AN ESTIMATE OF THE NUMBER OF STEELHEAD TROUT SPAWNING IN BABINE RIVER NEAR BABINE LAKE, SPRING, 1978

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Skeena Fisheries Report #78—8 (S.E.P.)
May 1979

INTRODUCTION

The purpose of this study was to estimate the size of the spawning population of steelhead trout (Salmo gairdneri) in Babine River, a tributary of the Skeena River located in West Central B.C. (Fig. 1). Babine steelhead are a summer run stock; adult steelhead enter the Skeena River in July and August and begin arriving in the Babine in early September where they are subjected to an intensive but highly regulated sport fishery (Narver, 1969; Pinsent, M.S. 1971; and Whately, M.S. 1978). After overwintering throughout the length of the river and coincident with rising water temperatures in April, the steelhead begin congregating in an area of the river extending from Nilkitwka Lake to about 2 km downstream (Fig. 2) preparatory to spawning which commences in early May.

A previous attempt to estimate population size was described by Pinsent (M.S. 1971). That study was conducted in October, 1970 during the peak of the sport fishery and mark and recapture data were collected with the assistance of sport fishermen. The project described herein was carried out in March, April and May, 1978 during the spring sport fishing closure using Fish and Wildlife Branch personnel with assistance from a local (Smithers) steelhead club. This project was undertaken in conjunction with a joint Fish and Wildlife Branch — Fisheries and Marine Service steelhead egg—take project (see Whately, M.S. 1978).

