

P/FR/SK/39
DE LEEUW, A. D.

STEELHEAD OF THE YAKOUN
RIVER: SOME ASPECTS OF
CPRJ c. 1 mm SMITHERS

STEELHEAD OF THE YAKOUN RIVER:

SOME ASPECTS OF THEIR LIFE HISTORY,

POPULATION SIZE AND THE SPORT FISHERY,

1981 -82

by

A.D. de Leeuw
and
M.R. Whately

BRITISH COLUMBIA MINISTRY OF ENVIRONMENT
FISH AND WILDLIFE BRANCH

SMITHERS, B.C.

Skeena Fisheries Report # 82-1
October, 1983

TABLE OF CONTENTS

	Page
INTRODUCTION	1
DESCRIPTION OF STUDY AREA AND THE FISHERY	2
METHODS	5
RESULTS	6
Spatial and Temporal Distribution	7
Movement and Residency	9
Age and Size	10
Population Estimate	15
DISCUSSION	15
Population Size and Questionnaire Catch	15
Stream Migration and Residency	17
Repeat Spawner Rate	18
SUMMARY	20
ACKNOWLEDGEMENTS	21
REFERENCES	22
APPENDICES	24

INTRODUCTION

Fishing is an important contributor to the socio-economic fabric of life on the Queen Charlotte Islands. In addition to extensive commercial and Indian fisheries, a major sport fishery exists on both tidal and non-tidal waters. In the latter, angling for coho salmon (Oncorhynchus kisutch), steelhead trout (Salmo gairdneri Richardson) and resident and sea-run cutthroat trout (Salmo clarki) is a popular activity of both "Islanders" and growing numbers of off-Island visitors.

The Islands' most intensive sport fishery for steelhead takes place on the Yakoun River which accounts for approximately 60% of all Queen Charlotte Island steelhead angler effort (Billings, 1982). As a first step towards gaining an understanding of this complex river and its important steelhead fishery, the Fish and Wildlife Branch sponsored a steelhead tagging study by the Port Clements Rod and Gun Club, which was carried out during the winter steelhead season of 1981-82. The project was funded by the Salmonid Enhancement Program as a Public Participation project. The objectives of the study were to:

1. Determine steelhead run timing and degree of movement within the river.
2. Estimate population size.
3. Describe life history characteristics.

DESCRIPTION OF THE STUDY AREA AND THE FISHERY

The Yakoun River flows north for approximately 60 km from its source in Yakoun Lake to its entry into Massett Inlet, near Port Clements, Graham Island, Q.C.I. (Figure 1). The river is of generally low gradient (Yakoun Lake's elevation is only 100 m) and heavily "tea-stained", which is typical of most streams that drain the bogs and rain-saturated spruce forests of the North coast. The valley through which the Yakoun flows has been heavily logged except for a portion of the watershed near the lake and near the mouth. The valley is therefore laced with active, semi-active and abandoned logging roads which make much of the river readily accessible.

During the 1972-73 season 13 km of the upper Yakoun were closed, by regulation, to angling (Figure 1). The closure was instituted primarily to protect spawning chinook salmon (Oncorhynchus tshawytscha) but was later extended to provide a sanctuary for steelhead. The closure presently encompasses the period from October 1 to April 30. Since the lower 16 km of the river are virtually inaccessible to anglers, the sport fishery is confined to the middle sections of the river, approximately 33 km in total length.

