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SUSTUT RIVER STEELHEAD
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SUSTUT RIVER

STEELHEAD INVESTIGATIONS

1986

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1.0 INTRODUCTION

The B.C. Ministry of Environment (Recreational Fisheries Branch) has identified summer steelhead in the Skeena River drainage as a top management priority. Although comprehensive fisheries information has been gathered for most major tributaries of the Skeena, the remote nature of some systems has permitted only minimal, preliminary surveys.

The Sustut River, situated approximately 200 km north of Smithers, remains as the last major tributary of the Skeena to be investigated. It supports significant populations of summer steelhead trout *(Oncorhynchus mykiss)* and chinook salmon *(0. tshawytscha),* and relatively small numbers of coho *(O.kisutch),* sockeye *(0. nerka),* chum *(0. keta)* and pink salmon *(0.* gorbuscha). Resident populations of rainbow trout *(0. mykiss)* and Dolly Varden char *(Salvelinus malma)* also occur throughout the drainage.

Proposed logging developments and improved access are expected to affect fish resources in the Sustut watershed. In recognition of this, the Fish and Wildlife Branch carried out detailed surveys of the Sustut between August and October, 1986 and in June, 1987. The objectives were to:

1. estimate the size of the 1986 summer steelhead population in the Sustut River;
2. examine in-stream movements of summer steelhead in relation to the Sustut sport fishery;
3. gather steelhead life history data; and
4. establish an enforcement profile on the river.

The following report documents the 1986 survey and summarizes all previous information regarding the Sustut fishery.

1.1 Study Area

The Sustut River flows in a southwesterly direction for approximately 100 km from its headwaters at Sustut Lake to its confluence with the Skeena (56° 19'N; 127° 22' W). It drains an area of approximately 20,007 km^2 and drops 685 m to enter the Skeena 610 m above sea level (Fig. 1).

Access is restricted to a mining road through the Johanson Creek area and the abandoned British Columbia Railway (B.C.R.) grade adjacent to the Bear and lower Sustut Rivers. Rough airstrips are situated at Johanson Lake, Bear Lake and the Sustut River 2 km downstream of the Bear River. Pinsent and Chudyk (1970) provide a more complete description of the Sustut.

Angling on the Sustut targets primarily on steelhead and occurs during September and October, although an escalating chinook fishery also takes place during August. The majority of anglers are guided by one of two commercial operations: Steelhead Valhalla Lodge and Suskeena Lodge. Sportfishing is concentrated in the Sustut between the mouth of the Bear River and the Skeena since regulations currently prohibit angling in the Sustut upstream of the Bear confluence. The entire system is closed to angling from December 1 - June 30 to protect overwintering and spawning steelhead.

