Carp Management Program Report

Lakes Crescent and Sorell

1995 - June 2004

The Program Objective:
"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".

Inland Fisheries Service 2004
Tasmania
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This report details the history, management and eradication of carp in Tasmania in Lakes Sorell and Crescent since 1995, as part of the Lakes Sorell and Crescent Carp Management Program.

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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Executive Summary

Since its creation within the Inland Fisheries Service (IFS) in 1995, the Carp Management Program (CMP) has been successful in its objective to contain European carp in lakes Sorell and Crescent. The dedicated staff who facilitate the CMP, now have the knowledge and skills to take this one step further in an attempt for total eradication. It was initially thought that this would be possible only through extreme measures, such as rotenone poisoning. However, containment and fish-down methodologies have been adopted since 1995 and despite the time frame involved, the results have come at less overall expense to the State and, have been far more environmentally friendly, than poisoning options initially considered.

In a significant achievement, the carp population in Lake Crescent has been reduced to a point where the lake will be re-opened to the public at the beginning of the Tasmanian brown trout season on 7 August 2004. With focussed effort during the coming Spring and Summer (2004/05) it is hoped that any remaining females can be captured without any successful recruitment occurring.

The National Heritage Trust funded work of Uytendaal (2003), Heffer (2003) and Hardie (2003), has now been completed. These studies addressed rehabilitation issues in lakes Crescent and Sorell, namely water quality, wetlands and native fish. Their reports provide detailed coverage of the important issues associated with these lakes and provide invaluable extensions to the carp management program currently in place. A better understanding of lakes Sorell and Crescent now exists.

The following report details the workings of the CMP from 1995 up until July of 2004. This report outlines the discovery of carp (*Cyprinus carpio*) in Tasmania and the subsequent need for the IFS to create a response group to tackle the threat of carp infestation. The report details the parameters the CMP is required to work within, with specific reference to lakes Crescent and Sorell and the major program undertaken to contain/control a closed population of carp within Tasmania (Picture 1).

The results from the containment and control methodologies applied, are included as information relating to carp eradication methods, biology, population dynamics, spawning characteristics and exploitation. Finance and staffing parameters are examined for the last nine years and future recommendations for the CMP in a broad context are also discussed.

Four technical reports have been prepared in conjunction with this main document and have been designed to focus on primary areas of the CMP. The technical reports examine:

- The use of biotelemetry in tracking carp movements
- Population estimates of carp within lakes Sorell and Crescent
- Age and growth of carp
- Size selectivity of all fishing equipment used to catch carp

Picture 1: A seine net haul of carp in Lake Crescent during 1995.

This aggregation was located by sight, as biotelemetry use was not employed by the CMP until 1997.

1.0 Introduction

European carp were introduced to mainland Australia in 1872. Their adaptability and fecundity have ensured their present position as the dominant fish species in the Murray-Darling basin and many other waterways on mainland Australia (Gehrke *et al.* 1995, McKinnon 1997).

Carp can inflict major environmental and economic costs on both the private and public sectors by reducing water quality and degrading aquatic habitats (Koehn *et al*. 2000). Carp have been implicated in macrophyte destruction, through:

- direct grazing;
- physical uprooting of plants;
- increasing water turbidity;
- increasing nutrient loads;
- continually resuspending sediments; and
- reducing invertebrate biomass and composition through predation.

In addition to this, they compete with native and other desirable fish species for both food and space (Fletcher *et al.* 1985, Brumley 1991, Koehn *et al.* 2000).

If left uncontrolled, carp have the potential to rapidly dominate a fish community. Carp can attain immense biomass densities due to their large body size and high fecundity rates. Biomass densities have been estimated as high as 3 144 kilograms of carp per hectare (Driver *et al*. 1997). It has been suggested that carp can also act as an energy trap and alter nutrient transfer through the aquatic ecosystem.

Due to the fact that carp obtain their energy from food items at the lower levels of the food chain, they compete directly with small native fish species such as the endemic golden galaxias (*Galaxias auratus*). This, combined with the fact that carp grow to large sizes and are relatively long-lived, means that this large volume of energy is not as readily available to the food chain as an equivalent biomass of small native fish species.

1.1 History of carp in Tasmania

The ornamental Koi strain of carp have probably been present in Tasmania since the turn of the century, however there has been no indication of carp establishing wild populations.

Carp of the vigorous 'Boolarra' strain were first discovered in Tasmania in the early 1970's, within a series of farm dams in northern Tasmania. These populations were subsequently eradicated using the fish poison, rotenone. A new population was discovered near Stowport in 1980, which was again eradicated using rotenone.

On 1 February 1995, IFS staff, acting on a report from an angler, captured a number of European carp in Lake Crescent. Subsequent surveys also confirmed the presence of carp in Lake Sorell, which is located immediately above Lake Crescent in the Clyde River catchment.

In 1998, a comprehensive survey was undertaken in the dams throughout the Stowport area in North-West Tasmania to ensure that re-infestation had not occurred. No carp were found.

1.2 Overview of Lakes Sorell and Crescent

Lakes Sorell and Crescent are large, shallow, freshwater, interconnecting lakes located in the south-east corner of the Tasmanian Central Plateau (Co-ordinates: Lake Sorell 147°17'E 42°11'S and Lake Crescent 147°16'E 42°18'S) (Figure 1). They are situated approximately 100 kilometres north of Hobart at 800m AHD and are about 5310 ha and 2305 ha in area respectively (Heffer 2003).

Lakes Sorell and Crescent are quite similar both physically and chemically and are located in an area of uniform geology, climate, soils and vegetation (Cheng and Tyler 1976). Dry sclerophyll forests dominate both catchments, which include some forestry, sheep and cattle grazing, and semi-cleared areas.

In times of full supply, both lakes have extensive wetland areas that connect to the main lake bodies. Kirkpatrick and Tyler (1988) described the wetlands at Lake Crescent as some of the largest areas of shallow freshwater marsh in Tasmania. A lakeside reserve in the north-west corner of Lake Crescent, is internationally recognised as a significant wetland by its listing under the convention on wetlands (Ramsar, Iran, 1971 - Ramsar Convention). The wetlands around both lakes, provide habitat to a diverse range of animals such as invertebrates (including the endemic snail *Austropyrgus sp*), frogs (with populations of the southern bell frog *Litoria raniformis* previously recorded), snakes, waterbirds, platypus, water rats and the endemic golden galaxiid fish (*Galaxias auratus*).

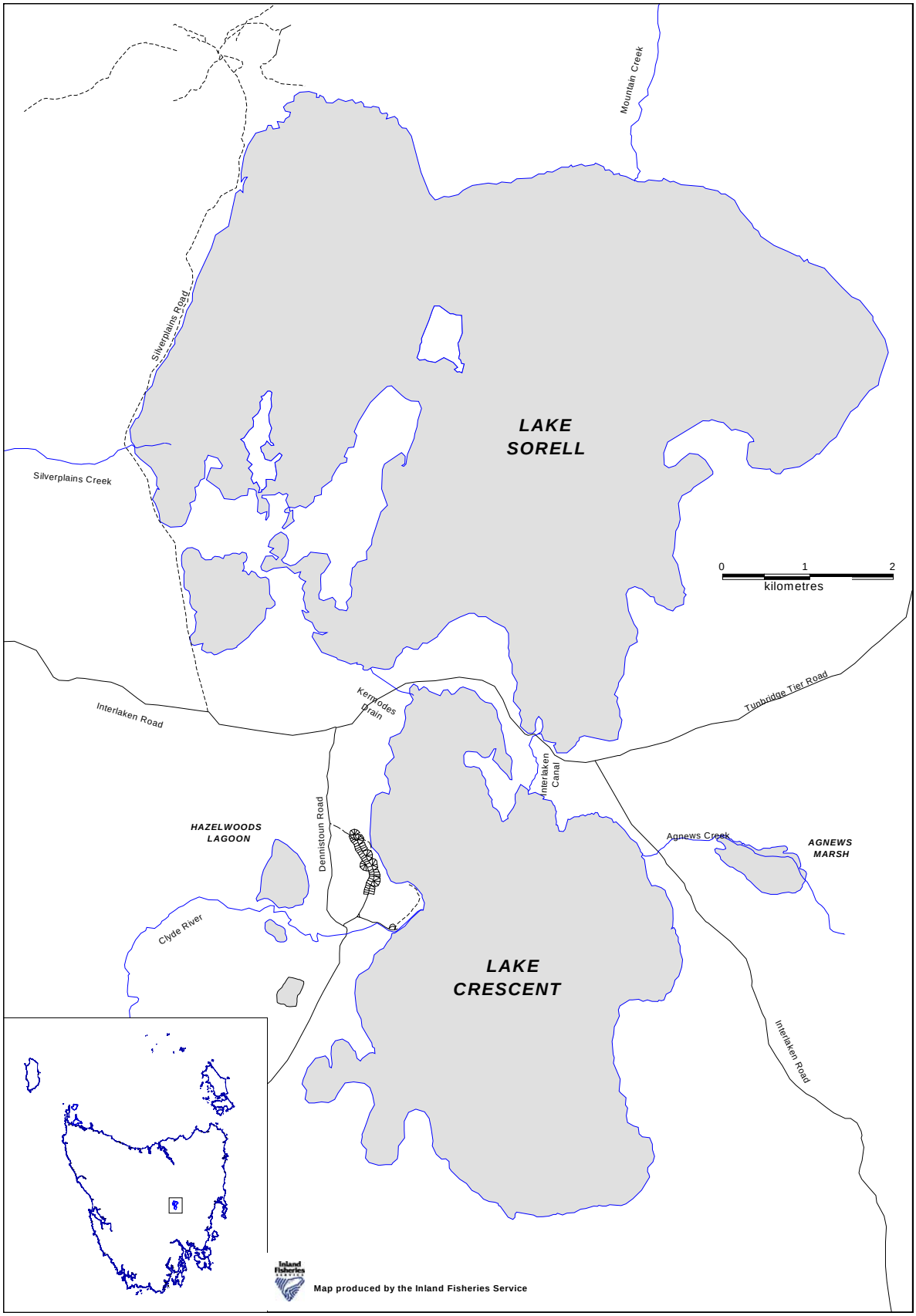


Figure 1: Map of Lakes Sorell and Crescent at full supply level.

(Taken from Heffer 2003)

1.3 The Carp Management Program and its response to carp

The confirmation of carp in the two largest water bodies on the eastern side of Tasmania's central plateau was of immediate concern to the IFS, anglers, environmentalists and other groups concerned with the health of our waterways.

In response to this threat to Tasmania's environment and economy, the State Government initiated a joint agency approach to the problem. A carp task force was formed incorporating all interest groups. This was later tailored to a carp-working group with expert representatives from Department of Primary Industry and Fisheries, IFS and Department of Environment and Land Management. The output from these groups led to the implementation of a series of strategies to deal with the carp problem in Tasmania.

1.4 Original objectives and strategies of the Carp Taskforce

Objective

"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".

In order to achieve that objective, the following broad strategies were adopted:

I. Contain carp in the lakes Sorell and Crescent catchment.

II. Develop a water management plan that provides for and protects the water supplies for Bothwell, Hamilton and irrigators and achieves **I** above along with satisfying **III** and **IV** below.

III. Reduce the existing carp population.

IV. Eradication of carp.

V. Prevention of re-introduction of carp to cleared waters from both interstate and intrastate.

VI. Undertake a communications strategy to minimise damage to tourism, and to support the above strategies **I** to **V**.

These objectives were then broadened to the following:

1. Contain carp in lakes Sorell and Crescent (Picture 2).
2. Improve the capacity of the containment screens.
3. Refine the water management plan to better provide for and protect the water supplies of Bothwell, Hamilton and irrigators.

4. Reduce the existing carp population.
5. Eradication of carp.
6. Protect native flora and fauna threatened by carp or carp management.
7. Gain an understanding of factors controlling the success of carp in lakes Sorell and Crescent.
8. Develop guidelines for recreational and commercial access to lakes Sorell and Crescent.
9. Prevent the reintroduction to cleared waters from both interstate and intrastate.
10. Undertake a communications and education strategy to minimise damage to tourism and increase awareness in fishing and general communities.

Picture 2: Outflow screens

Prevent eggs, juveniles and adult carp from escaping from Lake Crescent into the Clyde River.

2.0 Major Strategies

2.1 Containment

The first priority for the CMP, which allowed time to assess the various options, was containment. Primarily, this involved the prevention of escape or transfer of carp from the Lake Sorell and Lake Crescent populations. Given that these water bodies are at the top of the Clyde River branch of the Derwent River system, that was not an easy task. The stakes were high, as potentially carp could spread throughout the whole lower Derwent, as far down as Bridgewater (approximately 30 kms from Hobart).

2.1.1 Screens and water level management

Lake Crescent

In order to prevent the downstream spread of carp from Lake Crescent, fine mesh screens were installed at the outflow into the Clyde River shortly after carp were found (Picture 1). This made use of the limited confines of the original outlet structure. The screens constitute a physical barrier to carp by screening objects down to 1.1 mm using stainless steel mesh through which all water released must pass.

These screens are capable of screening small fish and eggs, however there is some doubt as to their effectiveness on larvae, which may be as small as 0.7 mm in diameter. There is speculation that these fragile fish larvae may not survive passage through the screens but this remains an unknown.

The fine mesh screen system currently in use has been developed by CMP staff and replaced purpose built screens located about 500m downstream of the outlet. The downstream screens failed to cope with high flows and were prone to overflowing when blocked. The use of these screens was discontinued after a trial period and further use is not recommended. The outflow screen system currently in use has a better flow capacity and has the added important advantage of stopping rather than overflowing when blocked.

The potential for failure of the downstream screens and the original screens at high release rates led to an initial extension of the original structure. Ultimately, this led to funding and construction of a duplicated screen structure in 1999. Prior to this, the inability to release enough water had led to the lakes filling to unmanageable levels (Spring 1996) and led to high levels (Summer 1996) which were

favourable for carp spawning. This required the managing of water levels at lower than preferred to provide a buffer to compensate for the inability of the screens to cope with reasonable flows.

In order to reduce the chance of spill and increase discharge rates, the 1.1mm screens can be replaced with 5mm screens for the higher rainfall months of May to October.

An increase in mesh size is justified by the expectation that eggs and larvae are not present due to lower water temperatures. This action requires an assumption that all of the small carp from the Summer have grown sufficiently to be screened by 5mm mesh. To date, small carp have proven too difficult to sample to assess early growth accurately. The duplication of the outlet structure has enabled the retention of the finest screens all year to avoid this potentially risky hypothesis. The increase to 5mm mesh should only now be necessary at the time of unusual weather events and high inputs.

The strategy of continued adult fishdown, complements the screening and containment strategy by reducing the possibility of small carp reaching the outlet screens. Conversely, the efficiency of the screens impacts on the ability to respond to changing water levels. Screens then become the critical link in terms of water level management and limiting the possibility of an uncontrolled spill.

The current screen configuration is an improvement on earlier versions, however, they have not been fully tested to assess what flow rates can be achieved. A conservative estimate of 4 cumecs for the 1.1mm mesh and spillway and 8 cumecs for 5mm mesh and spillway have been allowed in the Water Management Plan being developed for the catchment. Due to the large amounts of debris and fish coming onto the screens, this operation continues to require daily servicing for efficient operation during high flow or downstream irrigation events.

Ideally, screens are required that can operate down to 0.5 mm and pass up to 10 cumecs year round with a low blockage rate.

Lake Sorell

The CMP has isolated the populations of carp in lakes Sorell and Crescent from each other. Initially, the lakes were separated by 25mm vertical grate to stop adult carp moving upstream from Lake Crescent.

In 2001, 5mm horizontal screens were installed at the Lake Sorell outlet structure. These screens effectively isolate the lakes from each other preventing upstream and downstream movement of carp. This modification, however, limits the ability to pass water from Lake Sorell. Further development is needed to increase the outlet structure to its previous capacity. Funding has been approved (March 2004) for the duplication of the Lake Sorell outlet structure.

2.1.2 Water level management

This strategy was originally set on the ability to manipulate lake levels, to reduce the chance of carp having a successful spawning and to eliminate any chance of carp moving down the system via uncontrolled spillage. Both of these issues remain, but there is now more confidence in managing carp spawning at high water level because of the ability to pinpoint carp aggregations with the aid of the biotelemetry techniques now being employed. The ability to screen the Lake Crescent outflow at historical discharges is critical to successful water level management and preventing an uncontrolled spill. This has been met to a large degree by the duplication of the Lake Crescent outlet structure.

The Hydro Electric Commission (the Hydro) was enlisted initially as a consultant to formulate a water level management plan. The aim was to quantify the likelihood of meeting our containment objectives, while at the same time providing acceptable supply of water for other users.

The Hydro modelled the Sorell/Crescent system using all of the historical data available. The parameters included, rainfall, historical discharges, lake levels, as well as irrigation and township demands and the lower Lake Sorell outlet height. Any data that wasn't available was simulated from nearby sites.

The priority for consideration in the model was:

1= carp containment
2= supply townships
3= supply irrigators
4= prevent inundation of land surrounding lakes
5= maintain trout fishery
6= values of native flora and fauna

The requirements of each of these groups were derived through consultation.

The outcome of the modelling process is contained in “Modelling the operation of Lake Sorell and Lake Crescent” Hydro report No. 001-0587-CR-001, which has been provided to the various interest groups and stakeholders.

Since the formulation of the above priorities there has been a significant change in thinking regarding the water management and catchment management for the system. Now that the screens are in place and the risk of carp escape has been significantly reduced, the carp containment issue has been removed from consideration. A Lakes Sorell and Crescent Water Management Plan and River Clyde Water Management Plan are due to be released in 2004, giving priority to the following issues:

1. Township and stock water supply
2. Environmental considerations
3. Prescriptive rights (of which none exist in the Clyde catchment)
4. Hydro Tasmania
5. Irrigation and landowner requirements

If a carp containment issue should arise, the IFS can use the *Inland Fisheries Act 1995* to override the priorities outlined above.

