2019 SALMON MONITORING REPORT

Steve Terry
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INTRODUCTION

North Canterbury Fish & Game Council has been monitoring sea-run chinook salmon returns for 27 years. The South Island's East Coast salmon fishery has been steadily declining over the last decade, with very low returns to all rivers in 2018 and only marginally improved returns in 2019.

At present, fishery managers only have a limited number of options to try and ensure adequate salmon numbers reach their spawning grounds each year, the key tool being tighter regulations to reduce harvest. There is an acceptance by both North Canterbury (NC) and Central South Island Fish & Game (CSI) councils that we need to significantly reduce the harvest of wild salmon, in order to increase the numbers of fish returning to the spawning streams and rebuild the fishery. While we do not know the minimum number of spawning salmon required to sustain the population in each spawning stream or catchment, we do know that in the last decade salmon returns have steadily declined to record low levels. Regulations to incrementally reduce harvest have been put in place for the 2019/20 season, however introduction of a seasonal catch limit has been recommended by scientists as the least harmful regulation to reduce harvest and rebuild spawning numbers. It is possible that life history, genetic diversity and population resilience may be adversely affected by shortening the season and areas anglers can fish (R. Gabrielsson pers. comm).

While fishery scientists do not believe the salmon fishery is at risk of extinction, there is growing concern that the increasing proportion of the run caught by anglers during a period of decreasing run size may hinder recovery when conditions eventually favour their survival at sea. Ocean conditions have not favoured salmon survival in recent years and this is likely to be a significant influence on returning adult salmon abundance. However, there are also a number of factors in freshwater that influence salmon survival, such as degraded spawning stream habitat, reduced flows due to irrigation schemes and the resulting loss of rearing and migratory habitat, along with poor functioning fish screens.

METHODS

Estimates of annual salmon returns consist of combining the number of salmon that reach their spawning streams, angler catch, and returns to hatchery facilities such as Silverstream and the Fish & Game managed hatcheries. Financial constraints meant helicopters could not be used for spawning counts in 2019. Foot surveys were carried out in the key primary salmon spawning streams, with peak count estimates focused in the Rakaia and Waimakariri catchments. Flooded rivers restricted access to key Rakaia spawning streams around peak spawning period and we were fortunate enough to be given a free flight to count the upper Rakaia streams where access was limited. There is likely to be some error with the Rakaia spawning escapement as one flight does not allow for seasonal variances in the timing of the run peak, along with discoloured water below the spawning streams. Due to weather and time constraints the Hurunui and Waiau catchments were not counted.

a. Spawning Escapement

The accuracy of the reporting of salmon spawning escapement and catch estimates is affected by the methods used to interpret these counts, specifically the relationship between individual salmon aerial count data and the proportion of the run this represents, compared with angler catch. Since 2013, the key spawning streams in both the Rakaia and the Waimakariri River catchments have been assessed

by helicopter around the time of the average historic peak in salmon spawning numbers observed (Peak Count). Salmon generally congregate in pools around the entrance to the spawning streams in reasonable numbers towards the end of March in the Rakaia and end of April in the Waimakariri. Peak spawning occurs late April to late May, with the runs tapering off by mid-June, very few live salmon are left, although isolated runs of salmon have been reported spawning as late as August.

Generally, the Rakaia salmon numbers reach their peak in the spawning streams at the beginning of May, the Hurunui and Waiau rivers the second week of May, and the Waimakariri River the third week of May. When only a single trend count is carried out at peak spawning time, as much of the river is counted as possible to ensure any salmon waiting below the traditional spawning reaches are accounted for, as well as counting all carcasses. Historically during peak counts, very few dead salmon are usually observed.

To calculate the annual total trend count for the Rakaia River, the peak count data from all streams in the catchment was added to the aerial observations by CSI staff for Mellish Stream and the total salmon returning to the Montrose and Whisky Creek hatcheries, along with any returns to Bully Creek in the lower Rakaia, where hatchery releases have occurred in recent years. To calculate the annual total trend count for the Waimakariri River, the peak aerial count data from all streams in the catchment was added to the total returns to Silverstream hatchery. With no trap in the Otukaikino Stream flowing from the Isaacs hatchery where salmon have been released in recent years, no returns were recorded again this year.

Historical Area Under the Curve (AUC) peak aerial count data for each stream cannot be used to compare the more recent Peak Count data. Historic count data does not give a true representation of the total numbers of salmon present each flight, as there would usually still be a significant number of salmon waiting below the spawning reaches, along with a small number of spent carcasses that were not traditionally recorded, and these salmon are therefore not included in the historic AUC data.

Observations over the last 19 years indicate that the salmon observed during the peak counts represents the majority of the spawning salmon. There are usually very few carcasses observed at this time, <10%. Calculations indicate that the historically reported AUC spawning numbers are likely to be around 1.5 x the number seen on the recent Peak Counts. Using this multiplier for calculating comparable spawning numbers in each stream, the graphed results look very similar to the historically reported results using the AUC model (Figure 3).

No Waiau or Hurunui aerial peak counts were planned this year, however staff attempted to count peak salmon numbers by foot in the Hurunui catchment on May 7, unfortunately discoloured water upstream of Lake Mason prevented over a third of the spawning reach in the South Branch being counted. This count has historically been planned for the first day after the Rakaia peak count given the historically similar timing of the spawning in these two rivers. Data from these peak count flights has historically been used with similar weight for advocacy purposes, as the comprehensive data from the AUC method of five flights for the Rakaia and Waimakariri rivers.

b. Angler Salmon Catch

Email and phone surveys were carried out at the end of the salmon fishing season in conjunction with CSI to determine the number of salmon that were caught from each river. The survey results were then analysed and the results extrapolated to include all licence holders in both regions. An estimate of the total salmon catch in each river by NC & CSI licence holders was then calculated.

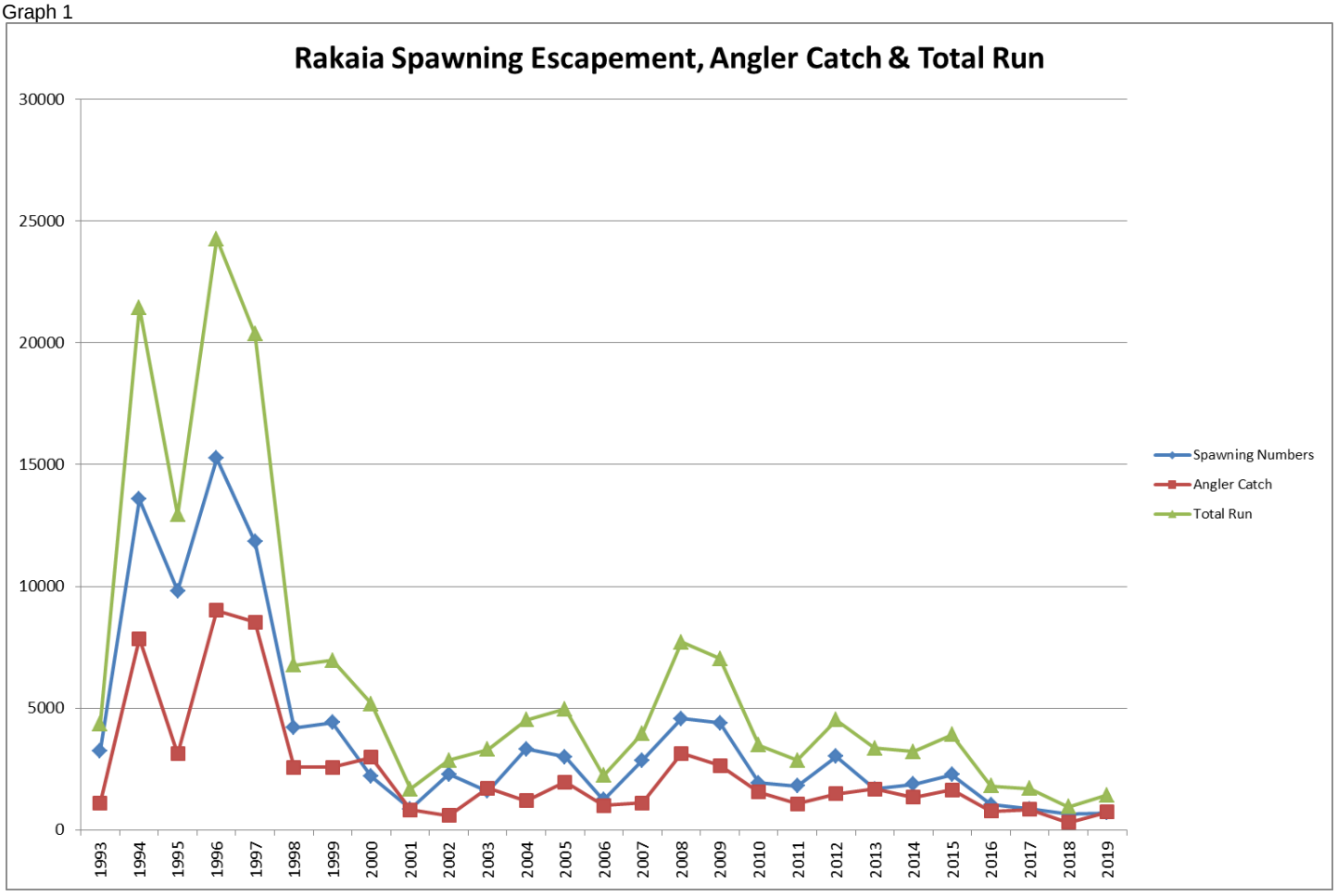
The full list of questions can be found in Appendix 3, however the survey format is not easily displayed here.

