Inland Fisheries Service Report

Recreational Fisheries Report

Fisheries Performance Assessment

Technical Report

Lake Leake - July 2017

Inland Fisheries Service

Tasmanian Government

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1 Introduction

Lake Leake is an artificial impoundment built during the early 1880's, situated 36 km east of Campbell Town. The lake was used as a town water supply for Campbelltown but now provides irrigation water for downstream users. Full supply level is 571 m ASL. The waters of the lake inundate a natural marsh and bushland, covering an area of approximately 6 square kilometres. Lake Leake is subject to annual drawdowns but the water quality is generally good with low turbidity typical. Much of the shoreline is lined with drowned timber and the lake supports extensive macrophyte beds.

The lake has a very large population of the invasive redfin perch and has in the past been stocked with short finned eels, rainbow trout and brown trout.

Lake Leake was initially stocked with rainbow trout by the then Fisheries Commission during 1889, with subsequent stockings to follow conducted by various angling associations. First reports of brown trout were from 1907, likely due to accidental transfer. Brown trout became established and generally have been the dominate species, although the lake was mostly known as a prime rainbow trout fishery. Actions were undertaken by the Inland Fisheries Commission in 1967 to redress the dominance of brown trout. This involved removing several thousand brown trout from the spawning run. This action proved unsuccessful and the plan ceased following protest from many anglers (Roberts 1983). Today the fishery is managed as a brown trout water, with supplementation of the rainbow trout population with commercially grown fish. Until 2003, the brown trout population was supplemented by stocking 30-40,000 fry per annum. By comparison to natural recruitment, the contribution of these fish has been negligible. In 2013, the Inland Fisheries Service commenced a program to stock the water with adult brown trout collected from the spawning runs from the Central Highland (mostly Liawenee Canal). These fish appear to be contributing to the underlying population and maintaining an acceptable catch rate.

2 Fishery Performance Methods

2.1 In-lake Surveys

In readiness for a capture-mark-recapture population estimate, 2,000 adult brown trout sourced from the trap at Liawenee Canal, Great Lake, were transferred to Lake Leake (24-25 May) . All fish were marked by having their adipose fin clipped. These fish were allowed to mix with the general brown trout population for eight weeks, before undertaking a recapture survey to estimate the population size. The average weight of these transferred fish was 977 grams.

During 24-27 July 2017, the Service undertook an intensive trapping survey within Lake Leake. The purpose of the survey was to gain information on:

- catch per unit effort,
- the size structure of the brown trout population,
- establish an estimate of the brown trout population size, and
- examine the rainbow trout population.

A total of 78 box traps (see figure 1) were set over two nights, with most deployed around the perimeter of the lake and eight deployed in the deep water sections in the north east basin.

From the 156 box trap sets, 410 trout were captured, consisting of 383 brown trout and 27 rainbow trout. A sample of 317 brown trout and 24 rainbow trout were sexed, weighed and measured. All brown trout captured were examined for the presence of an adipose finclip. Traps were checked and cleared after the first night and then cleared and retrieved after the second night.

Figure 1: Typical box trap set showing three co-joined traps *(Penstock Lagoon).*

2.2 Stocking History

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 (wild or domestic strain) and genotype, in addition to some length/weight data and comments of stocked fish, 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 of 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.

3 Fishery Performance Results

3.1 In-Lake Survey Brown Trout

Brown trout length weight data

From 156 box trap sets, a total of 410 trout were captured, consisting of 383 brown trout and 27 rainbow trout. A sample of 317 brown trout and 24 rainbow trout collected were sexed, weighed and measured. Unless otherwise stated, the results reported are for non-fin clipped ('resident') brown trout only, as fin-clipped fish had only been in the lake for 8 weeks. Some comments are made on these fin clipped fish below and within the relevant sections.

