



FISHERIES PERFORMANCE ASSESSMENT TECHNICAL REPORT

FOUR SPRINGS LAKE – 2012, 2013 AND 2015



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1 INTRODUCTION

Four Springs Lake is situated 14 km north of Westbury, on Sandy Creek. Access is via Selbourne Road north of Westbury, or east via Rosevale. Tasmap Bridgenorth 1:25,000 (88908 5417530 AGD 94). Four Springs Lake was formed in 1997 following the construction of 10 metre high, 260 metre long clay core dam wall on Sandy Creek. The lake was created to establish a passive aquatic recreation centre at Four Springs to service residents of northern Tasmania, with special provisions for the elderly, the disabled, the youth and family.

The lake inundates Four Springs Plain that drains into Four Springs Creek via a small tributary know as Sandy Creek. The inundated area supported a small patch of virgin forest that was logged prior to flooding, with most of the area being extensive open plain covered with sedges and low scrub. It is typically shallow with an average depth of 2.5 m and a maximum depth of 9 meters. Prior to flooding the natural depressions in the lake were connected to facilitate draining if the need arose in the future.

Key System Data

Water Storage: 3,430,000m³
Full Supply Level (FSL) 197m AHD
Catchment area 1000 Ha

No assessment of the trout population within Four Springs Lake has been previously been undertaken.

2 FPA SURVEY METHODOLOGY

2.1 IN-LAKE SURVEYS

During the period 24-26 July 2012, 24-26 Sept 2012, 16-17 April 2013 and 15-17 July 2013; four separate surveys were undertaken to gain information on catch per unit effort and the size structure of the brown trout population utilising the following methods:

- **July 2012** - 20 fine mesh fyke nets 600 mm opening and 40 coarse mesh fyke nets 600 mm opening, all nets were set over two nights with nets checked and cleared each morning.
- **September 2012** - 40 coarse mesh fyke nets 600 mm opening set over two nights. All nets were checked and cleared each morning.
- **April 2013** - 20 fine mesh fyke nets 600 mm and 10 box traps all set overnight for one night only. Additionally, the lake was electrofished using a Smith-Root electrofishing boat for a total shock time of 140 minutes. The boat however had mechanical problems and was only used on a limited basis

- **July 2013** – 45 box traps and 30 coarse mesh fyke nets set on the first night; with 40 box traps and 30 coarse mesh fyke nets reset for the second night (fyke nets 600 mm opening).

Prior to the survey, 2,000 adult brown trout from the spawning run at Liawenee were released into Four Springs. All of these fish had their adipose fin clipped so they could be easily distinguished from the resident brown trout, to allow for a capture - mark - recapture population estimate to be undertaken.

Other species ie eels, smelt (*Retropinna tasmanica*) and *Cherax destructor* were also captured and recorded.

2.2 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.

2.3 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 (wild or domestic strain) and genotype, in addition to some length/weight data and comments of stocked fish, eg denoting tagged fish. This information provides an historical record of supplementary recruitment into individual waters.

2.4 CREEL SURVEYS

Since the start of the 2002/03 angling season, IFS Inspectors have been supplied with angler catch information sheets. This survey seeks angler catch information based on location, fishing method and angling effort. During routine licence checking patrols, staff asked anglers about their fishing on the day of interview, as well as for the preceding two days. This information is recorded on a set data sheet and is transferred to an electronic format at a later date.

Additionally, a dedicated creel survey was undertaken over the opening weekend of the 2013/14 angling season.

2.5 ANALYSIS OF DATA

Analyses of mean weight, length and condition factor values between survey dates were undertaken using analysis of variance (Fisher's least significant difference), with a significance level of 0.05.

The population estimate for a single recapture period (over 3 days) was analysed using the basic Petersen Estimate model ($N=MC/R$).

3 RESULTS

3.1 IN-LAKE SURVEY

A total of 55 brown trout between 115 – 580 mm (and 4 rainbow trout or 7%) were captured across July 2012 – April 2013 survey dates. In addition, 460 brown trout (and 13 rainbow trout or 3%) were captured during the July 2013 survey. *Unless specified, all data is for brown trout only.* The summary statistics associated with weight, length and condition factor for each survey date are shown in table 1 below and figure 1 (see page 5). Table 2 shows the results separated by date and survey method.

	Mean	Std. Dev.	Count	Minimum	Maximum	Median
Length (mm), Total	474.4	81.7	246	115.0	621.0	493.5
Length (mm), Jul 12	437.9	107.9	18	115.0	580.0	467.5
Length (mm), Sep 12	486.4	44.2	17	428.0	570.0	492.0
Length (mm), Apr 13	381.6	162.4	20	115.0	540.0	446.5
Length (mm), Jul 13	486.5	59.8	191	264.0	621.0	495.0
Weight (g), Total	1363.6	494.1	244	20.0	2740.0	1440.0
Weight (g), Jul 12	1085.6	512.8	18	20.0	1910.0	1125.0
Weight (g), Sep 12	1360.6	403.0	17	740.0	2000.0	1490.0
Weight (g), Apr 13	1182.5	822.9	20	30.0	2520.0	1530.0
Weight (g), Jul 13	1409.5	443.3	189	320.0	2740.0	1450.0
CF, Total	1.2	0.2	244	0.7	2.2	1.2
CF, Jul 12	1.2	0.3	18	0.9	1.9	1.1
CF, Sep 12	1.2	0.2	17	0.8	1.6	1.2
CF, Apr 13	1.6	0.3	20	1.2	2.2	1.5
CF, Jul 13	1.2	0.2	189	0.7	1.8	1.2

Table 1: length, weight and condition factor for all brown trout, separated by sampling date (Total is combined data from all sample dates).

	Mean	Std. Dev.	Count	Minimum	Maximum	Median
Length (mm), Total	474.4	81.7	246	115.0	621.0	493.5
Length (mm), Jul 12, Fyke	437.9	107.9	18	115.0	580.0	467.5
Length (mm), Sep 12, Fyke	486.4	44.2	17	428.0	570.0	492.0
Length (mm), Apr 13, Box	451.5	138.7	8	115.0	539.0	506.5
Length (mm), Apr 13, EFB	334.9	165.5	12	140.0	540.0	423.5
Length (mm), Jul 13, Box	485.0	60.5	164	264.0	621.0	495.0
Length (mm), Jul 13, Fyke	496.0	55.7	27	363.0	572.0	510.0
Weight (g), Total	1363.6	494.1	244	20.0	2740.0	1440.0
Weight (g), Jul 12, Fyke	1085.6	512.8	18	20.0	1910.0	1125.0
Weight (g), Sep 12, Fyke	1360.6	403.0	17	740.0	2000.0	1490.0
Weight (g), Apr 13, Box	1435.0	611.8	8	30.0	2120.0	1570.0
Weight (g), Apr 13, EFB	1014.2	924.2	12	50.0	2520.0	1065.0
Weight (g), Jul 13, Box	1420.0	445.8	162	320.0	2740.0	1465.0
Weight (g), Jul 13, Fyke	1346.8	430.7	27	443.0	2170.0	1430.0
CF, Total	1.2	0.2	244	0.7	2.2	1.2
CF, Jul 12, Fyke	1.2	0.3	18	0.9	1.9	1.1
CF, Sep 12, Fyke	1.2	0.2	17	0.8	1.6	1.2
CF, Apr 13, Box	1.4	0.3	8	1.2	2.0	1.3
CF, Apr 13, EFB	1.7	0.3	12	1.2	2.2	1.6
CF, Jul 13, Box	1.2	0.1	162	0.8	1.8	1.2
CF, Jul 13, Fyke	1.1	0.2	27	0.7	1.3	1.1

Table 2: length, weight and condition factor for all brown trout, separated by sampling date and survey method (Total is combined data from all sample dates and methods). EFB = electrofishing boat, Box = box trap, Fyke = coarse mesh fyke net.

	Mean	Count	Median
Length (mm), Total	501.9	206	500.5
Length (mm), Jul 12	494.8	12	491.5
Length (mm), Sep 12	486.4	17	492.0
Length (mm), Apr 13	487.6	13	504.0
Length (mm), Jul 13	505.1	164	503.5
Weight (g), Total	1517.8	206	1510.0
Weight (g), Jul 12	1376.7	12	1265.0
Weight (g), Sep 12	1360.6	17	1490.0
Weight (g), Apr 13	1720.0	13	1700.0
Weight (g), Jul 13	1528.4	164	1520.0
CF, Total	1.2	206	1.2
CF, Jul 12	1.1	12	1.1
CF, Sep 12	1.2	17	1.2
CF, Apr 13	1.5	13	1.4
CF, Jul 13	1.2	164	1.2

Table 3: Mean and median length, weight and condition factor for each survey date for all brown trout captured equal to or greater than 420 mm length.

The average (mean) length of brown trout did not change significantly between July 12 – September 2012 and July 2012 – April 2013, however there was a significant difference between the average length of fish in the September 2012 – April 2013 samples (mean decrease of 105 mm). This difference was due to a small number of YOY captured during the April survey. These fish were from a stocking of 50,000 triploid brown trout fry (4.5

grams) in December 2012. The inclusion of these fish in the analysis also inflated the condition factor measure for April. There was a significant difference in the length of brown trout between April 2013 and July 2013, however this difference is highly influenced by the discrepancy in sample sizes, with just 20 in fish capture in April (including a number of small fish) and 191 fish captured and measured in the July 2013 survey.

When the comparison between survey dates is restricted to fish over 420 mm length (see table 3), the median length difference is 12 mm between July 2012 and July 2013. The difference in median weight increased by 255 grams with an associated condition factor measure of 1.1 k-factor for July 2012 and 1.2 k-factor for July 2013. This is despite the influence of stocked adult brown trout included in the analysis for July 2013.

