Tchesinkut Lake Creel Survey
2000-01

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ABSTRACT

A complementary roving/access point creel survey of Tchesinkut Lake was performed in 2000-01. The study lasted from July 31, 2000 until September 15, 2001. During this period 587 angler parties were interviewed. In the summer/fall portion of the survey 83% of all anglers originated from BC, with 63% of these anglers originating from the Lakes District. In the winter all anglers originated from BC, with 93% coming from the Lakes District. The most common angling method on Tchesinkut Lake in the open water fishery and the winter fishery, was using lures only (56% and 98% respectively). A much higher proportion of anglers used lures only in the winter fishery. The preferred species of fish for the majority of anglers in the open water fishery were lake trout and rainbow trout. However, lake trout was overwhelmingly the most popular species in the winter fishery. Anglers spent on average, 3.2 hr/day (±1.7 (standard deviation)) on Tchesinkut Lake in the summer, but only 2.5 hr/day (±1.2) in the winter. Fishing effort peaked in July and declined through to October, but increased during the ice fishery.

Rainbow trout were by far the most common (63%) fish species caught in Tchesinkut Lake for the open water portion of 2000-01 season. Lake trout were the second most common fish caught at 20% of the total catch, while kokanee constituted only 16% of the catch. In the winter, all but one reported fish caught was a lake trout. On average, the harvested lake trout were longer (67.6cm ± 6.6) and heavier (3.1kg ± 0.8) in the ice fishery than in the summer fishery. The lake trout harvested in the summer of 2000-01 were not significantly different in size than those harvested in 1988 ($t=0.71$, $p>0.4$). An annual estimate of 775 lake trout and 1,191 rainbow trout was estimated to be harvested from Tchesinkut Lake in 2000-01. Age data were analyzed for lake trout and it was found that the average age of harvested fish was 13.8 years old (±4.7). The average age of sampled young lake trout (≤ 15 years old) was younger in 2000-01 than in 1988 ($t=2.45$, $p<0.05$), but the lengths were not significantly different ($t=1.92$, $p>0.05$), indicating that young lake trout are growing faster than they were 13 years ago.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1 INTRODUCTION

Tchesinkut Lake is located 13 km south of Burns Lake in the Skeena Region of British Columbia and is utilized for several activities (Figures 1&2). Sportfishing for the lake's rainbow trout (*Oncorhynchus mykiss*), lake trout (*Salvelinus namaycush)*, kokanee (*Oncorhynchus nerka*), and burbot (*Lota lota*) is an important recreational activity for both resident and non-resident anglers. Tchesinkut Lake contributes substantially to the quality of life in the surrounding communities as well as the economy of Burns Lake.

Concerned anglers have recently suggested that fishing success on the lake has been deteriorating over the past number of years due to increased fishing pressure (Westenhofer *et al.,* 2000). The lake trout population was of particular concern in Tchesinkut Lake. Lake trout are characterized by slow growth, late maturity, low reproductive potential and a slow replacement rate. These attributes make the species especially vulnerable to overexploitation (Shuter *et al.,* 1998).

Significant angling pressure occurs on this lake with an estimated 8500 angling hours occurring during the open water fishery in 1988 (Bustard, 1989). The 1987-88 survey failed to sample the ice fishery on Tchesinkut Lake, but conservation officers have noted that significant pressure occurs during the winter months (De Gisi, 1998). Bustard (1988) also concluded that the lake trout harvest exceeded the maximum sustainable exploitation by 572 kg/year. Analysis of population age and length-at-age distributions demonstrated that the Tchesinkut lake trout population was being heavily exploited (deLeeuw *et al*., 1991).

The Fisheries Branch of the Ministry of Water, Land & Air Protection, with the assistance of the Regional District of Bulkley-Nechako and the Tchesinkut Watershed Protection Society, launched a two year survey to gather information on the lake. The goals of the Tchesinkut Lake Creel Survey 2000-01 were:

1. To determine if annual sportfishing harvest of lake trout is sustainable.

2. To determine if harvest levels of lake trout has aversely affected the lake trout population.

The objectives of the study were:

1. To collect representative demographic and angling method data from 2000-01 anglers on Tchesinkut Lake.

2. To collect accurate catch and effort data to estimate the total catch and effort by anglers on Tchesinkut Lake for both the open water and ice fishery.

3. To provide public education on fisheries concerns and lake stewardship for anglers and community groups in the Burns Lake area.

4. To compare results with previous studies; in order to determine if angling pressures have affected the Tchesinkut Lake lake trout population.

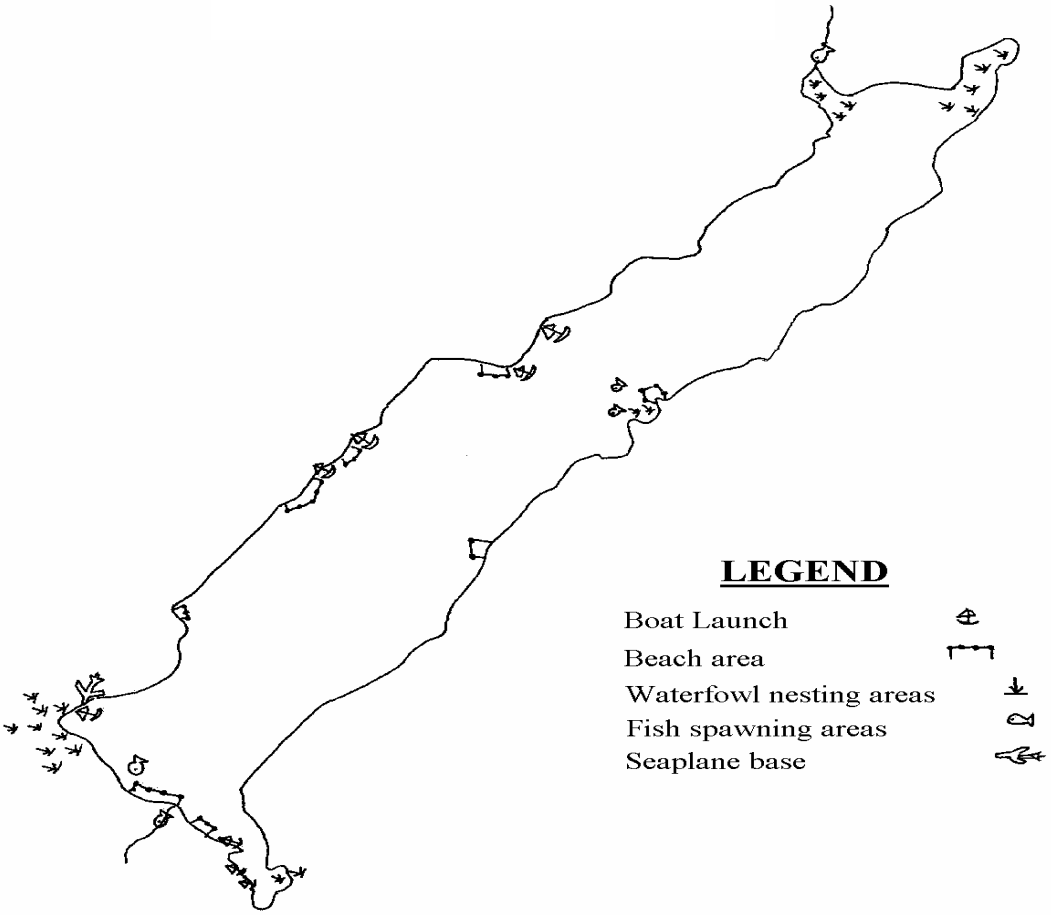
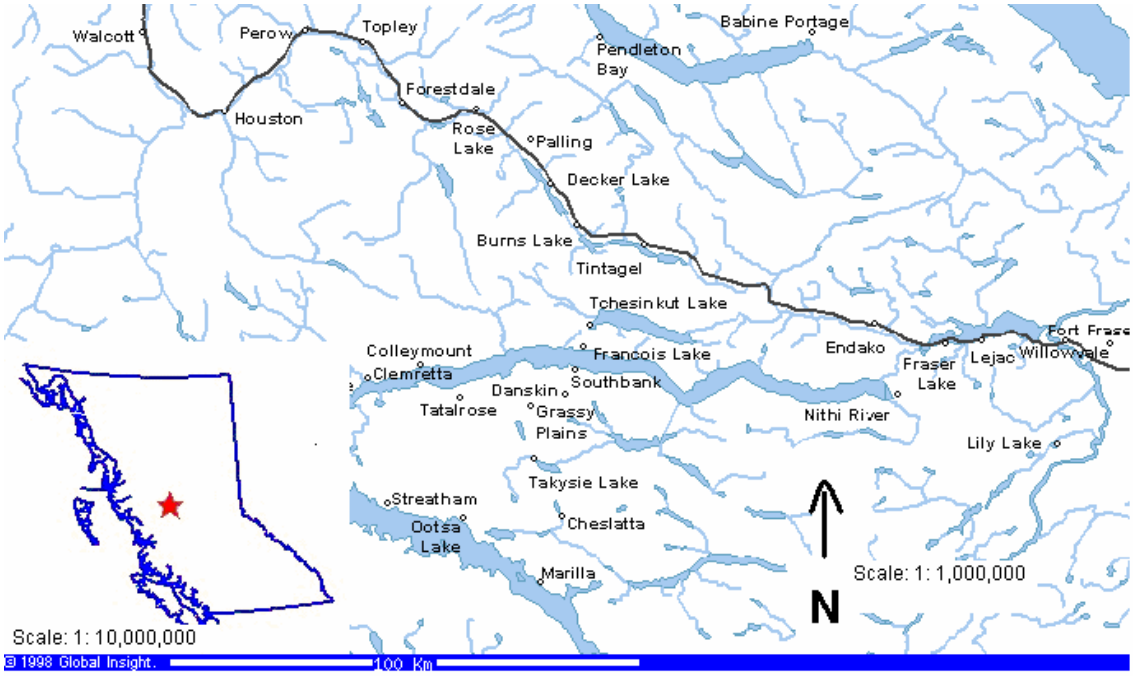


Figure 1. Water Usage Map of Tchesinkut Lake.

