Restoration of the Salmon Fishery – a Strategic Outline

By Steve Terry

Fish & Game Officer

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Abstract

Anglers are looking to Fish & Game to restore the sea-run Chinook salmon fishery to levels seen in the mid-nineties. In recent years salmon returns have fallen to record low levels in almost all rivers on the east coast of the South Island. This prompted the Sea-Run Salmon Symposium “Turning the Tide”, held in 2017. Following the symposium, keynote speaker David Willis, a biologist from the Department of Fisheries and Oceans Canada, produced a short report highlighting his observations of our fishery and provided several recommendations to help address the recent declines. Since the symposium, a National Salmon Committee has also been formed which has met twice, developed terms of reference and discussed how best practices can be implemented to restore the fishery across the South Island.

In March 2018, North Canterbury Fish & Game Councillor John Cumberpatch facilitated a strategic planning workshop for the region, to develop a roadmap for the next three years. This report outlines various strategies staff have developed alongside D. Willis’s recommendation’s to help restore the fishery, both short and long term (refer to page 13 for a summary of the strategic outline), highlighting some of the projects already underway, along with some of the issues the fishery faces on this journey to recovery.

Introduction

This year an estimated 334 salmon spawned in the Waimakariri River, 99 salmon more than the record low return of 235 salmon recorded in 2001. It should be noted however that in 2001 the Thompson, One Tree Swamp, Bealey, Railway and Turkey Flat spawning streams were not counted and if these had been, the total in 2001 would likely to be similar to this season.

In the Rakaia catchment, an estimated 585 salmon spawned this season, with 722 in 2001. It should also be noted that in 2001, Goat Hill, Mellish Stream and the Wilberforce Swamp spawning streams were not counted, which would have improved the 2001 numbers, further highlighting this seasons’ lowest return in 26 years of records. At the time of writing, angler harvest estimates have not been calculated for this season.

There are many variables that effect salmon survival and even more theories amongst anglers as to the reason the fishery has not been performing. There are essentially two areas the salmon spend their life, freshwater and the ocean. Almost all the ocean variables that influence salmon survival are beyond our control, however many of the freshwater variables that influence their survival can be improved to minimise mortality during this stage in their lifecycle. The main variables we can focus on in freshwater are harvest, habitat and hatcheries which have been outlined in this report (spawning, rearing and migration to and from the sea).

D. Willis posed some significant questions around our current hatchery practices and approach to ova planting, Staff will not elaborate on the best approach to artificial supplementation of wild fisheries through use of hatchery produced ova or reared stock, as this is a separate topic and an external review by Cawthron is currently being prepared, which Council will consider when it is received. It is worth noting that new science is continually emerging and we should continually evaluate our approach to enhancement to ensure it follows accepted best international practice.

Background Overview of Issues in the Fishery

Spawning and Juvenile Rearing Habitat

Preserving the pristine state of our spawning streams is critical to the ongoing sustainability of our nationally significant salmon fisheries and is one of the key areas where Fish & Game can influence survival of salmon during their time in freshwater. Considerable staff time is spent each year to advocate for improved environmental requirements in local and regional plans, however many of the factors and variables that are likely to influence juvenile salmon survival in fresh water are now beyond our direct control. These include variables such as increased water abstraction, ineffective fish screens and the long term cumulative degradation of habitat and water quality. Staff will continue to lobby ECan for recognition of the significance of ineffective fish screens. For example, a desk-top exercise suggests that loss of fry due to inadequate screening may exceed a third of the entire juvenile production of the Rakaia.

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 instream and riparian habitat on some of the streams is likely to have reduced the spawning and rearing habitat quality. This is likely to have resulted in reduced spawning success (lower % of fry hatch/emergence) and the premature migration of many juvenile fry from the streams, due to reduced food abundance, into the flood-prone main stems (S Terry, pers. obs, D. Willis, pers. comm.).

When premature migration occurs, fry are not strong enough to swim against flood currents, and the majority are forced downstream and out to sea before they smoltify at around seven grams. If they are forced from the river prior to smoltifying they are unable to make the transition to salt water and die. During most years, major spring floods are common, and therefore most of the salmon that are forced to migrate out of the spring creeks earlier than desirable are likely to suffer this fate.

River flats and riparian areas in the Canterbury high country bordering some of the salmon spawning streams continue to be developed. Staff are particularly concerned at the increasing use of brassica crops to feed stock during winter months.

Due to their concerning observations, in 2013 staff approached ECan and began a three-year monitoring program on the health of some of our key spawning streams. This monitoring should determine the significance of any changes and therefore identify the need to amend plans to achieve the desired environmental standards, although political pressure will be required. A report will be provided by ECan in July 2018, although staff have received a draft which clearly shows detrimental effects on some of the stream invertebrate and periphyton communities with only small elevations of nitrates. Once the final report is received, staff will use this to work with landowners to ensure improved protection of the key spawning streams.

Staff have found that monitoring provides a valuable opportunity to involve the landowners when gathering data, enabling long-term data sets to be collected for greater understanding of the issues, and ensuring that local changes can be suggested when required. The relationships that have been carefully developed with these landowners are critical to achieving changes in land management practice that we increasingly know are required.

Spawning Stream Evaluations

Staff have recently completed a priority assessment on all the major spawning streams in the Rakaia, Waimakariri, Hurunui and Waiau catchments, looking at protection and restoration work that is required to maximise spawning potential and rearing habitat. This work has been prioritised with an action-focused direction, i.e. short-term projects having the highest priority, rather than starting with the most degraded streams. Fortunately, a few streams do not require additional monitoring, protection or restoration.

Assessment of the Current State of the Key Salmon Spawning Streams in the North Canterbury Region

1. Cora Lynn Stream

Cora Lynn Stream is located on LINZ land adjacent to Cora Lynn Station on 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 toe toe, 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. Around six years ago staff asked the landowner, Jerry McSweeney, to exclude stock from both the stream, where they regularly grazed, along the wetland above the spawning stream. This was not seen as an option for the landowner as it was his bull wintering paddock. 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 following direction from ECan.

Gorse, broom and willow control has occurred along the riparian zone until around ten years ago, and staff would like to have the increasing number of willows on the true left of the stream removed. 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 salmon stock out when these floods occur from June – December, and this results in minimal survival following such events.

Recommendation

- Continue to monitor the health of Cora Lynn Stream at regular intervals to see if there is any change in the stream health. (Year 1 & ongoing)

- Contact LINZ to see if willow spraying/ removal is possible on the true left of the stream. (Year 1)

2. Poulter River

The Poulter River originates in 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 creek 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.

Recommendation

- Work with the landowners to retire further sensitive areas around Winding Creek. (Year 2)
- Approach the Overseas Investment Office to ensure Fish & Game have more input into the purchase of sensitive land by foreigners. (Year 2 & Ongoing)

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 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 is likely 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 Craigieburn Station. 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 elevated on the hillside to avoid flooding in the lower reaches, with the previous landowner indicating he was not willing to pay for this (recently purchased by a NZ farmer).

Recommendation

- Meet with the new landowner to discuss options for fencing the stream, 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. (Year 1 & ongoing)

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 and has a history of cattle grazing it. 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 that cattle have been 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 wetland would not be farmed.

The NZSAA plant salmon ova in Cora Lynn Stream each year. Staff would like Council to review this following the release of the Cawthron report.

Recommendation

- Meet with the landowner to discuss options for retiring the wetland above the stream. (Year 1 & ongoing)

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 clean water and no degradation of the riparian or instream habitat.

Rakaia Catchment

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 over 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 degraded the habitat in this area through burn-offs and cattle grazing.

