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WEEDS OF NATIONAL SIGNIFICANCE

Alligator weed control manual

Eradication and suppression of alligator weed
(*Alternanthera philoxeroides*) in Australia

Elissa van Oosterhout
NSW Department of Primary Industries



An Australian Government Initiative

DEFEATING
THE WEED MENACE



NSW DEPARTMENT OF
PRIMARY INDUSTRIES

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Foreword

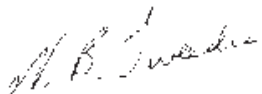
Alligator weed is one of the greatest threats to waterways, wetlands, floodplains and irrigation systems in Australia. As a weed that can grow both on land and in water and can tolerate a range of control methods – herbicides in particular – alligator weed has serious impacts worldwide and in Australia.

Since its introduction to Australia at least 60 years ago, alligator weed has infested many hundreds of hectares of land and water. Now we are witnessing a steady spread of this weed into previously uninfested areas, with the knowledge that it has the potential to become far more widespread in this country. It is now critical to contain the spread of alligator weed, taking the opportunity to eradicate small, new or isolated outbreaks and suppress larger infestations.

This publication brings together information and advice from over 30 years of research. The information has been reviewed by technical experts, managers and practitioners in order to extract the best and most effective advice for eradication, suppression and containment of alligator weed in Australia.

This manual provides the most comprehensive advice to those managing alligator weed in Australia, and I recommend it to all weed control authorities.

I thank those responsible for the production of this manual and for pursuing best practice in the face of such a recalcitrant and challenging weed.



Neale Tweedie

Chair
National Aquatic Weeds Management Group

Contents

Acknowledgments • 1
Foreword • 3
INTRODUCTION
About the manual • 8
Alligator weed in Australia • 8
A Weed of National Significance • 8
Impacts • 9
Current distribution • 11
Potential distribution • 14
Management in the future • 14
Legal status of alligator weed in Australia • 14
PART 1: THE ALLIGATOR WEED PROFILE
Physical characteristics of alligator weed • 17
Growth habits • 20
Habitat • 21
Growth rates • 22
Growing season • 22
Reproduction • 23
Spread • 23
Similar-looking plants • 24

PART 2: MANAGEMENT STRATEGIES
Introduction • 31
Immediate eradication • 34
Suppression leading to eradication • 35
Ongoing suppression • 36
PART 3: CONTAINMENT AND PREVENTION OF SPREAD
Introduction • 37
Quarantine and hygiene • 37
Physical containment • 41
Preventing spread in irrigation systems • 43
PART 4: CONTROL TECHNIQUES
Physical removal • 45
Disposal • 57
Herbicides • 63
Biological control • 72
PART 5: CASE STUDIES
Pinpoint mapping: keeping track of a moving target on the Hunter River • 75
Coolabah Reserve: immediate eradication by using shallow mechanical excavation • 79
Living and farming near alligator weed infested areas: Barren Box Swamp • 82
Containment and suppression of a non-core infestation: Currumbin District Horse Club • 85
REFERENCES AND FURTHER READING • 89



Introduction

Alligator weed is a perennial, stoloniferous plant that can grow both on land and in water. It poses one of the greatest threats to waterways, wetlands, floodplains and irrigation systems in Australia. Currently, alligator weed has serious impacts worldwide and in Australia, where it has great potential to become a far more widespread and serious weed.

Photo: Graham Prichard





▲ *Alligator weed*. Photo: Brian Worboys

▼ *Alligator weed grows in water and on land*. Photo: Daniel Kidd



About the manual

This manual presents best practice advice for the eradication and suppression of alligator weed in Australia. This advice is based on a review of over 30 years of published information and past and current field practices. To develop the best practice information presented here a technical reference group made up of researchers, managers and technical specialists reviewed the current knowledge and information over a series of workshops. Case studies provide examples of management strategies and control techniques.

