

Adaptive Management Strategy for Setting North Canterbury and Central South Island Sea Run Salmon Fishing Regulations

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Vision

To manage the wild Chinook salmon fishery at sustainable levels using a transparent, adaptive management approach to ensure adequate salmon spawn each year and to provide a healthy recreational sports fishery.

Background

A wild sea-run salmon fishery has established in the South Island since being introduced to New Zealand over a century ago. Sea-run Chinook salmon are an iconic sports fish that generate incredible passion and commitment in the anglers who fish for them. In recent years, since about 2000, the sea-run salmon fishery has been very depressed at historically low levels and has shown little sign of prolonged recovery. In response to anglers' concerns around the state of the fishery, a salmon symposium was held December 2017, where local and international salmon experts presented their thoughts as to what may be contributing to the decline.

Some of the likely reasons for the decline include warmer ocean temperatures on the east coast of the South Island in recent years, reduced and degraded spawning habitat due to land development, reduced river flows through abstraction, lower juvenile salmon survival through loss of habitat and ineffective fish screens, and a gradual increase in harvest levels over the period when the number of wild salmon returning to the rivers has been declining. A common concern was that the large, and in some cases increasing proportion of salmon caught by anglers during the period of depressed run size may prevent the fishery from taking advantage of favourable conditions at sea for recovery.

Monitoring of wild salmon in the Waimakariri, Rakaia and Rangitata rivers provides a record of annual angler catch, spawning population size, total run size and trends across 26 years. These fisheries, including the Waitaki for its shorter period of record, show very similar population trends, either increasing or decreasing together on an annual basis and they all share the current critically low state (Figure 1).

Fish & Game (F&G) is tasked with setting sea-run salmon angling regulations to ensure that harvest is sustainable, to enable all licence holders fair and equitable access to the fishery, and to provide a full and diverse range of angling opportunities. This has been difficult to achieve

for a number of reasons, notably we are required to set regulations well in advance of the season ahead and without a full understanding of the season that has just finished so we are unable to react quickly to salmon population changes. At the same time there is huge pressure to satisfy angler harvest expectations that are driven by historical achievements when the fishery was much stronger. With an increasing trend in the proportion of returning salmon that are harvested, particularly in the Waimakariri fishery, councils understand they must make some tough decisions and take steps to increase the number of salmon that survive to spawn.

