CENTRAL SOUTH ISLAND REGION

2021/2022 Central South Island Sea-run Salmon Returns - Season Summary

Mark Webb

February 2023

Prepared for the Central South Island Fish and Game Council

Report number: CSI2023-015

For any information regarding this report please contact Central South Island Fish and Game Council - phone: (03)615-8400, email: csi@fishandgame.org.nz

2021/22 Central South Island Sea-Run Salmon Returns – Season Summary (M Webb)

Salmon entering rivers to spawn are either caught by anglers and removed from the river or avoid anglers and continue upriver to spawn. The sum of angler catch and salmon escapement provides an estimate of the total population of salmon returning to fresh water each year and is the foundation for identifying trends across years. Salmon populations can exhibit large and unpredictable fluctuations in population size on a short-term annual basis, so it is trends across multiple years that are the focus for Fish and Game.

Introduction of a sea-run salmon season bag limit for the 2021/22 season across the Central South Island and North Canterbury Fish and Game regions was one of the most significant changes to the way salmon harvest is managed since salmon were first introduced to New Zealand over 100 years ago. A salmon endorsement issued to every angler eligible to fish for sea-run salmon requires details of every salmon caught to be returned to Fish and Game. This information enables more robust assessment of angler catch and its regulation through the season bag limit.

The spawning component of the run is assessed by two methods in the CSI Region. Salmon redd (nest) counts continue in the Ashburton River system, tributaries of the Rangitata, and the Orari, Opihi, Tengawai, Waihi-Temuka, Waitaki and Hakataramea rivers. Some of these counts are completed by volunteers. These counts provide a valuable and continuing long-term record used as an index of spawning population size. The second method used to assess salmon spawning requires multiple counts of live salmon present in spawning tributaries of the Rangitata River at fortnightly intervals from March to June. An estimate of Waitaki River spawners was able to be made by this method until about 1999 when the Hakataramea River run began to be impacted by low flows. In recent years lower Waitaki River spawning has been assessed by aerial redd count as part of a joint project with Meridian Energy Limited.

Estimates of the size of the spawning populations and of annual salmon harvest in the rivers supporting the largest salmon runs are the primary inputs to a sea-run salmon population management strategy adopted by Central South Island and North Canterbury Fish and Game Councils in 2020. The strategy sets spawning population targets for the Waimakariri, Rakaia and Rangitata rivers fisheries as a priority before setting the level of harvest able to be sustained and then implemented through the season bag limit.

The following report details application and results from the first season under the sea-run salmon season bag regime. This includes presentation of timing and size characteristics of the catch, application of the threshold management strategy to Waimakariri, Rakaia and Rangitata sea-run salmon population information, and spawning and harvest information for CSIFG Region fisheries.

1. Salmon Season Bag

1.1 Salmon Endorsement Issue

Salmon angler surveys across CSI and NC F&G regions up to 2020, previously identified about 3,500 anglers fishing annually for salmon and that level of demand for season bag cards was anticipated when applying the salmon endorsement requirement for the 2020/21 season.

In reality, 9,438 sea-run salmon endorsements were issued to anglers from all over New Zealand. Endorsements issued to CSIFG and NCFG licence holders comprised 81% of the total with 7% to Otago licence holders, and the remaining 12% to other regions. Ninety-eight % of endorsements were issued to South Island regional licence holders, 2% to North Island regional licence holders and 0.4% to overseas residents.

1.2 Salmon Endorsement Return

Season bag card information was returned from 1,819 endorsed licence holders through voluntary return by post or drop-in, email follow up survey, or random telephone survey. These surveys indicated that of the 9,438 anglers endorsed to fish for sea-run salmon, 3,562 went salmon fishing.

Approximately 60% of anglers who applied for an endorsement to fish for sea-run salmon did not fish for salmon at all. There was significant administrative time and printing and postage cost to servicing anglers who did not go salmon fishing.

1.3 Anglers and Catch

Of the estimated 3,562 endorsed anglers who went salmon fishing, 906 anglers were successful and caught 1,176 salmon. The average catch per successful angler was 1.3 fish for the season and about one-third of anglers who caught and kept one salmon went on to keep a second.

1.4 River Catch

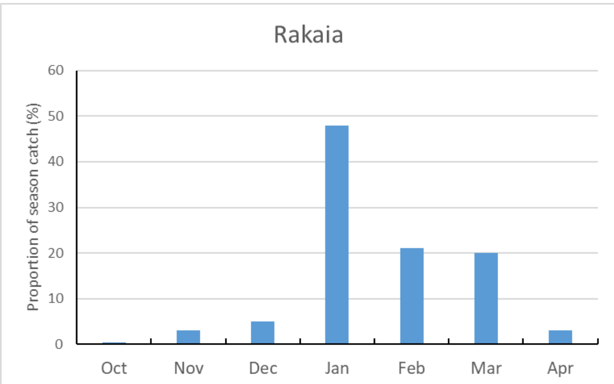
The Waimakariri, Rakaia and Rangitata rivers sustained 71% of catch by season bag endorsement holders and the Waitaki River a further 20% (Table 1). Nine percent of total estimated catch was attributed to the Ashley, Kaiapoi, Hurunui, Waiau, Ashburton, Opihi and Orari rivers combined.

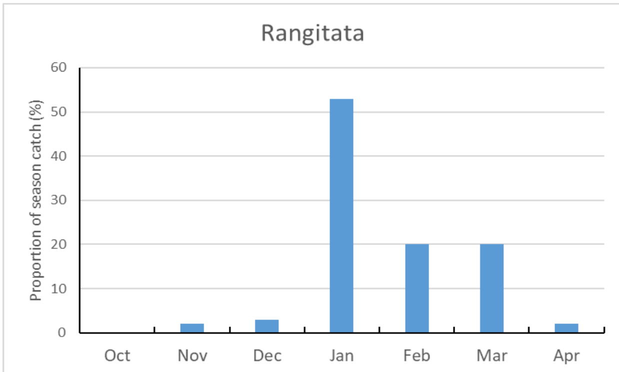
Table 1. Estimated catch of sea-run salmon from season bag card returns for the 2021/22 season.

