

Inland Fisheries Service Report

Recreational Fisheries Report



Fisheries Performance Assessment

Technical Report

Penstock Lagoon – May 2018

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I. Introduction

I.1. Water Management

Penstock Lagoon is a small and shallow water with a surface area of 1.4 square km's and a maximum depth of 1.8 metres. The lagoon has over a number of years, been subject to significant alterations in water management. Penstock Lagoon was once an important hydroelectric storage for generating power at nearby Waddamana power station. The lagoon was subject to large inflows of cold clear water from yingina/Great Lake. In 1993, Waddamana power station was decommissioned. Consequently, water flowing through the lagoon was reduced by many orders of magnitude. Water levels in the lagoon were maintained by diverting water from the Shannon River that originates from Shannon Lagoon. The quality of water was frequently poor with elevated levels of suspended sediment common. Consequently, during the mid 1990's, the lagoon was subject to elevated turbidity and hence the quality, catch rate and fishing experience declined.

In response to anglers concerns, Hydro Tasmania in-conjunction the Inland Fisheries Service (IFS), trialed various water management options. After some fine tuning, a satisfactory management regime was established. The lagoon now receives water from its own immediate catchment, with the lagoon level maintained over summer with releases of water from the Shannon River. These alterations in water level management have seen the lagoon enter a clear water phase, with turbidity at very low levels. This has implications for overall nutrient cycling, with potentially less nutrients entering the system and available nutrients locked up in macrophyte biomass.

I.2. Trout Fishery

The trout fishery at Penstock Lagoon has for many years been valued for a moderate catch rate of quality brown and rainbow trout. Brown trout have been the mainstay of the fishery with an estimated harvest of between 54%-92% of all trout during 2001-2017, with rainbow trout representing between 8%-46% percent for same period.

With the changes in water management, natural recruitment of both brown and rainbow trout became highly variable. In some cases, no spawning occurred in the inflow canal for multiple years. In response to this variability and falling catch rates, the IFS screened the inflow canals to prevent spawning and stranding of fish and began a stocking program consisting of both rainbow and brown trout fry. In addition, the Service also transferred between 100 - 750 (~ 1 kg) adult brown trout from yingina/Great Lake into the lagoon through the period 2001 - 2009. The initial rationale for this was to fill a void in recruitment while brown trout fry grew to a takeable size. This initiative was so successful it was continued, with transfer numbers increased to 500 in 2000, and again to 750 in 2003. However, with the consistent stocking of

the lagoon with a combination of diploid and triploid fry since 2003, the ongoing stocking of adult trout could no longer be justified as returns from fry stockings appeared to be reasonable. However, during 2012-14 anglers suggested trout stocks had fallen well below acceptable levels, with low catch rates being experienced by all anglers. In response to these concerns, an initial population survey was conducted during April 2013 to gain knowledge of CPUE using a combination of fyke and box nets. This survey suggested there was a reasonable numbers of large brown trout in Penstock Lagoon, however there was almost a complete absence of brown trout below the legal size limit of 420 mm. This indicated there had been a failure of fry stockings in the preceding three years. Consequently, a further survey was undertaken in July 2014 to examine CPUE, population structure and estimate the population size. The results of the 2013 and 2014 surveys suggested the size of the population was much lower than expected. During 2014 -2017, adult brown trout were consistently transferred into the lagoon. These transfers were primarily for fishery assessment purposes however, it became apparent these fish were contributing to a high proportion of angler's catches and displayed significant gains in both weight and length. A further fishery performance assessment in 2016 confirmed this position, with the ongoing transfer of adult brown trout becoming the preferred fishery management tool.

2. FPA Survey Methodology

2.1 In-Lake Population Surveys

During 30 April to 2 May 2018, 124 box traps were set across all habitat types, including several deeper water sets. All 258 brown trout captured on the first day were weighed and measured for fork length, while the second day a further 112 brown trout were weighed and measured, with the remaining 76 only counted. Just 10 rainbow trout were captured across the entire survey. During the survey, all brown trout were checked for the presence of a clipped adipose fin, an adipose fin punch or an unmarked adipose fin; this distinguished the 2014 and 2016 adult transfers from all other brown trout.

2.2 Stocking Database

The Service 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.

2.3 Annual Postal Survey

Since 1986, the Service has conducted a postal survey seeking information about anglers' catches. The survey comprises a form sent to ten percent 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, harvest 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 post 2000 are analysed.

3. Results

3.1 In-Lake Survey 2018

During 30 April – 2 May 2018, the Service conducted an in-lake survey at Penstock Lagoon to:

- examine CPUE for brown and rainbow trout,
- to assess the population structure of both brown trout and rainbow trout,
- assess the abundance and growth of two groups of adult brown trout,
 - 1) those released in June 2014 that were adipose fin clipped, and
 - 2) those released in June 2016 that had a distinctive adipose fin punch mark.

