Inland Fisheries Service Carp Management Program

Quarterly Report

January to March 2017

Australian Government

Inland Fisheries Service

Inland Fisheries Service

Tasmanian Government

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This quarterly report details the Carp Management Program activities from January to March 2017.

The objective of the program is: *To eradicate carp from Tasmanian waters and, in the meantime, to minimise the impact of carp on Tasmania from economic, recreational and ecological points of view.*

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Carp captures at a glance

Lake Sorell

January – March 2017 (Total)	Adult/Juvenile	Total 1995 to present
135	135 / 0	41,337

Lake Crescent

January – March 2017 (Total)	Adult/Juvenile	Total 1995 to present
0	0 / 0	7797

Overview

Lake Sorell

Fishing effort this quarter resulted in the removal of 135 carp from Lake Sorell. This is in comparison to 248 carp removed for the same period in 2016. Most fish were caught using gillnets in deep water. This approach was used in response to a falling lake level, mild temperatures, and low rainfall making the carp move away from the shore and into deeper water. This was in contrast to the previous quarter where rapidly rising water levels and temperatures over the spring months saw the carp display a strong drive to push in to the shore.

Table 1. Catch data from all methods used in Lake Sorell over the January-March 2017 quarter.

Gear Type	January	February	March	Total
Non-Targeted Gillnets	44	22	5	**71**
Inshore Set Gillnets*	30	-	10	**40**
Barrier Fyke Nets	4	1	-	**5**
In-Lake Fyke Nets†	-	-	-	**0**
Backpack Electro-shocker	3	-	4	**7**
Boat Electro-shocker	-	1	-	**1**
Gillnets Behind Marsh	11	-	-	**11**
Total	**92**	**24**	**19**	**135**

*These gillnets include blocking gillnets which prevent access to particular bays, gillnets set adjacent to the shore, and gillnets set around transmitter fish in the shallows.

†In-lake fyke nets include small fyke nets, double fyke nets, and box traps.

In addition to gillnets, a wide range of fishing methods were used over the last three months (Figure 1, Table 1). These included small fyke nets, big fyke nets stitched into barrier nets, double fyke nets, box traps, the boat electro-shocker, and backpack electro-shockers. All these methods combined select for both adult, and any potential juvenile carp. No juvenile carp were caught while fishing across a wide area of the lake.

In January and February as carp moved away from the shore and back to deeper water, we removed the gillnets from the marshes behind the barrier nets. A total of 10km of gillnets had been set in these areas over the past 3 months to catch carp as they tried to enter spawning areas. As these nets were removed from the shallows, they were added to the large amount of net already in use in deeper water. Trammel gillnets in particular were used for targeting areas where transmitter carp were found, in both inshore and offshore regions. Non-targeted gillnetting effort this season again occurred over a wide area of the lake, with regions of structure and habitat continuing to be a priority. This is to make sure that we are fishing across the whole lake, and to make sure we are catching carp that may be avoiding certain areas.

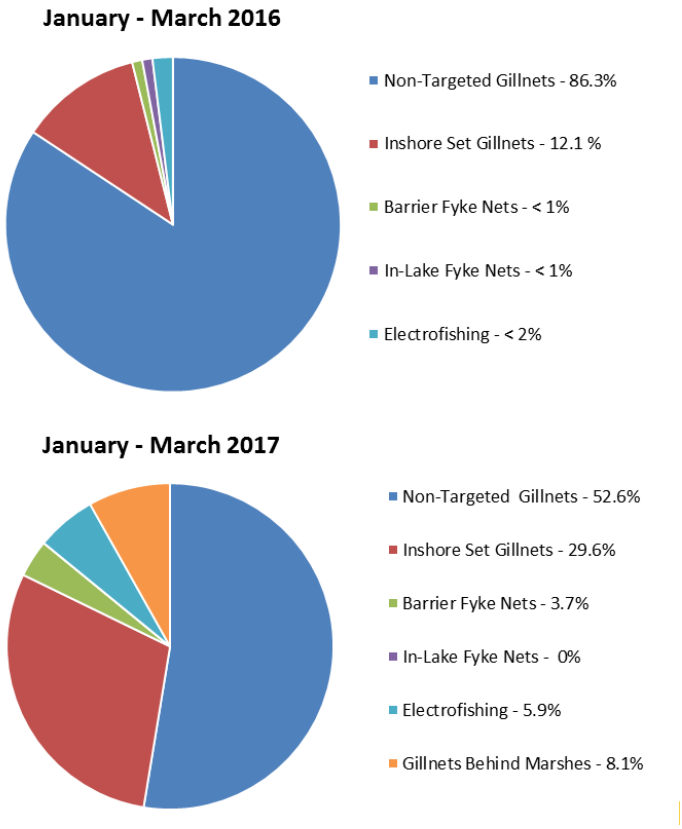


Figure 1. Percentage of total carp captures from all gear types used in Lake Sorell during the January-March quarter in both 2016 and 2017.

