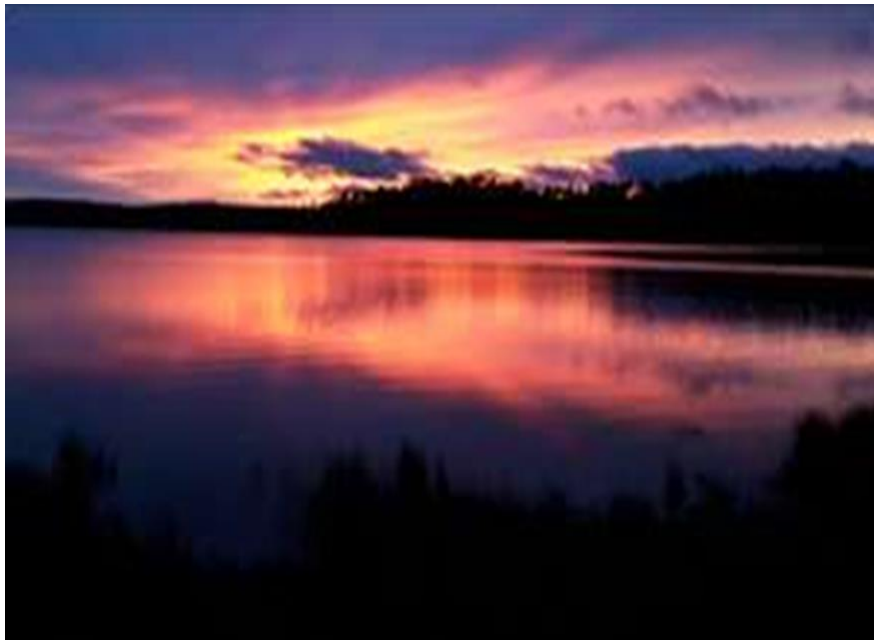


# Inland Fisheries Service

Penstock Lagoon July 2023

Fisheries Performance Assessment

Technical Report



# Inland Fisheries Service

## *Penstock Lagoon July 2023 Fisheries Performance Assessment Technical Report*

Author: Rob Freeman

Approved: John Diggle

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# Introduction

## Water Management

Penstock Lagoon is a small shallow water with a surface area of 1.4 square km's and a maximum depth of 1.8 metres. The lagoon was once an important hydroelectric storage for generating power at nearby Waddamana Power Station. However, during 1995 the Waddamana Power Station was decommissioned, consequently water flowing through the lagoon was reduced by many orders of magnitude. Water levels in the lagoon are now largely maintained by local inflows via the old Hydro canals, resulting in a mostly clear water fishery with stable lake levels.

## Trout Fishery

The trout fishery at Penstock Lagoon is valued for a moderate catch rate of quality brown trout and lower numbers of rainbow trout. Past stocking of brown trout fry and fingerlings has resulted in highly variable rates of survival, leading to unacceptable catch rates. Consequently, management of the fishery is now exclusively reliant on the transfer of adult brown trout from yingina / Great Lake, Arthurs Lake and to a lesser extent, Lake King William. Rainbow trout stockings have consisted of a mix of fry, fingerlings and yearlings, but the catch rate has, over the past ten years, remained consistently low. In 2021, a policy was implemented to only stock wild rainbow trout. Currently, fry collected from the artificial spawning channels at Liawenee are used.

# FPA Survey Methodology

## In-Lake Population Surveys

During 10-12 July 2023, 80 box traps (40 set each night) were set across all habitat types, including two deep water sets. A total of 209 brown trout were captured, weighed and measured on the first day. On the second day, 154 brown trout were captured, with 105 weighed and measured. Just one rainbow trout was captured. Prior to the survey, Penstock Lagoon was stocked with 2,000 adult brown trout that were adipose fin clipped. These were sourced from the Tumbledown Creek trap (n=500) and the Liawenee Canal trap (n=1,500). During the survey, all brown trout were checked for this adipose fin clip, in addition to a hole punched adipose fin, remaining from a transfer of 3,658 brown trout during 2016. It was assumed there would be no fin clipped fish remaining from the 2014 stocking.

Owing to a discrepancy between the population estimate and catch effort from the July 2023 survey, it was decided to resurvey Penstock Lagoon during 11-13 December 2023. This survey replicated the July 2023 survey methodology with 40 box traps set each night for two nights (80 box traps sets in total). The results of the December survey are included in the appendix, with comment in the discussion section of this report.

Condition factor was calculated using the basic formula of  $K=10^5 \times \text{weight}/\text{length}^3$ . This provides a generalised result that can be used to compare other fish and fisheries. The shortcomings of condition factor are acknowledged but are used for relative comparisons only. Categories are indicative and may not necessarily reflect the general perception of anglers.

## Stocking Database

The Inland Fisheries Service (IFS) keeps electronic records of public water stockings dating back to 1980. These records set out information on location, date of stocking, species, age, origin, stock type and genotype, in addition to some length/weight data and comments e.g. denoting tagged fish. This information provides an historical record of supplementary recruitment into individual waters. In this report, only records between 2000 and 2023 are examined.

## Annual Postal Survey

Since 1986, the IFS has conducted an annual postal survey seeking information about anglers' catches. The survey form is sent to ten per cent of all categories of anglers, asking set questions about their angling (catch of trout) for the past season. This information is entered into a database and information on catch per day, total seasonal catch and angling effort is

extrapolated. This provides a long-term overview of individual fishery performance in addition to characterising effort. In this report, only records between 2000 and 2023 are analysed.

## Angler Creel Data

Each season IFS officers collect fishing effort information from anglers interviewed at a range of waters. This information is entered directly into a dedicated 'Angler Creel' data collection App. Information on location, date, species, number of fish caught and method etc. are entered and stored in an electronic database. This information is used to examine the catch of trout at individual waters. Once analysed, the summary information is reported as the number of fish caught per day, irrespective if an angler had fished for three or more hours or was continuing to fish. All fish, irrespective of being kept or released were used, including zero catches. In this report, only records from anglers that fished for three or more hours were examined. Additionally, for the purpose of calculating the number of fish captured per day, a days fishing is deemed to be equal to six hours.

## Angler Diary App Data

During 2022, an angler diary app was developed and released for use by licenced freshwater anglers. The App allows anglers to enter information on location, date, fishing times (effort), angling method, species, length, weight, sex and if the fish was kept or released, and general comments. This data is stored in a dedicated database and is downloaded for use in analysing specific fisheries. In this report, only records showing fishing equal to or greater than three hours is used, irrespective if any fish were caught or not. Additionally, for the purpose of calculating the number of fish captured per day, a days fishing is deemed to be equal to six hours.

# Results In-Lake Survey July 2023

During 10 to 12 July 2023, the IFS conducted an in-lake survey at Penstock Lagoon to:

- examine the catch per unit effort (CPUE) for brown and rainbow trout,
- assess the population structure for brown and rainbow trout,
- estimate the size of the brown trout population, and
- assess the survival and growth of adult brown trout released in 2016 that were adipose hole punched.

## CPUE Information

Over three days (two nights), a total of 80 box traps were used to capture 363 brown trout with a CPUE of 4.54 brown trout per trap. This result was significantly lower (48% decrease) compared to a similar survey conducted during July 2022, but higher in comparison to 2016 and 2018 surveys (Table 1, Figure 5). A survey undertaken during 2014 that used a combination of methods (box traps and fyke nets), returned the lowest CPUE of all surveys at 2.15 fish per box trap, which was reflective of the lower abundance of brown trout at that time.

Of the 363 brown trout captured, three had a punched adipose fin from the 2016 stocking, with a CPUE of 0.04 fish per trap (Table 2).

Table 1: CPUE for brown trout, Penstock Lagoon 2014, 2016, 2018, 2022 and 2023 \* one trap removed for last sample night.

Year	Method	No. traps	Sample time	Effort	Catch No.	CPUE
2014	Box traps	21	3 overnight sets	*62 trap sets	133	2.15/trap
2016	Box traps	60	2 overnight sets	120 trap sets	417	3.48/trap
2018	Box traps	62	2 overnight sets	124 trap sets	446	3.60/trap
2022	Box traps	42	2 overnight sets	84 trap sets	722	8.60/trap
2023	Box traps	40	2 overnight sets	80 trap sets	363	4.54/trap



Table 2: Number and percentage of adipose fin marks (clips or punch) and non-marked brown trout 2023.

Total	Number	CPUE	Per cent of total catch
No adipose mark	314	3.93	86.5
Adipose fin clip from 2023	46	0.58	12.7
Adipose punch from 2016	3	0.04	0.83

The results of the 2023 survey indicate continued survival of the original 3,658 fin punched brown trout stocked during 2016, representing 26 per cent of the survey catch during 2016, 16 per cent for 2018, 1.3 per cent for 2022 and 0.83 per cent for 2023. There were no fin clipped fish identified from the stocking of 2,000 adult brown trout from 2014 (Table 3).