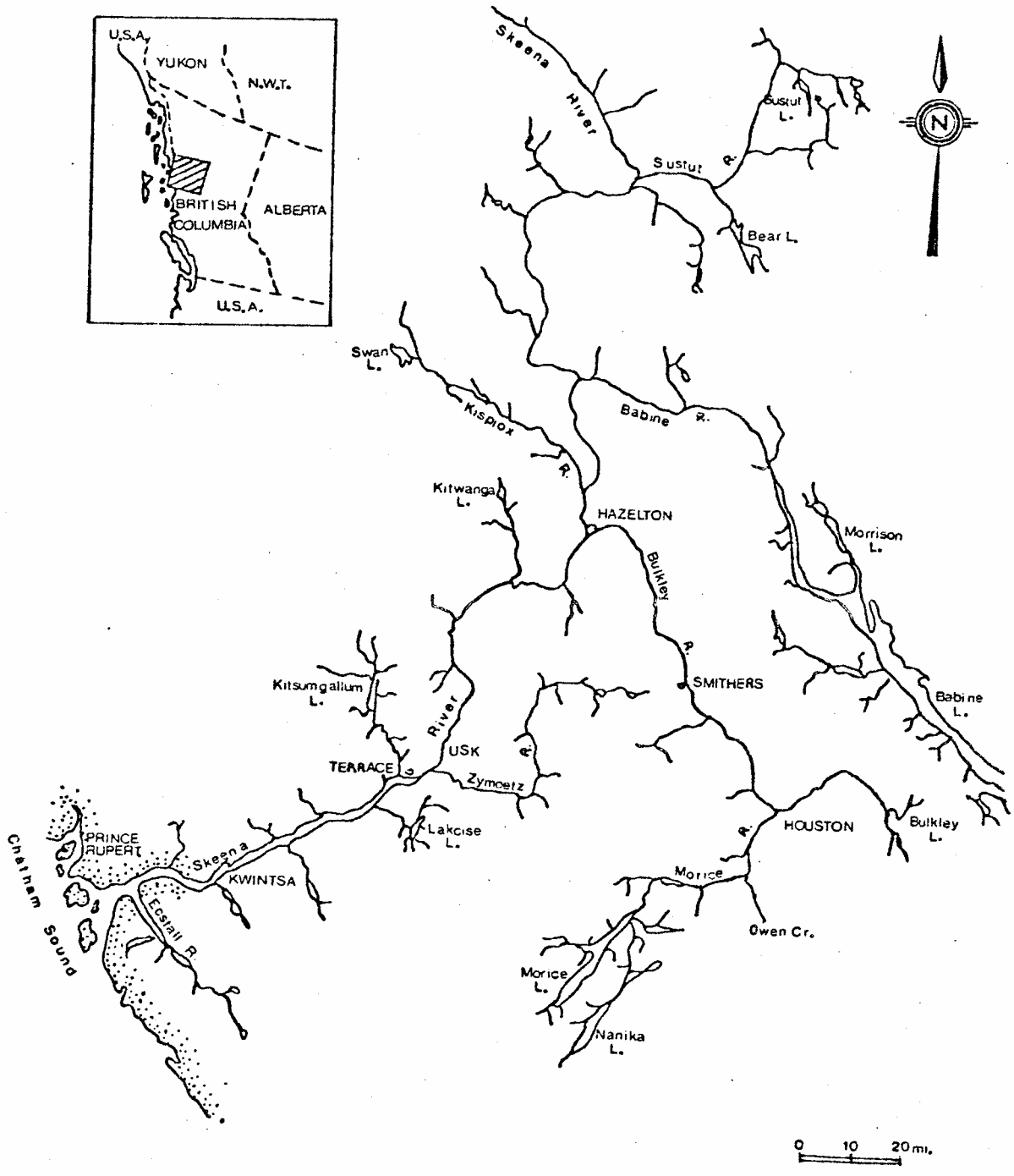

Fig. 1. The Skeena River and main tributaries.