RESULTS

a. Rakaia River Returns

The AUC historic total run has been calculated using the 1.5 multiplier of the Peak Count from 2013, and from the graph below, the total run in the Rakaia was the second lowest on record. See Appendix 1 for counts on each spawning stream, and Appendix 4 for total counts.

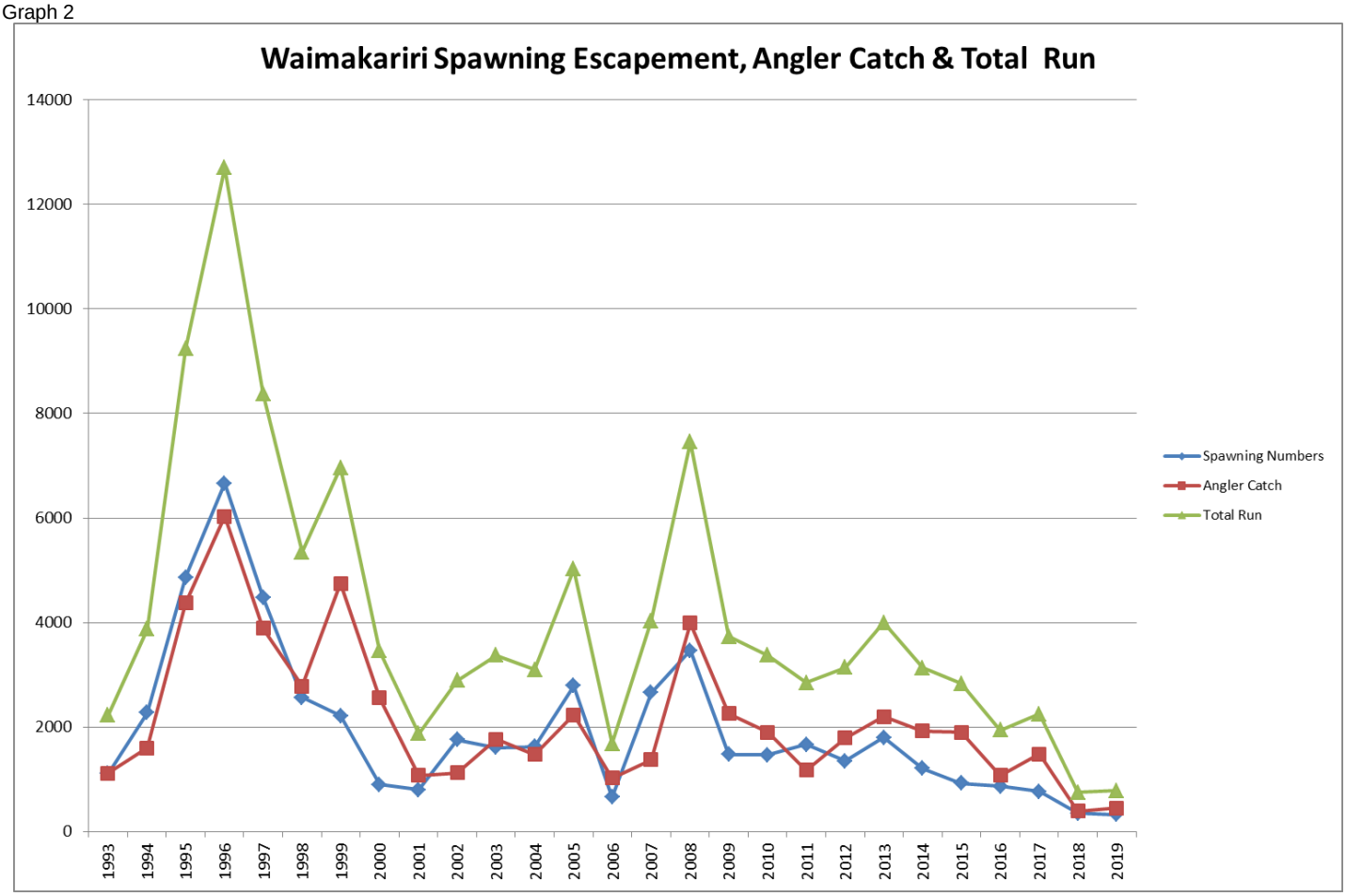
Graph 1



b. Waimakariri River Returns

Perhaps not surprisingly many Waimakariri anglers perceived last season as a poor salmon fishing season, and it was, marginally better than 2018, the poorest run of salmon record. The Peak Count total run has been estimated by multiplying the Peak Count by 1.5. See Appendix 1 for counts on each spawning stream, and Appendix 4 for total counts.

Graph 2

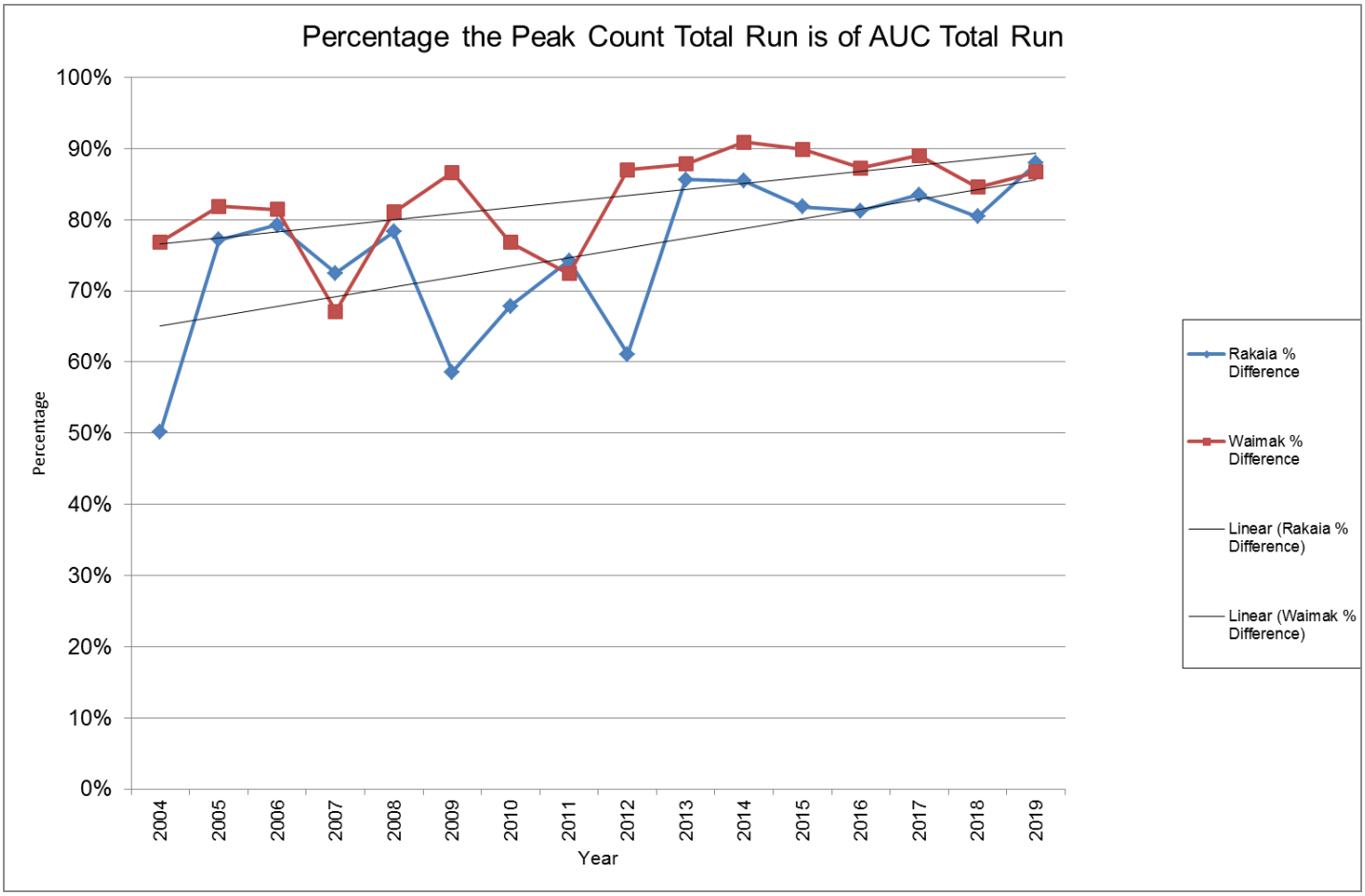


c. Peak Count vs Traditional AUC Methodology

The graph below shows what percentage the Peak Count calculated total run is, of the historically calculated AUC total run for the Rakaia & Waimakariri rivers. This ranges from around 65% in the Rakaia to 90% in the Waimakariri, but is trending up as the Peak Count method and angler harvest methodology is refined each year. The Peak Count method is likely to lead to a further reduction in this difference in future years, as carcasses and salmon below the spawning reaches are now also included in the Peak Count figures, which had not previously been included.