Alligator weed in Australia

Alligator weed is native to South America; where its native range is thought to be the Parana River region and associated wetland areas of southern Brazil, Paraguay and northern Argentina (Sainty *et al.* 1998). Alligator weed was first recorded in Australia in 1946 by the National Herbarium of New South Wales, which stated that the weed was present in marshland near the Carrington shipyards at Newcastle (Julien 1995). It was originally suggested that alligator weed was brought to Australia in ships' ballast (Hockley 1974); however, literature accompanying the earliest herbarium records shows that the last ballast was dumped at Carrington in 1914. Therefore, there is a more recent theory that alligator weed was introduced to the Newcastle area via cargo from ships, possibly during the Second World War (Julien & Bourne 1988).

A Weed of National Significance

Alligator weed was recognised as a potentially serious aquatic weed in Australia during the 1970s, when its ability and potential to spread, coupled with a lack of effective controls, was realised (Julien & Bourne 1988; Bowmer, McCorkelle & Eberbach 1991). The National Weeds Strategy Executive Committee has classified alligator weed as a Weed of National Significance because of its impacts, its invasiveness, its capacity to spread and regenerate from single plant fragments, and its ability to tolerate a range of control treatments, including herbicides.

In Australia, alligator weed invades both aquatic and terrestrial systems, influencing agricultural and irrigation systems and affecting natural waterways, banks, riparian and floodplain environments, and wetland systems.

Computer-based modelling has indicated that 'almost every wetland in Australia is at risk of infestation by alligator weed' (Sainty et al. 1998: 196).

Impacts

Alligator weed affects aquatic systems through excessive growth that restricts water use, alters aquatic ecology, excludes the growth of other plants, obstructs flows, causes problems associated with flooding and sedimentation, provides habitat for mosquitoes and degrades natural aesthetics. In terrestrial situations, impacts include degradation of agricultural land and pastures and contamination of crops, hay, turf, sand and soil.

Aquatic impacts

Floating mats of alligator weed crowd and out-compete native aquatic species, restrict light penetration and ultimately cause anoxic or anaerobic conditions. Prolific growth restricts flows and increases sedimentation, aggravating flooding by acting as a barrier and collecting debris. Floating mats can lodge against other structures and inhibit flow further, hindering access to, and use of, the waterway. Plant fragments can move through irrigation systems to contaminate crops and pastures.

Terrestrial impacts

Alligator weed will compete with, and displace, desirable pasture species, including kikuyu and clover (Julien & Bourne 1988). It is palatable and will be grazed by cattle and horses, but the grazing of alligator weed has been associated with photosensitivity and resultant skin lesions, liver damage and death in cattle, calves and lambs (Roberts & Sutherland 1989; Bourke & Rayward 2003).

Alligator weed forms dense monocultures, competing with and displacing native riparian vegetation, and infesting crops such as rice, turf, hay, and vegetables. Any irrigated or floodplain-based agricultural production is at risk in areas where alligator weed is present.



▲ *Alligator weed infests many crops.* Photo: Graham Prichard



▼ *Alligator weed degrades pastures.* Photo: Elissa van Oosterhout



▼ *Grazing alligator weed has been associated with photosensitivity, liver damage and death in livestock.* Photo: Graham Prichard





▲ *Prolific growth restricts flows.* Photo: Mic Julien

▼ *Soil moved from infested drains can cause alligator weed infestations in cultivation.* Photo: Brian Worboys



A major threat to irrigated and floodplain farming in Australia

In 1994, when alligator weed was discovered in the Barren Box Swamp in the Murrumbidgee Irrigation Area of NSW, the potential costs to the irrigation farming community were as high as \$250 million a year. An annual control program would have cost \$6 to \$8 per ML (megalitre, i.e. 1 million litres) of water at the farm gate – an increase of 30% in delivery costs. By 2000 \$3 million had been spent on control alone, and this figure has continued to rise (Agriculture & Resource Management Council of Australia & New Zealand 2000).

In the Hawkesbury–Nepean catchment alligator weed occurs upstream of the \$35-million-a-year turf industry and the \$50-million-a-year vegetable industry. Alligator weed has already eliminated small crops and turf farms in parts of the lower Hunter catchment (Agriculture & Resource Management Council of Australia & New Zealand 2000).

