



## CENTRAL SOUTH ISLAND REGION

# Comparisons of sports fish catch and angler use of the upper Tekapo Canal fishery during the 2019 and 2020 rainbow trout spawning seasons

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## Executive Summary

The Mackenzie Basin hydro canal fishery, including the Tekapo Canal has experienced extreme growth in angler use since the National Angler Survey was first undertaken in 1994/1995. In recent years specific parts of the canal system particularly the upper section of the Tekapo Canal has become increasingly popular during the wintertime for targeting the spawning runs of rainbow trout. This has led to angler concerns around the sustainability of the fishery under increased use during the spawning season and a perception of a diminished fishing experience.

An angler use and catch survey was undertaken on the upper Tekapo Canal during the winter of 2019 to provide information on the state of the fishery. Based on the reporting of that survey, the Central South Island Fish and Game (CSIFG) Council introduced a closed season for all sports fishing above the SH8 Bridge on the Tekapo Canal from June 1 to August 31, 2021. The closure was justified as representing a conservation-minded measure to address angler perceptions that the targeting of spawning run trout in the upper Tekapo Canal was unsustainable. The 2019 survey was repeated in 2020. This report provides comparisons of the two seasons and discusses the dynamics of wintertime fishing and the concerns of anglers at the upper Tekapo Canal.

Angler days during the period June through September increased by 34% in 2020 from 2019 levels, confirming the observations of anglers and staff of increasing angler use of the upper Tekapo Canal.

In addition to the increase in angler use, the fishing in 2020 was measurably more successful than 2019. The improvement in fishing included: a higher proportion of anglers catching at least one fish; higher catch rates for rainbow trout and more fish caught overall; and a higher proportion of trophy-sized, 10-pound-plus fish in the catch. In 2020, it is estimated that around 2,000 trophy-sized rainbow trout were landed.

In total it is estimated that 7,377 sports fish, mainly rainbow trout, were successfully landed in 2020, equating to a 57% increase in catch from 4,690 landed in 2019. Harvest levels remained similar across survey years for brown trout at 7% of catch but increased for rainbow trout from 3% in 2019 to 8% in 2020. The “egg rolling” method was the preferred method of angling and accounted for 86-90% of the catch in respective survey years.

Anglers were asked to rate their overall fishing experience as either “satisfied” or “unsatisfied” in 2020. Eighty-nine percent of responses were “satisfied” while eleven percent were “unsatisfied”. Unsatisfied anglers generally reasoned that their dissatisfaction was based on catch rates not meeting expectations.

Despite angler concerns, the fishery in 2020 has provided high satisfaction levels and thousands of fish to anglers whilst being subject to potentially the highest angler use levels in the history of the Tekapo Canal fishery. Annual surveys of either sports fish populations or angler use and catch are required to provide evidence-based assessment of long-term trends and sustainability of the fishery.

It is recommended that CSIFG:

- evaluate the use of sonar fish counting technology to establish an annual fish population survey at the canal fishery,
- evaluate the resourcing required to undertake annual creel surveys at the canal fishery, including the upper Tekapo Canal, and
- Evaluate the re-opening of the upper Tekapo Canal for the June to August period when annual population and/or annual angler use and catch surveys have been implemented.

## Introduction

The Mackenzie Basin hydro canal fishery incorporates the Tekapo, Pukaki-Ohau A, and Ohau canals and according to the 2014/15 National Angler Survey (NAS) is collectively the most popular freshwater sports fishery managed by Fish & Game New Zealand (Unwin, 2016). The popularity of the fishery has grown dramatically with greater than 16-fold increase in angler-use between 1994-95 and 2014-15 seasons. The Tekapo Canal attracted about one-quarter of all canal-based angling activity during the 2014-15 season in the CSIFG Region. Since about the 2016-17 season, anglers and staff have anecdotally observed a significant increase in the wintertime use of the fishery and in particular the upper section of the Tekapo Canal during the rainbow trout spawning season.

In recent years CSIFG staff have become aware of a concerning perception amongst a relatively small but dedicated part of the angling community, that the quality of canal fishing has steadily decreased since around the 2016-17 sports fishing season and that the increasing popularity in targeting of spawning trout is risking the sustainability of the fishery (Adams, 2020).

Historically, CSIFG staff have considered year-round angling in the canals as sustainable. This approach assumes that most canal trout are recruited via downstream migration from the headwater lakes rather than from within-canal spawning, as identified by Bloomberg & Graynoth (1991). Although within-canal spawning occurs, staff considered that it is likely to contribute to recruitment but is

insufficient to sustain the catch and harvest levels experienced. The rationale being that the within-canal spawning habitat is suboptimal and can be subject to dewatering, and that juvenile rearing habitat is limited and offers suboptimal cover that enables high predation levels on trout fry and parr by larger sports fish.