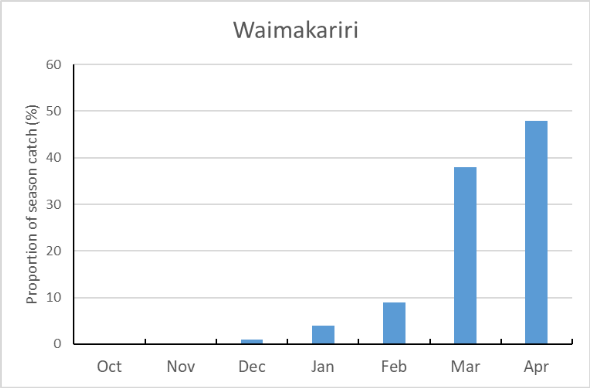
River	Salmon Catch
Hurunui	39
Waimakariri	178
Rakaia	407
Rangitata	274
Waitaki	234
Waiau, Ashley, Kaiapoi, Ashburton, Orari, Opihi	44
Total catch	1,176
Total salmon anglers	3,562
Total successful anglers	906

1.5 Monthly Catch

The season bag card provided for anglers to record the date on which salmon were caught. Sufficient information was returned for the four largest salmon fisheries – the Waimakariri, Rakaia, Rangitata and Waitaki, to identify monthly distribution of catch (Figure 1).







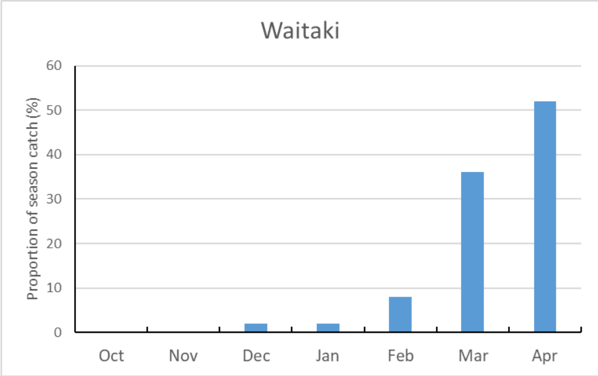


Figure 1. Proportion (%) of whole season harvest caught per month for the four largest sea-run salmon fisheries from season bag card returns and email survey.

Monthly distribution of season catch demonstrates strong similarities in the timing of the runs in paired rivers. The Rakaia and Rangitata peak catches were in January with about 50% of season catch in both rivers and about 20% of season catch in each of February and March. The Waimakariri and Waitaki peak catches were in April with about 50% of season harvest preceded by around 40% in March and 10% in February.

1.6 Daily Catch

Most anglers recording fish catch on their season bag card recorded the time of day that salmon were caught. Four hundred and six anglers returned time of catch information for the Waimakariri, Rakaia, Rangitata and Waitaki rivers (Figure 2).

The most successful hours of fishing for Rakaia and Rangitata caught salmon were similar with 64% of Rakaia catch and 67% of Rangitata catch taken in the six hours between 6am and midday. Approximately 40% of catch in these rivers was taken between 6am and 9am.

Hourly distributions of peak catch for Waimakariri and Waitaki caught salmon were slightly later starting and finishing compared to Rakaia and Rangitata catch. Approximately 61% of Waimakariri catch and 71% of Waitaki catch were taken in the six hours between 8am and 2pm.

Across all four rivers approximately two-thirds of salmon were caught in the morning and one third after midday. This assessment does not identify if the difference in morning and afternoon catch is related to the relative effort put in by anglers or whether there is truly a difference in success.