A total of 456 trout were captured, consisting of 446 brown trout and 10 rainbow trout.

3.2 CPUE Information

Over the three days (2 nights) of the survey, 62 box traps (124 sets) were used to capture 446 brown trout. In respect of CPUE, box traps returned 3.60 brown trout per box trap, with the vast majority of traps catching multiple fish. The CPUE for this survey is similar to that obtained from a duplicate survey using box traps during 2016 (see table 1). A survey undertaken in 2014 that used a combination of methods (box traps and fyke nets), returned a lower CPUE of 2.15 fish per box trap. This lower CPUE was confirmed at the time, with a population estimate for brown trout being undertaken. This estimate indicated a lower population size than anticipated and therefore validates the lower catch effort and the concern expressed by anglers.

Year	Method	No. traps	Sample time	Effort	Catch	CPUE fish
2014	Box traps	21	3 overnight sets	*62 net sets	133	2.15/net
2016	Box traps	60	2 overnight sets	120 net sets	417	3.48/trap
2018	Box traps	62	2 overnight sets	124 net sets	446	3.60/trap

Table 1: CPUE for brown trout, Penstock Lagoon 2014, 2016 and 2018.

* one net removed for last sample night.

A total of 10 rainbow trout were captured from box traps, representing two percent of the total catch from all traps. Mean CPUE was 0.08 fish per box trap. This figure was well down on the CPUE of 1.08 fish per trap for the 2016 survey, with 130 rainbow trout captured using the same methodology.

Total	Number	Percent
No adipose marks	322	72
Adipose clips 2014	54	12
Adipose punch 2016	70	16
Total	446	100

Table 2: Number and percentage of adipose fin marks.

Of the 446 brown trout captured, 28 percent possessed an adipose fin mark, with 12 percent having an adipose clip from 2014 and 16 percent an adipose fin punch from 2016 (see table 2). This result indicates good survival of the original 2,000 fin clipped brown trout stocked into the lagoon during 2014. During 2014, these fish represented 31% of the survey catch; during the 2016 they represented 20% and 12% for the 2018 survey. The 2016 adipose punched fish represented 26% of the survey catch in 2016 and 16% for the 2018 survey.

3.3 Length and Weight Information – Brown Trout

A total of 370 brown trout were weighed, measured and sexed, consisting of 245 males and 121 females with 4 fish identified as indeterminate. This bias in males reflects the preference in the stocking regime that favours the transfer of male fish to avoid the prevalence of egg bearing females.

The vast majority of brown trout displayed good growth across all lengths (see figure 1). Fish over 500 mm continued to show good weight gains, with very few longer fish displaying lower weight to length ratios (fish condition). There was just one fish over 600 mm, this is similar to the results obtained from the 2014 and 2016 surveys, where no brown trout over 600 mm

were captured. Furthermore, as evident in the 2016 survey, all fin marked fish (clipped and fin punched), had similar length/weight relationship to those brown trout that were unclipped, indicating similar growth characteristics.

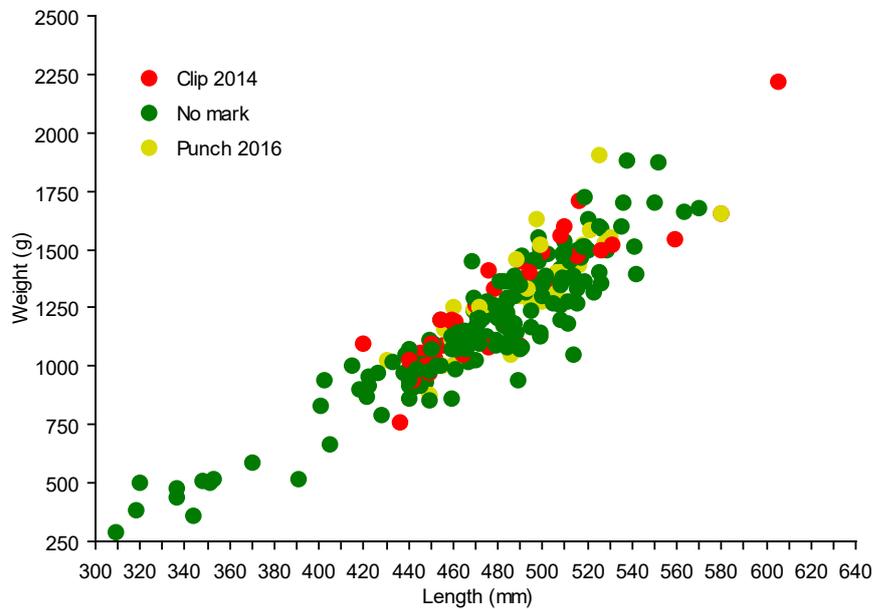


Figure 1: Length weight relationship for brown trout captured in 2018, showing non-clipped, fin clipped 2014 and fin punched 2016 fish (regression relationship: $Y = -1541.128 + 5.778 * X$; $R^2 = 0.835$).

