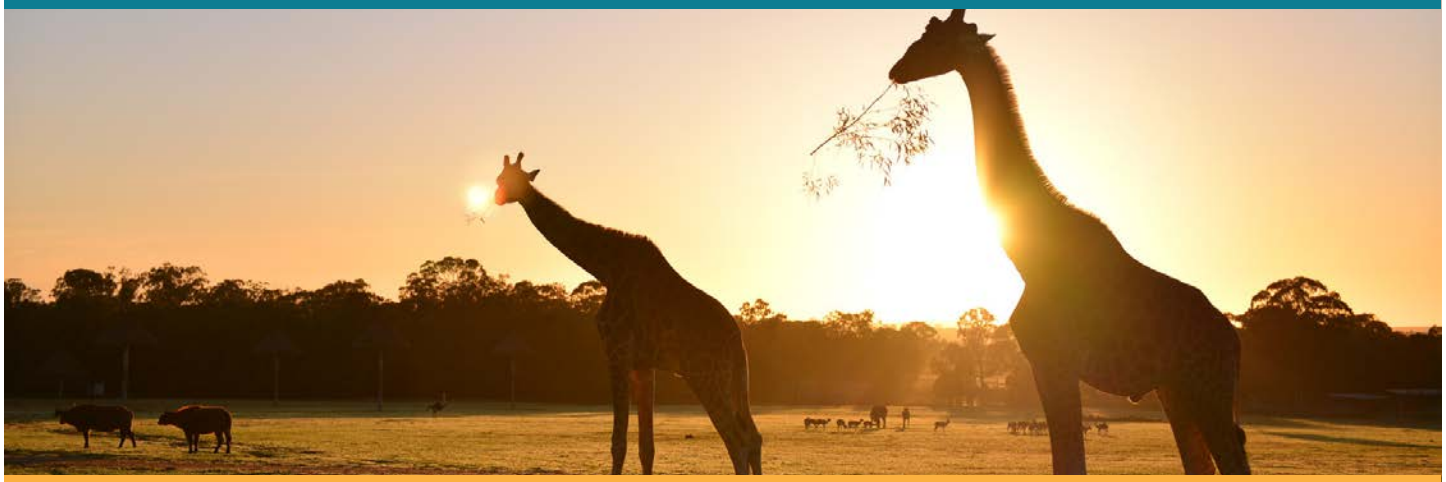
22nd Weeds

NSW CONFERENCE

DUBBO 2023

weeds gone wild



CONFERENCE PROGRAM & PROCEEDINGS

22ND NSW BIENNIAL WEEDS CONFERENCE

7 – 10 AUGUST 2023 • DUBBO

The Weed Society of New South Wales

DUBBO REGIONAL COUNCIL

Local Land Services

NSW GOVERNMENT

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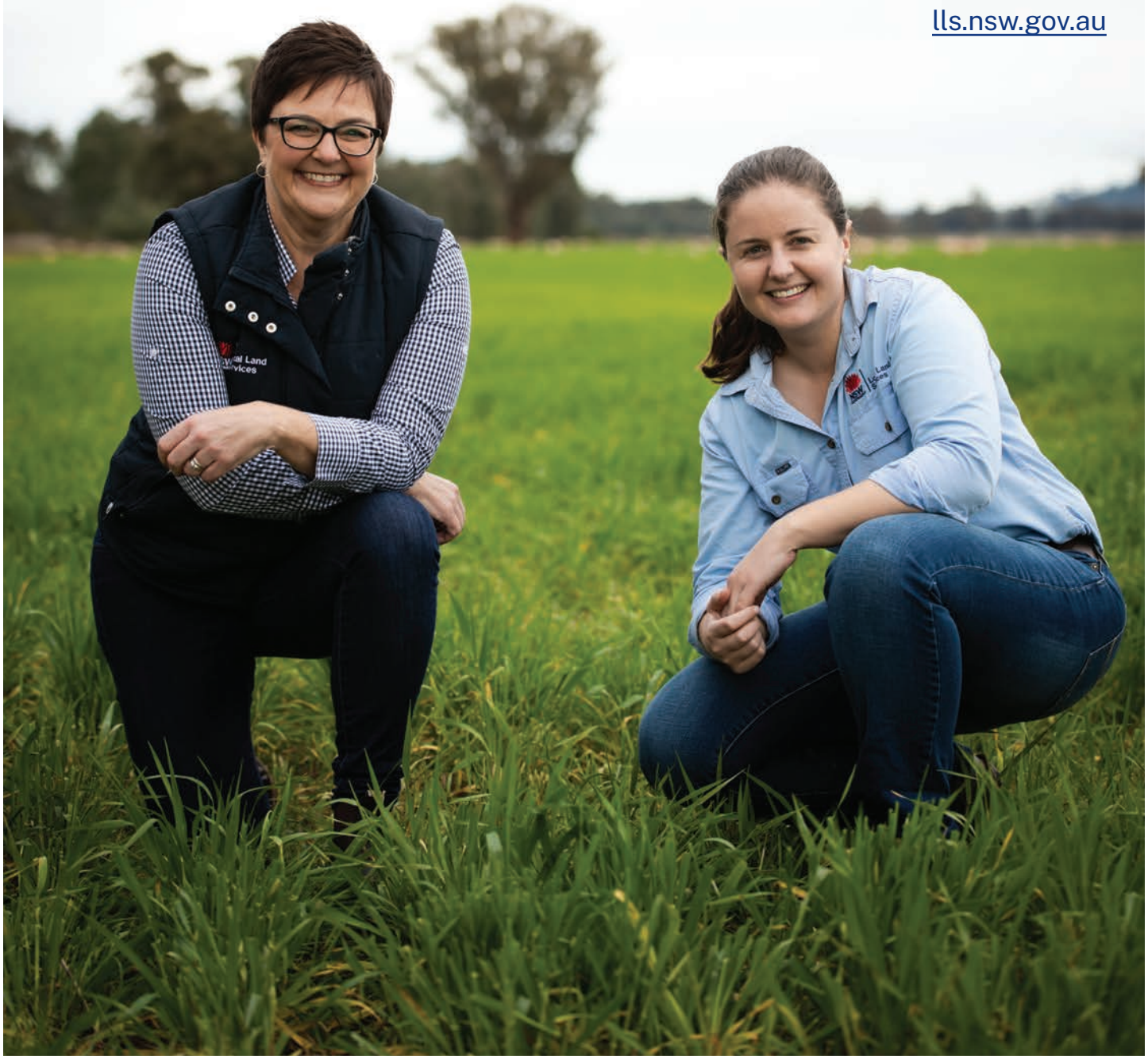
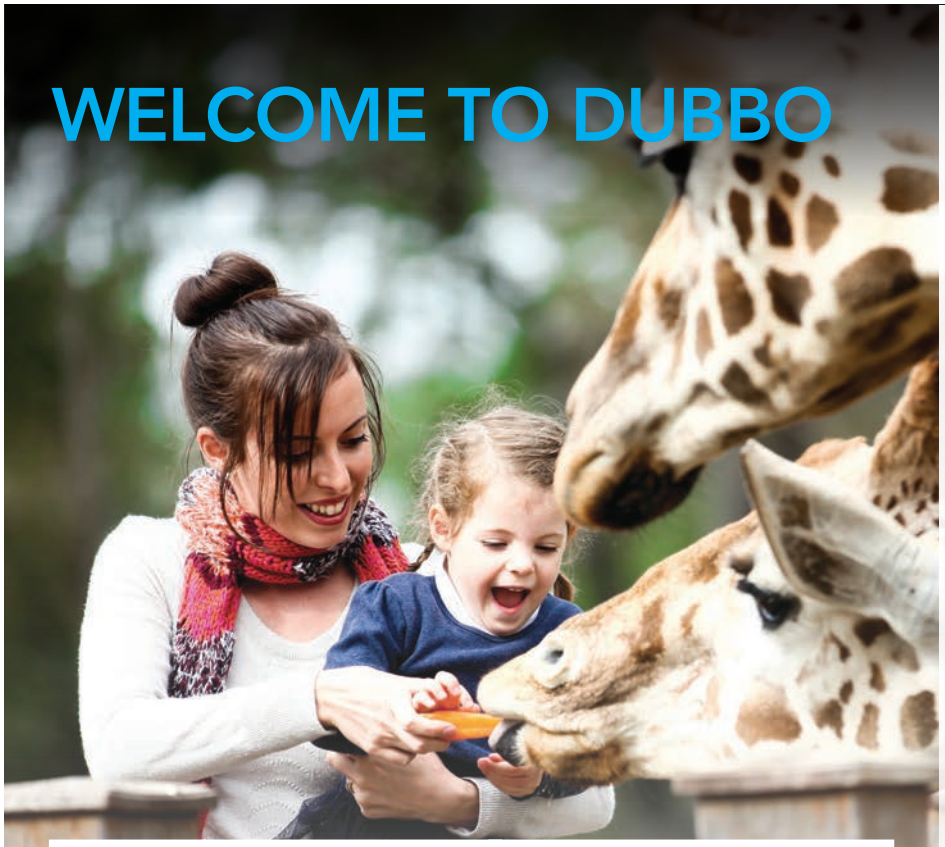
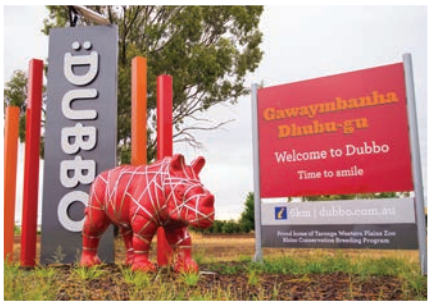
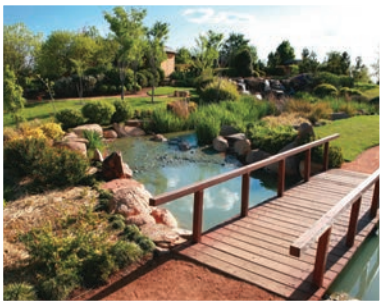


WELCOME TO DUBBO







Welcome to the Dubbo Region, an unforgettable holiday destination, filled with world-class attractions, larger-than-life experiences and is known as one of the friendliest regions in NSW. With so much to see and do, staying a night is never enough!

Affectionately known as 'the city of smiles', Dubbo is a thriving regional centre by the majestic Macquarie River with all the advantages of a city on the rise

For a taste of true blue Australia and a dose of good old country hospitality, a cold beverage or an event with heart, make sure you include a stop in our unique villages on your travel itinerary. You are sure to experience some classic country fare, conversation and a drink amongst the locals.

It's time to discover a great big adventure in the Dubbo Region.

