Kitsumkalum River Steelhead: Summary of Current Data and Status Review, 1997

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Abstract

A review of all information on Kitsumkalum River steelhead, *Oncorhynchus mykiss,* available from B.C. Ministry of Environment, Lands and Parks (MELP), Skeena Region, Canada Department of Fisheries and Oceans (DFO), Repap, the Kitsumkalum Band Council, federal and provincial ministry staff and local anglers was conducted in March, 1997. Tagging records on 487 fish collected over eight years indicated that the majority of Kitsumkalum River steelhead spent three years in freshwater and three years in saltwater before returning to spawn. Approximately 7.5% of these steelhead were repeat spawners. The sex ratio of adult females to males was 1.08:1. The mean fork length and weight for all fish were 75.6 cm and 4.6 kg respectively. Adult steelhead were observed throughout the mainstem river as far as 83 km from the mouth, in the Cedar and Little Cedar rivers, and in Deep, Lean-To, Clear, Swanson, Hadenschild and Star creeks. Juveniles utilized most of the low gradient parts of the watershed for rearing. Steelhead reportedly overwintered in the mainstem between Lean-To Creek and Kitsumkalum Lake, in the Kitsumkalum (known locally as the Beaver) River near the mouth of the Cedar River, and in Redsand, Treston and Kitsumkalum lakes. Between 1985 and 1989, 5000 to 16,000 hatchery raised Kitsumkalum steelhead fry were released, in the only enhancement attempt recorded. Tagging data indicated that steelhead returned to the river as early as August 28 and as late as May 20, and suggested there may be three overlapping runs. The mean annual catch over the 27 years of record was 1107 steelhead and the annual catch generally decreased after the maximum of 2799 fish in the 1986-87 season. The number of steelhead reported killed each year generally declined to a maximum of 43 fish during the most recent four years of record. The number of anglers and angler days remained relatively constant, however the catch per unit effort (CPUE) generally increased. The mean CPUE was 0.38 steelhead per angler day. Anglers resident in Region 6 comprised at least 63% of all anglers on the Kitsumkalum River. Since regulated guiding began in 1990, in any one year as many as 12 active angling guides used a maximum of 667 angler days to catch up to 122 steelhead for a maximum CPUE of 0.327 steelhead per angler day. Estimates of abundance and the minimum escapement requirement were considered unreliable. Recommendations for improved management and future studies are offered.

Acknowledgements

The authors would like to thank Rob Brown (Steelhead Society of B.C.), Jim Culp (Terrace Salmonid Enhancement Society), Archi MacDonald (Skeena Cellulose), Steve Roberts (Kitsumkalum Band Council), Len Seefried (BioLith) and Ron Tetreau (MELP) for their help on this project. We especially appreciated the substantial editing contribution by Dana Atagi (MELP) and Charles Parken (Cascadia Natural Resources Consulting).

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1. Introduction

The steelhead (*Oncorhynchus mykiss*) population of Kitsumkalum River forms a major part of the recreational sport fishing opportunity for residents of the Terrace area as well as for visitors from around the world. The Kitsumkalum is a relatively cold water river with reasonably good access that offers high quality angling. Kitsumkalum Lake acts to stabilize the water levels in the mainstem river. The presence of glacial flour makes the waters relatively turbid throughout most of the year.

Factors such as easy access throughout most of the year, relatively high angler effort, a guided recreational fishery and continued forestry development activities in the watershed make it important that the steelhead population and habitat be carefully monitored to allow intervention if there are significant changes. The purpose of this report is to provide a summary of data currently available on Kitsumkalum River steelhead and to provide suggestions for protection of this resource and for improvements in the information base for fisheries management.

The report covers the following topics:

1. Freshwater and ocean life history
2. Spawning, rearing and overwintering areas
3. Review of past enhancement attempts
4. Review of adult assessments
5. Review of adult run timing
6. Review of harvest, catch and angler effort
7. Review of angling guide activity
8. Review of creel survey information
9. Review of current angling regulations
10. Description of recreational fisheries
11. Review of First Nations uses and harvest
12. Review of minimum escapement requirements
13. Summary of current stock status

Information about steelhead in the Kitsumkalum River has been collected since at least 1967, however it has not been comprehensively collated and summarized. This literature review involved searching all existing information available as of March, 1997 and summarizing it in the form of a stock status report.

2. Study Area

The Kitsumkalum River is a 95 km long, 5th order (1:50,000) stream which first runs north, then easterly and finally south to enter the north bank of the Skeena River approximately 90 km above its mouth at Tyee and 2 km downstream from Terrace, B.C. (Figure 1). It drains Kitsumkalum Lake, a relatively cold lake which is the central feature of the watershed. The river drains approximately 2270 km^2 (227,000 ha) and has 21 major tributaries including Luncheon Creek, Alice Creek, Star Creek, Nelson River, Mayo Creek, Cedar River, Little Cedar River, Hadenschild Creek, Stirling Creek, Anweiler Creek, Clarence Creek, Clear Creek, Douglas Creek, Wesach Creek, Dry Creek, Maroon

Creek, Goat Creek, Glacier Creek, Lean-To Creek, Deep Creek and Spring Creek. Species found in the Kitsumkalum River include steelhead *(Oncorhynchus mykiss)*, chinook *(O. tshawytscha)*, *sockeye (O. nerka)*, pink *(O. gorbuscha)*, coho *(O. kisutch)*, chum *(O. keta)*, cutthroat trout (*O. clarki)*, Dolly Varden *(Salvelinus malma),* and mountain whitefish *(Prosopium williamsoni)* (MELP 1977).

3. Methods

All information that was considered potentially relevant to steelhead in Kitsumkalum River was sought from the B.C. Ministry of Environment, Lands and Parks (MELP), Skeena Region files, the Canada Department of Fisheries and Oceans (DFO), Repap B.C. Inc., the Kitsumkalum Band Council, regional ministry staff and local anglers (Appendix A).

All tagging and aging data were entered into a MS Access database . The database was then used to search for and remove duplicate entries, to clean the data of spurious entries and to then analyze the data (Appendix B). A parsimonious approach was taken in interpreting all recorded data.

3.1. Removal of Duplicate Records

In many cases the same tagged fish was recorded in more than one record. These duplications were detected after all records were entered into the database and then sorted. Each record corresponded to one fish, with information such as age, sex, weight, length and other parameters recorded. In a significant number of cases, no tag numbers were recorded, however much of the other data recorded suggested duplication of records. These duplicates were of two types.

The first type included those cases in which all recorded data in the suspected multiple entries were in complete agreement. In these cases the records were deemed to be duplications. Since one record for a given fish often contained some information missing from the duplicate record, the record with the most information was retained. It was then augmented with information it did not contain but which was present in the less comprehensive record. After this the less comprehensive record was deleted from the working copy of the database. The simplified hypothetical example below shows two duplicate records and the record that would have been retained following the procedure described above.

	Sex	Weight	Length	Date Tagged	Location	Colour
Record 1	M	4.6 kg	67 cm	78/10/25	2	Bright
Record 2	M	4.6 kg	67 cm	78/10/25		
Augmented & Retained Record	M	4.6 kg	67 cm	78/10/25	2	Bright

The second type included those cases where there was some minor disagreement between one or more data fields recorded in multiple records for the same fish. The disagreements were not enough to suggest that the records referred to different fish, but were significant enough to make both records' fields suspect. In order to be deemed the same fish, the two records were required to agree in at least the date of capture and in two of either weight, length, or age. The disagreements usually involved the sex, length or weight of the fish. In the case of disagreements in weight and length , the data was labeled suspect if the difference exceeded 5%. Disagreements in sex were settled only if there was a minority of one discrepant record among all multiple entries. For example, a common situation encountered involved five records for the same fish. Four listed the fish as a male and the other listed it as female. In this case the augmented and retained record listed the fish as male.

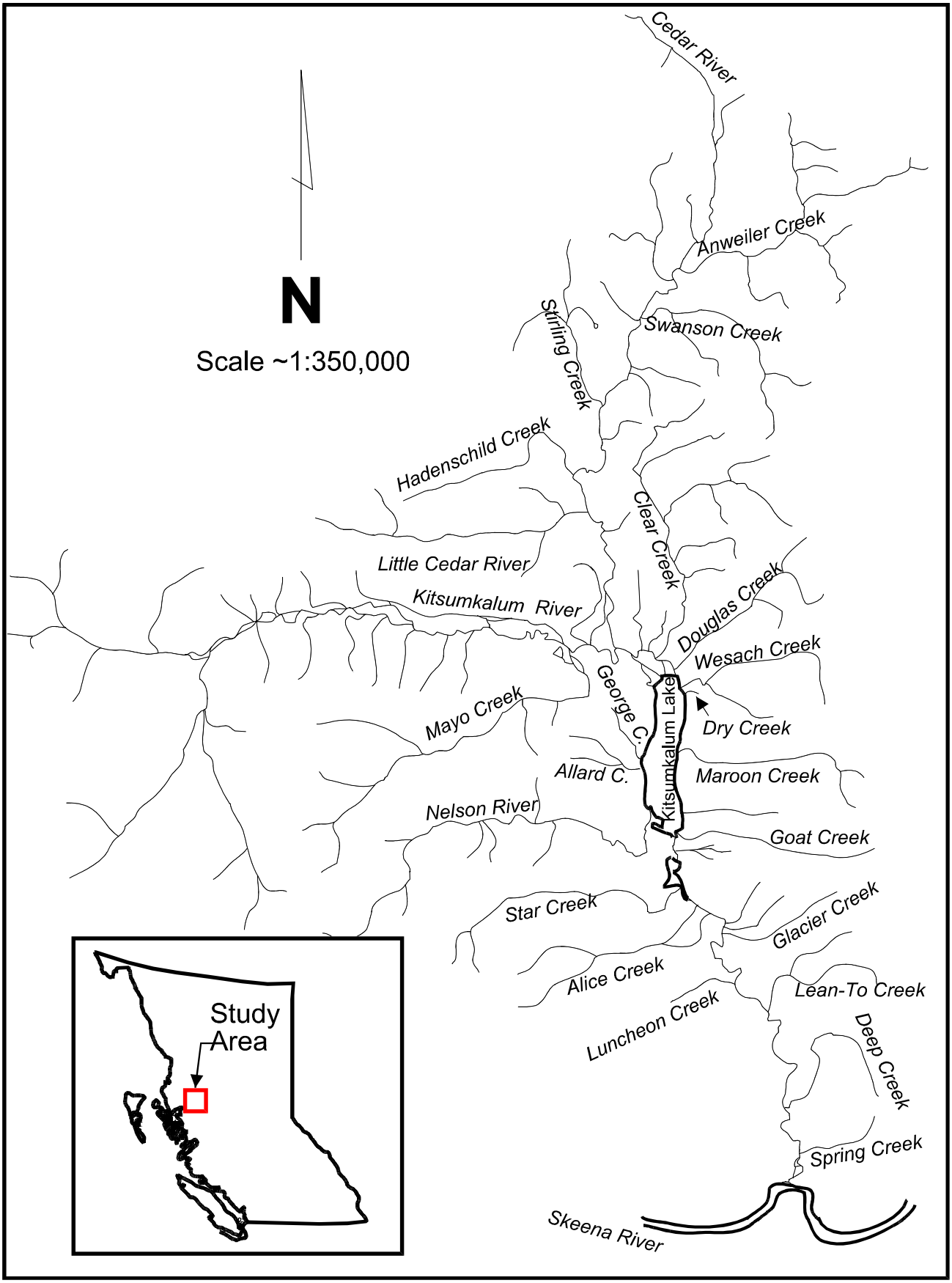

Figure 1. Map showing the location of the study area.

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However, if more than one out of the five multiple entries listed a female while the majority listed it as male then the sex was listed as suspect. Furthermore, if there were only two entries for the same fish and the sexes were contradictory, then the sex was noted as suspect data. Some of the records for ages from scales included two ages. These were the results from two different individuals who estimated the age of the same fish. The first age record was arbitrarily recorded in the database. The second age record was not recorded into the database and was not considered further in this study. Suspect data were not used in any further analyses in this study.

3.2. Other Comments

For the purposes of this report, references to rainbow trout were assumed to mean juvenile steelhead, as they are extremely difficult to differentiate. Fish less than or equal to 24.3 cm in fork length and whose lengths were recorded (n = 15) were considered juveniles, since their scales showed no evidence of any time spent in saltwater.

The only fish considered in the analyses of size and time in freshwater and saltwater were those with no regenerated scales, and those that were not recorded as repeat spawners.

Although the data refers to a total of 487 steelhead, specific analyses of the data usually involved smaller sample sizes due to the fact that not all fields in the record for a particular fish were complete. For example, analyses of subsets of the population, such as lengths of males, could only utilize the records of fish for which a length was given.

All references to locations were converted to a system of zones, partly based on sub-divisions provided by the Fisheries Branch, Ministry of Environment (R. Tetreau, pers. comm. 1997). These zones are shown in Figure 2. These zones are numbered from zone 1 in the headwaters to zone 8 at the mouth. The "Areas" recorded in the tagging data were considered to be the same as zones. Locations given as mileposts were assumed to refer to the local traditional names that refer to the mileage on the Nisga'a Highway. For example "10 mile" refers to an access road which contacts the river at the lower end of zone 6. Locations recorded simply as "Kalum" were not considered in the spatial analyses. Some of the locations are referred to by local names used by sportfishers. These are presented in the map in Figure 3.

Requests for information on steelhead in the Kitsumkalum River system were directed to the Kitsumkalum Band Council. Steve Roberts, chief councillor for the Kitsumkalum Band Council, was interviewed. Archi MacDonald of Repap B.C. Inc. explained that his company had no more information on steelhead than the Ministry of Environment, Lands and Parks. A list of persons contacted is given in Appendix A.

Original data are presented in Appendices B and C.

MELP and DFO are acronyms frequently used in this report. They refer to the Ministry of Environment, Lands and Parks and the Department of Fisheries and Oceans respectively.

Unless otherwise stated, significance tests were based on the t statistic.