During this quarter the majority (52.6%) of carp were caught in non-targeted gillnets set across Lake Sorell (Figure 1). This is an increase from only 28.4% of carp caught using this method during the previous quarter. Inshore set gillnets continued to produce high catch rates throughout January, however by the end of the month catch rates in these areas stopped. The reduction in overall carp caught this quarter continues the trend of declining catch rates as the 2009 cohort is fished out (Table 2, Figure 2). Catch from non-targeted gillnets is standardized to carp per 100 m net hour, in order to allow us to compare between different nets, months, and years. With this information, the gear has been adjusted to allow us to catch more fish. This quarter trammel gillnets continued to be utilized in greater quantities due to their proven high efficiency. They were again found to the most efficient net type during this period.

Table 2. Non-targeted carp captures, gillnet fishing effort, and catch per unit effort (carp per 100m net hour) in Lake Sorell during the January-March quarter for the 2015/16 and 2016/17 seasons.

	Non-Targeted Carp Captures *		100m Net Hours		Catch Per Unit Effort	
Season	2015/16	2016/17	2015/16	2016/17	2015/16	2016/17
January	109	44	57 707	31 137	0.001889	0.001413
February	93	22	58 531	47 341	0.001589	0.000465
March	6	5	10 521	6 547	0.00057	0.000764
Total	208	71	126 759	85 025	0.001640	0.000835

*Note: Non-targeted carp captures refers to carp caught without the aid of transmitter fish, and not part of aggregations.

Catch per unit effort (CPUE) of non-targeted gillnets peaked in January (Figure 2). This is likely to be due to the carp population being highly mobile during this period, as they moved from shallow shorelines to deep water. Ideal water temperature also would have contributed to their increased movement. This peak in catch rates corresponded with an increase in movement of transmitter fish. As in the October-December quarter, routine tracking revealed that transmitter fish moved great distances throughout the lake, often traveling many kilometers overnight.

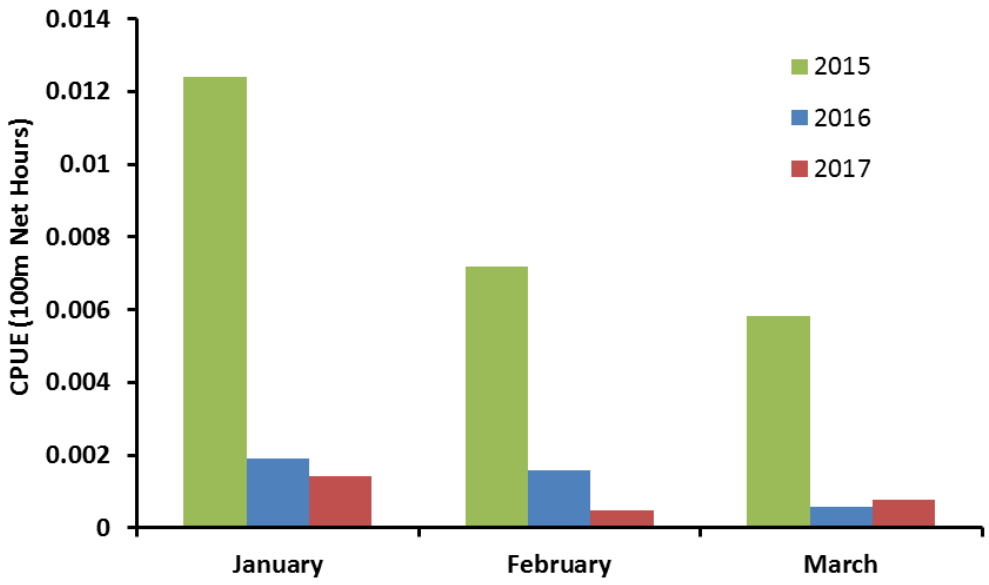


Figure 2. Catch per unit effort of non-targeted gillnet sets in Lake Sorell during the January-March quarter in 2015, 2016, and 2017.

Despite targeting transmitter fish throughout the 2016/17 season, no aggregations had been detected. However in mid-March after a period of warm settled weather, a single transmitter fish was found in a rocky backwater on Dago Point, and resulted in the first and only feeding aggregation for the season. Trammel gillnets were used to block off access to the area, while additional trammel gillnets were also zig zagged throughout the backwater and specifically around the transmitter carp. The backpack electro-shockers were then used to herd the transmitter fish into a gillnet. This fish was carefully removed from the gillnet and released back into the lake to hopefully continue to lead the CMP to more aggregations! Two backpack electro-shockers were used to steadily work each section of the backwater, in order to herd any remaining carp into the gillnets. As the electrofishing continued, numerous carp were seen bolting and jumping in all directions, with three carp being captured by electrofishing directly, without the aid of gillnets. One of these carp was a 2.86kg jelly gonad condition (JGC) male, which is the largest example of its kind seen to date on the program! The whole area was shocked multiple times and gillnets were checked periodically as carp were pushed into them. In total 14 carp were captured over three days. This late season aggregation shows us the importance of our radio transmitter fish in finding carp in Lake Sorell, given the small remaining population size and reduced activity brought on by cooling water.

Picture 1. The rocky backwater which was the site of the first and only carp aggregation detected for the 2016/17 season. The entry points were blocked off, and trammel gill nets were zig zagged through the whole area in conjunction with backpack electrofishing.