2 STUDY AREA

Tchesinkut Lake is located on the Central Interior Plateau of British Columbia near the geographic center of the province (Figure 2). The lake lies at 54°N latitude and 125°W longitude. It is approximately 13 kilometers south of Burns Lake and 5 kilometers north of Francois Lake within the Bulkley-Nechako Regional District. The surface area of the lake is 33.827 km^2 with a mean depth of 61.5 m and a maximum depth of 149 m (Webber and Tupniak, 1981). Tchesinkut Lake is a dimictic and oligotrophic lake, thermally stratified in winter and summer and low in nutrients (Westenhofer *et al.,* 2000).



(source: www.multimaps.com)

Figure 2. Location of Tchesinkut Lake in Lakes District, and in BC.

The Tchesinkut Lake watershed drains approximately 344.4 km^2. In this watershed several land uses occur including: residential housing, fishing lodge/resort, campgrounds, timber harvesting and agriculture (Westenhofer *et al.,* 2000).

3 METHODS

3.1 Field Methods

Four creel survey technicians alternated time periods conducting a creel survey on Tchesinkut Lake in 2000-01. This included roving rod-counts as well as complementary roving and access point (exit) surveys to obtain data on angler characteristics and catch. Complementary surveys are known to reduce bias and increase the amount of data collected (Pollock *et al.*, 1994). The study period was stratified into monthly blocks and into weekday and weekend/holiday types within the months (double (two-stage) stratified random sampling design). The survey took place over three periods: July 31-October 15, 2000; January 31-April 4, 2001 and June 3-September 15, 2001. The unsampled portions of the year are thought to contribute little to the annual angling effort. Sampling effort varied between these time periods for both weekday and weekend/holiday days due to differences in technician availability (Table 1). Field days were randomly selected and included all weather and water conditions. The open water fishery is the period immediately after the ice melts off of the lake, usually in late April, until the lake freezes over in winter, usually in late December. Harvest of lake trout is prohibited between September 15 and November 30. The winter ice fishery is the period when anglers ice fish the lake, usually beginning in mid-December, and lasting until early-April.

Effort counts were conducted by boat to determine the amount of angling pressure on Tchesinkut Lake. These counts were taken in three different time periods: the morning count was from sunrise until 12:00, the afternoon count was from 12:00 to 17:00 and the evening count was from 17:00 until sunset. In the winter, effort counts were conducted by observation points and were taken in the morning, mid-day and in the late afternoon. The start times for counts were determined randomly.

For the open water component of the survey, an aluminum boat powered by a 15 horsepower outboard motor was used to obtain daily effort counts, as well as, to interview anglers out on the lake during their angling day. Many anglers were also interviewed on shore at the lake's most popular access location, Beaver Point Resort, and at the adjacent public boat launch. For the winter component of the survey, a snowmobile was used to rove the area to count rods and interview anglers.

Fishing effort on Tchesinkut Lake was determined by conducting rod counts on the water. During the summer survey, the technician traveled by boat from Beaver Point Resort at the west end of the lake to the island near the center of the lake using binoculars to count boats and rods along the way. If any boats were situated in the eastern end of the lake, they would be approached to determine the number of rods and to conduct an interview. While returning to the starting point, anglers in their boats would be intercepted to conduct brief interviews. The round trip boat count was generally concluded in less than one hour at which point the technicians completed the Lake Effort Count Form (Appendix 1). The date, time, weather and water conditions at the lake were all recorded, along with the number of rods and boats observed fishing.

The technician would frequently forego performing the interviews if the angling party was known to be returning to Beaver Point Resort. These anglers would be interviewed upon arriving back to the Resort, allowing the technician to obtain a complete trip interview. During busier times of the season (i.e. long weekends), interviews were not conducted until all of the rods had been counted. This reduced the amount of time required to perform a count and minimized the "shadowing effect". The shadowing effect is described as the reduction in the probability of intercepting angling parties due to delays caused by interviewing (Wade *et al.*, 1991). However, the bias introduced by the shadowing effect would have been negligible at Tchesinkut Lake because of the small number of fishing parties on the lake at one time.

Rod counts can be classified as either instantaneous or progressive. The roving counts conducted on Tchesinkut Lake took upwards of an hour to complete, which is near the upper threshold for an instantaneous count (Pollock *et al*., 1994). The few boats present on the lake at one time, and individual boat recognition by the survey technician should have reduced the bias to a small amount and the counts were treated as being instantaneous.

The creel technician was stationed at Beaver Point Resort a majority of the time, where returning anglers would be interviewed. Details of completed trips obtained in the access survey component provided better data than the incomplete-trip interviews conducted out on the lake. Complete trip interviews have greater precision since they do not suffer from length-of-stay bias (Jones *et al.,* 1995). However, interviews from the roving survey were essential to the survey design in order to sample resident anglers that access the lake from private residences. Beaver Point Resort was chosen for the site of the access survey since the majority of anglers launch from the resort or the adjacent public boat launch facility.

During the winter survey, the technician traveled along East Tchesinkut Lake Road and stopped at various observations points to count anglers. There were seven primary locations that winter anglers frequented with a high degree of fidelity. These locations were easily visible from the road with the aid of binoculars.

Interviews from roving and access point surveys were used to obtain specific angler information. Tchesinkut Lake anglers were asked to participate in a short, confidential survey (Appendix 2). Name, address, guiding status, trip length, preferred species, angling hours and angling methods were recorded. Harvested fish were measured and the appropriate aging structure was acquired. The interviews were kept brief to appease the anglers and generally took less than a minute. No angler declined an interview during the survey; however, in the event an angler refused, the date, time, location and gender would be recorded.

3.2 Analysis Methods

The study period was stratified into monthly blocks and into weekday and weekend/holiday types within each month. August and the first two weeks of September were sampled in consecutive years (2000-2001). However, the amount of sampling effort exerted in the summer of 2000 was significantly less than in the following year[1]. To eliminate the potential of confounding the results, overlapping data from 2000 was omitted from calculations involving angling effort. However, the data from both years was pooled in the analysis of angler and catch rate attributes, i.e. CPUE.

3.2.1 Interviews

Interviewing times listed in Table 1 are reflective of the creel survey technician's availability for interviews. Often, there were large intervals of time when the technician was available but few or no anglers were on the lake.

3.2.2 Angler Characteristics

3.2.2.1 Angler Residence

The angler's residence was determined by the address that they verbally gave the interviewer, or through license inspection. Anglers who gave an address located in British Columbia were categorized as residents. Non-residents were categorized as all anglers who gave an address that was in Canada but outside British Columbia. Non-Canadians were categorized as all anglers who gave an address that was outside of Canada.

In order to determine the residence of many of the anglers, the address on their freshwater angling license was inspected. This had the dual purpose of checking the anglers for possession of licenses, although the creel technician had no authority to enforce the regulations. No statistics were taken of the proportion of anglers that failed to produce a license, but it is believed to be very low at Tchesinkut Lake.

Residents were sub-divided into the following categories: Lakes District, Bulkley Valley, Omineca-Peace, North Coast and Other. The 'Lakes District' category covered Burns Lake and the surrounding communities including Tchesinkut Lake, Francois Lake, Decker Lake and Topley. The 'Bulkley Valley' category included communities such as Houston, Telkwa, and Smithers. The 'North Coast' category included communities such as Prince Rupert, Terrace and Kitimat. The 'Omineca-Peace' category included Prince George and other northern interior locations, such as, Ft. St. John, Vanderhoof, etc.. The 'Other' category included all other locations in BC.

[1] Two creel technicians were employed in the summer of 2001, compared to just one in the summer/fall of 2000.

3.2.3 Angler Trip Characteristics

3.2.3.1 Angling Method

Angling methods were recorded as three categories: fly fishing, lures, and bait (Appendix 2). Since interviews often encompassed a party of anglers, more than one method was frequently recorded. In addition, one angler could use different methods throughout the angling day or could use a combination of methods at the same time. No differentiation was made between these possibilities.

3.2.3.2 Preferred Species

Preferred species were recorded in four categories: rainbow trout, lake trout, all species, and other. The 'all species' category was the one used when anglers responded that they were not fishing for any particular species. Anglers who did not have any preferred species likely meant that they preferred to catch any of the sport fish in Tchesinkut Lake (excluding burbot). Therefore, for the purposes of this survey, these anglers are presumed to be targeting the primary sport fish in the lake and are categorized as preferring lake trout and rainbow trout.

Most anglers surveyed did not discriminate between rainbow trout and kokanee. Few angling parties specified kokanee as a preferred species although, anglers targeting rainbow trout were equally satisfied with catching kokanee. Since the gear and technique for catching these two species is identical, all anglers targeting rainbow trout and/or kokanee were combined into the 'rainbow trout' category

Anglers characterized as fishing for both lake trout and rainbow trout were either targeting both species concurrently or fishing for one species for a certain time period and then altering their fishing strategy to pursue the other species.

3.2.3.3 Trip Length

Each interviewed angler was asked how long they had been fishing prior to the interview and how much time they anticipated fishing for the entire day. Most anglers were interviewed at the end of their fishing day (completed-trip) while others were interviewed during their fishing day (incomplete-trip). Because many factors, such as weather and fishing success, can influence trip duration, estimates of mean trip length from incomplete interviews can be biased (Pollock *et al.,* 1994).

Twenty-nine percent of interviews from the open water fishery were taken from anglers before they had completed their angling day. A two-tailed t-test was performed to compare discrepancies between expected trip length from complete and incomplete-trip interviews. The trip lengths were not found to be significantly different ($t=1.39$, $p>0.1$). Therefore, both the expected trip length from incomplete-trip interviews and trip length from complete-trip interviews can be used to calculate angler day (Table 6).

The average angler day was calculated using the equation:

Equation 1

$$A_b = \frac{\sum_{i=1}^{n_b} (h_{ib}\, g_{ib})}{\sum_{i=1}^{n_b} g_{ib}}$$

where A_b = the average angler day (hours) for period b, h_{ib} = expected hours fished for the i^{th} interview in period b and g_{ib} = number of people in angling party from i^{th} interview in period b and n_b = total number of interviews in period b.