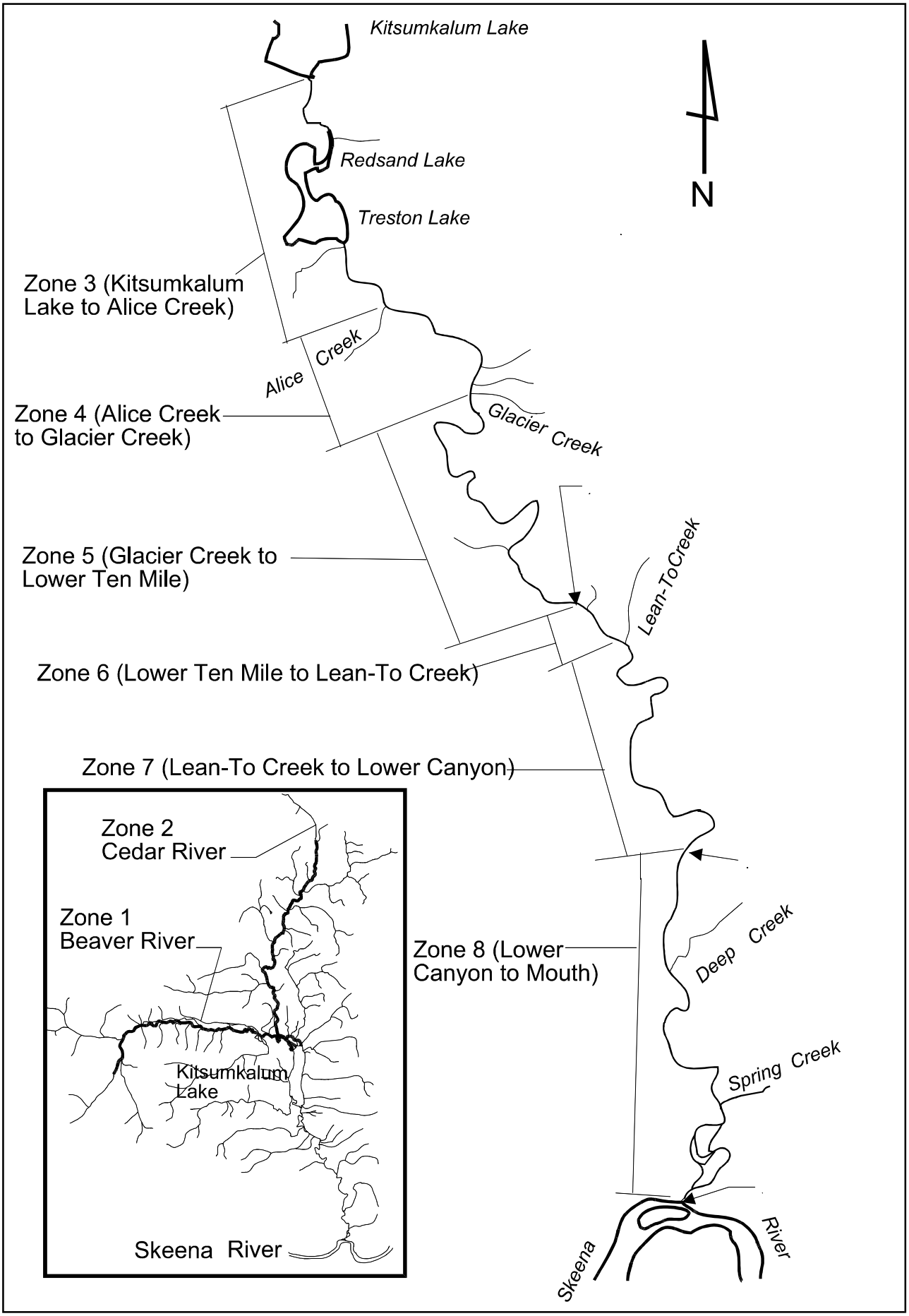
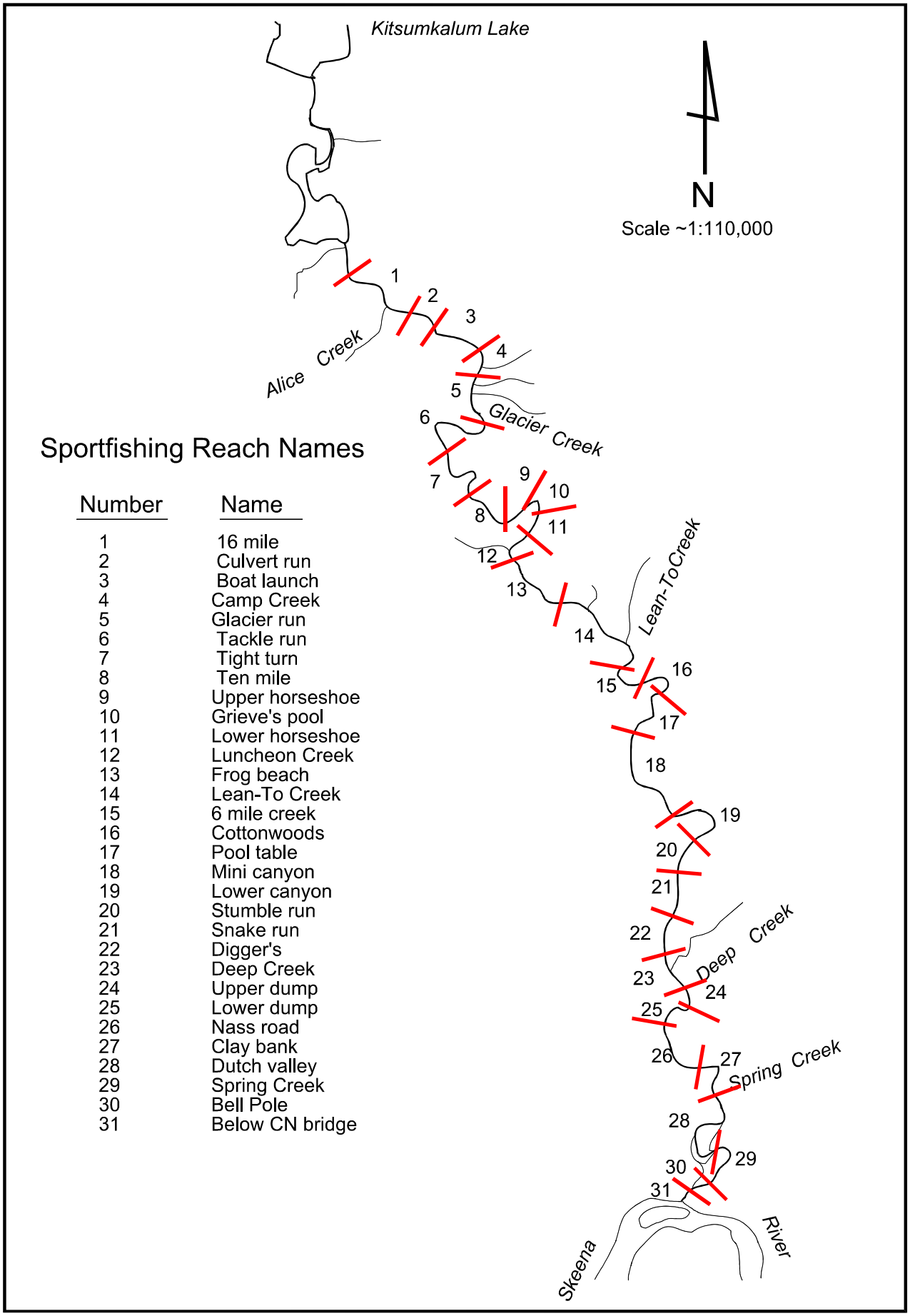


Figure 2. Map showing the boundaries of zones 1 to 8 on the Kitsumkalum River.



Sportfishing Reach Names

Number	Name
1	16 mile
2	Culvert run
3	Boat launch
4	Camp Creek
5	Glacier run
6	Tackle run
7	Tight turn
8	Ten mile
9	Upper horseshoe
10	Grieve's pool
11	Lower horseshoe
12	Luncheon Creek
13	Frog beach
14	Lean-To Creek
15	6 mile creek
16	Cottonwoods
17	Pool table
18	Mini canyon
19	Lower canyon
20	Stumble run
21	Snake run
22	Digger's
23	Deep Creek
24	Upper dump
25	Lower dump
26	Nass road
27	Clay bank
28	Dutch valley
29	Spring Creek
30	Bell Pole
31	Below CN bridge

Figure 3. Map showing the boundaries of locally named sportfishing reaches of the lower Kitsumkalum River.

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4. Results

4.1. Freshwater and Ocean Life History

Data from aging of scales taken from adult Kitsumkalum River steelhead between 1980 and 1987 are summarized in Table 1 (MELP 1990a). The age designators listed along the left hand margin of this table record the number of years spent in freshwater (smolt age) on the left, separated from the saltwater age on the right by a period. An S indicates that the captured fish had spawned. A number or another S to the right of the first S indicates that the fish returned to freshwater, and these were presumed to be repeat spawners. An R indicates that the analyzed scale was a replacement scale from which information was missing.

Table 1. Summary of age data for Kitsumkalum River steelhead. (Source: MELP 1990a).

Age Designator	Male	Female	All
2.2	0	2	2
2.3	0	1	1
3.1	20	3	23
3.1S	1	0	1
3.1S1	2	4	6
3.2	42	37	79
3.2S	0	1	1
3.2S1	2	3	5
3.3	36	54	90
3.3SS1	1	0	1
3.4	1	0	1
4.1	2	1	3
4.1S1	0	3	3
4.2	30	28	58
4.2S	0	2	2
4.2S1	1	4	5
4.3	14	28	42
4.4	3	4	7
5.2	1	0	1
5.4	1	0	1
R.1	1	1	2
R.1S1	2	2	4
R.2	7	7	14
R.2S1	1	0	1
R.2S2	0	1	1
R.2SS1	0	1	1

Age Designator	Male	Female	All
R.3	4	3	7
Totals	172	190	362

These data indicated that juveniles remained in freshwater for two to five years (mean = 3.36 years, S.E. = 0.0015, n = 332) and that the majority of Kitsumkalum River juveniles spent three (62%) or four (36%) years in freshwater. They further showed that steelhead spent one to four years (mean = 2.32 years, S.E. 0.0020, n = 362) in the ocean before returning to spawn and that the majority of the juveniles spent two (33%) or three (39%) years in salt water. The age before first spawning ranged from two to nine years (mean = 5.72, S.E. = 0.0027, n = 330) with the majority being five (28%) or six (47%) years old.

Table 2 is a summary of the recorded number of years female and male steelhead spent in freshwater and saltwater. There was no significant difference ($df = 330$, $p>0.5$) between the recorded mean number of years males and females spent in freshwater before smolting. Females spent 9.3% longer ($df = 360$, $p<0.01$) in saltwater than males before returning to freshwater. Females were 4.8% older ($df = 360$, $p<0.01$) than males before their first spawning.

Table 2. Summary of time spent in freshwater and saltwater. (Source: MELP 1990a).

	Freshwater			Saltwater			Age at First Spawning		
Years	Males	Females	All	Males	Females	All	Males	Females	All
1				28	14	42			
2		3	3	84	86	170			
3	105	102	207	55	86	141			
4	50	70	120	5	4	9	23	9	31
5	2		2				46	46	92
6							68	88	156
7							16	28	44
8							3	4	7
9							1		1
n	157	175	332	172	190	362	157	175	331
Mean Time (years)	3.34	3.38	3.36	2.22	2.42	2.32	5.57	5.84	5.72
S.E.	0.040	0.039	0.028	0.057	0.048	0.037	0.077	0.063	0.050

4.2. Repeat Spawning

Although not specifically referring to Kitsumkalum River fish, approximately 46% of the 1994 mixed stock Skeena River steelhead radio tagged in the ocean emigrated from the river after spawning (Alexander *et al.* 1996). Repeat spawning was also reported in the scale aging data for Kitsumkalum River fish (MELP 1990a). For the purposes of the database search, a repeat spawner was defined to be a fish whose age record indicated that either it had spent at least one year in freshwater after spawning the first time or that it had spawned again after spawning the first time. Of 362 tagged Kitsumkalum River adults whose ages were determined from scale samples (MELP 1990a), 27 (7.5%) were reported to be repeat spawners. Eighteen of these repeat spawners were females while nine were males. These repeat spawners were recorded from 1981 through 1985 and in 1987.

4.3. Sex Ratio

The sex was recorded unambiguously for 487 adult steelhead. Males accounted for 234 while females numbered 253, for an adult sex ratio of 1 male:1.08 females (MELP 1990b).

4.4. Size Distribution of Mature Steelhead

There was no significant difference (df = 485, p>0.5) in mean fork length between adult steelhead males and females but there was a greater range (13.6%) of fork lengths in the females sampled (Table 3). The longest female (102.0 cm) was 2.9% longer than the longest male (99.1 cm).

Table 3. Summary of fork lengths of adult Kitsumkalum River steelhead. (Source: MELP 1990b).

	Range (cm)	Mean (cm)	Standard Error	Sample Size
Females	47.0 - 102.0	75.4	0.5	253
Males	50.7 - 99.1	75.8	0.8	234
All Fish	47.0 - 102.0	75.6	0.4	487

Adult male steelhead were not significantly heavier (df = 350, p>0.1) on average than adult females. Females exhibited a greater range (24.7%) of weights than did males (Table 4). The heaviest female steelhead was 20.0% heavier than the heaviest male.

Table 4. Summary of weights of adult Kitsumkalum River steelhead. (Source: MELP 1990b).

	Range (kg)	Mean (kg)	Standard Error	Sample Size
Females	0.9 - 12.0	4.5	0.1	182
Males	1.1 - 10.0	4.7	0.2	170
All Fish	0.9 - 12.0	4.6	0.1	352

The distribution of fork lengths is presented in the frequency histogram in Figure 4. This diagram suggested a distribution with possibly as many as five populations.

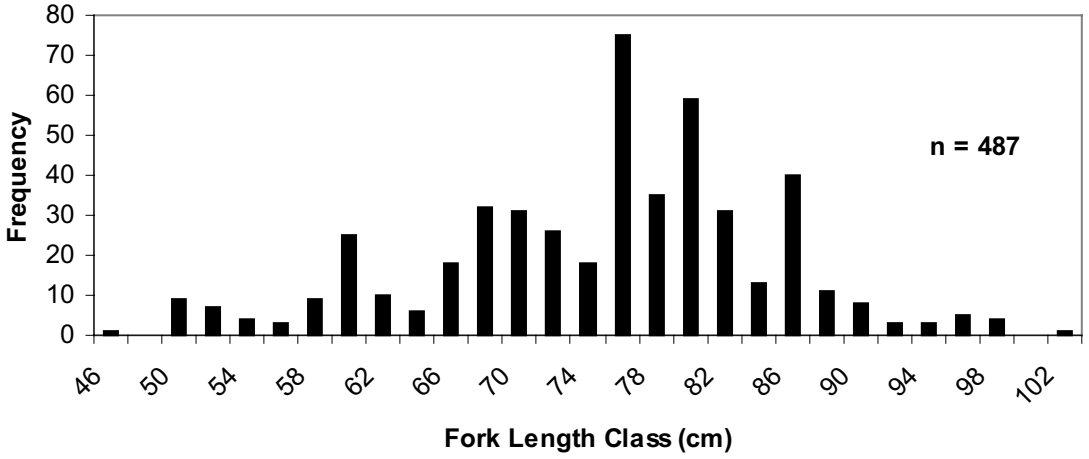

Figure 1. Fork length frequency histogram for Kitsumkalum River steelhead. (Source: MELP 1990b).

4.4.1. Length-Weight Relationship

The relationship between the log-transformed fork length and weight for adult Kitsumkalum River steelhead is shown in Figure 5. The linear regression coefficient indicated slightly negative allometric growth in weight with respect to length. The mean Fulton's condition factor for all steelhead whose records included both length and weight was 1.05 (S.E. = 0.008, n = 352) with a range of from 0.66 to 2.15.

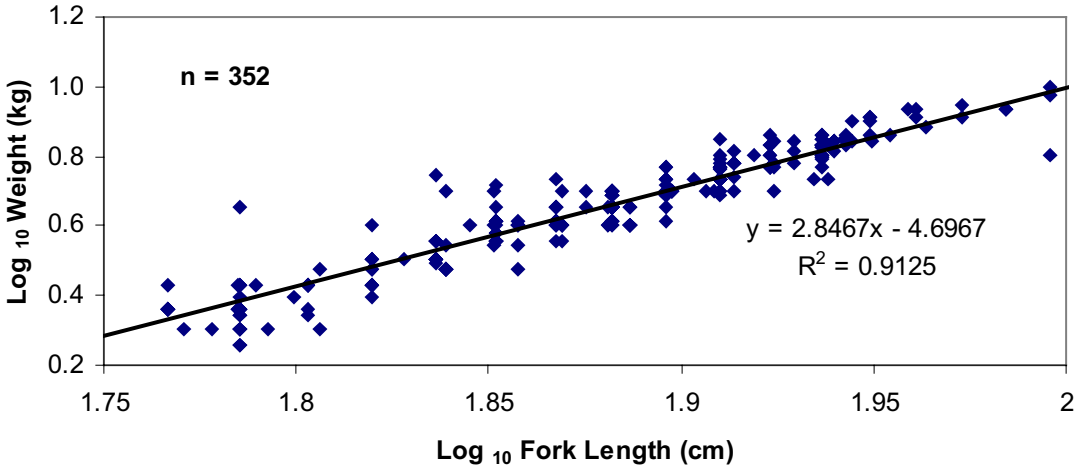

Figure 2. Relationship between log-transformed length and weight for adult Kitsumkalum River steelhead. (Source: MELP 1990b).

4.4.2. Relationship Between Time Spent Rearing in Freshwater and Length

The relationship between time in freshwater (smolt age) and mean adult length is shown in Figure 6. These data show a direct relationship between smolt age and adult length.

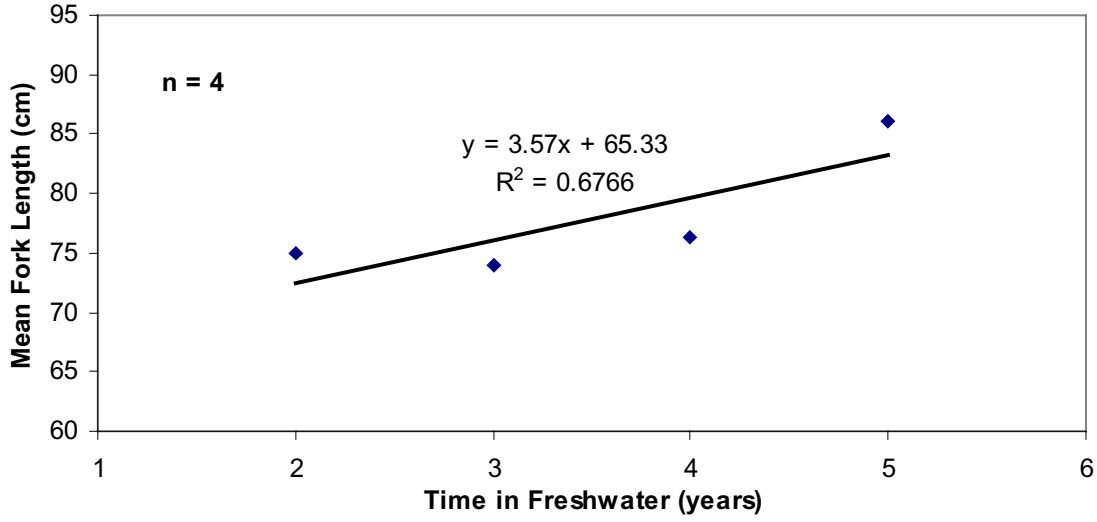

Figure 3. Relationship between years in freshwater (smolt age) and the mean length of adult Kitsumkalum River steelhead. (Source: MELP 1990a, b).

4.4.3. Relationship Between Time Spent Rearing in Saltwater and Length

The relationship between time spent in saltwater and adult length is shown in Figure 7. These data show there was a direct relationship between time spent in saltwater and the length of adult Kitsumkalum River steelhead.