The median length of non-fin clipped 'resident' brown trout (non ex-Liawenee adults) over 420 mm was 500 mm, with median weight 1,510 g and k-factor 1.2.

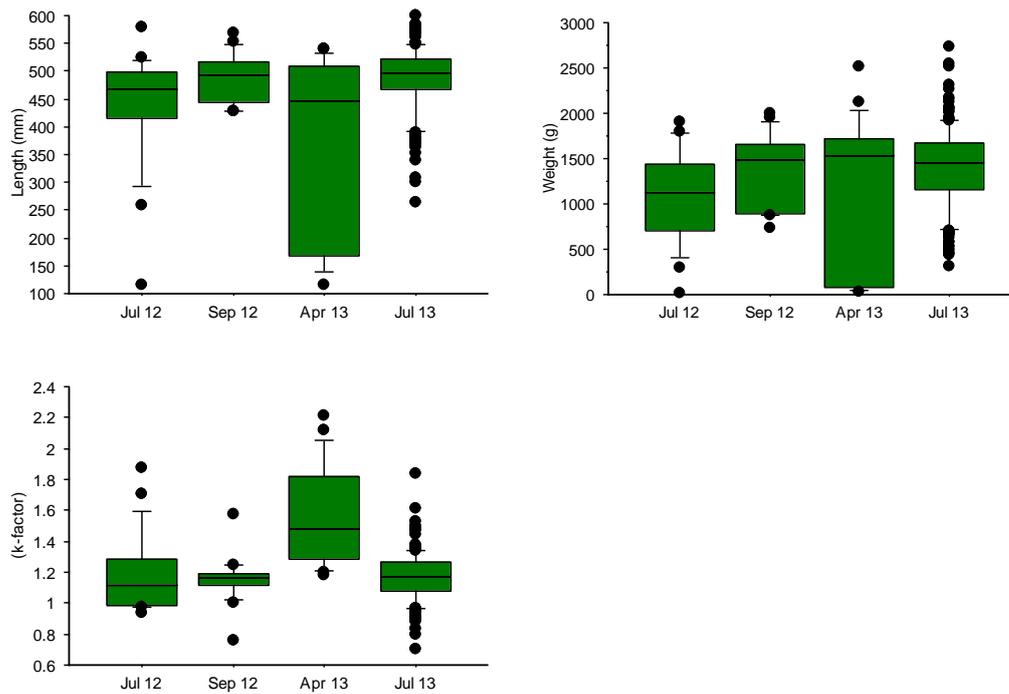


Figure 1: Box plots for length, weight and condition factor for each survey date for all brown trout captured.

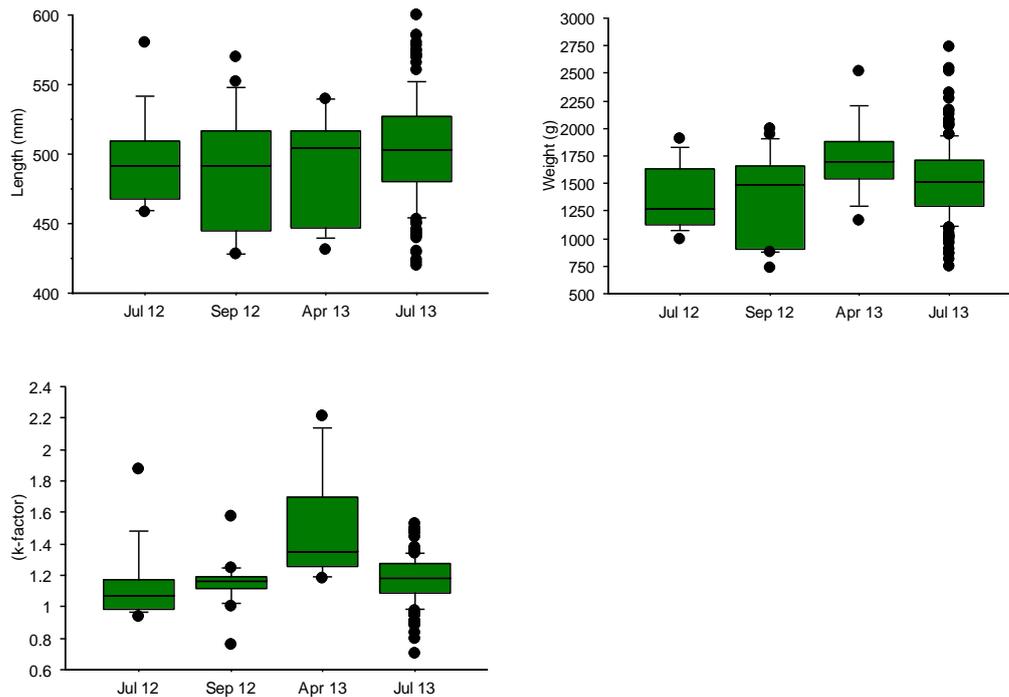


Figure 2: Box plots for length, weight and condition factor for each survey date for all brown trout captured equal to or greater than 420 mm.

A significant improvement in condition factor between July 2012 to April 2013 is highlighted in figure 3 below. For July 2012, just 11% of fish were classified as excellent and 27% as poor; compared to 60% excellent and nil as poor in the April 2013 survey. The improvement in condition factor for April 2013 is slightly influenced by the capture of six YOY fish, but despite this, the condition of adult fish increased significantly (see figure 5). A comparison of condition factor between July 2012 and July 2013 suggest that brown trout were in better condition generally at the start of the 2013 season relative to July 2012, therefore fish over 420 mm should on average be around 1.3 -1.4 k-factor by the end of the 2013/14 angling season.

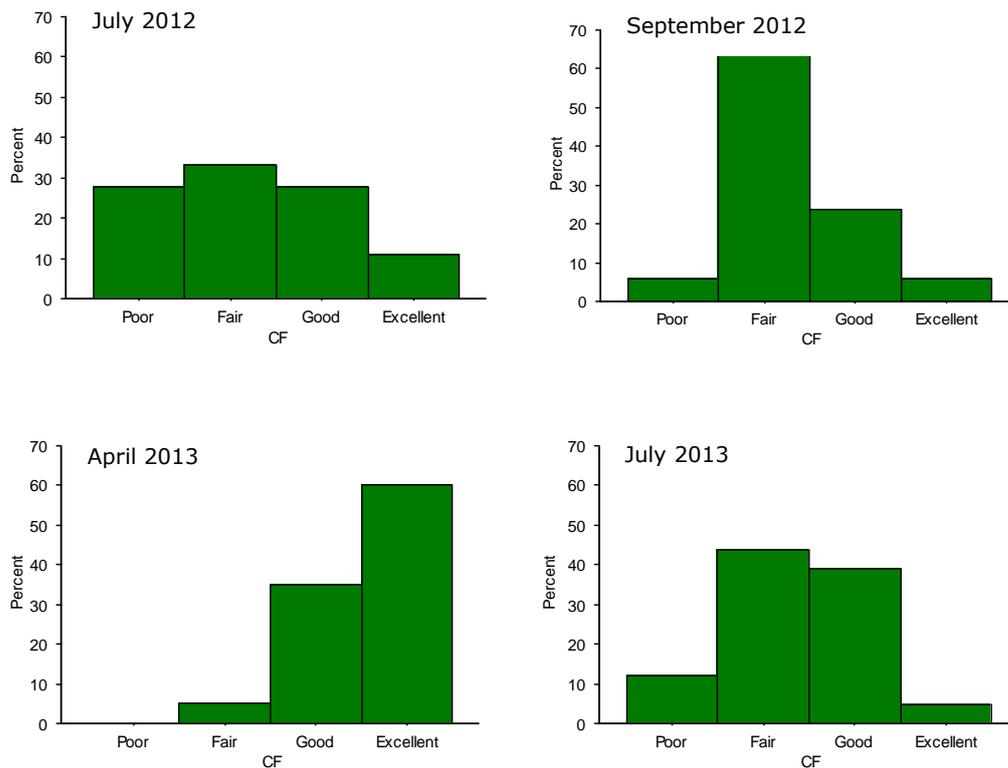


Figure 3: Condition factor category for brown trout for each sampling period – Four Springs Lake 2012-13.

The length/weight plot (see figure 4) shows strong exponential growth in the weight of fish relative to length. There does not appear to be any decrease in the rate of growth with increasing length, especially at the upper range of lengths between 500 mm and 600 mm.

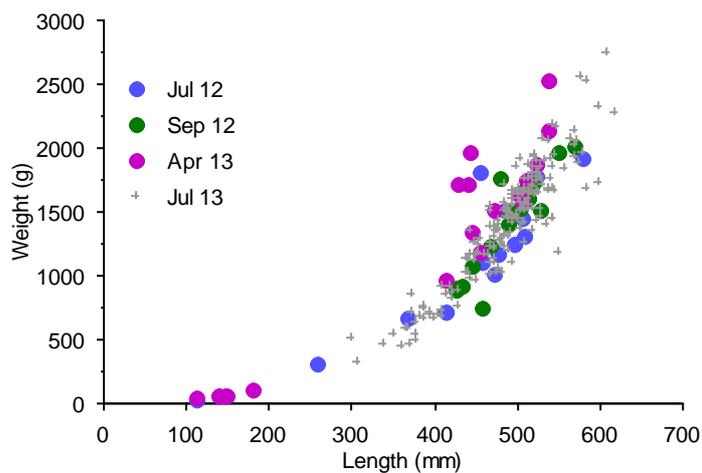


Figure 4: Length/weight relationship for brown trout showing all survey dates.

The normal pattern associated with the measure of condition factor relating to length is, the k-factor decreases as length increases. The plot of condition factor verses length (see

figure 5) shows this pattern for the July 2012 and July 2013, and to a lesser extent in September 2012; however, this is not apparent for fish surveyed in April 2013, across all length classes. This is indicative of adult fish continuing to put on condition at a significant rate through the period July 2012 – April 2013. The July 2013 sample is also slightly influenced with the inclusion of transferred adult brown trout from Liawenee, caught during this survey.