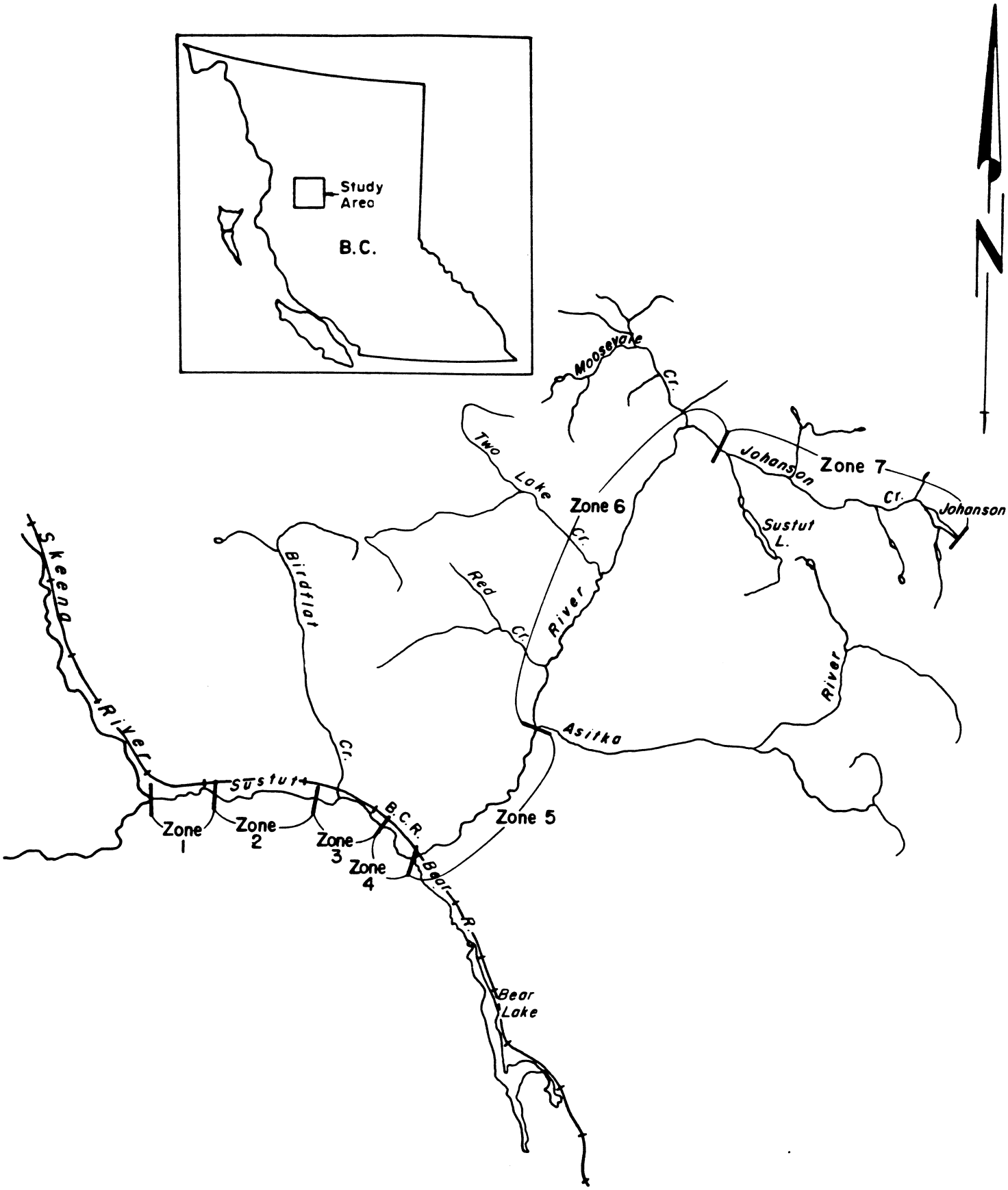

Fig. 1 Sustut River Study Area

2.0 METHODS

The 1986 study focused on marking and recapturing steelhead in the Sustut River during September and October. Branch personnel, as well as angling guides and their clients, captured as many steelhead as possible by angling. Each fish was tagged with a numbered Floy tag inserted near the dorsal fin, measured (fork length) and scales sampled.

An effort was made to deploy tags on the lower Sustut (below the Bear confluence) at the beginning of the study so that tagged fish could be monitored as they moved upstream. During September and October, one-man rafts were used to drift 30 km from the Bear River confluence to the Skeena. Rafts were then lifted back to the Bear River by helicopter. Additionally, areas upstream of the Bear River were accessed by helicopter in October.

Tagging and recapture data were used to estimate the Sustut steelhead population. Chapman (modified version), Schnabel, and Schumacher (Ricker 1975) population estimation methods were employed to provide a range of values.

In addition too simple mark-recapture studies, some steelhead were outfitted with orally implanted radio transmitters (Lotek Engineering Ltd., Aurora, Ontario). Fish were located the following spring to assist in identifying spawning locations. Tracking was undertaken by helicopter using a TR-2/-S-1 scanning receiver (Telonics Ltd., Mesa, Arizona). Methods of capture, tag application and

migration monitoring were similar to those described previously (eg. Lough M.S. 1980).

Steelhead ages were interpreted from scale growth. Scales were cleaned and mounted on gummed paper for impression on acetate cards. Scale impressions were subsequently viewed under 100 x magnification to determine fresh and saltwater age, as described by Koo (1962).

All anglers and hunters encountered during the study were interviewed.

3.0 RESULTS AND DISCUSSION

3.1 STEELHEAD MOVEMENTS AND DISTRIBUTION

Between August 30 and October 10, 1986, 628 Sustut River steelhead were tagged; Steelhead Valhalla Lodge (km 7 on the Sustut) was responsible for 115 tags while the remainder were deployed by project staff. Eight steelhead were radio tagged during this period. Floy tag recapture data provided nearly all the information on steelhead movement as the cost of monitoring radio tagged fish (i.e. helicopter) proved prohibitive.

The Sustut River study area was divided into eight zones for the purpose of data analysis (Fig. 1, Appendix I). Zones 1 through 4, referred to as lower Sustut, covered the portion of the river between the Skeena and Bear rivers. Zones 5 through 7 (that part of the Sustut between the Bear River confluence and Sustut and

Johanson lakes) was designated upper Sustut. Finally, the mainstem Skeena adjacent to the Sustut confluence was the eighth zone.

The majority (61.6%) of fish were tagged on the lower Sustut, followed by the upper Sustut (30.3%) and finally the Skeena River adjacent to its confluence with the Sustut (8.1%). Early tagging effort focused on the lower Sustut and Skeena, in part due to very low water conditions and apparent concentration of fish in that area. Spatial distribution of tags generally reflected the amount of angling effort expended in each zone.

Ninety-six percent of Skeena and 81% of lower Sustut tags were deployed in the first four weeks of the study. All but three of the upper Sustut steelhead (190 in total) were tagged in week five (Table 1).

Although steelhead have been observed in the Asitka River and Moosevale Creek (on file, Recreational Fisheries Branch, Smithers), attempts to angle steelhead in Zones 5 and 6 during September and October produced only one steelhead adult and Dolly Varden char. The main concentrations of adults during the fall occurred in Zones 4 and 7. Virtually all upper Sustut steelhead were caught in a few locations near the Sustut-Johanson confluence or at the lake outlets.

Of the 628 fish tagged, 81 (13%) were later recaptured (Appendices II, III). However, the sample of recaptures from which meaningful migration data could be gathered was limited by the fact that 23 (28%) of the recaptures occurred on the day of tagging.

