STEELHEAD MIGRATION BEHAVIOUR AND TIMING AS EVALUATED FROM RADIO TAGGING AT THE SKEENA RIVER TEST FISHERY, 1989

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SKEENA FISHERIES REPORT # SK 69

JUNE, 1991

Abstract

Between July 17 and August 16, 1989, Fisheries Branch personnel attended the Skeena River test (gillnet) fishery vessel which operated 6 km upstream of the Skeena River estuary. One hundred and thirteen steelhead trout (Oncorhynchus mykiss) were captured, of which 55 (48.7%) were dead when landed, 49 were radio tagged (43.4%) and 9 (8.0%) were anchor tagged. None of the anchor tagged fish were recaptured. Among 49 fish radio tagged, 7 (14.3%) were relocated by a stationary radio receiver 98 km upstream of the tagging site. These seven fish had an average migration rate of 7.0 km/day, less than that of seine caught fish for the same section of the Skeena River (10.4 km/day). One radio tagged fish was caught and killed in a native net fishery while another 3 were found dead near the original tagging site. The survival of steelhead released from gillnets is questioned.

Acknowledgements

I would like to thank R. Johnson, skipper, and J. Bonneshrantz, crewman, of the Skeena test boat Silver Token as well as the Department of Fisheries and Oceans. Without their cooperation this study could not have taken place. Branch staff J. Lough and R. Tetreau assisted in tagging steelhead and recording catches, while R. Hooton and C. Spence conceived and directed the study and edited the manuscript.

Introduction

More than a decade ago Chudyk and Narver (1976) concluded that the Skeena River summer steelhead (Oncorhynchus mykiss) population was on the decline and only a small portion of its former abundance. They attributed this to the intensified sockeye gillnet fishery and its by-catch of steelhead. Further to this they hypothesized that discrete stocks of steelhead move separately through the commercial fishery and that some stocks would therefore be impacted more than others.

In 1978 and 1979, radio tagging studies were undertaken to identify

the timing of specific stocks of steelhead as they entered the Skeena River (Lough 1979, Lough, 1981). Cox-Rogers (1985) further investigated run timing by examining the morphological characteristics of individual Skeena tributary stocks. More recent telemetry studies by Spence (1989) also attempted to provide further run timing data. Although previous studies have provided useful information, there remains some uncertainties about stock specific run timing within and between years.

This study is a continuation of radio telemetry work conducted previously. The purpose of this study was to further refine stock specific run timing for steelhead within the Skeena River watershed. A secondary objective was to obtain migration rate data.

Study Area

The Skeena River is situated in west central British Columbia. It drains an area of approximately 52 000 square kilometres and is the second largest watershed located entirely within the province of British Columbia. Originating in the Skeena Mountains, it flows southwest for approximately 530 kilometres before emptying into Chatham Sound near Prince Rupert at the 54th parallel. Extensive commercial gillnet, seine and or/troll fisheries exist in the areas adjacent to the Skeena estuary between late June and September (Spence 1989).