3.2.4 Angler Effort & Catch Rate

3.2.4.1 Angler Effort

Rod counts were stratified into two categories: weekends/statutory holidays and weekdays. Malvestuto and Knight (1991) found that stratification by day type significantly improved the precision of estimates of fishing effort by 10-15 percent. A two-tailed t-test confirmed that there was a significant difference between effort on weekend days and weekdays ($t=3.6$, $p<0.001$). Rod counts were also stratified by month to provide more detailed temporal information about the amount of fishing effort occurring on the lake.

The mean daily rod count for each monthly period and day type was calculated with Equation 2:

Equation 2

$$\hat{e}_{bh} = \frac{\sum_{k=1}^{n_{bh}} (\tilde{y}_{kbh}\, d_k)}{n_{bh}}$$

where $\hat{e}_{bh}$ = the mean number of rod-hours per day in monthly period b and day type h, $\tilde{y}_{kbh}$ = the mean rod count on day k in monthly period b and in day type h, d_k = the number of daylight hours on day k for Tchesinkut Lake (data obtained from the U.S. Naval Observatory website) and n_{bh} = the number of days sampled of day type h in monthly period b.

Although the standard definition of a fishing day is "from a half hour before sunrise to a half hour after sunset", the definition of a fishing day used in this report is from sunrise to sunset (Hayne, 1991). This definition was used because it was observed that early morning and late evening times had a reduced amount of fishing effort.

To calculate the effort directed at a specific species of fish, the proportion of angling effort targeting a species is estimated. All of the effort on Tchesinkut Lake can be attributed for lake trout and rainbow trout/kokanee. The species of fish targeted by each

angling party was determined from interviews and the proportion of the total effort targeting each species (Q_{sb}) was determined for each monthly period with Equation 3:

Equation 3

$$Q_{sb} = \frac{\sum_{i=1}^{n_b} (w_{ibs}\, u_{ibs})}{\sum_{i=1}^{n_b} (w_{ib}\, u_{ib})}$$

where w_{ibs} = number of hours fished for species s from i^{th} interview in monthly period b, u_{ibs} = number of rods used for species s from i^{th} interview in monthly period b, w_{ib} = number of hours fished from i^{th} interview in monthly period b, u_{ib} = number of rods used from i^{th} interview in monthly period b and n_b = total number of interviews in monthly period b.

Anglers stating that they were fishing for 'all species' or for both lake trout and rainbow trout were assumed to have spent half of their time fishing for lake trout and the other half of the time fishing for rainbow trout. Therefore, half of the angling party's rod-hours were assigned to rainbow trout angling while the other half was assigned to lake trout .

To ascertain approximate targeted effort, the proportion of total rod-hours spent fishing for either rainbow trout or lake trout (Q_{sb}) was included into the daily rod count calculation (Equation 4).

Equation 4

$$\hat{e}_{bhs} = \frac{\sum_{k=1}^{n_{bh}} (\tilde{y}_{kbh}\, d_k\, Q_{sb})}{n_{bh}}$$

The average daily rod-hours by month and day type ($\hat{e}_{bh}$ or $\hat{e}_{bhs}$) was then multiplied by the number of days in that month with that day type and added together to obtain the total monthly effort in rod-hours:

Equation 5

$$E_b = \sum_{h=1}^{2} (\hat{e}_{bh}\, N_{bh})$$

$$E_{bs} = \sum_{h=1}^{2} (\hat{e}_{bhs}\, N_{bh})$$

where E_b = total estimated rod-hours for month b, E_{bs} = total estimated rod-hours targeting species s for month b and N_{bh} = number of days of day type h in month b. The data from 1987 (Bustard, 1989) was also re-calculated with the previous methodology in order to allow comparisons.

The sample variance of monthly effort was calculated using equation 6:

Equation 6

$$s_{bh}^2 = \frac{\sum_{k=1}^{n_{bh}} (e_{bhk} - \hat{e}_{bh})^2}{n_{bh} - 1}$$

where e_{bhk} = the effort (in rod-hours) for day k in monthly period b day type h, $\hat{e}_{bh}$ = the mean daily effort in monthly period b day type h, and n_{bh} = the number of days sampled in month b day type h. The variance of the estimated total monthly effort by day type was calculated using equation 7:

Equation 7

$$Var(E_{bh}) = \frac{N_{bh}^2 \, s_{bh}^2 \, (1 - f)}{n_{bh}}$$

where (1-f) is the finite population correction factor = $(N_{bh} - n_{bh}) / N_{bh}$. The finite population correction factor (fpcf) is used to adjust for random sampling without replacement (Pollock *et al.* 1994). The fpcf was ignored when 100 percent of the stratum was sampled.

The variances for the total monthly effort by day type were added together to get a variance for the total monthly effort using equation 8:

Equation 8

$$Var(E_b) = \sum_{h=1}^{2} Var(E_{bh})$$

A 95% confidence interval was calculated using equation 9:

Equation 9

$$E_b \pm 1.96 \, (Var(E_b))^{1/2}$$

3.2.4.2 Catch Composition

The catch composition presented in Table 12 represents all fish caught including both harvested and released. Released fish were rarely seen by the creel survey technician because they were usually released prior to the interview.

3.2.4.3 Catch Rate

In the 2000 season, the number of anglers was ascertained, rather than the number of rods used. For the purposes of this report, rod-hours and angler hours are considered to be interchangeable. This is not completely accurate because in the open water lake fishery, BC Fishing Regulations (MELP, 2000) permit boats with single occupants to use a maximum of two rods. Solitary anglers interviewed in 2000 were not asked if he/she used more than one rod simultaneously. However, in the 2001 portion of the study it was noted how many rods the individual anglers used.

In roving surveys, anglers to be interviewed on a given day are intercepted with a probability proportional to the length of their completed fishing trip. To adjust for this unequal sampling probability, the mean-of-ratios estimator (Equation 10) was used to calculate catch-per-unit-effort rather than the more common ratio-of-means estimator (Pollock *et al.,* 1994; Jones *et al.,* 1995; Pollock *et al.,* 1997).

The observed catch rate was calculated using data from the angler interviews. The number of hours of fishing prior to the interview and the species and amount of fish caught and released were used to calculate catch rate. A two-tailed t-test showed that there were not any significant differences between lake trout catch-per-unit-effort between complete-trip and incomplete-trip interviews ($t=1.85$, $p>0.05$). Similarly, difference were not noted for rainbow trout catch rates with a two-tailed t-test with unequal variances ($t'_s=0.20$, $p>0.5$). Incomplete interviews were therefore included in the calculations (Palermo and Thompson, 2000; MacKenzie, 1991). Total catch rate (R_1) was estimated by:

Equation 10

$$R_1 = \frac{\sum_{i=1}^{n} (c_i/e_i)}{n}$$

where R_1 = catch rate (catch per rod-hour) of the sample, n = the number of interviews, c_i = the catch for the i^{th} interview and e_i = the total prior angler hours for the i^{th} interview. In order to reduce variance within the sample, interviews when less than 30 minutes of angling had occurred were removed from the sample (Pollock *et al.* 1997).

The catch rates from data from 1988 were calculated using the ratio-of-means estimator since only complete-trip interviews were obtained (Bustard, 1989). The ratio of means estimator (R_2) was calculated using this formula:

Equation 11

$$R_2 = \frac{\sum_{i=1}^{n} c_i}{\sum_{i=1}^{n} e_i}$$

where n = the number of interviews, c_i = the catch for the i^{th} interview and e_i = the total prior angler hours for the i^{th} interview. Differences in the CPUE calculated using the two equations results when catch is related to trip length.

Equations 10 and 11 assume that anglers catch all fish species with equal probabilities. At Tchesinkut Lake, this is not a valid assumption since anglers specifically targeting lake trout are unlikely to catch rainbow trout and kokanee because of differences in fishing strategies and vice versa. Targeted catch rates were obtained by calculating the

catch rates from angler interviews that were specifically targeting each species (Lockwood et al., 1999).

Equation 12

$$R_{1bs} = \frac{\sum_{i=1}^{n_{bs}} (c_{bis}/e_{bis})}{n_{bs}}$$

where R_{1bs} = catch rate for species *s* for month *b*, n_{bs} = the number of interviews with anglers targeting species *s* in monthly period *b*, c_{bis} = the catch of species *s* for the i^{th} interview in month b and e_{bis} = the total prior hours fishing for species *s* from the i^{th} interview in month b. Once again, fishing trips of less than 30 minutes were omitted from the sample and the rod-hours of anglers targeting 'all species' or both lake trout and rainbow trout were equally allocated to both species.

The sample variance of the catch rates for each targeted species (from equation 12) was calculated using equation 13:

Equation 13

$$w_{bs}^2 = \frac{\sum_{k=1}^{n_{bs}} (r_{bis} - R_{1bs})^2}{n_{bs} - 1}$$

where r_{bis} = the catch rate (in fish per rod-hour) for targeted species *s* for the i^{th} interview in monthly period *b* and n_{bs} = the number of interviews conducted with anglers targeting species *s* in month *b*.

The variance of estimated monthly catch rate was calculated using equation 14:

Equation 14

$$Var(R_{1b}) = \frac{w_{bs}^2}{n_{bs}}$$

3.2.4.4 Catch

The total harvest for each species by month was calculated using equation 15:

Equation 15

$$C_{bs} = E_{bs} * R_{1bs}$$

where R_{1bs} = the mean catch rate (harvested fish per rod-hour) for targeted species *s* in month *b* and E_{bs} = the total effort (rod-hours) directed at species *s* for monthly period *b*.

The variance of the total catch was calculated using equation 16:

Equation 16

$$Var(C_{bs}) = E_{bs}^2 Var(R_{1bs}) + R_{1bs}^2 Var(E_{bs}) + Var(E_{bs}) Var(R_{1b})$$

The 95 percent confidence interval was calculated for the total monthly catches using equation 17:

Equation 17 $C_{bs} \pm 1.96 \, (\mathrm{Var}(C_{bs}))^{1/2}$

Lake trout and rainbow trout harvested catches were calculated separately using the same methodology.

4 RESULTS AND DISCUSSION

4.1 Angler Characteristics

4.1.1 Interviews

Table 1 shows the sampling effort conducted for the angler survey at Tchesinkut Lake. The heaviest interviewing effort was conducted during the months of July and August. The largest number of interviews was also taken in these two months. Less effort was put forth in the winter; however, significantly less daylight hours during which to conduct interviews occurred during this period.