Table 3: Summary information for catches of fin clipped and fin punched stockings 2014 and 2016.

Grouping	Year	No. captured	Traps set	CPUE (per trap)
Fin Clipped 2014	2014	60	62	0.97
	2016	82	120	0.68
	2018	54	124	0.44
	2022	5	84	0.06
	2023	0	80	0
Fin Punched 2016	2016	109	120	0.91
	2018	70	124	0.56
	2022	10	84	0.12
	2023	3	80	0.04

## Population Estimate

To enable a capture-mark-recapture (CMR) population estimate, 2,000 adult brown trout were transferred from Arthurs Lake and yingina / Great Lake to Penstock Lagoon during April – June 2023. To identify these fish, each individual had its adipose fin clipped. During the survey, all fish captured were checked for an adipose clip and recorded.

Of the 363 brown trout captured, 46 had a clipped adipose fin (12.6%). Table 4 shows the parameters for the estimate, with 15,783 brown trout estimated to be within the lagoon. The associated estimate of bias was at acceptable levels i.e. > 4 and implies a reasonable degree of confidence in the estimate. This result is surprisingly high, considering a significant reduction in stocking rates over the past three years and moderately high harvest rates.

Table 4: Petersen population estimate for brown trout Penstock Lagoon 2023.

Parameter	Result
Total fin clipped released (M)	2,000
Total recaptures (C)	363
Total marked recaptures (R)	46
Population estimate: $MC/R = N$	15,783
Standard error	2,149
Lower and upper 95% CI limits	11,570 – 19,996
Estimate bias level: $MC/4N =$	11.5 (>4 acceptable bias)

## Length and Weight Information – Brown Trout

Of the 314 brown trout weighed, measured and sexed, 182 were male, 132 were female. There was no significant difference in the average weight or length of male and female brown trout. Male brown trout on average weighed 1,135 g and measured 457 mm, with females weighing 1,168 g and measuring 461 mm.

Most brown trout displayed good growth across all lengths (Figure 1). Fish over 500 mm continued to show good weight gains, with very few longer fish displaying lower weight to length ratios i.e., poor condition. There were no fish over 600 mm, which is similar to the 2014, 2016, 2018 and 2022 survey results.

The 2016 fin punched fish displayed similar weights to unmarked fish of the same length, despite being a minimum of ten years old.

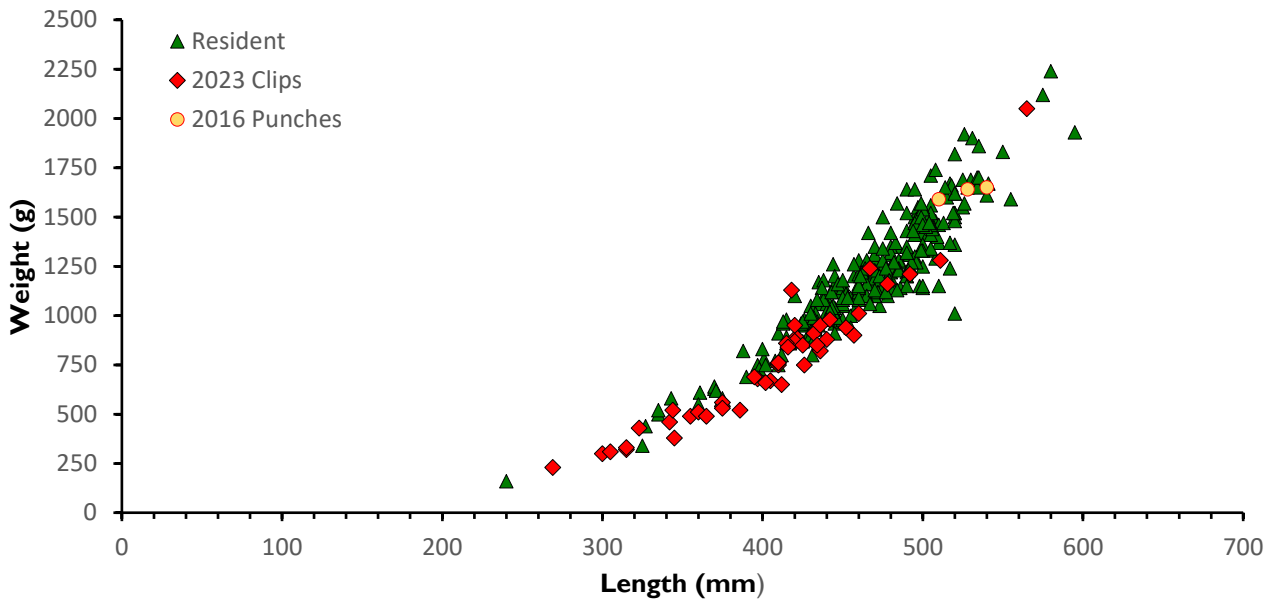


Figure 1: Length weight relationship for brown trout captured in 2023, showing non-clipped, 2023 adipose fin clipped and 2016 adipose fin punched brown trout.

Figure 2 shows the length frequency for the 314 brown trout weighed and measured. Sixty five per cent of these fish were between 400 – 500 mm and 23 per cent between 500 – 600 mm. There were a small number of resident fish (5%) in the 240 – 400 mm length range. The source of these smaller fish are possibly from a transfer of smaller adult fish from Arthurs Lake during June 2022 (Appendix A). There was one resident fish less than 240 mm, which may be from local natural recruitment. There was one fin clipped fish that was an outlier, being 565 mm and 2,020 g, which may have been the last of the 2014 stocking and misidentified as a 2016 transfer.

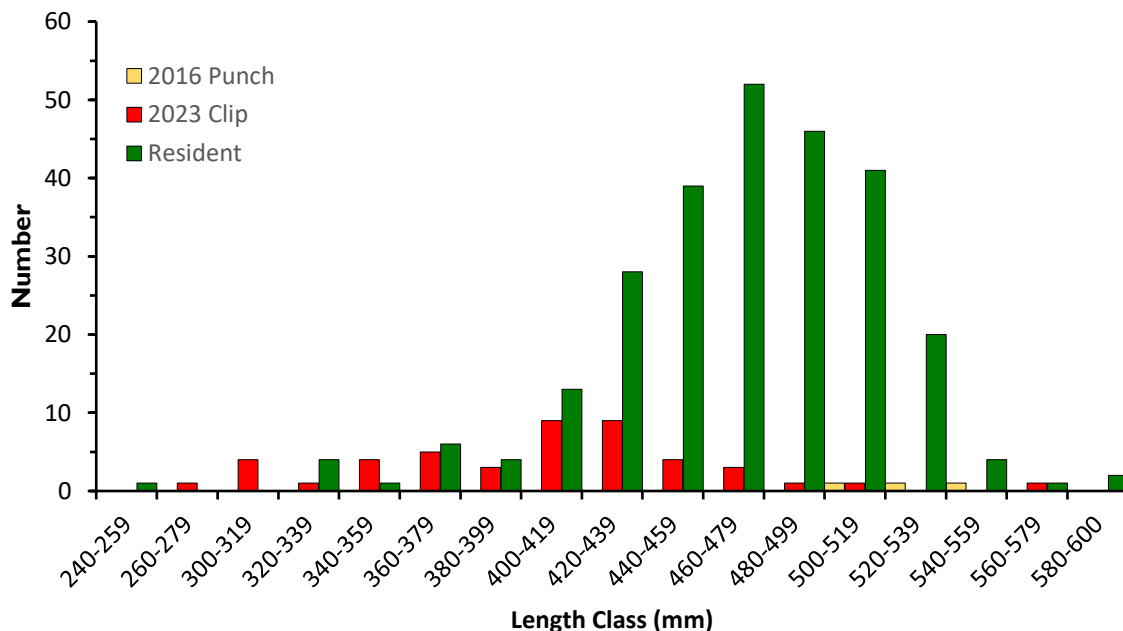


Figure 2: Length frequency histogram for brown trout, showing each fin clipped and resident fish, Penstock Lagoon 2023.

Brown trout over the minimum legal size of 400 mm measured an average of 472 mm and weigh 1.23 kg. Anglers can therefore potentially take most (89%) of fish they capture, within the confines of the daily bag limit. The largest fish was 2.24 kg and 595 mm length.

Table 5 shows the summary statistics for brown trout separated into four categories; all fish combined, resident fish (no-fin marks), 2023 adipose fin clip and 2016 adipose fin punch. By comparison to all other fish, the 2016 transfers are on average significantly larger. This is because these fish have been in the lagoon longer than most fish i.e. seven years. Resident fish weighed an average of 1.21 kg and are in relatively good condition. The 2023 fin clipped transfers on average, weighed less than all fish as they were a mix of yingina / Great Lake and Arthurs Lake fish, which had only recently been stocked into the lagoon.