One of the main differences between the two methods is the resulting effect the Peak Count methodology has on the reported angler harvest, as a percentage of the total run, with calculations showing the Peak Count average angler harvest is 10% higher than reported using the AUC method, at well over 60% in the Waimakariri River.

Graph 3


Percentage the Peak Count Total Run is of AUC Total Run
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percentage
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Year
Rakaia % Difference
Waimak % Difference
Linear (Rakaia % Difference)
Linear (Waimak % Difference)

d. Angler Catch in Canterbury Rivers

The Waimakariri had the second lowest number of salmon caught since records began. Anglers Colin and Diane Eaton, along with Neil McLean collected catch data from the McIntosh's Rocks area in the lower Waimakariri River again this year, including fin-clipped salmon (see appendix 5). Of note is the low harvest of fin-clipped salmon reported caught (13), when very few also arrived back to the Silverstream Hatchery (16). This data has not been compared with the phone harvest data as the phone survey does not break down catch into the different areas of the river below SH1, and covers all the river, with 38 salmon reported as fin-clipped from the lower Waimakariri River including the Kaiapoi River. Both the Rakaia & Waimakariri rivers have shown similar trends in catch numbers over the last 14 years. The angler catch in the Rakaia River was 729, and in the Waimakariri River (including the Kaiapoi River) the angler catch was 452.

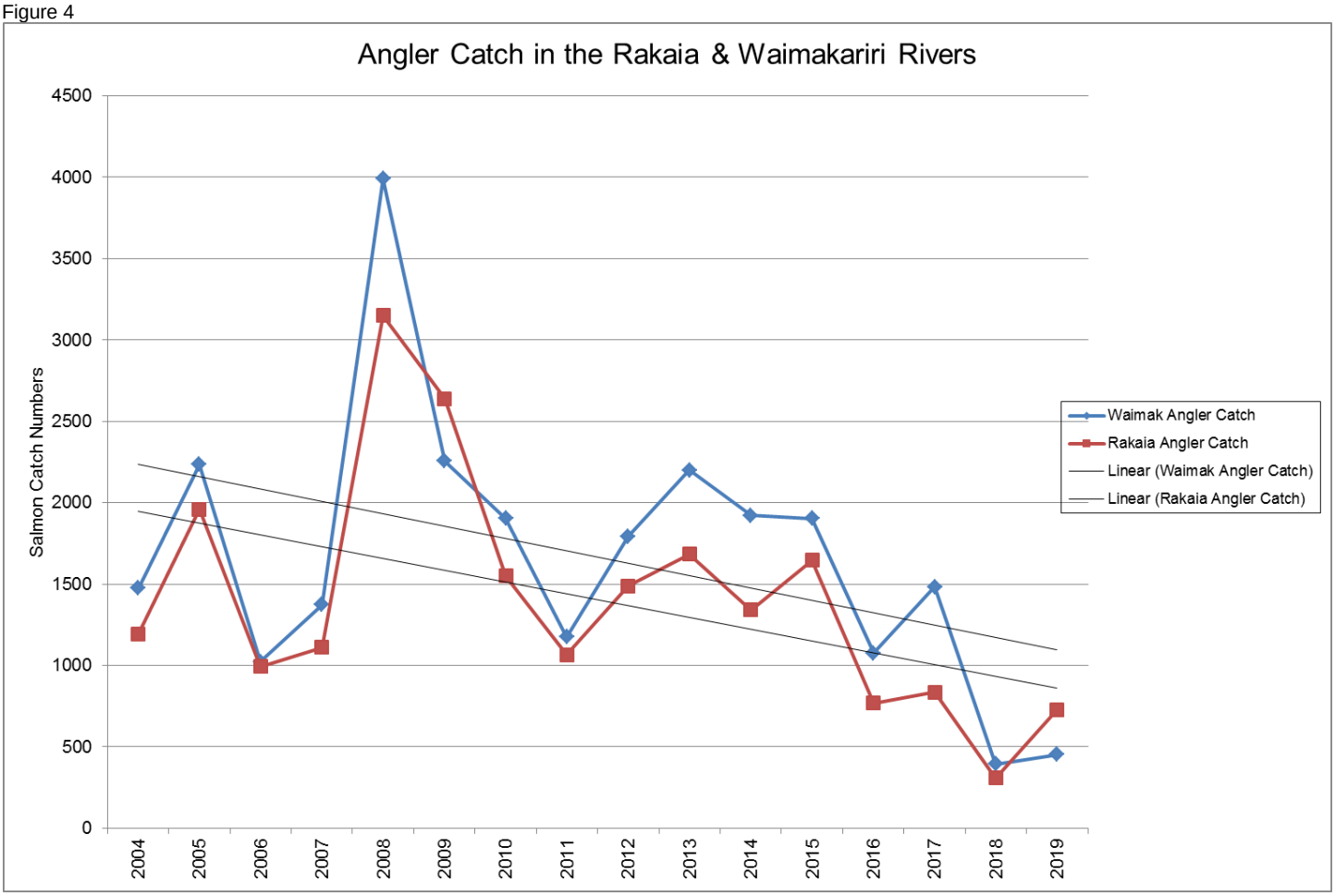
Table 1 Key for areas fished in Table 2

River / Zone	Waitaki	Rangitata	Opihi	Rakaia	Waimakariri
1	Mouth and tidal reaches	Mouth and tidal reaches	Mouth and tidal reaches	Below SH1	Below SH1
2	Above tidal reaches to SH1	Above tidal reaches to SH1	Above tidal reaches to junction of Temuka River	SH1 to gorge bridge	SH1 to gorge bridge
3	SH1 to Stonewall	SH1 to Arundel bridge	Whole catchment above Temuka River junction	Above gorge bridge	Above gorge bridge
4	Above Stonewall	Arundel bridge to bottom of gorge			
5		Gorge and above			