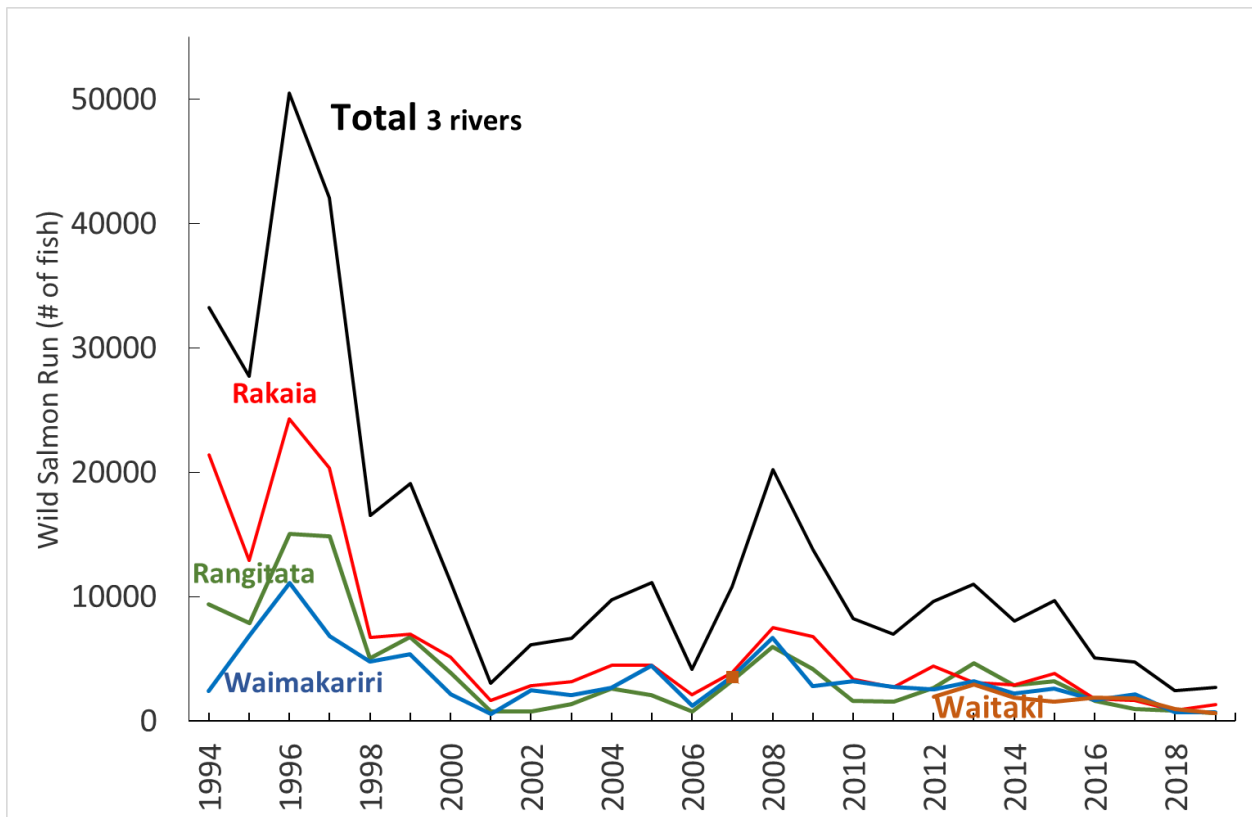


Figure 1. Estimated wild salmon returning to the Waimakariri (blue), Rakaia (red), and Rangitata (green) rivers for 1994 to 2019, Waitaki River (brown) 2007 and 2012 to 2019, and total for the Waimakariri, Rakaia and Rangitata (black) 1994 to 2019.

The proportion of the wild re-a-run salmon caught by anglers each year as a percentage of the total estimated returns, has been slowly increasing over time. For example in recent years harvest rates have been over 50% in the Waimakariri River and around 40% in the Rakaia and Rangitata. At the current run sizes, international experience would suggest harvest rates above 50% are not sustainable and it is possible that life history patterns, genetic diversity and salmon population resilience may be adversely affected. There is a growing acceptance by anglers that to rebuild the salmon fishery, we need to significantly reduce the harvest of wild salmon in order to increase the numbers of fish returning to the spawning streams.

F&G has a limited number of regulatory options to try and ensure adequate salmon numbers reach their spawning grounds each year, such as daily limits, changing season length and

opening/closing areas of river to fishing. In a perfect management regime we would be able to open and close the salmon fishery to ensure sufficient numbers return to their spawning grounds each season as they do in key north American fisheries. However, we do not currently have the resources to determine return numbers in real time, we don't know the spawning targets we need to achieve, nor do we have the legislative support to implement this adaptive approach.

Options for Harvest Management

The Anglers Notice sets out conditions under which licence holders may fish, being conditions relating to – the size of fish, bag limit, open/closed waters, fishing gear/methods and the hours of fishing, with access to a season bag as a control on harvest only becoming available in early 2020. Joint North Canterbury (NC) and Central South Island (CSI) F&G staff and councillor meetings in 2019 discussed standardising salmon fishing conditions across the regions and the need to improve wild salmon spawning numbers. A result of this process was the introduction of additional daily bag limit and season length restrictions that were predicted to reduce harvest across the two regions by about 18%. This reduction remained short of the 40% considered necessary given the state of the fishery and it was agreed that introduction of a season bag limit was the next step towards achieving the required control on harvest.

The daily limit bag for all sea-run salmon fisheries is currently one fish and cannot be made any lower. All F&G regions with sea run salmon reduced the daily limit bag from two fish to one fish for the 2019/20 season on the understanding that it would save about 10% of season harvest. Further justification for reducing the daily limit was that it applies equally to all successful anglers, it cannot be avoided by fishing somewhere else, and it may help to redistribute success to a greater number of anglers.