Table 5: Length, weight and condition factor for brown trout caputed in box traps, seperated by: combined sample, non-finclipped, 2014 adipose clips and 2016 adipose fin punched brown trout.

Grouping	Measurement	Average	Minimum	Maximum
All brown trout (n=314)	Length (mm)	459	240	595
	Weight (g)	1,148	160	2,240
	Cond Factor (k)	1.15	0.72	1.55
Resident (n=265)	Length (mm)	468	240	595
	Weight (g)	1,210	160	2,240
	Cond Factor (k)	1.16	0.72	1.48
Fin clipped 2023 (n=46)	Length (mm)	403	269	565
	Weight (g)	758	230	2,050
	Cond Factor (k)	1.09	0.90	1.55
Fin punch 2016 (n=3)	Length (mm)	526	510	540
	Weight (g)	1,627	1,590	1,650
	Cond Factor (k)	1.12	1.05	1.48

## Rainbow Trout

During the survey, only one rainbow trout was captured from a total of 80 box traps, representing a CPUE of 0.013 or 0.3 per cent of the total catch. This fish was 450 mm long and weighed 1,220 grams. This result was substantially lower than the CPUE of 1.08 fish per trap for the 2016 survey and 0.24 for the 2022 survey and marginally lower than 2018 at 0.08 and 2014 at 0.05 fish per trap.

# Comparison 2014 – 23 Surveys

## Weight and Length Information

Comparative summary data for FPA surveys at Penstock Lagoon between 2014 and 2023 are shown in Figures 3 and 4 and Table 6. The growth of brown trout is consistent across all survey periods. There are several younger fish in the 180 – 220 mm length range during the 2014 survey. These fish were from previous fry and fingerling stockings (Appendix A). Post 2014, all stockings of brown trout were exclusively adult brown trout from yingina / Great Lake, Arthurs Lake and Lake King William, consequently, except for one fish during 2023, there were no brown trout under 250 mm during the 2016, 2018 and 2022 surveys. Furthermore, during all five surveys, only one brown trout over 600 mm was capture, this was during 2018.

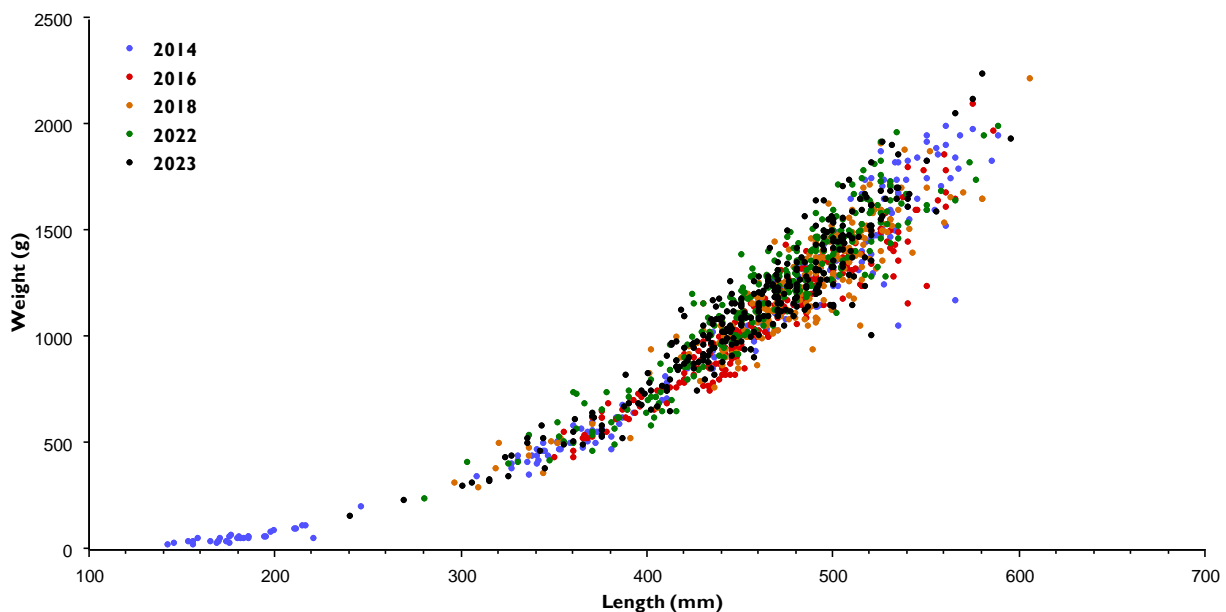


Figure 3: Length/weight regression for comparative surveys undertaken in 2014, 2016, 2018, 2022 and 2023 for brown trout, Penstock Lagoon.

The average length of brown trout has remained relatively stable across all surveys (Figure 4a). However, the average weight has increased between 2014 and 2022 surveys but reduced slightly for 2023, likely due to the stocking of smaller brown trout from Arthurs Lake, measuring under 400 mm (Figure 4b). The average condition factor has increased from 1.05 k during 2014 to 1.16 k for 2022 and 1.15 for the 2023 survey (Figure 4c).

During 2023, 88 per cent of brown trout were above the minimum legal size of 400 mm. This is due to only adult brown trout being stocked post 2014. This percentage has however, decreased from 96 per cent since the 2018 survey. This is due to the transfer of

smaller brown trout from Lake King William and Arthurs Lake. Despite this, the average weight and condition of fish during 2022 and 2023 remained relatively high (Table 6).

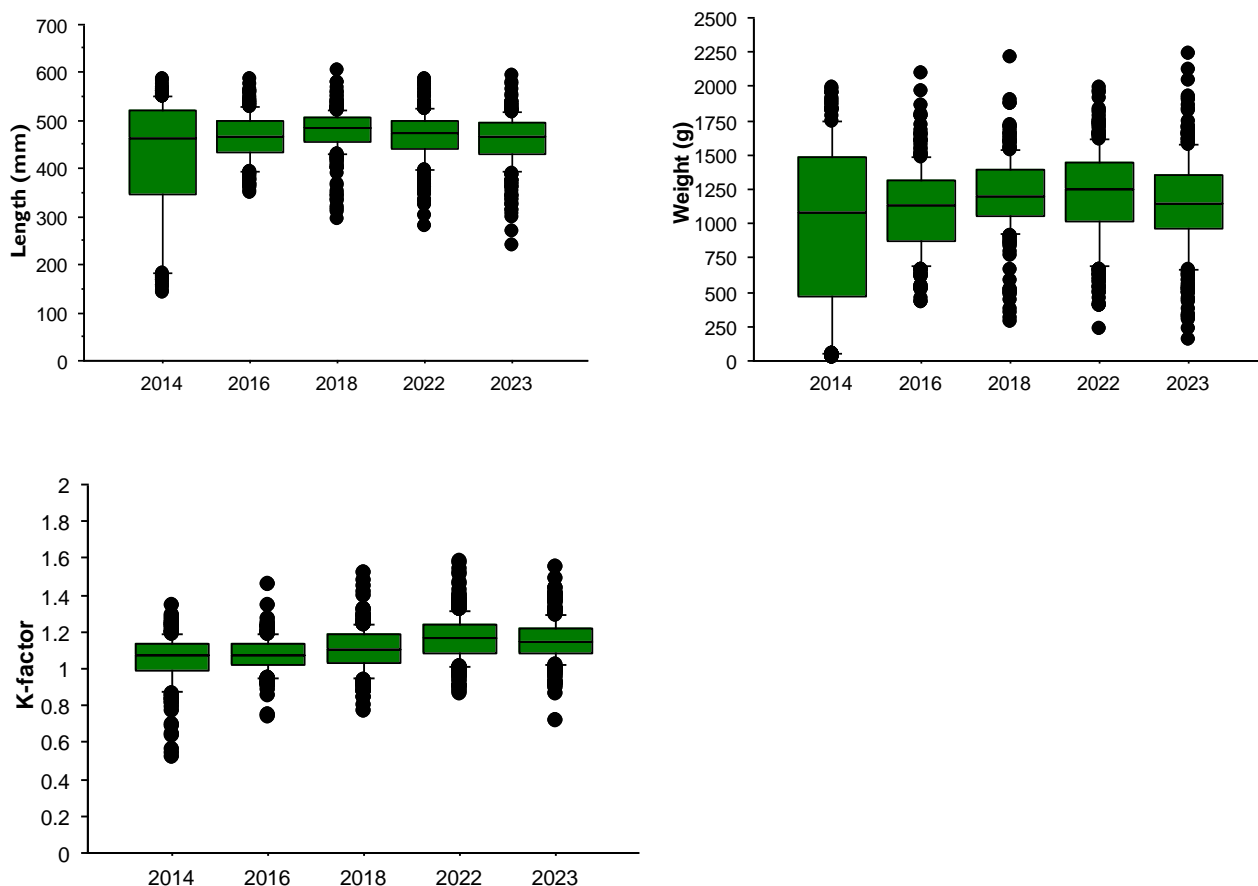


Figure 4: Box plots showing the median and associated upper and lower quartiles for, (a) length, (b) weight and (c) condition factor, for surveys undertaken during, 2014-23, for brown trout, Penstock Lagoon.