Figure 2 shows the length frequency for all brown trout captured and measured during the 2018 survey. Two thirds of these fish were between 400 – 500 mm, with 29 percent between 500 – 600 mm. These larger sized fish are to be expected, as the lagoon is stocked exclusively with adult fish, with most transferred fish measuring over 400 mm. There were a small number of fish in the 280 – 400 mm length range. The source of these fish is unclear but are likely from a small transfer of 770 brown trout from Arthurs Lake during 2017, where only fish under 400 mm were transferred. In addition, there may be some low level natural recruitment, with small numbers of juveniles trickling in via the inflow canals.

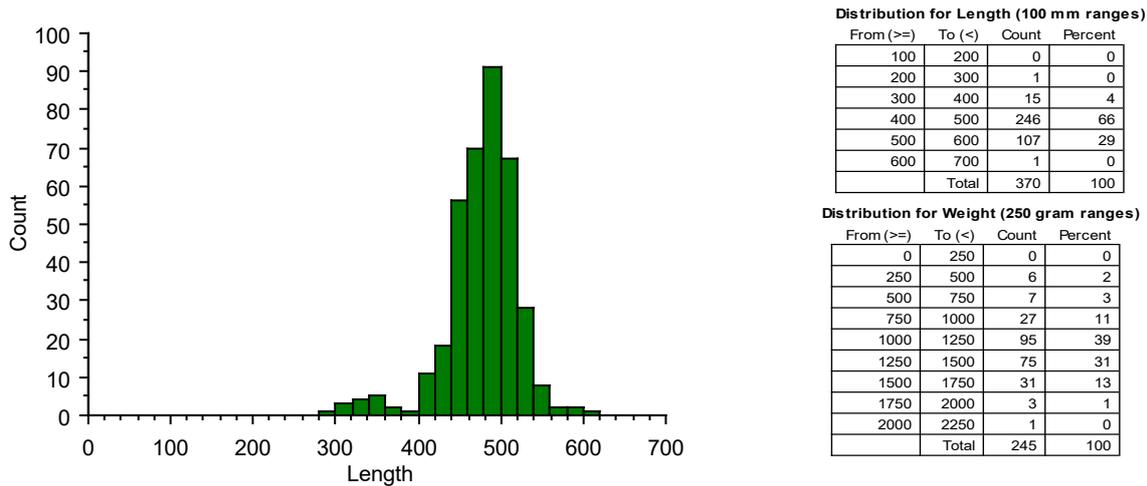


Figure 2: Length frequency and related weight and length information for brown trout, Penstock Lagoon 2018.

When the length frequency data is separated into non-clipped, 2014 adipose fin clips and 2016 adipose fin punches (see figure 3), it is apparent there are still a significant number of adipose clipped and adipose punched fish remaining, with most growing to around 420 – 560 mm. The remaining unclipped brown trout are from the 2015 and 2017 adult transfer program. The 2017 transfers consisted of around 80 percent collected from yingina/Great Lake, that were larger fish; while 20 percent were from Arthurs Lake and were generally smaller (less than 400 mm on release). Remaining fish are likely to be from the 2015 adult transfers.

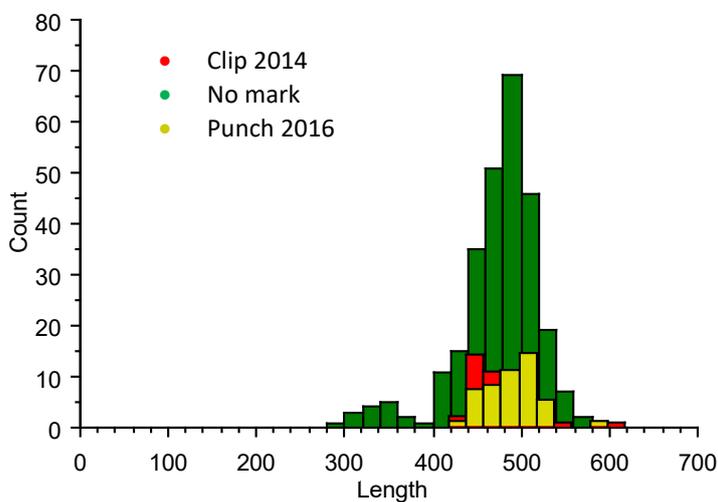


Figure 3: Length frequency for brown trout, Penstock Lagoon 2018; showing non-fin clipped, fin clips 2014 and fin punches 2016.

The survey data suggests at present, 95% of the brown trout within the lagoon meet the new (2018/19 season) legal size limit of 400 mm length. Brown trout over 400 mm on average, measured 483 mm length and 1.25 kg weight. This suggests anglers can potentially harvest the vast majority of fish they capture, within the confines of the daily bag limit.

