BC Environment

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

by

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Skeena Fisheries Report SK-99

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SUMMARY

This report summarizes the stock status, and current data available on, the Kluatantan River steelhead (*Oncorhynchus mykiss*) population. Total angler effort for steelhead, total catch of steelhead, and catch per unit effort trends on the Kluatantan River are summarized from the Steelhead Harvest Analysis database and from the Angling Guide Management System database. There is very little information available on the steelhead population utilizing the Kluatantan River, but the population size is very small, and the biology of the fish is likely similar to that of steelhead in the Sustut River due to close geographical proximity of the two watersheds. Management and future study recommendations are made to help in further study programs in the watershed.

ACKNOWLEDGEMENTS

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1.0 INTRODUCTION

Numerous steelhead (*Oncorhynchus mykiss*) populations are distributed throughout the Skeena River watershed, but very little is known about minor populations that are found in small tributaries (<50 km in length). This is particularly the case in the Kluatantan River which is located in the upper Skeena River watershed, and is thought to be the upstream limit of distribution of steelhead in the Skeena River. Based on the proximity of this system to the Sustut River, the biology of the steelhead found in the Kluatantan River is likely similar to that of steelhead in the Sustut River. The purpose of this report is to provide a summary of the data currently available on the population of steelhead that utilize the Kluatantan River, and to provide recommendations for future work to fill in the gaps in terms of life-history and fisheries management considerations. This review covers the following topics of the life-history of this stock of steelhead in the upper Skeena River:

1) Freshwater and ocean life-history review;
2) Identification and mapping of juvenile rearing areas, adult overwintering areas, and spawning site locations;
3) Review of past enhancement attempts;
4) Review of adult assessments;
5) Review of adult run timing;
6) Review of catch, angler effort, and catch per unit effort information;
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 harvests;
12) Review of minimum escapement requirements;
13) Summary of current stock status.

The main objective of this report is to also provide recommendations for management and future study of the population, and these recommendations are dealt with in the conclusions and recommendations section at the end of this report.

2.0 STUDY AREA

The Kluatantan River is a tributary to the upper Skeena River (Figure 1). The river arises in the Skeena Mountains, is approximately 35 km in length, and flows in a general north south direction. Other fish species found in the system include chinook salmon (*Oncorhynchus tshawytscha*), sockeye salmon (*O. nerka*), coho salmon (*O. kisutch*), bull trout (*Salvelinus confluentus*), Dolly Varden (*S. malma*), and Rocky Mountain whitefish (*Prosopium williamsoni*). There are two major lakes in the system, Kluayaz Lake and Kluatantan Lake(s), which provide rearing areas for juvenile sockeye salmon, and overwintering areas for adult steelhead. There are also two small tributaries in the system, Kluayaz Creek and Tantan Creek, that are important to salmonid populations in the watershed.