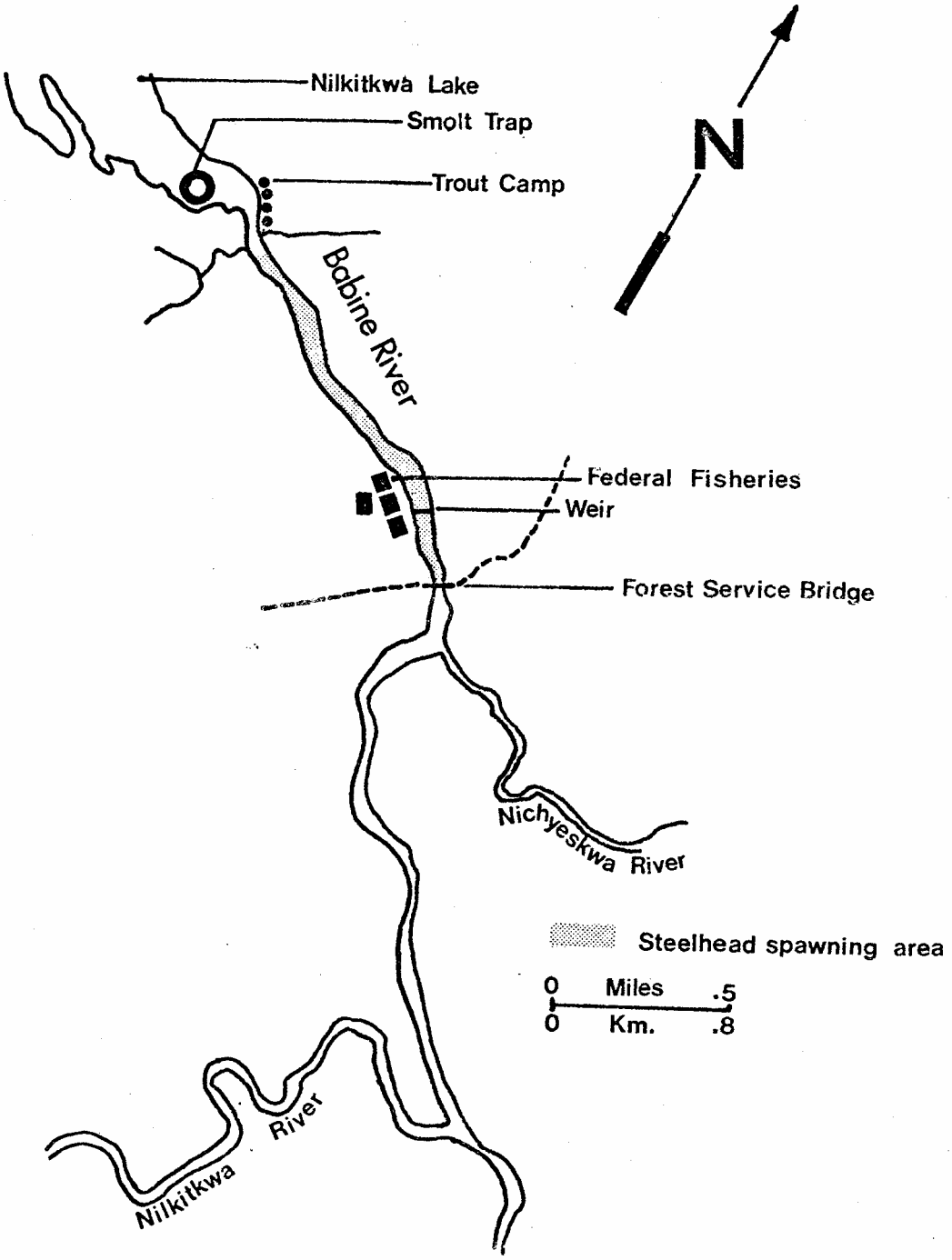

Fig. 2. Babine River steelhead spawning area and project site.

Some notes on Babine steelhead ages as determined for scale samples collected during this project are also provided, along with a discussion of factors that may influence annual run sizes and trends in the sport fishery.

METHODS AND MATERIALS

Field operations began on March 9, 1978 when a team composed of Fish and Wildlife Branch personnel and B.C. Steelhead Society members angled and tagged steelhead for three days. On April 5 a two man (B.C. Fish and Wildlife) crew established a base camp at the Federal Fisheries and Marine Services counting weir (Fig. 2). The crew used jet riverboat, inflatable rafts, snowmobiles, and snowshoes to cover the 22km study area below Nilkitkwa Lake.

Angling with conventional steelhead gear was the main collection method although beach seining and gill net drifts were used occasionally. Dennison Mark II tagging guns were used to apply numbered, International orange "anchor" tags. Some pink, "dart" tags were used early in the project but were discarded due to malfunctioning of the needle applicators. All tags were applied obliquely to the back of the steelhead immediately below the dorsal fin. Each capture (and recapture) was recorded as to date, time, tag number, location of capture and sex.

Scale samples were collected from 232 steelhead during the tagging project. Ages were interpreted by the authors and an assistant after the method described by Narver and Withler (1974).

RESULTS

SUMMARY OF CAPTURES AND RECAPTURES

Three hundred and twenty two adult steelhead were captured during the period March 9 through May 21, 1978 (Table 1). Of this total, 52 fish were removed from the study population for egg—take purposes (Whately, M.S. 1978) and an additional three fish were inadvertently killed during capture. Of the remaining 267 captures, 247 were tagged and released, of which 20 were subsequently recaptured (Tables 1 and 2). One steelhead was recaptured twice (the actual number of individual steelhead recaptured was 19). One recapture was removed from the study population to be used for the egg—take (total numbers of fish used for the egg—take was 53).

The ratio of males to females among the 247 tagged fish was 1:1.3. The ratio among the recaptures was 1:1.5 males to females.

The mean number of days between initial capture and recapture was 22, range 0 (same day) to 65 days.

The overall movement of recaptured fish was 0.13 km per day upstream. Among the 20 recaptures, 11 fish moved upstream, eight fish remained stationary and one moved downstream (0.1 km) following initial capture.

Table 1. Capture and tagging data for steelhead trout in Babine River, March, April and May, 1978.

Date	Daily Captures	Cumulative Captures	Recaptures	Number Marked (less removals)	Marked Fish at large
Mar. 9	10	10	0	10	0
10	20	30	0	20	10
11	6	36	0	6	30
Totals	36	76	0	36	
Apr. 4	1	37	0	1	36
5	8	45	0	8	37
6	8	53	0	8	45
7	18	71	0	17	53
8	1	72	0	1	70
9	3	75	0	3	71
11	5	80	0	4	74
12	20	100	0	20	78
13	12	112	0	12	98
14	7	119	0	7	110
18	3	122	2	1	117
19	34	156	2	31	118
20	15	171	0	15	149
21	4	175	0	4	164
22	10	185	0	10	168
23	16	201	2	14	178
24	1	202	0	1	192
25	8	210	2	0	193
26	9	219	0	6	193
27	5	224	0	2	199
28	7	231	0	2	201
29	1	232	0	1	203
30	5	237	0	0	204
Totals	118		8	87	

Table 1. (Cont'd.)