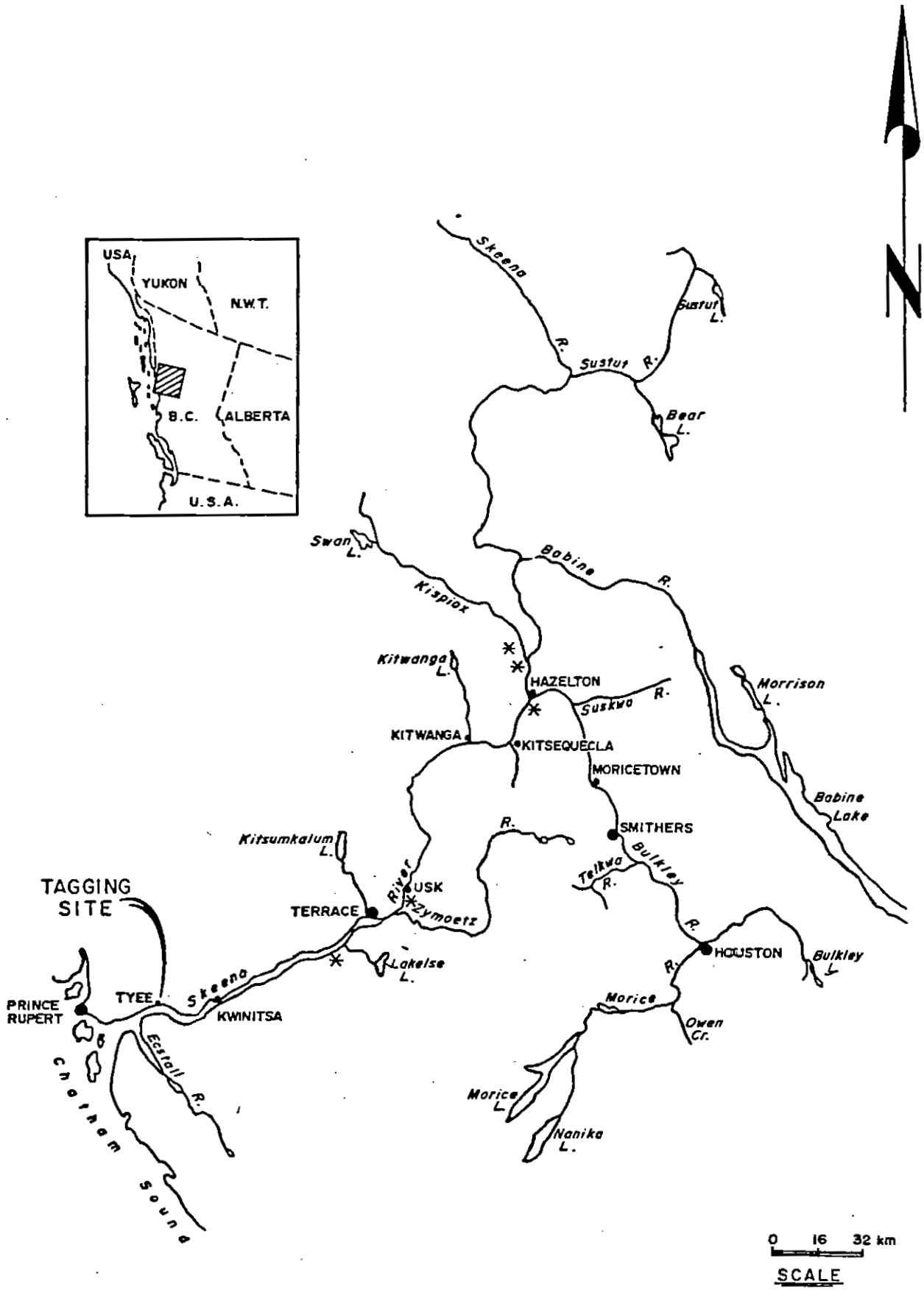

Figure I. Map of the Skeena River watershed showing important geographic reference points (* denotes stationary radio telemetry scanner stations).

In-river native and sport fisheries occur throughout the Skeena mainstem and several tributaries mainly through the July to October period.

The Skeena River watershed and its associated fisheries have been described previously (Chudyk and Narver 1976, Lough 1981, Spence 1989). The Skeena River test fishery operates at Tyee, approximately six kilometres upstream of the river mouth (Figure 1).

Materials and Methods

Tagging operations occurred aboard the Skeena River test fishing vessel, a twelve metre conventional gillnetter. The gillnet employed was 200 fathoms in length and between 2.5 and 2.7 fathoms deep (between 20 and 40 meshes deep, dependent on mesh size). The net consisted of 10 equal panels ranging in mesh size from 9 to 20 centimetres hung at a ratio of 2:1. Gillnet sets were made on each tide change occurring during daylight hours. The net was set perpendicular to the flow of the river for a duration of one hour. Retrieval of the net and removal of fish caught accounted for between three and thirty-one minutes of extra fishing time for the portion of net remaining in the water.

Live fish caught in the gillnet were either gently pulled from the net or the net was cut to extract fish. Steelhead were then held

for between two and seventy-five minutes in an oxygenated 150 litre plastic tub. Fish that appeared fatigued or bleeding (significant blood loss) were anchor tagged and released. Steelhead that appeared in good condition received orally implanted radio transmitters. Transmitters were gently inserted into the stomach with the aid of a hollow fibreglass tube (Hooton and Lirette, 1986) and two numbered anchor tags were affixed at the base of the dorsal fin to indicate the presence of a radio transmitter. Fork lengths were recorded for all steelhead captured. No anaesthetic was used during the handling process.