Area and season length controls are easily applied and many combinations of small changes can be introduced to achieve the required result. History has shown that introducing conditions that achieve only small changes tend to affect a minority of anglers with the hardships not equally distributed across all anglers. Area and season controls are not guaranteed to have the predicted effect if anglers displaced by the change in conditions instead fish the open area or time available elsewhere in the fishery.

To improve the success of season length controls, fish that are saved from being caught during the closure should not be exposed to angling later in the season – closure of the season early will be more effective than a later opening. On this basis fishing for sea-run salmon in April was uniformly closed in the NC and CSI F&G regions in 2019/20 with an estimated 8% reduction in season harvest. This estimate of saving was based on information available from the Rangitata River (Table 2). The two regions also closed October and November with an estimated 3% saving on season harvest.

Table 2. Impact of various season and area closures on season harvest from the Rangitata River based on multiple years of random harvest surveys between 1994 and 2018.

Condition	Application	Harvest reduction
Closed period	October + November	<3%
	December	<11%
	January	<30%
	February	<29%
	March	<22%
	April	5%
Closed area	Gorge & above	<5%
	SH1 to Gorge	<14%
	Lagoon to SH1	<27%
	Mouth, surf & lagoon	<54%

The Season Bag

Season limit bags have been a topic of conversation for many years, most often when there are good runs in the rivers and anglers have more opportunity to accumulate big tallies over the season. Anglers commonly talk of a season bag of 15 to 20 fish and this may be acceptable as an ethical limit but it is not a valid fish conservation strategy because a limit of this size effects only a small number of anglers and has negligible effect on overall harvest.

During the NC and CSI end of season harvest surveys – telephone and email – information is collected on angler catch in individual rivers that can be summed as a season tally across all rivers. From 1994 to 2017 these surveys were independent with each F&G region interviewing its own anglers at different sampling rates and with different questions. The 2018/19 season survey was the first where both regions anglers were interviewed as one sample population. This ensured consistency of effort and higher precision of the estimates.

The results of the 2018/19 season survey identified that 3,929 NC or CSI licenced anglers fished for salmon in the rivers of the NC and CSI F&G region. Of these anglers 879 were successful and caught 1,979 salmon. Three-quarters (78%) of salmon anglers caught no salmon and 94% of anglers caught two or fewer fish (Figure 2). The average season catch across all anglers who fished for salmon was 0.5 salmon for the season and the average for successful anglers was 2.25 fish for the season.

