Inland Fisheries Service

Arthurs Lake December 2023 Electrofishing Survey – Technical Report

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Introduction

The objective of this survey was to compare the catch of brown trout at Arthurs Lake with that of the electrofishing survey during December 2022. An electrofishing survey was conducted during 5 and 6 December 2023, using the same boat, staff and location as the previous December 2022 survey.

The *Fisheries Performance Assessment, Technical Report, Arthurs Lake – April 2023* details the results of the December 2022 survey. The results of this survey will be compared to those contained within the first part of that report.

The results will be used to test the hypothesis that the La Niña spring/summers of 2020-21, 2021-22 and 2022-23 have resulted increased recruitment of brown trout to the Arthurs Lake population. If this is the case, then how is that affecting the population?

Methodology

The IFS Smith-Root electrofishing boat was launched at Pumphouse Bay on the 5 and 6 December 2023. With three staff on board, the boat was driven over the routes shown in figure 1, (R1 to R7 on the 5 December and R8 to R10 on the 6 December). The generator was activated intermittently to capture as many brown trout as possible. The start and end time, shock time and the number of fish captured were recorded for each electrofishing run. Fish were also weighed, measured and sex recorded at the end of each run.

The aim of the survey to collect approximately 200 brown trout, a total of 209 were captured and processed. All fish were released back into the lake after processing.

Figure 1. Map of Arthurs Lake showing the electrofishing runs, R1to R8, 5 December and R8 to R10, 6 December.

Results

Effort

On 5 and 6 December 2023, Arthurs Lake was surveyed using a boat mounted electrofishing unit, the area covered is shown in Figure 1.

On 5 December, the boat covered approximately 6.5 km in three hours 20 minutes with 8,032 seconds of shock time (the time the electrofishing unit is active) for 146 brown trout. On 6 December, the boat covered approximately 4.1 km in one hour and 41 minutes with 3,762 seconds of shock time for 59 brown trout.

The catch per unit effort (CPUE) of this survey was measured in the number of fish caught per hour of shock time. The CPUE for each of the 10 runs varied from 4.88 to 9.25 fish per hour (Table 1), with an average of 6.62. The December 2022 survey had a range of 0.60 to 12.64, with an average of 4.08. Representing a 62 percent increase in average CPUE.
The total duration of the survey was five hours and one minute with a total shock time of 11,794 seconds. The December 2022 survey had a duration of 12 hours, 41 minutes and a total shock time of 28,073 seconds. The minimum target of 200 brown trout were captured during both surveys.

Table 1. Fishing effort using the boat mounted electrofishing unit for 5 and 6 December 2023. # average value

Date	Run no.	Survey time (h:m)	Shock time (s)	Distance covered (km)	Fish caught	CPUE fish/h
R1	05-Dec-24	0:20	504	0.500	11	7.86
R2	05-Dec-24	0:20	997	0.700	19	6.86
R3	05-Dec-24	0:25	623	0.300	16	9.25
R4	05-Dec-24	0:30	1,420	1.000	25	6.34
R5	05-Dec-24	0:35	1,548	1.500	21	4.88
R6	05-Dec-24	0:35	1,412	1.500	21	5.35
R7	05-Dec-24	0:35	1,528	1.000	33	7.77
R8	06-Dec-24	0:40	1,712	2.000	19	4.00
R9	06-Dec-24	0:36	1,413	1.500	28	7.13
R10	06-Dec-24	0:25	637	600	12	6.78
Total		5:01	11,794	10.600	205	6.62#

Brown trout length weight data

A total of 209 brown trout were caught. All fish were weighed, measured and sex recorded as male, female or indeterminate. There were 34 males, 115 females and 60 indeterminate. A summary of the biological parameters is shown in Table 2.

For analysis, fish that weighed less than 150 g were excluded. The accuracy of weights of small fish was questionable due to the processing issues, i.e. the type of scales used were not precise enough to accurately weigh fish under 150 grams.

