Cabomba control for the protection of the Ramsar listed Myall Lakes

Terry Inkson[1], Andrew Petroeschevsky[2], David Officer[3] and Terry Schmitzer[4]
[1] Great Lakes Council, PO Box 450, Forster, NSW 2428, Australia
[2] PO Box 1708, Grafton, NSW 2460, Australia
[3] Department of Primary Industries, PMB 2, Grafton, NSW 2460, Australia
[4] Mid North Coast Weeds Co-ordinating Committee, 961 Comboyne Road, Byabarra, NSW 2446, Australia
(terry.inkson@greatlakes.nsw.gov.au)

Summary This report summarises the results of a weed control project for the protection of the Ramsar listed Myall Lakes. Information is drawn from Caring for our Country (CFOC) annual reports, monitoring results and interviews with key stakeholders. During the project, significant gains were made towards achieving the key project goals of eradicating cabomba (*Cabomba caroliniana* A.Gray) to protect the Myall Lakes, increasing landholder and indigenous capacity to manage cabomba, and contributing to national best practice initiatives for controlling cabomba with herbicides.

This report details the first broad scale use in Australia of the recently registered Shark™ herbicide (240 g L^{-1} carfentrazone-ethyl) against the Weed of National Significance (WoNS) cabomba. Significant inroads into reducing the extent of cabomba infestations were made, however further efforts are still required. For a more detailed account of the project, download the comprehensive 'Cabomba Control Case Study 2011–2013 for the protection of the Ramsar listed Myall Lakes' at Councils website http://www.greatlakes.nsw.gov.au/Environment/Plants_Trees_and_Weeds/Weeds.

Keywords *Cabomba caroliniana*, herbicide control, Shark™, carfentrazone-ethyl, Ramsar, Myall Lakes.

INTRODUCTION

The project partners This project was a joint initiative between the Mid North Coast Weeds Co-coordinating Committee (MNCWCC), Great Lakes Council (GLC), New South Wales Department of Primary Industries (NSW DPI) and the National Aquatic Weeds Management Group (NAWMG).

About cabomba Cabomba is an aquatic plant native to South America. It is fully submerged except for occasional floating leaves and emergent flowers. It is identified by: its characteristic fan shaped leaves that are arranged oppositely on the stem; white flowers that emerge from the water; and a seasonally purple stem during the warmer months, especially when growing in full sun.

Cabomba was introduced to Australia through the aquarium industry as an ornamental and oxygenating plant for aquariums. It was first found naturalised in Australia in 1967 and has since spread to over 100 sites across eastern Australia. Its sale is now banned in all Australian states and territories.

Cabomba has the potential to cause significant impacts to water bodies. It can form dense underwater monocultures that affect the biodiversity and function of wetland and riparian ecosystems. It decreases water quality, interferes with water storage, distribution and infrastructure, and negatively impacts on the recreation and amenity values of water bodies.

Local infestations Cabomba was first discovered growing in the Great Lakes Council Local Government Area *c.* 1995 in a wetland at a retirement home in Forster. Between *c.* 1995 and 2011 an additional nine infestations totalling approximately 16 hectares were found in the Great Lakes Council Local Government Area and the southern reaches of the Greater Taree City Council Local Government Area, as a result of local council property inspections or self-reporting by the land owners.

Necessity A do nothing approach with cabomba management in the region, would potentially result in the further spread to key waterways, including the freshwater sections of the Ramsar listed Myall Lakes National Park and the 2200 million litre Bootawa Dam which is the main potable water supply for the Manning Valley of New South Wales.

Limited effective management options were available for the treatment of cabomba in Australia, especially in the high rainfall environment of the mid north coast of NSW. Up until 2011 a control program for cabomba was not feasible due to the lack of suitable control strategies for infestations in this region.

PROJECT CONCEPT

Management options Management options for the control of cabomba were considered to be limited. Drawdown (draining of water bodies) was considered unsuitable due to the high rainfall climate of the Great

Lakes region. Mechanical removal of the cabomba utilising aquatic weed harvesters, or control of the weed using shade provided by floating and benthic blankets was tedious and time consuming and unlikely to provide a long term management option.