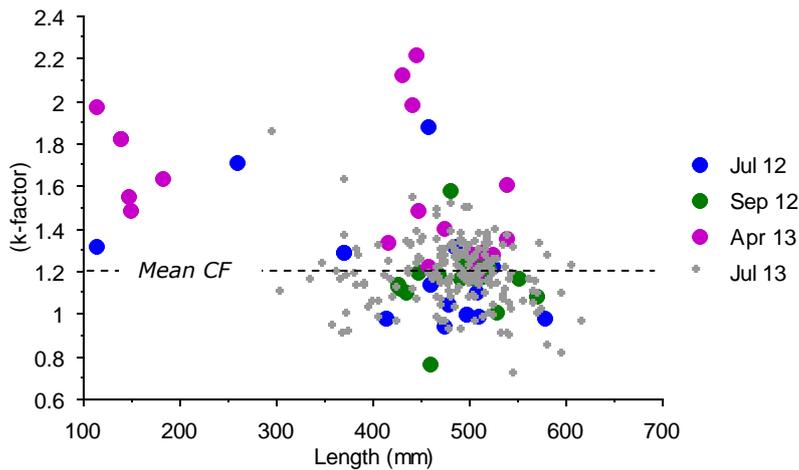


Figure 5: Length/condition factor relationship for brown trout showing all survey dates and mean CF.

The length frequency histograms for each survey period (see fig 6) show a very low number of fish in the 0-200 mm and 200 – 400 mm length classes. The vast majority of brown trout captured during all survey periods were between 400-600 mm, although the total numbers for all periods (except July 2013) were low. When using the electrofishing boat for sampling, a small number of fish in the 100-200 mm size range were detected during April 2013. These fish were from a stocking of 50,000, 4.5 gram triploid brown trout stocked in December 2012.

Figure 7 a and 7 b below shows the lengths of those brown trout captured during the July 2013 survey that includes fin clipped adult brown trout transferred from Liawenee canal, Great Lake in May 2013. While some resident brown trout were captured in the length range 200 mm – 400 mm, the majority were fish transferred from Liawenee. Therefore, the number of resident brown trout in this size range remained lower than expected given the consistent stocking of the lake with fingerlings and fry over recent years.

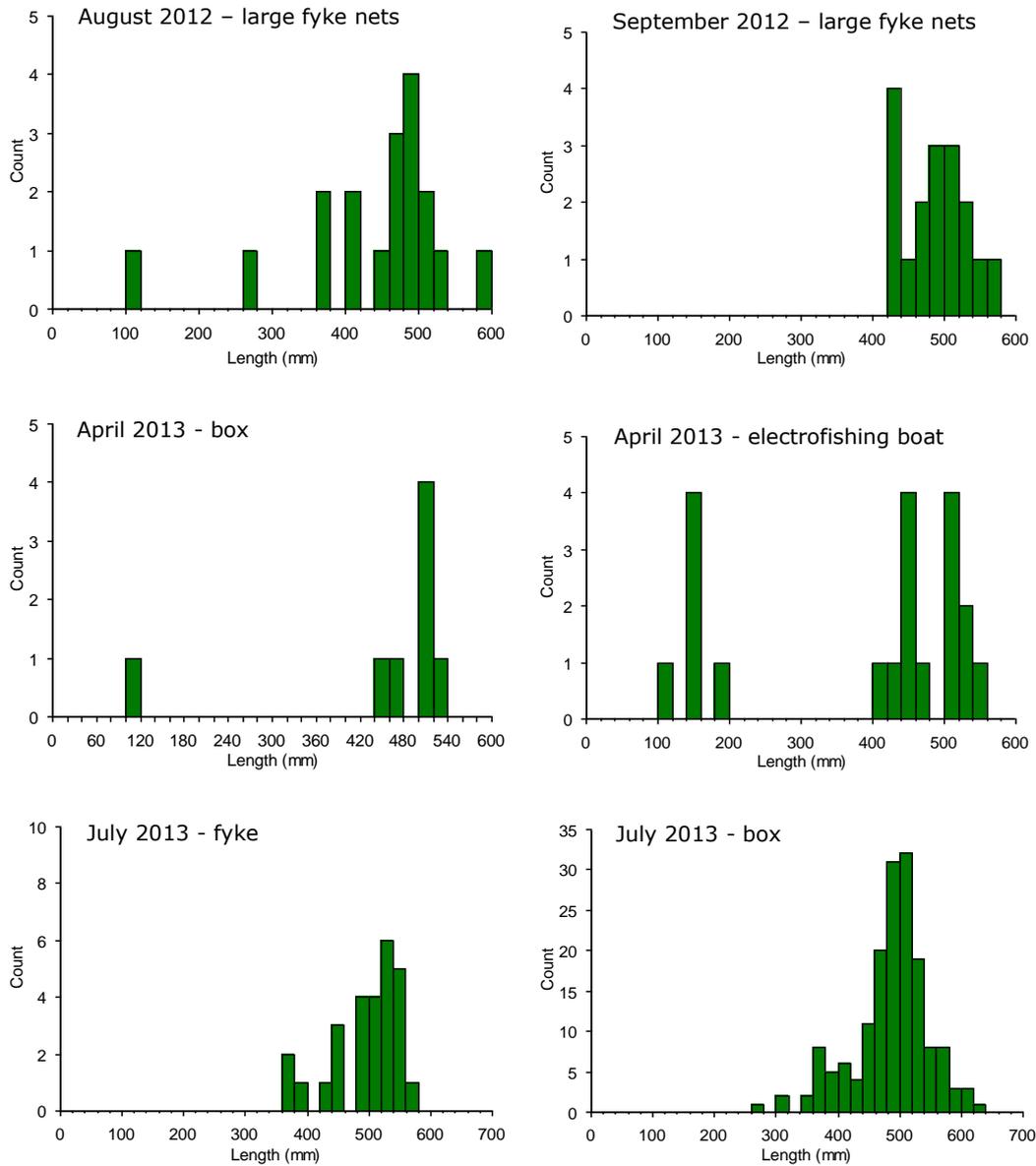


Figure 6: Length frequency histograms for brown trout split by survey date and method.

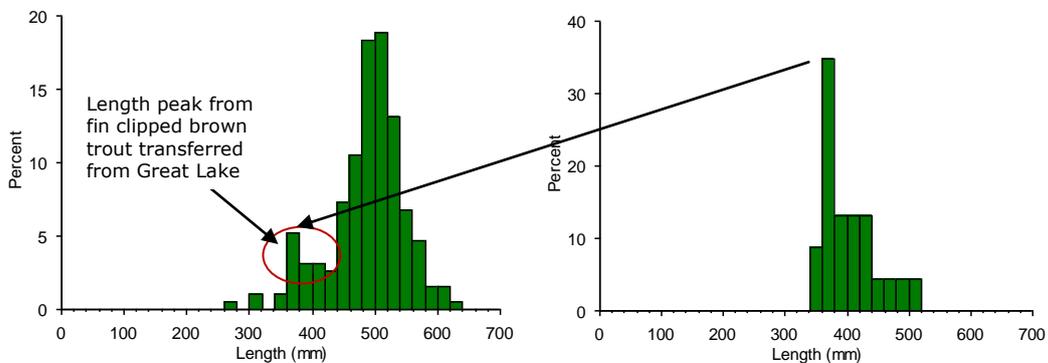


Figure 7: (a) Length frequency (*by percentage*) for all brown trout July 2013 combined box and fyke net catches and (b) length frequency (*by percentage*) for the 48 adipose clipped fish captured that were transferred from Liawenee, Great Lake, May 2013.

Catch Effort and Netting Information

Date	Method	No. nets	No. nights	Effort	No. brown trout	CPUE fish/net
July 2012	Fyke net large mesh	40	2	80 net sets	18	0.23
July 2012	Fyke net small mesh	20	2	20 nets set	Nil	Nil
September 2012	Fyke net large mesh	40	2	80 net set	17	0.21
April 2013	Fyke net small mesh	20	1	20 nets set	Nil	Nil
April 2013	Box traps	10	1	10 net sets	8	0.8
April 2013	Boat electrofishing			140 mins	14	5.1/hour
July 2013	Fyke net large mesh	30	2	60 net sets	52	0.9
July 2013	Box traps	45 night 1 40 night 2	2	85 net sets	408	4.8

Table 4: Survey details with associated CPUE.

Catch per unit effort data for July 2012 – April 2013 for both brown and rainbow trout was low. Results for CPUE for fyke netting using large mesh nets for July and September were comparable, with both dates returning very low CPUE results. These figures are supported by the April 2013 survey where the use of box traps, fine mesh fyke nets and boat electrofishing were used to sample the trout population, with similar low CPUE results (see table 4). No trout were captured in fine mesh fyke nets during any survey period ie July 2012 and April 2013. Six smelt, *Retropinna tasmanica* and two *Cherax destructor* were captured in fine mesh fyke nets during August 2012 (twenty nets over two nights), with one *Cherax* captured in the April 2013 survey (ten nets over one night).

During the July 2013 survey the CPUE for large mesh fyke nets remained low at 0.9 fish per net, per overnight soak time. However, the CPUE for box traps was significantly higher by comparison to all other sample dates at 4.8 fish per box trap per, overnight soak time (see table 4).

3.2 POPULATION ESTIMATE- JULY 2013 SURVEY

During May 2013, 2,000 adult brown trout were transferred from the spawning run at Liawenee, Great Lake, into Four Springs Lake. All of these fish had the adipose fin clipped prior to transfer so they could be easily identified once released and subsequently recaptured during the July 2013 in-lake survey. During the survey, 460 brown trout were captured in both box traps and fyke nets. Of these captures, 48 brown trout were adipose fin clipped, (with just one adipose fin clipped fish recaptured twice over the two days). Table 5 below shows the population estimate parameters. A total of 19,167 (+/- 5070) brown trout were estimated within Four Springs Lake within the range of lengths sampled during the survey (264 mm-621 mm). The ratio of MC/4N >4 (ie 12) indicates an acceptable limit of sample size bias.

