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COPPER CREEK (QCI)
STEELHEAD TROUT: A REPORT
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COPPER CREEK (Q.C.I.) STEELHEAD TROUT:
A REPORT ON THE EFFECT OF NON RANDOM RELEASE
OF KELTS FROM A FENCE BARRIER ON THEIR INCIDENTAL
CAPTURE IN AN INDIAN NET FISHERY,
AND SOME NOTES ON POPULATION SIZE

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INTRODUCTION

While most British Columbian anglers lament over lost or reduced stocks of steelhead trout (Salmo gairdneri), Queen Charlotte Island streams still boast better than average angler success. Among top Island producers is Copper Creek which flows approximately 10 km northeasterly from Skidegate Lake to Copper Bay, located 14 km south of Sandspit on the East coast of Moresby Island, British Columbia. (Fig.1)

The prime purpose for this study was to determine if the number of steelhead kelts caught in a tidal gill net sockeye salmon fishery could be reduced (Fig. 2). Subsequently the objectives were expanded to generate information on steelhead population size, patterns of instream fish movement and life history.

The study was a Salmonid Enhancement Program Public Participation project awarded to the Queen Charlotte Island Chapter of the Steelhead Society of British Columbia. The Society conducted the study with assistance from the British Columbia Fish and Wildlife Branch during the period November 1980 to 1981.

Background information on Copper Creek steelhead is available in a habitat assessment report by Caw (1976) and in the annual Fish and Wildlife Branch reports on steelhead angler punch card returns (Steelhead Harvest Analysis).

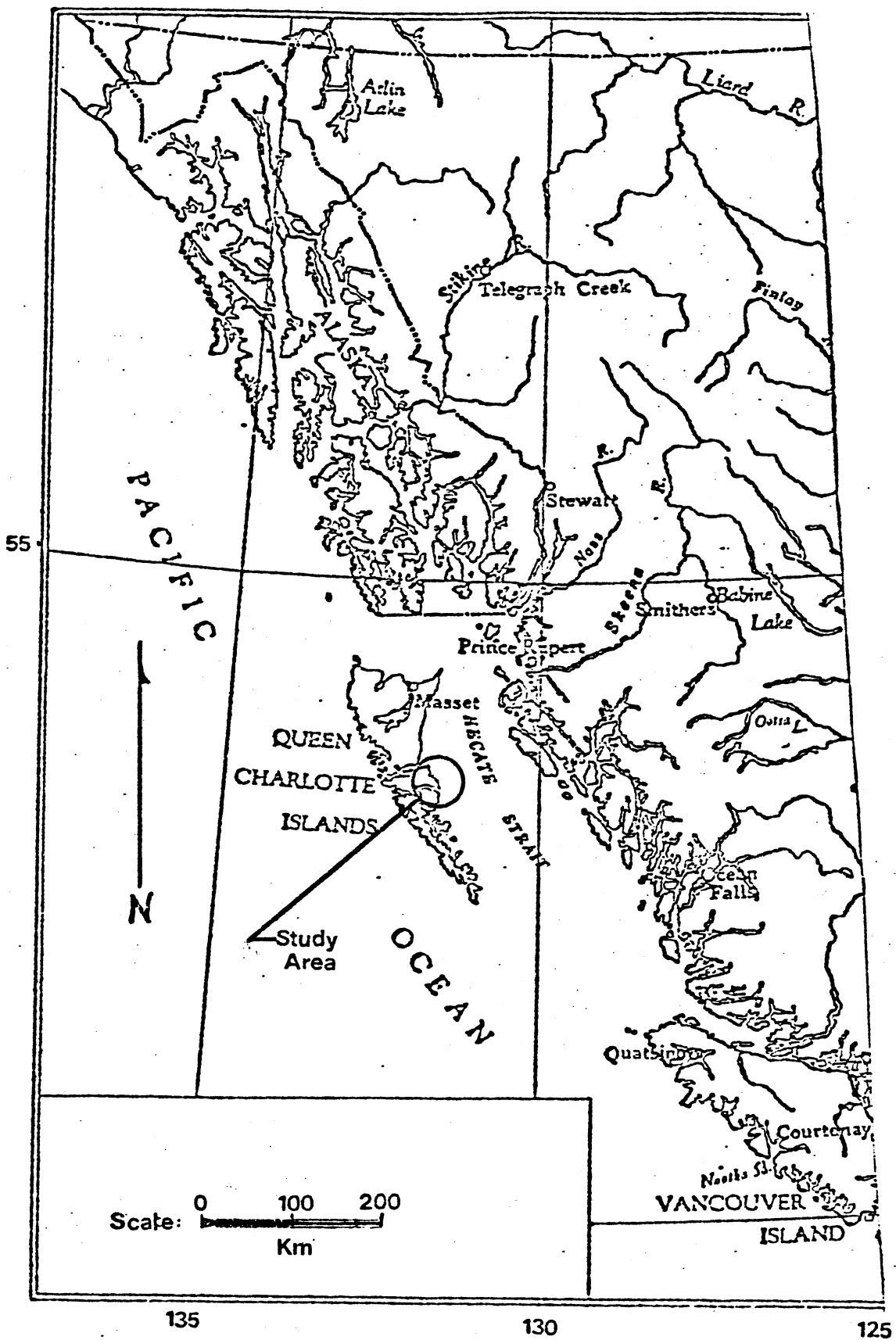


Figure 1. Location of Copper Creek.