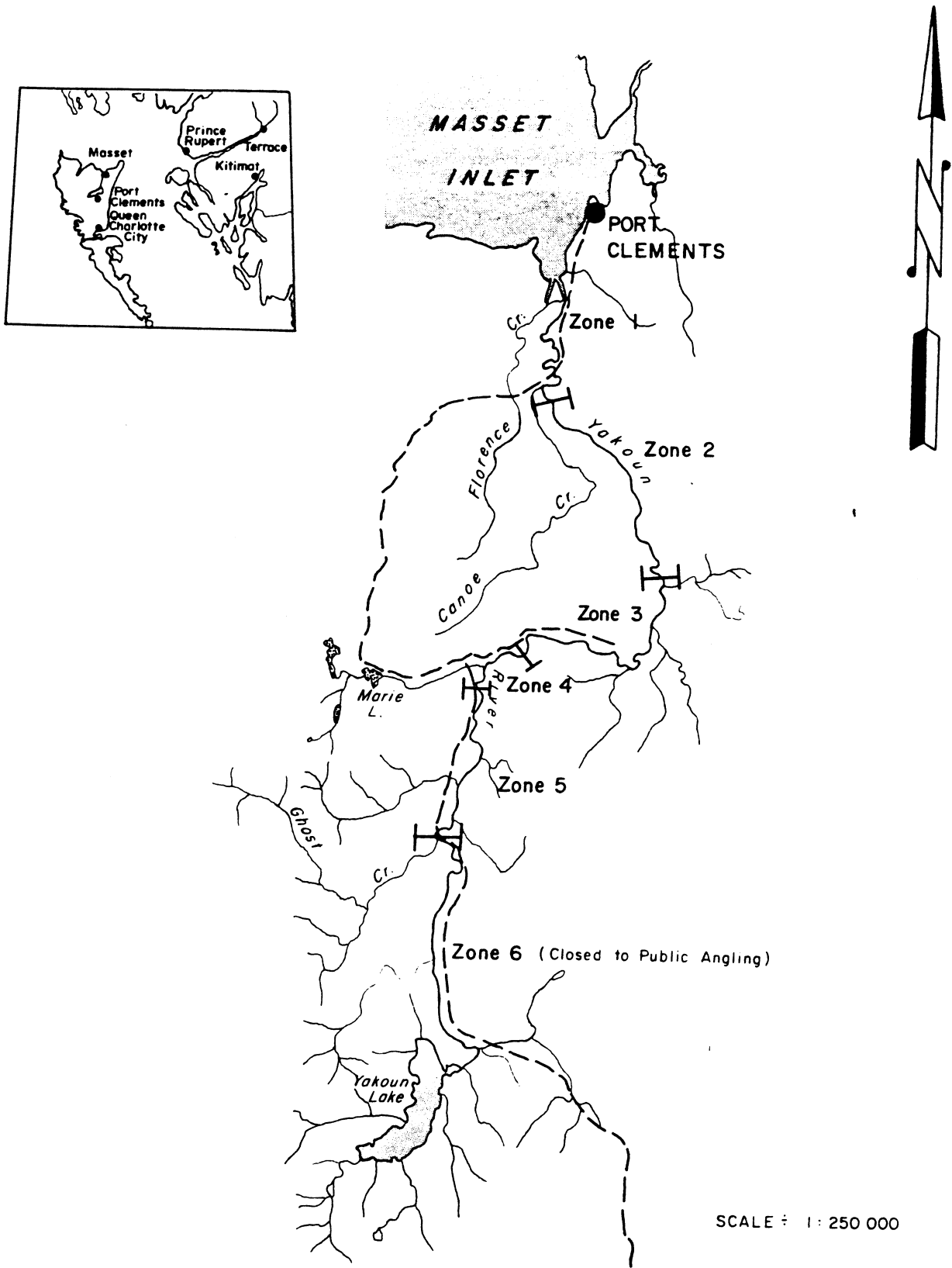


Fig. 1 Yakoun River Study Area and Zone Location

A summary of steelhead sport fishery data is presented below (Table 1). A steady decline in success rates from a high of one fish per day in 1971 to a low of about .3 fish per day in 1977 is shown, followed by a slow increase for the remaining years of record. The steelhead harvest (kill) for the same period has declined from a high in the early 1970's of approximately 900 fish to about 400 fish in more recent years.

Table 1. Steelhead sport catch data¹ for Yakoun River 1970-1981.

Season	Angler Days	Kills	Releases	Total Catch	Catch/day
1970-71	997	523	482	1005	1.00
1971-72	1431	888	616	1504	1.05
1972-73	2122	884	929	1813	0.85
1973-74	1664	633	398	1031	0.62
1974-75	1624	553	316	869	0.53
1975-76	1997	666	341	1007	0.50
1976-77	1528	287	229	516	0.34
1977-78	1519	356	304	660	0.43
1978-79	1477	400	254	654	0.44
1979-80	1603	422	526	948	0.59
1980-81	1383	369	569	938	0.68
1981-82 ²	1916	392	1495 ²	1887 ²	0.98
Mean	1604	531	538	1069	0.67

¹Steelhead Harvest Analysis. B.C. Fish and Wildlife Branch annual reports.

²Data for 1981-82 appears abnormally inflated and may be the result of the tagging study and its publicity.

METHODS

For the purposes of the tagging study, the river was partitioned into six zones, as follows:

- Zone 1 - Mouth of Yakoun River to Canoe Creek.
- Zone 2 - Canoe Creek to Log Creek.
- Zone 3 - Log Creek to Br. 40/Br. 40A junction.
- Zone 4 - Br. 40 junction to Gold Creek.
- Zone 5 - Gold Creek to Ghost Creek.
- Zone 6 - Ghost Creek to Yakoun Lake.

Adult steelhead were captured using conventional angling methods, and tagged with variously coloured, numbered anchor (spaghetti) tags. Fork lengths of fish were measured, weights were generally estimated. A few scales were removed from all steelhead captured (excluding recaptures) for age determination. Gender was noted as was date of capture, tag number and color, and location of capture. The fish were released at the capture site.

A large sign located on the primary access road to the river and notification in the local media alerted anglers to the tagging study and urged cooperation.

The scales were viewed in the laboratory using a dissecting microscope. The two best scales from each sample were selected, cleaned and mounted on gummed cards. Impressions of the scales were then made on acetate cards by applying heat and pressure. A Leitz Prado projector was then used to examine each scale for determination of freshwater and ocean age.

Population size was determined using the Schnabel, Schumacher and

Schnabel–Chapman adjusted multiple census estimation methods (Ricker, 1958). The formulas were:

$$\text{Schnabel: } \hat{N}_1 = \frac{\sum (C_t M_t)}{R}$$

$$\text{Schumacher: } \hat{N}_2 = \frac{1}{N} = \frac{\sum (M_t R_t)}{\sum (C_t M_t)}$$

$$\text{Schnabel, Chapman Revised: } \hat{N}_3 = \frac{\sum (C_t M_t)}{R+1}$$

where: t = 5 day time period
 C_t = Total catch during time t
 M_t = Total fish tagged and released during time t
M = Sum of M_t
 R_t = Total recaptures during time t
R = Sum of R_t

RESULTS

Steelhead were taken from October through to March. A total of 224 fish were captured, of which 3 were released untagged and 15 were killed. Of the latter, 14 were females. The remaining 206 were successfully tagged and released, of which 25 were recaptured. Three were recaptured twice (Appendices 1 and 2).

SPATIAL AND TEMPORAL DISTRIBUTION OF CATCH

The catch of steelhead was not distributed evenly from zone to zone (Table 2).

Table 2. Yakoun River steelhead catch by zone.

ZONE	ZONE LENGTH (KM)	CATCH	CATCH/KM
1	8.5 (tidal)	0	0
2	11.4	0	0
3	10.1	22	2.2
4	6.4	71	11.1
5	8.8	75	8.5
6	13.3 (closed)	53	4.0
TOTAL	58.5	221 ¹	3.8

¹Location of capture was not indicated for 3 of 224 fish.

The greatest number of fish were taken in Zones 4 and 5, with the former accounting for 71 steelhead (32%) and the latter, 75 steelhead (34%). In terms of steelhead caught per length of stream, Zones 4 and 5 accounted for catches of 11.1 and 8.5 steelhead per km respectively. The average catch was 3.8 per km.

Although steelhead were in the river from October to March, numbers of tags placed by Club members were highest during the last 3 weeks of November (Table 3). The large catches of late January and early February are attributed primarily to Fish and Wildlife personnel working in the upper reaches.

Table 3. Number of steelhead captured during the 1981-82 tagging study on Yakoun river. Recaptures not included. Data grouped by 10-day periods.