2.1.3 Capital works

In order to enhance water level control and thus gain greater security of containment, a variety of capital works were undertaken. The canal between Lake Sorell and Lake Crescent was assessed as inadequate to deliver sufficient flows to control the level in Lake Sorell. The capacity of the canal was improved by deepening and widening it. The outlet structure itself was also limiting, so two new control gates were installed.

Works were also conducted in Lake Crescent to address the problem of uncontrolled flood overflow. This involved the construction of a levee’ bank to direct all floodwaters through an overflow channel. This overflow was also screened to 5 mm to prevent the passage of juvenile and adult carp.

As mentioned in section 2.1.1, screens were also installed in the outflow from Lake Crescent. The outlet structure was extended and this doubled the surface area of the screens in 1997 but this still did not go anywhere near meeting the outflow rates required to prevent an uncontrolled spill.

In 1999, a capital works grant enabled the duplication of the outlet structure. There are now four outlet bays that have settings for a variety of screen heights to manage a number of variables and outputs. This structure has not been tested to any degree because of the low lake levels and low

outputs that have been encountered since it's commissioning. Modifications have also been made to the canal above the screens. In a number of locations the canal was narrowed to increase velocity and decrease sediment build up.

The build-up of sediment along with low water levels and the construction of screens at the outlet structure has resulted in the need to de-silt the entire 500 metre length of the canal on an annual basis so that continuous downstream flows could be maintained. This de-silt usually occurs just prior to the commencement of the irrigation season in October and involves the physical removal of the silt from the channel with an excavator.

Along with narrowing the canal, the construction of a stop log structure at the canal entrance has considerably reduced silt build up. This has resulted in a reduction of time and therefore cost for this contract work.

2.1.4 Closed waters

There are numerous instances of illegal introductions of pest fish species into Australian inland waters. In Tasmania, the Mainland Yabby (*Cherax destructor*), Eastern Gambusia (*Gambusia holbrooki*) and Carp (*Cyprinus carpio*) have all been introduced in recent years.

In order to prevent the transfer of carp from lakes Crescent and Sorell to other Tasmanian waters, the closure of these lakes to the public, was seen as a priority.

2.1.4.1 Legislation

Carp are declared a "Controlled Fish" under the *Inland Fisheries Act 1995*.

In order to support the containment strategy, Lake Crescent was quarantined. At this time, the quarantine measures comprise of the closure of Lake Crescent and the upper Clyde River to the public for all purposes.

The closure officially commenced on 17 February 1995 and remains in force (as at June 2004). The closure includes, but is not limited to, angling, duck shooting, boating of any sort, wading, swimming or any purpose that results in contact with the water. This action was enforced using powers relating to noxious fish under Section 152(2)(b) of the *Inland Fisheries Act 1995*. Under this Section, the Commissioner/Director of Inland Fisheries, with the authority of the Minister, could issue an order for the closure.

2.1.4.2 Criteria for closure

The risks to the containment strategy posed by public access to carp infested waters are that people will attempt to catch carp and transfer them to other waters, or inadvertently transfer carp eggs on equipment. This risk is directly related to access to carp or carp eggs, which further relates to carp densities. Due to the large population of carp in Lake Crescent, this lake has remained closed since carp were discovered in 1995. In 2002, full consideration was given to re-opening Lake Crescent to the public because it had been assessed that carp numbers were now low enough and the risk of their transfer minimal. A number of measures were considered to support the re-opening of the lake including seasons, times and methods of angling to limit access to carp and their spawn and not to detract from the activities of the CMP. The re-opening did not occur due to the extremely low water levels that were being experienced due to drought.

Lake Sorell was closed following the discovery of carp, subject to an assessment of the population and associated risks. The risk of carp or carp eggs being spread from this water were considered extremely low due to the small population of carp. As a result, the lake was re-opened to the public in August 1995 and has remained open to the present day.

2.1.5 Carp population reduction

The reduction of the carp population complements several other aspects of the containment strategy. There is a lower risk of human interference and reduced chance of carp passage through the screens, provided carp are kept at low densities.

Population reduction is achieved by both direct fish down and limiting recruitment success through prevention of access to spawning sites.

2.1.5.1 Lake Crescent

Population estimates have been conducted since 1998 in Lake Crescent. These estimates use capture-mark-recapture data of tagged male fish to give an estimate of the un-tagged fish remaining. It is thought that all the male carp have been tagged in this lake giving us an accurate gauge of untagged (ie., female) fish numbers. These estimates suggest that there are now less than 10 adult female fish remaining in Lake Crescent.

During the Spring/Summer of 2003, the CMP began relocating adult male specimens to a holding facility as they were captured, further reducing the carp population and allowing the CMP to home in

on the few remaining female carp. By March 2004, the CMP had 210 tagged male carp in this holding facility. At this point it was decided to split this population and transfer 46 of the smallest fish to a secure facility at the Salmon Ponds (at Plenty, which is approximately 80kms south of the lakes), for on growing. Of the remaining 164 fish in the holding facility, 161 carp were released back into Lake Crescent on 17 March 2004 as a conclusive population estimate. The other three fish (the largest that the holding facility contained), were retained for future transmitter implantation.

No successful recruitment has been identified from the Spring/Summer of 2001 and 2002, and as yet, no juveniles/larvae have been discovered from 2003. A number of fish were recruited to the population in the Spring/Summer of 2000, however these fish are extremely low in number. Catch-Per-Unit-Effort (CPUE) estimates suggest that less than 100 individuals were recruited (Donkers 2003a) and these are one season away from sexual maturity (for females). This allows the CMP the time to fish down this juvenile population before it becomes a viable spawning risk.

2.1.5.2 Lake Sorell

Since the discovery of carp in Lake Sorell, only 16 sexually mature female fish have been removed. This suggests that the population of adult female carp in Lake Sorell is extremely low. A cohort of sub-adult fish that were spawned in the Spring/Summer of 2000/01 is of greatest concern to the eradication efforts in this water. Donkers (2003a) has used (CPUE) data on this cohort to generate a population estimate. This data suggests that the sub-adult cohort number a maximum of 3000 individuals. This is likely to be an over-estimation as the data was treated conservatively at each step to ensure a maximum population/over-estimate was reached.

Approximately 2070 juveniles have been removed and destroyed since this cohort in Lake Sorell was discovered, suggesting that at most, around 930 remain. As the majority of these fish are not expected to reach sexual maturity for another season (female fish) the CMP has an opportunity to fish down this cohort further so the numbers remaining at maturity are very low.

During fyke net surveys in February 2004, the CMP caught a number of juveniles indicating that there was an isolated spawning in December 2003. Numbers of fish within this cohort are yet to be assessed, but are believed to be low as extensive fyke netting survey in February and March only captured 41 specimens from within this isolated area.

2.1.6 Distribution

Since carp were first discovered in Lake Crescent, the IFS has investigated sightings and undertaken surveys in order to determine the full distribution of carp in Tasmania. Up to this point (July 2004) established carp populations within Tasmania have only been proven to exist in Lake Sorell and Lake Crescent.

Three male Koi *(*ornamental species strain) carp were discovered in a fish pond at Berriedale, near Hobart, and a hybrid carp/goldfish was found in a small pond at Gladstone in the north east of the state.

There has been an expectation that carp would be found downstream of Lake Crescent since they were first discovered in 1995. There have been intensive surveys conducted each year in the Clyde River and connected irrigation dams as well as Lake Meadowbank (some 60kms south of the lakes).

The fact that no established populations have been found downstream of lakes Sorell and Crescent is good news in terms of the containment strategy. On-going monitoring will be required for several years further to confirm that populations have not established.

2.2 Kermodes Cut

This man-made drain exists between Kermodes Bay in Lake Sorell and the northern end of Lake Crescent and is a potential means of passage for carp between the lakes during times of high water levels.

In 1995, when carp were found, a temporary screen was placed in Kermodes Cut to stop the passage of fish. This was replaced with a more permanent screen that was fastened to the concrete footings of the Interlaken Road Bridge shortly after. The screen is constructed of 50mm square galvanised mesh so will only restrict the passage of larger fish.

2.3 Eradication methods considered

Since carp are clearly an undesirable species, at this stage eradication of carp from Tasmanian freshwater systems must remain a preferred option. However the practicalities of successful eradication are not simple. To date there have been very few successful eradication’s from large freshwater systems like lakes Sorell and Crescent. Most failures seem to be linked to incomplete eradication, or re-introduction via the human factor.

If carp are discovered downstream from Lake Crescent at some later date, then it is suggested that with present technology, eradication would no longer be an option. In this instance, the issue of control and containment would also be rigorously challenged. However, the CMP up to this point has managed to control and contain the carp population in Tasmania within a closed system with a view to total eradication. Following are the methods considered and being developed for eradication.

2.3.1 Rotenone poisoning

Rotenone is a poison selective for fish and some invertebrates. This means that at the concentrations used for fish, it is not toxic to humans or other higher vertebrates.

Rotenone is commonly used for eradicating populations of fish in small water bodies. For these applications it is ideal, since high concentrations can be delivered to guarantee a complete kill at reasonable cost. It is also commonly used in fisheries research as a sampling method.

Temperature, UV radiation and a variety of water quality parameters affect the effectiveness of rotenone. For this reason, when it is used to treat large water bodies there are many variables that can cause problems. This becomes critical when large amounts are needed and cost becomes a problem. The difference between treatment at 2 ppm or 3 ppm can mean millions of dollars worth of product, particularly when dealing with water bodies as large as lakes Sorell and Crescent. Supply of product and the logistics of application also become more difficult as the size of water body increases.

For these reasons, an American consultant with expertise in this area was employed to consider the feasibility of the rotenone eradication option.

2.3.1.1 Rotenone consultancy

Dr Jim Fajt and the rotenone supplier Prentiss Inc, prepared a detailed submission on the feasibility of a rotenone eradication of the Lake Sorell and Lake Crescent carp populations. This report suggests that poisoning is technically feasible at a cost of around 4.8 million dollars US (1998). Given the cost associated with the poisoning and the problems associated with its application to a large water body, not to mention the lack of any other case study where this type of treatment has been successful, this option was discounted.

2.3.2 Carp specific poison

There is currently a plan to develop a carp specific poison. If successful, this type of technology, regardless of cost, will have advantages over other more general poisons. Water bodies such as lakes Crescent and Sorell could be treated with no risk to other species. This opens up the possibility of multiple applications and even if eradication is not successful, this may provide a control option.

2.3.3 Suicide Gene

The suicide or lethal gene option has been discussed, but it is only a theoretical possibility at this stage. The idea is being developed be Peter Grewe of the CSIRO in Hobart, but this is not a short-term option. The theory behind the concept is that if a lethal gene can be fully integrated into the wild carp population through successive generations and then triggered by a carp specific cue, the total carp population can be killed.

So far, neither the gene nor the trigger have been identified. Furthermore, the theory demands that genetically manipulated fish be introduced, and have access to, the whole carp population across its entire range. This is unlikely. The problem of fully integrating a gene into populations would necessitate the fish carrying the gene having a selective advantage over wild fish.

Clearly this option would require a lot of development before it could become a workable option and it could be 50 years or more before this option could be implemented.

2.3.4 Spring Viraemia Virus

The Spring Viraemia Virus is a Rhabdovirus, which can kill European carp. The disease is a problem for carp hatcheries and fish farms in Europe where carp are typically kept in high densities. But there is little evidence to suggest that this virus will be of any use to control wild populations of carp effectively. Furthermore, there would probably be an unacceptable risk involved to our aquaculture industry, native fish and recreational fisheries by the introduction of a fish virus.

There seems little opportunity for this type of method to be used to control or eradicate the Tasmanian carp population.

2.3.5 Daughterless carp technology

The technology involves manipulating the genes of carp to produce an inheritable “daughterless carp”. This restricts all offspring to males and can be introduced into the carp population. Despite

breeding normally, fewer and fewer females are produced with every generation until the carp population is mostly male (CSIRO). This technology is currently being developed by CSIRO and may be available in five to ten years.

2.3.6 Physical removal

Fish down of the carp populations in lakes Sorell and Crescent offers the best opportunity to eradicate carp entirely from the system (Picture 3). The sequence of events and the effort required for this to be achieved are extremely demanding, but possibly more cost effective than other options in the long term. The aim is to remove all of the female carp in the two lakes whilst preventing successful recruitment.

Picture 3: Adult carp caught in a 5” gill net.

3.0 Carp Population Characteristics

3.1 Genetic strain

Samples from twenty carp were taken from the Lake Crescent population and analysed to determine the strain of carp that had been introduced to the state. The results showed a mixture of strains, both the Boolara (European or river type) and Koi (Asian) varieties (Davis 1995). Given that the same strains have spread through the Murray Darling catchment (Boolara strain entered Murray Darling system in Gippsland and the Koi variety entered the Murray Darling system in several areas including Sydney) and that the strains in Lake Crescent were mixed, the introduction was probably of a wild population rather than aquarium fish.

An interesting observation relating to the genetic make-up of the carp population found in lakes Crescent and Sorell, is the large proportion (≈10 %) of mirror carp observed in the populations. The mirror carp is a less common form of carp with unusual patterning of large scales on the body. This character indicates a high level of inbreeding (as it is a recessive characteristic), which would be consistent with a small stocking.

3.2 Aging of fish

Recapture and re-release of tagged carp since December 1998 has provided accurate growth information. When this data is combined with length /frequency data (derived from killed carp), a strong body of knowledge on growth and aging can be obtained. Modal length-frequency and recapture growth data (Figure 2) provide the most reliable aging information. This indicates that there is a relatively rapid period of growth in the first four years. The majority of carp reach 400 mm in approximately five years. After this point, growth slows markedly and nearly comes to halt at 500mm indicating that any fish over 520 mm could be well in excess of 10 years in age.

A comprehensive otolith collection has been built up over the years of carp removal, however, results from otolith aging have been unreliable. Over 1000 sets of otoliths were sent to the Victorian Department of Primary Industries to be analysed. Fish read as year zero correlated reasonably with actual observation with the exception of some outliers (Donkers 2003b). Year one and year two fish presented major discrepancies with some year one fish being over 400 mm long and some year two fish over 500 mm. In this instance, it is therefore likely that several growth checks were missed in many cases.

3.3 Age at Maturity

Environmental conditions in lakes Sorell and Crescent with low water temperatures over more than half the year mean that carp here generally mature more slowly than those on the mainland. Males take three to four years to mature and females, four to five years, and capture/tagging/recapture data has shown some females do not mature until approximately 7 years old. There were still immature females from the Spring 1996 cohort being caught in Lake Crescent in early 2003 whereas the last immature male from this cohort was caught in December 2001. The Lake Sorell males from the Spring 2000 cohort began to mature in Spring/Summer 2003/04 and the current (July 2004) indications are that a very small percentage of the females from the Spring 2000 cohort will be mature by Spring/Summer 2004/05.

3.4 Population estimates.

Until 1998, estimates of carp abundance in lakes Crescent and Sorell were only guesswork. In the Summer of 1998/99 a Petersen capture-mark-recapture study was initiated on Lake Crescent (Picture 4). In December, a total of 366 carp were captured, tagged and released. This sample comprised of 75 adult males and 291 juveniles. In January of the following year, 513 carp were captured, of which 71 were tagged. Twenty-three of these were adult males and 48 were juveniles. From these results, Petersen estimated that 270 adult males, 215 adult females and 1567 juveniles remained in the lake (Donkers 2003a). Fish-down rates to date (Figure 3) support these Figures. Subtracting the fish caught since this study from the Petersen estimate leaves less than 24 untagged carp from the pre-2000 cohorts remaining. CPUE data indicates that current juvenile numbers in Lake Crescent are well below one hundred (Donkers 2003a).

Fish-down data from 1995 to present in Lake Sorell indicates that there were less than 200 pre-2000 cohort carp and that over 90% of these had been removed prior to the Spring 2000 spawning event. CPUE data (Donkers 2003a) indicates that this event added between two and three thousand juveniles to the Lake Sorell.

Picture 4: Tagging a juvenile carp

Part of a 'Capture-Mark-Recapture' population estimate.