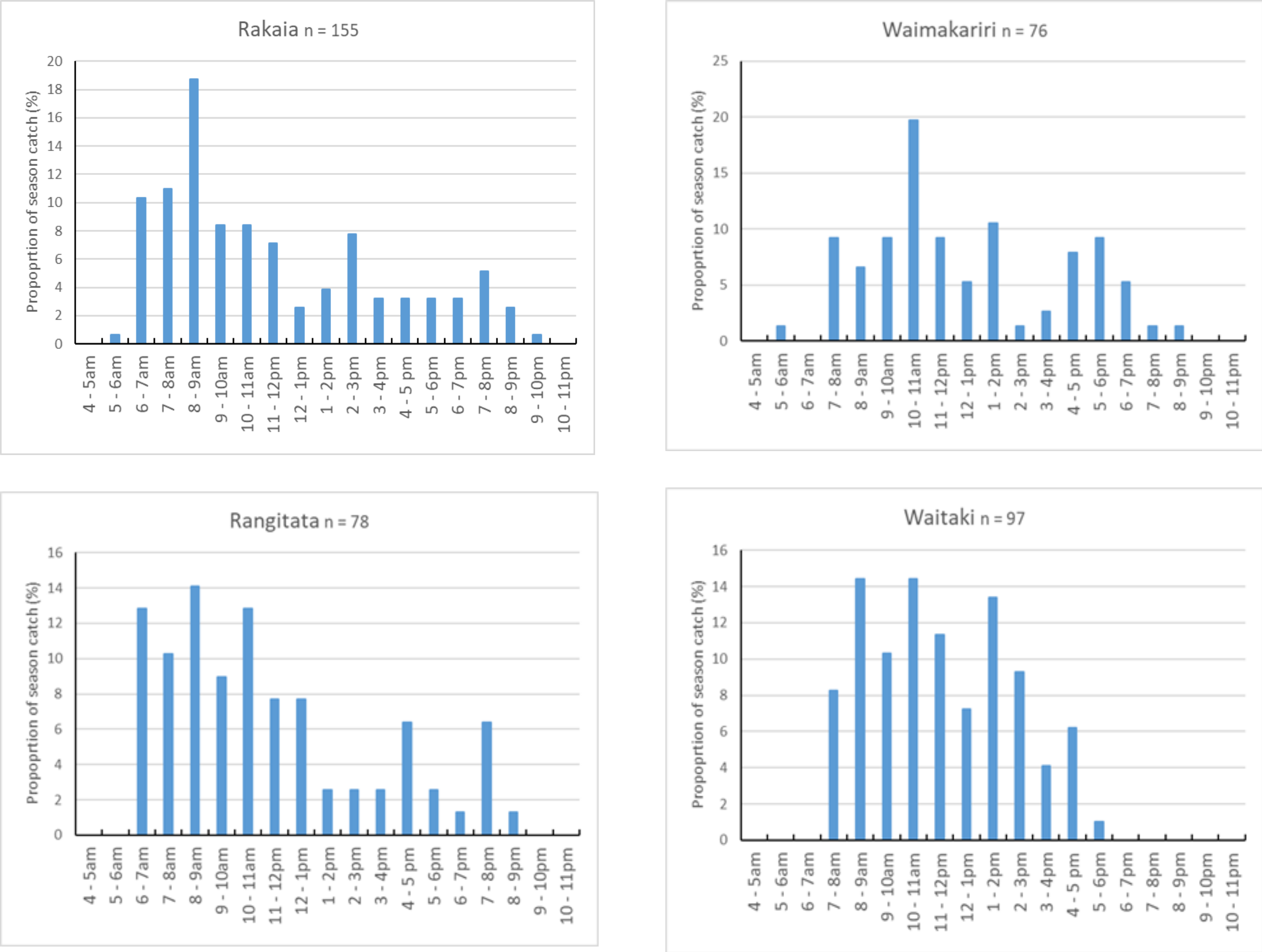


Figure 2. Proportion (%) of whole season harvest caught by time of day for the four largest sea-run salmon fisheries from season bag card returns.

Hourly distribution of catch does not take account of changing day length across the season, location on the river, tide or river flow. In time, season bag card information collected over a number of years will enable the influence of these factors and others on catch success to be analysed.

1.7 Size of Salmon

The season bag card asked anglers to record the length and weight of salmon caught. Traditionally anglers talk of salmon size in terms of weight, usually in pounds and ounces, however by far the most important measure of size from a fishery management perspective is the length. From a review of the length of all salmon caught an indication of the age structure of the returning adult population can be obtained. The returning run can have aged 2, 3, 4 and sometimes 5-year-old salmon. Each year class will have a size range and while there will be significant overlap in size ranges for the different ages, generally the proportion of each year class in the returning run can be identified if the sample size is large enough and the sample is random. This information is very important for assessing the relative survival of each year class through its lifetime.

Future season bag card salmon size records are likely to target recording of salmon length rather than weight to increase the return of information from anglers that will help to establish year class survival for correlation with spawning success, habitat quality, climate and other information.

Confounding the assessment of the size/age composition of the run from angler catch, particularly when the season bag limit is small, is the tendency for anglers to catch and release until an acceptably large salmon is caught. This can lead to the sample of angler-caught salmon lengths being biased towards longer and therefore older fish and not a true reflection of the age composition of the run.

Season bag card returns provided 458 length measurements and 592 weights of angler caught fish (Table 2).

Table 2. Length (cm) and weight (kg) information for five sea-run salmon fisheries from season bag card returns of a minimum of 10 samples.

		Rakaia	Rangitata	Waimakariri	Waitaki	Hurunui
Length	No. of samples	165	102	89	89	13
	Average (cm)	76.3	76.8	70.3	74.8	71.0
	Maximum (cm)	100	100	93	100	90
	Most common (cm)	80 - 90	80 - 90	70 - 80	70 - 80	70 - 80
Weight	No. of samples	221	118	105	130	18
	Average (kg)	6.01	6.47	5.11	5.56	5.37
	Maximum (kg)	9.5	10.4	8.5	10.0	9.1
	Most common (kg)	6 – 7	6 – 7	5 – 6	5 – 6	5 – 6

Length and weight statistics may suggest minor differences between fisheries - Waimakariri and Hurunui average and maximum lengths may have been shorter than the Rakaia, Rangitata and Waitaki, and for weights the average and most common weights for Rakaia and Rangitata fish may have been heavier than the three other fisheries. In strict statistical terms the variability in distribution of weights and lengths for each fishery means there is no statistical difference between them.

Across all fisheries just under half of all salmon recorded by anglers on their season bag cards were between 70 cm and 80 cm and between 5 kg and 7 kg.

2. Salmon Run Size

The Waimakariri, Rakaia, Rangitata, and Waitaki rivers and more particularly the first three, have annual monitoring programmes for spawning, angler catch and run size that are robust, have been undertaken for 26 years and have generally been consistent in methodology.

Spawning in the Waimakariri, Rakaia and Rangitata rivers occurs in a few well defined and stable spring streams in their upper reaches while spawning in the Waitaki River occurs in the 70km of mainstem below the Waitaki Dam. It is almost impossible to undertake repeat live fish counts to estimate the spawning run size for the Waitaki. As a consequence, Waitaki run size estimates require a further assumption in converting redd (nest) counts to live fish. For this reason, and that consistent annual redd counts for the Waitaki only began in 2013, the Waitaki spawning and run size estimates are not yet extensive or robust enough for contribution to a cross-region sea-run salmon spawning population database.

Estimated sea-run salmon harvest plus spawning population sizes for the four large East Coast salmon rivers indicate total runs for these rivers ranging from 700 to 3,600 fish (Table 3). Independent surveys identified an estimated 40 successful anglers fished for salmon without a salmon endorsement and caught 48 salmon.

Table 3. Estimated returning sea-run salmon runs from the sum of spawning population sizes and angler catch by season bag card (sbc) holders and non-sbc holders for the four large East Coast salmon rivers, 2021/22.

	Waimakariri	Rakaia	Rangitata	Waitaki
Harvest by sbc holders	178	407	274	234
Harvest by non-sbc holders	8	18	12	10
Spawners	548	3,217	1,823	1,800
Total salmon run	734	3,642	2,109	2,044

Returning runs of wild sea-run salmon were the best for the last six years in the Rakaia, Rangitata and Waitaki and the best for the last three years in the Waimakariri. The combined run for the Waimakariri, Rakaia and Rangitata at 6,485 fish was the best since 2015 (Figure 3).

