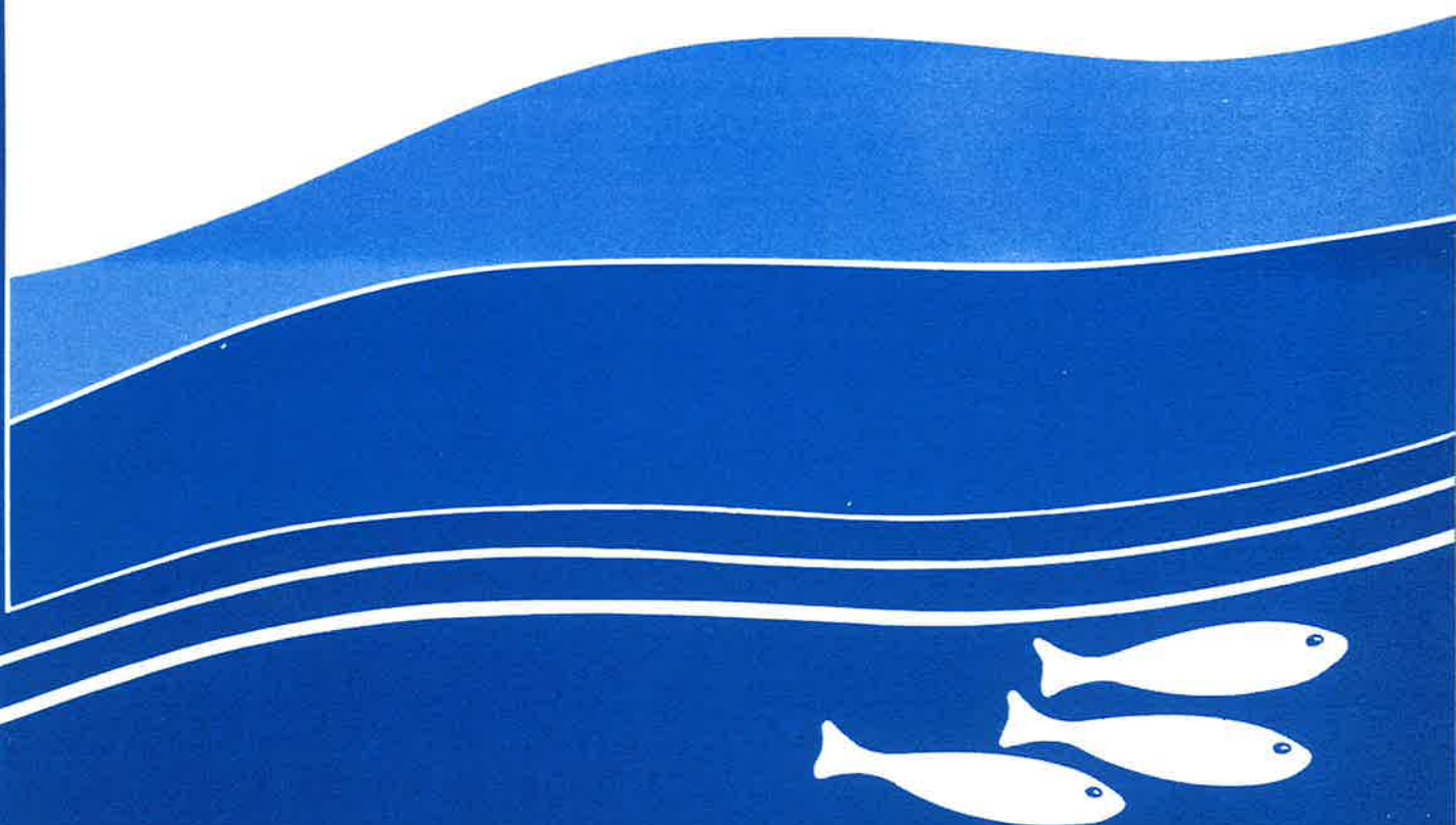




Chinook salmon angler catch and effort
for the lower Waitaki River,
1985 — 1987



New Zealand Freshwater Fisheries Report No. 132

**Chinook salmon angler catch and effort
for the lower Waitaki River,
1985 - 1987**

by
G.D. James

**Freshwater Fisheries Centre
MAF Fisheries
CHRISTCHURCH**

Servicing freshwater fisheries and aquaculture

**February
1992**

NEW ZEALAND FRESHWATER FISHERIES REPORTS

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ISBN 0-477-08601-2

Edited by:
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MINISTRY OF AGRICULTURE AND FISHERIES
TE MANATU AHUWHENUA AHUMOANA

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CONTENTS

	Page
SUMMARY	5
1. INTRODUCTION	5
2. METHODS	5
2.1 Postal Surveys	5
2.2 Creel Survey	6
3. RESULTS	8
3.1 Postal Surveys	8
3.1.1 Replies	8
3.1.2 Numbers of Anglers	8
3.1.3 Angler Catch	8
3.1.4 Angling Effort	8
3.1.5 Catch Rate	9
3.2 Creel Survey, 1987/88	9
3.2.1 Number of Anglers	9
3.2.2 Licence District and Home Town of Anglers	9
3.2.3 Hours Fished	10
3.2.4 Catch	10
3.2.5 Distribution of Angling	12
4. DISCUSSION	12
4.1 Total Catch Estimates	12
4.2 Total Effort Estimates	14
4.3 Total Run Estimates	14
4.4 Salmon Catch Estimates for Major South Island East Coast Rivers	14
5. ACKNOWLEDGEMENTS	15
6. LITERATURE CITED	15