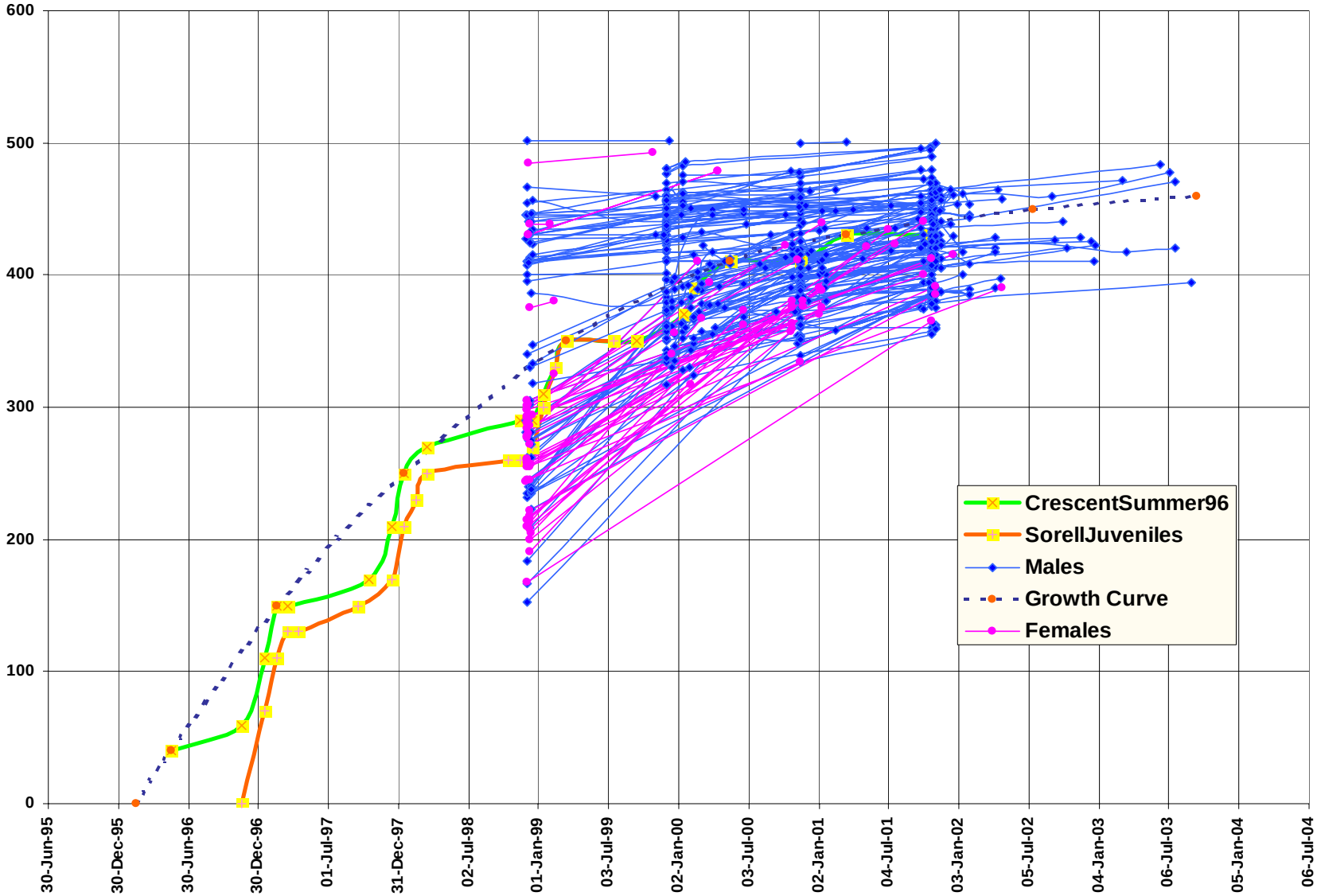
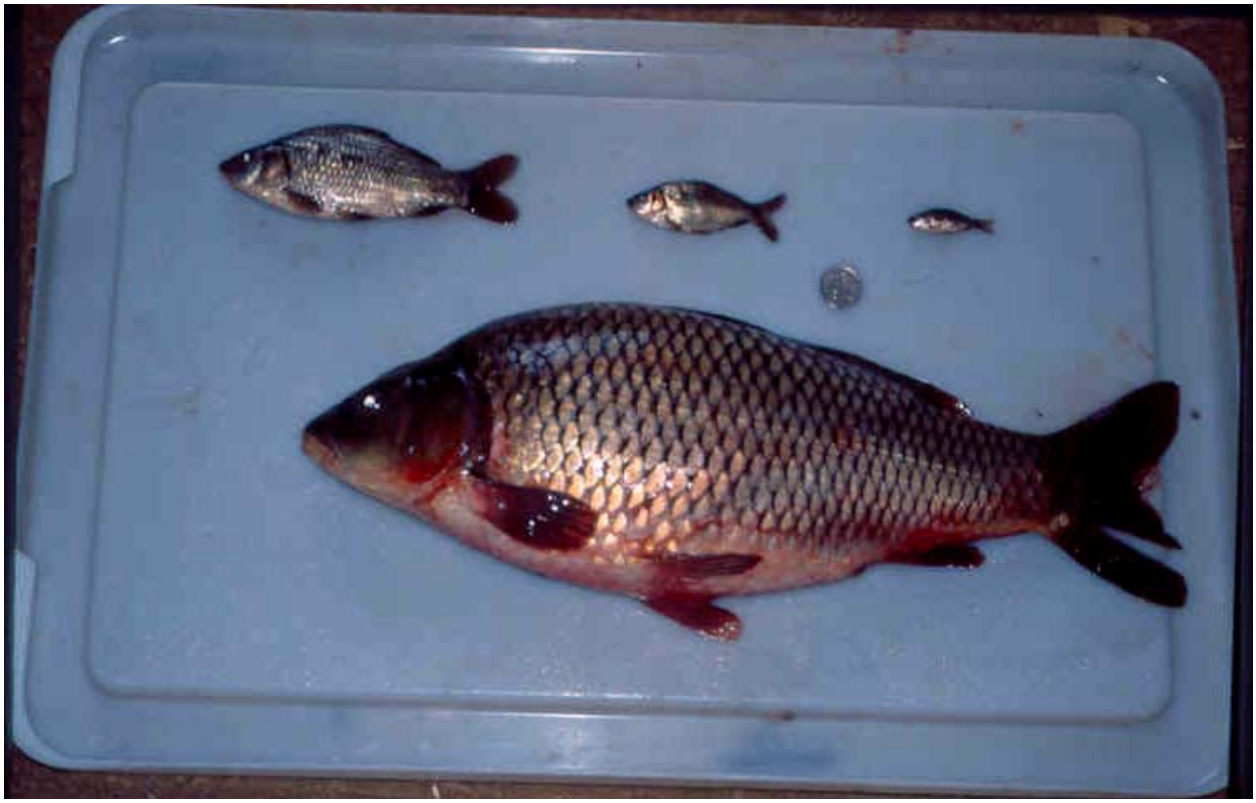


Figure 2: Growth curve
Derived from carp in both lake Sorell and Crescent, as well as curve frequency

3.5 Cohorts

3.5.1 Lake Crescent

When carp fish-down began in 1995 there were at least two cohorts comprising less than 200 adults and over 4000 sub-adults. Length frequency data suggests that the adults were made up of several cohorts. Less than 20 fish, larger than 520mm fork length, have ever been caught and growth data indicates that these fish are approaching L_∞ (Figure 2) for Lake Crescent meaning that they could have been well over 10 years old. Unfortunately, otolith readings of these fish yielded inconclusive results (Donkers 2003b). The sub-adults from 1995 appear to be a discrete cohort, which was probably spawned in Spring 1992. The next two cohorts were spawned in 1996, one in late Summer (evidenced by a 40mm juvenile found on screens in May 1996) and the other in Spring (Picture 5). Although initially distinguishable from each other due to different length frequencies, the two cohorts had melded by late Summer 1998. The sum of these two cohorts was just over 3000 fish (Donkers 2003a). The most recent cohort originates from Spring/Summer 2000/01 and is comprised of less than 130 individuals (Donkers 2003a).



Picture 5: May 1996: size range of carp in Lake Crescent

Juveniles are from two spawning events, one late Summer the other in Spring.

Monthly carp removals from Lake Crescent February 1995 - June 2004.

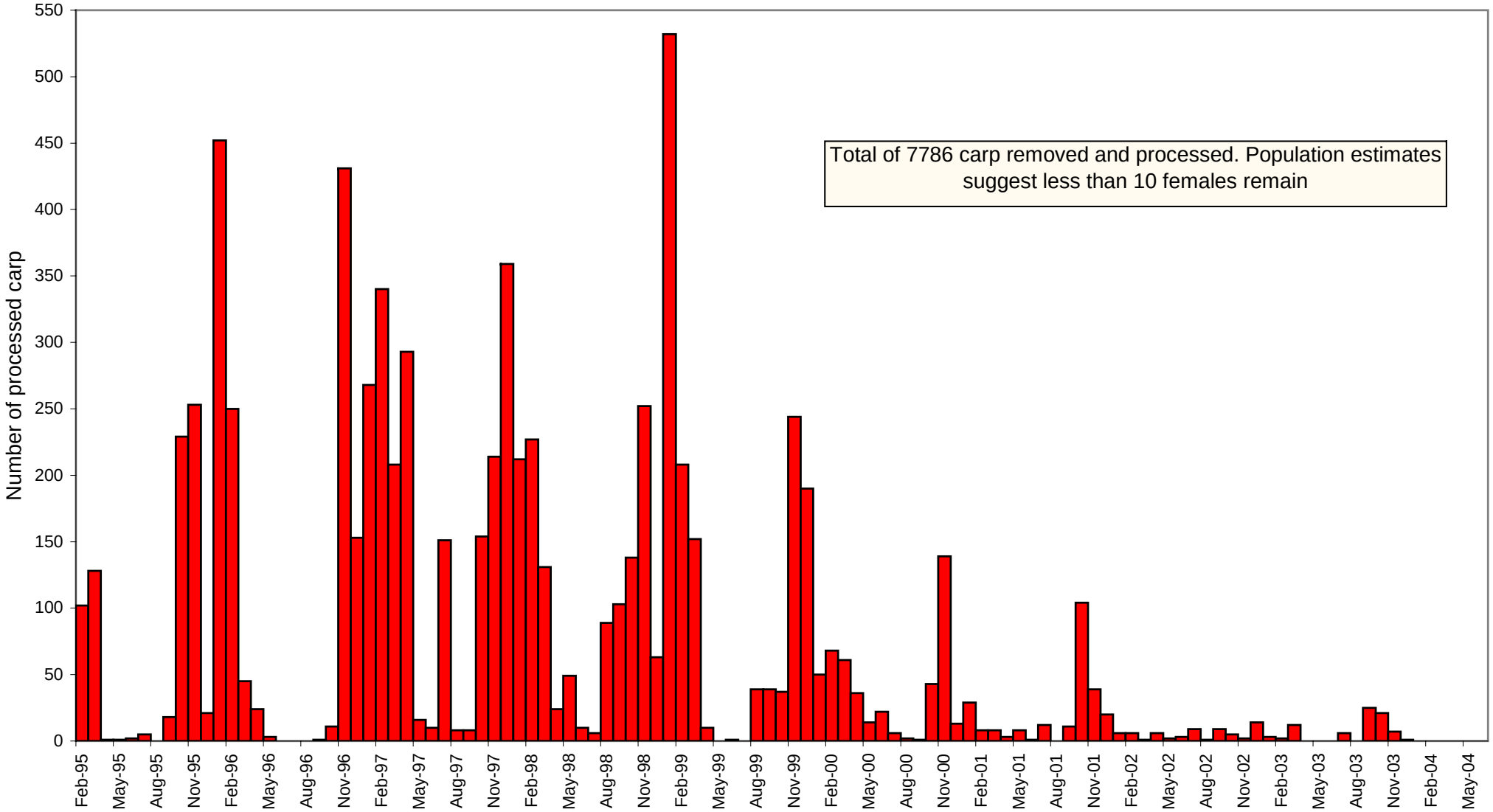


Figure 3: Monthly catches of carp from Lake Crescent 1995 - July 2004

3.5.2 Lake Sorell

In 1995, there were less than 30 adult and sub-adult carp. It is thought that these fish come from the same cohorts that already existed in Lake Crescent at the time but the timing is uncertain. Prior to the CMP, fish could move freely between the two lakes. Since then, there have been four successful recruitments. A spawning event in Spring 1996 resulted in about 30 juveniles and 1998 added a further 120 carp. The largest recruitment occurred in Spring 2000 with an estimate of around 3000 fish (Donkers 2003a). The finding of juveniles during fyke net surveys in February 2004 indicates that there was a small isolated spawning in December 2003. Numbers are yet to be assessed.

It is important to note that there was no carp recruitment from 1993 and 1994 prior to the CMP, which began in 1995. This shows that natural conditions do not favour successful recruitment every year. The major triggers for spawning aggregations are a combination of rising lake levels and increasing water temperatures. These conditions often appear to be the result of pre-frontal weather in Spring, which is usually followed by a burst of cold air after the front. The subsequent frosty weather can rapidly reduce water temperatures in the shallow marshes resulting in high egg mortality.

3.6 Population Structure

3.6.1 Lake Crescent

The population structure of carp in Lake Crescent has changed markedly since discovery in 1995. Initially only sub-adult and adult carp were detected (Figure 4) although these were in reasonably large numbers. The fact that large numbers were sampled suggests that these fish were the result of a spawning rather than part of the original introduction.

The initial carp captures used methods suitable for sampling all size classes. Consequently, unless juveniles were only present in very low numbers, it is expected that they should have been sampled if present. Juvenile carp have successfully recruited in three seasons since this population was initially sampled. A spawning event in Summer 1995/96 and a second in 1996/97 resulted in, and estimated, 3275 fish being recruited into the population (Figure 4, 1997). A third small recruitment event also occurred in 2000/01 (Figure 4, 2002). A catch-per-unit-effort population estimate was carried out on this population and it showed that this recruitment event was extremely small, numbering less than 130 individuals.

The plots of length frequencies in Figure 4 show that the late Summer 1996 cohort demonstrated rapid growth between 1997 and 1998, but did not reach the size distribution of the fish originally sampled in 1995, until 2000.

Given these observations, it is suggested that the majority of carp captured in 1995 were three years old, ie, progeny of a spawning in the Spring 1992. The interesting possibility, if assumptions on ages are correct, is that carp did not recruit successfully from the two seasons prior to the 1994/95 season or in fact the 1994/95 season itself. This begs the question, why not? From observations of water temperature and water levels, and findings from other studies, it seems carp have two main prerequisites for successful spawning - water temperatures in the range 17 to 25 °C (perhaps as low as 15 °C) in conjunction with rising or high water levels.

Currently (Winter 2004), the structure of the carp population consists of a low number of adult fish, approximately 170 tagged males and <10 adult females. In addition to these, are the remaining juvenile fish from the 2000/01 spawning. As mentioned previously (para 2), these fish number less than 100 (of which 49 have already been caught) and these are expected to be mostly removed from the population by the time the majority become sexually mature (by Spring 2005 for the females).

3.6.2 Lake Sorell

The carp population in Lake Sorell was initially much smaller than that in Lake Crescent. Upon discovery that only adult carp were recorded from this water, and given they were of a similar size to the majority of Lake Crescent fish, it is suggested that they either moved through from Lake Crescent, or were released into Lake Sorell.

Plots of length frequency for each year from 1996 – 2001 clearly show that carp captures numbered less than 10 individuals per year (Figure 5). Small numbers of small carp were discovered in 1997 and, given their size, were probably spawned in the 1995/96 season.

By 1998, there were three cohorts of fish within the population. The youngest of these was the result of the Spring 1996 spawning while the others are the sub-adult and adult specimens that were present prior to carp discovery in this lake.

By 2000, the population in Lake Sorell had changed once again. The rapid growth of the smaller cohorts had meant that the population had returned to the 1995 composition of near mature and mature specimens only (albeit in larger overall numbers). This composition changed once more with the discovery of small specimens in early 2001. Otolith analysis shows that this cohort was

spawned in Spring 2000 and were approximately 3 months old when first sampled (Donkers 2003b).

Today, the composition of carp in Lake Sorell consists of sub-adult specimens spawned in 2000. A small number of adult specimens still remain from the initial population (ie., pre 1995) as well as remnants of the 1996 and 1998 spawning. In February 2004, during fyke net surveys, recruitment was found to have occurred (December 2003). This cohort appears to be in small numbers but further work will be required to assess the true size of the population.

The 1996 and 1998 spawning events resulted in only a small population increase when compared to the 2000 recruitment event. The reasons for this are unclear. The conditions in 1996 and 1998 were suitable for spawning, as they were in 2000, and the fencing infrastructure and fishing effort were not then in place to prevent these spawnings from occurring. There is speculation that because by the year 2000 there may have been less biological control with the commercial depletion of over 20 tonnes of adult eels (Picture 6) by commercial fishermenand a natural reduction in the *Galaxias auratus* population due to low water levels.

The reduction of eels since in-lake eel fishing commenced in Lake Sorell in 1997 is clearly shown in the CPUE graph in Figure 6.

Picture 6: A natural predator - the short finned eel (*Anguilla australis*)

A high density of this eel is likely to have a significant predatory impact on carp larvae and juveniles.

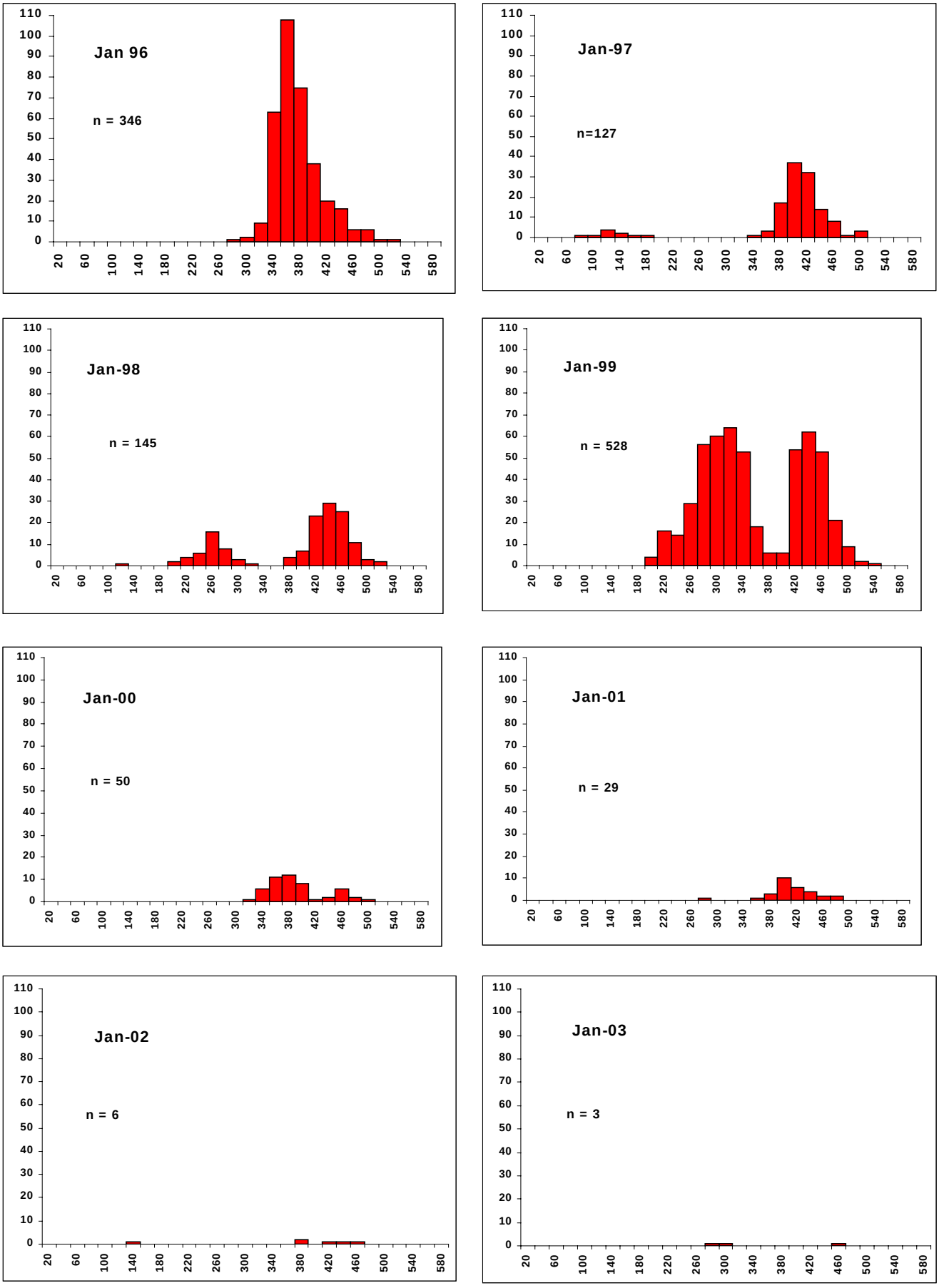


Figure 4: Frequency plots for Lake Crescent showing all processed fish for each January 1995-2004.
Note: Length (mm), also 2004 not shown as no fish were caught.