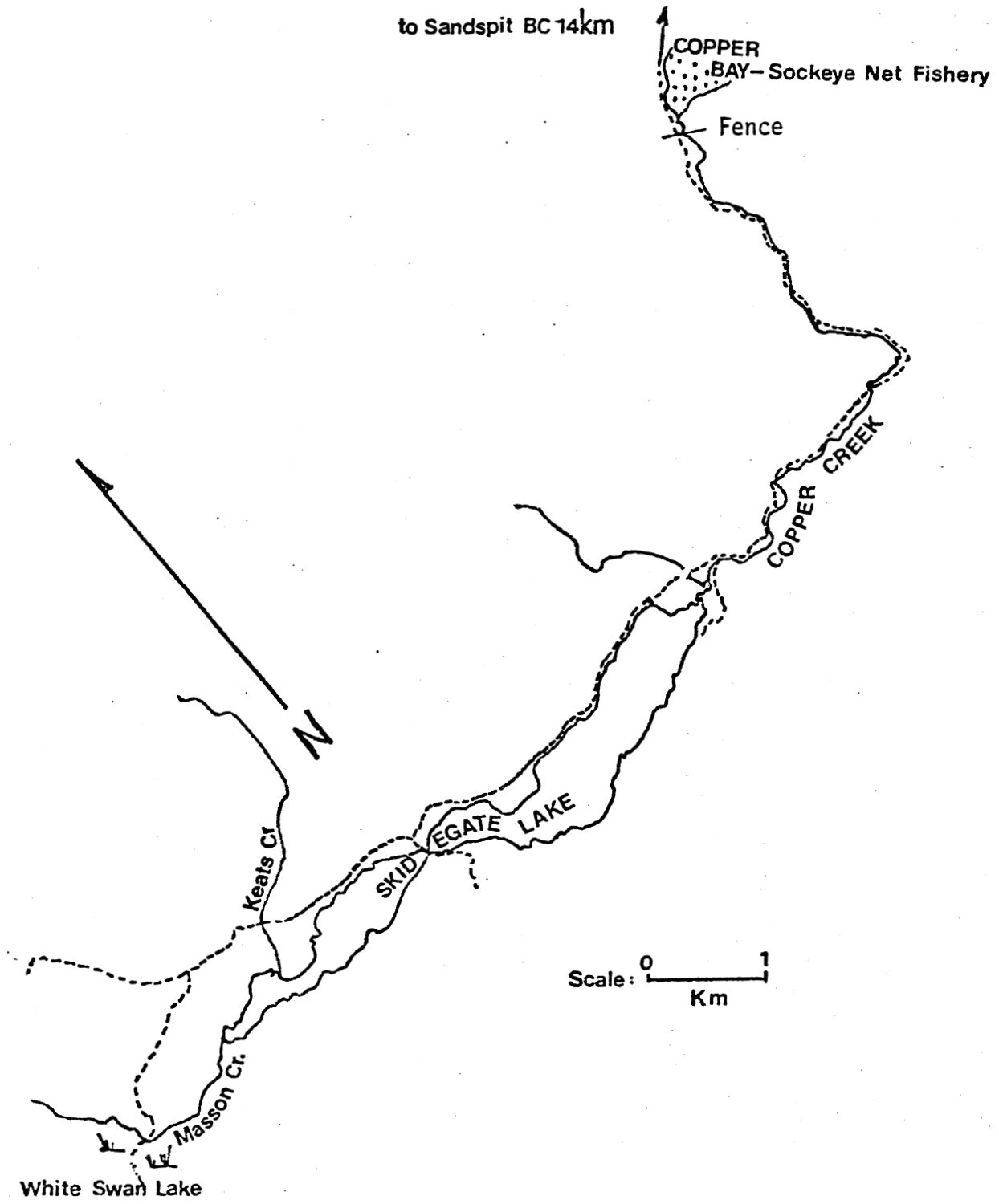


Figure 2. Copper Creek, showing the location of the fence and the sockeye net fishery.

THE FISHERY

Copper Creek steelhead co-inhabit with chums, coho, sockeye and pink salmon, cutthroat trout, Dolly Varden char and some coarse fish species. "Copper" steelhead are winter run fish which first enter the system in November with spawning occurring from February through June. Sockeye salmon begin upstream migration in early February with peak migration in mid May and early June during which time an intensive Indian gillnet fishery operates in Copper Bay (Table 1). Copper Creek anglers, as shown by the Steelhead Harvest Analysis (1977-1981), are almost exclusively local residents. Steelhead harvest data show that in an average year 90 anglers kill 86 steelhead and release 185 in Copper Creek (Table 2).

Table 1. Number of steelhead killed in the Copper Creek Indian food fishery during weekly openings from 1976 to 1981 (L. Gordon... personal communication). Fresh run upstreaming steelhead.()

Year ¹	Number of days per week	Number of ² Steelhead (n)
1976	4	32
1977	3	48
1978	4	76
1979	4	132
1980	2	21(3)
1981	2	47(5)

¹Early data, 1976 to 1978 are underestimates of steelhead killed (L. Gordon...pers. comm.).

