional information on pages NA.

APPENDIX 4a

SURVEY METHODS

The following general guidelines for sampling lake trout have been developed.

1. In order to obtain the greatest number of lake trout with the widest possible age range, sinking variable mesh mono-filament gill nets should be set overnight at right angles from shore during spring on bouldery substrates with each net set at a depth of 5m. near shore to 30m. at the deep end. The smallest mesh should be set at the deepest end. This procedure, in addition to catching adult and juvenile lake trout, will also reduce the number of other fish taken.

   In small lakes (less than 500 ha) two nets set overnight should suffice regardless of the number of lake trout obtained; a small sample probably indicates a small population. No more than two nets should be set in any single lake for a 24 hr. period, and a maximum of four individual sets should be made during a sampling period. Sinking variable mesh experimental gill nets should measure 91.4 by 2.4 m. with the following mesh sizes in panel order: 25, 76, 51, 891 381 64 mm.

2. At the very least, fork length and age must be determined for each lake trout caught. On any given lake, age should be determined consistently using either the finray or otolith method. The two techniques will age the same population with an average age difference of about 1 year. If the release of live fish is important, lake trout should be aged using the finray method whereby the basal portion of the first pectoral finray can be removed with surgical scissors or pruning shears. Information which should also be recorded include weight, state of maturity, stomach contents and any additional measurements which may be useful.

3. With restricted sampling capabilities and moderate to low population abundance of lake trout, the smallest change in average fork length which can realistically be detected is five cm or more, while the small lest detectable change in average age is greater than one year. Both these changes can be detected with sample sizes of between 24 and 36 fish, and a confidence coefficient of 0.8. The detection of smaller changes or the use of larger confidence coefficients requires unattainably large sample sizes and are therefore very likely not applicable for the monitoring of most Skeena region lake trout populations.

APPENDIX 4a (cont'd)

ADDITIONAL SURVEY METHODS INFROMATION:

45m sinking gill nets comprised of 1", 2" and 3" stretch mesh were set perpendicular to shore with a 15-20 m shore anchor line. Nets were left to fish for a minimum of 1 hour during day light hours. Nets were fished at a rate of 1 set/0.75km^2 of lake area. Additional sets were completed until a minimum sample size of 30 LT was obtained. Supplementary netting may have included 90m SGN where two of the 45m nets were ganged together. Lake depth at each end of the net was measured with an Eagle depth sounder.

A large female LT (97 cm fl; age 38) suffered mortality after capture. Upon internal inspection, it was discovered to have been afflicted with a large tumour. The eggs were atritic.

APPENDIX 5a

SURVEY RESULTS

LAKE TROUT ABUNDANCE ANALYSIS

LAKE NAME: Augier Lake

SAMPLE DATE: 2 (YY) 6 (MM) 6 (DD)

Correction Factor Calculation

Net Number	Net Length (m)	x	Hrs.	=	m.net hrs.
1	45.0		46.1		2076
2	90.0		21.9		1967
3					
4					
5					
6					
Total nets	(2)		Total m.net hrs.		(4042)

[(2400 x number of nets 2) / (total m.net hrs. 4042)]
/ [number of nets 2] = CF = correction factor = 0.59

Catch/100 m Gillnet/day Calculation

Species #	Name	Catch	x	CF	= Catch/100 m net/day
1	Lake trout	31		0.59	18.4
2	Lake trout over 70 cm.	14		0.59	8.31
3	Longnose Sucker	12		0.59	7.12
4	CSU	2		0.59	1.19
5	LW	480		0.59	285
6	BB	2		0.59	1.19
7	KO	2		0.59	1.19
8	RB	1		0.59	0.59
9				0.59	
10				0.59	

CONCLUSION, LAKE TROUT ABUNDANCE: (lake trout catch/100m gillnet/day).

TOTAL: Poor ☐ (0-5), Moderate ☐ (5-15), Good ☒ (over 15)

OVER 70 cm Poor ☐ (0-.5), Moderate ☐ (.5-1), Good ☒ (over 1)

APPENDIX 5a (cont'd)

SURVEY RESULTS

LAKE TROUT SURVIVAL TO MATURITY ANALYSIS

LAKE NAME: Augier Lake

SAMPLE DATE: 2 (YY) 6 (MM) 6 (DD)

Fork Length cm.	Frequency (N) Immature	Maturing	Mature	Total
1 - 4				0
5 - 9				0
10 - 14				0
15 - 19				0
20 - 24				0
25 - 29				0
30 - 34				0
35 - 39	5			5
40 - 44	3			3
45 - 49	2	2	1	5
50 - 54			2	2
55 - 59				0
60 - 64		1		1
65 - 69		1		1
70 - 74		2	5	7
75 - 79		1	2	3
80 - 84		1	1	2
85 - 89			1	1
90 - 94				0
95 - 99			1	1
100 - 100+				0
Total (%)	32.3	25.8	41.9	100

CONCLUSION, SURVIVAL TO MATURITY: (%immature fish in sample).

Poor ☐ (80-100% IMM), Moderate ☐ (60-80% IMM), Good ☒ (-60% IMM)

APPENDIX 5a (cont'd)

SURVEY RESULTS

LAKE TROUT SURVIVAL TO AGE 20 ANALYSIS

LAKE NAME: Augier Lake   SAMPLE DATE: 2 (YY) 6 (MM) 6 (DD)

Age	N	(%)	Cumulative (%)	Fork Length mm.
1	0	0.0	0.0	
2	0	0.0	0.0	
3	0	0.0	0.0	
4	0	0.0	0.0	
5	0	0.0	0.0	
6	1	3.3	3.3	393
7	2	6.7	10.0	368.5
8	2	6.7	16.7	449.5
9	1	3.3	20.0	399
10	3	10.0	30.0	413.3
11	6	20.0	50.0	511.7
12	1	3.3	53.3	710
13	3	10.0	63.3	632.3
14	1	3.3	66.7	730
15	1	3.3	70.0	740
16	1	3.3	73.3	714
17	0	0.0	73.3	
18	1	3.3	76.7	799
19	0	0.0	76.7	
20	0	0.0	76.7	
21	2	6.7	83.3	783.5
22	1	3.3	86.7	720
23	0	0.0	86.7	
24	1	3.3	90.0	880
25	1	3.3	93.3	795
26	0	0.0	93.3	
27	0	0.0	93.3	
28	1	3.3	96.7	825
29	0	0.0	96.7	
30	0	0.0	96.7	
31	0	0.0	96.7	
32	0	0.0	96.7	
33	0	0.0	96.7	
34	0	0.0	96.7	
35	0	0.0	96.7	
36	0	0.0	96.7	
37	0	0.0	96.7	
38	1	3.3	100.0	970
39	0	0.0	100.0	
40+	0	0.0	100.0	
Total	30	100	30	609

CONCLUSION, SURVIVAL TO AGE 20 YEARS: (% of fish 20 years or older).

Poor ☐ (0-5%), Moderate ☐ (5-10%), Good ☒ (+10%)

APPENDIX 5a (cont'd)

SURVEY RESULTS

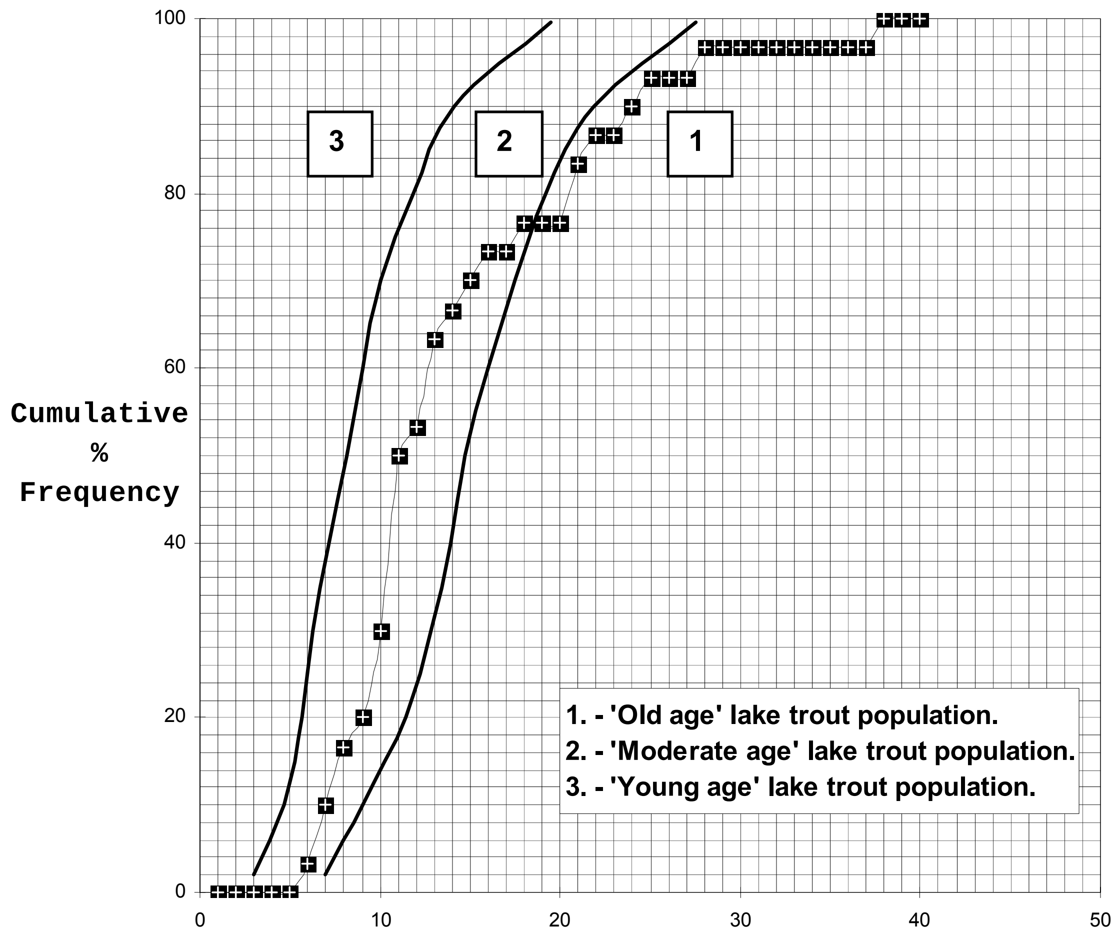
LAKE TROUT AGE ANALYSIS

LAKE NAME: Augier Lake

SAMPLE DATE: 2 (YY) 6 (MM) 6 (DD)

SAMPLE METHOD: Gillnet

SAMPLE SIZE: 31, ADEQUATE ☒, NOT ADEQUATE ☐



CONCLUSION, AGE: Old ☒ → Moderate ☒ Young ☐

APPENDIX 5a (cont'd)

SURVEY RESULTS

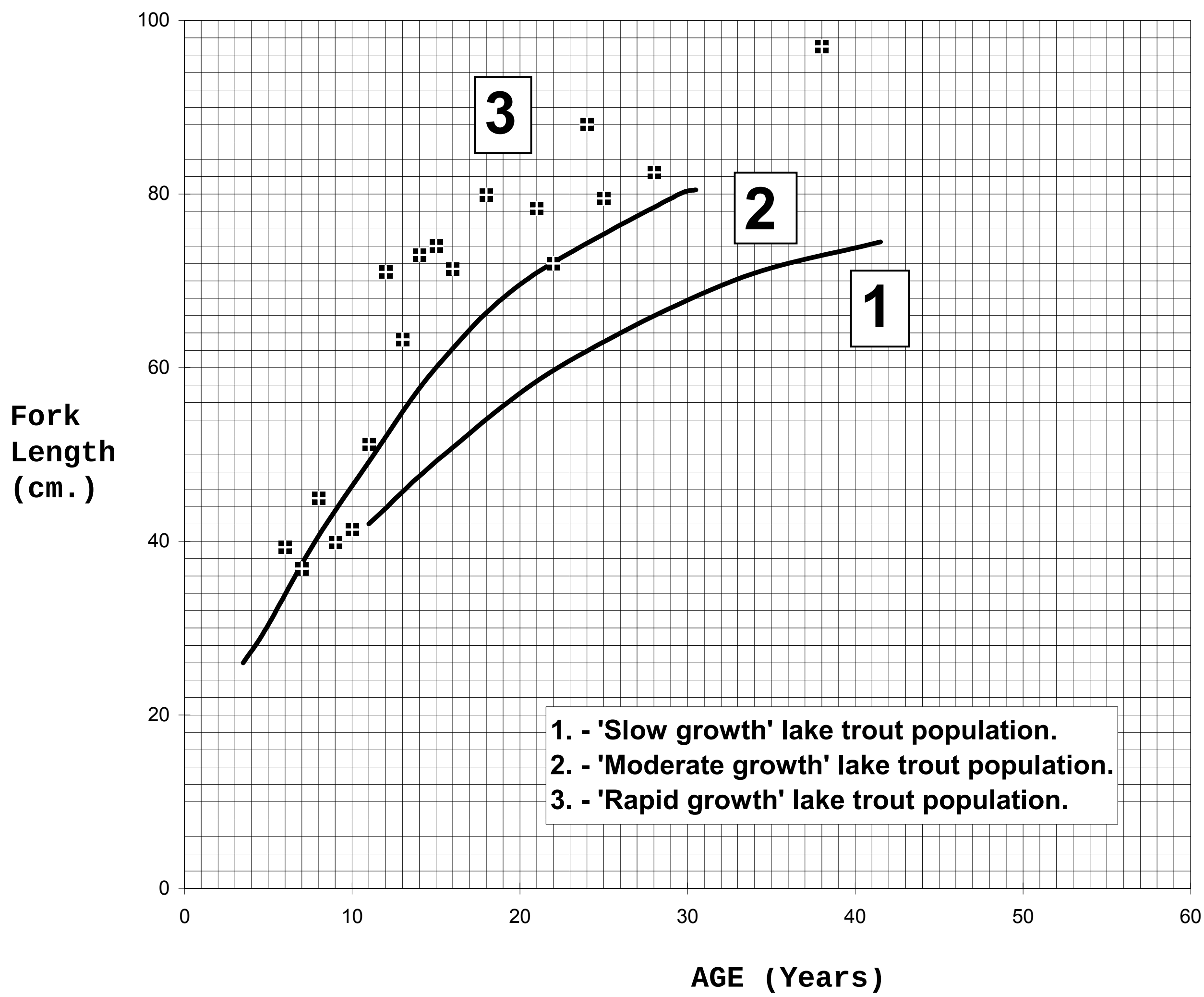
LAKE TROUT GROWTH ANALYSIS

LAKE NAME: Augier Lake

SAMPLE DATE: 2 (YY) 6 (MM) 6 (DD)

SAMPLE METHOD: Gillnet

SAMPLE SIZE: 31, ADEQUATE ☒, NOT ADEQUATE ☐



CONCLUSION, GROWTH: Slow ☐ Moderate ☐ Rapid ☒

APPENDIX 5a (cont'd)

SURVEY RESULTS

LAKE TROUT SURVEY LOCATION

LAKE NAME: _Augier Lake_______ SAMPLE DATE: _02_ _06_ _6-7_
YY MM DD

MAP NUMBER: _NTS 1:50 000 103K/05___

LT Raw data

Length	Weight	Age (FR)	Sex	Maturity
350	420	7	M	IM
365	410	10	M	IM
387	580	7	U	IM
393	580	6	U	IM
399	590	9	M	IM
400	580	10	U	IM
404	575	8	U	IM
428	690	11	M	IM
470	630	11	U	U
475	1075	10	M	IM
487	1090	11	U	U
495		11	U	IM
495	1210	8	M	MT
515	1080	11	F	MT
542	1640	13	M	MT
645	2940	13	U	U
675	4180	11	F	MT
710	3840	12	M	M
710	3840	13	M	M
714	4040	16	M	M
720	5380	22	M	MT
730	3290	14	M	M
737	4030	21	U	MT
740	3840	15	M	M
795	5645	25	U	U
795	8350		F	MT
799	6680	18	F	MT
825	6880	28	F	MT
830	6890	21	M	M
880	8060	24	F	M
970	10500	38	F	M

APPENDIX 1b

SKEENA REGION LAKE TROUT ASSESSMENT REPORT: PINKUT LAKE

LAKE NAME: Gazetted PINKUT LAKE, Alias ____.