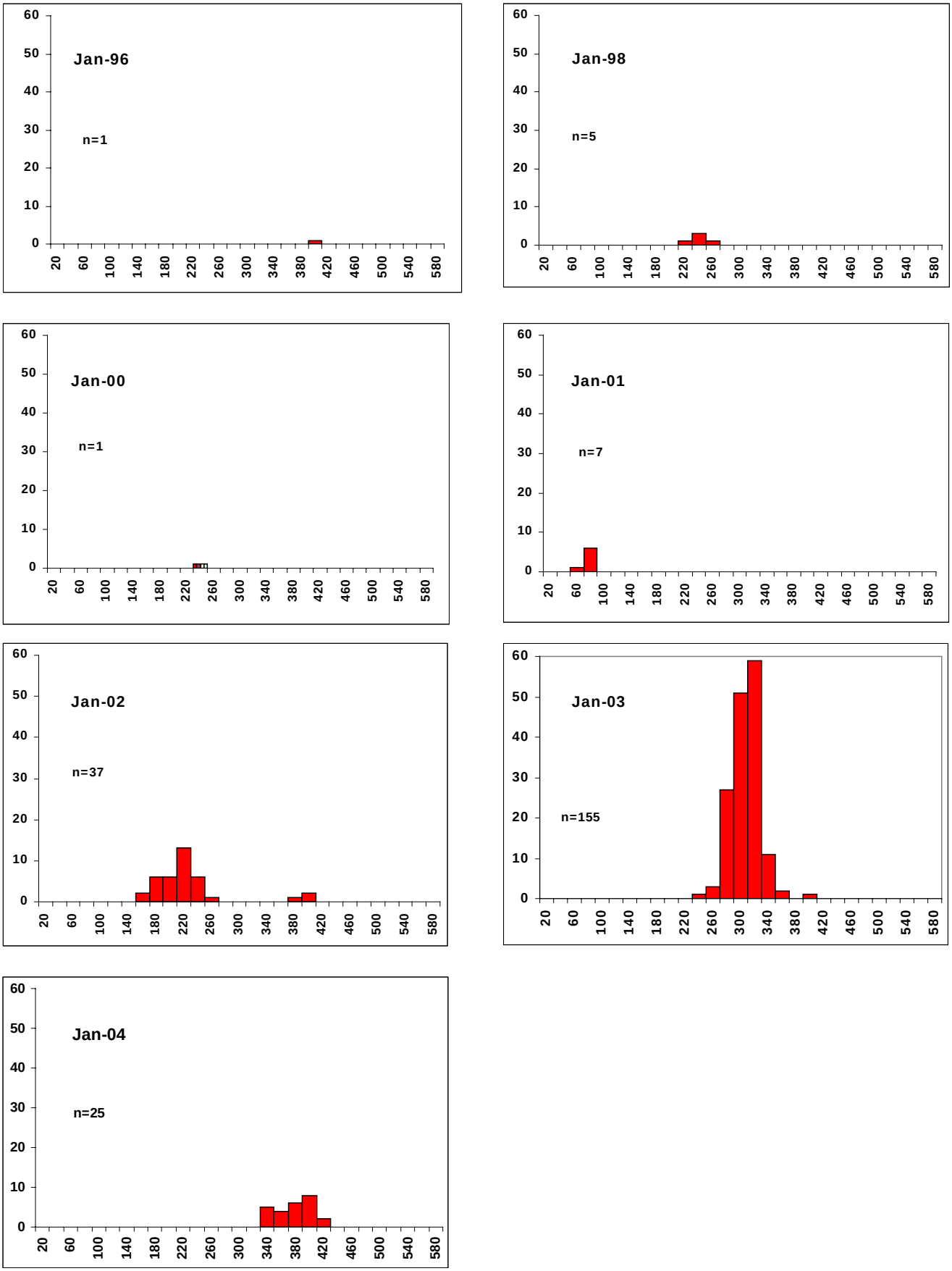


Figure 5: Frequency plots for Lake Sorell showing all processed fish for each January 1996-2004.

Note: Fork Length (mm), also 1996 and 1999 are not shown as no fish were caught.

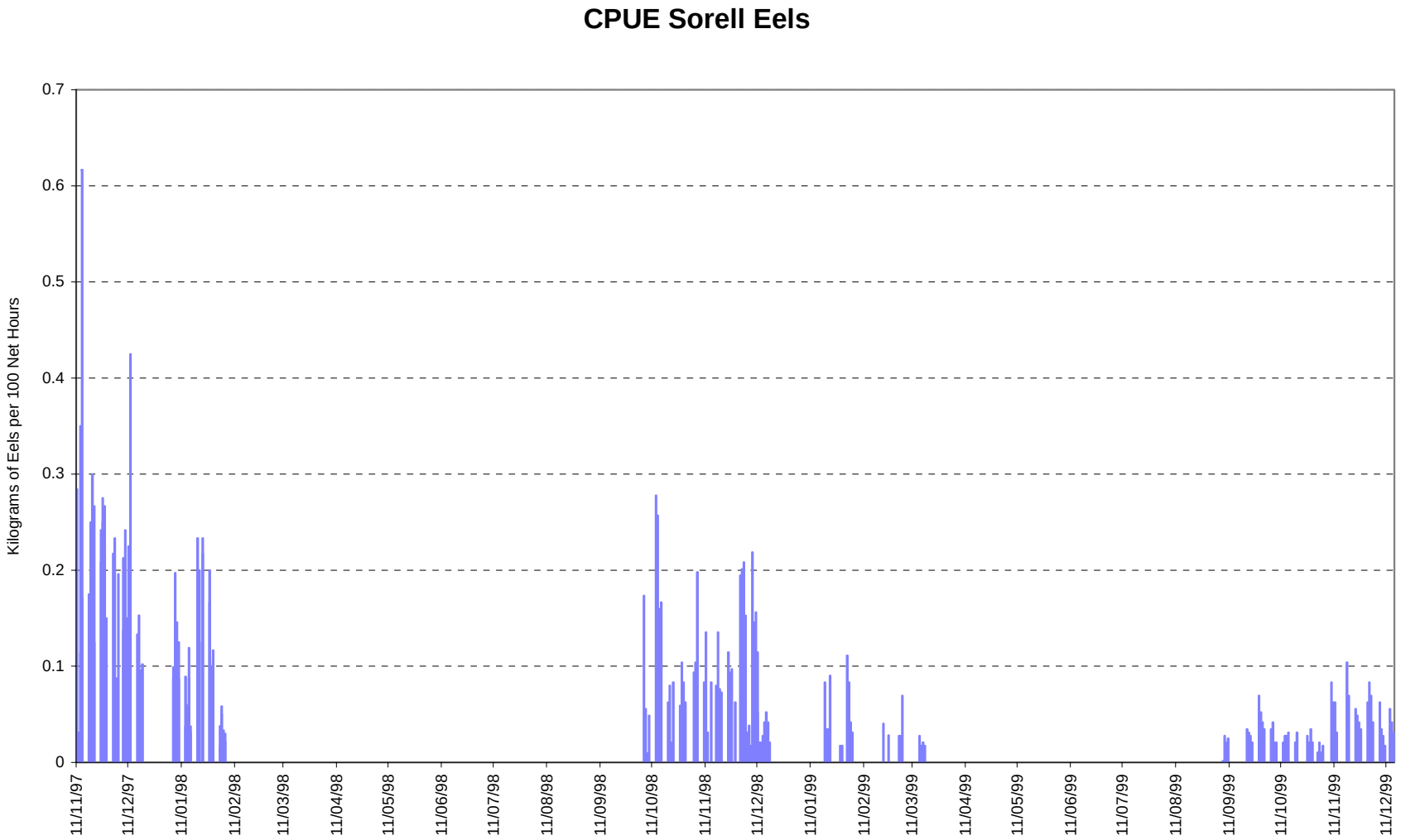


Figure 6: Catch Per Unit Effort (CPUE) of commercial eel fishing in Lake Sorell.

4.0 Fishery Management

4.1 Growth and maturity - implications for control

Much of the Sorell 2000 cohort remained in their marsh nursery area for the first three months after they were spawned. This allowed the use of small mesh seine nets to reduce numbers rapidly. Fast juvenile growth rates mean that fishing methods need to be changed regularly to maintain maximum impact. Optimum gillnet mesh sizes change from 2.5" to 3" to 4" in effectively targeting carp during their first year of growth (Walker 2003).

Experience in both lakes has shown that after their first year, juvenile carp often aggregate with mature carp making them vulnerable to biotelemetry methods. This means that there were times when 4", 5" and 6" mesh length gillnets were needed for the single aggregation (Walker 2003).

Spawning aggregations provide unique opportunities to kill large numbers of carp. Sexual maturation of carp in lakes Crescent and Sorell takes longer than for mainland carp. Males mature in 3 to 5 years and females 4 to 7 years (Donkers 2003-b). This means that the window of opportunity in which to reduce numbers before spawning is increased. Conversely, a longer period exists before all females can be targeted in spawning aggregations.

4.2 Water Temperature - implications for control

Carp tend to prefer warmer water temperatures in terms of general activity. In terms of spawning, carp prefer water temperatures between 17 - 25 °C before moving into shallow, vegetated areas to spawn. In lakes Sorell and Crescent, carp have been observed spawning in October at temperatures as low as 11°C. However, there is no evidence of these spawnings at such low temperatures being successful. The temperature data collected from Lake Crescent (Figure 7) indicates suitable temperatures in shallow areas for spawning will exist each year, usually from November to February.

Water temperatures in Lake Sorell are similar to Lake Crescent, the main difference being that Lake Sorell appears to respond more slowly to air temperature changes. A comparison of Figures 7 and 8 indicate that Lake Sorell is less variable in temperature and therefore does not experience the extremes of temperature of Lake Crescent. In addition to this, the variation in mean daily temperatures appear to be much smaller indicating that short periods of high or low air temperatures has a much smaller effect on Lake Sorell compared to Lake Crescent. This difference is due to Sorell's larger volume.

While it may take longer for Lake Sorell to warm up over Summer, resulting in a smaller water temperature window for spawning, there is an obvious advantage – the mean temperature is much more stable in Lake Sorell and so, once the critical temperature for egg survival is surpassed, fluctuations in core water temperature will be less. Potentially this could give better recruitment success in spawning areas in close proximity to deeper water.

In extensive shallows where temperature fluctuations are greater, Spring spawning success in both lakes depends more critically on overnight air temperature. Water temperatures below 10°C are lethal to carp eggs (Penaz *et al* 1983) and this frequently occurs about the lake edges during Spring frosts.

During January 2000, the temperatures averaged 15.3°C in the mid-lake, but were reaching temperatures in the early twenties in shallow areas. A comparison of the mid-lake logger and a logger set up in the shallow water of Bullies marsh, show that the average daily temperature was 3.2°C higher in the shallow water compared to the open water recordings. This high variation in water temperatures is due to the fact that when lake levels are low, the shoreline, which is composed of fine black detritus and absorbs heat, readily transfers this energy to the water. Figure 10 also indicates that the lake level rose sharply around this time even though the trend at this time was for a falling lake level.

From observations, the principle spawning cue is likely to be rising or high water levels, from September, coinciding with rising water temperatures. Observations suggest that early season spawnings have limited success due to the variability of weather conditions.

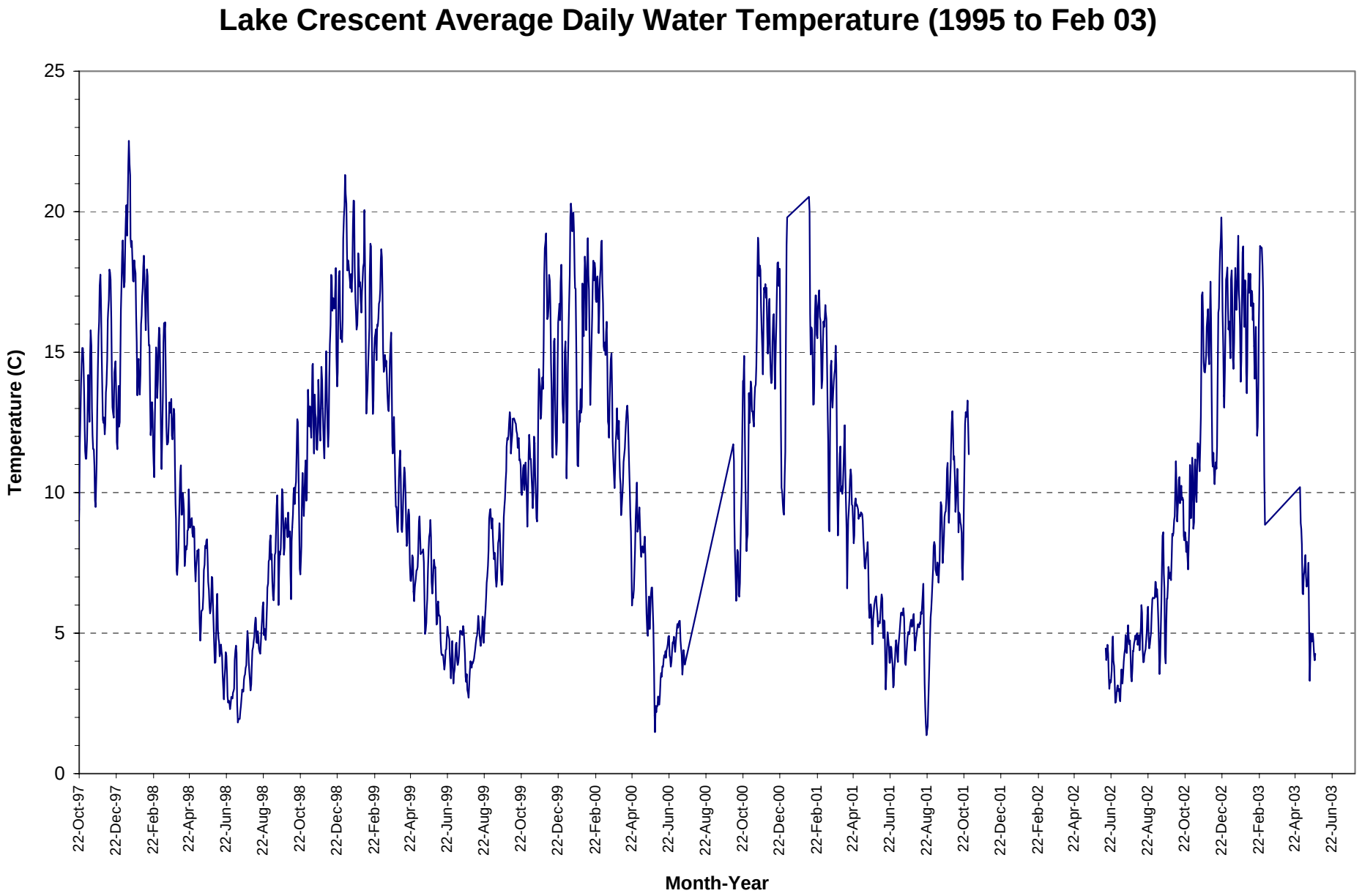


Figure 7: Lake Crescent mean daily water temperatures as measured at an 'open water' site.