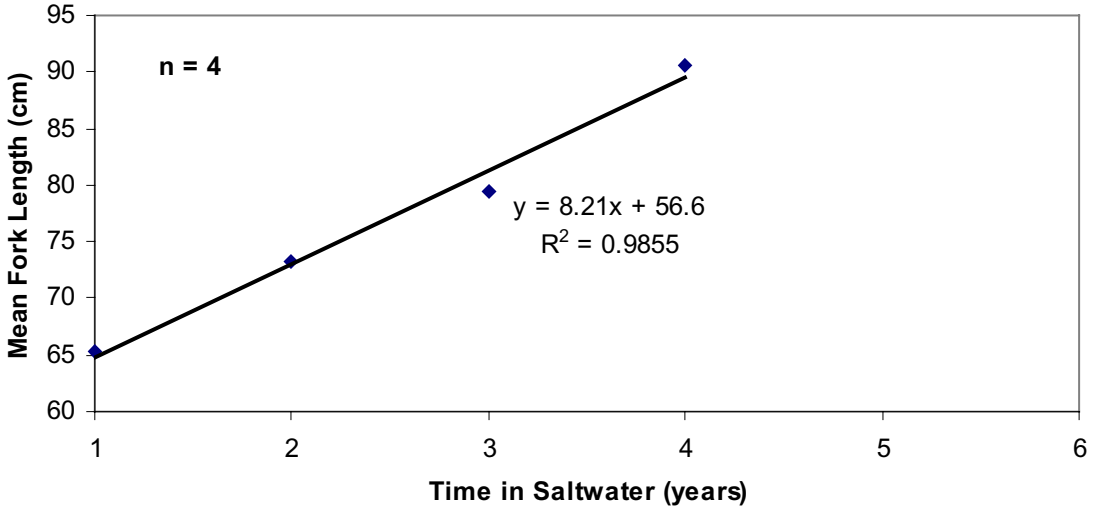

Figure 4. Relationship between years in saltwater and the mean length of adult Kitsumkalum River steelhead. (Source: MELP 1990a, b).

4.5. Spawning, Rearing and Overwintering Areas

4.5.1. Spawning Sites

The locations of documented Kitsumkalum River steelhead spawning habitats are shown in Figure 8. The reader should be aware that the observation of an adult steelhead at a particular site does not necessarily mean that it is a spawning site, even though this may be likely. For example, one fish was tagged at 16 km above Kitsumkalum Lake in the mainstem river (Beaver River) and then moved downstream and entered the Cedar River to spawn (Lough and Whately 1984). This suggested that there may be significant movement of fish within the system after any initial observation of location and prior to arrival at a spawning site.

Telemetry studies of 22 tagged steelhead from November, 1980 to April, 1981 identified the importance of tributary spawning (Lough and Whately 1984). Of the 19 fish whose spawning sites were identified, 11 were located in tributaries while eight were in the Kitsumkalum mainstem or side channels**.** The important tributaries identified were Deep Creek (5 spawners), Lean-To Creek (3 spawners) and Cedar River (3 spawners). The Deep Creek and Lean-To Creek spawners were reported as a mixture of summer and winter run steelhead. Only summer run steelhead were reported to have spawned above Kitsumkalum lake. All of the mainstem spawning of radio tagged fish in the river below Kitsumkalum Lake occurred from the mouth of Lean-To Creek (14 km) upstream to Alice Creek (29 km). One spawner was observed in a side channel.

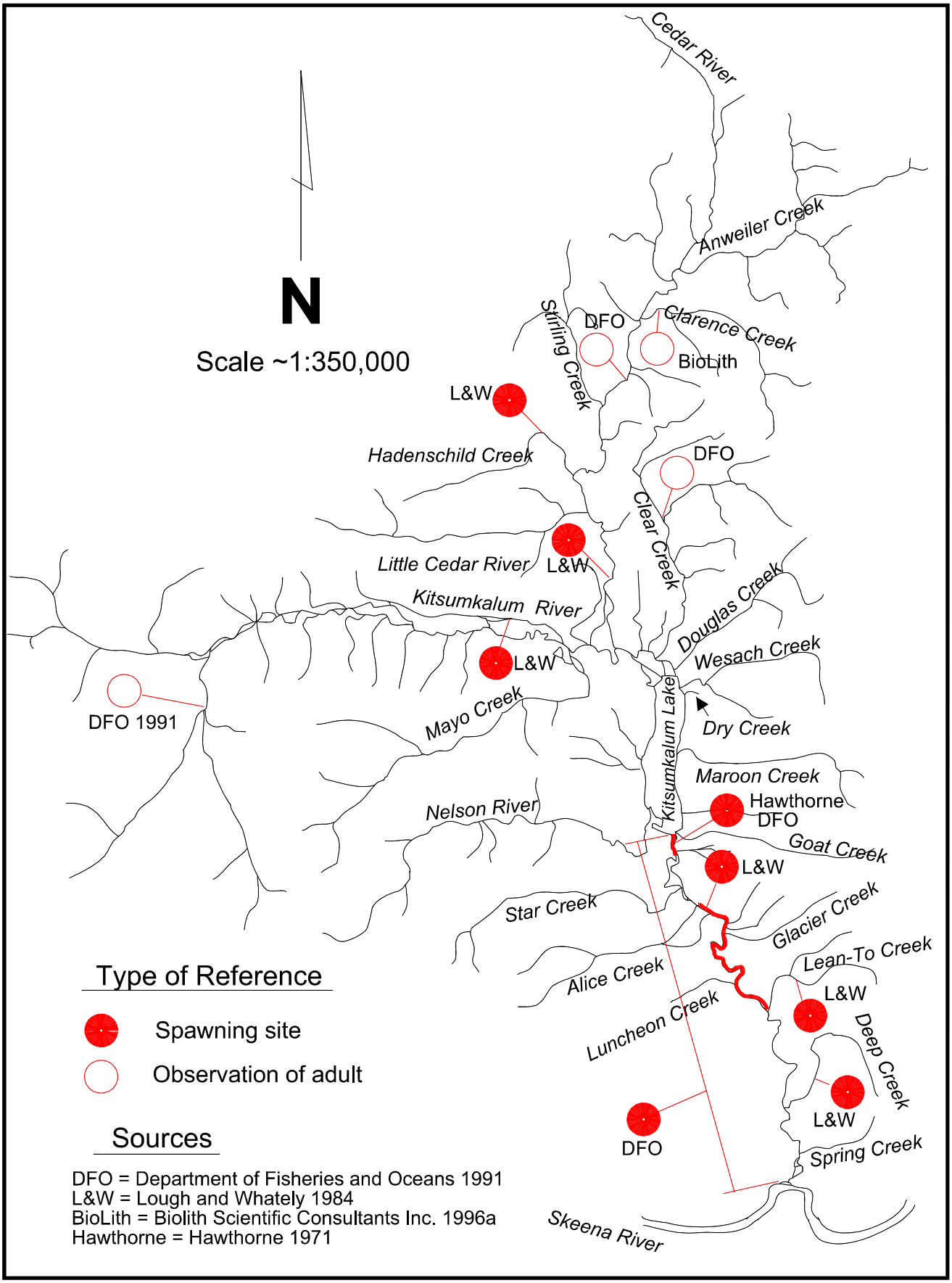

Figure 8. Map showing documented locations of Kitsumkalum River steelhead spawning habitat.

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The outlet of Kitsumkalum lake (Hawthorn 1971) and the mainstem river for 750 metres below the lake (DFO 1991) have also been identified as spawning areas. Other tributaries where adult steelhead have been observed include Clear Creek (DFO 1991), Little Cedar River, (DFO 1991), Swanson Creek (Biolith 1996b), Hadenschild Creek (Lough and Whately 1984) and Star Creek (Lough and Whately 1984). Steelhead were also observed at 83 km on the mainstem (Beaver) river (DFO 1991).

The radio telemetry study reported that spawning occurred in Deep Creek from April 30 to May 27 with a water temperature of 7 to 9° C (Lough and Whately 1984). It occurred in Lean-To Creek from May 7 to May 21 with a water temperature of 5 to 8.5° C and in the mainstem river it occurred between late April, when the water temperature was 4° C, and mid-May, when the water temperature was 8° C. All fish had left their spawning sites by June 9th.

A comparison of the number of fish tagged in each zone in each month (Table 5), from 1980 through to 1987 (n = 335), indicated that more fish were tagged in the upper portions of the river during the fall whereas more were tagged in the lower river in the spring (MELP 1990b). The results of this analysis supported the contention of Lough and Whately (1984) that there was a spatial segregation of the runs, with summer run fish moving above the 20 km point on the river, late fall arrivals moving to and remaining in the middle portions overwinter and spring arrivals remaining in the lower river. The reader should be aware, however, that these conclusions may be inaccurate. For example, the lower river is generally more easily accessible during the spring than is the upper river, and this could have positively biased the numbers of fish tagged in spring. Blanks in the table represent no information available.

Table 5. The number of fish tagged in each zone in each month from 1980 to 1987. (Source: MELP 1990b).

	Zone								
	1 Beaver R. to Lake	**2 Cedar R. to Beaver R.**	**Kitsum-kalum Lake**	**3 Lake to Alice Cr.**	**4 Alice Cr. to Glacier Cr.**	**5 Glacier Cr. to Lower Ten Mile**	**6 Lower Ten Mile to Lean-To Cr.**	**7 Lean-To Cr. to Lower Canyon**	**8 Lower Canyon to Skeena R.**
Month									
Aug									2
Sep									1
Oct		1		15	4				
Nov	3	10		11	22	1			
Dec				5	13	2	3	4	
Jan	14	3		10	4	13	8	12	5
Feb				1	10	10	5	8	8
Mar	5			2	3	7	8	16	33
Apr	1			1	3	3			35
May								4	6

4.5.2. Juvenile Rearing Sites

Rainbow trout, which were assumed to be juvenile steelhead for the purposes of this study, were reported throughout much of the Kitsumkalum River watershed (Anon. 1984; BioLith 1996a, 1997; DFO 1991; Harding 1976; Morgan 1985; Morris and Eccles 1976; Tredger 1983, 1985; Triton 1996a, b). The locations of observations of juvenile steelhead are shown in Figure 9. Since there are no barriers to migration below any of the points shown on the map in Figure 9, it was assumed that all waters downstream from these points were accessible. Most of these waters offer excellent habitat for rearing juvenile steelhead.

Some studies that involved fishing effort in tributary streams indicated that there may be some exceptions to the widespread distribution of juveniles noted above. No juvenile steelhead were found in Culp Creek (a small unnamed creek between Glacier and Camp Creeks on the east side of the mainstem river) or Pontoon Creek (Biolith Scientific Consultants Inc. 1997), Maroon or Mayo creeks (D. Gordon, pers. comm. 1997), Wesach or Douglas creeks (Morris and Eccles 1976) or the Nelson River (Tredger 1985). Morris and Eccles (1976) and Tredger (1985) reported no juveniles in Dry Creek but Morgan (1985) found juveniles in a swamp off Dry Creek.

From the information available and our knowledge of the watershed, it is likely that juveniles also utilize the upper Kitsumkalum (Beaver) River to 83 km, which is the farthest upstream point at which adults have been observed (DFO 1991). In addition, juveniles likely rear in the extensive off channel habitat in the lower Beaver River valley and near the confluence of the Cedar River and Hadenschild Creek. Furthermore, they are likely to utilize most of Anweiler and Swanson creeks and at least the lowest reaches of Goat and Stirling creeks. Finally, as Harding (1976) and Morgan (1985) pointed out near Deep Creek, juveniles are likely to be found throughout the excellent and extensive habitat offered in back channels and ground water creeks along the Kitsumkalum River below Kitsumkalum Lake.

Tredger (1985) reported the highest densities of steelhead juveniles in Deep Creek, Lean-To Creek, Spring Creek and the Cedar River. Tredger (1986) calculated smolt yield in selected tributaries and found that the major contributor was the Cedar River followed by the mainstem Kitsumkalum River, Clear Creek, Star Creek and Deep Creek. Morris and Eccles (1976) also emphasized the relative importance of the Cedar River for rearing of juvenile steelhead. Little information was available on the upper portion of the Cedar River, which has been made accessible only relatively recently by logging roads. Field work during watershed restoration studies (Biolith 1996b, 1997) in this portion of the system concluded that it contained excellent and extensive habitat. Juvenile steelhead were observed at least as far as the 8 km bridge over Anweiler Creek and one adult was observed at the main road crossing over Swanson Creek. These are large systems that are likely significant. They should be protected until they can be adequately assessed.

4.5.3. Adult Overwinter Areas

The documented locations of adult steelhead overwintering habitat are shown in Figure 10. During the 1980-81 telemetry studies (Lough and Whately 1984), 55% (12 fish) overwintered in the deeper, slow moving portions of the mainstem river between 20 and 30 km. The other tagged fish (45% or 10 fish) spent at least part of the winter in either Kitsumkalum, Redsand or Treston lakes. Some radio tagged steelhead spent only a few weeks in the lakes before moving back into the mainstem river. A concentration of overwintering steelhead was noted at the confluence of the upper Kitsumkalum (Beaver) River and Cedar River approximately 5 km above Kitsumkalum Lake.

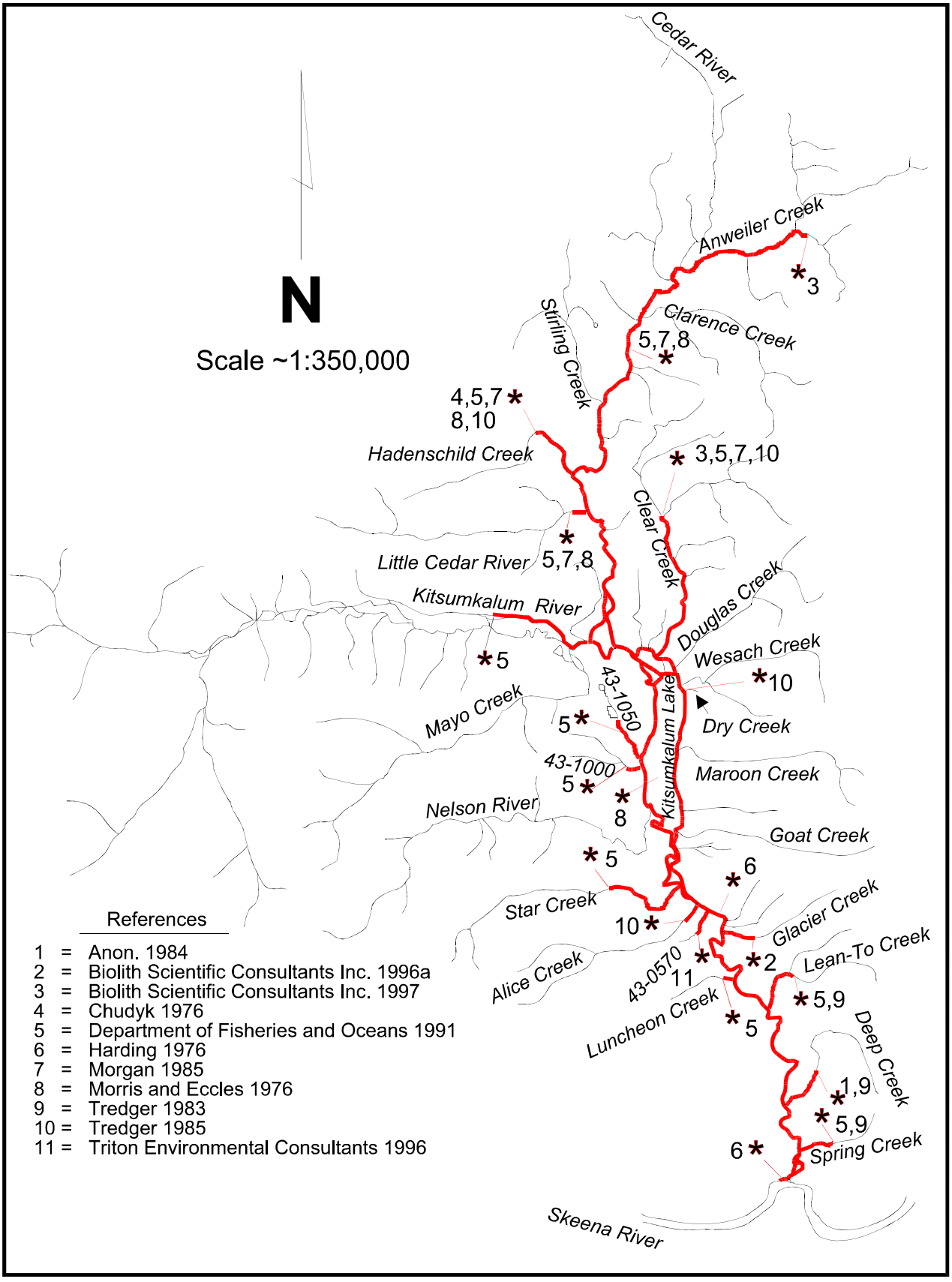

Figure 9. Map showing documented locations of Kitsumkalum River steelhead juvenile rearing habitat.