DUBBO REGIONAL COUNCIL

The Dubbo Region is situated in the traditional lands of the Wiradjuri Nation. The conference organising committee acknowledges and pays its respects to Elders, past and present and emerging of the land we are meeting on.

Obligations to care for Country remain integral to Aboriginal and Torres Strait Islander lore, identity, culture and social and emotional well-being. The way in which traditional lands are being managed is of great interest to First Nations communities and conference organising committee understands that Aboriginal and Torres Strait Islander peoples have a significant contribution to make in relation to land management in the region.

Welcome to the 22nd NSW Weeds Conference

On behalf of the Weed Society of NSW we welcome you to the Central West region for the 22nd NSW Biennial Weed Conference hosted by the Dubbo Regional Council.

Thanks to everyone involved in organising the conference and to all of our speakers. We have a wonderful variety of interesting weeds topics in the program and some amazing field trips.

Thank you for attending and enjoy the conference.

CONFERENCE ORGANISING COMMITTEE

Jodie Lawler (Central West LLS)

Nikki Abercrombie (Abercrombie Management)

Des Mackey (Dubbo Regional Council & Weeds Officer Association of NSW)

Lana Willetts (Dubbo Regional Council)

Andrea Fletcher-Dawson (Weed Society of NSW & Castlereagh Macquarie County Council)

Wendy Gibney (Weed Society of NSW & NSW DPI)

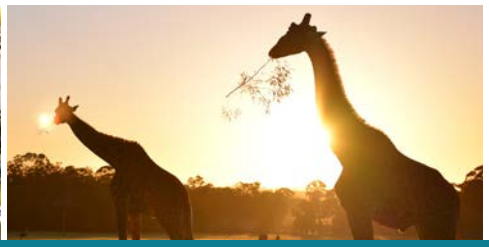
Tanya Muccillo (Central West LLS)

Damian Wray (Bogan Shire Council)

Jill O'Grady (NSW DPI)

Rod Ensbey (NSW DPI)

The Weed Society of New South Wales

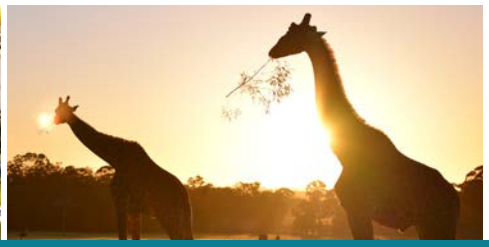

CONFERENCE PROGRAM

Monday August 7, 2023

3:00 PM - 4:30 PM	**Summit Biosecurity Users Group Meeting**
4:00 PM - 5:30 PM	**Registrations Open**
5:30 PM - 7:30 PM	**Welcome Reception | Sponsored by NSW Weeds Officers Association** Join us for the opening event on the program, the Welcome Reception, which will be held at our conference venue, Dubbo Regional Convention Centre.

Tuesday August 8, 2023

8:30 AM - 8:45 AM	**Welcome to Country**		
8:45 AM - 9:00 AM	**Welcome and opening from dignitaries**		
9:00 AM - 9:30 AM	**Keynote Speaker | Tom Price** *Department of Environment, Parks and Water Security, Northern Territory Government.* The Northern Territory Government's response to Siam weed and the nature and challenges of the program		
9:30 AM - 10:00 AM	**Keynote Speaker | Dr Daniel Tan** *University of Sydney* Best Practice weed management in Cambodia including the use of drones		
10:00 AM - 10:25 AM	**Morning Tea and Trade Display**		
	Weeds Surveillance **Location: Parthenium Theatre**	**Weed Identification** **Location: Miconia Room**	**Community, Stakeholders & Sharing Knowledge** **Location: Frogbit Room**
10:25 AM - 10:45 AM	Reviewing the success of the NSW Biosecurity (Chinese Violet) Control Order 2019 **Terry Bignell & Jordan Skinner**	A hard nut to crack - Japanese walnut identification & control **Matt Bell**	Multi stakeholder collaboration between private & public landholders to address target weed species **Emma Tilley**
10:45 AM -11:05 AM	"Where the rivers run" Parkinsonia **Andrea Fletcher-Dawson**	Range Extension of a new weed species, Perennial soybean (*Neonotonia wightii)* for NSW **Natalie James**	Industry agreed qualifications - a beneficial partnership for NSW Weeds **Paul Marynissen**
11:05 AM - 11:25 AM	14610sq km of Weed Surveillance & Property Inspections **Damian Wray**	WEEDSCAN – A community tool for weed identification, reporting & management **Dr Hanwen Wu & Dr Emily Thomas**	A Case Study Of A Beneficial Relationship Between a Local Control Authority and a Local Landcare Network **Katherine Clare & Phil Price**
11:25 AM - 11:45 AM	Miconia – Eradicating the 'Purple Plague' An inside look at 20 years of locating and removing this colourful threat **Brook Hooson & Jesse Telford**	Integrated Weed Identification: how to get the most out of weed identification tools **Wendy Gibney**	Weeds and Wind Farms **Richard Sharp**
11:45 AM - 12:05 PM	Stopping Weeds Going Wild Post Flood **Alysha Wynan & Angel Marotte**	Much ado about some things: When does plant identification lead to weed response in NSW **Dr Stephen Johnson**	A Case Study of a Beneficial Relationship Between a Local Control Authority and a University **Phil Price**


CONFERENCE PROGRAM

Tuesday August 8, 2023

12:05 PM - 12:15 PM	**Session Question Time**		
12:15 PM - 1:00 PM	**Lunch and Trade Display**		
1:05 PM - 1:35 PM	**Keynote Speaker | Roger J Fletcher OAM |** *Fletcher International Exports*		
1:35 PM - 2:05 PM	**Keynote Speaker | Dr John Tracey** *Deputy Director General, Biosecurity and Food Safety NSW DPI* Research, innovation, people - managing biosecurity threats now and into the future		
2:05 PM - 2:35 PM	**Keynote Speaker | Dr Jodie Benton** *OzArk Environment and Heritage* NSW Aboriginal Heritage - Sites and context		
2:35 PM - 3:00 PM	**Afternoon Tea and Trade Display**		
	Weed Control | Biocontrol **Location: Parthenium Theatre**	**Prohibited Matter Research & Surveillance** **Location: Miconia Room**	**Managing Weed Risks** **Location: Frogbit Room**
3:00 PM - 3:20 PM	Biocontrol research for weed management in NSW **Dr Andrew McConnachie**	Species specific QPCR Assay for detection of *Limnobium laevigatum* (Humb. & Bonpl. ex Willd.) Heine **Dr Xiaocheng Zhu**	Weed Risk Australia: futureproofing Australia's post-border weed risk management process **Claire Lock**
3:20 PM - 3:40 PM	Giant Rats Tail Leaf Smut found in NSW **David Officer**	Development of Environmental DNA methods for the detection and management of Amazon Frogbit incursions **Dr Karen Bell**	Peering over the fence: an update on the gardening responsibly movement **Julia Rayment**
3:40 PM - 4:00 PM	Weed Biocontrol agent mass rearing and implementation in NSW **Fritz Heystek**	Where could it be now? Vulnerability of New South Wales to parthenium weed invasion **Dr Stephen Johnson**	Managing risk on high risk pathways **David Pomery**
4:00 PM - 4:20 PM	Progress on the biological control of narrow-leaf privet in Australia **Dr Muhammad Nawaz**	Hawkweed Delimitation **Liesl Grant**	Wrangling Hudson Pear at Quanda **Jodie Lawler & Andrea Fletcher-Dawson**
4:45 PM - 5:30 PM	**Session Question Time**		
4:45 PM - 5:30 PM	**Weeds Officers Association Annual General Meeting.** All members welcome		
6:30 PM - 10:00 PM	**Social Networking Function | Sponsored by Dubbo Regional Council** Join us for a conference tradition, our Social Networking Dinner. This year we will venture to Dubbo Zoo for this casual and fun evening.		

22nd Weeds

NSW CONFERENCE

DUBBO 2023

weeds gone wild

22ND NSW BIENNIAL WEEDS CONFERENCE PROCEEDINGS

BEST PRACTICE WEED MANAGEMENT FOR CAMBODIAN LOWLAND RICE

Integrated weed management for direct seeded lowland rice systems of northwest Cambodia

Daniel K.Y. Tan[1], Chinaza Onwuchekwa-Henry[1] and Robert J. Martin[1,2]

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Email: asrcambo@gmail.com

SUMMARY

This paper presents results on the integrated weed management for the lowland rice systems of northwest Cambodia funded by the Australian Centre for International Agricultural Research (ACIAR). The project determined the benefits of improved establishment methods with direct drill seeders and pre-emergence herbicide applications (including oxadiazon, butachlor, pretilachlor and pendimethalin) as alternatives to high seeding rates (e.g. 200 kg/ha) to improve weed suppression in dry seeded rice. All the plots were infested with different weed species such as grasses, sedges and broadleaf. Pendimethalin consistently controlled the grasses compared with other pre-herbicide options. Oxadiazon showed higher efficacy in controlling sedges and grasses, while butachlor mostly controlled broadleaf weeds. Pre-emergence herbicides, oxadiazon and butachlor were effective in suppressing weeds at low seeding rates of 80 kg/ha. Pretilachlor was not as effective in controlling weeds in dry seeding compared with wet seeding conditions. Pendimethalin can effectively control weeds but crop damage was a risk in poorly prepared Cambodian seedbed. Plants can recover from pendimethalin herbicide toxicity and grain yield can potentially increase by 55% in dry seeding conditions with pendimethalin application. We collaborated with the Cambodian Agriculture Value Chain Program (CAVAC) and the CGIAR Excellence in Agronomy (EiA) to test the efficacy of applying pre-emergence herbicides (e.g. pretilachlor + fenclorim safener) using Unmanned Aerial Vehicle (UAV) drones with a water volume of 14 L/ha at 1 to 3 days after sowing in wet seeded fields. The pre-emergence herbicides applied at the recommended rates (with low water volumes) using UAV effectively suppressed weeds.

Keywords: Weed management, rice systems, Mekong region, Cambodia

REVIEWING THE SUCCESS OF THE NEW SOUTH WALES BIOSECURITY (CHINESE VIOLET) CONTROL ORDER 2019

A Case Study of the Port Stephens Local Government Area

Terry Bignell[1] and Jordan Skinner[2]

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Chinese violet (*Asystasia gangetica subsp. micrantha*) is a serious environmental and agricultural threat to Australia, first recorded as naturalised in New South Wales in 1999 at Boat Harbour in Port Stephens. Most infestations in the State are currently found across the Hunter region, with the majority occurring in the Port Stephens Local Government Area.