Copper Creek fence was operated to reduce incidental net harvest of steelhead in both 1980 and 1981.

²1981 results include 10 fish caught in the net fishery following an unfortunate low water level release May 20.

Table 2. Steelhead sport catch data for Copper Creek from 1978 to 1981.

Year	Days Fished	Number of Anglers	Kill	Release	Kill/Day	Catch/Day
1977-78	1011	91	148	285	.155	.431
1978-79	560	118	74	170	.131	.460
1979-80	195	25	40	72	.212	.577
1980-81	545	127	83	213	.159	.548
Total Average	578	90	86	185	.164	.504

METHODS

Adult steelhead angled from Copper Creek from November through April were tagged using serially numbered and coloured Floy spaghetti tags. Fish were tagged according to a colour/time schedule to allow instream visual identification of fish of particular entry times:

orange ... November 30 - December 31

green January 1 - February 1

yellow .. February 1 - February 28

blue March 1 - April 22

Angler tagged steelhead were recaptured in the angler fishery, on a downstream fence and in the sockeye net fishery. An estimate of steelhead population size in Copper Creek was derived using angler tag recovery and fence tag recovery data as prescribed in Ricker (1975) for application of Schaeffers' and Baileys' (1951) formulae.

Three steelhead were internally equipped with radio transmitters in an attempt to monitor instream fish movements and in particular steelhead spawning sites. To help anglers identify recaptured radio tagged fish double floy spaghetti tags were applied externally. Radio tags and receivers were of Wildlife Materials Inc. manufacture operating on a frequency of 151.006 MHz.

As mentioned above a broomstick fish wier was constructed 2 km upstream of tide water (Photograph A). Although in place on April 22 the fence was not fully operational until April 29. The fence was used for several purposes; to count downstreaming steelhead tagged in the angler fishery, to prevent random downstream migration of steelhead kelts through to the Indian gill net fishery and as a capture station for applying spaghetti tags to unmarked steelhead. Tags were applied to kelts released downstream of the fence so that fence marked fish could be identified in the sockeye net fishery catch.

Scale samples were collected from all angler caught and fence caught steelhead. Scales were mounted on gummed tape and pressed on to acetate sheets. Scale images were interpreted using microfiche viewer according to the techniques described in Narver and Withler (1974).



PHOTOGRAPH A.

Copper Creek fence.

Table 3. Number of steelhead released at the fence and subsequent number of steelhead recaptured in the Indian Food Fishery from April 26 to June 6, 1981.

Number Released	Date	Number Recaptured	Dates ¹
1	April 26	0	0
2	April 29	0	0
5	May 3	0	0
4	May 14-20	0	0
13	May 10	1	May 17
1	May 11	1	May 17
8	May 18	3	May 16, May 24
37	May 20	10	May 24
27	May 24	1	May 31
24	May 31	2	June 6
3	June 1	0	0
7	June 2	1	June 7
5	June 3	3	June 6
<hr/> 137		<hr/> 22	

¹Four steelhead not released at the fence site were caught in the Indian Food Fishery.

From angler-tagged fish recapture data two separate estimates of population size were determined. First, using Schaeffers' method on strictly angler information, population size was affixed at 502 fish for the period between November 30 and April 22, 1981-82. Then, using Bailey's 1951 formula on data generated by the recovery of angler tagged steelhead at the fence, a population estimate of 1290 fish was derived. As some angler tagged steelhead had left the system before the fence became fully operational, Baileys' estimate is not strictly legitimate (see discussion for further explanation).

Forty-three steelhead killed in the Indian food fishery represents 9% of the first population estimate or 3% of the second estimate.

Table 3. Angler capture and three station recapture data for angler tagged steelhead trout in Copper Creek, November 1980 to April 1981. Dates of recapture in parentheses.

Date	Daily Captures	Cummulative Captures	Angler	Recaptures ¹ Fence	Food Net
Nov. 30	1	1	-	-	-
Dec. 1	1	2	-	-	-
3	1	3	-	-	-
7	1	4	1 (Mar.3)	-	-
8	2	6	-	-	-
9	3	9	-	1 (May 10)	-
10	1	10	1 (Dec.27)	-	-
14	1	11	-	-	-
17	3	14	1 (Mar.19)	-	-
18	2	16	-	-	-
22	1	17	-	-	-
23	1	18	-	-	-
26	2	20	-	1 (Apr.29)	-
Jan. 4	4	24	-	-	-
5	4	28	-	-	-
6	2	30	-	-	-
7	1	31	-	-	-
8	1	32	1 (Feb.25)	-	-
10	3	35	1 (Jan.11)	-	-
11	1	36	-	-	-
13	3	39	-	-	-
17	2	41	1 (Mar.14)	-	-
18	2	43	-	-	-
19	1	44	-	-	-
27	1	45	1 (Apr. 22)	-	-
28	3	48	-	-	-
29	4	52	1 (Feb.2)	1 (June 3)	-
30	2	54	-	-	-
31	4	58	1 (Mar.15)	-	-
Feb. ² 1	9	67	3 (Feb.1) (Feb.3) (Mar.26)	3 (May 24) (May 7)	-
2	6	73	-	-	-
3	3	76	1 (Mar.11)	-	-
4	2	78	1 (Mar.14)	-	-
7	3	81	-	1 (Apr.29)	-
8	2	83	-	-	-
14	6	89	-	2 (May 18) (May 20)	-
15	6	95	2 (Mar.13) (Feb.28)	1 (June 1)	-
16	1	96	-	-	-
18	1	97	-	-	-
26	2	99	-	1 (May 20)	-
27	1	100	-	-	-
28	4	104	1 (Apr.13)	-	-

¹ Recaptures are only of angler tagged fish.