Table 3 shows the summary statistics for brown trout separated into four categories; all fish combined, no-fin marks, fin clipped 2014 and fin punched 2016. The average (mean) weight and length for all groups; except fin punched 2016 and non-fin marks, were similar. This difference in both the weight and length between non-fin marks and fin punches 2016, likely relates to a small number of brown trout in the 300 – 400 mm range transferred from Arthurs Lake during 2017. Other than this, most fish appear to grow to around 1.0 – 1.5 kg with approximately 14 percent growing to 1.5 – 2.0 kg (see tables associated with figure 2).

Grouping	Measurement	Mean	Std Error	Count	Minimum	Maximum
All brown trout (n=370)	Length (mm)	477	2.28	370	296	605
	Weight (g)	1,208	18.39	245	290	2,220
	Cond Factor (k)	1.10	0.01	245	0.78	1.53
No – fin marks (271)	Length (mm)	473	2.84	271	296	570
	Weight (g)	1,176	22.22	175	296	1,880
	Cond Factor (k)	1.10	0.01	175	0.78	1.53
Fin clipped 2014 (52)	Length (mm)	483	5.08	52	420	605
	Weight (g)	1,269	46.39	37	763	2,220
	Cond Factor (k)	1.13	0.01	37	0.92	1.23
Fin punch 2016 (47)	Length (mm)	491	4.12	47	430	580
	Weight (g)	1,309	39.88	33	880	1,907
	Cond Factor (k)	1.12	0.02	33	0.85	1.33

Table 3: Length, weight and condition factor for all brown trout captured in box traps, separated by: combined sample, non-finclipped, 2014 adipose clips and 2016 adipose fin punch.

3.4 Length and Weight Information – Rainbow Trout

Despite 6,000 rainbow trout stocked in 2015 and 3,000 during 2017 (see table 5), just 10 rainbow trout were captured during the survey. Their mean length was 430 mm and mean weight 924 grams. This low catch is below expectation; however, it is likely to reflect a gross decline in the number of rainbow trout that remain in the lagoon. All rainbow trout were in good condition, with three sizes of fish recoded, 345, 450 and 500⁺mm.

3.5 Comparison 2003, 2013, 2014 & 2016 Surveys

Comparative summary data for all formal in-lake surveys undertaken at Penstock Lagoon since 2003 are shown in figures 4 & 5 and table 4. In general, the rate of growth of brown trout is consistent across all years. The 2003 result shows a small number of brown trout were growing to a large size in excess of 600 mm length. This size class was detected during the 2013 and 2018 surveys but at very low numbers; they were absent in the 2014 and 2016 surveys. Nevertheless, all surveys contained a high number of fish in the 500 - 600 mm length

range. This result indicates a proportion of fish are not being harvested and therefore growing through to this size range. However, increased angling effort during the coming seasons and its effect on harvest will need to be monitored (see figure 6 & 8).

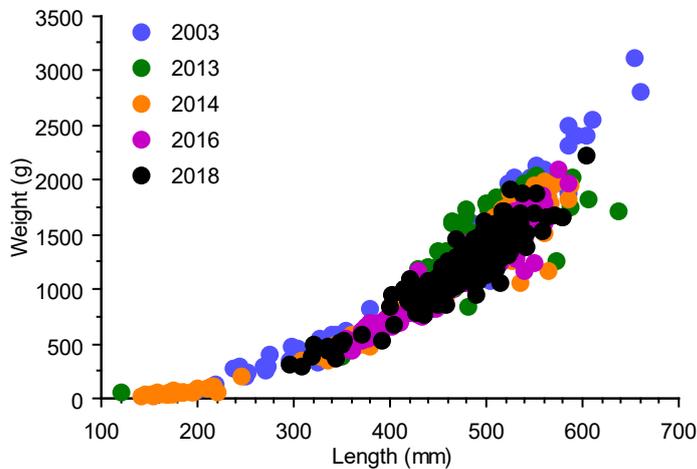


Figure 4: Length/weight regression for comparative surveys undertaken in 2003, 2013, 2014, 2016 or 2018 brown trout, Penstock Lagoon.

Figure 9 shows the median and spread of values for weight, length and condition factor for in-lake surveys. During 2003 and 2014, there were a greater spread of fish lengths and weights in comparison to 2013, 2016 and 2018. The compressed length data for 2013, 2016 and 2018 are likely to be a result of two separate circumstances. The 2013 result is a consequence of poor recruitment with low total numbers and very few smaller fish present (as highlighted in the 2014 survey report, IFS 2014); whereas the 2016 and 2018 result is the outcome of multiple years of adult transfers (2014 – 2018) and no stocking of juvenile fish. This has resulted in a high proportion of brown trout (96%) being over 400 mm length.