Herbicide availability Since the suspension of the registration of AF Rubber vine Spray™ (800 g L^{-1} 2,4-D n-butyl ester) in 2004, no registered herbicides were available for the treatment of cabomba in Australia. Between January 2008 and June 2010 New South Wales Department of Primary Industries in partnership with Great Lakes Council and other stakeholders undertook a national project to find a suitable herbicide for the effective control of cabomba and to seek its registration nationally.

Registration Shark™ herbicide (240 g L^{-1} carfentrazone-ethyl) proved to be very effective (Officer *et al.* 2009) and in 2011 was subsequently registered for use on cabomba. The registration of Shark provided weeds managers with a much needed tool to control this weed. Shark is a contact herbicide with no systemic properties. It works by attacking the fats and proteins of the plant cell membranes. It does not translocate through the plant and requires a good level of contact with the plant biomass to achieve control.

Funding In 2011 with the impending availability of Shark, Great Lakes Council partnered with the Mid North Coast Weeds Coordinating Committee successfully applied for $191,760 from the Australian Government's 'Caring for our Country' program to implement a two year project to control cabomba and prevent its spread to high value water bodies, build landholder and indigenous capacity to manage cabomba, and refine herbicide management techniques for cabomba.

Steering committee A project team consisting of representatives from Great Lakes Council, Mid North Coast Weeds Coordinating Committee, Macspred Australia, New South Wales Department of Primary Industries and the National Aquatic Weeds Management Group was established to oversee the implementation of the project and the rollout of the Shark herbicide. This project commenced in late 2011 and concluded in June 2013.

PROJECT SCOPE

Planning The project aimed to target the ten known cabomba sites that were located within a 50 km radius of Myall Lakes National Park. These infestations had the potential to spread to the parks wetlands and other high value water bodies in the region through floodwaters, as a contaminant on eel traps, or via the backyard trading of ornamental aquatic plants collected from infested sites.

Herbicide control was selected as the primary treatment method for cabomba by the project Steering Committee, as it was the most cost effective. Given the climatic conditions of the region and environmental conditions of the individual sites, the use of Shark provided a greater likelihood of eradicating infestations than any of the other control methods.

On ground control programs aimed to reduce the biomass of cabomba infestations to less than 1% of their original size within the two year time frame with a longer term goal of eradication.

One landholder, however, had concerns over the use of herbicides killing exotic water lilies on their dam, and subsequently withdrew from the offer of assistance within the scope of the project. The project team, in conjunction with National Parks and Wildlife Service, will be pursuing adequate control of cabomba in this water body over the coming years through negotiations with the landholder and, if necessary utilising the functions of the New South Wales *Noxious Weeds Act 1993*.

Data collection Prior to the commencement of the control program, baseline data on the size and density of the infestations was collected. Baseline data on cabomba density (percentage cover) was collected through visual estimates and samples. Sampling entailed the use of two separate devices for gathering cabomba from strategic locations on the floor of individual water bodies. These samples were washed, dried and weighed so later comparisons could be made to measure the effectiveness of subsequent treatments.

In addition to sampling, photo points were established at each site to provide visual records of the changes to cabomba density pre- and post-treatment.

Accurate measurement of water body volumes was essential to ensure that compliance with chemical label requirements was met, and to maximise the effects of the herbicide.

Water body volumes were assessed by mapping dam depths, and combining these profiles with the surface areas of each dam. Both infested and non-infested sections of each dam were mapped concurrently. All gathered data was used to calculate the amount of chemical needed to conduct an individual treatment.

Implementation Larger water bodies were broken into management units to assist with the precise delivery of herbicide mixtures to the respectively mapped areas.

Some ponds required pre-treatment of non-target vegetation (e.g. *Eleocharis sphacelata*, *Eleocharis acutus*, *Philydrum lanuginosum*, *Nymphaea* species, *Ludwigia peploides* ssp. *montevidensis*, etc.) with aquatic registered glyphosate formulations of up to 1.3% concentration. This was done to either provide improved access to cabomba, manage low dissolved oxygen issues, reduce herbicide costs or increase the efficacy of Shark by limiting wastage on non-target vegetation.

Shark herbicide was applied only where cabomba was present, at a rate of 2 ppm (active ingredient) to a maximum of 50% of each water body, as per label directions.