TABLES

1.	Sales of adult and junior angling licences in the WVAS district during recent fishing seasons	6
2.	Sample sizes, response rates, and estimated numbers of salmon anglers holding WVAS adult whole season licences, who fished the lower Waitaki River during the 1984/85, 1985/86, and 1986/87 fishing seasons	8
3.	Catch (number of salmon), effort (angler-days fished), and catch rate (salmon/angler-day), by WVAS adult whole season licence holders, for the lower Waitaki River in the 1984/85, 1985/86, and 1986/87 fishing seasons	9
4.	Survey data, licence districts of anglers, and expected hours fishing, for the salmon angler creel survey conducted on the lower Waitaki River during the 1987/88 fishing season	10
5.	Number of anglers, by licence district and licence type, interviewed during the salmon angler creel survey on the lower Waitaki River during the 1987/88 fishing season	11
6.	Salmon catch and catch rate from the 1987/88 creel survey on the lower Waitaki River	11
7.	Number of salmon anglers counted on different sections of the lower Waitaki River during the 1987/88 creel survey	12
8.	Estimated angler catch of salmon from the lower Waitaki River, 1980-82 and 1985-87	13
9.	Estimated effort (angler-days) by anglers fishing for salmon on the lower Waitaki River, 1980-82 and 1985-87	14
10.	Summary of estimates of salmon catch, spawners, and total run (thousands of fish) in the lower Waitaki River, 1980-82 and 1985-87	14
11.	Comparison of salmon catch estimates from postal surveys on the lower Waitaki and five other South Island east coast rivers	15

FIGURES

1.	Lower Waitaki River showing localities mentioned in the text, and the sections covered during the creel survey	7
2.	Number of anglers interviewed, and proportion with WVAS adult whole season licences, during the 1988 salmon angling creel survey on the lower Waitaki River	9
3.	Distribution of salmon angling by section and sampling date, for the 1988 salmon angling creel survey on the lower Waitaki River	14

SUMMARY

Estimates of chinook salmon angler effort and catch were derived for the lower Waitaki River for the 1984/85, 1985/86, and 1986/87 fishing seasons. Postal surveys of expert and randomly selected anglers with Waitaki Valley Acclimatisation Society adult whole season licences, gave annual estimates of catch ranging from about 2300 to 9300 salmon. The number of days fished annually by the same group of anglers varied from about 24 000 to 28 000. Catch rates for the first two seasons were similar at about 0.3 salmon/day, but this dropped markedly in 1986/87 to about 0.1 salmon/day.

Incorporating data from the creel survey conducted for the 1987/88 fishing season gave estimates of annual catch by all angler groups ranging from about 5000 fish in a very poor year to about 20 000 in a very good year. Effort varied only slightly over the same period, from about 51 000 - 59 000 angler-days. Catches were markedly higher than in the early 1980s, when previous surveys indicated that catches were about 2000 fish per year, and angling effort had more than doubled. Estimated salmon catches of 5000 to 20 000 (mean 13 000) for the three seasons surveyed rank the Waitaki River as perhaps the most important east coast South Island salmon fishery. The total run of salmon into the Waitaki during these seasons was estimated to range between about 10 000 and 35 000 fish, with the anglers' catch estimated to be about 50% of the total run each year.

Creel survey data indicated that almost 41% of anglers lived within 50 km of the river, just over 9% between 50 km and 100 km, 24% between 100 km and 200 km, nearly another 24% between 200 km and 300 km, and just over 1% over 300 km away. Almost 1% of anglers were visitors from overseas. Most angling occurred below State Highway 1 bridge, with 50% of anglers fishing at the mouth and 32% between there and the bridge.

1. INTRODUCTION

Several salmon angling surveys have been undertaken on the lower Waitaki River over the last 30 years, including diary schemes, conducted between 1956/57 and 1978/79, and creel surveys in 1965/66 and between 1973 and 1981 (Freshwater Fisheries Centre (FFC) unpublished data). Postal surveys were carried out in 1980/81 and 1981/82, and are described in Pierce and Smith (1989), while aerial surveys of anglers

undertaken between 1974 and 1983 are reported in Pierce (1989). Most of these surveys attempted to distinguish between anglers fishing for salmon and those fishing for trout. In addition, Teirney *et al.* (1982) described the relative value of rivers in the Waitaki Valley district for angling from the results of a postal survey.

The creel and postal surveys described in this report were undertaken to provide more up-to-date information on salmon catch and effort. This was considered important because of continuing investigations into further hydro development on the lower Waitaki River, and because salmon runs in 1984/85 and 1985/86 were reported to be much higher than when the last surveys were conducted in the early 1980s.

Several postal surveys of salmon anglers have been undertaken on other east coast South Island rivers by the FFC in recent years, including the Rakaia River (Unwin and Davis 1983, West and Goode 1986), Rangitata River (Davis *et al.* 1987), lower Clutha River (Whiting 1986), and Hurunui River (Davis 1982, Bonnett *et al.* 1991). Comparisons have been made in this report with some of the results of these surveys.

Since 1976, helicopter surveys of salmon spawning in the lower Waitaki system (lower Waitaki and Hakataramea Rivers) have been carried out when river conditions were suitable (James and Deverall 1987). Estimates of numbers of spawning fish from these surveys have been combined with catch estimates from the postal surveys to give estimates of total run size.