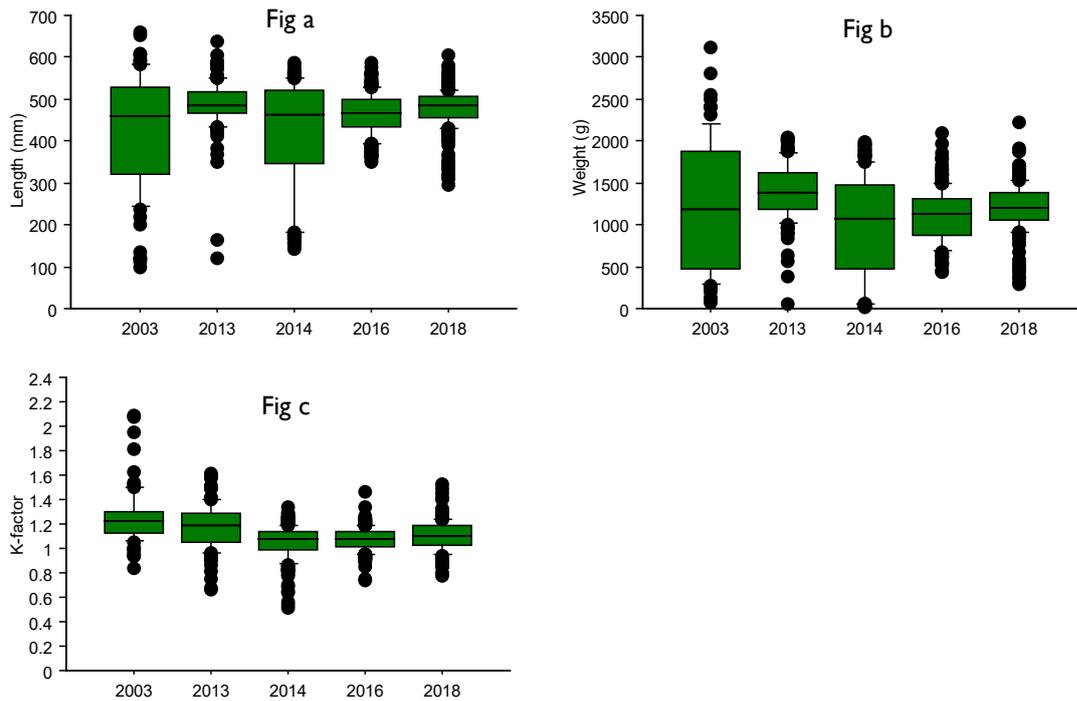


Figure 5: Box plots showing median and associated upper and lower quartiles for, (a) length, (b) weight and (c) condition factor for surveys undertaken in 2003, 2013, 2014, 2016 and 2018 for brown trout, Penstock Lagoon.

Variable	Mean	Std dev	Count
Weight 2003	1198	758.4	81
Length 2003	419	136.7	85
CF 2003	1.3	0.2	80
Weight 2013	1391	348.9	131
Length 2013	488	67.9	132
CF 2013	1.2	0.2	131
Weight 2014	976	608.0	192
Length 2014	417	127.6	192
CF 2014	1.1	0.1	192
Weight 2016	1106	313.8	231
Length 2016	465	49.0	231
CF 2016	1.1	0.1	231
Weight 2018	1208	287.92	245
Length 2018	477	43.95	370
CF 2018	1.1	0.12	245

Table 4: Length, weight and condition factor of surveys undertaken in 2003, 2013, 2014, 2016 and 2018, brown trout, Penstock Lagoon.

4. Stocking History

Over the past 14 years, Penstock Lagoon has undergone a number of changes to the trout stocking regime. These changes have been driven by two main factors, access to additional adult brown trout for transfer and the resulting lower than expected contribution of fry and fingerlings from the IFS hatchery. During the early 2000's, the lagoon was stocked with a combination of adult brown trout transferred from yingina/Great Lake and both brown and rainbow trout fry from the Salmon Ponds hatchery. With the commissioning of the New Norfolk hatchery in 2007, the focus changed toward producing slightly larger fingerling sized brown trout and the provision of limited numbers of triploid brown and rainbow trout, rather than adult brown trout (see table 5). There is strong evidence (both from previous surveys and anecdotal) to suggest adult brown trout have been successful, both in terms of growth and catch rate. The stocking of fry and fingerlings has been assumed to be successful, as past precedence suggests. However, the degree to which these stocking events have contributed to the sustainability of moderately high catch rates is less certain. As suggested from the results of the previous 2014 and 2016 surveys.

The length frequency analysis from the this survey and the 2016 survey, demonstrates that for Penstock Lagoon at least, the transfer of adult brown trout has been successful, in terms of survival, growth, catch rate and overall harvest.