Faced with the concerns of anglers, staff considered it appropriate to re-assess the potential for anglers to affect the sustainability of the Tekapo Canal fishery by targeting trout in the spawning season. A creel survey of wintertime angler use and catch was undertaken on the upper part of the Tekapo Canal during the rainbow trout spawning months of June to October 2019. The survey targeted the upper part of the Tekapo Canal, an area identified by anglers and CSIFG staff as having experienced a dramatic increase in wintertime angler use over the 2016-2018 seasons and having widespread and evident spawning. The survey provided a “snap-shot” of angling dynamics that yielded important information for the discussion around the sustainability of wintertime fishing in a spawning area. The reporting of the survey also provided a platform to re-assess the sustainability of wintertime fishing at the canals.

The 2019 survey showed that over 4,000 angler days were spent at the upper Tekapo Canal between June and October resulting in the successful landing of 4,712 sports fish. Anglers favoured the “egg rolling” method and caught mainly rainbow trout including many of trophy size. Ninety-seven percent of rainbow were released, and no surveyed angler harvested their entitled 2-trout daily bag limit, demonstrating the popularity of catch and release. Although this information provided valuable insight into a productive wintertime trophy trout fishery, it did not provide any indication of trends in trout population size or angler use and catch, and questions of sustainability were not specifically addressed.

In the Adams (2020) report it was recognised that the management of the canal fishery was based on a wealth of observation, knowledge, and research. Yet many fundamental aspects that related directly to the sustainability of the fishery, remained unknown and that addressing potential issues of sustainability of the canal fishery was a difficult task. It was acknowledged that aside from the NAS, which is completed on a seven-year cycle, there were no regular monitoring programs in place to assess changes in the fishery and inform ongoing reviews of canal fisheries management. This combined with a lack of evidence relating to the relative importance of recruitment from within-canal spawning versus headwater migrations, led to the adoption of a precautionary approach to managing wintertime fishing at the upper Tekapo Canal.

Based on the Adams (2020) report, the CSIFG Council introduced a closed season for all sports fishing above the SH8 Bridge on the Tekapo Canal from June 1 to August 31, 2021. This closure was justified as representing a conservation-minded measure to address angler perceptions that targeting of spawning trout in the upper Tekapo Canal was unsustainable. Further, the three-month closure would allow undisturbed spawning that would likely result in the full utilisation of the small area of spawning habitat available while maintaining highly valued opportunities for anglers to undertake some “spawning season” fishing in the “shoulder season” months of May, September, and October. If future research and monitoring showed that year-round fishing was sustainable then it was suggested that it should be reinstated to provide the maximum fishing opportunity possible.

With the three-month closure not in place until 2021, the 2020 season remained open year-round and wintertime surveying of angler use and catch in 2020 was endorsed by CSIFG Council to provide an additional “snap-shot” of wintertime angling dynamics on the upper Tekapo Canal and provide comparisons in angler use and catch between two successive winters. This report summarises the 2020 angler use and catch survey and compares results with the 2019 survey where possible.

## Survey Programme

The 2020 survey programme was based on the 2019 June-to-October survey, with two main differences. Firstly, the month of May was included in 2020 to initiate assessment of the adjoining “shoulder season” months of the June-August 2021 closure, predicted to gain in popularity in future seasons with the closure in place. Secondly, the month of October was omitted as the 2019 survey showed angler activity and catch in October 2019 was relatively low and survey effort was best directed to other months.

During the months of June to September 2020, inclusive, on the upper Tekapo Canal, CSIFG’s four Fish & Game Officers collected angler interview and angler count information spanning 24 dates. Survey effort was divided into 12 strata that were broken down by month, and type of day including weekday, weekend and holiday weekend. Twelve randomly selected dates were surveyed to capture all stratum types. Additional data were collected where possible with angler counts occurring on one non-scheduled date, and fishing information collected on 9 non-scheduled dates.

The boundary for the upper/lower canal was the State Highway 8 Bridge. The upper canal section makes up 45% or 11.9km of the Tekapo Canal. Four canal sections were identified within the upper canal: Tekapo A Power Station to Tekapo Powerhouse Road Bridge (0.85km), Tekapo Powerhouse Road Bridge to the angler’s carpark at the locked road gate (5.78km), angler’s carpark/locked gate to pine tree block (2.35km), and pine tree block to the State Highway 8 Bridge (2.92km). The section of canal from the angler’s carpark/locked gate down to the pine block incorporated part of the canal that is colloquially known as the “Magic Carpet”. This area of canal is a hotspot for fishing and is mainly visited by anglers who park their vehicles at the angler’s carpark.