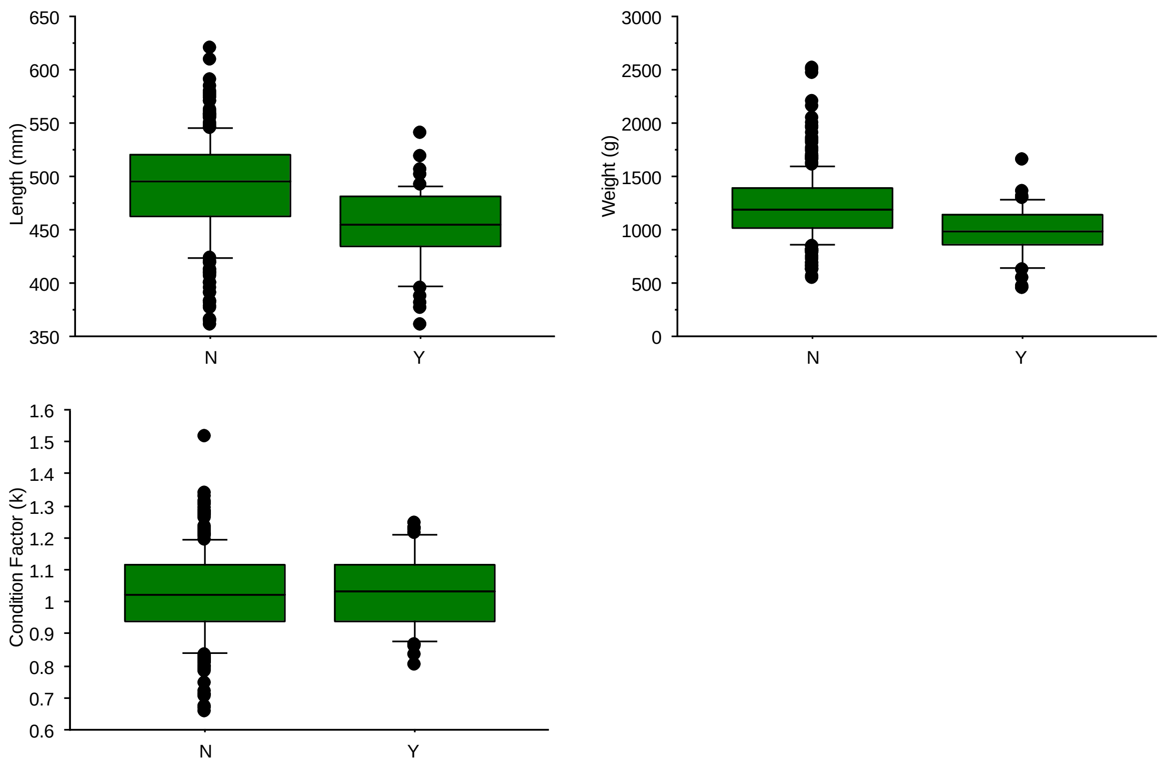


Figure 2: Box plots for brown trout - length, weight & condition factor separated by fin clipped transferred fish (Y) and non – fin clipped resident fish (N).

Of the 317 brown trout weighed and measured, 264 did not have fin clips and were therefore fish from either natural recruitment or adult transfers from previous years and a fry stocking done in 2013 (see appendix a). The remaining 53 brown trout had fin clips, indicating they were the adult brown trout transferred in May 2017. Non-clipped fish had a mean weight of 1 221 g with mean length of 491 mm. By comparison to the clipped fish transferred from Great Lake, they were on average heavier and longer (see figure 2 and table 1). However, the mean condition factor for both groups was almost the same at 1.03 for clipped fish and 1.02 for non-clipped fish.

Grouping	Measurement	Mean	Std Error	Count	Minimum	Maximum
All brown trout (n=317)	Length (mm)	484	2.73	317	361	620
	Weight (g)	1 180	18.28	317	460	2 520
	Cond Factor (k)	1.03	0.01	317	0.66	1.52
Non – clipped (n=264)	Length (mm)	491	2.97	264	361	620
	Weight (g)	1 221	19.93	264	540	2 520
	Cond Factor (k)	1.02	0.01	264	0.66	1.52
Clipped (n=53)	Length (mm)	453	5.17	53	361	540
	Weight (g)	977	34.46	53	460	1 650
	Cond Factor (k)	1.03	0.02	53	0.08	1.25

Table: 1 Descriptive statistics for brown trout - length, weight & condition factor for combined sample and for fin clipped and non – fin clipped fish.

Brown trout length, weight and condition data (all non-fin clipped fish)

In total, 264 non-fin clipped brown trout were captured in box traps, consisting of 117 males and 147 females, one immature fish was captured (180 mm), but it is not included in most analysis. Male fish were significantly longer and heavier compared to female fish ($P<0.05$) (see figure 3 and table 2). There was however, no significant difference in the mean condition factor between sexes. At the time of the survey, many of the female fish were still carrying large quantities of eggs, as low winter inflows had hampered access to the spawning stream.

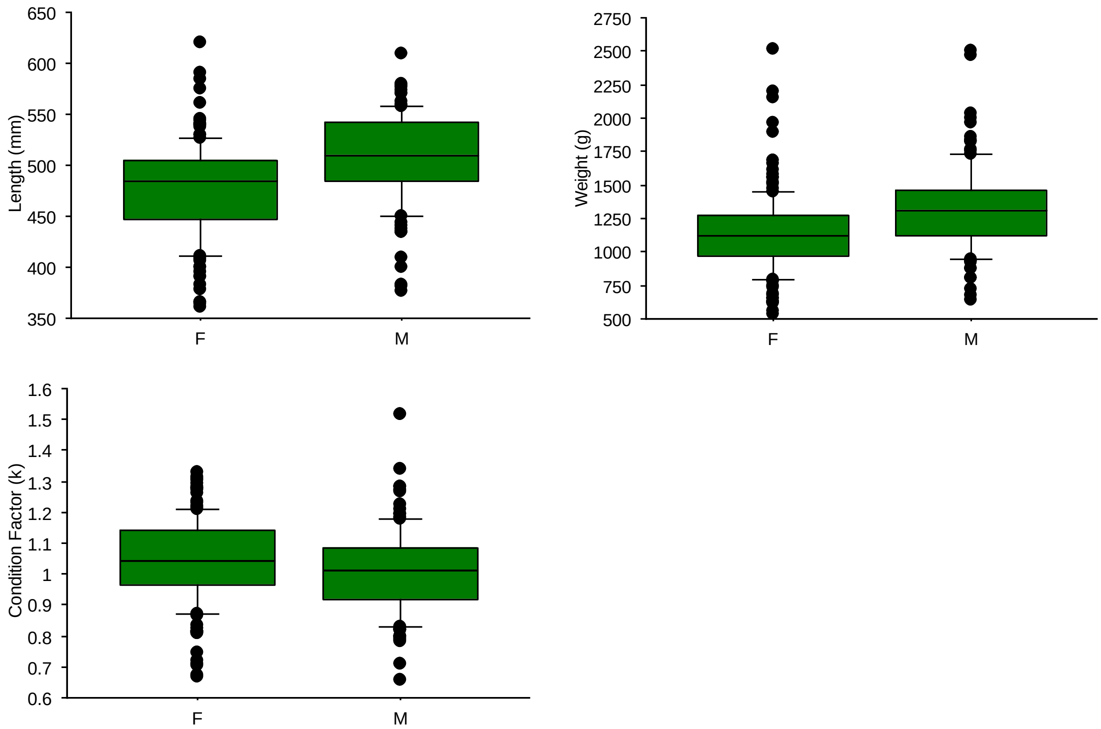


Figure 3: Box plots for brown trout - length, weight & condition factor separated by sex (F=female & M=male).

