CENTRAL SOUTH ISLAND REGION

2022/2023 Central South Island Sea-run Salmon Returns - Season Summary

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Executive Summary

12,859 sea-run salmon licence endorsements were issued in the 2022/23 season. An increase of 3,400 on last year. 2022/2023 Licence endorsements issued to Central South Island and North Canterbury licence holders comprised 87% of the total licence endorsements issued.

3,645 voluntary season bag card returns reported a total harvest of 666 salmon in the 2022-23 season. 1,000 random telephone surveys were completed from the remaining 9,214 anglers and a further 449 salmon were estimated to be harvested equating to a total estimated harvest for North Canterbury and Central South Island Regions of 1,115 salmon.

Combined live fish spawning estimates for the three indicator rivers was 2,555 fish and places the status of the fishery in the 'low health' management band (1200 – 5100 spawning fish). On the basis of this, the North Canterbury and CSI Fish and Game councils have decided the season bag limit will remain at 2 fish.

The Rangitata and Waitaki River total runs were estimated to be approximately 820 and 1,400 fish respectively. The combined total wild run for the three indicator rivers, Waimakariri, Rakaia and Rangitata, in the 2022/23 season is 3,262 fish.

1. Introduction

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 (CSI) and North Canterbury (NC) 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 licence 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. In 2021/22 we received 5,938 thousand more applications for a season bag card than we expected.

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/Rakitata, and the Orari, Opihi, 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 the application and results from the second 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.

2. Salmon Season Bag

1.1 Salmon licence endorsement

Salmon angler surveys across CSI and NCFG regions up to 2020, previously identified about 3,500 anglers fishing annually for salmon. Therefore, when the season bag limit card was introduced, that same level of demand for season bag cards was anticipated when applying the salmon licence endorsement requirement for the 2020/21 season.

In actuality, 9,438 sea-run salmon licence endorsements were issued to anglers from all over New Zealand in the 2021/22 season, which came at a significant cost. This season, a $5 charge was added to the licence endorsement to offset the cost of printing each card. With this addition, it was predicted that the number of sea-run salmon licence endorsement holders would decrease but this was not the reality. 12,859 sea-run salmon licence endorsements were issued in the 2022/23 season.

2022/2023 Licence endorsements issued to Central South Island and North Canterbury licence holders comprised 87% of the total licence endorsements issued. 98% of licence endorsements were issued to the South Island, 1.5% to the North Island and 0.5% to overseas residents *(Table 1).*

Table 1. Number of sea-run salmon endorsements issued in the 2021-22 and 2022-23 seasons across South Island regions, combined North Island regions, and non-residents.

Licence Region	2021-22	2022-23
Nelson/Marlborough	566	437
West Coast	120	92
North Canterbury	5,065	6,352
Central South Island	2,597	4,858
Otago	643	624
Southland	215	257
All North Island regions	195	180
Non-resident	37	59
Total	9,438	12,859

1.2 Salmon Season Bag Limit Card Returns

Season bag card information was voluntarily returned by 3,645 endorsed licence holders by online form, post, email or drop-in. 471 of those anglers (12.9%) reported that they harvested salmon during the 2022-23 season. 1,572 anglers (43.1%) reported that they fished for sea-run salmon but did not harvest any salmon. 56.1% reported that they did not fish for sea-run salmon this season.

A random selection of 1,003 anglers out of the remaining anglers participated in a telephone survey. Three of these random telephone survey participants had their responses excluded due to a combination of factors such as human error or participant ineligibility. This resulted in returned data from 4,645 anglers.

1.3 Mean Angler Harvest

The salmon harvest data is analysed in multiple strata (subgroups). Firstly, we isolated those who voluntarily returned their season bag cards from those who were randomly phone surveyed.

The mean harvest for those who voluntarily returned their season bag card is 0.33 fish per angler which is five times the mean harvest of those who did not voluntarily return their bag card and were surveyed by phone. The two groups are statistically distinct therefore harvest information from the voluntary salmon bag card returns was not extrapolated to any non-respondents. The information gathered from the random telephone survey is used to extrapolate out to the 8,214 remaining non-respondents.

Using previous harvest survey data, we identified anglers who are known to have harvested at least one salmon between 2018-19 and 2021-22 fishing seasons. These anglers are referred to as the "known success" stratum while all remaining anglers are referred to as the "no known success" stratum.