Angler interviews were undertaken in addition to regular licence and regulation compliance checks by Fish & Game Officers. Anglers were asked if they wished to participate in a survey, which most anglers (~95%) agreed to. Questions were asked at the time of the compliance check and a phone number was collected so that the angler could be interviewed by phone either later that day/evening or the next day once their current day’s fishing had been completed. The interviewers collected information on licence type, primary fishing method, time spent fishing, fish species caught (successfully landed). For each fish landed, anglers were asked to provide whether the fish was harvested (meaning kept/killed) or released and the estimated weight of each fish. One additional question relating the angler’s satisfaction with their fishing experience was asked in 2020. During the field interview, anglers were asked if they fished the canal the day prior, and if so, a full record of that day’s fishing information was collected. Not all anglers present on the canal were approached for interview, and not all that agreed to be surveyed could be later contacted to provide their catch information. No angler interviews were undertaken in May due to limitations on ranger-to-public contact associated with Covid-19 lockdown level-3 rules.

During individual angler counts of the survey reach, it was noted that not all anglers counted could be subsequently interviewed due to them leaving the survey area. Comparing the number of anglers observed and the numbers of angler successfully interviewed, it is estimated that between 50-90% of the anglers observed were successfully interviewed on a given survey day.

Angler counts were undertaken to estimate the total angler effort at the upper Tekapo Canal on each survey day. Six to seven counts were completed daily during visible day-light hours on scheduled surveys days. Two additional counts were completed on the non-scheduled survey day. The length of the canal to the locked road gate was driven and all active anglers observed from the road were counted. Binoculars were used at times for assistance and a spotting scope used to count anglers on the downstream sections from the locked gate. The angler counts were spread throughout the day to

capture variability of angler use. Due to staff resourcing and perceived angler detectability issues, no night-time angler counts were completed. Therefore, the survey only estimated harvest and angler use from approximately dawn until dusk within visible day-light hours.

Angler use was estimated by calculating representative “angler days”. An “angler day” represents the effort (hours spent fishing) of one angler over a single day. Angler days were estimated by using an ‘Area Under the Curve’ (AUC) method. This method predicts a pattern or ‘curve’ of angler counts over a specified day length from actual angler counts recorded at individual times within each stratum. Specified day length was standardised for each month to match the day length of the middle day of each month. This was applied to 2019 data to enable direct comparison between survey years, consequently there are minor changes to results presented in Adams (2020).

A trail camera was set up to count vehicles at the angler’s carpark. This information was used to estimate angler counts at the Magic Carpet sections only and was combined with all other non-Magic Carpet sections to estimate angler numbers. The vehicle counts were hourly records and were converted to angler counts using a factor of 1.27 anglers per vehicle in 2020 and 1.48 anglers per vehicle in 2019. This factor was established during each survey using the average number of anglers per vehicle observed during the angler counts undertaken by CSIFG staff. Individual anglers per vehicle observations were plotted and assessed by applying a linear regression to the data. The regression showed that there was a very strong relationship between the numbers of cars in the Magic Carpet carpark and the number of anglers fishing the Magic Carpet ( $r$ -squared = 0.925 for 2019).

## Results

Over the 2020 survey, a total of 336 anglers were successfully surveyed on 12 scheduled survey dates, providing 441 records of daily angling activity. This compares to a total of 300 anglers being successfully surveyed based on 14 scheduled survey dates, providing 358 records of daily angling activity for the 2019 survey.

Over the 2020 survey, 81 angler counts were completed spanning 13 dates and 1,203 trail camera photographs were taken over 119 dates. This compares to 109 angler counts over 24 dates and 1,509 trail camera photographs on 141 dates during the 2019 survey.

### Angler use of the upper Tekapo Canal fishery

Angler use in the period of June to September was substantially higher in 2020 than in 2019 (Table 1) showing an increase of 1,314 angler days or 34%. The individual months of June and September showed minor variation between survey years, whereas, for the months of July and August, 2020 angler use increased substantially from 2019 levels.

As no angler interviews were undertaken in May 2020, the average time spent fishing in that month was estimated by applying the average time spent fishing in June 2020 (residency time). May 2020 angler use (527 days) appears to be low-moderate compared to angler use for all other months across the two winters surveyed, except for October 2019.

The highest individual count of active anglers within the total survey area occurred on the Monday of the Queen’s Birthday Weekend Holiday in both 2019 and 2020. For 2020 the count was substantially higher at 66 anglers compared to 43 in 2019. Queen’s Birthday weekend started on 31 May in 2020. To allow direct comparison with 2019, in which Queens Birthday weekend was within the month of June, the 31<sup>st</sup> of May was incorporated into the data for June 2020.

**Table 1.** Estimates of time (hours) spent fishing and angler days for the total survey period and each strata for 2019 and 2020 upper Tekapo Canal surveys. There is distinction made between the section of the survey area including the Magic Carpet and the rest of canal. Survey totals are relevant to the June to September period. Some differences due to rounding error are presented.