Alligator weed is a serious weed in 30 countries, including the United States, China, New Zealand, Thailand, Indonesia and India. It is a major weed of transplanted rice wherever rice is grown in the world (Agriculture & Resource Management Council of Australia & New Zealand 2000).

In North Carolina in 1999 alligator weed was infesting over 4000 ha of cropping land. In China alligator weed reduces the production of rice by 45%, wheat by 36%, sweet potato by 63%, and lettuce by 47%. Cotton, soybean and peanut growers also suffer significant losses due to alligator weed, but these have not been calculated. The weed also affects orchards, tea plantations, berry fields, and herb crops (Agriculture & Resource Management Council of Australia & New Zealand 2000).



Agricultural floodplain infested with alligator weed. Photo: Graham Prichard



Alligator weed has infested rice crops in Australia. Photo: Andrew Petroschovsky



Alligator weed in a newly planted wheat crop. Photo: Birgitte Verbeek

A major threat to the use of waterways

Before 2000, Liverpool City Council in NSW spent \$8000 annually to maintain a section of river free of alligator weed for use by rowers and to reduce the visual impacts of the infestation.

In the USA alligator weed has caused major navigation impediments on the Mississippi River. In China alligator weed affects hydroelectric power production, impedes fishing, and has seriously degraded famous scenic places.

Current distribution

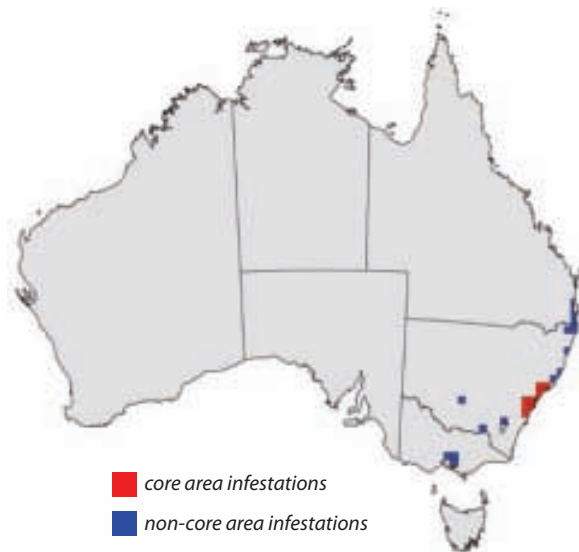
There are approximately 4000 ha of known alligator weed infestations in Australia. The current area of alligator weed infestation is small when compared with the potential distribution of the weed.

The National Alligator Weed Strategy classifies two main types of alligator weed infestation (core and non-core) in Australia and has made recommendations for the management and control of the weed in the corresponding areas. The two types of area are differentiated by the extent of the alligator weed infestations they contain.

Core-area infestations

To date, the Lower Hunter and Greater Sydney sub-catchments in NSW form the core areas of alligator weed infestation in Australia. In these areas the infestation is widespread, long established and continuous. Some core area infestations cover up to 100 ha, of which up to 90% is alligator weed. Eradication in most core area infestations is generally not feasible. Long-term management strategies aim for containment, reduction of impact by limiting spread, and suppression of biomass and density. There is a strong emphasis on preventing spread from the core areas.

Current distribution of alligator weed in Australia, not including domestic cultivations



▲ A recent infestation threatening the Patterson River in Victoria.
Photo: Lalith Gunasekera



Approximately 40 km of channels west of Barren Box Swamp and a substantial area of the swamp's perimeter were affected by alligator weed.

Photo: NSW DPI



Aerial view of alligator weed in Barren Box Swamp in 1994. Photo: Murrumbidgee Irrigation



Turf farms are at risk of infestation by alligator weed. Photo: Brian Worboys



▲ *Long-established broadacre core infestations at Williamtown.*
Photo: Graham Prichard

▼ *Non-core infestation in a stormwater retention basin at Port Macquarie (after treatment).* Photo: Elissa van Oosterhout



Part of the non-core infestations on Wilson Creek in northern NSW.
Photo: Far North Coast Weeds



▲ *Non-core infestation in irrigated pasture at Taree (after treatment).* Photo: Elissa van Oosterhout

▼ *The original site of a long established non-core infestation at Lewis Creek in NSW (after treatment).* Photo: Elissa van Oosterhout



A recent non-core infestation near Bangalow in northern NSW – too extensive for immediate eradication. Photo: Elissa van Oosterhout

Non-core-area infestations

Any infestations occurring outside the core areas are by definition non-core-area infestations. These range from small, isolated infestations yet to spread beyond their point of introduction and with a high possibility of eradication, to infestations that have reached an extent where eradication is not feasible in the short to medium term but may be possible in the longer term if infestations are significantly suppressed and depleted.