Radio transmitters (Lotek Engineering, Aurora, Ontario) of three sizes were used (1.6 x 4.5 centimetres, 1.6 x 7.0 centimetres, 2.0 x 7.5 centimetres). Transmitters were cylindrically shaped and equipped with an external whip antenna on the anterior end of the tag that was allowed to protrude from the fish's mouths. Four transmitters of different pulse types (pulse repetition encoding) were assigned to a given frequency to facilitate a reduction in scan time necessary to search through all frequencies at large. Transmitter life expectancy varied between five and ten months according to battery size. Radio frequencies ranged from 151.014 MHz to 151.274 MHz.

Transmitter equipped steelhead were monitored by both by stationary receivers (Lotek Engineering, Aurora, Ontario) and aircraft. Five receivers with three or four element Yagi antennas were deployed at strategic points (98, 128, 250, 265 and 269 kilometres) upstream of

the point of tagging. Telemetry equipment and migration monitoring has been described previously (Spence, 1989).

Migration rates were calculated by dividing the distance travelled by the elapsed time between detections. These rates therefore represent only an average for a given period.

Results and Discussion

One hundred and thirteen steelhead were captured in the test fishery net between July 17 and August 16, 1989. Of these, 55 (48.7%) were dead or died almost immediately after being landed. Among 58 steelhead which survived gillnetting, 49 were judged to be sufficiently healthy to be radio tagged. The remainder were visibly injured and received only an anchor tag (Table 1).

Steelhead were randomly distributed over the depth of the gillnet. Fish were gilled, girthed and tangled with no relationship between fish size and mesh size. Oguss and Andrews (1977) also found that there was no significant influence of mesh size on steelhead catch. However, in the same study it was determined that steelhead at the mouth of the Skeena appear most likely to be caught in the top of the gillnet.

Steelhead moved into the river with the greatest frequency on incoming tides. Gillnet sets made at low slack tide caught 95 (84%) of the 113 fish caught while sets made at high slack tide

caught only 18 (16%).

The length-frequency distribution of all steelhead caught in the Tyee test fishery between July 17 and August 16, 1989 (Figure 2) shows that steelhead ranged in length from 53 to 105 centimetres with females (64.6%) outnumbering males almost 2 to 1. The mean length of all 112 measurable steelhead obtained was 76.8 centimetres.

Only twenty eight radio tagged steelhead were relocated. Of these fish, a mere eight continued their upstream migration (as indicated by stationary receivers located along the mainstem Skeena River), three were found dead floating near the original tagging site, and the remaining seventeen fish lingered near the tagging site or drifted downstream after a brief upstream migration (the implication is that these fish had died and were drifting with the tidal influence). None of the anchor tagged steelhead were recovered.

Of the eight radio tagged fish that are known to have continued their upstream migration, one was killed in a native net fishery near Kitseguecla and two were recaptured and released by anglers (Sustut River, Babine River). There were no discernable patterns among the eight surviving fish. Appendix I describes and details the fate of the radio tagged steelhead.

Individual radio tagged fish that passed the first stationary

TABLE 1. Summary of adult steelhead dead when landed and the number radio and anchor tagged at the Tyee test fishery, July 17-Aug 16, 1989.

Date	Dead	Radio	Anchor	Total
17-Jul-89				0
18-Jul-89				0
19-Jul-89		1		1
20-Jul-89				0
21-Jul-89	1			1
22-Jul-89				0
Weekly Summary	1	1	0	2
23-Jul-89	2			2
24-Jul-89	2	1		3
25-Jul-89	1	2		3
26-Jul-89	1	1		2
27-Jul-89	2	1		3
28-Jul-89	1	1		2
29-Jul-89	3		1	4
Weekly Summary	12	6	1	19
30-Jul-89	5		1	6
31-Jul-89	3	5		8
01-Aug-89	2	2		4
02-Aug-89		4		4
03-Aug-89	2	3		5
04-Aug-89	2	5		7
05-Aug-89		1		1
Weekly Summary	14	20	1	35
06-Aug-89	2	1		3
07-Aug-89	4	6		10
08-Aug-89	2	2	1	5
09-Aug-89	2	1		3
10-Aug-89				0
11-Aug-89	2			2
12-Aug-89	2	3	2	7
Weekly Summary	14	13	3	30
13-Aug-89	6	2	1	9
14-Aug-89	2	3		5
15-Aug-89	4	2	1	7
16-Aug-89	2	2	2	6
Weekly Summary	14	9	4	27
Total	55	49	9	113
Percent	48.7%	43.4%	8.0%	100.0%
Total Tagged			58	
Percent			51.3%	