Table 1. Number of steelhead Floy tagged in each zone of the Sustut River, September - October, 1986.

Week ending	Zone 1	2	3	4	5	6	7	8	All
Sept. 6	7	16	4	3	0	0	0	5	35
Sept. 13	11	21	3	55	0	0	0	10	100
Sept. 20	26	1	18	27	0	0	0	25	111
Sept. 27	10	5	0	91	0	0	0	9	115
Oct. 4	5	22	10	22	0	0	187	2	248
Oct. 11	3	7	0	4	0	1	1	0	16
Oct. 18	0	0	0	0	0	0	1	0	1
Oct. 25	0	2	0	0	0	0	0	0	2
All	62	88	35	202	0	1	189	51	628

The recapture sample on which migration studies were based therefore totaled only 58. Approximately 70% of all recaptures occurred during the 2 weeks commencing September 27 (Appendices II, III).

Recapture data indicated overall migration rates between 0 and -0.5 km/day (downstream) were most common (Figure 2). However, extremes in movement ranged between -2.8 km/day and 7.0 km/day. Recaptures In the lower Sustut suggested a slightly lower tendency to migrate downstream following initial capture. No clear trend toward increases or decreases in upstream or downstream movements was observed as the season progressed.

Overall movements suggested that nearly the entire sample tagged in the lower river remained downstream of the Bear River confluence for the duration of the study. Angling in the upper Sustut in late September and early October yielded only one recapture of a fish tagged in the lower river. In addition, no tagged fish were present among approximately 250 steelhead observed in the vicinity of the Sustut-Johanson confluence in early October, despite excellent viewing conditions. This suggests fish found in the upper Sustut passed through the lower river prior to initiation of the study.

These data are consistent with observations of Fennelly (1963), who noted steelhead in the upper Sustut as early as August during the 1960's. Anglers interviewed during the survey also indicated that steelhead were found at the Bear River confluence from mid

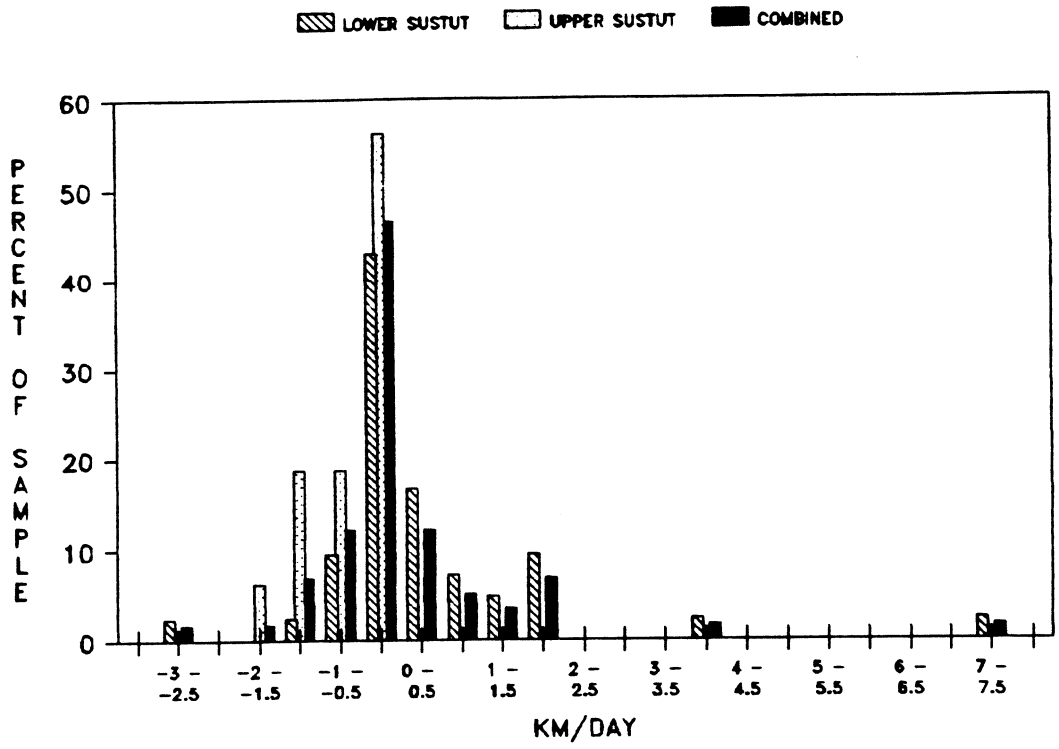

Figure 2. Rates of migration determined from recaptures of steelhead tagged in the lower and upper Sustut study areas, 1986.

to late August. Such fish likely migrated to the upper river before the present study had begun.

This information, combined with the apparent lack of steelhead in zones 5 and 6, suggests two distinct populations. One of these groups migrated early and quickly to the upper Sustut River and Johanson Creek, utilizing lakes and lake outlets as their primary overwintering habitat. The other remained in the lower Sustut at least until completion of the angling season. It is possible, however, that handling and tagging may have exaggerated this phenomenon. Other studies have shown that slowed or even reversed

migrations can occur as artifacts associated with the stress of capture and tagging (Hooton and Lirette 1986).