Date	Daily Captures	Cumulative Captures	Recaptures	Number Marked (less removals)	Marked Fish at large
May 1	3	240	0	0	204
2	1	241	1	0	204
3	5	246	0	0	203
4	2	248	0	0	203
5	3	251	0	0	203
6	6	257	0	1	203
7	11	268	0	1	204
8	2	270	1	0	205
9	1	271	0	0	205
10	5	276	0	5	205
11	16	292	1	15	210
12	4	296	0	4	225
13	3	299	2	1	229
14	2	301	0	2	230
15	5	306	1	3	232
16	3	309	0	3	235
18	4	313	1	2	238
19	4	317	0	4	240
20	3	320	0	3	244
21	2	322	0	-	247
Totals	85		7	44	

Table 2. Number of tagged adult steelhead recaptured, and the distance/time relationship between fish tagged and recaptured in Babine River, March - May, 1978.

Cumulative Steelhead Recaptured	Tag Number	Date Tagged	Sex	Date Recaptured	Time Interval (Days)	Space Interval (km)[1]
1	190	Apr. 7	F	Apr. 7	0	0
2	368	Apr. 9	M	Apr. 11	3	0
3	366	Apr. 8	M	Apr. 18	11	0
4	353	Apr. 4	F	Apr. 18	15	-0.1
5	012	Mar. 10	F	Apr. 19	41	0
6	560[2]	Apr. 13	M	Apr. 19	7	0
7	531	Apr. 19	M	Apr. 19	0	0
8	185	Apr. 6	F	Apr. 23	18	+1.5
9	242	Mar. 10	M	Apr. 23	44	+3.5
10	560[2]	Apr. 13	M	Apr. 25	13	+8.7
11	382	Apr. 12	M	Apr. 25	14	+5.0
12	196	Apr. 7	F	May 2	26	+4.3
13	537	Apr. 20	F	May 8	19	+8.7
14	012	Mar. 10	F	May 11	63	+2.5
15	550	Apr. 12	F	May 13	32	+5.2
16	236	Mar. 10	F	May 13	65	+3.2
17	543	Apr. 22	F	May 15	24	+5.2
18	523	May 11	F	May 15	5	0
19	220	May 18	F	May 18	0	0
20	570	Apr. 14	M	May 18	36	+3.4

[1] "+" indicates upstream movement while "—" indicates downstream movement.
[2] Double recapture.

ESTIMATION OF POPULATION SIZE

Both Schnabel and Schumacher multiple census formulae, as outlined by Ricker (1958), were used to calculate the size of the Babine River steelhead spawning population (Table 3). The Schnabel estimate was 2068 fish with an estimated confidence range at the 95 percent level of 1409 to 3559 fish. The Schumacher estimate was 2183 fish with a range of 1392 to 5059.

Table 3. Multiple census population estimates of adult Babine River steelhead from March — May, 1978.

Type	Formula	N	95 percent confidence interval
Modified Schnabel	$N = \frac{(C_t\ M_t)}{R + 1}$	2068	1409 - 3559
Schumacher	$1/N = \frac{(M_t\ R_t)}{(C_t\ M_t\ 2)}$	2183	1392 - 5059

STEELHEAD LIFE HISTORIES

During the mark—recapture study, scale samples from 232 steelhead were collected for age analysis. Seventeen age groups were identified, ten of which were for first—time spawners (Table 4). Numbers and percentage of fish in each age group were compared with samples collected in 1967 and 1968 and analyzed by Narver (1969) (Table 4). In the latter study, 13 age groups were identified, of which nine were for first—time spawners.

In 1978, the largest number of fish were found in the 3.2+ age group, accounting for 46.1 per cent of the total sample and 50.5 per cent of first—time spawners. This was also the most predominant age group in the earlier study, accounting for almost 60 per cent of the total sample and 62 per cent of first—time spawners.

Table 4. Steelhead trout age groups, Babine River, Spring 1978 (n = 232) and Autumn, 1967 and 1968[1] (n = 104).