Amongst anglers with known success, an average harvest per angler was 0.4 fish, however, only 71.6% of those anglers surveyed actively fished for salmon in the 2022-23 salmon season. Accounting for this, the average harvest is 0.56 fish per active angler (± 0.087) in the known success stratum.

Amongst anglers with no known success, 33.1% of those surveyed actively fished for salmon in the 2022-23 salmon season, with an average harvest of 0.08 fish per active angler (± 0.019).

1.4 Total Harvest

Voluntary season bag card returns reported a total harvest of 666 salmon in the 2022-23 season. A further 449.1 salmon were estimated to be harvested from the remainder of the salmon bag card holders equating to a total estimated harvest for North Canterbury and Central South Island Regions of 1,115.1 (± 89.6) salmon.

Approximately 40.5% of harvest estimated from the phone surveys was attributed to anglers with known success. About 40% of anglers who caught and kept one salmon went on to keep a second fish in the season.

1.5 River Catch

The Rakaia, Rangitata, Waitaki and Waimakariri rivers sustained more than 87% of the total catch by sea-run salmon licence endorsement holders *(Table 2).* The remainder was reported from the Ashley, Kaiapoi, Hurunui, Waiau, Clarence, Ashburton, Opihi and Orari rivers.

Table 2 Estimated catch of sea-run salmon from season bag card returns for the 2021/22 and 22/23 seasons.

River	2021/22 Salmon Catch	2022/23 Salmon Catch
Hurunui	39	34
Waimakariri	178	245
Rakaia	407	299
Rangitata	274	161
Waitaki	234	195
Waiau, Ashley, Kaiapoi, Ashburton, Orari, Opihi	44	94
Clarence		5
Total catch	1,176	1,115
Total salmon anglers	3,562	12,859

Relative to the 2021-22 season, estimated harvest has decreased on most rivers with the main exception of the Waimakariri River which has an estimated increase in harvest this season of 59 fish. The Waimakariri River is estimated to have received a greater amount of angler effort than any other river this season, which could go some way to explain this harvest outcome.

1.6 Monthly Catch

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

Results show that more than 90% of harvest occurred after January 1st.
As has happened historically the main four rivers are paired in terms of run timing. The Rangitata and Rakaia demonstrate strong similarities with most of the harvest out of these rivers occurring between January and March. The Waimakariri and Waitaki have a March-April peak harvest time. 63% of the Waitaki River catch occurs in April alone.

1.7 Size of Salmon

This year the salmon season bag differed from the previous in that it only provided for the length to be returned and not the weight. Traditionally, anglers talk of salmon size in terms of weight however by far the most important measure of size from a fishery management perspective is the length. Length data can provide an indication of the age structure of an adult fish. The returning run can comprise two, three, four and sometimes five-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 can be used for assessing the relative survival of each year class through its lifetime.

Salmon bag card return data cannot be classed as a random sample, particularly when the season bag limit is small due to 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.

The average length of harvested salmon this season was 67cm, smaller on average than those reported during the 2021-22 season.

Table 3. Mean (average), maximum, and 1st-3rd quartile length (cm) of sea-run salmon harvested during the 2022-23 fishing season in North Canterbury and Central South Island regions of Fish & Game, as reported by anglers. Values are provided for all fish. (Garrick 2023)

Length (cm)	All Rivers	Rakaia	Rangitata	Waimakariri	Waitaki
N	640	192	103	141	112
Mean	67.1	68.2	70.8	67.0	63.1
Maximum	96.0	93.0	96.0	90.0	82.0
Most Common	61 - 74	62-75	65-76	63-72	60-71

3. 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 27 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 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 463 to 1,659 fish (Table 5).

Table 4. Estimated returning sea-run salmon runs from the sum of spawning population sizes and wild 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
Estimated harvest by sbc holders	245	299	161	195
Spawners	671	1332	552	1121
Total salmon run	916	1631	713	1316

The combined wild run for the Waimakariri, Rakaia and Rangitata in the 2022/23 season is 3262 fish. This is the second highest total run estimate in the last six years.