Grouping	Measurement	Mean	Std Error	Count	Minimum	Maximum
All brown trout (n=264)	Length (mm)	491	2.97	264	361	620
	Weight (g)	1 221	19.93	264	540	2 520
	Cond Factor (k)	1.02	0.01	264	0.66	1.52
Female (n=147)	Length (mm)	477	3.88	147	361	620
	Weight (g)	1 138	25.23	147	540	2 520
	Cond Factor (k)	1.04	0.01	147	0.67	1.33
Male (n=116)	Length (mm)	508	4.11	117	377	610
	Weight (g)	1 325	29.56	117	640	2 500
	Cond Factor (k)	1.01	0.01	117	0.66	1.52

Table 2: Descriptive statistics for non-fin clipped brown trout - length, weight & condition factor for combined sample and for each sex.

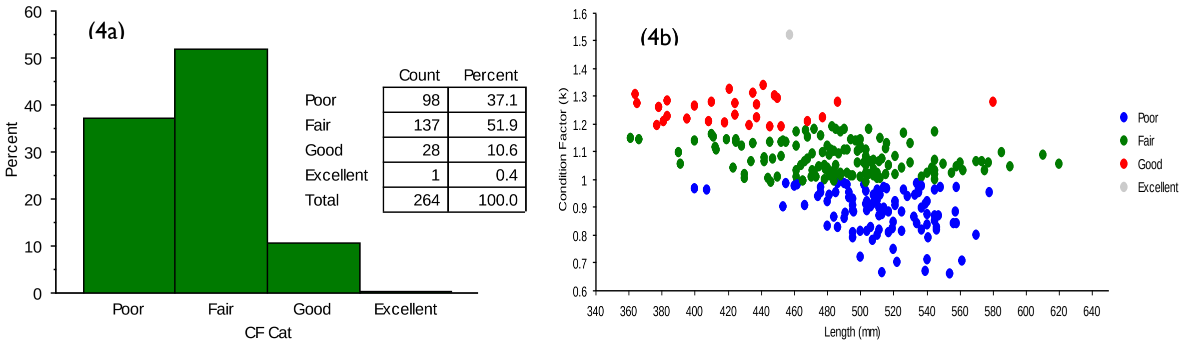


Figure 4: a) Condition factor category for all non-clipped brown trout, b) relationship for condition factor and length.

Overall, the condition of brown trout was poor to fair with 89 percent of fish in these two categories, with 11 percent classified as good, with just one fish in the excellent category (see figure 4 a&b). Many female fish still carried eggs and males had milt, indicating they were yet to spawn. Fifty five percent of brown trout over 500 mm were categorised as poor and several in the 500 - 560 mm length range in very poor condition (see figure 4b).

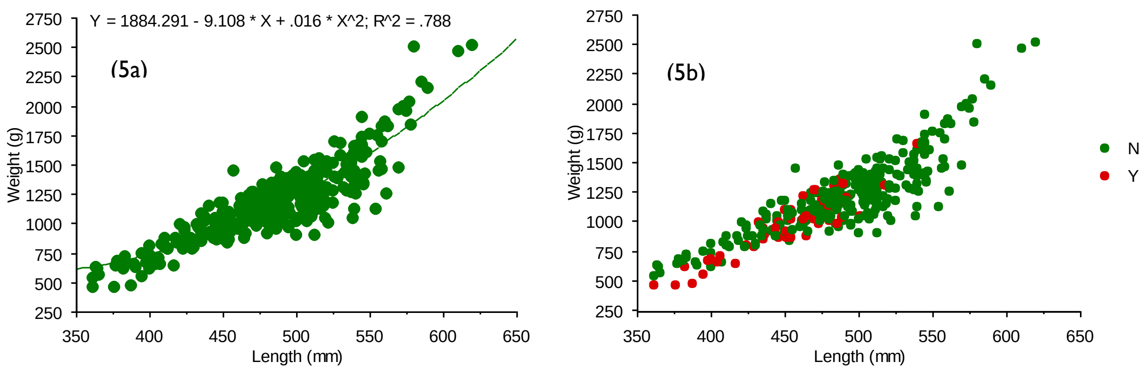
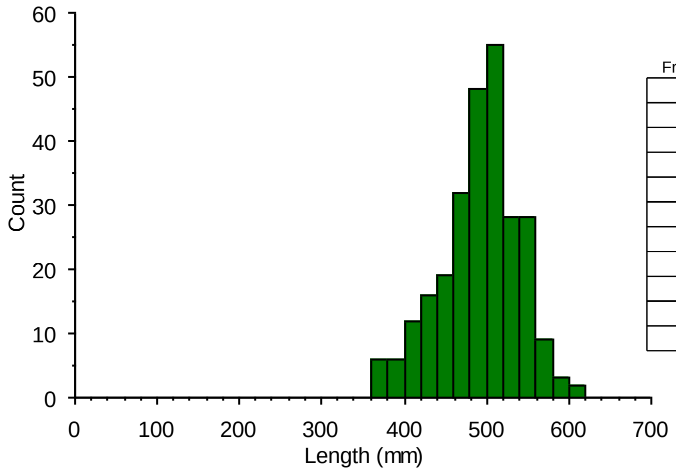


Figure 5: Length/weight relationship for brown trout; 5a) non-fin clipped fish; 5b) comparison of non-fin clipped fish (N) and fin clipped fish (Y).