LAKE LOCATION: Nearest Town: Burns Lake, Drainage Taltapin Lake → Babine Lake → Babine River → Skeena River.
Accessed by: Road ☒ Air ☐ (note Appendix 1, page 3)

LAKE TROUT MANAGEMENT OBJECTIVE: (Definition & Methods, Note Appendix 2, page 4 & 5)

Objective 1.	Maintain natural population.	☒
Objective 2.	Develop population of small fish.	☐
Objective 3.	Develop/maintain population of large fish.	☐

MANAGEMENT/SURVEY HISTORY: (Note Appendix 3, page 6)
Previous surveys: Yes ☒ No ☐
Previous lake trout assessment: Yes ☒ No ☐

SURVEY METHODS: (note Appendix 4, page 7 & 8)

Method			Date (YY.MM.DD)	Crew
Fish	Gillnet	☒	June 6, 2002	Paul Giroux/Matt Jessop
Chem.	Water Samp.	☐		
Physical	No	☐		
Temp.	Yes	☒	June 6, July 27 2002	Mark Beere/Jeff Lough

SURVEY RESULTS: (Note Appendix 5)

Fish caught: lake trout Y___ , other species LSU, BB, CSU, LW, RB, WSU.

Adequate for further analysis: Yes ☒ No ☐

Lake Trout Abundance and Survival Analysis

	Poor	Moderate	Good	
Abundance of fish total.	☐	☒	☐	Page 9
Abundance of fish over 70 cm.	☐	☐	☒	Page 9
Survival to maturity.	☐	☒	☐	Page 10
Survival to age 20 years.	☐	☒	☐	Page 11

APPENDIX 1b

Lake Trout Age and Growth Analysis

Age.	Old ☐	Moderate ☐	Young ☒	Page 12
Growth. .	Slow ☐	Moderate ☐	Rapid ☒	Page 13

	Yes	No	
Survey location.	☒	☐	Page 14
Catch and survey information.	☒	☐	Page __
Photo documentation.	☒	☐	Page __

SURVEY CONCLUSIONS:

Objective	Objectives Achieved Yes	No	Unknown	Reason
4. Natural population.	☒	☐	☐	
5. Small fish.	☐	☐	☐	
6. Large fish.	☐	☐	☐	

RECOMMENDATIONS:

A. Assessment. Re-assess Pinkut Lake lake trout population in 5 – 10 years. Creel survey necessary to determine LT harvest levels.

B. Other. Harvest restriction regulation changes may be prudent. LT catch and release for 10 years or slot limits for retention between minimum 50 cm and maximum 65 cm.

COMMENTS:

Survey methods employed do not correspond directly to those described by deLeeuw (1990; see page 9 for details).

REPORT BY : Paul Giroux, DATE (YY-MM-DD): 03-01-10.

APPENDIX 1b

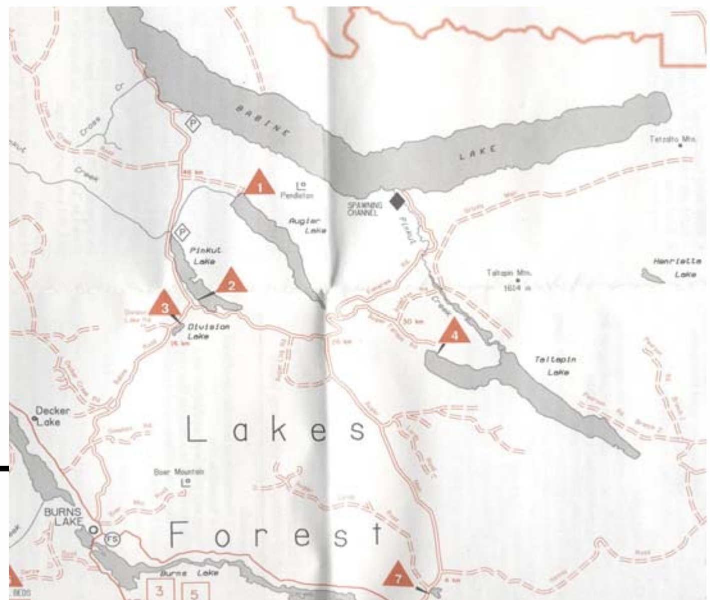
LAKE LOCATION

LAKE NAME: Pinkut Lake

DRAINAGE: BABL

MAP NUMBER: 93L / 15

ACCESS DIRECTIONS: HWY 16 → North on Babine Rd from Burns Lake



APPENDIX 2b

LAKE TROUT MANAGEMENT OBJECTIVE

In addition to province wide fisheries goals, strategic objectives of lake trout management in northern British Columbia will be to promote the maintenance and development of three types of lake trout populations and their associated fisheries. Strategic objectives for lake trout include the following:

STRATEGIC OBJECTIVE 1: Maintain natural populations.

Definition: The majority of lake trout lakes will fall into this category including those for which there is no information. Management intent will be to maintain the natural size and age distribution as well as population abundance of char. These lakes will generally receive low to moderate angling pressure. In some very accessible popular lakes where over harvest of lake trout has occurred, management for this objective will be required in order to restore such lake trout populations to natural levels.

Method: Methods to obtain this objective will include conservative region wide angler regulations and required habitat maintenance measures. This objective allows for the future implementation of objectives 2 and 3 below. In overfished lakes, catch and release regulations may have to be implemented.

STRATEGIC OBJECTIVE 2: Develop populations of small fish.

Definition: A few productive, generally very accessible and heavily angled lakes will be managed to obtain large numbers of primarily small, uniform sized lake trout.

Method: Methods to achieve this objective will include, in addition to habitat maintenance, the implementation of more liberal catch and minimum size restrictions on a few specified lakes. Once implemented the future option of providing large lake trout will very likely not be possible.

APPENDIX 2

STRATEGIC OBJECTIVE 3: Develop/maintain populations of large fish.

Definition : In a few lakes it will be desirable to maintain/develop trophy size lake trout. These fish will always be "rare" and somewhat dependent on lake size and available forage base.

Method: Very likely the only possible method to achieve this objective will be severely restricted catch quotas or catch and release fisheries. This objective allows for the future implementation of objectives 1 and 2.

APPENDIX 3b

MANAGEMENT/SURVEY HISTORY

MANAGEMENT HISTORY:

Pinkut Lake has not had any lake specific management or regulations (deLeeuw 1992). Angling regulations have been 3 LT/day, 1 over 50cm, with a possession limit of two daily limits. Harvest of lake trout is closed annually from September 15 – November 15. A Forest Service recreation site is actively maintained on the southern shore of the lake. The Pinkut Lake Recreation Site has been in place since 1979 and currently has an average annual visitation estimate of 2000-3500 users (Alex Bergen, MoF Rec. Officer, Burns Lake). Pinkut Lake has been accessible by road since 1920. Pinkut Lake has had past subsistence fisheries and presently supports a first nations subsistence fishery for LT, WF, BB and SU.

Additional information on pages NA.

SURVEY HISTORY AND ADDITION INFORMATION:

This assessment report was completed as part of a HCTF funded project to develop a non-destructive assessment methodology for LT populations in small lakes of Region 6. deLeeuw & Hatlevik sampled Pinkut Lake in 1991, capturing 1 (2, 91.4m nets @ 2691 m/net hr) LT and concluded the abundance of the catch was poor and recommended catch & release regulation change be implemented for LT for at least 10 years. They also note the failure to meet the “Natural Population” objective was attributed to over-fishing. Forage fish were noted as abundant (n=215 SU).

Additional information on pages NA.

APPENDIX 4b

SURVEY METHODS

The following general guidelines for sampling lake trout have been developed.

1. In order to obtain the greatest number of lake trout with the widest possible age range, sinking variable mesh mono-filament gill nets should be set overnight at right angles from shore during spring on bouldery substrates with each net set at a depth of 5m. near shore to 30m. at the deep end. The smallest mesh should be set at the deepest end. This procedure, in addition to catching adult and juvenile lake trout, will also reduce the number of other fish taken.

   In small lakes (less than 500 ha) two nets set overnight should suffice regardless of the number of lake trout obtained; a small sample probably indicates a small population. No more than two nets should be set in any single lake for a 24 hr. period, and a maximum of four individual sets should be made during a sampling period. Sinking variable mesh experimental gill nets should measure 91.4 by 2.4 m. with the following mesh sizes in panel order: 25, 76, 51, 891 381 64 mm.

2. At the very least, fork length and age must be determined for each lake trout caught. On any given lake, age should be determined consistently using either the finray or otolith method. The two techniques will age the same population with an average age difference of about 1 year. If the release of live fish is important, lake trout should be aged using the finray method whereby the basal portion of the first pectoral finray can be removed with surgical scissors or pruning shears. Information which should also be recorded include weight, state of maturity, stomach contents and any additional measurements which may be useful.

3. With restricted sampling capabilities and moderate to low population abundance of lake trout, the smallest change in average fork length which can realistically be detected is five cm or more, while the small lest detectable change in average age is greater than one year. Both these changes can be detected with sample sizes of between 24 and 36 fish, and a confidence coefficient of 0.8. The detection of smaller changes or the use of larger confidence coefficients requires unattainably large sample sizes and are therefore very likely not applicable for the monitoring of most Skeena region lake trout populations.

APPENDIX 4b (cont'd)

ADDITIONAL SURVEY METHODS INFORMATION:

45m sinking gill nets comprised of 1", 2" and 3" stretch mesh were set perpendicular to shore with a 15-20 m shore anchor line. Nets were left to fish for a minimum of 1 hour during day light hours. Minimum effort for netting included fishing nets at a rate of 1 set/0.75km^2 of lake area. Additional sets were completed with two 45m nets ganged together to form 90m nets, and fished until a minimum sample size of 30-40 LT was obtained. The area off-shore and west of the small island in the south-east end of the lake provided the most consistent catch of lake trout. Twenty cm (two year old) lake trout were captured on the south shore of the mid-lake peninsula.

2002 sample results indicate short set day light netting appears to have improved capture rates than the 14-20hrs 91.4 SGN sets deployed by deLeeuw & Hatlevik 1991 for LT and lower capture rates for SU. Therefore, direct comparison of abundance results between methods appears to be nominal.

APPENDIX 5b

SURVEY RESULTS

LAKE TROUT ABUNDANCE ANALYSIS

LAKE NAME: PINKUT LAKE

SAMPLE DATE: 02 (YY) 06 (MM) 11,1 (DD)

Correction Factor Calculation

Net Number	Net Length (m)	x	Hrs.	=	m.net hrs.
1	90.0		73.4		6607
2	45.0		23.1		1041
3					
4					
5					
6					
Total nets	(2)		Total m.net hrs.		(7648)

[(2400 x number of nets 2) / (total m.net hrs. 7648)]
/ [number of nets 2] = CF = correction factor = 0.31

Catch/100 m Gillnet/day Calculation

Species #	Name	Catch	x	CF	= Catch/100 m net/day
1	Lake trout	40		0.31	12.6
2	Lake trout over 70 cm.	5		0.31	1.57
3	Longnose Sucker	57		0.31	17.9
4	White Sucker	27		0.31	8.47
5	LW	299		0.31	93.8
6	BB	15		0.31	4.71
7	RB	16		0.31	5.02
8	CSU	6		0.31	1.88
9				0.31	0
10				0.31	0

CONCLUSION, LAKE TROUT ABUNDANCE: (lake trout catch/100m gillnet/day).

TOTAL: Poor ☐ (0-5), Moderate ☒ (5-15), Good ☐ (over 15)

OVER 70 cm Poor ☐ (0-.5), Moderate ☐ (.5-1), Good ☒ (over 1)

APPENDIX 5b (cont'd)

SURVEY RESULTS

LAKE TROUT SURVIVAL TO MATURITY ANALYSIS

LAKE NAME: PINKUT LAKE   SAMPLE DATE: 02 (YY) 06 (MM) 11,12 (DD)

Fork Length cm.	Frequency (N) Immature	Maturing	Mature	Total
1 - 4				0
5 - 9				0
10 - 14				0
15 - 19	2			2
20 - 24	3			3
25 - 29	2			2
30 - 34	2			2
35 - 39	5			5
40 - 44	6			6
45 - 49	6			6
50 - 54	2	4		6
55 - 59		1		1
60 - 64				0
65 - 69		1		1
70 - 74		1		1
75 - 79				0
80 - 84				0
85 - 89			1	1
90 - 94		1	2	3
95 - 99				0
100 - 100+				0
Total (%)	71.8	20.5	7.7	100

CONCLUSION, SURVIVAL TO MATURITY: (%immature fish in sample).