2019							2020						
Month-Stratum	Average daily time spent fishing	Average Non-Magic Carpet angler days	Average Magic Carpet angler days	Total survey area average angler days	Days in stratum	Total survey angler days	Month-Stratum	Average daily time spent fishing	Average Non-Magic Carpet angler days	Average Magic Carpet angler days	Total survey area average angler days	Days in stratum	Total survey angler days
							weekday	4.3	13	5	18	21	369
							weekend	4.8	9	10	20	8	158
							<b>May total</b>						<b>527</b>
weekday	6.5	9	13	22	19	420	weekday	4.3	6	10	16	21	333
weekend	5.6	35	20	55	8	444	weekend	4.8	20	14	34	8	275
holiday weekend	3.8	37	33	71	3	212	holiday weekend	3.3	90	28	118	3	354
<b>June total</b>						<b>1,076</b>	<b>June total</b>						<b>962</b>
weekday	4.0	17	20	37	23	857	weekday	4.3	39	21	60	23	1,382
weekend	3.5	27	27	55	8	436	weekend	4.1	48	34	82	8	655
<b>July total</b>						<b>1,294</b>	<b>July total</b>						<b>2,037</b>
weekday	5.8	3	7	9	22	200	weekday	4.1	18	14	33	21	687
weekend	4.1	39	14	52	9	469	weekend	5.1	66	19	85	10	851
<b>August total</b>						<b>669</b>	<b>August total</b>						<b>1,539</b>
weekday	1.7	19	12	31	20	616	weekday	4.7	14	7	20	21	425
weekend	4.3	14	10	24	7	170	weekend	5.5	20	9	29	7	206
holiday weekend	1.9	9	15	24	3	73	holiday weekend	4.1	15	6	21	2	42
<b>September total</b>						<b>859</b>	<b>September total</b>						<b>674</b>
weekday	4.0	3	2	5	22	113							
weekend	1.4	17	12	29	6	174							
holiday weekend	2.1	27	2	29	3	86							
<b>October total</b>						<b>372</b>							
<b>Survey Total June to September</b>					122	<b>3,898</b>	<b>Survey Total June to September</b>					124	<b>5,212</b>

## Sports fish catch

Salmon were occasionally present in the survey area and did get caught. However, Staff did not observe any anglers successfully landing a salmon. Staff strongly believe that some of the salmon recorded by anglers were small, silver-coloured rainbow trout, and therefore incorrectly identified by anglers. It must be noted that the catch of salmon within the survey is likely to be an overestimate, and conversely the catch of rainbow trout is likely to be an underestimate by a maximum of about 5% in 2019 and about 2% in 2020.

Total number of fish successfully landed per outing was compared between survey years to assess the success of anglers (Table 2). Anglers were generally more successful in 2020 when compared to 2019 as the occurrence of not catching a fish decreased; approximately 46% of outings resulted in nothing caught in 2020, a notable improvement from 56% in 2019 (Table 2). The occurrence of catching 1 to 4 fish per day was notably higher in 2020.

**Table 2.** The percentage of daily outings resulting in a specified number of sports fish successfully landed at the upper Tekapo Canal during the June to September period of 2019 and 2020.

Fish successfully landed per day	Percentage occurrence 2019	Percentage occurrence 2020
0	56	46
1 to 4	37	47
5 to 16	7	7

Species catch and total sports fish catch per month were compared between 2019 and 2020 survey years (Table 3). Other than for June, monthly catches of all sports fish were higher in 2020 than 2019. Overall, for the June to September period approximately 2,687 more sports fish were caught in 2020 than 2019, equating to a 57% increase in catch. A summary of the catch and harvest including statistical error is presented in Appendix 1.

**Table 3.** Comparison of total estimated catch of sports fish species to monthly and June to September survey period level between 2019 and 2020 survey years at the upper Tekapo Canal. Some differences due to rounding error are presented.

Month	2019				2020			
	Rainbow	Brown	Salmon	Total	Rainbow	Brown	Salmon	Total
June	1,386	476	53	1,916	1,038	317	23	1,378
July	1,030	265	95	1,390	2,252	736	73	3,061
August	800	265	31	1,096	1,468	284	0	1,752
September	175	112	0	287	943	231	11	1,185
Total	3,392	1,118	180	4,690	5,702	1569	107	7,377

## Catch rate

For the period June to September, average catch rate, being the number of sports fish successfully landed per hour of fishing averaged over all surveyed anglers, was compared between 2019 and 2020 surveys (Table 4). For rainbow trout and all sports fish combined there was a statistically significant higher catch rate in 2020 compared to 2019. A *T*-Test (two-tailed) provided *p*-values of 0.002 for rainbow trout and 0.003 for all sports fish combined. There was no statistically significant difference analysed for brown trout catch rate between survey years with a *p*-value of 0.21 (Table 4).



