NATIONAL WEED BIOCONTROL INVESTMENT REPORT

MAY 2025

National Weed Biocontrol Pipeline Strategy: Initial Stage

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EXECUTIVE SUMMARY

Weeds have a major impact on Australia's environment, livelihood and agricultural productivity. They cause significant impacts and are estimated to impose an overall average cost of nearly $5 billion across Australia each year.[1,2] Weeds negatively affect natural ecosystems, waterways and vast areas of agricultural and pastoral lands, impacting the health, viability and function of ecological communities, ecosystems and landscapes.[3]

Biocontrol is the practice of managing a weed by the deliberate introduction of one or more natural enemies (biocontrol agents) sourced from the weed's native range. All targets of weed biocontrol must be endorsed by the Environment and Invasives Committee (EIC) through the current procedure before permission is sought to release a biocontrol agent.[4] The Protocol for Biological Control Agents[5] provides a national standard for the assessment and introduction of exotic biocontrol agents into Australia under the *Biosecurity Act 2015* and the *Environment Protection and Biodiversity Conservation Act 1999*. Candidate biocontrol agents are only approved for release into the Australian environment if rigorous risk assessment demonstrates them to be of negligible risk to native and other valuable non-target plant species.

This National Weed Biocontrol Investment Report (Investment Report) seeks to guide future weed biological control (biocontrol) research, development and extension activities (RD&E) for priority weeds at a national scale for the next five years. It presents five-year priority investment activities for 18 projects covering 20 weed species.

This Investment Report is guided by the outcomes of two key documents: the *National Weed Biocontrol Pipeline Strategy*[6], developed in 2022 to guide biocontrol research, development, and extension (RD&E) across government, industry, and community sectors; and the *National Weed Biocontrol Prioritisation Framework*[7], which supports the transparent assessment and prioritisation of future biocontrol targets. The strategy was developed first, followed by the initiation of the National Weed Biocontrol Pipeline's first phase of research and implementation. Based on the outcomes of this framework and associated prioritisation results, the Environment and Invasives Committee endorsed the target weeds, the *National Weed Biocontrol Prioritisation Results*[8], included in this Investment Report.

The Investment Report aims to ensure the return on investment provided by biocontrol is sustained, commencing from the first of four five-year cycles of RD&E outlined in the Pipeline Strategy, covering four phases (Figure 1). The five-year timeframe for well-planned and executed RD&E will lead to tangible advances towards desired weed management outcomes for national priority weed targets. The total cost of this investment plan, if pursued in full, is $38m. Current complementary funding initiatives may contribute to the funding of the priority weeds detailed in this Investment Report.

The potential return on investment in the Pipeline Strategy and Investment Plan is persuasive. Biocontrol is a cost-effective weed management tool that is self-sustaining and occurs at the landscape scale. Annual benefits of $95.3 million from an average annual investment of $4.3 million was demonstrated in a CSIRO review of all weed biocontrol undertaken in Australia between 1903 and 2016.[9] This makes biocontrol one of the most cost-effective solutions currently available in the integrated weed management toolbox, with benefits outweighing costs by over 23:1.[10,11] Sustaining such returns on investment is vital for maintaining Australia's biodiversity, ecosystem health and agricultural productivity going forward.

National Weed Biocontrol Pipeline Strategy: Initial Stage

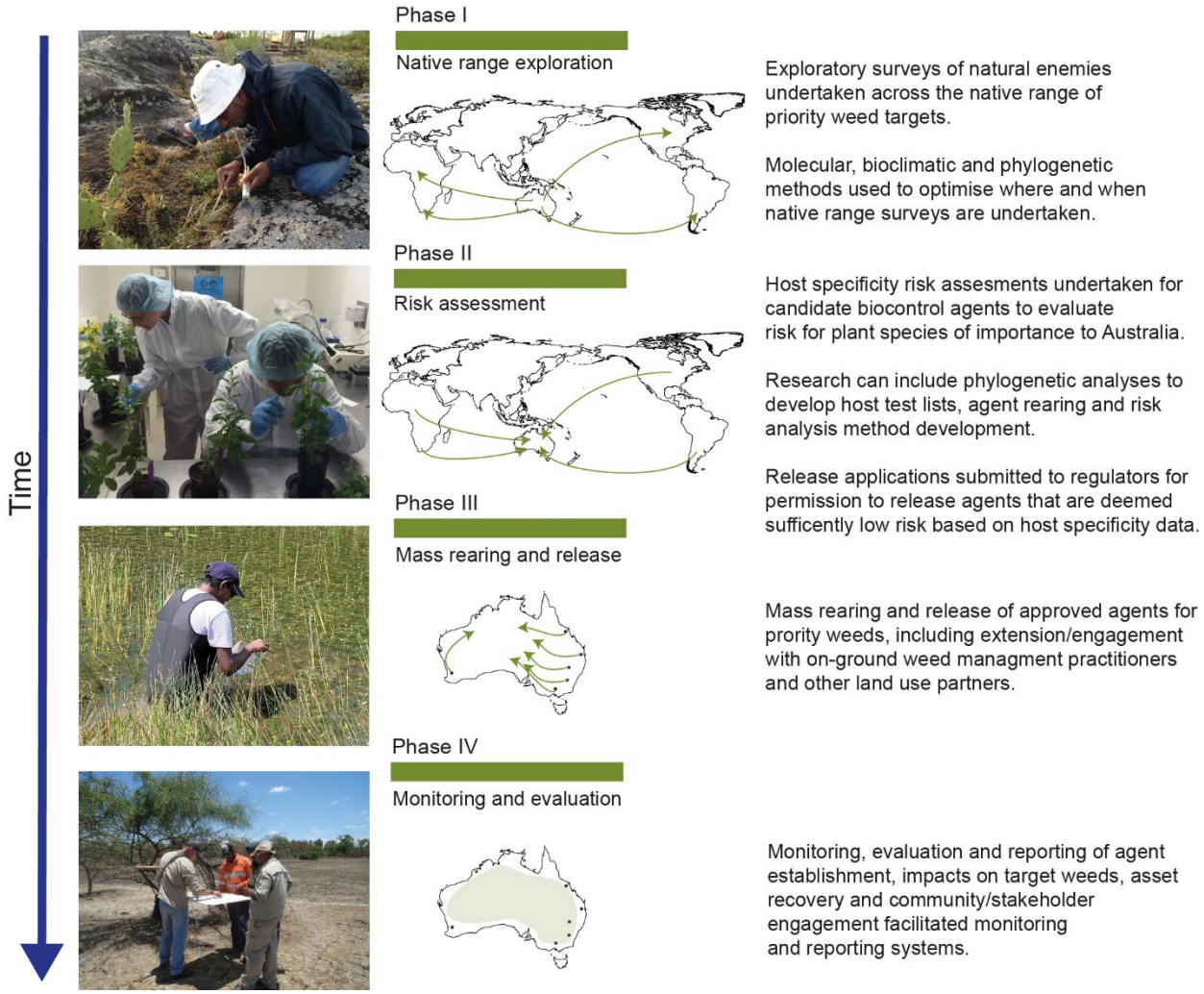


Figure 1: Biocontrol pipeline research and delivery phases top to bottom: Phase I, collecting biocontrol agents on mother-of-millions in the native range of Madagascar. Phase II, Quarantine host-specificity testing for a rust fungus on African boxthorn. Phase III, releasing biocontrol agent weevil into a dam infested with cabomba. Phase IV, inspecting parkinsonia infestation for biocontrol agents using a beat sheet in northwestern Queensland.

PRIORITISED WEEDS FOR INVESTMENT CONSIDERATION

Following the application of the prioritisation framework and review by the Weed Biocontrol Alliance and the Environment and Invasives Committee's Weed Working Group (EIC WWG), the EIC endorsed 20 weed species, spanning 18 research projects, for inclusion in this National Weed Biocontrol Investment Report (Figure 2). These weeds were selected based on their high threat level and promising biocontrol potential within their respective RD&E pipeline phases. *Sida* and *Cryptostegia* weeds, due to their complementary research needs, were grouped into two combined target projects (Figure 2), resulting in 20 weeds across 18 projects.

Across the weed biocontrol RD&E pipeline, five Phase I (native range exploration), seven Phase II (risk assessment), seven Phase III (mass rearing and release) and two Phase IV (monitoring and evaluation) projects across 20 weed targets are detailed in this report.