² On February 3 the first steelhead kelt was tagged henceforeward 16 more kelts were included in the tagged sample.

Table 3 (continued)

Angler capture and three station recapture data for angler tagged steelhead trout in Copper Creek, November 1980 to April 1981. Dates of recapture in parentheses.

Date	Daily Captures	Cummulative Captures	Angler	Recaptures ¹ Fence	Food Net
Mar. ² 1	6	110	-	-	-
2	2	112	-	-	-
3	1	113	-	-	-
4	1	114	-	-	-
7	3	117	-	-	-
8	2	119	-	1 (May 16)	1 (May 23)
11	1	120	-	-	-
13	2	122	-	-	-
14	6	128	-	1 (May 24)	1 (May 23)
15	4	132	-	-	-
18	2	134	-	1 (Apr. 26)	-
19	4	138	-	-	-
20	2	140	-	-	1 (May 23)
21	2	142	-	-	-
22	5	147	-	2 (May 24) (May 14)	1 (May 23)
23	2	149	-	-	-
25	2	151	-	-	-
27	1	152	-	1 (May 24)	-
Apr. 3	5	157	1 (Apr. 4)	1 (June 3)	1 (June 6)
4	3	160	-	1 (May 10)	-
7	1	161	-	-	-
9	1	162	-	-	-
11	1	163	-	-	-
18	3	166	-	2 (May 10) (May 20)	-
20	1	167	-	-	-
22	1	168	-	-	-
TOTAL			18	21	5

¹ Recaptures are only of angler tagged fish.

² On February 3 the first steelhead kelt was tagged henceforward 16 more kelts were included in the tagged sample.

Patterns of instream Movement

Tracking data from the three transmitter-tagged steelhead is summarized in Figures 3, 4 and 5 showing the date tagged and the date and location of fish at various time intervals. One fish (Fish "A") moved through Skidegate Lake into Masson Creek.

Steelhead began spawning in mid February and continued spawning through June.

Life History

Two hundred and sixteen samples with readable scales were collected from Copper Creek from 1975 to 1981 (one hundred and fifty-eight steelhead with complete life histories). Eighteen age groups were in the sample, eight for maiden fish, four repeat spawning groups and four groups of kelt steelhead (Table 4). The dominant age groups for maiden fish were 3.2 (43%), 3.3 (29%), 3.1 (3%) and 2.2 (3%) while 3.1S1 (11%) and 3.2S1 (3%) were dominant groups for repeat spawners. Males occurred in six of eight maiden age groups while females occurred in all eight maiden age groups. Of the total sample, maiden fish comprised 80.6% and repeat spawners 19.4%.

The most common fresh water ages for one hundred and fifty-three maiden fish were 3 (91.5%), 2 (5.2%) and 4 (3.3%) (Table 5).

The proportion of age 2., 3. and 4. do not seem significantly different between sexes.

The dominant ocean age group (.2) forms 66.9% of the total sample of 139 maiden fish (Table 6). 75% of the total male sample and 60.8% of the total female sample occur within the two-ocean group. The younger and older age groups .1 (4.3%) and .3 (28.8%) were composed mainly of females (1 male: 1.6 females).

Table 4. Steelhead trout age groups from Copper Creek on the Queen Charlotte Islands from 1975 to 1981 (No scales with regenerated freshwater zones are included).

Age Group	Number of Steelhead	Number Male	Number Female	Percent Total
2.1	1	0	1	.6
2.2	4	2	2	2.5
2.3	2	1	1	1.3
3.1	4	2	2	2.5
3.2	67	33	31	42.5
3.3	30	10	19	18.9
4.2	3	1	1	1.9
4.3	2	0	2	1.3
2.2S1	1	0	1	.6
3.S1	2	2	0	1.3
3.1S (kelts)	7	3	4	4.4
3.1S1	17	5	12	10.9
3.1SS (kelts)	3	0	0	1.9
3.1SS1	1	0	1	.6
3.1SSS (kelts)	1	0	1	.6
3.2S (kelts)	7	2	5	4.4
3.2S1	5	1	4	3.2
<u>4.1S1</u>	<u>1</u>	<u>0</u>	<u>1</u>	<u>.6</u>
18	158 ¹	62	91	100

¹ Six steelhead sampled were not sexed.

Table 5. Numbers and percentages of male and female steelhead of different freshwater ages from Copper Creek on the Queen Charlotte Islands, 1981.