Of note this quarter was a further increase in the ratio of carp with JGC. This altered from 1 "affected" carp caught for every 3 healthy male fish during October-December 2015, shifting to 1 "affected" carp for each 1.7 healthy male carp between January-March 2016. The ratio during the October-December 2016 quarter was 1:1.3, shifting to 1:1 for the January-March 2017 quarter. This increased occurrence of male carp affected by JGC further supports the hypothesis that the remaining numbers of carp are low, and the remnants of the population with the slowest development are currently being fished out.

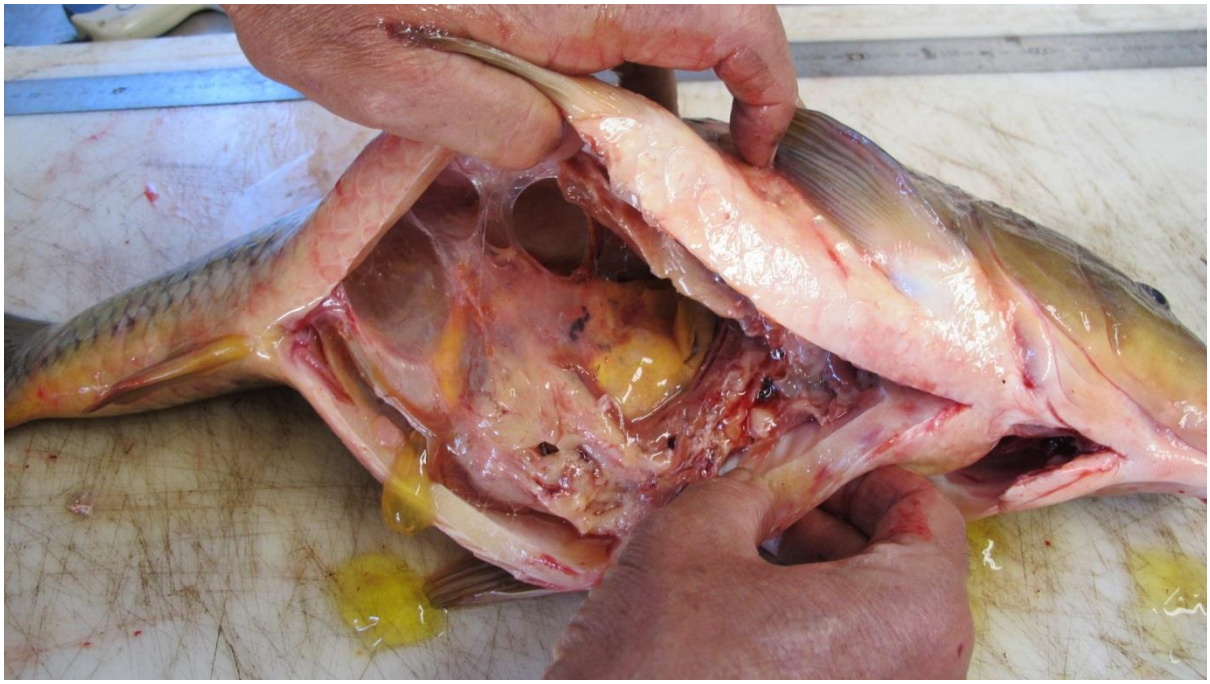
In mid-March six more carp were surgically implanted with transmitters, in order to prepare for any potential winter aggregations in Lake Sorell. All carp implanted were male JGC fish, and ranged in size from 564 to 1297gms. It has been shown this season that despite the low fertility of these fish, they still respond to environmental cues, and actively look for opportunities to aggregate in the shallows when conditions allow. Taking this information into account, the JGC carp are the perfect candidates for transmitter fish, as the risk of accidental fertilization of eggs (if involved in an aggregation) is minimal. The current model of transmitter used for these fish weighs only 7gm, and has a battery life of 6 months. All six carp swum off strongly when released, and will hopefully lead the CMP team to some successful captures over the next few months.

Picture 2. The 2.86kg JGC male carp which was caught by backpack electrofishing in the March aggregation.

The population estimate tag-return ratio between January to March was 10:1, with 11 tagged fish captured in this period. In late March, the population estimate analysis was re-run to account for these new tag returns. This estimate is based on a 2012 mark-recapture tagging operation which involved the release of 803 tagged carp into Lake Sorell. The population estimate analysis was calculated by Dr. Paul Burch, a Post-Doctoral Research Fellow from the Institute for Marine and Antarctic Studies/University of Tasmania and the Australian Antarctic Division. This resulted in a population estimate ranging from approximately 392 to 1306 carp as of the end of March 2017 (Table 3). There are several assumptions used in this estimate, and as the time since the tag release event increases, the choices of mortality values begins to drive the estimated population size. For example, increasing the sum of chronic tag-induced mortality and natural mortality to 20% results in a negative population size. This means the point has been reached where the assumptions are driving the estimates, with conservative values being required to achieve a positive population size. Based on this and on the dramatic decrease in catch rates, it is likely that the remaining population of carp in Lake Sorell is lower than what this tag-return analysis suggests.

Table 3. Population estimates of carp in Lake Sorell for the 2016/17 season including confidence limits and variables.