On average in 2020 the catch rate for all sports fish was 0.34 fish landed per hour of fishing, which equates to 1 fish landed for every 2 hours and 56 minutes fishing compared to 0.23 fish landed per hour of fishing in 2019, which equates to 4 hours and 21 minutes fishing. The month of August provided the highest catch rates for all sports fish combined for both 2019 (0.29) and 2020 (0.44) survey periods. In every 2020 month the catch rate was higher than the corresponding month in 2019.

**Table 4.** Average catch rate of rainbow and brown trout and all sports fish compared between 2019 and 2020 survey year for the period June to September. Catch rate is the number of fish successfully landed per hour of fishing. Significant difference and *p*-values presented are relative to the results of T-Test (two-tailed).

Month/year	Rainbow		Brown		All sports fish	
	2019	2020	2019	2020	2019	2020
June	0.16	0.21	0.07	0.07	0.23	0.29
July	0.16	0.23	0.05	0.10	0.23	0.34
August	0.20	0.34	0.08	0.10	0.29	0.44
September	0.07	0.23	0.04	0.11	0.10	0.35
Overall	0.16	0.24	0.06	0.09	0.23	0.34
Significant difference - Overall	Yes		No		Yes	
<i>p</i> -value	0.002		0.21		0.003	

#### Outcome of catch – release or harvest

The outcome of catch, either for an angler to release their successfully landed fish or harvest it (kept) was compared between 2019 and 2020 survey years (Table 5). The percentage of rainbow trout harvested (kept) increased notably from 3% to 8% comparing 2019 to 2020. Brown trout harvest remained proportionately similar at approximately 7%.

**Table 5.** Summary of trout and salmon kept and released comparing 2019 and 2020 surveys years for the period June to September.

	2019	2020
Rainbow kept	114	476
Rainbow released	3278	5226
% Rainbow kept	3	8
Brown kept	79	112
Brown released	1040	1457
% Brown kept	7	7
Salmon kept	24	26
Salmon released	156	81
% Salmon kept	13	25

#### Trout bag Limit

In 2020, approximately 1% of all anglers harvested/kept their bag limit of 2 trout. In 2019 no anglers surveyed throughout the period harvested more than one sports fish per day, indicating that the true proportion of anglers that harvest their 2-trout daily bag limit was likely to be very small in 2019.

#### Size (weight)-assemblage of catch

Where an angler could provide the estimated weight of every fish caught on a date, those data were compiled to provide an unbiased index of the size (weight) of the fish caught throughout the survey

period (Table 6). Both rainbow and brown trout show a similar range of sizes (weight) over survey years, rainbows ranged from approximately 0.25 to 30 pounds and browns from approximately 0.5 to 19 pounds. The catch for both the 2019 and 2020 survey years follows similar size-assemblage with over half of fish caught being relatively “small” (<4.5lb), less than one-quarter of fish being relative “medium” (4.5-9.9lb), and about one-quarter of fish being considered “trophy” size or bigger (10lb+).

Medium and large size rainbow trout more prevalent in the 2020 catch compared to 2019. A T-Test (two-tailed) provided statistical evidence that brown trout were slightly heavier on average in 2020 ( $P = 0.001$ ) while there was no statistical evidence to suggest a size difference of rainbow trout between survey years ( $P = 0.18$ ).

**Table 6.** Summary data of fish weights in pounds (lb) of fish caught throughout the June to September 2019 and 2020 survey periods as reported by anglers.

Year	Species	Fish Caught	Min weight (lb)	Max weight (lb)	Average weight (lb)	% < 4.5 (lb)	% 4.5 - 9.9 (lb)	% 10+ (lb)	Total
2019	Rainbow	253	0.25	34	6.7	44	7	21	72
	Brown	89	0.5	19	4.1	16	8	1	25
	Salmon	10	0.25	7	2.3	2	1	0	3
	<b>Total</b>	<b>352</b>				<b>62</b>	<b>16</b>	<b>22</b>	<b>100</b>
2020	Rainbow	484	0.25	30	7.3	36	14	27	77
	Brown	137	0.5	16	2.9	19	2	1	22
	Salmon	9	0.5	16	5.4	1	0	0	1
	<b>Total</b>	<b>630</b>				<b>56</b>	<b>16</b>	<b>28</b>	<b>100</b>

The unbiased catch data as presented in table 6 was extrapolated to estimate the total size assemblage of the catch of the 2019 and 2020 surveys to provide an assessment of the productivity of the Tekapo Canal (Table 7). It was estimated that anglers caught 992 and 2,015 trout of trophy size (10+lb) in the 2019 and 2020 surveys, respectively. This estimate does not account for those fish caught and released multiple times but regardless demonstrates that the Tekapo Canal provides a highly productive trophy sports fishery.

**Table 7.** Extrapolated total estimates of fish caught in three weight categories throughout the June to September 2019 and 2020 survey periods based on unbiased catch records. Some differences due to rounding error are presented.