Use of lakes by adult steelhead for overwintering has been documented for several Skeena tributaries (Lough M.S. 1980) and appears common in the Sustut system as well. Steelhead are known to winter in Bear Lake (on file, Recreational Fisheries Branch, Smithers), and were observed in both Sustut and Johanson Lakes during the present study. Groups of up to 250 fish were observed by project staff in pools at the outlets of these lakes during late fall. Fennelly (1963) also described angling for steelhead in lakes in the upper Sustut during the 1950's and 1960's.

3.2 Spawning

Steelhead spawn in the Sustut during May and June, after river ice melts and water temperature rises. On June 6, two radio tagged fish were located in the Bear River, when the water temperature was 7°C. Five fish, all of which were kelts, were captured at this site, indicating that peak spawning had already occurred. The upper Sustut, however, was only 3°C on this date. Active spawning was observed throughout Johanson Creek and the Sustut River above the Johanson confluence where water temperature was 6°C. One radio tagged fish was located in Sustut Lake. Lake ice was just breaking up at this time and it was possible the fish were spawning in extensive springs which upwell throughout the shallow northern portion of the lake.

Although the Asitka River appeared to offer excellent spawning conditions, a low level flight detected no spawning activity. The extent of spawning in the lower Sustut mainstem could not be determined because of water turbidity.

3.3 Population Estimate

Population estimates from mark and recapture data ranged from 3254 (Chapman method) to 3554 (Schumacher method, Table 2). The accuracy of these estimates depended on strict adherence to the following assumptions:

(1) marked fish suffered the same natural mortality as unmarked fish;

(2) marked fish were as vulnerable to sampling (i.e. angling) as unmarked ones;

(3) marked fish did not lose their mark;

(4) distribution of fishing effort (in subsequent sampling) was proportional to the number of fish present in different parts of the body of water;

(5) recruitment to the catchable population was negligible during the time recoveries are made.

As no guarantee can be made that all, or any, of these conditions were met, it must be stressed that the population sizes were rough estimates at best. However, no other realistic means of measuring run size exists at this time.

3.4 Age and Growth

Project personnel noticed an apparent difference in the size and coloration of fish between the lower Sustut River (downstream of

Table 2. Population estimates and associated 95% confidence intervals (C.I.) for Sustut River steelhead from mark and recapture studies using Schnabel, Chapman and Schumacher formulae.

Method	Upper Sustut	Lower Sustut	Total Sustut
Schnabel N	816	2890	3295
95% C.I.	(566—1459)	(2233—4092)	(2991—4246)
Chapman N	792	2830	3254
95% C.I.	(570—1141)	(2136-3848)	(2621—4037)
Schumacher N	823	3072	3554
95% C.I.	(604—1287)	(2609-3737)	(2972—4422)

the Bear River confluence) and the upper Sustut River (upstream of the Bear River confluence). In fact, the mean fork length of lower Sustut steelhead was 81.3 cm; significantly larger than the 79.1 cm mean of upper Sustut steelhead (P<.001, Table 3). These differences. though small, were significant for both males and females (P<.001). Upper river fish also displayed darker coloration, suggesting longer freshwater residence than their lower river counterparts

Observed size differences suggest the presence of at least two discrete substocks, one of which overwintered and spawned in the upper Sustut while the other utilized lower reaches of the system. Size differences may have resulted from differing periods of ocean

Table 3. Fork lengths of male and female steelhead sampled at Sustut River, September 1986 - June 1987.

	Males			Females		
	Number	Length (cm)	Range	Number	Length (cm)	Range
L. Sustut	146	86.3	(61.0 - 104.1)	289	78.8	(66.0 - 96.5)
U. Sustut	66	84.1	(76.2 — 97.8)	119	76.2	(67.3 - 87.6)
All	212	85.6	(61.0 — 104.1)	408	78.1	(66.0 — 96.5)

residency for these groups. Tagging data indicate upper Sustut fish entered the river earlier, possibly to facilitate the longer migration. This would have shortened ocean residency by one or more months, thus yielding the slightly smaller adults observed.

Between 1977 and 1986, a total of 546 readable scale samples were collected; 174 from the upper Sustut and 372 from the lower Sustut. Ten separate age groups were identified in the upper Sustut and 20 in the lower Sustut. Scale analysis indicated that most juveniles resided in freshwater for 4 years before smolting (Table 4). Analyses of freshwater age were not considered reliable, however, since Fisheries Branch personnel sampled fry smaller than 30 mm as the Sustut was starting to freeze in October (on file, Fisheries Branch, Smithers). Fry entering their first winter at

Table 4. Freshwater ages of adult steelhead from the upper and lower Sustut River, 1977 - 86.

Freshwater Age	Lower Sustut	Upper Sustut	Combined
	n (%)	n (%)	n (%)
2	1 (0.17)	0	1 (0.12)
3	176 (30.5)	50 (21.3)	226 (27.8)
4	382 (66.2)	174 (74.0)	556 (60.5)
5	18 (3.1)	11 (4.7)	29 (3.6)

such a small size do not develop a detectable annulus and would therefore be older than future scale analysis would detect (Wallis 1982).