The threat that Chinese violet poses to Australia's agriculture and environment is well documented, with the species considered the third highest threat posed by a sleeper weed to Australia. Due to the severity of risk that Chinese violet poses, *The Biosecurity (Chinese violet) Control Order 2019* was introduced on 1 July 2019 following the NSW State Weed Committee's consideration of a proposal by The Hunter Regional Weeds Committee. The Control Order has effect for a period of 5 years, therefore, a decision whether or not to extend the control order will need to be made by the end of June 2024.

To determine whether eradication of Chinese violet is still feasible and if so, whether the control order is achieving its intended outcomes, we analysed data collected by Port Stephens Council's Biosecurity Officers between February 2004 and July 2022. In July 2022, 66% of Chinese violet infestations had no plants present and the proportion of sites with no plants was increasing over time. 129 had no plants found on site for 6 consecutive years or more with 71 of these at 12 consecutive years or more. We also compared data from the 3 years prior to and 3 years following the introduction of the control order. There were 3798 inspections conducted across 482 sites in this period with the data showing increased efficiencies for Council to conduct inspections and an improved management outcome of the species following the introduction of the Control Order.

Keywords: inspection data, eradication, weed management outcomes

SEARCHING THE WILD / WEED SURVEILLANCE

Andrea Fletcher-Dawson[1] and Ian Schwartz[2]

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2. Senior Biosecurity Officer, Moree Plains Shire Council, Level 2, Max Centre 30 Heber Street Moree NSW 2400, Australia. E-mail: Ian.Schwartz@mpsc.nsw.gov.au

Parkinsonia (*Parkinsonia aculeata*), also known as Jerusalem thorn, poses a high biosecurity risk to the state of NSW. It can: make mustering difficult, reduce water flows, lower the water table, reduce livestock access to water, reduce pasture productivity, reduce land values, outcompete native plants, reduce food and habitat for native animals, cause erosion, and provide shelter for feral animals. It is a state priority weed that is regulated under a Control Order in NSW.

Parkinsonia was introduced to Australia in the 1800s as a shade and ornamental tree. Infestations have been recorded in SA, WA, QLD and NSW.

In February 2023, there were only 11 active parkinsonia infestations in NSW, in the shires of Moree, Walgett, Broken Hill and Brewarrina. Weeds officers from Moree Plains Shire Council and Castlereagh Macquarie County Council have diligently inspected and controlled the Barwon, Namoi and Narran river infestations over many years of dedicated groundwork.

Flooding in 2020-2022 significantly increased the risk of parkinsonia introduction into NSW through the waterways, but rendered the terrain inaccessible. Staff were no longer able to inspect the riparian areas where parkinsonia could be expected to establish.

The two councils collaborated to conduct aerial surveillance over 5 days, covering more than 250kms of waterways. This paper shares the methodology that used to strategically plan the exercise, how plants were identified and accurately recorded, what was detected, and next steps for control.

Keywords: Parkinsonia weed, education and awareness, aerial surveillance, collaboration, inspection.

14610 SQ. KM OF WEED SURVEILLANCE AND PROPERTY INSPECTIONS.

Tricks, tips, tools and resources required in the bush.

Damian Wray
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damian.wray@bogan.nsw.gov.au

SUMMARY
La Nina in all its glory revitalised the drought stricken Bogan LCA, from dust storms to good rain, good vegetative growth to happy cockies and townsfolk and then, too much rain and 10 weeks of flooding along all the major and minor watercourses.
This paper addresses the unique variety of plant life and soil type and what tools, tricks and resources are required when conducting weed surveillance over such a diverse area in the most optimum growing conditions for the past few decades.
As well as the do's and don'ts of communicating with both experienced and inexperienced farmers across the LCA and having reliable lines of communication with other stakeholders to complete targets and pinpoint old and new weed incursions.

Keywords: drought, floods, growth, communication, stakeholders

MICONIA – ERADICATING THE 'PURPLE PLAGUE'

An inside look at 20 years of locating and removing this colourful threat.

Brook Hooson

State Priority Weeds Coordinator, Invasive Species Biosecurity, Department of Primary Industries, 1245 Bruxner Highway, Wollongbar NSW 2477
Email: brook.hooson@dpi.nsw.gov.au

Four species of *Miconia* (*M. calvescens, M. racemosa, M. nervosa and M. cionotricha*) are regulated as Prohibited Matter under the NSW *Biosecurity Act 2015*. All pose a significant threat to our rainforests and are targeted for eradication. Capable of rampant growth and high seed yield, this invader can form dense thickets capable of outcompeting native understorey plants, affecting wildlife populations and increasing the risk of erosion and landslides on steep slopes.

Miconia calvescens was first detected in NSW in 1982 growing in the Sydney Botanical Gardens, since then an additional 13 infested premises (IP's) have been identified on the Far North Coast of NSW. In 2003 extensive detection and eradication programs were put in place following the inclusion of the species in the National Tropical Weeds Eradication Program (NTWEP) cost share agreement which is managed by QLD Department of Agriculture and Fisheries (QLD DAF).

Identifying and removing incursions of Miconia have been an ongoing battle on the Far North Coast for the past twenty years. This attractive garden addition has been a plant collectors' favourite, inspiring budding botanists and passionate gardeners to share germinated seedlings within their local community. Nurseries within the region also found the species easy to grow and sell amongst other exotic rainforest varieties. For the past twenty years these individual trees have been slowly but successfully identified and controlled by weed officers with Rous County Council on the Far North Coast. The importance of extension and engagement with the local community has been highlighted throughout this program in addition to hundreds of kilometres of on-ground surveillance for the seedlings that continue to emerge.
This paper will provide a brief history of *Miconia calvescens* detection in NSW before detailing the NSW Government and local government programs that are successfully being implemented on the Far North Coast of NSW.

Keywords: Miconia; surveillance; rapid response; awareness raising; ornamental

SEARCHING THE WILD – WEED SURVEILLANCE

Weed Biosecurity – Miconia Calvescens

Jesse Telford

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Jesse.telford@rous.nsw.gov.au

The unique green and purple leaves with flashy white venation of Miconia calvescens made it an attractive ornamental plant in the 1970's and 80's. It was sold at markets and nurseries in the Northern NSW region. This lead to the purchase the plant some years ago without the biosecurity threat being known. Most cases of Miconia in the region have been plants in situ on properties and the residents being unaware of the biosecurity threat. Miconia is recognised as a highly invasive species and is listed at prohibited matter in NSW. From how Miconia has behaved in other location in Australia and internationally it poses a threat to the subtropical rainforests of the north coast.
Rous County Council weed biosecurity officers conduct property surveillance of areas around know Miconia sites. These areas can be isolated and steep terrain with high rainfall and densely forested. Miconia can thrive in a dense canopy. Data is collected in this surveillance and is used to draw a picture of how Miconia is behaving. Maps are generated and are used to cover as much ground as possible within a 500-meter radius of the original plant.
Building good relationships with landowners where Miconia is present is crucial. Miconia seedlings have been found 16 years after the original seeding plant has been removed and surveillance is still being conducted on these properties.

SEARCHING THE WILD – WEED SURVEILLANCE

Stopping Weeds Going Wild Post Flood

Angel Marotte[1], Peta Holcombe[2] and Alysha Wynan[3]

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3 Project Weeds Officer, Local Land Services, Kempsey, NSW 2440, Australia.
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The spread of weeds along with a reduction in landholder capacity to manage them post flood was recognised as a major threat to production, making it a priority action for Local Land Services to partner with Local Control Authorities to act.
Local Land Services (LLS) have partnered with 6 Local Control Authorities (LCA) on the North Coast to deliver additional weed surveillance and control programs in response to the February 2022 floods under the Early Needs Recovery Program (ENRP). The ENRP is a part of the $150 million Primary Industries Support Package co-funded by the Australian and NSW governments under the Disaster Recovery Funding Arrangements and aims to assist primary producers regain lost productivity as a result of the floods through the provision of:

- Landscape scale weed, pest and disease control programs
- Additional specialist support within both government and industries to assist producers regain productivity and increase capacity to better handle future adverse events.
- Funding for volunteer/not-for-profit organisations to re-establish fence lines on flood affected properties

An example of the work being carried out by the LCA's is Rous County Council (RCC) who are inspecting flood affected properties and controlling high priority weeds including, tropical soda apple, alligator weed, parthenium weed, frogbit, job's tears, hymenachne, aleman grass and water lettuce on both private and public land. The area of control covers approximately 20, 000 hectares of land for weed control and inspections are undertaken as required.
Using flood inundation modelling and historical data, RCC have used a variety of methods to undertake inspections of large areas of land to search the wild for intensive weed surveillance, including canoeing, boating, using all-terrain vehicles and on foot. These inspections have resulted in the identification of the prohibited matter, frogbit in the Byron Bay LGA and an emergency response to control the weed.

Keywords: Control program, North Coast, frogbit

A HARD NUT TO CRACK

Japanese walnut control in the Wilson River valley, North Coast NSW

Matt Bell

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In 2019-20 Biosecurity Officers from Port Macquarie-Hastings Council confirmed the long-suspected presence of Japanese walnut (*Juglans ailantifolia*) on a property on the Wilson River in Rollands Plains NSW, approximately 30km north-west of Port Macquarie. Subsequent investigations led to the discovery of several infestations across the valley and tributaries, and revealed an interesting timeline of probable introductions to the region over the previous decades.

Believed to be the only currently known infestation of this species in the State, funding for control works was provided by North Coast Local Land Services and initial control works commenced. This coincided with the largest flooding event to hit the Wilson River in recorded history.

This paper describes the various challenges presented to Local Control Authorities and land managers when attempting to detect and control a new invasive species. It demonstrates how vital the appropriate training and resources are to on-ground managers when trying to fulfil our obligations under the Biosecurity Act.

Keywords: new species, biosecurity, infestation, challenges

SIGNIFICANT RANGE EXTENSION (NSW) OF A NEW INCURSION OF A WEED SPECIES, PERENNIAL SOYBEAN (NEONOTONIA WIGHTII) FOR THE GREATER SYDNEY REGION.

Natalie James.
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This presentation will present a case study on the successful identification and control of Perennial soybean *(Neonotonia wightii*).
Perennial soybean is a weed that has become a major threat to agricultural and environmental systems in various parts of the world. In recent years, the presence of this weed has been identified in two incursion sites in our County. This is the first incursion in NSW for 6 years and the first for the Greater Sydney region. At the primary incursion site, the weed demonstrated its ability to spread rapidly and outcompete native vegetation by smothering over 90% of the ground and shrub layers and extending into the canopy resulting in significant biodiversity loss and only being confined by a water body and road.
Once the presence of the weed was confirmed via the identification by the National Herbarium of New South Wales. The Local Control Authority staff sort assistance from the state weeds coordinator for control methods. From this, they advised staff to reach out to colleagues in Queensland for the best control methods, as no LCAs in NSW had significant experience in treating this weed species. Once this was done the LCA implemented a range of control measures, including the treatment of all existing plants, via the use of herbicides to prevent regrowth. The council also developed a management plan to monitor the area for any signs of regrowth and prevent future incursions.
This case study demonstrates the successful containment and probable eradication of a new weed species in the Greater Sydney region and a limited weed species in NSW through the expertise of industry professionals sharing knowledge and working together.
LCA staff are currently undertaking a Weed Risk Assessment on the species.