Variables		2016/17 Season	Confidence Limits	
Initial Tagging Mortality	Chronic Tag-Induced Mortality	Population Size	2.5%	97.5%
20%	10%	732	447	1187
25%	10%	563	392	956
30%	5%	803	475	1306



Picture 3. The advanced stage of the JGC is illustrated by the 2.86kg male carp caught in the March aggregation. Officially known as Stage 4, the gonads exhibit loss of big jelly blisters, clear fluid, no presence of visible sperm, and no visible structure of gonad tissue. By this stage this individual is likely to be completely sterile.

In summary, this quarter required a different fishing strategy when compared to the strategy used during the October to December 2016 quarter. A falling lake level and lack of warm, settled weather resulted in the carp population seeking areas of deep water. As a result the risk of spawning decreased, and effort was able to be moved away from inshore regions. Radio tracking led to important carp catches, the most significant occurring in late march. The focus moving into April will be pulling set fishing gear from the lake to prepare for winter. Radio tracking and gill net fishing effort will continue throughout the winter months to focus on cold water aggregations.

Lake Crescent

Lake Crescent's water quality is continuing to show signs of improvement (Figure 7). Since the extremely low water levels in 2008, the average total turbidity of Lake Crescent has decreased considerably. This is the direct result of high water levels flushing the lake after large rainfall events. The capture of a lone female carp in an aggregation with a number of transmitter fish in December 2007 proved to be very important, with no other carp caught since this event. Despite lots of fishing effort and monitoring over the past ten years there has been no evidence of recruitment or the presence of any carp. Timely rains over the winter period have returned the lake to full supply level, allowing the marshlands to fully recover.

Picture 4. The striking markings of the golden galaxias are hard to appreciate in the turbid waters of Lake Crescent.

Juvenile Carp Surveys

Lake Crescent

The annual Lake Crescent juvenile carp survey took place on the 15th of March 2017. The aim of this survey was to make sure that carp had not made their way back into Lake Crescent, and to look for any signs of new recruitment if spawning had occurred recently. Although no carp have been seen in Lake Crescent since 2007, surveys are still carried out every year to ensure a carp free lake.

Previously fyke nets were set around the margins of the lake, in order to target any juvenile or adult carp attempting to push into the shallow marshes. However since carp have not been found over the last 10 years, it was decided that the fyke nets were not needed. Backpack electrofishing was undertaken in areas where historically carp were known to favour. These habitats included rocky shores, sandy shores, and areas with lots of underwater vegetation. 11 areas around the lake were surveyed using backpack electro-shockers for a minimum of 10 minutes at each location. A total of 135 electrofishing hours was undertaken, with brown trout, short-fin eels, and golden galaxias making up the catch. There was no sign of any carp of any size present in Lake Crescent.

Picture 5. Backpack electrofishing amongst the strap weed for any presence of juvenile or adult carp in Lake Crescent.

Picture 6. Backpack electrofishing patches of baumea behind the barrier net at Dogs Head marsh to search for any presence of juvenile carp.

Lake Sorell

The Lake Sorell juvenile carp survey was conducted from Monday the 6th to Friday the 10th of March 2017. The aim of this survey was to determine if spawning had occurred over the past few months, and whether any new cohorts of carp could be detected.

64 fyke nets were set around the lake in close proximity to macrophytes and near shore areas where young of the year carp have been caught previously. In addition to this, backpack electro-shockers were used at 24 sites around the lake. Electrofishing was undertaken for a minimum of 15 minutes at each location. In total, 6144 fyke net hours were put in over the duration of the survey, as well as a total of 394 electrofishing hours. This resulted in numerous juvenile brown trout, eels, and golden galaxiids caught, but no sign of any new young of the year carp.

This season additional monthly juvenile surveys from December to February were also conducted in response to numerous carp being caught behind the barrier nets at Kermodes, Silver Plains, and Robertsons Marsh. The increased frequency of these surveys this season maximizes detection of potential spawning events, enabling prompt implementation of control measures, resulting in increased capture efficiency of juvenile fish. These were undertaken over three to four days and involved intensive backpack and boat electrofishing, as well as fine mesh dip netting of the whole wetland area, from the barrier net back to the shoreline. A total of 687, 922, and 398 electrofishing hours were undertaken in December, January, and February, respectively. No juvenile carp were detected on any of the surveys which suggests that spawning may have been avoided this season.

Picture 7. Checking fyke nets set around the periphery of the lake to target any juvenile carp moving around the shallows.

The Clyde River Survey

In conjunction with the lakes Sorell and Crescent juvenile carp surveys, a downstream carp survey of the Clyde River was also undertaken. The survey examines selected sites that feature ideal carp habitat immediately downstream of Lake Crescent to the township of Hamilton, and ensures that carp have not become established in the Clyde River system. The survey has been undertaken annually since carp were first found in lakes Crescent and Sorell. Backpack electrofishing was undertaken at three sites on the Clyde River which includes the Nant Bridge (300m stretch), the Bothwell sewage works (100m stretch), and the Hamilton Weir (100m stretch). A minimum of 30 minutes of backpack electrofishing was undertaken at each site, with a range of bycatch species captured. 17 redfin perch, 17 tench, 13 brown trout, and 18 eels were shocked in total. Most importantly no carp were found, which indicates that the containment strategy employed since 1995 continues to be successful.