Date	MALES		FEMALES		TOTAL
	No. Tagged	Mean Length (sample size)	No. Tagged	Mean Length (sample size)	
10/1-10	0	---	1	---	1
10/11-20	1	---	0	---	1
10/21-30	1	---	2	78.8 (2)	3
11/1-10	7	85.9 (5)	3	73.3 (2)	10
11/11-20	14	82.5 (12)	25	78.2 (15)	39
11/21-30	20	72.1 (18)	27	76.0 (23)	47
12/1-10	2	---	8	77.5 (1)	10
12/11-20	6	83.0 (6)	3	76.6 (3)	9
12/21-30	3	76.6 (3)	9	76.2 (3)	12
01/1-10	3	87.6 (3)	1	78.1 (1)	4
01/11-20	2	76.2 (2)	1	---	3
01/21-30	21	78.4 (18)	31	76.8 (29)	52
02/1-10	11	81.1 (11)	16	78.8 (16)	27
02/11-20	0	---	0	---	0
02/21-30	0	---	0	---	0
03/1-10	0	---	0	---	0
03/11-20	0	---	4	70.5 (4)	4
03/21-30	1	83.8 (1)	1	86.4 (1)	2
	92	80.7 (79)	132	77.3 (100)	224

MOVEMENT AND RESIDENCY

Of the 28 recaptured steelhead, 18 (64%) were taken in the zone of initial capture and tagging (Table 4). The number of days between captures for these fish ranged from 0 to 152 days. Movement was recorded for 16 steelhead both within zones and between zones. Large distances however were not evident and only one fish was observed to have moved through more than one zone between initial capture and recapture. Of 173 fish caught and tagged in Zones 1 through 5, only 5 were recaptured by fisheries technicians in the closed area (Zone 6).

Table 4. Movement and residency of recaptured steelhead in the Yakoun River, 1981-82.

Zone to Zone Movement	Numbers of Fish	Distance (km)			Time (days)		
		Min.	Max.	Ave.	Min.	Max.	Ave.
3-3	1	0					28
4-4	6	0	0.8	0.13	0	48	12
4-5	5	6.4	7.6	7.3	7	43	21
4-6	2	11.1	18.6	14.9	31	78	54
5-5	6	0			0	152	35
5-6	3	11.1	11.1	11.1	55	83	68
6-6	5	0			0	5	3
Total	28						

AGE AND SIZE

Although scales were removed from 224 fish, only 172 samples were readable for fresh water and 204 for ocean age determination. Of the 9 age groups identified, the 3.3 age group was the most dominant (60.5%) (Table 5). The next most common age group was 3.2 (23.8%), with the remaining 7 age groups contributing less than 5% in total (Table 5).

Table 5. Steelhead trout age groups from Yakoun River, 1981-82 (n = 172)

Age Group	Number of Steelhead	Number of Males	Number of Females	Percent of Total
2.2	3		3	1.7
2.3	4		4	2.3
3.2	41	25	16	23.8
3.3	104	36	68	60.5
3.4	7	5	2	4.1
4.3	4	1	3	2.3
2.1S1	1	1		.6
3.1S1	1		1	.6
3.2S1	7	1	6	4.1
	172	69	103	100

Three years of juvenile fresh water residency was the prevailing (93.0%) feature of Yakoun River fish (Table 6). The remaining 7% spent either 2 or 4 years in fresh water prior to ocean migration.

Seventy-three and 23 percent of all fish spent 3 and 2 years respectively in the marine environment prior to their first spawning (Table 7).

Overall repeat spawner rate was 4.4%. The majority of these fish were females of ocean age .251 (Table 8).

Overall sex ratio favoured females (59%) over males (41%). This ratio was consistent throughout the study; females were virtually always found in slightly greater numbers than males. On the other hand, there was no evidence of one sex entering the fishery either before or after the other.

The average length of males (80.7 cm) was only marginally larger than that of females (77.3 cm) (Table 3). No discernable pattern of large fish entering the river during any specific part of the season was evident, although the average length of males in early November were slightly larger (85.9 cm) than the seasonal mean (80.7). Maximum and minimum lengths of males were 96.5 and 50.8 cm respectively, while for females they were 94.6 and 43.2 cm respectively.

Weight and length of fish was closely related to ocean age, with an average weight increase of approximately 2.5 kg per ocean year (Table 9). After two years of ocean growth, males were generally smaller than females, the former weighing 3.5 kg, the latter weighing 3.8 kg. This situation was reversed however in steelhead of older ocean residency, with 3 and 4 year ocean males averaging 5.8 and 8.27 kg. respectively, while females of similar ages averaged 5.0 and 6.4 kg.

Table 6. Number of male and female steelhead of different freshwater ages, Yakoun river, 1981-82 (n=172).

Freshwater Age	Males	Females	Total	% of Total
2	1	7	8	4.7
3	67	93	160	93.0
4	1	3	4	2.3
	69	103	172	100

Table 7. Numbers and percentages of male and female steelhead of different ocean ages, Yakoun River, 1981-82 (n=204).

Ocean Age	Males	Females	Total	% of Total
.1	0	1	1	.5
.2	26	21	47	23.0
.3	54	95	149	73.0
.4	5	2	7	3.5
	85	119	204	

Table 8. Numbers and percentages of repeat spawning steelhead of different ocean age groups sampled from the Yakoun river (n=9, or 4.4% of 204).

Ocean Age	Males	Females	Total	% of Total
.1S1	1	2	2	22.2
.2S1	1	6	7	77.8

Table 9. Round weights and fork lengths of male and female steelhead of different ocean ages from the Yakoun River in the fall and winter of 1981-92. Numbers of fish for each age category vary because of incomplete information as to weight or length or both.

Sex	Ocean Age		Range
Average Wts - kg			
Male	.2	3.5	1.3 - 4.0
	.3	5.8	2.7 - 6.8
	.4	8.3	7.7 - 9.1
Female	.1	1.0	1.0 -
	.2	3.8	2.0 - 4.5
	.3	5.0	3.0 - 7.7
	.4	6.4	5.0 - 7.7
Average Lengths - cm			
Male	.1	---	----
	.2	66.2	50.0 - 71.1
	.3	86.8	78.7 - 94.0
	.4	90.8	86.4 - 94.0
Female	.1		
	.2	71.3	55.9 - 77.5
	.3	79.0	71.1 - 87.6
	.4	83.8	80.5 - 94.5

Table 10. Yakoun River steelhead population estimates during the Winter of 1981-82.