Despite the lower condition factor displayed by the majority of brown trout, the growth of fish across all length ranges was good (see figure 5a). A few fish over 500 mm displayed poor condition yet others continued to grow to larger sizes, this was regardless of sex, with both male and female fish showing similar growth characteristics. The length weight relationship for fin clipped brown trout transferred from the Great Lake spawning run during May 2017, showed a similar pattern in weight for a given length to that of non-fin clipped fish (see figure 5b). The average condition factor of these two groups of fish was similar (see figure 2).



From (>=)	To (<)	Count	Percent
200	250	0	0
250	300	0	0
300	350	0	0
350	400	12	5
400	450	37	14
450	500	90	34
500	550	103	39
550	600	20	8
600	650	2	1
650	700	0	0
	Total	264	100

Figure 6: Length frequency for non-fin clipped brown trout.

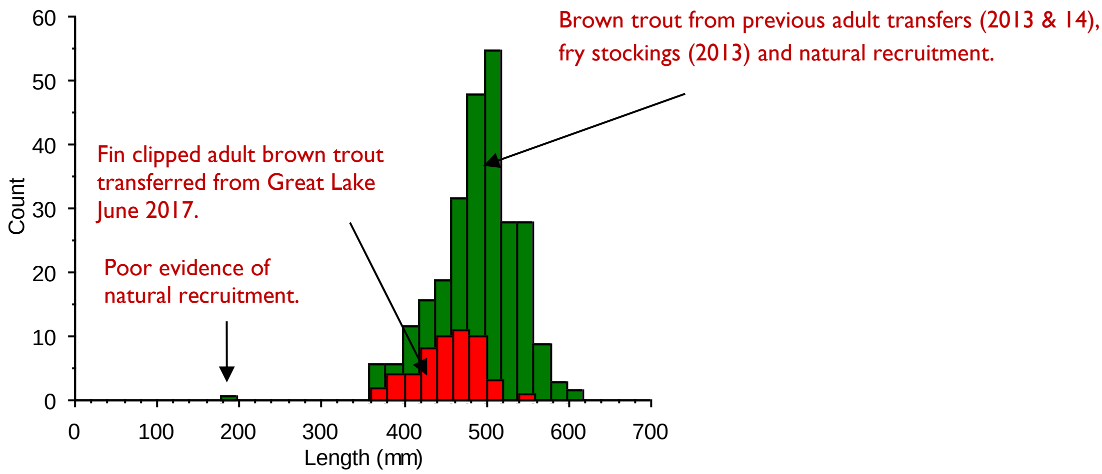


Figure 7: Length frequency for brown trout, showing fin clipped transfers and non-fin clipped captures, *(including the only juvenile fish (180 mm) captured during the survey).*

There appears to be very little structure to the length data for the brown trout population, with most fish clumped in the 420 – 560 mm range (see figure 6). Length data suggest some fish are growing to an old age (i.e. length > 560 mm). There are no signs of any substantial natural recruitment for the last two years with just one fish captured less than 360 mm. The fin-clipped transfers from Great Lake are distinguished in the figure 7 and generally encompass the length range 360-520 mm. It is difficult to draw any conclusions from this data in terms of past stocking events and the effects of natural recruitment pre 2014. However, during favourable periods, natural recruitment must be a substantial contribution in maintaining the population, as there are reasonable numbers of larger fish within the lake.

3.2 CPUE Information

Brown trout

Generally, the capture of brown trout in box traps was moderate with 383 brown trout capture from 78 box traps set over two nights with the nets cleared each day (total 156 sets). This equates to a mean CPUE of 2.54 brown trout per trap (see table 3).

Rainbow trout

Rainbow trout represented 6.6% of the total capture from box traps with a CPUE of 0.17 fish per trap. This figure is lower than expected, especially as 18 000 fingerlings had been stocked during December 2016 to January 2017. Approximately 40% of the rainbow trout captured and measured were less than 400 mm in length.

Species	No. traps	No. nights	Effort	No. brown trout	CPUE
Brown trout	78 deployed	2	156 net sets	383	2.45/trap set
Rainbow trout	78 deployed	2	156 net sets	27	0.17/trap set

Table 3: Survey CPUE for brown and rainbow trout.