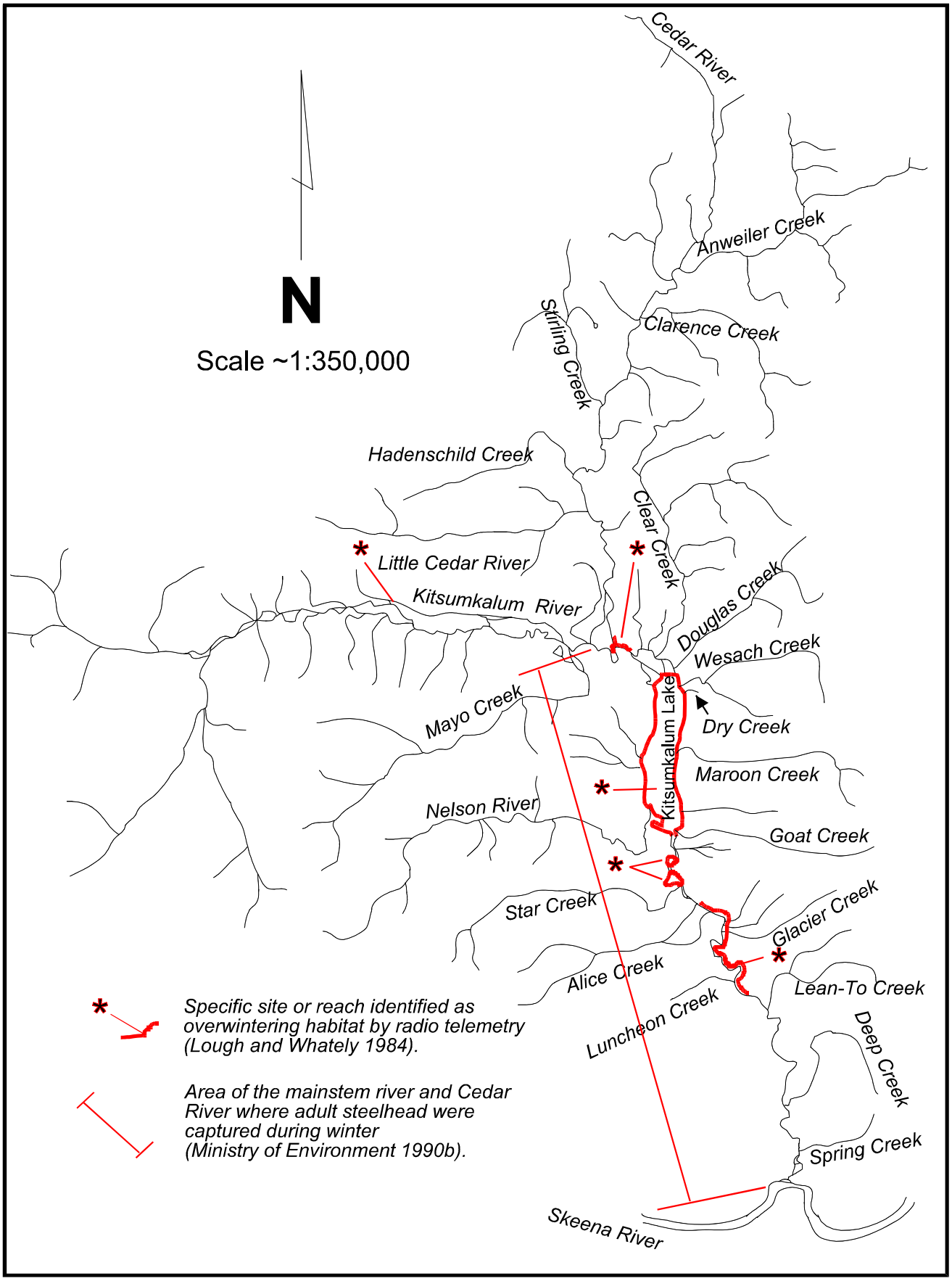

Figure 10. Map showing documented locations of overwintering habitat for adult steelhead in Kitsumkalum River.

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Tagging locations recorded from 1980 to 1987 suggested that steelhead overwintered throughout the mainstem system and in the Cedar River. These data are presented in Table 5. Records did not specify the exact location of tagging within the Cedar or Beaver Rivers, therefore the map in Figure 10 shows the upper limit of winter adult presence near the mouth of the Cedar River, when in fact they may have been captured further up the Cedar or Beaver rivers, both of which extend more than 30 km upstream from this confluence.

4.6. Past Enhancement Attempts

Lough and Whately (1984) reported that Deep Creek, Lean-To Creek, and the Cedar River appeared to have some enhancement potential. They recognized the barriers on Deep and Lean-To Creeks and suggested reconnaissance work for the upper reaches. They suggested that consideration could be given to a spawning platform for Hadenschild Creek. They further suggested that spawning and rearing habitat could be created by opening up the Kitsumkalum mainstem side channels that had been closed off for attempted log drives. If fry stocking was found to be a viable enhancement option, they recommended working with summer run steelhead stock and suggested obtaining brood stock from the Cedar/Beaver confluence during winter and from the Kitsumkalum mainstem above 25 km before April.

Using the Deep Creek Hatchery, from 1985 to 1989 the Terrace Salmonid Enhancement Society caught Kitsumkalum River brood stock, conducted an egg take, and reared steelhead fry that were released at two grams in weight in October of each year (Hazelwood 1989). From approximately 5,000 to 16,000 fry were released in each of four consecutive years (Table 6). The Society attempted to enhance only summer run steelhead and for that reason caught brood stock in the fall of each year. Adults were held isolated in plastic tubes from capture dates until ready for spawning in the late spring. During the last year, fish were overwintered in a small outside pond. Fungus growth on these adult fish was a problem and chemicals were used in attempts to control this. Adult mortality was high and replacements were made until staff were unsure replacements were summer run fish. At the end of April 1989, with only one female left, the project was terminated.

Table 6. Summary of Deep Creek hatchery steelhead fry releases to the Kitsumkalum River. (Source: Tetreau 1986).

Year	Number of steelhead fry released
1985	9,010
1986	15,296
1987	16,000
1988	5,379

No records of any hatchery raised adult fish were found in the tagging database (MELP 1990b), however, 456 steelhead, or approximately 1% of the total catch, were recorded as hatchery fish in the Steelhead Harvest Analysis database starting in the 1981-82 year (MELP 1996a). The results expected from the enhancement program were not apparent in these data (Table 7). Hatchery-raised steelhead have their adipose fins removed as a means of differentiation. It was presumed that all reports of hatchery fish were based on the observation of a missing adipose fin. It is known (D. Atagi, pers. comm. 1997), however, that the absence of an adipose fin can occur naturally and through causes other than fin clipping, so that this may explain the existence of these records of hatchery fish in the Kitsumkalum River system.

Table 7. Summary of steelhead captured and reported as hatchery fish. (Source: MELP 1996a).

FISCAL	HATCHERY KEPT	HATCHERY RELEASED	TOTAL CATCH	HATCHERY FISH AS % OF TOTAL CATCH
1967-68	0	0	567	0
1968-69	0	0	659	0
1969-70	0	0	463	0
1970-71	0	0	450	0
1971-72	0	0	491	0
1972-73	0	0	895	0
1973-74	0	0	958	0
1974-75	No Data			
1975-76	0	0	774	0
1976-77	0	0	583	0
1977-78	0	0	466	0
1978-79	0	0	308	0
1979-80	0	0	298	0
1980-81	0	0	419	0
1981-82	3	0	1089	0
1982-83	0	4	1466	0
1983-84	8	4	1126	1
1984-85	7	50	2112	3
1985-86	0	11	2392	0
1986-87	0	11	2799	0
1987-88	4	15	2645	1
1988-89	16	23	1443	3
1989-90	22	43	1628	4
1990-91	4	11	1173	1
1991-92	30	72	832	12
1992-93	0	23	681	3
1993-94	0	38	1270	3
1994-95	0	21	1618	1
1995-96	0	36	1392	3
Totals	94	362	30997	1

4.7. Adult Assessments

The estimates of adult steelhead abundance in the literature available were considered unreliable.

The number of steelhead harvest each year were considered a reliable minimum population size. During the first ten years of angler harvest data (1967-68 to 1977-78) the number of steelhead kept averaged 495 fish with a maximum of 683 (MELP 1996a).

Based on 'some local knowledge', it was estimated (MELP Undated b) that the population of spawning fish, after an estimated 500 angled fish were removed from the population, was 700 fish, resulting in an overall estimate of 1200 adult fish returning to the Kitsumkalum system. Lough (1985) estimated a total spawning escapement of 1500 steelhead with 225 summer runs and 1000 to 1500 winter runs. The Department of Fisheries and Oceans (1991) estimated a mean annual escapement of 666 fish for the period 1980-84, with a recorded maximum of 1413, but no target escapement figure was given.

From August 23 to September 14, 1994, during brood stock collection for chinook, the Deep Creek Hatchery seined 70 steelhead (D. Webb, pers. comm. 1997). Based on a sample of 70 fish and one radio tagged fish, an estimate of 77 fish was given for the early component of the Kitsumkalum steelhead run (Koski *et al*. 1995).

4.8. Adult run timing

It was reported that in April and May (DFO 1991), at a time determined by water temperature, photoperiod and genetic background, steelhead moved onto spawning sites in the Skeena system (Alexander *et al*. 1996). Timing of captures of adult steelhead suggested that fish returned to the Kitsumkalum River as early as August 28 (in 1981 and 1986) and as late as May 20 (in 1982 and 1984). There were no records of steelhead initially tagged in the Kitsumkalum being recaptured outside the Kitsumkalum system, suggesting that these steelhead stayed in the system after their arrival (MELP 1990b).

The number of steelhead captured for their first time in each week between 1980 and 1987 is shown in Figure 11. Tagging dates were categorized into 'weeks' of eight days in all cases except week #4. This resulted in a potential negative bias in the number of fish recorded in week #4. No fish were captured in June or July.

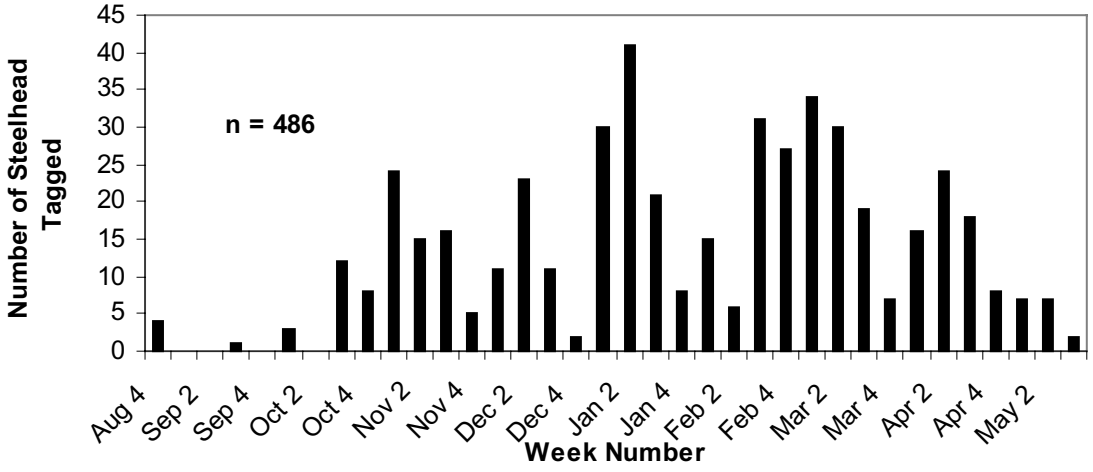

Figure 5. The number of steelhead captured for their first time for each week between 1980 and 1987. (Source: MELP 1990b).

The Kitsumkalum River was reported as having three main runs; one in late summer, another in late fall and yet another in the spring, all of which remained in the river until spawning in May (DFO 1991). Allowing for a reduced tagging effort near Christmas and the negative bias in the fourth week of each month, interpretation of the data in Figure 11 supports the existence of three runs; one peaking in October-November, another in December-January and a third from February through May. The reader is cautioned that no data were available to determine whether equal effort to capture fish was expended throughout the year, so that the observed pattern may not be reliable.

One fish was radio tagged in the lower Skeena River in the third week of August and was later detected in the Kitsumkalum River (Lough 1981). Five observations of fish (possibly the same fish) radio tagged in the ocean were recorded in the river from August 27 to September 10, 1994 (Koski et.

al. 1995). Seventy steelhead were caught in beach seines during the Deep Creek Hatchery chinook brood stock collection from August 23 to September 14 in 1994 (D. Webb, pers. comm. 1997). Most spawning was reported to have occurred during early and mid-May, and most kelts had reportedly left the Kitsumkalum by June (Lough and Whately 1984).

4.9. Catch, Harvest, Angler Effort and Angler Residency

4.9.1. Catch and Harvest

Annual records of anglers' reports of numbers of anglers, angler days, hatchery fish, wild fish, killed and released fish and total catch were kept for the fiscal years from 1967-68 through 1973-74 and 1975-76 through 1995-96 for Kitsumkalum River (MELP 1996a).

The mean annual catch was 1107 steelhead (S.E. = 4.0, n = 27) with a range of 298 in 1979-80 to 2799 fish in 1986-87. The reported annual catch generally increased before and declined after the 1986-87 fiscal year (Figure 12).

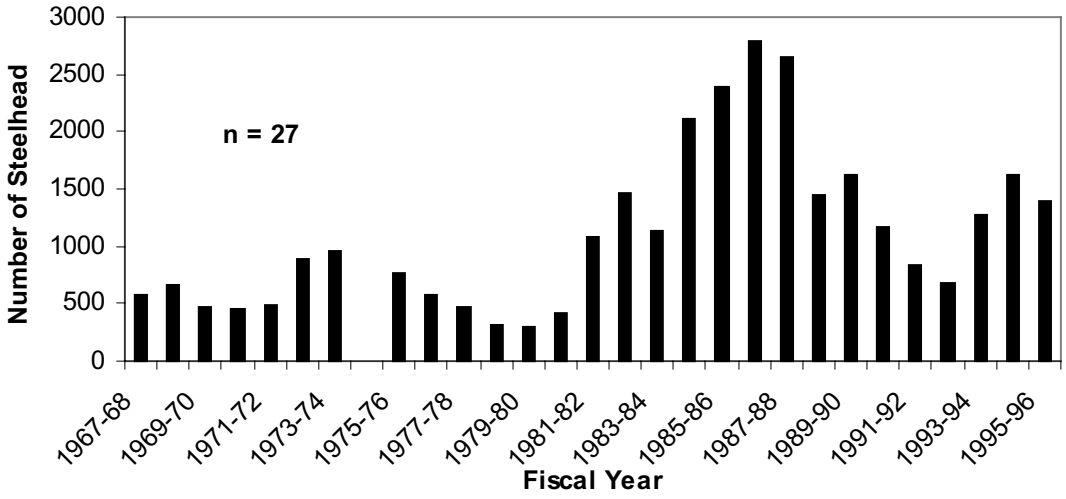

Figure 6. Anglers' reports of the number of steelhead caught in Kitsumkalum River from fiscal year 1967-68 through 1973-74 and from 1975-76 through 1995-96. (Source: MELP 1996a).

The mean annual number of adult steelhead harvested (Figure 13) from the Kitsumkalum River system from fiscal year 1967-68 through 1973-74 and from 1975-76 through 1995-96 was 331 (S.E. = 2.1, n = 27) with a range of 16 adults in 1993-1994 to 683 in 1973-74 (MELP 1996a). The number of adult steelhead released each year generally increased over time from zero prior to 1970 -1971, to a maximum of 2309 in 1986-1987, after which it generally declined. The number harvested over this time period generally declined. The observed decline may have been related to changes in angling regulations or angler ethics.

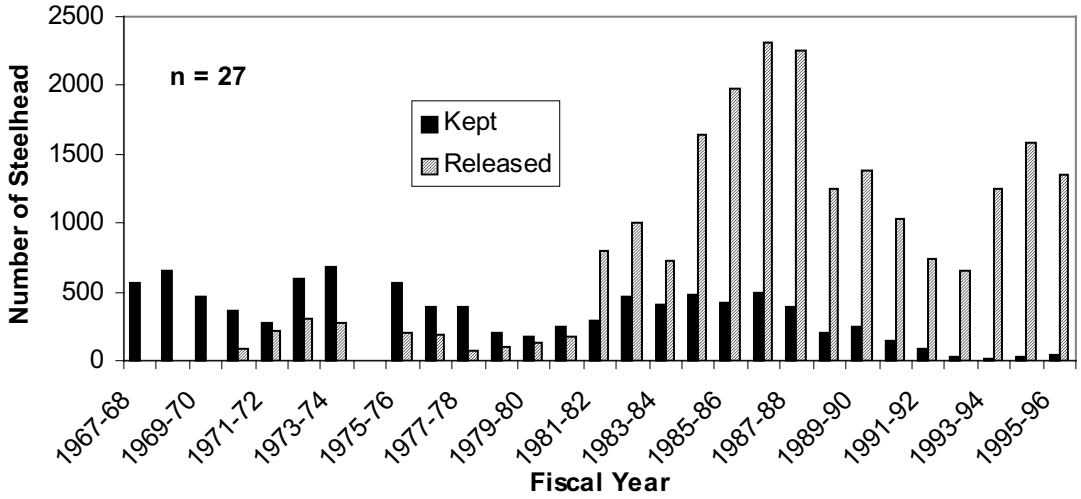

Figure 7. Anglers' reports of the number of steelhead kept and released in Kitsumkalum River from fiscal year 1967-68 through 1973-74 and from 1975-76 through 1995-96. (Source: MELP 1996a).

The number of adult steelhead harvested each year relative to the total catch (Figure 14) generally declined from 100% to a low of 1% in 1993-94 (MELP 1996a).

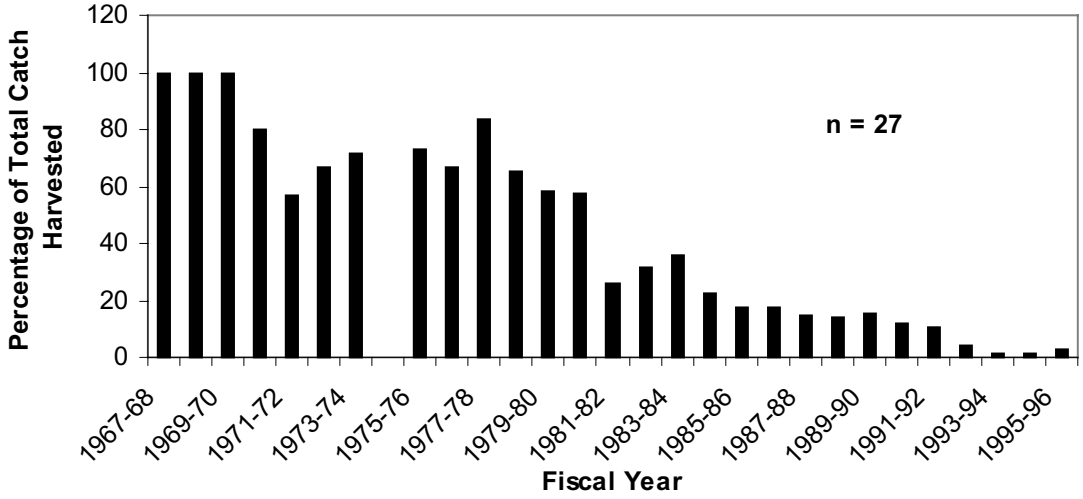

Figure 8. The number of adult Kitsumkalum River steelhead harvested as a percentage of the total catch for each year from fiscal year 1967-68 through 1973-74 and from 1975-76 through 1995-96. (Source: MELP 1996a).