2. METHODS

2.1 Postal Surveys

A survey of adult anglers holding Waitaki Valley Acclimatisation Society (WVAS) whole season fishing licences was undertaken following each of the 1984/85, 1985/86, and 1986/87 fishing seasons. (N.B. The Waitaki Valley acclimatisation district is now part of the Central South Island Fish and Game Council's region.) These surveys were based on those described by Unwin and Davis (1983) and Jellyman *et al.* (1987), but differed in that two groups of anglers were sampled - expert and random. Several studies, including those by West and Goode (1986) and Davis *et al.* (1987), have documented that a small group of skilled and dedicated salmon anglers take a major portion of the total catch. Thus, to improve the precision of the final estimates, a list of known, successful salmon anglers - the expert sample - was developed in conjunction with WVAS

staff. The list was modified slightly over successive seasons by deleting the names of those few anglers who had not fished or caught salmon the previous season, and substituting names of those with high catch rates who had been identified from the random sample replies. The second group was drawn each season from the WVAS licence receipts using computer-generated random numbers, and was termed the random sample. All the expert anglers' licence receipts were removed before the random sample was drawn.

Previous FFC experience has shown that part season (weekly and daily) licence holders contribute little to catch and effort (Unwin and Davis 1983, West and Goode 1986, Davis *et al.* 1987). Amongst WVAS licence holders, just under 60% have adult whole season licences, over 20% adult part season licences, and less than 20% junior licences (Table 1). Only adult whole season licence holders were sampled. Estimates of catch and effort for part season and junior licence holders are available in Pierce and Smith 1989) and from the FFC (unpublished data).

TABLE 1. Sales of adult and junior angling licences in the WVAS district during recent fishing seasons.

Season	Adult				Junior	
	Whole season		Week and day		N	%
	N	%	N	%	N	%
1984/85	3342	57.7	1414	24.4	1038	17.9
1985/86	3423	57.5	1508	25.4	1018	17.1
1986/87	3543	61.9	1128	19.7	1058	18.4
1987/88	3436	59.0	1274	21.9	1113	19.1

Of more importance to the final results was the geographic area or Acclimatisation Society districts covered by the survey. It was decided to include only WVAS anglers in the postal survey, and to estimate the number of anglers from other districts based on creel survey data, including data described in this report.

Each angler selected was sent an explanatory letter, a questionnaire, and a reply-paid envelope. Those who had not replied after six weeks were sent a reminder letter, another questionnaire, and another reply-paid envelope. Those who did not respond to the second letter were contacted by telephone if possible.

2.2 Creel Survey

All anglers observed fishing the lower Waitaki River between the mouth and the power lines near Black Point (Fig. 1) were interviewed on 14 survey dates during the 1987/88 salmon season. The main period of the salmon fishing season (from late January to late April) was sampled in the following manner. Sampling dates were chosen to cover weekdays and weekend days/public holidays in approximately equal proportions, and were spread throughout the period, to follow the buildup and decline in numbers of salmon anglers. On two occasions, sampling dates were postponed from those originally chosen because of poor weather conditions and the likelihood of finding few anglers. The river was divided into four sections (Fig. 1):

- mouth;
- mouth to State Highway 1 (S.H.1) (3.2 km in length);
- S.H.1 to Ferry Road (about 6 km);
- Ferry Road to the power pylons near Black Point (about 19 km).

The river between the power lines and Waitaki dam was not included in the survey, as previous studies (Pierce 1989) had shown that very few anglers (<2%) fished this area for salmon, and including this area would have almost doubled the survey time. The mouth area was defined as including the surf near the mouth, the mouth itself, and the estuary area behind the shingle bars on either side of the mouth.

Each day's survey followed a similar pattern. Interviewing began at the river mouth about an hour after dawn and proceeded upriver, generally finishing at the power lines by mid to late morning. This was considered to cover the period when most anglers (both locals and visitors) would be on the river (Pierce 1989). Main braids were traversed by jet boat as we moved upriver. Side braids were checked only when visible from the main channels, because salmon anglers do not normally fish such areas. All anglers interviewed were fishing solely or primarily for salmon.

The following information was recorded for each interview: date, section, time, licence district, licence type (adult/junior), licence category (weekly/whole season), home town, catch, and hours fished. On some survey dates, a record was made of the hours that the angler expected to fish that day, and also whether the angler was fishing from the shore or from a boat.