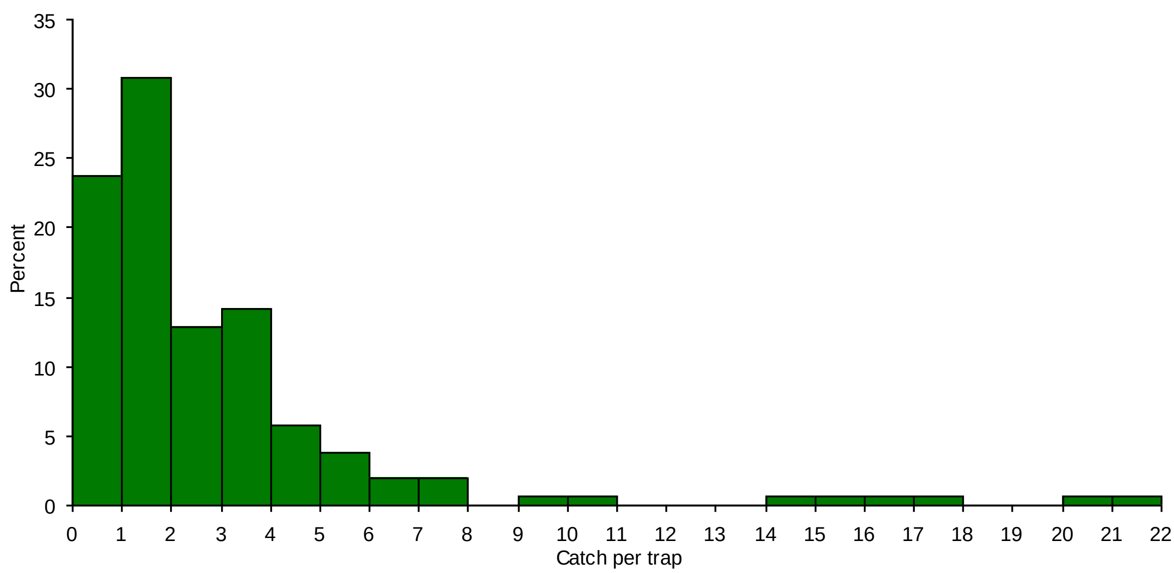


Figure 8: Capture frequency for brown trout expressed as a percentage of box traps that caught fish.

Figure 8 shows the percentage of box traps that caught a specified number of brown trout. Forty four percent of the traps caught between 1 to 3 brown trout per trap with 24 percent capturing no brown trout. The highest number of brown trout captured in one individual net was 22. Box traps captured a wide range of length classes between 360 – 620 mm. The lack of brown trout captured less than 360 mm indicates an absence of young fish (except YOY) rather than sampling bias, as box traps have captured a wide range of length class fish during surveys at other waters. Even in this survey, rainbow trout in the 200 – 340 mm length range were captured.

3.3 Population Estimate

During 24-25 May 2017, 2 000 adult brown trout that had been adipose fin clipped were transferred from Liawenee Canal to Lake Leake to allow a population estimate to be conducted. An eight week settling in period was allowed before a recapture survey was undertaken. A total of 383 brown trout were captured in box traps over a three day period (two nights). Of these fish, 71 had adipose fin clips (18.5%). Table 5 shows the parameters of the Petersen estimate, with 10 789 brown trout estimated to be within the lake. The associated estimate of bias was at acceptable levels i.e. > 4 and implies a reasonable degree of confidence of the estimate.

Parameter	Result
Total fin clipped released (M)	2 000
Total recaptures (C)	383
Total marked recaptures (R)	71
Population estimate: MC/R = N	10 789
Standard error	1 135
Lower and Upper 95% CI limits	8 564 – 13 013
Estimate bias level: MC/4N =	17.8 (>4 acceptable bias)

Table 5: Petersen population estimate for brown trout Lake Leake.

3.4 In-Lake Survey Rainbow trout

From 156 box trap sets, 27 rainbow trout were captured. A sample of 24 rainbow trout were sexed, weighed and measured. The sex of most rainbow trout was unable to be determined as it's likely they were all triploid stock (see appendix a).

The average length for the 24 rainbow trout sampled was 419 mm and average weight 960 g, with the largest fish weighing 1.7 kg. There were two distinct length ranges with fish in the 200 - 340 mm range resulting from a stocking of fingerlings in December 2016 and January 2017, and larger fish in the 460 – 580 mm range (see figure 9). .

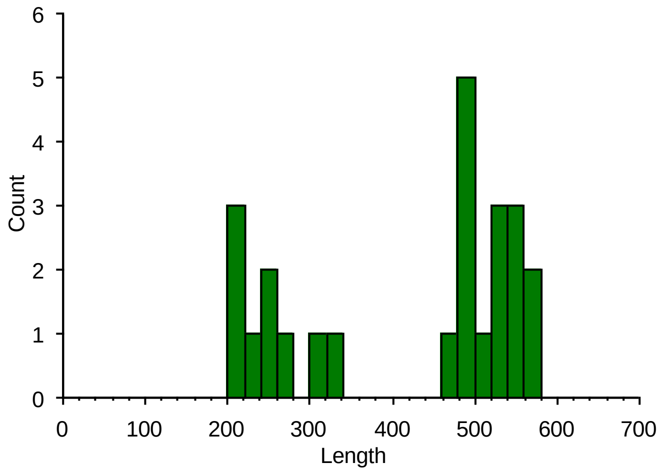
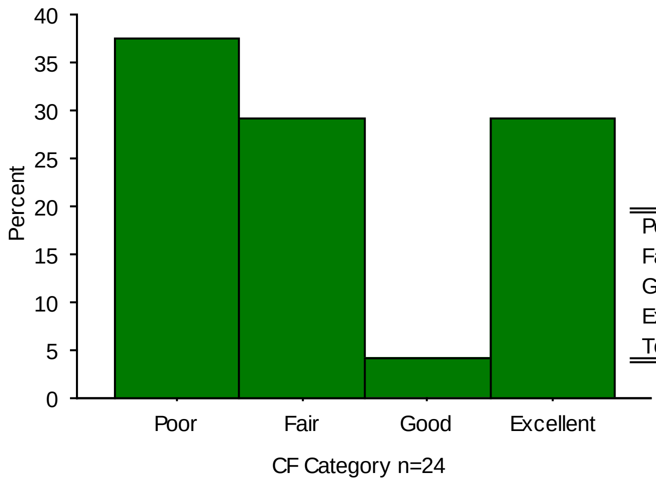


Figure 9: Length frequency for rainbow trout.



	Count	Percent
Poor	9	38
Fair	7	29
Good	1	4
Excellent	7	29
Total	24	100

Figure 10: Condition factor for rainbow trout.

Of the 24 rainbow trout weighed and measured, 33 percent were classified as being in good or excellent condition, while 38 percent were classed as poor (see figure 10). However, overall mean condition factor was a healthy 1.20. Most poor conditioned fish were over 450 mm.