Parameters	Recapture Data
Number marked (M)	2000
Number recaptured (C)	460
Number marked recaptures	48
Pop ⁿ Estimate (N)	19,167
Variance	6,690,581
Std Error	2,587
Confidence limits +/-	5,070
Lower CI	14,097
Upper CI	24,236
Bias Ratio MC/4N	920000/76667 =12

Table 5: Petersen population estimate parameters from the July 2013 in-lake recapture survey.

3.3 ANGLER CREEL SURVEY

During the period 2003-2012, a total of 1,369 anglers were interviewed by IFS Staff, primarily while checking licence details. During interviews anglers were asked a range of questions regarding their fishing on the day of interview and for up to two preceding days at that water. Of the angler creel data collected, 166 records were deemed to be unusable, therefore the following analysis was generated out of 1,203 angler records. Figure 8 shows the number of anglers who completed fishing for the day or were still fishing when interviewed.

The average number of anglers surveyed at Four Springs Lake on an annual basis 2003 – 2012 was 133, with a peak of 195 anglers in 2007/08 and a low of 65 anglers in 2011/12 (see fig 8).

Generally there was a decline in the average number of hours fished by anglers in the period 2003 – 2012 however, despite this, the average CPUE of brown trout increased

during the period 2003 – 2012. The long term average was 0.48 fish per hour with the highest average CPUE recorded in the 2009/10 season at 0.78 fish per hour. The CPUE for 2010-12 period remained around the long term average despite the number of anglers surveyed falling well below the average of 133 anglers per season.

The long term average CPUE for rainbow trout was 0.48 but has fallen to 0.19 fish for the 2011/12 season. It's likely that the decline in CPUE for rainbow trout is a combination of a real decline in rainbow trout stocks and a reflection of low numbers of anglers interviewed during the period 2010-12.

The long term average CPUE for brown and rainbow trout combined was 0.24 fish per hour, with a low of 0.13 in 2011/12 season, primarily due to the large decline in rainbow trout catches for that season.

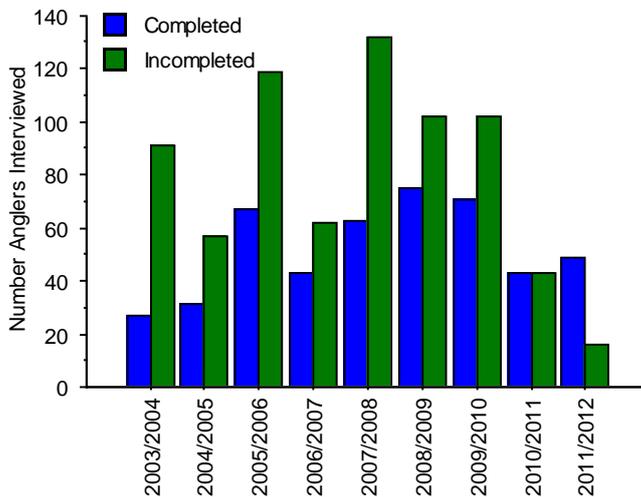


Figure 8: Number of anglers interview each season and if completed or incomplete fishing.

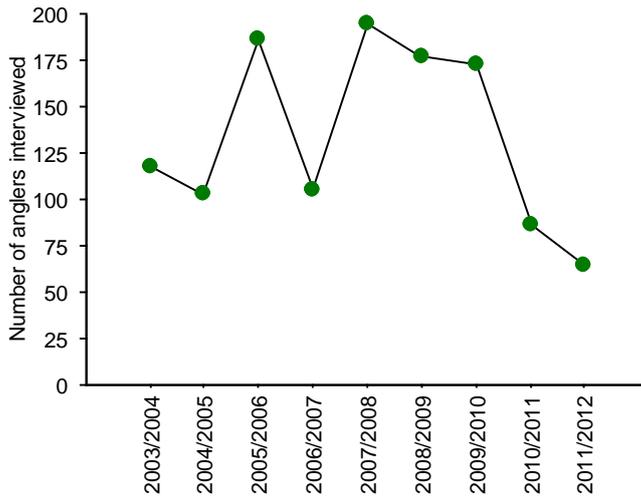


Figure 9: Number of anglers interview each season.

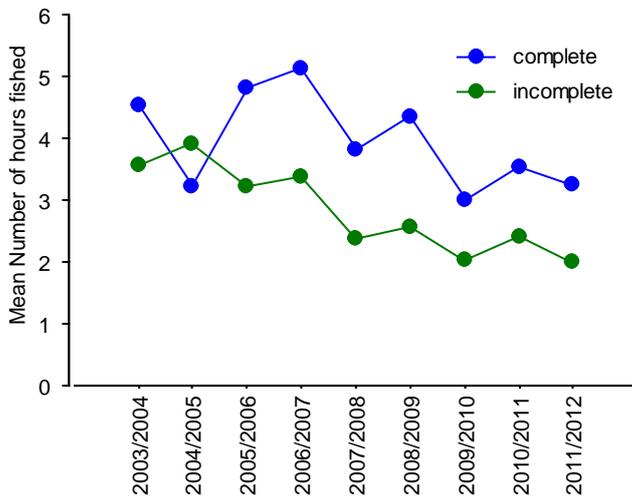


Figure 10: Mean number of hours fished by anglers for each season.

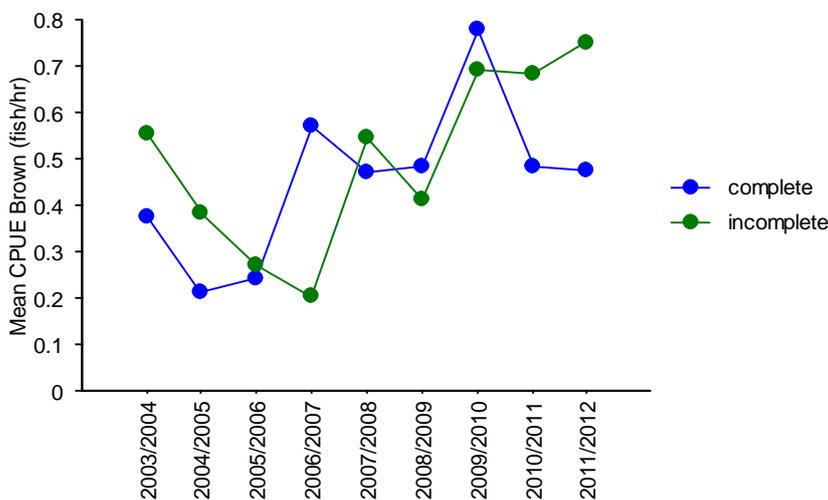


Figure 11: Mean CPUE for brown trout for both complete and incomplete fishing.

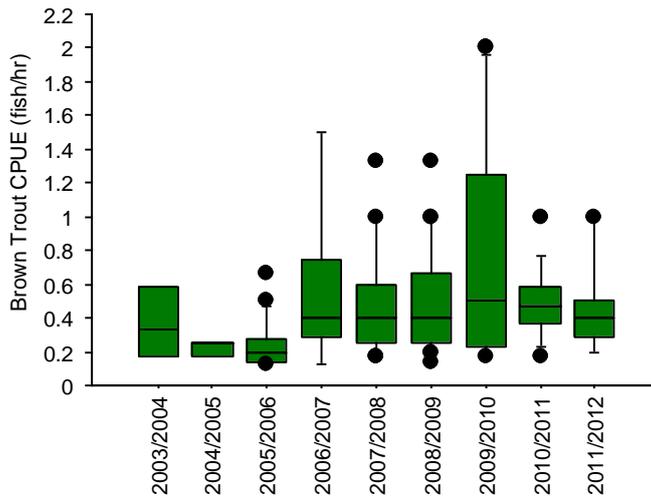


Figure 12: Box plots showing CPUE for brown trout, completed fishing only.

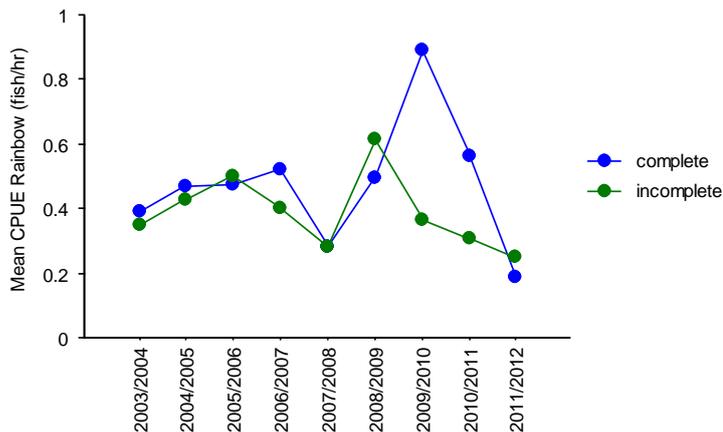


Figure 13: Mean CPUE for rainbow trout for both complete and uncompleted fishing.

3.4 ANGLER CREEL SURVEY SEASON OPENING 2013/14

Over Saturday and Sunday of the opening weekend of the 2013/14 angling season, 128 anglers were checked at Four Springs for a catch of 140 brown trout and 21 rainbow trout, with 7% of the catch (all sized fish except one brown trout) released. Of the 101 anglers that had completed fishing, 75% of anglers caught either a brown trout or rainbow trout. The mean catch rate for anglers that had completed fishing was 1.6 fish per angler. Mean time anglers spent fishing was 3.6 hours.