Picture 8. A couple of redfin perch electrofished from the Clyde River downstream survey.

Golden galaxias survey

The annual golden galaxias *(Galaxias auratus)* survey was conducted from the 28th to the 29th of March 2017. This is the 12th consecutive year this action from the Lakes Sorell and Crescent Water Management Plan 2005 has been completed.

At lakes Sorell and Crescent, twelve fine-mesh fyke nets were set overnight at three locations within each lake. Sets consisted of four fyke nets at each location, with the number of golden galaxias captured per fyke net recorded. In addition, the fork lengths of 100 golden galaxias were recorded.

The total catch of golden galaxias in Lake Crescent was 1,485, which was lower than recent surveys, as four fyke nets were badly impacted by wind, therefore reducing the total catch. All fyke nets set at Lake Sorell caught effectively, with 1,590 golden galaxias captured (Table 4).

*Table 4. Captures of golden galaxias in fyke nets, set at three locations within each of lakes Crescent and Sorell (*denotes site impacted by wind).*

Lake	Location	No. Fyke Nets	Number Captured
Crescent	Site 1 Agnew Creek Shore*	4	900
	Site 2 Boathouse Shore*	4	151
	Site 3 Lower Clyde Marsh	4	434
	Total	***12***	***1,485***
Sorell	Site 1 East side of Island	4	85
	Site 2 Inside Grassy	4	1042

	Point		
	Site 3 Dogshead Point	4	463
	Total	***12***	***1,590***

Total captures of golden galaxias in Lake Crescent were reduced due to strong winds affecting four nets across two sites (Table 4). However, the adjusted CPUE figure using only the data from the eight unaffected nets, suggest the galaxiid population numbers remain robust. There is evidence of a continued decline in CPUE following a peak during 2014 (Figure 3). This on-going decline is likely to be a settling of population numbers and a response of slightly lower lake levels than experienced during 2013/14 that provide optimal spawning conditions and resulting high recruitment. At Lake Sorell, the decline in CPUE is minimal, suggesting the population has reached a relatively robust and stable state. The pooled long term median CPUE data (2011-2017) for both lakes suggest the present catch effort is well within the normal variability for the population (Figure 6).

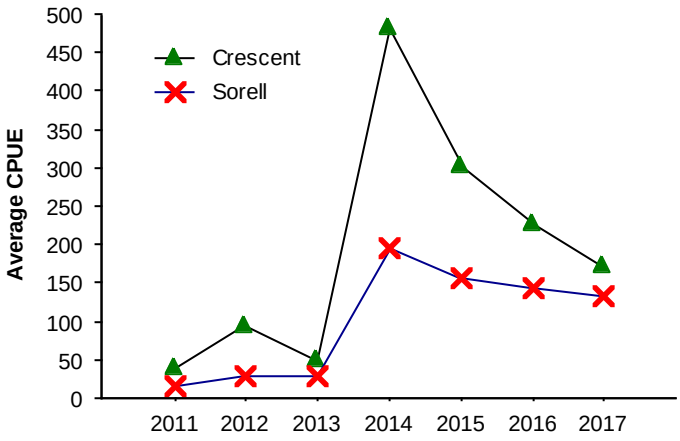


Figure 3. Average (mean) CPUE of golden galaxias for lakes Crescent and Sorell, 2011-2017.

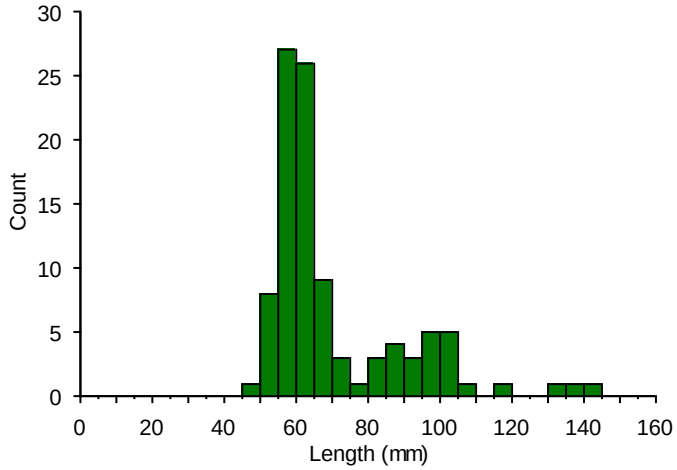


Figure 4. Length frequency of golden galaxias sampled from Lake Crescent 2017 (n=100).