Table 1. Total monthly interviewing effort, 2000-01[2]

Monthly Period	Interviewing Time (hr)	Number of Interviews
February	81	73
March	93	84
June	134	91
July	225	114
August	267	139
September	145	84
October	15	2
Total	**960**	**587**

4.1.2. Angler Residence

Most of the anglers interviewed in the summer were BC residents (83%), of which 63% resided in the Lakes District (Table 2). In 1988, only 50% of BC resident interviews were from Lakes District residents. Bulkley Valley anglers composed a larger component of BC resident anglers (28%) in 1988 than in 2000-01 (13.4%).

The second largest proportion of interviews was from Canadian non-resident anglers (10%), which was up substantially from the 4% of all interviews in 1988. However, a decrease in the proportion of non-Canadian anglers, by nearly 4%, has occurred over the years. Almost all out-of province Canadians interviewed were from Alberta or Saskatchewan. Foreign visitors came from the U.S.A. and Europe exclusively.

The winter ice fishery was made up entirely of BC resident anglers. Of those anglers, the vast majority were from the Lakes District (93%) while only 6% were from the Omineca-Peace and less than 1% visited from other locations in BC.

[2] The interviewing time for February, March, June and July are from the 2001 season, whereas the October value is from the 2000 season. August and September represent pooled data from both seasons: the actual interviewing time and number of interviews for August 2000 is 59 hours and 49 interviews, respectively while for September 2000, they are 46 hours and 47 interviews. For August 2001, these values equal 208 hours and 90 interviews and for September 2001, they are 99 hours and 37 interviews.

Table 2. Anglers by residence.

	1988 Summer*	2000-01 Summer	2001 Winter
Resident (B.C.)	**84.6%**	**82.7%**	**100%**
Lakes District	49.6%	63.1%	93.2%
Bulkley Valley	28.1%	13.4%	0.0%
Omineca-Peace	13.2%	14.6%	6.2%
North Coast	5.0%	2.1%	0.0%
Other	4.1%	6.8%	0.6%
Non-Resident (Can.)	**4.2%**	**9.9%**	**0.0%**
Non-Canadian	**11.2%**	**7.4%**	**0.0%**
	n=143	n=943	n=161

*Bustard, 1989

Many anglers were interviewed more than once during the course of the 2000-01 creel survey. By design, anglers who fished more days (i.e. more fishing effort) were sampled more often. Forty-eight percent of all interviews in the summer were repeat interviews, while 60% of all interviews in the winter were from anglers that had already been encountered. Removing the repeated interviews does not appreciably alter the angler residence distribution. The high percentage of repeat interviews for both seasons indicates that many anglers spend multiple days fishing Tchesinkut Lake.

4.1.3 Angler Gender

Of all the different individual anglers interviewed throughout the summer seasons, 79% were male and 21% were female (Table 3). Female anglers were proportionately highest in the BC resident category (23%), while being lowest in the foreign contingent (10%). Of the 64 individual anglers interviewed during the winter, only four anglers (6%) were females, which was substantially less than the summer figures.

Table 3. Angler gender by residence.

Residence	Summer 2001		Winter 2001	
	Male	Female	Male	Female
All Anglers	**79%**	**21%**	**94%**	**6%**
Resident (B.C.)	77%	23%	94%	6%
Non-Resident (Can.)	83%	17%	-	-
Non-Canadian	90%	10%	-	-
	n = 312	n = 86	n = 60	n = 4

4.1.4 Angler Guided Status

None of the anglers interviewed in the summer were guided. The question of whether the angler was guided or not on the interview questionnaire was ignored for the winter

survey. Guides were not observed on Tchesinkut Lake by the winter creel survey technician.

De Gisi (1998) reported that only two guides utilized Tchesinkut Lake between the years of 1990-1998. During this period, nine lake trout were captured by clients (four of which were released) in fifty-four guided angler days. Guided anglers represent a very minor portion of the fishery on this lake.

4.2 Angler Trip Characteristics

4.2.1 Angling Methods

The fishery on Tchesinkut Lake is dominated by anglers trolling from boats. As shown in Figure 3, the most common method of angling in the summer was using lures only (56%). The second most common angling method was using lures and bait (37%), followed by bait only (4%) and fly fishing only (2%). On the other hand, lures were the most widely employed angling method in the winter (98%), lures & bait and bait only followed at one percent each.

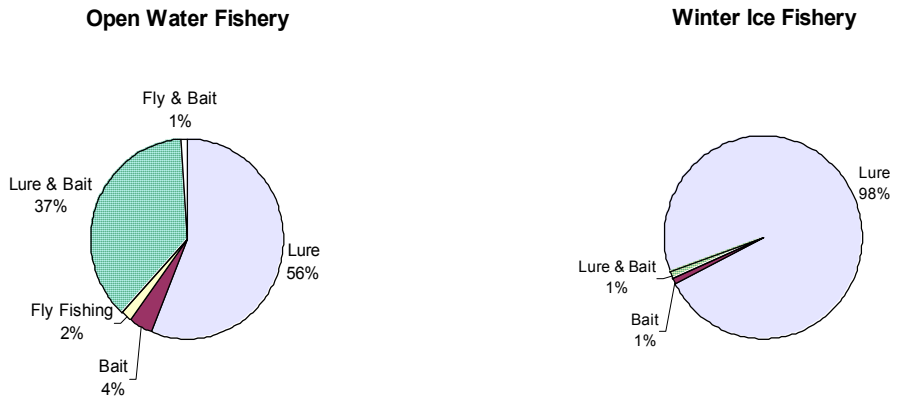


Figure 3. Percentage of angler interviews by angling method and season.

4.2.2 Preferred Species

Since 1988 (Bustard, 1989), it appears that the importance of rainbow trout as a preferred species has decreased by 10% (Table 4). Lake trout, on the other hand, have comparatively increased in popularity in the open water fishery to become the most targeted fish species in Tchesinkut Lake with 36% of all anglers specifically targeting them. Ninety-nine percent of all angler parties interviewed in the ice fishery preferred lake trout. The winter ice-fishery can therefore be characterized primarily as a lake trout fishery.

Table 4. Percentage of angler interviews by preferred species.

Species Preferred	1988* Summer	2000-01 Summer/Fall	2001 Winter
Rainbow Trout**	40%	30%	0%
Lake Trout	27%	36%	99%
Lake & Rainbow Trout***	32%	33%	0.5%
Burbot	2%	1%	0.5%
	n = 60	n = 430	n = 161

*Bustard, 1989
**Includes kokanee anglers
***Includes anglers that claimed to prefer 'all species'

The preferred species often influenced the choice of angling method or vice-versa. In the summer, anglers who were fly fishing were exclusively targeting rainbow trout; however, using lures with bait was still the most common method of angling for rainbow trout (Table 5). Anglers who were exclusively pursuing lake trout primarily used lures while anglers fishing for either rainbow trout or lake trout were evenly split between using lures only and lures with bait.

Table 5. Angling method by preferred species during the open water fishery.

Angling Method	Preferred Species		
	Rainbow	**Lake Trout**	**Rainbow & Lake Trout**
Lure	20%	97%	48%
Bait	7%	0%	2%
Fly Fishing	6%	0%	0%
Lure & Bait	66%	3%	49%
Fly & Bait	1%	0%	1%
	n = 131	n = 154	n = 140

In the winter, of the 159 angler parties interviewed who preferred lake trout, 158 of them were using only lures and one was using lures and bait. The one angler interviewed who preferred burbot was using bait on a set line. The winter fishery, in contrast to the summer, was dominated by a single preferred species and a single angling method.

4.2.3 Trip Length

Overall, Tchesinkut Lake anglers expected to spend 3.2 hours fishing per day during the open water season (Table 6). Throughout the season the mean angler trip remained steady in the range of 3.0 – 3.4 hours per day. At 2.5 hours, the overall mean expected rod day in the winter was significantly less ($t=5.58$, $p<0.01$) than the summer. Weather patterns and fishing success were major factors affecting the trip length.

Table 6. Mean expected angler day in hours by month.

Month	Angler day

	(standard deviation)
June	3.4 (1.7)
July	3.0 (1.5)
August	3.2 (1.6)
September	3.4 (2.2)
October	3.3 (0.3)
Avg. Summer	**3.2 (1.7)**
February	2.2 (1.1)
March	2.8 (1.3)
Avg. Winter	**2.5 (1.2)**

4.3 Angler Effort & Catch

4.3.1 Angling Effort

Total angling effort peaked in July with approximately 2801 rod-hours (Table 7). Following that, effort steadily declined into the fall months. Ice fishing pressure remained stable in February and March with 1044 and 1282 rod-hours respectively. No pressure was estimated for December or January due to the later than usual freeze-up of the lake during the study.

Table 7. Estimated total rod-hours by month.

Month	Estimated Total Rod-Hours			
	1988*		2000/2001	
	Effort (95% C.I.)	Daily Avg.	Effort (95% C.I.)	Daily Avg.
May	392 (±261)	12.6	n/a	n/a
June	2785 (±765)	92.8	2238 (±524)	74.6
July	3520 (±1783)	113.5	2801 (±201)	90.4
August	1896 (±556)	61.2	1786 (±203)	57.6
September	n/a	n/a	1133 (±265)	37.8
October	n/a	n/a	142 (±74)	4.6
February	n/a	n/a	1044 (±187)	31.6
March	n/a	n/a	1282 (±198)	41.4

*Bustard, 1989

When comparing the estimated effort between 1988 and 2000-01, there is no statistically significant difference between the analogous months (Table 7). The seasonal trend has also remained the same (Figure 4). However, slightly greater effort was observed in 1988 when compared to 2000-01 for June, July, and August (Table 7).