Due of the broad geographic and micro-climatic variations between the individual areas, each site posed its own unique challenges for the management team. Consequently, every treatment was a learning experience as site specific delivery techniques had to be developed, often on the fly, to overcome each sites challenges.

MERI (Monitoring Evaluation Reporting and Improvement) Following the herbicide treatments, each site was monitored by the landholders for any adverse effects. All sites were inspected post-treatment by members of the project team at strategic intervals.

Information gathered during monitoring was used in the production of reports, and to identify areas were improvement was necessary.

A comprehensive assessment of each pond was conducted at the completion of the project during September and October 2013 and again in January 2014.

CAPACITY BUILDING

Education Stakeholder capacity building and engagement activities included several community information sessions, field days and media releases, plus the erection of interpretive signage, training of indigenous workers and involvement of landholders in on-ground works and monitoring.

Community engagement The project had a strong emphasis on working with landholders, who provided the project team with in-kind support where requested. These contributions included the provision of on ground assistance during treatments, visual monitoring of waterways post herbicide treatment, before and after photography, and storage and maintenance of plant and equipment.

RESULTS

Treatments and monitoring All sites were originally scheduled to be treated in Summer 2011/12. However adverse weather conditions postponed treatment of smaller ponds until late March 2012. Treatment of the larger water bodies was further postponed until January 2013, in an attempt to mitigate wastage of the herbicide and to comply with label requirements.

The herbicide control program has resulted in effective control of cabomba at all of the targeted sites, with each reduced to less than 1% of their original density by January 2014.

Table 1. Percentage of cabomba cover within infestations of the project area.

Site name	Size (ha)	Cabomba cover (pre-treatment)
Charlotte Bay	0.3	66%
Golden Ponds (4 ponds)	2.0	80%
Mayers Flat	5.0	66%
Nabiac 1 (East)	2.0	50%
Nabiac 2 (West)	3.8	80%
Tea Gardens 1	0.5	100%
Tea Gardens 2	0.5	100%
Topi Topi	0.5	33%
Wootton 1	0.5	50%
Wootton 2	1.5	50%

BEST PRACTICE MANAGEMENT

This project was the first opportunity for broad scale use of the herbicide Shark following its registration in late 2011.

As such the project pioneered some innovative herbicide application techniques and learned some key lessons about this herbicides effectiveness against cabomba.

Mixing technique The project team identified that a 'water penetration' and 'mechanical mixing technique' provided a far more effective means of treating cabomba than herbicide broadcasting.

This technique helps improve the deep distribution of the herbicide throughout the water column, which is important for cabomba control.

Broadcasting of chemical onto the water surface fails to provide adequate mixing throughout the water body and results in a poor kill of cabomba.

Injecting the herbicide into the water at high pressure (15–20 bar with a 3 mm nozzle) helped the herbicide break through the surface tension of the water being treated.

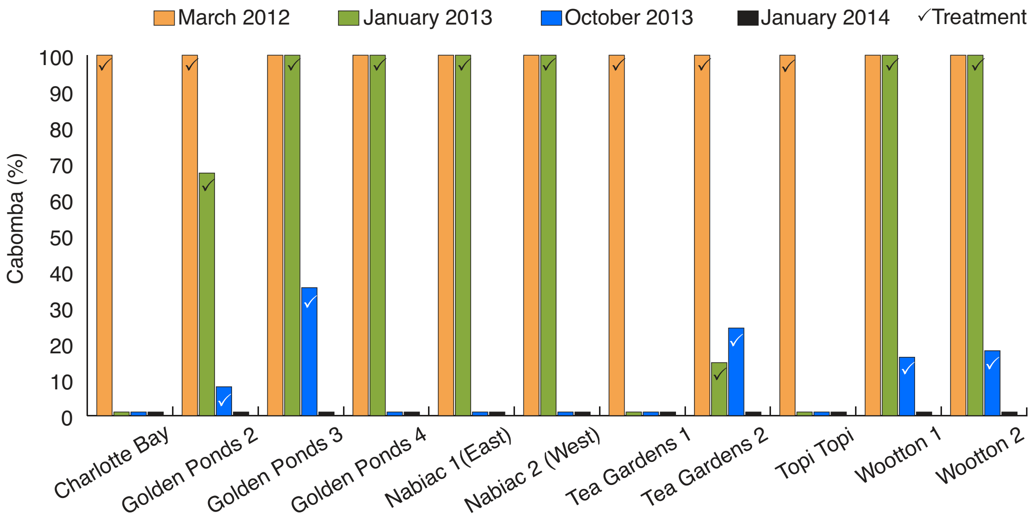

Figure 1. Effect of respective herbicide treatments on cabomba density at monitoring intervals.