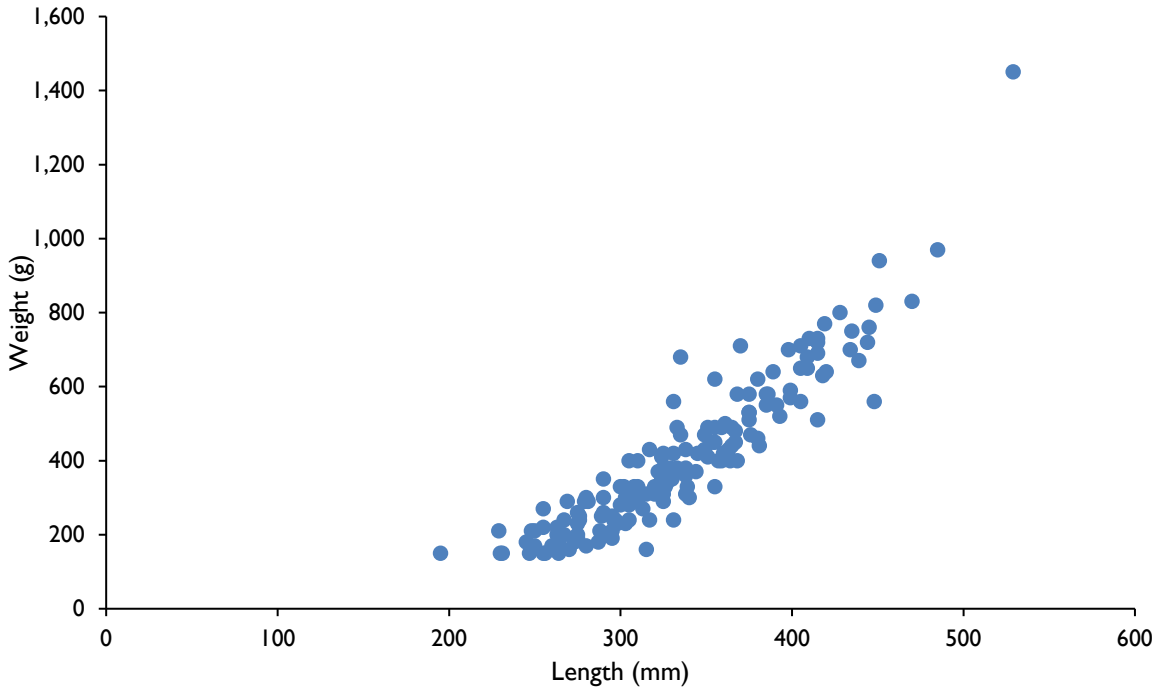

Figure 2: Length weight relationship for brown trout greater than 150 grams, Arthurs Lake, December 2023.

Fish that did not show external morphological characteristics as being male or female were immature and were recorded as indeterminate.

The largest fish caught was a male at 529 mm and 1,450 g. The smallest fish was 100 mm. Males were on average heavier and longer than females but in slightly poorer condition. Indeterminate fish were generally in better condition that either males or females.

Table 2: Descriptive statistics for brown trout processed from the 5 and 6 December 2023 catch - length, weight and condition factor separated by sex.

Grouping	Measurement	Mean	Minimum	Maximum
All brown trout (n=164)	Length (mm)	335	195	529
	Weight (g)	408	150	1,450
	Condition Factor (k)	1.03	0.51	2.02
Female (n=114)	Length (mm)	334	248	448
	Weight (g)	395	150	770
	Condition Factor (k)	1.02	0.51	1.81
Male (n=34)	Length (mm)	379	225	529
	Weight (g)	559	240	1,450
	Condition Factor (k)	0.99	0.71	1.63
Indeterminate (n=16)	Length (mm)	252	195	275
	Weight (g)	182	150	275
	Condition Factor (k)	1.17	0.81	2.02

Compared to the 2022 survey, there was a decrease in the overall condition of the fish in the catch. This change can be seen by comparing Figure 3 (2023 survey) and Figure 4 (2022 survey). The categories of k are poor ≤ 0.9, fair > 0.9 and ≤ 1.2, good >1.2 and ≤ 1.6, Excellent >1.6.

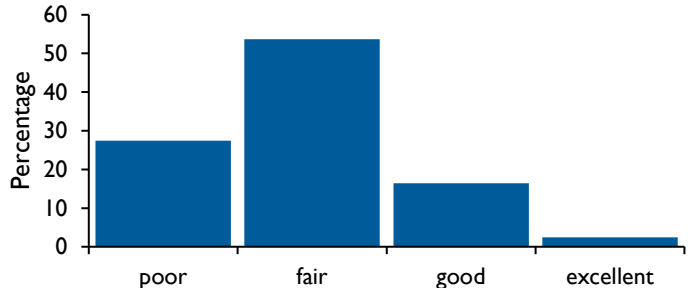

Figure 3: Condition factor category for all brown trout for the 2023 survey.