Poor ☐ (80-100% IMM), Moderate ☒ (60-80% IMM), Good ☐ (-60% IMM)

APPENDIX 5b (cont'd)

SURVEY RESULTS

LAKE TROUT SURVIVAL TO AGE 20 ANALYSIS

LAKE NAME: PINKUT LAKE   SAMPLE DATE: 02 (YY) 06 (MM) 11,12 (DD)

Age	N	(%)	Cumulative (%)	Fork Length mm.
1	0	0.0	0.0	
2	3	7.5	7.5	233.3
3	2	5.0	12.5	194.5
4	2	5.0	17.5	256
5	3	7.5	25.0	350.3
6	5	12.5	37.5	381.6
7	3	7.5	45.0	423.3
8	4	10.0	55.0	468.5
9	3	7.5	62.5	480
10	3	7.5	70.0	491.7
11	3	7.5	77.5	535
12	2	5.0	82.5	520
13	0	0.0	82.5	
14	1	2.5	85.0	640
15	0	0.0	85.0	
16	0	0.0	85.0	
17	2	5.0	90.0	796
18	0	0.0	90.0	
19	0	0.0	90.0	
20	0	0.0	90.0	
21	0	0.0	90.0	
22	0	0.0	90.0	
23	1	2.5	92.5	650
24	0	0.0	92.5	
25	1	2.5	95.0	900
26	1	2.5	97.5	932
27	1	2.5	100.0	925
28	0	0.0	100.0	
29	0	0.0	100.0	
30	0	0.0	100.0	
31	0	0.0	100.0	
32	0	0.0	100.0	
33	0	0.0	100.0	
34	0	0.0	100.0	
35	0	0.0	100.0	
36	0	0.0	100.0	
37	0	0.0	100.0	
38	0	0.0	100.0	
39	0	0.0	100.0	
40+	0	0.0	100.0	
Total	40	100		473

CONCLUSION, SURVIVAL TO AGE 20 YEARS: (% of fish 20 years or older).

Poor ☐ (0-5%), Moderate ☒ (5-10%), Good ☐ (+10%)

APPENDIX 5b (cont'd)

SURVEY RESULTS

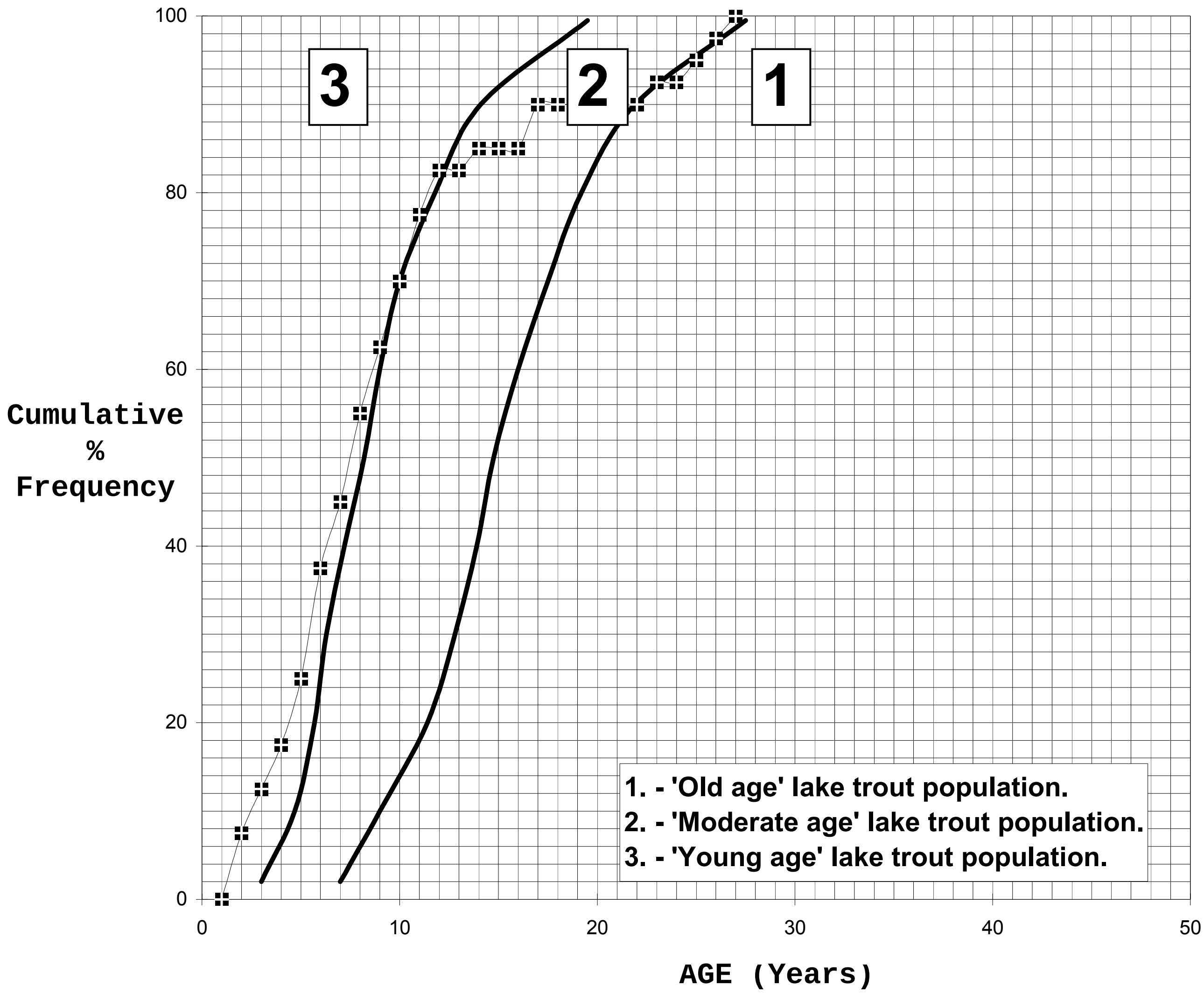
LAKE TROUT AGE ANALYSIS

LAKE NAME: PINKUT LAKE

SAMPLE DATE: 02 (YY) 06 (MM) 11,12 (DD)

SAMPLE METHOD: Gillnet

SAMPLE SIZE: 40, ADEQUATE ☒, NOT ADEQUATE ☐



CONCLUSION, AGE: Old ☐ → Moderate ☐ Young ☒

APPENDIX 5b (cont'd)

SURVEY RESULTS

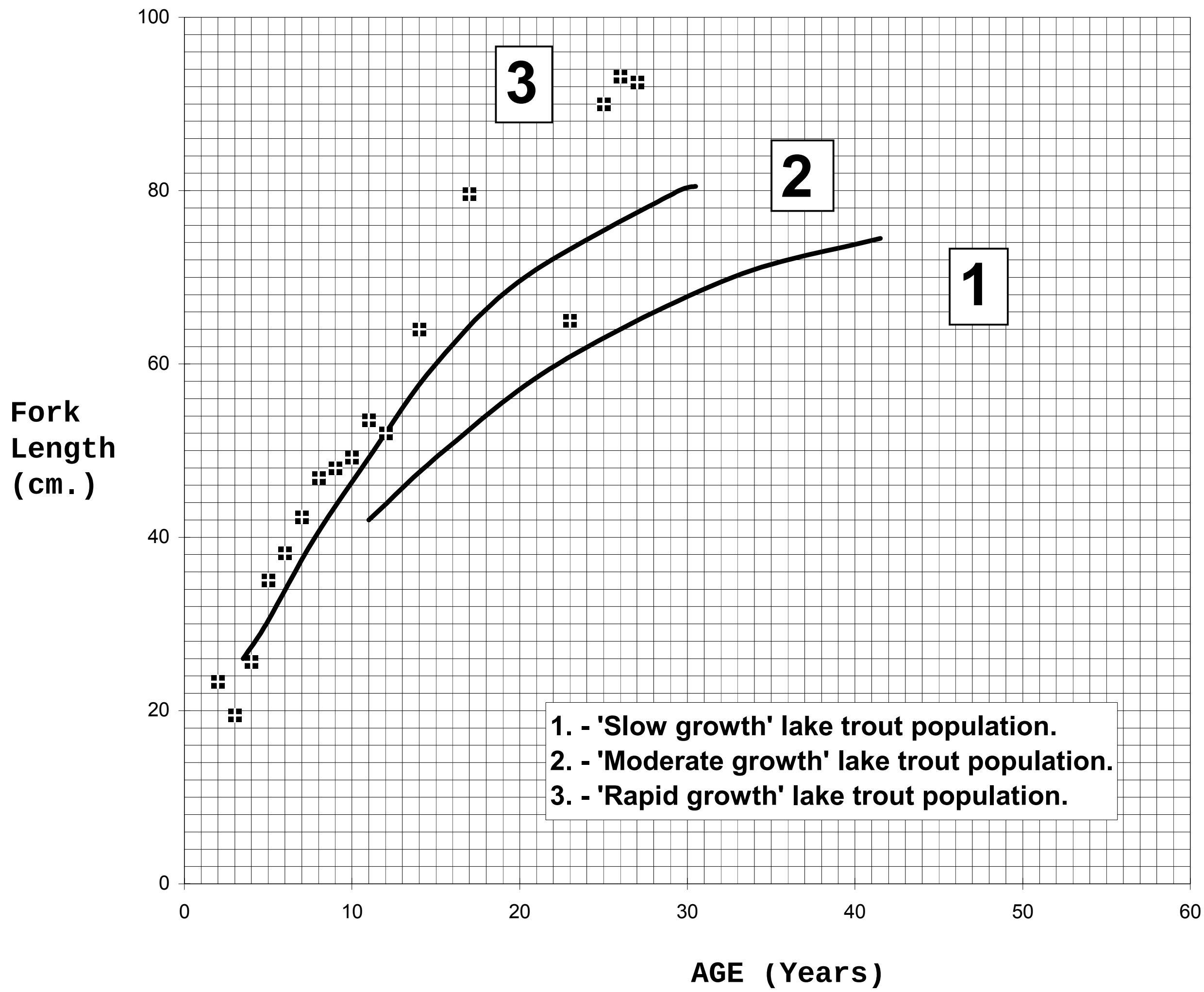
LAKE TROUT GROWTH ANALYSIS

LAKE NAME: PINKUT LAKE

SAMPLE DATE: 02 (YY) 06 (MM) 11,12 (DD)

SAMPLE METHOD: Gillnet

SAMPLE SIZE: 40 , ADEQUATE ☒, NOT ADEQUATE ☐



CONCLUSION, GROWTH: Slow ☐ Moderate ☒ Rapid ☒

APPENDIX 5b (cont'd)

SURVEY RESULTS

LAKE TROUT SURVEY LOCATION

LAKE NAME: _Pinkut Lake_____ SAMPLE DATE: _02_ _06_ _11,12_
YY MM DD

MAP NUMBER: _NTS 1:50 000 93K/05___

RAW DATA

Length	Weight	Age	Sex	Maturity
194	57	3	F	IM
195		3	M	IM
215	75	2		
235	110	2		IM
235	118	4	M	IM
250	150	2		IM
277	230	4		IM
311	295	5	M	IM
340	500	6		IM
355	410	6	F	IM
365	410	5	F	IM
375	495	5	F	IM
385	540	7		IM
390	560	6	M	IM
405	700	6		
410	600	7		
418	710	6	M	IM
430	800	8		IM
440	720	9	M	IM
444	860	8	M	IM
455	1025	10		IM
475	100	8		IM
475	1180	9	M	IM
475	1020	11	F	IM
475	1350	7		IM
485	1220	10		IM
510	1350	12	F	MT
525	1650	8	M	IM
525	1675	9	M	IM
530	2180	12		MT
535	1700	10	M	MT
545	1600	11	M	MT
585	1980	11		MT
640	3600	14		
650	3400	23	F	MT
720	4330	17	F	MT
872	7450	17	M	M
900	10450	25	M	M
925	10200	27	M	MT
932	10950	26	F	M

APPENDIX 1c

SKEENA REGION LAKE TROUT ASSESSMENT REPORT: TALTAPIN LAKE

LAKE NAME: Gazetted TALTAPIN LAKE, Alias ____.

LAKE LOCATION: Nearest Town: Burns Lake, Drainage Babine Lake → Babine River → Skeena River.
Accessed by: Road ☒ Air ☐ (note Appendix 1, page 3)

LAKE TROUT MANAGEMENT OBJECTIVE: (Definition & Methods, Note Appendix 2, page 4 & 5)

Objective 1.	Maintain natural population.	☒
Objective 2.	Develop population of small fish.	☐
Objective 3.	Develop/maintain population of large fish.	☐

MANAGEMENT/SURVEY HISTORY: (Note Appendix 3, page 6)
Previous surveys: Yes ☒ No ☐
Previous lake trout assessment: Yes ☒ No ☐

SURVEY METHODS: (note Appendix 4, page 7 & 8)

Method			Date (YY.MM.DD)	Crew
Fish	Gillnet	☒	June 13,14, 2002	M. Beere,J.Lough
Chem.	Water Samp.	☐		
Physical	No	☐		
Temp.	Yes	☒	June 13, July 27 2002	P.Giroux/ M.Jessop

SURVEY RESULTS: (Note Appendix 5)

Fish caught: lake trout Y , other species LSU, BB, CSU, LW, RB, WSU.

Adequate for further analysis: Yes ☒ No ☐

Lake Trout Abundance and Survival Analysis

	Poor	Moderate	Good	
Abundance of fish total.	☐	☒	☐	Page 9
Abundance of fish over 70 cm.	☐	☐	☒	Page 9
Survival to maturity.	☐	☒	☐	Page 10
Survival to age 20 years.	☐	☒	☐	Page 11

APPENDIX 1c

Lake Trout Age and Growth Analysis

Age.	Old ☐	Moderate ☐	Young ☒	Page 12
Growth. .	Slow ☐	Moderate ☐	Rapid ☒	Page 13

	Yes	No	
Survey location.	☒	☐	Page 14
Catch and survey information.	☒	☐	Page __
Photo documentation.	☒	☐	Page __

SURVEY CONCLUSIONS:

Objective	Objectives Achieved: Yes	No	Unknown	Reason
7. Natural population.	☐	☒	☐	Over-harvest
8. Small fish.	☐	☐	☐	
9. Large fish.	☐	☐	☐	

RECOMMENDATIONS:

A. Assessment. Re-assess Taltapin Lake lake trout population in 5 – 10 years. Creel survey necessary to determine LT harvest levels.