Table 6: Length, weight and condition factor for surveys undertaken during 2014-23, for brown trout, Penstock Lagoon.

Year	Variable	Average	Count
2014	Weight (g)	976	192
	Length (mm)	417	192
	CF (k)	1.05	192
2016	Weight (g)	1,106	231
	Length (mm)	465	231
	CF (k)	1.07	231
2018	Weight (g)	1,208	245
	Length (mm)	477	370
	CF (k)	1.10	245
2022	Weight (g)	1,209	296
	Length (mm)	466	296
	CF (k)	1.16	296
2023	Weight (g)	1,148	314
	Length (mm)	459	314
	CF (k)	1.15	314

# Population Estimate and Catch Effort

The CPUE for all surveys since 2014 shows an increasing trend over time (Figure 5). However, the CPUE result for 2022 compared to all other years, is significantly higher. Though a high catch effort was expected at this time, the figure of 8.6 fish per trap appears to be inflated and sits well above the long term trendline.

While there were only three population estimates undertaken between 2014-23, the results show a moderately strong relationship with CPUE (Figure 5), indicating in general that CPUE can be used to indicate population size, although more work needs to be done to validate and strengthen this relationship.

Figure 6 shows the CPUE for the two groups of marked fish (2014 fin clips and 2016 fin punches) for each survey between 2014 and 2023. This data is shown as 'years since the initial stocking' and provides both a comparison between the two groups and mortality over time. This information was used to generate a generalised linear model ( $Y = 0.046 + 0.103 * X$ ;  $R^2 = 0.943$ ) to predict the number of brown trout remaining from each adult brown trout stocking since 2014, and to predict the total number of fish remaining (Table 7, Figure 7).

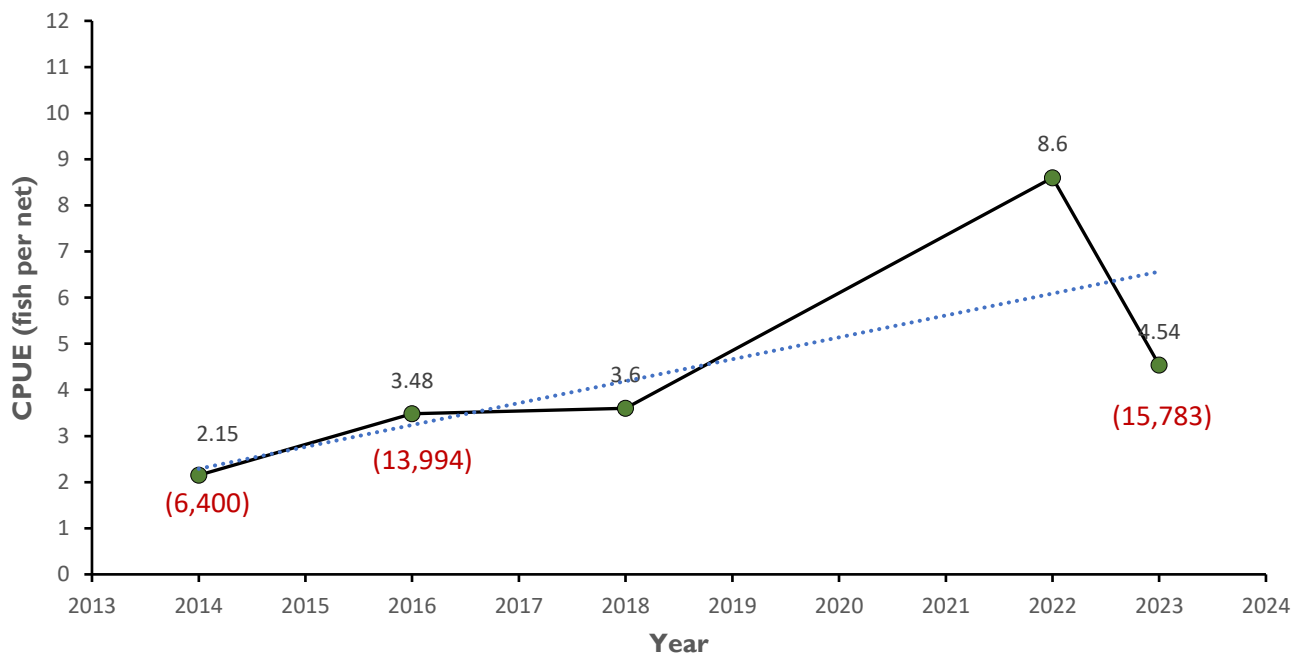


Figure 5: CUPE results for all brown trout captures for each survey, Penstock Lagoon 2014-23, showing each of the three CMR population estimates during 2014, 2016 and 2023 (see red text).

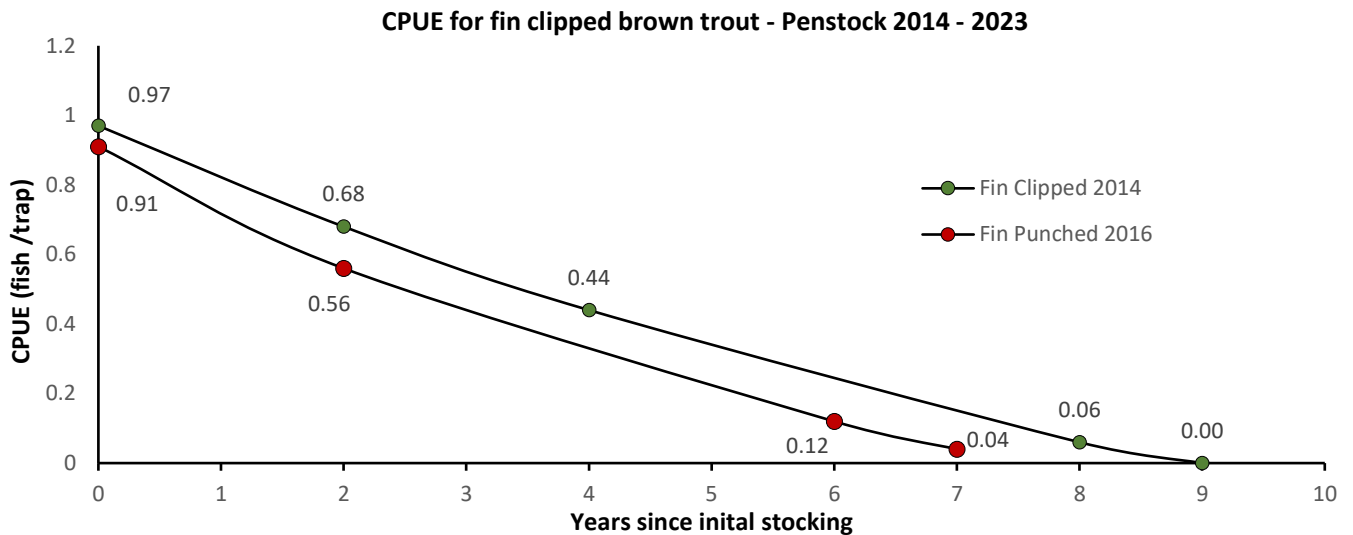


Figure 6: CUPE results for fin clipped and fin punched brown trout showing time from initial stocking.

Table 7: Estimated annual mortality and minimum age of adult brown trout transfers 2014 – 23.