	Freshwater Age			TOTAL
	2	3	4	
Male n	3	58	1	62
%	4.8	93.6	1.6	40.5
Female n	5	82	4	91
%	5.5	90.1	4.4	59.5
TOTAL n	8	140	4	153
%	5.2	91.5	3.3	

Table 6. Numbers and percentages of male and female steelhead of different ocean ages from Copper Creek on the Queen Charlotte Islands, 1975 to 1981 (scales with regenerated freshwater zones included. Repeat spawners excluded.)

	Ocean Age			TOTAL
	.1	.2	.3	
Male n	2	45	13	60
%	3.3	75	21.7	43.2
Female n	4	48	27	79
%	5.0	60.8	34.2	56.8
TOTAL n	6	93	40	139
%	4.3	66.9	28.8	

Table 7. Numbers and percentages of different ocean ages of repeat spawning steelhead sampled from Copper Creek on the Queen Charlotte Islands from 1975 to 1981 (sample size 191 including scales with regenerated freshwater zones).

	.S1	.1S1	.1SS1	.S2	.2S1	TOTAL
Male n	3	5	0	1	1	10
%	30	50	0	10	10	27
Female n	0	17	4	0	6	27
%	0	63	14.8	0	22.2	73
TOTAL n	3	22	4	1	7	37
%	8.1	59.5	10.8	2.7	18.9	19.4

Table 8. Average lengths (cm), weights (kg), and ranges of lengths and weights by sex for Copper Creek steelhead age groups from 1975 to 1981 (n=127). Numbers of fish in each category are parenthesized.

Age Group	Average Wgt. (n)		Range		Average Lgth. (n)		Range	
	Male	Female	Male	Female	Male	Female	Male	Female
.1	1.1(2)	.44(3)	1.1	.2-.7	479(2)	381(2)	457-500	355-457
.2	3.3(34)	3.0(36)	2.2-6.8	1.4-5.4	688(37)	673(37)	603-914	584-875
.3	5.2(11)	4.8(24)	1.8-7.7	3.6-6.3	797(12)	771(27)	609-889	609-838

The incidence of repeat spawning steelhead sampled from Copper Creek is 19.4% of which females outnumbered males almost three to one. Four of the thirty-seven repeat spawners were returning for a third time. (Table 7).

The overall sex ratio for Copper Creek steelhead is 1:1.43 males to females.

Adult steelhead sex, length, and weight relationships are summarized for all Copper Creek samples collected from 1975 to 1981 (Table 8). On average a two-ocean fish from Copper Creek weights between 3.0 and 3.3 kg and is between 673 and 688 mm long.

DISCUSSION

Indian Food Fishery

The Copper Creek fence as per design reduced incidental harvest of steelhead in the Indian food fishery (Table 1). Fence releases were aligned with water levels and net fishing closures with one exception, on May 20 37 kelt steelhead were released (technical reasons) May 20 at extreme low water levels. Subsequently 10 of the May 20 released steelhead were caught following a weekend rainstorm (May 24), whereas other releases midweek during rainstorms or on rising water levels were most successful with respect to reduced catch.

Any success due the fence operation for reduction of kelt harvest must be metered with some thoughts on fungused downstream migrants that died or were dead at the fence.

Of 43 steelhead caught in the 1981 food fishery 22 (51%) were fence released fish and 17 (36%) were unmarked fish. These unmarked fish may be partially explained by the following: A small number of kelts escaped downstream through small holes made in the fence by upstreaming sockeye, untagged fish were released downstream of the fence on April 26 before the fence became fully operational, and an undetermined number of steelhead spawned downstream of the fence.

Population Size

Use of population estimates for other than an indication of population trends for setting meaningful fisheries management regulations are pre-empted by the following limiting considerations:

1. Between April 22 and April 29 neither the angler fishery nor the fence installation were operational. This factor would in effect reduce the number of recaptures causing estimates to be high.

2. Before the fence facility became functional as a tag recovery station, many angler tagged steelhead had already spawned and left the system again reducing the number of recaptures possible, resulting in a high estimate.

3. The voluntary reduction of angling/tagging pressure on spawning steelhead following installation of the fence but while fresh run fish were still entering the system resulted in a low angler (Schaeffer) estimate and a low fence (Bailey) estimate.

4. As mentioned earlier the efficiency of the fence as an effective barrier to downstreaming steelhead had shortcomings, resulting in high or low estimates dependant on whether tagged or untagged fish went undocumented.

5. Some tagged fish moved through the main angler fishery and into remote and upstream areas closed or inaccessible to anglers hence were unavailable for recapture. Reduced recaptures would result in a high estimate.

In consideration of the above, the population estimate (by Sheffer's method) of 502 Copper Creek steelhead seems most credible for selection of conservative management goals.

Patterns of Instream movement

As only three radio transmitters were implanted little can be inferred with respect to the total stock other than that fish do move above Skidegate Lake.

Life History

It was considered legitimate to include pre 1981 life history information in this report after determining that incidence of repeat spawning for early fish was 21%.