Keywords: Local Control Authority, Containment, Threat, Successful Control, Biodiversity Loss, Control Methods, Management Plan.

WEEDSCAN – A COMMUNITY TOOL FOR WEED IDENTIFICATION, REPORTING AND MANAGEMENT

Hanwen Wu[1], Emily Thomas[1], Matthew Shillam[2], Andrew Michell[3], and Alexander N Schmidt-Lebuhn[4]

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WeedScan, a website and smartphone app, has been recently developed for identifying, reporting and managing priority weeds in Australia. With the funding support from the National Landcare program via the Centre for Invasive Species Solutions, NSW Department of Primary Industries, CSIRO and other state partners have joined forces to develop this world first community tool to engage citizen science to not only identify weeds without the need of advanced taxonomic skills, but also to automatically notify control authorities for subsequent management actions. The project team has made significant progress over the last three years, including the nominations of 325 priority weed species from the states and territories, the collection and curation of more than 80,000 quality weed photos, machine learning, and the development of the WeedScan website and app. In the meantime, a large-scale user consultation across Australia was conducted in 2022 to identify desired functionalities for inclusion in WeedScan.

WeedScan is different to many generic plant ID app, such as such as PlantSnap, Pl@ntNet PictureThis and iNaturalist. It is much more than just an ID tool. WeedScan has the additional capabilities to record priority weeds, instantly notify local and state weed authorities if a high priority weed is recorded in the region, and link to local management information. Focused groups can be created in WeedScan to share records. Users can also browse the public records in Weedscan by local government areas, states and territories across Australia. The official launch of WeedScan is expected in June 2023, with approximately 300 priority weed species properly trained through machine learning. It will be available in app stores for both Android and iOS. Public adoption of WeedScan will allow more eyes on the ground, ensuring the early detection of new and emerging weeds in Australia and minimising future biosecurity threats due to weeds.

Keywords: Invasive weeds, machine learning, artificial intelligence, machine learning

INTEGRATED WEED IDENTIFICATION:

How to get the most out weed identification tools.

Wendy Gibney[1] and Paul Marynissen[2]

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[2]Paul Marynissen Training Coordinator Invasive Species, , NSW Department of Primary Industries, Loop Rd, Ourimbah NSW 2258
Email: Paul.Marynissen@dpi.nsw.gov.au

New technologies are helping weeds professional identify weeds. Apps and websites that use artificial intelligence and machine learning can identify weeds from photographs and NSW DPI has interactive 3-dimensional digital models available to help identify prohibited matter weeds. These new tools save weeds professionals time, however, they have limitations. The following resources can be used in conjunction with these new technologies to improve weed identification:

- Plant keys help determine weeds to species level. Many are freely available online and they include interactive keys, dichotomous keys and websites that allow you to search by plant attributes.
- Weed distribution maps can be used to determine the likelihood of a weed growing in each region. There are both state-wide and national maps available online. As well as current distribution, some maps include predicted distribution.
- Many publications are available online or in print. They include location specific resources (e.g. Weeds of the North Coast), plant habit specific resources (e.g. grass or waterweed identification guides) and taxonomically grouped resources (e.g. Opuntioid Field Identification Guide).
- Online herbarium websites have detailed descriptions of plants.
- National herbarium of NSW provides identification services.

Familiarisation with plant families and weeds species is an important part of weed identification but may take a long time to learn in the field. Attending weed identification training courses can quickly improve knowledge and skills. Asking advice from peers is still an important part of weed identification and weeds professionals across NSW have a wealth of identification knowledge and skills to share.

This presentation will discuss the benefits and limitations of new technologies. It will also show how to access and use a wide range of identification tools and training.

Keywords: apps, artificial intelligence, training

MUCH ADO ABOUT SOME THINGS:

After plant identification when does the stony pathway lead to weed response in NSW?

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Many plants species are introduced to Australia each year. Some of these plants naturalise. That is, they can be later found growing where they were not planted. A small but significant proportion of these naturalising plants become invasive where they cause an impact on our economic, environmental, societal (political, technological/infrastructural, legal) and/or cultural interests.

As the lead-agency for weed management, NSW DPI responds to the most invasive plant species that threaten our economic, environmental, societal and/or cultural interests. But to do this, our response starts with you. If you see something unusual, please tell us. Take a photo, record the location, and/or use WeedScan. Consider submitting a plant specimen to a herbarium like the National Herbarium of NSW, where it can be accurately identified.

Accurate identification is a critical first step to drive any weed response. Our assessments then commence with research to understand if the plant is: a weed anywhere in the world; known to occur elsewhere in Australia; able to invade our natural and agro-ecosystems; and through its invasion, produce impacts. Many plants that present as weedy will then be assessed with the NSW Weed Risk Management system. This system considers its invasiveness, impact and potential distribution (weed risk); and control costs, persistence and current distribution (feasibility of coordinated control). Finally, NSW DPI considers an externality test and the program rationale/linkages around current response planning and capacity, before recommending management options.

This paper discusses each of these steps in more detail to help you understand how the NSW government prioritises its weed response activities to “new” weeds. Further, we will discuss a new project about horizon scanning. This will help identify and assess plants: that could enter but are not yet in Australia; or are not yet in NSW; or that have not yet escaped from cultivation.

MULTI STAKEHOLDER COLLABORATION BETWEEN PRIVATE AND PUBLIC LANDHOLDERS TO ADDRESS TARGET WEED SPECIES

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This paper explores the power of cross tenure collaboration between community-based Landcare organisations with public and private land managers to work together to promote and undertake control works to create positive production and environmental outcomes. The Severn River Honey Locust project was developed to address an identified need to both monitor and control the population of Honey Locust (Gleditsia triacanthos) along the Severn River in the headwaters of the Murray-Darling. Honey locust is a priority weed in the Northern Tablelands and has serious impacts on agricultural production and biodiversity. The project has brought together two community based Landcare networks representing over 2,000 members; individual private land managers, including farmers and owners of land for conservation; government agencies; Ashford Local Aboriginal Lands Council and local control authorities together to discuss, plan and execute the project activities. Project collaboration has ensured that the project is locally relevant and delivered to maximise the investment in financial resources. The project has contributed to an increased awareness of the target weed, engaged new participants to weed control planning and action, and fostered the development community of practice for interested individuals and organisations to work together in the future on a range of land management practices.

Keywords: community, monitor, control, Landcare, cross-tenure.

INDUSTRY AGREED QUALIFICATIONS – A BENEFICIAL PARTNERSHIP.

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SUMMARY

The educational and training space for invasive species is dynamic with multiple issues/changes to traditional frameworks being challenged. Qualifications within the Conservation and Ecosystem Management (CEM) training package (formerly Conservation and Land Management) have been seen as a benchmark of qualifications suitable for NSW weed professionals. However, the complexity of skills needed in the role of an Authorised Officer are not currently captured in formal training packages such as the CEM.

From consultation with key groups and committees in NSW weed industry, the main area of focus for the invasives training program has been to develop and promote relevant industry credentials, recommended minimum training and qualification pathways.

The first step in achieving this is The Weeds Biosecurity Essentials Certificate, developed for recently employed staff. This industry-agreed credential combines relevant competency units from several nationally accredited training packages to form one certificate issued from Tocal College, a Registered Training Organisation.

Training modules include compliance, chemical accreditation, plant identification, inspections, risk management, and working with community and stakeholders. With key training such as this listed on the one certificate, The NSW Weeds Biosecurity Essentials can provide local councils and employers with a minimum standard for weed biosecurity Authorised Officers.

To ensure weeds professionals across NSW are provided with relevant, recognised and transferable accreditation, the DPI Invasives Training Program continues to work in partnership with Tocal College and the Weeds Officers Association to expand industry-recognised accreditations at various levels.

Keywords: training, vocational education and training, VET, biosecurity essentials

A CASE STUDY OF A BENEFICIAL RELATIONSHIP BETWEEN A LOCAL CONTROL AUTHORITY AND A LOCAL LANDCARE NETWORK.

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This presentation will outline the positive relationship and outcomes achieved in Hawkesbury River County, as a direct result of the Local Control Authority, Hawkesbury River County Council (HRCC), integrating Landcare into its operations and partnering with Hawkesbury-Nepean Landcare Network (HNLN). This partnership is founded on shared values and objectives that include protecting the natural environment, preserving biodiversity, and promoting community engagement. It combines the different, though complementary approaches of each organisation to achieve these objectives through more holistic programs, with greater long-term results. Since starting in 2019, this approach has proven undoubtedly worthwhile and has led to greater outcomes for priority weed management, environmental restoration, stakeholders, and the community in Western Sydney.

HRCC focuses on priority weed surveillance, and management to reduce and prevent new incursions. HNLN's focuses on increasing the community's participation, community capacity, and partnerships to improve achieve outcomes management independently, and in the long term. As specialists in their respective approaches, neither organisation has the capacity to integrate what the other does – except through partnership. Thus, in 2019, HRCC moved to integrate Landcare into its Operations by hosting and contributing funding to the HNLN Local Landcare Coordinator (LLC) role. This has directly led to improved community relationships between HRCC, Landcare groups, and NRM staff in the County; targeted weed management assistance, threatened species identification and an increased representation /awareness of the LCA, its roles and aims beyond the capacity of staff, particularly in the disaster space.

HRCC's Biosecurity Weeds Coordinator and HNLN's Local Landcare Coordinator will outline how this partnership functions practically in their roles and share some of the unique outcomes it has enabled them to achieve. Overall, the presentation offers a useful and insightful case study with a new angle to on how LCAs and Landcare Networks can work together, hosting and/or funding LLCs or otherwise, to deliver greater outcomes for the environment, stakeholders, and the community.

Key words: Landcare, Local Control Authority, Shared Values, Community Engagement, Holistic Programs, Priority Weed Management, Environmental Restoration, Community Participation.