Table 2 Salmon harvested by NC & CSI anglers

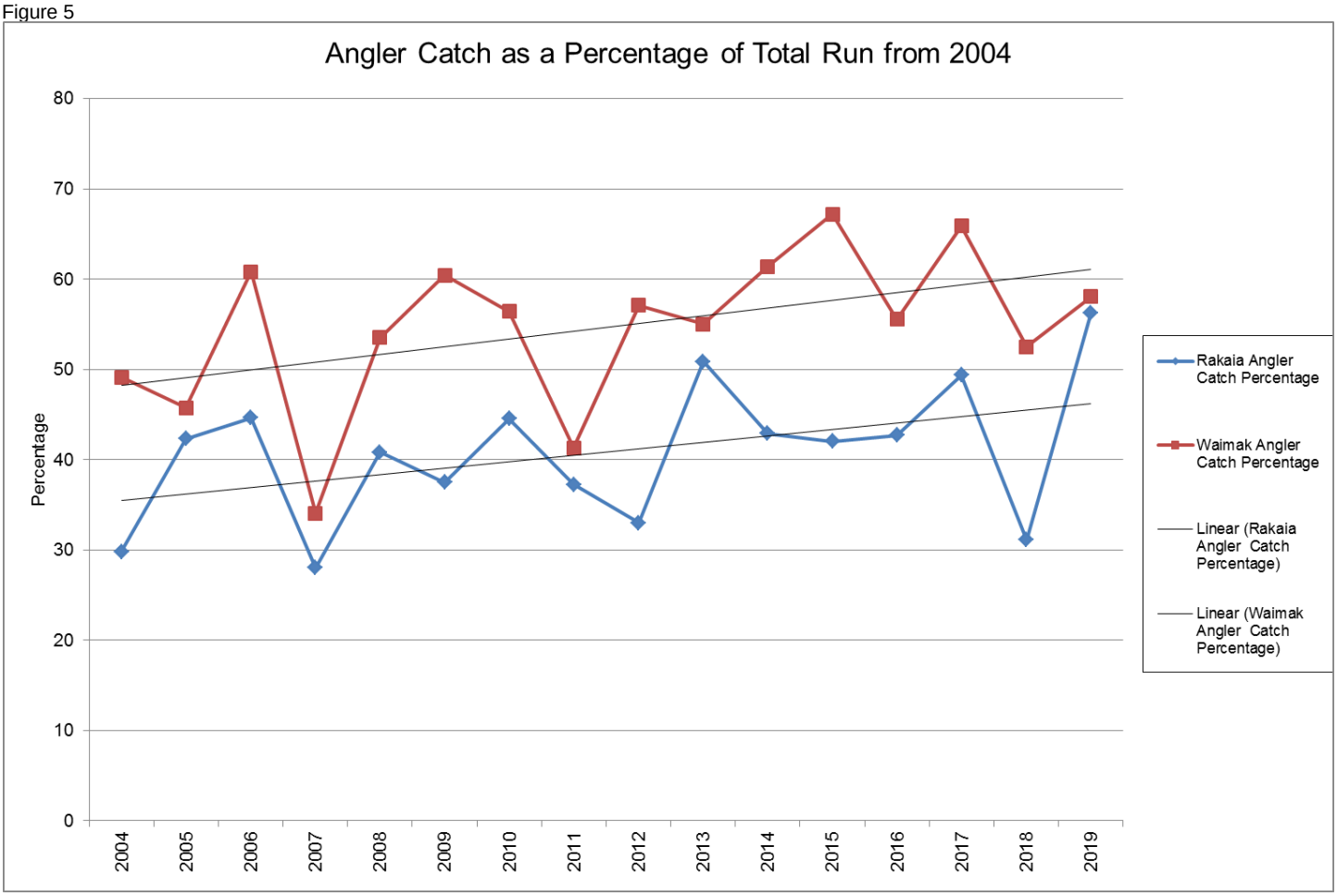
Region	River	Zone	Anglers			Successful Anglers			Salmon			Finclips		
CSI	Ashburton	A	130	±	55	5	±	2	6	±	4	-	±	-
CSI	Kakanui	A	2	±	-	1	±	-	1	±	-	-	±	-
CSI	Opihi	1	230	±	73	19	±	23	32	±	24	-	±	-
CSI	Opihi	2	59	±	25	2	±	-	3	±	-	1	±	-
CSI	Opihi	3	17	±	6	2	±	1	2	±	1	-	±	-
CSI	Opihi	U	25	±	33	-	±	-	-	±	-	-	±	-
CSI	Opihi	A	271	±	80	22	±	23	37	±	24	1	±	-
CSI	Orari	A	151	±	60	5	±	7	5	±	7	-	±	-
CSI	Rangitata	1	471	±	87	51	±	15	131	±	49	21	±	8
CSI	Rangitata	2	215	±	42	16	±	11	35	±	18	4	±	-
CSI	Rangitata	3	93	±	18	14	±	11	26	±	11	-	±	-
CSI	Rangitata	4	55	±	25	20	±	25	28	±	29	5	±	8
CSI	Rangitata	5	91	±	25	52	±	25	104	±	36	-	±	-
CSI	Rangitata	U	77	±	55	1	±	1	4	±	3	-	±	-
CSI	Rangitata	A	725	±	112	124	±	37	327	±	94	30	±	17
CSI	Waitaki	1	186	±	54	18	±	8	23	±	9	2	±	1
CSI	Waitaki	2	152	±	49	35	±	28	36	±	28	1	±	-
CSI	Waitaki	3	119	±	33	33	±	21	97	±	103	-	±	-
CSI	Waitaki	4	67	±	25	2	±	-	2	±	-	-	±	-
CSI	Waitaki	U	41	±	40	3	±	4	8	±	13	-	±	-
CSI	Waitaki	A	397	±	88	84	±	36	166	±	108	3	±	1
NC	Ashley	A	9	±	-	1	±	-	1	±	-	-	±	-
NC	Avon	A	3	±	-	1	±	-	1	±	-	1	±	-
NC	Hurunui	A	498	±	51	86	±	19	184	±	48	8	±	1
NC	Kaiapoi	A	241	±	41	29	±	14	56	±	43	7	±	-
NC	Rakaia	1	988	±	90	267	±	56	475	±	78	59	±	27
NC	Rakaia	2	440	±	52	80	±	18	106	±	33	27	±	11
NC	Rakaia	3	330	±	58	55	±	12	79	±	20	-	±	-
NC	Rakaia	U	88	±	58	30	±	33	69	±	54	2	±	2
NC	Rakaia	A	1,409	±	121	397	±	67	729	±	106	87	±	29
NC	Selwyn	A	1	±	-	-	±	-	-	±	-	-	±	-
NC	Tentburn	A	19	±	11	8	±	2	17	±	4	-	±	-
NC	Waiau	A	198	±	31	29	±	8	72	±	40	1	±	-
NC	Waimakariri	1	1,473	±	91	156	±	29	254	±	55	31	±	18
NC	Waimakariri	2	732	±	60	62	±	16	102	±	36	5	±	2
NC	Waimakariri	3	223	±	33	40	±	15	40	±	20	13	±	10
NC	Waimakariri	U	12	±	23	-	±	-	-	±	-	-	±	-
NC	Waimakariri	A	1,811	±	98	239	±	34	396	±	84	49	±	21
NM	Clarence	A	15	±	8	2	±	-	2	±	-	-	±	-
NM	Wairau	A	14	±	8	6	±	8	6	±	8	-	±	-
OG	Clutha	A	20	±	22	11	±	21	11	±	21	-	±	-
OG	Taieri	A	4	±	-	-	±	-	-	±	-	-	±	-
WC	Arahura	A	1	±	-	-	±	-	-	±	-	-	±	-
WC	Haast	A	1	±	-	-	±	-	-	±	-	-	±	-
WC	Hokitikia	A	7	±	8	-	±	-	-	±	-	-	±	-
WC	Lake Mapourika	A	2	±	-	1	±	-	1	±	-	-	±	-
WC	Lake Moeraki	A	1	±	-	-	±	-	-	±	-	-	±	-
WC	Mahitahi	A	5	±	8	-	±	-	-	±	-	-	±	-
WC	Paringa	A	19	±	21	4	±	-	4	±	-	-	±	-
WC	Taramakau	A	6	±	-	1	±	-	1	±	-	-	±	-
WC	Waitaha	A	5	±	8	-	±	-	-	±	-	-	±	-
WC	Wanganui	A	5	±	8	5	±	8	5	±	8	-	±	-
WC	Whataroa	A	1	±	-	-	±	-	-	±	-	-	±	-
SI	All	A	3,986	±	206	909	±	96	2,028	±	231	187	±	40

Figure 4


Angler Catch in the Rakaia & Waimakariri Rivers
Salmon Catch Numbers
4500
4000
3500
3000
2500
2000
1500
1000
500
0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Waimak Angler Catch
Rakaia Angler Catch
Linear (Waimak Angler Catch)
Linear (Rakaia Angler Catch)

The following graph shows the angler catch as a percentage of the total run in the Rakaia & Waimakariri rivers, with both these catch rates trending up over the last 16 years.