4.9.2. Angler Effort

The mean number of anglers per year (Figure 15) was 467 (S.E. = 1.4, n =27), with a range of 239 in 1993-1994 to 919 in 1986-1987 (MELP 1996a). There was relatively little change in this number during the recorded time period. The mean number of angler days per year (Figure 15) spent on the Kitsumkalum River was 2881.3 (S.E. = 3.8, n = 27), with a range of 1375 in 1992 -1993 to 4831 in 1984-1985 (MELP 1996a). This number varied significantly over the time period recorded.

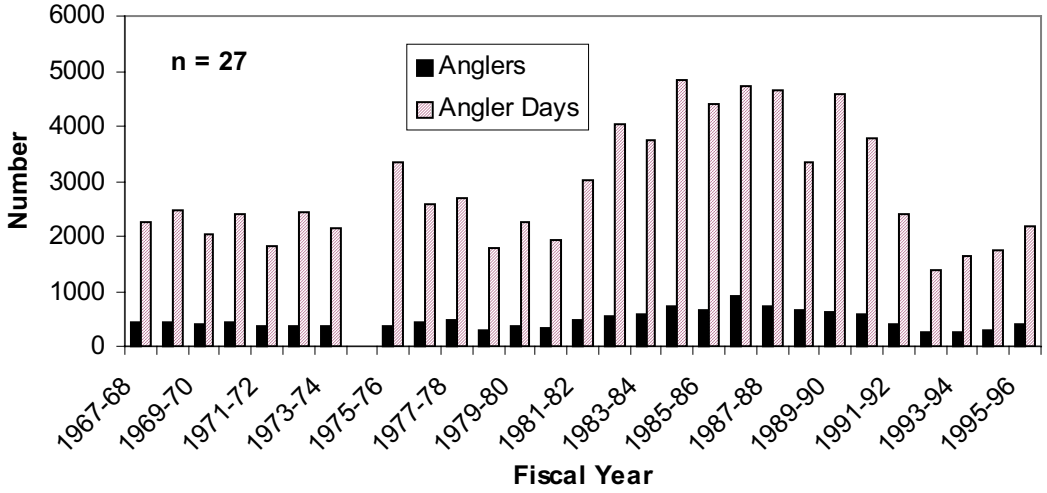

Figure 9. Number of anglers and angler days on the Kitsumkalum River from fiscal year 1967-68 through 1973-74 and from 1975-76 through 1995-96. (Source: MELP 1996a).

4.9.3. Catch Per Unit Effort

The mean annual catch per unit effort (CPUE; Figure 16), in fish per angler day, was 0.38 (S.E. = 0.04, n = 27), with a range of 0.13 in 1979 -1980 to 0.92 in 1994 -1996 (MELP 1996a). The CPUE generally increased over the time period for which records were kept.

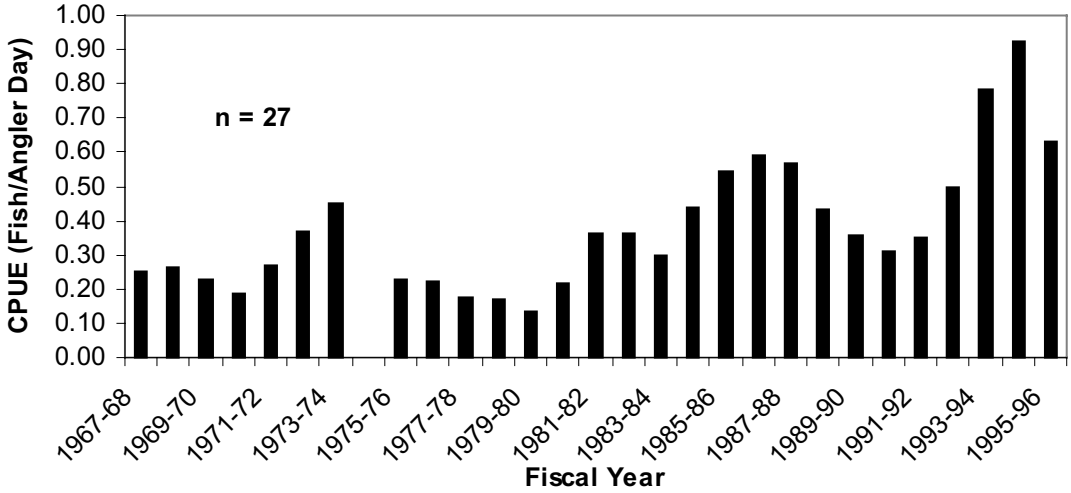

Figure 10. Catch per unit effort (CPUE) for steelhead in the Kitsumkalum River from fiscal year 1967-68 through 1973-74 and from 1975-76 through 1995-96. (Source: MELP 1996a).

4.9.4. Angler Residency

Records of angler residency and related catch and harvest data (MELP 1996a) were available for the Kitsumkalum River from fiscal year 1983-84 through 1995-96. Over the 13 years for which records were available, anglers resident in Fish and Wildlife Region 6 generally accounted for a dominant proportion of the number of anglers, angler days, catch and harvest of Kitsumkalum River steelhead adults (Table 8, Figures 17 through 20). The proportions of activity for each resident group have not changed significantly over the thirteen year period.

Table 8. Number of Kitsumkalum River steelhead anglers resident in Region 6 as a percentage of all anglers. (Source: MELP 1996a).

	Mean % (S.E., n)	**Minimum % (Year)**	**Maximum % (Year)**
Number of Anglers	77.4 (1.7, 13)	63 (1995-96)	85 (1983-84, 1993-94)
Number of Angler Days	87.9 (1.4, 13)	79 (1988-89)	95 (1983-84)
Catch	87.7 (2.4, 13)	63 (1988-89)	96 (1984-85)
Harvest	83.6 (3.9, 13)	46 (1994-95)	100 (1993-94)

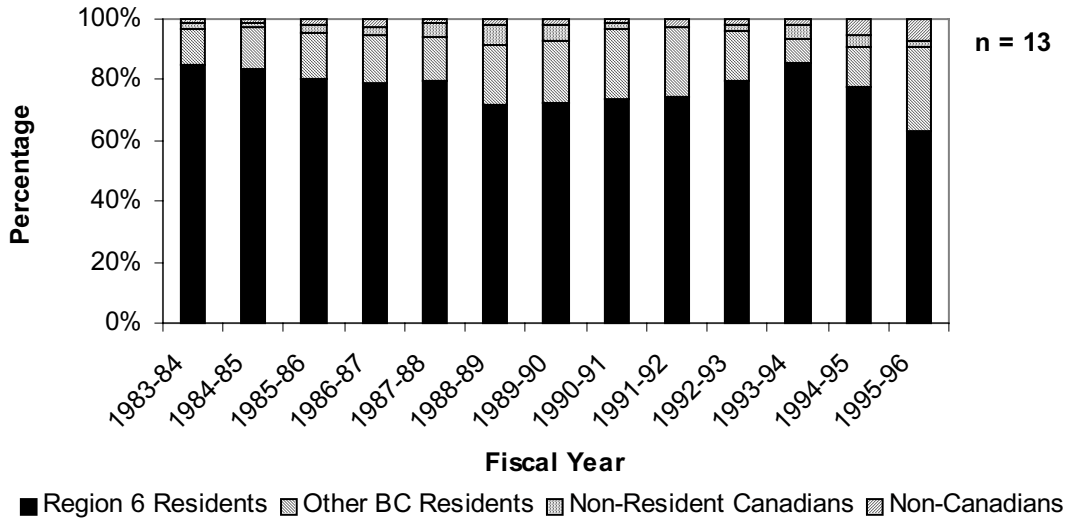

Figure 11. Percentage of anglers by residency group. (Source: MELP 1996a).

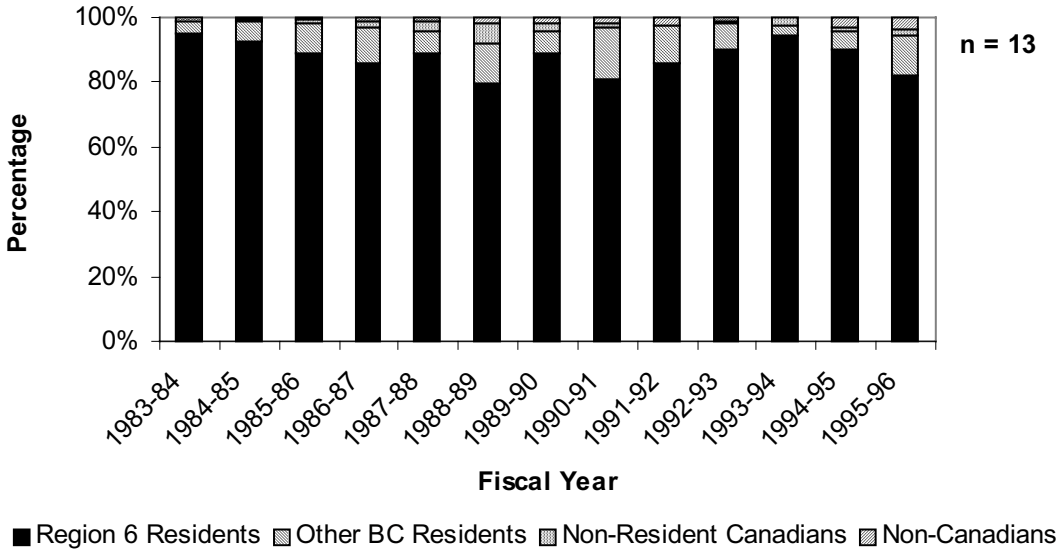

Figure 12. Percentage of angler days by residency group. (Source: MELP 1996a).

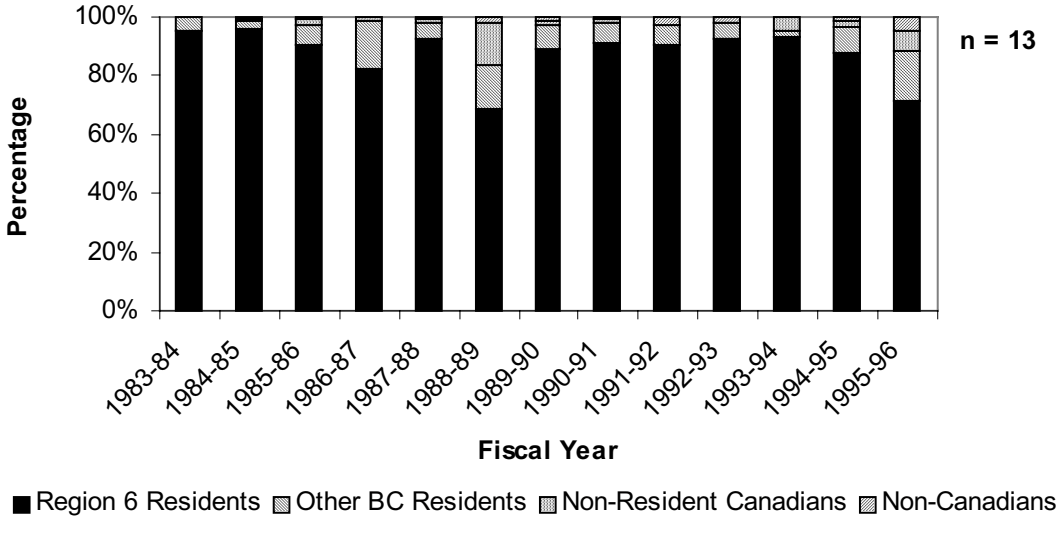

Figure 13. Percentage of catch by residency group. (Source: MELP 1996a).

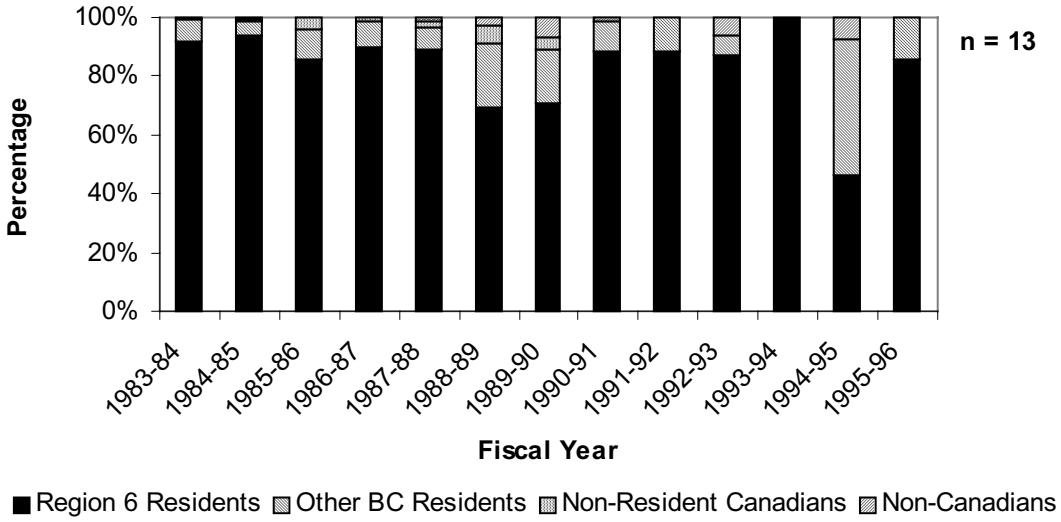

Figure 14. Percentage of harvest by residency group. (Source: MELP 1996a).

4.10. Angling Guide Activity

Records of the number of angling guides, active guides, angler day quotas, angler days used and catch were available from the 1990/91 season through to the 1995/96 season (Table 9). The number of guides and the number of active guides declined, while the angler day quotas issued, the number of days used and the CPUE increased during this period. Angling guiding was restricted to the period between March 15 and October 15 (MELP 1997). No guiding was allowed on the river above Kitsumkalum Lake (Beaver River). Guiding mainly targets chinook and spring steelhead, and was not permitted after October 15 to protect overwintering fall run steelhead (D. Webb, pers. comm. 1997).

Table 9. Summary of angler guiding data. (Source: MELP 1997).

Season	Number of Guides	Number of Active Guides	Quota Angler Days Issued	Quota Angler Days Used	Total Steelhead Catch	CPUE
1990/91	22	12	861	667	72	0.108
1991/92	20	10	983	259	19	0.073
1992/93	14	10	975	420	30	0.071
1993/94	13	11	959	339	52	0.153
1994/95	13	12	959	381	78	0.205
1995/96	13	9	983	373	122	0.327
1997/98	16		1103			

4.11. Creel Survey Information

No information was available.

4.12. Current Angling Regulations

The effects of laws regulating angling for steelhead in the Kitsumkalum River (MELP 1996b) provided protection for all smolts throughout the river and overwintering steelhead above the lower canyon. A summary of the regulations is given in Table 10. The Kitsumkalum River was designated as Class II waters and this required that anglers whose residence was outside B.C., as well as guided B.C. residents must purchase a Classified Waters Licence (MELP 1996b). Guided anglers required a Guided Only Classified Waters Licence and non-guided anglers required a Non-Guided Classified Waters Licence.

Table 10. Summary of angling regulations for the Kitsumkalum River during 1996-97. (Source: MELP 1996b).

Area of Application	**Summary of Regulation**
British Columbia	To fish for steelhead, residents of B.C. over age sixteen required an annual or short term basic fishing license and a steelhead conservation surcharge stamp.
	To fish for steelhead, non-residents (includes Canadian and non-Canadian) over age sixteen required an annual or short term basic fishing license, a steelhead conservation surcharge stamp and a special Class 2 Waters license if angling January 1 to December 31.
	Annual catch quotas for all BC steelhead was 10.
Skeena System Regulations	The daily catch quota was 1 steelhead over 50 cm (measured from tip of nose to fork of tail).
	Daily catch quota for steelhead from 30-50 cm was two.
	Release of any steelhead under 30 cm was mandatory.
	Possession quota was two daily quotas.
	Monthly catch quota was two steelhead.
	After catching and retaining the daily quota of steelhead from any waters, the angler was required to stop fishing those waters for the remainder of that day.
	Limited to single hook in all streams of region 6, all year.
Kitsumkalum River	Steelhead caught in the Kitsumkalum River above signs below lower canyon November 1 to June 15 were required to be released.
	The Kitsumkalum River was classified as class 2 waters.
	Steelhead Quota Changes - special notice in regulations Skeena and Nass steelhead quotas are subject to in-season changes and are likely to be reduced to 0 (catch and release only) beginning July 1 to protect summer run stocks. Anglers must check with their local B.C. Environment office or angling license issuer.