Date (t)	$C_t M_t$	M	R_t	R	N_1	N_2	N_3		
Oct. 1-5	1	1		0	0	0	0	0	0
Oct. 6-10	0	0		1	0	0	0	0	0
Oct. 11-15	0	0		1	0	0	0	0	0
Oct. 16-20	1	1		1	0	0	0	0	1
Oct. 21-25	0	0		2	0	0	0	0	1
Oct. 26-30	3	2		2	0	0	0	0	7
Nov. 1-5	3	3		4	0	0	0	0	19
Nov. 6-10	8	5		7	1	1	75	65	37
Nov. 11-15	17	15		12	2	3	93	94	70
Nov. 16-20	24	22		27	0	3	309	658	232
Nov. 21-25	26	21		49	3	6	367	465	314
Nov. 26-30	26	21		70	2	8	503	661	447
Dec. 1-5	2	1		91	1	9	467	554	420
Dec. 6-10	10	10		92	0	9	569	761	512
Dec. 11-15	10	7		102	3	12	512	581	473
Dec. 16-20	2	2		109	0	12	530	614	489
Dec. 21-25	4	0		111	0	12	567	683	523
Dec. 26-30	9	7		111	2	14	557	640	520
Jan. 1-5	1	1		118	0	14	566	655	538
Jan. 6-10	3	2		119	0	14	591	700	552
Jan. 11-15	0	0		121	0	14	591	700	552
Jan. 16-20	4	2		121	1	15	584	675	548
Jan. 21-25	0	0		123	0	15	584	675	548
Jan. 26-30	59	52		123	7	22	728	837	697
Feb. 1-5	30	27		175	3	25	851	1033	818
Feb. 6-10	0	0		202	0	25	851	1033	818
Feb. 11-15	0	0		202	0	25	851	1033	818
Feb. 16-20	0	0		202	0	25	851	1033	818
Feb. 21-25	0	0		202	0	25	851	1033	818
Feb. 26-30	0	0		202	0	25	851	1033	818
Mar. 1-5	0	0		202	0	25	851	1033	818
Mar. 6-10	0	0		202	0	25	851	1033	818
Mar. 11-15	0	0		202	0	25	851	1033	818
Mar. 16-20	4	2		202	0	25	883	1100	849
Mar. 21-25	4	2		204	2	27	848	1001	818
Mar. 26-30	0	0		206	0	27	848	1001	818
Apr. 1-5	0	0		206	0	27	848	1001	818
Apr. 6-10	0	0		206	0	27	848	1001	818
Apr. 11-15	0	0		206	0	27	848	1001	818
Apr. 16-20	1	0		206	1	28	825	948	797
Apr. 21-25	0	0		206	0	28	825	948	797
Apr. 26-30	0	0		206	0	28	825	948	797
	$\Sigma = 252$	$\Sigma = 206$		206	$\Sigma = 28$	28	825	948	797

POPULATION ESTIMATION

The Schnabel, Schumacher and Schnabel-Chapman Revised census population methods estimated 825, 948 and 797 steelhead respectively in the Yakoun River during and at the end of the 1981-82 winter season (Table 10.)

DISCUSSION

POPULATION SIZE AND QUESTIONNAIRE REPORTED CATCH

One of the underlying assumptions made during a tagging study of this nature is that those fish captured, tagged, released and recaptured (catch) accurately reflect the behaviour of the steelhead population as a whole (catch + fish not caught). Several factors deviate from this condition.

Spatial catch distribution along the Yakoun River was far from homogeneous. Large catches in Zones 4 and 5 were likely the result of good angler access to these areas rather than some habitat or biological criterion. The river from lake to estuary is remarkably similar throughout. Furthermore, the high catches during November are at least partly attributable to the Yakoun River being the only readily accessible stream with a substantial steelhead run during that time. The population

estimate of 857 steelhead is therefore somewhat of an underestimate since catch was preferentially distributed over time (November) and place (Zones 4 and 5). The Schnabel and associated population estimates are still appropriate however, even if all the necessary requirements are not precisely met (Ricker, 1970).

Despite the above, the degree of difference between questionnaire reported catch (1887, Table 1 includes 392 killed and 1495 released) and estimated population size of steelhead (857) is too large to be acceptable. This is especially true since the repeat capture rate of steelhead angled during the study period was only 12%. If the questionnaire catch is accepted, then either the population estimate is less than half of what it should be, or individual fish are caught and released 2 to 3 times each. Both scenarios are unlikely. The most probable reason for the large discrepancy between the two figures is the inflated steelhead harvest questionnaire estimate. A 32% positive bias (range from 4% to 63%) has been noted in B.C. steelhead angler questionnaire kill estimates when compared to on site creel census results (Billings, 1982). Similar findings were observed in specific areas and/or streams of the province (Hemus, 1974; Hooton, 1978; Walker, et.al., 1974). Applying this percentage to 1887, a reduced catch of 1283 is obtained, slightly larger than the total before harvest estimated steelhead population (1248). On the Copper River, a stream also on the Charlottes, a conservative population estimate of 502 steelhead comfortably encompasses the total catch (296) for that time period (Chudyk, 1982). Billings (1982) goes on to state that steelhead harvest questionnaire estimation errors

should be examined on a river specific basis. The overall population estimate and questionnaire reported angler catch results are disturbing to say the least, with a large catch rate of a possibly small steelhead population.

STREAM MIGRATION AND RESIDENCY

On the basis of recapture data, it appears that Yakoun River steelhead migrate into an area (zone) and stay there. Initial migration rate is likely related to stream flows, with fish moving rapidly when the stream is in freshet and angling conditions are poor. Once fish reach a holding area, movement appears minimal, since 60% of recaptured steelhead were taken in their original capture zones. Credibility of this result is questionable as only 14% of all tagged fish were recaptured.