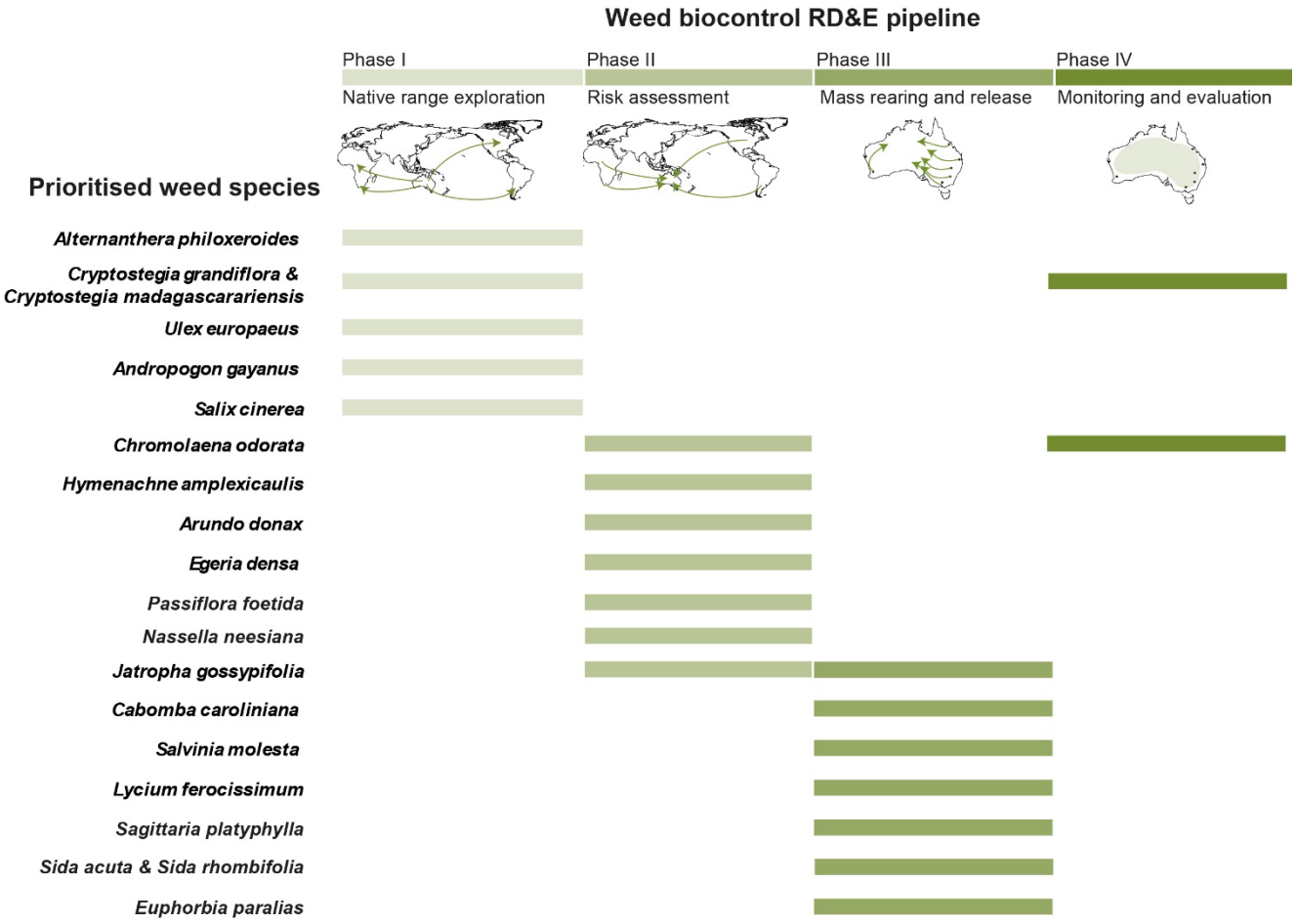


Figure 2: Pipeline-based representation of 20 prioritised weed species listed across 18 suggested projects (Sida and Cryptostegia species have been recommended as combined targets for project consideration).

KEY TO BIOCONTROL INVESTMENT REPORTS FOR PRIORITISED WEEDS

Weed species Latin name (Common name)

Weed distribution maps generated using occurrence records from the Atlas of Living Australia and climatic zones from https://data.gov.au/data/organization/abcb.

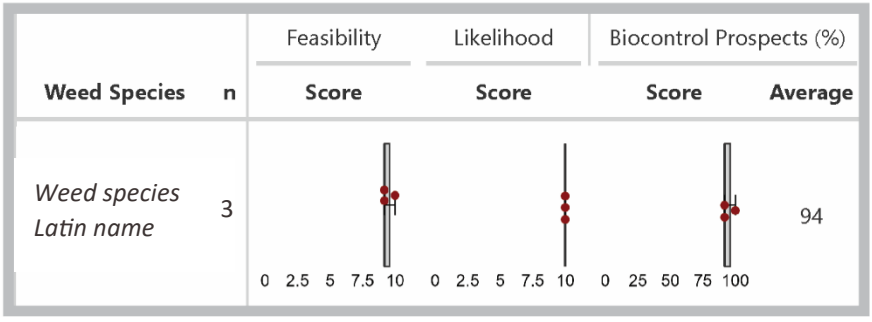
Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact score	Invasiveness score	Weed threat	Land use	Cultural weed
Six questions that assess a weed's potential environmental, social and economic impacts by focusing on the types and size of the impacts, as related to weed density and abundance. Scores range from 0 (minimum) to 10 (maximum).	Five questions to analyse a weed's competitiveness by assessing how quickly a weed can establish, reproduce and spread within a particular land use. Scores range from 0 (minimum) to 10 (maximum).	The score for weed threat is calculated by multiplying the impact and invasiveness scores. Scores range from 0 (minimum) to 100 (maximum). The higher the score, the greater the threat posed by the weed.	Assessments are made in accordance with any land use that the weed is likely to invade and affect. Land use categories are based on the Australian Land Use Mapping Classification System V8.[12]	Weeds that were identified as impacting the cultural values of First Nations peoples have been noted, though not specifically assessed for weed threat. Results are presented as yes (with cultural value) or no.

Comprehensive details around how weeds were nominated, checked for eligibility and the weed threat assessment methodology and workflow are outlined in the Framework document.[7]

Biocontrol prospects assessment summary



Biocontrol feasibility encompasses six criteria concerning the logistical and ecological factors related to the target weed and candidate agent/s that influence the ability to obtain, host-range test and release those agent/s into the Australian environment.

Likelihood of success considers seven criteria concerning the abiotic and biotic factors that predict the impacts of biocontrol agent/s on the target weed in Australia.

Weeds were assessed for both 'biocontrol feasibility' and 'likelihood of success' by at least three biocontrol experts (n). A single biocontrol prospects value was then calculated for each expert as the product of their feasibility and

likelihood of success values (maximum: 10 feasibility × 10 likelihood of success = 100). Average and median biocontrol prospects for each target weed were calculated across the participating experts.

A summary of the three biocontrol experts' opinions on the phase of research and biocontrol prospects is presented under the box and whisker plots of 'Feasibility', 'Likelihood' and 'Biocontrol Prospects %'.

Biocontrol contextualisation summary of outcomes

In the Framework, the potential benefits of biocontrol to weed management and asset protection are contextualised against conflicts of interests and investment risks for relevant stakeholder groups and land use sectors. This was done by gathering publicly available information for each component (literature review) and complementing it, where necessary, with targeted conversations with relevant jurisdictional and sectoral representatives. The outcomes of the biocontrol contextualisation do not influence the prioritisation results per se but provide further background on potential risks and benefits underpinning investment decisions and research opportunities. These contextual considerations are defined in the table below. A written summary of the outcomes is presented using a traffic light system for each weed included in the investment report:

- Green indicates no mitigating actions are required; proceed with research implementation planning.
- Amber indicates some mitigating actions required at the research implementation planning stage.
- Red indicates a stepwise approach and significant mitigating actions should be considered at the research planning and implementation planning stage.