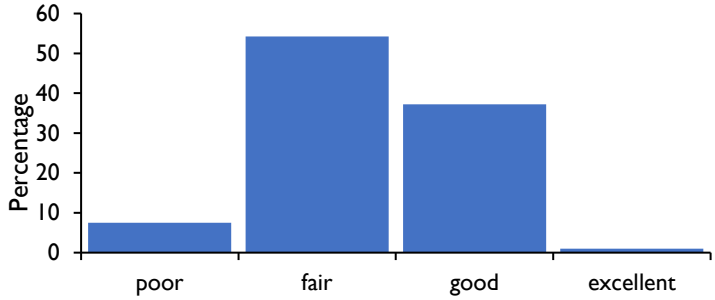

Figure 4: Condition factor category for all brown trout for the 2022 survey.

The length frequency distribution shown in Figure 5 indicates a large cohort in the 100 to 200 mm range, representing just over 20% of all fish caught in the 2023 survey. A similar cohort, 120 to 200 mm, in the 2022 survey represented 34% of all fish caught, as shown in Figure 6. The analysis of otoliths from the 2022 catch showed this represents fish of 1+ age.

Just under 45% of fish caught during the 2023 survey were under the minimum takeable size for anglers in Arthurs Lake of 300 mm. Compared to the 2022 survey, 51% were under 300 mm.

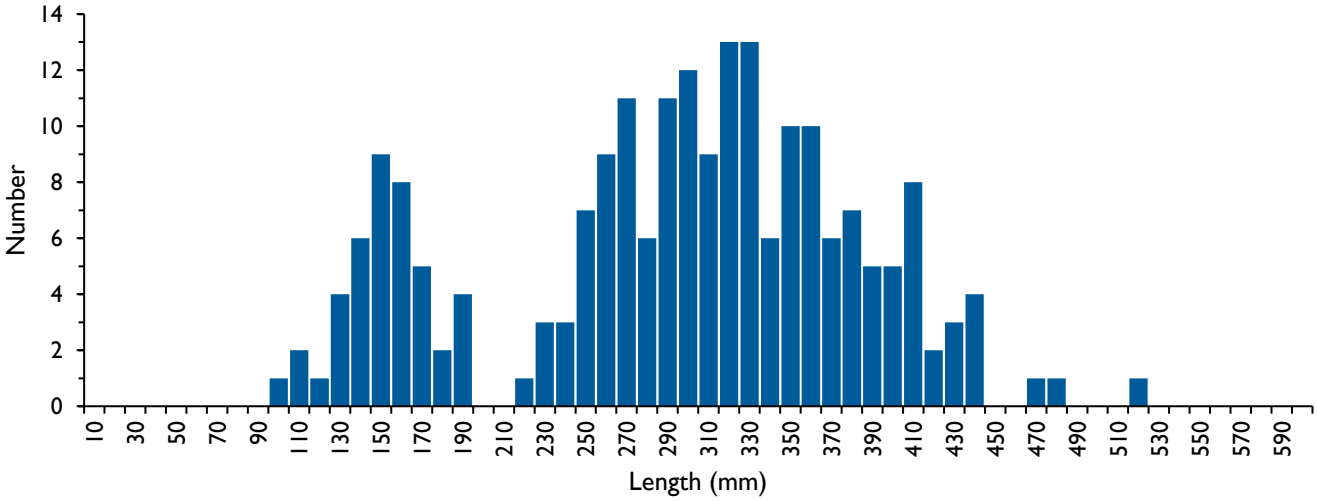

Figure 5: Length frequency for brown trout – Arthurs Lake, December 2023.