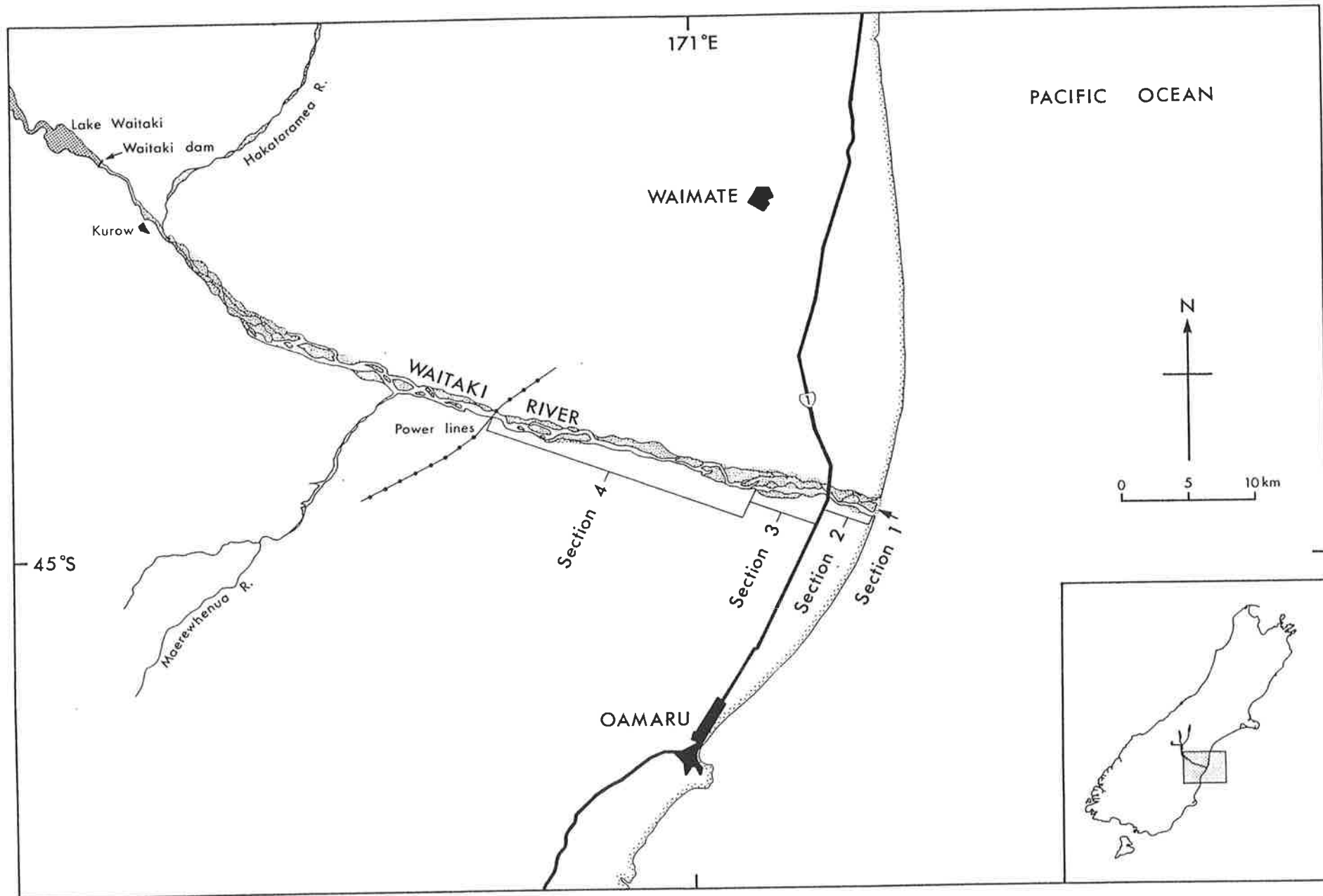


FIGURE 1. Lower Waitaki River showing localities mentioned in the text, and the sections covered during the creel survey.

3. RESULTS

3.1 Postal Surveys

3.1.1 Replies

Response rates were very high, varying between 92% and 100% (Table 2). A greater proportion of expert anglers replied compared to those who were selected randomly. Total response rates for the three seasons were 98.3%, 96.2%, and 92.7%, respectively. Most non-respondents had gone leaving no address, while a very small number had died.

3.1.2 Numbers of Anglers

In each survey, licence holders were asked whether they had fished the lower Waitaki River for salmon. About 98% of anglers in the expert samples had done so (Table 2), compared with between 46% and 60% of randomly selected anglers. A noticeably smaller proportion of randomly selected anglers fished during the 1986/87 season (46%), than had done so during the previous two seasons (58% and 60%), presumably because of the much smaller run size and catch. Expert anglers, however, fished in only slightly reduced numbers in 1986/87 (Table 2).

The proportion of anglers who fished for salmon, combined with licence sales information, provided estimates of the number of WVAS adult whole season licence holders who fished for salmon on the lower Waitaki River in each of the three seasons surveyed (Table 2). During the 1984/85 season, an estimated 1968 ± 170 anglers fished, compared with 2081 ± 173 in 1985/86, and 1652 ± 182 in 1986/87.

3.1.3 Angler Catch

Estimated catches of salmon by WVAS adult whole season anglers varied by a factor of four over the three seasons, from about 9300 in 1985/86 to 2300 in 1986/87 (Table 3). Catches by expert and randomly selected anglers increased by 8% and 50%, respectively, in 1985/86 compared with the previous season, but declined by 71% and 76% the following season. For all anglers combined, catches increased by 38% in 1985/86 and then declined by 75% the following year. The 95% confidence limits for the estimated total catch in Table 3 represent errors of about $\pm 20\%$.

3.1.4 Angling Effort

The number of days fished by salmon anglers holding WVAS adult whole season licenses was estimated at between 24 000 and 28 000 per year for the three

TABLE 2. Sample sizes, response rates, and estimated numbers of salmon anglers holding WVAS adult whole season licences, who fished the lower Waitaki River during the 1984/85, 1985/86, and 1986/87 fishing seasons.

	1984/85			1985/86			1986/87		
	Expert	Random	Total	Expert	Random	Total	Expert	Random	Total
No. of licences sold	-	-	3342	-	-	3423	-	-	3543
No. of licences sampled	107	350	457	114	353	467	114	368	482
% of licences sampled	3.2	10.5	13.7	3.3	10.3	13.6	3.2	10.4	13.6
No. of replies	107	342	449	110	339	449	109	339	447
% of replies	100	97.7	98.3	96.5	96.0	96.2	94.7	92.1	92.7
No. of respondents fishing for salmon	105	197	-	107	202	-	102	153	-
% of respondents fishing for salmon	98.1	57.6	-	97.3	59.6	-	94.4	46.1	-
Estimated no. of anglers fishing for salmon	105	1863	1968	107	1974	2081	102	1550	1652
95% CL* for no. of anglers who fished	-	± 170	± 170	-	± 173	± 173	-	± 182	± 182

*CL = confidence limits.

seasons surveyed (Table 3). Total angling effort did not drop markedly in 1986/87 as had catch, although, compared to the previous season, expert anglers put in relatively less effort than randomly selected anglers, i.e., the former appeared to respond more to the poor season by reducing effort than did the randomly selected anglers.