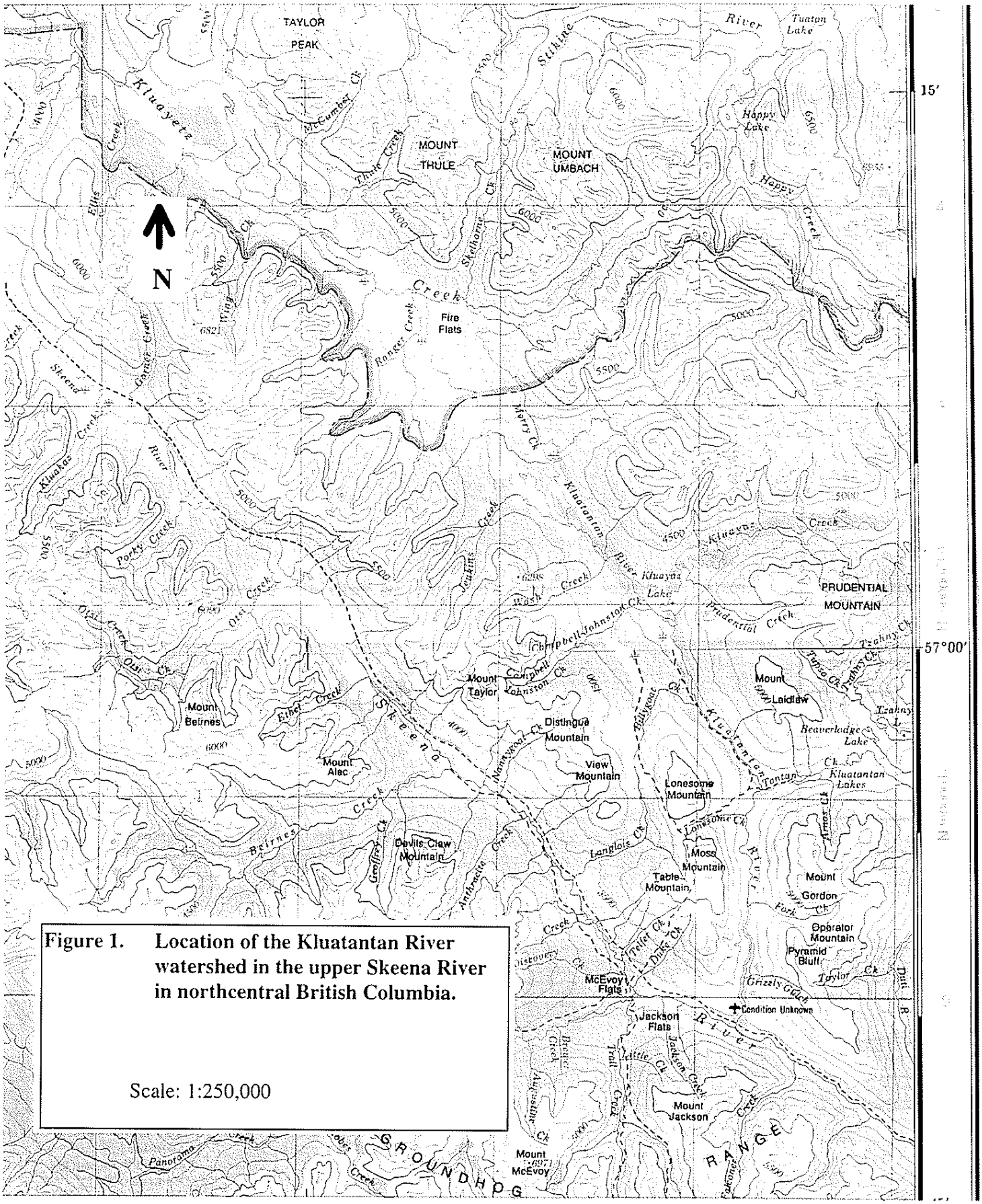


Figure 1. **Location of the Kluatantan River watershed in the upper Skeena River in northcentral British Columbia.**

Scale: 1:250,000

3.0 MATERIALS AND METHODS

3.1 Data Collection and Review

For this review, data were collected and reviewed from a number of sources to fully compile information available on the biology of this stock of steelhead. These sources included:

1) Ministry of Environment, Lands, and Parks (M.E.L.P.) stream files (Smithers, B.C.);
2) FISS/SISS database;
3) Cataloged reports in the M.E.L.P. library (Smithers, B.C.);
4) Steelhead Floy tag (TAGS) database;
5) Angling guide management system (AGMS) database;
6) Watershed Restoration Program reports;
7) Forest Renewal BC stream inventory reports;
8) Reports submitted under fish collection permit;
9) Steelhead harvest analysis (SHA) database;
10) Forest industry licensee(s);
11) Fisheries Improvement and Assessment Unit stream inventory reports;
12) Creel survey reports;
13) Primary literature sources;
14) M.E.L.P. fish scale archive data;
15) Personal communications with people that have worked in the Sustut River watershed.

3.2 Data Entry

Data were entered that were collected from M.E.L.P. aged scale information from sampled steelhead, and this entered data were used to calculate average lengths, weights, and ocean and freshwater residency periods where possible (the entered scale age data is found in Appendix I).

3.3 Database Searches

Supplied databases from M.E.L.P. were searched to collect information on steelhead movements and run timing, as well as information regarding angling activity from both the Steelhead Harvest Analysis (SHA) database and the Angling Guide Management System (AGMS) database.

4.0 RESULTS AND DISCUSSION

4.1 Ocean Life-History (as determined by scale aging)

From a small sample of scales that were collected from steelhead in the Kluatantan River, most fish spent 2 years in the ocean before returning to spawn (Table 1). This is similar to the population utilizing the Sustut River.

4.2 Migration Timing through Fisheries and Oceans Canada Statistical Area 4 and into the Lower Skeena River

There are no data from Floy tag recaptures in the TAGS database, so an estimation of migration timing through Statistical Area 4 can not be made directly. There are however a few incidental reports and data that can be used to roughly estimate timing. Steelhead have been caught in the Kluatantan River as early as the September 2nd in some years, and based on the time estimated for steelhead to migrate to the upper Sustut River (30 days) this would place this population as moving through the commercial fishery sometime around late July and early August. In 1979, one radio tagged steelhead was also tracked in the Kluatantan system, and this fish was tagged in the Skeena River below Terrace between August 20th and 22nd (Lough 1979). This would extend the timing into the lower Skeena River to mid August. It can be suggested then that Kluatantan River steelhead move through Statistical Area 4 from mid July to mid August, which would predispose this stock of steelhead to a higher degree of incidental catch in the commercial fishery due to their migration during the peak of commercial fishing effort each year.

4.3 Minimum Escapement Levels

In 1992, Tautz *et al.* (1992) produced a model that predicted adult production of steelhead at carrying capacity, and the number of spawners at maximum sustainable yield (MSY) in rivers throughout the Skeena River watershed. This model was based on the total area and total useable area of streams containing steelhead for the summer low-flow period, and estimated stream width, as well as known population dynamics parameters for one B.C. steelhead population (Keogh River on Vancouver Island). For the Kluatantan

Table 1. Number of years that adult Kluatantan River steelhead (*Oncorhynchus mykiss*) remain in the ocean after migrating to sea as smolts prior to their first spawning (as determined from scale aging done by M.E.L.P.).

	Mean (years)	S.E.	Median (years)	Range (years)	N
All Fish	2.1	0.1	2	2-3	9
Females	2.0	0.0	2	NA	4
Males	2.2	0.2	2	2-3	5

River the predicted adult production at carrying capacity (K) was estimated at 630 individuals, while the number of spawners at maximum sustainable yield (MSY) was estimated at 239 individuals.