An area of land comprising approximately 200ha, located 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. A site sampled below 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).

Recommendations

- Continue regular liaison with the landowner to ensure ongoing and possibly further protection of the Hydra Waters wetland, along with regular habitat and water quality assessments, increasing in the lower reaches. (Year 1 & ongoing)

- Work with the landowner to exclude wild deer and pigs from the Hydra Waters in time. (Ongoing)

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 had a history of extensive stock grazing until around 17 years ago, 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 therefore has minimal 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.

Recommendation

- 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. (Year 1 & ongoing)

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 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 three 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 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 randomly into the East Branch. The land surrounding this stream has been intensified and staff are investigating options with the landowner to address this issue, as there is very little streamside riparian habitat. This was one of the streams surveyed during the ECan study and data collected indicates further protection of the stream is required. Recent spawning numbers in the East Branch range from 6 – 20 salmon each season. This stream has also had a history of ova planting in a well-intentioned but likely 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 2km 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 the South Branch 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 restoring 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, cultivated land either side, to well-fenced zones in the upper reaches with good riparian habitat. 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 adjacent to 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 from a number of sources including Rakaia Promotions, ECan and Fish & Game, to fence an additional 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 on the hillside 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 may require fence repairs afterwards.

Recommendation

- Continue to liaise with the landowners to highlight the habitat issues on the streams and work on possible restoration projects. (Year 1 & ongoing)

10. Double Hill Stream

Double Hill Flat Stream is comprised of three main streams flowing from historic flood plains on the eastern side of Double Hill, located approximately 800m to the true left of the Glenariffe Stream. Double Hill Flat Stream has three tributaries, of which the true left stream is the predominant stream 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, (during the Glenariffe hatchery releases, again errors with AUC method are also likely here) with a median of around 150 and now accounts for approximately 8 % of the Rakaia 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 tussock.

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.

Salmon ova is planted into one of the secondary Double Hill Flat streams each year. Staff would like Council to review this strategy following the release of the Cawthron report.

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 often 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 carrying out 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 smaller salmon perceived as landlocked salmon caught by many 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 D. Willis on this scenario, D. Willis 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 unobstructed opportunity down Lake Stream. In support of D. Willis's advice, Fish & Game staff have not seen these small salmon spawning, as we see in other land-locked populations such as Lake Coleridge.

D. Willis's advice was to collect otoliths from spawning salmon to determine whether salmon spawning in Mellish Stream above Lake Heron (along with 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 in place of one 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.

Recommendation

- Work collaboratively with CSI to investigate the life history of Mellish Stream salmon and reduce harvest of the pre – migrating salmon if necessary. (Year 2)

12. Lower Goat Hill Stream & Wilberforce Swamp Stream

Lower Goat Hill Stream in located on the true right of the Wilberforce River, to the south east of Goat Hill. Wilberforce Swamp Stream is located approximately 2km upstream on the true left of the Wilberforce, above the Harper River and below the Oakden Canal flowing into Lake Coleridge. Both these streams are approximately 1.5km in length and historical salmon returns to the streams range from 2 – 100, with a median of around 20 – 30 salmon in each. Periodic floods in the Wilberforce River flow through the Lower Goat Hill Stream and some year classes are washed away. In recent years staff have worked with Mt. Algidus Station landowner to ensure cattle no longer have access to this stream. Wilberforce Swamp Stream is not grazed; however, the lower section of the stream is also prone to regular Wilberforce flooding.

<u>Hurunui Catchment</u>

13. South Branch

Salmon predominantly spawn in the main stem from the top of the Esk Gorge to the head of the river, which is susceptible to flooding some years. Historical salmon returns to this river range from 50 – 500, with a median of around 200 and likely accounts for approximately 80% of the Hurunui wild salmon returns. The valley has low – moderate levels of cattle grazing by Lake Taylor Station, however staff believe this is unlikely to impact on salmon spawning or rearing, compared to the frequency of floods in this river.

14. Landslip Stream

Landslip Stream is located on the true left of the North Branch of the Hurunui River, approximately 5km above Lake Sumner. The Lakes Station has freehold title of the river flats and has extensive cattle grazing along the stream margin. Ideally stock would be excluded from these river flats, however, part-owner of the station, Hugh Fletcher, opposed Fish & Game's submissions in recent years requesting that Landslip Stream be fenced. In 2015/6 the main stem of the North Branch of the Hurunui River changed course and broke into Landslip Stream, where it now limits spawning in the lower 50% of the stream. Historical salmon returns to this river range from 20 – 100, with a median of around 60 and likely accounts for approximately 20% of the Hurunui wild salmon returns.

As with Mellish Stream above Lake Heron, staff believe that salmon perceived as landlocked in Lake Sumner and targeted by anglers during busy holiday periods, could be a significant proportion of the run. Staff have recently collected otoliths from spawned salmon in Landslip Stream to determine if these lake salmon form a significant proportion of the Hurunui salmon fishery.

The salmon harvest phone survey regularly shows harvest greater than spawning escapement (although there is likely a significant error in this phone survey for the Hurunui & Waiau rivers due to extrapolation errors) which shows a high angler harvest ratio. This could be the result of prolonged periods with low flows in some years where salmon congregate around the river mouth and are subject to increased harvest.

Staff have flown all tributaries in the Hurunui catchment during peak spawn and found only a handful of salmon spawning outside the two streams above.

Recommendations

- Seek funding to analyse the otoliths collected, to determine whether these salmon spend significant time in Lake Sumner where they are susceptible to harvest, before migrating to the ocean. (Year 1)

- Carry out netting surveys in the lake to research salmon abundance and size composition in Lake Sumner. (Year 2)

- Work with ECan to tighten regulations in the catchment around cattle access to sensitive streams (and preferably the entire North Branch above the lake). (Year 1 & ongoing)

<u>Waiau River</u>

Most of the salmon spawning in the Waiau River occurs in the main stem on St. James Station. Historical salmon returns to this section of the river range from 100 – 1,000, with a median of around 300 and likely accounts for approximately 90% of the Waiau wild salmon returns. The station was purchased by the Crown around ten years ago and was retired from farming. The habitat has recovered significantly during this period, as prior to this, cattle had unlimited access to the spawning streams. There is also spawning in the main stem of the Hope, Boyle and Lewis rivers, which collectively accounts for around 10% of the wild spawning numbers, however budget constraints limit the extent of the aerial surveys.

<u>Salmon loss from rivers through ineffective fish screens</u>

For some time, the North Canterbury Fish & Game Council has expressed concerns to ECan and local bodies about the state and effectiveness of fish screen designs and their operation in Canterbury, as well as their maintenance and compliance with consent requirements. There is a high demand for in-stream flows in Canterbury to be diverted for irrigation and continuing development of new irrigation schemes requiring increasing quantities of water.

Appropriately designed fish screens are necessary to prevent the loss of sports fish such as Chinook salmon, brown trout and rainbow trout to water diversion schemes. A review of fish screens in North Canterbury by Fish & Game in 2004 identified several issues with most of operating fish screens. The review confirmed Fish & Game's view that the design and maintenance of many of the operating screens does not conform to current best international practice.

Most of the fish screens in Canterbury were designed and installed prior to the completion of overseas scientific work on fish screen design and the subsequent development of guidelines and standards, with a full set of guidelines produced by NIWA & Fish & Game for ECan in 2006.

Even on screened intakes (e.g. Amuri scheme), fish rescue operations yield more than 1,000 sports fish each year. The design of any fish screen should be such as to enable migrating and resident fish, safe passage past the structure. A successful fish screen requires various criteria to be considered at the design stage, with all individual parameters required to ensure the effectiveness of the screen. Fish & Game is continuing to work with ECan to ensure compliance and monitoring staff are familiar with the various parameters required for fish screens to work effectively.