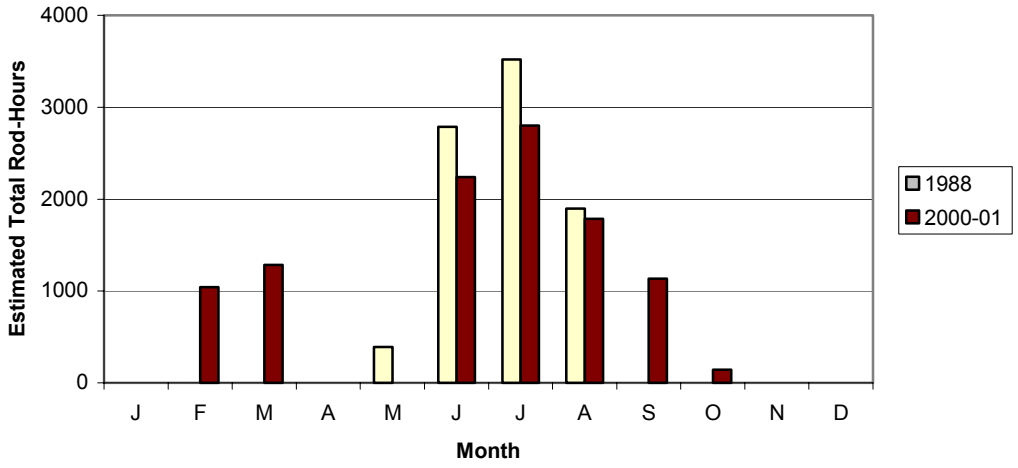


Figure 4. Total estimated rod hours by month (months without any effort data have not been surveyed).

The slight decline in effort that has occurred over the years is consistent with changes in angler attitudes. Many of the anglers interviewed stated that they fish Tchesinkut Lake less often than they used to, choosing instead to fish nearby Francois Lake, which is considered to have a greater catch rate. The difference between years may also be attributable to climatic differences between the two years. The variation within years is a result of an influx of summer vacation anglers from June until August.

Although no dates in May were surveyed in 2000-01, the trend from 1988 (Bustard, 1989) shows that it is a relatively minor component of the entire fishery (6.5%). This data disputes information from nearby Uncha Lake (Hatlevik, 1982), which indicated that considerable targeted effort of lake trout occurs in April and May. However, the smaller size of Uncha Lake relative to Tchesinkut Lake (1270 and 3383 hectares respectively) would allow Uncha Lake to warm up earlier in the season and thus, provide an earlier fishery.

This is the only creel study in the Skeena Region to document trends in angling effort in different decades. A creel survey on Babine Lake (Bustard, 1989) documented effort for two consecutive years (1985-86). The Babine Lake survey found significant differences in effort between subsequent years (~30%). This may indicate substantial year to year variability in lake fishing pressure, although the variation on Babine Lake was attributed primarily to Expo 86.

Since angling techniques for lake trout and rainbow trout/kokanee differ appreciably, the effort directed at each species was calculated for each month (Table 8). The greater pressure directed towards rainbow trout in the fall months of September and October are a consequence of the lake trout release regulations taking into effect in the middle of September. No anglers responded that they were fishing for lake trout during the release

period. Angling pressure for rainbow and kokanee is nil on Tchesinkut Lake in the winter months.

Table 8. Targeted effort in rod-hours by month (2000-01).

Month	Estimated Rod-Hours	
	Lake Trout (95% C.I)	Rainbow Trout/ Kokanee (95% C.I.)
June	1340 (±314)	897 (±210)
July	1342 (±96)	1459 (±105)
August	1175 (±133)	611 (±69)
September	317 (±116)	816 (±201)
October	0 (± 0)	142 (±74)
February	1044 (±187)	0 (± 0)
March	1282 (±198)	0 (± 0)

4.3.2 Angler Catch Composition

Rainbow trout were by far the most common (63%) fish species caught in Tchesinkut Lake for the open water portion of 2000-01 (Table 9). Lake trout were the second most common fish caught, followed closely by kokanee. Compared to the catch composition in 1988, rainbow trout have increased in relative amount from 52 % to 63% while lake trout have declined from 29% to 20%. The proportion of lake trout in the catch has decreased even though the percentage of anglers targeting lake trout has increased (Table 4).

Burbot were caught in Tchesinkut Lake using overnight setlines. It was difficult to assess the number of anglers using this passive method because they were only encountered during the short time they were setting up or checking the setlines; therefore, estimates were not made on the burbot harvest. Although the survey methodology may underestimate the pressure on the burbot population, it is unlikely that there is as much pressure as there was in the early 1980's, when an estimated 150 burbot were harvested annually (Bustard, 1989).

Of the 64 fish reported caught in the winter, 63 of them were lake trout. The only other fish reported caught was a burbot. This corresponds directly with the 99 percent of anglers interviewed who preferred lake trout (Table 4).

Table 9. Species composition of angler catch.

Species	1988*	2000-01 Summer	2001 Winter
Rainbow Trout	55 (52.0%)	467 (63.0%)	0 (0.0%)
Lake Trout	31 (29.0%)	152 (20.0%)	63 (98.5%)
Kokanee	19 (18.0%)	117 (16.0%)	0 (0.0%)
Burbot	1 (1.0%)	7 (1.0%)	1 (1.5%)
Whitefish	0 (0.0%)	1 (0.1%)	0 (0.0%)
	n = 106	n = 744	n = 64

*Bustard, 1989

In the summer/fall of 2000-01, over 70% of all angled lake trout and rainbow trout were likely to be harvested (Table 10). Only half of all kokanee caught were killed. Kokanee were released more often than other sport fish because of the perception that they were too small. In the winter, the percentage of lake trout harvested increased to 92%. The increased harvest rate in the winter fishery may reflect angler attitude differences between seasons, or it could be a result of the difficulty in performing successful catch and release through the ice.

Table 10. Proportion of catch harvested and released by species.

Species	Summer 1988		Summer/Fall 2000-01		Winter 2001	
	Harvest	Release	Harvest	Release	Harvest	Release
Rainbow Trout	47 (86%)	8 (14%)	334(72%)	133(28%)	-	-
Lake Trout	28 (91%)	3 (9%)	112(74%)	40 (26%)	58 (92%)	5 (8%)
Kokanee	17 (89%)	2 (11%)	6 (52%)	56 (48%)	-	-
Whitefish	-	-	0 (0%)	1 (100%)	-	-
Burbot	1 (100%)	0 (0%)	7 (100%)	0 (0%)	1 (100%)	0 (0%)

The low proportion of released lake trout in the Tchesinkut Lake fishery is a management concern, although the increased percentage of released lake trout since 1988 is an encouraging sign.

4.3.3 Catch Rate

Catch rates are calculated using the ratio-of-means estimator when completed-trip interviews are conducted, while the means-of-ratios estimator is more appropriate with data from incomplete-trip interviews (Pollock *et al.,* 1997). The catch rates derived from the access survey conducted in 1988 (Bustard, 1989) were calculated using the ratio-of-means estimator, while the 2000-01 catch rates were calculated using the mean-of-ratios estimator since some of the data collected were from incomplete-trip interviews (Table 11). The overall catch rate for rainbow trout has increased dramatically since 1988, while lake trout catch rate has remained relatively constant.

Table 11. Catch/rod-hour by species for the open water fisheries of 1988 and 2000-01.

Year	Rainbow Trout	Lake Trout	Kokanee	Total	# of Interviews
1988*	0.13	0.07	0.04	0.25	69
2000-01	0.21	0.06	0.06	0.34	405

* Bustard 1989

Changes in the catch rate have been proposed as an indicator of over-exploitation of fish populations. DeLeeuw (1991) found that lake trout gillnet catch rates were ten times higher in inaccessible (and thus, rarely fished) Skeena region lakes compared to easily

accessed Skeena region lakes. It does not seem from the data that a decrease in lake trout angling success has occurred and conversely, a considerable increase in the rainbow trout catch rate is evident. The catch rate for lake trout has not decreased significantly since 1988, but this may be an artifact of improved fishing technology. Lake trout anglers in 2000/01 frequently employed the use of downriggers and electronic fishfinders. Even in a depressed population, these instruments may allow catch rates to remain comparably high especially should these techniques not have been deployed in 1988.

4.3.4 Targeted Catch Rate

Rainbow trout targeted catch rates, analyzed from interviews of anglers specifically targeting rainbow trout, were calculated for each month (Figure 5). The highest total catch rate was observed in September (0.52 trout/rod-hour), while a dramatic drop was exhibited in August (0.28 trout/rod-hour). September also had the highest rainbow trout harvest per unit effort (0.41 trout kept/rod-hour). No rainbow trout were observed to be released in October; however, the result is confounded by the paucity of angler encounters in this month (two interviews). Rainbow trout were not captured through the ice.

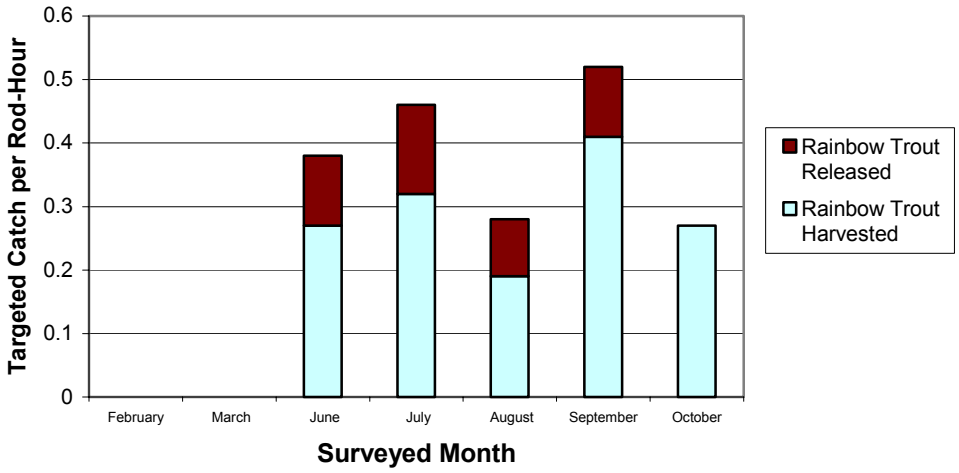


Figure 5. Targeted catch rate for rainbow trout by month.

The lake trout catch rate in September (0.14 trout/rod-hour) was the highest in the open water season (Figure 6). However, the maximum lake trout targeted catch rates were found to occur during the winter months of February (0.18 trout/rod-hour) and March (0.15 trout/rod-hour). Since ice fishermen preferred only lake trout, the targeted lake trout catch rate equals the total catch rate in the winter months.