TABLE 3. Catch (number of salmon), effort (angler-days fished), and catch rate (salmon/angler-day), by WVAS adult whole season licence holders, for the lower Waitaki River in the 1984/85, 1985/86, and 1986/87 fishing seasons.

	Catch	CL*	Effort	CL	Catch rate	CL
<u>Expert sample</u>						
1984/85	1963	-	3285	-	0.60	-
1985/86	2124	-	3419	-	0.62	-
1986/87	610	-	2938	-	0.21	-
<u>Random sample</u>						
1984/85	4761	±1125	20775	±3492	0.23	±0.09
1985/86	7158	±1934	24398	±3864	0.29	±0.12
1986/87	1661	±640	21111	±4480	0.08	±0.05
<u>Total sample</u>						
1984/85	6724	±1125	24060	±3492	0.28	±0.09
1985/86	9282	±1934	27817	±3864	0.33	±0.12
1986/87	2271	±640	24049	±4480	0.09	±0.04

* = 95% confidence limits.

3.1.5 Catch Rate

Catch rates (expressed as number of salmon caught per day fished) (Table 3) were very similar for the first two seasons, at about 0.3 salmon/day, but dropped markedly in 1986/87 to about 0.1 salmon/day. Not surprisingly, catch rates by the two groups of anglers were quite different. Expert anglers catch rates (0.60, 0.62, and 0.21 salmon/day for the three seasons, respectively) were between 2.1 and 2.6 times those of the randomly selected group (0.23, 0.29, and 0.08 salmon/day, respectively).

3.2 Creel Survey, 1987/88

3.2.1 Number of Anglers

The salmon angler creel survey was undertaken on six weekdays and eight weekend/holidays (Table 4), and between 22 and 176 anglers per day were observed and

interviewed (Fig. 2). The mean number of anglers/day over all sampling dates was about 85, but numbers on weekdays were markedly less (average 57) than on weekend/holidays (average 105). During the 1987/88 fishing season, which was acknowledged as being poor, the main period for salmon angling appeared to be mid February to perhaps mid April, based on the number of anglers on the river (Fig. 2). In better seasons, it might be expected that the number of anglers would remain high through to the end of the fishing season at the close of April, rather than declining, as occurred towards the end of the survey.

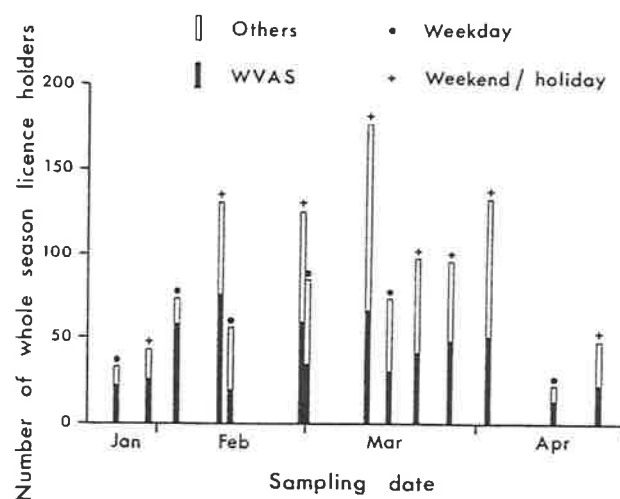


FIGURE 2. Number of anglers interviewed, and proportion with WVAS adult whole season licences, during the 1988 salmon angling creel survey on the lower Waitaki River.

Some anglers would have arrived and others left each day after we covered each section. However, because the surveys were conducted during the early morning when most anglers go fishing (Pierce 1989), the number of anglers recorded is probably a reasonable indication of the peak number of anglers fishing on any survey day.

3.2.2 Licence District and Home Town of Anglers

Anglers were asked for their licence district and home town. The proportion of anglers with WVAS adult whole season licences varied on different days from 34% to 79%, but averaged out over the season at 47.1% (Table 4). The proportion of WVAS licence holders was higher early in the season (Fig. 2). This is consistent with the view that anglers from outside the

TABLE 4. Survey data, licence districts of anglers, and expected hours fishing, for the salmon angler creel survey conducted on the lower Waitaki River during the 1987/88 fishing season.

Date	Type of day	No. of anglers interviewed	No. of anglers				with other licences		Expected hours fishing		
			with adult whole season licences from WVAS		other districts		N	%	No. of anglers asked	Expected hours	SD
			N	%	N	%	N	%			
25.01.88	weekday	33	22	67	10	30	1	3	0	-	-
31.01.88	weekend	43	26	60	12	28	5	12	0	-	-
05.02.88	weekday	73	58	79	15	21	0	0	0	-	-
13.02.88	weekend	130	75	58	46	35	9	7	0	-	-
15.02.88	weekday	56	19	34	33	59	4	7	0	-	-
28.02.88	weekend	125	59	47	59	47	7	6	0	-	-
01.03.88	weekday	84	34	40	47	56	3	4	55	4.96	2.72
12.03.88	weekend	176	66	38	97	55	13	7	140	5.62	2.40
16.03.88	weekday	73	30	41	42	58	1	1	17	4.59	1.53
21.03.88	holiday	94	41	44	50	53	3	3	12	2.92	1.49
27.03.88	weekend	95	48	51	40	42	7	7	0	-	-
03.04.88	holiday	132	50	38	68	51	14	11	129	4.81	2.18
15.04.88	weekday	22	13	59	9	41	0	0	0	-	-
23.04.88	weekend	48	22	46	22	46	4	8	0	-	-
Total (mean)		1184	563	(47.1)	550	(46.5)	71	(6.0)	353	(4.86)	(2.07)

district mostly come to fish when the season is likely to be at its peak.