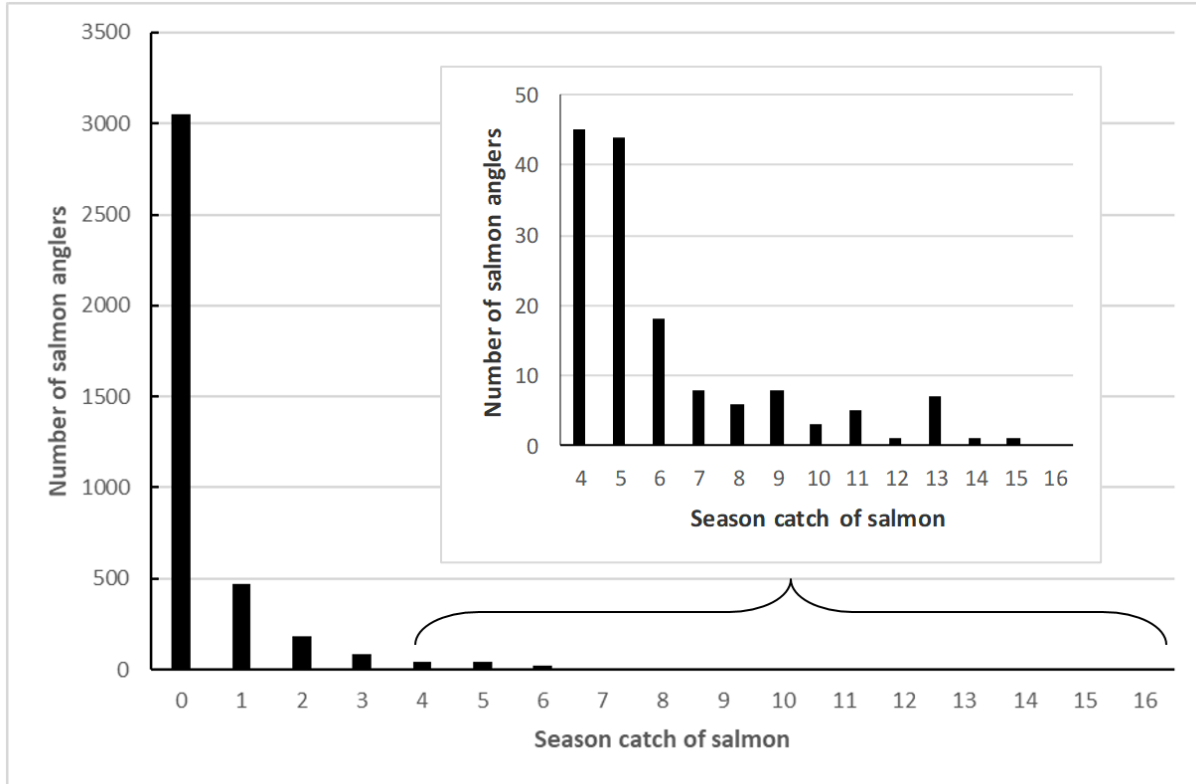


Figure 2. Distribution of season limit bags for NC and CSI F&G region licenced anglers who went sea-run salmon fishing in the NC or CSI F&G regions in the 2018/19 season.

Knowing the distribution of season limit bags enables the impact on anglers and fish survival of a range of season limit bag sizes to be assessed. Survey records identify the number of anglers that would have been affected, how they would be affected and what the potential increase in spawning numbers would have been for a range of season limit bag sizes had they been implemented in the 2017/18 season (Table 3).

Table 3. Impact of various season bag limits on 879 successful salmon anglers who caught 1,979 sea-run salmon across all NC and CSI F&G regions salmon fisheries in the 2018/19 season and potential stock saved that could have improved spawning in the Waimakariri, Rakaia and Rangitata rivers in 2019.

Season bag size	Successful anglers achieving bag size	Number of salmon saved	Proportion of total harvest saved	Potential increase in Waimakariri, Rakaia, Rangitata spawning
20	0%	0	0	0
10	2%	37	2%	1.6%
5	12%	211	11%	10%
4	17%	313	16%	14%
3	26%	460	23%	21%
2	47%	689	35%	32%
1	100%	1,100	56%	50%

In the 2018/19 season, 2% of anglers caught more than 10 salmon and the total number of salmon these anglers caught above the 10 was an additional 37 fish. Had the season bag of 10 operated the saving on harvest would have been 2% and these additional fish could have added 1.6% more fish onto the spawning grounds. Similarly, a season bag limit of 2 would have affected 47% of successful anglers and 689 fish would not have been caught and could have added 32% onto the spawning population. The calculations for additional spawners assumes 65% of the region-wide salmon that were not caught by anglers because of the season bag, spawned in either the Waimakariri or Rakaia or Rangitata which is the estimated proportion of region-wide spawning occurring in those rivers.

Using the season bag provides a simpler and more even-handed method for implementing significant control on angler catch instead of a number of less significant area or season restrictions. Only one condition is required to achieve a saving on harvest to meet the spawning target and this is particularly important when a 20% or greater improvement in spawning population size is required.

The season bag analysis of the 2018/19 season indicates that a season bag of three fish could have reduced harvest by about 41% in combination with the daily bag and season controls already introduced. To achieve a similar level of control using only the season limit bag would require a season limit bag of two fish for a 35% reduction in harvest.

Current salmon fishing regulations across the two F&G regions contain season length and river area restrictions and a daily bag limit. Introduction of a season bag limit provides an opportunity to allow anglers to choose when and where they fish and how many salmon they may take while retaining greater control of season harvest with just the one season bag Angler Notice condition.