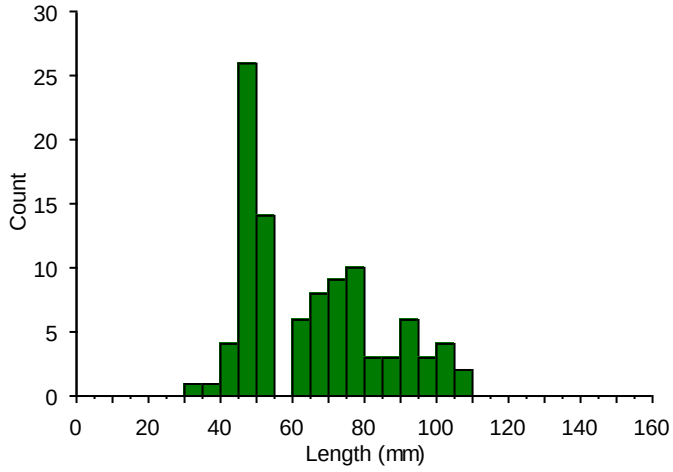


Figure 5. Length frequency of golden galaxias sampled from Lake Sorell 2017 (n=100).

Captures of YOY golden galaxias were significant in both lakes with a strong cohort of juvenile fish in the 50 – 70 mm length range for Lake Crescent (Figure 4), and 40 – 55 mm for Lake Sorell (Figure 5).

Unlike previous survey results from 2015 and 2016, there is evidence of substantial numbers of fish within both lakes not surviving into their second and third years (Figures 4 & 5). This is especially evident in Lake Crescent.

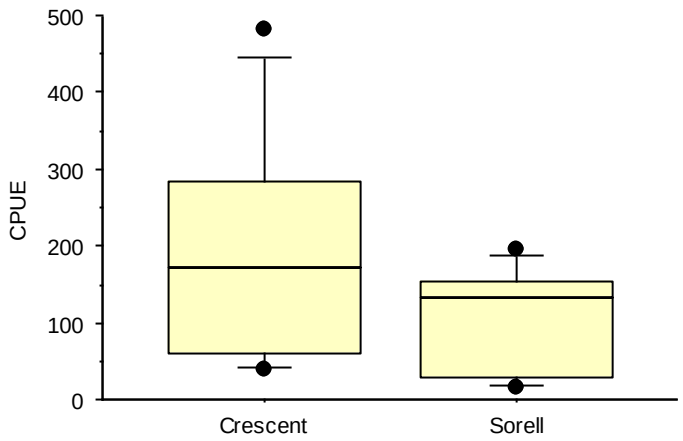


Figure 6. Median and interquartile range for CPUE, lakes Crescent and Sorell pooled data 2011-2017.

Based on these results, the golden galaxias populations within lakes Crescent and Sorell presently appears to be robust, with strong recruitment evident in the period 2014 – 2017. However, by comparison to previous survey results, the survival of two and three year old galaxiids appears to be significantly lower. The continued decline in CPUE within the period 2014 to 2017 for Lake Crescent needs monitoring to ensure this population remains robust.

Picture 9. Larger golden galaxias that were present in low numbers during the 2017 survey.

Work experience

The Inland Fisheries Service (IFS) receives regular requests from schools, universities, and interested graduates looking for work experience in freshwater fisheries. The CMP is especially sought after due to the overall diversity of work in the field. Gareth Edwards graduated from Charles Sturt University in Albury with a Bachelor of Applied Science, recreation, and heritage. However, soon after completion he realised he wanted to focus on the fisheries field and decided to start a graduate certificate in Fisheries Management with the Australian Maritime College. As a prerequisite for this unit, he was required to undertake 5 days of work experience in a related field, which led him to contacting the IFS. As a recreational freshwater and saltwater angler, he was keen to see what was involved in the management of a recreational fishery. He spent all five days on the CMP in January due to the high field work component at this time of the year. He was involved in setting and checking fyke nets, setting and retrieving gill nets in the lake using a hydraulic net reel, removal of gill nets from marshes behind barrier nets, backpack electrofishing the shallows to look for any aggregations, the recording of biological carp data, using telemetry receivers to pin point the locations of radio transmitter carp, and extensive general boating activities. As a result of his hard work and initiative shown during the five days of work experience, he secured a casual position working on the CMP till March.

Overall, he found his time spent with the CMP gave him a good insight into the practical side of fisheries operations, which he had not experienced during his undergraduate studies. The time he spent on the IFS vessels also allowed him to accrue a sufficient amount of sea time to apply for an AMSA Coxswains Grade 2 certification. Taking these skills into account, he found his experience with the CMP gave him a "foot in the door" into the fisheries/aquaculture industry, and as a result he secured a full time permanent position on a salmon farm in late March. Being brought up in NSW, Gareth was well aware of the carp situation on mainland Australia, and he was proud to be involved in a program where carp have been confined to one water body, and the possibility of complete eradication from a whole state was a reality.

Picture 10. Gareth Edwards gaining firsthand experience with the backpack electro-shocker, while searching for carp amongst the structure.

Employment and funding

Six casual workers were employed to assist with the onset of the carp spawning season and the repair of gillnets.