Contrary to expectations, there was no obvious difference in the percentage of WVAS licence holders sampled on weekend/holidays to those on weekdays (Fig. 2). It had been considered that the proportion of non-WVAS licence holders might increase at weekends as these anglers came from further afield, but this did not appear to be the case.

Anglers with WVAS licences were recorded most commonly (50.6%), followed by Otago (16.3%), Southland (12.8%), North Canterbury (8.4%), South Canterbury (5.6%), Southern Lakes (3.9%), and five other districts with <2% each (Table 5). Anglers were asked for their home town, since some anglers purchase licences in districts other than where they live. These data showed that 40.9% of anglers lived within 50 km of the Waitaki River, 9.3% between 50 km and 100 km, 24.0% between 100 km and 200 km (principally Dunedin), 23.6% between 200 km and 300 km (principally Christchurch and Invercargill), and 1.4% over 300 km from the river. In addition, 0.8% of anglers were visitors from overseas. Only two anglers (<0.2%) indicated that they had no licence, although licences were not checked.

3.2.3 Hours Fished

On some survey days, anglers were asked how many hours they expected to fish for that day. The results

(Table 4) showed that, on average, anglers expected to fish for slightly less than 5 hours per day ($X = 4.86 \pm 2.07$). When these data were analysed by home town, little difference was found between those anglers living less than 50 km from the river (who expected to fish for 4.4 hours/day), and those living further than 50 km away (5.0 hours/day).

3.2.4 Catch

Salmon catches were very poor throughout the survey, reflecting the very small size of the salmon run that season (James 1988a,b). Only 22 salmon had been caught by all anglers surveyed (Table 6), giving a mean catch rate of 0.013 fish/hour or 78.7 hours fishing/fish caught. Most of the salmon recorded were caught in February and late March/early April. No fish were caught at the beginning or end of the survey period, and, surprisingly, none were caught on three of the survey days during the middle of the season in early March. It had been found during earlier surveys that monthly catch rates showed no consistent seasonal pattern from year to year (FFC unpublished data).

Of the 22 fish caught, 13 (59%) were taken in Section 1, five (23%) in Section 2, and two in each of Sections 3 and 4 (Fig. 1).

TABLE 5. Number of anglers, by licence district and licence type, interviewed during the salmon angler creel survey on the lower Waitaki River during the 1987/88 fishing season.

Licence district	Adult			Junior			Total
	Whole season	Weekly	Daily	Whole season	Weekly	Daily	
Waitaki Valley	563	11	4	32	1	1	612
Otago	181	3	0	5	0	0	189
Southland	142	0	0	6	0	0	148
North Canterbury	93	0	0	4	0	0	97
South Canterbury	63	0	0	3	0	0	66
Southern Lakes	43	0	0	0	0	0	43
Ashburton	15	0	0	0	0	0	15
Nelson	6	0	0	0	0	0	6
Wellington	5	1	0	0	0	0	6
West Coast	1	0	0	0	0	0	1
Bay of Islands	1	0	0	0	0	0	1
Total	1113	15	4	50	1	1	1184

TABLE 6. Salmon catch and catch rate from the 1987/88 creel survey on the lower Waitaki River.

Survey date	No. of anglers	Catch	Catch/angler	Hours fished at time of interview	Catch/hour fished
25.01.88	33	0	0	28.13	0
31.01.88	43	1	0.023	59.89	0.017
05.02.88	73	3	0.041	123.32	0.024
13.02.88	130	7	0.054	227.98	0.031
15.02.88	56	0	0	74.50	0
28.02.88	125	3	0.024	212.64	0.014
01.03.88	84	0	0	130.14	0
12.03.88	176	0	0	251.80	0
16.03.88	73	0	0	87.00	0
21.03.88	94	2	0.021	151.50	0.013
27.03.88	95	4	0.042	100.75	0.040
03.04.88	132	2	0.015	221.75	0.009
15.04.88	22	0	0	17.25	0
23.04.88	48	0	0	48.25	0
Total	1184	22		1734.90	
Mean			0.019		0.013

3.2.5 Distribution of Angling

Most anglers fished the mouth area (Section 1) (Table 7), 50% of anglers being found there. Thirty-two percent fished between the mouth and S.H.1 (Section 2), 13% between there and Ferry Road (Section 3), and 5% between Ferry Road and the power lines (Section 4). Thus, 82% of salmon angling on the lower Waitaki River during this season occurred below S.H.1.

There was little variation in angler use of the four river sections throughout the season (Fig. 3), the only obvious difference occurring at the beginning of the survey period when relatively few anglers fished the mouth, and relatively more fished Section 2. This could be related to the higher proportion of local anglers (generally WVAS licence holders) fishing during this part of the season (Fig. 2). There was no apparent relationship between the number of anglers fishing different sections, and the type of day (weekday or weekend/holiday) (Fig. 3).