WEEDS AND WIND FARMS

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With the creation recently in NSW of five Renewable Energy Zones (REZs) to help ensure a strategic approach to electricity infrastructure development, there is also now a need to better understand and appreciate the planning and environmental approval considerations associated with wind farm developments in the five new REZs, especially in relation to biosecurity matters such as weeds. Wind farms are generally built in regional areas and with that comes the risk of intra-regional and inter-regional weed dispersal. This paper highlights the variable approach to the prevention, elimination, minimisation and management of the biosecurity risk posed or likely to be posed by weeds during the construction and operations of wind farms in NSW. Because of this variable approach, there are potential and obvious strategic and on-ground failings emerging with regards to weeds and this problem needs to be recognised. If biosecurity is to be shared community, industry and government responsibility, then concept of a general biosecurity duty and weed management investment needs to be better integrated into future decisions about renewable energy projects such as wind farms.

Keywords: electricity, biosecurity, construction, operation

A CASE STUDY ON THE DEVELOPMENT OF A BENEFICIAL RELATIONSHIP BETWEEN A LOCAL CONTROL AUTHORITY AND A UNIVERSITY.

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The relationship between local councils (Local Control Authorities (LCA's)) and universities is critical for promoting knowledge exchange, fostering innovation, and improving the overall quality of life in communities. Establishing a strong partnership between LCAs and universities can help to address local challenges, promote collaboration, and enhance community engagement in the priority weeds research and control spaces. This presentation will outline the positive outcomes achieved between the development of the research, and the educational relationship developed between Hawkesbury River County Council and Western Sydney University. This presentation will demonstrate the growing need for and importance of LCAs and industries as a whole in developing relationships with the educational and research sectors to ensure the passing down of knowledge and continued education of younger generations. This presentation will also provide a framework for establishing a successful relationship between LCAs and universities and highlight the benefits that can be achieved through strong partnerships. This relationship itself has resulted in novel research being undertaken on prohibited matter species, research on biological control species, and education provided to students on the biosecurity act, functions and roles of local control authorities, students being involved in real-world LCA's requested research, and the knowledge-sharing relationships that exist between all levels of government. Ultimately this presentation will present a case study of how LCAs and universities can work together, to deliver greater outcomes for the environment, stakeholders, and the community. When both parties work together, it creates a win-win situation that benefits everyone.

Keywords: Relationship, Knowledge Exchange, Networking, Local Control Authorities, Innovation, Partnership, Novel Research, Community Engagement

BIOCONTROL RESEARCH FOR WEED MANAGEMENT IN NSW

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Classical weed biological control (biocontrol) involves the deliberate introduction of host-specific natural enemies of target weeds, from their native to their invaded range. To quantify the host range (and therefore risk) of introducing these species, the NSW Department of Primary Industries (DPI) invested into, and established, a state weed biocontrol quarantine facility at the Orange Agricultural Research Institute in 2016. This allowed NSW DPI to conduct research on state priority weeds and collaborate on national weed biocontrol programmes. With further investment by DPI, additional upgrades in 2021 resulted in two additional glasshouses. In conjunction with sustained investment into research from federal government (Rural Research and Development for Profit, Federation Funding), state government (NSW Environmental Trust) and other vested entities (NSW Weed Biocontrol Taskforce), the research capacity and output of the facility has been significantly increased. Currently, the quarantine houses potential biocontrol agents (a total of six insect species) for four weed targets (*Kalanchoe delagoensis*, *Leucanthemum vulgare*, *Pereskia aculeata and Ligustrum sinense*). In addition, DPI has contracts with overseas partners exploring potential biocontrol options (a total of five insect species) for *Harrisia martini*, *Heliotropium amplexicaule*, *Eragrostis curvula* and *Solanum sysimbrifolium*. This talk will explore the front end of DPI's weed biocontrol pipeline, highlighting new and upcoming biocontrol solutions for the integrated management of NSW's and Australia's weed challenges.

Keywords: Biological control, *Kalanchoe delagoensis* (mother-of-millions), *Leucanthemum vulgare* (ox-eye daisy), *Pereskia aculeata* (leaf cactus) *and Ligustrum sinense* (narrow-leaf privet), *Harrisia martini* (Harrisia cactus), *Heliotropium amplexicaule* (blue heliotrope), *Eragrostis curvula* (African lovegrass) and *Solanum sysimbrifolium* (sticky nightshade).

GIANT RATS TAIL LEAF SMUT FOUND IN NEW SOUTH WALES
A potential new biocontrol agent for *Sporobolus natalensis* and *S. pyramidalis*

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A survey of northern New South Wales (NSW) giant rats tail grass infestations was made in November 2021 for the African leaf smut, *Ustilago sporoboli-indici*. The aim was to determine whether the disease had spread to NSW from Queensland since its' discovery in Australia in 2017. The pathway of introduction of the leaf smut into Australia is unknown, and its impact on introduced and native Sporobolus grasses is still being evaluated. Seven sites from Grafton to the Queensland border were checked for the characteristic sooty black fungal lesions on leaves and stems of known hosts *Sporobolus natalensis* and *Sporobolus pyramidalis*. One site west of Casino (-28.8669, 152.9897) was found to have the leaf smut. This discovery was significant because it was an extension of the smut's southerly range from the Queensland Sunshine Coast's hinterland. Giant rats tail grass is increasing in density and extent within NSW and this discovery may, with further research into its' host specificity and in field infection requirements, provide the first biological control method for this weed.

Keywords: Survey, GRT, range extension, *Ustilago sporoboli-indici*, biological control

WEED BIOCONTROL AGENT MASS REARING AND IMPLEMENTATION IN NSW

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The New South Wales Department of Primary Industries (NSW DPI) maintains and operates a state biocontrol mass-rearing facility at the Grafton Primary Industries Institute (GPII) and, in collaboration with the Castlereagh Macquarie County Council (CMCC), supports operations at the Don Mackenzie Weed Biocontrol facility at Lightning Ridge. Here we discuss the range of weed biocontrol agent species that are currently reared, released and evaluated at these facilities, including solutions for aquatic weeds (*Pontederia crassipes*, *Salvinia molesta, Pistia stratiotes, Sagittaria* spp., *Cabomba caroliniana*), climbing weeds (*Dolichandra unguis-cati* and *Anredera cordifolia*), and several cactus species (*Harrisia* spp., *Opuntia monacantha*, *Cylindropuntia* spp.). Over the last year, the two most released biocontrol agents from the GPII facility were the Salvinia weevil (*Cyrtobagous salviniae*, 13,000 adults at 20 sites), and the cat's claw jewel beetle (*Hedwigiella jureceki*, 3,000 adults at seven sites). The Lightning Ridge facility has focussed on releasing lineages of *Dactylopius tomentosus*, primarily for *Cylindropuntia pallida*, *Cylindropuntia tunicata* and *Cylindropuntia fulgida* var. *mamillata*. So far, over 80,000 cochineal-infested cactus segments have been reared and released from this facility. At the GPII facility, the bulk of all releases were facilitated through various council weed officers, followed by releases from DPI staff, but also by posting starter colonies directly to affected landholders that requested assistance. Post-release evaluation studies are conducted for several targets (e.g., *C. pallida, S. molesta, Sagittaria platyphylla* and *Harrisia martinii*) to more fully understand agent establishment, dispersal and impact. With new prospects primed in DPI's biocontrol pipeline, additional species will be reared through both mass-rearing facilities in the future.

Keywords: Invasive plants, impact, biological control, releases, evaluation.

PROGRESS ON THE BIOLOGICAL CONTROL OF NARROW-LEAF PRIVET IN AUSTRALIA

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Ligustrum sinense Lour. (Oleaceae), is native to China and invasive in several parts of the world including New Zealand, USA, and Australia. In Australia, this deciduous hardy shrub has naturalised in Queensland, New South Wales, and Victoria through invading mixed forests, valleys, riverine areas, thickets, and ravines where it displaces the native shrub layer. Australia has a native privet species, *Ligustrum australianum* F.Muell, which is distributed across the rainforest margins throughout coastal, central and north-eastern Queensland. With funding from the NSW Environmental Trust, a culture of a biocontrol agent, released in New Zealand in 2015 (the privet lace bug, *Leptoypha hospita*; Tingidae), was collected with assistance of Landcare Research in early 2022 and exported into Australian quarantine. The primary objective of this project was to establish the risk of the agent to the native *L. australianum*. In this regard, host-range testing was conducted under quarantine conditions at DPI's containment facility in Orange. Data from conservative no-choice tests revealed that the lace bug primarily feeds, oviposits and develops on its target, *L. sinense*. Significantly reduced feeding and oviposition was, however, recorded on *L. australianum* compared to that on the control (*L. sinense*). Development of the lace bug was also significantly delayed on *L. australianum* as opposed *L. sinense.* The next step in the host-range testing process will be to conduct less conservative paired-choice tests, and if the risk to *L. australianum* is resolved through these, an application will be made to the NSW Environmental Trust for funding to conduct a full evaluation of the lace bug (testing a full complement of closely related test species).

Keywords: Biocontrol, *Ligustrum sinense*, *Leptoypha hospita*, privet lace bug.

SPECIES SPECIFIC QPCR ASSAY FOR DETECTION OF *LIMNOBIUM LAEVIGATUM* (HUMB. & BONPL. EX WILLD.) HEINE

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Amazon frogbit (*Limnobium laevigatum*) is a fast-growing, perennial aquatic plant that forms dense colonies on the water surface, smothering native freshwater plants. Frogbit seeds and propagules can easily entrain into aquatic systems, leading to rapid emergence of new or sustained weed infestations. Although native to Central and South America, it was initially reported in QLD in 2011 and has since spread into NSW and VIC. Managing this species mainly relies on herbicide treatment and physical removal, but residual persistence of its seed and propagules confounds long-term extirpation of the weed from affected sites. Its management in NSW and QLD is complicated by the copresence of another frogbit (*Hydrocharis dubia* [Blume] Backer). These two species are morphologically very similar and hard to distinguish before flowering. To quickly identify and manage Amazon frogbit, a species-specific molecular assay is required. Environmental DNA or eDNA, defined as trace DNA shed into the environment, can be collected and tested for the presence of a particular species. We are developing eDNA protocols for trace identification of aquatic weeds, and herein, we report a frogbit specific qPCR assay targeting a 124bp fragment in the chloroplast rpoB gene. We evaluated the assay using samples of Amazon frogbit (N=47) and 34 other aquatic and terrestrial species (N=69). We confirmed that the assay is highly species-specific with no off-target amplification in any of the tested species and highly sensitive with a detection limit down to 100 copies/µl. The assay will be further tested using field water samples from systems where the weed is known to be present. Once optimised and integrated with eDNA sampling, the assay will allow rapid surveillance of frogbit, and could also be modified for detection of other high priority aquatic weeds.