B. Other. Harvest restriction regulation changes may be prudent. LT catch and release for 10 years or slot limits for retention between minimum 50 cm and maximum 65 cm.

COMMENTS:

Survey methods employed do not correspond directly to those described by deLeeuw (1990; see page 9 for details).

REPORT BY : Paul Giroux, DATE (YY-MM-DD): 03-01-17.

APPENDIX 1c

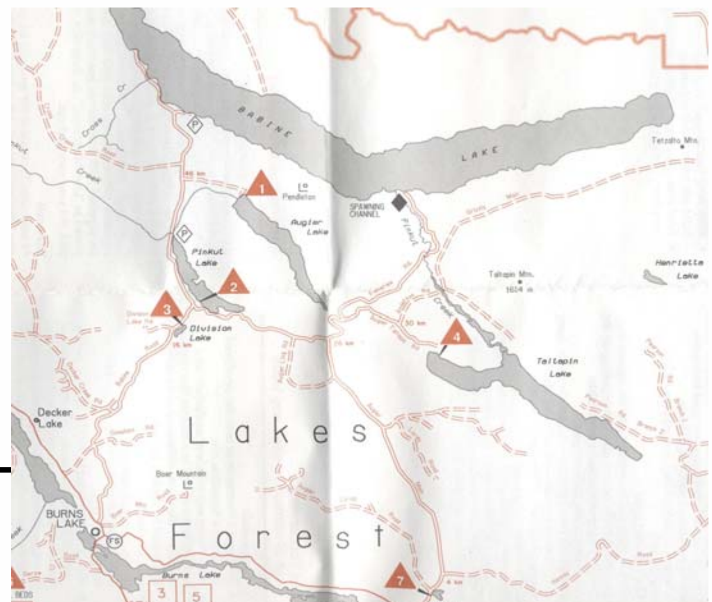
LAKE LOCATION

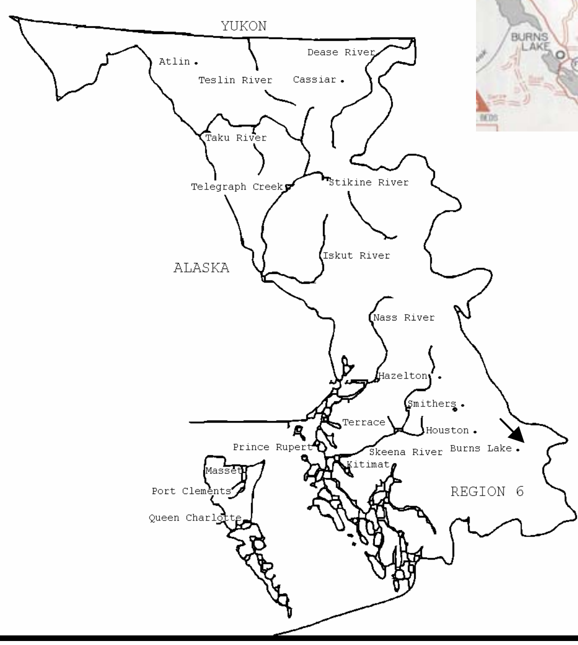
LAKE NAME: Taltapin Lake

DRAINAGE: BABL

MAP NUMBER: 93L / 15

ACCESS DIRECTIONS: HWY 16 → North on Babine Rd from Burns Lake → left on Augier-Taltapin Lk Rd





APPENDIX 2c

LAKE TROUT MANAGEMENT OBJECTIVE

In addition to province wide fisheries goals, strategic objectives of lake trout management in northern British Columbia will be to promote the maintenance and development of three types of lake trout populations and their associated fisheries. Strategic objectives for lake trout include the following:

STRATEGIC OBJECTIVE 1: Maintain natural populations.

Definition: The majority of lake trout lakes will fall into this category including those for which there is no information. Management intent will be to maintain the natural size and age distribution as well as population abundance of char. These lakes will generally receive low to moderate angling pressure. In some very accessible popular lakes where over harvest of lake trout has occurred, management for this objective will be required in order to restore such lake trout populations to natural levels.

Method: Methods to obtain this objective will include conservative region wide angler regulations and required habitat maintenance measures. This objective allows for the future implementation of objectives 2 and 3 below. In overfished lakes, catch and release regulations may have to be implemented.

STRATEGIC OBJECTIVE 2: Develop populations of small fish.

Definition: A few productive, generally very accessible and heavily angled lakes will be managed to obtain large numbers of primarily small, uniform sized lake trout.

Method: Methods to achieve this objective will include, in addition to habitat maintenance, the implementation of more liberal catch and minimum size restrictions on a few specified lakes. Once implemented the future option of providing large lake trout will very likely not be possible.

APPENDIX 2c

STRATEGIC OBJECTIVE 3: Develop/maintain populations of large fish.

Definition : In a few lakes it will be desirable to maintain/develop trophy size lake trout. These fish will always be "rare" and somewhat dependent on lake size and available forage base.

Method: Very likely the only possible method to achieve this objective will be severely restricted catch quotas or catch and release fisheries. This objective allows for the future implementation of objectives 1 and 2.

APPENDIX 3c

MANAGEMENT/SURVEY HISTORY

MANAGEMENT HISTORY:

Taltapin Lake has not had any lake specific management or regulations (deLeeuw 1992). Taltapin Lake is impounded to provide timed release of water to DFO sockeye spawning channels downstream at Pinkut Creek. Angling regulations have been 3 LT/day, 1 over 50cm, with a possession limit of two daily limits. Harvest of lake trout is closed annually from September 15 – November 15. A Forest Service recreation site is actively maintained on the western end of the lake. The Taltapin Lake Recreation Site has been in place since 1971 and currently has an average annual visitation estimate of 1800-3000 users (Alex Bergen, MoF Rec. Officer, Burns Lake). Taltapin Lake has been accessible by road since the early 1920s. Taltapin Lake has had past subsistence fisheries and presently supports a first nations subsistence fishery for LT, WF, BB and SU.

Additional information on pages __NA______.

SURVEY HISTORY AND ADDITION INFORMATION:

This assessment report was completed as part of a HCTF funded project to develop a non-destructive assessment methodology for LT populations in small lakes of Region 6. deLeeuw & Hatlevik sampled Taltapin Lake in 1991, capturing 5 (1, 91.4m nets @ 1919 m/net hr) LT and concluded the abundance of the catch was poor. They also note the failure to meet the “Natural Population” objective was attributed to over-fishing and a poor sample due to poor net placement.

Additional information on pages __NA______.

APPENDIX 4c

SURVEY METHODS

The following general guidelines for sampling lake trout have been developed.

1. In order to obtain the greatest number of lake trout with the widest possible age range, sinking variable mesh mono-filament gill nets should be set overnight at right angles from shore during spring on bouldery substrates with each net set at a depth of 5m. near shore to 30m. at the deep end. The smallest mesh should be set at the deepest end. This procedure, in addition to catching adult and juvenile lake trout, will also reduce the number of other fish taken.

   In small lakes (less than 500 ha) two nets set overnight should suffice regardless of the number of lake trout obtained; a small sample probably indicates a small population. No more than two nets should be set in any single lake for a 24 hr. period, and a maximum of four individual sets should be made during a sampling period. Sinking variable mesh experimental gill nets should measure 91.4 by 2.4 m. with the following mesh sizes in panel order: 25, 76, 51, 891 381 64 mm.

2. At the very least, fork length and age must be determined for each lake trout caught. On any given lake, age should be determined consistently using either the finray or otolith method. The two techniques will age the same population with an average age difference of about 1 year. If the release of live fish is important, lake trout should be aged using the finray method whereby the basal portion of the first pectoral finray can be removed with surgical scissors or pruning shears. Information which should also be recorded include weight, state of maturity, stomach contents and any additional measurements which may be useful.

3. With restricted sampling capabilities and moderate to low population abundance of lake trout, the smallest change in average fork length which can realistically be detected is five cm or more, while the small lest detectable change in average age is greater than one year. Both these changes can be detected with sample sizes of between 24 and 36 fish, and a confidence coefficient of 0.8. The detection of smaller changes or the use of larger confidence coefficients requires unattainably large sample sizes and are therefore very likely not applicable for the monitoring of most Skeena region lake trout populations.

APPENDIX 4c (cont'd)

ADDITIONAL SURVEY METHODS INFORMATION:

45m sinking gill nets comprised of 1", 2" and 3" stretch mesh were set perpendicular to shore with a 15-20 m shore anchor line. Nets were left to fish for a minimum of 1 hour during day light hours. Minimum effort for netting included fishing nets at a rate of 1 set/0.75km^2 of lake area. Additional sets were completed with two 45m nets ganged together to form 90m nets, and fished until a minimum sample size of 30-40 LT was obtained. The south west end of the lake provided the most consistent catch of lake trout.

2002 sample results indicate short set day light netting appears to have improved capture rates compared to the 14-20hrs 91.4m SGN sets deployed by deLeeuw & Hatlevik 1991 for LT and results in lower capture rates for SU. Therefore, direct comparison of abundance results between sample events appears to be limited.

APPENDIX 5c

SURVEY RESULTS

LAKE TROUT ABUNDANCE ANALYSIS

LAKE NAME: TALTAPIN LAKE

SAMPLE DATE: 02 (YY) 06 (MM) 13,14 (DD)

Correction Factor Calculation

Net Number	Net Length (m)	x	Hrs.	=	m.net hrs.
1	90.0		68.9		6197
2	80.0		23.9		1909
3	45.0		20.0		898
4					
5					
6					
Total nets	(3)		Total m.net hrs.		(9004)

[(2400 x number of nets 3) / (total m.net hrs. 9004)]
/ [number of nets 3] = CF = correction factor = 0.27

Catch/100 m Gillnet/day Calculation

Species #	Name	Catch	x	CF	= Catch/100 m net/day
1	Lake trout	43		0.27	11.5
2	Lake trout over 70 cm.	5		0.27	1.33
3	Longnose Sucker	66		0.27	17.6
4	White Sucker	27		0.27	7.2
5	LW	27		0.27	7.2
6	BB	14		0.27	3.73
7	RB	3		0.27	0.8
8	CSU	11		0.27	2.93
9				0.27	0
10				0.27	0

CONCLUSION, LAKE TROUT ABUNDANCE: (lake trout catch/100m gillnet/day).

TOTAL: Poor ☐ (0-5), Moderate ☒ (5-15), Good ☐ (over 15)

OVER 70 cm Poor ☐ (0-.5), Moderate ☐ (.5-1), Good ☒ (over 1)

SURVEY RESULTS

LAKE TROUT SURVIVAL TO MATURITY ANALYSIS

LAKE NAME: TALTAPIN LAKE   SAMPLE DATE: 02 (YY) 06 (MM) 13,14 (DD)

Fork Length cm.	Frequency (N) Immature	Maturing	Mature	Unknown	Total
1 - 4					0
5 - 9					0
10 - 14					0
15 - 19	1				1
20 - 24	4				4
25 - 29	8			4	12
30 - 34	8			5	13
35 - 39	2			1	3
40 - 44	6			4	10
45 - 49	2			2	4
50 - 54	1			1	2
55 - 59		1		2	3
60 - 64				1	1
65 - 69			1	1	2
70 - 74				2	2
75 - 79				1	1
80 - 84					0
85 - 89			2		2
90 - 94					0
95 - 99					0
100 - 100+					0
Total (%)	53.3	1.7	5.0	40.0	100.0

CONCLUSION, SURVIVAL TO MATURITY: (%immature fish in sample).

Poor ☐ (80-100% IMM), Moderate ☒ (60-80% IMM), Good ☐ (-60% IMM)

Inconclusive ☒

APPENDIX 5c (cont'd)

SURVEY RESULTS

LAKE TROUT SURVIVAL TO AGE 20 ANALYSIS

LAKE NAME: TALTAPIN LAKE SAMPLE DATE: 02 (YY) 06 (MM) 13,14 (DD)

Age	N	(%)	Cumulative (%)	Fork Length mm.
1	0	0.0	0.0	
2	1	2.5	2.5	194
3	3	7.5	10.0	211.3
4	11	27.5	37.5	297.5
5	6	15.0	52.5	340.3
6	3	7.5	60.0	375
7	5	12.5	72.5	429.6
8	1	2.5	75.0	563
9	2	5.0	80.0	647.5
10	1	2.5	82.5	554
11	0	0.0	82.5	
12	1	2.5	85.0	687
13	1	2.5	87.5	646
14	0	0.0	87.5	
15	0	0.0	87.5	
16	0	0.0	87.5	
17	2	5.0	92.5	826.5
18	1	2.5	95.0	735
19	0	0.0	95.0	
20	2	5.0	100.0	774.5
21	0	0.0	100.0	
22	0	0.0	100.0	
23	0	0.0	100.0	
24	0	0.0	100.0	
25	0	0.0	100.0	
26	0	0.0	100.0	
27	0	0.0	100.0	
28	0	0.0	100.0	
29	0	0.0	100.0	
30	0	0.0	100.0	
31	0	0.0	100.0	
32	0	0.0	100.0	
33	0	0.0	100.0	
34	0	0.0	100.0	
35	0	0.0	100.0	
36	0	0.0	100.0	
37	0	0.0	100.0	
38	0	0.0	100.0	
39	0	0.0	100.0	
40+	0	0.0	100.0	
Total	40	100		426

CONCLUSION, SURVIVAL TO AGE 20 YEARS: (% of fish 20 years or older).