Avoidance response is unlikely since at least 3 steelhead were recaptured 10 minutes after their original tagging and an additional 3 were captured 3 times. Tackle avoidance was also not deemed a consideration in a similar study on the Babine River (Whately, et. al., 1979). The most plausible reasons therefore for the low repeat capture rate are migration into non angling waters and small initial sample size. The latter was primarily due to the unequal catch distribution as discussed previously. Long term residency by steelhead within specific stream locations is accepted in this case, since the data suggests it (albiet circumstantial) and no other local information is available.

REPEAT SPAWNER RATE

Description of the age, size and sex ratios of Yakoun River steelhead has been adequately discussed in the results section. The low repeat spawner rate of 4.4% however is inconsistent with other winter steel head streams.

On Vancouver Island the following repeat spawner rates were encountered; Somas River 15% (Horncastle, 1981), Nanaimo River 18% (Narver, et. al., 1974), while on the Big Qualicum it ranged from 2.3% to 20% (Peterson, 1968). Further north, on the Kitimat River, multiple spawners comprised 32% of the steelhead population (Chudyk, et. al, 1977), in St. Petersburg, Alaska it was 32.7% (Jones, 1975), and on the Copper River (Queen Charlotte Islands) it was 19.4% (Chudyk, 1982). Repeat spawner rates in other coastal streams therefore although variable from year to year, are generally higher than it was on the Yakoun River.

As with the Copper river, concern was expressed over the Yakoun River and the incidental catch of steelhead kelts by the native gillnet food fishery of sockeye salmon. Entry dates of sockeye salmon to the Yakoun River overlaps with the exodus of steelhead kelts. The food fishery could therefore have a negative impact on the steelhead repeat spawner rate.

The 1981 food fishery (the season affecting this study) commenced on April 29, and ended June 15, encompassing 7 4-day periods, or 57% of the total native food fishery season. If all kelts emmigrated during this time, and assuming 15 to 20% to be a "normal" repeat spawner rate, then the remaining 43% of the season (non food fishing days) does not account

for the low repeat spawner rate. Complete removal of the gillnet fishery would theoretically increase the number of multiple spawners from 4.4 to about 10% ($4.4\% \div .43 = 10.2\%$). This estimate is still half of what it should be, and completely ignores any kelt exodus prior to the food fishery.

Other factors such as increased predation in the marine environment and/or natural fluctuations in kelt mortality are also contributing factors responsible for the low repeat spawner rate. The issue is far from resolved, and further investigation is required.

SUMMARY

1. Two hundred and twenty-four steelhead were captured in the Yakoun River Queen Charlotte Islands from October 1981 to March 1982. Of these, 3 were released untagged, 15 were killed, and 206 were tagged and released of which 25 were recaptured once and an additional 3 were recaptured twice.
2. Schnabel, Schumacher and Schnabel-Chapman revised population estimation methods estimated 825, 948 and 797 steelhead respectively in the Yakoun River during the study period. These figures contrast sharply with the province wide steelhead harvest questionnaire survey of 1981-82, where an estimated 392 fish were killed, and 1495 were released for a total catch of 1887 steelhead.
3. Movement of recaptured steelhead was minimal, with 60% of all recaptures being caught at, or near, their original capture sites and from 0 to 152 days after their first capture. Average upstream migration rates of the remaining 40% was .25 km/day. The fastest recapture traveled .91 km/day.
4. Sex ratio favoured females (59%) over males. The latter were only marginally larger (average 80.0 cm) than the former (77.1 cm). A discernable pattern of large fish entering during a specific period of the season was apparent.
5. Average weight gain per ocean year was approximately 2.5 kg.
6. The most dominant age groups were 3.3 (60.5%) and 3.2 (23.8%). Only 9 age groups were represented in the catch, and the repeat spawner rate was 4.4%.

ACKNOWLEDGEMENTS

This project would not have been possible had it not been for the Port Clements Rod -and Gun Club. Interpretation of scales collected and additional catches were accomplished by R. Tetreau, M. O'Neill and G. Schultze of the Fish and Wildlife Branch. A. May typed the report.

The study was funded as a Public Participation Project by the Salmonid Enhancement Program.

REFERENCES

- Billings, S.J. 1982. Steelhead harvest analysis 1981-82, Fisheries Technical Circular No. 56, ISSN0229-1150. Fish and Wildlife Branch, Victoria, B.C. 26 pp.
- Chudyk, W.E. 1982. Copper Creek (Q.C.I.) Steelhead Trout, a report on the effects of non random release of kelts from a fence barrier on their incidental capture in an Indian net fishery, and some note on population size and life history characteristics. Un published. Skeena Fisheries Report #81-1, 27 pp. British Columbia Fish and Wildlife Branch, Smithers, B.C.
- Fish and Wildlife. 1982. Summary of revenue derived from the sale of various licences, collections, etc. Fish and Wildlife Branch, B.C. , Victoria. 20 pp.
- Hemus, D. 1974. Dean River summer steelhead observations on life history, population and fishery in 1973. Typed report, Fish and Wildlife Branch, Victoria. 64 pp.
- Hooton, R.S. 1978. Campbell/Quinsam creel survey report Fisheries Technical Circular No. 35, 10 pp., B.C. Fish and Wildlife Branch.
- Horncastle, G.S. 1981. Life history of steelhead trout from the Somass River of Vancouver Island. Fisheries Technical Circular No. 51, Ministry of Environment, B.C. 19 pp.
- Jones, D.E. 1975. Steelhead and sea-run cutthroat, trout life history study in southeast Alaska. Study AFS-42-3 Sport Fish Division, Alaska, Dept. of Fish and Game, Juneau, A.K. 211 pp.
- Narver, D.W. and F.C. Withier, 1974. Steelhead of the Nanaimo River. Aspects of their biology and the fishery from three years of anglers catches. Fisheries and Marine Services, Nanaimo, B.C. Cir. No. 99, 25 pp.
- Peterson, G.R. and J.C. Lyons, 1968. A preliminary study of steelhead in the Big Qualicum River. Fisheries Management Report #56, 46 pp. B.C. Fish and Wildlife Branch.
- Ricker, W.E. 1970. Handbook of computations for biological statistus of fish populations. Bulletin #119. Fisheries Research Brd. Canada.
- Steelhead Harvest Analysis. 1967-68 through to 1981-82, Fish and Wildlife Branch, Victoria, B.C.