4.4 Escapement Information

There are no direct estimates of steelhead escapement to the Kluatantan River. It has been suggested that the total spawning population in the Kluatantan River is likely between 100 and 200 fish (Chudyk 1975). This is a reasonable estimate based on the minimal number of steelhead that are reported to be caught by anglers each year. The discrepancy however between the number of spawners suggested to likely occur in the river (Chudyk 1975), and the estimated adult escapement at carrying capacity (Tautz *et al.* 1992) might indicate that actual escapement might fall somewhere in between the two estimates. Estimating escapement to the Kluatantan River might prove difficult given the glacial nature of the water (Hancock *et al.* 1983). Based on the rough estimation of the possible numbers of spawners, and the fact that the Kluatantan is so isolated, it appears that there is likely not a conservation concern due to escapement levels not being met. Given the small population size and early run timing however, this stock could be subject to small impacts due to events such as over harvest, and must be managed properly.

4.5 Sex Ratio

Although there is no data to directly calculate the sex ratio of steelhead in the Kluatantan River, perhaps the best estimate can be made from data provided by a guide (Ray Collingwood) in the mid 1970's (see Chudyk 1975). The guide reported that from September 11th to October 3rd a total of 26 steelhead were caught in the Kluatantan River. Of these fish 11 were male, and 15 were female, a sex ratio of 1.36 females to males. This would suggest that the sex ratio is close to 1:1 females to male, and that the sex ratio is not skewed towards one sex or the other.

4.6 Size Distribution (Fork Length and Weight) of Mature Steelhead

Fork length and weight data have been collected from a few steelhead sampled for scale aging by M.E.L.P. and by guides that have operations on the Kluatantan River. Males are larger than females in both length and weight (Table 2), and the size of these fish is similar to steelhead from the Sustut River. More biological data needs to be collected from this system, and this could be carried out by the guide operation on the river.

Table 2. Summary of fork length and weight data collected from adult steelhead (*Oncorhynchus mykiss*) sampled in the Kluatantan River for scale aging and by angling guides.

	Fork Length (cm)				Weight (kg)			
	Mean	**S.E.**	**Range**	**N**	**Mean**	**S.E.**	**Range**	**N**
All fish	78.9	2.3	64.8-91.4	10	5.91	0.48	2.7-10.4	22
Females	73.0	3.3	64.8-80.0	4	4.25	0.26	2.7-5.4	12
Males	82.8	2.0	76.2-91.4	6	7.91	0.53	5-10.4	10

4.7 Adult Overwintering Areas

There have been few observations of steelhead in overwintering areas in the Kluatantan watershed, but based on the use of lakes by overwintering steelhead in other watersheds, a few inferences can be made. On November 9th, 1979, one radio tagged steelhead was

tracked into Kluayaz Lake near the South East shore (Lough 1979) identifying this system as a overwintering site. On this same survey it was suggested that in the lower Kluatantan River, five miles above the confluence with the Skeena River, a canyon might provide suitable habitat for overwintering. There also exists the possibility that steelhead might overwinter in the Kluatantan Lakes, and in the mainstem Skeena River near the confluence of the Kluatantan River (Figure 2).

4.8 Spawning Timing

There have been no direct observations of steelhead spawning in the Kluatantan watershed, but the timing of spawning likely is similar to that of the Sustut River steelhead (late May to late June).

4.9 Spawning Locations

Again there have been no observations of steelhead spawning in the Kluatantan watershed, but spawning locations can be inferred by observations of spawning of other Pacific salmon, and from habitat observations during overflight surveys. Three areas of possible spawning gravel were identified by an angling guide in the area (Ray Collingwood) in 1975 (Chudyk 1975). These were the inlet to Kluayaz Lake, the outlet of Kluayaz Lake, and Tantan Creek draining the Kluatantan Lakes (Figure 3). Sockeye salmon have been observed to shore spawn in both Kluayaz Lake and the first Kluatantan Lake (Hancock *et al.* 1983). Lough (1979) also reports that steelhead have been sampled in the Kluatantan River above Kluayaz Lake suggesting that some spawning may occur in that area. As well both Chudyk (1975) and Bustard (1975) report that suitable spawning habitat occurs in the upper Kluatantan River above Kluayaz lake.

Spawning locations can also be estimated from the presence of juvenile steelhead. In August 1984, the Kluatantan watershed was sampled for juvenile steelhead (Tredger 1986). Four sites were sampled, and juvenile steelhead were found in all areas. The study suggested that steelhead spawning might occur in Kluayaz Creek above Kluayaz Lake, Tantan Creek below the Kluatantan Lakes, and in the Kluatantan River below Kluayaz Lake (Figure 3).