Poor ☒ (0-5%), Moderate ☐ (5-10%), Good ☐ (+10%)

SURVEY RESULTS

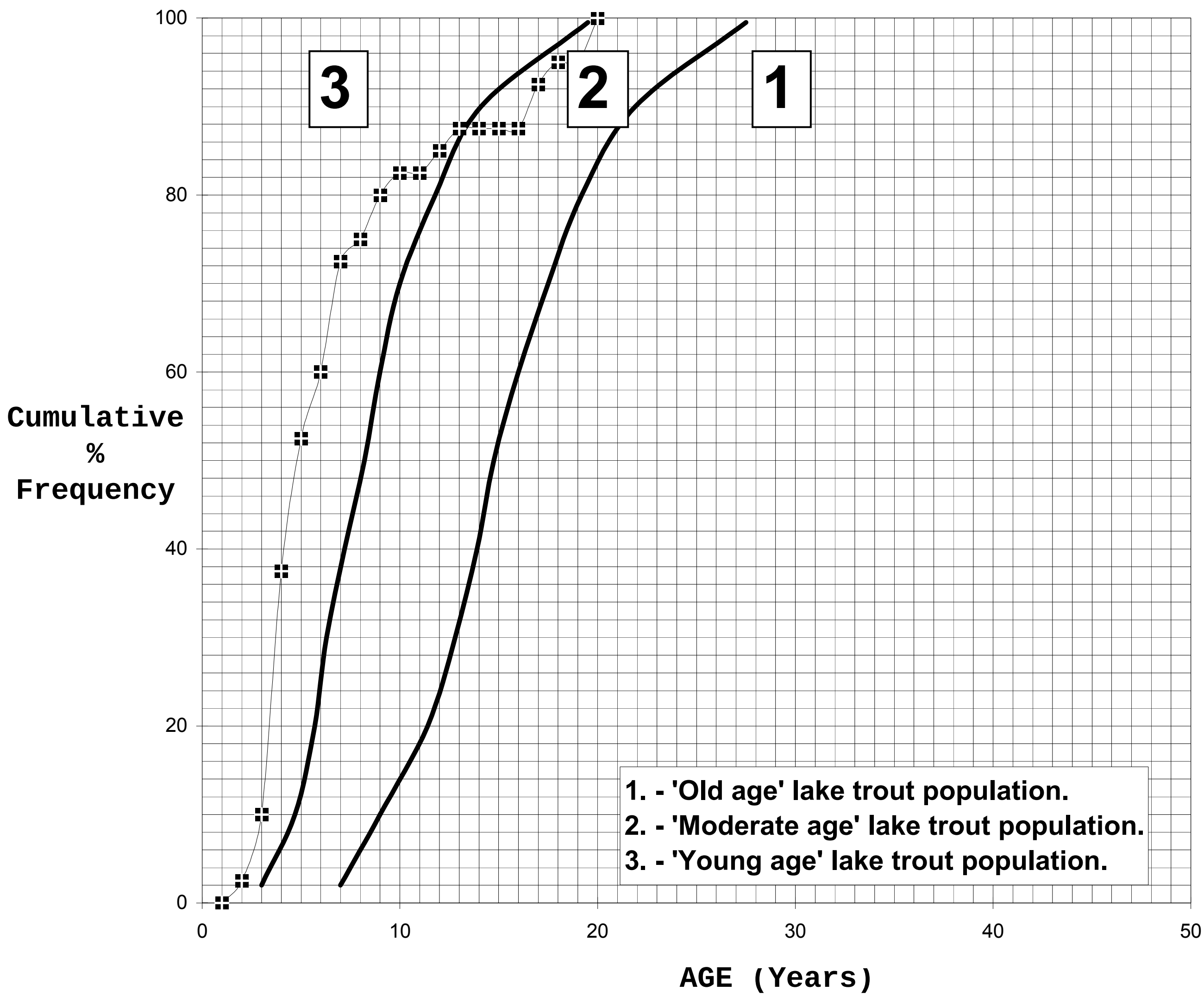
LAKE TROUT AGE ANALYSIS

LAKE NAME: TALTAPIN LAKE

SAMPLE DATE: 02 (YY) 06 (MM) 13,14 (DD)

SAMPLE METHOD: Gillnet

SAMPLE SIZE: 43, ADEQUATE ☒, NOT ADEQUATE ☐



CONCLUSION, AGE: Old ☐ → Moderate ☐ Young ☒

APPENDIX 5c (cont'd)

SURVEY RESULTS

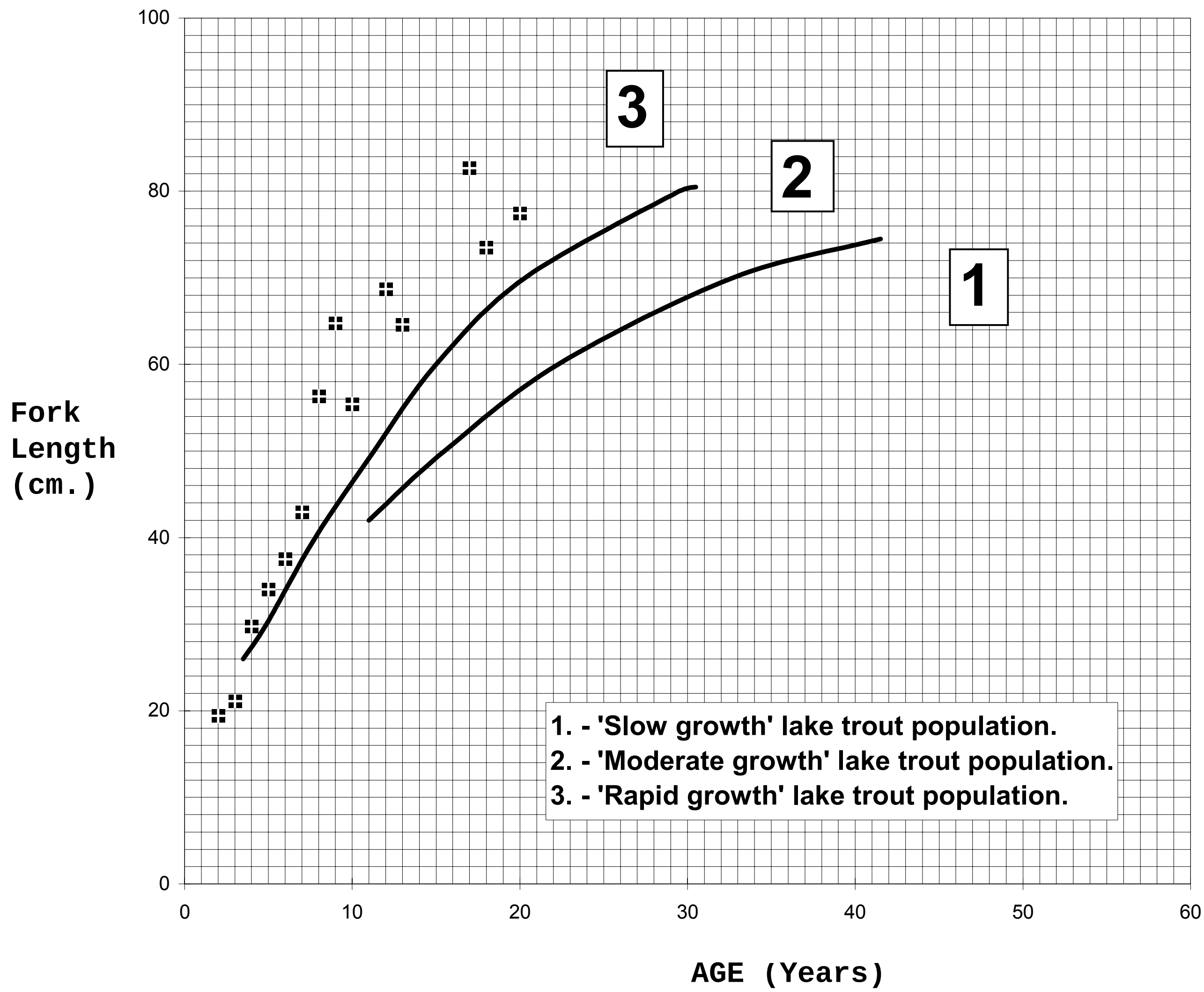
LAKE TROUT GROWTH ANALYSIS

LAKE NAME: TALTAPIN LAKE

SAMPLE DATE: 02 (YY) 06 (MM) 13,14 (DD)

SAMPLE METHOD: Gillnet

SAMPLE SIZE: 43, ADEQUATE ☒, NOT ADEQUATE ☐



CONCLUSION, GROWTH: Slow ☐ Moderate ☐ Rapid ☒

APPENDIX 5c (cont'd)

SURVEY RESULTS

LAKE TROUT SURVEY LOCATION

LAKE NAME: _Taltapin Lake_ SAMPLE DATE: _02_ _06_ _11,12_
YY MM DD

MAP NUMBER: _NTS 1:50 000 93K/05___

RAW DATA

Length	Weight	Age	Sex	Maturity
194	75	2		IM
204	75	3		IM
212	85	3	M	IM
218	95	3	F	IM
226	95	5		IM
264	155	4		IM
270	175	4		
273	205	4	M	IM
285	245	4		IM
291	245	5		IM
295	225	4		
298	225	4		
299	225	4		
300	270	6		IM
304	250	4		
324	295	4		IM
325	335	4		
327	325	5		
335	330	4		IM
340	325	5		
341	390	7		
381	455	6		
385	270			IM
400				
404	860	5		
413	620	7		
415	660	7		IM
444	770	6		IM
444	1050	7		
454				
454	870	5		
535	1695	7		
550	1770	9		
554	2010	10		
563	1750	8	M	MT
646	3470	13		
674	4170	20		
687	4220	12	F	M
735	5070	18		
745	4220	9	M	
765	6270	17		
875	7220	20	F	M
888	7640	17	M	M

APPENDIX 1d

SKEENA REGION LAKE TROUT ASSESSMENT REPORT: CHAPMAN LAKE

LAKE NAME: Gazetted CHAPMAN LAKE, Alias ____.

LAKE LOCATION: Nearest Town: Smithers__, Drainage Fulton River → Babine Lake → Babine River → Skeena River.
Accessed by: Road ☒ Air ☐ (note Appendix 1, page 3)

LAKE TROUT MANAGEMENT OBJECTIVE: (Definition & Methods, Note Appendix 2, page 4 & 5)

Objective 1.	Maintain natural population.	☒
Objective 2.	Develop population of small fish.	☐
Objective 3.	Develop/maintain population of large fish.	☐

MANAGEMENT/SURVEY HISTORY: (Note Appendix 3, page 6)
Previous surveys: Yes ☒ No ☐
Previous lake trout assessment: Yes ☒ No ☐

SURVEY METHODS: (note Appendix 4, page 7 & 8)

Method			Date (YY.MM.DD)	Crew
Fish	Gillnet	☒	May 24-31, 2002	P.Giroux/J.Lough
Chem.	Water Samp.	☐		
Physical	No	☐		
Temp.	Yes	☒	May 31, July 27 2002	P.Giroux/J. Lough

SURVEY RESULTS: (Note Appendix 5)

Fish caught: lake trout Y___, other species LSU__, BB _, CSU ________________________, LW, RB, CT, PCC, NSC, MW.

Adequate for further analysis: Yes ☒ No ☐

Lake Trout Abundance and Survival Analysis

	Poor	Moderate	Good	
Abundance of fish total.	☐	☐	☒	Page 9
Abundance of fish over 70 cm.	☐	☐	☒	Page 9
Survival to maturity.	☐	☐	☒	Page 10

APPENDIX 1d

Survival to age 20 years.	☐	☐	☒	Page 11

Lake Trout Age and Growth Analysis

Age.	Old ☐	Moderate ☒	Young ☐	Page 12
Growth. .	Slow ☐	Moderate ☐	Rapid ☒	Page 13

	Yes	No	
Survey location.	☒	☐	Page 14
Catch and survey information.	☒	☐	Page __
Photo documentation.	☒	☐	Page __

SURVEY CONCLUSIONS:

Objective	Objectives Achieved Yes	No	Unknown	Reason
10. Natural population.	☒	☐	☐	Low angling pressure
11. Small fish.	☐	☐	☐	
12. Large fish.	☐	☐	☐	

RECOMMENDATIONS:

A. Assessment. Re-assess Chapman Lake lake trout population in 5 – 10 years. Creel survey results would assist in determining harvest levels of LT.

B. Other. No regulation changes recommended.

COMMENTS:

Survey methods employed do not correspond directly to those described by deLeeuw (1990; see page 9 for details).

REPORT BY : Paul Giroux, DATE (YY-MM-DD): 03-01-10_ .

APPENDIX 1d

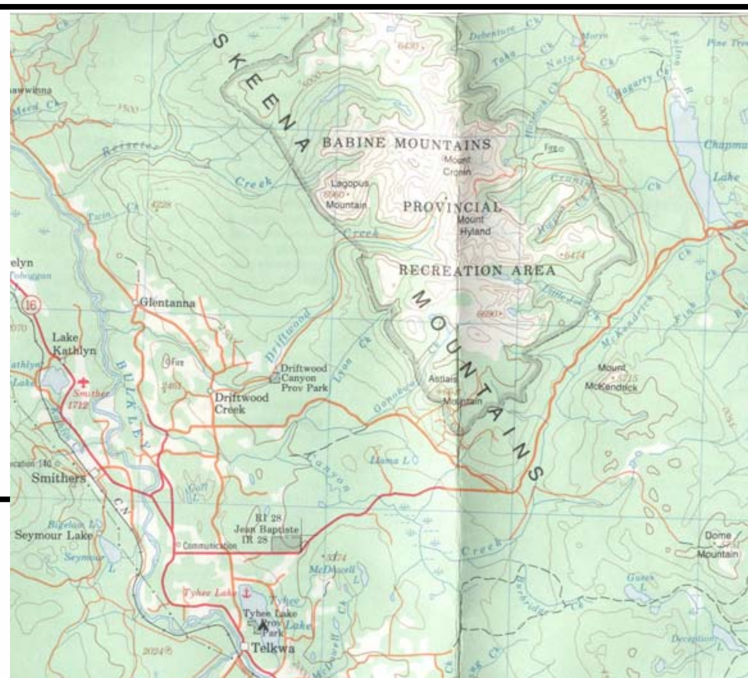
LAKE LOCATION

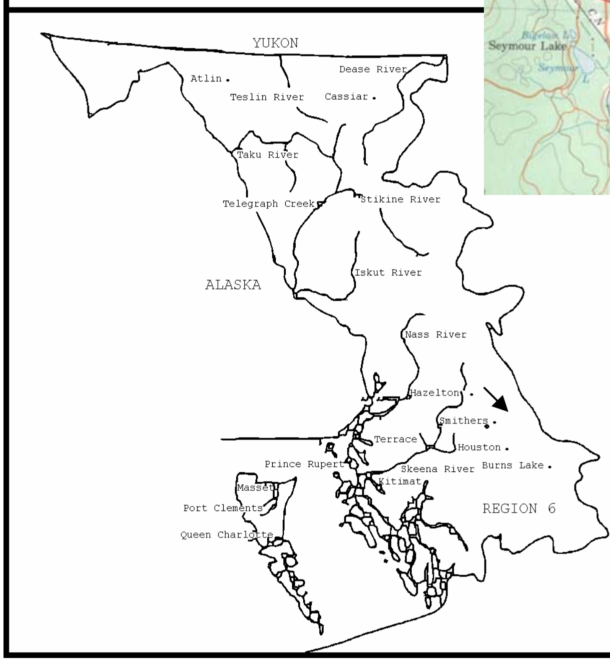
LAKE NAME: Chapman Lake

DRAINAGE: BABL

MAP NUMBER: 93L / 15

ACCESS DIRECTIONS: HWY 16 → North on Babine Lake Rd from Smithers → left on Upper Fulton Rd





APPENDIX 2d

LAKE TROUT MANAGEMENT OBJECTIVE

In addition to province wide fisheries goals, strategic objectives of lake trout management in northern British Columbia will be to promote the maintenance and development of three types of lake trout populations and their associated fisheries. Strategic objectives for lake trout include the following:

STRATEGIC OBJECTIVE 1: Maintain natural populations.