Adipose fin clipped fish represented 15.7% of the brown trout captured by anglers and there were good signs of these fish beginning to put on weight.

Over the weekend, 67% of anglers indicated they either trolled or spun using hard-bodied lures or soft plastics, 21% bait fished (with several anglers also spinning), 12% fly fishing.

3.5 STOCKING HISTORY

Brown Trout

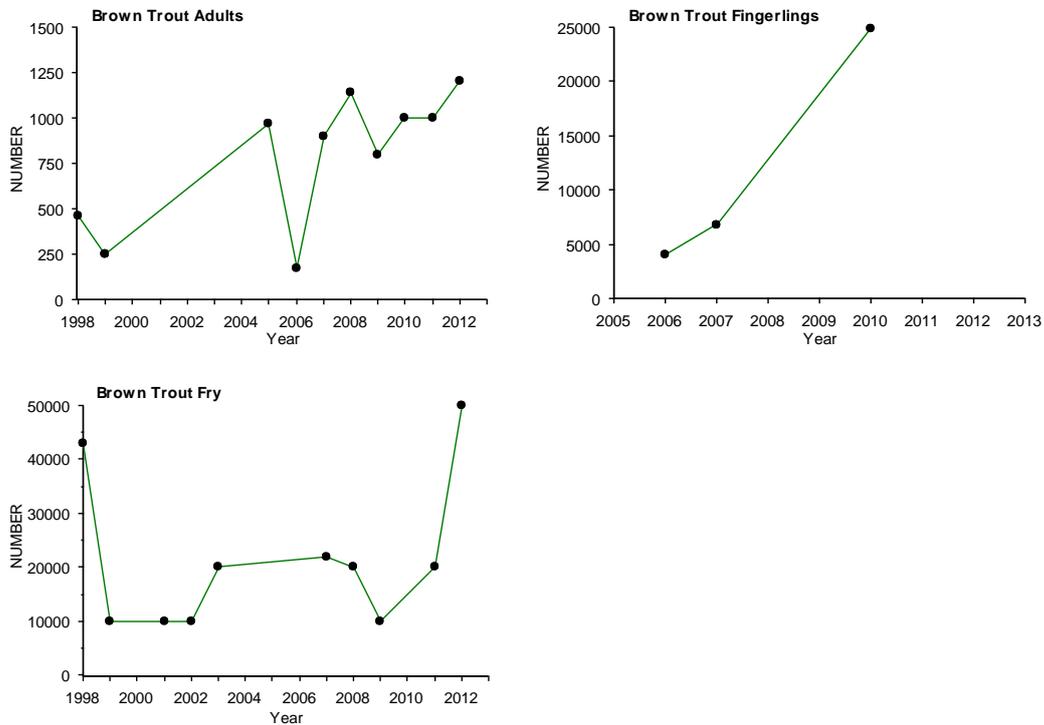


Figure 14: Brown trout stocking history for each stocking 'age'.

Since being flooded in 1997/98, Four Springs Lake has been consistently stocked with both brown and rainbow trout. Brown trout have been stocked mainly using a mix of fry from IFS hatcheries and adult fish harvested from the spawning runs at Liawenee and Arthurs Lake. Fingerlings from the Salmon Ponds were stocked in 2006 and 2007, and a large stocking from the New Norfolk hatchery occurred in 2010. The release of adult brown trout has been recognised as an effective method to supply ready to catch fish that grow well in the lake, however the number of fish stocked annually is often restricted by availability issues. An increase in the number of fry stocked in 2012 was as a result of ceasing production of larger hatchery reared fingerlings and therefore increasing the number of younger fish stocked out, ie 4.5 gram fish in 2012 against 8-10 gram fish in 2010.

Rainbow Trout

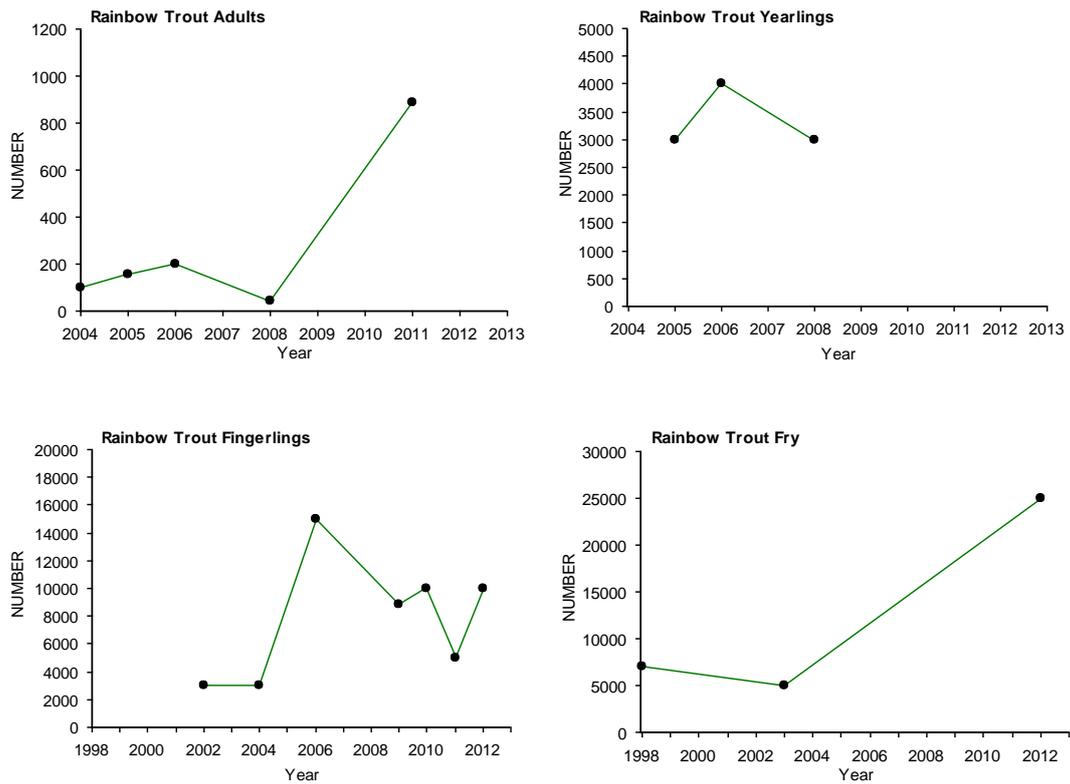


Figure 15: Rainbow trout stocking history 1998 – 2012, for each stocking 'age'

The stocking of both yearling and adult rainbow trout has been entirely dependent on the opportunistic supply of fish from commercial hatcheries and therefore varies considerably. The use of triploid fingerlings (10 – 30 grams) 2009-2011 from the IFS New Norfolk hatchery has been the main source of rainbow trout stock until 2012, when hatchery production moved away from growing fingerlings to focus on fry. The large number of fingerling in 2006 was from a commercial hatchery.

3.6 ANGLER POSTAL SURVEY

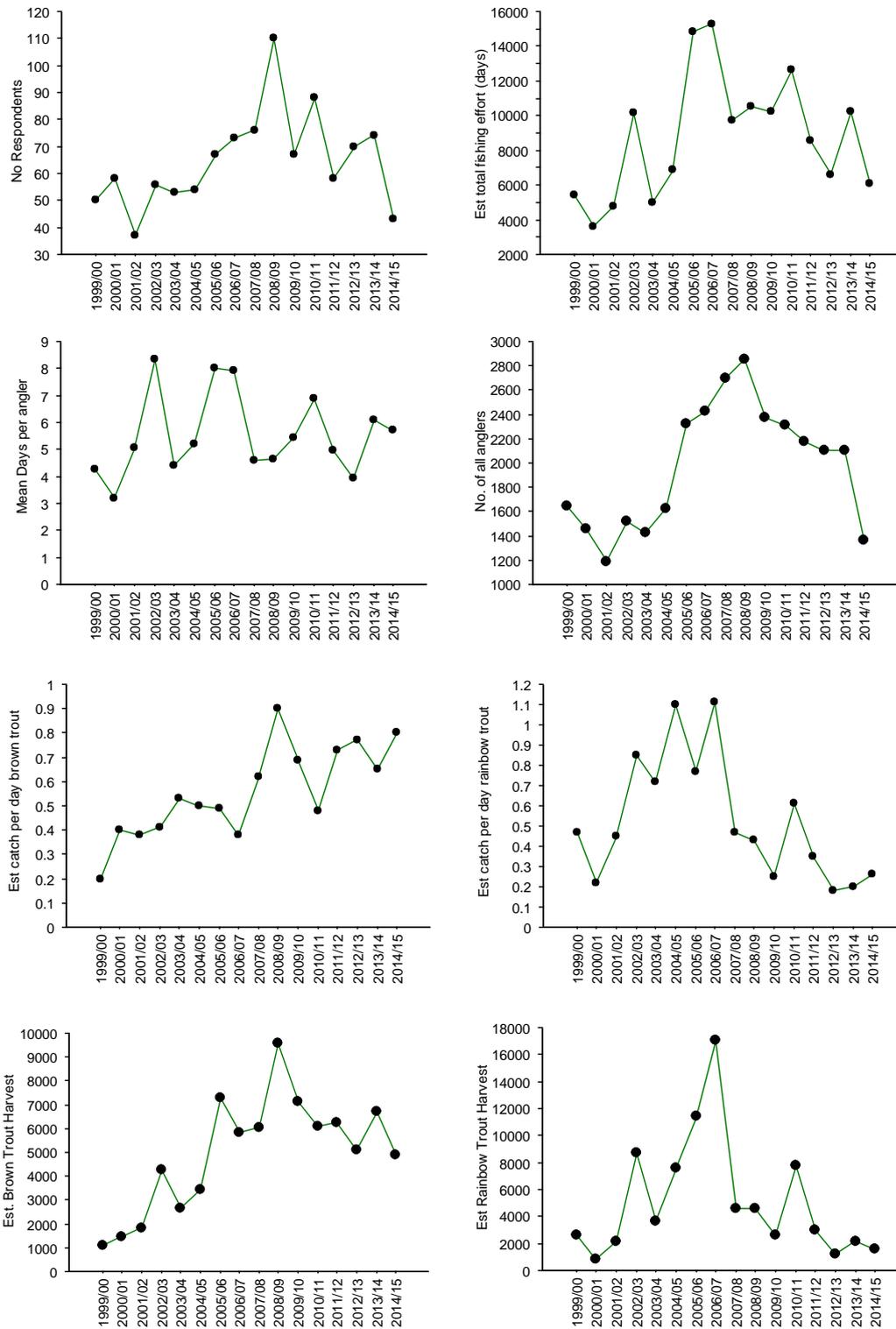


Figure 16: Associated results for the Annual Angler Postal Survey (APS) 1999-2012 for Four Springs Lake.