4. DISCUSSION

4.1 Total Catch Estimates

Estimates of total catch (Table 8) were made by weighting the estimated catch by WVAS whole season licence holders (derived from the postal surveys, Table 3), by the percentage (47.1%) that this angler group represented on the river, as determined from the creel survey (Table 4). Estimated total salmon catch for the three seasons surveyed varied from 5000 during the poor season of 1986/87, to almost 20 000 in the preceding season, which was generally acknowledged as extremely good. Using data from Pierce and Smith (1989) and the same weighting factor, estimated catches for the 1980/81 and 1981/82 fishing seasons were 1700 and 2100 (Table 8), much less than for the later three seasons. The catch estimate reported by Pierce and Smith for the 1981/82 season, obtained by sampling anglers from the Waitaki Valley, Otago, and South Canterbury acclimatisation districts, was 2050, very similar to the 2100 derived by weighting Waitaki Valley catches alone (Table 8). Thus it is considered that the weighting factor used to estimate the total catches is reasonable, and, therefore, that the rather high catch

TABLE 7. Number of salmon anglers counted on different sections of the lower Waitaki River during the 1987/88 creel survey.

Date	Section								Total
	1	(%)	2	(%)	3	(%)	4	(%)	
25.01.88	9	27.3	21	63.6	3	9.1	0	0	33
31.01.88	8	18.6	24	55.8	5	11.6	6	14.0	43
05.02.88	35	48.0	27	37.0	8	11.0	3	4.0	73
13.02.88	83	63.9	18	13.8	20	15.4	9	6.9	130
15.02.88	28	50.0	26	46.4	0	0	2	3.6	56
28.02.88	56	44.8	42	33.6	16	12.8	11	8.8	125
01.03.88	36	42.9	23	27.4	19	22.6	6	7.1	84
12.03.88	103	58.5	58	33.0	11	6.2	4	2.3	176
16.03.88	42	57.5	19	26.0	12	16.5	0	0	73
21.03.88	44	46.8	26	27.7	24	25.5	0	0	94
27.03.88	51	53.7	24	25.3	11	11.6	9	9.4	95
03.04.88	52	39.4	59	44.7	17	12.9	4	3.0	132
15.04.88	15	68.2	6	27.3	1	4.5	0	0	22
23.04.88	30	62.5	12	25.0	6	12.5	0	0	48
Total	592	50.0	385	32.5	153	12.9	54	4.6	1184

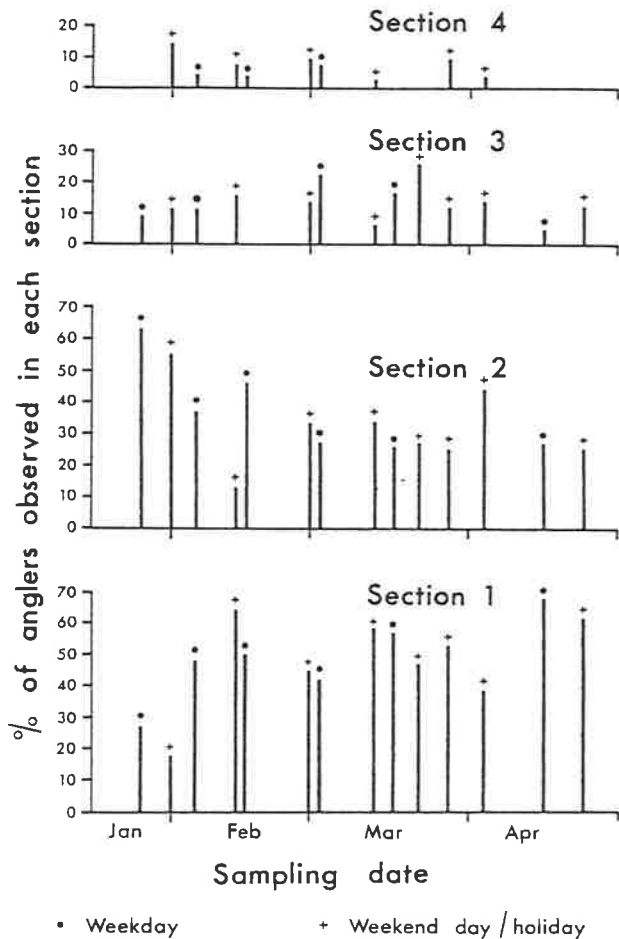


FIGURE 3. Distribution of salmon angling by section and sampling date, for the 1988 salmon angling creel survey on the lower Waitaki River. (Sections are shown in Figure 1.)

estimates obtained for the 1984/85 and 1985/86 seasons are valid.

In deriving the catch estimates, several assumptions have been made. Firstly, it has been assumed that the proportion of WVAS whole season anglers was similar in the 1987/88 season, when the creel survey was undertaken, to the proportion in the preceding three seasons when the postal surveys were carried out. Earlier creel surveys (FFC unpublished data) showed that WVAS whole season anglers comprised 49% of licence holders during the period 1973-81, suggesting that the percentage of anglers in this group has remained relatively stable for some time, and justifying this assumption.

Secondly, it was assumed that catch rates (salmon/day) of WVAS anglers who were sampled during the postal surveys were similar to those of groups of anglers who were not sampled. FFC unpublished data indicated that juniors and short season licence holders on the Waitaki

TABLE 8. Estimated angler catch of salmon from the lower Waitaki River, 1980-82 and 1985-87.

Season	Est. catch by WVAS adult whole season licence holders	Est. catch by all angler groups sampled	95% CL ^o	Est. total angler catch [†]
1980/81	800*	1530*	430*	1700
1981/82	990*	2050*	770*	2100
1984/85	6724	6724	1125	14300
1985/86	9282	9282	1934	19700
1986/87	2271	2271	640	4800

^o = confidence limits.

* = from Pierce and Smith (1989).