Definition: The majority of lake trout lakes will fall into this category including those for which there is no information. Management intent will be to maintain the natural size and age distribution as well as population abundance of char. These lakes will generally receive low to moderate angling pressure. In some very accessible popular lakes where over harvest of lake trout has occurred, management for this objective will be required in order to restore such lake trout populations to natural levels.

Method: Methods to obtain this objective will include conservative region wide angler regulations and required habitat maintenance measures. This objective allows for the future implementation of objectives 2 and 3 below. In overfished lakes, catch and release regulations may have to be implemented.

STRATEGIC OBJECTIVE 2: Develop populations of small fish.

Definition: A few productive, generally very accessible and heavily angled lakes will be managed to obtain large numbers of primarily small, uniform sized lake trout.

Method: Methods to achieve this objective will include, in addition to habitat maintenance, the implementation of more liberal catch and minimum size restrictions on a few specified lakes. Once implemented the future option of providing large lake trout will very likely not be possible.

APPENDIX 2d

STRATEGIC OBJECTIVE 3: Develop/maintain populations of large fish.

Definition : In a few lakes it will be desirable to maintain/develop trophy size lake trout. These fish will always be "rare" and somewhat dependent on lake size and available forage base.

Method: Very likely the only possible method to achieve this objective will be severely restricted catch quotas or catch and release fisheries. This objective allows for the future implementation of objectives 1 and 2.

APPENDIX 3d

MANAGEMENT/SURVEY HISTORY

MANAGEMENT HISTORY:

Chapman Lake has had rainbow trout planted in the past (deLeeuw, 1992). Angling regulations have been 3 LT/day, 1 over 50cm, with a possession limit of two daily limits. Harvest of lake trout is closed annually from September 15 – November 15. A Forest Service recreation site is actively maintained on the south shore of the lake.

Additional information on pages NA.

SURVEY HISTORY AND ADDITION INFORMATION:
This assessment report was completed as part of a HCTF funded project to develop a non-destructive assessment methodology for LT populations in small lakes of Region 6.

Additional information on pages NA.

APPENDIX 4d

SURVEY METHODS

The following general guidelines for sampling lake trout have been developed.

1. In order to obtain the greatest number of lake trout with the widest possible age range, sinking variable mesh mono-filament gill nets should be set overnight at right angles from shore during spring on bouldery substrates with each net set at a depth of 5m. near shore to 30m. at the deep end. The smallest mesh should be set at the deepest end. This procedure, in addition to catching adult and juvenile lake trout, will also reduce the number of other fish taken.

   In small lakes (less than 500 ha) two nets set overnight should suffice regardless of the number of lake trout obtained; a small sample probably indicates a small population. No more than two nets should be set in any single lake for a 24 hr. period, and a maximum of four individual sets should be made during a sampling period. Sinking variable mesh experimental gill nets should measure 91.4 by 2.4 m. with the following mesh sizes in panel order: 25, 76, 51, 891 381 64 mm.

2. At the very least, fork length and age must be determined for each lake trout caught. On any given lake, age should be determined consistently using either the finray or otolith method. The two techniques will age the same population with an average age difference of about 1 year. If the release of live fish is important, lake trout should be aged using the finray method whereby the basal portion of the first pectoral finray can be removed with surgical scissors or pruning shears. Information which should also be recorded include weight, state of maturity, stomach contents and any additional measurements which may be useful.

3. With restricted sampling capabilities and moderate to low population abundance of lake trout, the smallest change in average fork length which can realistically be detected is five cm or more, while the small lest detectable change in average age is greater than one year. Both these changes can be detected with sample sizes of between 24 and 36 fish, and a confidence coefficient of 0.8. The detection of smaller changes or the use of larger confidence coefficients requires unattainably large sample sizes and are therefore very likely not applicable for the monitoring of most Skeena region lake trout populations.

APPENDIX 4d (cont'd)

ADDITIONAL SURVEY METHODS INFROMATION:

45m sinking gill nets comprised of 1″, 2″ and 3″ stretch mesh were set perpendicular to shore with a 15-20 m shore anchor line. Nets were left to fish for a minimum of 1 hour during day light hours. Minimum effort for netting included fishing nets at a rate of 1 set/0.75km^2 of lake area. Additional sets were completed until a minimum sample size of 30 LT was obtained. The north shore of the lake provided the most consistent catch of lake trout and as a result received the highest amount of supplementary netting effort.

APPENDIX 5d

SURVEY RESULTS

LAKE TROUT ABUNDANCE ANALYSIS

LAKE NAME: Chapman Lake   SAMPLE DATE: 2 (YY) 5 (MM) 24-31 (DD)

Correction Factor Calculation

Net Number	Net Length (m)	x	Hrs.	=	m.net hrs.
1	45.0		43.3		1950
2					0
3					
4					
5					
6					
Total nets	(1)		Total m.net hrs.		(1950)

[(2400 x number of nets 1) / (total m.net hrs. 1950)]
/ [number of nets 1] = CF = correction factor = 1.23

Catch/100 m Gillnet/day Calculation

Species #	Name	Catch	x	CF =	Catch/100 m net/day
1	Lake trout	41		1.23	50.5
2	Lake trout over 70 cm.	12		1.23	14.8
3	Longnose Sucker	7		1.23	8.61
4	CSU	11		1.23	13.5
5	LW	569		1.23	700
6	BB	1		1.23	1.23
7	RB	3		1.23	3.69
8	PCC	13		1.23	16
9	NSC	6		1.23	7.38
10				1.23	

CONCLUSION, LAKE TROUT ABUNDANCE: (lake trout catch/100m gillnet/day).

TOTAL: Poor ☐ (0-5), Moderate ☐ (5-15), Good ☒ (over 15)

OVER 70 cm Poor ☐ (0-.5), Moderate ☐ (.5-1), Good ☒ (over 1)

APPENDIX 5d (cont'd)

SURVEY RESULTS

LAKE TROUT SURVIVAL TO MATURITY ANALYSIS

LAKE NAME: Chapman Lake SAMPLE DATE: 2 (YY) 5 (MM) 24-31 (DD)

Fork Length cm.	Frequency (N) Immature	Maturing	Mature	Total
1 - 4				0
5 - 9				0
10 - 14				0
15 - 19				0
20 - 24				0
25 - 29				0
30 - 34	1			1
35 - 39	4			4
40 - 44	6			6
45 - 49	5			5
50 - 54	2	2		4
55 - 59	1	1		2
60 - 64		2	2	4
65 - 69		1	2	3
70 - 74		1	1	2
75 - 79		1	1	2
80 - 84			1	1
85 - 89			1	1
90 - 94				0
95 - 99				0
100 - 100+				0
Total (%)	54.3	22.9	22.9	100

CONCLUSION, SURVIVAL TO MATURITY: (%immature fish in sample).

Poor ☐ (80-100% IMM), Moderate ☐ (60-80% IMM), Good ☒ (-60% IMM)

APPENDIX 5d (cont'd)

SURVEY RESULTS

LAKE TROUT SURVIVAL TO AGE 20 ANALYSIS

LAKE NAME: Chapman Lake   SAMPLE DATE: 2 (YY) 5 (MM) 24-31 (DD)

Age	N	(%)	Cumulative (%)	Fork Length mm.
1	0	0.0	0.0	
2	0	0.0	0.0	
3	0	0.0	0.0	
4	0	0.0	0.0	
5	2	5.1	5.1	410
6	0	0.0	5.1	
7	4	10.3	15.4	411.3
8	1	2.6	17.9	380
9	3	7.7	25.6	431.7
10	1	2.6	28.2	455
11	1	2.6	30.8	450
12	5	12.8	43.6	508
13	2	5.1	48.7	622.5
14	0	0.0	48.7	
15	2	5.1	53.8	535
16	1	2.6	56.4	715
17	2	5.1	61.5	590
18	2	5.1	66.7	675
19	2	5.1	71.8	705
20	0	0.0	71.8	
21	5	12.8	84.6	710
22	1	2.6	87.2	820
23	1	2.6	89.7	760
24	0	0.0	89.7	
25	2	5.1	94.9	860
26	2	5.1	100.0	797.5
27	0	0.0	100.0	
28	0	0.0	100.0	
29	0	0.0	100.0	
30	0	0.0	100.0	
31	0	0.0	100.0	
32	0	0.0	100.0	
33	0	0.0	100.0	
34	0	0.0	100.0	
35	0	0.0	100.0	
36	0	0.0	100.0	
37	0	0.0	100.0	
38	0	0.0	100.0	
39	0	0.0	100.0	
40+	0	0.0	100.0	
Total	39	100		581

CONCLUSION, SURVIVAL TO AGE 20 YEARS: (% of fish 20 years or older).

Poor ☐ (0-5%), Moderate ☐ (5-10%), Good ☒ (+10%)

APPENDIX 5d (cont'd)

SURVEY RESULTS

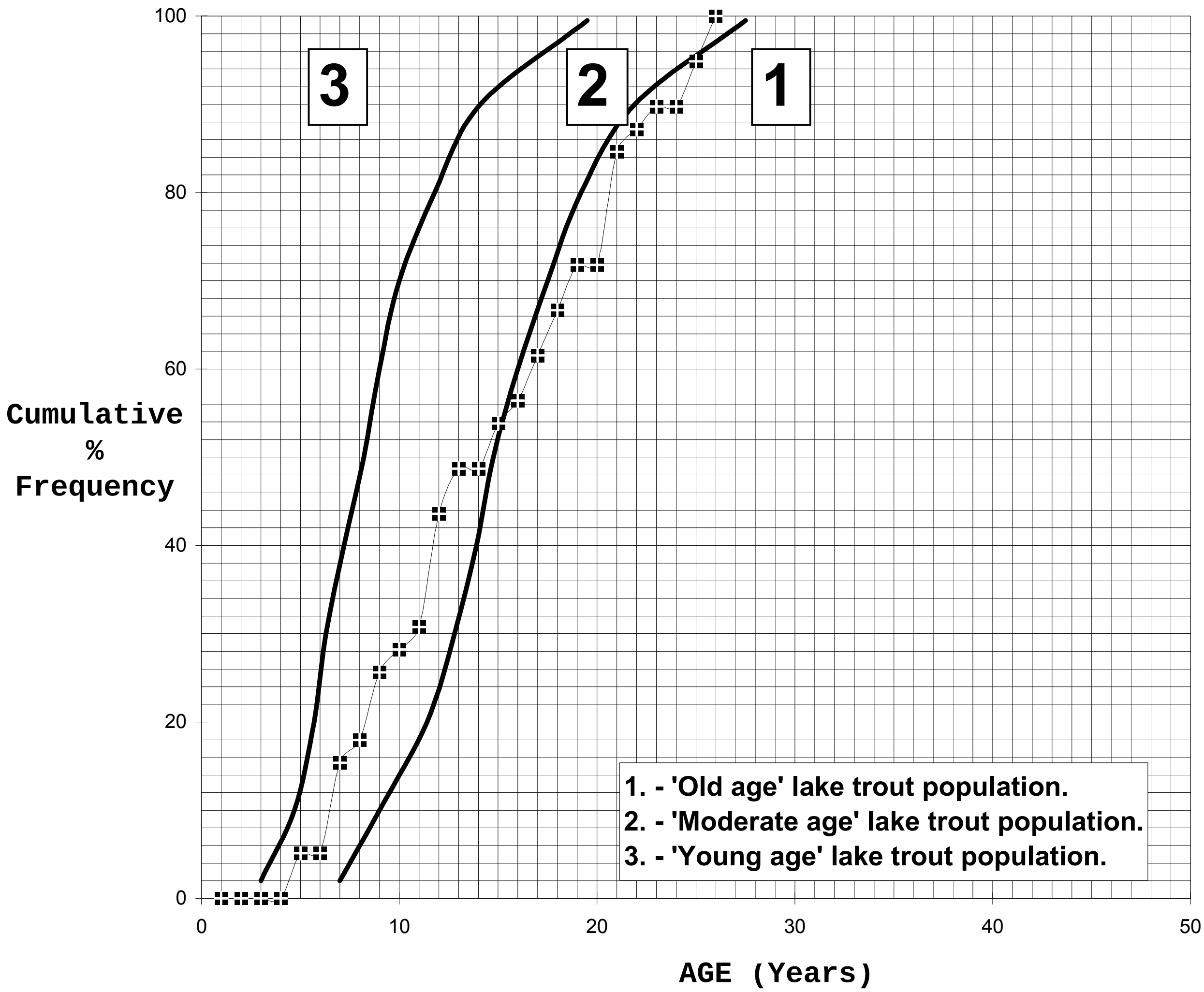
LAKE TROUT AGE ANALYSIS

LAKE NAME: Chapman Lake

SAMPLE DATE: 2 (YY) 5 (MM) 24-31 (DD)

SAMPLE METHOD: Gillnet

SAMPLE SIZE: 41, ADEQUATE ☒, NOT ADEQUATE ☐



CONCLUSION, AGE: Old ☒ → Moderate ☒ Young ☐

APPENDIX 5d (cont'd)