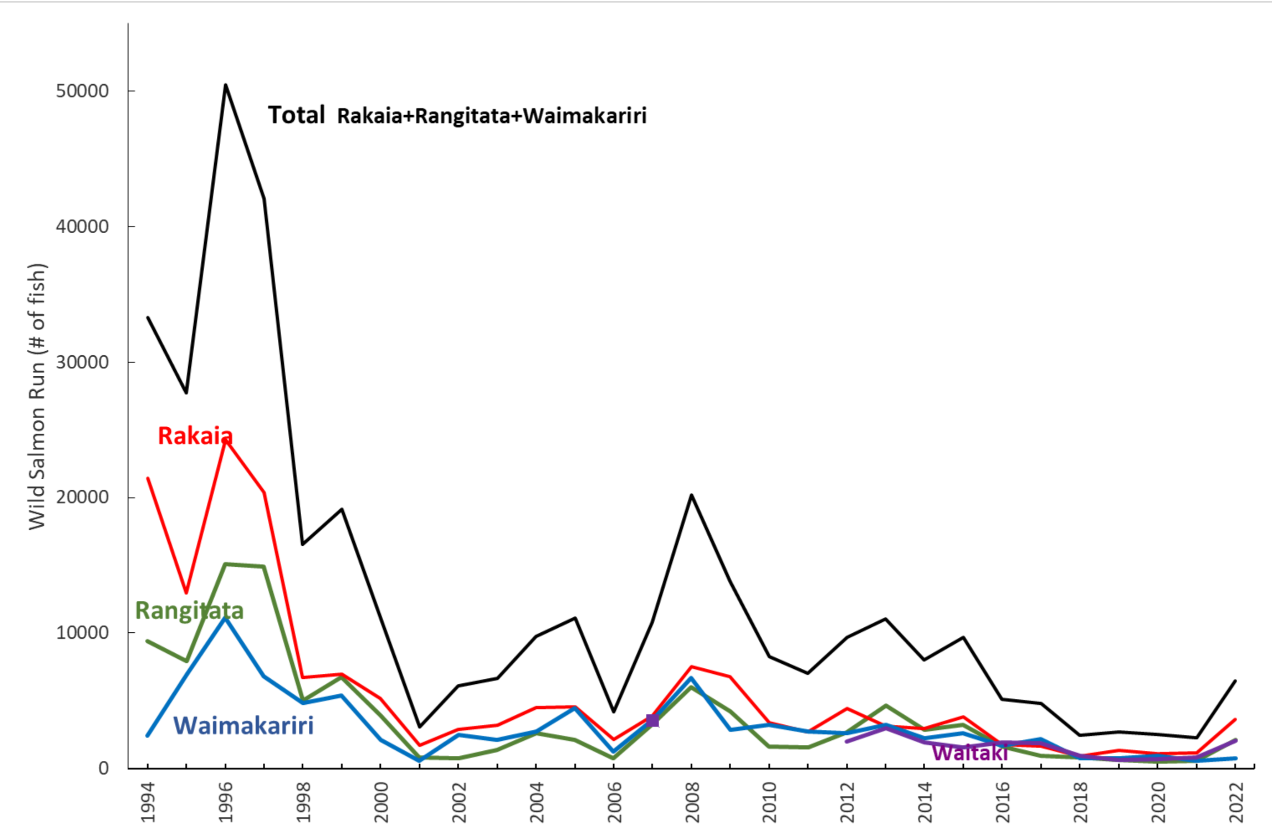


Figure 3. Estimated wild salmon returning to the Rakaia (red), Rangitata (green), and Waimakariri (blue) rivers for 1994 to 2022, Waitaki River 2007 (purple cross) and 2012 to 2022 (purple line), and total combined for the Rakaia, Rangitata and Waimakariri (black), 1994 to 2022.

3. 2021/22 Salmon Harvest

It is estimated that salmon anglers harvested between 11% and 25% of wild sea-run salmon returning to the large East Coast rivers in the 2021/22 season (Table 4). The degree of confidence associated with these harvest estimates obtained from season bag card returns remains disappointingly low with 95% confidence intervals across the fisheries of between ±30% and ±50% of the harvest estimate. It is expected that these confidence intervals will reduce as anglers who are not salmon anglers decide not to seek a salmon endorsement and as more anglers who are endorsed comply with the requirement to return their catch information.

Table 4. Estimated proportion (%) of the returning runs of wild sea-run salmon to the four large East Coast fisheries caught by anglers in the 2021/22 season.

	Waimakariri	Rakaia	Rangitata	Waitaki
Harvest	186	425	272	240
Spawners	548	3,217	1,823	1,800
Combined spawning total	5,588			
Total salmon run	734	3,642	2,095	2,040
Proportion of run caught by anglers	25.3%	11.7%	13.0%	11.8%

For the Waimakariri and Rakaia rivers the level of harvest was the lowest since reliable harvest and spawning surveys were introduced in 1994. For the Rangitata, harvest in 2021/22 was the second lowest for the same period (Figure 4). The limited record of consistent spawning counts for the Waitaki prevent review of long-term trends in harvest for this fishery.