Over the last year, staff have significantly increased fish screen advocacy work, resulting in an ECan trial to assess and record separately, screen effectiveness alongside monitoring consent condition compliance, which can then be used to show the poor effective performance of most existed screens, with the end goal being either a plan change or a S128 RMA review of existing consents, to align them with the agreed NIWA guidelines.

Recommendation

- Continue intensive lobbying and liaison with ECan around reviewing existing fish screen consent conditions. (Year 1 & ongoing)

<u>Reduction in Harvest</u>

At the recent Salmon Symposium there was discussion around reducing salmon harvest to ensure a greater proportion of returning salmon reached their natal spawning grounds. The Waimakariri River for example frequently has 60% harvest of the returning salmon. Long-term datasets of harvest and spawning numbers in the Rakaia and Waimakariri rivers have been analysed by Alaskan statistician Dr Steve Fleischman, along with D. Willis and they have both concluded that we are likely harvesting our salmon above the maximum sustainable yield and that the current harvest levels are likely to be delaying the rebuild of the fishery, or even accelerating the decline.

D. Willis recommended introducing several regulations that could be implemented to achieve a reduction in harvest. He noted that each incremental reduction in harvest was likely to have the compounding effect of increasing spawning numbers, which would help rebuild the fishery.

In 2010, six years of angler harvest surveys; from 2004 – 2009 were analysed by French intern masters students, to look at the effect of individual angler catches across all North Canterbury rivers (refer appendix 1). In poor seasons such as those seen in recent years, the number of salmon saved under the various seasonal bag limits shown will be lower than shown in the study due to higher returns over the study period, however the percentage of salmon harvested should remain similar. This study was repeated in 2011, looking at 11 years of data, with very similar results.

In addition to the season bag limit regulation options, D. Willis recommended significant changes to our hatchery practices, including greater steps to ensure fish of commercial origin do not mix with our wild fish, and stopping practices such as ova planting because it is not recommended internationally. D. Willis would prefer to see any surplus ova hatched and grown to 7g at one of the hatcheries before being released into lowland waters or released directly from the Montrose hatchery. As stated earlier, it is presumed a wide-ranging review of our hatchery practices will be undertaken once we receive the Cawthron report.

Recommendations

- Reduce the daily limit bag to one salmon. Anglers can continue fishing, but with trout gear only. (Year 1)

- If the fishery shows no sign of recovery in the next two years, consider shortening the salmon fishing season to the end of March in all North Canterbury rivers. (Year 3)

- Introduce a voluntary season limit of four salmon, negating the need for a complex tag system (i.e. rely on most anglers adhering to the move to reduce harvest. In future there is likely to be electronic options to immediately register catch, rather than a tag system per say, which is something council may wish to consider later). Please refer to the attached harvest summary report, Appendix 1. (Year 1)

<u>Research Project: Population Genetics of New Zealand Wild Chinook salmon</u>

South Island Fish & Game staff have recently begun a research project gathering salmon DNA from as many spawning streams as possible, to build up a baseline to see what level of genetic diversity exists between the various populations. The overall goal of this project is to estimate the level of population divergence among New Zealand Chinook salmon. Research in the 1990's indicated that Pacific salmon populations can diverge after colonization and genetic changes may have taken place since the introductions. However, these studies only included a small number of populations and relied on less informative DNA markers to examine population structure. Recent advances in population genomics make it possible to detect previously unidentified population structure, and explore adaptive divergence, potentially revolutionizing the way genetic data is used to manage wild populations. Internationally, this work has also led to greater recognition of some of the risks associated with enhancement programs.

This project aims to obtain samples from a range of locations across all major wild Chinook salmon populations, facilitating the collection of genome-wide sequence information, allowing a comprehensive South Island wide population genomic analysis to be investigated. The findings are expected to provide valuable information about the current genetic stock structure of New Zealand's wild Chinook salmon populations, assisting sports fishery management, enhancement and conservation efforts. Findings will also improve the understanding of how an introduced sportfish species establishes and forms locally adapted populations.

Helen Trotter (Otago Fish & Game) has taken on the project coordination role and has successfully secured a $10,000 external funding contribution towards DNA analysis costs. A comprehensive South Island wide population genomic analysis of the DNA results from each river and reporting costs is anticipated to require an additional application for $10,000 from the 2018/19 national Fish & Game research fund. If approved, the combined research project budget (i.e. $20,000 of external and internal contributions) will be matched by in-kind funding support towards population analysis and reporting from the Cawthron Institute.

Recommendation

- Staff to collect DNA from as many streams as possible during field work to contribute to the Cawthron DNA study. (Year 1)

Salmon at Sea

Fish & Game often receive anecdotal reports of large quantities of wild salmon have been caught off the Canterbury coast, with last season no exception, with reports of tonnes of salmon landed by the commercial sector. Investigations showed a large number of salmon had recently escaped from a commercial salmon farm in Akaroa Harbour and these were the salmon being landed. There are only a limited a number of boats allowed to fish for salmon in the exclusion zone off Banks Peninsula, where there is a maximum of 5,000kg permitted each year as by-catch amongst the parties who originally signed Salmon at Sea Agreement. The owner of Pegasus Fisheries based in Lyttelton, indicated this season had been very poor season for Red Cod, Barracouta and Blue Warehou, their three main quota species which tend to have similar abundance periods as salmon and he pointed to ocean temperatures as a strong indicator, which had been 2 – 3 degrees warmer than usual this year.

Staff do not believe by-catch is a significant issue affecting wild salmon survival at sea. Staff liaise regularly with the commercial fishing sector, along with the MPI and will set up a meeting between the various parties to discuss various issues and concerns around commercial by-catch at sea.

Recommendation

- Organise a meeting between the various parties associated with the Salmon at Sea Agreement to discuss various issues and concerns around commercial by-catch. (Year 1)

General Submission

In discussions with both ECan & Cawthron biologists, staff would also like Council to consider proactive monitoring for the potential long-term detrimental downstream effects of intensification in the headwaters of the salmon catchments. The cumulative impact this is likely to have on downstream water quality is unknown, but discussions with biologists indicate potentially negative long-term effects from this intensification.

Current research shows that even relatively small increases in nitrogen causes changes to periphyton communities, reducing abundance and diversity of invertebrates relied upon by juvenile salmon as they migrate to sea. This is further compounded by the continued reduction in the number of side braids in the lower reaches, due to abstraction. We must be able to strongly advocate for conservation of these critical habitats that are valued by thousands of anglers.

Recommendations

- Staff would like the NZ Salmon Committee to consider having internationally recognised fisheries experts, such as D. Willis, travel to NZ on a regular basis to offer further advice on fisheries management science.

- In addition to the above recommendations, staff would like to secure funding for a scientific review of the AUC vs Peak Count methodology, to ensure best estimates of spawning escapement are recorded. (Year 2)

- Continue to advocate with ECan for restrictions on intensive land use in the catchments of key spawning streams. (Year 1 & ongoing)

- To adequately carry out the aerial spawning surveys, staff request the annual budget for this be increased from $12,000 to $18,000. (Year 1)

- Implement a long-term monitoring program on the health of the main salmon rivers in their mid - lower reaches. (3 Year & ongoing)

Summary of the Strategic Outline

Year 1;

- Once the joint Fish & Game / ECan water monitoring project has been released, advocate with ECan for land use restrictions in the catchments of key spawning streams.

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

- Contact LINZ to see if willow spraying/ removal is possible on the true left of the stream.