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
<b>2014</b>	2,000									
<b>2015</b>	1,702	4,292								
<b>2016</b>	1,273	3,652	3,658							
<b>2017</b>	821	2,732	3,113	3,694						
<b>2018</b>	445	1,762	2,328	3,144	3,030					
<b>2019</b>	195	955	1,502	2,351	2,579	3,022				
<b>2020</b>	66	419	814	1,517	1,929	2,572	1,500			
<b>2021</b>	15	141	357	822	1,244	1,924	1,277	1,200		
<b>2022</b>	2	33	120	361	674	1,241	955	1,021	1,000	
<b>2023</b>	0	4	28	121	296	672	616	764	851	2,000
	Estimated total brown trout remaining:									<b>5,352</b>
<b>Minimum age in 2023</b>	12	11	10	9	8	7	6	5	4	3



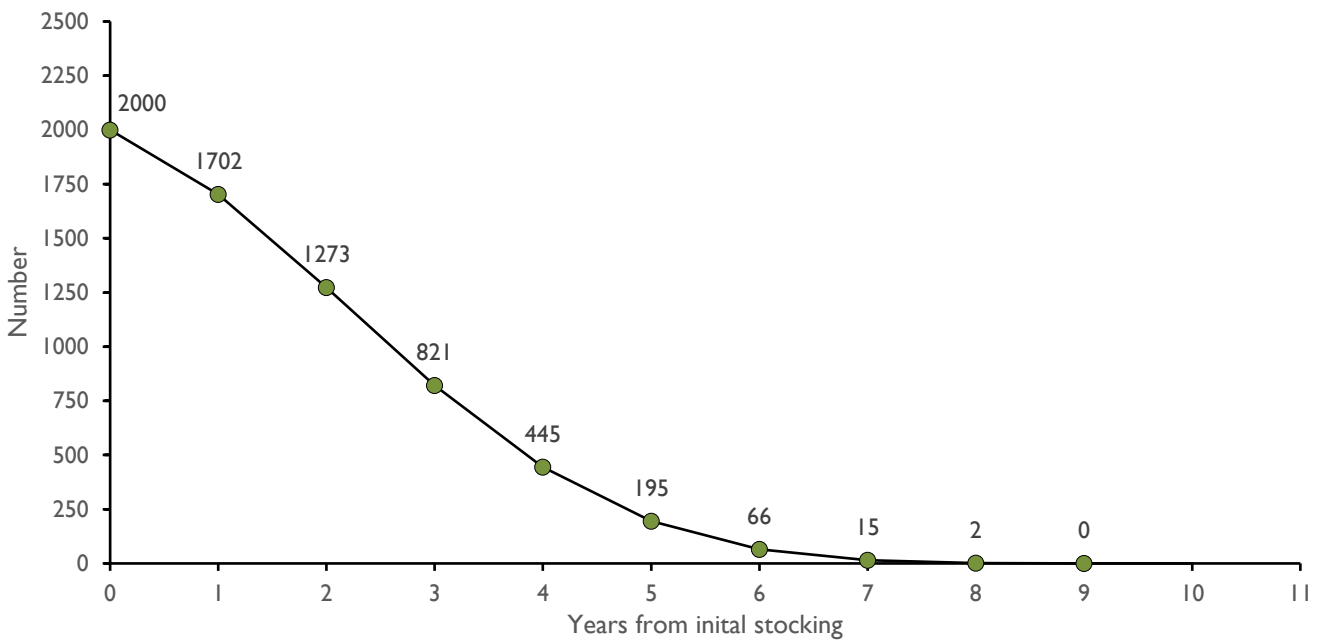


Figure 7: Modelled decrease in numbers for a nominal stocking of 2,000 adult brown trout, based on CPUE from all surveys between 2014-23 ( $Y = 0.046 + 0.103 * X$ ;  $R^2 = 0.943$ )

## Stocking History

Over the past 18 years, Penstock Lagoon has undergone several changes to the trout stocking regime. These changes have been driven by access to additional adult brown trout and inconsistent results from fry and fingerling stockings and associated declining catch rates. Appendix A presents this data, showing only adult brown trout were stocked post 2014. The stocking of rainbow trout has mainly consisted of fry or fingerlings. Yearling rainbow trout have been released during 2015 and 2016, but they have not yielded any long-term increases in catch or fish quality. Presently, the exclusive use of adult brown trout collected from several highland locations is providing a consistent and quality fishery.

## Angler Postal Survey Summary

Average fishing effort during the period 2000 – 2023 was 10,755 angler days per season, with a low of 4,190 days during 2000-01 and a high of 20,685 days during 2020-21 (Figure 8). The initial increase in fishing effort around 2006-07 coincides with prolonged drought, low lake levels and poor catches at other major fisheries. Consequently, a large influx of anglers moved to less impacted waters, such as Penstock Lagoon. Since this period, fishing effort has trended down to 5,075 days for the 2013-14 season. Following the resumption of adult

brown trout stocking in 2014 and resulting higher catch rates (Figure 9), total fishing effort rebounded to high levels. However, total fishing effort for the 2022-23 season was 7,007 days, which is a 56 per cent decrease from the 2021-22 season.

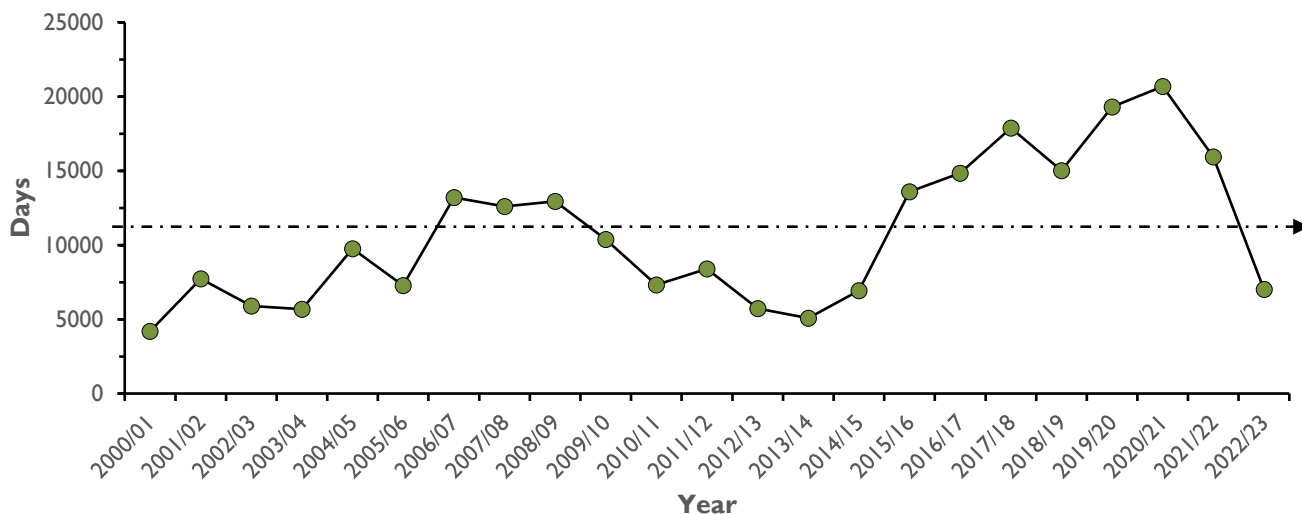


Figure 8: Total fishing effort 2000 – 2023, expressed as the number of days fished by anglers during each season (dotted line indicates long term average).

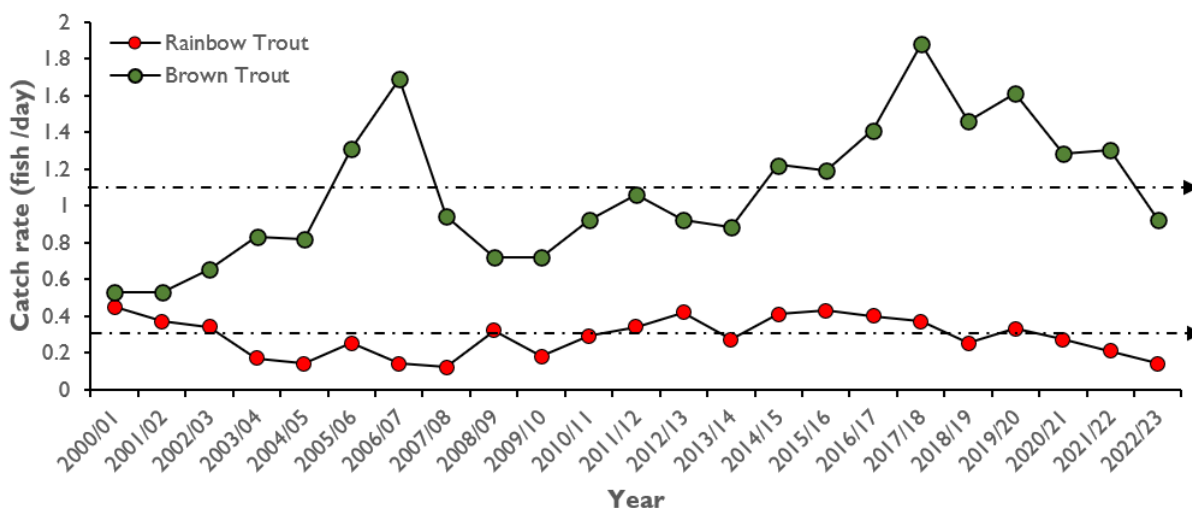


Figure 9: Daily catch rate for brown and rainbow trout 2000 – 2023 (dotted line indicates long term average).