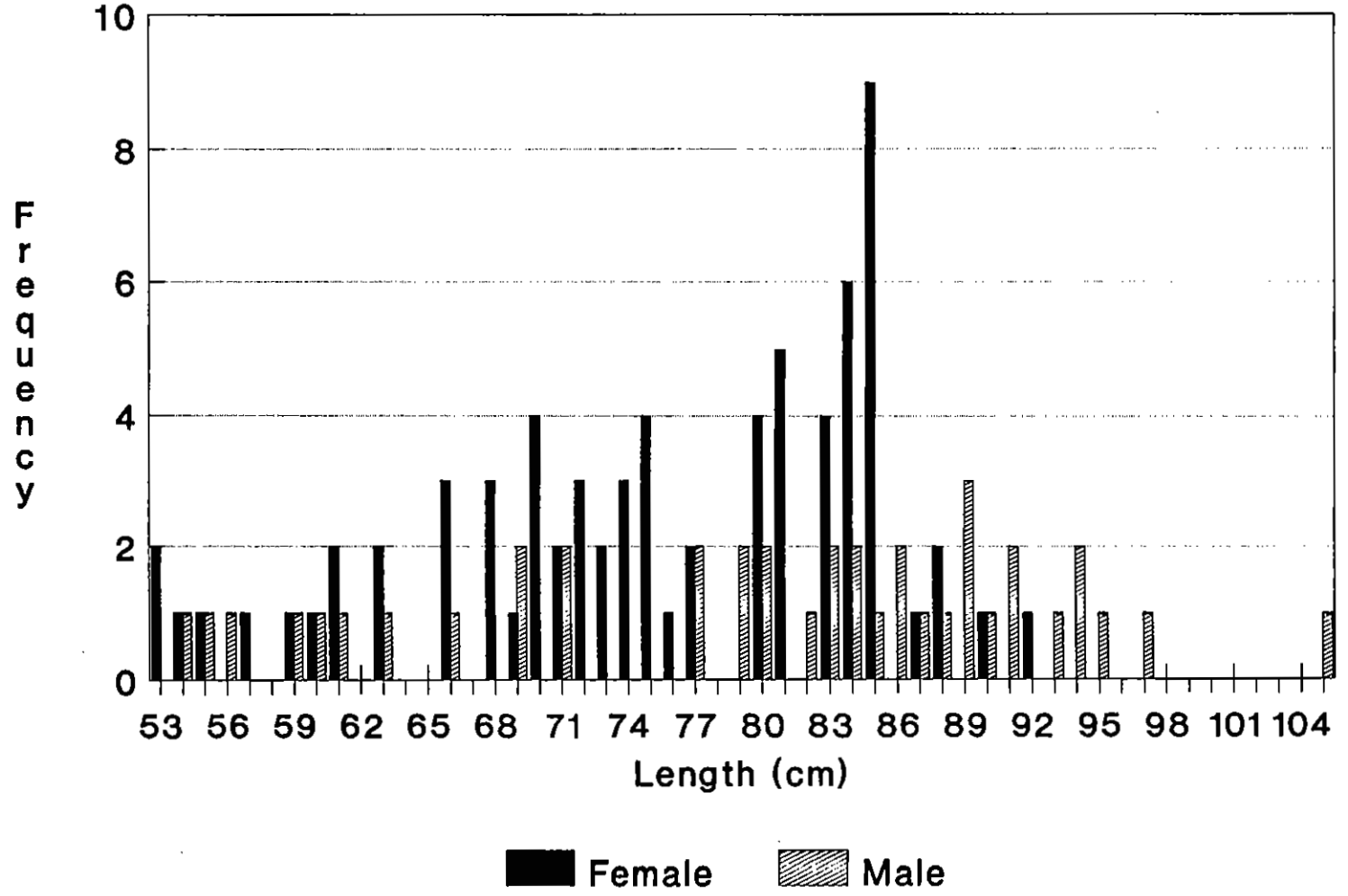

Figure 2. Length-frequency distribution of steelhead landed in the Tyee test fishery, 1989.

receiver 98 km upstream of the original tagging site had overall average migration rates ranging from 3.1 to 12.3 kilometres/day. Appendices II and III document the movements of radio tagged steelhead as located by aerial flights and stationary radio receivers respectively.