Year	Species	< 4.5 (lb)	4.5 - 9.9 (lb)	10+ (lb)	Total
2019	Rainbow	2,078	322	992	3,392
	Brown	716	352	50	1,118
	Salmon	144	36	0	180
	<b>Total</b>				<b>4,690</b>
2020	Rainbow	2,651	1,037	2,015	5,702
	Brown	1,351	172	46	1,569
	Salmon	59	12	36	107
	<b>Total</b>				<b>7,377</b>

### Size (weight)-assemblage of harvest

The size assemblage of all estimated fish harvested (caught and kept) is presented for the 2019 and 2020 survey years (Table 8). For both survey years, anglers harvested proportionately high levels of rainbow trout 10 pounds or larger and small brown trout under 4.5 pounds. However, the harvest rate

for rainbow trout 10 pounds or greater is still relatively low at 6% for 2019 and 14% for 2020, considering all rainbow trout landed in that weight range.

**Table 8.** Extrapolated total estimates of fish numbers harvested (kept) in three weight categories throughout the June to September 2019 and 2020 survey periods. Some differences due to rounding error are presented.

	Species	<4.5 (lb)	4.5-9.9 (lb)	10+ (lb)	total fish count
2019	Rainbow	48	10	57	114
	Brown	47	16	16	79
	Salmon		24		24
	<b>Total</b>				<b>217</b>
2020	Rainbow	46	139	278	464
	Brown	93	9	9	112
	Salmon			26	26
	<b>Total</b>				<b>602</b>

### Fishing methods

The primary method used by interviewed anglers was recorded against daily angler catch. For analysis, the methods were categorised into the three authorised methods: fly, spin and bait. Additionally, the “egg rolling” technique was recorded as its own method. Technically, an egg-rolling assembly, which uses a spin rod rigged with a small sinker and generally 1-2 imitation eggs, is spin fishing. Occasionally, imitation egg lures used are scented synthetic soft baits, which then makes the method bait fishing.

Egg rolling dominated the catch accounting for over 86% of all sports fish caught in 2019 and 90% in 2020 (Table 9). Consequently, spin fishing was by far the most successful method used during the survey. Traditional spin fishing accounted for a small amount (2 & 1%, respectively) of total catch. Bait fishing, including scented soft bait, accounted for a small but significant part (12 & 8%, respectively) of the catch and would be an underestimate because an unknown proportion of egg rolling is legally defined as bait fishing. Fly fishing was seldom undertaken during the survey and accounted for approximately 0.1% of total catch.

**Table 9.** Percentage of sports fish catch taken by method for the 2019 and 2020 survey periods of June to September.

Method	2019	2020
	% catch	% catch
Egg Rolling	86	90
Bait	12	8
Spin	2	1
Fly	<1	<1

### Angler satisfaction

During the 2020 survey anglers were asked “how do you rate your overall fishing experience today, “satisfied” or “unsatisfied?””. The question was designed to be broad and polarising and if anglers suggested uncertainty, they were encouraged to make a call either way. Three-hundred-seventy-six responses or 81% of interviews gained satisfaction ratings. Anglers were largely satisfied (89%) and a small but notable proportion were unsatisfied (11%). Although justification for satisfaction rating was not recorded, anecdotally, staff identified that anglers were often “satisfied” because they “enjoyed the scenery”, “observed big fish”, “caught a fish” or “it was better than being at work”. However, for

those respondents that rated their experience “unsatisfied”, staff gained a strong appreciation that the catch rate, or the size and number of fish caught did not match their expectation either from previous experience or from their perception of the fishery gained prior to fishing it.

## Discussion

Angler days were 34% higher at the upper Tekapo Canal during the 2020 survey period compared to that during 2019. This is the first confirmed angler use increase specific to the upper section of the Tekapo Canal and is consistent with anecdotal observations by anglers and CSIFG staff of a dramatic and ongoing increase in the wintertime use of the area since the 2015-16 sports fishing season. The effects of covid-19 and the increase in domestic tourism caused by closed international borders may have contributed to increased use. Within-region travel was permitted in early May 2020 and national travel was permitted from May 14, 2020.

From about late July onwards, knowledge of the 2021 season’s June to August closure started to become apparent on social media after the relevant Anglers Notice was published. Knowledge of the closure may have compelled anglers who otherwise would not have fished the upper Tekapo Canal in August 2020 while that was still an option.

With the June to August closure in place indefinitely from 2021, any angler use of this section of the canal during the spawning run is only measurable for the months adjoining the closure, May and September. Surveys in May and September 2021 will be undertaken to assess if the closure is causing an increase in angler use in these “shoulder season” spawning months.

In addition to an increase in angling pressure, anglers were more successful in 2020 than 2019. In particular, the catch rate of rainbow trout, the most prolific species caught, was higher. Further, in 2020 more fishing trips resulted in the successful capture of at least one fish and more fish were caught overall. Of particular interest is the “trophy” fishery. In 2020 the catch of trophy size, 10 pound-plus, rainbow trout was proportionately higher than in 2019; about 2,000 trophy rainbows were estimated to be landed for the 2020 period.

