Inland Fisheries Service

Recreational Fisheries Report

Fisheries Performance Assessment Technical Report Shannon Lagoon – October 2017

Inland Fisheries Service

Tasmanian Government

Introduction

Shannon Lagoon is an impounded wetland on the Shannon River south of yingina/Great Lake. Presently, the lagoon provides habitat for threatened native aquatic plant and animal species, including two species of threatened freshwater fish. The lagoon is managed by Hydro Tasmania for power generation by pumping water into yingina/Great Lake making it available for use at the Poatina Power Station. Additionally, water from the lagoon is released downstream to supply riparian users and irrigators via the Shannon River.

The trout fishery at Shannon Lagoon relative to other highland lake fisheries is minor, with low angler visitation. Hydro Tasmania and the Inland Fisheries Service are working jointly to provide a more amenable and productive trout fishery at Shannon Lagoon. This is being achieved by limiting the period of peak turbidity and attempting to maintain total turbidity between 10 to 30 NTU (Nephelometric Turbidity Units). This goal is presently achieved by actively maintaining a high water level within the lagoon and using current irrigation flows to flush the lagoon. This situation will be enhanced with the installation of an automated pump at the Miena Dam that will assist in achieving this goal.

To gauge the effects of these actions and assess the brown trout population, a survey was undertaken during October 2017.

Fishery Performance Methods

In-lake Surveys

In readiness for a capture-mark-recapture population estimate, 503 adult brown trout sourced from the trap at the River Derwent upstream of Lake King William, were transferred to Shannon Lagoon (19 July 2017). All fish were tagged with a single white individually numbered t-bar tag, with each fish weighed and measured. The fish were allowed to mix with the general brown trout population within Shannon Lagoon for eleven weeks, before undertaking a recapture survey to estimate the population size. The average weight of these transferred fish was 339 grams.

During 10-12 October 2017, the Service undertook an intensive trapping survey within Shannon Lagoon. The purpose of the survey was to gain information on:

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

A total of 40 box traps (see figure 1) were set over two nights, with most deployed around the perimeter of the lagoon and nine deployed in a slightly deeper section in the middle of the eastern basin.

From the 80 box trap sets, 106 brown trout and one rainbow trout were captured. All fish were weighed and measured for length. Brown trout were examined for the presence of a tag. 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)*.

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.

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.

Fishery Performance Results

In-Lake Survey Brown Trout

Brown trout length weight data

From 80 box trap sets, 106 brown trout and one, rainbow trout were captured. All trout were weighed and measured. Unless otherwise stated, the results reported are for non-tagged ('resident') brown trout only (81 fish), as tagged fish had only been in the lake for 11 weeks. Some comments are made on these tagged fish below and within the relevant sections.