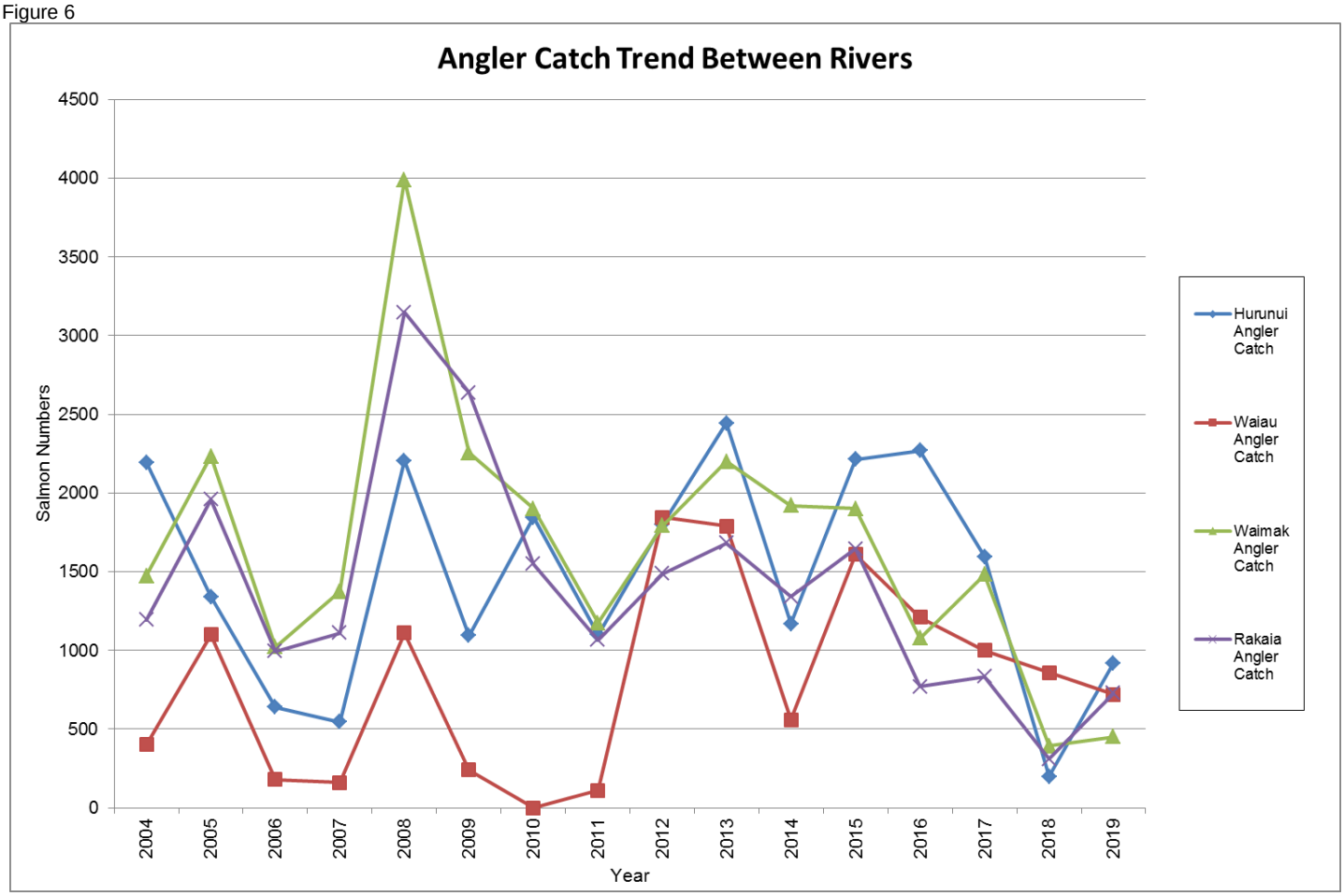
Figure 5



e. Trends in Angler Catch Between the Four Main Rivers in North Canterbury

The following graph shows the trend in angler catch between the four main North Canterbury rivers each season. To show catch figures in this graph on a similar scale, Hurunui catch figures have been multiplied by five and Waiau figures by ten. This shows that the catch trend largely mirrors itself across all North Canterbury rivers each year (high error has the Waiau at odds with the trend some years). The accuracy of angler catch figures for the Waiau and Hurunui rivers has increased over the last five years following the change in the angler catch monitoring method, to include surveying all anglers each year that had caught a salmon in the previous five years. Over time, this new survey method of classifying anglers previously surveyed with high harvest levels as "experts" and removing them from the random survey, will reduce the chance of anglers who have caught significant numbers of salmon showing up in the random survey, increasing the accuracy of the data. Note; the 2010 angler catch was calculated as 0 in the Waiau, but likely followed a similar trend as other rivers with an estimated catch of around 100.

Figure 6



DISCUSSION

The sea-run salmon fishery on the East Coast of the South Island has performed poorly in recent years and anglers are looking to Fish & Game to restore the fishery to at least average historic sustainable levels. There are many variables that effect salmon survival and even more theories amongst anglers as to the reason the fishery has not been performing. From Fish & Game's perspective, there are essentially two areas the salmon spend their life, freshwater and the ocean. While ocean variables such as sea temperature, predator numbers, food available etc, are beyond

our control, many of the freshwater variables that influence salmon survival can be improved to minimise mortality during this stage in their lifecycle.

Considerable staff time is spent each year to advocate for improved environmental requirements in local and regional plans. Unfortunately, many of the factors and variables that are likely to influence juvenile salmon survival in fresh water are beyond our direct or immediate control. However, it is hoped that ongoing advocacy can influence issues such as water abstraction, ineffective fish screens and the long-term cumulative degradation of habitat and water quality.

In recent years, staff have placed more emphasis on the overall ecological health of the high-country salmon spawning streams, including the wetlands and riparian zones surrounding them. A gradual decline in in-stream and riparian habitat on some of the streams is likely to have reduced the spawning and rearing habitat quality. Staff have found that instream monitoring provides a valuable opportunity to involve the landowners when gathering data, enabling long-term data sets to be collected for greater understanding of issues, and ensuring that local changes can be suggested when required. The relationships that have been developed with these landowners are critical to achieving changes in land management practice that are required around sensitive streams.

Staff continue to work with key landowners and managers in the high country to advocate for improvements in water quality and have a number of projects to work towards in the future. Appendix 6 summarises the state of our key spawning streams and highlights key actions staff are focusing on to further protect these streams.

NCFGC is tasked with setting regulations with the intent of maintaining sustainable fisheries. This is difficult to achieve for a number of reasons, notably our inability to regulate adaptively, as we are required to set regulations well in advance of the season ahead. Sustainability requires sufficient returns to spawning streams, while trying to satisfy angler harvest expectations at the same time, almost a contradiction in objectives. However, with an increasing trend in the proportion of returning salmon harvested, particularly in the Waimakariri fishery, the Council has taken steps to reduce angler harvest.

Ideally we would be able to open and close the salmon fishery using adaptive management as they do in key North American fisheries, ensuring sufficient numbers return each season. However, we do not currently have the resources to determine return numbers in real time, other than anecdotal reports from anglers, nor do we have the legislation to implement this adaptive approach. Our reliance on income from licence sales to salmon anglers that contribute to running the organisation also influences our reluctance/willingness to close the fishery.

Moving towards an adaptive salmon management strategy and identifying minimum escapement targets at river or sub-catchment levels, implementing a model for setting harvest regulations aims to rebuild the fishery over the long term. This requires a long-term commitment to quality monitoring. In addition to designing, funding and conducting robust total run size surveys there is also a need to continue high quality salmon harvest monitoring between Fish & Game regions, consistent with how the current national gamebird harvest survey is conducted.

Introduction of a seasonal catch limit has been recommended by scientists as the least harmful regulation to reduce harvest and rebuild spawning numbers. The most common angler catch each season is zero salmon. Between 1999 and 2010 on average one third of anglers did not catch a salmon in a season. The next most common seasonal catch was one salmon. In recent poor-return-years this percentage is likely to be far higher, with the more experienced anglers most likely to

succeed when salmon numbers are low. A more detailed analysis of data from poor return years will be completed later this year.

ACKNOWLEDGEMENTS

The North Canterbury Fish & Game Council would like to thank the following people for their assistance with the 2018/19 salmon monitoring program:

Richard Hill (Flock Hill Station), Mark & Belinda Ensor (Glenariffe Station), Don & Julie Paterson (Manuka Point Station), James & Jane Smiley (Mt Algidus Station), Paul & Belinda Ensor (Glenaan Station), Tim & Anna Hutchinson (Double Hill Station), Silverstream Hatchery staff, Tony Threadwell (Pegasus Fisheries), Mike Smith & Damian Pang (Montrose Station), Jayde Couper, Mark Webb & Hamish Stevens (CSIF&G), Dirk Barr & Ryton Barr (NCF&G hatcheries), Colin and Dia Eaton, Peter Robinson (Lower Waimakariri salmon catch records).

APPENDIX 1

Aerial Count Dates

2019	30-Apr	Winding Creek	21 live		
	2-May	Cora Lynn	10 live		
	2-May	Double Hill Flats	16 live		16 dead
	2-May	Hydra Waters	116 live		6 dead
	2-May	Manuka Point	95 live		8 dead
	2-May	Glenariffe	52 live		3 dead
	3-May	One Tree Swamp	7 live		
	3-May	Bealey Springs	0		
	4-May	Cass Hill Stream	37 live		11 dead
	7-May	Hurunui Sth Branch	8 live	(discoloured)	
	13-May	Cora Lynn	10 live		
	13-May	One Tree Swamp	19 live		
	20-May	Winding Creek	18 live		1 dead
	23-May	Poulter	48 live		3 dead
	29-May	Bealey Springs	12 live		
	4-Jun	Cora Lynn	32 live		2 dead
	7-Jun	Turkey Flat	4 live		
	11-Jun	Winding Creek	3 live		1 dead
	11-Jun	One Tree Swamp	13 live		
	11-Jun	Bealey Springs	4 live		
	12-Jun	Poulter	52 live		17 dead
	18-Jun	Poulter	35 live		12 dead

APPENDIX 2

Hatchery Returns

Hi Steve,

Montrose Hatchery 86, Whisky Creek 10, (Bully Creek 2 but not accessible at the right time) Silverstream 16.