To assess the effect of the Indian food fishery on present and future runs of steelhead it was necessary to determine life history, and in particular the percentage of repeat spawners among the population. Since the Indian fishery harvests mainly kelts, a low incidence of repeat spawners in a population sample should indicate the degree of impact. When compared to information on repeat spawning in four coastal streams. (Somas (15%), Nanaimo (18%), Kitimat (32%) and St. Petersburg in Alaska (32.7%)) percentage of repeat spawners in Copper Creek (19.4%) was not unusually high or low (Table 10). Although average in this five-stream comparison of repeat spawning fish, Copper Creek is more akin to Somas and Nanaimo Rivers with respect to spawning duration (months) and angler fishery, and has by comparison higher incidence of repeat spawning. St. Petersburg and Kitimat streams have what might be termed "flash spawning" steelhead populations where fish typically spawn and leave within 30 days, hence would be expected because of reduced stress and angler pressure to have higher incidence of repeat spawning fish. Nineteen percent repeat spawning incidence in Copper Creek seems healthy by virtue of the above comparisons.

Table 10. Percentages and number of repeat spawning steelhead in various life history categories from Copper, St. Petersburg Creeks and Somas, Nanaimo, and Kitimat Rivers.

Age Group	Somas ¹ 1976-1978 (n)	Nanaimo ² 1969-1972 (n)	Kitimat ³ 1976-1977 (n)	St. Petersburg ⁴ 1974 (n)	Copper 1975-1981 (n)
S1					
1S1	40 (6)	66.6 (12)	30 (12)	22.2 (20)	8.1 (3)
1SS1		5.6 (1)	10 (4)	8.9 (8)	59.5 (22)
1SSS1	6.7 (1)			3.3 (3)	10.8 (4)
1SSSS1				1.1 (1)	
S2					2.7 (1)
1S2		5.6 (1)			
2S1	46.6 (7)	22.2 (4)	50 (20)	35.6 (32)	18.9 (7)
2SS1	6.7 (1)		7.5 (3)	23.3 (21)	
2SSS1			2.5 (1)	3.3 (3)	
2SSSS1				2.2 (2)	
TOTAL n	15	18	40	90	36
% Repeat Spawners	15	18	32	32.7	19.4

¹ Horncastle (1981).

² Narver & Withler (1974).

³ Chudyk, Whately & Morris (1977).

⁴ Jones (1975).

CONCLUSIONS

The Copper Creek fence did prevent the incidental harvest of downstreaming steelhead kelts in the Indian food fishery by manipulation of releases on periods of high water and fishing closures. However, the cost of operating the fence weighed against a healthy steelhead population with good returns of repeat spawning steelhead and in light of reduced Indian food fishing effort (2 days) may outbalance the benefits of reduced catch attributable to annual fence installation. In future years if net fishing pressure increases or if population numbers of repeat spawning steelhead drop significantly then a fence operation would result in improved steelhead stocks.

There were approximately 502 steelhead available to spawn in Copper Creek in 1981. As mentioned earlier 502 is the most credible estimate for selection of conservative management goals.

Radio tag data shows that steelhead migrate through Skidegate Lake and into above lake tributaries (Masson Creek).

In 1981 Copper Creek steelhead trout began to spawn in mid February and continued to spawn through June.

From life history data it was determined that most (42.5%) Copper Creek fish spend three years in fresh water and two in the ocean (age group 3.2) while most repeat spawning fish are of age 3.1S1. Almost all (92%) of Copper Creek steelhead spend three years in fresh water. Over half 67% of all steelhead returning to Copper Creek spent two years in the ocean (.2). The current incidence of repeat spawning for the Copper system is 19.4 percent.