Considerations	Summary and recommended outcomes for *Weed species Latin name*
Conflicts of interest	This component identifies and describes any potential socioeconomic values that may be disrupted by the release of biocontrol agent/s and thus reduce the acceptability of biocontrol for the target weed (e.g. the weed is a significant threat to environmental assets but is also valued as a productive pasture species supporting the livestock industry). When such conflicts are likely to be high, it is recommended that comprehensive stakeholder engagement is conducted as a standalone dedicated research project that accompanies an application for approval of the target weed as a candidate for biocontrol by the Environment and Invasives Committee (EIC).
Management goals	This component outlines key management objectives for each target weed and describes the potential contribution of biocontrol to meeting those objectives (e.g. mitigating invasion risk by reducing seed set or reducing competitive performance to enhance pasture production and livestock health outcomes).
Biocontrol complementarity	This component considers feasibility of existing weed control methods and the potential benefits of biocontrol for enhancing existing weed management outcomes. The assessment highlights any instances in which the target weed is known to have low feasibility for existing control tools or limited opportunities for coordinated control across jurisdictions. These weeds are likely to benefit more strongly from the sustained landscape-scale impacts of biocontrol activity and thus represent more attractive investment targets.[13] Consideration is also given to how weed biocontrol could be integrated with existing management technologies and strategies (e.g. WoNS best practice management plans), and opportunities or benefits of coordination across stakeholder groups and land use sectors.
Knowledge gaps and research opportunities	This component summarises key knowledge gaps related to weed biocontrol feasibility and likelihood of success that were identified by experts during the elicitation stage of the biocontrol prospects assessment. Identifying such knowledge gaps supports research-implementation planning (e.g. analysis of weed population genetics and modelling of climate envelopes to optimise the location of native range exploratory

Considerations	Summary and recommended outcomes for *Weed species Latin name*
	surveys for novel candidate biocontrol agents). Identification of many knowledge gaps across key biocontrol feasibility and likelihood of success criteria may highlight any significant risks for investment (e.g. low confidence in returns on investment and achieving desired outcomes for weed threat mitigation). This may trigger preliminary investment in addressing such knowledge gaps before commencement of the prioritised research phase.
Investment complementarity	This component brings together information across jurisdictions on historical and current investments that support research into one or more activities for each prioritised weed. The aim of this exercise is to identify complementarities and align research interests to enhance the overall value and likelihood of achieving desired outcomes.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: States the phase or phases of the biocontrol RD&E pipeline that was identified through the prioritisation process as the priority for investment.

Lead agency: The research agency responsible for developing and implementing proposed five-year RD&E plans for each prioritised weed species.

Agencies involved/project participants: Partners involved with delivery of the proposed five-year RD&E plan.

Identified research priorities for [*Weed species Latin name*] biocontrol program: Gantt chart of research activities and timeframes for delivery within the five-year timeframe.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30

Key Outputs

An overview of the direct results and key deliverables that will result from the key research activities detailed in the five-year RD&E Gantt chart, above.

Expected outcomes after five years of RD&E investment

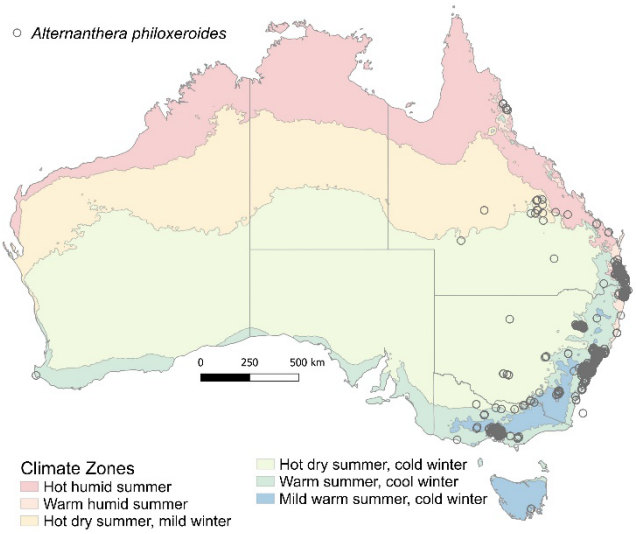
The expected broader impacts and effects of the research activities detailed in the five-year RD&E Gantt chart above.

Identified stakeholders

A list or overview of parties that will be engaged in the implementation of the proposed RD&E research activities or who will benefit from the proposed research investment. Additional agencies or project partners that have not been identified in this document could emerge during any resulting implementation planning.

PRIORITISED WEED BIOCONTROL INVESTMENT REPORTS

Alternanthera philoxeroides (Alligator weed)

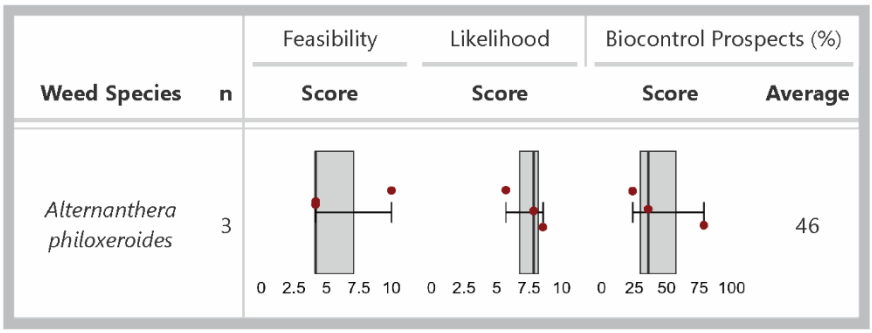


Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact score / 10	Invasiveness / 10	Weed threat / 100	Land use	Cultural weed
8.416	8.004	67.36	Water	No

Biocontrol prospects assessment summary



Further exploration is needed to specifically look for agents targeting 'terrestrial forms' of *Alternanthera philoxeroides*, which is currently not under biocontrol from existing agents. 'Terrestrial forms' of the weed are the same species but are growing in areas adjacent to water infrastructure in damp soil. Population genetic analysis of invasive and native range *A. philoxeroides* populations should be used to direct new exploration efforts.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Alternanthera philoxeroides*
Conflicts of interest	A biocontrol program for *A. philoxeroides* existed before the process of formal approval of weed targets for biocontrol, the program commenced in the 1970s. No significant conflicts of interest are identified. Commence implementation planning for new research program.

Considerations	Summary and recommended outcomes for *Alternanthera philoxeroides*
Management goals	Strong alignment of biocontrol prospects with overall management goals for this weed. The desired biocontrol management outcomes are well articulated in management plans, such as the need for candidate agents to control terrestrial growth forms and in cooler environments. Commence implementation planning for new research program.
Biocontrol complementarity	There are existing control options, but they may not always be effective, affordable and available, depending on land use, location, land manager experience and capacity. This includes existing biocontrol options which are only effective for aquatic *A. philoxeroides* infestations. Even where existing control options are effective, the addition of novel biocontrol agents will likely enhance overall management outcomes.
Knowledge gaps and research opportunities	Some key knowledge gaps have been identified that can be readily resolved through targeted research during the implementation-planning phase. These include population genetics and climatic analysis to prioritise areas in the native range for exploration.
Investment complementarity	No existing research investments identified for *A. philoxeroides*. Commence implementation planning for new research program.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase I, Native range exploration

Lead agency: CSIRO

Agencies involved/project participants: Fundación Para El Estudio de Especies Invasivas, Argentina (FuEDEI)

Identified research priorities for *Alternanthera philoxeroides* biocontrol program: Population genetic analysis of invasive and native range *A. philoxeroides* populations should be used to direct new exploration efforts. Existing bioclimatic distribution modelling should also be reviewed to identify areas in the native range where cold adapted candidate agents could be surveyed. A few candidate agents remain to be risk assessed and evaluated for impact, including two leaf-mining fly species, *Ophiomyia alternantherae* and *Ophiomyia buski*, as well as the rust *Uredo pacensis*. These known candidates will be prioritised for native range preliminary host-specificity screening, while also surveying areas prioritised by population genetics to determine if any other candidate arthropod or fungal species that impact terrestrial alligator weed can be unearthed.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Molecular characterisation of plant populations in both the invasive and native range to prioritise areas for exploration in South America.					
Bioclimatic distribution modelling to identify native range areas for exploration, with a focus on cold adapted agents for cooler areas of the Australian invaded range.					
Engage South American native range research organisation (FuEDEI) to					

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
collaborate on exploration of terrestrial *A. philoxeroides*.					
Conduct surveys of prioritised areas of the native range over multiple seasons to ensure the breadth of potential arthropod and fungi candidate agents are encountered.					
Identify and catalogue arthropods and fungi from surveys using relevant taxonomists and molecular tools.					
Characterise the biology of candidate agents to determine if they can be cultured under restrictive quarantine conditions in Australia.					
Conduct native range preliminary host-specificity testing of candidate agents.					
Import at least one potential agent into quarantine – ready for the next phase of the biocontrol RD&E pipeline.					