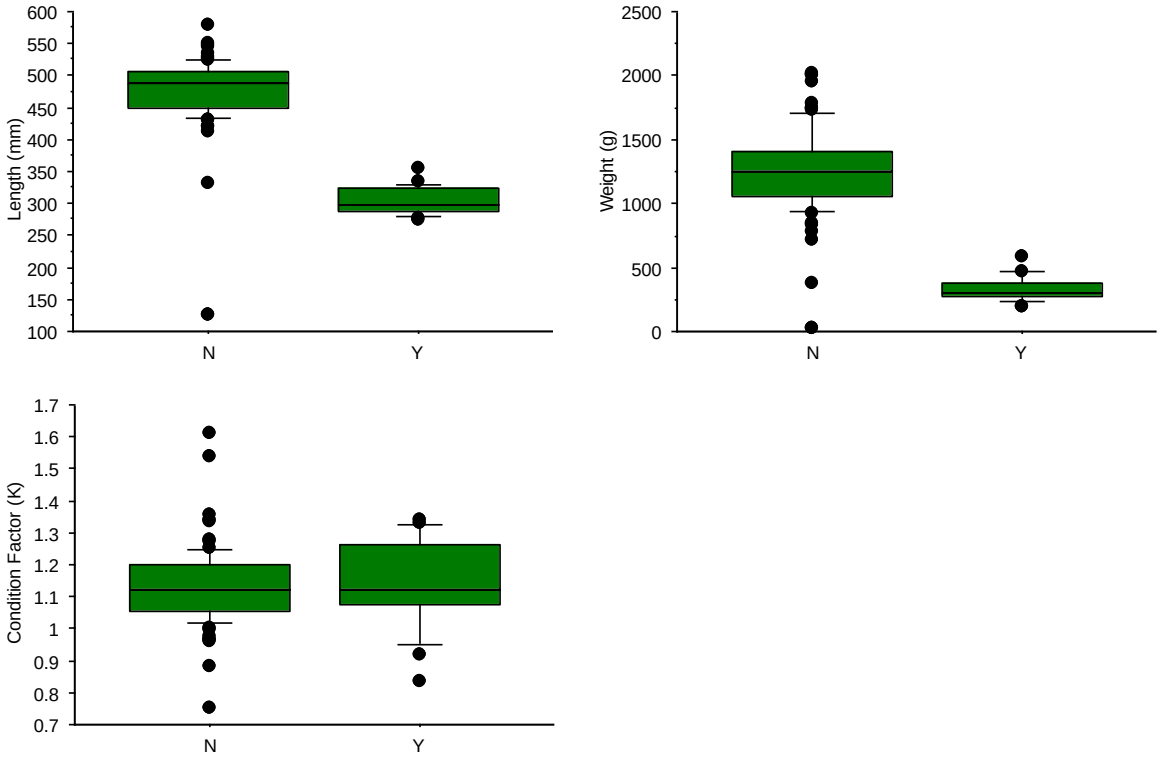


Figure 2: Box plots for brown trout - length, weight & condition factor separated by tagged transferred fish (Y) and non – tagged resident fish (N).

Of the 106 brown trout weighed and measured, 81 were un-tagged and therefore were fish from natural recruitment. The remaining 25 brown trout were tagged, indicating they were the adult brown trout transferred from Lake King William during July 2017. Un-tagged fish had a mean weight of 1 244 g with mean length of 473 mm. By comparison to the tagged fish transferred from Lake King William, they were on average significantly heavier and longer (see figure 2 and table 1). However, the mean condition factor for both groups was almost the same at 1.13 for un-tagged fish and 1.15 for tagged fish.

Grouping	Measurement	Mean	Std Error	Minimum	Maximum
All brown trout (n=106)	Length (mm)	434.00	9.10	125.00	580.00
	Weight (g)	1 029.00	48.59	30.00	2 020.00
	Cond Factor (k)	1.13	0.01	0.75.00	1.61
Un-tagged (n=81)	Length (mm)	473.00	7.53	125.00	580.00
	Weight (g)	1 244.00	39.58	30.00	2 020.00
	Cond Factor (k)	1.13	0.01	0.75	1.61
Tagged (n=25)	Length (mm)	305.00	4.33	274	355.00
	Weight (g)	332.00	19.11	200.00	580.00
	Cond Factor (k)	1.15	0.03	0.84	1.34

Table: 1 Descriptive statistics for brown trout - length, weight & condition factor for combined sample and, for tagged and un-tagged fish.

Brown trout length, weight and condition data (un-tagged fish)

In total, 81 un-tagged brown trout were captured in box traps, consisting of 33 males, 46 females and two immature fish (both 125 mm and 30 grams). On average, female fish were 46 grams heavier than male fish. There were several female fish that were considerably larger than the maximum size for males, this feature was noticeable during the survey with 79 percent of the fish over 1.5 kg being females, implying good survival of longer/older female fish. Nonetheless, both sexes were on average similar in length and condition factor (see figure 3 and table 2).