ACKNOWLEDGEMENTS

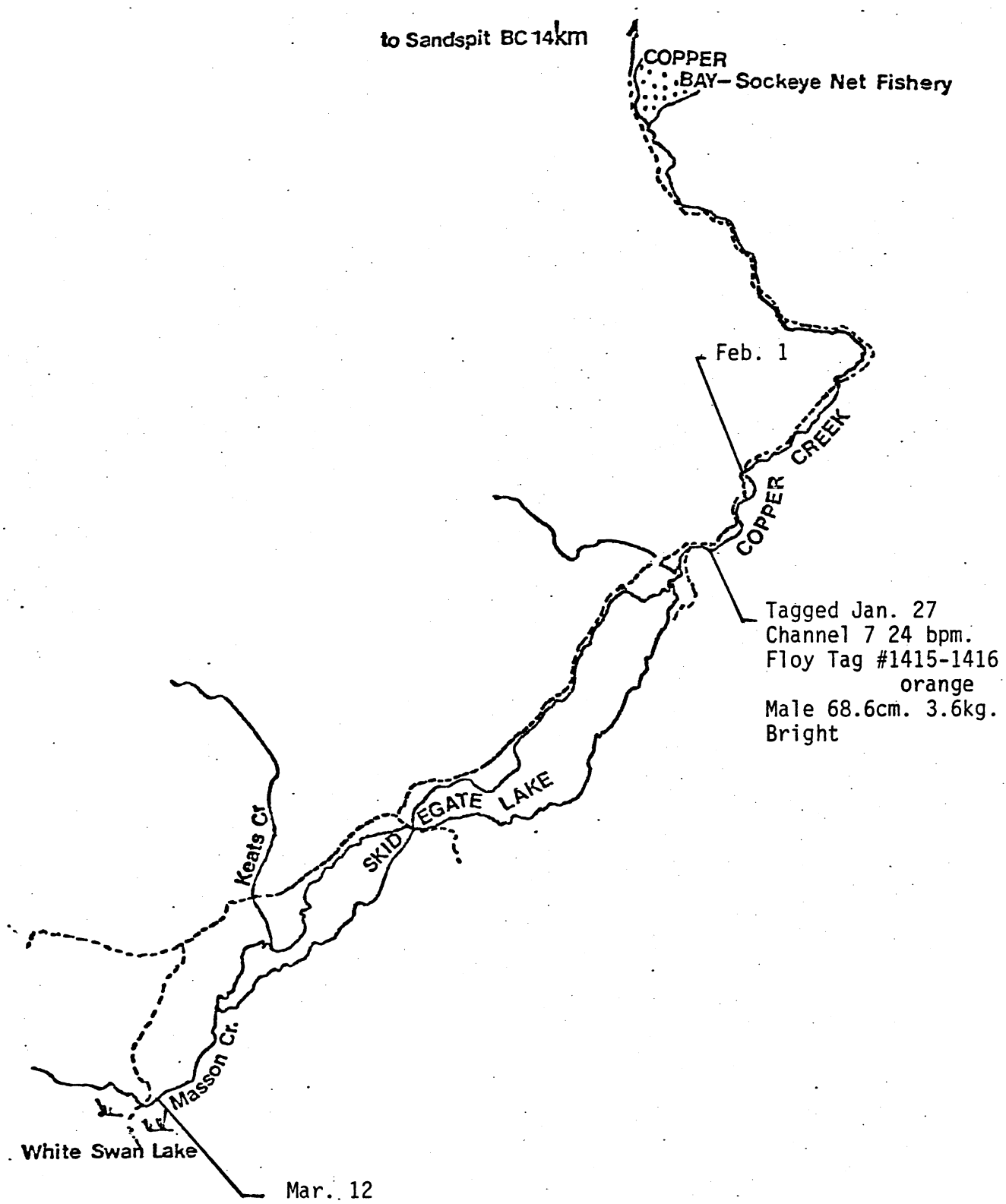
In spirit of true cooperation the following people deserve thanks for their hard work: the membership of the Q.C.I. chapter of the S.S.B.C., Fish and Wildlife Branch Technicians R.E. Tetreau and M. Morris, and L. Gordon and D. Lawseth of Department of Fisheries and Oceans.

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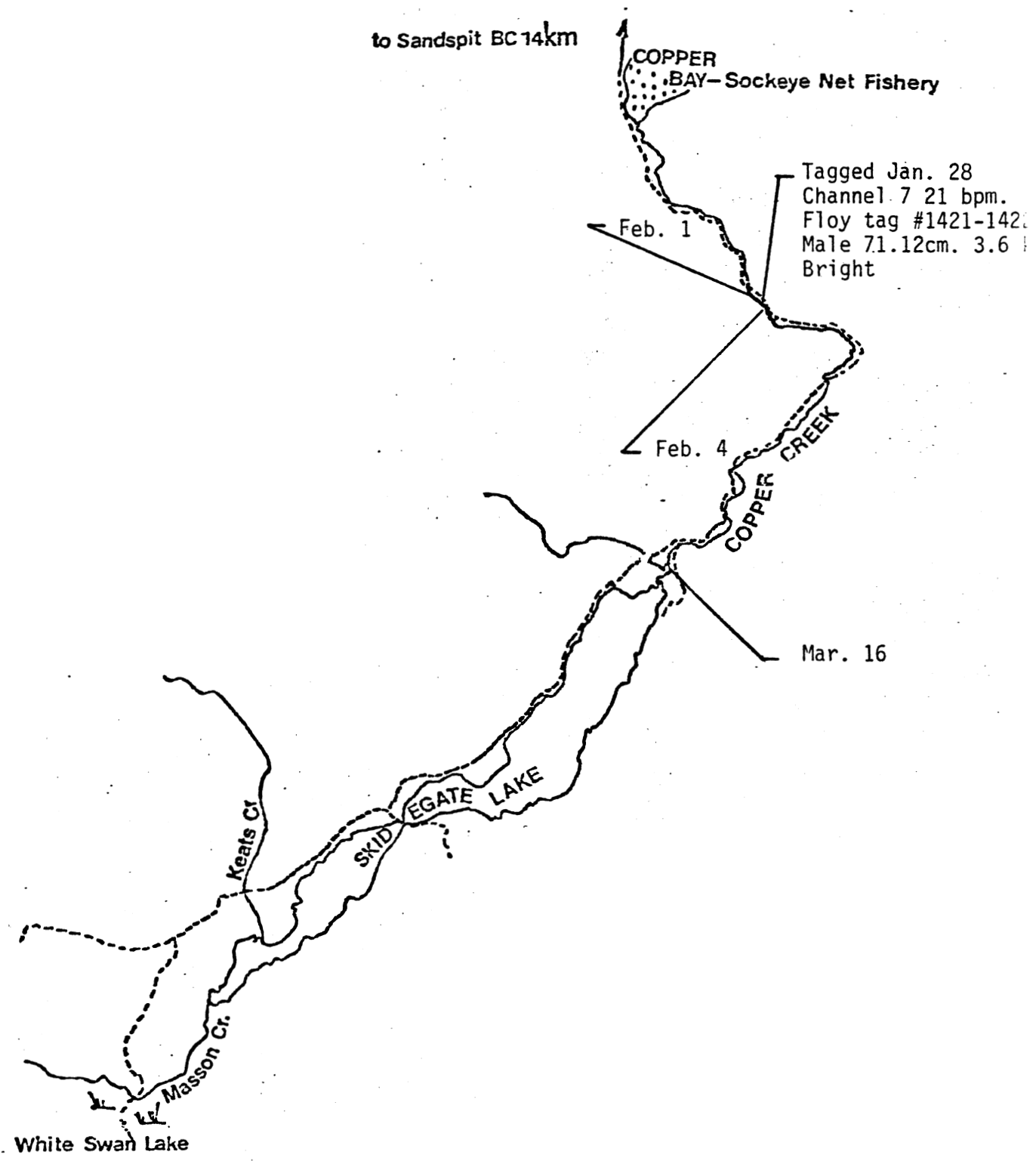
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APPENDIX I