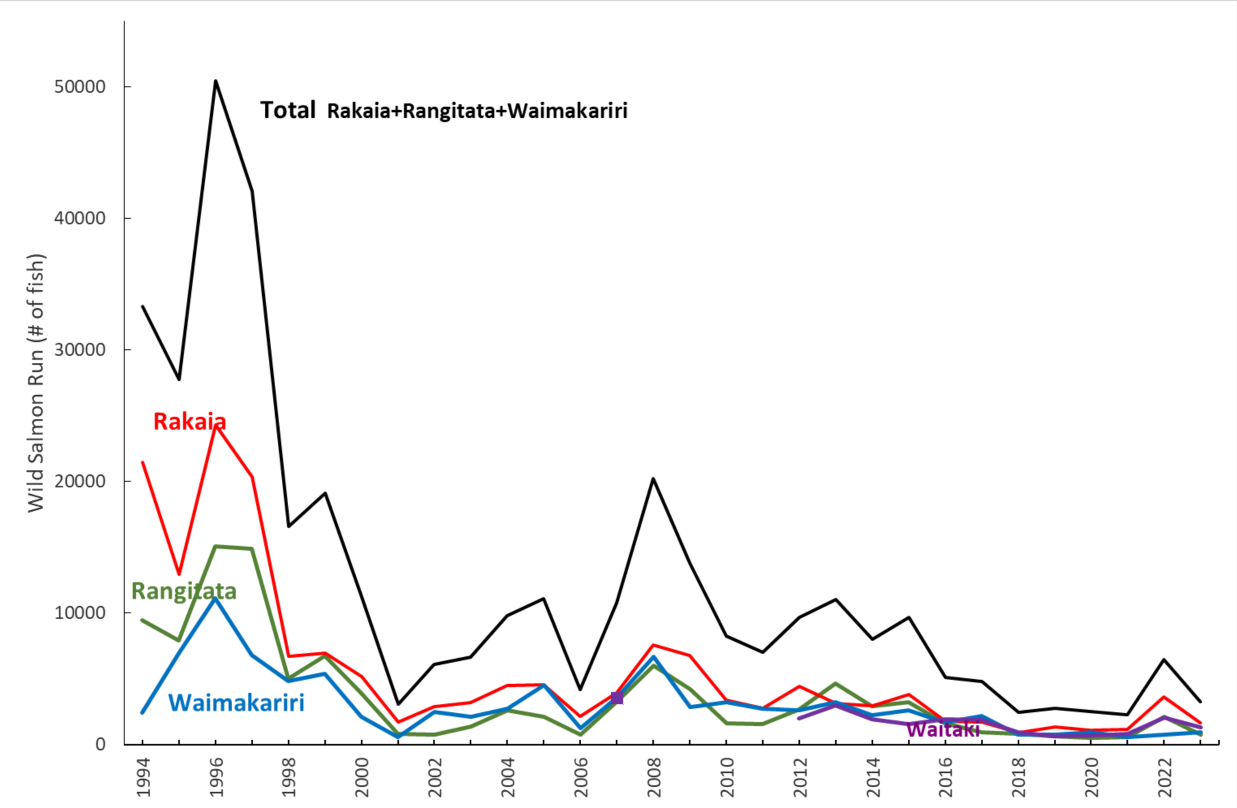

Figure 1. Estimated wild salmon returning to the Rakaia (red), Rangitata (Green), and Waimakariri (Blue) rivers for 1994 to 2023. Waitaki River 2007 (Purple cross) and 2012 to 2022 (purple line), and total combined for the Rakaia, Rangitata, and Waimakariri (black)

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 1).*

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. 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. 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 the season bag conditions triggered from these.

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 scientific 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 2022/23 combined Waimakariri, Rakaia and Rangitata rivers salmon spawning count was 2,555 fish and places the status of the fishery in the low health band *(Figure 2).* Though considerably less than last year, this season's live spawning total is still a lot healthier than the average run of the last six years where the total combined spawning total has dipped as low as 1,300.

The season bag limit for the 2023/24 season remains at two sea-run salmon.

The management strategy described above requires the estimated spawning population to exceed 5,100 for three consecutive years or drop below 1,200 before any change in the bag limit is considered.