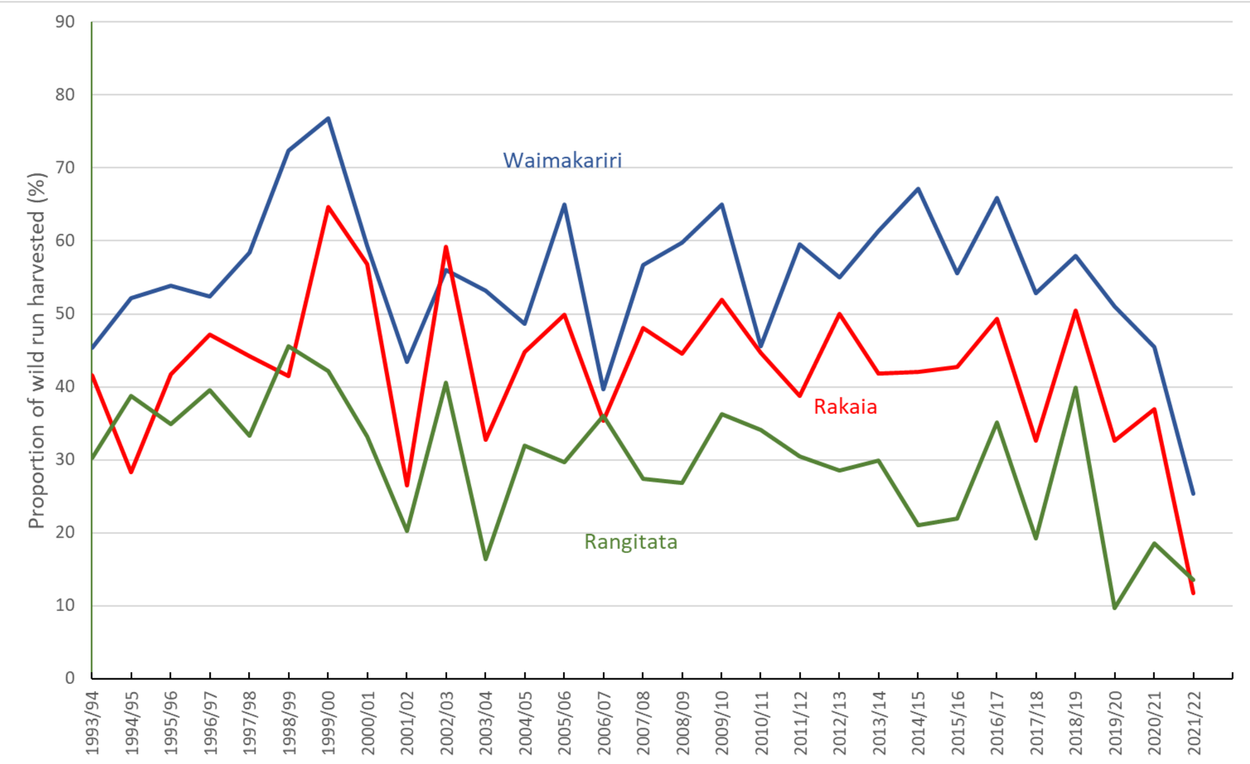


Figure 4. Proportion (%) of the returning runs of wild sea-run salmon to the Waimakariri (blue), Rakaia (red) and Rangitata (green) rivers caught by anglers for each season from 1993/94.

Prior to introduction of the season bag limit as the principal method for regulating angler catch of sea-run salmon for the 2021/22 season, the proportion of salmon caught by anglers each year as a percentage of total estimated returns, had been high. For example, over the previous three decades harvest rates had consistently exceeded 50% in the Waimakariri River and around 40% in the Rakaia (Figure 4).

Implementation of the season bag limit appears to have contributed either wholly or at least significantly to a marked reduction in the proportion of the salmon run harvested from the Waimakariri, Rakaia and Rangitata rivers compared to harvest rates prior to introduction of the season bag. Introduction of the season bag limit also coincided with a moderate improvement in total returning run sizes in the 2021/22 season that, when combined with reduced harvest, boosted returns to the spawning grounds.

4. Management Implications

Monitoring of wild salmon in the Waimakariri, Rakaia and Rangitata rivers provides a record of annual angler catch, spawning population size, total run size and trends across 28 years. These fisheries, plus the Waitaki across its shorter period of record, show very similar population trends, either increasing or decreasing together on an annual basis and they all share the current critically low state (Figure 3).

The similarity in trends across the four rivers and particularly for the Waimakariri, Rakaia, and Rangitata rivers for their longer periods of record, indicate the significance of the reduction in salmon numbers that occurred around 1998 to 2001. The trends also show the absence of improvement since that time, and strongly suggests that salmon survival in these rivers is very likely controlled by common influences when salmon are in a common environment. If the Waimakariri, Rakaia and Rangitata sea-run salmon fisheries are subject to the same principal population controls this provides strong support for consistent management and consideration of them as one harvest management unit.

Approximately three-quarters of all South Island sea-run salmon caught by anglers are taken from the Waimakariri, Rakaia and Rangitata rivers. Based on these rivers' contributions to the South Island East Coast sea-run salmon fishery, their shared population trends, and their on-going population monitoring programmes, in 2020 the CSIFG and NCFG Councils adopted a joint Threshold Management Strategy across the three rivers for setting sea-run salmon fishing regulations. The strategy aimed to manage angler catch to ensure adequate sea-run salmon spawn each year and to provide a healthy recreational sports fishery.

Over time, monitoring to the required standard in other CSIFG and NCFG salmon fisheries, and in particular the Waitaki River fishery, will enable further salmon runs to be added to the sea-run salmon management strategy.

The strategy targets the spawning population size of wild salmon since it is from the spawning population in any year that the next generation of adult returns are generated. Annual spawning population monitoring results are also the earliest available measure of the salmon population. Each year the estimates of live fish on the spawning grounds are available in May and recommendations on angling conditions to be applied for the following season can be accommodated within the timeframe for Anglers Notice recommendations to the New Zealand Fish and Game Council and the Minister of Conservation. Using spawning population size as the guide for harvest management ensures decisions are made on the most up-to-date information.

When CSIFG and NCFG Councils were considering how to rebuild the sea-run salmon fishery, priority was assigned to identifying a minimum acceptable spawning population size for the combined annual spawning totals for the Waimakariri, Rakaia and Rangitata fisheries.

Four spawning population bands were identified that would characterise the health of the spawning populations with the upper band being the level at which the fishery would be considered healthy and where minimum harvest conditions would apply. The second and third bands would be subject to increasing restrictions on harvest to help prevent the fishery falling below the third band. The fourth band would have maximum harvest restrictions without closing the fishery and this level has been determined to be just below the sum of the lowest recorded spawning population sizes in each of the rivers over the long-term monitoring record (Table 5).

Table 5. Threshold Management Strategy combined spawning population bands for the Waimakariri, Rakaia and Rangitata rivers and season bag conditions triggered.

Management band	Combined number of spawners	Season bag applied
Healthy	Greater than 7,800	10
Moderate	5,101 to 7,800	4
Low	1,200 to 5,100	2
Severe	Less than 1,200	1

Following identification of spawning population targets CSIFG and NCFG Councils then considered how angler harvest would be managed to achieve spawning targets. At that time both Fish and Game regions had one fish daily bag limits and a range of detailed season length and area conditions.

Introduction of a season catch limit was recommended by science advisors as the favoured method to reduce harvest and rebuild spawning numbers. A season bag limit offered a simple and consistent method to achieve staged population targets. The simplicity came from the need to change only the size of the bag limit to reach a target rather than a range of different season, area and timing conditions. Consistency would be achieved from its equal application to all salmon anglers fishing all rivers.