4 Stocking History

Prior to 2004, Lake Leake was regularly stocked with around 30 000 brown trout fry from the Salmon Ponds hatchery. Stocking ceased in the period 2005 to 2013 and there appears to be no evidence this action was detrimental to the fishery. Natural recruitment has typically maintained the fishery until the drought of 2006 - 2008. Adult brown trout were stocked in 2013 and 2014 (see appendix a) but their contribution to the population and anglers' catches has not been assessed, except for examination via the postal survey, as reported below.

The stocking of rainbow trout has been more consistent but has been almost entirely dependent on the supply of fish from commercial hatcheries, consisting of fingerling and yearling fish. Brook trout were stocked in the period 2005-2008 but this was entirely due to an oversupply of fish from a commercial operation. The stocking of this species is not a normal practice.

5 Angler Postal Survey

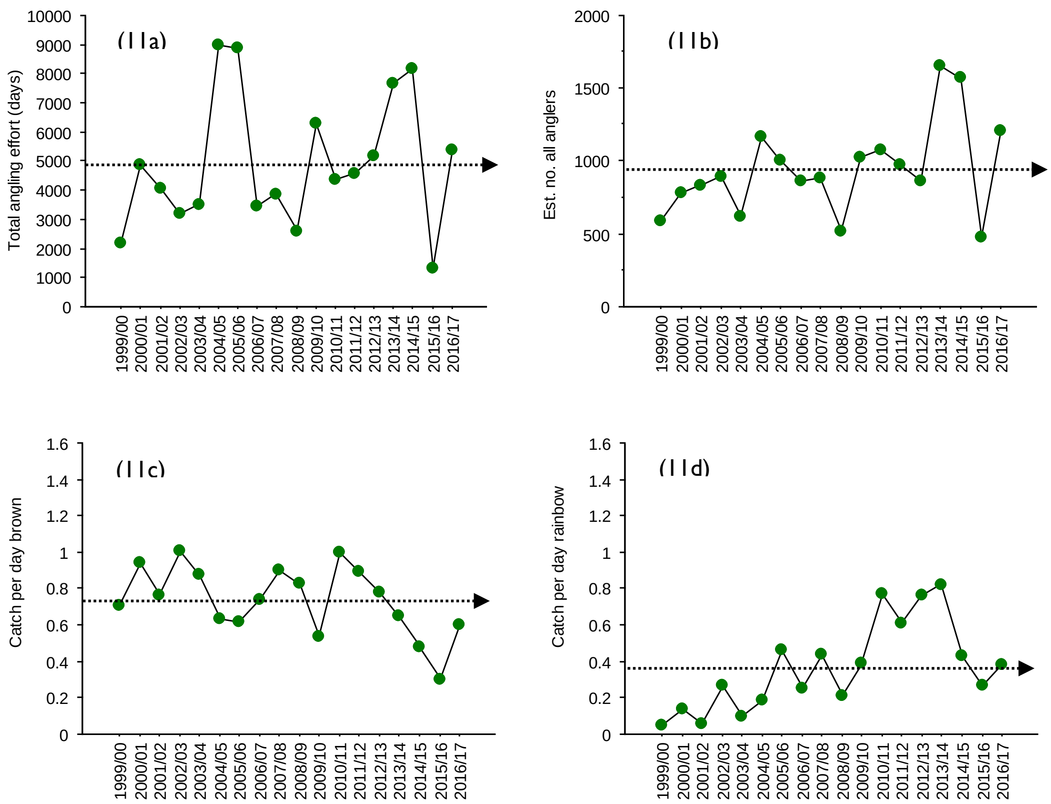


Figure 11: Results for the Angler Postal Survey for; a) angling effort, b) angler numbers, c) daily catch rate brown and d) daily catch rate rainbow trout, Lake Leake, 1999 - 2017. Dotted line indicates the long-term average (mean).

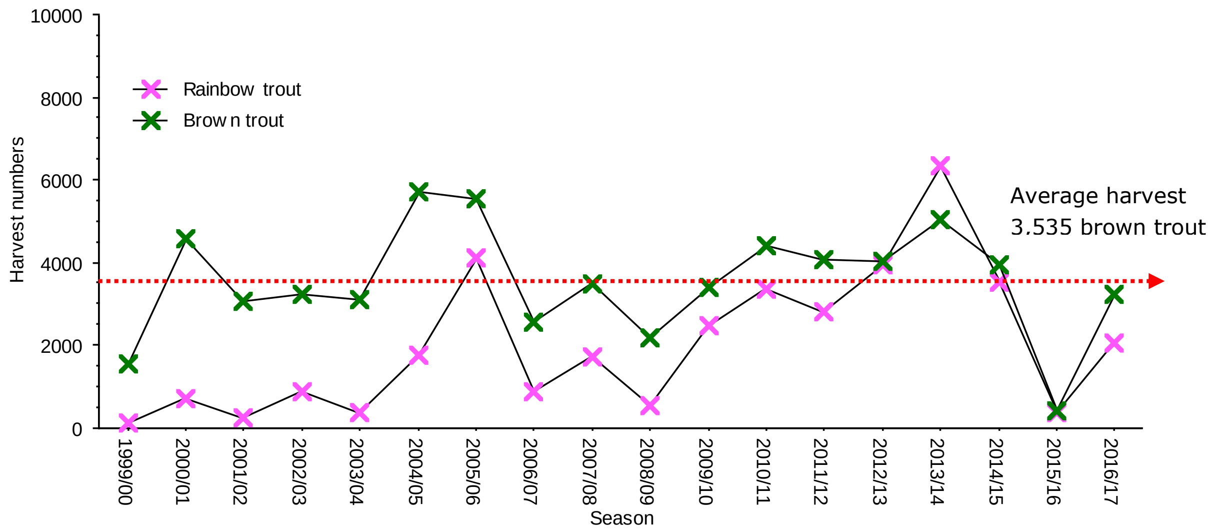


Figure 12: Results for the Angler Postal Survey for estimated harvest of brown and rainbow trout, Lake Leake 1999-2017, red dotted line indicates the long-term average (mean) harvest of brown trout.