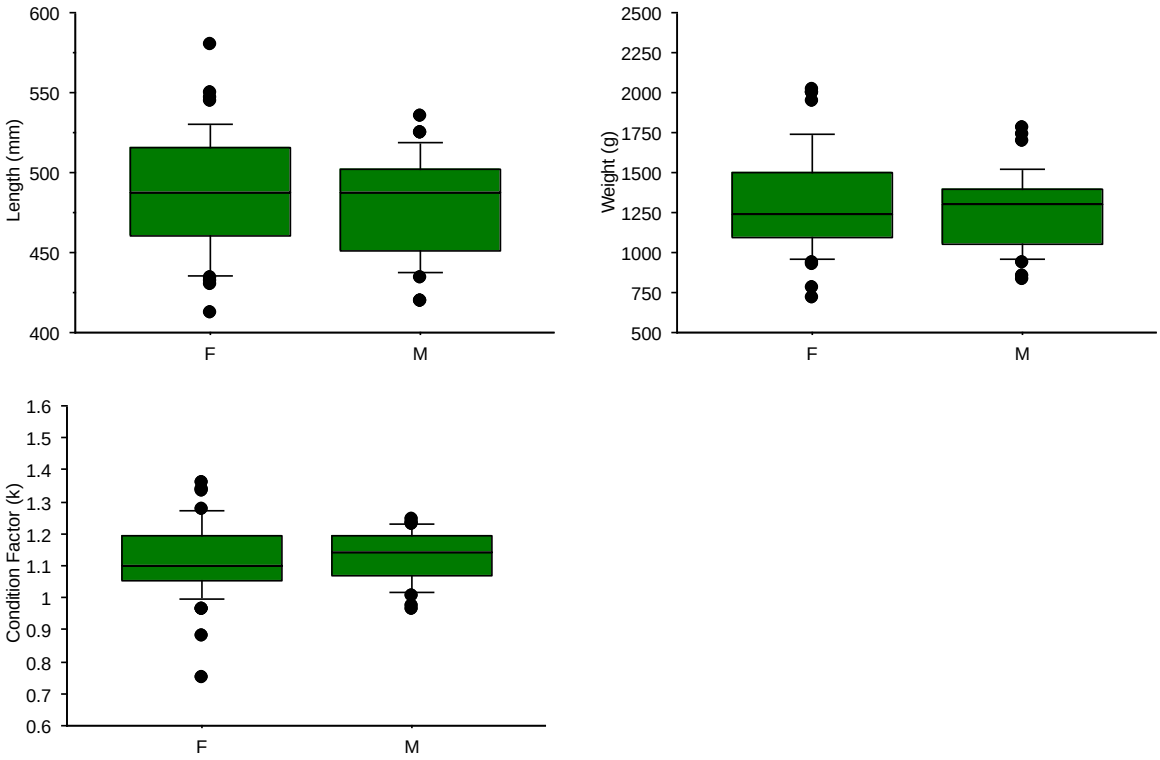


Figure 3: Box plots for brown trout - length, weight & condition factor separated by sex (F=female & M=male).

Grouping	Measurement	Mean	Std Error	Minimum	Maximum
Female (n=46)	Length (mm)	487.00	5.63	412.00	580.00
	Weight (g)	1 306.00	47.02	720.00	2 020.00
	Cond Factor (k)	1.12	0.02	0.75	1.36
Male (n=33)	Length (mm)	480.00	5.53	420.00	535.00
	Weight (g)	1 260.00	42.41	830.00	1 780.00
	Cond Factor (k)	1.13	0.01	0.96	1.25

Table 2: Descriptive statistics for un-tagged brown trout; length, weight & condition factor for combined sample & for each sex.

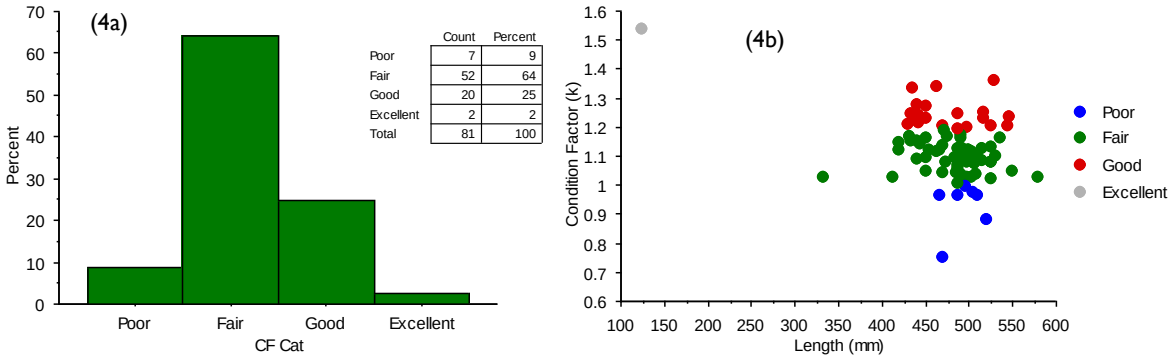


Figure 4: a) Condition factor category for all un-tagged brown trout, **b)** relationship for condition factor and length.