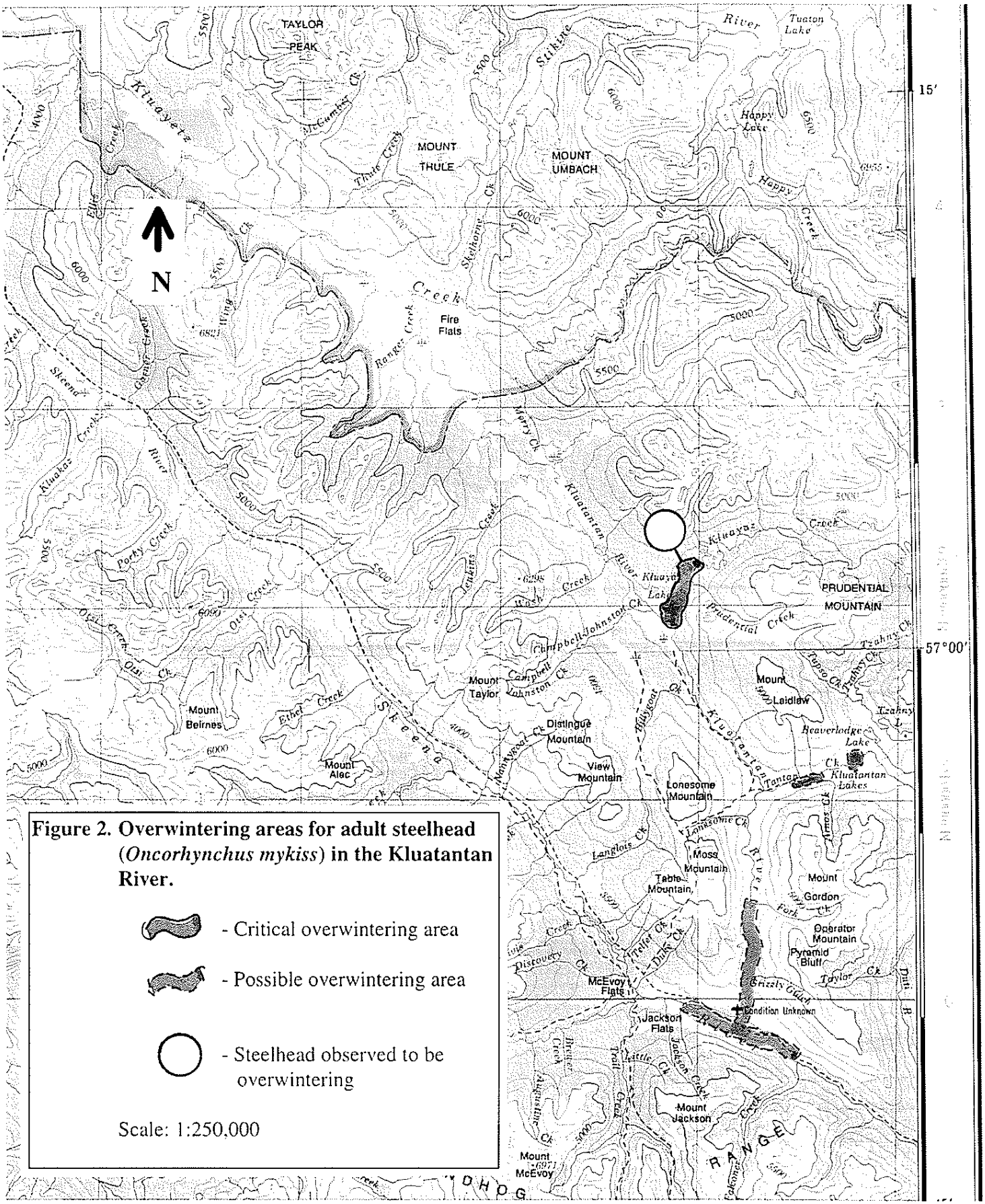


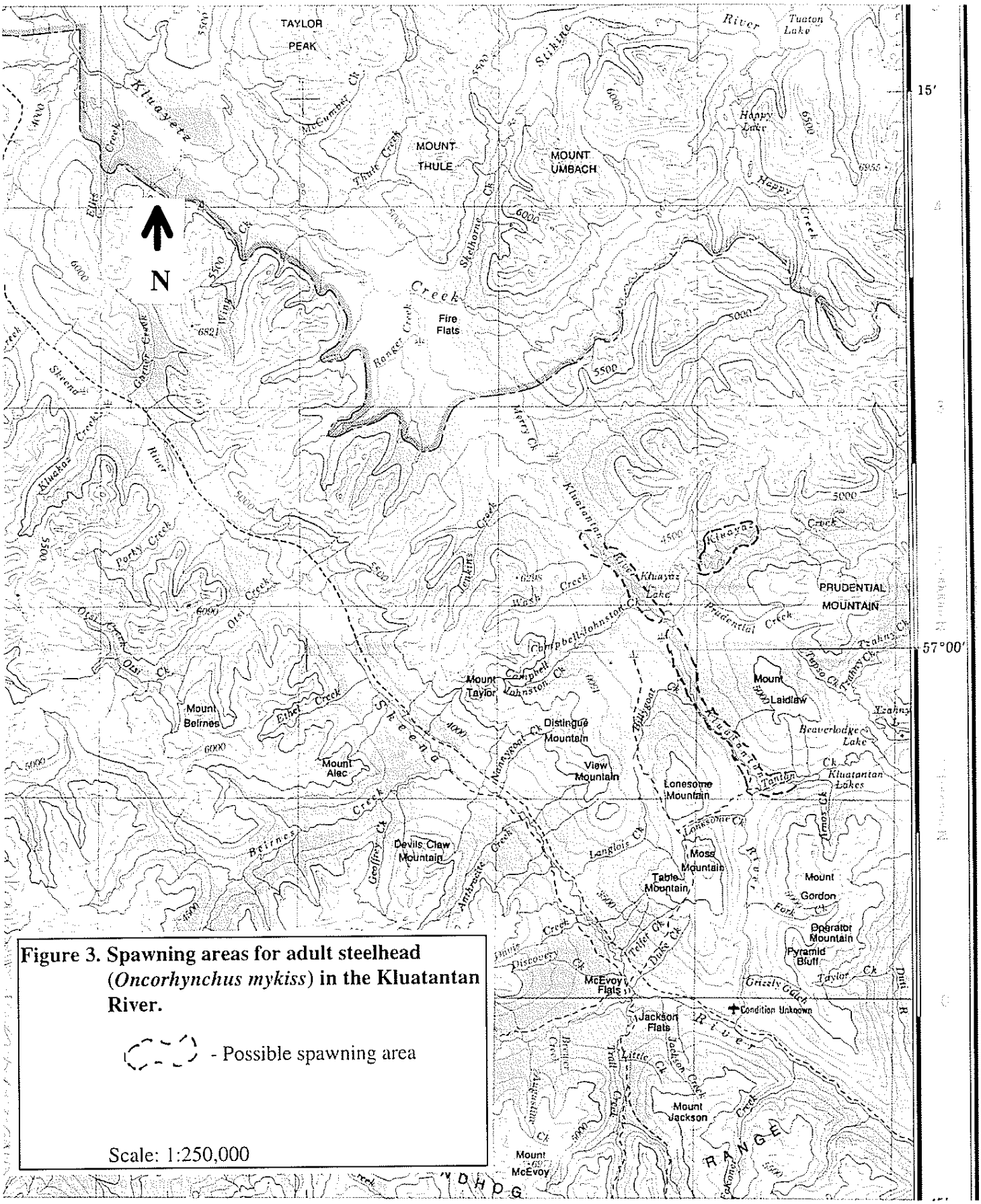
Figure 2. Overwintering areas for adult steelhead (*Oncorhynchus mykiss*) in the Kluatantan River.