Currently, non-core-area infestations occur at Lake Ginninderra and Yerrabi Pond in Canberra; Bangalow, Casino, Coffs Harbour, Taree, Port Macquarie, Lewis Creek and Hawks Nest in northern NSW; Wah Wah, Barren Box Swamp and Woomargama in south-west NSW; Mudgeeraba, Currumbin, Beenleigh, Rocklea and Caboolture in south-east Queensland; and Kew, Dandenong, Brunswick, Eumemmerring, Hallam, Darebin Creek, Carrum and the Patterson River in Victoria.

Domestic cultivation: 'backyard infestations'

In December 1995 alligator weed was discovered by an entomologist in a domestic vegetable garden in Brisbane, where it was being grown and used as a leafy vegetable in the mistaken belief that it was the popular Sri Lankan vegetable plant *mukunuwenna*, or sessile joyweed (*Alternanthera sessilis* – see *Similar-looking plants* in Part 1).

Over the next 4 years domestic cultivations were found throughout eastern Australia, from Port Douglas to Tasmania (three sites), in South Australia (five sites),

Western Australia (25 sites) and the Northern Territory (two sites). Over 800 domestic sites were identified in Victoria, and seven infestations were located in natural waterways. In Queensland over 70 backyard infestations were found, and one backyard-associated infestation was found in the Logan River. In NSW domestic cultivations were found at Byron Bay, Wollongong, Dubbo, Parkes, Forbes, Peak Hill, Brewarrina, Grafton, Lismore and Armidale. The plant was so widely used that it was available at vegetable markets in Brisbane and by mail order from the Australian Capital Territory (Julien & Stanley 1999).

An intensive eradication and education program against the domestic cultivation of alligator weed managed to significantly reduce the number of backyard infestations; however there are cases where control is still occurring, and new domestic cultivations are being reported in urban areas (now there are over 100 sites under treatment in the greater Brisbane area alone).

Domestic cultivations pose high risks of spread through both intentional (residents giving plants to others) and unintentional (mowing and disposing of lawn and garden clippings) means. All backyard infestations should be subject to diligent control aiming for immediate eradication.

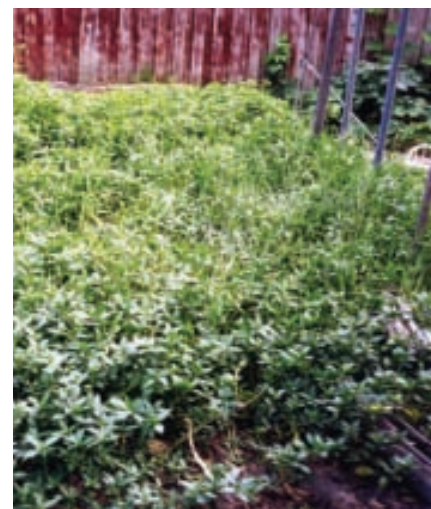
As part of the public awareness program, the Victorian Government has researched and promoted an alternative food plant, the related *Alternanthera denticulata* (common or lesser joyweed). This species is preferable to alligator weed as a vegetable plant and is native to Australia and Asia.



The weed being grown and used as a leafy vegetable.
Photo: Lalith Gunasekera



Backyard infestation in an old vegetable garden bed. Photo: Lalith Gunasekera



Domestic cultivation of alligator weed. Photo: Lalith Gunasekera

Potential distribution

In Australia the potential distribution of alligator weed is extensive, with most non-arid areas capable of supporting infestations. Studies have shown that large tracts of Australia are suitable for infestation by alligator weed (Julien & Stanley 1999).