The mean migration rate for the seven surviving radio tagged fish was 7.0 kilometres/day. Spence (1989) found the mean rate of movement of seine caught Skeena River summer steelhead in the mainstem below the Zymoetz River to be 10.4 kilometres/day. The greater rate of migration for seine caught fish may be attributed to the fact that the seine captain first pursed the net alongside the vessel, at which time steelhead could be inspected with minimal handling. Selected fish were dip-netted and therefore perhaps not stressed to the same extent as gillnet caught steelhead.

One hundred and four radio transmitters were originally allocated for this study. After one month and the application of 49 transmitters the study was terminated due to the low survival of radio tagged steelhead. Only 6.2% of all steelhead caught during the study period are known to have survived despite the fact that gillnet sets were of short duration, only trained handlers were involved in the study, and steelhead radio tagged appeared to be in good condition upon release. Spence (1989) in comparison radio tagged 55 steelhead captured by a seine vessel during a 1988 study. Thirty nine (70.9%) of the radio tagged steelhead were accounted for in that study. The consistently high survival rates of

steelhead noted in other radio telemetry studies (Hooton and Lirette, 1986; Lirette and Hooton, 1988; Lough, 1979; Lough, 1981; McCleave et al., 1985; Spence, 1981; Spence, 1989) would indicate that tagging and handling effects were not the cause of the high mortality rate experienced in this study.

Low incidence of recaptures of steelhead tagged at the Tyee gillnetter was also documented between 1987 and 1989. Table 2 shows the comparison of tagging methods and recapture incidence for adult steelhead on the Skeena River. Riverine recaptures were lowest from fish caught by the Tyee test gillnetter (1.8% to 4.8%) and highest from fish caught by the Tyee test seine vessel (8.0%). Low riverine recapture rates indicate that fish tagged on the Tyee gillnetter have a lower incidence of survival than steelhead captured by seine net. Saltwater recaptures were highest from Tyee gillnet caught fish (0.8% to 1.6%) and lowest from Tyee seine caught fish (0.4%).

The fact that saltwater recaptures were highest from gillnet caught steelhead suggests that the migration behaviour of these fish was disrupted. The increased incidence of drop-back in gillnetted steelhead makes these fish more susceptible to recapture in the commercial fishery. The importance of this implication should not be overlooked as more that 900 vessels have participated in Skeena River area (Department of Fisheries and Oceans' statistical area 4) fisheries during a single commercial opening. Low survival of gillnet caught steelhead in combination with high incidence of

Table 2. Comparison of tagging methods and reported recapture incidence for adult steelhead on the Skeena River.

Collection Method	Year	Number Tagged	Saltwater Recaptures		Freshwater Recaptures	
			n	%	n	%
Tyee gillnet	1987	128	1	(0.8)	5	(3.9)
	1988	252	4	(1.6)	12	(4.8)
	1989	112	0		2	(1.8)
Tyee seine net	1988	238	1	(0.4)	19	(8.0)

drop-back strongly contradicts management strategies which require releasing gillnet caught steelhead; there is little benefit in releasing gillnet caught steelhead that are in poor condition during large scale commercial openings when the probability of recapture is high.

Harbour seals (Phoca vitulina) were evident throughout the study period and could have affected survival rates of radio tagged steelhead. Stressed and fatigued radio tagged steelhead would likely have been more vulnerable to seal predation. While in the test net, a single steelhead was decapitated by a harbour seal. This was the only steelhead landed whose death could be directly attributed to harbour seal predation. However, it was not possible to estimate the number of fish removed from the net by seals prior to net retrieval.