Age Group	Number 1978			% Total 1978	Number 1967 & 1968			% Total 1967 & 1968
	M	F	Total		M	F	Total	
2.1+	-	-	-	-	1	-	1	0.9
2.2+	-	1	1	0.4	-	1	1	0.9
2.2S1+	-	-	-	-	-	1	1	0.9
3.1+	3	1	4	1.7	2	1	3	2.9
3.2+	40	67	107	46.1	20	42	62	59.6
3.3+	22	-	22	9.5	11	6	17	16.4
3.4+	1	-	1	0.4	-	-	-	-
3.1S1+	1	-	1	0.4	-	-	-	-
3.1S2+	1	-	1	0.4	-	-	-	-
3.2S+	-	-	-	-	-	1	1	0.9
3.2S+	1	8	9	3.9	-	1	1	0.9
3.2S1S1+	-	1	1	0.4	-	-	-	-
3.3S1+	1	-	1	0.4	-	-	-	-
4.1+	4	3	7	3.0	3	2	5	5.8
4.2+	25	37	61	26.3	2	7	9	8.7
4.3+	6	-	6	2.6	1	-	1	0.9
4.1S1+	1	-	1	0.4	-	-	-	-
4.2S1+	1	5	6	2.6	-	1	1	0.9
5.1+	1	-	1	0.4	-	1	1	0.9
5.2+	2	-	2	0.9	-	-	-	-
Totals	109	123	232		40	64	104	

[1] Narver, 1969.

DISCUSSION

According to Ricker (1958) the validity of a population estimate derived from a mark and recapture study depends to a large extent upon the following conditions:

1. That natural mortality on marked fish is the same as that for unmarked fish.

2. That marked fish are as vulnerable to being caught as unmarked fish.

3. That mark loss is zero.

4. That marked fish redistribute randomly with unmarked fish.

5. That all mark recoveries are recognized and reported.

6. That recruitment into the study population during mark and recovery is zero.

We were reasonably assured that the above conditions were met during the study. Mortalities among tagged fish should have been nonexistent; tagging crew members were highly experienced in all aspects of' capturing, handling, and tagging steelhead. No fish were released that showed any sign of debilitating damage (three fish were, in fact, removed from the study due to excessive bleeding as a result of capture).

The fact that tagged fish were recaptured, often more than once, and within minutes of the initial capture, should indicate that avoidance of tackle through experience was minimal.

Tag loss should have been minimal; the study was short and the tagging crew had several years of experience with the equipment. Movement of tagged fish and subsequent recapture with other untagged fish indicates compliance with the random mixing condition. The ability of the crew to recognize their own tags was considered obvious. That there was no recruitment to the population was a difficult assumption to assess. It was assumed however, that all Babine steelhead would attempt to spawn in the prime spawning area immediately downstream of Nilkitkwa Lake and would be holding within easy distance of that site. During the early stages of the study, the tagging crew operated over approximately 22 km of river but the greatest concentrations of fish were found within 10 km of the lake. As the study progressed, the crew ceased to find any fish at the downstream limits of the fishing zone, indicating that most, if not all, fish had moved to upstream (spawning) locations.

The number of steelhead that spawned in Babine River below Nilkitkwa Lake during the spring of 1978 can be assumed, for practical purposes, to be 2100 fish. During the previous Autumn (1977), an estimated 146 steel— head were killed in the sport fishery (Steelhead Harvest Analysis 1977—78). The Indian food harvest is unknown,[1] but if we assume at least as many steelhead taken by Indians as sport fishermen, then the total non—commercial harvest of the 1977—78 Babine steelhead run was approximately 300 fish, for a total post—commercial escapement of 2400 fish.

[1]The Indian food fish harvest of steelhead was estimated to be 200 fish in 1972, however no estimates have been made since (Friedlaender and Reif, 1979)

The exploitation rate was therefore a mere 12.5 per cent. The harvest of Babine—bound steelhead by sport and Indian fisheries in mainstem Skeena in 1977 was (and still is) a totally unknown factor but for the purposes of this report was assumed to be negligible.

Pinsent (M.S. 1971) estimated a run of 1500 steelhead to the Babine in the Autumn of 1970, plus 500 additional fish to account for possible late fall or winter migrants. The angler harvest during that study year was estimated to be approximately 600 fish (Steelhead Harvest Analysis, 1970—71). Assuming a relatively constant Indian food fish harvest (1977 not substantially more or less than 1970), the total harvest in 1970 was 750 fish for an exploitation rate of 27.3 per cent on a population of 2,750 fish.