A Strategy to Rebuild the Wild Fishery

The NC and CSI F&G councils are aiming to introduce an adaptive salmon management strategy that identifies minimum spawning targets across key rivers and implements a model for setting harvest regulations to help rebuild the fishery. Harvest management of salmon will be guided by the number of wild sea run salmon spawning such that when spawning numbers are low there will be tighter control of angler catch to generate higher survival of spawners. When spawner numbers are high and the fishery is deemed to be healthy then angling conditions will be relaxed. This requires a long-term commitment to the management strategy supported by quality monitoring that identifies the effectiveness of actions taken. NC and CSI F&G staff are continuing to advance mechanisms for applying harvest controls under a proposed threshold management regime to target achievement of minimum spawning numbers.

An estimated three-quarters of all South Island sea-run salmon caught are taken from the Waimakariri, Rakaia and Rangitata and these are the rivers for which we have the most robust and consistent monitoring information. It is sensible that these rivers should be the indicators

of the state of the NC and CSI salmon fishery and management of the fishery as a whole should be referenced to the dynamics of the Waimakariri, Rakaia, and Rangitata fisheries. Over time, monitoring to the required standard in other NC and CSI salmon fisheries would enable these rivers to be added to the adaptive management strategy.

The first part of the strategy requires the setting of thresholds for the number of spawning salmon that are needed based on the 26-year historical spawning population range and minimum acceptable spawning population size. Between the thresholds there are defined spawning population bands.

Three spawning thresholds should be sufficient to categorise the health of the spawning population with the upper threshold being the level above which the fishery can be considered healthy and where a minimum of harvest conditions would apply (Table 4). Across the last 26 years of spawning population information, the 75th percentile could be the level above which the fisheries are considered to be healthy. The second and third thresholds provide two bands with increasing restrictions on harvest to help prevent the fishery falling below the third threshold. The second threshold could correspond to the median or middle value of the 26-year spawning records for the Rangitata, Waimakariri and Rakaia rivers. Below the third threshold the fishery would have maximum harvest restrictions imposed without closing the fishery and this level has been determined to be just below the lowest recorded spawning population size in each of the rivers over the last 26 years.

Table 4. Example of possible spawning population thresholds and season bag conditions triggered, based on 26 years of records for Rangitata, Rakaia, and Waimakariri spawning numbers combined.

Combined No. of Spawners	Season Bag
less than 1,000	1
1,000-5,100	2
5,100-7,800	4
7,800+	10

The second part of the strategy is to identify what the conditions on angler catch are that will apply when the spawning population is in each band. Catch regulations will be aimed at increasing the number of fish that survive to spawn when the population is in a low population band or relax angling restrictions when the population is healthy.

Season Length

The proportion of season harvest attributable to months of the fishing season has been estimated from angler surveys during full-length seasons. In estimating potential harvest saved by closing parts of the season there is no way to consider changed angler behaviour in response to the closure. If anglers transfer the effort they would have put in, from the newly closed period to the remaining open period, then there is no reduction in season effort and likely no change in season harvest. The estimated reduction in harvest would be a maximum estimate

that assumes anglers don't fish the open season more intensively. The real effect on harvest will be less than estimated from the assumption that anglers do not transfer their activity.

Concentrating angler effort into a shorter time period may have adverse effects on resilience of the salmon population. Research on Pacific salmon indicates that salmon in the population will run at predetermined times and this is an inherited trait. By concentrating angling to a shorter time within the greater period of the run, the natural diversity of the population is threatened. This works against population resilience which is the feature that helps salmon populations cope with adverse environmental conditions. Ideally harvest pressure should be spread across the whole run in response to the number of salmon present and this normally occurs when anglers respond to the presence of runs of salmon.

Our salmon rivers do not all have their traditional peak salmon fishing at the same time. The Waimakariri and Waitaki rivers have their peak salmon runs in March and April compared to the Rakaia and Rangitata rivers that peak in January and February. Closed seasons set across all the rivers will affect some to a greater extent than others, while closed seasons that differ between rivers risk shifting angler pressure to those that remain open.

In summary, changing the availability of the salmon fishing season may not achieve the savings in harvest anticipated and may negatively impact the resilience of the salmon population to the adverse environmental conditions that we believe are active now.