4.13. Recreational Fisheries

The Kitsumkalum River has a substantial recreational steelhead fishery. Over the 27 years during which records of anglers' reports were kept (MELP 1996a), an annual average of 467 recreational anglers, angling an average of 2881 angler days/year, reported an average catch of 1107 steelhead/year for a mean annual CPUE of 0.38 fish/angler day (Figures 17 to 20).

Access for recreational anglers in the lower Kitsumkalum below the canyon includes two boat launches below the highway, trails from the tree farm off the west side logging road, and from the sub-divisions at Deep Creek and above the Kitsumkalum canyon. The river is jet boat navigable to the canyon. The middle river is accessible on trails from Pat Roy Road at Lean-To Creek on the east side and from a road parallel to and north of Luncheon Creek on the west. Access to the upper river below Kitsumkalum Lake includes a boat launch and trail above Glacier Creek, direct access from the Nisga'a Highway opposite Benoit Creek, and a trail at the Kitsumkalum Lake outlet. The middle river is navigable from Kitsumkalum Lake to Lean-To Creek, however travelling below Lean-To Creek through the canyons is extremely dangerous. Access to the navigable upper Kitsumkalum (Beaver River) is from a boat launch at the old logging road crossing south of the Nisga'a highway. Access to the Cedar River is from the Cedar Forest Service Road off the Nisga'a highway.

The steelhead fishery has been described as starting in September with anglers fishing throughout the river (Lough and Whately 1984). Winter angling has occurred mainly in the upper river below the lake, with the concentrated effort above Glacier Creek where access from the Nisga'a Highway is easiest. A less intense winter fishery has occurred on the Beaver and Cedar rivers. During the spring fishery, anglers were reported to have dispersed throughout the river (Lough and Whately 1984).

4.14. First Nations Uses and Harvest

Aside from recreational angling by band members there was no directed native fishery for Kitsumkalum steelhead (S. Roberts, pers.comm. 1997). Documented records for Kitsumkalum River were not available from the Kitsumkalum Band Council. Although not directly applicable to the use of Kitsumkalum River steelhead, historical estimates of native steelhead harvest from the entire Skeena River system ranged from approximately four to 11% of the total steelhead catch (Chudyk and Narver 1976). The same report further suggested that the native catch may be as high as 15%. In 1995, four to 19% of the radio tagged steelhead that passed Kitselas on the Skeena River were harvested by natives (Alexander *et al*. 1996).

4.15. Minimum Escapement Requirements

Only one estimate of the required escapement was available but this was considered unreliable. An anonymous report estimated that 600 fish were needed to fully utilize the spawning potential of the Kitsumkalum system (MELP Undated a).

4.16. Summary of Current Stock Status

The estimates relating to abundance of adult steelhead in the available information on the Kitsumkalum River were considered unreliable, mainly due to a lack of descriptions of methods used and a lack of references cited to support the estimates. The available data were also inadequate to estimate any trends in population size.

Estimates of abundance of adult steelhead in the Kitsumkalum River ranged from a mean of 666 (DFO 1991) to 1500 (Lough 1985). Tredger (1985) estimated a smolt yield of 8,670 for some

tributaries of the Kitsumkalum river. He determined that this number was not enough to meet the approaching summer's projected adult escapement. In the same study, but by projecting parr survival, he estimated that the present smolt yield of Cedar, Deep, Lean-To and Spring creeks were above the estimated smolt capacity. In a subsequent study, Tredger (1986) attempted to use fry density to determine if the Kitsumkalum River was seeded to capacity. He concluded that a density of 0.82 fry/m^2 for selected tributaries of the Kitsumkalum was near target. Furthermore he observed that although Deep Creek and Lean-to creeks were above the 1 fry/m^2 full capacity target, the Cedar River was below this target, and because it contained the majority of good habitat the overall fry population in the system must be below capacity.

Continued forest harvesting in the tributary valleys of the Kitsumkalum system should be monitored carefully. Particular attention should be paid to the tributaries in the Cedar River system, as there was essentially no available information on fish use, logging activity continues, and steelhead as well as other species have been observed in some streams. Anweiler Creek is of special concern in this regard as it may be one of the most productive streams in the Kitsumkalum River system.

In general, the limited information available did not allow a reliable assessment of the current stock status.

5. Discussion and Conclusions

The Kitsumkalum River is an important recreational angling and economic resource in Region 6, with a steelhead population that is exploited heavily. Relatively easy access, high aesthetic values, a guided angling economy, proximity to Terrace and the presence of five other species of Pacific salmon, cutthroat trout and Dolly Varden all result in a high fishing pressure. Yet, although the Kitsumkalum River steelhead population is a very significant one in this region, relatively little is known about its biology.

The results of this literature review suggested that good data on:

- overwintering habitat locations,
- spawning habitat locations off the mainstem,
- rearing habitat locations off the mainstem,
- the significance of the tributaries, especially in the Cedar River system,
- the minimum escapement requirement, and
- the adult population size

were not available.

Although some information was found on adult run timing, the data were suspect due to a lack of records of temporal and spatial effort. A more rigorous design of research programs would help with this problem.

Very little information on native peoples' use of Kitsumkalum steelhead was found and local anglers suggest it has been minimal over the last 20 years (R. Brown and D. Webb, pers. comm. 1997). Addressing this deficiency is not recommended at this time.

In general, the quality of data available in the literature reviewed suffered from the lack of statistically rigorous research design.

Information on fish age, fish size, harvest, catch, angler effort, anglers' residency and guides' reports was adequate.

5.1. Management Recommendations

Little is known with certainty about either the abundance of Kitsumkalum River steelhead, the minimum required escapement, or the locations of critical overwintering and spawning habitat for adults. Until more reliable information is available, the steelhead population should be managed conservatively. The existing catch and release regulation did this from November 1st through to June 15th for the majority of the river, from the lower canyon upstream. Consideration should be given to extending this regulation downstream to include the entire river. This should not significantly affect the majority of anglers since in recent years most of the steelhead caught have been released. For example, during the last four years of record, an average of only 29 steelhead, or 2.3% of the total catch, were reported killed (MELP 1997). Furthermore, of the 263 steelhead caught by guided anglers over the most recent 3 years of record, none were reported killed (MELP 1997).

Some Kitsumkalum River steelhead likely overwinter in the Skeena River near the confluence of the two streams. Pending future studies providing more information on overwintering habitat locations, consideration should be given to extending the November 1st to June 15th catch and release restriction to include this area of the Skeena River.

5.2. Future Study Recommendations

- An extensive radio telemetry tagging study of adults would provide more comprehensive information regarding the locations of spawning and overwintering habitats, as well as timing of fish utilization of these habitats and would provide needed information on the significance of the tributaries.
- An effort should be made to more accurately measure indices of abundance each year. This could be done through minnow trapping of juveniles at index sites or by the installation of temporary fences to enumerate adults on Deep and Anweiler creeks.
- Conduct a juvenile census upstream from currently known limits of habitat use in the main tributaries and in the watershed above the lake, to determine the significance of these extensive areas as rearing habitat.
- Investigate the effect of opening up side channels closed for log drives on juvenile rearing. This was first suggested by Lough and Whately (1981).
- Temporarily halt logging in the upper Cedar River valley, especially in the Anweiler Creek (Watershed Code 43-1500-080) and Swanson Creek (Watershed Code 43-1500-060) watersheds. Then assess these systems adequately before allowing any further development activities.
- Although the Steelhead Harvest Analysis database (MELP 1996a) and the tagging records for 487 steelhead captures (MELP 1990b) were adequate for analyses of parameters such as CPUE and size distribution, the information was not adequate for reliably determining temporal and spatial distribution patterns. This information would be valuable for rational management. To get this information, the angling licence form could be modified to be a record of angling rather than simply a record of successful angling. This could be done by requiring anglers to record the locations and dates of both successful and unsuccessful angling and by requiring more accurate recording of locations on the river. If more space is required on the licence, consideration could be given to issuing licences that are unique for Region 6, thereby eliminating the need for references to Shuswap char and Kootenay rainbow.
- A tagging program involving local angler groups should be actively encouraged by MELP. This program should be aimed at determining run timing and locations.

- The significance of the tributaries, especially those in the Cedar River drainage, should be investigated thoroughly.
- An effort should be made to determine a reliable estimate of the minimum escapement requirement.

6. References

Alexander, R.F., K.K. English and W.R. Koski. 1996. Distribution, Timing and Numbers of Steelhead returning to the Skeena Watershed in 1995. LGL Limited. Environmental Research Associates. Prepared for Fisheries Branch, B.C. Ministry of Environment, Lands and Parks, Victoria, B.C. Available at Ministry of Environment Library, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Anonymous. 1984. Deep Creek Bio-Reconnaissance 1984. Prepared under the direction of the Terrace Kitsumkalum Enhancement Society through the Deep Creek Hatchery. Commercial Fisherman's Program. Available at the Deep Creek Hatchery, Kalum Lake Drive, Terrace B.C.

Atagi, D. 1997. Personal communication. Senior Fisheries Biologist, Ministry of Environment, Lands and Parks, 3726 Alfred Ave, Smithers, B.C., V0J 2N0.

Biolith Scientific Consultants Inc. 1996a. Level 1 assessment of fish and stream habitat for the Kitsumkalum River east. Volume 2. Prepared for Kitsumkalum Band Council and the Kitsumkalum Watershed Restoration Program. Available in Ministry of Environment Library, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Biolith Scientific Consultants Inc. 1996b. Level 1 assessment of fish and stream habitat for the Cedar River and Clear Creek watersheds. Volume 3. Prepared for Kitsumkalum Band Council and the Kitsumkalum Watershed Restoration Program. Available in Ministry of Environment Library, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Biolith Scientific Consultants Inc. 1997. Kitsumkalum River WRP Project Level II: Clear and Anweiler Creeks. Prepared for Kitsumkalum Band Council and the Kitsumkalum Watershed Restoration Program. Available in Ministry of Environment Library, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Brown, R. 1997. Personal communication. 4603 Munthe, Terrace, B.C., V8G 2H5.

Chudyk, W.E. and D.W. Narver. 1976. Commercial interception of steelhead trout in the Skeena River -- A preliminary review. Skeena Fisheries Report #76 - 1. Fish and Wildlife Branch, Ministry of Environment. Available at Ministry of Environment Library, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Department of Fisheries and Oceans. 1991. Stream Summary Catalogue: Sub-District #4B Terrace. Available in Ministry of Environment Library, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Gordon, D. 1997. Personal communication. Triton Environmental Consultants Ltd., 300-4546 Park Ave. Terrace, B.C., V8G 1V4.

Harding, D. 1976. A letter to W.E. Chudyk with two pages attached containing records of Gee's trap catches of steelhead on the Kalum river. Prepared for Environment Canada, Fisheries and Marine. October 27, 1976. Available in the Stream Files, Fisheries Branch, B.C. Ministry of Environment, Lands and Parks, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Hawthorn, R.S. 1971. Flight Report - Steelhead Research - Lakelse and Kalum Rivers. A report of observations made from a helicopter flight on April 22, 1971. Available in the Stream Files, Fisheries Branch, B.C. Ministry of Environment, Lands and Parks, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Hazelwood, G. 1989. Project manager's reports 1985- 1989. Terrace Salmonid Enhancement Society. Available at Deep Creek Hatchery, Kalum Lake Drive, Terrace, B.C.

Koski, R.W., R.F. Alexander and K.K. English. 1995. Distribution, timing and numbers of coho salmon and steelhead returning to the Skeena watershed in 1994. LGL Limited Environmental Research Associates. Prepared for Fisheries Branch, B.C. Ministry of Environment, Lands and Parks, Victoria, B.C. Available at Ministry of Environment Library, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Lough, M.J. 1981. Commercial interceptions of steelhead trout in the Skeena River --- Radio telemetry studies of stock identification and rates of migration. SK - 32. Fish and Wildlife Branch, Ministry of Environment. Available at Ministry of Environment Library, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Lough, M.J. and M.R. Whately. 1984. A preliminary investigation of Kitsumkalum River steelhead trout, 1980-81. Skeena Fisheries Report SK - 38. Available in Ministry of Environment Library, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Lough. 1985. Personal comment. Cited in Tredger. 1985. Kitsumkalum River reconnaissance. Reconnaissance report, Fisheries Improvement Unit, Fisheries Branch. Available in Ministry of Environment Library, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Ministry of Environment. Undated a. Summary of steelhead numbers in major Skeena tributaries. An undated and anonymous one page table of information. Located in the Stream Files, Fisheries Branch, Ministry of Environment, 3726 Alfred Avenue, Bag 5000, Smithers, B.C., V0J 2N0.

Ministry of Environment. Undated b. The Kitsumkalum (Kalum) River. A five page summary focusing on steelhead. Located in the Stream Files, Library, Fish and Wildlife Branch, Ministry of Environment, Lands and Parks, Smithers B.C., V0J 2N0.

Ministry of Environment. 1977. Aquatic Biophysical Map 103 I 10, 103 I 15, 103 P 2. Available at the Fisheries Branch, Ministry of Environment, 3726 Alfred Avenue, Bag 5000, Smithers, B.C., V0J 2N0.

Ministry of Environment. 1990a. Scale Cards, Kitsumkalum River, 1980-1990. Obtained from R. Tetreau, Fisheries Branch, Ministry of Environment, 3726 Alfred Avenue, Bag 5000, Smithers, B.C., V0J 2N0.

Ministry of Environment. 1990b. Tag Records, Kitsumkalum River, 1980-1990. Obtained from R. Tetreau, Fisheries Branch, Ministry of Environment, 3726 Alfred Avenue, Bag 5000, Smithers, B.C., V0J 2N0.

Ministry of Environment. 1996a. Steelhead Harvest Analysis Data. Digital Files: HARV97. Available from D. Atagi, Fisheries Branch, Ministry of Environment, Lands and Parks, 3726 Alfred Avenue, Smithers, B.C.

Ministry of Environment. 1996b. Freshwater Fishing Regulations Synopsis, British Columbia, 1996-97. Fisheries Branch, Ministry of Environment, Lands and Parks, Victoria, B.C.

Ministry of Environment. 1997. Digital File: AGMS database. A digital record of files relating to the Angling Guide Management System. Obtained from D. Atagi, Fisheries Branch, Ministry of Environment, Lands and Parks, 3726 Alfred Avenue, Bag 5000, Smithers, B.C., V0J 2N0.

Morgan, J.D. 1985. Biophysical reconnaissance of the Kitsumkalum River system, 1975-1980. E.V.S. Consultants Ltd. Prepared for Fisheries and Oceans Canada, SEP Facility Operations, New Projects Unit. Available at Ministry of Environment Library, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Morris, M. and B. Eccles. 1976. Preliminary survey of juvenile salmonid rearing habitat. Summer 1976. Upper Kitsumkalum River and tributaries. Fish and Wildlife Branch. Smithers, B.C. SK - 3. Available at Ministry of Environment Library, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Roberts, S. 1997. Personal communication. Chief Councillor, Kitsumkalum Band Council, Box 544, Terrace, B.C., V8G 4B5.

Tetreau, R. 1986. Deep Creek (Kalum River) Steelhead Project. A summary of an abandoned project to take steelhead brood stock and keep them in isolation tubes until ready to spawn. This consists of notes from a book of observations and three memos (File 40.3406, dated January 27, 1986, File 40.340503, dated May 29, 1986 and File 40-340503, dated June 2, 1987). Available in the Stream Files, Fisheries Branch, Ministry of Environment, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Tetreau, R. 1997. An E-mail response to a question about steelhead enhancement attempts in Lakelse River on July 16, 1997.

Tredger, C.D. 1983. Reconnaissance Report. Fish Habitat Improvement. File 0140 - 6 Kitsumkalum River. Available in Stream Files, Fisheries Branch, Ministry of Environment, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Tredger, C.D. 1985. Reconnaissance Report. Fisheries Improvement Unit, File 0140 - 6 Kitsumkalum. Available at Deep Creek Hatchery, Kalum Lake Drive, Terrace, B.C.

Tredger, C.D. 1986. Steelhead stock monitoring report. Fisheries Improvement Unit, File 0140 - 6 Kitsumkalum. .Available at Deep Creek Hatchery, Kalum Lake Drive, Terrace, B.C.

Triton Environmental Consultants Ltd. 1996a. Level 1 assessment of fish and stream habitat for the Kitsumkalum River west and above Kitsumkalum Lake. Volume 1. Prepared for Kitsumkalum Band Council and the Kitsumkalum Watershed Restoration Program. Available in Ministry of Environment Library, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Triton Environmental Consultants Ltd. 1996b. Kalum WRP Project: Level II assessment, Luncheon Creek, Benoit Creek and George Creek. Prepared for Kitsumkalum Band Council and the Kitsumkalum Watershed Restoration Program. Available in Ministry of Environment Library, 3726 Alfred Avenue, Smithers, B.C., V0J 2N0.

Webb, D. 1997. Personal communication. 4716 McConnell Avenue, Terrace, B.C. V8G 2G8.

Appendix A. List of Contacts

- Robert Brown, Recreational Angler, 4603 Munthe, Terrace, B.C., V8G 2H5.
- Jim Culp, Manager, Terrace Salmonid Enhancement Society, Deep Creek Hatchery, Kalum Lake Drive, Terrace, B.C.
- Archi MacDonald, Supervisor, Repap/Skeena Cellulose Inc., 4900 Keith Avenue, Terrace, B.C., V8G 5L8.
- Steve Roberts, Chief Councillor, Kitsumkalum Band Council, West Kalum Road, Terrace, B.C., V8G 2M1.
- Ron Tetreau, Fisheries Technician, Fisheries Branch, Ministry of Environment, Lands and Parks, 3726 Alfred Ave., Smithers, B.C., V0J 2N0.