Angling effort and the harvest of brown trout appears to fluctuate with annual weather patterns and consequently lake level. Periods of high angling effort and harvest occur at moderate to high lake levels (2004-06 and 2010-15), but were punctuated with decreased participation and low harvest figures during the drought periods and subsequent low lake levels during 2000-04, 2006-08 and 2015-16 (see figure 12 and appendix b). This pattern is not apparent when considering catch rate, with high catch rates during 2000-03 and 2006-08, periods of low lake level. However, higher catch rates occurred during 2010-13 when higher lake levels existed. All measures declined dramatically during 2015-16 and catch rate showed an ongoing declined during 2014-16. All measures have however, rebounded to near the long-term average for 2016-17 season.

6 Discussion

The results of the 2017 survey indicate Lake Leake at the time of the survey contained a moderately low population of brown trout (10 789). The average weight for resident (non-clipped) brown trout was 1.2 kg, with a number of fish in the 1.5 - 2.0 kg range. However, the average is to some degree inflated by an absence of fish under 360 mm.

A significant number of the brown trout captured were in poor to fair condition (89%). To a certain extent this is expected, as some fish were in post spawning condition, although a considerable number of female fish still carried high quantities of eggs. It's likely a delay in spawning due to low inflows has affected these mature fish. Nonetheless, several brown trout in the 500-560 mm length range were in very poor condition and 55 percent of brown trout over 500 mm were categorised as poor.

The cause of poor condition is unlikely to be related to the density of the brown trout population, as the estimated population size is at the lower range of expectation. Factors such as the high density of the redfin perch (as was the case in this survey) and recovering environmental conditions following a period of low lake level can provide some explanation.

Analysis of the length structure of the population suggests a lack of recruitment of young fish into the fishery for the last two years, with just one fish measuring less than 360 mm (i.e. the general minimum size for a three year old fish). A review of the rainfall records for 2014/15 and reference to the Tooms Lake FPA 2015, highlights this probable deficiency in recruitment for both 2014 and 2015. There was no sign of any recruitment from 2016 but this may be due to the survey method used, with box traps not conducive in targeting YOY fish located in shallow rocky habitat.

A comparison of the contribution of the 2017 fin clipped brown trout and the existing brown trout population, suggest that natural recruitment for the period pre 2014 has maintaining a reasonable population base. A modest number of resident brown trout were captured above what might have been expected from the effects of past stocking events. While this figure is not high, given favourable climatic conditions the contribution of these fish should be enough to provide an acceptable fishery. However, given the highly variable nature of natural recruitment overtime, it would be prudent to establish an ongoing stocking program. This program should utilise adult brown trout transfers, as past stocking programs based on fry and fingerlings has in the past, provided little evidence of success.

Angling effort and therefore total harvest of both rainbow and brown trout is highly influenced by climatic conditions and lake level. Peak angling effort and harvest of brown trout occurred during 2004 – 06, a time when ideal climatic conditions prevailed in the preceding years and favoured high natural recruitment. Additionally, lake levels at this time were more conducive, allowing easy access for both shore-based and boating anglers. Succeeding this period, a marked decline in angling effort and harvest occurred. These declines were driven primarily by prolonged dry periods with well below average rainfall.

This situation continued until mid-2009, when significant rainfall caused the lake to spill. However, the catch rate for brown trout during 2006-08 did not respond the same as angling effort and harvest, with higher catch rates recorded during this time. The reasons for this are not clear but with lower lake levels, the efficiency of anglers targeting fish can be enhanced, therefore leading to higher catch rates. These factors need to be taken into account when developing the annual stocking plan for Lake Leake. Adjustments need to be made to account for variance in climate, natural recruitment and the efficiency of anglers to harvest higher numbers of fish at lower lake levels.

7 Recommendations

I. A base population of brown trout is maintained by an annual stocking of adult brown trout. This action will ensure there is no lag time between a return to a favourable environmental conditions and maintenance of acceptable catch rates.

II. The present regime of stocking rainbow trout on a consistent basis is maintained taking into account climatic conditions.