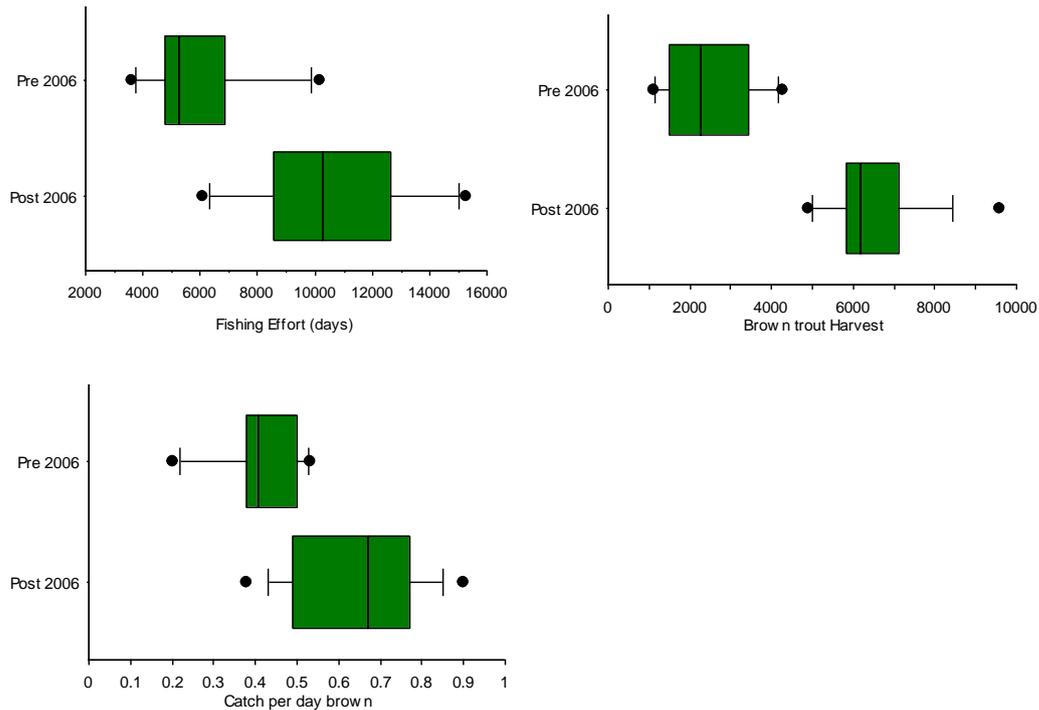


Figure 17: Comparison of median fishing effort for the period 1999-2005 against 2006-2015.

Figure 16 and associated plots show the graphed data from the Annual Postal Questionnaire (APS) 1999 to 2015 for each season, while figure 17 shows the data for angling effort, harvest and catch rate only, comparing pre and post 2006 results. Table 6 below displays the summary statistics for all years 1999-2015 combined.

Since the commencement of Four Springs Lake as a fishery, on average 7% of all licensed anglers (2,261 anglers) fished there on a seasonal basis. This number has varied, ranging from a low of 1,186 anglers in 2001/02 to a high of 2,859 anglers in 2008/09. As expected, angling effort closely mirrored the number of anglers fishing this water. The maximum effort occurred during the 2006/07 season with 15,252 days fished while in 2000/01, this figure was 3,625 days. The average number of days fished per angler each season has generally been around 5-6 days with a maximum of 8.3 days and a minimum of 3.2 days. Brown trout harvest has steadily trended upward since the fishery was first established in 1999. A large increase occurred in the 2008/09 season (see figure 16), this was driven mainly by a higher catch rate of 0.9 fish per day (see figure 16) with total effort down 7 percent compared to the 2006/07 season.

When the average fishing effort for the period 1999-2006 (mean 7,243; median 5,461 days) is compared to 2006 – 2015 (mean 9,994; median 10,260 days) there is a 38 percent increase in fishing effort. The average catch rate for brown trout increased 75 percent post 2005/06 (0.7 mean fish per day) compared to pre 2005/06 (0.4 mean fish

per day). The average harvest of brown trout doubled post 2005/06 (mean 6,408 fish) compared to pre 2005/06 (mean 3,146 fish) (see fig 17).

The catch rate and harvest for rainbow trout has in general been influenced by the stocking of yearling and adult fish from commercial farms. This is especially true for the period 2004-2008 and 2011 (see fig 16). A stocking of 4,000 rainbow trout in 2006 appears to have influenced anglers to fish this water and resulted in a large increase in the number of anglers fishing Four Springs. As a consequence it has led to a marked increase in the harvest of both rainbow and brown trout post 2006.

	Mean	Minimum	Maximum	Median
Total No Resp this year	890.1	776.0	1082.0	859.0
No Resp this water	64.6	37.0	110.0	62.5
Total No Days fished	361.4	186.0	605.0	319.5
Days per angler	5.5	3.2	8.3	5.1
Catch per day brown	0.6	0.2	0.9	0.5
Catch per day rainbow	0.5	0.2	1.1	0.5
Brown trout Harvest	4981.3	1097.4	9586.2	5473.5
Rainbow Harvest	5099.4	818.6	17043.6	3349.3
Total effort	8791.0	3625.2	15252.3	9141.6
Percent of all anglers this water	6.8	4.0	10.0	7.0
No. full season anglers	1559.1	936.0	2261.0	1669.0
No. all anglers	1974.7	1186.0	2859.0	2103.0
Short Term	415.6	250.0	598.0	434.0

Table 6: Summary statistics for APS 1998 – 2015 combined.

4 DISCUSSION

Other than surveys for the presence of redfin perch prior to the flooding of the area, and a single boat electrofishing survey on 7th February 2012, no surveys have previously been undertaken at Four Springs Lake.

During surveys in 2012 and 2013, CPUE returns for brown trout were low for all survey periods except July 2013. There was strong evidence of extremely low numbers of brown trout under 360 mm, indicating failure of previous stocking events in 2010-2011. There was some evidence of a successful stocking of 50,000 triploid brown trout released in December 2012, although the strength of this year class is uncertain. The CPUE for rainbow trout was extremely low for all surveys; this most likely reflects the low population size in combination with low detection rates for the species.

The condition and growth of brown trout greater than 420 mm was excellent. During the April 2013 survey, fish averaged 1.72 kg with an average condition factor of 1.5 k- factor.

There was no evidence to suggest that fish condition had declined with increasing size (age), and larger specimens had not reached their full growth potential.

Retropinna were captured during an electrofishing survey during February 2012 and during fyke net surveys during July 2012 and September 2012, however none were captured during the April 2013 and July 2013 surveys. Several individuals of *Cherax destructor* were captured in all survey periods.

The average CPUE for brown trout as collected during angler interviews has steadily increased since 2005/06; this is despite a corresponding decline in the average number of hours fished by anglers. The reliability of the creel data is however uncertain, and may not truly reflect the effort and catches of anglers throughout the whole data collection period. This is especially true for the 2009/10 season with a wide range of catches reported possibly inflating the CPUE in that year. Creel data for the opening weekend of the 2013/14 season indicated above average catch rates, with anglers returning an average of 1.6 trout per angler for 3.6 hours fishing.

Data from the APS indicates that angling effort has increased markedly since 2004/05. This has resulted in a significant increase in the harvest of brown trout to around 6,000 – 7,000 fish per season. During this period the estimated catch per day also increased, varying between 0.5 – 0.95 fish, this range is higher than for the period 1999 – 2006, but the magnitude of the increase is less than what might be expected given the large increase in both angling effort and harvest.

The catch rate and harvest of rainbow trout generally corresponded to individual stocking events when yearling and adult fish were released. During 2005-2006 over 7,000 yearling rainbow trout were stocked out. These releases appear to have acted as a catalyst for an influx of anglers, therefore increasing total angling effort in the preceding years.

Conclusion

Four Springs Lake despite being stocked with a significant number of brown trout over the past 13 years, at present, appears to hold a low to moderate population of brown trout, with an estimated 19,000 (+/- 5,000) fish. There is evidence suggesting a number of recent stocking events may have failed, most likely as a result of high mortality and/or downstream dispersal during flood events. Brown trout that did grow through to takeable size appear to do so at a fast rate, and all were in excellent condition. There is little evidence to suggest that brown trout are reaching their full growth potential before being taken by anglers.

Since 2005/06, angling effort at Four Spring Lake has double, and the harvest of brown trout has increased three fold. During the corresponding period, the daily catch has

increased, but only by around one third. Anecdotal evidence and information collected during creel surveys indicate that most anglers return very few fish to the lake.

As a consequence of the increased angling effort and harvest, in combination with low recruitment from stocking, the population of brown trout is low - moderate.

The head of rainbow trout in the lake appears to be very low and previous high catch rate periods correspond with individual stocking events of yearling and adult rainbow trout.