† = estimates assume WVAS adult whole season anglers comprise 47.1% of all anglers and take a similar proportion of the total catch (data from this report).

between 1972 and 1981 had catch rates only slightly less than adult whole season anglers. Further, during that period and in 1988 these groups made up only a very small percentage of anglers, so that errors introduced by not sampling these groups would be small.

By far the largest group not sampled, and which it is assumed had similar catch rates to WVAS adult anglers, were adult whole season licence holders from other districts. Evidence that catch rates for local and non-local adult anglers are similar is somewhat contradictory. Records from Rangitata salmon fishing competitions in 1984 and 1985 (Davis *et al.* 1987) indicated that locals had slightly higher catch rates than non-locals: 67% and 63% of successful anglers were locals in 1984 and 1985, respectively. Although numbers were very small, the 1988 creel census on the lower Waitaki River showed that, of the successful anglers, locals had marginally higher catch rates (0.69 salmon/hour) compared with non-locals (0.62 salmon/hour).

However, Pierce and Smith (1989) listed data from postal surveys on the Waitaki in the early 1980s, which gave catch rates for non-locals (0.051-0.069 salmon/day) almost double that of locals (0.034-0.035 salmon/day). It seems very unlikely that non-locals would be that much more successful, but it could possibly be true if non-locals fished more hours per day, which they might do if they had travelled some considerable distance. Data from the 1988 creel survey indicate, however, that non-locals only expected to fish about 0.6 hour longer per day, on average, than locals.

It is difficult to reconcile the markedly different catch rates noted above for local and non-local adult whole

season anglers. It seems more reasonable to expect that catch rates for the two groups would be fairly similar, with locals being more familiar with the river and being able to respond when runs were occurring, thus having a slightly higher catch rate. It does not seem likely that non-locals would have twice the catch rate of local anglers.

Thus we have assumed that catch rates of sampled anglers (locals) and non-sampled anglers (non-locals) were similar. If catch rates of non-locals were in fact higher than locals, the catch estimates given would need to be increased. The catch estimates given are therefore likely to be minimum values.

4.2 Total Effort Estimates

Estimates of total angling effort (Table 9) were made using the same procedure as for total catch. The total estimated number of angler-days for the three seasons surveyed ranged between about 51 000 and 59 000, whereas for the earlier two seasons reported on by Pierce and Smith (1989), the estimates for salmon angling were less than half, at about 19 000 - 24 000 angler-days.

TABLE 9. Estimated effort (angler-days) by anglers fishing for salmon on the lower Waitaki River, 1980-82 and 1985-87.

Season	Est. effort by WVAS adult whole season licence holders	Est. effort by all angler groups sampled	95% CL ^o	Est. total angler effort [†]
1980/81	8900*	16400*	1900	19000
1981/82	11300*	19200*	2500	23900
1984/85	24060	24060	3492	51100
1985/86	27817	27817	3864	59100
1986/87	24049	24049	4480	51100

^o = confidence limits.

* = from Pierce and Smith (1989), Table 14, and estimate that 39% of angling effort was for salmon, 61% for trout (page 13).

† = estimates assume that WVAS adult whole season anglers comprise 47.1% of all anglers and expend a similar proportion of the total effort. (Rounded to nearest hundred.)

4.3 Total Run Estimates

Estimates of total run size (catch plus spawners) varied from about 5000 fish in 1980/81 to about 35 000 in 1985/86 (Table 10). The percentage of the total run taken by anglers each season was apparently lower in the early 1980s, but was about 50% during the three

seasons surveyed. The spawner estimate for 1981/82 appears too high in relation to the catch and spawner figures for the other seasons. This could be because the spawner estimate for the lower Waitaki River for that season (and for 1980/81) were based on extrapolations from counts made in the Hakataramea River. If the 1981/82 spawner estimate was reduced, then the total run estimate would be less for that season and the percentage taken by anglers would increase. Such a result would make the data more consistent.

TABLE 10. Summary of estimates of salmon catch, spawners, and total run (thousands of fish) in the lower Waitaki River, 1980-82 and 1985-87.

Season	Catch	Number of spawners	Total run	% of run taken by anglers
1980/81	1.7	3.8 [†]	5.5	31
1981/82	2.1	11.1 [†]	13.2	16
1984/85	14.3	16.1 [†]	30.4	47
1985/86	19.7	15.9 [†]	35.6	55
1986/87	4.8	4.7*	9.5	51

[†] = from James and Deverall (1987).

* = based on redd count reported in James (1987).

4.4 Salmon Catch Estimates for Major South Island East Coast Rivers

Postal surveys have been undertaken on six east coast South Island rivers and salmon catch estimates derived (Table 11). These estimates indicate that the lower Waitaki and Rakaia Rivers have produced the highest catches, followed by the Rangitata and Waimakariri, and then the Hurunui and lower Clutha.

It appears that lower Waitaki salmon (and trout) catches were depressed over the 1979-1983 period (including the 1980/81 and 1981/82 seasons when the first surveys were conducted), at least in part because of high sediment loads caused by hydro construction in the upper Waitaki catchment (Waitaki Valley Acclimatisation Society Annual Reports 1981, 1984, 1985; Pierce and Smith 1989), but possibly also by natural, high intensity rainfall events in the catchments of the source lakes (T. Chinn pers. comm.). If the first two surveys were conducted during a period of abnormally low fishability, then the estimates from the last three surveys could be more representative of the normal situation. The mean catch estimate for the later three seasons was 13 000, considerably more than the average of 8600 estimated for all five surveys combined. Since these three seasons included one