Steelhead from the upper Sustut generally spent longer in freshwater than their counterparts from lower reaches of the system. This may be largely a reflection of water temperatures, which were as low as 2°C on June 20 and then down again to 2°C on October 4 at the Sustut/Johanson confluence. Such harsh environmental conditions reduce the productive growing season to less than 3 months, necessitating a relatively long freshwater residency to attain smolt size. The lower Sustut, however, is moderated by the warmer surface waters of Bear Lake. Incubation time of eggs would be reduced and juvenile growth greater in the warmer, more productive waters of the Bear River and lower Sustut.

The predominant ocean residency of Sustut steelhead is 2+ years (Table 5). Two ocean fish were slightly more common among upper Sustut steelhead (79%) than lower Sustut steelhead (68%). The most common overall age group was 4.2+ for both upper Sustut and lower Sustut steelhead.

Differences between upper and lower Sustut steelhead may be more pronounced than the results of this survey indicated. Samples taken below the Bear confluence could have been from a mix of the two stocks if some steelhead caught in that area were eventually destined for the upper river. Complete separation of these stocks would be required before the actual extent of differences could be determined.

3.5 Commercial Fishery

Returns of summer steelhead to the Skeena River generally occur from late July through early September, at the peak of commercial net fisheries for sockeye and pink salmon in northern B.C. and southeast Alaska. Considerable effort has been directed toward gathering catch data for the various Canadian and American fisheries which harvest Skeena origin steelhead. Major commercial catches occur in the extensive gillnet fishery at the mouth of the Skeena (Statistical Area 4).

Sustut steelhead pass through Area 4 throughout the months of July, August and September, but migrations likely peak during late July and early August (Lough 1980). Given current commercial harvesting patterns for sockeye and pink salmon, early steelhead destined for

Table 5. Ocean ages of adult steelhead from the upper and lower Sustut River, 1977 - 86.

Ocean Age	Lower Sustut	Upper Sustut	Combined
	n (%)	n (%)	n (%)
.1	8 (1.4)	1 (0.4)	9 (1.1)
.2	390 (67.6)	186 (79.1)	576 (70.9)
.3	143 (24.8)	36 (15.3)	179 (22.0)
.4	3 (0.5)	0	3 (0.4)
Repeat Spawners	33 (5.7)	12 (5.1)	45 (5.5)

the Sustut would be subject to disproportionately high harvest rates. Recent studies by Spence (in prep.) suggest about one month would be required for steelhead to travel from the inner boundary of the commercial fishery to the lower Sustut. Thus, fish caught at the Bear-Sustut confluence in mid-late August would have entered the Skeena itself in the latter part of July, during the peak in the sockeye net fishery. Steelhead arriving at the mouth of the Skeena in late August through September would pass through the commercial fishing area after the majority of netting activity was completed for the year.

Commercial harvest modelling has been undertaken for most Skeena steelhead substocks, including the Sustut (data on file; Recreational Fisheries Branch, Smithers, B.C.). Recent modelling

suggested a harvest of about 1500 Sustut-bound steelhead in the commercial fishery in 1986. The 1963-86 average harvest of about 1400 fish was close to the 1986 catch. However, extremes have ranged from as low as 590 in 1976 to as high as 3400 in 1984 and 1985.

3.6 Sport Fishery

Compulsory angling guide returns indicate only 18 Sustut steelhead were killed by guided Sustut anglers in 1986. Spot checks of non-guided anglers revealed at least 59 additional steelhead were killed during the same period. The total kill as estimated from the annual Steelhead Harvest Analysis questionnaire was 112 fish in 1986 (Billings 1987). However, this estimate only described catches on the Sustut itself and does not include harvests of Sustut steelhead which occur as these fish ascend the Skeena. In addition, a positive response bias is known to affect the results of the questionnaire (eg. Carswell *et al* 1986).

A harvest model has been employed to take all of these factors into account. Using the model, it was estimated that in 1986 all recreational fisheries combined harvested 225 Sustut origin steelhead (on file, Recreational Fisheries Branch, Smithers, B.C.). This harvest represented less than 7% of the population determined from mark-recapture analyses in the present study. Total harvests in the sport fishery were only 15% of the estimated commercial harvest.

The estimated angler effort on the Sustut in 1986 totalled 799 rod days in 1986 (Billings 1987). A review of historical Steelhead Harvest Analysis data showed a steady increase in the number of anglers and angler-days since 1970 (Appendix IV), largely due to improved access from development of the B.C. Rail line. Increased angling activity was also attributed to the addition of a second fishing lodge (Steelhead Valhalla). Another noticeable trend in the data was a drop in total steelhead catch and catch per rod day during the mid 1970's. The total run strength was poor during this period, not only for the Sustut, but for the entire Skeena (on file, Recreational Fisheries Branch, Smithers).

In addition to the legal sport kill, illegal harvests are known to occur. Natives take steelhead by angling in the Bear River, at the outlet of Bear Lake and in the Sustut downstream of the Bear (Schultze M.S. 1984). Fisheries Branch personnel have also frequently found evidence of angling activity in Johanson Creek and Lake. No data are available to determine the exact magnitude of these harvests but they are thought to be small.