	Species	Number	Age	Type
2007	Brown trout	20000	Fry	Diploid
2008	Brown trout	10000	Fry	Diploid
2009	Brown trout	5000	Fry	Triploid
2010	Brown trout	10000	Fry	Diploid
2011	Brown trout	10000	Fry	Triploid
2012	Brown trout	15000	Fry	Triploid
2013	Brown trout	10000	Fry	Triploid
2014	Brown trout	55000	Fry	Triploid
2007	Brown trout	3500	Fingerling	Diploid
2008	Brown trout	250	Fingerling	Diploid
2009	Brown trout	5000	Fingerling	Triploid
2009	Brown trout	5000	Fingerling	Diploid
2007	Brown trout	490	Adult	Diploid
2008	Brown trout	280	Adult	Diploid
2009	Brown trout	100	Adult	Diploid
2014	Brown trout	2320	Adult	Diploid
2015	Brown trout	4292	Adult	Diploid
2016	Brown trout	3658	Adult	Diploid
2017	Brown trout	3694	Adult	Diploid
2018	Brown trout	3000	Adult	Diploid
2007	Rainbow trout	7000	Fingerling	Diploid
2008	Rainbow trout	5000	Fingerling	Diploid
2009	Rainbow trout	10000	Fingerling	Triploid
2010	Rainbow trout	10000	Fry	Diploid
2011	Rainbow trout	10000	Fingerling	Triploid
2012	Rainbow trout	10000	Fry	Diploid
2013	Rainbow trout	15000#	Fry	Triploid
2014	Rainbow trout	50000*	Fry	Triploid
2015	Rainbow trout	6000	Yearlings	Triploid
2017	Rainbow trout	3000	Yearlings	Triploid

Table 5: Stocking history for Penstock Lagoon, 2007 – 2018. (*split between 2013-14; # stocked Dec 2012)

5. Angler Postal Survey

Average (mean) fishing effort in the period 2001 – 17 was 8,808 angler days per season, with a low of 4,190 in the period when the fishery was rebuilding after a decline in water quality and low fish stocks in the late 1990's, and highs of 13,190 days during 2006/07 and 14,800 days during 2016/17 (see figure 6). The first peak in fishing effort coincides with a prolonged drought that resulted in low lake levels and poor catches at other major fisheries.

Consequently, a large influx of anglers moved from these waters to other 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 during 2014-17, total fishing effort rebounded to high levels, with an estimated 14,800 angler days during 2016/17.

The average number of days fished per angler, per season was 4.4 days (see figure 7).

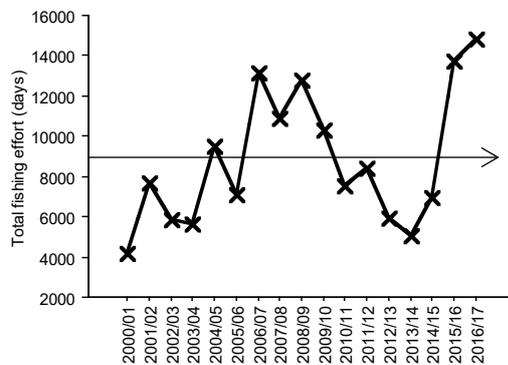


Figure 6: Total angling effort 2000 – 2017.

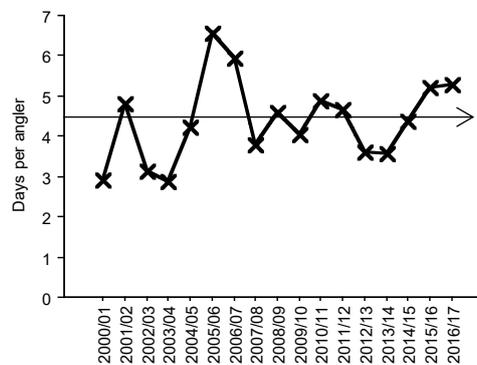


Figure 7: Number of days fished per angler for each season 2000 – 2017.

The estimated mean harvest of brown trout for the period 2000 – 2017 was 9,000 fish. Since the very high harvest in 2006/07 of 22,299 brown trout, the annual harvest figure has trended down to 4,488 brown trout in the 2013/14 season (see figure 8). Following three consistent years of adult brown trout transfers and the continued under performance of the Arthurs Lake fishery, the total harvest of brown trout has returned to high levels, with an estimated 20,934 brown trout caught during the 2016/17 season. This level of harvest is likely to compromise some values of the fishery (i.e. moderate catch rate of well-conditioned fish in the 1.3 – 2.0 kg weight range). This survey suggest larger fish over 1.8 kg are absent.