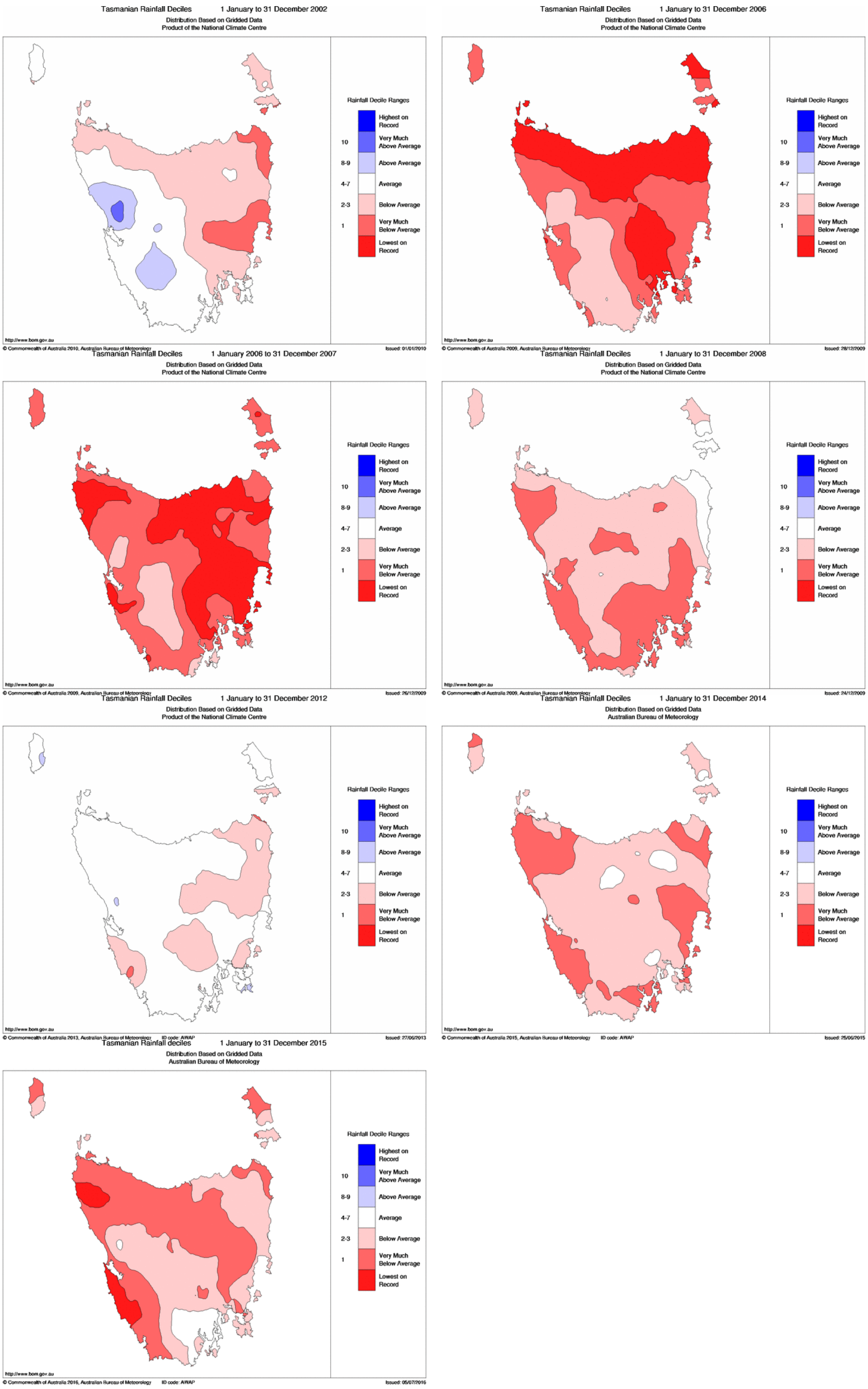
III. Retain the present regulatory management regime of a five fish bag limit of which only two fish greater than 500 mm is permitted to be taken.

IV. A further survey and population estimate is conducted during 2019 to examine survival and growth of the 2017 fin clipped fish and undertake an additional population estimate for the brown trout population.

8 Appendix

SPECIES	AGE	ORIGIN	DATE	NUMBER	WEIGHT (g)
Brown trout	Adult	Mountain Ck	25 July 2013	260	900
Brown trout	Adult	Hydro Ck	26 July 2013	347	450
Brown trout	Adult	Hydro Ck	30 July 2013	250	900
Brown trout	Adult	Hydro Ck	1 August 2013	129	900
Brown trout	Fry	IFS New Norfolk	17 October 2013	35000	1.2
Brown trout	Adult	Liawenee Canal	23 May 2014	650	750
Brown trout	Adult	Tumbledown Ck	23 May 2014	1000	600
Brown trout	Adult	Mountain Ck	25 June 2014	205	800
Brown trout	Adult	Liawenee Canal	24 May 2017	1000	1000
Brown trout	Adult	Liawenee Canal	25 May 2017	1000	1000
Rainbow trout	Fingerling	Cressy	12 January 2011	10000	20
Rainbow trout	Yearling	Cressy	27 March 2011	2200	120
Rainbow trout	Yearling	Cressy	30 March 2011	1100	120
Rainbow trout	Yearling	Cressy	22 March 2012	8000	400
Rainbow trout	Yearling	Springfield	19 October 2012	1000	200
Rainbow trout	Adult	Springfield	19 October 2012	300	2500
Rainbow trout	Fry	IFS New Norfolk	9 January 2013	20000	0.8
Rainbow trout	Fry	IFS New Norfolk	9 January 2013	30000	0.35
Rainbow trout	Adult	Springfield	3 July 2013	900	1000
Rainbow trout	Fingerling	Cressy	9 September 2013	10000	70
Rainbow trout	Fingerling	Springfield	8 April 2014	2500	60
Rainbow trout	Fingerling	Springfield	14 April 2014	2500	60
Rainbow trout	Fingerling	Springfield	16 April 2014	110	800
Rainbow trout	Fingerling	Springfield	8 May 2014	3330	150
Rainbow trout	Fingerling	Springfield	12 November 2014	19000	10
Rainbow trout	Fingerling	Springfield	2 December 2014	1300	120
Rainbow trout	Fingerling	Springfield	3 December 2014	4300	150
Rainbow trout	Yearling	Cressy	9 October 2015	120	500
Rainbow trout	Fingerling	Bridport	14 December 2016	10000	20
Rainbow trout	Fingerling	Salmon Ponds	20 January 2017	8000	60

Appendix a): Stocking list for Lake Leake 2001 – 2017.



Appendix b): Periods of rainfall deficiency by deciles for Tasmania (source: www.bom.gov.au accessed 28/8/2017).