The introduction of the 2 fish season bag limit in 2021/22 reduced harvest across the three fisheries and added about 1,500 fish to the spawning population that year that would otherwise have been caught if harvest rates had remained as they were in 2020/21. The continuation of the season bag limit in the 2022/23 season has again contributed to the higher than recent average spawning population.

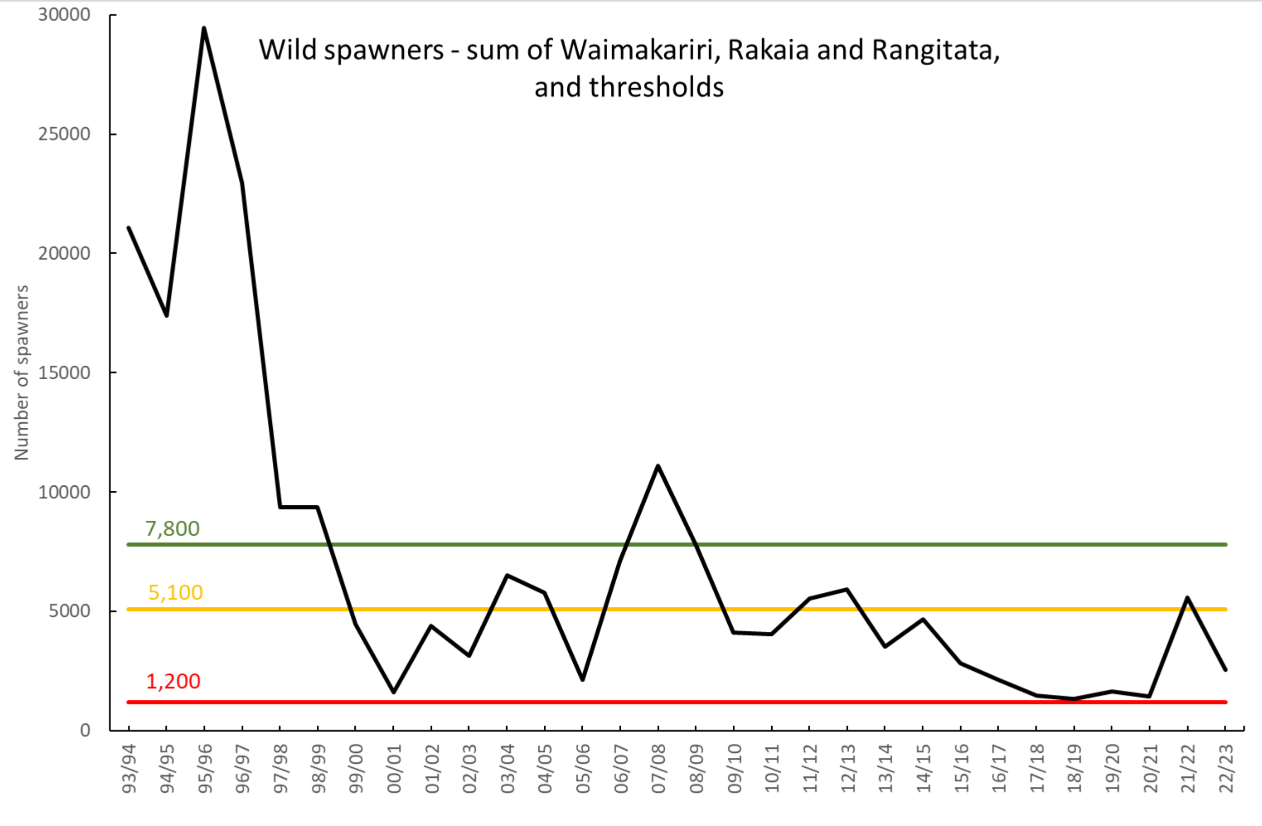

Figure 2. Combined Waimakariri, Rakaia and Rangitata annual sea-run salmon spawning population (black line) 1993/94 to 2022/23 and Threshold Management Strategy population band limits.

5. Central South Island Fisheries

4.1 Ashburton River

Spawning: Six redds were identified in the Māori Lakes outlet and a further six from Bowyers stream. A spawning population of 30 live fish was estimated.

Harvest: Season bag returns and follow-up surveys indicated an estimated harvest of two salmon from the Ashburton River. Two salmon were reportedly released at the mouth in late January, both around 80cm long. A daily diary record for observations at the river mouth identified the river mouth was open all season until it closed on the 26th of April for the last five days of the season. Historically, the Ashburton river mouth is blocked for 20 to 65 days per season.