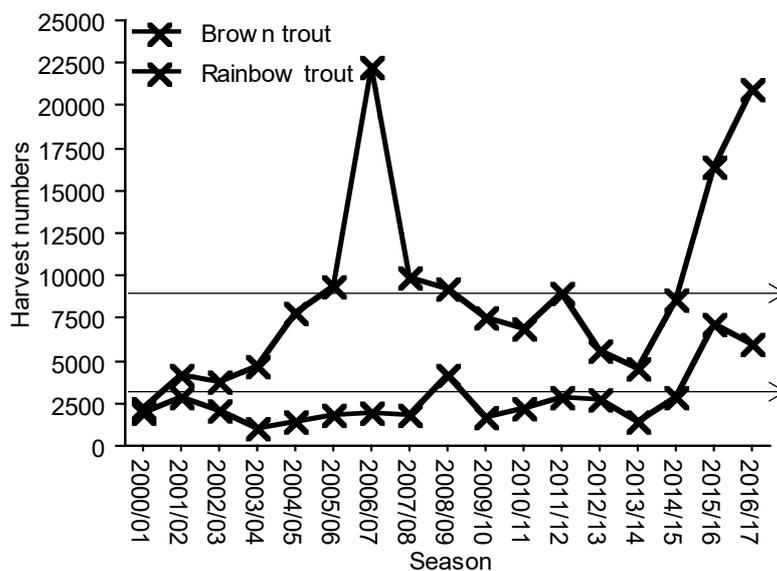


Figure 8: Estimated harvest of brown and rainbow trout 2000 – 2017.

The average daily catch rate for the period 2000 – 2017 was 1.0 brown trout per day (see figure 9). Despite a fall in angling effort and corresponding annual harvest, the daily catch rate over the period 2011 - 2013 remained around the long term average. Since 2014, the daily catch rate has been at strong 1.2 – 1.4 brown trout per day.

Over the period 2000 – 2017, brown trout represented on average 75 percent of the total harvest of all trout, correspondingly, rainbow trout represented 25 percent (see figure 10).

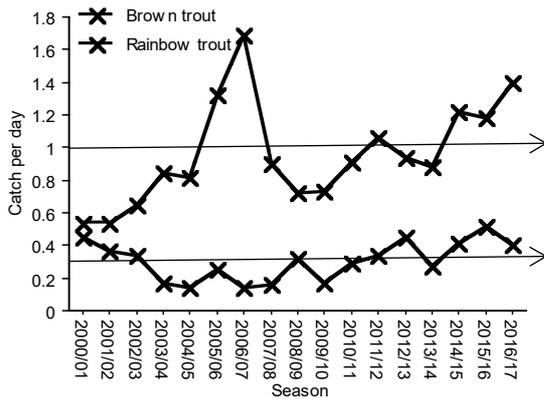


Figure 9: Daily catch rate for brown and rainbow trout, 2000 – 2017.

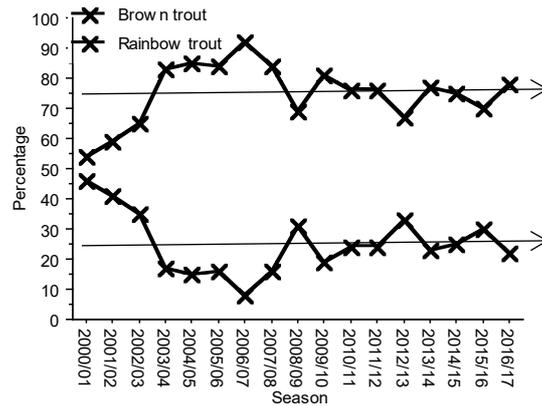


Figure 10: Percentage harvest for brown and rainbow trout, 2000 – 2017

The average catch rate for rainbow trout has generally remained around the long term average of 0.3 fish per day (see figure 9), with an average annual harvest of 2,700 fish (see figure 8). An increase in both harvest and catch rate for the 2015-17 period generally relates to a stocking of 6,000 yearling rainbow trout in November 2015 and 3,000 yearling in 2017, in addition to an overall increase in total fishing effort for this period.

6. Discussion

The CPUE of 3.6 brown trout per trap is comparable to the result from the 2016 survey and indicates the abundance of fish remains moderately high, this is despite a large increase in angling effort and total estimated harvest. The growth and condition of fish indicates there does not appear to be any suppression of growth due to density dependent factors. This situation is supported by the growth displayed by the 2016 adipose fin punched brown trout that increased in weight on average by 42% from 924 g to 1.31 kg. The growth of the 2014 fin clipped brown trout slowed markedly after 2016. These fish were released into the lagoon during May-June 2014 at an average weight of 580 g, by 2016, they were 1.3 kg. The average weight from this survey for this group was 1.27 kg. The modal length of this group of fish also decreased from 520 mm during 2016, to 460 for this survey (see appendix A1), indicating larger fish are being harvested (or some are dying of natural causes). The same pattern was not observed for the 2016 adipose fin punched fish. The modal length of this group increased from 440 mm when released in 2016, to 520 mm for 2018 (see appendix A2).