Table 5. Volunteer positions (January – March 2017)

Name	Background	Timeline
Gareth Edwards	Charles Sturt University	23rd – 27th January
Mark Cuthbertson	Commercial scale fisherman- Tasman Peninsula	25th – 26th February

Table 6. Casual positions (January – March 2017)

Name	Background	Timeline
Storm Eastley	Rosny College	1st January – 29th March
Raihan Mahmud	Institute for Marine and Antarctic Studies PHD student	24th – 25th January
Garath Edwards	Charles Sturt University	1st February – 15th March
Helen O'Neill	Bangor University, Wales	4th January – 24th February
Kim Clark	Interlaken Shack Owner	3rd – 22nd February
Will Ertler	Don College	11th – 17th January

Water Management

Table 7. Water Release data (January – March 2017)

Month	Lake Sorell release (ML)	Lake Crescent release (ML)
January	-	1199.14
February	-	1525.35
March	-	1450.56
TOTAL	**-**	**4175.05**

* Note: There is no continuous flow monitoring on the Lake Sorell release, only spot checks are done. However release from Lake Sorell into Lake Crescent commenced in late June, but the total release volume was not determined.

Picture 11. By the end of March the majority of the marshes around Lake Sorell had become de-watered, as illustrated here. In early spring the lake had risen to such a height that it was possible to drive a boat up to the tree line behind the marsh.

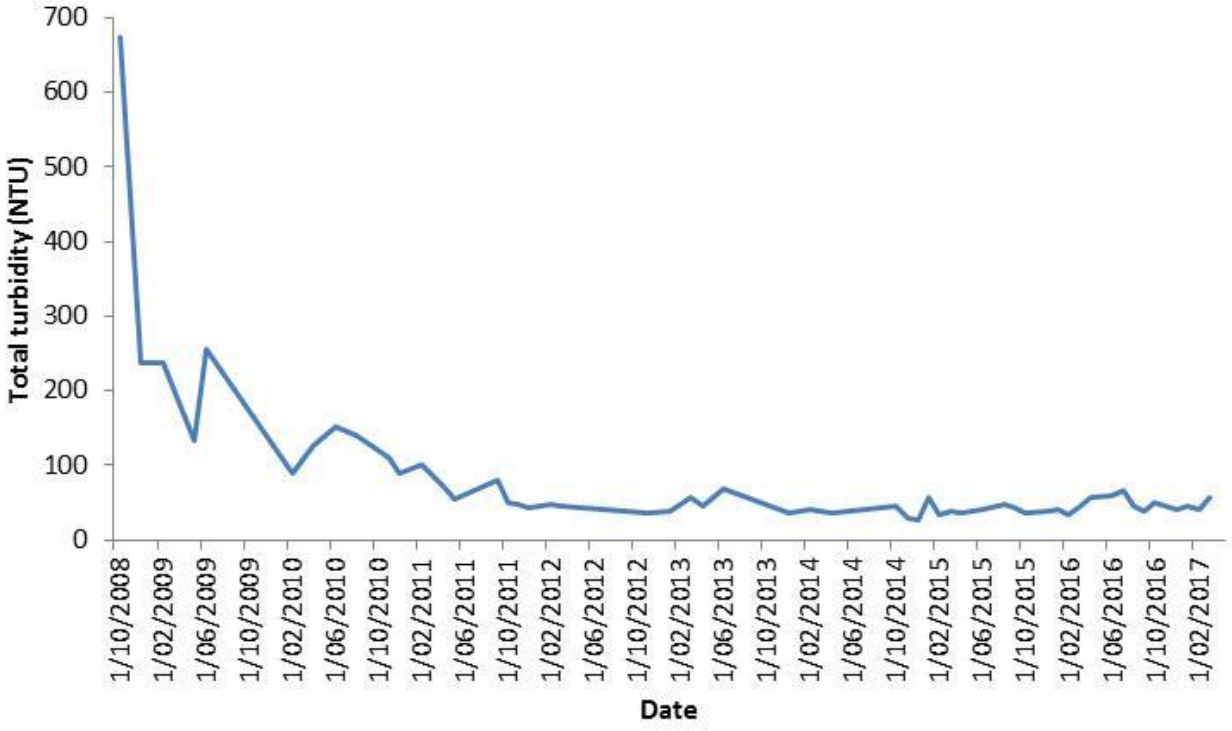


Figure 7. Turbidity levels in Lake Crescent from October 2008 to March 2017.