3.7 Native Food Fishery

In 1986, the Department of Fisheries and Oceans (D.F.O.) issued permits to Native fishermen from the Takla Band during July 1 - September 15 to gillnet sockeye in Bear Lake. Approximately 5 - 6 nets were involved in this fishery. Since 1986, however, this fishery has expanded to include a snare/dipnet fishery for a quota of 300 chinook salmon in Bear Lake, the Bear River and the Sustut below the Bear over the period from July 1 - September 15.

An additional permit has also been initiated to allow snagging of 50 chinook and 50 sockeye in upper Sustut just below the Sustut - Johanson confluence. This permit has been valid 7 days per week for the entire month of August. Some steelhead are known to be taken in these fisheries but exact numbers are unknown.

Further harvests of Sustut steelhead occur in Native fisheries as these fish ascend the Skeena itself. Lough (1988) and Morrell *et al* (1985) provide general descriptions of the Skeena mainstem fishery. Stock specific catches have not been documented in these studies or by the permitting agency. However, rough estimates of catch in the Skeena have been obtained annually from D.F.O. District Offices. These figures were applied to harvest models and resulted in an estimated harvest of approximately 730 Sustut River steelhead in all Native food fisheries combined in 1986 (data on file, Recreational Fisheries Branch, Smithers, B.C.).

3.8 Run Reconstruction Modeling

A model has been prepared to estimate harvest rates of Skeena steelhead. This is a "reconstruction model", which simply adds numbers of returning steelhead harvested by each user group to the spawning escapement to determine the total (pre-harvest) population size. This exercise has been undertaken on a tributary specific basis to permit an examination of the proportions of each sub-stock harvested by the various user groups, as well as a general indication of harvest rate trends. At present, only catches at the mouth of the Skeena are included in the harvest estimate for

commercial fisheries. Since other net fisheries in southeast Alaska and northern B.C. are known to harvest Skeena steelhead, the estimate of total population provided by the model is low.

The reconstructed run size (before commercial, Native and sport fisheries) for the Sustut totaled approximately 5000 steelhead in 1986 (Table 6). This estimate is considerably higher than the 25 year average total run estimate of 3470. Commercial catches at the mouth of the Skeena totaled about 1500, or about 30% of the population. Over the period for which modeling is available, the average rate of harvest of Sustut steelhead by the commercial fishery was 42%. In contrast, the 1986 sport harvest of Sustut steelhead was less than 5% of the total population. The 25 year average rate of exploitation by anglers is slightly more than 3%. Harvests by the native food fisheries in 1986 were nearly double the long term average. Figures for this segment of the fishery are not as reliable as those for the commercial or sport sectors, however, and should be viewed with caution.

The 1986 escapement as calculated by the model was only 2500 steelhead, in contrast to the population estimates of 3250 - 3550 calculated through mark-recapture studies. Part of this difference may have resulted from errors in the population estimate due to violations of the mark-recapture study assumptions outlined in section 3.3. However, the model itself likely has a number of more significant weaknesses, primarily relating to inaccuracies in catch reporting and the time period over which the number of fish entering the Skeena is calculated. Thus, figures generated by this model must be viewed with caution, and the mark-recapture

population estimates (3250 - 3550) should be considered the best indicator of escapement for 1986.

In general, it is important to note that the 1986 total run size was considerably larger than average for the Sustut, and that the rate of exploitation in the commercial fishery was notably lower than usual. Combined, these factors resulted in an atypically strong return to the Sustut sport fishery during the period described in this study.

Table 6. Summary of run reconstruction modelling results for Sustut River steelhead, 1986.

Run Component	Estimated Number	Percent Population
Commercial harvest	1500	30.3
Sport harvest	225	4.5
Native harvest	730	14.7
Escapement	2500	50.5
All	4955	100.0

4.0 SUMMARY

1. A study of summer run steelhead in the Sustut River system was undertaken between August and October, 1986 to determine population size, migration behavior and life history characteristics.

2. A total of 620 steelhead were floy tagged, and an additional 8 were equipped with radio tags. Recapture data revealed slow, irregular movements following tagging. The majority of the sample showed net movements downstream at rates of 0 to -0.5 km/day.

3. Tagging data suggested steelhead found in upper reaches of the Sustut system in late summer pass through the lower river before steelhead angling peaks

4. Sustut River steelhead were observed spawning in the Bear River and throughout the upper Sustut River and Johanson Creek. No spawners were observed in the Asitka River despite seemingly excellent spawning conditions. Turbid waters curtailed observations on the lower Sustut.

5. Mark and recapture estimates suggested approximately 3400 steelhead were present in the Sustut during the study.

6. Scale analyses indicated most Sustut River juveniles reside in freshwater for a least 4 years before smolting. The predominant period of ocean residency was 2+ years. Freshwater ages were notably higher among fish from the upper Sustut compared to steelhead sampled below the Bear confluence. The presence of two distinct stocks was indicated.

7. Sustut River male and female steelhead averaged 85.6 and 78.1 cm respectively. Lower Sustut steelhead were slightly larger than upper Sustut steelhead, further supporting the concept that fish found above the Bear confluence in the fall are distinct from those in lower reaches of the system.