Using the 26-year record of harvest and spawning population sizes that existed in 2020, significant modelling of the impact of different season bag limits on population sizes was completed. Overall, the scenario that assigned a 5% reduction in harvest to the healthy band, 20% reduction to the moderate band and 40% reduction to the low band had the least impact on anglers of the scenarios modelled and generated significant long-term increases in spawning, angling and total run population sizes. Reductions in harvest of 5%. 20% and 40% could be achieved with season bag limits of 10, 4 and 2 fish respectively (Table 5). Below the low band threshold of 1,200 spawners, while the fishery may not be closed, restrictions would be very severe e.g., a one-fish season bag limit in addition to season length and closed area restrictions.

In the situation where the spawning population declined through a threshold from a stronger population band to a lower population band, the management strategy provided for immediate increase in restriction in harvest by reduction of the season bag limit for the following fishing season. This enables Fish and Game to cautiously manage harvest ahead of a possible multi-year declining population trend.

In the opposite situation, where the spawning population rises above a threshold and into a heathier population band, the management strategy requires the spawning population to remain in a higher band for a minimum of three years before the season bag is changed to allow for increased harvest. The delay in relaxing the season bag limit is to ensure that the spawning population increase is a true reflection of a stronger population trend that is able to sustain higher harvest and not a single-year anomaly where allowing increased harvest would be detrimental. Increasing harvest on the strength of a single year increase in the spawning population could lead to yoyoing of the population in reaction to annual changes in harvest conditions.

The 2021/22 combined Waimakariri, Rakaia and Rangitata rivers salmon spawning count was 5,588 fish (Table 4) and places the status of the fishery in the moderate health band (Figure 5). This is a considerable improvement on combined spawning counts for 2020/21 of 1,420 fish and for 2019/20 of 1,600 fish. The introduction of the 2 fish season bag limit reduced harvest in 2021/22, and across the three fisheries added about 1,500 fish to the spawning population that would otherwise have been caught if harvest rates had remained as they were in 2020/211. The bulk of the increase in the spawning population, accounting for about 2,500 fish, resulted from an overall stronger returning run to the rivers.

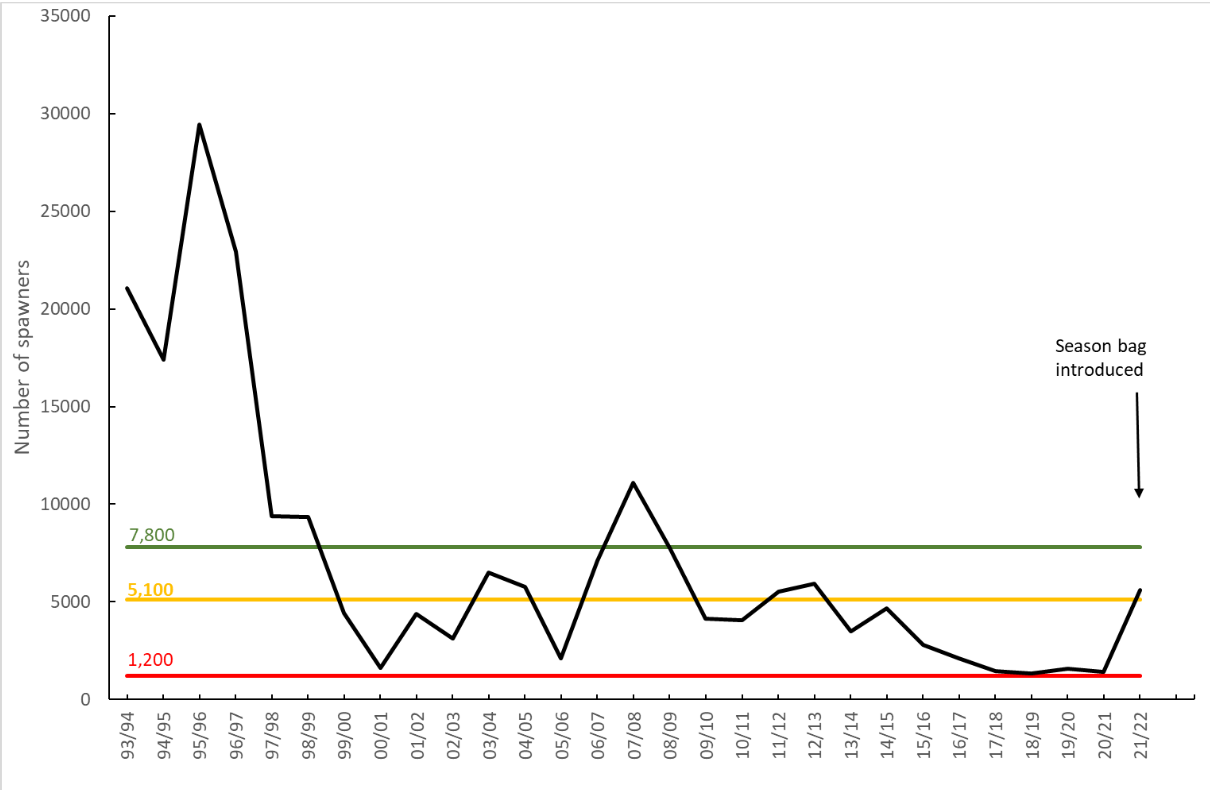


Figure 5. Combined Waimakariri, Rakaia and Rangitata annual sea-run salmon spawning population (black line) 1993/94 to 2021/22 and Threshold Management Strategy population band limits.

The season bag limit for the 2022/23 season will remain at two fish. While the 2021/22 spawning population was in the moderate population band the management strategy requires the spawning population to be in a higher band for three years when recovering from a lower population status before the season bag can be increased.

5. Central South Island Fisheries

5.1 Ashburton River

Spawning: 5 redds in Māori Lakes Outlet and indicator of 15 redds likely elsewhere in the Ashburton Catchment.

Harvest: Season bag returns and follow-up surveys indicated an estimated catch of 39 salmon from the Ashburton River, this estimate was the result of surveyed anglers catching one salmon in December and another in January and these results being scaled up. Experience would indicate it is very doubtful this estimate is correct. A daily diary record for observations at the river mouth identified 2 salmon caught in the surf in late January. The river mouth was open apart from just 2 days in late April. Typically, the Ashburton mouth is blocked for 20 to 65 days per season.