- Meet with the new landowner to discuss options for fencing Cass Hill Stream if funds were available, or negotiate the exclusion of cattle from this area of the farm.

- Meet with the landowner of One Tree Swamp to discuss options for retiring the wetland above the spawning stream and consider a trial to manage emergent macrophyte growth through annual spraying.

- Continue regular liaison with the landowner of the Hydra Waters to ensure ongoing and further protection of the adjacent wetland, along with regular habitat and water quality assessments, increasing in the lower reaches. (Ongoing)

- Liaise with the landowner at Manuka Point Station more frequently to ensure farm practices are not impacting on stream health. Carry out stream habitat assessments similar to those in the ECan project. (Ongoing)

- Continue to liaise with the landowners in the Glenariffe catchment to highlight the habitat issues on the streams and discuss possible restoration projects. (Ongoing)

- Seek funding to analyse the otoliths collected to determine whether salmon spend significant time in Lake Sumner where they are susceptible to harvest, before migrating to the ocean.

- Work with ECan to tighten regulations in the Hurunui catchment around cattle access to sensitive streams (and preferably the entire North Branch above the lake). (Ongoing)

- To adequately carry out the aerial spawning surveys, staff request the annual budget for this be increased from $12,000 to $18,000.

- Reduction of the daily limit bag to one salmon.

- Introduce a voluntary season limit of 4 salmon, without the need for a complex tag system (rely on most anglers adhering to the rules, as the anglers that are not likely to would not under a more complex system either).

- Continue intensive lobbying and liaise with ECan around reviewing existing fish screen consent conditions.

- Staff to collect DNA from as many streams as possible to contribute to the Cawthron DNA study.

- Continue transferring salmon to the lower Rakaia for imprinting before release (this was noted by D. Willis as a key restoration measure to replace ova planting).

- Staff will liaise with MPI and commercial fishers in the Salmon at Sea Agreement to organise a meeting between the various parties.

Year 2;

- Work with the landowners to retire further sensitive areas around Winding Creek.

- Approach the Overseas Investment Office to ensure Fish & Game have more input into the purchase of sensitive land by foreigners.

- Work collaboratively with CSI to investigate the life history of Lake Heron / Mellish Stream salmon and reduce harvest of the pre – migrating salmon if necessary. (Ongoing)

- Carry out netting surveys in Lake Sumner to research salmon abundance and size composition in the lake.

- Carry out an external scientific review of the AUC vs Peak Count methodology, to ensure best estimates of spawning escapement are recorded.

- At the 2019 regulation review, discuss the introduction of single, rather than treble hooks for salmon fishing.

Year 3;

- Work with the landowner to exclude wild deer and pigs from the Hydra Waters. (ongoing)

- Consider shortening the salmon fishing season to the end of March across all rivers if the fishery has not showed significant signs of recovery.

- Implement a long-term monitoring program (in conjunction with ECan & Cawthron) on the health of the main salmon rivers in their mid - lower reaches.

- Review outcomes of the above strategy.

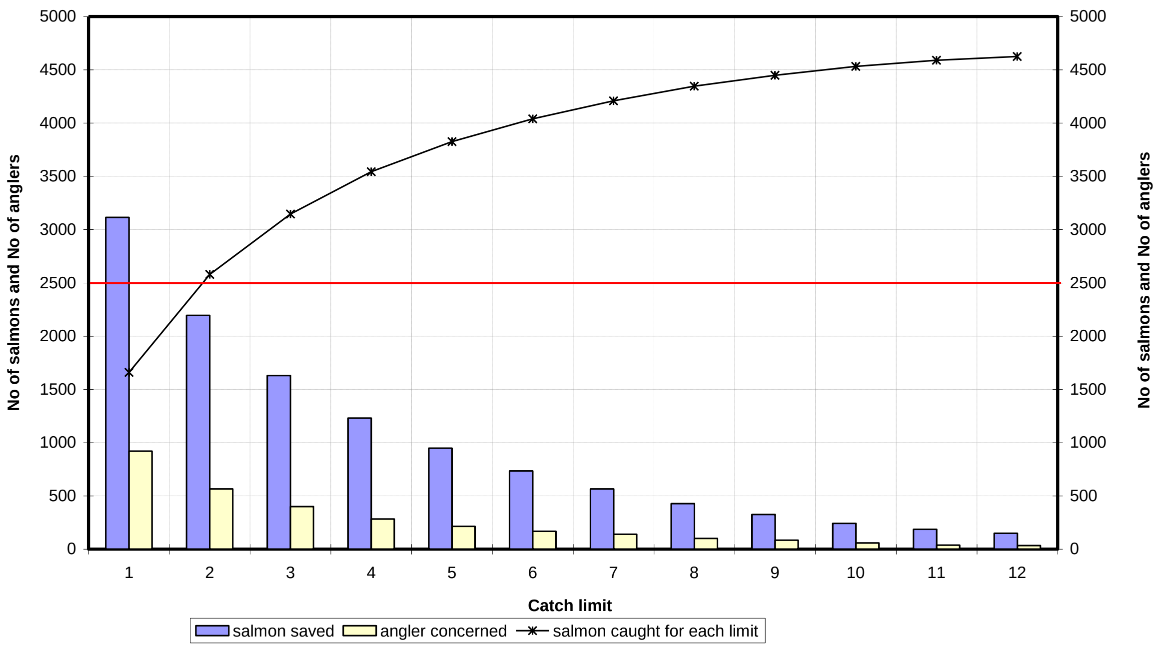
Any regulation changes agreed by the Council need to be sent to National Office to be gazetted by the end of June. Additionally, if Council would like any articles relating to the salmon fishery included in the Fish & Game magazine sent out to last season's licence holders in September, this is also required by the end of June.

Introduction of new regulations shows serious commitment to conserving the fishery during this prolonged period of record low returns, with the worst-case scenario being, "that we were over conservative", with the fishery rebounding and we could review the regulations when conditions at sea favour salmon survival. While not everyone will like these changes, the status quo is not working and incremental savings in harvest and habitat protection and restoration will have a compounding effect on returns over time.

Appendix 1

The graphs below are a summary of the angler harvest and the effect of different bag limits if they were applied across all rivers in North Canterbury. The data was analysed to look at the number of salmon saved per limit bag and the number of anglers affected in all rivers. In addition, the Waimakariri and Rakaia rivers have been analysed separately.

1. The graph below shows **the cumulative number of salmon caught annually across all North Canterbury rivers** (—×—), the number of salmon saved for each potential **seasonal** bag limit (larger bar graph) and the total number of North Canterbury licence holders that would be affected for each **seasonal** bag limit (smaller bar graph). The tables beneath the graph show the same data with highlighted examples and explanations.



Total North Canterbury	1	2	3	4	5	6	7	8	9	10	11	12
Salmon Saved	3114	2195	1629	1230	948	734	566	427	326	242	185	149
Anglers Concerned	920	566	399	282	215	168	139	101	83	57	36	33
Salmon Caught For Each Limit	1660	2579	3145	3544	3826	4040	4208	4347	4448	4532	4588	4625

Calculations averaged over last six years

Total Annual Licences	10732
Total no. of Salmon Anglers	4775
Total salmon caught annually	4774
No. anglers who caught salmon per season	1660
Salmon caught in Waimakariri	2180
Waimakariri anglers who caught salmon	723
Salmon caught in Rakaia	1673
No. of Rakaia anglers who caught salmon	590
Average no. of anglers surveyed annually	691

Below are examples of the above data.

If the annual catch limit is 2 salmon per angler, this will save 2195 salmon per year across all rivers and affect 566 anglers.