The average daily catch rate for the period 2000 – 2023 was 1.1 brown trout per day (Figure 9). Despite a fall in angling effort and corresponding total seasonal catch, the daily catch rate during 2011 - 2013 was near the long-term average. Since 2014, the daily catch rate increased and has been between 1.2 – 1.6 brown trout per day, with a high of 1.9 during 2017-18. The catch rate decreased from 1.30 during 2021-22 to 0.92 for the 2022-23 season, representing a 30 per cent reduction.

The average catch rate for rainbow trout has generally remained around the long-term average of 0.3 fish per day (Figure 9), with an estimated total seasonal catch of 3,200 fish

(Figure 10). An increase in total seasonal catch since 2015-16 likely relates to a stocking of predominately yearling rainbow, in addition to an overall increase in total fishing effort for that period. The catch rate has declined since 2020-21, with a 33 per cent reduction between the 2021-22 and 2022-23 seasons.

The estimated average total seasonal catch of brown trout for the period 2000 – 2023 was 12,848 fish (Figure 10). Since the very high total seasonal catch in 2006-07 of 22,299 brown trout, the catch has trended down to 4,488 for the 2013-14 season. Following several consistent years of adult brown trout transfers and the continued under performance of the Arthurs Lake fishery, the total seasonal catch of brown trout returned to high levels, with an estimated 20,838 brown trout caught during the 2021-22 season. However, with a decrease in angling effort and daily catch rate, the seasonal harvest declined by almost 70 per cent to 6,453 brown trout for the 2022-23 season. In percentage terms, brown trout represented 86 per cent of the total seasonal catch, with rainbow trout 14 per cent.

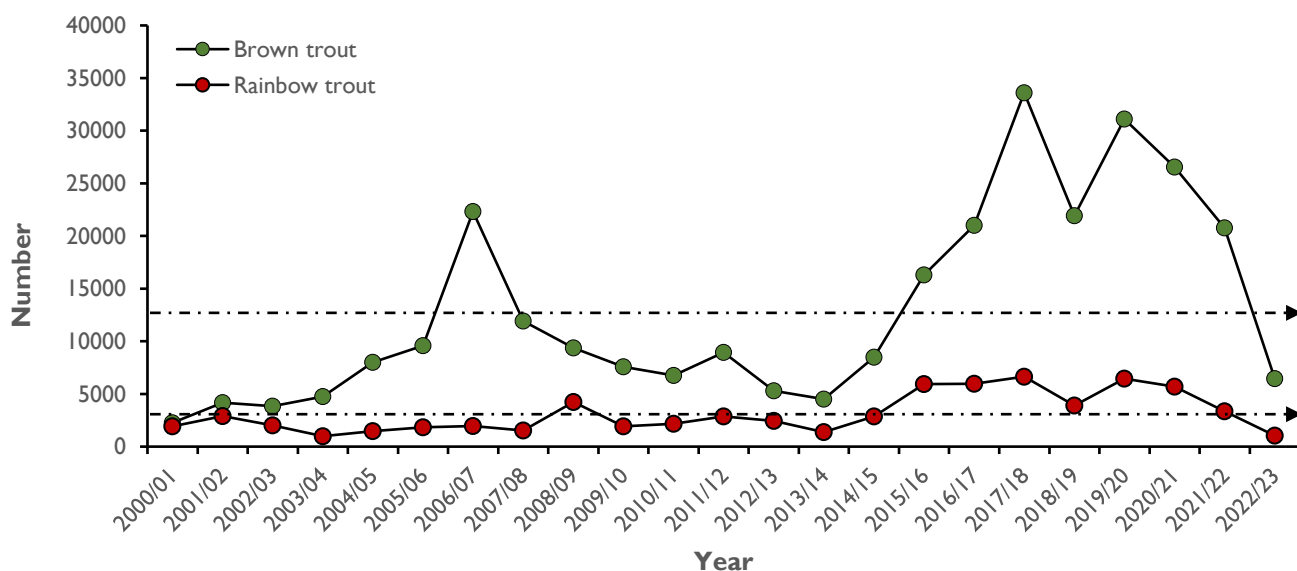


Figure 10: Estimated total seasonal catch of brown and rainbow trout 2000 – 2022 (dotted line indicates long term average).

# Creel Interview Summary

Over the period 8 August 2021 to 20 August 2023, 268 anglers were interviewed regarding their days fishing at Penstock Lagoon. For analysis purposes, only those anglers that fished three or more hours were included, resulting in a total of 132 records. These anglers fished a total of 774 hours, catching 174 brown trout and 20 rainbow trout. Of these fish, 109 brown trout (63%) and 11 rainbow trout (55%) were released. Based on a full days fishing being equivalent to six hours, the daily catch rate for brown trout is estimated at 1.35 brown trout and 0.16 rainbow trout.

## Angler Diary Summary

During the period 26/8/2022 to 25/9/2023, there were 178 valid records entered by anglers into the Angler Diary App (record for none or multiple fish capture) for fishing at Penstock Lagoon. Of these records, 148 met the criteria of fishing for three or more hours. These 148 records (each single or nil fish capture is a record) were attributed to 70 individual trips, with an average trip being 6.3 hours. The total number of brown trout captured was 128, with 91 of these released (71%). Six rainbow trout were captured with four of them released (66%). Total fishing effort was 464 hours. Based on the assumption that a full days fishing is six hours, this is equal to 77 days. The average daily catch of brown trout is therefore estimated at 1.66 fish per day and 0.08 rainbow trout per day. This result is likely to be slightly inflated, as highly engaged anglers mostly used the Angler Diary App, leading to higher catch rates.

# Discussion

The CPUE of 4.5 brown trout per trap represents a significant decrease compared to the 2022 survey at 8.6 per trap, indicating a reduction in the abundance of brown trout. However, based on the long term catch effort dataset, the 2022 result appears to be an inflated outlier. This large decline in CPUE was not reflected in the CMR population estimate that increased from 13,994 for the 2016 survey to 15,783 for this survey. Furthermore, 23,366 adult brown trout have been stocked into the lagoon since 2015, and while angling effort has been high, there is no evidence to suggest harvest rates have been enough to cause such a large decline in abundance. It is therefore reasonable to assume the lagoon still holds a moderate to high number of brown trout, with daily catch rates reported by anglers remaining around the long-term average.

Due to the discrepancy between the CPUE and the high estimated population size, it was decided to re-survey the brown trout population in December 2023. The results of this survey (see Appendix E) were unfortunately poor, with only 27 brown trout captured from 80 box trap sets. This essentially made the results unusable for catch effort or reviewing the CMR population estimate. The reasons for the low catch numbers were unclear but may be related to high overnight water temperatures and associated low dissolved oxygen levels in the shallow margins of the lagoon being unfavorable for trout.

The abundance of brown trout and consistent catch rates by anglers are underpinned by high rates of catch and release fishing. The high rate of catch and release in conjunction with the longevity of brown trout and higher stocking rates (2015-19), have combined to maintain a high level of angler satisfaction. However, there has been a significant reduction in fishing effort during 2021-22 and corresponding reduction in the harvest of brown trout. Consequently, it would be prudent to adjust stocking rates to prevent an unwarranted increase in abundance. This is especially so with catch and release rates for brown trout at 63 per cent.

The survival of brown trout from previous stockings has been high. Adult brown trout released during 2014 were not identified during the 2023 survey, although one fish may have been misidentified and is likely from this cohort (possibly 12 years old). The 2016 hole punched brown trout were present, but in low numbers. These fish are now a minimum of ten years old but remain in good condition.

Similar to the 2022 survey results, 55 per cent of brown trout weighed between 1.0 - 1.5 kg and 14 per cent 1.5 – 2.0 kg, with one fish over 2 kg. There is essentially no evidence of natural recruitment occurring, with just one fish under 260 mm recorded. There are no signs of any density dependent impacts, with very few fish displaying poor condition, including older/longer fish, which remain in good condition.

In reference to the *Tasmanian Inland Recreational Fishery Management Plan 2018-28* (TIRFMP) criteria for Penstock Lagoon (Appendix C), the recently revised goals for catch rate and population size have been met (although there are concerns regarding the population estimate). The goal for average weight for fish greater than 400 mm (the minimum size), is set at; 1.4 - 1.6 kg, presently it is 1.23 kg. The goal for large brown trout over 600 mm is five per cent. Presently, there are no brown trout over this size. The main factors preventing these goals from being achieved are; the removal of larger trout by anglers, (even with high rates of catch and release), the stocking of adult fish of varying ages that is limiting overall growth potential, and the overall lower productivity of the lagoons ecosystem. Penstock Lagoon is a vastly altered system compared to when it had high volumes of water flowing through it (pre 1995). This has implications for the overall productivity of the fishery and its management. Fishery goals and management actions will need to be adjusted to account for the innate nature of the lagoon and the significant downward trend in annual harvest.