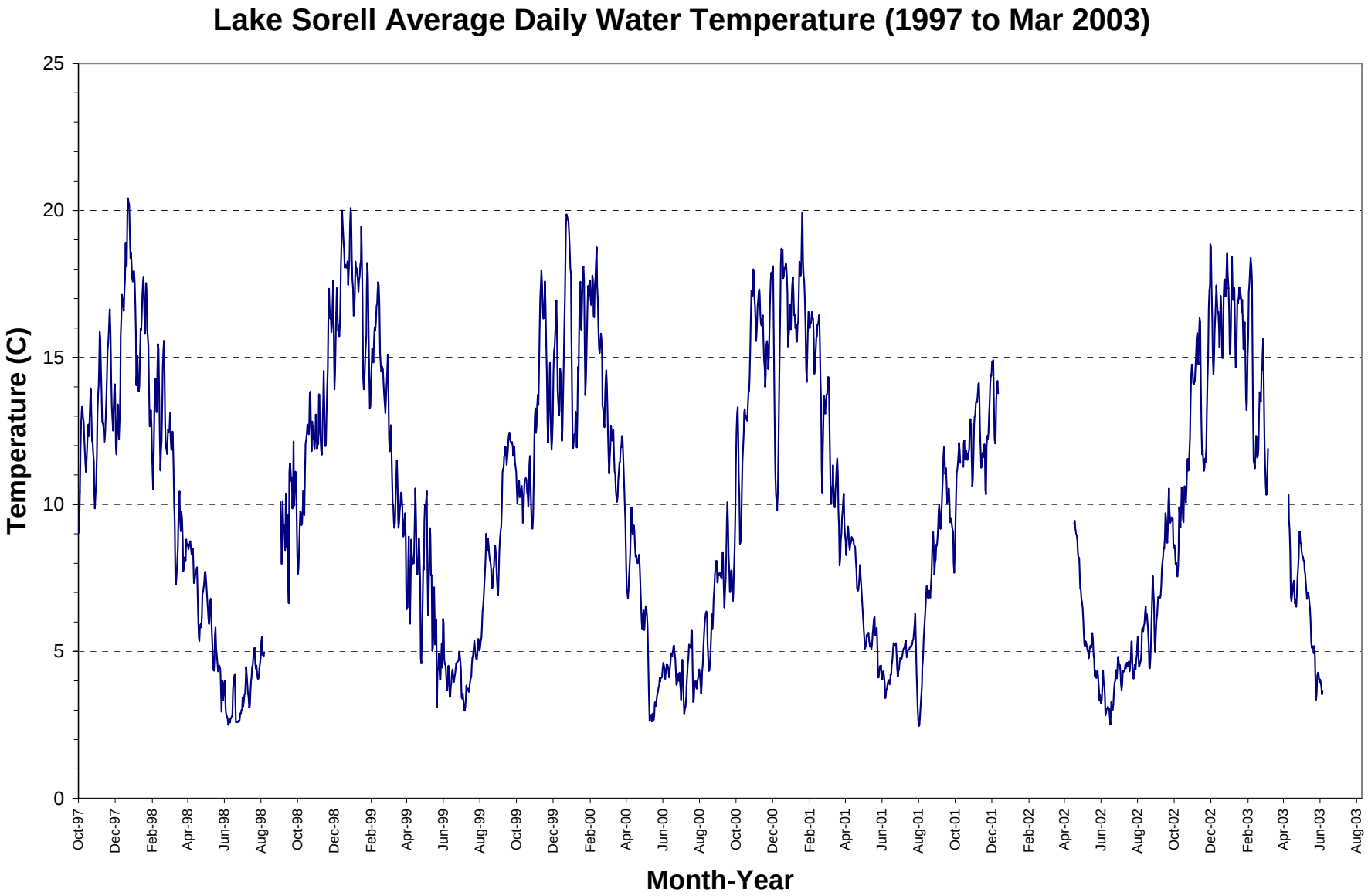


Figure 8: Lake Sorell mean daily water temperatures as measured at the 'open water' site from October 1997-July2003.

4.3 Water Levels - implications for Control

Recruitment in Lake Crescent has been successful in season's 1995/96, 1996/97 and 2000/01. The prerequisites for a successful spawning were met in each of these years. Water levels were suitable, in that a sudden rise occurred in January 1996 and flooded conditions existed in the Summer of 1996/97 due to a wet Winter in 1996 (Figure 9). Both of these spawning cues coincided with periods of suitable temperature. The importance of water level as a spawning cue on these two occasions was confirmed from observations of carp aggregating in marsh habitat.

In 1995/96, carp responded to the sharp rise in water level by invading freshly inundated marsh habitat. In the following Spring, carp were found aggregated in what was thought to be a pre-spawning aggregation, again, in flooded marsh habitat. It is suggested that this aggregation of carp was stationed in the warmest part of the marsh for conditions to become optimal in terms of temperature for spawning.

The recruitment event in Spring/Summer 2000/01 is thought to have occurred in January 2001. Although no spawning was witnessed, the CMP targeted an aggregation in mid-January, and this was the only recorded event around this time.

Although the two lakes are interconnected, the lake levels can vary significantly from each other. The major catchment areas for the two lakes are quite different once the flow between them is stopped. Figures 9 and 10 compare the water levels in each lake from 1995 to July 2004. Both lakes are manipulated but Lake Sorell has a larger catchment with greater variables.

As mentioned earlier for Lake Crescent, carp spawning success is strongly influenced by rising water levels or high levels following flooding. The scope for controlling water levels as a means of carp control in Lake Sorell is very limited, since releases from this lake will also impact Lake Crescent water level management which, as discussed, is already limited by the ability to screen the outflow.

Improved screening and the ability to release water from Lake Sorell to Lake Crescent is continually being reassessed. It is thought that the 5mm horizontal screens installed at the Lake Sorell outlet structure have considerable limitations, as they only have a small surface area. Although they have not been rated, it is expected that they will not be able to take anywhere near the flows required at flood times. Because of the lack of head between the lakes, moderate to high water levels in Lake Crescent will back flood the screens, which means they will not perform

effectively. Further structural development will be required if the carp problem in these waters needs to be managed individually in the future.

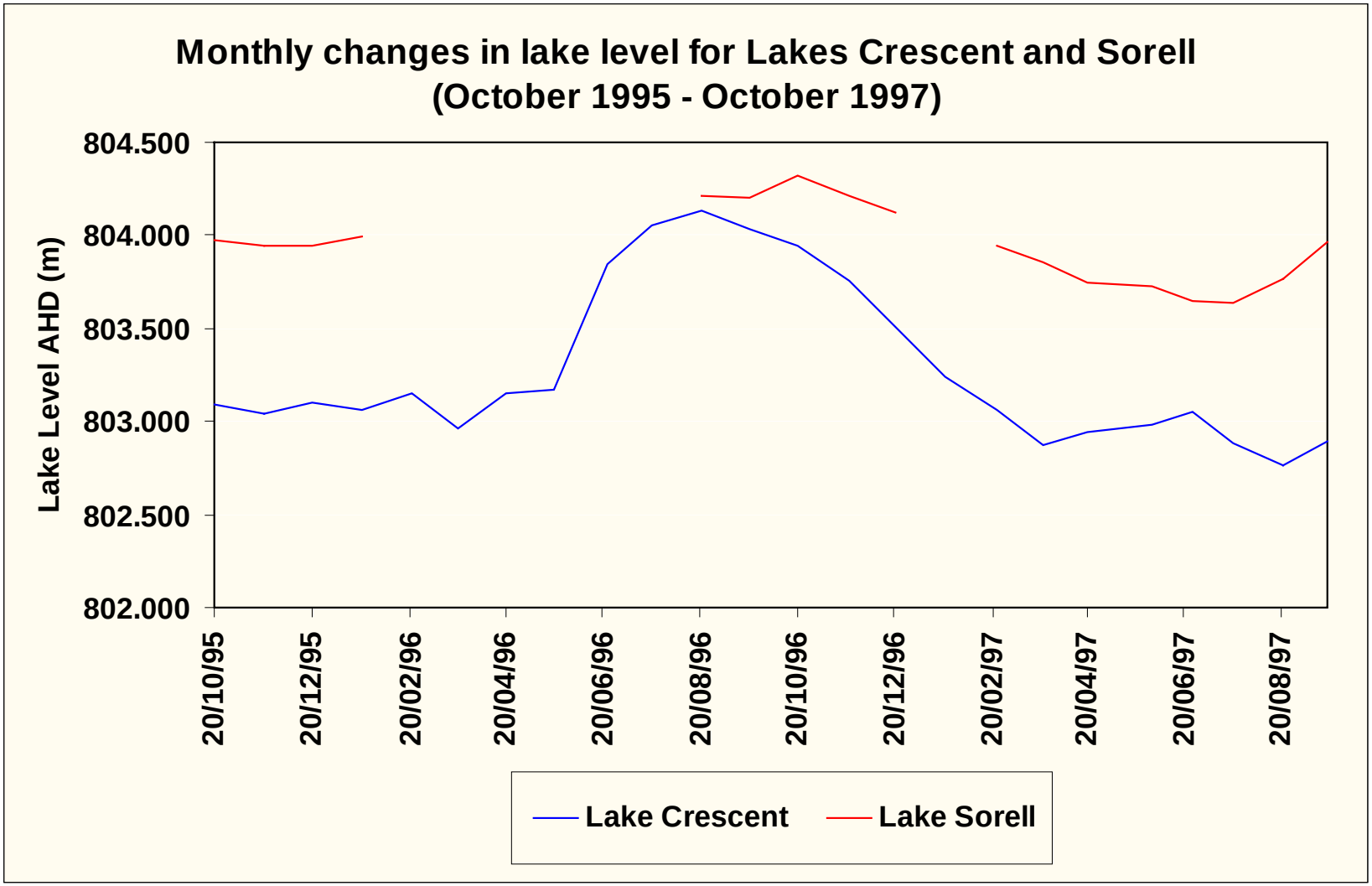


Figure 9: Lake levels for Lakes Sorell and Crescent from October 1995-October 1997.

Note: After October 1997, lake level and water yield plots were calculated to give a better understanding of water usage for management purposes. For this plot refer to Figure 10. Note no gauge boards present in Lake Sorell for the first half of 1996.

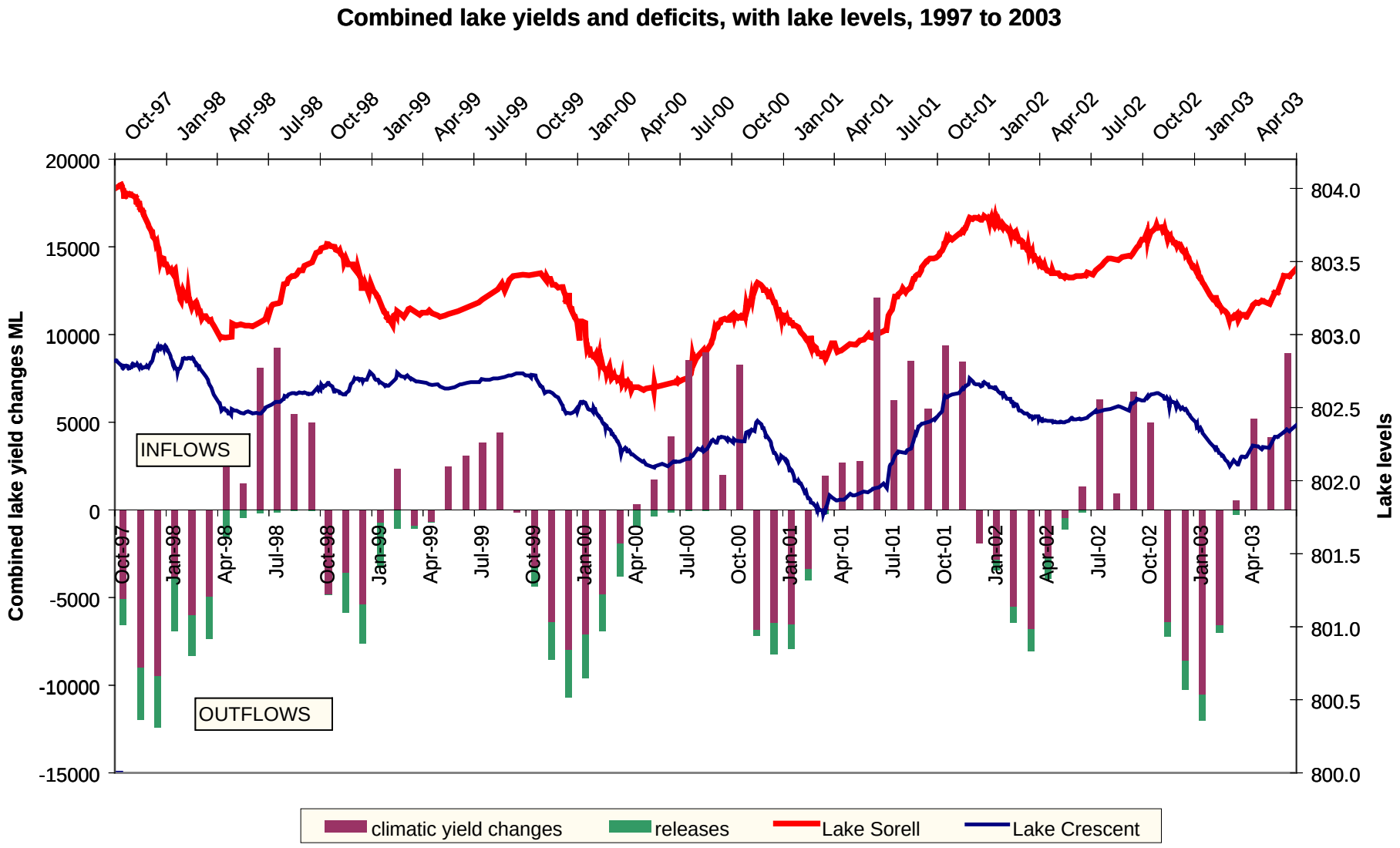


Figure 10: Plot of combined lake yields and deficits for lakes Sorell and Crescent from October 1997 to present.

4.4 Management of fish between lakes

Since the discovery of carp in Lake Sorell, it has been a policy to not re-release any carp into this water unless the fish is a transmitter implanted male. This was decided for a number of reasons:

- low numbers of carp in this water;
- the fact that the water remains open to angling; and
- the need to only manipulate carp numbers in one water body.

With this policy in place, Lake Crescent became a holding facility where tagged males were stored for use in population estimates and for implanting once over 1.5kg. Any adult male carp taken from Lake Sorell that is not currently used in radio tracking is tagged and placed into either Lake Crescent or one of the holding facilities (outlined in 2.1.5).

4.5 Number of males used annually for tracking

As required, male carp are caught in Lake Crescent and are surgically implanted with a radio transmitter into the stomach cavity. These fish are then released into either Lake Crescent or Sorell depending on demand.

A minimum of eight to a maximum of fourteen active tracker fish in either lake has been preferred since the radio tracking first commenced. The CMP use Suretrack STR1000 receivers manufactured by Lotek. These units are set to scan our transmitter frequencies at three-second intervals. Having greater than fourteen tracker fish per lake would simply take too long to complete a scan of all frequencies, increasing the probability of not detecting a transmitter fish.

In 2002, the CMP introduced Advanced Telemetry System (ATS) transmitters. These units have battery lives that range from 2.25 years to approximately 4.5 years. These new transmitters were trialed in low numbers throughout 2002/2003, and proved to be reliable and emit a strong signal. They are smaller and lighter than the previous brands and have allowed the CMP to reduce the number of male carp implanted each year.

Following is Table 1, showing the number of carp implanted and put into each lake since the start of radio tracking. This table does not include fish that had their old transmitters removed and a new transmitter inserted.

Calender Year	Lake Sorell	Lake Crescent
1997	**10** (first released 6/11/97)	**9** (first released 10/03/97)
1998	**11**	**10**
1999	**15**	**19**
2000	**10**	**15**
2001	**17**	**12**
2002	**18**	**10**
2003	**11**	**15**
2004 (6 months)	**0**	**1**

Table 1: Numbers of male carp implanted with radio transmitters

This table shows how many carp have been implanted and released into each lake (per calender year) since the use of biotelemetry started in 1997.

Transmitters can be lost for a range of reasons, resulting in additional male carp needing to be implanted to maintain numbers. Some transmitters simply fail and these are recovered once that carp is re-caught (usually in an aggregation). Fish may also expel the transmitter either because the wound becomes infected and the unit falls out through the wound, or because the transmitter causes irritation within the body, resulting in the transmitter being pushed out of a healthy area of the body wall.

Numerous transmitters have been found on the shoreline with carp remains. Transmitters have been found dragged up into the bush, with teeth marks in their waterproof coating and down inside burrows. At least two transmitters have been tracked to a sea eagles nest high up in a large eucalypt tree on the St Georges Island, Lake Sorell. Sea eagles have been observed closely watching carp aggregations in shallow water.

To try and avoid the implant wounds becoming infected, the carp are implanted during the cooler months of the year using procedures designed to maintain sterile conditions (Macdonald 2003). During these cooler months (April – August), the wounds tend to heal at a slower rate, but as a trade off, the infection rates are also much lower allowing the wounds to completely heal.

As mentioned in section 2.1.5.1, the CMP placed all non-implanted male carp into a separate area during 2003 and early 2004. In March 2004, 161 tagged male carp were released back into Lake Crescent to act as another population estimate. The reasoning behind this release is that

when all 161 tagged males recaptured there will be a high confidence in the resultant estimate of untagged fish. Already (July 2004) the CMP has re-caught three of these fish without any untagged fish being captured.

Prior to 2002, the majority of male carp that had been used for transmitter implantation were killed and processed once that transmitter had passed its battery life. It is often difficult to re-implant these fish with fresh transmitters, as the body wall envelops the transmitter making its removal difficult. Now, because there are low numbers of large male carp remaining, these fish are sewn up (providing the wound can be closed neatly) and placed in the holding area. The carp management team has found that these wounds heal surprisingly well once the transmitter is removed and this allows the fish to be re-implanted at a later date, usually in the opposite side to the first implantation.

5.0 Recommendations for the future

5.1 Short term - Next 12 months

The containment of the carp population in Tasmania is primarily reliant on isolating any carp movement between lakes Sorell and Crescent, screening the outflow from Lake Crescent to prevent escape and a compliance effort on both waters. This remains as the main strategy of the carp program. Following are activities that support this strategy.

5.1.1 Screens

- Continue to screen the outflows from Lake Crescent and Lake Sorell.
- Manage water levels to prevent uncontrolled spill from either lake.
- Continue to investigate options to improve the screen efficiency.