Appendix B. Steelhead Tagging and Aging Data

* Numbered locations are described in the text and shown in Figure 2. (Source: MELP 1990a, b).

D/M/Y	ID	Sex	Length (cm)	Weight (kg)	Age	Tag #	Comments	Zone	Recap Zone	Date Recaptured
	31	M	87.7	6.8	3.3	0	COLORED			
20/11/80	80	M	58.4	2.3	3.1+	0		2		
20/11/80	81	F	58.4	2.3	3.1+	0		2		
20/11/80	82	M	58.4	2.3	3.1+	0		2		
21/11/80	484	M	58.4	0		256		2		
21/11/80	83	M	53.3	1.4	3.1+	0		2		
21/11/80	84	M	58.4	2.3	3.1+	0		2		
21/11/80	85	F	66	2.7	3.1+	0		2		
21/11/80	483	M	53.3	0		162		2		
21/11/80	481	F	66	0		164		2		
9/12/80	91	M	78.7	5	3.2+	0				
9/12/80	460	M	78.7	4.9		1551		3		
6/1/81	87	F	63.5	2.3	3.2+	0				
6/1/81	438	F	63.5	2.2		1401		3		
7/1/81	92	F	81.3	5.4		0	NO SCALES			
7/1/81	498	F	73.7	4		301	SCALES	5		
7/1/81	440	F	81.3	5.4		1781		5		
7/1/81	439	M	88.9	8		1554		5		
7/1/81	499	M	76.2	4		302	SCALES	4		
7/1/81	90	M	88.9	8.2	4.2+	0	SCARRED			
7/1/81	89	F	73.7	4.1	4.2+	0				
7/1/81	88	M	76.2	4.1	3.2+	0				
8/1/81	443	M	88.9	7.1		1573		3		
8/1/81	95	M	88.9	7.3	3.2+	0	COLORED			
8/1/81	72	M	78.7	5	4.2+	0	COLORED			
8/1/81	71	F	75	4.5	3.2+	0	WINTER RUN			
8/1/81	500	F	73.7	4		303	SCALES; SCAR ON HEAD	5		
8/1/81	442	M	86.4	6.7		1405		5		
8/1/81	75	M	76.2	4.5	3.2+	0				

D/M/Y	ID	Sex	Length (cm)	Weight (kg)	Age	Tag #	Comments	Zone	Recap Zone	Date Recaptured
8/1/81	74	F	73.7	4.1	3.2+	0	SCAR ON HEAD			
8/1/81	93	F	71.1	3.8	4.2+	0	SCAR ON MOUTH			
8/1/81	94	M	86.4	6.8	3.2+	0				
8/1/81	445	F	73.7	4.5		1558		8		
8/1/81	441	M	76.2	4.5		1403		4		
8/1/81	73	F	78.7	5.2	4.2+	0	BRIGHT			
8/1/81	501	F	71.1	3.8		304	RECAP; HOOK AND SCAR	5		18/1/81
8/1/81	444	M	78.7	4.9		1556		3		
9/1/81	79	M	81.3	7.1	3.3+	0	BRIGHT			
9/1/81	448	M	86.4	6.3		1560				
9/1/81	503	M	73.7	4		101		5		
9/1/81	447	M	87.6	7.1		1785		6		
9/1/81	446	M	81.3	6		1783		6		
9/1/81	78	M	78.7	5.4	4.2+	0	COLORED			
9/1/81	77	M	86.4	6.4	4.2+	0				
9/1/81	502	M	78.7	5.4		305	HOOKED DEEP, BLEEDING	6		
9/1/81	76	M	73.7	4.1	4.2+	0	COLORED			
9/1/81	40	M	87.7	7.3	3.3+	0	COLORED			
12/1/81	41	F	76.2	5	3.2+	0	COLORED			
12/1/81	449	F	76.2	4.9		1408		3		
13/1/81	44	F	50.8	0	4.1+	0				
13/1/81	42	F	76.2	4.5	4.2+	0	BRIGHT			
13/1/81	504	F	76.2	4.5		166		5		
13/1/81	505	F	50.8	0.9		165		5		
13/1/81	43	M	81.3	5.4	3.3	0	COLORED			
13/1/81	45	F	81.3	5.9	4.2+	0	BRIGHT			
13/1/81	450	F	81.3	5.8		1411		5		
13/1/81	451	M	81.3	5.4		1978		7		
14/1/81	48	M	50.8	1.4	4.1+	0	COLORED	1		
14/1/81	53	M	61.6	2.7	3.2+	0	COLORED	1		
14/1/81	509	M	61	2.2		310		1		
14/1/81	508	M	63.5	2.7		309		1		
14/1/81	507	M	61	2.7		308		1		
14/1/81	46	M	71.1	4.1	4.2+	0	COLORED	1		
14/1/81	47	F	67.3	3.2	3.2+	0	COLORED	1		

D/M/Y	ID	Sex	Length (cm)	Weight (kg)	Age	Tag #	Comments	Zone	Recap Zone	Date Recaptured
14/1/81	510	F	61	2.2		349		1		
14/1/81	452	M	71.1	4		1413				
14/1/81	49	F	63.5	2.7	R.2+	0		1		
14/1/81	51	M	61	2.3	3.2+	0	COLORED	1		
14/1/81	52	M	63.5	2.7	3.2+	0	COLORED	1		
14/1/81	50	F	61	2.3	4.2+	0	COLORED	1		
14/1/81	54	M	50.8	1.4	3.1+	0	COLORED	1		
14/1/81	506	M	50.8	1.3		306		1		
20/1/81	55	F	76.2	4.5	2.2	0	BRIGHT			
12/2/81	56	M	83.8	6.8	3.3	0	BRIGHT			
15/2/81	58	F	76.2	4.5	3.2+	0	BRIGHT			
19/2/81	518	F	76.2	4		103		4		
19/2/81	57	F	76.2	4.1	3.3	0	BRIGHT			
23/2/81	59	F	76.2	4.5	3.2	0	PINK			
23/2/81	512	F	76.2	4.5		260	DEAD NEAR TAGGING SITE 24/2/81	4		
23/2/81	511	F	76.2	4.5		261		4		
23/2/81	60	F	76.2	4.5		0	NO SCALES, PINK			
24/2/81	516	F	81.3	5.4		264	HOOKED DEEP	5		
24/2/81	517	F	68.6	3.6		265		4		
24/2/81	515	F	81.3	5.4		0	HOOKED DEEP	5		
24/2/81	514	M	78.7	4.9		263		6		
24/2/81	513	F	68.6	3.1		262		4		
24/2/81	61	F	68.6	3.2	R.2	0	PINK			
24/2/81	64	F	68.6	5.6	3.2	0	PINK			
24/2/81	63	F	81.3	5.4	3.3	0	BRIGHT			
24/2/81	62	M	76.2	5	4.2	0	COLORED			
25/2/81	66	M	83.8	6.8	3.2+	0	COLORED			
25/2/81	453	F	81.3	5.4		1562		4		
25/2/81	454	F	81.3	5.4		1608		4		
25/2/81	65	M	81.3	5.4	5.2+	0	COLORED			
25/2/81	461	M	81.3	5.4		266		4		
25/2/81	67	F	81.3	5.4	4.1S1+	0	BRIGHT			
25/2/81	68	F	81.3	5.4	4.2S	0				
26/2/81	463	M	76.2	4.5		268		4		

D/M/Y	ID	Sex	Length (cm)	Weight (kg)	Age	Tag #	Comments	Zone	Recap Zone	Date Recaptured
26/2/81	464	M	86.4	7.1		269		4		
26/2/81	465	M	86.4	7.1		270		5		
26/2/81	466	F	76.2	4.5		271		5		
26/2/81	467	M	81.3	6.2		272		5		
26/2/81	468	M	78.7	4.9		273		5		
26/2/81	70	M	86.4	6.8	4.2+	0	COLORED			
26/2/81	33	F	76.2	4.5	3.2	0	BRIGHT			
26/2/81	34	M	78.7	5	3.2	0	COLORED			
26/2/81	69	M	76.2	4.5	R.2+	0	COLORED			
26/2/81	32	M	81.3	6.4	3.2+	0	COLORED			
4/3/81	37	F	68.6	3.2	3.2	0		1		
4/3/81	470	M	61	1.8		172		1		
4/3/81	36	F	76.2	4.1		0		1		
4/3/81	35	M	61	1.8	3.1+	0		1		
4/3/81	469	F	71.1	3.6		170		1		
5/3/81	38	F	80	5.4	4.2+	0				
5/3/81	471	F	81.3	5.4		102		8		
6/3/81	472	M	86.4	6.7		173	NO ANAL FIN, SCAR ON SIDE	8		
10/3/81	39	M	76.2	5	4.2+	0				
10/3/81	473	F	81.3	5.4		0		8		
10/3/81	474	F	71.1	3.6		149		8		
10/3/81	475	M	76.2	4.9		150		8		
10/3/81	23	F	81.3	5.4	3.2+	0	BRIGHT			
10/3/81	22	F	68.6	3.6	3.2+	0	SLIGHT COLOR			
19/3/81	27	M	81.3	5.9	3.2+	0	COLORED			
19/3/81	477	F	81.3	5.8		148		8		
7/4/81	478	M	81.3	5.4		174		8		
7/4/81	24	M	81.3	5.4	R.2+	0	DARK			
10/4/81	25	F	68.6	3.6	3.2+	0	PINK			
15/4/81	456	F	76.2	4.5		1611		4		
15/4/81	26	F	76.2	4.5	3.2+	0				
23/4/81	28	F	76.2	4.1	4.2	0				
23/4/81	457	M	94	8.9		1792		8		
23/4/81	458	M	86.4	6.2		1575		8		
23/4/81	479	F	76.2	4.5		105		8		

D/M/Y	ID	Sex	Length (cm)	Weight (kg)	Age	Tag #	Comments	Zone	Recap Zone	Date Recaptured
24/4/81	29	M	71.1	3.8	3.1S1	0	FRESH			
24/4/81	459	F	81.3	5.4		0		8		
25/4/81	30	F	76.2	4.5	3.2	0	COLORED			
25/4/81	480	F	76.2	4.5		146		8		
28/8/81	20	M	61	2.3	3.1+	0				
29/8/81	21	M	61	2.3	3.1+	0				
21/11/81	86	M	58.4	2.3	4.2+	0		2		
22/11/81	96	M	76.2	4.9	3.2+	0				
6/12/81	98	F	71.1	3.6	3.2	0	BRIGHT			
6/12/81	100	M	86.4	5.9	R.2	0	BRIGHT			
6/12/81	101	F	81.3	4.9	3.2+	0	BRIGHT			
6/12/81	99	F	60.9	2.7	2.2	0	BRIGHT			
9/12/81	102	M	60.9	2.3	3.2	0	BRIGHT			
10/12/81	105	M	66	2.7	3.2	0	BRIGHT			
10/12/81	104	F	60.9	2.3	R.1+	0	BRIGHT			
10/12/81	103	F	78.7	5.9	3.3+	0	BRIGHT			
13/12/81	111	M	96.5	8.6	3.3+	0	DARK			
13/12/81	110	M	96.5	8.6	R.3+	0	DARK			
13/12/81	109	M	81.3	5.9	4.2	0	BRIGHT			
13/12/81	108	M	78.7	5.9	4.2+	0	DARK			
13/12/81	107	F	76.2	4.9	3.1S1	0	BRIGHT			
13/12/81	106	F	86.4	6.3	R.3	0	BRIGHT			
22/12/81	423	M	71.1	3.6	4.2	0				
22/12/81	422	M	99.1	6.4	3.2+	0				
22/12/81	424	F	68.6	3.2	4.2+	0				
22/12/81	421	M	81.3	5	3.2+	0				
22/12/81	425	F	71.1	3.6	4.2+	0				
21/1/82	426	F	78.7	4.5	R.2+	0	BRIGHT			
31/1/82	427	F	76.2	4.5	3.2S1+	0				
3/2/82	429	F	71.1	4.1	3.2+	0	BRIGHT			
3/2/82	428	M	91.4	8.6	R.2+	0	DARK			
10/2/82	430	F	86.7	5.4	4.2S1+	0	BRIGHT			
23/2/82	431	M	50.8	1.9	3.1+	0	DARK			
28/2/82	433	M	86.7	6.8	3.2S1	0	BRIGHT			
17/3/82	434	M	53.3	1.1	3.1	0	BRIGHT			

D/M/Y	ID	Sex	Length (cm)	Weight (kg)	Age	Tag #	Comments	Zone	Recap Zone	Date Recaptured
10/4/82	435	F	81.3	5.4	4.3	0	BRIGHT			
13/4/82	436	F	81.3	5.4	3.2	0	BRIGHT			
20/5/82	432	F	71.1	3.6	4.2S	0				
12/1/83	137	F	76.2	4.5	4.3	0	BRIGHT			
25/1/83	139	M	76.2	4.5	3.3	0	DARK			
25/1/83	138	F	83.8	5.9	4.3	0	BRIGHT			
2/2/83	141	M	86.4	7.3	R.3	0	DARK			
2/2/83	142	F	61	2.3	3.3	0	BRIGHT			
2/2/83	143	M	71.1	3.6	3.2	0	BRIGHT			
2/2/83	140	M	88.9	8.2	4.2S1	0	BRIGHT			
3/2/83	144	F	76.2	4.5	3.3	0	BRIGHT			
3/2/83	145	F	66	2.7	4.2	0	BRIGHT			
10/2/83	146	F	73.7	3.6	3.2	0	BRIGHT / SLIM			
16/2/83	147	F	76.2	5	R.2	0	BRIGHT / DEEP			
16/2/83	148	F	73.7	4.1	3.3	0				
20/2/83	149	M	91.4	8.2	3.3	0				
23/2/83	150	F	76.2	4.5	4.3	0				
23/2/83	152	F	66	2.7	3.3	0				
23/2/83	151	M	68.6	3.2	3.2	0				
27/2/83	121	F	83.8	5.9	3.3	0				
9/3/83	122	F	81.3	5.4	4.3	0	NET MARKS			
9/3/83	123	F	83.8	6.4	3.3	0	BRIGHT			
13/3/83	124	F	76.2	4.5	3.3	0	BRIGHT			
16/3/83	125	F	71.1	3.6	3.3	0				
16/3/83	126	M	76.2	5	3.3	0				
16/3/83	127	M	50.7	1.4	3.2	0				
19/3/83	128	M	83.8	7.3	3.3	0				
19/3/83	129	F	76.2	4.5	3.2	0	BRIGHT			
19/3/83	130	F	55.9	2.3	4.2	0	BRIGHT			
27/3/83	132	F	78.7	4.1	3.3	0				
1/4/83	135	M	53.3	1.8	R.2	0				
1/4/83	133	F	76.2	4.5	4.2	0				
1/4/83	134	F	83.8	5.9	3.3	0				
6/4/83	113	F	68.6	3.2	4.2	0	BRIGHT			
6/4/83	112	F	81.3	5.4	3.2	0	BRIGHT			

D/M/Y	ID	Sex	Length (cm)	Weight (kg)	Age	Tag #	Comments	Zone	Recap Zone	Date Recaptured
6/4/83	136	F	81.3	5.4	4.3	0	BRIGHT			
9/4/83	114	M	99.1	9.5	3.3SS1	0	DARK			
9/4/83	115	F	86.4	6.8	3.3	0	DARK			
9/4/83	116	F	78.7	5	3.3	0				
10/4/83	117	F	76.2	4.5	4.3	0				
20/4/83	120	F	78.7	5	3.3	0				
20/4/83	118	F	76.2	4.5	3.3	0				
20/4/83	119	F	76.2	4.5	3.3	0				
29/10/83	166	F	76.2	4.5	R.2+	0				
29/10/83	165	M	66	3.2	3.2	0				
29/10/83	164	M	76.2	5	4.2+	0				
4/11/83	167	M	61	2.7	3.1+	0				
4/11/83	168	F	68.6	3.2	3.2+	0				
4/11/83	169	F	73.7	4.5	R.2+	0				
4/11/83	170	F	78.7	5	3.3+	0				
6/11/83	172	M	50.8	1.8	3.1+	295		1		
6/11/83	171	M	50.8	0	R.1+	296		1		
6/11/83	710	F	47	1.8	3.1+	293		1		
11/11/83	175	F	73.7	4.5	3.2+	0				
11/11/83	174	M	68.6	3.2	3.1+	0				
24/11/83	176	F	86.4	6.8		0	SD, NO SCALES			
24/11/83	177	M	86.4	7.3	3.2+	0				
30/11/83	178	M	83.8	6.4	R.1S1	0				
30/11/83	180	M	78.7	5.4	3.3	0				
30/11/83	181	M	83.8	0	4.2+	0	SUMMER			
30/11/83	179	F	81.3	5.4	4.2+	0				
4/12/83	184	F	81.3	0	4.2+	253		5		
4/12/83	183	F	71.1	4.1	4.2+	252		5		
9/12/83	186	M	90.2	0	3.3+	255		7		
11/12/83	233	M	86.4	6.4	4.3	261		4		
11/12/83	188	M	73.7	0	3.1+	257	SUMMER	4		
11/12/83	523	M	57.2	0	3.2	256	WINTER	4		
15/12/83	190	F	76.2	0	3.2+	259		4		
15/12/83	192	F	77.5	0	3.2+	289		4		
15/12/83	191	F	68.6	0	3.2+	260		4		