Different methods were used to ensure the chemical mixed rapidly within the water column. Applying the herbicide close to the motors propeller, enabled it to mix through the water column more efficiently. Traversing the boat through the treatment area immediately after application also assisted with mixing.

Physical obstacles to control Treatment sites were often plagued with old tree stumps, branches and palm fronds, many of which were not visible from the surface. Fallen branches sometimes impeded the use of motors for propulsion, which caused problems for fluent navigation.

Branches in the water often meant the need to use ropes to move the spray platform around and also made sampling a challenge.

The use of propellers through cabomba leads to fragments in the water. These fragments can foul the intakes on water-cooled motors leading to overheating problems. This was overcome by the use of an electric motor, which enabled improved access to even the densest infestations.

Non-target vegetation, when it was co-inhabited with cabomba, was pre-treated with aquatic registered glyphosate mixes four to six weeks prior to the cabomba treatments. Pre-treatment provided better access for watercraft, helped prevent low dissolved oxygen issues, and reduced the amount of non-target vegetation that would otherwise absorb the Shark herbicide, ensuring more Shark was available for uptake by the cabomba plants.

The treatment window For effective control, the cabomba needs to be actively growing. This means treating in late spring and summer is the optimum treatment window.

In most cases Shark treated cabomba was still declining three months after treatment (late summer or autumn). Because the cabomba was not showing signs of recovery we found only one treatment per year was possible at the treated sites.

It was common practice during this project to use tank mixes of around seven to eight litres of Shark in 100 L of water to treat a surface area of approximately 800 m^2. If physical challenges were present in a particular area, the water volume was increased to 150 or 200 L to ensure adequate coverage of the chemical throughout the section of the water body being treated.

Water quality and daylight hours As Shark is light dependent, ideally at treatment time the water will have low turbidity. This means there are low levels of inorganic or organic solids suspended in the water column allowing maximum penetration of light. The higher the turbidity the less effect the chemical may have on its target. Avoid treating cabomba when you cannot see a Secchi disk at a depth of 45 cm.

It is also important not to begin treatment too late into the day. The more daylight hours available immediately after application of the chemical, the better the results will be.

Sections of a water body which are shaded throughout the day should be treated prior to treating areas that receive full sun.

Adverse weather conditions Rescheduling programmed treatments when rainfall events have been predicted is a difficult call, especially when taking into account inaccuracy of both long and short range weather forecasts, and the potential of missing windows of opportunity in regards to optimum treatment times within a growing season.

Delaying treatments in a growing season could lead to missed opportunities for up to a twelve month period. On the other hand, careless applications could lead to increased treatments adding further cost to an already expensive program.

Where there is potential for significant rainfall to flush the herbicide from water bodies, careful consideration needs to be given to delaying control, especially when treating large areas where a lot of chemical is required to achieve the desired 2 ppm concentration.

CONCLUSION

Sound planning and thorough monitoring is imperative for a successful project.

Approach each water body knowing that the control program may need to be tailored to address unique or site specific challenges.

Herbicide treatment of exotic water lilies (*Nymphaea* spp.) can lead to rafts of decaying root matter floating to the surface, which can result in aesthetic impacts at the site. It is recommended that allowances be made in projects to remove these rafts.

ACKNOWLEDGMENTS

The authors acknowledge NSW Department of Primary Industries, Great Lakes Council and Mid North Coast Weeds Coordinating Committee for their continuing support of the cabomba control program for the protection of the Ramsar listed Myall Lakes.

REFERENCES

Inkson, T., Petroeschevsky, A., Officer, D. and Schmitzer, T. (2014). Cabomba control case study 2011–2013 for the protection of the Ramsar listed Myall Lakes. (Great Lakes Council).