The consistent transfer of adult brown trout in the 1 kg range is resulting in the population structure becoming compressed. The population consists of a large number of fish in the 400-500 mm length range, with significant numbers of fish in the 1.25 – 1.75 kg weight range. This does not however, appear to be effecting growth. There was just one fish over

600 mm indicating fish are being harvested before they are able to reach this size. Given the number of brown trout in the lagoon at present, if angling effort reduces overtime, it will be prudent to lower the numbers transferred and consider stocking a wider size range of fish.

Survival of the 2014 and 2016 fin marked fish was relative high, indicating a high rate of catch and release that is contributing to a higher than expected abundance of fish. However, continuation of high angling effort and associated harvest, means sustained high stocking numbers will be necessary in the immediate future.

The catch of rainbow trout was extremely low and well below expectation. This is likely a reflection of the high angling effort and the low survival of this species once captured. It may be prudent to consider alternate strategies for the stocking of rainbow trout into the lagoon, or accept a higher abundance of rainbow trout is required to maintain the angling values as set for this species (refer Tasmanian Inland Recreational Fishery Management Plan 2018-28) (TIRFMP).

With regard to the fishery goals as set out in the TIRFMP, Penstock Lagoon at present meets the values for catch rate and population size. It did not reach the goal for average weight for fish over 400 mm set at; 1.4 - 1.6 kg (presently 1.25 kg) and fish over 600 mm at 5% (presently <1%). The main factors preventing the goals for average weight and percentage of brown trout over 600 mm is high angling effort. Presently, the stocking of adult fish in the 1 kg range and the effects of angling effort, are confining a high number of brown trout to the 1.25 – 1.75 kg range. If high angling effort continues, and fishery goals are to be met, there will be a need to limit the take brown trout over 500 mm.

For rainbow trout, the fishery meets the goal for catch rate (0.3 fish per day) but due to a low sample size, it was not feasible to assess other relevant fishery criteria.

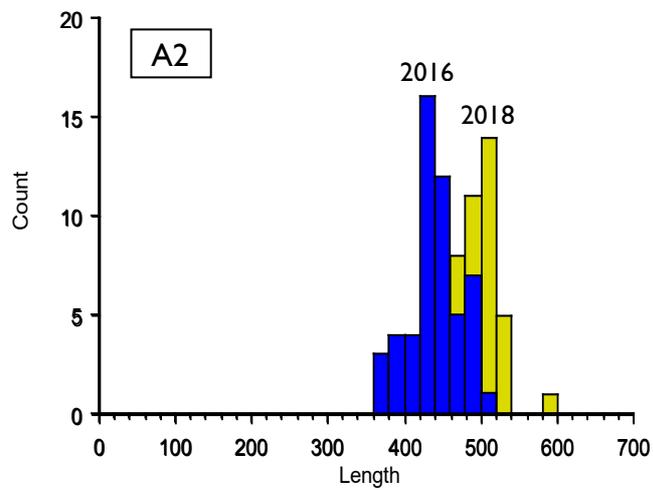
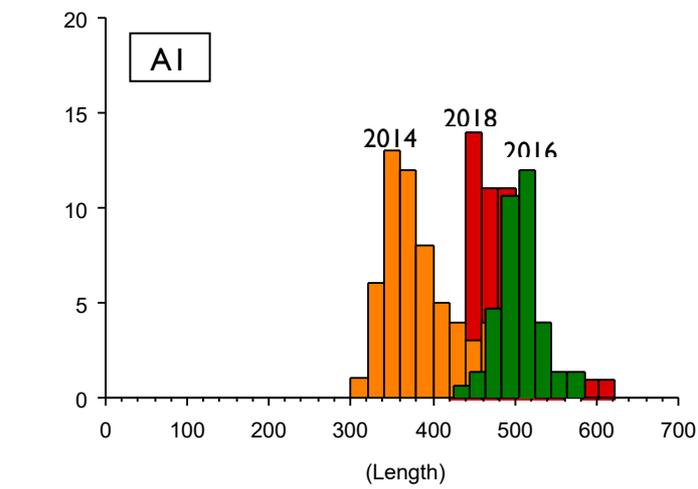
In summary, the Penstock Lagoon fishery is performing to expectations, but some minor adjustments to stocking, the take of larger fish and reducing total angling effort will provide benefits in achieving the goals set for the fishery.

7. Recommendations

- The use of wild adult brown trout as the primary method of restock is continued.
- Adult fish transfers should contain a higher percentage of younger fish.
- Reduce angling effort at Penstock Lagoon by managing other similar valued fisheries e.g. improved access and/or increased angler satisfaction.
- Educate anglers regarding good catch and release techniques.
- Revise the stocking program for rainbow trout and consider alternate strategies to meet the goals for the fishery.

8. Appendix

A) Length frequency plots for (A1) adipose clipped brown trout 2014 and (A2) adipose fin marked brown trout 2016, as analysed for each survey 2014, 2016 and 2018.



9. References

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