Keywords: Amazon frogbit, eDNA, aquatic weed, environmental DNA

DEVELOPMENT OF ENVIRONMENTAL DNA METHODS FOR THE DETECTION AND MANAGEMENT OF AMAZON FROGBIT INCURSIONS

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Effective biosecurity operations are dependent on detecting invasive species when they are locally rare, including early detection of new incursions and assessing the success of eradication programs. Traditional surveys can be time-consuming and ineffective when the target species is rare. New technologies for detecting trace levels of organism DNA in the environment (eDNA) provide a breakthrough in species surveillance and biomonitoring. Amazon frogbit (*Limnobium laevigatum*) is an aquatic plant, native to Central and South America. It was first detected in QLD in 2011, and has since spread to NSW and VIC. It is a Prohibited Matter species in NSW, requiring eradication. Amazon frogbit is temporarily controlled by herbicides and manual removals, but often returns at sites through vegetative propagation and its long-lived seed bank. We developed a qPCR assay for rapid and specific detection of Amazon frogbit DNA. To assess the sensitivity of this assay for trace detection of Amazon frogbit in water, we analysed water samples from tanks spiked with small quantities of the weed and from natural water bodies where it is present. Water is sampled by filtration through a membrane, specifically designed for eDNA capture in the field. In the laboratory, the DNA is released from the membrane and purified, before being analysed using the qPCR assay. Our trial results are presented here, and we discuss how this new information will help us to design the most effective sampling strategy for eDNA detection of Amazon frogbit. For example, improved understanding of the sensitivity of the assay and longevity of DNA in the water will inform on optimal spatial and temporal sampling strategies required for detection of the weed in different aquatic habitats and systems. Finally, we will show how generalisations from these results could be used to design protocols for eDNA detection of other invasive plant species.

Keywords: *Limnobium laevigatum*, eDNA, qPCR, biosecurity, aquatic weeds

WHERE COULD IT BE NOW?

The vulnerability of New South Wales to parthenium weed (*Parthenium hysterophorus*) invasion

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Parthenium weed (*Parthenium hysterophorus* L.) is a State Prohibited Weed in New South Wales (NSW) and a Weed of National Significance. This aggressive pasture and rangeland weed is increasingly invading cropping land, reducing establishment, production and yield by competing with more desirable pasture and crop species. It also causes severe health reactions in grazing animals and humans.

Parthenium weed is increasingly problematic in central and southern Queensland but has been a target for eradication since its first incursion into NSW in 1982. Climate change will impact the distribution of many weed species across Australia, including parthenium weed.

This paper reports on research done through the NSW Department of Primary Industries Vulnerability Assessment project. The project developed a series of Multi-Criteria Analysis (MCA) models to investigate the impact of climate change on a range of biosecurity threats to primary production, including parthenium weed.

Published literature and expert opinion were used to inform the development of these models. The process identified the key climatic variables (e.g. temperature, rain) for each life stage in the growth cycle. This information was then used to create an MCA model that underpins the climate suitability model. The model captures the extent to which the climate conditions satisfy seedling emergence and establishment, vegetative growth, and reproductive growth requirements without considering other factors like management decisions, soil, and irrigation.

This climate suitability was then mapped for NSW using historical climate data from 1970 to 2019 (50-years). The historical suitability maps indicate areas of high and low climate suitability for the weed. Data was extracted for incursion/previous invasion sites allowing us to view the annual changes in climate suitability in NSW to validate the model. Future work will use these state-wide climate suitability maps to identify research, management and adaptation priorities that can be used strategically by industry, government and community to enhance weed risk assessment and management in NSW.

HAWKWEED DELIMITATION
Mouse-ear hawkweed example

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The New South Wales Hawkweed Eradication Program is on track to eradicate mouse-ear hawkweed in the next 5-8 years. In order to achieve this target, we need to be sure we have found the outer extent of the infestation. Learning from previous eradication programs which were either successful or unsuccessful, delimitation early on is key to achieving eradication of an invasive species. There is not much in the way of documentation relating to the delimitation of weeds and therefore we took an approach that used modelling and expert knowledge to achieve this outcome. The hawkweed team has always incorporated new area surveillance into each season but to be more systematic towards delimitation we have taken new approach to determining whether the extent of hawkweed has been found. Using the 50m x 50m grid system, each grid cell was given a ranking of likelihood of mouse-ear hawkweed from 0 (least likely) - 10 (most likely). The rank will highlight the areas which are most likely to have mouse-ear hawkweed. The ranking is based of modelling of habitat suitability, wind dispersal, and previously surveyed areas (to exclude). Grids were selected into blocks that were between 1-7 hectares in size and incorporated a cross-section of the grid rankings to test the delimitation model. On the ground, surveillance efforts were more than doubled in the 2022-2023 hawkweed season to progress towards delimitation. The most up to date results from this can be shared at the conference once they have been analysed on completion of this season.

Keywords: invasive, eradication, surveillance, extent, model

WEED RISK AUSTRALIA
Future-proofing Australia's Post-Border Weed Risk Management Process

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Weed risk assessment processes are used in Australia to support legislative listings and management prioritisation, particularly for new and emerging weeds. However, these systems are largely inaccessible to land managers outside of government and are typically restricted to spreadsheets or internal databases. There may also be duplication of effort when a weed is assessed independently by multiple jurisdictions using the same reference material. To increase accessibility and facilitate data sharing, a national online hub, Weed Risk Australia, is being developed to enable online hosting of jurisdictional weed risk methodologies and/or data. A user-friendly interface with readily available instructional material could enable jurisdictions to devolve some assessment processes to other groups, including local or regional government, seed importers and land managers more broadly. To further complement existing jurisdictional weed priorities and improve land managers' capacity to strategically target weeds, new methodologies are being developed to prioritise weeds for management after fire, flood and drought. The 'disturbance modules' will be available through the national online hub. These modules are being designed and tested through consultation with stakeholders and will leverage post-disturbance weed response lessons from the 2019-20 bushfires, 2022 New South Wales floods and the recent drought. Funding for this project has been provided through the Australian Government's Established Pest Animal and Weed Management Pipeline Program. This presentation provides a demonstration of the prototype national online hub; details the development and testing processes for the post-disturbance modules; outlines future data needs such as plant trait information; and provides an opportunity for further participation and input from other jurisdictions and land managers.

Keywords: Risk assessment, data sharing, fire, flood, decision support.

PEERING OVER THE FENCE: AN UPDATE ON THE GARDENING RESPONSIBLY MOVEMENT

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Over 72% of environmental weeds in Australia are garden escapes. There is a strong desire within industry, government and the community to reduce the use of 'weedy' ornamental plants to prevent future weed invasions. Gardening Responsibly is an industry-led initiative providing tools to assess the invasive risk of ornamental plants in trade. Using high quality science and a certification scheme Gardening Responsibly is working to reduce the sale and use of high-risk plants and promote the use of certified low-risk plants. The Gardening Responsibly initiative aims to ultimately elicit long-term attitudinal and behavioral change to generate positive environmental outcomes. The program is designed to be accessible, and beneficial, to all audiences, from backyard gardeners to professional horticulturists and leading industry suppliers. In October 2022 we officially launched the program with the Hon Minister Matt Kean and high-profile industry experts. Here, we provide an update on the initiative since its launch including: 1) The Gardening Responsibly website and research portal, 2) media presence and engagement, 3) collaboration and partnerships and 4) our next steps. We call on others to join us in promoting best practice to protect our environment from potential threats. With your help we can protect our environment for generations to come.

Keywords: Risk Assessment, Prevention, Environment, Ornamental plants, Decision support

MANAGING RISK ON HIGH-RISK PATHWAYS

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The spread of weeds along artificial corridors such as roads is a significant pathway for increasing weed distribution at State, regional and local levels. In effect these pathways provide a source of infestation to neighbouring properties.
High risk pathways may be any pathway along which vectors can accelerate the transport of weeds. They are typically heavily trafficked, being a main road for example, and have a high risk of new weed incursions being introduced from external sources. They may also have an existing issue with a high risk weed.
The management of weeds along high-risk pathways also poses a significant safety threat to those involved.
This paper illustrates the importance of both managing weeds along artificial pathways such as roads whilst at the same time managing the risk to Weeds Biosecurity staff whom are vested the responsibility under the Biosecurity Act 2015 to schedule and conduct routine inspections.
In the Illawarra region of NSW the Illawarra District Weeds Authority (IDWA) and Transport for NSW (TfNSW) have committed to a coordinated and cooperative approach to managing priority weeds along designated high risk road pathways.
As part of routine road maintenance activities undertaken by TfNSW the IDWA has been able to coordinate its priority weed inspection and control program to align with TfNSW night road closures. Closing all or part of the road ensures the safety of workers, means less disruption to motorists and allows for the completion of essential weed surveillance and maintenance work.
The willingness of TfNSW to participate in this approach to weed management has further potential to be used as part of maintenance shutdowns along other major transport corridors as well as on regional and local roads. It also provides opportunities for managers of high risk pathways to connect with Local Control Authorities and bring positive engagement.

Keywords – road, weed spread, safety, cooperation, coordination.

WRANGLING HUDSON PEAR AT QUANDA
Controlling a prickly outlier with multiple landholders and pathways

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Hudson pear (*Cylindropuntia pallida*), an extremely prickly segmented cactus, has been present at a small, isolated block of Crown land located at Quanda five-ways, between Coonabarabran and Coonamble, for more than 50 years. Until recently this was the only known incursion of this species in the Central Division of NSW, with all other incursions being in the Western Division and associated with opal fields.

Control at this site has been ad-hoc over many years but in more recent times Hudson pear has been establishing on neighbouring properties to the alarm of landholders and has been spread along roadways for more than 5km. Landholders were becoming concerned by the increasing rate of spread of this species and the apparent lack of interest in a coordinated control effort. To add to the degree of difficulty, Coonamble Shire Council, who are not the local control authority, have a licenced gravel pit at Quanda and Inland Rail proposes to build their Brisbane to Melbourne railway directly through the infested area.

The paper will discuss how a facilitated approach has brought all stakeholders together to finally achieve a coordinated approach to control for a Regional Priority species of very high concern in an area that had previously failed to attract much interest.

LIMNOCHARIS A NATIONAL ERADICATION SPECIES

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Yellow Burrhead or Limnocharis (*Limnocharis flava)* is regulated as Prohibited Matter under the NSW *Biosecurity Act 2015* because it can potentially invade lakes, rivers and dams; outcompete desirable water plants; causes silt to build up and can alter the course of water flows. Yellow burrhead is an erect plant anchored in mud or sediment and can grow up to 1 m above the water surface. In year-round wet conditions, it behaves as a perennial. In seasonally dry areas it grows as an annual plant. It has pale green 5-30cm long leaves, with pale yellow, three petaled flowers.