Small brown trout less than 4.5-pound and large rainbow trout 10-pounds-plus were most often harvested in both 2019 and 2020. It was a more common occurrence for an angler to keep a landed rainbow trout in 2020 than in 2019. Some concern has been raised anecdotally about a perceived over-harvest of trophy-sized spawning rainbow trout. These surveys have provided reassurance that although large rainbow trout are commonly the type of fish that anglers keep, overall, only a small proportion (6% 2019, 14% 2020) of trophy rainbows landed were kept; most anglers chose to catch and release trophy-sized trout at the upper Tekapo Canal between June and September.

The comparisons of the 2019 and 2020 surveys provide a limited but valuable insight into the ongoing sustainability of the Tekapo Canal fishery. The fact that angler use increased, confirmed the observation of many anglers and CSIFG staff that the fishing pressure is still increasing, even after a dramatic increase in use anecdotally observed from 2016 to 2019 winter periods. Despite the high levels of angler use, that are likely the highest ever experienced, fishing success did not decline. In fact, the fishing was measurably better in 2020 than in 2019 and combined with the physical aesthetics of the fishery, most-often provided anglers with a satisfactory overall fishing experience. High satisfaction levels indicate that despite some angler’s perceptions that the fishing experience has diminished in quality, the upper Tekapo Canal usually provided a satisfactory fishing experience in 2020. It is likely that for some of the 11% of experiences registered an “unsatisfied”, that those anglers were expecting an experience in 2020 to match those experienced before the upper Tekapo fishery

became intensively fished. In doing so they may have been setting an unrealistic expectation of the fishery to provide satisfaction.

This survey does not identify why the fishing was more successful in 2020, which could relate to many factors like an increased angling population skill level, increased size of the spawning population, water clarity variation, flow level variation or the variable timing of runs of spawning fish. There may have also been an appreciable increase in the size of the trout population resulting from large scale downstream migration from Lake Tekapo to the canal during the significant spilling and flow diversion events of December 2019 to July 2020. Assessing the potential of the 2019-20 spilling and flow event to contribute to 2020 catch is beyond the scope of this report. This may be achievable by reviewing the catch returns of tagged fish that were salvaged and released into the canal as a result of the flow event and were recaptured by anglers during the survey period.

Comparing 2019 and 2020 surveys provided no evidence of a fishery in decline and although this evaluation is limited to only the 2019 and 2020 seasons, it should go some way to reassuring concerned anglers that the fishery is resilient and has withstood the angling pressure of recent years. When assessing the relevance of the precautionary June-August closure of the upper Tekapo Canal, we can now put into perspective that there is evidence of high and increasing angler use but that the fishery can still provide most anglers with a satisfactory fishing experience at the catch rate and use levels observed in 2020.

Although no surveys were completed prior to 2019 at the upper Tekapo Canal to specifically evaluate spawning run fishing, it is fair to assume that perhaps prior to the winter of 2018, angler use was only a fraction of that measured during 2019 and 2020. It is also a reasonable assumption that prior to the boom in angler use of the area, the catch rate of sports fish and the occurrence of any individual angler catching one or more trophy trout in a day would have been significantly higher. Put simply, the fishing was likely better prior to 2018 at the upper Tekapo Canal. This is believed to be because there were less anglers to compete for fishing areas and the fish were easier to catch subject to minimal angling pressure. There is a possibility that the catch of large rainbow trout was more common prior to 2018 because there were higher numbers of these fish present, but the catch during the 2020 survey year would suggest that numbers of large rainbow trout are currently significant as approximately 2,000 successful catches of trophy-sized rainbows were estimated.

Anglers who experienced the fishing before the boom in angler use and their comparisons with recent catch rates are considered to be the key driver in angler concerns for the fishery and perceptions of current use of the upper Tekapo Canal being unsustainable. Unless angler numbers are controlled to the extent that they reflect angler use and fishing pressure of 'days gone by', it is unlikely that the experience those anglers had before 2018 could be replicated and concerns alleviated in an open winter season at the upper Tekapo Canal.

### **Management Considerations**

The perception of high angler use causing a diminished fishing experience has contributed to the implementation of the June to August winter closure of a fishery. Despite this perception, the 2020 winter provided high angler use, high satisfaction levels and thousands of fish to the anglers. The fishery may well be sustainable at 2020 levels of catch and satisfaction if that is considered the appropriate measure. In this context "sustainable" means that natural trout recruitment (spawning, migration, and survival to catchable size) levels could sustain the current angler use and catch.

Assessing the sustainability of a fishery is best achieved under an annual monitoring programme that detects the annual population level variation in measured variables and their long-term trends. If an

annual assessment of either fish population size or angler catch is established at the upper Tekapo Canal, there would be an evidential basis to decide season length.