Cheers,
Dirk

APPENDIX 3

Questions in Email/Phone Surveys

1	Timestamp
2	First name
3	Surname
4	Licence number
5	Did you fish for sea run salmon in the 2018/2019 Season?
6	Did you fish the Central South Island rivers (Waitaki, Opihi, Rangitata, Orari and Ashburton) for salmon this season?
7	Did you fish the Waitaki River or river mouth for salmon?
8	Did you fish the Opihi River catchment or river mouth for salmon?
9	Did you fish the Orari River or Orari River mouth for salmon?
10	Did you fish the Rangitata river or mouth for salmon?
11	Did you fish the Ashburton River catchment or mouth for salmon?
12	Did you fish for salmon in the North Canterbury Rivers? (Rakaia, Waimakariri, Kaiapoi, Hurunui or Waiau)
13	Did you fish for salmon in rivers not already listed?
14	Did you fish for salmon in the mouth and tidal zone of the Waitaki?
15	Did you fish for salmon in the area above the tidal zone but below State Highway 1 on the Waitaki?
16	Did you fish for salmon in the area above State Highway 1 but below Stonewall (Bortons/Black point pond) on the Waitaki?
17	Did you fish for salmon above Stonewall (Bortons/Black point pond) on the Waitaki?
18	How many salmon did you keep at the mouth and tidal zone of the Waitaki?
19	How many of those salmon were fin clipped?
20	How many salmon did you keep above the tidal zone but below State Highway 1 in the Waitaki?
21	How many were finclipped?
22	How Many Salmon Did you keep above State highway 1 but below Stonewall(Bortons/Black point pond) on the Waitaki?
23	How many were finclipped?
24	How Many Salmon did you keep above Stonewall (Bortons/Black point pond) on the Waitaki?
25	How many were finclipped?
26	Did you fish for salmon at the mouth/ tidal reaches of the Opihi River?
27	Did you fish for salmon above the tidal reach but below State Highway 1 on the Opihi?
28	Did you fish for salmon above State Highway 1 in the Opihi catchment?
29	How many salmon did you keep at the mouth/tidal reaches of the Opihi?
30	How many were finclipped?

31	How many salmon did you keep above the tidal reaches but below State Highway 1 on the Opihi?
32	How many were finclipped?
33	How many salmon did you keep above State Highway 1 in the Opihi System?
34	How many were finclipped?
35	How many salmon did you keep in the Orari?
36	How many were finclipped?
37	Did you fish for salmon at the mouth/tidal reaches of the Rangitata?
38	Did you fish for salmon above the tidal reaches but below State highway 1 on the Rangitata?
39	Did you fish for salmon above State Highway 1 but below Arundel Bridge on the Rangitata?
40	Did you fish for salmon above Arundel Bridge but below the gorge on the Rangitata?
41	Did you fish for salmon in or above the gorge on the Rangitata?
42	How many salmon did you keep in the mouth/tidal reaches of the Rangitata?
43	How many were finclipped?
44	How many salmon did you keep above the tidal zone but below State Highway 1 on the Rangitata?
45	How many were finclipped?
46	How many salmon did you keep above State Highway 1 but below Arundel bridge on the Rangitata?
47	How many were finclipped?
48	How many salmon did you keep in the Rangitata between Arundel bridge and the bottom of the gorge?
49	How many were finclipped?
50	How many salmon did you keep in or above the gorge on the Rangitata?
51	How many were finclipped?
52	How many salmon did you keep in the Ashburton System?
53	How many were finclipped?
54	Did you fish for salmon in the Rakaia?
55	Did you fish for salmon in the Waimakariri? (not including the Kaiapoi)
56	Did you fish for salmon in the Kaiapoi River?
57	Did you fish for salmon in the Hurunui?
58	Did you fish for salmon in the Waiau?
59	Did you fish for salmon on the Rakaia below state highway 1?
60	Did you fish for salmon on the Rakaia between state highway 1 and the gorge bridge?
61	Did you fish for salmon on the Rakaia above the gorge bridge?
62	How many salmon did you keep in the Rakaia below state highway 1?
63	How many were finclipped?
64	How many salmon did you keep in the Rakaia between state highway 1 and the gorge bridge?
65	How many were finclipped?
66	How many salmon did you keep in the Rakaia above the gorge bridge?
67	How many were finclipped?
68	Did you fish for salmon in the Waimakariri River below State highway 1? (not including the Kaiapoi)

69	Did you fish for salmon in the Waimakariri River between State highway 1 and the gorge bridge?
70	Did you fish for salmon in the Waimakariri River above the gorge bridge?
71	How many salmon did you keep in the Waimakariri below State Highway 1 (not including the Kaiapoi)?
72	How many were finclipped?
73	How many salmon did you keep in the Waimakariri between state highway 1 and the gorge bridge?
74	How many were finclipped?
75	How many salmon did you keep in the Waimakariri above the gorge bridge?
76	How many were finclipped?
77	How many salmon did you keep in the Kaiapoi River?
78	How many were finclipped?
79	How many salmon did you keep in the Hurunui?
80	How many were finclipped?
81	How many salmon did you keep in the Waiau?
82	How many were finclipped?
83	What is the name for the first other river you fished in?
84	How many salmon did you keep in this river?
85	How many were finclipped?
86	Did you fish for salmon in any further rivers?
87	What is the name for the second other river you fished in?
88	How many salmon did you keep in this river?
89	How many were finclipped?
90	Did you fish for salmon in any further rivers?
91	What is the name for the third other river you fished in?
92	How many salmon did you keep in this river?
93	How many were finclipped?

APPENDIX 4

Spawning Stream Counts, Angler Catch, Total Run

Rakaia Tributaries											Rakaia
	Hydra Waters	Manuka Pt	Double Hill	Glenariffe	Mellish, Goat	Montrose	Nat Spawning	Spawning	Angler	Total	Angler
	RT=14.67	RT=16.7*	RT=13.95	RT=18.5	Wilberforce Strm	Trap Census	(Exc. Montrose)	Numbers	Catch	Run	Catch %
1993	1113	209	704	713	504		3243	3243	1116	4359	26
1994	4021	467	2491	4497	2110		13586	13586	7861	21447	37
1995	3689	386	1185	3026	1524		9810	9810	3120	12930	24
1996	4653	811	1985	5442	2371		15262	15262	9008	24270	37
1997	2998	966	2401	3630	1838		11833	11833	8531	20364	42
1998	1559	216	857	912	652		4196	4196	2567	6763	38
1999	1510	302	377	1528	684		4401	4401	2567	6968	37
2000	812	175	604	271	342		2204	2204	2975	5179	57
2001	476	43	103	100	133		855	855	829	1684	49
2002	1382	193	258	93	354		2280	2280	585	2865	20
2003	674	196	284	89	229	120	1472	1592	1714	3306	52
2004	1456	298	303	649	498	110	3204	3314	1195	4509	27
2005	898	289	306	325	334	850	2152	3002	1958	4960	39
2006	357	87	132	147	400	110	1123	1233	994	2227	45
2007	1471	286	243	583	90	180	2673	2853	1110	3963	28
2008	1499	990	463	811	550	250	4313	4563	3149	7712	41
2009	1372	618	647	958	350	450	3945	4395	2639	7034	38
2010	497	377	289	504	150	112	1817	1929	1550	3479	45
2011	748	169	98	173	350	257	1538	1795	1066	2861	37
2012	798	758	129	628	500	210	2813	3023	1488	4511	33
2013	516	198	98	234	384	250	1430	1680	1683	3363	50
2014	183	533	111	198	341	500	1366	1866	1341	3207	42
2015	503	602	173	599	263	130	2140	2270	1647	3917	42
2016	153	368	101	165	228	17	1015	1032	769	1801	43
2017	288	227	30	47	245	20	837	857	834	1691	49
2018	185	122	32	81	117	101	537	638	309	947	33
2019	**183**	**155**	**48**	**83**	**130**	**96**	**599**	**695**	**729**	**1424**	**51**
	Note from 2013 stream counts are Peak Count x 1.5					**Note from 1993 - 2003, Mellish, Goat Hill etc is an avg of 2004 - 2018**					