Overall, the condition of brown trout was fair to good with 89 percent of fish in these two categories, with 2 percent classified as excellent. Nine percent were classified as poor conditioned, this is generally normal in older fish (see figure 4 a&b)..

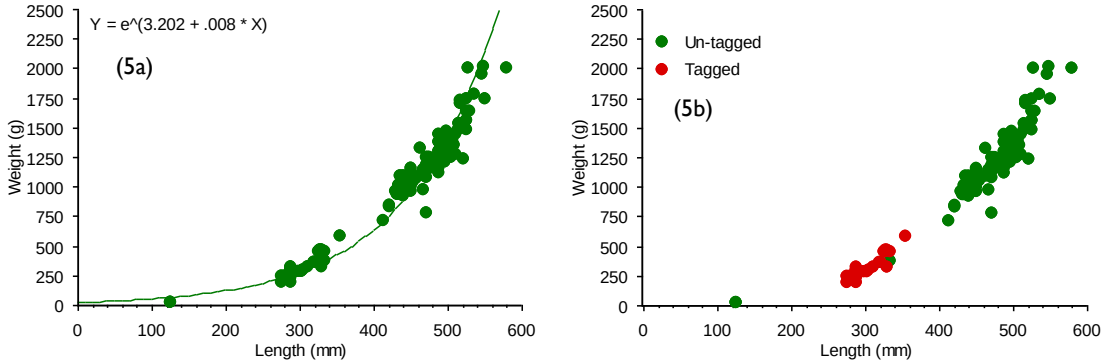
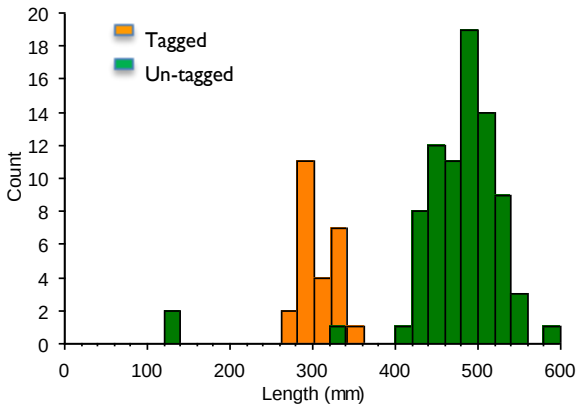


Figure 5: Length/weight relationship for brown trout showing both tagged and untagged fish**.**

Based on a comparison of the weight/length relationship, growth of resident Shannon Lagoon fish was good, with most fish growing to a large size. The survival of longer/older fish was high (see figure 5a) with many fish growing well beyond 500 mm. During the survey, one fish was captured that had an adipose fin clip. A review of the stocking records (see appendix) suggest this fish was from a stocking of adult fish undertaken in May 2003, therefore making the fish at least 17 years old *(assuming the fish was clipped by IFS and not an angler).* Tagged fish from the Lake King William trap that had been in the lagoon for only 11 weeks were in good condition. Tagged fish displayed a similar length/weight relationship to resident Shannon Lagoon fish (see figure 5b). The average condition factor of tagged and untagged fish was similar (see figure 2).

The length structure for the resident (un-tagged) brown trout population is highly skewed toward longer/older fish, with 33 percent being 500 mm or greater (see figure 6 and associated summary tables). This suggests that during favourable periods, natural recruitment can maintain a reasonable population and survivorship is high. The high survival of larger fish implies the total harvest of brown trout by anglers is very low. There is only one untagged fish between 140 – 400 mm length range, indicating poor recruitment from 2014 and 2015 spawning periods.

Two young of the year fish (125 mm) from the 2016 spawning were captured. Tagged brown trout from Lake King William represented almost all the catch in the 250 – 400 mm length range and fortuitously fill the gap in recruitment.



From (>=)	To (<)	Count	Percent
0	50	0	0
50	100	0	0
100	150	2	2
150	200	0	0
200	250	0	0
250	300	13	12
300	350	12	11
350	400	1	1
400	450	15	14
450	500	36	34
500	550	25	24
550	600	2	2
	Total	106	100

From (>=)	To (<)	Count	Percent
0	50	0	0
50	100	0	0
100	150	2	2
150	200	0	0
200	250	0	0
250	300	0	0
300	350	1	1
350	400	0	0
400	450	15	19
450	500	36	44
500	550	25	31
550	600	2	2
	Total	81	100

Figure 6: Length frequency for all brown trout and summary tables for 1) all fish; and 2) resident, un-tagged fish.