5.1.2 Compliance

- Continue the strategy to prevent the illicit removal of carp from lakes Sorell and Crescent including:
    - Continually assess carp densities
    - Monitor for carp spawnings
    - Continue to assess public access and the risk of carp being transferred
    - Amend legislation as required
    - Educate the public on containment issues
    - Deliver compliance effort as required

5.1.3 Distribution

- Continue annual distribution surveys downstream of Lake Crescent.

- Investigate all carp sightings.
- Continue education and compliance activities.

5.1.4 Control and eradication of carp

- Continue to develop techniques and fish down the carp population in lakes Sorell and Crescent.
- Take measures to prevent access to preferred spawning sites.
- Identify opportunities to target the populations for long-term control with reduced effort.
- Actively encourage and support other agencies in trials of eradication methods.
- Contain carp to present distribution to support any new technology.

5.1.5 Recreation and commercial access

- Develop criteria for opening/closing water bodies in relation to carp.
- Investigate need for limited seasons, and/or allowable fishing methods.

5.1.6 Communications

- Continue talks to angling groups on request where possible.
- Regular CMP updates in the IFS newsletter.
- Update carp poster and disseminate to key localities.
- Continue commitment to present carp issues at major shows, events and in the media.
- Produce an annual report summarising successful strategies.

6.0 Marketing and Communication

6.1 Talks and Presentations

The CMP has been active in an attempt to educate the public about the progress that is being made and on issues about pest fish. The CMP attends the IFS Open Weekend at Liawenee each year where the staff use displays and interact with the public to continue awareness. Regular displays can also be seen at AGFEST and The Royal Hobart Show.

The CMP has developed stringent guidelines and protocols for the display of live carp.
Appendix 2 details the events that the CMP have attended, given presentations and/or displayed CMP material.

6.2 Conferences

The CMP has had representation on the Carp Control Coordination Group since it's inception and has regularly attended conferences and workshops. The CMP is also a member of the National Carp Task Force.

It also has had representation at the:

- Federal Police Environmental Crime Conference, on 5 May 2003, where it presented a case study on the Tasmanian perspective; and
- Daughterless Carp Workshop held at CSIRO Hobart in January 2004.

6.3 Pamphlets and Posters

A number of posters and pamphlets have been designed and used at public events:

- The Tasmanian Carp Program (Pamphlet)
- The Tasmanian Carp Program (Poster)
- Tasmanian Carp Eradication Using radio Tracking (Poster)
- STOP! THINK BEFORE YOU ACT! (Pamphlet)
- Tasmanian Pest Fish Species. (Pamphlet)
- Pest Fish in Tasmania (Poster)

The CMP regularly updates notice boards at Dago Point and Silver Plains boat ramps at Lake Sorell. This is undertaken on a quarterly basis. Articles detailing the CMP, its activities and progress have been published in a range of print media and interviews have been broadcast on radio, TV and electronic media outlets. A list of these is outlined in Appendix 3.

7.0 Carp Sightings

7.1 Surveys to follow up public report of carp

As part of the overall control of carp in Tasmania, the CMP ensures that all reported potential carp sightings are followed up with surveys. These surveys are designed to locate any future outbreaks of carp within the state as well as give concerned members of the public an avenue to report any unusual fish sightings. The CMP also uses these sightings as a means to educate interested members of the public.

Table 2 is a list of survey dates, locations and fish located since the CMP was formed.

DATE	LOCATION	SPECIES LOCATED
15-Apr-96	Bradys Lake	Redfin perch (*Perca fluviatilis*)
14-May-96	Launceston	eels (*Anguilla australis*)
03-Jun-96	Collinvale	goldfish (*Carassius auratus*)
30-Jul-97	Sandspit River	Spotted galaxias (*G. truttaceus*),Common jollytail (*G. maculatus*), Sandies(*Pseudaphritis urvillii*), eels (*Anguilla australis*)
14-Aug-97	Wynyard	goldfish (*Carassius auratus*)
15-Sep-97	Macquarie River, Charlton	Redfin perch (*Perca fluviatilis*)
26-Sep-97	Longley	goldfish (*Carassius auratus*)
13-Oct-97	Westbury	goldfish (*Carassius auratus*)
20-Oct-97	Margate	tench (*Tinca tinca*)
27-Oct-97	Longford	tench (*Tinca tinca*)
29-Oct-97	Railton	Pygmy perch (Nannoperca australis), Common jollytail (G. maculatus), eels (Anguilla australis)
15-Dec-97	Evandale	goldfish (*Carassius auratus*), Redfin perch (*Perca fluviatilis*), Blackfish (*Gadopsis marmoratus*), brown trout (*Salmo trutta*), tench (*Tinca tinca*)
03-Feb-98	Richmond	tench (*Tinca tinca*)
01-May-98	Longley	goldfish (*Carassius auratus*), eels (*Anguilla australis*)
03-Aug-98	Longley	goldfish (*Carassius auratus*)
24-Aug-98	Trevellyn	goldfish (*Carassius auratus*)
15-Sep-98	Bridgenorth	Redfin perch (*Perca fluviatilis*)
14-Oct-98	Taroona	goldfish (*Carassius auratus*)
16-Dec-98	Sorell	tench (Tinca tinca), rainbow trout (*Oncorhynchus mykiss*)
02-Feb-99	Hobart	goldfish (*Carassius auratus*)
16-Mar-99	Prospect	Redfin perch (*Perca fluviatilis*), eels (*Anguilla australis*), goldfish (*Carassius auratus*)
01-Apr-99	nth Esk/St. Pats confluence	goldfish (*Carassius auratus*)
07-Apr-99	Margate	goldfish (*Carassius auratus*)
05-May-99	St. Pauls	brown trout (*Salmo trutta*), Blackfish (*Gadopsis marmoratus*)
17-Jun-99	Dee	Redfin perch (*Perca fluviatilis*)
23-Jul-99	Wilmot	goldfish (*Carassius auratus*)
18-Aug-99	Bridgenorth	Redfin perch (*Perca fluviatilis*)
16-Sep-99	Arthurs Lake	brown trout (*Salmo trutta*), Saddled galaxias (*G. tanycephalus*), Arthurs paragalaxias (*P. mesotes*)
10-Dec-99	Ridgley	goldfish (*Carassius auratus*)
11-Dec-99	Wilmot	goldfish (*Carassius auratus*)
18-Dec-99	Fingal	goldfish (*Carassius auratus*)
14-Jan-00	St. Helens	goldfish (*Carassius auratus*)
13-Apr-00	Cluan	Redfin perch (*Perca fluviatilis*)
05-Sep-00	Sorell	goldfish (*Carassius auratus*)
20-Sep-00	Big Waterhouse lake	Common jollytail (*G. maculatus*), brown trout (*Salmo trutta*), Rainbow trout (*Oncorhynchus mykiss*), Sandies (*Pseudaphritis urvillii*), Pygmy perch (*Nannoperca austra*
21-Sep-00	bluetier	goldfish (*Carassius auratus*)
27/09/00	grindlewald	Rainbow trout (*Oncorhynchus mykiss*), eels (*Anguilla australis*), goldfish (*Carassius auratus*)
28-Sep-00	Split rock	Spotted galaxias (*G. truttaceus*), Climbing galaxias (*G. brevipinnis*), brown trout (*Salmo trutta*)
28-Sep-00	1st lagoon	brown trout (*Salmo trutta*), Climbing galaxias (*G. brevipinnis*)
02-Oct-00	legana	goldfish (*Carassius auratus*)
04-May-01	Den Ranges	goldfish (*Carassius auratus*)
02-Jul-01	Sheffield	Spotted galaxias (*G. truttaceus*), brown trout (*Salmo trutta*), eels (*Anguilla australis*)
16-Jul-01	Glengary	freshwater mussels
30-Jul-01	Quamby Bluff	goldfish (*Carassius auratus*)
11-Nov-02	Flinders Island	goldfish (*Carassius auratus*)
15-Nov-02	Craigbourne Dam	tench (*Tinca tinca*)
26-Nov-02	Mannings Creek	nil
23-Mar-03	Burnie	nil
15-Apr-03	Golden Valley	goldfish (*Carassius auratus*)
03-May-03	Devonport	goldfish (*Carassius auratus*)
16-May-03	Turners Marsh	goldfish (*Carassius auratus*)
21-May-03	Rannalagh	goldfish (*Carassius auratus*)
15-Jul-03	Latrobe	goldfish (*Carassius auratus*)
16-Jul-03	Franklin	nil
31-Oct-03	Great Musselroe	carp/goldfish hybrid

Table 2 : Surveys carried out across Tasmania in response to public reports of potential carp sightings.

8.0 Carp studies outside the IFS

8.1 State

Studies on carp within Tasmania only began in earnest when carp were found within lakes Sorell and Crescent in 1995. The CSIRO has begun research into several aspects of genetic manipulation of pest fish and population parameters since 1995.

Biologist Ron Thresher, of the CSIRO, heads a team in Hobart Tasmania, investigating the use of genetic manipulation as a method of control for pest fish species including carp. It is hoped that multiple copies of a daughterless gene can be inserted into the genome of male carp, resulting in any future progeny being entirely male. If the population is flooded with these genetically modified fish, the long-term projections suggest that the population would eventually run out of viable females and the population would fail.

Dr Nic Bax, an ecosystem modeller with the CSIRO was conducting another avenue of research on behalf of the IFS. His team was funded by Fisheries Research Development Corporate (FRDC) to investigate the probability of removing the last female carp by the CMP current fish-down methods. In addition, his team modelled the estimated carp populations in both lakes using parameters including expected natural mortality and tag loss estimates. An Access database was designed by Dr Nic Bax's team from this FRDC funding, to ensure the integrity of all future data collected and will be available to any future research groups. This project concluded July 2004. The FRDC report entitled "Eradicating European carp from Tasmania and implications for national European carp eradication", is currently being finalised.

8.2 National

Carp are declared noxious pests in Queensland and Victoria and are considered a 'controlled' species in Tasmania and South Australia, so in all these states it is illegal to keep, release and transport carp. Carp are acknowledged as pests in New South Wales. Transport and release of live carp is prohibited. The spread of carp is not considered desirable in any State or Territory and some States have attempted eradication programs on a local scale (Koehn *et al* 2000).

The management of carp has been perceived by many as the responsibility of State and Territory agencies, mainly fisheries departments and, as a result, little coordination has occurred at a national level (Koehn et al 2000). Table 3 shows the status of carp, responsible management agencies and relevant supporting legislation for carp management in Australia.

	Commonwealth	QLD	NSW	ACT	VIC	SA	TAS	WA
Status of carp	Import of live carp prohibited	Noxious	Not declared noxious, but recognised as a pest by policy	Not declared a pest	Noxious	Exotic	Controlled Fish	Not declared a pest
Responsible management agencies	CCG, MDBC, AFFA, Environment Australia	DPI for QFMA	NSW Fisheries	Environment ACT	Fisheries Victoria, Department of Natural Resources and Environment	SA Fisheries, South Australian Research and Development Institute	Inland Fisheries Service	Fisheries WA
Actions undertaken	Checks by customs and quarantine officers	Enforcement, education, raising of community awareness	Enforcement, education, raising of community awareness, inter-agency cooperation	Education, raising of community awareness	Enforcement, education, raising of community awareness. Fisheries officers to check use of live bait and transport	Enforcement, education, raising of community awareness	Enforcement, education, raising of community awareness	Enforcement of non-translocation law, education, raising of community awareness
Relevant legislation	Wildlife Protection (Regulation of Exports and Imports) Act 1982	Fisheries Act 1994	Fisheries Management Act 1994	Fisheries Act 1967	Fisheries Act 1995	Fisheries Act 1982	Fisheries Act 1995	Fisheries Act 1994

Table 3 : Status of carp, responsible managing agencies and relevant legislation for carp managment in Australia

(Taken from Koehn *et al* 2000).

The need for a national approach to carp management emerged only recently and is still being developed and refined (Koehn *et al* 2000). In 1997, the Commonwealth Government announced funding for a carp campaign. The campaign established two groups to provide leadership and implementation of national carp control initiatives. The Carp Control Coordinating Group (CCCG) provided leadership and coordination of research and management activities. The group goals, as outlined in its terms of reference, are the development of a National Management Strategy and a National Research Strategy, and the promotion of effective liaison among groups involved in carp management. The National Carp Task Force (NCTF) provided a forum for the community and assisted in the development of business plans for carp-related industries. Both groups worked together to ensure that a coordinated approach was taken to carp management.

The CCCG was made up of nominated representatives from all States and Territories and the Commonwealth. The CCCG held a series of workshops throughout the 1990's to review and focus attentions on research already conducted, as well as develop a clear direction and priority for future research. The National Management Strategy and the National Research Strategy were completed and released in 2000 and the CCCG was essentially disbanded. It is the objectives and knowledge gaps in these documents that are the major focus of researchers within Australia concerned with the carp problem. Copies of these strategies are available in each state from the Fisheries authorities outlined in Table 3, or, the strategies are outlined by Barrett in 'Managing invasive freshwater fish in New Zealand'.

Since the break up of the CCCG, the Murray-Darling Basin Commission (MDBC) has granted a multi-million dollar research grant to an organisation called the Pest Animal Control CRC or PAC (CRC). This company is now the overarching body that governs research into the genetic and modelling components of the carp research within Australia. In essence, the genetic research is still conducted through the CSIRO here in Tasmania but the pooling of research from each state is handled by the PAC (CRC).

8.3 International

Research into carp control is essentially limited to the Southern Hemisphere and North America. In the Southern Hemisphere the major research focus outside Australia is in New Zealand, where carp and goldfish have spread to several catchment areas. The New Zealand carp appear to be Koi carp, however this still needs to be confirmed.

The major focus on carp in New Zealand is preventing further spread and limiting the impacts of carp on the environment and native species. It would appear that carp in New Zealand are not yet causing the problems witnessed on mainland Australia, however a close monitoring program and intensive research into control methodologies is being conducted to enable a rapid response if the populations boom.

A fisheries employee from Environment Waikato regional council visited Tasmania and spent two weeks working closely with the CMP in order to assess the viability of implementing a similar program in New Zealand. Reports recently from New Zealand indicate that such a program may be commencing in the near future. This program is not orientated to eradication but simply to reducing numbers and preventing carp spread.

Carp were first introduced into Northern America in 1877. Since that time, countless introductions both intentional and unintentional have allowed carp to become one of the most widely distributed fish species in North America, ranging from central Canada to central Mexico, and from coast to coast. In Texas, common carp are found everywhere.

The potential problems these fish could cause in North America are similar to the problems faced on mainland Australia, however, apart from eutrophic dams and lakes, these fish do not reach the densities witnessed throughout much of the Murray-Darling System. Research into carp control in North America has a strong focus on poisoning. Poison baits have been trialed that are designed to be carp specific, floating on the water surface and affecting only the target species. Although the trials appear to have killed many carp, they do not appear to be an eradication tool, rather a control method once fish densities are high.

Anglers have also taken an interest in this species, as a sport fish in North America as is the case in much of Europe. This poses another problem that Australian authorities do not contend with on a regular basis, that is, the spread of this species for the purposes of angling.

9.0 Staffing

9.1 Number of staff

Since the establishment of the CMP there has been a considerable turnover of staff. The initial structure consisted of one inspector and two technical officers. The IFC senior scientist who was also the representative on the Carp Task Force oversaw the project.

In 1996, a second inspector, a scientific officer and a field officer (screen maintenance) were appointed to the program. For six months, each Spring/Summer, in 2000/01/02/03 a technical officer was appointed under joint FRDC funding with CSIRO.

At the start of the 2002/03 financial year, a restructure took place within the CMP and jobs were advertised and filled. The new structure took the form of a senior inspector to manage the program, a scientist, a senior technical officer, an inspector, a field officer (screen maintenance), a casual field officer (screen maintenance on weekends), two short-term (3 months) field officers and the FRDC funded technical officer (6 months). This structure was to enable the focused monitoring and fish-down during the peak carp-spawning period.

The following is a list of officers that have been appointed to the program since its inception. Staff that are named multiple times have changed position within the program:

Field Officers	Rob Cordwell, Terry Byard, Michael Schottmeier and Jed Macdonald.
Technical Officers	Rod Green, Richard Morrisson, Tim Farrell, Dave Jarvis, Chris Cleary, Paul Donkers, Sven Frijlink, Andrew Harvey and Alasdair Macdonald.
Senior Technical Officers	Brett Mawbey and Paul Donkers.
Scientific Officers	John Diggle, Tim Farrell and Rodney Walker.
Inspectors	Robert McLaine and Chris Wisniewski.
Senior Inspector	Chris Wisniewski.
Senior Scientist	Andrew Sanger and John Diggle.

Along with this group, the program regularly receives support from other IFS staff.

9.2 Work rostering

Staff working on the CMP are supplied with a monthly roster. This takes into consideration both the needs of work and home. It enables the CMP to meet its goals and help satisfy family obligations. The roster enables planning and assists in meeting obligations in relation to the IFS industrial agreement.

There has been a considerable change in the way staff resources have been allocated to the CMP over time. The two main influences to work patterns have been through the knowledge that has

been gained about carp behaviour under Tasmanian conditions and the change in focus from the extensive amount of time that was spent on compliance early in the program.

The knowledge and data that have been collected since the start of the program now allows for a much more focused effort on carp fish down. Early in the program, large amounts of time were spent searching for carp and a considerable amount of time was spent fishing indiscriminately. This was not wasted time because it was the start of building up the sound knowledge base that now exists.

With the introduction of the biotelemetry techniques, in 1997, the effort to catch carp has become more focused. It is now possible to predict carp movements at different times of the year and at varying water levels. During the Spring of 2002/03, two additional staff were employed for a 3 month period and, along with an FRDC funded position for 6 months, this allowed monitoring of the lakes to occur on a daily basis through this crucial spawning period. In 2003/04, two 3 month positions were utilised from October to December. These positions have enabled the CMP to monitor closely both lakes through this critical spawning time and it is planned to continue this staff regime into the future.