- Critical overwintering area

- Possible overwintering area

- Steelhead observed to be overwintering

Scale: 1:250,000


TAYLOR PEAK
MOUNT THULE
MOUNT UMBACH
Fire Flats
PRUDENTIAL MOUNTAIN
Mount Taylor
Mount Laidlaw
Mount Belines
Distingue Mountain
Mount Alec
View Mountain
Lonesome Mountain
Devils Claw Mountain
Moss Mountain
Table Mountain
Mount Gordon
Operator Mountain
Pyramid Bluff
McEvoy Flats
Jackson Flats
Mount Jackson
Mount McEvoy
Beaverlodge Lake
Kluatantan Lakes
Khayas Lake
Tuaton Lake
Happy Lake
Condition Unknown
15'
57°00'
N
Figure 3. Spawning areas for adult steelhead (*Oncorhynchus mykiss*) in the Kluatantan River.
- Possible spawning area
Scale: 1:250,000

4.10 Repeat Spawning

From the minimal scale aging data that has been collected, of the nine steelhead aged, two were repeat spawners (22%). This estimate is likely biased in some way due to the small sample size, but may indicate that repeat spawning in this small population may play a major role in maintaining the population.

4.11 Summary Data from the Steelhead Harvest Analysis

4.11.1 Period from 1971 to 1992

In the years that the Steelhead Harvest Analysis questionnaire has been sent out, data on effort and catch in the Kluatantan River has been minimal and decreased over time. For this reason data from all angler groups were pooled for the entire time period, and this section reports on number of angler days and total catch for all angler groups.

For the fiscal years of the period from 1971 to 1992 the total catch of steelhead reported in returns of the mailed out questionnaires was high in 1971 and 1972, and has remained relatively stable and minimal from 1973 to 1992 (Table 3 and Figure 4). The high catch in1971, 1972, and 1976, corresponded to high number of angler days in those years (Table 3 and Figure 4). Catch per unit effort (CPUE) has remained relatively stable during the period when there was a good amount of data, and is generally higher than 1.0 fish per angler day in those cases (Table 3 and Figure 5).

4.12 First Nations Uses/Harvests

There is no documented data on uses and harvests of steelhead in the Kluatantan River by First Nations people.

4.13 Current Angling Regulations

General Skeena Region angling restrictions that apply to the Kluatantan River are the use of a single hook, and no fishing from January 1st to June 15th. Anglers fishing for steelhead are also required to purchase a steelhead tag in order to allow them to fish for steelhead. Specific angling restrictions that apply to the Kluatantan River are a bait ban

Table 3. Summary of the number of anglers, angler days, total catch of steelhead (*Oncorhynchus mykiss*), and catch per unit effort (CPUE) of anglers on the Kluatantan River from 1971 to 1992 that sent in returns to the steelhead harvest analysis questionnaire.

Year	Number of Anglers	Angler Days	Total Catch	CPUE (fish per angler day)
1971	5	111	144	1.297
1972	48	234	166	0.709
1973	2	2	0	0.000
1974	6	26	28	1.077
1975	9	43	33	0.767
1976	19	60	123	2.050
1977	8	32	30	0.938
1978	1	6	19	3.167
1979	8	16	3	0.188
1980	16	84	9	0.107
1981	3	9	12	1.333
1982	3	3	0	0.000
1985	3	19	22	1.158
1986	5	30	50	1.667
1987	11	76	81	1.066
1988	2	4	2	0.500
1989				
1990				
1991				
1992	4	4	0	0.000

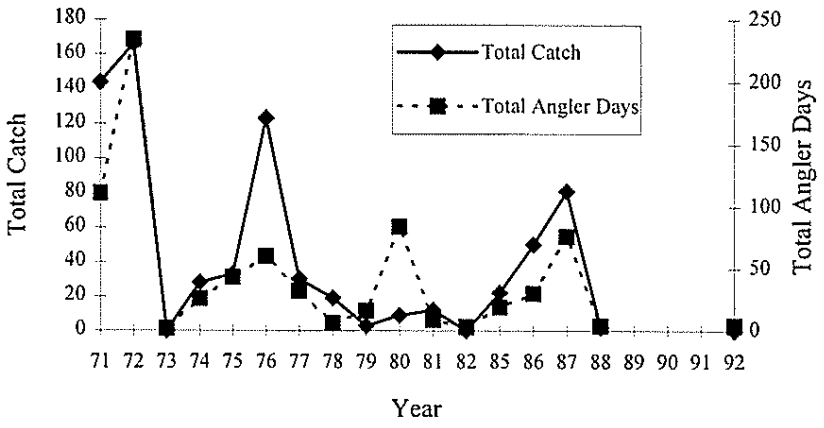


Figure 4. Summary of total catch of steelhead (*Oncorhynchus mykiss*) and total angler days for anglers on the Kluatantan River from 1971 to 1992 as reported on returned steelhead harvest analysis questionnaires (no data from 1989-1991).