Key Outputs

- Molecular characterisation of *Alternanthera philoxeroides* in the native and invasive Australian range, with area of origin in the native range delimited.
- A catalogue of candidate agents from native range exploration compiled, including putative species identification, genomic barcodes where relevant, observed impact on terrestrial forms of *A. philoxeroides* and observed plant host-range associations on co-occurring weed relatives.
- The biology of impactful candidate agents described, including lifecycle, developmental time, optimal temperature, humidity and light intensity for development. These details are needed to develop quarantine laboratory cultures for risk assessment in Australia.
- Preliminary host-specificity screening of up to five close relatives of *A. philoxeroides* that are available in the native range. Filter any agents that are not sufficiently host specific before transporting them into Australian quarantine.
- At least one candidate agent imported into Australian quarantine.

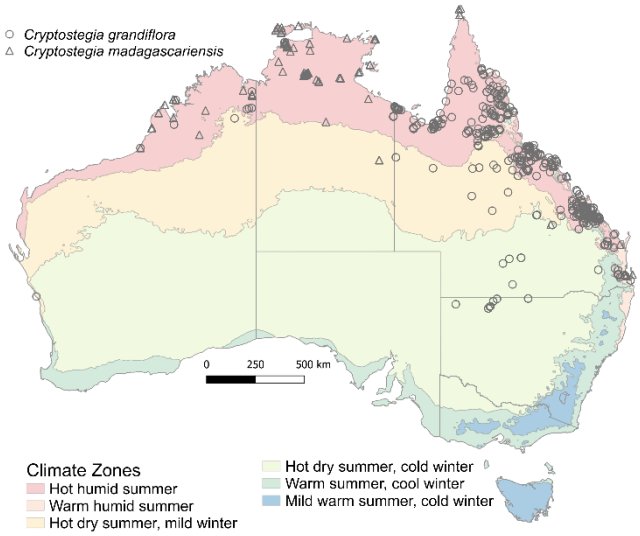
Expected outcomes after five years of RD&E investment

After five years of Phase I native range exploration, it should be known if there are prospective candidate agents for terrestrial and cold-climate *A. philoxeroides* infestations that warrant Phase II risk assessment. Prospective agents will have been identified from populations which are a genetic match and collected from areas in the native range that are climatically similar to prioritised Australian invasive populations. This increases the likelihood that if candidate agents are found to be sufficiently host specific, they will be able to establish self-sustaining populations across the Australian landscape.

Identified stakeholders

Regions in New South Wales where *A. philoxeroides* is a regional priority for either asset protection or containment, private irrigation corporations and water management authorities.

Cryptostegia grandiflora **and** ***Cryptostegia madagascariensis*** (Rubber vine and purple rubber vine)



Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

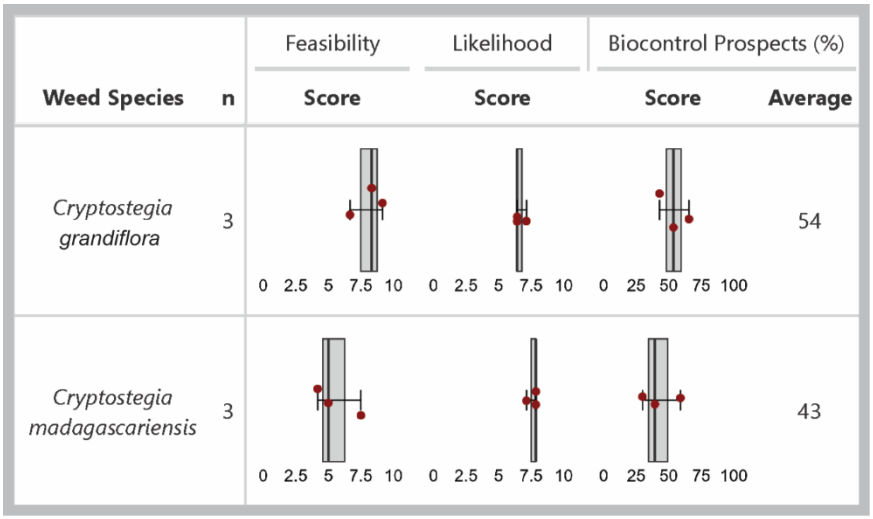
Cryptostegia grandiflora

Impact score / 10	Invasiveness / 10	Weed threat / 100	Land use	Cultural weed
8.416	6.670	56.13	Production from relatively natural environments	Yes

Cryptostegia madagascariensis

Impact score / 10	Invasiveness / 100	Weed threat / 100	Land use	Cultural weed
7.890	6.670	52.63	Conservation and natural environments	No

Biocontrol prospects assessment summary



All three assessors nominated the native range exploration phase of research (Phase I) in conjunction with monitoring and evaluation (Phase IV monitoring and evaluation) to provide quantitative understanding of the impacts of previously released agents to determine what is required from any additional biocontrol agents for these species. The previous biocontrol program used the same agents across both *C. grandiflora* and *C. madagascariensis.* Two strains of rubber vine rust (*Maravalia cryptostegiae*) collected from *C. grandiflora* were found to be damaging to both species in laboratory testing, but only one strain was found to be damaging after field releases. Previous evaluations of the establishment and impact of rubber vine rust were conducted on the more common *C. grandiflora.* However, originally reported efficacy is now refuted. It is possible that more severe infection in the field on *C. madagascariensis* could be achieved if an accession of this rust is isolated directly from *C. madagascariensis* in its native range. Native range surveys on both *C. grandiflora* and *C. madagascariensis* should focus on identifying prospective stem and root feeders to complement existing agents. Population genetic analysis is recommended to direct new exploration efforts for both species. Monitoring and evaluation to assess impact of rust (*M. cryptostegiae*) released in 1995-1997 and leaf feeding moth *(Euclasta whalleyi = Euclasta gigantalis)* released in 1988-1991. Outcomes of monitoring and evaluation will determine if impacts could be increased through agent redistribution in the future or if there is a need to identify new agents through native range exploration surveys.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Cryptostegia grandiflora* and *Cryptostegia madagascariensis*
Conflicts of interest	A biocontrol program for both species of invasive rubber vine existed before the formal process for approval as candidate weeds for biocontrol. The program for rubber vine commenced in 1985. No significant conflicts of interest have been identified.
Management goals	Anecdotal evidence suggests that the efficacy of previously released agents is dependent on local environmental conditions and that in some regions they cannot be established. Phase IV monitoring and evaluation of this program aims to quantify the efficacy of biocontrol agents already present in Australia. Phase I aims to assess the prospect for increased biocontrol of rubber vine by determining if there are candidate agents in the native range that complement the current agents, such as those that target stems and roots and those that might have a greater impact in drier environments.
Biocontrol complementarity	Chemical and mechanical control are not economically or logistically viable for large, well-established infestations of rubber vine in the remote regions of central and far north Queensland, the Northern Territory and Western Australia. A damaging

Considerations	Summary and recommended outcomes for *Cryptostegia grandiflora* and *Cryptostegia madagascariensis*
	biocontrol agent would be greatly beneficial where alternative management options are not viable. Even where existing control options are effective, the addition of complementary biocontrol agents will likely enhance overall management outcomes.
Knowledge gaps and research opportunities	Key knowledge gaps related to the feasibility and likelihood of success of a renewed biocontrol program include: a quantified understanding of the impacts of the previously released biocontrol agents and how their establishment and efficacy is influenced by climate; specificity of the rubber vine rust strains released and whether there are other strains in the native range that might provide improved impact on the target species; whether further native range surveys will reveal additional insect species, such as cryptic and nocturnal species that were not investigated during past surveys; whether there is genetic variation among rubber vine populations in Australia that could influence the specificity and impact of current and future biocontrol agents; knowledge of where best to search for natural enemies overseas that are genetically matched with Australian invasive populations – enhancing the prospects for greater impact.
Investment complementarity	No current research investments have been identified for rubber vine in Australia. However, in a recent research collaboration between CABI UK and the Brazilian National Council for Scientific and Technological Development, rubber vine samples from invasive populations in north-east Brazil were genetically compared with rubber vine in Madagascar. Additionally, several new strains of rubber vine rust were collected from both target species and preserved by CABI for future biocontrol research. CABI can be contracted for access to genetic data from Madagascar and to screen additional strains of rubber vine rust against both Australian target species. Our aligned research interests enhance the overall value and likelihood of achieving desired outcomes.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase I, Native range exploration & Phase IV, Monitoring and evaluation

Lead agency: QDPI

Agencies involved/project participants: Centre for Agriculture and Biosciences International (CABI)

Identified research priorities for *Cryptostegia grandiflora* and *Cryptostegia madagascariensis* biocontrol program: Establishment and impact of the previously released biocontrol agents for *C. grandiflora* and *C. madagascariensis* are believed to be limited by environmental conditions in some regions. Assessment of the current distribution and quantification of the impact of the previously released agents is warranted to determine where additional biocontrol agents may provide improved management outcomes. New exploration, guided by genetic comparison of invasive and native range populations, followed by habitat suitability modelling, are expected to determine targeted regions in the native range to search for new agents that are both climatically and genetically matched to populations in Australia. Stem and root feeding agents that improve the impact from the current agents should be prioritised.