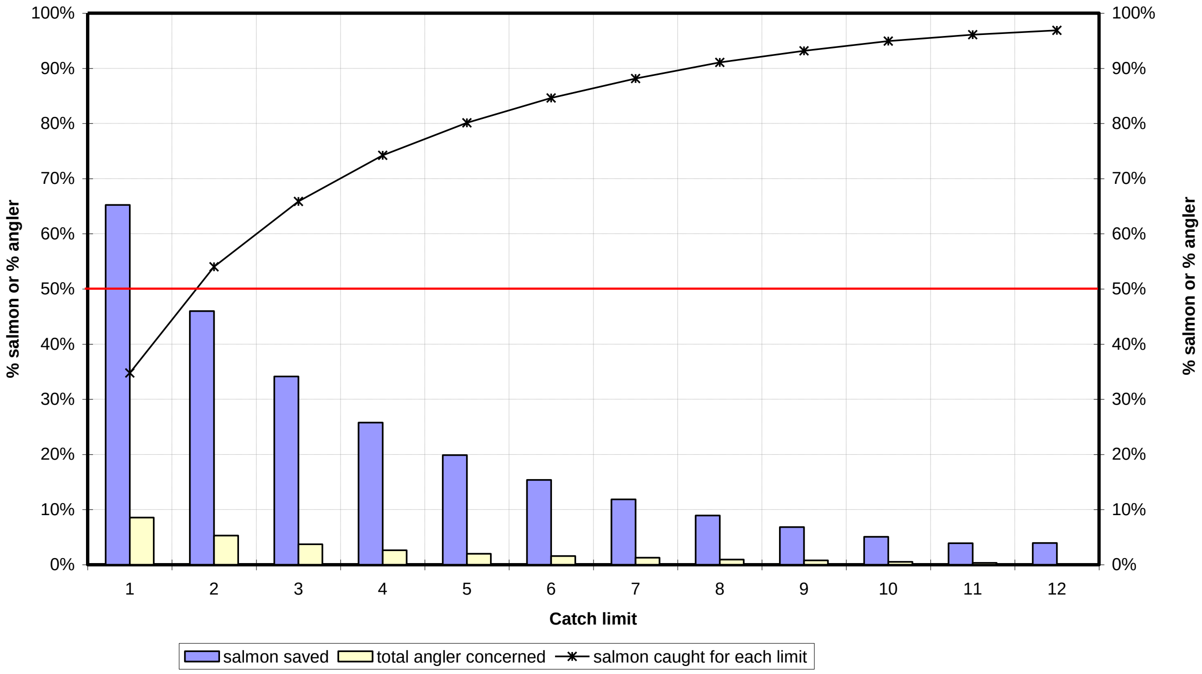
The number of salmon caught per year will be 2579.

If the catch limit is 5 salmon per angler, this limit will save 948 salmon per year across all rivers and affect 215 anglers.

The number of salmon caught per year will be 3826.

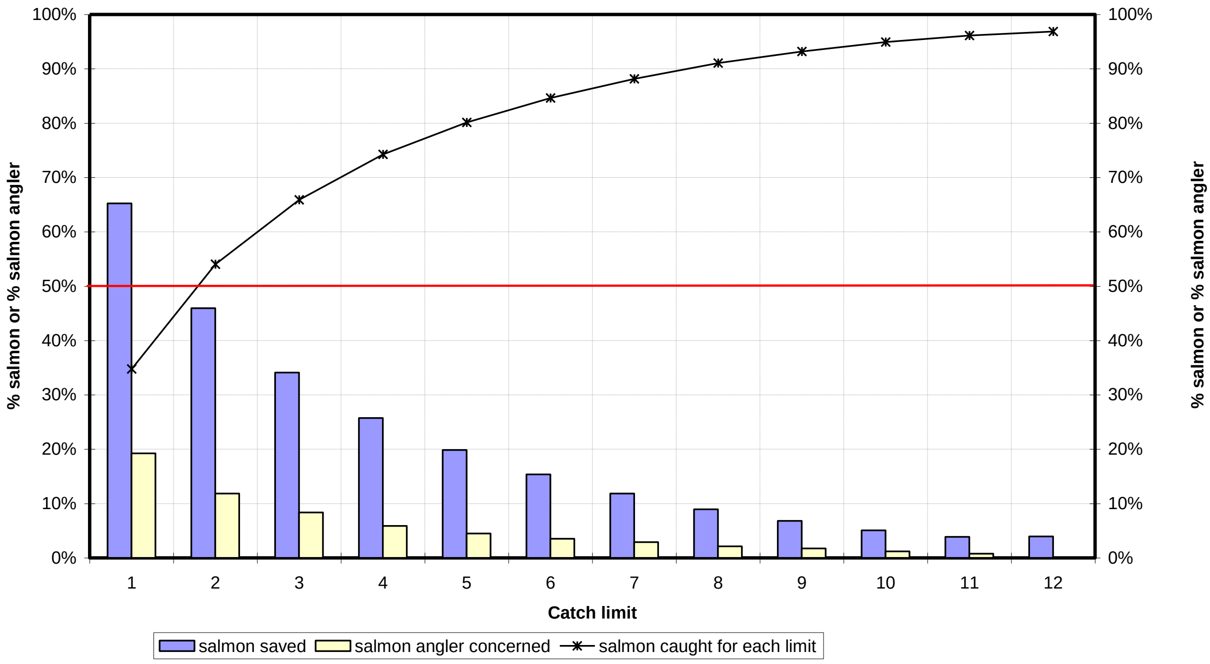
2. The graph below shows similar data to graph 1 but as percentages rather than numbers, and shows the percent of total North Canterbury **licence holders affected** for each limit (smaller bar graph), the percent of salmon saved on average for each bag limit (larger graph) and the cumulative percent of salmon caught annually(—×—). The tables beneath the graph 3 show the same data with highlighted examples and explanations.

Survey of salmon angling in North Canterbury



3. The graph below shows the **percent of all North Canterbury salmon anglers affected** for each seasonal bag limit (smaller bar graph), the percent of salmon saved on average for each bag limit (larger graph) and the cumulative percent of salmon caught annually for each seasonal bag limit (—×—). The tables beneath the graph show the same data with highlighted examples and explanations.

Survey of salmon angling in North Canterbury



North Canterbury	1	2	3	4	5	6	7	8	9	10	11	12
% total anglers concerned	9%	5%	4%	3%	2%	2%	1%	1%	1%	1%	0%	0%
% salmon anglers concerned	19%	12%	8%	6%	4%	4%	3%	2%	2%	1%	1%	0%
Salmon caught for each limit	35%	54%	66%	74%	80%	85%	88%	91%	93%	95%	96%	97%
Salmon saved	65%	46%	34%	26%	20%	15%	12%	9%	7%	5%	4%	4%

Below are examples of the above data.