Yellow burrhead has not been found growing in NSW and is the subject of a national cost share eradication program, led by Queensland Biosecurity. In QLD there are a number of historic infestations near Cairns under eradication. Yellow Burrhead has been grown and promoted online as an Asian vegetable, with a number of seizures undertaking in QLD. In NSW there has been 5 historic online sales recorded that have been inspected with no plants found. One site near Lismore viable seed has been detected, excavated from the site and disposed.

NSW Department of Primary Industries have drafted an online sales policy and will develop a work procedure to monitor and seize weeds where appropriate.

Keywords: Limnocharis, online sales, eradication program, surveillance.

BLACK KNAPWEED IN THE NORTHERN TABLELANDS

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Black knapweed (*Centaurea x moncktonii)* is regulated as Prohibited Matter under the NSW *Biosecurity Act 2015* because it can outcompete desirable pasture plants, is not usually eaten by stock and produces chemicals that suppress other plants. Plants in the Asteraceae family are difficult to control with herbicides when in flower. However, plants are hard to detect prior to flowering, making targeted control at this earlier growth stage challenging. x

A 150 ha infestation of black knapweed was detected in Tenterfield on the Northern Tablelands of NSW in 2019. Plants were found on eight premises. The discovery followed several years of drought and at the time the weed was one of the few green plants visible in the area. The majority of all plants found were present in just one paddock of approximately 74 ha where they were grazed heavily by cattle, with very high plant numbers concentrated in a 2 ha core. Interestingly, there is strong evidence to suggest that black knapweed had been deliberately introduced to the infected property over 100 years earlier. No other potential source of infestation has been uncovered.

Black knapweed is a hybrid of *C. jacea* and *C. nigra*. Based on research for these two species, black knapweed is presumed to have a seed longevity of five years. Repeated multi-agency surveillance exercises have been conducted since the infestation was first detected and will continue until proof of freedom can be established at all eight infested premises. Survey transects established in 2019 prior to repeated boom and spot-spray treatments show there has been a reduction in the black knapweed population over time. Development of an algorithm for remote detection of flowering plants, and use of scent detector dogs are under investigation.

Keywords: knapweed; survey; surveillance.

PARTHENIUM WEED 40 YEARS ON

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SUMMARY

Parthenium weed *(Parthenium hysterophorus)* is regulated as Prohibited Matter under the NSW *Biosecurity Act 2015* because it can cause health problems in humans and livestock as well as posing other significant biosecurity risks. This species was first detected in NSW in 1982. Despite being widely established in Queensland where it affects 68 million hectares, there are currently only 48 parthenium weed infestations in NSW.

This paper will provide a brief history of parthenium weed incursion into NSW before showcasing the NSW Government and local government programs that successfully implement the NSW Parthenium Weed Strategic Plan.

Keeping NSW free from self-sustaining populations of parthenium weed has been the enduring mission of parthenium weed planning and management programs since the 1970s. It is being achieved via: coordinated governance through the Parthenium Weed Task Force; new pathway identification and interception; the quarantine and inspection program on the NSW/Qld border for grain harvesting machinery; early detection of new incursions through routine inspections of high risk sites and pathways; rapid response to new incursions; deployment of scent detector dogs to assist with delimitation; extension and awareness raising efforts, and; use of regulatory tools to formalise public and private landholder commitments to measures that will prevent any further spread.

Keywords: parthenium weed; inspection; rapid response; awareness raising.

FROGBIT IN NEW SOUTH WALES

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Frogbit (*Limnobium laevigatum)* is regulated as Prohibited Matter under the NSW *Biosecurity Act 2015* as it is highly invasive and can invade freshwater waterbodies; outcompeting desirable water plants; impacting fish and other aquatic life; restricting access to water ways and increase the risk of flooding. Frogbit is a floating aquatic plant with glossy green leaves rounded at the tip. Young leaves are spongy on the underside and float on the surface. Older leaves lose their spongy underside and can extend 50 cm above the water surface.

Frogbit has been found naturalised in NSW since 2017 and currently there are 233 infestations recorded. Of these 111 occur in creeks, rivers, dams, drains or wetlands. The remainder occur in aquariums or ponds in residential properties. Frogbit has been a popular plant in the aquarium trade and is often sold online. Its sale is not regulated in several other states in Australia and trading via online sales has been one of the main pathways of spread in NSW. Other pathways of spread have been flooding and water birds.

All frogbit infestations are managed for eradication with incident management teams organised for significant infestations and regional response programs involving surveillance undertaken.

Keywords: frogbit, online sales, eradication, surveillance.

MEXICAN FEATHER GRASS IN NSW

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Mexican feather grass (*Nassella tenuissima)* is regulated as Prohibited Matter under the NSW *Biosecurity Act 2015* because it can outcompete desirable plants in pastures and bushland.
Mexican feather grass is a perennial tussock forming plant native to southern USA, Central and South America. Each Mexican feather grass plant can produce up to 100 000 seeds per year. Most seeds germinate within two years but they can live in the soil for at least 7 years before germinating. From mid spring to summer seeds germinate on well-drained soils where there is little competition from other vegetation.

Mexican feather grass plants were first discovered in a garden Tamworth in 2006 by a weeds officer who at first thought it was a Serrated tussock plant. Mexican feather grass looks like Serrated tussock *(Nassella trichotoma)* which has drooping flower heads, rather than erect flower heads. Serrated tussock is also shorter (45 cm), has a wider seed, and a much smaller (25 mm) awn. Within the same year Mexican feather grass was found at Tenterfield (Northern Tablelands).

Mexican feather grass was accidentally introduced as a garden plant. It has been sold through nurseries under incorrect labelling.
In 2008 a retailer sold potted plants of Mexican feather grass that were labelled with another name. All plants in NSW were quickly recovered and destroyed. However, some plants in ACT and Victoria had been sold on and planted into gardens.

Other Mexican feather grass plants have later been discovered around Leeton (Riverina) 2018, Lithgow (Central Tablelands) in 2019, and Barden Ridge (Greater Sydney Region) in 2020.

RUBBER VINE: A WEED WITH A COLONIAL HISTORY
Detection and eradication in the remote West

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Rubber vine (*Cryptostegia grandiflora*) is regulated as Prohibited Matter under the NSW *Biosecurity Act 2015*. This many stemmed, climbing shrub can climb up to 30m into tree canopies and over infrastructure with all parts of the plant being poisonous to both humans and stock. This vigorous climber has the ability to rapidly spread and colonise areas once introduced, favouring waterways and gardens where it can have easy access to water. Once established, rubber vine smothers native riparian vegetation and can form dense, sometimes impenetrable thickets, decreasing biodiversity and preventing movement of both livestock and native animals.

Identified in Australia in the 1860's, it quickly spread its roots from mining town gardens to naturalise in semi-arid regions with tropical and subtropical rainfall. During the past four years NSW has joined the battle against rubber vine, identifying established plants found growing in the gardens of four colonial homesteads within the Western region of the state. Remote location and absence of regular surveillance and inspection programs present challenges in the detection and removal of infestations. Utilising remote community communication, collaboration with neighbouring councils and a focus on extension and awareness raising amongst these remote sites is essential in detecting and eradicating rubber vine in NSW.

This paper will provide a brief history of *Cryptostegia grandiflora* detection in NSW before detailing the NSW Government approach to identifying and controlling this remotely located invader.

Keywords: surveillance; remote detection; raising awareness; rubber vine

ALTERNATIVE CHEMISTRIES FOR MANAGING AFRICAN LOVEGRASS

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Eragrostis curvula (African lovegrass) is a highly invasive, summer growing C_4 tussock grass, posing serious threats to agricultural and natural ecosystems in Australia. It is adapted to a broad range of climatic and soil conditions, infesting prime agricultural land, native grass land, fence lines, roadsides, parks and natural reserves across all the states and territories. The perennial nature of African lovegrass, coupled with its new seedling emergence, prolific seed production and an extensive seedbank, contribute to its rapid spread and expansion in Australia. It is unattractive to livestock especially, when plants are mature, although it has sometimes been considered a useful pasture species due to its palatability at early growth stage. African lovegrass strongly competes with native grasses and other desirable pasture species, affects pasture productivity, reduces stock carrying capacity, and degrades biodiversity in natural ecosystems. There are limited options to effectively manage African lovegrass, with glyphosate and flupropanate being the two commonly used herbicides. The evolution of flupropanate resistance in African lovegrass, as well as the lack of market access to flupropanate, create further difficulties in managing this weed. Our multi-year and multi-site study was conducted to identify alternative chemistries for controlling African lovegrass through screening a broad range of residual and post-emergent herbicides. Several effective candidates will be reported. The integration of these alternative chemistries with other non-chemical control options will be discussed.

Keywords: *Eragrostis curvula*, invasive grasses, residual herbicides, post-emergent herbicides, integrated weed management

CAN EXPOSURE TO LOW HERBICIDE RATES INCREASE RESISTANCE EVOLUTION IN WEEDS?

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There is growing evidence that the stimulation of weed fitness by low doses of herbicides, namely "hormesis," can change the sensitivity of weed populations to herbicides. We quantified the herbicide hormesis response of three key weed species: flaxleaf fleabane (*Conyza bonariensis* L), tall fleabane (*C. sumatrensis*) and awnless barnyard grass (*Echinochloa colona*). In our study, glyphosate at a rate of 0.36 kg a.e/ha was applied to plants at the rosette stage of 27 glyphosate-resistant flaxleaf fleabane populations. Seeds collected from the sprayed plants had higher germination in 75% of populations than the unsprayed control plants. However, the germination rate either declined or remained unchanged in 25% of populations that were categorised either as developing resistant or susceptible to glyphosate

Hormesis was observed in two paraquat-resistant tall fleabane populations (TB-1 and TB-6). Both populations had a hormetic growth increase at two lower doses (62.5 and 125 g a.e/ha) of paraquat, resulting in 17% to 31% and 11% to 19% higher plant biomass and 33% to 40% and 65% to 68% higher numbers of seed buds/plants, respectively when compared to untreated controls.

Hormetic effects were also found in awnless barnyard grass populations (2B21 and 2B37) where resistant phonotypes (R-2B21 and R-2B37) of these populations had a higher biomass, spikes/plant, and seeds/plant than that of their respective susceptible counterparts at 100 g a.e/ha or higher rate of glyphosate. The susceptible plants of these two populations accumulated more biomass (10%-20%) and produced more spikes/plant (32%-38%) than the resistant phenotypes at the hormetic dose range of rates 34 and 67.5 g a.e/ha of glyphosate. Our results suggest that herbicide hormesis may be common in weeds and low or inaccurate doses of herbicide could favour the resistant individuals, increasing the dominance of the resistant population.