REFERENCES (cont'd)

Walker, J.H.C. and F.N. Anford. 1974. Untitled report of Campbell River steelhead creel survey, Fish and Wildlife Branch, Victoria. 27pp.

Whately, M.R. and W.E. Chudyk. 1979. An estimate of the number of steelhead trout spawning in Babine River near Babine Lake, spring, 1978. Unpublished. Skeena Fisheries Report #78-8 (S.E.P.), 17 pp. B.C. Fish and Wildlife Branch, Smithers, B.C.

APPENDIX 1 Original steelhead captures from Yakoun River
1981-82 winter season

FISH NO.	DATE	SEX	LENGTH (cm)	WEIGHT (kg)	TAG NO & COLOR	ZONE	REMARKS
1	Oct. 1	F		7.26	Y00853	5	Bright
2	17	M		3.16	orange 03649	4	Bright
3	31	M		4.99	Y00851	4	Slightly coloured
4	31	F	71.1	5.44	Killed	—	—
5	31	F	86.4	4.99	Y00852	5	Bright
6	Nov. 1	F		4.54	Y00217	5	Bright
7	4	M	83.8	5.44	Y00230	5	---
8	5	M	86.4	6.35	Y00216	5	---
9	6	M	91.4	7.71	Y00218	5	Bright
10	7	M		5.44	Y00855	5	Dark
11	8	M	81.3	5.90	Y00275	5	
12	8	M		3.16	Y00856	5	Bright
13	8	F	74.9	5.44	Killed		
14	8	F	71.7	4.99	Killed		
15	9	M	86.4	5.44	Y00215	5	Bright
16	12	F		5.44	Y00857	5	Slightly coloured
17	12	M		2.72	Y00858	5	Slightly coloured
18	12	F		4.54	Y00859	4	Bright
19	13	M	60.9	1.36	Y00261	5	
20	14	F		4.54	Y00860	4	Bright
21	14	F	86.4	4.99	Y00321	4	Bright
22	14	F		5.44	Y00322	4	Bright
23	14	F		5.90	Y00323	4	Bright
24				4.99	Y00324	4	Bright
25	14	F		7.26	Y00325	4	Bright
26	14	F		4.08	Y00326	4	Bright
27	15	F		7.26	Y00327	5	Bright
28	15	F	72.4	4.54	Y00231	3	
29	15	F		4.99	Y00232	4	
30	15	F	85.1	6.35	Y00240	3	Bright

APPENDIX 1 Original steelhead captures from Yakoun River
1981-82 winter season

FISH NO.	DATE	SEX	LENGTH (cm)	WEIGHT (kg)	TAG NO & COLOR	ZONE	REMARKS
31	Nov. 16	F	78.7	4.99	Killed	5	
32	16	F	81.3	5.90	Y00246	5	Bright
33	16	M	81.3	5.44	Y00247	5	Slightly coloured
34	16	M	83.8	5.44	Y00248	4	Dark Fish
35	16	F	73.7	4.08	Y00250	4	Bright
36	16	F	81.3	4.99	Y00251	4	Bright
37	16	F		4.08	Y00328	4	Bright
38	17	M	78.7	4.54	Y00262	5	Dark
39	17	M	88.9	6.35		5	
40	17	M	66.0	3.63	Y00219	4	Bright
41	18	M	96.5	6.35	Y00252	4	Bright
42	18	F	78.7	4.08	Y00253	4	Bright
43	18	M	88.9	6.80	Y00254	4	Bright
44	18	F	78.1	4.54	Y00255	4	Bright
45	18	M	88.3	5.44	Y00256	4	Bright
46	18	M	78.7	4.54	Y00257	4	Bright
47	18	F	81.3	5.89	Y00258	4	Bright
48	18	M	96.5	7.26	Y00259	4	Bright
49	18	F	73.7	3.63	Y00260	4	Bright
50	19	F	77.5	4.54	Y00264	5	Bright
51	19	F	78.7	5.44	Y00265	5	
52	19	F	77.5	4.99	Y00266	5	Bright
53	19	F	78.7	4.99	Y00267	5	
54	20	M	88.9	6.80	Y00276	4	
55	21	M		2.72	Y00326	4	Slightly coloured
56	21	F		4.08	Y00330	4	Bright
57	21	F		4.99	Y00331	4	Bright
58	21	F		4.08	Y00332	5	Bright
59	22	M		2.04	Y00333	5	Bright

APPENDIX 1 Original steelhead captures from Yakoun River
1981-82 winter season

FISH NO.	DATE	SEX	LENGTH (cm)	WEIGHT (kg)	TAG NO & COLOR	ZONE	REMARKS
					Y00334		
60	Nov. 22	F		3.18		4	Bright
61	22	M	91.4	6.35	Y00901	4	
62	22	M	83.8	5.44	Y00902	4	
63	24	F	73.7	3.63	Y00903	4	
64	24	M	76.2	4.54	Y00904	4	
65	24	M	93.9	7.03	Y00905	5	
66	24	F	83.8	5.44	Y00906	5	
67	24	F	78.7	4.54	Killed	4	
68	24	F	78.7	4.54	Killed	5	
69	24	M	63.5	3.63	Y00221	5	Bright
70	25	F	76.2	4.54	Y00907	5	
71	25	M	94.0	6.80	Y00908	5	
72	25	M	76.2	3.63	Y00909	5	
73	25	F	73.7	3.63	Y00910	5	
74	25	M	81.3	5.44	Y00911	5	
75	25	M	63.5	4.08	Y00220	4	
76	25	F	86.4	4.76	Y00222	5	
77	25	M	58.4	1.81	Orange 269	5	Bright
78	27	F	73.7	3.63	Y00912	5	
79	26	F	73.7	3.63	Y00913	5	
80	26	F	73.7	3.63	Y00914	5	
81	26	F	73.7	3.63	Y00918	5	
82	26	F	76.2	4.08	Y00915	5	
83	26	F	76.2	4.08	Y00920	5	Bright
84	26	M	81.3	5.44	Y00916	5	Slightly coloured
85	26	F	88.9	5.90	Y00917	5	
86	26	M	81.3	4.98	Y00919	5	Dark
87	26	F	66.0	3.18	Killed	5	
88	27	F	78.7	4.99	Y00921	5	Bright