The Babine steelhead sport fishery declined in terms of angler success in the years following 1970 and 1971 (Table 5). The immediate assumption is that "excessive" exploitation rates in the years leading up to and including 1970 and 1971 finally resulted in a declining population. One might also assume that regulation changes, most notably reduced catch and possession limits,[1] resulted in the noticeable upswing in angler success rates in the 1976 and 1977 fisheries even though angler kills had been reduced by almost 75 per cent (Table 5).

[1]Steelhead catch and possession limits during the 1970 fall fishery were two fish per day and six fish in possession, and a maximum of 40 fish per year. In 1972 — 1 fish daily and 3 in possession. In 1976 — 1 fish daily and 1 in possession. In 1977 — the maximum river limit was reduced to 10 fish.

Table 5. Babine Steelhead angler harvest data[1], Autumn 1970 to Autumn 1977.

Fall Sport Fishery	Angler-Days	Number of Anglers	Kills	Releases	Catch/Day	Catch/Angler
1970	1706	379	597	1321	1.12	5.06
1971	1746	320	390	1265	0.95	5.17
1972	1211	260	231	668	0.74	3.46
1973	858	173	109	654	0.89	4.41
1974	1162	262	145	775	0.79	3.51
1975	1350	272	172	762	0.69	3.43
1976	1185	275	157	977	0.96	4.12
1977	1757	315	146	2016	1.23	6.86

[1]From Steelhead Harvest Analysis 1970-71, 1971-72, 1972-73, 1973-74, 1974-75, 1975-76, 1976-77, **1977-78**

However, one must also bear in mind the age structure of Babine steelhead when comparing run sizes and discussing factors contributing to apparent population declines or recoveries. Steelhead scale samples collected in 1967 and 1968 (Narver, 1969) and during the 1978 study (Table 4) showed that fish in their sixth year (3.2+ and 4.1+) are the most prevalent among "maiden" Babine steelhead (77, 76, and 54 per cent among 1967, 1968 and 1978 samples, respectively). It is then seen that the 5+ year—old progeny of the strong 1970—71 and 1971—72 year classes would appear in the 1976 and 1977 fall runs. In fact, angler success rates on the Babine during 1976 and 1977 were considerably higher than the previous four years (Table 5).

Based on these limited data, the assumption is that the Babine steelhead population is characterized by a six—year cycle, featuring two "high" years followed by four "low" years — Unfortunately, angler harvest data is not available (or not complete) for the years prior to 1970—71, hence acceptance or rejection of the above theory must depend upon several future years of angler harvest analyses.

Studies are presently under way to establish the extent to which Babine and other Skeena River steelhead stocks are being intercepted by the commercial gill net fleet based at Prince Rupert. An estimate of the proportion of the Babine run intercepted by the commercial fishery should be generated by head recoveries of nose tagged steelhead, 30,000 of which are to be released in the spring of 1979 as smolts.

Evidence that Babine steelhead, among other Skeena stocks, are in fact migrating through the estuary during the peak fishing period of late in July — early August (Chudyk and Narver, M.S. 1976) was established by radio tagging in 1978. Of seven upstreaming steelhead tagged with radio transmitters just above tide water in early August 1978, three were later located in Babine River (M.J. Lough, pers. Comm.).

CONCLUSIONS

Babine steelhead hatch, rear, migrate from and to and spawn in the largest and most stable lake—headed tributary of the Skeena River. Yet, there are “only” approximately 2500 adult fish in the population. Steelhead managers, anglers and other users must continually remind themselves of the scarcity of these fish in their wild state, particularly in rivers not as protected (naturally or by management), as the Babine River.

ACKNOWLEDGEMENTS

The success of this project was wholly attributable to the expertise and hard work of Fish and Wildlife Branch technicians R.E. Tetreau and G.G. Wadley. Special thanks are also due to the Bulkley Valley Steel— head Club (S.S.B.C.), in particular Messrs. T.C. Jones and E. Weger; and to M.J. Lough and S.P. Hatlevik, Fish and Wildlife Branch, who assisted from time to time in the project. The assistance of Fisheries and Oceans Service in providing equipment and accommodation is gratefully acknowledged.

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