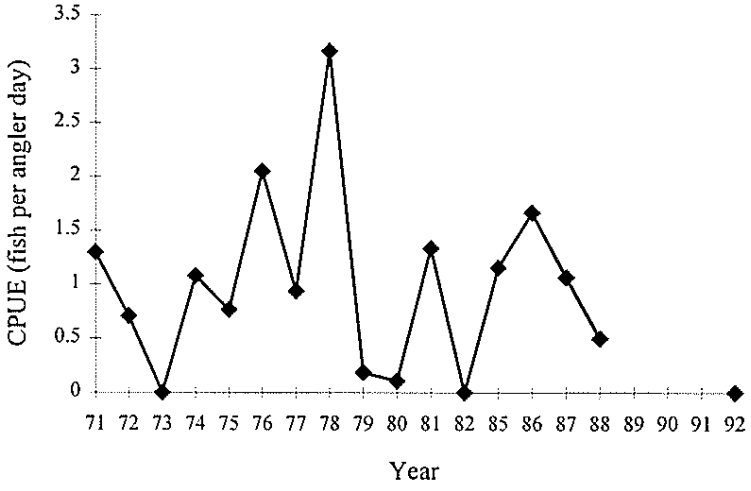


Figure 5. Summary of catch per unit effort (CPUE) of steelhead (*Oncorhynchus mykiss*) for anglers on the Kluatantan River from 1971 to 1992 as estimated from data provided on returned steelhead harvest analysis questionnaires (no data from 1989-1991).

from September 1st to December 31st, non-retention of steelhead, and classified water the entire year. The Kluatantan was classified as a Class II water, but for the 1997/98 season all rivers that were classified as Class I or II are simply called classified waters. Previous to 1997/98 the classification required that B.C. Residents fishing a Class II River with an angling guide purchase a Class II waters license at $1 per day, and that Canadian Residents and Non Canadian anglers purchase a Class II waters license at $10 per day. For the 1998/99 season these regulations will change so that B.C. Residents purchase a classified waters licence for all waters for $10 per year, and that Canadian Residents and Non Canadian anglers purchase a classified waters licence at $40 per day.

4.14 Juvenile Life-History

4.14.1 Fry and Parr Length at Age

There have been a few studies conducted in the Kluatantan River that have concentrated on studying juvenile steelhead, and measuring lengths of juvenile steelhead has been a component of these studies. The best set of data that summarizes the measures of juvenile length were carried out in 1984 by Tredger (1986). This study was carried out at four sites throughout the watershed during August. The length data for juvenile steelhead sampled in the are found in Table 4.

Table 4. Summary of mean steelhead (*Oncorhynchus mykiss*) fry and parr fork length at age in the Kluatantan River in 1984 (summarized from Tredger 1986).

	Age (years)	Mean (mm)	S.E.	Range (mm)	N
Fry	0+	36.3	0.5	30-52	51
Parr	1+	67.9	1.8	62-80	9
	2+	93.5	3.3	86-102	4
	3+	124.0	5.9	115-135	3
	4+	170.0	NA	NA	1

4.14.2 Stream Rearing Life-History (as determined by scale aging)

From scales collected from upstream migrating adult steelhead, it is possible to estimate the number of years that an individual reared in freshwater prior to entering the ocean. From scales collected in 1983, 1984, and 1985, all steelhead sampled in the Kluatantan River spent on average four years in the river prior to moving to the ocean as smolts (Table 5). There was no difference in the number of years that males or females spent in freshwater prior to smolting. Tautz et al. (1992) estimated that the mean age to smolting for Kluatantan River steelhead was 4.4 years. It is also possible that there might be an under aging of scales so the mean age to smolting could be 5 years.

Table 5. Number of years that adult steelhead (*Oncorhynchus mykiss*) of the Kluatantan River resided in freshwater prior to migrating to sea (as determined by scale aging).

	Mean (years)	**S.E.**	**Median (years)**	**Range (years)**	**N**
All Fish	4	0	4	NA	8
Females	4	0	4	NA	4
Males	4	0	4	NA	4

4.14.3 Juvenile Density Estimates

Detailed juvenile surveys carried out in 1984 included estimates of juvenile densities at four sample sites in the Kluatantan River (Tredger 1986). This study found that steelhead fry densities were highest below the Tantan Creek confluence, and that there were low fry densities in the lower mainstem Kluatantan River near the Skeena confluence and below Kluayaz Lake (Table 6). Parr densities were generally low at all sites, but highest below Kluayaz Lake. This may suggest that parr move upstream into these sites. The mean (±S.E.) fry density at these sites was 0.12 (0.10) fry per m^2, and the mean (±S.E.) parr density at these sites was 0.02 (0.01) parr per m^2. These densities are similar to fry and parr densities in the Sustut River.

Table 6. Density (fish per m^2) of juvenile steelhead (*Oncorhynchus mykiss*) sampled in the Kluatantan River in 1984 (from Tredger 1986).