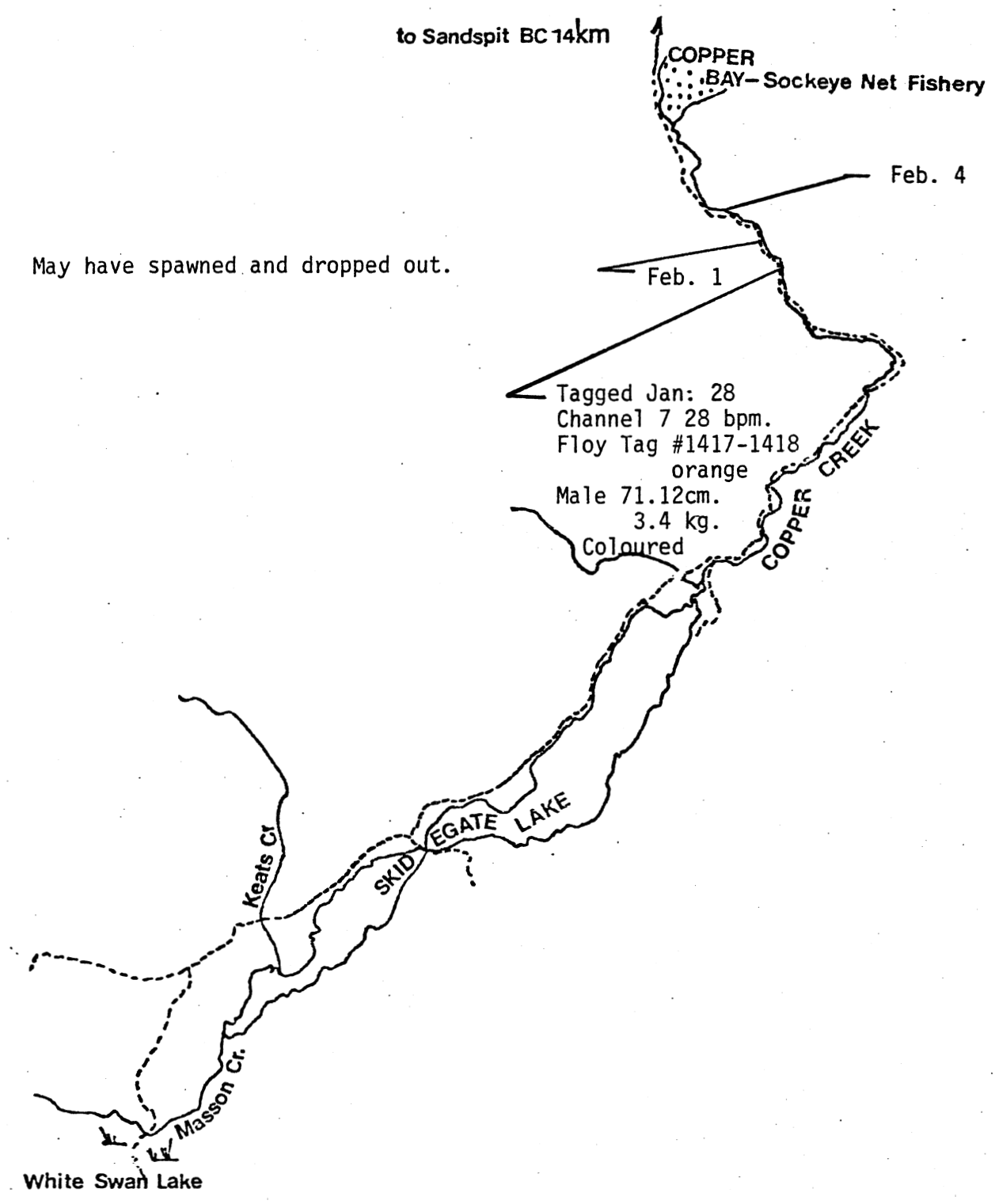
Details of Radio Telemetry
Copper Creek Steelhead 1981



Location and dates for tracking steelhead A.



Location and dates for tracking steelhead B.



May have spawned and dropped out.

Location and dates for tracking steelhead C.