For rainbow trout, the catch rate was at the lower bounds of the goal as set in the TIRFMP at 0.3 fish per day. It was not feasible to assess other criteria for rainbow trout due to low sample sizes. The stocking of fry, fingerling or yearling rainbow trout does not correlate with any significant long term change in catch rate.

The catch rate for brown trout reported by anglers during creel interviews, the APS and to a lesser extent the angler diary were similar, providing reasonable confidence in the catch data. However, future refinements across all three platforms will need to be undertaken if the relevance of this data is to be maintained and improved.

In summary, the Penstock Lagoon fishery is performing well, although adjustments to fishery goals, stocking and a reduction in the take of larger fish will provide beneficial outcomes. The confounding results between the population estimate and CPUE for the July 2023 survey raises some concerns. The use of adult transfers as marked fish for the purpose of accurately estimating the population size needs to be assessed, as the model assumption of even mixing within the population may be violated. A review of past survey results and validation of the present CMR methodology would be prudent.

## Recommendations

- The use of wild adult brown trout as the primary method of restock is maintained.
- To balance out the high rates of catch and release fishing, decreasing in fishing effort and resulting lower harvest, in conjunction with the longevity of brown trout; a reduction in the stocking number to 1,200 – 1,500 adult brown trout is recommended.

- The policy of using a mix of adult brown trout of varying sizes is maintained, with preference for a higher percentage of smaller fish.
- The use of rainbow trout fry sourced from wild stocks and released at the fry stage is recommended to continue. Historical records indicate 10,000 – 20,000 fry will sustain a low but meaningful population of rainbow trout.
- Angling effort is monitored to assess future influences i.e. El Niño/La Niño cycles and resulting changes in fishing effort related to preferences in fishing locations.
- Collection of angler catch data via the APS, creel surveys and the Angler Diary are reviewed and refined to provide more consistent and comparable results.

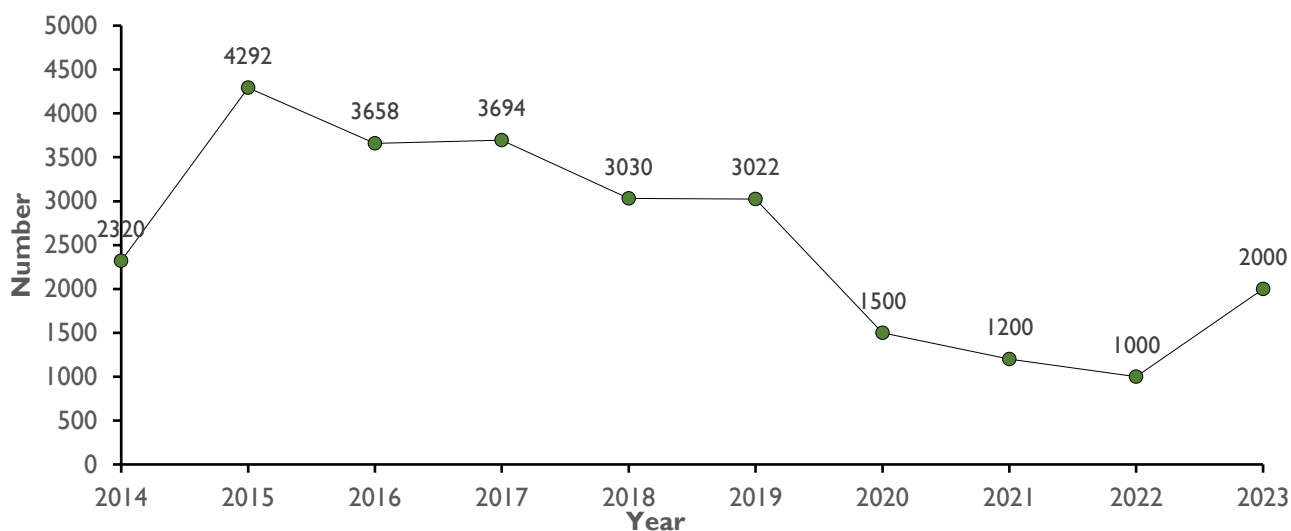
# Appendix

Appendix A: Stocking history for Penstock Lagoon, 2007 – 2023. (\*split between 2013-14; # stocked Dec 2012)

Year	Species	Number	Age	Type
<b>Brown Trout</b>				
2007	Brown trout	20,000	Fry	Diploid
2008	Brown trout	10,000	Fry	Diploid
2009	Brown trout	5,000	Fry	Triploid
2010	Brown trout	10,000	Fry	Diploid
2011	Brown trout	10,000	Fry	Triploid
2012	Brown trout	15,000	Fry	Triploid
2013	Brown trout	10,000	Fry	Triploid
2014	Brown trout	55,000	Fry	Triploid
2007	Brown trout	3,500	Fingerling	Diploid
2008	Brown trout	250	Fingerling	Diploid
2009	Brown trout	5,000	Fingerling	Triploid
2009	Brown trout	5,000	Fingerling	Diploid
2007	Brown trout	490	Adult	Diploid
2008	Brown trout	280	Adult	Diploid
2009	Brown trout	100	Adult	Diploid
2014	Brown trout	2,320	Adult	Diploid
2015	Brown trout	4,292	Adult	Diploid
2016	Brown trout	3,658	Adult	Diploid
2017	Brown trout	3,694	Adult	Diploid
2018	Brown trout	3,000	Adult	Diploid
2019	Brown trout	3,022	Adult	Diploid
2020	Brown trout	1,500	Adult	Diploid
2021	Brown trout	1,200	Adult	Diploid
2022	Brown trout	1,000	Adult	Diploid
2023	Brown trout	2,000	Adult	Diploid
<b>Rainbow Trout</b>				
2007	Rainbow trout	7,000	Fingerling	Diploid
2008	Rainbow trout	5,000	Fingerling	Diploid
2009	Rainbow trout	10,000	Fingerling	Triploid
2010	Rainbow trout	10,000	Fry	Diploid
2011	Rainbow trout	10,000	Fingerling	Triploid
2012	Rainbow trout	10,000	Fry	Diploid



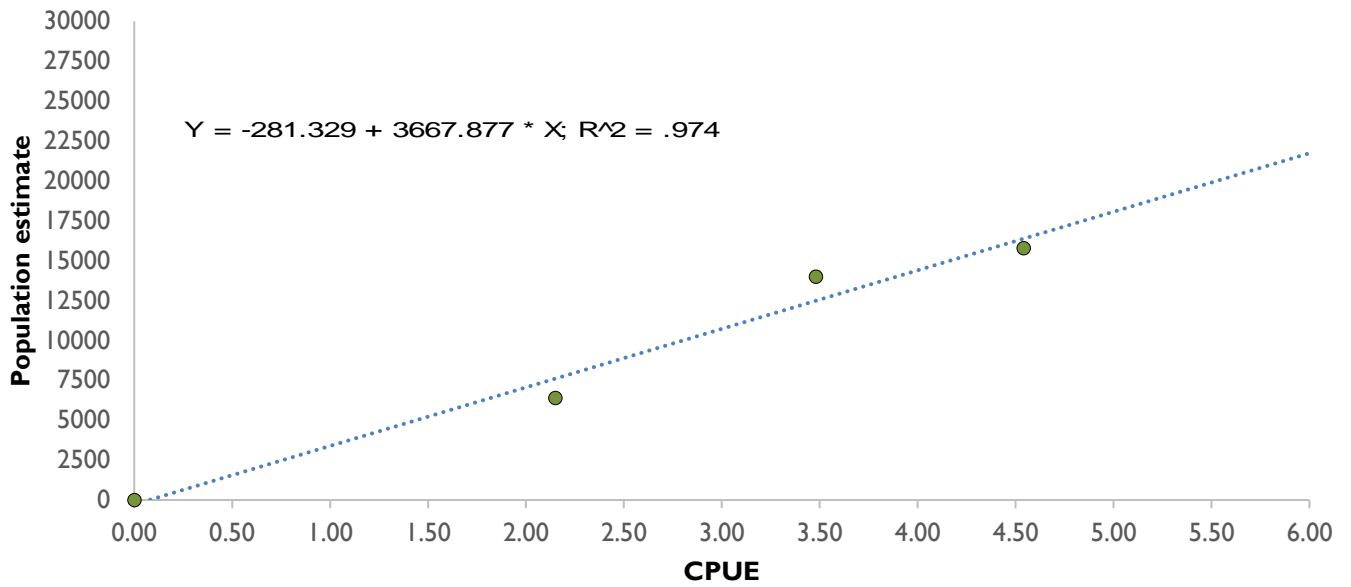
Year	Species	Number	Age	Type
2013	Rainbow trout	15,000#	Fry	Triploid
2014	Rainbow trout	50,000*	Fry	Triploid
2015	Rainbow trout	6,000	Yearlings	Triploid
2017	Rainbow trout	3,000	Yearlings	Triploid
2018	Rainbow trout	2,100	Adult	Triploid
2019	Rainbow trout	1,500	Adult	Triploid
2020	Rainbow trout	1,000	Yearlings	Triploid
2021	Rainbow trout	1,246	Fry	Diploid
2022	Rainbow trout	87	Adults	Diploid
2023	Rainbow trout	1,000	Fry	Diploid



Appendix B: Stocking numbers of adult brown trout, Penstock Lagoon 2014 – 2023.