Waimakariri Tributaries											Waimak
	Poulter	Winding Crk	Cass Hill	Cora Lynn	Bealey/Rail/Turk	Silverstream	Nat.Spawning	Spawning	Angler	Total	Angler
	RT=21*	RT=15.42	RT=16.7	RT=28	One Tree Swamp	TrapCensus	excl.Silverstrm	Numbers	Catch	Run	Catch %
1993	304	327	213	186	75		1105	1105	1116	2221	50
1994	363	236	438	285	96	855	1418	2273	1597	3870	41
1995	1225	1011	817	337	247	1230	3637	4867	4372	9239	47
1996	1559	2336	1045	508	397	818	5845	6663	6033	12696	48
1997	726	824	1362	491	248	830	3651	4481	3893	8374	46
1998	505	417	840	389	157	260	2308	2568	2778	5346	52
1999	593	417	302	289	117	500	1718	2218	4748	6966	68
2000	166	86	185	80	38	347	555	902	2553	3455	74
2001	63	27	117	28	17	547	252	799	1075	1874	57
2002	878	313	148	69	103	250	1511	1761	1128	2889	39
2003	414	183	342	Not Counted^	68	600	1007	1607	1764	3371	52
2004	480	278	251	312	96	205	1417	1622	1475	3097	48
2005	960	689	320	381	138	300	2488	2788	2234	5022	44
2006	89	88	131	101	80	170	489	659	1022	1681	61
2007	521	433	532	788	110	275	2384	2659	1373	4032	34
2008	1601	443	386	355	320	360	3105	3465	3991	7456	54
2009	537	109	244	127	100	360	1117	1477	2256	3733	60
2010	468	318	473	109	40	60	1408	1468	1902	3370	56
2011	577	354	281	333	65	60	1610	1670	1175	2845	41
2012	400	297	148	192	70	240	1107	1347	1793	3140	57
2013	723	140	162	408	24	340	1457	1797	2199	3996	55
2014	362	173	129	108	86	350	858	1208	1921	3129	61
2015	495	77	83	126	78	70	859	929	1902	2831	67
2016	386	41	107	86	123	120	743	863	1077	1940	56
2017	405	35	107	93	101	27	741	768	1482	2250	66
2018	171	48	51	45	29	8	344	352	394	746	53
2019	**104**	**32**	**72**	**51**	**53**	**16**	**312**	**328**	**452**	**780**	**58**
	Note from 2013 stream counts are Peak Count x 1.5						**Note from 1993 - 2004, Bealey, One Tree etc is an avg from 2005 - 2018**				

APPENDIX 65

Hi Steve,
With the best intention of accuracy and the help of others, especially Neil McLean, the number of salmon landed at Mackintosh's area this year 2018/ 2019 was short of a good season but an improvement on last year.

The following was how it panned out:

December 2018 = 4 fish landed, 2 were finned clipped.
January 2019 = 4 fish landed, nil were finned clipped.
February 2019 = 24 fish landed,5 were finned clipped.
March 2019 = 44 fish landed, 5 were finned clipped.
April 2019 = 2 fish landed, 1 was finned clipped.

The total for this year was 78 fish landed and 13 were finned clipped, given a 16.66% (17%) of caught fish were hatchery released fish.

I trust this information can be helpful to you as keeping an on-going survey of the Mackintosh's area.

Kind Regards
Colin Eaton
Vice President NZSAA.

APPENDIX 6

Spawning Stream Evaluations

During the 2019 salmon spawning season, staff completed an assessment on all the major spring creeks in the Rakaia and Waimakariri catchments, looking at the state of the streams, protection and restoration work that might be required to maximise spawning potential and rearing habitat.

1. Cora Lynn Stream

Located on LINZ land adjacent to Cora Lynn Station at the head of the true right of the Waimakariri River. Historic returns to the stream are in the order of 30 – 500, with a median of around 250 and now accounts for approximately 15 % of the Waimakariri salmon run each year. Current habitat consists mainly of willow, flax, matagouri and toetoe, or pampas grass on the true right and part of the true left, and open riverbed vegetation for the remainder of the true left, with this being the river floodplain.

For a number of years, Fish & Game staff have been concerned that intensive land use in the wetland area at the head of the spring was leading to increased nutrients entering the stream. This was one of the streams monitored during the ECan project and showed signs of degradation over the sampling period. For a number of years, staff asked the landowner, Jerry McSweeney to exclude stock from both the stream, where they regularly grazed and the wetland above the spawning stream. LINZ directed the stock removal from the riverbed around five years ago. However, removal of stock from the headwater wetland was met with resistance, until around six months ago when the landowner fenced the wetland area to exclude stock. This was due to ECan threatening to take enforcement action.

Gorse, broom and willow control has occurred along the stream margins in the past, and the need for which will continue to be monitored in the future. One of the uncontrollable threats to this stream is when the Waimakariri flows through it during flood events, or for prolonged periods when the Waimakariri uses the true right bank as its main stem (2003). This has the potential to flush whole year classes of stock out when these floods occur from June – December, and consequentially minimal survival following such events.

Action

- Continue to monitor the health of Cora Lynn Stream at regular intervals to see if there is any change in the stream health

2. Poulter River

The Poulter River originates in the Arthurs Pass National Park and flows for approximately 30km below the salmon spawning streams before joining the Waimakariri River just above the Esk River confluence, above the Waimakariri Gorge. It holds the main spawning streams for the Waimakariri River, with historical runs ranging from 100 – 1,600 with a median of around 550 and now accounts for 40% of the wild salmon returns to the Waimakariri River each year. There are a number of spawning streams in the upper catchment and the habitat varies from beech forested streams, to open tussock streams, all of which have relatively good riparian zones. Mt. White Station cattle have grazed these streams historically but have been excluded for some time now at the park boundary. Although some cattle find their way beyond the fence due to flood damage, there are no immediate threats to the spawning streams other than naturally occurring changes in river flows, which at times prevent passage or temporarily flood sections of these streams.

3. Winding Creek

Winding Creek flows from Lake Pearson for approximately 10km, before reaching Broken River 5km above the Waimakariri River confluence. The creek flows through both Craigieburn and Flock Hill Stations with the majority on Flock Hill Station. Most of salmon spawning habitat is in the upper section where the stream opens out and meanders through tussock flats before dropping more rapidly down to Broken River. Historical salmon returns to the stream range from 30 – 2,000 with a median or around 250 and now accounts for approximately 15 % of the Waimakariri wild salmon returns each year. Historically the creek has had extensive cattle grazing and this is visibly evident with collapsing banks and siltation of gravels. Flock Hill Station no longer grazes cattle along the stream, with extensive fencing completed in recent years instigated by Fish & Game and funded by several organisations including Fish & Game, ECan and NZSAA. Recent discussions with the Directors of Flock Hill Station have led to the retirement of a further 20ha of wetland at the head of the creek. There is considerable intensification occurring on the station at present, with foreign ownership under the OIO likely requiring this intensification.

Action

- Approach the Overseas Investment Office to ensure Fish & Game have more input into the purchase of sensitive land by foreigners.
- Continue to monitor the health of Winding Creek at regular intervals to see if there is any long-term change in the stream health.

4. Cass Hill Stream

Cass Hill Stream (Bullock Creek) flows through Craigieburn Station and is located on the true right of the Waimakariri River, beginning approximately 4km below the Mt. White Bridge. The stream flows against the true right hillside for approximately 5km before joining the Waimakariri River. Historical salmon returns to the stream range from 100 – 1,300 with a median or around 200 and now accounts for approximately 15% of the Waimakariri wild salmon returns each year. The stream was probably once an old braid of the river with subsurface water enhancing the flow throughout its reach. The stream is surrounded primarily by gorse and broom and has had cattle access to the stream for many

years, as there is no fence between the stream and the farm. The stream bed is heavily silted in many reaches and there are limited areas salmon utilise to spawn. This would be an expensive stream to fence as it would need to be on the hillside to avoid flooding in the lower reaches and the past landowner has indicated he is not willing to pay for this (recently purchased by a NZ farmer).

Action

- Meet with the new landowner to discuss options for fencing the stream if funds were available or negotiate the exclusion of cattle from a much broader area of the farm in this area to a point where a fence could be installed

5. One Tree Swamp

One Tree Swamp Stream is located on the true left of the Waimakariri River and flows into the Waimakariri just above the Hawdon River confluence. The stream flows through approximately 1.5km of tussock flats. Historical salmon returns to the stream range from 80 – 300, with a median of 100 and accounts for approximately 10% of the Waimakariri wild salmon returns each year. This stream is on Mt. White Station land and has a history of cattle grazing in the stream. Around 12 months ago the landowner agreed to fence the stream and associated wetland area to exclude cattle, however this has led to prolific macrophyte growth in the stream now cattle are excluded. The wetland area above the stream continues to be grazed by cattle and there are several drains channelled through the wetland towards One Tree Swamp. Ideally this would not be farmed.

Action

- Meet with the landowner to discuss options for retiring the wetland above

6. Bealey Springs, Railway Springs, Turkey Flat Springs

These three springs are located above both Mt. White and Cora Lynn stations and have no access by stock. The Waimakariri River often flows sub-surface immediately above Cora Lynn and in some seasons, salmon have no access into these streams. They are counted once each season during the peak aerial count, usually have 10 – 20 salmon in each and collectively account for around 3 – 5% of the wild salmon returns each year. Bealey Springs was used for the ECan study as a control stream and showed no degradation of the riparian or instream habitat.

<u>Rakaia Catchment</u>

7. The Hydra Waters

The Hydra Waters is a wetland area including Titan Stream and encompasses approximately 320ha. The area is a mix of freehold and leasehold property on Mt. Algidus Station located between the Rakaia, Matthias and Wilberforce rivers. Historical salmon returns to the stream range from 350 – 4,500 with a median of around 800 (figures vary due to errors associated with the AUC count methodology) and accounts for approximately 40% of the Rakaia wild salmon returns each year.