A considerable amount of time was spent early in the program ensuring compliance with the closure of the lake. Two inspectors were allocated to the program and additional compliance support was supplied as required. With carp numbers still high the compliance of the closure was an important issue in relation to the containment of carp to the lakes. The compliance effort was extremely successful, and with some early prosecutions, non-compliance became hard to detect. With the reduction of carp numbers and reduced poaching, the CMP had the opportunity re-focus and further its work in educating the community. This was something that there was little time for early in the program. The experience of the compliance officers became valuable in the targeting, and further removal of, carp.

With the re-opening of Lake Crescent to the public in the near future, there will be the need to increase compliance effort and further educate the public. This will again change the focus of staff rostering.

10.0 Finance

10.1 Annual budget allocations

The CMP has been funded from the Consolidated Fund since carp were discovered in Lake Crescent in February 1995. Extra funding has been allocated for further development of screens and outlet structures. The funding breakdown by year is as follows:

Year	Funding ($)
1994/95	743 850
1995/96	0
1996/97	511 000
1997/98	372 000
1998/99	350 000
1999/00 (Crescent Screen Duplication)	120 000
1999/00	365 000
2000/01	395 000
2001/02	395 000
2002/03	402 500
2003/04	395 000
2003/04 (Sorell Screen Duplication)	79 000
Total	**4 128 350**

10.2 Establishment and initial costs

In the first years of the CMP, a considerable amount of the annual funding was allocated to capital works and infrastructure as can be seen in the table above. In the initial allocation there was funding for the purchase of:

$39 500	interstate electrofishing boat hire
$80 000	Lake Crescent Field Base and associated buildings
$68 000	electrofishing boat
$12 000	hydrological modelling
$12 000	Lake Crescent canal de-silt
$15 000	supporting equipment, nets etc
$25 000	consultant fees to look at the feasibility of poisoning
$28 600	initial screens
$100 000	Lake Sorell outlet structure and canal widening
$20 000	Lake Crescent Spillway and Screens
$80 000	Upgrade of the Lake Crescent outlet structure and screens.

10.3 Annual costs

Since 1997/98, the largest percentage of the allocated budget has gone to staff salaries. The funds now employ seven staff (6.25 FTE), the remainder provides an operating budget to support active control plan for the carp problem. The budget breakdown for the 2003/04 year is attached in Figure 11.

10.3.1 Allowances

This component of the budget pays for all travel and camp allowances for the carp program. Given the large number of days away from base for most of the staff, this component is fully committed. Present costs, as per staff agreement, are all meals per officer at Lake Crescent and elsewhere around the state. At the present rates this equates to $52.75 a day. Field officers average about 2 nights per week away from base, 90% at Lake Crescent Field Station, 10% hotels / motels. This represents about $20 000 per annum. In addition there is intra/inter state travel for the Senior Inspector (≅$3 000 / ≅$3000) and limited travel for the Operational Officers (≅ $2 000).

10.3.2 Equipment

The carp program is constantly trying to develop new methods for carp control and support its present activities. This component of the budget is expended fully due mainly to the development of the highly successful radio tracking methods. Because of the demanding nature of the fish down work nets, electrofishing equipment and associated gear require ongoing maintenance and replacement. A large amount of money has been invested in equipment purchases, which will also be utilised in the coming seasons.

10.3.3 Vehicle and boat running costs

The carp program runs three vehicles and three boats. These are used intensively at lakes Sorell and Crescent and around the state. These vehicles allow the flexibility for multiple teams to operate simultaneously and to undertake carp management, compliance and allow for the CMP to clean regularly the outflow screens to provide constant downstream flows.

The three boats include the electrofishing boat, which is used for carp sampling and surveys and two netting boats. This range of vessels allows the team to work simultaneously on lakes Sorell and Crescent, or other waters as required.

Due to the difficult and dangerous navigational conditions encountered in lakes Sorell and Crescent there are high maintenance costs associated with frequent operations on these waters

If the program is to continue to fish down the carp population effectively and investigate distribution, then this component will continue to be fully used.

10.3.4 Capital works including de-silting.

This component is dedicated to the annual de-silting of the outflow canal and replacement of the mesh screens due to wear and tear. The de-silting will continue to account for around $5 000 per annum and has been reduced due to efficiencies in screening. If the canal is not de-silted then screen blockage rates exceed the rate at which the screens can be cleaned which as mentioned has implications for containment and downstream supply.

10.3.5 Communications & publications

This component is utilised to promote the program and educate the community about the real issues in relation to pest fish introductions into Tasmania. There is a continued commitment for the program to attend major events around the state.

10.3.6 Operation Costs

This budget item is used to supplement special equipment purchases and to support the running of the field accommodation at Lake Crescent and office costs at Lampton Avenue. This component is also necessary to deal with unforeseen circumstances and any additional minor capital works.

10.4 External funding

10.4.1 Fisheries Research Development Corporation Funding

The IFS was successful in securing funding with FRDC for a project to investigate the feasibility of eradicating carp from lakes Sorell and Crescent by physical removal and to assess the success of the fish down operations. These Federal funds totalled $175 000 over three years from 2000 to 2003. This report is currently being completed and should be published during 2004.

Description	Total Prds	Jul-03	Aug-03	Sep-03	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04
3301 Annual Cont	-395000	0	0	-395000	0	0	0	0	0	0	0	0	0
3807 Refunds-Ins	-209.1	0	0	0	0	0	0	0	0	0	0	0	-209.1
TOTAL REVENUE	-395209.1	0	0	-395000	0	0	0	0	0	0	0	0	-209.1
5011 Salaries	231915.51	23640.88	18271.79	16795.48	18953.06	23588.93	27521.42	16062.89	15736.86	14271.9	15729.67	14271.9	27070.73
5013 Otime-Penalties	3304.12	0	0	0	0	725.29	1215.03	336.11	517.04	0	287.24	0	223.41
5015 Allowances	35840.07	4042.16	2787.62	2800.74	2108.54	2813.26	3959.32	2471.4	2473.26	2473.26	2473.26	2473.26	4963.99
5021 Superannuation	27205.32	2793.11	2096.93	1965.24	2099.73	2644.46	3243.79	1899.62	1886.78	1708.4	1865.45	1708.4	3293.41
5022 Payroll Tax	19738.56	45.77	34.27	63.7	208.33	137.07	128.65	100.11	59.81	152.38	94.09	55.76	18658.62
5025 Work Comp Prem	9940.83	0	0	0	0	2537.83	0	0	0	0	0	0	7403
5027 Staff Recruitment	44	0	44	0	0	0	0	0	0	0	0	0	0
5028 Training	1030	0	0	965	65	0	0	0	0	0	0	0	0
5101 Council Rates	500	0	0	0	0	0	0	0	0	0	0	0	500
5102 Building Clean	1022.24	0	0	0	0	0	0	0	0	22.24	0	0	1000
5103 Prop Maintainance	2061.36	0	0	0	0	61.36	0	0	0	0	0	0	2000
5105 Elect & Power	2500	0	0	0	0	0	0	0	0	0	0	0	2500
5107 Gas	20	0	0	0	0	0	0	0	20	0	0	0	0
5212 Intrastate Travel	19978.77	1262.07	549.15	1020.75	3423.8	2091	2860.7	1604.15	958.6	2626.55	1507.9	1287.65	786.45
5216 Vehicle Fuel	14639.34	525.08	1148.57	835.86	816.69	2148.16	1641.35	1554.4	1426.2	1524.57	1350.87	790.17	877.42
5217 Vehicle Hire	0	908.49	971.73	905.63	945.25	-3731.1	0	0	0	0	0	0	0
5301 Phones & Fax	4725.36	103.62	685.33	134.97	157.1	922.13	0	1815.21	226.95	0	442.33	590.32	-352.6
.5302 Mob Phones	2076.27	0	371.54	0	0	446.8	0	357.68	173.29	0	196.68	342.65	187.63
5303 Postage/Freight	1075.1	379.1	147.31	343.76	204.93	0	0	0	0	0	0	0	0
5512 Equipment Maintainance	1102.11	0	9.06	250.91	0	13.64	0	0	102.27	126.23	600	0	0
5513 Equip Purchases	18075.09	77.27	2548.03	1018.14	2089.07	3724.82	0	0	992.27	395	754.1	6476.39	0
5522 Vehicle Maintainance	5192.56	775.27	6.36	291.64	62.8	727.27	0	267.41	2299.42	20	402.9	0	339.49
5532 Seacraft Costs	3437.75	52.37	536.28	205.41	825.91	434.33	0	0	433.7	0	0	949.75	0
5621 Protective Clothing	2031.79	438.74	58.09	270.95	436.07	258.65	0	0	196.93	34.95	331.28	-116.73	122.86
5631 Operating Supplies	8762.08	10.91	505.6	686.09	1538.5	3321.1	-937.36	0	1694.44	1590.55	593.37	-247.8	6.68
5633 Cont Services	990	0	0	0	0	0	0	0	0	990	0	0	0
5634 Adv/Promotion	1238.87	0	0	0	0	0	0	0	0	0	0	852.09	386.78
5711 Office Req	265.25	0	63.94	0	0	0	0	0	62.48	138.83	11.67	-11.67	0
5714 Bank Charges	21.15	0	3.15	2.1	3.45	4.35	0	0	1.2	2.25	2.7	1.95	0
5724 Meetings & Conf	222.46	92	0	0	62.5	0	0	0	52.91	0	15.05	0	0
5725 Entermnt FBT	47	0	0	0	47	0	0	0	0	0	0	0	0
5727 Misc Expenditure	2366.29	0	0	0	0	0	0	0	0	0	0	0	2366.29
5731 Printing/Publications	162.03	0	116.8	0	0	0	0	0	45.23	0	0	0	0
9994 Bal C'fwd	-31258.59	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXPENDITURE	**390272.69**	**35146.84**	**30955.55**	**28556.37**	**34047.73**	**42869.35**	**39632.9**	**26468.98**	**29359.64**	**26077.11**	**26658.56**	**29424.09**	**72334.16**

Figure 11: Overview of annual budget and spending for the 2003/04 financial year.

Appendix 1 - Time Line of Major Events:

1995	
January	
28	Graham Porter finds part of a fish on the SE shore of Lake Crescent.
30	Incomplete specimen of a fish handed to IFS staff.
February	
1	Carp found in Lake Crescent by IFS staff.
	Downstream surveys begin
18	Lake Crescent closed to the public.
20	Electro fishing boat arrives from NSW for surveys.
24-28	Screens installed in Lake Crescent outlet.
March	
4	Electro fishing boat arrives from Victoria for surveys.
6	Carp found in Lake Sorell.
9	Lake Sorell closed to the public.
13	Carp sent to NSW university for genetics.
15	Carp and trout sent to Mount Pleasant for parasite checks.
April	
	Downstream surveys continue.
May	
	Downstream surveys continue.
10	IFS Electro fishing boat arrives from USA.
June	
	Downstream surveys continue.
22	Vessel IFC 8 re-deployed to Lake Crescent.
27	Three male carp seized from ponds at Berridale.
July	
	Downstream surveys continue.
7	Lake Crescent canal de-silt.
9	One carp found downstream of Lake Crescent outlet during de-silt.
14	Lake Crescent boat ramp extended.
29	Lake Sorell re-opened to the public.
August	
7	Coarse screen installed at old outlet at Lake Sorell
September	
1	Purchase shack at Laycock Drive Lake Crescent.
18	Inspector transferred to program.
October	
24	Temperature loggers fitted to both lakes. 1mm screens re-fitted to Lake Crescent outlet.

D e c e m b e r	
7	Exclusion fencing attempted Clyde and Tea Tree Marshes (Cres).
8-9	Eel trap constructed in Interlaken Canal by Ted Archer.

1 9 9 6	
J a n u a r y	
24	Crescent Spillway and levee completed.
F e b r u a r y	
5	Interlaken Canal excavations begin (wider and deeper).
6	100 carp from Island and 240 from Bullies Marsh (Crescent)
22	207 carp Bullies Marsh (Crescent)
M a r c h	
	Interlaken Canal excavations completed.
	New outlet structure completed at Lake Sorell.
	Lake Crescent outlet walkway and coarse screen installed.
13	Commenced construction of Clyde downstream screens.
28	Electro boat fishing on Meadowbank.
M a y	
	Downstream surveys.
8	5mm mesh fitted to Lake Crescent spillway.
29	Juvenile found on Clyde River downstream screens.
J u l y	
1	Scientific officer appointed to program.
26	Lake Sorell notice boards erected.
A u g u s t	
7	Fitted 5mm internal screens in Lake Crescent outlet.
13	Fitted 5mm flow deflector in Lake Crescent outlet.
O c t o b e r	
7	Field assistant appointed to program.
N o v e m b e r	
6-8	Andrews Bay Aggregation (Crescent) 390 carp.
D e c e m b e r	
16-20	Downstream surveys.
21	First field trials with radio transmitters (no fish) at Crescent.
1 9 9 7	
J a n u a r y	
6-30	Downstream surveys.
30	Lake Crescent outlet extension.

F e b r u a r y	
3	Construct in-lake holding pen.
10-12	Fit new internal screens to extended Lake Crescent outlet structure.
M a r c h	
10	First male carp implanted and released with radio transmitters (Cres).
A p r i l	
9	First radio transmitter aggregation targeted. 202 carp captured.
14	5mm screens fitted inside Lake Crescent outlet.
M a y	
5-13	Lake Crescent canal de-silt.
8	Rotenone bio-assay commences.
28	New walkway and front screen fitted at Lake Crescent outlet.
29	Rotenone Clyde River between screens.
S e p t e m b e r	
12	Senior Scientist leaves.
O c t o b e r	
10	First juvenile carp captured in Duck Bay (Sorell) by backpack electrofishing
N o v e m b e r	
6	First male carp implanted and released with radio transmitters (Sorell).
D e c e m b e r	
8-11	Downstream Survey
1 9 9 8	
J a n u a r y	
20-21	Lake Crescent internal screens lowered.
M a y	
4-8	Downstream survey.
J u n e	
26	Commissioner leaves.
J u l y	
6-10	Stowport carp survey
O c t o b e r	
26-30	Lake Crescent Canal de-silt.
N o v e m b e r	
3	Lake Crescent outlet extensions.
30-Dec11	Population estimate (tag release) begins in Lake Crescent.

1 9 9 9

J a n u a r y	
4-15	Population estimate (recapture) continues in Lake Crescent.
M a r c h	
24-26	Downstream survey (Meadowbank).
29-30	Complete Stowport survey.
N o v e m b e r	
13	Started berley trials in Crescent.
23-24	Jason Garrett visit to Lake Sorell.

2 0 0 0	
F e b r u a r y	
4	Excavate in front of Lake Sorell gates due to low levels.
M a r c h	
13-Apr6	Undertake stream bed rebuild in Mountain Creek.
M a y	
9	Downstream survey.
J u l y	
18-19	Excavate footings for Interlaken Canal trap.
22	Construct base for wind tower in Lake Sorell.
A u g u s t	
2	Pour concrete footings Interlaken Canal trap.
N o v e m b e r	
13-14	Interlaken Canal carp spawning.
15	Clyde marsh carp spawning aggregation.

2 0 0 1	
J a n u a r y	
4	Lake Crescent Canal de-silt.
16	Grass traps constructed in Crescent Canal.
M a r c h	
19-28	Downstream survey.
A p r i l	
3	Pour concrete pad below anti-jump barrier in Mountain Creek.
14-16	Construct abutments Interlaken Canal trap.
27	Build Duck Bay exclusion fence.
M a y	
14	Carp display protocol produced.

26	Heazelwoods Lagoon outlet channel blocked.
A u g u s t	
14-16	Construct Crescent canal silt stop log structure.
14-17	Crescent Canal de-silt.
S e p t e m b e r	
15	5mm horizontal screens installed at Lake Sorell outlet.
24-25	Lake Crescent Canal de-silt.
N o v e m b e r	
6	Old outlet/Clyde Marsh spawning Lake Crescent.

2 0 0 2	
M a r c h	
12-15	Lake Crescent Canal de-silt.

2 0 0 3	
M a r c h	
31-2Apr	Rebuild Duck Bay exclusion fence.
A p r i l	
2-14	Build Kemps Marsh exclusion fence.
J u n e	
16-18	Victorian government agencies visit.
O c t o b e r	
2	Raise Lake Sorell outlet screens.
9	Block Kermodes Drain with sandbags.
N o v e m b e r	
17-28	Johlene Kelly New Zealand (Environment Waikato) visit
18	Fit out and raise old outlet bays at Lake Crescent screens with new design.

2 0 0 4	
J a n u a r y	
12	CSIRO carp conference Hobart
F e b r u a r y	
9	Excavate carp holding pond at Interlaken.
18	46 male carp transferred to Salmon Ponds holding tank.
24	Find juvenile carp at Boathouse Bay (Lake Sorell) during fyke survey.
M a r c h	
1	161 tagged male carp released into Crescent for a population estimate

2	Rotenone Boathouse Bay.
15	Construct exclusion fence at Boathouse Bay drain (Lake Sorell).
16	Construct exclusion fences at Jacks Point, Triffets Point and Tea-tree.
22-23	Construct exclusion fence at Kermodes Marsh.
29-30	Construct exclusion fences at Silverplains, Boathouse Bay and Kemps.
A p r i l	
5-7	Construct exclusion fences at Robertson's and Grassy.