5 RECOMMENDATIONS

- I. *To examine angler participation an annual review of the Postal Questionnaire for Four Springs Lake is be undertaken for the next 5 years.*
- II. *Creel surveys are scheduled for additional days at key times.*
- III. *In the short term (3-5 years) the lake is stocked with adult fish to fill the void in recruitment over the past three years. Stocking of juvenile fish is increased to 50,000 brown trout and 50,000 rainbow trout.*
- IV. *Bag and size limits are reviewed with the recommendation of reducing the bag limit and increasing the minimum takeable size.*

6 APPENDIX

LAKE	DATE	SPECIES	AGE	NUMBER	TYPE	ORIGIN
Four Springs	30-Jun-05	brown trout	Adult	105	Diploid	Lake Crescent
Four Springs	06-Nov-05	brown trout	Adult	860	Diploid	Salmon Ponds
Four Springs	29-May-06	brown trout	Adult	70	Diploid	Lake Crescent
Four Springs	20-Jul-06	brown trout	Adult	100	Diploid	Liawenee
Four Springs	23-May-07	brown trout	Adult	900	Diploid	Liawenee
Four Springs	13-May-08	brown trout	Adult	1000	Diploid	Liawenee
Four Springs	30-Sep-08	brown trout	Adult	30	Diploid	Crescent
Four Springs	01-Oct-08	brown trout	Adult	55	Diploid	Crescent
Four Springs	02-Oct-08	brown trout	Adult	54	Diploid	Crescent
Four Springs	26-May-09	brown trout	Adult	800	Diploid	Liawenee
Four Springs	17-Jun-10	brown trout	Adult	1000	Diploid	Liawenee
Four Springs	26-May-11	brown trout	Adult	1000	Diploid	Liawenee
Four Springs	25-May-12	brown trout	Adult	1200	Diploid	Liawenee
Four Springs	22-May-13	brown trout	Adult	1000	Diploid	Liawenee
Four Springs	23-May-13	brown trout	Adult	1000	Diploid	Liawenee
Four Springs	12-Jul-06	brown trout	Fingerling	2000	Diploid	Salmon Ponds
Four Springs	13-Jul-06	brown trout	Fingerling	2000	Diploid	Salmon Ponds
Four Springs	11-Jul-07	brown trout	Fingerling	1750	Diploid	Salmon Ponds
Four Springs	17-Jul-07	brown trout	Fingerling	5000	Diploid	Salmon Ponds
Four Springs	07-Jan-10	brown trout	Fingerling	4850	Diploid	New Norfolk
Four Springs	14-Dec-10	brown trout	Fingerling	20000	Diploid	New Norfolk
Four Springs	12-Dec-02	brown trout	Adv Fry	10000	Diploid	Salmon Ponds
Four Springs	29-Nov-07	brown trout	Adv Fry	22000	Diploid	Salmon Ponds
Four Springs	29-Oct-03	brown trout	Fry	20000	Diploid	Salmon Ponds
Four Springs	18-Dec-08	brown trout	Fry	20000	Diploid	New Norfolk
Four Springs	20-Oct-09	brown trout	Fry	10000	Triploid	New Norfolk
Four Springs	17-Nov-11	brown trout	Fry	20000	Triploid	New Norfolk
Four Springs	18-Dec-12	brown trout	Fry	50000	Triploid	New Norfolk
Four Springs	15-Oct-13	brown trout	Fry	50000	Triploid	New Norfolk

A) Stocking data for brown trout - Four Springs Lake 1999-2013.

Date	Method	Species	Length (mm)	Weight (g)
Jul-12	Fyke	RT	160	40
Jul-12	Fyke	BT	260	300
Jul-12	Fyke	BT	510	1300
Jul-12	Fyke	BT	480	1150
Jul-12	Fyke	BT	580	1910
Jul-12	Fyke	BT	508	1440
Jul-12	Fyke	BT	485	1500
Jul-12	Fyke	BT	458	1800
Jul-12	Fyke	BT	115	20
Jul-12	Fyke	BT	475	1000
Jul-12	Fyke	BT	525	1760
Jul-12	Fyke	BT	370	650
Jul-12	Fyke	BT	460	1100
Jul-12	Fyke	BT	415	700
Jul-12	Fyke	BT	498	1230
Jul-12	Fyke	BT	370	650
Jul-12	Fyke	BT	460	1100
Jul-12	Fyke	BT	415	700
Jul-12	Fyke	BT	498	1230
Sep-12	Fyke	BT	460	740
Sep-12	Fyke	BT	552	1950
Sep-12	Fyke	BT	481	1750
Sep-12	Fyke	BT	530	1500
Sep-12	Fyke	BT	435	900
Sep-12	Fyke	BT	510	1650
Sep-12	Fyke	BT	428	880
Sep-12	Fyke	BT	428	890
Sep-12	Fyke	BT	570	2000
Sep-12	Fyke	BT	515	1600
Sep-12	Fyke	BT	506	1510
Sep-12	Fyke	BT	448	1070
Sep-12	Fyke	BT	469	1220
Sep-12	Fyke	BT	492	1390
Sep-12	Fyke	BT	494	1490
Sep-12	Fyke	RT	240	180
Sep-12	Fyke	BT	430	890
Sep-12	Fyke	BT	520	1700
Apr-13	EFB	BT	445	1950
Apr-13	EFB	BT	540	2520
Apr-13	EFB	BT	431	1700
Apr-13	EFB	BT	442	1710
Apr-13	EFB	BT	526	1860
Apr-13	EFB	BT	458	1170
Apr-13	EFB	BT	416	960
Apr-13	EFB	BT	140	
Apr-13	EFB	BT	183	

Apr-13	EFB	BT	148	
Apr-13	EFB	BT	150	
Apr-13	EFB	BT	140	
Apr-13	EFB	RT	453	1360
Apr-13	EFB	RT	369	730
Apr-13	Box	BT	513	1730
Apr-13	Box	BT	504	1630
Apr-13	Box	BT	509	1560
Apr-13	Box	BT	475	1500
Apr-13	Box	BT	539	2120
Apr-13	Box	BT	448	1330
Apr-13	Box	BT	509	1580
Apr-13	Box	BT	115	

Date	Method	Species	Length	Weight	CPUE	Fin Clipped
Jul-13	Fyke	BT	503	1590	2	
Jul-13	Fyke	BT	388	650		Y
Jul-13	Box	BT	570	2020	5	
Jul-13	Box	BT	571	1920		
Jul-13	Box	RT	561	2440	1	
Jul-13	Box	BT	497	1540		
Jul-13	Box	BT	475	1210		
Jul-13	Box	BT	520	1840		
Jul-13	Box	BT	442	1010	9	
Jul-13	Box	BT	370	580		Y
Jul-13	Box	BT	480	1360		
Jul-13	Box	BT	454	1240		
Jul-13	Box	BT	482	1270		
Jul-13	Box	BT	424	810		Y
Jul-13	Box	BT	510	1500		
Jul-13	Box	BT	445	1350		
Jul-13	Box	BT	385	670		
Jul-13	Box	BT			0	
Jul-13	Box	BT	497	1540	15	
Jul-13	Box	BT	378	530		Y
Jul-13	Box	BT	500	1850		
Jul-13	Box	BT	422	860		Y
Jul-13	Box	BT	575	1870		
Jul-13	Box	BT	504	1440		Y
Jul-13	Box	BT	495	1590		
Jul-13	Box	BT	526	1790		
Jul-13	Box	BT	530	1840		
Jul-13	Box	BT	500	1640		
Jul-13	Box	BT	512	1570		
Jul-13	Box	BT	378	630		Y
Jul-13	Box	RT	387	790	1	
Jul-13	Box	BT	457	1280		

Jul-13	Box	BT	533	1700	6	
Jul-13	Box	BT	548	1930		
Jul-13	Box	BT	518	1640		
Jul-13	Box	BT	488	1520		
Jul-13	Box	BT	470	1530		
Jul-13	Box	BT	470	1530		
Jul-13	Box	RT	505	1650	1	
Jul-13	Box	BT	510	1520	9	
Jul-13	Box	BT	560	1830		
Jul-13	Box	BT	574	2040		
Jul-13	Box	BT	510	1250		
Jul-13	Box	BT	462	1160		
Jul-13	Box	BT	500	1450		
Jul-13	Box	BT	420	910		
Jul-13	Box	BT	366	580		
Jul-13	Fyke	BT			0	
Jul-13	Fyke	BT	455	1170	1	
Jul-13	Fyke	BT	538	1390	1	
Jul-13	Fyke	BT	510	1400	1	
Jul-13	Fyke	BT	480	1050	4	
Jul-13	Fyke	BT	510	1670		
Jul-13	Fyke	BT	572	2130		
Jul-13	Fyke	BT	525	1650		
Jul-13	Box	BT	470	1000	16	Y
Jul-13	Box	BT	600	1720		
Jul-13	Box	BT	444	1150		Y
Jul-13	Box	BT	495	1440		
Jul-13	Box	BT	520	1700		
Jul-13	Box	BT	515	1860		
Jul-13	Box	BT	510	1750		
Jul-13	Box	BT	500	1450		
Jul-13	Box	BT	496	1450		
Jul-13	Box	BT	580	1950		
Jul-13	Box	BT	510	1660		
Jul-13	Box	BT	524	1420		
Jul-13	Box	BT	520	1800		
Jul-13	Box	BT	510	1670		
Jul-13	Box	BT	515	1640		
Jul-13	Box	BT	450	1110		
Jul-13	Box	BT	566	2070	14	
Jul-13	Box	BT	440	1130		
Jul-13	Box	BT	450	1250		
Jul-13	Box	BT	515	1750		
Jul-13	Box	BT	375	850		Y
Jul-13	Box	BT	470	1500		
Jul-13	Box	BT	610	2740		
Jul-13	Box	BT	495	1650		