APPENDIX 1 Original steelhead captures from Yakoun River
1981-82 winter season

FISH NO.	DATE	SEX	LENGTH (cm)	WEIGHT (kg)	TAG NO & COLOR	ZONE	REMARKS	
89	Nov.	28	F	78.7	4.08	Killed	4	
90		28	F	76.2	3.63	Killed	4	
91		28	M	83.8	4.99	Y00335	5	Dark
92		28	M	81.3	4.55	Y00336	5	Slightly coloured
93		28	M	68.6	2.75	Y00337	5	Slightly coloured
94		28	F	76.2	5.44	Y00233	5	Bright
95		28	F	94.6	7.71	Y00234	4	Bright
96		28	M	64.8	3.18	Y00235	4	Dark
97		28	F	68.6	4.08	Y00236	5	Bright
98		28	F	84.2	6.35	Y00237	5	Bright
99		29	F	43.2	.91	Y00922	3	Bright
100		29	M	63.5	3.63	Y00278	4	
101		29	M	64.8	2.04	Y00274	5	Bright
102	Dec.	6	F		3.63	Y00338	4	Bright
103		6	F		2.72	Y00339	4	Bright
104		6	F		3.18	Y00340	4	Bright
105		7	M		7.27	Y00342	5	Dark
106		7	F		5.44	Y00343	4	Bright
107		7	M		4.54	Y00344	4	Bright
108		7	F		3.63	Y00345	4	Bright
109		7	F		4.08	Y00346	4	Bright
110		8	F		4.99	Y00347	5	Dark
111		10	F	77.5	3.86	Orange 273	5	Slightly coloured
112		11	M	81.3	6.35	Y00291	4	
113		11	F	74.9	4.54	Y00292	4	
114		11	M	80.0	4.99	Y00292	5	
115		13	M	82.6	5.90	Y00293	5	Dark
116		13	F	78.7	4.54	Y00294	5	
117		13	M	88.9	6.80	Y00995	5	Dark
118		14	M	86.4	6.35	Orange 754	3	Bright

APPENDIX 1 Original steelhead captures from Yakoun River
1981-82 winter season

FISH NO.	DATE	SEX	LENGTH (cm)	WEIGHT (kg)	TAG NO & COLOR	ZONE	REMARKS	
119	Dec.	20	F	76.2	4.54	Orange 746	3	Bright
120		20	M	78.7	4.99	Orange 747	3	Bright
121		23	F		6.35	Killed	5	
122		23	F		4.99	Killed	4	
123		23	F		5.44	Killed	4	
124		25	M	95.3	7.63	Killed	4	Dark
125		26	F	74.9	3.63	Orange 748	3	Slightly coloured
126		26	F	82.6	5.90	Orange 749	3	Bright
127		27	M	60.9	3.63	Orange 731	4	Bright
128		27	F	76.2	5.44	Orange 732	4	Bright
129		28	M	73.7	3.18	Orange 776	4	
130		29	F	76.2	4.54	Orange 750	4	
131		29	F	73.7	3.63	Orange 751	4	Bright
132		30	F	73.7	4.08	Orange 791	4	
133	Jan.	2	M	83.8	6.80	Orange 792	3	
134		7	M	83.8	6.35	Orange 752	4	Dark
135		7	M	95.3	7.71	Orange 753	4	Dark
136		7	F	78.1	4.54	Killed	5	Bright
137		17	M	88.9	5.90	Orange 774	5	Dark
138		17	M	63.5	2.04	Orange 775	5	Dark
139		18	F		4.08	Killed	5	Bright
140		27	F	87.6	7.71	Orange 733	3	Bright
141		27	F	83.8	7.72	Orange 734	3	Slightly coloured
142		27	F	55.9	2.04	Orange 735	4	Bright
143		27	F	76.2	4.34	Orange 736	4	Bright
144		27	M	80.0	6.35	Orange 737	4	Bright
145		27	F	78.7	6.35	Orange 738	4	Bright
146		27	F	80.0	6.35	Orange 739	4	Bright
147		28	M	90.2	9.07	Orange 740	3	Dark
148		28	M	78.7	6.80	Orange 741	3	Dark

APPENDIX 1 Original steelhead captures from Yakoun River
1981-82 winter season

FISH NO.	DATE	SEX	LENGTH (cm)	WEIGHT (kg)	TAG NO & COLOR	ZONE	REMARKS
149	Jan. 28	M	88.3	3.18	Orange 742	3	Bright
150	28	F	72.4	5.90	Orange 743	3	Bright
151	28	M	86.4	8.62	Orange 744	3	Dark
152	28	F	61.0	3.63	Orange 745	3	Bright
153	29	F	73.7	4.08	Orange 716	5	
154	30	F	83.8	5.90	Orange 717	6	
155	30	M	93.9	7.71	Orange 719	6	
156	30	F	82.6	5.44	Orange 720	6	
157	30	F	73.7	3.63	Orange 721	6	Dark
158	30	F	71.1	3.63	Orange 722	6	Bright
159	30	M	94.0	7.71	Orange 723	6	Dark
160	30	F	80.0	5.22	Orange 724	6	Bright
161	30	M	68.6	3.18	Orange 725	6	
162	30	F	76.2	4.54	Orange 726	6	
163	30	F	73.3	4.08	Orange 727	6	
164	30	M	78.7	4.99	Orange 728	6	
165	30	F	78.7	4.54	Orange 1189	6	Bright
166	30	F	81.3	5.44	Orange 1190	6	Bright
167	30	M	71.1	2.95	Orange 1191	6	Dark
168	30	M	81.3	4.99	Orange 1192	6	Dark
169	30	F	81.3	4.54	Orange 1193	6	Dark
170	30	F	73.7	3.86	Orange 1194	6	Dark
171	30	F	81.3	5.44	Orange 1195	6	Bright
172	30	M	80.0	5.44	Orange 1196	6	Dark
173	30	M	50.8	1.36	Orange 1197	6	Dark
174	30	F	78.7	4.99	Orange 1198	6	Dark
175	30	M	68.6	3.18	Orange 1199	6	Dark
176	30	M	78.7	4.99	Orange 1669	6	Bright
177	30	F	78.7	4.99	Orange 1670	6	Bright
178	30	F	76.2	4.54	Orange 1671	6	Bright