Key research activities (Phase I native range exploration)	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Molecular characterisation of *C. grandiflora* and *C. madagascariensis* populations in both the invasive and					

Key research activities (Phase I native range exploration)	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
native range to target areas for native range surveys.					
Conduct species bioclimatic distribution modelling to identify where best suited candidate biocontrol agents will be found in the native range.					
Engage a native range research organisation to collaborate on exploration for potential biocontrol agents for the target weed species.					
Conduct native range surveys of prioritised areas of *C. grandiflora* and *C. madagascariensis* over multiple seasons to ensure the breadth of potential arthropods and fungi are encountered.					
Identify and catalogue arthropods and fungi from surveys using relevant taxonomists and molecular tools.					
Engage CABI UK to screen *M. cryptostegiae* rust strains recently collected and preserved to determine pathogenicity on rubber vine from Australia.					
Import at least one potential agent into quarantine – ready for the next phase of the biocontrol RD&E pipeline.					

Key research activities (Phase IV monitoring and evaluation)	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Conduct field surveys to determine the current distribution and impact of previously released agents across the invasive range of both target rubber vine species. Including surveys for any non-target impact on closely related species that grow within the same regions as the target species.					

Key research activities (Phase IV monitoring and evaluation)	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Sample rubber vine rust from Australian *C. grandiflora* and *C. madagascariensis* populations and conduct genetic analysis to detect whether both released *M. cryptostegiae* strains are currently present. If different strains are found, quantify the impact on each of the target species.					
Conduct laboratory and field trials to determine the optimal environmental conditions that maximise the impact of biocontrol agents currently present, on each of the target species.					
Guided by the results of the previous activities, conduct species bioclimatic distribution modelling to identify whether redistribution of the current agents is warranted and where they are most likely to have successful establishment and impact.					

Key Outputs

- Phase I Native range exploration. Molecular characterisation of *C. grandiflora* and *C. madagascariensis* in the native and invasive Australian range, with the area of origin in the native range delimited for each species.
- A catalogue of candidate agents from native range exploration compiled for each target rubber vine species, including putative species identification and genomic barcodes where relevant.
- Results of field investigations to detect any impact from candidate agents on closely related species in the native range as a preliminary screening for potential non-target impact on Australian native and economically important species.
- A selection of those candidate agents that are likely to be well-matched with environmental conditions across the invasive range in Australia.
- The biology of impactful candidate agents described, including lifecycle, developmental time, optimal temperature, humidity and light intensity for development. These details are needed to develop quarantine laboratory cultures for risk assessment in Australia.
- At least one candidate agent imported into Australian quarantine.

Phase IV monitoring and evaluation

- Molecular characterisation of *Maravalia cryptostegiae* rust strains currently present in Australia on each target species.
- Mapping of the current distribution of biocontrol agents in Australia and subsequent habitat suitability modelling based upon bioclimatic data from the established distribution.
- Field and laboratory quantification of established biocontrol agent impacts on both target species with respect to growth rate and reproduction at different temperatures and water availability.

- Recommendations regarding the suitability and potential efficacy of mass rearing and redistribution of the current biocontrol agents, or for further development of inundative treatment methods using the currently available fungal pathogens where they are climatically suited.

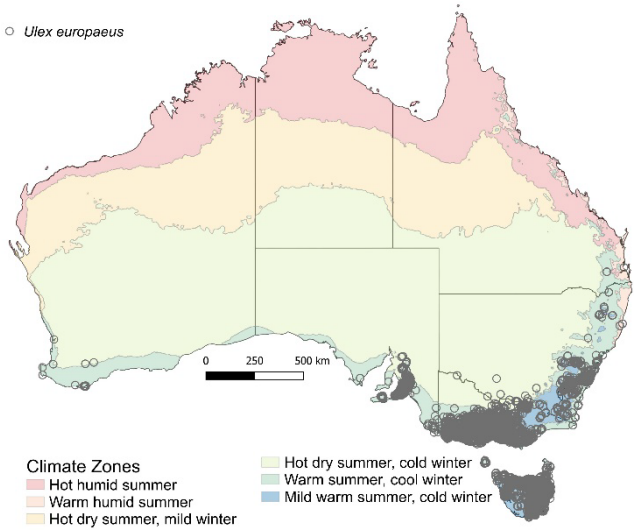
Expected outcomes after five years of RD&E investment:

- After five years of initial investment the weeds will be ready for Phase II research – testing a range of taxonomically related native and economically important species in Australia to determine if new biocontrol agents imported under Phase I research are host specific to the target weed species.
- Identification of optimal locations and methods for targeted redistribution of the current biocontrol agents.

Identified stakeholders

CABI UK – Plant pathology; local government NRM groups and other stakeholders throughout Queensland, the Northern Territory and Western Australia.

Ulex europaeus (Gorse)



Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact score /10	Invasiveness / 10	Weed threat / 100	Land use	Cultural weed
7.364	7.337	54.03	Production from dryland agriculture and plantations	Yes

Biocontrol prospects assessment summary

Weed Species	n	Feasibility Score	Likelihood Score	Biocontrol Prospects (%) Score	Biocontrol Prospects (%) Average
Ulex europaeus	3	0 2.5 5 7.5 10	0 2.5 5 7.5 10	0 25 50 75 100	45

Biocontrol assessors identified a need to revisit the native range exploration phase as at least two subspecies of the weed have been recently identified. Thus, native and invasive populations of *Ulex europaeus* need to be assessed, mapped and matched to delimit the area to search for new agents. This would include population genetic analysis to direct new exploration efforts.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Ulex europaeus*
Conflicts of interest	*Ulex europaeus* was approved for biocontrol in Australia in 1995, led by the Tasmanian Institute of Agricultural Research and other state departments. The approval process did not reveal any specific conflicts of interest or legal disputes, and it drew on previous research from New Zealand. Overall, the initiative proceeded without significant controversy.

Considerations	Summary and recommended outcomes for *Ulex europaeus*
Management goals	The primary management goal for gorse biocontrol in Australia is to reduce its spread and impact, focusing on decreasing plant vigour, seed production, and the seed bank. There is strong alignment between biocontrol prospects and management goals, as agents like the gorse seed weevil, gorse soft shoot moth, gorse thrips, and gorse spider mite target complementary stages of the weed's life cycle. However, ongoing research is essential to optimize their effectiveness and ensure they work alongside other control methods.
Biocontrol complementarity	Biocontrol can enhance existing weed management strategies by significantly reducing the seed banks of *U. europaeus* infestations. Agents such as the gorse soft shoot moth, thrips and spider mites weaken gorse plants, facilitating their control through other techniques. Continuous monitoring of these agents helps optimize management practices and ensures long-term effectiveness in controlling invasive species.
Knowledge gaps and research opportunities	Key knowledge gaps hindering biocontrol research include a lack of understanding of genetic variation within populations, insufficient host-specificity testing for biocontrol agents, and limited data on the long-term impacts of these agents. To fill these gaps, research activities should focus on genetic assessments of *U. europaeus*, expanded host-specificity testing, longitudinal impact studies, phenological research, and integrated management trials that combine biocontrol with other techniques. While a suite of agents has been introduced into Australia, not all are widely established across the weed's distribution. Opportunities to re-distribute the less-well established agents, such as the gorse soft shoot moth, should be implemented. Addressing these areas will enhance the effectiveness and confidence in biocontrol strategies for weed management.
Investment complementarity	In Australia, biocontrol efforts against *U. europaeus* have been largely funded by several agencies including the Australian Government through DAFF, state governments (Tasmania, Victoria) and industry (MLA). Currently there is no funded project investigating new biocontrol agents or redistributing and monitoring existing agents.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase I, Native range exploration

Lead agency: Agriculture Victoria

Agencies involved/project participants: European research partner (e.g., CABI)

Identified research priorities for *Ulex europaeus* biocontrol program: The identified research priorities are focussed on revisiting native range exploration research due to the recent identification of at least two subspecies. Key actions include assessing and mapping native and invasive gorse populations, conducting population genetic analyses, and documenting introduced agents. There is a need to survey natural enemies in the native range and assess gaps based on comparative analyses. Additionally, priorities include identifying and evaluating natural enemies, developing and screening a test list of high-priority agents, obtaining import permits, and initiating host-specificity testing in quarantine for the highest priority species.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Map the genetic variation of Australian weed populations and					

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
document observations of introduced agents.					
Map the genetic variation in native range *U. europaeus* populations and conduct a comparative analysis with Australian invasive populations.					
Survey natural enemies in the native range, targeting areas with identified gaps and areas prioritised by population comparative analysis.					
Natural enemy identification and prioritisation, including evaluation of agents/genetic populations introduced elsewhere (e.g., *Pempelia* sp. in New Zealand).					
Develop test list and screen (e.g. through preliminary host-specificity screening of important lupin cultivars) high priority natural enemies prior to importation.					
Obtain import permits. Culture weed/non-target species in Australia. Iteratively update test list based on stakeholder input and agent/s.					
Import highest priority agent/genetic population and commence host-specificity testing in Australian quarantine.					