SURVEY RESULTS

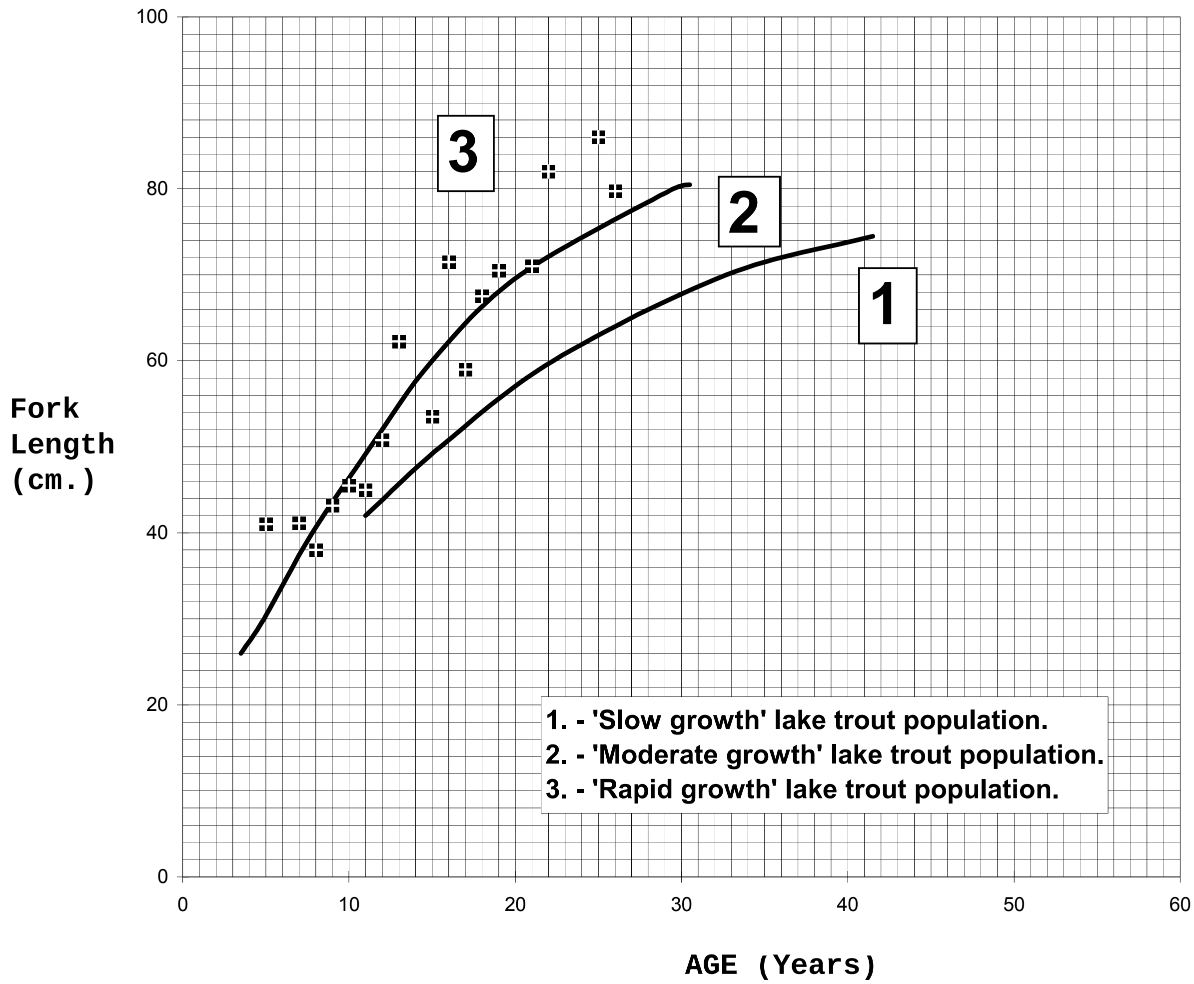
LAKE TROUT GROWTH ANALYSIS

LAKE NAME: Chapman Lake

SAMPLE DATE: 2 (YY) 5 (MM) 24-31 (DD)

SAMPLE METHOD: Gillnet

SAMPLE SIZE: 41, ADEQUATE ☒, NOT ADEQUATE ☐



CONCLUSION, GROWTH: Slow ☐ Moderate ☒ Rapid ☒

APPENDIX 5d (cont'd)

SURVEY RESULTS

LAKE TROUT SURVEY LOCATION

LAKE NAME: _Chapman Lake_____ SAMPLE DATE: _02_ _06_ _6-7_
YY MM DD

MAP NUMBER: _NTS 1:50 000 93L/04___

RAW DATA

Length	Weight	Age	Sex	Maturity
300				
370	1290	5		
380	500	8	M	IM
385	510	7	M	IM
390	340	9		IM
400	1950	7		IM
420	250	7		
420	665	12		IM
430	680	12	F	IM
440	700	7	F	IM
445	490	9		IM
450	840	11		
450	740			IM
450	690	5		IM
455	690	10		IM
460	880	9		IM
500	1040	12	M	IM
500	990	15	M	MT
525	425	13	F	MT
540	1240	17		IM
570	1715	12		
570	4140	15		IM
620	1990	12		
630	2590	21		
630	2840	18	M	MT
640	2990	17	F	MT
650				
660	3140	21		MT
690	3540	21		MT
700	4140	19		M
710	4640	19		
715	5590	16		
720	4440	13		
720	3740	18		MT
760	5690	23	F	MT
760	4540	21	M	M
780	4490	26		
810	4740	21		
815	6590	26		MT
820	5890	22		
830	5240	25		
890	6340	25		MT

APPENDIX 1e

SKEENA REGION LAKE TROUT ASSESSMENT REPORT: DORIS LAKE

LAKE NAME: Gazetted DORIS LAKE, Alias ____.

LAKE LOCATION: Nearest Town: Smithers__, Drainage

Tanglechain Lake → Fulton River → Babine L. → Babine R. → Skeena River.
Accessed by: Road ☒ Air ☐ (note Appendix 1, page 3)

LAKE TROUT MANAGEMENT OBJECTIVE: (Definition & Methods, Note Appendix 2, page 4 & 5)

Objective 1.	Maintain natural population.	☒
Objective 2.	Develop population of small fish.	☐
Objective 3.	Develop/maintain population of large fish.	☐

MANAGEMENT/SURVEY HISTORY: (Note Appendix 3, page 6)

Previous surveys: Yes ☒ No ☐
Previous lake trout assessment: Yes ☒ No ☐

SURVEY METHODS: (note Appendix 4, page 7 & 8)

Method			Date (YY.MM.DD)	Crew
Fish	Gillnet	☒	02.06,10.05,09	PG/FG,MJ/JL
Chem.	Water Samp.	☐		
Physical	No	☐		
Temp.	Yes	☒	02.06.05	PG/FG & PG/MJ

SURVEY RESULTS: (Note Appendix 5)

Fish caught: lake trout N___, other species LSU__, CSU, LW, RB, CT, LKC, NSC, RSC.

Adequate for further analysis: Yes ☐ No ☒

Lake Trout Abundance and Survival Analysis

	Poor	Moderate	Good	
Abundance of fish total.	☒	☐	☐	Page 9
Abundance of fish over 70 cm.	☒	☐	☐	Page 9
Survival to maturity.	☒	☐	☐	Page 10

APPENDIX 1e

Survival to age 20 years.	☒	☐	☐	Page 11

Lake Trout Age and Growth Analysis

Age.	Old ☐	Moderate ☐	Young ☐	Page 12
Growth. .	Slow ☐	Moderate ☐	Rapid ☐	Page 13

	Yes	No	
Survey location.	☒	☐	Page 14
Catch and survey information.	☒	☐	Page __
Photo documentation.	☒	☐	Page __

SURVEY CONCLUSIONS:

Objective	Objectives Achieved Yes	No	Unknown	Reason
13. Natural population.	☐	☒	☐	LT not detected
14. Small fish.	☐	☐	☐	
15. Large fish.	☐	☐	☐	

RECOMMENDATIONS:

A. Assessment. Re-assess Doris Lake spring 2003 in an effort to capture LT and establish presence/absence.

B. Other. LT catch & release emergency order if LT detected in spring.

COMMENTS:

Survey methods employed do not correspond directly to those described by deLeeuw (1990; see page 9 for details).

REPORT BY : Paul Giroux, DATE (YY-MM-DD): 03-01-17.

APPENDIX 1e

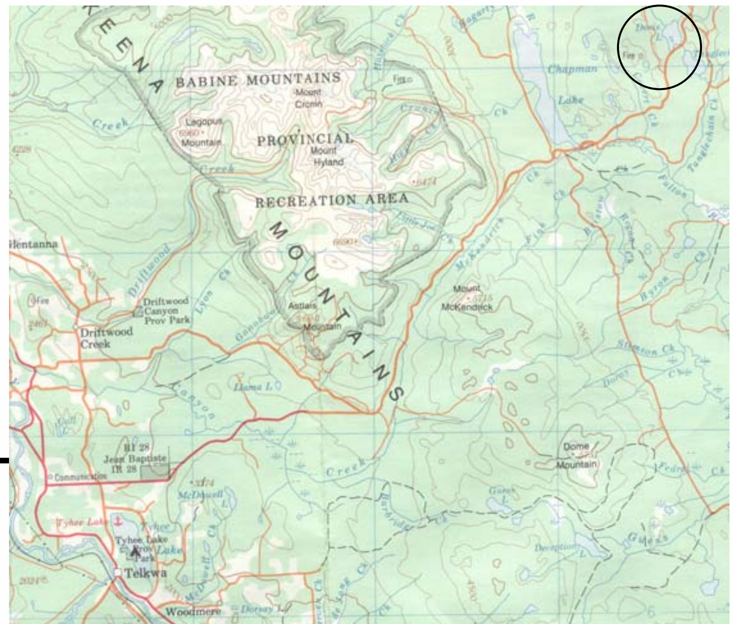
LAKE LOCATION

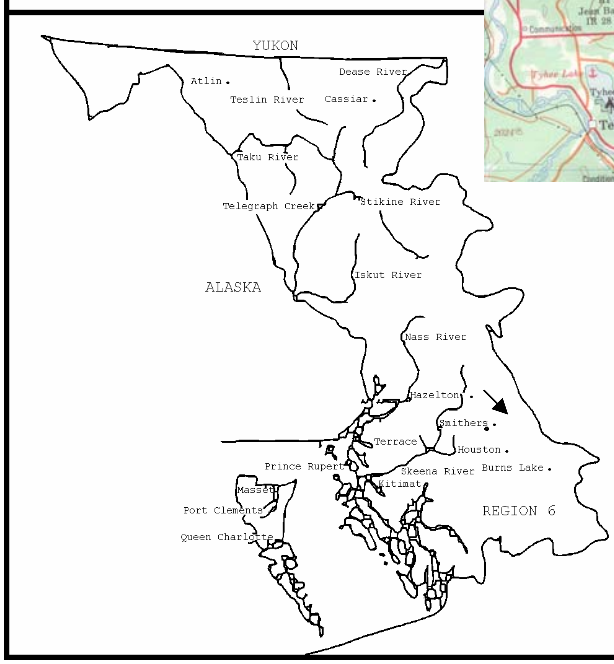
LAKE NAME: Doris Lake

DRAINAGE: BABL

MAP NUMBER: 93L / 15

ACCESS DIRECTIONS: HWY 16 → North on Babine Lake Rd from Smithers





APPENDIX 2e

LAKE TROUT MANAGEMENT OBJECTIVE

In addition to province wide fisheries goals, strategic objectives of lake trout management in northern British Columbia will be to promote the maintenance and development of three types of lake trout populations and their associated fisheries. Strategic objectives for lake trout include the following:

STRATEGIC OBJECTIVE 1: Maintain natural populations.

Definition: The majority of lake trout lakes will fall into this category including those for which there is no information. Management intent will be to maintain the natural size and age distribution as well as population abundance of char. These lakes will generally receive low to moderate angling pressure. In some very accessible popular lakes where over harvest of lake trout has occurred, management for this objective will be required in order to restore such lake trout populations to natural levels.

Method: Methods to obtain this objective will include conservative region wide angler regulations and required habitat maintenance measures. This objective allows for the future implementation of objectives 2 and 3 below. In overfished lakes, catch and release regulations may have to be implemented.

STRATEGIC OBJECTIVE 2: Develop populations of small fish.

Definition: A few productive, generally very accessible and heavily angled lakes will be managed to obtain large numbers of primarily small, uniform sized lake trout.

Method: Methods to achieve this objective will include, in addition to habitat maintenance, the implementation of more liberal catch and minimum size restrictions on a few specified lakes. Once implemented the future option of providing large lake trout will very likely not be possible.

APPENDIX 2e

STRATEGIC OBJECTIVE 3: Develop/maintain populations of large fish.

Definition : In a few lakes it will be desirable to maintain/develop trophy size lake trout. These fish will always be "rare" and somewhat dependent on lake size and available forage base.

Method: Very likely the only possible method to achieve this objective will be severely restricted catch quotas or catch and release fisheries. This objective allows for the future implementation of objectives 1 and 2.

APPENDIX 3e

MANAGEMENT/SURVEY HISTORY

MANAGEMENT HISTORY:

From 1955-1960 40k RB fry were planted. Post 1960, Doris Lake has not had any lake specific management or regulations. Angling regulations for LT have been 3 LT/day, 1 over 50cm, with a possession limit of two daily limits. Harvest of lake trout is closed annually from September 15 – November 15. A Forest Service recreation site (5 sites) is actively maintained on the north shore of the lake.

Additional information on pages __NA______.

SURVEY HISTORY AND ADDITION INFORMATION:

This assessment report was completed as part of a HCTF funded project to develop a non-destructive assessment methodology for LT populations in small lakes of Region 6. Lake surveys were completed in 1959 (J.Balkwell), 1968 (Neilson and Whately), 1970 (Bustard & Janssen) & 1991 (deLeeuw & Hatlevik). Lake trout were captured in overnight gillnet sets completed in 1968 (n=2, 67,80cm) and again in 1991 (n=6). Netting was not conducted in 1970 and the 1959 sampling event does not report lake trout capture, but does report burbot.

Additional information on pages __NA______.

APPENDIX 4e

SURVEY METHODS

The following general guidelines for sampling lake trout have been developed.

1. In order to obtain the greatest number of lake trout with the widest possible age range, sinking variable mesh mono-filament gill nets should be set overnight at right angles from shore during spring on bouldery substrates with each net set at a depth of 5m. near shore to 30m. at the deep end. The smallest mesh should be set at the deepest end. This procedure, in addition to catching adult and juvenile lake trout, will also reduce the number of other fish taken.

   In small lakes (less than 500 ha) two nets set overnight should suffice regardless of the number of lake trout obtained; a small sample probably indicates a small population. No more than two nets should be set in any single lake for a 24 hr. period, and a maximum of four individual sets should be made during a sampling period. Sinking variable mesh experimental gill nets should measure 91.4 by 2.4 m. with the following mesh sizes in panel order: 25, 76, 51, 891 381 64 mm.