CPUE Information

Brown trout

Generally, the capture of brown trout in box traps was low with 106 brown trout capture from 40 box traps set over two nights, with the nets cleared each day (total 80 sets). This equates to a mean CPUE of 1.33 brown trout per trap. Unexpectedly, one rainbow trout (930 g and 405 mm) was captured, most likely due to downstream dispersal at some stage during irrigation releases from yingina/Great Lake.

Population Estimate

During 17 July 2017, 503 adult brown trout that had been tagged were transferred from Lake King William to Shannon Lagoon to allow a population estimate to be conducted. An 11 week settling in period was allowed before a recapture survey was undertaken. A total of 106 brown trout were captured in box traps over a three day period (two nights). Of these fish, 25 were tagged (23.6%). Table 5 shows the parameters of the Petersen estimate, with 2 133 brown trout estimated to be within the lagoon. The associated estimate of bias was at acceptable levels i.e. > 4 and implies a reasonable degree of confidence of the estimate.

Parameter	Result
Total tagged fish released (M)	503
Total recaptures (C)	106
Total marked recaptures (R)	25
Population estimate: MC/R = N	2 133
Standard error	364
Lower and Upper 95% CI limits	1 420 – 2 845
Estimate bias level: MC/4N =	6.25 (>4 acceptable bias)

Table 5: Petersen population estimate for brown trout Shannon Lagoon.

Stocking History

There have been very few stocking events undertaken at Shannon Lagoon. Before 2017, the most recent stocking of brown trout was a release of 400 adult brown trout from Liawenee Canal during 2003, these were all adipose fin clipped. During the survey, one adipose fin clipped fish was captured (1.54 kg and 515 mm) and is possibly from this stocking *(assuming the fish was clipped by IFS and not an angler)*. The only other recent stocking was a release of 11 000 rainbow trout fry during 2002. None of these would be expected to have survived.

Angler Postal Survey (APS)

Due to the low number of respondents for this water (average 2.7 replies per season), no detailed analysis has been undertaken. The APS data for brown trout is summarised in the appendix, with the averages for the period 2000 – 2017 displayed. On average, 81 anglers fish this water per season at a catch rate of 0.5 brown trout, with an estimated annual harvest of 91 brown trout, with no fish captures reported by respondents over the past five years.

Discussion

The results of the 2017 survey indicate Shannon Lagoon has a relatively small population of brown trout. The population estimate of around 2 200 brown trout is consistent with the low CPUE of 1.13 fish per trap set. This estimate seems reasonable given the very shallow nature of the lagoon and the potential low productivity.

Those resident (un-tagged) brown trout captured were mostly larger fish in the 450-600 mm length range. Survivorship for this group was high, with one third of fish greater than 500 mm, with some growing to greater than 550 mm. It was difficult to gauge the rate of growth but the length/weight relationship suggests typical growth for brown trout from a comparable highland lake environment. All fish were generally in fair to good condition with just 9% of fish in poor condition. This result is consistent with a population of large, older fish.

There was evidence of poor recruitment from 2014 and 2015 spawning periods, with just one fish capture in the 140 - 400 mm length range. The stocking of adult brown trout from Lake King William has however filled this void and should benefit the fishery over the next 2-3 years.

Because of low angling effort, the harvest of brown trout is minimal. Consequently, the population consisted of a considerable number of large (and most likely older) brown trout. Interestingly 79 percent of the fish over 1.5 kg were females.

Given the results of the survey there is scope to increase the harvest of brown trout, especially fish over 500 mm. This action may however need to be underpinned with a small supplementary stocking of fish, as the survey results suggest variable recruitment. The transfer of smaller Lake King William fish for this survey appears to have filled a void in in the population i.e. fish in the 260 – 360 mm length range. Subsequent stockings of fish of this size should therefore have some benefits in the future. In addition, as these King William fish were tagged, it will be necessary to resurvey Shannon Lagoon within 1-2 years to examine their growth and evaluate the success of this stocking.