Total run: Estimated to be 30 fish for 2022/23 season. Between 2000 and 2015 the average run size for the Ashburton was about 150 salmon and between 1990 and 2000 about 250 salmon.

4.2 Rangitata River

Spawning: Live fish counts saw 513 fish total for Deep Stream and Deep Creek equated to approx. 552 catchment-wide (minimum).

Harvest: 161 fish were estimated to have been caught by season bag card holders in the Rangitata River this season. An estimated 31 fish of angler caught salmon were fin- clipped and of hatchery origin. For the last four seasons, 100% of hatchery released juvenile salmon have been fin-clipped.

Total Run: About 820 fish.

Hatchery: An estimated 103 McKinnon's Creek hatchery-origin fish returned to the Rangitata of which 31 were caught by anglers and 72 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 McKinnon's Creek hatchery was 105 fish of which 33 were wild strays.

4.3 Orari

Spawning: The Ohapi South Branch was surveyed in early June and eight salmon redds were counted. One further salmon redd was identified in the lower Orari River. We estimate the total wild spawning in the Orari River to be approximately 25 fish.

Harvest: Season bag card returns identified 2 salmon caught in the Orari River at the beginning of Feburary and the beginning of March for the 2022/23 season. One of these salmon was identified by the angler to be fin clipped, indicating hatchery origin.

Total Run: Unlikely to have been more than 30 fish.

4.4 Opihi

Spawning: Spawning surveys were undertaken in four identified sections of the Opihi River mainstem and the Waihi-Temuka River. 48 Salmon redds were counted in four sections the Opihi River in late June and eight in the Waihi-Temuka River in May. Using these counts and previous data an estimate was made of 110 redds laid and a spawning run of 300 fish in the Opihi catchment this year.

Harvest: It is estimated that 38 salmon were harvested from the Opihi river this year, 10 of which were fin clipped indicating hatchery origin.

Run: Unlikely to be more than 250 fish.

4.5 Waitaki River

Spawning:	An estimated 425 redds were counted in the Waitaki catchment this season. This is based on an aerial survey of 35 side streams, four main-stem reaches and the Hakataramea River. The catchment count was about average for the previous nine years.
Harvest:	Season bag card results and other surveys estimated 195 salmon caught by anglers compared to 244 in 2021/22 and 170 in 2020/21. The Waitaki Riparian Enhancement Society reported 8 confirmed fin-clipped hatchery-origin salmon.
Run:	The total run is estimated at about 1,400 fish.
Hatchery:	The Waitaki Riparian Enhancement Society had 14 fin clipped fish reported as caught this season. A member of the society was able to view and confirm 9 of them. This year the hatchery released 5, 600 fish into Welcome Stream and 1300 to Bells Pond.

6. 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 2022/23 season was the 15th season where adult returning hatchery-origin fish have supplemented angler catch.

In the 2022/23 season, 31 McKinnon's-origin fin-clipped salmon were caught by anglers in the Rangitata. For the last four 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 31 hatchery-origin fish caught by Rangitata anglers, a further 72 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 10 in the Opihi River.

Overall, McKinnon's-origin salmon totalled 194 fish or 16% of the 1,180 returning salmon in the Rangitata, Opihi and Orari rivers in the 2022/23 season *(Table 6).*

Table 6. 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 2022/23 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
	22/23	31	0	72	103		130	552	33	715
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
	22/23	1	0		1		1	25		26
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

	22/23	10	80		90		28	220		248

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 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 7).*

Table 7. 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 on 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	5	48	0.64
2020	61,100	Jan/Jul 21	100	4	169	2023/24	173+	
2021	5,000	Apr/Jul 22	100	20	2023/24	2024/25		
2022	81,000	Feb/Jul 23	100	2023/24	2024/25	2025/26		

To date there have been 12 hatchery releases that have run their full life cycle. The 2006 to 2019 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 1.0% (10 fish returning for every 1,000 released).

7. References

Garrick H S (2023). 2022-23 Sea-run salmon Harvest
Webb M (2023). 2021/22 Central South Island Salmon Run Returns – Season Summary

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