Location	*Fry*	*Parr*			
	0+	1+	2+	3+	4+
lower mainstem river	0.04	0.03	0.01	0.01	0.00
below Tantan Creek	0.31	0.03	0.000	0.01	0.00
below Kluayaz Lake	0.00	0.04	0.06	0.00	0.02
Kluayaz Creek			Present		

4.15 Juvenile Rearing Areas

As no detailed juvenile surveys have been undertaken in the Kluatantan River, there is no quantitative way of identifying key juvenile rearing areas. Sites where juvenile steelhead have been sampled previously are shown in Figure 6. In a rough sense these data might suggest that a large amount of steelhead spawning occurs in Tantan Creek, and that subsequent downstream migration and recruitment of juvenile steelhead from this creek might be important to overall juvenile production in the Kluatantan watershed.

4.16 Angling Guide Data

Currently on the Kluatantan River, there is one angling guide licensed to operate on the river. This guide is allocated a total of 55 guided angler days that they have been able to use each year since the Kluatantan River was made a Class II water in 1991 (Table 7). These angling days are used between the 1st of August and the 16th of October each year, after the river is open to fishing after June 16th.

The angling guide database contains data on the number of angler days guided and total catch of steelhead for angling guides from the 1990/1991 season to the 1995/1996 season. For this period, the angling guide on the Kluatantan River has not used the total allocated angler days in any year (Table 8). Total effort directed towards steelhead is low as is the

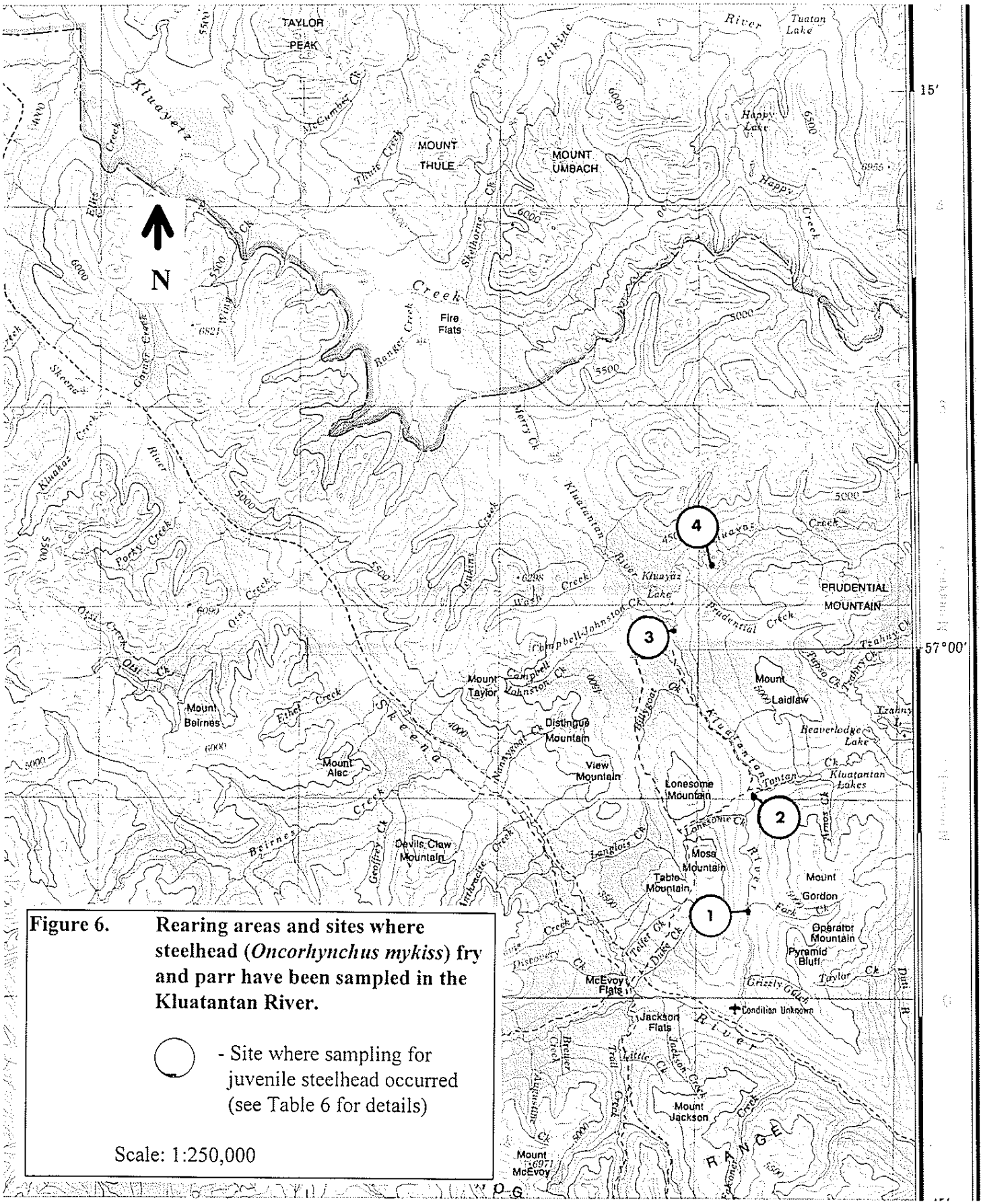


Figure 6. **Rearing areas and sites where steelhead (*Oncorhynchus mykiss*) fry and parr have been sampled in the Kluatantan River.**

○ - Site where sampling for juvenile steelhead occurred (see Table 6 for details)

Scale: 1:250,000

total catch of steelhead (Table 8). Catch per unit effort has remained constant and low (about 1.0 fish per angler day) for this period (Table 8).