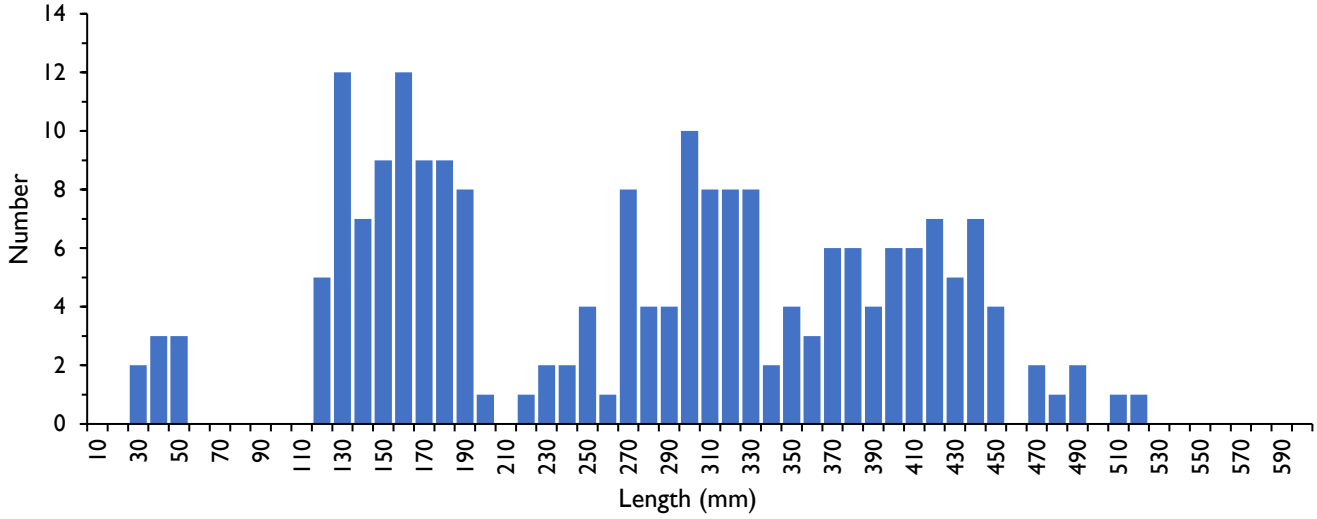

Figure 6: Length frequency for brown trout – Arthurs Lake, December 2022. *The 0+ cohort, visible as 30 to 60 mm fish was specifically fished for during the survey using backpack mounted electrofishing. This was not repeated for the 2023 survey.

The results of this survey show a relative increase in the number and strength of cohorts under 340 mm in comparison to the 2022 survey. These are fish that are under four years of age (3+), as shown in the otolith study of the 2022.

There are more age cohorts within 220 to 440 mm length range than in the catch of the previous year's survey. As more fish are entering the population through natural recruitment there is a tendency for reduced growth rate, especially in the older cohorts. The length frequency distribution shown in this survey, Figure 5, is characteristic of overpopulation and slow growth.

Discussion

This survey replicates the December 2022 survey with the technique, time of year and sample locations essentially the same. This allows for the results of the 2022 and 2023 surveys to be directly compared and assess changes in the brown trout population between years.

The CPUE for the 2023 survey was 62 percent greater compared to 2022 and indicates a significant increase in the relative abundance of brown trout within Arthurs Lake.

The presence of one year old brown trout was strong during both surveys, although the relative abundance of one year old fish was greater in 2022 than 2023. This is indicative of slightly stronger recruitment from the winter spawning of 2021.

Thirty percent of the fish captured during 2022 were in the 200 to 350 mm length range, during 2023 this increased to 50 %. This change in relative abundance is due to the persistence of the La Niña climate pattern resulting in three 'wet' years. The third 'wet' year has resulted in an additional strong year class being present in 2023 catch. This is on top of two strong recruitment years that were apparent during the 2022 catch.

Average weights, lengths and k factor are lower in the majority of 2023 measurements. The two previous years of high recruitment, 2020 and 2021, have brought down the average of

these variables. A further reduction in average size and condition can also be expected in 2024 after another good spawning run in 2022.

Compared to the 2022 result, the average condition factor for brown trout was lower in the 2023 sample. This was especially relevant to longer/older fish. However, young fish less than 230 mm and especially those in the one plus cohort, displayed better condition, indicating they were able to compete for food and maintain body weight. This situation is indicative of overpopulation, with younger fitter fish out competing older poorer conditioned fish. This situation has caused slower growth across most mature fish.

With consistently high recruitment comes more competition, resulting in less food available for the entire population. The overall condition of fish in the population declines as does the growth potential. The situation is likely to continue in coming years whilst this three year pulse of high recruitment from 2020 to 2022 remains in the population.

Recommendations

- Use the spawning traps at Tumbledown, Scotch Bobs and Hydro creeks to control future over recruitment by limiting the total number of brown trout accessing the upstream spawning areas.
- Transfer adult spawning fish from the Arthurs Lake fish traps into Assisted Fisheries for anglers.
- Repeat the electrofishing survey in December 2024, using the same location and methodology.
- Carry scales suitable for weighing small fish on board the survey vessel.

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