2. At the very least, fork length and age must be determined for each lake trout caught. On any given lake, age should be determined consistently using either the finray or otolith method. The two techniques will age the same population with an average age difference of about 1 year. If the release of live fish is important, lake trout should be aged using the finray method whereby the basal portion of the first pectoral finray can be removed with surgical scissors or pruning shears. Information which should also be recorded include weight, state of maturity, stomach contents and any additional measurements which may be useful.

3. With restricted sampling capabilities and moderate to low population abundance of lake trout, the smallest change in average fork length which can realistically be detected is five cm or more, while the small lest detectable change in average age is greater than one year. Both these changes can be detected with sample sizes of between 24 and 36 fish, and a confidence coefficient of 0.8. The detection of smaller changes or the use of larger confidence coefficients requires unattainably large sample sizes and are therefore very likely not applicable for the monitoring of most Skeena region lake trout populations.

APPENDIX 4e (cont'd)

ADDITIONAL SURVEY METHODS INFROMATION:

45m sinking gill nets comprised of 1", 2" and 3" stretch mesh were set perpendicular to shore with a 15-20 m shore anchor line. Nets were left to fish for a minimum of 1 hour during day light hours. Minimum effort for netting included fishing nets at a rate of 1 set/0.75km^2 of lake area. Additional sets of both 45m and 90m have been completed in an effort to locate lake trout without success. The lakes deep hole, located in the lakes north-east shore, as well as, the northern side of the island received the highest amount of supplementary netting effort do to the high catch rates of LW.

APPENDIX 5e

SURVEY RESULTS

LAKE TROUT ABUNDANCE ANALYSIS

LAKE NAME: DORIS LAKE

SAMPLE DATE: 02 (YY) 06,10 (MM) 6,9 (DD)

Correction Factor Calculation

Net Number	Net Length (m)	x	Hrs.	=	m.net hrs.
1	90.0		10.6		952
2	45.0		13.9		624
3					
4					
5					
6					
Total nets	(2)		Total m.net hrs.		(1576)

[(2400 x number of nets 2) / (total m.net hrs. 1576)]
/ [number of nets 2] = CF = correction factor = 1.52

Catch/100 m Gillnet/day Calculation

Species #	Name	Catch	x	CF	= Catch/100 m net/day
1	Lake trout	0		1.52	0
2	Lake trout over 70 cm.	0		1.52	0
3	Longnose Sucker	4		1.52	6.09
4	CSU	70		1.52	107
5	LW	70		1.52	107
6	CT	11		1.52	16.8
7	RB	1		1.52	1.52
8	NSC	32		1.52	48.7
9	RSC	3		1.52	4.57
10	LKC	3		1.52	4.57

CONCLUSION, LAKE TROUT ABUNDANCE: (lake trout catch/100m gillnet/day).

TOTAL: Poor ☒ (0-5), Moderate ☐ (5-15), Good ☐ (over 15)

OVER 70 cm Poor ☒ (0-.5), Moderate ☐ (.5-1), Good ☐ (over 1)

APPENDIX 5e (cont'd)

SURVEY RESULTS

LAKE TROUT SURVIVAL TO MATURITY ANALYSIS

LAKE NAME: DORIS LAKE   SAMPLE DATE: 02 (YY) 06,10 (MM) 6,9 (DD)

Fork Length cm.	Frequency (N) Immature	Maturing	Mature	Unknown	Total
1 - 4					0
5 - 9					0
10 - 14					0
15 - 19					0
20 - 24					0
25 - 29					0
30 - 34					0
35 - 39					0
40 - 44					0
45 - 49					0
50 - 54					0
55 - 59					0
60 - 64					0
65 - 69					0
70 - 74					0
75 - 79					0
80 - 84					0
85 - 89					0
90 - 94					0
95 - 99					0
100 - 100+					0
Total (%)	####	#####	######	#DIV/0!	######

CONCLUSION, SURVIVAL TO MATURITY: (%immature fish in sample).

Poor ☐ (80-100% IMM), Moderate ☐ (60-80% IMM), Good ☐ (-60% IMM)

APPENDIX 5e (cont'd)

SURVEY RESULTS

LAKE TROUT SURVIVAL TO AGE 20 ANALYSIS

LAKE NAME: DORIS LAKE SAMPLE DATE: 02 (YY) 06,10 (MM) 6,9 (DD)

Age	N	(%)	Cumulative (%)	Fork Length mm.
1	0	#####	#####	
2	0	#####	#####	#####
3	0	#####	#####	#####
4	0	#####	#####	#####
5	0	#####	#####	#####
6	0	#####	#####	#####
7	0	#####	#####	#####
8	0	#####	#####	#####
9	0	#####	#####	#####
10	0	#####	#####	#####
11	0	#####	#####	
12	0	#####	#####	#####
13	0	#####	#####	#####
14	0	#####	#####	
15	0	#####	#####	
16	0	#####	#####	
17	0	#####	#####	#####
18	0	#####	#####	#####
19	0	#####	#####	
20	0	#####	#####	#####
21	0	#####	#####	
22	0	#####	#####	
23	0	#####	#####	
24	0	#####	#####	
25	0	#####	#####	
26	0	#####	#####	
27	0	#####	#####	
28	0	#####	#####	
29	0	#####	#####	
30	0	#####	#####	
31	0	#####	#####	
32	0	#####	#####	
33	0	#####	#####	
34	0	#####	#####	
35	0	#####	#####	
36	0	#####	#####	
37	0	#####	#####	
38	0	#####	#####	
39	0	#####	#####	
40+	0	#####	#####	
Total	0	#####		####

CONCLUSION, SURVIVAL TO AGE 20 YEARS: (% of fish 20 years or older).

Poor ☒ (0-5%), Moderate ☐ (5-10%), Good ☐ (+10%)

APPENDIX 5e (cont'd)

SURVEY RESULTS

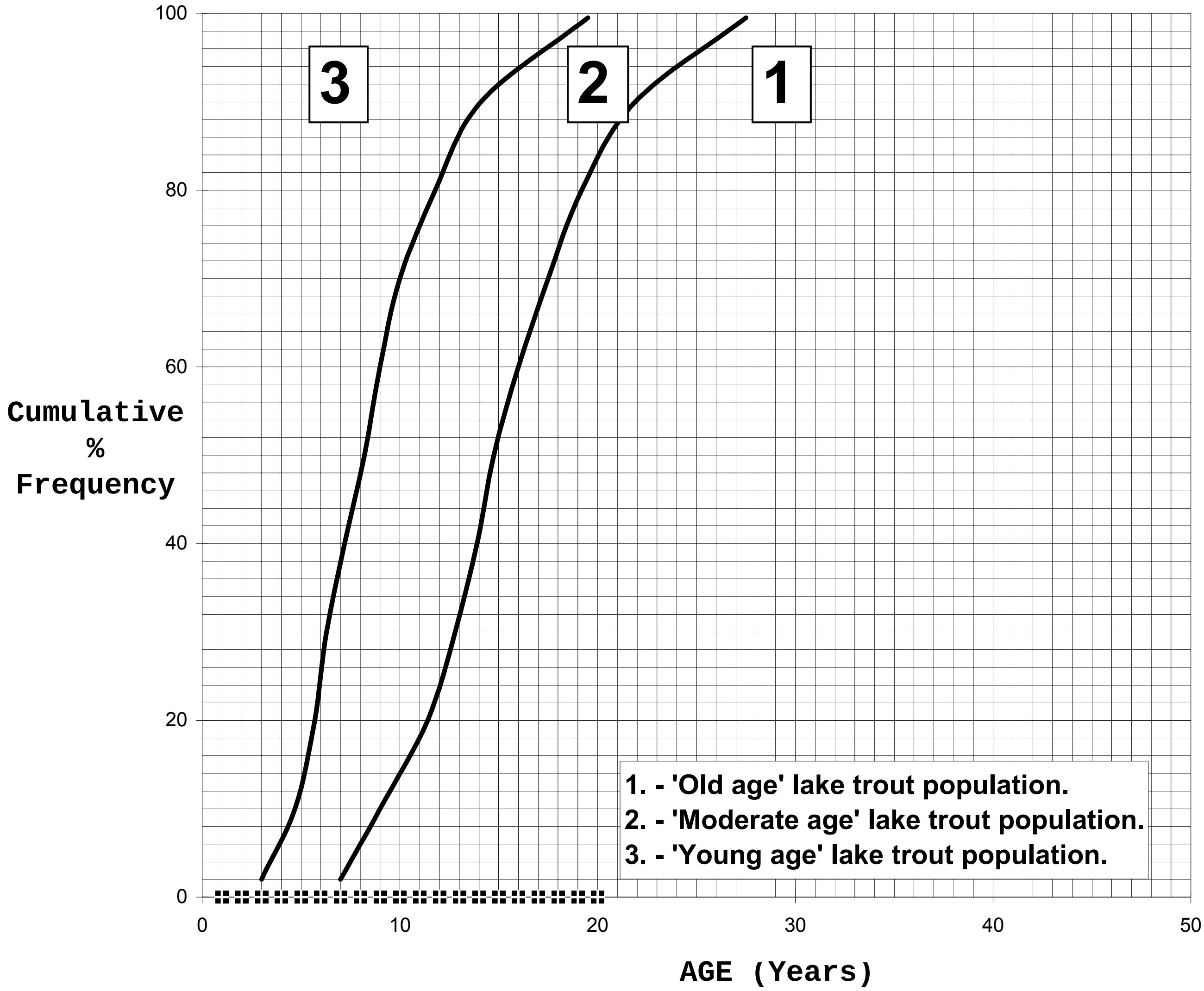
LAKE TROUT AGE ANALYSIS

LAKE NAME: DORIS LAKE

SAMPLE DATE: 02 (YY) 06,10 (MM) 6,9 (DD)

SAMPLE METHOD: Gillnet

SAMPLE SIZE: 0 , ADEQUATE ☐, NOT ADEQUATE ☒



CONCLUSION, AGE: Old ☐ → Moderate ☐ Young ☐

SURVEY RESULTS

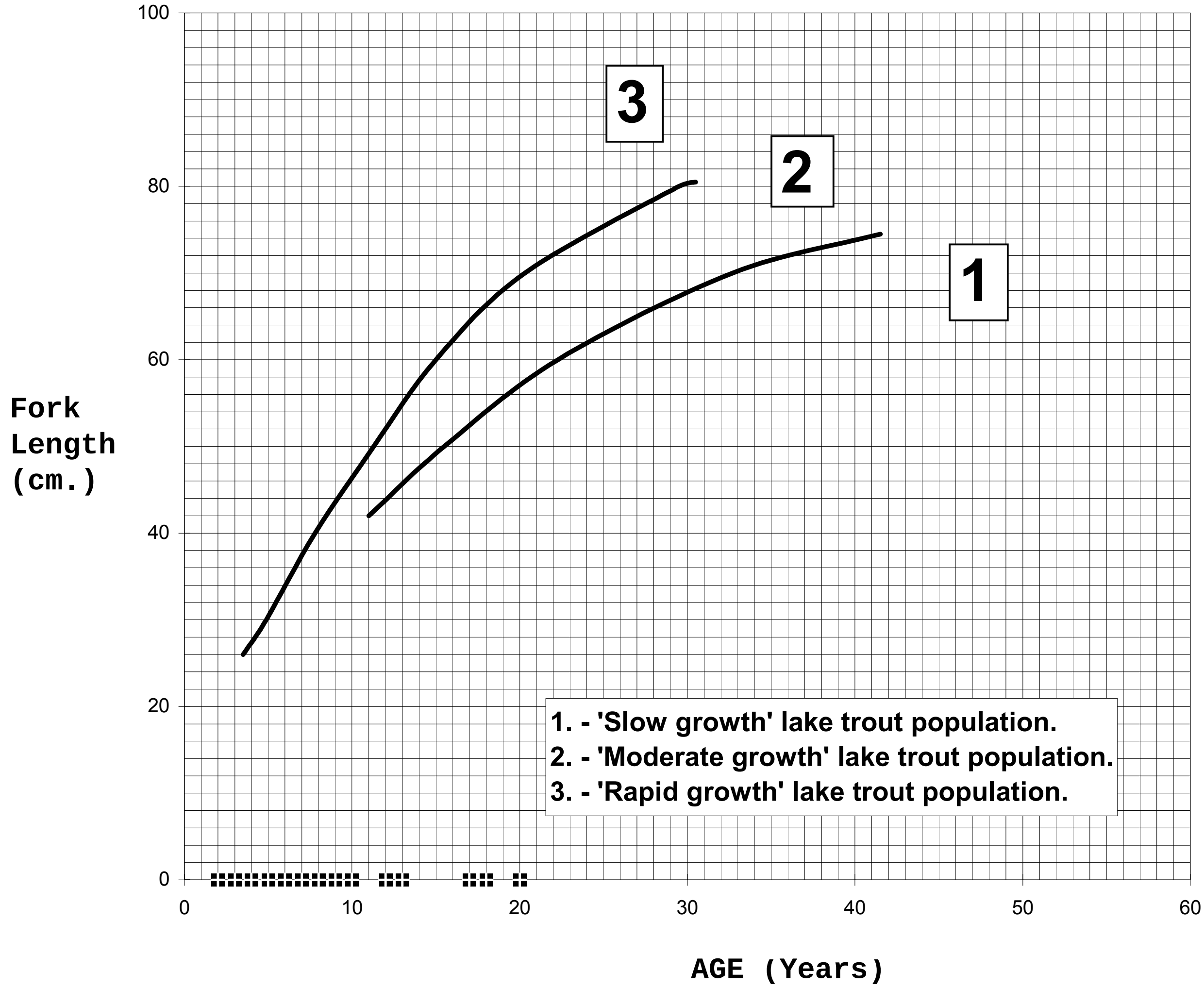
LAKE TROUT GROWTH ANALYSIS

LAKE NAME: DORIS LAKE

SAMPLE DATE: 02 (YY) 06,10 (MM) 6,9 (DD)

SAMPLE METHOD: Gillnet

SAMPLE SIZE: 0 , ADEQUATE ☐, NOT ADEQUATE ☒



CONCLUSION, GROWTH: Slow ☐ Moderate ☐ Rapid ☐

APPENDIX 5e (cont'd)

SURVEY RESULTS

LAKE TROUT SURVEY LOCATION

LAKE NAME: _Doris Lake______ SAMPLE DATE: _02_ _6,10_ _6,9_
YY MM DD

MAP NUMBER: _NTS 1:50 000 93L/04___

LT RAW DATA

None Captured