Several spring fed streams make up the Hydra Waters and they are frequently referred to as Titan Stream on maps. Most of the upper Hydra Waters has been fenced to exclude cattle for around 30 years. This fenced area has well established red tussock up to 2m high and the habitat is in great condition, having recovered significantly. Prior to fencing, farming practices at the time severely degraded the habitat in this area through burn-offs and extensive cattle grazing. The area of land

comprising approximately 200ha immediately above the wetland has been developed for extensive farming. The Hydra Waters was a stream sampled regularly during the ECan study, with the top site sampled showing pristine habitat and water quality. The site beneath the Hydra Waters shows low levels of the impacts from farming practices during low flow periods, however this is in a flood prone area and currently below all levels of concern. The landowner has indicated he would work with us to exclude wild deer and pigs from the Hydra Waters, possibly through deer fencing (estimated to cost around $200,000).

Action

- Continue regular liaison with the landowner to ensure ongoing and possibly further protection of the Hydra Waters wetland including establishing a QEII covenant on the wetland, along with regular habitat and water quality assessments, increasing in the lower reaches
- Work with the landowner to exclude wild deer and pigs from the Hydra Waters in time

8. Manuka Point Stream

Manuka Point Stream runs parallel with the Rakaia River for approximately 5km on the true left bank, until it joins the Rakaia approximately 500m above the Mathias confluence. Historical salmon returns to the stream range from 50 – 1,000 with a median of around 350 and account for approximately 15% of the Rakaia wild salmon returns each year. This stream has had a history of stock grazing, mainly with merino sheep, with small numbers of beef cattle in recent years. The farm is managed as a safari deer hunting station and this operation has no impact on the stream health.

The landowner has indicated he is keen to protect and enhance the salmon returns to the stream and believes grazing by wild deer and hares, are the main problem in the stream and riparian zone, more so than sheep.

Action

- Liaise with the landowner more frequently to ensure farm practices are not impacting on stream health, carry out stream habitat assessments similar to those in the ECan

9. Glenariffe Stream

Glenariffe Stream flows along the true right of the Rakaia River to the south east of Double Hill, until it reaches the Rakaia River at the old Glenariffe salmon hatchery site. The Glenariffe Stream is often referred to as Double Hill Stream on some maps. Historical salmon returns to the stream range from 100 – 5,000 with a median in recent years of around 200 salmon and account for approximately 18 % of the Rakaia wild salmon returns each year. The Glenariffe streams flow through 3 properties, Glenaan Station in the lower reaches, Glenariffe Station in the mid reaches encompassing the East and South branches and Double Hill Station in the upper reaches. An extensive ECan-rated stop bank and groyne structure exists above Double Hill, which stops Rakaia floodwaters from entering the Glenariffe Main Stream. Aerial views of the area below the stop bank show many derelict braids on the floodplain of which the main stem of the Glenariffe is only one.

The Glenariffe has three main branches. The East Branch is located at the lower end of Glenariffe Station on the true right of the Main Stem and is approximately 1km in length. For approximately 25 years ending in 2000, the East Branch was diverted 100m from the bottom end of the stream to supply water to run the NIWA-run Glenariffe research salmon farm and the salmon run was effectively managed as an enhanced stream, with returns to the hatchery released unrecorded into the East

Branch. The land surrounding this stream has been intensified and staff are investigation options with the landowner to address this issue, as there is very little streamside vegetation habitat. This was one of the streams surveyed during the ECan study and shows signs of degradation due to farming intensification. Recent spawning numbers in the East Branch range from 6 – 20 wild salmon each season. This stream has also had a history of ova planting in a well-intentioned but misguided effort to restore salmon numbers here (D. Willis pers. comm.), however this no longer occurs.

The South Branch flows along the mountainside on the true right of the mainstem of the Glenariffe for approximately 3km, before joining the mainstem approximately 3km above the Rakaia confluence. Riparian vegetation cover is very good in the upper reaches of the South Branch following retirement of the wetland area around the headwaters of this stream around 25 years ago, through the tenure review process. The South Branch now accounts for approximately 200 Rakaia wild salmon returns each year, which is over 50% of the salmon collectively spawning in the Glenariffe Stream each year, and approximately 10% of the Rakaia salmon return, whereas historically it was only around 30% of the Glenariffe run (M. Unwin pers. comm). This is likely the result of the improved habitat following land retirement, compared to the remainder of the Glenariffe catchment, and is an excellent example of the impact of habitat on salmon recruitment and natal-stream behaviour.

The mainstem of the Glenariffe is approximately 10km long and meanders down the old floodplain through a variety of habitats, ranging from extensively grazed, to cultivated land either side, to well-fenced zones in the upper reaches with good riparian habitat beside Double Hill. Historical salmon returns to the Main Stem range from 50 – 5,000 (during the hatchery release period) with a median of around 150 and this accounts for approximately 8% of the Rakaia wild salmon returns each year. Discussions with the landowner of Double Hill Station in recent years has resulted in the retirement of approximately 70ha of wetland in the headwaters of the Main Stem above Double Hill. This adjoins an area of the stream previously fenced to exclude stock during the tenure review process. Over the last eight years, staff have secured funding to fence approximately 5km of the Main Stem in the mid to lower reaches, including the establishment of a QE11 Covenant on one of the tributaries in the lower reaches.

Following heavy rain in the catchment, on the true right of the streams there is often heavy runoff which can flood the various branches of the Glenariffe. In May 2009 a flood which reached 4,000 cumecs at the Fighting Hill flow gauge in the Rakaia Gorge, saw landowners in the catchment report large parts of the valley floor either side of the Glenariffe under water for some time. This type of event is likely to occur periodically and would likely require fence repairs afterwards.

Action

- Continue to liaise with the three landowners to discuss possible protection and restoration projects on the various streams

10. Double Hill Stream

Double Hill Stream is made up by three main streams flowing from the eastern side of Double Hill, approximately 500m to the true left of the Glenariffe Stream. Double Hill Stream has three tributaries, of which the true left stream is predominantly used by salmon to spawn, with only the lower 100m used by salmon on the other two. Historical salmon returns to the stream range from 100 – 2,500 (again errors with AUC method possible here) with a median of around 200 and now accounts for approximately 10 % of the Rakaia wild salmon returns each year. Recent erosion of the river flats to the true left of this stream has left it vulnerable to flooding in the lower reaches when the Rakaia is in flood. The main tributary runs for approximately 2 km, through LINZ land, historically grazed by

Glenaan Station, before reaching the Rakaia River (historically at the same point as the Glenariffe Stream, but now 500m upstream following recent erosion of the lower stream). The land surrounding the stream consists of modified dryland pasture with some matagouri and small tussocks.

Staff have met with river engineers to look at options to stop the Rakaia from eroding these flats, however this was not deemed practical given the scale of remedial works required.

11. Mellish Stream

Mellish Stream flows into Harrisons Bight on the eastern side on Lake Heron. Lake Heron drains into Lake Stream, which flows through Lake Heron and Glenfalloch stations. Mellish Stream is relatively short, approximately 1km of effective spawning area and years with high spawning numbers lead to superimposition of redds. Historical salmon returns to the stream range from 90 – 550, with a median of around 300 and now accounts for approximately 15% of the Rakaia wild salmon returns.

Historic Fish & Game boundaries have resulted in the upper half of Lake Stream and Lake Heron managed by CSI F&G, including the aerial spawning counts, regulation setting and compliance, with North Canterbury managing the lower section of Lake Stream down to the confluence with the Rakaia River. Liaison between the two regions in recent years resulted in CSI prohibiting the catch of adult salmon traditionally caught in the lake on their return to Mellish Stream, with a slot size of 250mm – 450mm.

Lake Heron has a very productive salmon fishery during the main fishing season, with these smaller salmon perceived as landlocked salmon by most anglers. However, staff believe these salmon being caught are juvenile sea-run fish that choose to remain in the lake for greater than a year before migrating to the ocean. They are likely to return at an older age than their stream-reared cousins, possibly as the early pre - Christmas run of larger four-year-old salmon.

Following discussions with David Willis on this scenario, David noted that if these ‘land-locked’ salmon did not migrate to the ocean, they would be the only population of Chinook salmon in the world that behaved in this way given the opportunity down Lake Stream. In support of David’s advice, F&G staff have not seen these small salmon spawning, as we see in other land-locked populations such as Lake Coleridge.

David’s advice was to collect otoliths from spawning salmon to determine whether salmon spawning in Mellish Stream above Lake Heron (& Lake Sumner in the Hurunui catchment) spend a significant time in the lake, prior to migrating to the ocean. If salmon do remain for over 12 months in such a system international research suggests their survival may be extremely high at around 25-30%. If this proves to be the case, these ‘landlocked’ fish have been extremely undervalued in the past, as we’ve effectively allowed harvesting three or four juvenile lake fish for a mature sea-run adult.

CSI staff have collected a number of otoliths from spawned salmon in Mellish Stream and will have these analysed using micro chemistry to determine if they have spent significant time in the lake before migrating to the ocean.