Jul-13	Box	BT	470	1220	
Jul-13	Box	BT	542	1750	
Jul-13	Box	BT	523	1920	
Jul-13	Box	BT	490	1500	
Jul-13	Box	BT	495	1410	
Jul-13	Box	BT	410	900	
Jul-13	Box	BT	528	1800	19
Jul-13	Box	BT	479	1340	
Jul-13	Box	BT	470	1250	
Jul-13	Box	BT	443	1130	
Jul-13	Box	BT	515	1550	
Jul-13	Box	BT	600	2320	
Jul-13	Box	BT	475	1380	
Jul-13	Box	BT	486	1500	
Jul-13	Box	BT	475	1130	
Jul-13	Box	BT	483	1020	Y
Jul-13	Box	BT	470	1378	
Jul-13	Box	BT	484	1280	
Jul-13	Box	BT	470	1100	
Jul-13	Box	BT	411	670	Y
Jul-13	Box	BT	476	1340	
Jul-13	Box	BT	500	1470	
Jul-13	Box	BT	372	460	Y
Jul-13	Box	BT	475	1300	
Jul-13	Box	BT	466	1160	
Jul-13	Fyke	BT	490	1510	1
Jul-13	Fyke	BT	530	1450	1
Jul-13	Fyke	BT	545	1430	1
Jul-13	Box	BT	396	700	5
Jul-13	Box	BT	497	1440	
Jul-13	Box	BT	522	1940	
Jul-13	Box	BT	585	1670	
Jul-13	Box	BT	388	750	Y
Jul-13	Box	BT	520	1510	7
Jul-13	Box	BT	540	2050	
Jul-13	Box	BT	530	1750	
Jul-13	Box	BT	550	2160	
Jul-13	Box	BT	510	1570	
Jul-13	Box	BT	482	1260	
Jul-13	Box	BT	375	710	Y
Jul-13	Box	BT	485	1560	8
Jul-13	Box	BT	505	1360	
Jul-13	Box	BT	578	2540	
Jul-13	Box	BT	495	1620	
Jul-13	Box	BT	505	1910	
Jul-13	Box	BT	505	1500	
Jul-13	Box	BT	509	1630	

Jul-13	Box	BT	352	530	Y
Jul-13	Fyke	BT			0
Jul-13	Fyke	BT	530	1760	1
Jul-13	Box	BT	492	1440	5
Jul-13	Box	BT	585	2520	
Jul-13	Box	BT	400	650	
Jul-13	Box	BT	492	1520	
Jul-13	Box	BT	301	500	
Jul-13	Box	BT			0
Jul-13	Box	BT			6 Y
Jul-13	Box	BT			7 Y
Jul-13	Box	BT			0
Jul-13	Box	BT			0
Jul-13	Box	BT			0
Jul-13	Fyke	BT			0
Jul-13	Box	BT			0
Jul-13	Box	BT			1
Jul-13	Box	BT			1
Jul-13	Box	BT	265		2
Jul-13	Box	RT	392		1
Jul-13	Box	BT			16 Y
Jul-13	Box	BT			0
Jul-13	Box	BT			9
Jul-13	Box	BT			16 Y
Jul-13	Box	BT			0 Y
Jul-13	Box	BT			6
Jul-13	Box	BT	264		3
Jul-13	Box	BT			6
Jul-13	Box	BT			5 Y
Jul-13	Box	BT			13
Jul-13	Fyke	BT			4
Jul-13	Box	BT			2
Jul-13	Box	BT			8 Y
Jul-13	Box	RT			1
Jul-13	Box	BT			7 Y
Jul-13	Fyke	BT			0
Jul-13	Fyke	BT			1
Jul-13	Fyke	BT			2
Jul-13	Fyke	BT			0
Jul-13	Fyke	BT			0
Jul-13	Box	BT	370		5 Y
Jul-13	Box	RT			2
Jul-13	Box	BT			2 Y
Jul-13	Box	BT			10 Y
Jul-13	Box	RT			2
Jul-13	Fyke	BT			1 Y
Jul-13	Fyke	BT			2

Jul-13	Fyke	BT			1	
Jul-13	Box	BT			3	Y
Jul-13	Box	BT			5	
Jul-13	Box	BT			2	
Jul-13	Fyke	BT			0	
Jul-13	Fyke	BT			1	Y
Jul-13	Box	BT			1	
Jul-13	Box	BT			3	
Jul-13	Box	BT			1	Y
Jul-13	Box	BT			2	
Jul-13	Box	BT			3	Y
Jul-13	Box	BT			1	
Jul-13	Box	BT			0	
Jul-13	Box	BT			0	
Jul-13	Box	BT			0	
Jul-13	Box	BT			4	
Jul-13	Box	BT			4	
Jul-13	Box	BT			3	Y
Jul-13	Box	BT			13	Y
Jul-13	Box	BT			11	Y
Jul-13	Fyke	BT			0	
Jul-13	Fyke	BT	451	960	1	
Jul-13	Fyke	BT			0	
Jul-13	Fyke	BT			0	
Jul-13	Fyke	BT			0	
Jul-13	Box	BT	545	1850	9	
Jul-13	Box	BT	430	750		Y
Jul-13	Box	BT	501	1440		
Jul-13	Box	RT	419	810	1	
Jul-13	Box	BT	522	1620		
Jul-13	Box	BT	340	450		Y
Jul-13	Box	BT	495	1540		
Jul-13	Box	BT	495	1100		
Jul-13	Box	BT	480	1420		
Jul-13	Box	BT	395	690	8	Y
Jul-13	Box	BT	545	1670		
Jul-13	Box	BT	524	1890		
Jul-13	Box	BT	525	1730		
Jul-13	Box	BT	389	740		
Jul-13	Box	BT	485	1710		
Jul-13	Box	BT	476	1020		
Jul-13	Box	BT	405	690		
Jul-13	Box	BT	504	1670	7	
Jul-13	Box	BT	515	1590		
Jul-13	Box	BT	493	1490		
Jul-13	Box	BT	505	1560		

Jul-13	Box	BT	453	1160		
Jul-13	Box	BT	473	1220		
Jul-13	Box	BT	503	1640		
Jul-13	Fyke	BT			0	
Jul-13	Fyke	BT	519	1680	1	
Jul-13	Fyke	BT			0	
Jul-13	Box	BT	486	1220	3	
Jul-13	Box	BT	515	1520		
Jul-13	Box	BT	508	1520		
Jul-13	Box	BT	416	840	2	Y
Jul-13	Box	BT	410	720		Y
Jul-13	Box	BT	508	1400	6	
Jul-13	Box	BT	539	1670		
Jul-13	Box	BT	474	1090		
Jul-13	Box	BT	492	1290		
Jul-13	Box	BT	309	320		
Jul-13	Box	BT	484	1230		
Jul-13	Fyke	BT			0	
Jul-13	Fyke	BT	544	2170	3	
Jul-13	Fyke	BT	494	1330		
Jul-13	Fyke	BT	446	970		
Jul-13	Box	BT	621	2270	4	
Jul-13	Box	BT	441	1020		
Jul-13	Box	BT	520	1770		
Jul-13	Box	BT	476	1350		
Jul-13	Box	BT	519	1350	1	
Jul-13	Box	BT	532	2070	8	
Jul-13	Box	BT	534	1890		
Jul-13	Box	BT	570	2020		
Jul-13	Box	BT	489	1460		
Jul-13	Box	BT	486	1320		
Jul-13	Box	BT	480	1390		
Jul-13	Box	BT	540	1650		
Jul-13	Box	BT	541	1900		
Jul-13	Fyke	BT			0	
Jul-13	Fyke	BT	548	1650	1	
Jul-13	Fyke	BT			0	
Jul-13	Fyke	BT			0	
Jul-13	Fyke	BT			0	
Jul-13	Fyke	BT			0	
Jul-13	Fyke	BT			0	
Jul-13	Fyke	BT	429	870	1	
Jul-13	Fyke	BT	379	490	7	Y
Jul-13	Fyke	BT	490	1190		
Jul-13	Fyke	BT	528	1640		
Jul-13	Fyke	BT	544	1430		
Jul-13	Fyke	BT	530	1520		

Jul-13	Fyke	BT	551	1170	
Jul-13	Fyke	BT	363	443	
Jul-13	Box	BT			0
Jul-13	Box	BT			0
Jul-13	Box	BT			0
Jul-13	Fyke	BT			0
Jul-13	Fyke	BT			1
Jul-13	Fyke	BT			1
Jul-13	Fyke	BT			0
Jul-13	Fyke	BT			0
Jul-13	Box	BT			1
Jul-13	Box	BT			2
Jul-13	Box	BT			9 Y
Jul-13	Fyke	BT			1
Jul-13	Fyke	BT			0
Jul-13	Box	BT			3
Jul-13	Box	BT			6
Jul-13	Box	BT			8
Jul-13	Fyke	BT			1
Jul-13	Fyke	BT			4
Jul-13	Fyke	BT			0
Jul-13	Box	BT			0
Jul-13	Box	RT			1
Jul-13	Box	BT			6 Y
Jul-13	Box	RT			1
Jul-13	Box	BT			0
Jul-13	Fyke	BT			0
Jul-13	Fyke	BT			0
Jul-13	Fyke	BT			0
Jul-13	Fyke	BT			0
Jul-13	Fyke	BT			0
Jul-13	Fyke	BT			1
Jul-13	Box	BT			2 Y
Jul-13	Box	BT			6 Y
Jul-13	Box	RT			1
Jul-13	Box	BT			0
Jul-13	Fyke	BT			0
Jul-13	Fyke	BT			4 Y
Jul-13	Box	BT			2 Y
Jul-13	Box	BT			0
Jul-13	Box	BT			10 Y
Jul-13	Box	BT			6

B) Data from in-lake surveys, Four Springs Lake – July 2012, September 2012, April 2013 and July 2013.