Spawning surveys in the upper Tekapo Canal are considered to provide an unreliable estimate of recruitment potential or spawning population size and therefore are not recommended for assessing the long-term sustainability of the fishery. This is for several reasons including: not all potential spawning habitat is visible, redds are often dug in suboptimal substrate size and many spawning redds are within operational water levels and are subject to regular dewatering. Although counts of visible redds are possible, there remains a high level of uncertainty of the success of those redds to produce surviving trout fry and their contribution to recruitment alongside other sources, namely, downstream migration from Lake Tekapo through the Tekapo A Power Station and spillway.

Currently there is no established method to assess the sports fish population size in the canals. The depth and water clarity of the canal means drift diving is unsuitable. Sonar fish counting surveys are worthy of consideration as they may be the best tool to potentially assess the sustainability of the canal sports fisheries. Sonar methods and technologies need to be investigated and developed to assess their suitability for yielding canal-specific estimates of sports fish population size and to assess the cost of equipment and effort.

Angler-use and catch surveys used established methodology and required high levels of staff resourcing. The current method used on a small scale, like for the 2019 and 2020 upper Tekapo Canal surveys, provided sufficient data for assessing angler use and catch. If the geographical extent of the survey area was to be increased, then the staffing requirement would need increase significantly. Before any annual angler surveys are established on the canals there needs to be an evaluation of staff resourcing required to provide robust and defensible data suitable for the long-term assessment of the sustainability of the canal fisheries.

Re-opening the June to August months at the upper Tekapo Canal could be achieved in conjunction with an annual population or angler catch survey programme. Ideally, a framework of thresholds for management intervention would be established, such as a specified catch rate or population level that would determine the implementation of some form of closure during the spawning season.

The proactive management of the canals is currently a strategic priority of the CSIFG Council. Evaluating the development of methods and resourcing required for annual monitoring programmes should be the next step towards an evidence-based approach to assessing the long-term sustainability of the canal fishery under a high and potentially increasing level of angler use. Fish population estimates sit at the top of the hierarchy of information required to manage the fishery. CSIFG should assess any available fish counting sonar technology as a method to count sports fish populations. If fish counts cannot be developed as an annual monitoring tool, then the resourcing required to continue annual angler use and catch surveys should be evaluated.

### Staff Recommendations

- 1. Evaluate the use of fish counting technology to establish an annual fish population survey at the canal fishery.**
- 2. Evaluate the resourcing required to undertake annual creel surveys at the canal fishery, including the upper Tekapo Canal.**
- 3. Evaluate the re-opening of the upper Tekapo Canal for the June to August period when viable annual population and/or annual angler use and catch surveys have been implemented.**

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Acknowledgement must also be given to the hundreds of anglers who willingly participated in the survey.

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## Appendix

**Appendix 1.** Comparison of total estimated catch of sports fish species to monthly and survey period level between 2019 and 2020 survey years at the upper Tekapo Canal (90% confidence intervals).

	Month	Rainbow kept	±	Rainbow released	±	Total Rainbow catch	±	Brown kept	±	Brown released	±	Total Brown catch	±	Salmon Kept	±	Salmon Released	±	Total Salmon Catch	±
2019	June	46	37	1,340	464	1,386	468	16	22	460	176	476	176	0	0	53	46	53	46
	July	0	0	1,030	617	1,030	617	24	38	241	136	265	140	24	38	71	64	95	73
	August	32	29	768	240	8,00	241	10	16	255	122	265	123	0	0	31	28	31	28
	September	35	47	140	100	175	109	29	46	84	66	112	77	0	0	0	0	0	0
	<b>Total</b>	<b>114</b>	<b>67</b>	<b>3,278</b>	<b>815</b>	<b>3,392</b>	<b>819</b>	<b>79</b>	<b>66</b>	<b>1,040</b>	<b>262</b>	<b>1,118</b>	<b>267</b>	<b>24</b>	<b>38</b>	<b>156</b>	<b>84</b>	<b>180</b>	<b>91</b>
2020	June	107	39	931	214	1,038	228	29	20	287	84	317	85	6	9	17	15	23	17
	July	249	120	2,002	565	2,252	569	44	42	692	232	736	233	20	33	53	68	73	75
	August	47	54	1,421	505	1,468	505	24	38	261	148	284	150	0	0	0	0	0	0
	September	72	47	871	252	943	259	15	13	217	106	231	106	0	0	11	17	11	17
	<b>Total</b>	<b>476</b>	<b>145</b>	<b>5,226</b>	<b>827</b>	<b>5,702</b>	<b>836</b>	<b>112</b>	<b>61</b>	<b>1,457</b>	<b>306</b>	<b>1,569</b>	<b>309</b>	<b>26</b>	<b>34</b>	<b>81</b>	<b>78</b>	<b>107</b>	<b>79</b>