D/M/Y	ID	Sex	Length (cm)	Weight (kg)	Age	Tag #	Comments	Zone	Recap Zone	Date Recaptured
15/12/83	189	F	73.7	0	R.1S1	258		4		
17/12/83	194	M	58.4	0	3.1+	290		4		
17/12/83	193	M	96.5	0	4.3+	291		4		
27/12/83	234	M	68.6	3.2	4.2	262	RECAP	4		9/1/84
28/12/83	235	M	55.9	2.3	3.2	263		4		
8/1/84	195	F	90	7.3	4+.4	292		4		
15/1/84	236	F	66	3.2	3.3	264		2		
15/1/84	237	M	61	2.3		265		2		
15/1/84	238	F	68.6	3.6	4.3	266	RECAP	2	7	28/5/84
22/1/84	239	M	71.1	4.5	4.3	267		7		
22/1/84	240	M	66	3.2	4.2	268		7		
22/1/84	241	F	83.8	5.9	4.3	269		7		
1/2/84	242	F	81.3	5.4		270		3		
18/2/84	196	F	83	0	3.2S1	293		6		
26/2/84	197	F	80	0	4.3	294		7		
26/2/84	198	F	77	0	4.3	295		7		
26/2/84	243	M	81.3	5.9	R.1S1	301		7		
29/2/84	202	M	72	0	4.2	328		6		
29/2/84	201	M	80	0	3.3	327		6		
3/3/84	244	M	81.3	5.9	4.2	302		3		
7/3/84	245	M	68.6	3.2	4.2	303		8		
7/3/84	200	M	73	0	3+.3	326		8		
11/3/84	247	F	76.2	4.5	4.3	305		7		
11/3/84	246	M	94	8.2	4.4	304		7		
14/3/84	248	M	68.6	3.2	4.2	306		4		
14/3/84	249	F	73.7	4.1	3.3	307		3		
15/3/84	250	F	83	6.4	4.4	308		5		
15/3/84	251	F	76.2	4.5	3.3	309		6		
15/3/84	252	M	53.3	1.8	3.2	310		6		
17/3/84	204	F	80	0		330		7		
17/3/84	205	M	85	0	4.3	331		7		
17/3/84	203	F	77	0	4.3	329		7		
17/3/84	206	F	89	0	3.3	332		7		
18/3/84	253	M	58.4	2.7	3.2	311		4		
22/3/84	207	M	87	0	3.1S1	333		7		

D/M/Y	ID	Sex	Length (cm)	Weight (kg)	Age	Tag #	Comments	Zone	Recap Zone	Date Recaptured
23/3/84	208	M	68	0	3.2	334		8		
24/3/84	209	M	72	0	4.2	335		8		
25/3/84	254	F	76.2	4.5	4.3	312		6		
25/3/84	227	M	68.6	3.2	3.2	271		8		
25/3/84	223	F	61	4.5	3.3	280		6		
27/3/84	210	F	76	0	3.3	346		8		
28/3/84	255	F	71.1	3.6	3.3	313		5		
4/4/84	213	F	78	0	3.3	350		8		
4/4/84	211	F	79	0	4.3	348		8		
4/4/84	212	M	91	0	5.4	349		8		
7/4/84	256	F	86.4	6.4	4.4	314		4		
8/4/84	258	M	63.5	2.7	4.2	316		8		
8/4/84	257	M	68.6	3.6	4.2	315		8		
9/4/84	259	F	81.3	5.4	3+.3	317		8		
10/4/84	214	F	83	0	3+.3	351		8		
11/4/84	216	M	83	0	3+.3	353		8		
11/4/84	215	F	71	0	3+.1S1	352		8		
13/4/84	260	F	83.8	5.9	R.1S1	318		8		
14/4/84	217	F	83	0	R.3	354		8		
14/4/84	218	F	84	0	R.2S2	355		8		
14/4/84	219	F	77	0	4.2S1	356		8		
15/4/84	568	M	63.5	0		319		8		
15/4/84	261	F	71.1	4.1	4.3	319				
20/4/84	228	F	71.1	5.2	3.3	272		4		
22/4/84	262	F	86.4	6.8	4.3	320		8		
22/4/84	224	M	71.1	3.6	3.2	279		8		
28/4/84	222	F	78.7	5	4.2	323		8		
28/4/84	221	M	71.1	4.1	3.3	322		8		
28/4/84	220	F	78.7	5	3.3	321		8		
29/4/84	230	F	81.3	5	3.3	336				
29/4/84	532	F	81	0		396		1		
20/5/84	232	F	73.7	5.4	3.2S	0	SPAWNING			
29/8/84	324	F	66	0	3+.3	388		8		
19/9/84	263	M	85	6.5	4.3+	324		8		
3/10/84	269	F	82	5.5	3.2S1+	362		3		

D/M/Y	ID	Sex	Length (cm)	Weight (kg)	Age	Tag #	Comments	Zone	Recap Zone	Date Recaptured
3/10/84	268	F	56	2		361	NO SCALES	3		
7/10/84	270	F	76	4.5	3.2+	363		3		
17/10/84	271	M	66	2.5	3.1+	364		2		
21/10/84	274	M	82	6		367		3		
21/10/84	276	F	76	4	3.2+	369		4		
21/10/84	275	F	66	4	4.2+	368	RECAP	3	5	14/4/85
21/10/84	273	M	69	3	3.1+	366		3		
21/10/84	277	M	85	7		370		4		
21/10/84	272	M	79	5	3.2S1+	365		3		
24/10/84	264	F	75	5	3.2+	357		3		
24/10/84	265	F	70	4	3.2+	358		3		
24/10/84	266	M	61	2	4.1+	359		3		
24/10/84	317	F	81	0	4.3	296		3		
24/10/84	278	M	63	2.5	3.1+	371		3		
27/10/84	320	F	69	0	3.2+	299		3		
27/10/84	319	M	65	0	3.1+	298		4		
27/10/84	318	F	77	0	4.2+	297		4		
28/10/84	267	M	74	4	4.2+	360	RECAP	3	8	17/2/85
28/10/84	279	M	77	4.5	3.1S+	372		3		
1/11/84	280	F	76	4	3.2+	373		3		
1/11/84	281	M	87	6.5	3.3+	374		3		
1/11/84	282	F	79	5	4.1S1+	375		3		
1/11/84	283	F	79	5	4.2+	376		3		
1/11/84	284	F	71	3.5	4.2S1+	377		4		
1/11/84	326	M	81	0	4.3	390		3		
2/11/84	350	M	92	7.7	3.3+	700		4		
4/11/84	287	F	85	6	4.2S1+	380		4		
4/11/84	288	M	69	3.5	R.2+	381		4		
4/11/84	286	F	77	4.5	4.3	379		4		
4/11/84	285	M	72	3.5	4.2+	378		4		
4/11/84	225	M	61	2.7	4.2	278		3		
4/11/84	289	M	61	2.5	3.1+	382	RECAP-COMM. FISHERY	4		16/7/85
7/11/84	302	M	87	7	3.2+	610		3		
7/11/84	290	F	74	4	R.2+	383		3		
7/11/84	291	M	60	2	3.2	384		3		

D/M/Y	ID	Sex	Length (cm)	Weight (kg)	Age	Tag #	Comments	Zone	Recap Zone	Date Recaptured
7/11/84	292	M	69	3	3.2	385		4		
10/11/84	293	M	77	4	3.2+	601		4		
10/11/84	294	F	69	3	3+.2+	602		4		
10/11/84	295	M	77	4	R.2+	603		4		
10/11/84	296	M	64	3	3.2	604		4		
11/11/84	300	F	79	5	4.3	608		4		
11/11/84	299	M	82	6.5	3.3	607		4		
11/11/84	301	M	84	7	3.3	609		4		
11/11/84	298	F	69	3	4.2+	606		4		
11/11/84	297	M	88	8	R.3	605		4		
14/11/84	303	M	87	7	3+.3	611		4		
14/11/84	304	M	74	4	3+.2+	612		4		
14/11/84	305	F	77	4	3+.3	613		4		
16/11/84	321	F	78	0	3.3	300	RECAP	3	8	31/1/85
17/11/84	344	M	79	0	4.3	692		4		
21/11/84	306	M	82	6	3+.3	614		4		
24/11/84	345	F	72	4.1	3.2+	694		5		
27/11/84	307	M	99	10	3.3	615		3		
5/12/84	310	F	72	3	4.2+	618		4		
5/12/84	308	F	74	4	4.2+	616		3		
5/12/84	312	F	102	12	4.4	620		4		
5/12/84	309	M	77	4	3+.3	617		3		
6/12/84	313	M	59	2	3.2	621		3		
12/12/84	314	M	72	4	4.2	622		3		
16/12/84	327	F	70	0	3.3	391		7		
16/12/84	328	M	92	0	3.4	392		7		
18/12/84	311	M	62	2	4.2	619		6		
19/12/84	329	M	80	0	R.3	393		6		
19/12/84	330	M	87	0	3.3	394		6		
21/12/84	331	M	86	0	4.3	395		7		
6/1/85	346	F	79	0	3.3	695		7		
6/1/85	335	F	75	0	4.3	399		7		
6/1/85	332	M	85	0	3.3	396		7		
6/1/85	333	F	89	0	4.1S1	397		7		
10/1/85	316	F	82	6	4.3	624		7		

D/M/Y	ID	Sex	Length (cm)	Weight (kg)	Age	Tag #	Comments	Zone	Recap Zone	Date Recaptured
10/1/85	315	M	82	6	4.3	623		7		
17/1/85	355	M	66	3	3+.2	625		3		
17/1/85	356	M	66	3	4.3	626		3		
19/1/85	393	F	77	0	4.3	670		5		
19/1/85	394	F	71	5	3.3	671		5		
19/1/85	395	F	69	5	3.3	672		5		
20/1/85	397	F	75	0	4.3	674		7		
20/1/85	396	F	81	0	3.3	673		7		
20/1/85	357	F	80.6	5	3+.3	627		4		
23/1/85	359	F	72	4	3.3	629		6		
23/1/85	360	M	89	7	4.3	630	RECAP	6		15/6/85
23/1/85	354	M	67	0	3+.2	221		3		
23/1/85	358	F	74	3.6	3.3	628		6		
23/1/85	351	F	53	0	4.2	222		3		
23/1/85	352	F	53	3.2	3+.2	218		3		
23/1/85	353	F	63	0	4.3	220		3		
23/1/85	361	F	69	3	3.3	631		6		
27/1/85	362	M	74	5	3.3	632		6		
30/1/85	366	F	61	2	3.1S1	636		8		
30/1/85	365	M	54	2	4.2	635		8		
30/1/85	364	F	77	4	4.3	634		8		
30/1/85	363	M	72	4	3+.3	633		8		
1/2/85	386	M	81	0	3.3	662		7		
2/2/85	389	F	76	0	3.3	665		7		
2/2/85	388	F	82	0		664		7		
3/2/85	368	F	87	7	R.2SS1	637		6		
6/2/85	371	F	71	4	3.3	640		5		
6/2/85	372	F	84	5	R.3	641		5		
17/2/85	383	F	74	4	3.3	651		8		
20/2/85	415	F	65	0	3.2	669		7		
20/2/85	374	F	81	5	3.3	643	RECAP	8		16/6/85
23/2/85	412	M	86	5.4	3.3	710		8		
23/2/85	661	F	81	0		675		7		
23/2/85	398	M	65	0	3.2	682		5		
24/2/85	617	F	88	0		0		8		

D/M/Y	ID	Sex	Length (cm)	Weight (kg)	Age	Tag #	Comments	Zone	Recap Zone	Date Recaptured
24/2/85	375	F	82	5	3.3	644		8		
24/2/85	376	F	77	4	3.3	645		8		
24/2/85	377	F	88	7	2.3	0		8		
25/2/85	420	F	71	0	3.3	686		5		
26/2/85	419	M	92	0	R.2S1	687		8		
1/3/85	414	F	80	0	4.3	707		6		
2/3/85	643	M	79	0		690	KELT, RECAP-COMMERCIAL FISHERY	8		16/7/85
2/3/85	380	M	84	6	3.3	647		8		
2/3/85	417	F	73	0	3.3	689		8		
2/3/85	413	F	74	0	3+.3	708		7		
2/3/85	410	M	71	0	3.2	712		8		
2/3/85	381	M	87	7	4.3	648		8		
2/3/85	379	F	69	3	3.3	646		8		
3/3/85	404	M	86	0	4.4	718		7		
3/3/85	399	M	83	0	3.3	638		6		
3/3/85	406	M	76	0	4.3	716		7		
3/3/85	405	M	85	0	3.3	717		7		
3/3/85	407	F	81	0	4.3	715		7		
6/3/85	384	M	91	8.6	4.4	650		6		
6/3/85	382	M	64	2	3.2	649		6		
6/3/85	400	M	71	0	3.3	753		5		
6/3/85	401	M	84	5.9	3.3	752		5		
6/3/85	402	M	61	2	3.2	751		5		
7/3/85	409	M	81	0	3.3	713		8		
7/3/85	668	M	97	0		702		8		
7/3/85	682	M	69	0		754		8		
8/3/85	672	F	66	0		719		5		
8/3/85	673	M	77	0		720		4		
9/3/85	403	M	55.9	0		721		7		
10/3/85	662	M	84	0		676		7		
13/3/85	685	M	87	0		757		8		
13/3/85	675	F	82	0		723		8		
13/3/85	674	M	66	0		722		8		
13/3/85	684	M	87	0		756		8		

D/M/Y	ID	Sex	Length (cm)	Weight (kg)	Age	Tag #	Comments	Zone	Recap Zone	Date Recaptured
13/3/85	683	F	77	0		755		8		
15/3/85	663	M	69	0		678		7		
16/3/85	664	F	74	0		679		8		
16/3/85	669	F	81	0		703		8		
16/3/85	676	F	70	0		724		8		
17/3/85	677	M	99	0		725		7		
22/3/85	679	F	82	0		727		8		
23/3/85	671	F	86	0		709		8		
23/3/85	670	M	56	0		704		8		
24/3/85	665	M	90	0		680		8		
28/3/85	686	M	64	0		758		5		
5/4/85	667	F	61	0		684		5		
7/4/85	666	M	74	0		681		8		
11/4/85	687	M	97	0		759		8		
11/4/85	688	M	69	0		760		8		
11/4/85	689	F	72	0		761		8		
11/4/85	690	M	87	0		762		8		
14/4/85	691	M	79	0		763		3		
17/4/85	692	F	79	0		764		8		
24/4/85	696	M	82	0		768		8		
24/4/85	695	M	87	0		767		8		
24/4/85	693	F	82	0		765		8		
24/4/85	694	F	82	0		766		8		
24/4/85	680	M	90	0		728		5		
27/4/85	681	M	67	0		730		5		
1/5/85	700	F	79	0		772		8		
1/5/85	697	F	82	0		769		8		
1/5/85	698	M	77	0		770		8		
1/5/85	699	M	87	0		771		8		
8/5/85	701	F	84	0		773		8		
9/5/85	702	F	74	0		774		8		
15/5/85	706	F	78	0		804		7		
15/5/85	703	F	94	0		801		7		
15/5/85	704	F	76	0		802		7		
15/5/85	705	F	61	0		803		7		

D/M/Y	ID	Sex	Length (cm)	Weight (kg)	Age	Tag #	Comments	Zone	Recap Zone	Date Recaptured
28/8/86	322	M	86	0	4.3	386		8		
6/5/87	16	F	78	0	3.1S1+	0				
6/5/87	19	F	75	0	4.2+	0				
13/5/87	18	F	74	0	4.2+	0				
13/5/87	17	F	75	0	4.2+	0				

Appendix C. Steelhead Harvest Analysis Data

Source: MELP 1996a

FISCAL	ANGLERS	DAYS FISHED	WILD KEPT	WILD RELEASED	HATCHERY KEPT	HATCHERY RELEASED	TOTAL KEPT	TOTAL RELEASED	TOTAL CATCH
1967-68	454	2265	567	0	0	0	567	0	567
1968-69	426	2490	659	0	0	0	659	0	659
1969-70	406	2030	463	0	0	0	463	0	463
1970-71	428	2394	361	89	0	0	361	89	450
1971-72	349	1827	278	213	0	0	278	213	491
1972-73	348	2429	596	299	0	0	596	299	895
1973-74	348	2132	683	275	0	0	683	275	958
1974-75	No Data								
1975-76	367	3351	567	207	0	0	567	207	774
1976-77	435	2591	387	196	0	0	387	196	583
1977-78	459	2695	389	77	0	0	389	77	466
1978-79	305	1799	200	108	0	0	200	108	308
1979-80	377	2248	173	125	0	0	173	125	298
1980-81	332	1944	240	179	0	0	240	179	419
1981-82	466	3006	283	803	3	0	286	803	1089
1982-83	531	4037	459	1003	0	4	459	1007	1466
1983-84	565	3759	397	717	8	4	405	721	1126
1984-85	710	4831	466	1589	7	50	473	1639	2112
1985-86	652	4405	417	1964	0	11	417	1975	2392
1986-87	919	4738	490	2298	0	11	490	2309	2799
1987-88	738	4656	384	2242	4	15	388	2257	2645
1988-89	656	3344	183	1221	16	23	199	1244	1443
1989-90	635	4585	224	1339	22	43	246	1382	1628
1990-91	596	3784	136	1022	4	11	140	1033	1173
1991-92	406	2389	56	674	30	72	86	746	832
1992-93	270	1375	31	627	0	23	31	650	681
1993-94	239	1626	16	1216	0	38	16	1254	1270
1994-95	275	1751	28	1569	0	21	28	1590	1618
1995-96	388	2198	42	1314	0	36	42	1350	1392