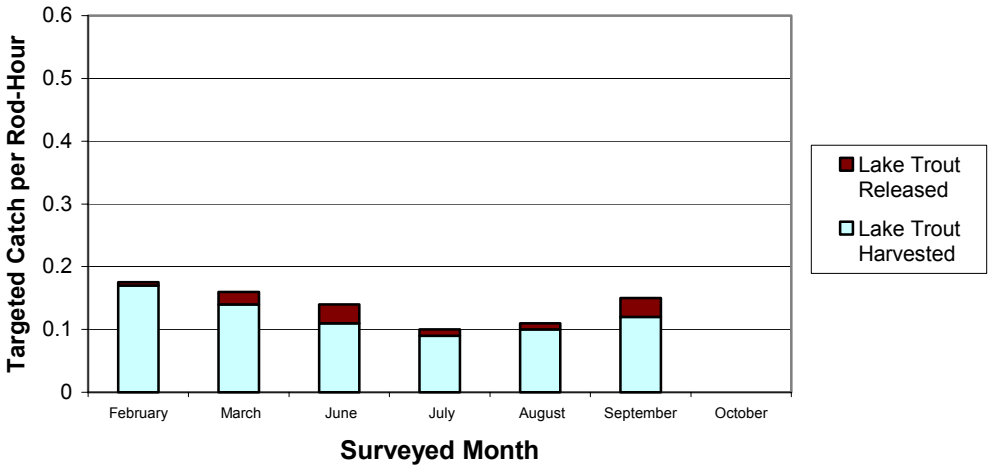


Figure 6. Targeted catch rate for lake trout by month.

Catch rates of rainbow and lake trout were plotted on the same axis, the y-axis, for easy comparison of Figures 5 and 6. It can be seen that lake trout targeted catch rate is substantially lower than that of rainbow trout with the highest TCPUE (targeted catch-per-unit-effort) for lake trout not exceeding that of the lowest rainbow trout TCPUE.

4.3.5 Angler Catch and Harvest

The total annual harvest of rainbow trout from Tchesinkut Lake is estimated at 1,191 fish (Table 12). A sizeable portion of the Tchesinkut Lake rainbow trout catch was taken in July with 460 fish estimated to be harvested (Figure 7). October had the smallest rainbow trout harvest in the open water season (38), primarily because of very low fishing pressure expended during this month. The rainbow trout harvest through the ice is negligible.

Table 12. Estimated catch of rainbow trout and lake trout by month.

	Rainbow Trout	Lake Trout
February	0	179
March	0	176
June	243	146
July	460	120
August	115	117
September	335	37
October	38	0
TOTAL	**1 191**	**775**

The estimated catch for lake trout was highest in February (179) and in March (176), giving an aggregate winter harvest estimate of 355 lake trout. The winter of 2000-01 was particularly mild and Tchesinkut Lake experienced a late freeze-up relative to a typical year. The ice fishing season usually commences near the end of December and lasts until

April, but it didn't get going until late January in 2001. Since the particular circumstances made sampling in early winter impractical in this creel survey, the total catch in the winter fishery during a more representative year is considered to be greater than was observed and predicted in this study.

During the open water period, the trend shows a steady decline in lake trout harvest as the season progresses (Figure 7). Lake trout harvest is presumed to not occur from the third week in September until the end of the fall. The total harvest from the open water fishery was estimated to be 420 lake trout.

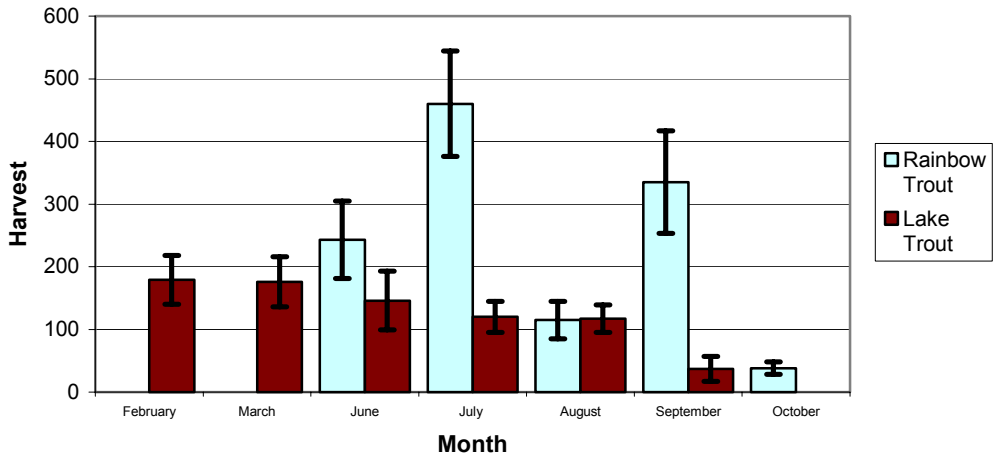


Figure 7. Estimated catch by month (error bars represent one unit of standard deviation).

The variability in estimated monthly catch is a function of the low numbers of daily interviews conducted at Tchesinkut Lake coupled with low catch per unit effort (Lester *et al*., 1991: Figure 7).

The estimated annual harvest of lake trout (open water fishery estimate + ice fishery estimate) is 775 fish[3]. With an average weight of 2.79 kg per lake trout, the annual harvest would equate to 2,162 kg/year. By season, the winter harvest is 1,100.5 kg (355 lake trout (LT): mean weight 3.1 kg) and the summer harvest is 991.2 kg (420 LT x mean weight 2.36 kg). The reported annual harvest is three times greater than the estimated maximum sustainable exploitation rate[4] for lake trout in Tchesinkut Lake of 716 kg/year (Bustard, 1989). The current exploitation rate is approximately 0.64 kg/ha. Healey (1978b) stated that maximum sustainable yield for lake trout rarely exceeds 0.5 kg/ha. None of the study lakes that Healey examined were located in BC. It is possible that lake

[3] This value is an underestimate since the months of April, May, November, December and most of January were not surveyed. However, the angling pressure during these months was relatively low.
[4] The maximum sustainable exploitation rate was derived by multiplying 0.225 kg/ha (average annual yield as described in deLeeuw *et al*., 1991) by the lake's surface area (3383 ha).

trout populations in BC do not conform to the models derived elsewhere, which underscore the lack of data from local systems. Using the Healy (1978b) method of estimating maximum sustainable yield, other lakes containing lake trout in BC were found to be overexploited. DeLeeuw *et al*. (1991) reported that Muncho Lake was surpassing its sustainable yield by over four-fold (0.97 kg/ha), while Lirette (1991) calculated an exploitation rate sixteen times greater (3.6 kg/ha) for Bridge Lake. It is noteworthy that the mean fork lengths for lake trout populations sampled by the later two authors were 40.5 cm for Muncho Lake and 45.8 for Bridge Lake 45.8 cm respectively.

The harvest calculated by Bustard (1989) using the same methodology was 1,288 kg/year. Since this survey did not encompass the winter fishery, this approximation would have to be considered a gross underestimation. Assuming that the same ratio of summer harvest to winter harvest existed in 1988 as in 2000-01, the lake trout harvest in 1988 comes out to 2,266 kg/year.

4.4 Fish Characteristics

4.4.1 Rainbow Trout

Rainbow trout length demonstrates a normal distribution for 2000-01, with the peak near the mean fork length of 32.8 cm (Figure 8). This corresponds well to the mean fork length obtained in 1988 of 32.5 cm. Rainbow trout mean fork length of harvested fish has not changed over the past 13 years (t=0.31, p>0.5).

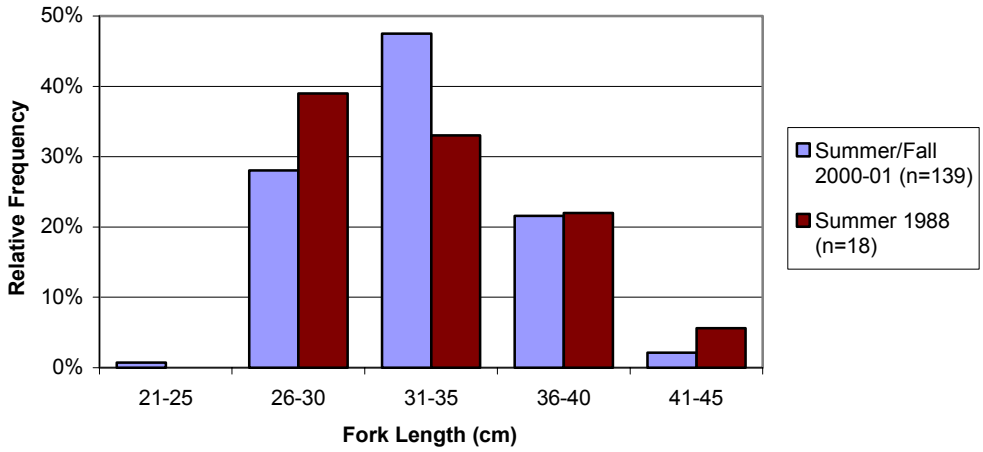


Figure 8. Rainbow trout relative frequency by fork length for 2000-01 and 1988.

4.4.2 Kokanee

The average fork length for kokanee has increased from 24.5 cm in the summer of 1988 to 27.8 cm in 2000-01 (Figure 9). Local residents state that the kokanee catch in Tchesinkut Lake varies noticeably from year to year. Kokanee comprise a major part of

the diet of large lake trout since they were the most prevalent food item found in the stomach contents.

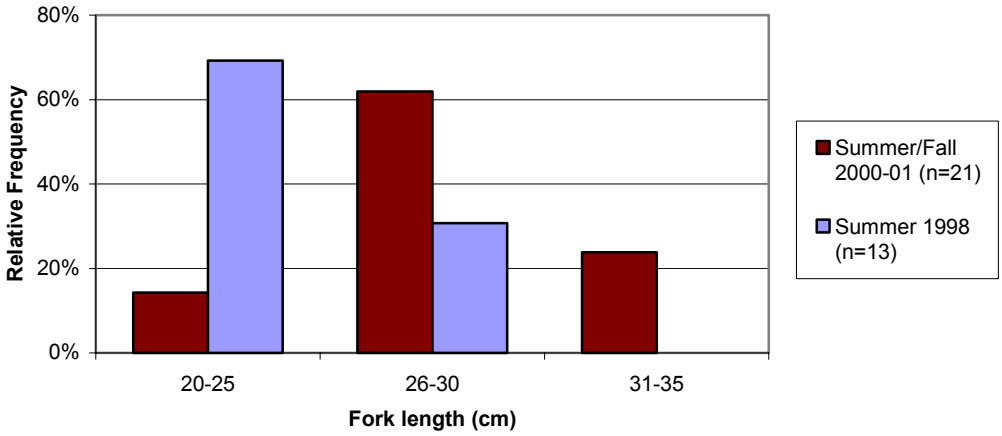


Figure 9. Kokanee relative frequency by fork length for 2000-01 and 1988.