Total run: Estimated to be 50 fish and above average for the last 5 years. Between 2000 and 2015 average run size was about 150 salmon and between 1990 and 2000 about 250 salmon.

5.2 Rangitata River

Spawning: Live fish counts – 1,695 fish total for Deep Stream and Deep Creek equated to approx. 1,820 catchment-wide (minimum). This is the highest count since 2013. Black Mountain Stream produced 28 redds.

Harvest: Approximately 280 fish were estimated to have been caught by season bag card holders. Compared to 108 caught by CSI and NC licence holders in 2020/21 and 119 in 2019/20. An estimated 14 fish or 5% of angler caught salmon were fin-clipped and of hatchery origin. For the last three seasons 100% of hatchery released juvenile salmon have been fin-clipped.

Total Run: About 2,100 fish and likely to be the strongest run for 6 years.

Hatchery: An estimated 38 McKinnons hatchery-origin fish returned to the Rangitata of which 14 were caught by anglers and 24 returned to the hatchery. No fin-clipped fish were found on the Deep Stream and Deep Creek spawning grounds during spawning surveys. The total run to McKinnons hatchery was 37 fish of which 13 were wild strays.

5.3 Orari

Spawning: The Ohapi South Branch was surveyed in early June and 5 salmon redds were counted. Estimated catchment spawning of 14 redds from approximately 40 fish.

Harvest: Season bag card returns and additional surveys identified only one salmon caught at the Orari mouth for the season and this was identified as fin clipped. This is supported by angler comments and staff observations. In the last 20 seasons there have been extremes in angler success with 5 years that have returned no fish to the Orari angler, a further 5 years where the catch has been less than 20 fish and 640 caught in 2013/14.

Total Run: Unlikely to have been more than 50 fish.

5.4 Opihi

Spawning: Spawning surveys were undertaken in identified sections of the Waihi-Temuka, Opuha and Opihi mainstem. Fifty-one salmon redds were counted and the live fish spawning population estimated at 130 fish.

Harvest: Three salmon recorded for the season none of which were fin-clipped.

Run: Unlikely to be more than 150 fish.

5.5 Waitaki River

Spawning: Estimated 660 redds in the catchment based on aerial survey of 35 side streams, four main-stem reaches and the Hakataramea River. The catchment count was double that of the previous four year’s counts and about 50% higher half the average of 470 redds for the previous nine years.

Harvest: Season bag card results and other surveys estimated 244 salmon caught by anglers compared to 170 in 2020/21 and 85 in 2019/20. The Waitaki Riparian Enhancement Society reported four fin-clipped hatchery-origin salmon confirmed by them as being angler caught.

Run: The total run is estimated at about 2,050 fish. Run size records since 2000, would indicate a total run of around 3,000 salmon with around 500 caught by anglers should be a goal for the Waitaki salmon fishery.

5.6 Regional Perspective

Prior to the 2021/22 season CSI Fish and Game had been making annual harvest estimates for catch of all salmon by CSI licence holders since 1993. Introduction of the season bag requirement enabled catch of all salmon anglers regardless of licence Region of issue to be assessed. Across those 29 seasons there have been significant changes to fishing opportunity through reduction in season length from 2006/07, introduction of a one-fish daily bag limit in 2019/20 and the season bag in 2021/22. Supplementation of angler catch with hatchery fish in at least four rivers since 2008/09 may have offset some of these restrictions (Table 6).

Table 6. Season angler catch of sea-run wild salmon in CSI Region rivers and total for the Region for fishing seasons from 1993/94 to 2019/20 and estimated catch of hatchery-origin salmon from 2008/09 in the Rangitata, Orari and Opihi rivers and from 2013/14 for the Waitaki River. Regulation Category "A" had a season from October to April, and a two-salmon daily bag limit. Regulation Category "B" had an October to March season and a two-salmon daily bag limit. Regulation Category "C" had a December to March season and a one-salmon daily bag limit. Category "D" first season of a 2 fish season bag.

Season	Regulation Category	Ashburton	Rangitata	Orari	Opihi	Waitaki	Total Wild fish	Rangitata + Orari + Opihi Hatchery fish (Waitaki)
93/94	A	216	2,628	54	810	3,420	7,128	
94/95	A	28	2,497	97	662	2,261	5,545	
95/96	A	271	4,483	57	760	2,217	7,788	
96/97	A	105	4,890	5	178	3,135	8,313	
97/98	A	0	1,430	22	120	2,306	3,878	
98/99	A	62	2,706	25	481	1,903	5,177	
99/00	A	60	1,228	141	390	1,143	2,962	
00/01	A	21	247	0	87	500	855	
01/02	A	9	152	165	171	623	1,120	
02/03	A	0	449	49	28	807	1,333	
03/04	A	0	367	0	230	1,108	1,705	
04/05	A	11	533	70	1,600	611	2,825	
05/06	A	11	216	0	55	240	522	
06/07	B	23	1,163	0	248	576	2,010	
07/08	B	60	1,389	0	425	686	2,560	
08/09	B	24	998	27	277	327	1,653	490
09/10	B	25	506	32	197	353	1,113	232
10/11	B	19	485	23	225	314	1,066	374
11/12	B	21	740	177	252	715	1,905	419
12/13	B	37	1,229	94	665	811	2,836	178
13/14	B	41	812	371	408	280	1,912	706 (5)
14/15	B	6	914	86	28	222	1,256	180 (2)
15/16	B	30	338	15	25	232	640	84 (3)
16/17	B	6	293	22	15	115	451	46 (6)
17/18	B	6	136	16	33	127	318	23 (6)
18/19	B	6	267	5	35	183	496	62 (3)
19/20	C	2	58	0	20	77	157	83 (8)
20/21	C	0	93	5	13	171	287	20 (0)
21/22	D	2	272	0	3	240	517	15 (4)

5.7 Hatchery Supplementation

Since 2007, McKinnons Hatchery on the lower Rangitata has been annually releasing between 7,000 and 95,000, one-year old fin-clipped juvenile salmon to the Rangitata. The 2021/22 season was the fourteenth season where adult returning hatchery-origin fish have supplemented angler catch.