Key Outputs

- An understanding of *U. europaeus* populations in Australia and their origins within Europe.
- Results of natural enemy surveys across targeted regions of the weed's native range.
- Recommendations for new agents/genetic populations for future Phase II research.
- Results of initial host-specificity testing for at least one agent/genetic population.
- Documentation of the distribution of *U. europaeus* biocontrol agents in Australia.

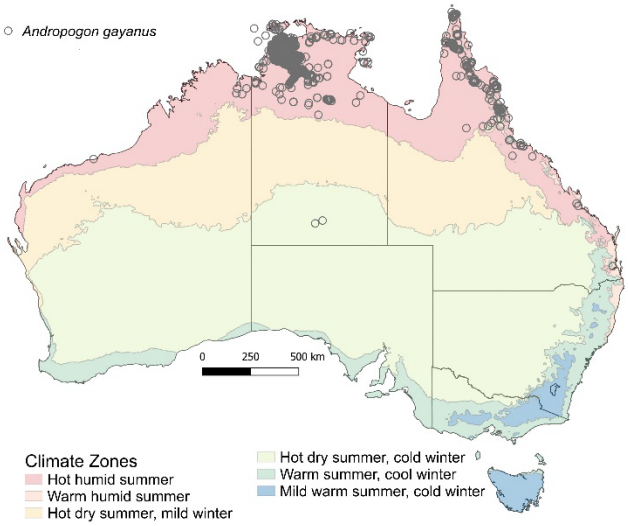
Expected outcomes after five years of RD&E investment

Ulex europaeus biocontrol Phase I completed, and candidate agents/genetic populations identified to progress to Phase II. At least one new biocontrol agent/genetic population in development and entering Phase II.

Identified stakeholders

State government agriculture and conservation departments (New South Wales, Victoria, Tasmania, South Australia), NRMs, public land managers (e.g., Parks Victoria), producers, MLA, local government, Landcare and community-based NRM groups.

Andropogon gayanus (Gamba grass)



Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact score / 10	Invasiveness / 10	Weed threat / 100	Land use	Cultural weed
8.416	6.670	56.13	Conservation and natural environments	Yes

Biocontrol prospects assessment summary

Weed Species	n	Feasibility Score	Likelihood Score	Biocontrol Prospects (%) Score	Biocontrol Prospects (%) Average
Andropogon gayanus	3	0 2.5 5 7.5 10	0 2.5 5 7.5 10	0 25 50 75 100	46

Systematic native range exploration research needed, as *Andropogon gayanus* has not been investigated as a biocontrol target previously. Population genetic analysis of the grass is needed to direct exploration efforts in the African native range.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Andropogon gayanus*
Conflicts of interest	Gamba grass is a Weed of National Significance and it is declared throughout northern Australia but is also utilised by some in the pastoral industry. Ongoing conflicts of interest will need to be managed by regular communication of research activities with the pastoral industry. *Andropogon gayanus* was endorsed as a candidate for biocontrol research by the EIC in 2022. Project initiation should include planning for new research program that includes a stakeholder engagement phase to define management goals in parallel to native range exploration surveys of candidate biocontrol agents throughout Africa. Exploratory surveys will focus on prospective biocontrol agents that reduce seed

Considerations	Summary and recommended outcomes for *Andropogon gayanus*
	production and biomass rather than palatability or foliage quality, so the beneficial qualities of these weeds can be maintained even after a biocontrol agent is released.
Management goals	Strong alignment of biocontrol prospects with overall management goals for the target weed, with a focus on candidate agents that attack seed production and the culm region to reduce the height but not palatability of foliage.
Biocontrol complementarity	There are existing control options (chemical and mechanical), but the weed is frequently able to regenerate following control and continues to spread to new areas outside of the core management zones in northern Australia due to high seed production and rapid spread. Biocontrol agents targeting inflorescence production may result in broadscale decline in seed set, leading to reducing invasion risk across the weed's range.
Knowledge gaps and research opportunities	Key knowledge gaps, including the need for population genetics and climatic analysis to prioritise areas in the native range for exploration, can be readily resolved through targeted research during the implementation-planning phase.
Investment complementarity	No existing research investments identified for *A. gayanus*. Commence implementation planning for a new research program.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase I, Native range exploration research

Lead agency: CSIRO

Agencies involved/project participants: Northern Territory government, Northern Land Council and Rio Tinto

Identified research priorities for *Andropogon gayanus* biocontrol program: Population genetic study of native populations in South Africa and Zimbabwe, grass phylogeny and host test list, defining management goals, native range surveys, establishing cultures and prioritization of agents based on the preliminary host testing in South Africa.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Stakeholder consultation and defining management goals.				If Phase I native range exploration research identifies candidate agents for Phase II risk assessment, engage stakeholders for further RD&E investment.	
Collection of *A. gayanus* samples in Australia and South Africa, molecular characterization and population genetics studies.					
Native range surveys and prioritization of agents for preliminary host testing.					
Grass phylogeny studies completed and development of a host test list using the decision support tool – PhyloControl.					

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Identify and catalogue arthropods and fungi from surveys using relevant taxonomists and molecular tools.					
Establish cultures of potential agents that are found to be host specific based on field host range surveys.					
Conduct preliminary host testing to prepare for importation of potential agents into Australian quarantine for the next phase of research.					

Key Outputs

- Management goals defined for areas of *A. gayanus* infestation in consultation with land managers and producers.
- Molecular characterisation in the native and invasive Australian range, with area of origin in the native range delimited.
- A catalogue of candidate agents from native range exploration, including putative species identification, observed impact, and field host range testing.
- A culture of potential agents established, pending results of field host range surveys.
- Preliminary host-specificity testing completed for at least one candidate agent, pending results of field host range surveys.

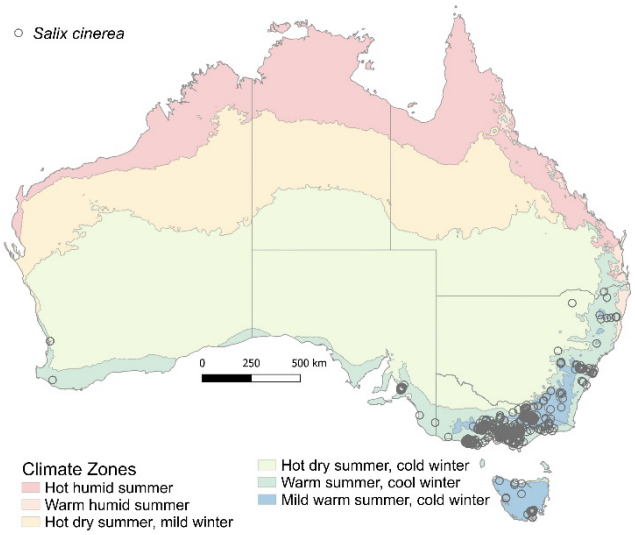
Expected outcomes after three years of RD&E investment

After three years of Phase I native range exploration research investment, it should be known if there are prospective candidate agents for *Andropogon gayanus* that warrant Phase II risk assessment. Prospective agents will have been identified from native range populations which are a genetic match, and which are collected from areas in the native range that are of a similar climate to Australian invasive populations. This increases the likelihood that if candidate agents are found to be sufficiently host specific, they will be able to establish self-sustaining populations across the Australian landscape.

Identified stakeholders

Mining companies (e.g. Inpex, Rio Tinto), State government agriculture and conservation departments (Northern Territory, Queensland, Western Australia), NRMs, public land managers (e.g., Parks Australia), producers, MLA, local government.