8. Returns of summer steelhead to the Skeena River generally occur from mid July through early September, at the peak of commercial net fisheries for sockeye and pink salmon in northern B.C. and southeast Alaska. The estimated commercial catch of 1500 steelhead in 1986 was close to the long term average.

9. Guided anglers from two camps on the Sustut accounted for the majority of the estimated 799 rod days expended on the system in 1986. Although only 18 steelhead were harvested by guided anglers on the Sustut, other fishermen on the Sustut and lower Skeena bar fishery harvested an estimated 207 additional steelhead of Sustut origin.

10. Native food fisheries harvest Sustut steelhead in the Skeena mainstem, as well as in the lower Sustut, upper Sustut and the Bear Rivers. Although the extent of these fisheries is not well documented, the 1986 harvest was estimated at 730 steelhead.

5.0 RECOMMENDATIONS

1. Future harvesting restrictions aimed at maintaining high quality steelhead angling opportunities on the Sustut should focus on commercial and Native net fisheries, since these sectors account for the large majority of the harvest of Sustut River steelhead.

2. Enforcement patrols should be intensified, particularly in view of the heightened profile of this fishery resulting from the impending Class 1 designation.

3. Surveys of juvenile abundance and distribution and habitat capability should be carried out to quantify steelhead production and address habitat protection concerns associated with logging developments proposed for the Sustut watershed.

4. The freshwater life history of Sustut steelhead should be verified. In relation to this, the theory of two distinct stocks should be more completely investigated.

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APPENDIX I. Sustut River steelhead migration study zones, 1986.

Lower Sustut:

Zone #1 - The area from the confluence with the Skeena River to Valhalla Lodge.

Zone #2 - The area from Valhalla Lodge to 3 Tier.

Zone #3 - The area from 3 Tier to Graveyard Rapids.

Zone #4 - The area from Graveyard Rapids to Bear River/Sustut confluence.

Upper Sustut:

Zone #5 - The area from Bear River/Sustut confluence to the Asitka River.

Zone #6 - The area from the Asitka River to 1 km below the Sustut/Johanson confluence.

Zone #7 - The area from 1 km below Johanson/Sustut confluence up to Johanson and Sustut Lakes.

Skeena:

Zone #8 - The area in the Skeena River to Valhalla Lodge.

APPENDIX II. Recaptures of Floy tagged steelhead in the lower Sustut River, 1986.

TAGGING DATA				RECAPTURE DATA					
DATE	LOCATION	KM	ZONE	DATE(S)	LOCATION	KM(S)	ZONE(S)	DAYS TO RECAP	DIST(S) TRAVELLED
Aug 30	Anderson's	10	2	Sept 19	Anderson's	10	2	20	0
Sept 5	Branch Run	9	2	Sept 11	Forget Me Not	8	2	6	-1
Sept 6	Forget Me Not	8	2	Sept 7	Forget Me Not	8	2	1	0
Sept 6	Lookout	1	1	Sept 7	Forget Me Not	8	2	1	7
Sept 7	Bear Jnx	32	4	Sept 18	Lookout	1	1	11	-31
Sept 7	Lookout	1	1	Sept 29	Birdflat	19	3	12	18
Sept 8	Below BCR	31	4	Sept 26	BCR	31.5	4	18	0.5
Sept 8	Bear Jux	32	4	Sept 28	Birdflat	19.5	3	20	-12.5
Sept 8	BCR	31.5	4	Sept 25	Bel Meat hole	29	4	17	-2.5
Sept 8	Patsy's	-1.5	Sk	Sept 13	Patsy's	-1.5	Sk	5	0
Sept 9	Paravan	28	4	Sept 14	Del Paravan	28	4	5	0
Sept 11	Branch	9	2	Sept 28	Lookout	1	1	17	-8
Sept 11	319	3	1	Oct 10	BCR	31.5	4	29	28.5
Sept 11	Long Dong	9	2	Sept 26	Bear Jux	32	4	15	23
Sept 11	Lookout	1	1	Sept 27	Del BCR	31	4	16	30
Sept 12	Bear Jux	32	4	Oct 2	Sustut L	102	7	20	70
Sept 12	Bear Jux	32	4	Sept 15,25	Corner hole, Bear Jnx	31.75,32	4,4	3,13	-0.25,0
Sept 12	Corner hole	31.75	4	Sept 13	BCR	31.5	4	1	-0.25
Sept 13	Below BCR	31	4	Sept 27	Below meatbole	28.5	4	14	-2.5
Sept 13	BCR	31.5	4	Sept 15	Above meat hole	29	4	2	-2.5
Sept 14	Below Meat hole	28.5	4	Sept 27	BCR	31.5	4	13	-7
Sept 14	Below Meat hole	28.5	4	Sept 26,27	Corner hole, Below BCR	31.75,31	4,4	12,13	3.25,2.5
Sept 15	Below Meat hole	28.5	4	Sept 27	Above meat hole	29	4	12	0.5
Sept 15	Above Meat hole	29	4	Sept 25	Bear Jux	32	4	10	3
Sept 15	Z John	-2.5	Sk	Sept 16	Z John	-2.5	Sk	1	0
Sept 16	Anderson's	10	2	Sept 28	Paravan	28	4	12	18
Sept 16	Lookout	1	1	June 26	Bear River	32	4	283	31
Sept 16	Boulder	2	1	Sept 29	3 Tier	18	2	13	18
Sept 17	Patsy's	-1.5	Sk	Oct 24	Patsy's	-1.5	Sk	37	0
Sept 17	319	3	1	Sept 29	Below Suskeena	13	2	12	10
Sept 17	319	3	1	Sept 20	Below Valhalla	7	1	3	4
Sept 20	Lookout	1	1	Sept 27,28	Patsey's, Patsey's	-1.5,-1.5	Sk,Sk	7,8	-2.5,-2.5
Sept 21	Suskeena	13	2	Oct 16	Suskeena	13	2	25	0
Sept 22	Below BCE	31	4	Sept 26	Corner hole	31.75	4	4	0.75
Sept 22	Eagle	6	1	Sept 26	Surprise	7	2	4	1
Sept 25	Bear Jnx	32	4	Sept 26	BCR	31.5	4	1	-0.5
Sept 26	BCR	31.5	4	Sept 27	BCR	31.5	4	1	0
Sept 26	Boulder	2	1	Oct 10	Marvin's Garden	12	2	14	10
Oct 10	Bear Jnx	32	4	Oct 24	Bear Jux	32	4	14	0