In the 2021/22 season, 14 McKinnon's-origin fin-clipped salmon were caught by anglers in the Rangitata. For the last three seasons all hatchery-origin salmon released from McKinnons hatchery have been fin-clipped meaning that the proportion of hatchery-origin fish in the returning run is the number of fin-clipped fish without the need to account for any hatchery-origin fish released that were not fin-clipped.

In addition to 14 hatchery-origin fish caught by Rangitata anglers, a further 24 fin-clipped salmon returned to the hatchery. Surveys on the upper Rangitata River spawning grounds did not find any fin-clipped salmon. One fin-clipped salmon was caught in the Orari River and none in the Opihi River.

Overall, McKinnon's-origin salmon totalled 39 fish or 1.7% of the 2,300 returning salmon in the Rangitata, Opihi and Orari rivers in the 2021/22 season (Table 7).

Table 7. Number of wild and hatchery-origin salmon returning to the Rangitata, Orari and Opihi rivers that were caught by anglers, or spawned in those rivers, or returned to McKinnons Hatchery for the 2008/09 to 2021/22 seasons.

		Hatchery Origin					**Wild Origin**			
River	Season	Angler caught	Spawned in wild	Returned to hatchery	Total		Angler caught	Spawned in wild	Returned to hatchery	Total
Rangitata	08/09	240	39	650	929		994	2,714	0	3,708
	09/10	68	2	314	384		512	901	0	1,413
	10/11	240	33	774	1,047		483	905	31	1,419
	11/12	237	42	731	1,010		740	1,610	79	2,429
	12/13	68	61	408	537		1,215	3,042	42	4,299
	13/14	294	18	344	656		814	1,283	621	2,718
	14/15	161	24	64	249		978	1,666	346	2,990
	15/16	76	15	37	128		337	1,055	146	1,538
	16/17	30	7	28	65		293	498	42	833
	17/18	23	0	0	23		136	573	0	709
	18/19	60	0	18	78		268	403	0	671
	19/20	61	0	25	86		58	437	105	600
	20/21	15	0	11	26		93	397	11	501
	21/22	14	0	24	38		272	1,820	13	2,105
Orari	08/09	28	72		100		27	48		75
	09/10	28	90		118		32	60		92
	10/11	70	62		132		23	41		64
	11/12	29	49		78		177	51		228
	12/13	13	24		37		94	176		270
	13/14	270	350		620		371	150		521
	14/15	20	4		24		86	12		98
	15/16	0	0		0		15	15		30
	16/17	4	7		11		22	40		62
	17/18	0	0		0		16	50		66
	18/19	0	0		0		5	35		40
	19/20	13	35		48		0	0		0
	20/21	0	0		0		5	30		35
	21/22	1	0		1		0	50		50
Opihi	08/09	221	25		246		277	525		802
	09/10	137	30		167		197	670		867
	10/11	63	32		95		225	668		893
	11/12	104	27		131		252	573		825
	12/13	13	9		22		665	591		1,256
	13/14	142	23		165		408	477		885
	14/15	10	30		40		28	70		98
	15/16	8	24		32		25	76		101
	16/17	12	2		14		15	148		163
	17/18	0	0		0		33	100		133
	18/19	2	4		6		35	71		106
	19/20	8	57		65		20	143		163
	20/21	5	28		33		13	72		85
	21/22	0	0		0		3	130		133

The age composition of returning hatchery-origin salmon has been determined from scale growth ring analysis of angler-caught and hatchery-trapped salmon for some season's returns since the 2008/09 season. In addition, the frequency with which certain sized (length) salmon occur in the angler and hatchery returns can be used to identify age classes of salmon. Age class returns, and fin-clip rates are essential information for estimating overall return (survival) for each release of juvenile fish from McKinnons Hatchery (Table 8).

Table 8. Brood year, year of release, age at return and overall return rate as a percentage of the total number of fin-clipped and non-fin-clipped juvenile salmon released from McKinnons Hatchery. For cohorts yet to return the season of expected return is shown.

Brood year	Number released	Date of release	% fin-clipped	No. return 1^+	No. return 2^+	No. return 3^+	Total return	Percent return
2006	55,000	July 07	100	0	1,253	183	1456	2.64
2007	72,000	July 08	100	22	390	89	544	0.75
2008	52,000	July 09	100	96	836	7	951	1.82
2009	65,000	July 10	100	349	1,072	8	1,429	2.20
2010	70,000	July 11	53.7	189	636	21	846	1.21
2011	95,000	July 12	47.4	36	1,400	5	1,441	1.51
2012	63,000	July 13	68.25	20	292	5	317	0.50
2013	64,000	June 14	50	5	140	5	150	0.23
2014	35,000	Jun 15	100	15	58	2	75	0.21
2015	65,000	June 16	60	27	21	42	100	0.15
2016	68,000	Jun/Jul 17	0	-	-	-	-	-
2017	55,000	July 18	37	42	200	3	245	0.45
2018	0	-	-	-	-	-	-	-
2019	7,500	July 20	100	8	35	2022/23	43+	
2020	61,100	Jan/Jul 21	100	4	2022/23	2023/24	4+	
2021	5,000	Apr/Jul 22	100	2022/23	2023/24	2024/25		

To date there have been eleven hatchery releases that have run their full life cycle. The 2006 to 2017 broods have completed return out to 3^+ (almost four years old) and produced a range of returns from 0.15% (1.5 fish returning for every 1,000 released) to 2.64% (26.4 fish returning for every 1,000 released) and averaged 1.04% (10.4 fish returning for every 1,000 released).

Acknowledgements

Central South Island Fish and Game thanks the following volunteers for their enthusiasm, time and effort in maintaining annual spawning records, and to runholders for permitting access to streams and rivers. Thank you to the Salmon and Riparian Support Trust (McKinnons Hatchery) and Waitaki Riparian Enhancement Trust (Welcome Stream and Bells Pond hatcheries) for their continued enthusiasm and diligence.

River mouth Dairy Keepers:

Robert Mann, Linda Whipp

Runholders:

Scott Hussey - Mt Potts
Malcolm Prouting - Mesopotamia
Michael Tayler - Korari
James Wright - Forest Creek
Leighton Pye - Ohapi