Keywords: Dose; Stimulation; Biphasic; Endpoint; Fitness

IMPLEMENTATION OF A RAPID RESPONSE BIOSECURITY PROGRAM TO ERADICATE A NOVEL INVASIVE SPECIES IN NSW

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As illustrated by the generalised invasion curve, a conceptual framework widely adopted within the biosecurity community, early detection and rapid response programs are necessary for the timely and cost-effective eradication of new invasive species. In January 2021 a specimen of the potentially invasive Plume Poppy (*Bocconia frutescens*) was detected near Taree on the mid-north coast of New South Wales. The incursion appears to be the result of seed bank dispersed from a horticultural plant that has germinated after a significant bushfire disturbance in 2019. It has been detected in rural residential land, as well as adjacent high-value conservation assets including National Park and Council bushland reserve. Plume Poppy has been recorded as being a highly invasive weed of disturbed areas in tropical and subtropical regions throughout the world, notably in Hawaii.

This paper describes the response of the local control authority (MidCoast Council) in carrying out an identification, eradication and education program in the area where the incursion was detected, in accordance with the Hunter Regional Weeds Committees' 'New Weed Incursion and Rapid Response Plan (2017-2022)'. A cross-tenure collaborative management approach is described, involving cooperation with stakeholders including NPWS and volunteer groups working on Council land. The implementation of a rapid response process is recorded in the context of managing the Plume Poppy incursion, and the efficacy of the initial control is documented through ongoing monitoring of the distribution of the target species. This case study illustrates the importance of community engagement in enhancing the early detection capabilities of biosecurity agencies, as well as the importance of community cooperation in the ongoing detection and control of an invasive species during an eradication program.

Keywords: plume poppy, Bocconia frutescens, garden escapee, emerging weed, community awareness

FIRE AND WEEDS

Learnings from the 2019/20 Bushfires

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Eurobodalla was significantly impacted by the 2019-20 bushfires. Weeds pose a significant threat to native vegetation and habitat after fires. They can intensify at known sites or move into newly disturbed areas and compete with native plants for resources. The post-fire landscape provides an opportunity to monitor for emerging weed seedlings and to undertake control works for high priority weeds.
Monitoring photo points and plots were set up in February 2020 at 14 fire affected survey sites in the Eurobodalla Shire following the fires. Monitoring sites were repeated four times over the next year. The purpose of the monitoring was to spatially capture the recovery of, and changes in, our vegetation across multiple communities; and to detect any previously unrecorded species, including plants of concern with respect to biosecurity.
Capturing data on the emergence of post-fire ephemeral and pioneer species have allowed us to be better informed for future decision making with respect to weed burden and prioritising management after fire.

Keywords: monitoring, ephemeral, disturbance

WHEN IS A WINDBREAK NO LONGER A WINDBREAK

The successful removal of 89 established Athel Pines

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With the passing of bi-planes and the rapid development of aircraft in the 20th century the need for wind breaks along airport boundaries/runways is more aesthetic than functional. Along the western boundary of the Nyngan airport a row of 89 Athel pines were grown as a windbreak. These trees have been through at least 5 flooding events in the last 23years that I am aware of, the latest was 2022 and the most severe 1990.
This paper addresses the processes, obligations and involvement undertaken from suddenly realizing the trees you have looked at for many years were in fact Weeds of National Significance to having the trees removed, what happens to the organic matter when removing the trees as well as initial and ongoing follow up surveillance.

Keywords: Flooding, involvement, obligations, CASA, WoNS

BRINGING IN THE BIG GUNS
Using Mechanical Methods to Tackle Pines Gone Wild

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Hunter Water Corporation (Hunter Water) manages buffer lands surrounding Grahamstown Dam north of Raymond Terrace. The area provides habitat for threatened biodiversity including a large population of the threatened plant *Callistemon linearifolius* as well as habitat for endangered Koalas. In 2019, it was estimated that in excess of 50 ha of buffer land at the southwestern end of the dam had become heavily infested with Radiata Pine (*Pinus radiata*), with the weed forming monospecific stands in some areas.

Radiata Pine poses a significant threat to the populations of *Callistemon linearifolius* and Koala, and biodiversity values in general, by reducing wildlife corridor functionality, suppressing native species regeneration, reducing structural habitat diversity and limiting native species diversity. Pine infestations around the dam also present a bushfire risk, which in turn presents a risk to water quality within the dam.

In 2020, Hunter Water commenced large scale works to remove the majority of the pine infestation. Various options for eliminating the pines were considered, with the adopted methodology involving the use of heavy machinery to mulch high density areas of pine, and manual felling in lower density areas containing native vegetation.

Although natural regeneration is progressing well in most areas, continual suppression of pines will be ongoing for years to come. Hunter Water has secured an Environmental Trust grant to assist with this enormous task, with secondary weed treatment, targeted planting and ecological burns, planned to occur over the next four years.

INNOVATIONS IN GNSS, AI & DRONES TO WAGE A MORE EFFECTIVE WAR ON WEEDS

The future of biosecurity surveillance is well on the way to the next leap in productivity through digital weed identification and control.

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Having worked closely with natural resource and land managers as a Spatial technology provider since 1993, we understand the importance of efficient weed management and pest animal control and the challenge of limited funding, labor and time to gather evidence-based field intelligence. This paper is to share insights into the recent innovations in:

1. GNSS accuracy made possible with investment by Geoscience Australia into SouthPan,
- UAVs to deploy herbicide to difficult to access locations,
- Drones to capture large areas with high resolution imagery with a single flight plan
- Rapidly evolving AI and Earth Observation solutions, and
- 360 Mobile Mapping imagery capture along road and rail corridors

These new technologies are being applied to increase our ability to quantify and communicate the extent of infestations and can be used with our field GIS technologies to support Biosecurity Officers to radically improve mobile field works to quickly detect, map and prioritise classified weeds that require treatment or control activities.
We are now able to radically help Local Control Authorities (LCAs) have been previously recognized with industry awards and commendations for how efficiently and informed their weed and pest management activities are performed using our GIS field mapping and automated workflow systems to radically leap forward in productivity by embracing digital Ai inspections too. RapidMap has established partnerships with former military specialists and environmental service providers to identify ways to integrate various weed management systems utilizing the latest spatial mobile GIS technologies to identify, contain, and reduce the biosecurity risk of invasive plants to the environment, economy, and community.

Keywords:
Ai Weed Identification, Drone imagery, UAV Herbicide Treatments, Biosecurity Technologies, Spatial workforce management.

SEARCHING THE WILD – WEED SURVEILLANCE
Weed Biosecurity in the Aftermath of Flood Devastation

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The floods of early 2022 severely impacted Lismore and surrounding areas of the Far North Coast of NSW. With the highest rainfall in NSW, a unique combination of sub-tropical climate and extensive floodplains in the area, these climatic conditions combined to produce a high-risk setting for the dispersal, germination, and growth of weed species. Whilst community, industry and the economy rebuild, Weed Biosecurity Officers have worked tirelessly to identify new and emerging weed biosecurity threats along high-risk pathways. Using flood inundation modelling and historical data, officers have trekked, canoed, used boats and buggies to try to cover large areas of land and search the wild for new and emerging weed threats.

At a highly sensitive time for the Far North Coast, Rous County Council Weed Biosecurity Officers have built relationships with landholders who have lost everything and have also seen sudden incursions of new weed species. Post-Flood Weed Biosecurity Officers worked closely with Project Officers to develop targeted and needs-based weed biosecurity campaigns and educative resources.

Field efforts have resulted in identifying, mapping and controlling many Priority Weeds. A good example being the identification of Frogbit (*Limnobium laevigatum*) in the Byron Bay LGA and the following emergency response. Managing incursions of Prevention weed species is something that requires community participation, to support comprehensive identification, mapping and control works. Officers have worked creatively to ensure community and environmental needs are met in the aftermath of flood devastation.

DRONE SURVEILLANCE OF INVASIVE WEEDS: A LESSON LAEARNT FROM NORTH-WEST NSW

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Invasive weeds are a risk to the social and economic wellbeing of regional NSW as they negatively impact agriculture and environment. Eight species of *Cylindropuntia spp*. (Cactaceae) are recorded in north-west NSW. Among them, Hudson pear (*Cylindropuntia pallida*) is considered the most problematic because of its capability to spread easily by segments or cladodes. It has significant spines which can penetrate footwear, vehicle tyres and injure livestock and native wildlife. Chemical and mechanical control can be effective under particular conditions, but cost limitations prevent these management approaches being rolled out through the entire invaded range of Hudson pear.

A biocontrol was introduced in NSW to complement the conventional methods. A cochineal insect, *Dactylopius tomentosus* ('californica var. parkeri' lineage), was released in the core invaded areas of north-west NSW in 2017. NSW DPI and LLS jointly monitoring the dispersal and impact of the biocontrol at the research sites in the north-west using drone (UAV) remote sensing. The high resolution imagery datasets facilitated an understanding of the spatial and temporal assessment of the biocontrol agent's spread and impact across the incursion sites. This paper discusses the efficacy of this approach, highlighting the key lessons learnt from the project and recommendations for a fit-for-purpose drone-based, long-term monitoring approach for weed biocontrol projects.

Keywords: Unmanned Aerial Vehicle, Hudson pear, Spatial and temporal assessment

A LOWCOST GREEN ON BROWN WEED DETECTION SPRAYER

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Detection sprayers such as the WeedSeeker® and WEED-IT using green on brown technology have now been around for many years and have proved useful in reducing herbicide cost and assisting in the management of herbicide resistant weeds. The costs of these systems remains relatively high.

The University of Sydney have developed a low cost weed detection system the - Open Weed Locator (OWL) which uses off the shelf electronic components and open source software. This unit requires relatively low levels of skill to assemble and operate and can be used to trigger spray nozzles for use in fallow paddocks or for pathways/industrial areas.

This paper outlines the experience of North West Local Land Services in building a demonstration unit with this technology and the potential of this technology for wider application.

Keywords: Herbicide, resistance, detection, software, university.

BIOSECURITY AUDITS OF LOCAL CONTROL AUTHORITIES
Helping LCAs achieve continuous improvement

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Local control authorities have statutory functions under the *Biosecurity Act 2015*. These functions have been developed in a measurable framework called the Standard for Weed Management Capacity in New South Wales. The Standard establishes processes to deliver best practice weed management through a supported, skilled and accountable network.

The Standard covers five main areas:

1. Partnerships, engagement and adoption,
2. A skilled and informed workforce,
3. Assessment, monitoring and recording,
4. Effective and professional use of regulation,
5. Reporting and analysis.

The Standard provides the basis for formal auditing of local control authorities (LCAs) under the Biosecurity Act. The target of the biosecurity audits will be LCA middle and senior management. The audits will not focus on operational activities.

Biosecurity audits in relation to the Standard are intended to be educative rather than punitive and are part of a process of continuous improvement. However, participation in a biosecurity audit is mandatory.

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