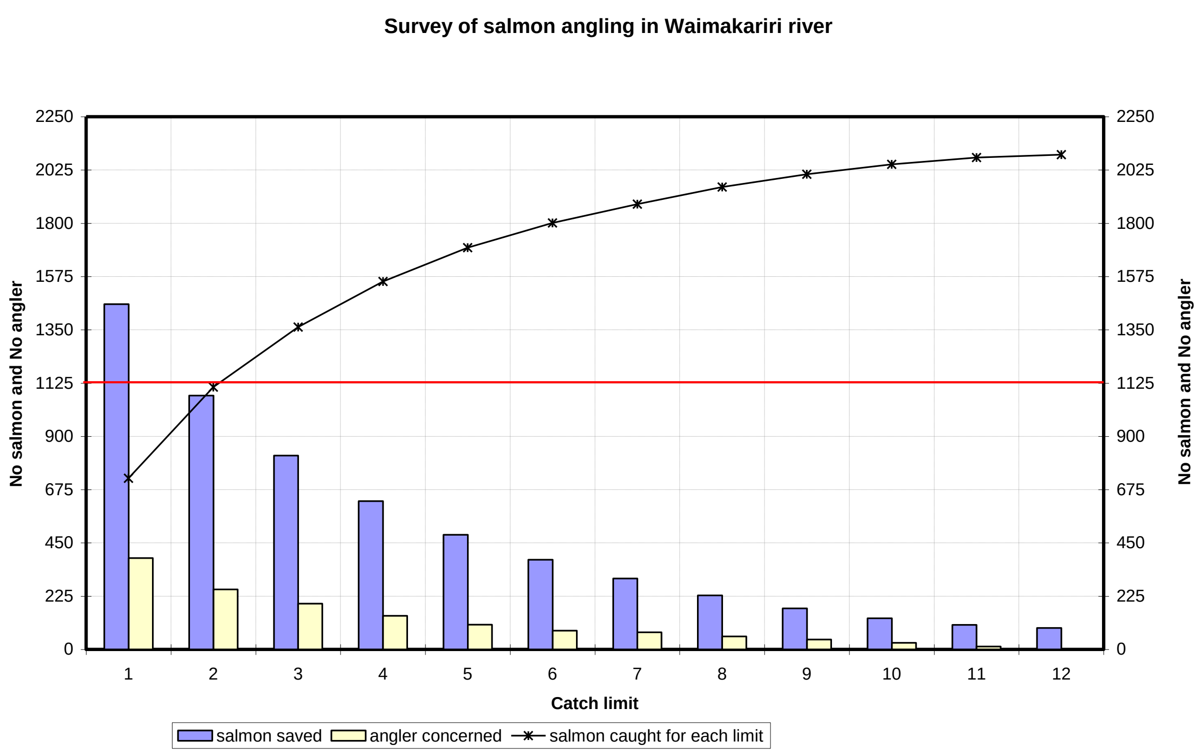
If the catch limit is 2 salmon per angler, this limit will save 46% of the total salmon caught per year and affect 12% of the salmon anglers and 5% of all licence holders.

The % of salmon caught per year will be reduced to 54% of the total salmon currently caught.

If the catch limit is 5 salmon per angler, this limit will save 20% of the total salmon caught per year and affect 4% of the salmon anglers and 2% of all licence holders.

The % of salmon caught per year will be reduced to 80% of the total salmon currently caught.

4. The graph below shows **the number of Waimakariri salmon anglers affected if the seasonal bag limit applied to the Waimakariri only** (smaller bar graph), the number of salmon saved for each bag limit (larger graph) and the cumulative number of salmon caught annually for each bag limit (—×—). The tables beneath the graph show the same data with highlighted examples and explanations.



Waimakariri	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Salmon saved	1458	1072	819	626	484	379	300	228	173	131	103	91
Anglers concerned	386	253	193	142	105	79	72	55	42	28	13	13
Cumulative salmon caught for each limit	723	1108	1361	1554	1696	1801	1880	1953	2007	2049	2077	2090

Calculations averaged over last six years

Total annual licences	10732
Total no. of salmon anglers	4775
Total no. of salmon caught	4774
Total no. of anglers who caught salmon	1660
Salmon caught annually in Waimakariri	2180
Waimakariri anglers who caught salmon	723
Total no. of salmon caught in Rakaia	1673
Rakaia anglers who caught salmon	590
Average no. of anglers surveyed	691
% anglers who caught salmon	15

Below are examples of the above data.

If the catch limit is 3 salmon per angler, this limit will save 819 salmon per year and affect 193 anglers.

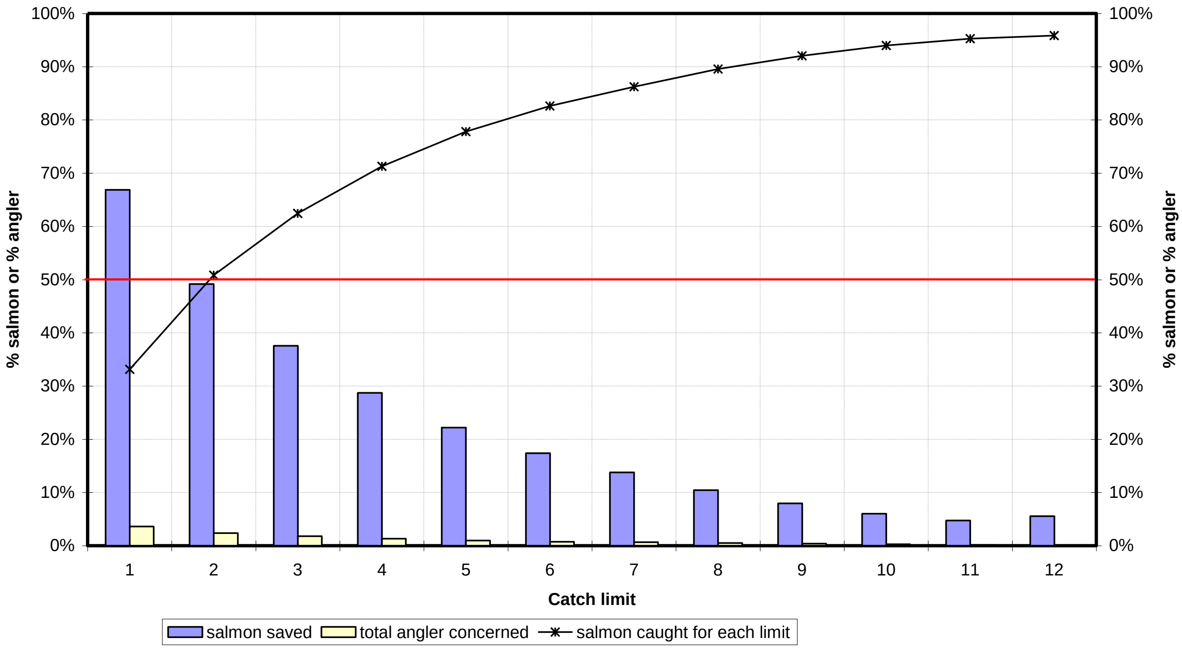
The number of salmon catch per year will be to 1361.

If the catch limit is 4 salmon per angler, this limit will save 626 salmon per year and affect 142 anglers.

The number of salmon caught per year will be reduced to 1554.