Daily Bag Limit

Reduction of the daily limit bag from two salmon to one was estimated to achieve a 10% to 15% reduction in season harvest. In years with good runs when anglers were more likely to catch a second fish in one day, the reduction of the daily bag to one fish was estimated to save around 15% of season harvest. In the poor run years that we have been having in most of the last 20 years, there is less opportunity for anglers to catch two fish so a daily limit of one fish was estimated to save about 10% of season harvest.

To a large extent introduction of a season bag replaces the function of a daily bag, particularly when the season bag is two fish or less. If the season bag is one or two fish then the additional constraint of a daily bag is not required. In this situation an angler may choose to catch two fish in one day if the daily bag limit allows and that angler's season is then over. Alternatively, the angler may choose to keep one fish on each of two days. If the season bag limit is one fish then automatically the daily bag is also one fish. With a low season limit, anglers who choose to keep a fish when the run size is small quickly catch their limit and leave the fishery. When the season bag is three or more fish and the salmon population is stronger, the daily bag limit of two fish provides more opportunity for anglers to spread their catch over multiple days and extend their fishing opportunities.

The current conditions around catch and release are that no licence holder shall continue to fish for a particular species of sports fish on any day in which he or she has already killed the limit bag for that species.

In summary, a daily bag limit of two fish is more effective at spreading catch at higher population levels when the season bag limit is three or more fish. In low salmon population seasons when the proposed season bag limit would be one or two fish, the addition of a daily bag restriction of one or two fish respectively has very little impact on season harvest or the distribution of catch across the season.

Closed Areas

The issue of closing upper reaches of salmon rivers to salmon angling has been frequently raised in areas where upriver fishing remains available. All headwater salmon rivers where spawning is confined to small headwater spring-fed tributaries close to salmon fishing in the mainstem at the end of February. The early closures compared to the remainder of the river reaches, prevents salmon being taken in the spawning streams and in the mainstem reaches where they congregate prior to entering the spawning streams.

In summary, one of the benefits of application of the season bag limit is that it can reduce the need for other season, area and method regulations that make current fishing regulations complicated. The over-riding issue is control of harvest to meet spawning targets and provided fishing remains ethical and sporting, and the targets are met, where and when harvest occurs is less significant.

This Adaptive Management Strategy being developed by NC and CSI staff identifies the conditions on angler catch that could apply when the spawning population is within each of the threshold bands. These conditions would be aimed at increasing the number of fish that survive to spawn when the population is in a low abundance band or relaxing angling conditions when abundance is high (Table 5).

Table 5. Example of possible spawning population thresholds and the angling regulations triggered based on 26 years of record for Rangitata, Rakaia, and Waimakariri spawning numbers combined.

Spawning Thresholds	Season Bag	Daily Bag	Season Length	Above Gorge Bridges/Klondyke
less than 1,000	1	1	1 Oct-30 Apr	Closed
1,000-5,100	2	2	1 Oct-30 Apr	Open
5,100-7,800	4	2	1 Oct-30 Apr	Open
7,800+	10	2	1 Oct-30 Apr	Open

Although the exact minimum spawning threshold is likely to change as our understanding of minimum escapement targets improves, the objective is to maintain the spawning populations above the minimum threshold and to move toward a more transparent and responsive management system for setting harvest regulations.

Summary

Introduction of a season catch limit has been recommended by scientists as the favoured regulation to reduce harvest and rebuild spawning numbers. A season limit bag offers a consistent and simple method to achieve staged spawning population targets. The simplicity arises from the need to change only the size of the bag limit to reach a target rather than a range of different season, area and timing conditions. The consistency is achieved from its equal application to all salmon anglers fishing all rivers.

Total spawning in the Waimakariri, Rakaia and Rangitata rivers last year was only 1,300 salmon and the threshold management strategy for setting salmon fishing regulations indicates this would likely justify application of a season bag limit of two fish. Access to a season bag as a control on harvest only became available in early 2020 and as a novel and significant control it may face potential administrative and acceptance issues in its early years. A period of adjustment particularly for anglers would be warranted and it is recommended a season bag limit of 4 salmon be introduced for 2020/21 for an estimated 16% reduction in angler harvest and 14% increase in wild spawning (Table 3).