Salix cinerea (Grey sallow)

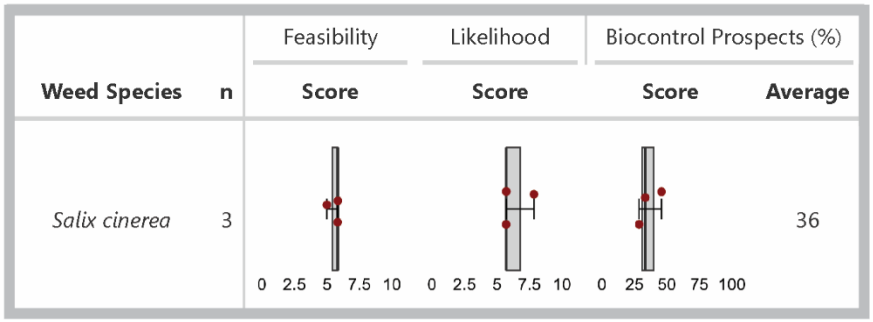


Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact score /10	Invasiveness / 10	Weed threat / 100	Land use	Cultural weed
8.942	8.004	71.57	Water	No

Biocontrol prospects assessment summary



Salix cinerea is a novel biocontrol target in Australia, thus a comprehensive targeted native range research program is needed to catalogue and identify prospective biocontrol agents.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Salix cinerea*
Conflicts of interest	*Salix cinerea* is a highly invasive species causing significant ecological damage to riparian and wetland habitats. Its control is essential for protecting environmental assets, such as biodiversity and water quality and availability. However, willows, as a species group, may also have economic value (e.g. they can be used for erosion control and ornamental plants). *Salix cinerea* belongs to a separate subgenus from tree willows and alpine willows, which are the major ornamental and economic plants. *Salix alba var. vitellina* (Indian Willow) and *S. alba caerulea* (English Willow) produce wood used for cricket bats whereas the wood produced by *S. cinerea* is not well-suited for cricket bat manufacture. Nonetheless this dual role can create conflicts (and perceived conflicts) between environmental management goals and economic interests.

Considerations	Summary and recommended outcomes for *Salix cinerea*
	Implementation planning for a new research program must include stakeholder-engagement and nomination of the weed as a candidate for biocontrol research.
Management goals	*Salix cinerea* has high capacity for resilience to attack by candidate agent/s (e.g. through resprouting from cuttings and branches or seeds that readily disperse long distances). This resilience enables recovery from damage unless it is very severe and sustained over many years. An agent that attacks the catkins and reduces seed spread will assist in the integrated control of this weed. Other forms of attack such as leaf defoliation will reduce plant health if sustained over the long term.
Biocontrol complementarity	Manual and mechanical removal and herbicides are effective control options, but seed spread over long distances means that the simultaneous control of seed production across all infestations, possible with biocontrol, offers the only permanent solution to this weed problem.
Knowledge gaps and research opportunities	Some key knowledge gaps were identified that can be readily resolved through targeted research during the implementation-planning phase. Because naturalised *Salix* in Australia readily hybridise and form complex combinations, partial targeting of willows for biocontrol in Australia could fail if taxa suppressed by biocontrol are replaced by less affected taxa. Literature surveys have identified some potential biocontrol agents, including two fungal pathogens present in Australia, but further native range surveys are required to identify agents that are best suited to targeting management outcomes. Research opportunities include population genetics and climatic analysis to prioritise areas in the native range for further exploration to prioritise agents that will have the greatest control of spread and current weed impacts.
Investment complementarity	No existing research investments identified for *S. cinerea*. Natural Resource Management Agencies and Catchment Management Authorities have had responsibility for control programs to protect waterways. Commence implementation planning for new research program.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase I, Native range exploration research

Lead agency: Agriculture Victoria

Agencies involved/project participants: CABI (UK and Switzerland)

Identified research priorities for *Salix cinerea* biocontrol program: This project aims to import at least one candidate biocontrol agent for *S. cinerea* in preparation for Phase II risk assessment. This research will build on published literature that identified some potential natural enemies in both the native and invaded range of this weed. Native range surveys will be guided by this work and supplemented with population genetics to target geographic regions within the large native range that are the closest genetic match to the Australian infestations.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Stakeholder-engagement and nomination of the weed as a candidate for biocontrol research.					

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Sampling and population genetics of Australian weed populations and associated fungal pathogens.					
Sampling and population genetics of European *S. cinerea* populations for comparison with Australian populations.					
Native range surveys for natural enemies and field host range studies on sympatric Salicaceae species.					
Identify and catalogue arthropods and fungi from surveys using relevant taxonomists and molecular tools.					
Prioritisation of new agents for future Phase II research.					
Characterise the biology of candidate agents in European laboratories to determine if they can be cultured under restrictive quarantine conditions in Australia.					
Preparation of import permits.					
Import at least one candidate agent into quarantine – ready for the next phase of the biocontrol RD&E pipeline.					

Key Outputs

- Molecular characterisation of *Salix cinerea* in the native and invasive Australian range, identifying geographic areas that most closely match genomics of Australian infestations.
- A catalogue of candidate agents from native range exploration, including putative species identification, genomic barcodes where relevant, and observed plant host-range associations on co-occurring relatives.
- The biology of impactful candidate agents described, including lifecycle, developmental time, optimal temperature, humidity and light intensity for development. These details are needed to develop quarantine laboratory cultures for risk assessment in Australia.
- At least one candidate agent imported into Australian quarantine.

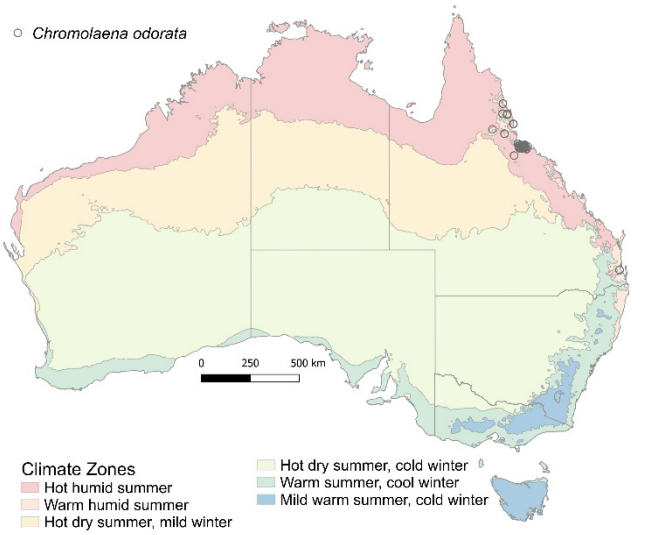
Expected outcomes after five years of RD&E investment

Salix cinerea biocontrol Phase I completed, and candidate agents identified to progress to Phase II.

Identified stakeholders

Nursery and Garden Industry, Land managers, waterway authorities and managers, Catchment Management Authorities (Victoria), Local Land Services (New South Wales), Tasmanian NRMs, State and local governments.

Chromolaena odorata (Siam weed)



Occurrence of *Chromolaena odorata* in Northern Territory confirmed in 2019 but these data are not presented in the map.[14]

Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact score / 10	Invasiveness / 10	Weed threat / 100	Land use	Cultural weed
8.416	7.337	61.75	Production from dryland agriculture and plantations	Yes

Biocontrol prospects assessment summary

Weed Species	n	Feasibility Score	Likelihood Score	Biocontrol Prospects (%) Score	Biocontrol Prospects (%) Average
Chromolaena odorata	4	0 2.5 5 7.5 10	0 2.5 5 7.5 10	0 25 50 75 100	60