Table 7. Number of quota angler days allocated, number of quota angler days used, and total number of angler days fished by one guide on the Kluatantan River from the 1990/91 season to the 1995/96 season targeting all species of salmonids.

Season	Quota Angler Days Allocated	Quota Angler Days Used	Total Angler Days Fished
1990/91	20	8	8
1991/92	55	26	26
1992/93	55	34	34
1993/94	55	35	35
1994/95	55	17	17
1995/96	55	0	0

Table 8. Number of quota angler days allocated and fished, total catch of steelhead (*Oncorhynchus mykiss*) for those angler days, and catch per unit effort (CPUE) on the Kluatantan River from the 1990/91 season to the 1995/96 season.

Season	Quota Angler Days Allocated	Quota Angler Days Used	Total Catch of Steelhead	CPUE (fish per angler day)
1990/91	40	2	2	1.000
1991/92	55	2	2	1.000
1992/93	55			
1993/94	55			
1994/95	55			
1995/96	55	2	2	1.000

Prior to 1990 there is little data of steelhead catch and effort for guides on the Kluatantan River. This data suggests that there was a greater amount of effort and catch of steelhead prior to the period from 1990/1991 to 1995/1996 (Table 9). Catch per unit effort was higher than in most systems for this time frame, and greater than 1.0 fish per angler day in all years. The small sample size might influence this statistic.

Table 9. Number of angler days fished, total catch of steelhead (*Oncorhynchus mykiss*) for those angler days, and catch per unit effort (CPUE) on the Kluatantan River prior to the 1990/91 season.

Year	Angler Days Fished	Total Catch of Steelhead	CPUE (fish per angler day)
1975	25	32	1.280
1983	1	5	5.000
1984	35	41	1.171
1985	36	42	1.167
1986	15	20	1.333
1990	8	2	0.250

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Despite the fact that the Kluatantan River is a classified river, very little is known about the steelhead population, and other salmonid populations, that are found in the watershed. Realistically there may be very little that can be done in the system to study the population given the isolated and glacial nature of the system that makes enumeration and field work difficult. There are however some opportunities to collect some baseline information through cooperation with the outfitter that has a guiding licence on the river. By providing scale envelopes, a measuring tape, weigh bag, Floy tagging gun, and data book, length, weight, sex, and migration data can be collected for relatively little cost. Of particular benefit would be a tagging program which would enable migration timing to be monitored through tag recaptures.

Key spawning locations in the system are unknown, and in terms of protecting critical habitat for this species, this would be an area to identify. This would be a fairly easy task to accomplish through the use of a few radiotags, and overflights in May and June, but would involve some cost in terms of accessing the system using a helicopter to tag and track the fish. Again very little is known about the juvenile life history of this population, and a detailed juvenile survey might provide information identifying critical rearing areas in the watershed.

Although it appears that the Kluatantan River steelhead population is stable, Tautz *et al.* (1992) suggest that the available habitat in the system precludes the population from being very large. Due to the small size, the population is vulnerable to extirpation, disturbance, and overharvest. The location of the population in the upper Skeena River implies that the population is likely suffering from commercial interception due to probable run timing. Factors that are most likely offsetting the commercial interception are the remote location of the Kluatantan River, poor access to the system, and undisturbed habitat.

Angling guide activity that specifically impacts steelhead is minimal, and in fact the catch of steelhead in the Kluatantan by the angling guides has been 0 or 2 fish per year in each of the last 5 years. Based on this low catch it might prove useful for M.E.L.P. personnel to conduct a tagging survey to determine whether the low catches over the past 5 years are due to minimal effort on the part of the guide or due to a decline in the number of steelhead returning. Based on the catches of steelhead in 1971 and 1972, the possibility exists that the population has declined, and may warrant further investigation.

5.2 Recommendations

There is limited information available on this population, so most of the recommendations deal with collecting increased information on life-history.

1. Determine if there is a method to estimate escapement in the lower river, possibly through aerial redd counts.

2. Provide the angling guide with data books, Floy tags, and tagging guns to apply tags to steelhead and to record any tag information they recover.

3. Radio tag steelhead in the lower river to further determine critical overwintering and spawning locations.

4. Conduct an overview assessment of the Kluatantan River to sample and tag adult steelhead; collect length, weight and sex data; Floy tag steelhead; and collect fin tissue samples for genetic study.

5. Conduct a detailed juvenile survey to identify key rearing areas.

6. Should potential development occur in the future, critical spawning areas should be identified and protected.

6.0 REFERENCES

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Appendix I. Biological data of adult steelhead (*Oncorhynchus mykiss*) sampled in the Kluatantan River for scale aging.

Year	Date	Sex	Length (cm)	Weight (kg)	Age fw	Age sw	Age plus	Tag #
1983-84	12/10/83	f	64.8	2.7	4	2	S1+	
1983-84	10/10/83	m	81.3	5.0	R	3	+	
1983-84	10/10/83	f	71.1	3.6	4	2	+	
1984-85	29/9/84	m	91.4		4	2	S1+	
1985-86	20/9/85	m	76.2		4	2	+	b100920
1985-86	23/9/85	m	82.6		4	2	+	b100255
1985-86	23/9/85	m	83.8					b100923
1985-86	24/9/85	m	81.3		4	2	+	b100259
1985-86	24/9/85	f	80.0		4	2	+	b100256
1985-86	26/9/85	f	76.2		4	2	+	b100261