The population estimation using the capture-mark-recapture method appears to be robust, with around 24 percent of the brown trout capture being tagged. The survival of fish appeared to be high and there was no evidence of tag loss with the tag wound still showing clearly, therefore any tag loss would have been obvious. There were no fish recaptured twice during the survey.

Recommendations

I. A small transfer of Lake King William fish is undertaken to ensure consistent recruitment.
II. Consider changing the management regime to a five fish bag limit with only two fish greater than 500 mm permitted to be taken.
III. A further survey and population estimate is conducted during 2019 to examine survival and growth of the 2017 tagged fish.
IV. If brown trout are stocked during 2018, they should be marked for identification purposes, in readiness for a March 2019 survey (prior to any other transfers).

Appendix

Appendix a): Stocking list for Shannon Lagoon 2000 – 2017.

SPECIES	AGE	ORIGIN	DATE	NUMBER	WEIGHT (g)	Comments
Rainbow trout	Advanced fry	Salmon Ponds	23 January 2002	11 000		
Brown trout	Adult	Liawenee Canal	22 May 2003	400	1 000	Adipose clip
Brown trout	Adult	Lake King William	19 July 2017	503	370	Tagged

Appendix b): Results for the Annual Postal Survey 2000 – 2017, brown trout only.

Season	Respondence this water	Catch per day brown	Brown Harvest	Total effort days	No. all anglers
1999-00	1	0.0	0	51	32
2000-01	2	0.7	117	175	50
2001-02	7	0.8	279	356	224
2002-03	7	1.2	305	262	189
2003-04	3	0.4	43	107	80
2004-05	5	0.0	0	146	150
2005-06	2	0.5	165	303	69
2006-07	1	0.0	0	53	33
2007-08	4	1.4	306	223	141
2008-09	2	0.0	0	41	51
2009-10	1	1.0	28	28	35
2010-11	3	0.0	0	163	76
2011-12	2	2.5	296	118	74
2012-13	1	0.0	0	22	27
2013-14	0	0.0	0	0	0
2014-15	3	0.0	0	197	94
2015-16	1	0.0	0	21	26
2016-17	2	0.0	0	166	60
Average	2.6	0.5	86	135	78

Appendix C): Fisheries assessment results – Shannon Lagoon 2014.

Overview - Shannon Lagoon Fisheries Assessment Survey: April 2014 and May 2014
(Prepared by: R Freeman)

Introduction

As part of the feasibility review for establishing Shannon Lagoon as a viable fishery, the Service undertook a survey to gain information on the trout and native fish populations of the lagoon. Over a three day period 7-9 April 2014, a combination of 28 box trap sets and 40 course mesh fyke net sets were used to capture trout. In addition, electrofishing for juvenile trout and native fish was conducted on 9 April 2014 and 9 May 2014.

Brown Trout

In total, 42 brown trout were captured during the survey 7-9 April; however, just 28 of these were adult fish, the remainder (14) were young of the year fry between 55-82 mm length (see fig 1). The catch rate for brown trout was very low at 0.64 fish per box trap for each overnight set and 0.25 fish per course mesh fyke net for each overnight set. This low CPUE likely reflects the low abundance of brown trout within the lagoon. The CPUE for electrofishing was considerably higher at a standardised 23.1 fish per 20 minutes of electrofisher on-time, this result is somewhat inflated however, as most fish were YOY fry collected from the inflow creek that offered ideal fry habitat.

Of the 28 adult fish captured, the average weight was 942 grams with the average length 433 mm. Fifty four percent of fish were nevertheless, 1 kg or over, with the largest fish being 1.32 kg (see fig 3). The majority of fish (86%) were in good to excellent condition (see fig 2) with only 4 fish being classified as poor. No rainbow trout were evident.

There was only one brown trout captured in the 100-320 mm length range, suggesting one to two years of minimal recruitment (see figure 1).

The max depth of the lagoon is 1.26 m with the vast majority of the lagoon being just 0.66 m deep or less (see fig 4). Sediments depth ranged from 0.3 m to 1.3 m plus, with most areas being at least 0.5 m.