Appendix C: Fishery performance criteria (goals) for Penstock Lagoon, from the TIRFMP 2018-28 NB revised 2023.

Species	Average weight (g)	Catch rate (fish per day)	Large fish (percentage)	Population size (BT) at full lake level
Brown trout	> 400mm 1.35 kg +/- 0.1	0.9 +/-0.2	> 600mm 5%	7,000 – 10,000 *
Rainbow trout	> 400mm 1.4 kg +/- 0.2	0.3 +/-0.1	> 500mm 3%	



Appendix D: Regression plot for estimating brown trout population size from CPUE data, Penstock Lagoon surveys 2014 – 23.

## Appendix E - December 2023 Survey Results

During 11-13 December 2023, the brown trout population at Penstock Lagoon was resurveyed. This survey replicated the July 2023 FPA methodology. A total of 27 brown trout (10 females, 17 males) and one rainbow trout were captured from 80 box trap sets, for a CPUE of 0.34 brown trout and 0.01 rainbow trout per trap. Two brown trout had adipose fin clips from the 2023 transfer program, representing 7.4 percent of the catch, with no 2016 hole punched adipose fin brown trout captured. Average weight for brown trout was 1.22 kg with an average length of 480 mm and condition factor of 1.1 k-factor. The relevant summary data is shown below (Figures E1, E2 & E3), and comment provided in the Discussion section page 17.

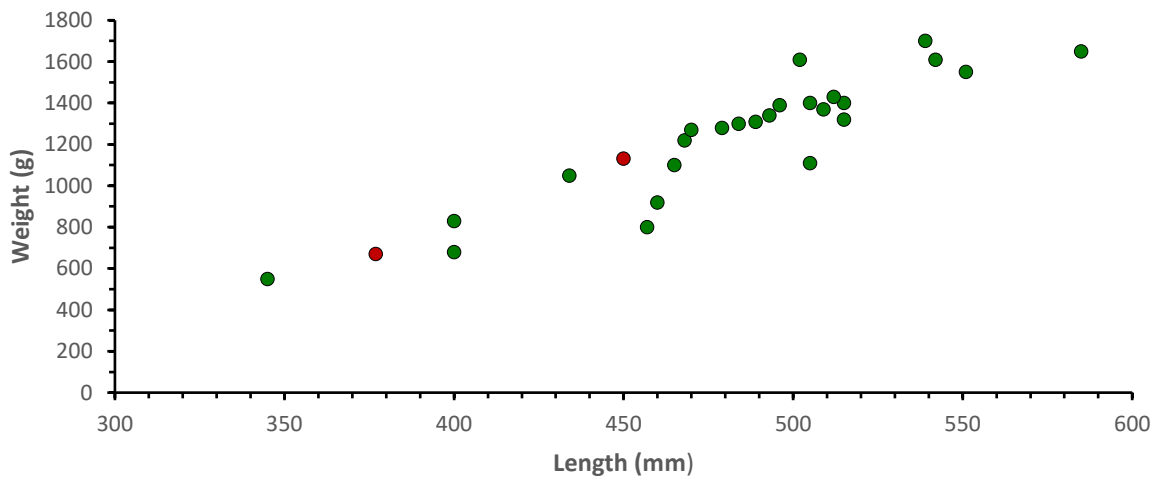


Figure E1: Length weight relationship for brown trout captured in December 2023, showing non-clipped (green) and 2023 adipose fin clipped (red) brown trout, n=27.

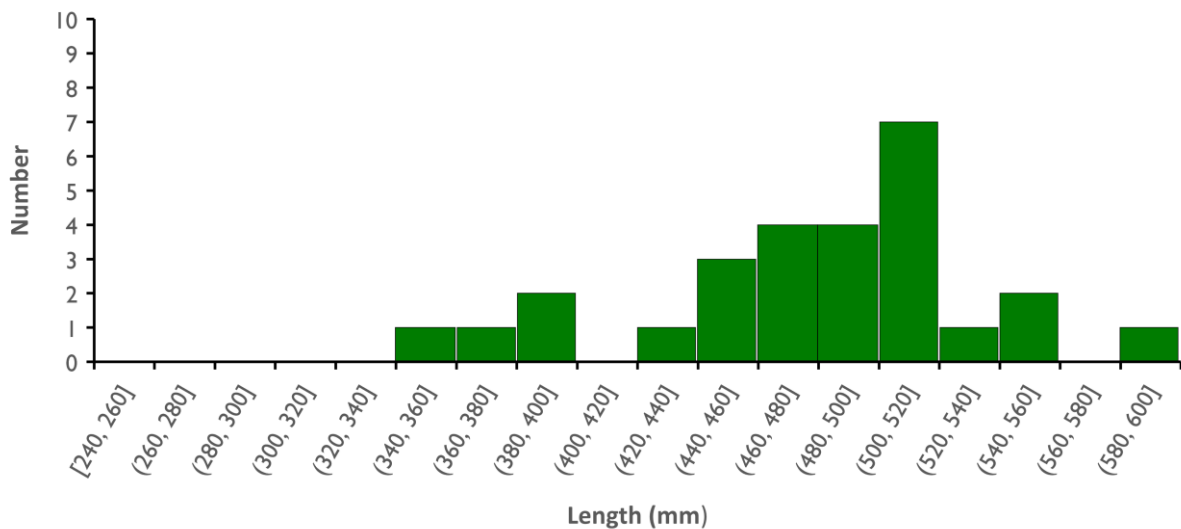


Figure E2: Length frequency histogram for brown trout captured in December 2023, n=27.

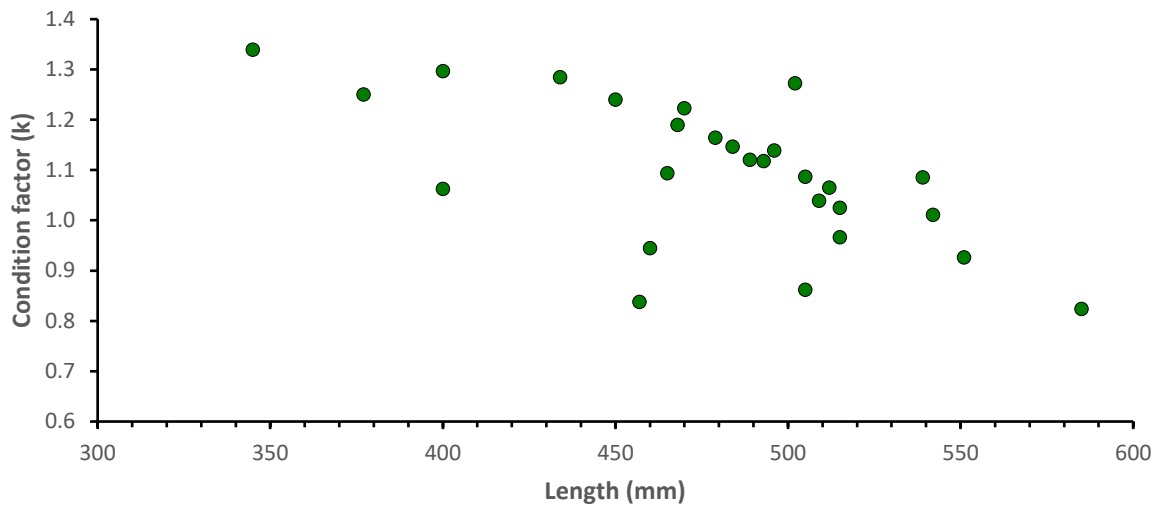


Figure E3: Condition factor by length for brown trout captured in December 2023, n=27.

# References

1. IFS, (2023); *Tasmanian Inland Recreational Fishery Management Plan 2023-28*.
2. IFS, (2014); Fisheries Performance Assessment, Technical Report, Penstock Lagoon – 2014.
3. IFS, (2016); Fisheries Performance Assessment, Technical Report, Penstock Lagoon – 2016.
4. IFS, (2018); Fisheries Performance Assessment, Technical Report, Penstock Lagoon – 2018.
5. IFS, (2018); Fisheries Performance Assessment, Technical Report, Penstock Lagoon – 2022



**Inland Fisheries Service**

**Phone:**  
1300 INFISH

**Email:**  
[infishifs.tas.gov.au](mailto:infishifs.tas.gov.au)

**[www.ifs.tas.gov.au](http://www.ifs.tas.gov.au)**