APPENDIX 1 Original steelhead captures from Yakoun River
1981-82 winter season

FISH NO.	DATE	SEX	LENGTH (cm)	WEIGHT (kg)	TAG NO & COLOR	ZONE	REMARKS
179	Jan. 28	M	88.3	3.18	Orange 742	3	Bright
180	28	F	72.4	5.90	Orange 743	3	Bright
181	28	M	86.4	8.62	Orange 744	3	Dark
182	28	F	61.0	3.63	Orange 745	3	Bright
183	29	F	73.7	4.08	Orange 716	5	
184	30	F	83.8	5.90	Orange 717	6	
185	30	M	93.9	7.71	Orange 719	6	
186	30	F	82.6	5.44	Orange 720	6	
187	30	F	73.7	3.63	Orange 721	6	Dark
188	30	F	71.1	3.63	Orange 722	6	Bright
189	30	M	94.0	7.71	Orange 723	6	Dark
190	30	F	80.0	5.22	Orange 724	6	Bright
191	30	M	68.6	3.18	Orange 725	6	
192	Feb. 30	F	76.2	4.54	Orange 726	6	
193	30	F	73.3	4.08	Orange 727	6	
194	30	M	78.7	4.99	Orange 728	6	
195	30	F	78.7	4.54	Orange 1189	6	Bright
196	30	F	81.3	5.44	Orange 1190	6	Bright
197	30	M	71.1	2.95	Orange 1191	6	Dark
198	30	M	81.3	4.99	Orange 1192	6	Dark
199	30	F	81.3	4.54	Orange 1193	6	Dark
200	30	F	73.7	3.86	Orange 1194	6	Dark
201	30	F	81.3	5.44	Orange 1195	6	Bright
202	30	M	80.0	5.44	Orange 1196	6	Dark
203	30	M	50.8	1.36	Orange 1197	6	Dark
204	30	F	78.7	4.99	Orange 1198	6	Dark
205	30	M	68.6	3.18	Orange 1199	6	Dark
206	30	M	78.7	4.99	Orange 1669	6	Bright
207	30	F	78.7	4.99	Orange 1670	6	Bright
208	30	F	76.2	4.54	Orange 1671	6	Bright

APPENDIX 1 Original steelhead captures from Yakoun River
1981-82 winter season

FISH NO.	DATE	SEX	LENGTH (cm)	WEIGHT (kg)	TAG NO & COLOR	ZONE	REMARKS	
209	Feb.	4	F	80.6	4.99	Orange 897	6	Bright
210		4	M	90.2	2.27	Orange 905	6	Dark
211		4	F	90.0	4.99	Orange 907	6	
212		4	F	77.5	4.54	Orange 908	6	
213		4	M	92.7	7.71	Orange 909	6	Dark
214		4	M	91.4	7.26	Orange 910	6	Dark
215		4	M	71.1	3.16	Orange 911	6	Bright
216		4	F	86.4	6.35	Orange 919	6	
217		5	F	82.6	4.54	Orange 793	4	
218		5	F	77.5	4.08	Orange 794	4	
219	Mar.	20	F	80.0	6.35	Orange 858	3	Slightly coloured
220		20	F	60.3	2.27	Orange 859	3	Bright
221		20	F	60.3	3.18		2	Bright
222		20	F	81.3	7.26		3	Bright
223		22	F	86.4	5.90	Orange 758	5	Dark
224		22	M	83.8	5.44	Orange 759	5	Dark

Total Killed = 15

Total released and not tagged = 3

Total released and tagged = 20

APPENDIX II Steelhead recaptures from Yakoun River
1981-82 winter season

FISH NO.	TAG NO.	FIRST CAPTURE		SECOND CAPTURE		THIRD CAPTURE		DISTANCE ¹	TIME (days)
		DATE	LOCATION	DATE	LOCATION	DATE	LOCATION		
3	851	Oct. 31	4	Nov. 7	5			+6.4	7
9	218	Nov. 6	5	Dec. 11	5			0	35
11	275	Nov. 8	5	Jan. 30	6			+11.1 ¹	83
16	857	Nov. 12	5	Nov. 12	5			0	<1
17	858	Nov. 12	5	Nov. 28	5			0	16
22	322	Nov. 14	4	Nov. 14	4	Jan. 30	6	(0)+11.1 ¹	78
25	325	Nov. 14	4	Dec. 26	5			+7.6 ¹	43
37	328	Nov. 16	4	Nov. 28	5			+7.6 ¹	12
41	252	Nov. 18	4	Nov. 21	4			0	3
44	255	Nov. 18	4	Nov. 25	5	Apr. 18	5	+7.2	152
47	258	Nov. 18	4	Nov. 21	4			+ .8	3
57	331	Nov. 21	4	Dec. 26	5			+7.6 ¹	36
64	904	Nov. 24	4	Dec. 13	4	Dec. 13	4	0	20
72	909	Nov. 25	5	Dec. 2	5			0	8
79	913	Nov. 26	5	Jan. 30	6			+11.1 ¹	66
132	791	Dec. 30	4	Jan. 30	6			+18.6	31
138	775	Jan. 17	5	Jan. 17	5			0	<1
140	733	Jan. 27	3	Jan. 31	3			0	28
153	716	Jan. 29	5	Mar. 25	6			+11.1	55
158	722	Jan. 30	6	Jan. 30	6			0	<1
159	723	Jan. 30	6	Feb. 4	6			0	5
161	725	Jan. 30	6	Jan. 30	6			0	0
164	628	Jan. 30	6	Feb. 4	6			0	5
178	1671	Jan. 30	6	Feb. 4	6			0	5
217	793	Feb. 5	4	Mar. 25	4			0	48

¹ Distance travelled was calculated from mid points of zone.