Pre-spawn kokanee (approximately 1500 fish) were observed aggregated on a shoal off the south end of the island on September 13, 2001.

4.4.3 Lake Trout

4.4.3.1 Lake Trout Length

The winter ice fishery is characterized by a large proportion of lake trout captured in the 60-75 cm range (Figure 10). The average length of the winter lake trout was 67.6 cm, with the average weight being 3.14kg. The length-class distribution for lake trout sampled in the winter, has a distinct lack of smaller fish with only one sampled that was less than 50 cm. The ability to capture medium to large lake trout with relatively high catch rates contributes to the popularity of the ice fishery on Tchesinkut Lake.

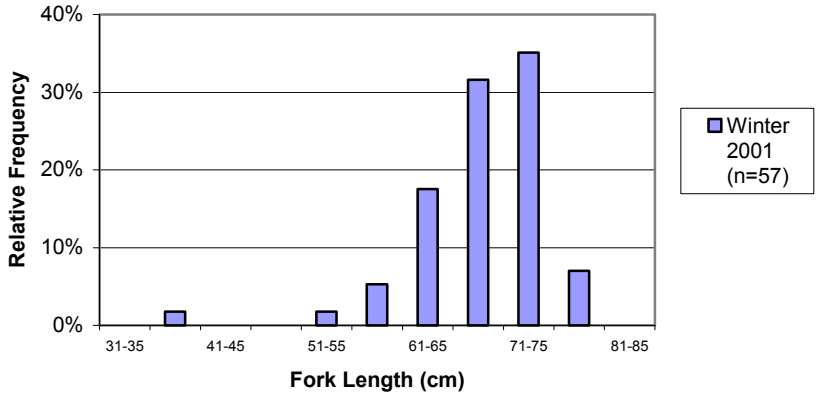


Figure 10. Lake trout relative frequency by fork length for winter 2001.

The mean fork length of the 85 lake trout measured in the summer was 60.2cm, which is significantly smaller than the winter fish ($t=4.16$, $p<0.001$). The average weight of the 83 lake trout weighed in the summer was 2.57kg. The distribution of lake trout in the summer is more evenly distributed (Figure 11).

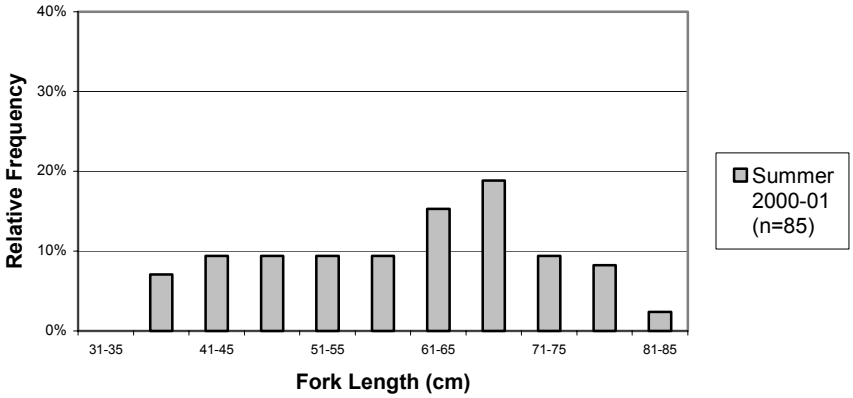


Figure 11. Lake trout relative frequency by fork length for summer 2000-01.

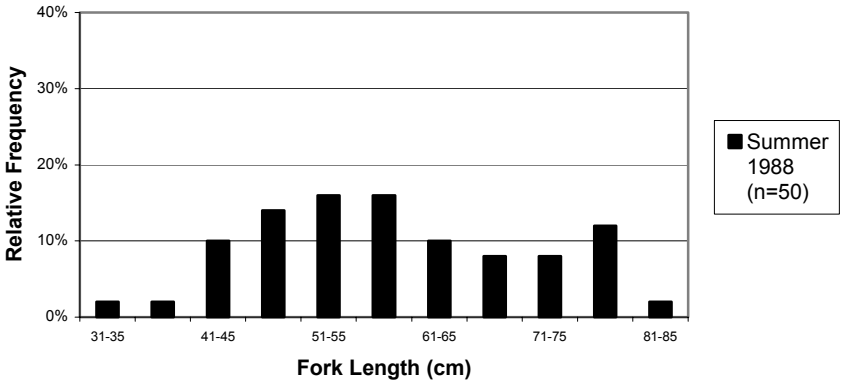


Figure 12. Lake trout relative frequency by fork length for summer 1988.

The mode of lake trout fork length is located in the range of 66-70 cm for the summer of 2000-01, but the mode for the summer of 1988 is at 51-60 cm. The mean fork length in 1988 was 58.2 cm, which was not statistically different from the mean (60.2 cm) in the summer 2000-01 ($t=0.71$, $p>0.4$). Although harvested lake trout tend to be larger in the winter fishery, a larger effort is exerted in the open water fishery.

The proportion of large fish (>70 cm) has declined slightly since the 1988 survey: 20% were greater than 70 cm in 2000/01 while 23% were in this range in 1988. Similarly, a marginal decline in the proportion of smaller lake trout (≤50 cm) caught by anglers was observed: 25% in 2000-01 and 28% in 1988. This has important implications for the

lake's attractiveness to the sportfishing community and subsequent management decisions.

4.4.3.2 Lake Trout Age

Lake trout ages were analyzed by North-South Consultants, which conducted double blind analyses of otoliths and fin rays. These age structures were collected from fish in the summer and winter. The ages were plotted against fish length along with the age data from lake trout caught in 1988 (Figure 13). Lake trout from Tchesinkut Lake seem to grow very little after 18 years of age.

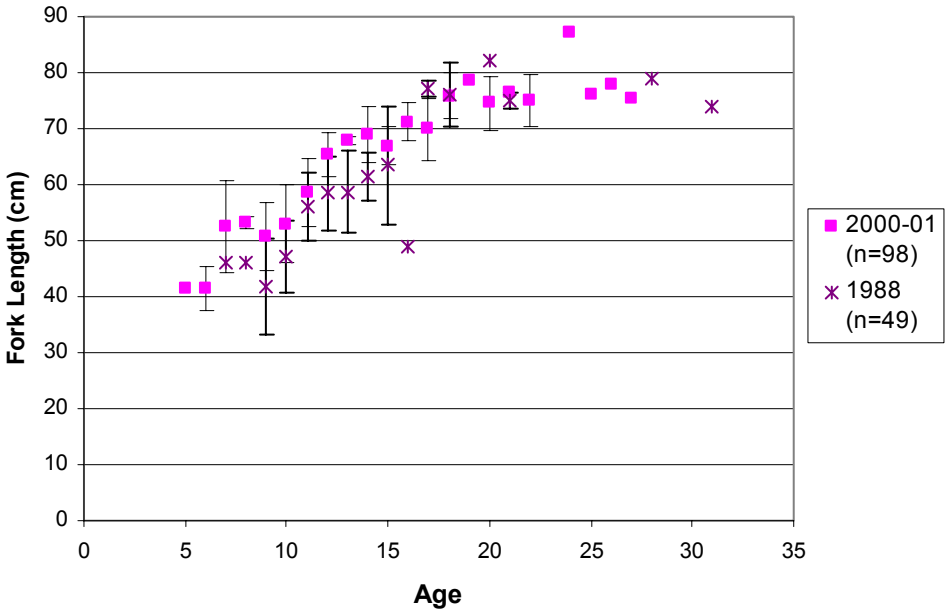


Figure 13. Mean length-age data for lake trout (error bars represent one standard deviation; points without error bars correspond to data from a single fish).

Studies have shown that lake trout populations can compensate for increased harvest rates by increasing the growth rate of juvenile fish (Healey, 1978a); however, this outcome has not been shown in the lakes of the Skeena Region (deLeeuw, 1991). Instead, the lake trout populations in heavily fished lakes in the Skeena Region seem to decline without compensating for harvest. Average ages of young lake trout (≤15 years old) from 1988 and 2000-01 were compared. It was found that the average age of the young lake trout sampled in 2000-01 were significantly younger than the young lake trout sampled in 1988 ($t=2.45$, $p<0.05$). Average lengths of these fish were also compared, and it was found that the lengths were significantly different at the 0.01 level of significance, but not at the 0.05 level of significance. Therefore, the young lake trout sampled in 2000-01 are significantly younger than those of 1988, with an average length not significantly different between the two years. This signifies that young lake trout are

growing faster than they were 13 years ago, indicating that a growth response is occurring in Tchesinkut Lake lake trout. If young lake trout are growing faster, it is an early indication of over-exploitation and a refutation of previous claims that compensation does not occur in Skeena Region lakes.

Most of the data comes from otolith examination, but only fin rays were obtained from gillnet sampling. Sharp and Bernard (1988) found that otoliths provided the best estimation of lake trout ages. Otolith age was graphed versus the fin ray age of the same fish for a subsample of the creeled lake trout (Figure 14). Using the resulting linear equation, it was possible to derive a more accurate age prediction from the analysis of the fin rays.

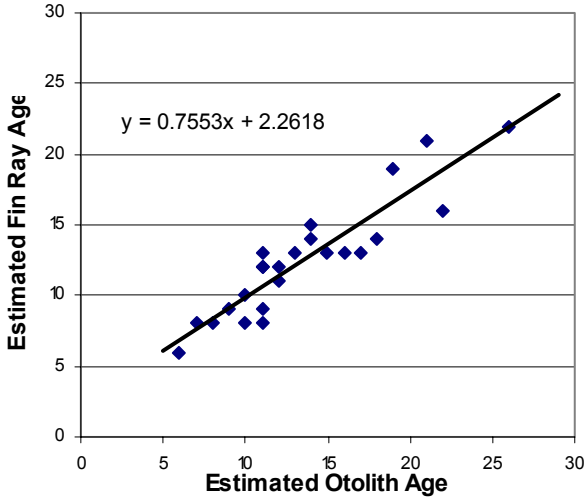


Figure 14. Relationship between estimated age from fin rays and from otoliths (n=24).