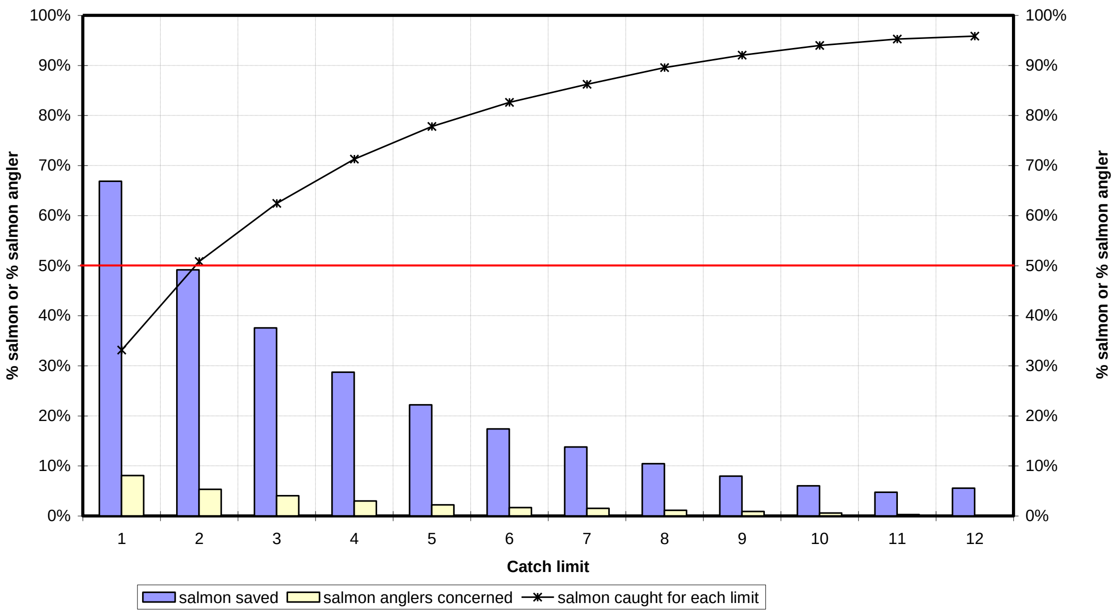
5. The graph below shows the **percent of the total anglers affected if the seasonal bag limit applied to the Waimakariri only** (smaller bar graph), the percent Waimakariri salmon saved for each bag limit (larger graph) and the cumulative number of salmon caught annually for each bag limit (—×—). The tables beneath graph 6 show the same data with highlighted examples and explanations.

Survey of salmon angling in Waimakariri river



6. The graph below shows the **percentage of Waimakariri salmon anglers affected for each seasonal bag limit if the regulation only applied to the Waimakariri** (smaller bar graph), the percent of Waimakariri salmon saved for each bag limit (larger graph) and the cumulative number of salmon caught annually for each bag limit (—×—). The tables beneath the graph show the same data with highlighted examples and explanations.

Survey of salmon angling in Waimakariri river



Waimakariri	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of anglers concerned	4%	2%	2%	1%	1%	1%	1%	1%	0%	0%	0%	0%
% salmon anglers concerned	8%	5%	4%	3%	2%	2%	2%	1%	1%	1%	0%	0%
% salmon caught for each limit	33%	51%	62%	71%	78%	83%	86%	90%	92%	94%	95%	96%
% salmon saved	67%	49%	38%	29%	22%	17%	14%	10%	8%	6%	5%	6%

Below are examples of the above data.

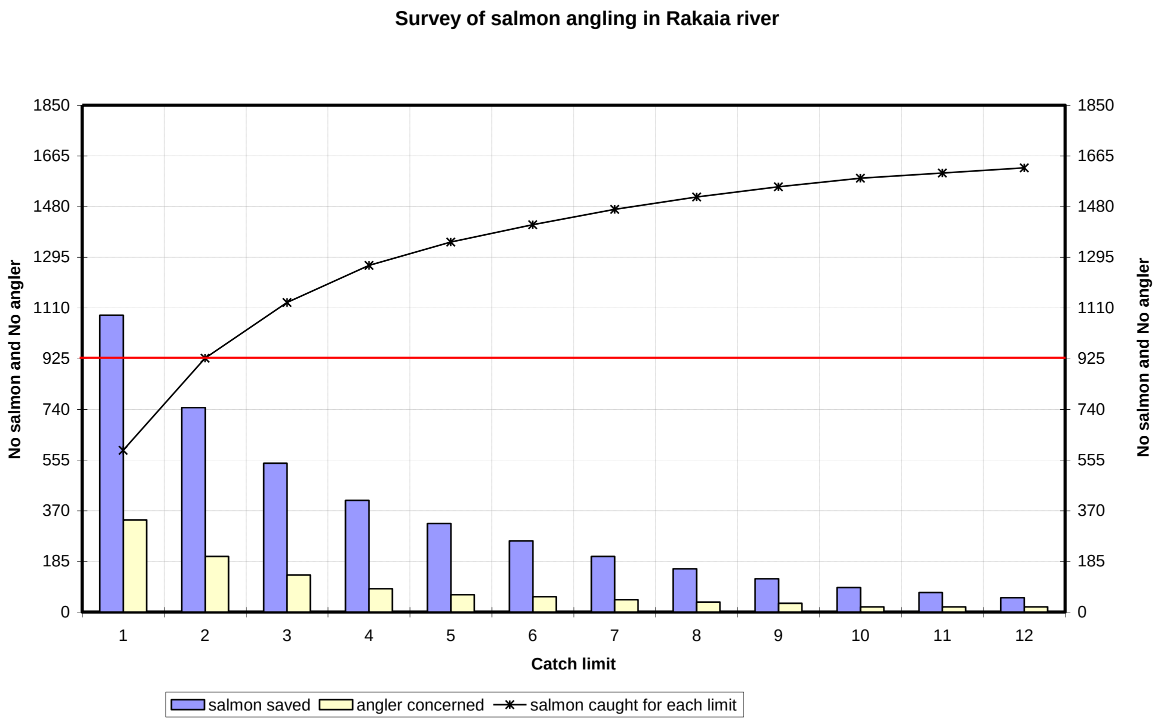
If the catch limit is 3 salmon per angler, this limit will save 38% of the total salmon caught per year and affect 2% of the anglers and 4% of the salmon anglers.

The % of salmon caught per year will be reduced to 62% of the total salmon currently caught.

If the catch limit is 5 salmon per angler, this limit will save 29% of the total salmon caught per year and affect 1% of the anglers and 3% of the salmon anglers.

The % of salmon caught per year will be reduced to 71% of the total salmon currently caught.

7. The graph below shows the **number of Rakaia salmon anglers affected for each seasonal bag limit if the regulation applied to the Rakaia only** (smaller bar graph), the number of Rakaia salmon saved for each bag limit (larger graph) and the cumulative number of Rakaia salmon caught annually for each bag limit (—×—). The tables beneath the graph show the same data with highlighted examples and explanations.



RAKAIA	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Salmon saved	1083	746	543	408	323	260	203	158	121	90	71	52
Anglers concerned	337	203	135	85	63	56	45	37	32	19	19	19
Cumulative salmon caught for each limit	590	927	1130	1265	1350	1414	1470	1515	1552	1584	1602	1621

Calculations averaged over last six years.

Total licences	10732
Total of salmon anglers	4775
Total salmon caught	4774
Total anglers who caught salmon “expert”	1660
Salmon caught in Waimakariri	2180
Waimakariri anglers who caught salmon	723
Total salmon caught in the Rakaia annually	1673
Rakaia anglers who caught salmon	590
Average no. of anglers surveyed	691
% anglers who caught salmon	15

Below are examples of the above data.

If the catch limit is 4 salmon per angler, this limit will save 408 salmon per year and affect 85 anglers.