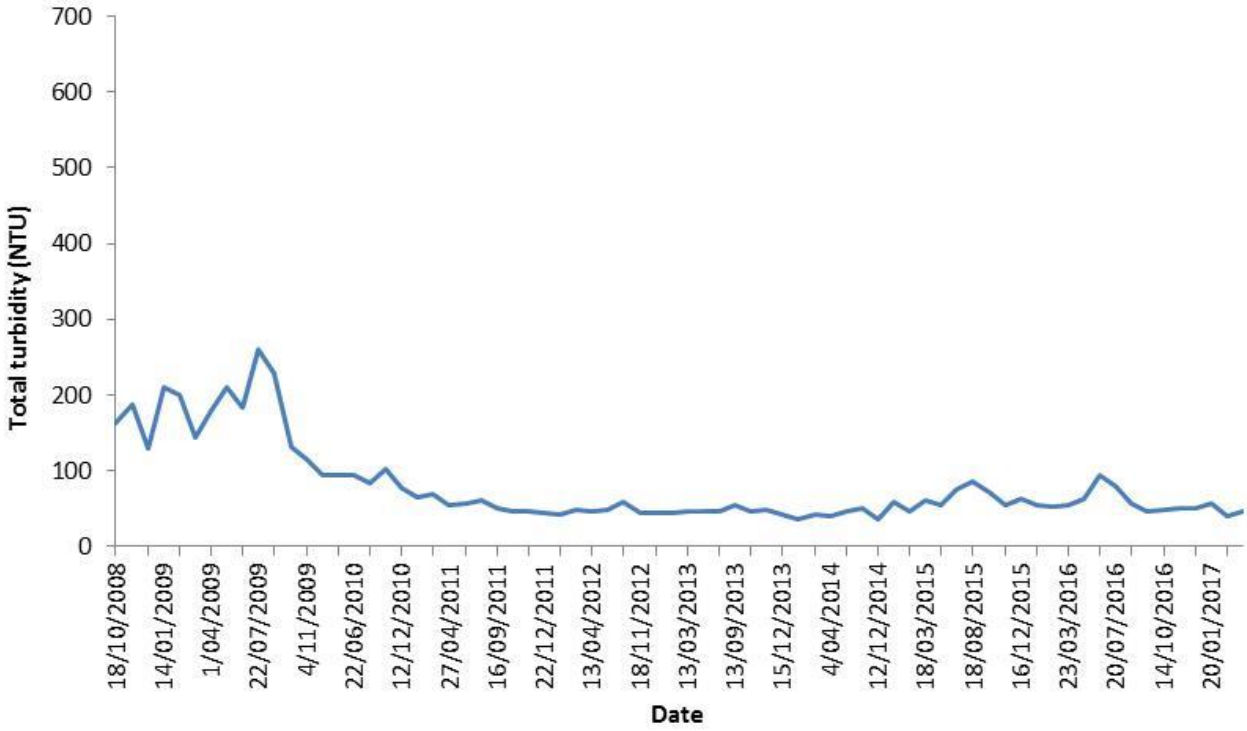
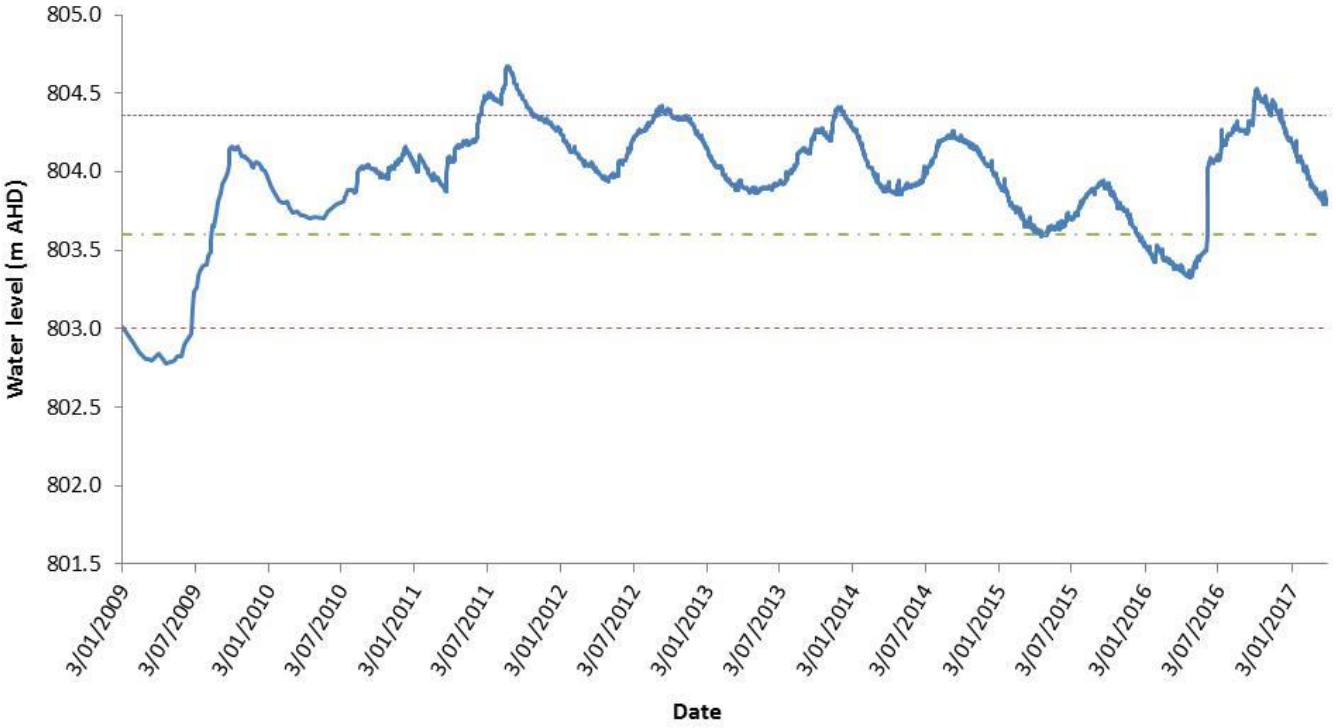


Figure 8. Turbidity levels in Lake Sorell from October 2008 to March 2017.

Lake Sorell



Lake Crescent