Conclusions

1. Of 113 Skeena River steelhead captured by the Tyee test fishing gillnetter, 55 died during or immediately after capture. Of the 49 fish radio tagged and 9 anchor tagged, only 8 steelhead are known to have ascended the Skeena River mainstem. Of those 8 fish, a single steelhead was captured and killed in a native net fishery. Only 6.2% of gillnet captured steelhead are known to have survived.

2. Steelhead were captured in all mesh sizes irrespective of fish size, and at random throughout the depth of the net.

3. Steelhead ascending the Skeena River mainstem migrated at rates averaging 7.0 kilometres/day in the area downstream of the Skeena-Zymoetz River confluence (n=8).

4. This study indicated that very few gillnet caught steelhead survive. There is little to be gained by releasing steelhead that are in poor condition when the probability for recapture by another gillnet vessel is high and chance of survival is minimal.

5. This study failed to better define patterns in the timing of individual stocks of steelhead within the Skeena River watershed due to the small number of fish that survived the gillnet and subsequent handling and tagging.

Recommendations

1. The results from this study indicate that steelhead released from gillnets have a high mortality rate. Combined with the increased susceptibility for recapture during times of intense fisheries, release of gillnet caught steelhead is not a desirable nor beneficial management option.

2. Studies aimed at reducing steelhead catch by altering mesh size should be approached with scepticism as steelhead were captured in all mesh sizes independent of fish size.

3. Studies aimed at reducing steelhead catch by altering the depth at which the gillnet fishes should also be approached with scepticism as steelhead were captured randomly throughout the depth of the gillnet. This recommendation pertains specifically to the in-river area; differing results may be noted in ocean fisheries.

4. Seine net vessels should be employed in any further radio telemetry studies of this nature to reduce release mortality; fish survival is statistically significantly higher in seine rather than gillnet caught fish.

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Appendix I. Description and fate of radio tagged adult steelhead caught in the Tyee test fishery, Skeena River, 1989.