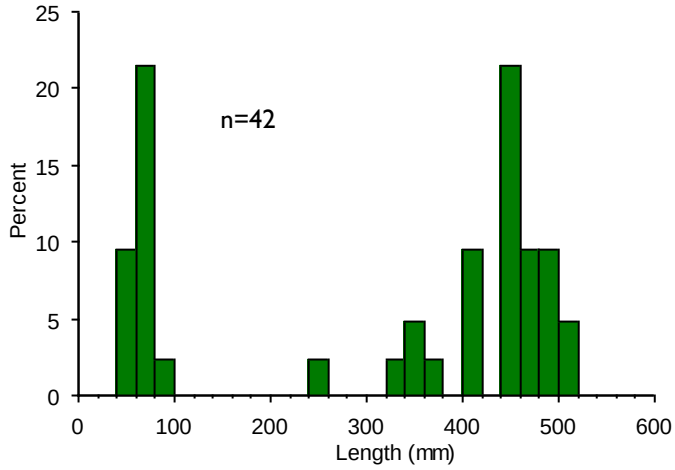


Figure 1: Percentage of brown trout in each 20 mm length range – Shannon Lagoon 7-9 April 2014.

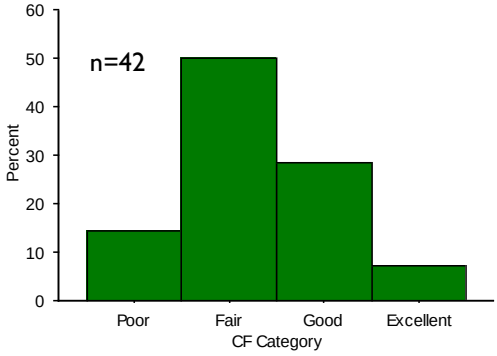


Figure 2: Percentage of brown trout in each condition factor category – Shannon Lagoon 7-9 April 2014.

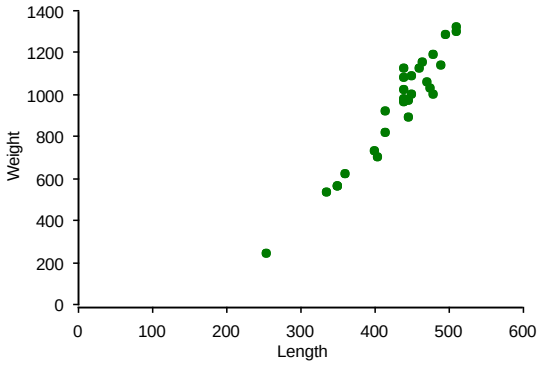


Figure 3: Length/Weight relationship for adult brown trout – Shannon Lagoon 7-9 April 2014.

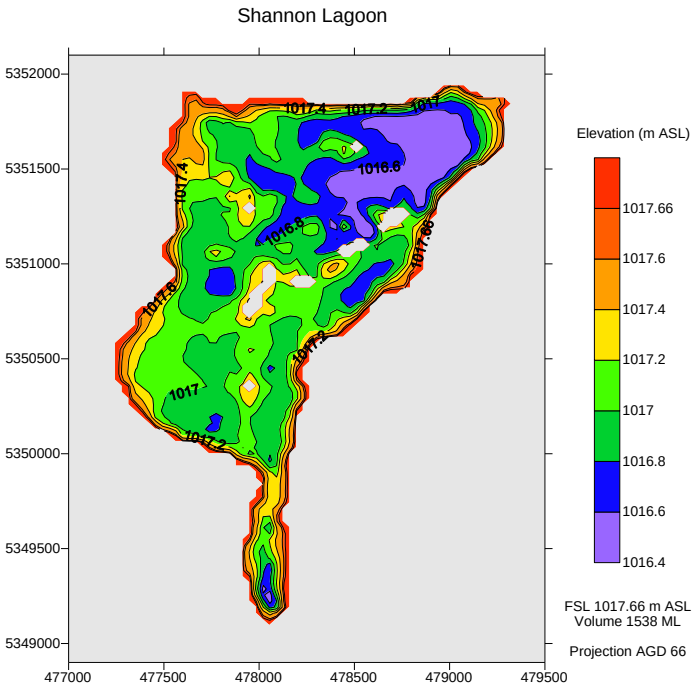


Figure 4: Bathymetric map of Shannon Lagoon *(Manser and Uytendaal unpublished)*.

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