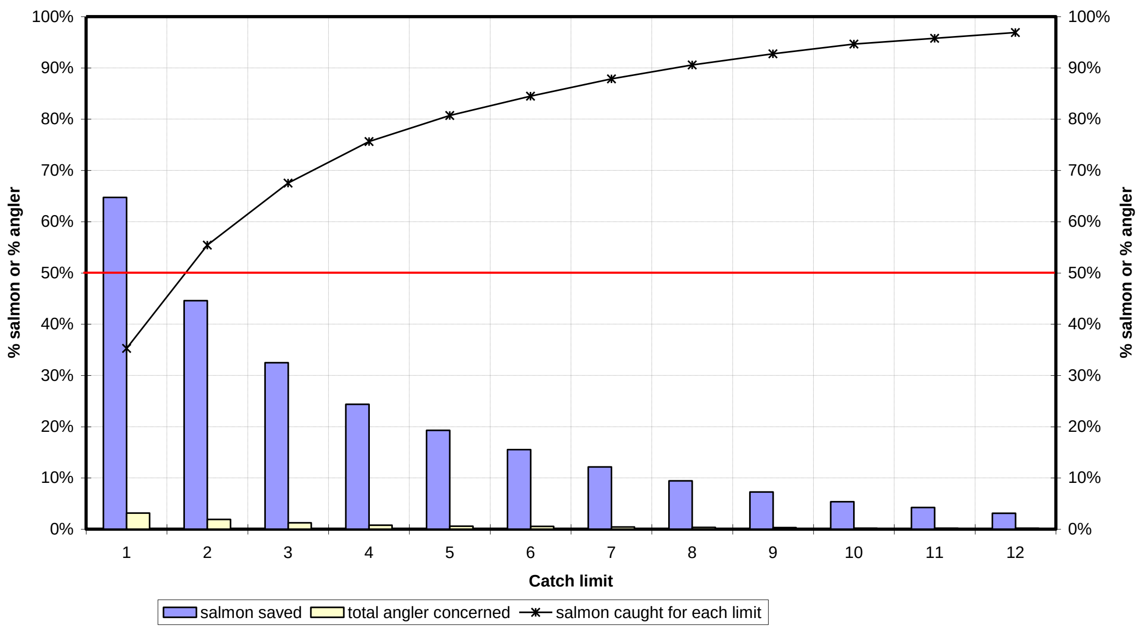
The number of salmon caught per year will be reduced to 1265.

If the catch limit is 6 salmon per angler, this limit will save 260 salmon per year in the Rakaia and affect 56 anglers.

The number of salmon caught per year will be reduced to 1414.

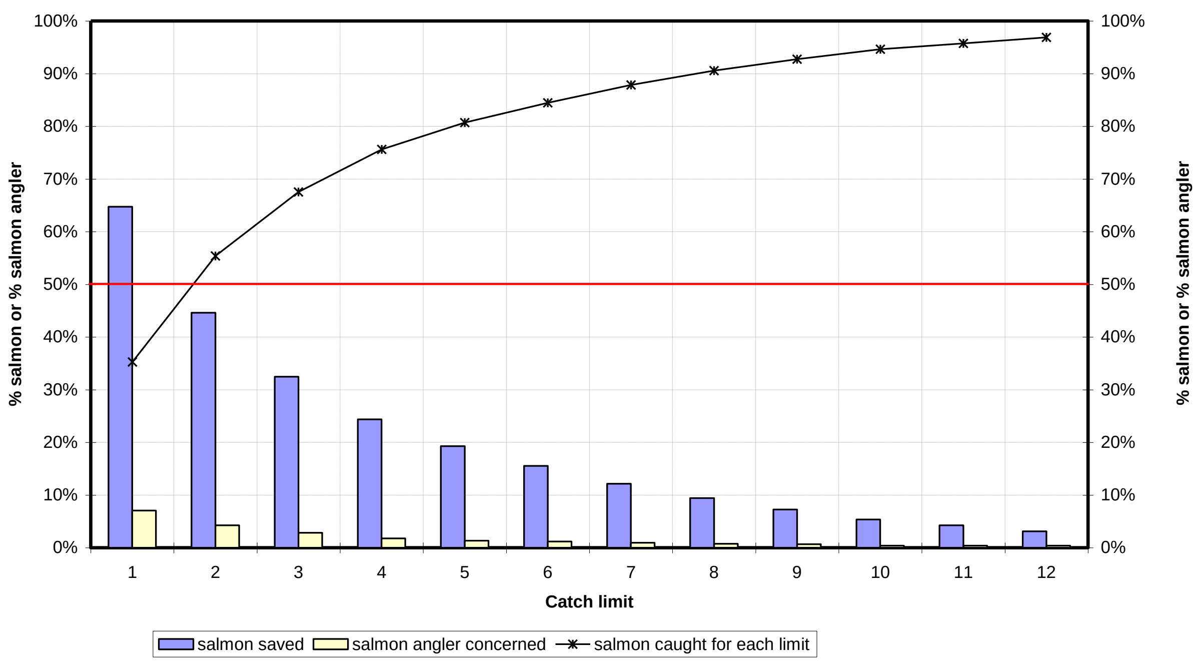
8. The graph below shows the **percentage of total anglers affected if the regulation applied to the Rakaia only** (smaller bar graph), the percent of Rakaia salmon saved for each bag limit (larger graph) and the cumulative number of salmon caught annually for each bag limit (—×—). The tables beneath graph 9 show the same data with highlighted examples and explanations.

Survey of salmon angling in Rakaia river



9. The graph below shows the **percentage of total Rakaia salmon anglers affected for each seasonal bag limit applied** (smaller bar graph), the number of Rakaia salmon saved for each bag limit (larger graph) and the cumulative number of salmon caught annually for each bag limit (—×—). The tables beneath the graph show the same data with highlighted examples and explanations.

Survey of salmon angling in Rakaia river



RAKAIA	1	2	3	4	5	6	7	8	9	10	11	12
% total anglers concerned	3%	2%	1%	1%	1%	1%	0%	0%	0%	0%	0%	0%
% salmon anglers concerned	7%	4%	3%	2%	1%	1%	1%	1%	1%	0%	0%	0%
% salmon caught for each limit	35%	55%	68%	76%	81%	84%	88%	91%	93%	95%	96%	97%
% salmon saved	65%	45%	32%	24%	19%	16%	12%	9%	7%	5%	4%	3%

Below are examples of the above data.

If the catch limit is 4 salmon per angler, this limit will save 24% of the total salmon caught per year and affect 1% of the total anglers and 2% of salmon anglers.

The % of salmon caught per year will be reduced to 55% of the total salmon currently caught.

If the catch limit is 6 salmon per angler, this limit will save 16% of the total salmon caught per year and affect less than 1% of the total anglers and just over 1% of the salmon anglers.

The % of salmon caught per year will be reduced to 84% of the total salmon currently caught.

Discussion

Explanation of salmon likely to be saved using the example of a seasonal bag limit of 4**.**

With a seasonal bag limit of 4 salmon, around 26% of salmon currently caught will be saved, averaged across the Rakaia and Waimakariri Rivers (or around 13% of the total salmon run assuming 40% harvest currently in the Rakaia and 60% in the Waimakariri, i.e. 50% of the returning salmon are caught on average). 29% (Waimakariri) and 24% (Rakaia) of salmon currently caught will be saved with a limit bag of 4.

The difference of 5% above (29% Waimakariri / 24% Rakaia) between these two rivers means more anglers currently catch 4 or more salmon on the Rakaia than on the Waimakariri.

The above example is optimistic in terms of the percentage of salmon likely to be saved, as the additional salmon that would no longer be caught by anglers who would usually catch 5 salmon or more would then be available for other anglers, and assuming new catch statistics with a seasonal bag limit of 4, around 25% of these salmon may then be caught by those anglers that catch 4 or less each season.

Central South Island Fish & Game provided a summary of their 2010 salmon catch below. This also highlights the need for a conservative limit bag to have any significant difference to the number of salmon saved.

8873 licence holders
6418 did not go salmon fishing
Of 2455 who fished for salmon 1834 caught nothing
621 fished for salmon and caught 1623 fish average 2.6 per successful angler
253 caught 1, 166 caught 2, biggest catch 29
14 anglers caught more than 10

20% of harvest was contributed by those catching more than 8 but the season bag limit would have to be 4 before you would get a 20% decrease in season harvest.