Date	Sex	Length (cm)	Tag #	Freq.	Type	Condition/Comments	Fate
July 19	F	75	150	151.014	double	fair scale loss, some blood loss, held 45 min, strong	Never relocated
July 24	F	88	151	151.034	double	fair scale loss, held for 1 hr, strong	Never relocated
July 25	F	74	152	151.054	double	fair scale loss, some blood loss, good shape yet fatigued	Never relocated
July 25	F	68	153	151.074	double	fair scale loss, some blood loss	Relocated, dead?
July 26	F	81	154	151.094	double	fair scale loss, lots of vigor	Relocated, dead?
July 27	M	77	155	151.114	double	heavy scale loss, held in tube for 0.5 hr, revived well	Never relocated
July 28	F	83	156	151.135	double	fair scale loss, some blood loss held 45 min, strong	Relocated, alive
July 31	M	80	157	151.154	double	fair scale loss, some blood loss held 45 min, strong	Never relocated
July 31	F	69	158	151.174	double	fair scale loss, held 45 min	Never relocated
July 31	F	63	159	151.195	double	fair scale loss, held 45 min	Never relocated
July 31	F	72	160	151.215	double	fair scale loss, held 30 min	Never relocated
July 31	M	54	161	151.235	double	heavy scale loss, held 45 min, strong	Never relocated
Aug 1	F	85	162	151.254	double	fair scale loss, vigorous, slow on release, held 10 min	Relocated, dead?
Aug 1	M	94	163	151.274	double	little scale loss, hanging in net, released immediately	Relocated, alive, Babine R.
Aug 2	F	81	228	151.014	fast	fair scale loss, strong	Never relocated
Aug 2	F	70	229	151.034	fast	little scale loss, strong	Relocated, alive, Morice R.
Aug 2	F	85	230	151.054	fast	caught during net retrieval, released in excellent condition	Never relocated
Aug 2	F	70	231	151.074	fast	fair scale loss, released quickly, good condition	Relocated, dead
Aug 3	M	90	232	151.094	fast	little scale loss, swam away strongly when released	Relocated, dead
Aug 3	M	88	233	151.114	fast	in excellent shape	Relocated, dead?
Aug 3	F	68	234	151.135	fast	little scale loss, good condition	Relocated, alive, Bulkley R.
Aug 4	M	77	235	151.154	fast	in excellent shape, little scale loss, caught along lead line	Never relocated
Aug 4	F	85	236	151.174	fast	fair scale loss, caught along lead line, vigorous	Never relocated
Aug 4	F	85	238	151.195	fast	little scale loss, some blood loss, held 15 min, strong	Relocated, dead?
Aug 4	F	66	240	151.235	fast	fair scale loss, caught along lead line, good condition	Relocated, dead?
Aug 4	F	68	241	151.254	fast	fair scale loss, little blood loss, weak on release	Relocated, dead?
Aug 5	F	85	242	151.274	fast	little scale loss, held 10 min, good condition	Relocated, dead?
Aug 6	F	73	202	151.014	slow	recapture, held 15 min, weak but revived to fair condition	Relocated, alive
Aug 7	M	89	204	151.054	slow	caught in large mesh, girthed, little scale loss, strong	Never relocated
Aug 7	F	87	205	151.074	slow	little scale loss, excellent condition	Relocated, dead
Aug 7	F	72	206	151.094	slow	some blood, good condition	Never relocated
Aug 7	F	63	207	151.114	slow	fair scale loss	Never relocated
Aug 7	F	61	208	151.135	slow	excellent condition	Never relocated
Aug 7	F	77	209	151.154	slow	fair scale loss, caught on cork line	Dead, Native net
Aug 8	M	105	210	151.174	slow	little scale loss around head, good condition	Relocated, dead?
Aug 8	F	84	211	151.195	slow	good condition	Relocated, alive, Bulkley R.
Aug 9	M	93	212	151.215	slow	fair scale loss around middle	Never relocated
Aug 12	M	82	213	151.235	slow	fair scale loss around middle, 2 small seal bites, strong	Never relocated
Aug 12	F	84	214	151.254	slow	fair scale loss around middle, strong on release	Relocated, dead?
Aug 12	F	77	215	151.274	slow	little scale loss, some blood loss, vigorous on release	Relocated, dead?
Aug 13	M	85	176	151.014	triple	little scale loss, strong, recaptured after release, ok	Relocated, dead?
Aug 13	F	85	232	151.094	fast*	little scale loss, some blood, split tail, revived	Never relocated
Aug 14	F	80	233	151.114	fast*	little scale loss, held briefly, strong fish	Never relocated
Aug 14	M	91	177	151.034	triple	little scale loss, held 10 min, energetic on release	Relocated, alive, Sustut R.
Aug 14	M	84	178	151.054	triple	on cork line, held 15 min, strong on release	Relocated, dead?
Aug 15	M	84	179	151.074	triple	fair scale loss, held 15 min, strong fish	Relocated, dead?
Aug 15	M	87	180	151.094	triple	little scale loss, held 5 min, strong fish	Relocated, dead?
Aug 16	F	85	181	151.114	triple	fair scale loss, held 15 min, strong fish	Never relocated
Aug 16	F	83	182	151.135	triple	fair scale loss, held 75 min as an experiment, strong	Relocated, dead?

Appendix II. Aerial tracking of radio tagged adult steelhead caught in the Tyee test fishery July 17-August 16, 1989, and the distance travelled upstream of the tagging site.

Date Tagged	Tag #	Aug 8 (km)	Aug 15 (km)	Aug 25 (km)	Miscellaneous Tracking (date, km)
Jul 28	156	58	66	89	
Aug 1	163		21	67	
Aug 2	229	79	122		Oct 13 424
Aug 4	235	55			Oct 6 253
Aug 7	204	24	82	94	
Aug 9	212		55	99	
Aug 14	178			55	Oct 11 451

Appendix III. Dates that radio tagged adult steelhead caught in the Tyee test fishery July 17-Aug 16, 1989, were detected by stationary radio receivers positioned along the mainstem Skeena River.

Date Tagged	Tag #	Lakelse Station 98 km u/s Tyee	Copper Station* 128 km u/s Tyee	Bulkley Station 250 km u/s Tyee	Skeena Station 265 km u/s Tyee
Jul 28	156	Aug 25			
Aug 1	163	Sept 1			
Aug 2	229	Aug 9		Aug 24	
Aug 4	235	Aug 11	Aug 13	Aug 21	
Aug 7	204	Aug 25		Sept 3	Sept 4
Aug 9	212	Aug 24		Sept 3	
Aug 14	178	Aug 29			

* removed Aug 23