The regression line has a slope which is not close to one. Fin ray aged fish were corrected to otolith ages for the analysis.

Figure 15 shows the distribution of lake trout ages in the surveyed years. Eighty percent of the aged fish in 1988 were less than fifteen years old, compared to 68% in 2000-01. For both years, almost all of the lake trout are younger than twenty years old (~90%). Similar age distributions have been observed in Babine and Tagish Lakes (deLeeuw *et al*., 1991). Skeena Region lakes exhibiting these ranges of age data were considered to be heavily exploited. However, age data from angled fish may not provide a representative sample of the overall population and could be confounding the true age distribution.

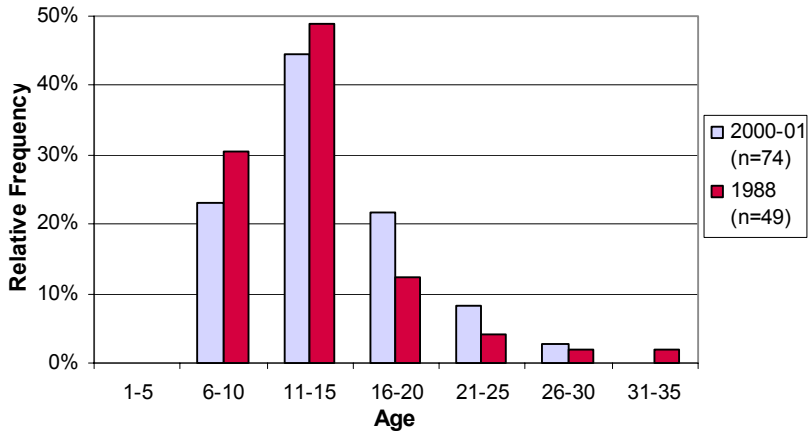


Figure 15. Age distribution of lake trout in Tchesinkut Lake.

4.5 Gillnet Data

Gillnets were placed in Tchesinkut Lake by fisheries personnel on May 28th – 31st, 2001. Sinking nets[5] were placed at systematic location and at specific locations perpendicular to and approximately twenty meters from shore. Lake trout, whitefish and rainbow trout were the only species captured in the nets (Appendix 9). Nets were checked every 1-3 hours and all captured fish were identified and measured before release. Furthermore, non-lethal age structures were removed and twenty of the lake trout were fitted with white Floy anchor tags posterior to the dorsal fin prior to release.

The lake trout sampled by gillnet were on average smaller than those captured by angling methods (Figure 16). The distribution obtained from gillnet data is considered to be more representative of the population since gillnets are not as discriminating, while angler surveys are known to be selective towards larger and older cohorts of fish (Pollock *et al*., 1994).

[5] Both standard 90 meter RIC experimental sinking gill nets and 60 foot sinking gillnets (20' 1" stretch, 20' 2" and 20' 3") were employed.

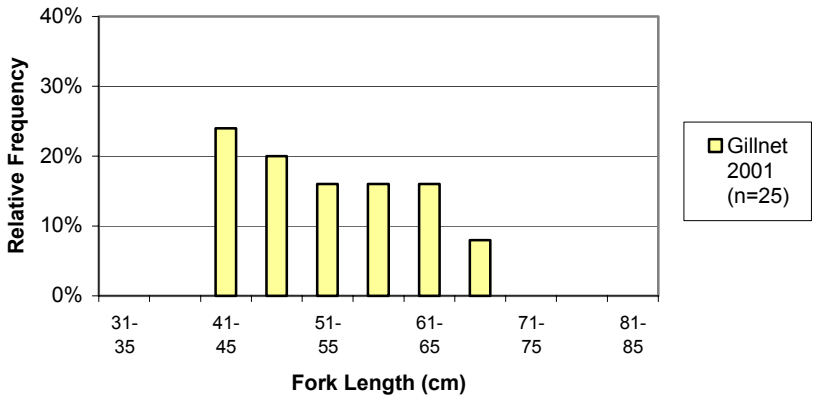


Figure 16. Relative frequency of lake trout captured by gillnet by fork length in May 2001.

Fin ray samples were obtained from 25 lake trout throughout the course of gillnetting. Of these, 18 fin rays were in good condition, and were included in the analysis of lake trout length at age data.

5 LIMITATIONS OF THE SURVEY

Although certain measures were taken to minimize any biases that could arise in the survey, particular attention must be taken to the following limitations.

Inherent in the design of a roving creel survey is a length of stay bias. This bias is the result of the fact that the probability of intercepting anglers is proportional to their trip length. Thus roving surveys interview more anglers who have been fishing longer than average (Pollock *et al.* 1994). Several tests in this report suggest that angling characteristics are not dependent on trip length. The length of stay bias for the data in this report is expected to be small.

Because the survey technician took one hour to complete a circuit of the lake, rod counts in the summer were not instantaneous. Anglers, during that one hour period, could have been either double counted or not counted at all depending on their movements with respect to the survey technician. If the survey technician began the count at a random point on the lake, anglers entering and exiting the counting area would be theoretically equal. Because of the size of the lake and the length of time it took to do one rod count, the summer survey technician began at the same point (Beaver Point Resort) every time. In this way, rod counts could be biased to some degree.

During the 2000 survey, interviewed anglers were not asked how many rods they used and one rod per angler was assumed. Solitary anglers in boats were permitted to use two rods. During the effort counts, both rods would be counted. The units that the effort was calculated in (rod hours) are not completely equal to the catch rate units in 2000 (angler hours). Few anglers in the 2000 season, however, used two rods when permitted so the bias is expected to be small.

Under-representation of effort may occur from anglers fishing during months that were not surveyed or anglers fishing at night. This bias is expected to be low from anecdotal knowledge. Nonetheless, the lack of fishing effort during these periods should be verified in any subsequent surveys.

6 CONCLUSIONS

The fish population in Tchesinkut Lake receives considerable pressure from sport fisherman. The rainbow trout fishery appears to be stable with adequate catch rates comparable to those of 1988. Average sizes of rainbow trout are the same as 13 years ago. These facts indicate that the rainbow trout population is currently not being over-exploited.

The main objective of this study was to determine if current harvest levels of lake trout populations are sustainable. The annual harvest estimate of lake trout from Tchesinkut Lake is notably greater than the estimated maximum sustainable yield (Bustard, 1989). However, annual biomass removed from the lake in 2001 (2162 kg/year) is similar to the estimated annual value derived in 1988 (2266 kg/year, Bustard, 1989).

The total average lengths of lake trout in the summer of 1988 were 58.2 cm, while the average lengths in the summer of 2000-01 were 60.2cm, but these differences were not found to be significantly different ($t=0.71$, $p>0.4$). However, of the young fish ($\leq$ 15 years old) sampled, it was found that the average age of young fish in 1988 was greater than that of 2000-01 ($t=2.45$, $p<0.05$). Therefore, a change in the lake trout population has occurred or is currently occurring in Tchesinkut Lake; young fish appear to be growing faster. A compensation appears to be occurring, which is an early sign of over-exploitation.

Concluding notes:

1) Effort.
Angling effort has remained unchanged in the past 13 years, and catch rates have remained relatively constant. Higher proportions of anglers are targeting lake trout than 13 years ago, but a lower proportion of the total catch is lake trout than in 1988. However, this difference may be attributable to either changes in the population dynamics of the lake trout, or in a change in dynamics and/or demographics of anglers.

2) Winter/Summer fishing differences.
Angling in the open water fishery is markedly different than angling in the ice fishery. In the summer, large proportions of anglers target rainbow trout, while no anglers reported angling for rainbow trout in the winter. The winter fishery can be classified predominantly as a lake trout fishery with little to no catch and release. Higher catch rates, and larger fish characterize the winter fishery. A higher catch rate occurs in the winter fishery, but a greater overall effort is exerted on lake trout during the summer months.

3) Angler Demographics.
A majority of people angling Tchesinkut Lake during the open-water portion of the fishery originate from BC (85%), of which 63% reside in the Lakes District. Since 1988 an increase in proportion of non-resident Canadians has occurred, while a slight decrease

in foreign anglers has occurred. In the winter fishery all anglers originated from BC, with 93% residing in the Lakes District. These differences in summer and winter angler demographics may result in the different catch rates between the two seasons.

4) Harvest/Release characteristics of the fishery.
Catch and release plays a vital role in maintaining fish populations. Since 1988 an increase in release of lake trout has occurred, jumping from a release rate of 9% to a release rate of 26% for the open water fishery. An increase in this trend will undoubtedly increase the vitality of the lake trout population. In the winter, only 5% of all lake trout caught were subsequently released. This depressed number may be attributed to the high probability of mortality from releasing fish during ice fishing. Whatever the case may be, increasing the awareness of the importance of catch and release is vital to protecting the Tchesinkut Lake lake trout population.

7 RECOMMENDATIONS

1. Limited sampling should be performed for the months that were not surveyed in 2000-01 to verify that fishing effort and catch is inconsequential. In particular, the months of January, April and the latter half of December should be surveyed in a typical year to assess any additional ice fishing pressure.

2. To obtain better representation of anglers accessing the lake through private residences, it may be possible to promote the usage of an angler diary (Anderson and Thompson, 1991). To ensure high compliance and accuracy, volunteers who are actively involved in conservation should be sought out (a.k.a.- members of the Tchesinkut Watershed Management Society). Anglers accessing the lake from private residences were under-represented since they were only encountered in the roving portion of the creel survey. These anglers likely have different angling characteristics than those anglers that do not know the lake as intimately (i.e. tourists). For instance, Tchesinkut Lake residents may have higher catch rates, shorter trip lengths, etc. due to their accumulated knowledge of the fishing.

3. Further live release, small mesh gill netting, which may prove to be an effective method for obtaining unbiased length and age data from a lake trout population.

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