Potential distribution of alligator weed in Australia.

Map by Andrew Petroeschovsky



In the USA and China, alligator weed infestations are larger and occur in a wider variety of habitats and climates than in Australia, indicating that there is potential for the weed to tolerate a broader range of conditions than it does in its current Australian distribution.

Alligator weed has the potential to spread further throughout Australia's inland waters. Of particular concern are its presence and potential impacts on water resources in the Murray Darling catchment. These infestations are now the subject of ongoing containment and eradication strategies that aim to prevent further spread through the Murray Darling system.

Management in the future

With much of Australia vulnerable to alligator weed it is essential that management aims to eradicate new, small and isolated infestations, and that long-term management of larger infestations is based on ongoing suppression and depletion, leading to future opportunities for eradication (see Part 2). Containment and prevention of spread is essential in every situation. Early detection is critical for taking advantage of opportunities to eradicate new infestations.

Legal status of alligator weed in Australia

The legal status of alligator weed in Australia reflects the serious potential for spread and the importance of containment and eradication of new infestations. All infestations in non-core areas must be controlled with the aim of eradication, and this is required by law in each State and Territory. There is also a strong emphasis on preventing spread from any infestations in non-core areas (see Table).



Part of the non-core infestation at Woomargama in the Murray Darling Catchment. Photo: Thomas White

LEGAL STATUS OF ALLIGATOR WEED IN EACH STATE	
State	Legal status
ACT	C1 Notifiable and C4 prohibited pest plant under the <i>Pest Plants and Animals Act 2005</i> ; presence of plant must be notified to chief executive; importation, supply and propagation prohibited.
NSW	<p>Class 2 regionally prohibited weed and Class 3 regionally controlled weed under the <i>Noxious Weeds Act 1993</i>; Class 2 plants are notifiable and must be eradicated and land must be kept free of plants. Class 2 plants are banned from sale, trade or distribution throughout the whole of the State. Class 3 plants must be fully and continuously suppressed and destroyed.</p> <p>Class 2 throughout State except for the following local government areas that are Class 3: Auburn, Bankstown, Baulkham Hills, Blacktown, Burwood, Camden, Campbelltown, Canterbury, Sydney, Fairfield, Gosford, Hawkesbury, Hawkesbury River County Council, Holroyd, Hurstville, Kogarah, Ku-ring-gai, Lake Macquarie, Lane Cove, Leichhardt, Liverpool, Maitland, Manly, Marrickville, Mosman, Newcastle, North Sydney, Parramatta, Penrith, Pittwater, Port Stephens, Randwick, Rockdale, Ryde, Strathfield, Sutherland, Botany, Ashfield, Hunters Hill, Hornsby, Warringah, Waverly, Willoughby, Wollondilly, Woollahra, Wyong.</p>
NT	Class A and Class C noxious weed under the <i>Weeds Management Act 2001</i> ; to be eradicated; not to be introduced to the Northern Territory; restricted from sale in the Northern Territory.
QLD	Class 1 pest plant under the <i>Land Protection (Pest and Stock Route Management) Act 2002</i> ; Class 1 plants established in the State are subject to eradication. It is an offence to introduce, keep or sell Class 1 plants without a permit.
SA	Class 1@ declared plant under the <i>Natural Resources Management (NRM) Act 2004</i> ; prohibited entry to the State; to be destroyed throughout the State; sale and transport prohibited; notifiable throughout the State.
TAS	Declared under the <i>Weed Management Act 1999</i> ; importation, movement and sale prohibited; all plants/infestations to be eradicated.
VIC	State Prohibited Weed under the <i>Catchment and Land Protection Act 1994</i> ; all plants occurring in Victoria to be eradicated by Victorian Government; prohibited entry to State, movement, and sale.
WA	Category P1 and P2 Declared Plant under the <i>Agriculture and Related Resources Protection Act 1976</i> ; cannot be introduced to the State; prohibited from sale, trade or movement throughout the State; to be eradicated.
Commonwealth	Alligator weed (<i>Alternanthera philoxeroides</i>) is prohibited entry to Australia under the Quarantine Proclamation 1998.