APPENDIX III. Recaptures of Floy tagged steelhead in the upper Sustut River, 1986.

TAGGING DATA				RECAPTURE DATA					
DATE	LOCATION	KM	ZONE	DATE(S)	LOCATION	KM(S)	ZONE(S)	DAYS TO RECAP	DIST(S) TRAVELLED
Sept 30	Upper Sustut	100	7	Oct 1	Upper Sustut	100	7	1	0
Sept 30	Upper Sustut	100	7	Oct 3	Below Sustut Johanson Jnx	98.25	7	3	-1.75
Sept 30	White Rock	95.55	7	Oct 3	White Rock	95.75	7	3	0
Sept 30	Bel Sus/Joh Jnx	98.25	7	Oct 3	White Rock	95.75	7	3	-2.5
Sept 30	Bel Sus/Joh Jnx	98.25	7	Oct 3	Below Sustut Johanson Jnx	98.25	7	3	0
Sept 30	Bel Sus/Joh Jnx	98.25	7	Oct 1	Below Sustut Johanson Jnx	98.25	7	1	0
Sept 30	Bel Sus/Joh Jnx	98.25	7	Oct 1	Below Sustut Johanson Jnx	98.25	7	1	0
Sept 30	Bel Sus/Joh Jnx	98.25	7	Oct 3	White Rock	95.75	7	3	-2.5
Sept 30	Upper Sustut	100	7	Oct 1	Upper Sustut	100	7	1	0
Sept 30	Upper Sustut	100	7	Oct 3	White Rock	95.75	7	3	-4.25
Sept 30	Upper Sustut	100	7	Oct 3	White Rock	95.75	7	3	-4.25
Sept 30	Upper Sustut	100	7	Oct 1	Upper Sustut	100	7	3	0
Oct 1	Sus/Joh Jnx	98.5	7	Oct 3	Below White Rock	95.5	7	2	-3
Oct 1	Bel Sus/Joh Jnx	98.25	7	Oct 3	White Rock	95.75	7	2	-2.5
Oct 1	Bel Sus/Joh Jnx	98.25	7	Oct 3	Below Sustut Johanson Jnx	98.25	7	2	0
Oct 3	White Rock	95.75	7	Oct 4	Below White Rock	95.5	7	1	-0.25

APPENDIX IV. Summary of Steelhead Harvest Analysis data for the Sustut River, 1970-87.

Steelhead Harvest Analysis for the Sustut River[1]

Year	Days Fished	No. Anglers	Wild Kill	Wild Release	Hatch. Kill	Hatch. Release	Total Kill	Total Release	Total Catch	Kill/ Day	Catch/ Day
70/1	536	57	191	289			191	289	480	0.36	0.90
71/2	321	84	114	190			114	190	304	0.36	0.95
72/3	186	48	117	254			117	254	371	0.63	1.99
73/4	248	58	44	18			44	18	62	0.18	0.25
74/5	70	27	34	0			34	0	34	0.49	0.49
75/6	219	53	43	59			43	59	102	0.20	0.47
76/7	273	48	31	76			31	76	107	0.11	0.39
77/8	257	55	56	82			56	82	138	0.22	0.54
78/9	314	71	52	87			52	87	139	0.17	0.44
79/0	255	81	52	32			52	32	84	0.20	0.33
80/1	240	35	36	33			36	33	69	0.15	0.29
81/2	475	60	62	81			62	81	143	0.13	0.30
82/3	290	105	68	142			68	142	210	0.23	0.72
83/4	361	93	57	189		10	57	199	256	0.13	0.72
84/5	678	112	71	388			71	388	459	0.10	0.68
85/6	621	147	61	455		3	61	458	519	0.10	0.84
86/7	799	162	108	555	4	2	112	557	669	0.14	0.87

[1] Data compiled from Steelhead Harvest Analysis 1970-1987, B.C. Fish and Wildlife Branch, Ministry of Environment, Victoria, B.C.