Appendix 2 – Public Awareness Presentations

CMP staff have attended the following venues to give presentations:

1 9 9 6

4 February	Carp Information Day, Dago Point.
15 February	Huon Anglers Club.
29 February	Kingborough Anglers Club
3 April	Northern Fly Fishers Club
19 May	Liawenee Open Day
17/20 October	Melbourne Fishing Show

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5 February	Southern Tasmanian Licenced Anglers
25 February	Bridgewater Anglers Club
19 March	New Norfolk Anglers Club
6 May	Glenorchy Angler Club
18 May	Liawenee Open Day
6 August	Fly Tyers Hobart
7 August	Northern Tasmanian Anglers Association
6 September	Downtown Fishing Promotion
11 September	Ulvertsone Anglers Club
17 September	New Norfolk Anglers Club
25 September	Devonport Fly Fishers
10 November	Penguin Anglers Club

1 9 9 8

3 March	Carp Workshop (Minister)
31 March	Bridgewater Anglers Club
11 May	Cabinet
16/17 May	Liawenee Open Weekend
10 June	Clarence Anglers Club
20 July	Fly Tyers
1/ 2 August	CCCG
2 September	Georgetown Anglers Club
21/22 October	Hobart Show

1 9 9 9

15 March	Fly Fishers Hobart
7 April	Southern Tasmanian Licenced Anglers Association
27 April	Bridgewater Anglers Club
6 May	Launceston Anglers Club
16 May	Liawenee Open Weekend

19 May	New Norfolk Anglers Club
8 June	Bishopbourne Anglers Club
17 July	Trout Guides Association
4 August	Fly Fishers Launceston
11 August	Clarence Anglers Club
26 August	Kingborough Anglers Club
21 September	South East Field and Game
9 October	Devonport Scouts
25 October	Beaconsfield Anglers Club

2 0 0 1

3/4 May	Agfest
19/20 May	Liawenee Open Weekend
31 May 1 June	Recfish Australia Conference
27 November	Bridgewater Anglers Club
2 November	Beaconsfield Primary School

2 0 0 2

6 April	Tamar Island Wetland Centre
1/2/3 May	Agfest
18/19 May	Liawenee Open Weekend
14 August	New Norfolk High School
12/13 October	Bronte Tie In

2 0 0 3

1/2/3 May	Agfest
17/18 May	Liawenee Open Weekend
5 May	Federal Police Environmental Crime Conference
21 June	Fishcare Beauty Point
24 July	Illawarra Primary School
18 October	Bronte Tie In
30 October	Kingborough Anglers

2 0 0 4

19 January	Scotts Childcare
30 March	Bridgewater Anglers
3 April	Lake Crescent Shack Owners
5 April	Margate Primary School
6/7/8 May	Agfest
22/23 May	Liawenee Open Weekend

The CMP has also been involved with a clean up day at Lake Crescent on 16 May 1998 and gives ongoing training presentations to Fishcare volunteers.

Appendix 3 – Media Articles

Articles detailing the CMP, its activities and progress have been published in a range of print media and interviews are regularly broadcast on radio, TV and electronic media outlets.

February 1995	On the Rise Vol.24 No.1(Carp in Lake Crescent-Special Edition)
3 February 1995	The Mercury (Tassie trout wipe-out fear)
3 February 1995	The Examiner (Carp threaten State's trout)
4 February 1995	The Mercury (Drain-lake call over trout crisis)
4 February 1995	The Advocate (Funding blamed for entry)
4 February 1995	The Advocate (Stowport outbreak)
4 February 1995	The Advocate (The fish that beat Victoria)
5 February 1995	The Examiner (Time to move quickly on carp problem)
6 February 1995	The Examiner (Push for federal carp funds)
6 February 1995	The Examiner (State will seek funds to fight ecology threats)
6 February 1995	The Examiner (Unwelcome invader of our waterways)
7 February 1995	The Examiner (Poison option to destroy carp)
7 February 1995	The Advocate (Carp warning 20 years old)
7 February 1995	The Mercury (Interloper may foul prized waters)
8 February 1995	The Examiner (Carp lake closed to allow fish cull)
8 February 1995	The Advocate (Government closes lake to fishermen)
8 February 1995	The Derwent Gazette ('Invaders' threaten highlands)
8 February 1995	The Advocate (Lake carp curse (letters to the editor))
8 February 1995	The Mercury (Lake closed in bid to contain carp)
8 February 1995	Television Crew
8 February 1995	The Advocate (Govt to wage war on carp)
8 February 1995	The Advocate (Anglers rocked by bad news)
9 February 1995	The Examiner (Quick action needed on carp menace)
9 February 1995	The Examiner (Carp crisis (letters to the editor))
9 February 1995	The Mercury (Carp find (letters to the editor))
10 February 1995	Win TV 'A Current Affair'
10 February 1995	The Examiner (Carp could be a threat to Tas. Tourism)
11 February 1995	The Mercury (Poser of the 'underwater rabbit')
11 February 1995	The Mercury (Carp lake out of bounds)
11 February 1995	The Examiner (Lake out of bounds in bid to wipe out carp)
13 February 1995	The Mercury (Answer for carp critics(editorial))
16 February 1995	The Examiner (Carp removal top priority (editorial))
16 February 1995	The Examiner (Carp look a fixture)
16 February 1995	The Examiner (Know your enemy: how to spot a carp)
17 February 1995	The Examiner (Carp program (letters to the editor))
20 February 1995	The Advocate (Angling dilemma (Letters to the editor))
21 February 1995	The Mercury (Commission put carp in the picture)
23 February 1995	The Examiner (Commission is hoping to locate all carp infestations)
24 February 1995	The Advocate (Carp threat (letters to the editor))

26 February 1995	The Examiner (European carp still confined)
27 February 1995	The Advocate (Carp confined: Cleary)
27 February 1995	The Mercury (Carp only in Crescent)
March 1995	The Highlands Digest (Wings vs Fins! sea eagle to the rescue)
7 March 1995	Television Crew
8 March 1995	The Mercury (Trout faces new menace from carp)
8 March 1995	The Mercury (High-tech anglers, giant ask))
8 March 1995	The Examiner (Lake off limits to State's anglers)
8 March 1995	The Derwent Gazette (Anglers want cap lakes sealed off)
9 March 1995	The Examiner (Carp threat to Tasmania's $30 million trout industry)
9 March 1995	The Mercury (Stay of execution for state's killer carp)
9 March 1995	The Advocate (Trust criticises carp poisoning)
10 March 1995	The Advocate (Anglers hail bid to isolate carp)
11 March 1995	The Mercury (Carp fears (letter to the editor))
12 March 1995	The Examiner (Anglers support closure of carp lakes)
14 March 1995	The Mercury (Spread of carp (letters to the editor))
14 March 1995	The Examiner (Carp problem (letters to the editor))
15 March 1995	The Mercury (New bid to find carp source)
16 March 1995	The Mercury (Carp action (letters to the editor))
16 March 1995	The Examiner (A human side to the carp quandary)
18 March 1995	The Mercury (Carp concerns (Letters to the editor))
20 March 1995	The Advocate (Disappearing carp (letters to the editor))
24 March 1995	The Examiner (Carp in lakes may be poisoned)
25 March 1995	The Mercury (Poison plan on carp menace)
25 March 1995	The Examiner (Poison to kill carp may be too late)
25 March 1995	The Advocate (Carp kill on hold)
26 March 1995	The Mercury (Editorial-Weighing facts on carp menace)
26 March 1995	The Mercury (Carp wars (letters to the editor))
29 March 1995	The Mercury (Carp campaign (letters to the editor))
10 April 1995	Time (Tasmania's Catch 22)
2 April 1995	Sunday Tasmanian (Carp in our waters 'scandalous tragedy)
3 April 1995	The Examiner (European carp (letters to the editor))
4 April 1995	The Mercury (Carp concern (letters to the editor))
5 April 1995	The Advocate (Catching carp (Letter to the editor))
6 April 1995	The Advocate (Editorial-Carp issue must not die)
7 April 1995	The Advocate (Carp concern (letter to the editor))
8 April 1995	The Advocate (Carp 'risk to water quality')
9 April 1995	Sunday Examiner (Carp poisoning to wait for research)
10 April 1995	The Advocate (Carp threat (letter to the editor)
12 April 1995	The Mercury (Carp worries (letter to the editor))
12 April 1995	The Advocate (Carp targeted (letter to the editor)
12 April 1995	The Advocate (Carp presence an 'ecological disaster)
13 April 1995	The Advocate (Carp menace (letter to the editor))

15 April 1995	The Mercury (Carp wars: $57,000 weapon coming soon)
17 April 1995	The Advocate (Carp comments (letter to the editor))
26 April 1995	Derwent Valley Gazette (Equipment boost for carp attack)
3 May 1995	The Advocate(Carp virus may be years off)
9 May 1995	The Mercury (Carp boat ready in a fortnight)
16 May 1995	The Age (Carp a threat to Tasmanian trout fishing)
16 May 1995	The Advocate (Vessel to rid carp has arrived)
17 May 1995	The Mercury (Lake fears(letter to the editor))
20/21 May 1995	Liawenee Open Weekend
24 May 1995	Derwent Valley Gazette (Carp concern at open day)
2 June 1995	The Advocate ($1M plan to wipe out carp)
2 June 1995	The Mercury ($1M to beat carp menace)
2 June 1995	The Examiner ($1M allocated to war on carp)
6 June 1995	The Mercury (Angling-Carp menace)
17 June 1995	The Examiner (How we foul our nest)
21 June 1995	The Examiner (Carp screens in work)
21 June 1995	The Advocate (Flood screens for carp lakes)
21 June 1995	Derwent valley Gazette (War declared on carp)
22 June 1995	The Examiner (Carp work begins)
29 June 1995	The Mercury
29 June 1995	The Advocate (Meeting to discuss carp, fungus)
5 July 1995	The Examiner (Talks on carp eradication plans)
5 July 1995	Derwent Valley Gazette (Work to screen Lake Crescent floodway)
9 July 1995	The Examiner (Carp attack plans spelled out)
13 July 1995	The Examiner (Carp can be recognised by their barbels)
14 July 1995	The Examiner (Carp found in Clyde River, and anglers now fear for the Derwent)
14 July 1995	The Mercury (Tassie admits defeat on carp menace)
15 July 1995	The Mercury (Inland Fisheries vows to continue carp fight)
15 July 1995	The Advocate (Clyde fish find not a surprise to locals)
15 July 1995	The Advocate (Carp eradication not a lost cause)
15 July 1995	The Mercury (Carp disaster)
19 July 1995	Derwent Valley Gazette (Hunt for carp delayed)
20 July 1995	The Advocate (Carp a challenge for IFC)
31 July 1995	The Mercury (Not a carp on the line as ‘top’ trout season starts)
8 August 1995	The Mercury (A finned fiend to carp about)
20 August 1995	Sunday Tasmanian (World-wide web cast for carp controller)
28 August 1995	The Mercury (Lake based plan for carp campaign)
28 August 1995	The Examiner (Action on carp)
12 October 1995	The Advocate (Fisheries group winning carp war)
24 October 1995	The Mercury (Lake’s fishing future hangs on carp catch)
December 1995	On the Rise Vol.24 No.3 (Carp update)
19 December 1995	The Examiner (Decision soon on carp fate)
26 December 1995	The Mercury (Carp problem high on fishing agenda)

16 January 1996 The Mercury (New attack on carp egg spread)
23 January 1996 The Mercury (Carp information)
25 January 1996 The Advocate (Carp eradication virus for state)
30 January 1996 The Mercury (Killer virus hope for war on carp)
1 February 1996 The Mercury (Open day on carp battle)
1 February 1996 The Advocate (Carp information day)
2 February 1996 The Mercury (Costly day for lake anglers)
2 February 1996 The Examiner (Progress report on carp)
5 February 1996 The Examiner (Poisoning of lake carp still an option)
10 February 1996 The Mercury (Carp control (letter to the editor))
3 March 1996 Sunday Herald Sun (Carp plague spreads)
23 March 1996 The Mercury (US biologist to join carp fight)
23 March 1996 The Advocate (US carp expert to join battle)
6 April 1996 The Mercury (Carp-control "secret' offer-Boffin wants $250 000 guarantee)
June 1996 On the Rise Vol.25 No.1(What is happening with carp?)
5 July 1996 The Mercury (Facing up to carp and trout problems in lakes)
25 July 1996 The Examiner (Need to find out more about carp and their containment)
31 July 1996 The Examiner (Carp keeping Lake Crescent closed)
11 August 1996 The Examiner (Stop carping and eat your fish)
October 1996 On the Rise Vol. 25 No.2 (Carp update 1996)
6 October 1996 Sunday Tasmanian (Poison plan to fight carp)
18 October 1996 The Mercury (Crusade against carp gets timely boost
6 November 1996 The Mercury (Scientific answer to carp 20 years away)
6 November 1996 The Examiner ('Suicide gene' mooted to beat carp plague)
8 November 1996 The Mercury (Carp problem still plagues Lake Sorell)
10 November 1996 Sunday Tasmanian (Wasted food (letters to the editor))
January 1997 On the Rise Vol. 25 No.3 (Carp update)
8 April 1997 The Examiner (Carp concern over plan)
May 1997 On the Rise Vol.26 No.1 (Carp update)
September 1997 On the Rise Vol.26 No.2 (Carp update)
December 1997 On the Rise Vol.26 No.3 (Carp update-November 1997)

14 February 1998 The Advocate ($1400 for fishing offences)
17 February 1998 The Examiner (Fish thrower fined $1400 for Lake Crescent catch)
22 April 1998 The Mercury (Poisoning lake to beat carp unlikely)
11 June 1998 The Mercury (Control of carp problem linked to cash)
September 1998 On the Rise Vol.27 No.1 (Carp-Winter update)
December 1998 On the Rise Vol.27 No.2 (Carp and Water Level Management in lakes Sorell and Crescent)

10 March 1999 Derwent Valley Gazette (Commission must act on lake concerns)
April 1999 On the Rise Vol.28 No.1 (Carp pictorial and Carp-Now for the good news)
17 April 1999 The Mercury (Plan to restore lakes)

24 April 1999	The Mercury (Bringing home the bacon-with carp)
September 1999	On the Rise Vol.26 No.1 (The Carp Report)
3 December 1999	The Examiner (Carp invaders tracked down)
3 December 1999	The Mercury (Carp program foils ecological disaster)
4 December 1999	The Advocate (Threat to Tasmanian trout fishing contained-Carp growth on hold)
6 December 1999	The Mercury (Carping critics)
28 February 2000	The Examiner (Call for action over Lake Crescent silt)
28 February 2000	The Advocate (Concern over Lake Crescent)
1 March 2000	Derwent Valley Gazette (Lake Crescent 'muddy pond')
April 2000	On the Rise Vol.29 No.1 (Carp Update February 2000)
6 April 2000	The Examiner (Lake Crescent set for limited season)
6 April 2000	The Advocate (Lake Crescent could re-open)
6 April 2000	The Mercury (Crescent lures anglers after carp clean out)
13 April 2000	The Mercury (Carp lakes are on the way back)
26 April 2000	Derwent Valley Gazette (Carp lakes are on the way back)
27 April 2000	The Mercury (Government hopeful on carp lakes)
4 May 2000	The Mercury (Interim plan for carp lake)
20/21 May 2000	Liawenee Open Weekend
25 May 2000	The Mercury (Money to aid carp battle)
31 May 2000	The Mercury ($400,000 for carp, eel data)
12 June 2000	ABC Radio
September 2000	On the Rise Vol.29 No.2 (Carp update: July 2000)
9 October 2000	The Mercury (Remains have carp fighters on watch)
20 February 2001	The Advocate (Advice on Lake Crescent details)
15 March 2001	The Mercury (Carp 'rabbits of the river')
16 March 2001	The Advocate (Carp's move into Lake Sorell riles)
May 2001	On the Rise Vol.30 No.1 (Carp update-April 2001)
11 October 2001	The Mercury (Setback in carp war)
September 2001	On the Rise Vol.30 No.2 (Carp Program update August 2001)
11 November 2001	Sunday Tasmanian (Costly carp battle)
13 December 2001	The Mercury (IFS winning carp war)
January 2002	On the Rise Vol.31 No.1 (Carp update Summer 2001-02)
25 April 2002	The Mercury (New life for old favourite)
13 June 2002	The Mercury (Saving troubled waters)
22 June 2002	The Mercury (New trout give lake hope)
26 June 2002	Derwent Valley Gazette (Restocking gives fishery hope)
4 July 2002	The Examiner (Lake Crescent set to reopen)
14 November 2002	The Mercury (Lake hopes dashed for anglers)
20 November 2002	The Mercury (Crescent carp cut below50)
21 November 2002	The Examiner (Crescent's cap now a 'few dozen')

21 November 2002	The Advocate (Carp cut, but lake is closed)
27 November 2002	Derwent Valley Gazette ('Few' carp left in lake)
13 January 2003	Herald Sun (Carp sex switch a turn off)
April 2003	Modern Fishing (Feral Fish)
27 July 2003	The Mercury (Hard fight to beat carp curse- Doomsday fish on drawing board)
27 July 2003	The Mercury (Tassie's carp warriors land big one)
30 July 2003	The Mercury (Editorial – Winning war on carp)
August 2003	Angler News (Carp Update)
18 September 2003	The Mercury (End near for carp)
October 2003	Angler News (Carp hunting begins in earnest)
23 October 2003	ABC Television News
11 December 2003	ABC Television News
21 December 2003	Sunday Examiner (Fighting a losing battle-Feral frontline)
28 December 2003	Sunday Examiner (Lake stays closed as carp lose battle)
January 2004	Angler News (Applications of carp control techniques across the Tasman)
January 2004	Angler News (Victorians follow Tasmanian lead on carp control)
1 February 2004	Sunday Tasmanian (Frankenfish spells carps' doom)
2 April 2004	The Examiner (Lake Crescent announcement)
3 April 2004	The Examiner (Lake Crescent to re-open for trout fishing)
3 April 2004	The Advocate (Lake to reopen after $4m carp war)
20/21 May 2004	ABC Television Landline

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