Chromolaena odorata has been the target for biocontrol research in Africa and the Asia Pacific, resulting in numerous prospective agents being released or investigated to some degree by overseas organisations. Australia has already benefited from such research, through the fast-tracking of the host-specificity testing and risk assessment of the stem-galling fly *Cecidochares connexa,* completed in 2018 and subsequently approved and released in Queensland and the Northern Territory. Australia can continue to leverage such research conducted overseas to explore additional biocontrol agents to complement *C. connexa*. Supplementary host-specificity testing is required to assess risk for release in the Australian context.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Chromolaena odorata*
Conflicts of interest	*Chromolaena odorata* has already undergone stakeholder engagement, first as a target for eradication beginning in 1995, then as a target for biocontrol beginning in 2012. One biocontrol agent, the stem-galling fly *C. connexa*, has been released on this weed in Australia between 2019 – 2024 in Queensland and 2019 to present in the Northern Territory. As there are no conflicts of interest for this species, implementation planning for a new research program can commence immediately.
Management goals	Management goals should seek to target all weed life stages to impede plant growth, break up damaging monocultures and slow invasive range expansion. Multiple defoliating, stem boring and flower-feeding agents have been released globally which can contribute to these goals on local and landscape scales. Implementation planning for a new research program can commence immediately.
Biocontrol complementarity	Existing traditional control options, including slashing, herbicide treatment and burning, do not provide long-term control and can be expensive and time-consuming at a landscape scale. *Cecidochares connexa* attacks both mature and juvenile plants, predominately resulting in the reduction of seed production. Australian endemic leaf-spot fungal diseases can also cause widespread defoliation to *C. odorata*, particularly in the dry tropics, although this has not been quantified extensively. Additional biocontrol agents attacking different parts of the plant or at different stages of the plant's lifecycle would assist with reducing weed populations and preventing monocultures.
Knowledge gaps and research opportunities	Two known invasive "biotypes" of *C. odorata* exist globally (Asian-West African biotype 'AWAB' and South African biotype 'SAB'). *Chromolaena odorata* invasive in Australia is believed to be the AWAB, but population genetics work is required to confirm this. This is an essential first step for selecting candidate agents since, in a global context, several effective agents released on AWAB populations have failed to establish on SAB populations. Candidate agents that have been released globally, or investigated by overseas organisations as prospective agents, could be evaluated in an Australian context. These agents would complement existing biocontrol and endemic leafspot diseases impacting *C. odorata* in Australia.
Investment complementarity	There are no existing research investments. New investment would support population genetics studies into the origin of invasive weed populations in Australia and structured field surveys of the impact of the stem-galling fly on the weed. The data derived from these studies would inform the selection of the next candidate agent species for host-testing in Australia, which would also require new research investments to complete.

Five-year RD&E plan

Phase(s) of the weed biocontrol RD&E pipeline: Phase II, Risk assessment & Phase IV, Monitoring and Evaluation

Lead agency: QDPI

Agencies involved/project participants: QDPI & Northern Territory Government

Identified research priorities for *Chromolaena odorata* biocontrol program: The stem-galling fly, *C. connexa,* has been released in Queensland and the Northern Territory, monitoring and evaluation is now needed to determine the impact it is having on *C. odorata*. There are several candidate agent species, either released globally or investigated

by overseas organisations as prospective agents for *C. odorata* control, which Australia could explore. *Pareuchaetes pseudoinsulata* (defoliating Erebid moth) has been released and is established in the Asia Pacific (including Papua New Guinea) where it is proven to be effective. *Conotrachelus reticulatus* (stem-galling beetle) and *Carmenta chromolaenae* (stem-feeding Sesiid moth) have been investigated by Agriculture Research Council South Africa.

Key research activities (Phase II risk assessment)	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Molecular characterisation of weed populations in Australia to confirm biotype/variety with published literature (Asian/West African or South African).					
Habitat suitability modelling to confirm compatibility of candidate agents with Australian environment.					
Development of a host test list using the decision support tool – PhyloControl.					
Engage with organisations (West Africa, Papua New Guinea, or Philippines etc.) to collaborate on exploration, collection and exportation of *P. pseudoinsulata* Erebid moth agent.					
Import *P. pseudoinsulata* into quarantine, establish a colony and commence host-specificity screening of up to 20 test list species.					
Provided risks to non-target plants are acceptable, submit application to Commonwealth regulators seeking approval to release *P. pseudoinsulata.*					
Engage with organisations (South Africa or Venezuela) to collaborate on exploration, collection and exportation of stem-galling beetle, *C. reticulatus* or stem-feeding Sesiid moth, *C. chromolaenae.*					
Import either *C. reticulatus* or *C. chromolaenae* into quarantine, establish a colony and commence host-specificity screening of up to 40 test list species.					
Provided risks to non-target plants are acceptable, submit application to Commonwealth regulators seeking approval to release the agent.					

Key research activities (Phase IV monitoring and evaluation)	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Build upon existing research on the impact and establishment of *C. connexa* in northern Australia.					
Monitor spread of *C. connexa* across new invasive range of *C. odorata* in northern Australia.					
Survey and record presence and impact of leafspot pathogen on *Chromolaena* present in northern Australia.					

Key Outputs

- Molecular characterisation of *Chromolaena odorata* in invasive Australian range, and provenance confirmation of biotype AWAB or SAB, with published literature.
- Habitat suitability modelling of prospective agents to prioritise agents based on suitability to Australian environment.
- *Pareuchaetes pseudoinsulata* imported into Australian quarantine and a culture established, with host-specificity screening of up to twenty close *Chromolaena* relatives. If appropriate, application submitted to the Commonwealth regulators seeking approval for release of the agent.
- A second prospective biocontrol agent (*C. reticulatus* or *C. chromolaenae*) imported into Australian quarantine and culture established, with host-specificity screening of up to forty close *Chromolaena* relatives. If appropriate, application submitted to the Commonwealth regulators seeking approval for release of the agent.
- Comprehensive distribution data and map for the expanded invasive range of *C. odorata* in northern Australia.
- Expand expertise in biocontrol research in the Northern Territory through collaborative mentorship and training in monitoring and impact evaluation methodology.
- Distribution, population and seasonal data on the gall fly, *C. connexa*.
- Prioritised localities for additional biocontrol agent release.
- Assessment of established leafspot pathogens and compatibility with existing and future biocontrol agents.

Expected outcomes after five years of RD&E investment

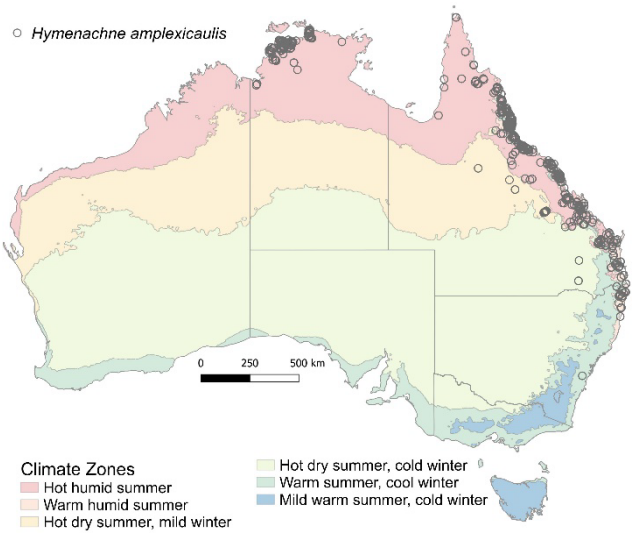
After five years of Phase II risk assessment, it is anticipated that one prospective candidate agent will be host-tested comprehensively, and if demonstrated to be sufficiently host-specific, an application to release them in the Australian context will be prepared and submitted to federal regulators. It is anticipated that the host-testing of a second prospective candidate agent would be well progressed and nearing completion.

Two years of Phase IV monitoring and evaluation is anticipated to provide a more detailed understanding of the gall fly distribution and factors that influence establishment and impact of the agent on invasive weed populations. Capacity within the Northern Territory to undertake monitoring and evaluation of biocontrol programs will have increased substantially.

Identified stakeholders

Charters Towers Regional Council, Burdekin Shire Council, Townsville City Council, Cairns Regional Council, Cassowary Coast Regional Council, Hinchinbrook Shire Council, Mareeba Shire Council, Tablelands Regional Council, Douglas Shire Council, Queensland Parks and Wildlife, Queensland Mains Roads, Department of Defence, and Northern Territory Government.

Hymenachne amplexicaulis (Olive hymenachne)



Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact score / 10	Invasiveness / 10	Weed threat / 100	Land use	Cultural weed
7.890	6.670	52.63	Water	Yes

Biocontrol prospects assessment summary

Weed Species	n	Feasibility Score	Likelihood Score	Biocontrol Prospects (%) Score	Biocontrol Prospects (%) Average
Hymenachne amplexicaulis	3	0 2.5 5 7.5 10	0 2.5 5 7.5 10	0 25 50 75 100	58

Preliminary host use characterisation of a sap-feeding bug (*Ischnodemus variegatus*) undertaken in Florida, but no specific risk analysis undertaken for the Australian context. Supplementary exploratory work likely required to recollect *I. variegatus* and catalogue any additional candidate biocontrol agents.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Hymenachne amplexicaulis*
Conflicts of interest	*Hymenachne amplexicaulis* was declared a Weed of National Significance in 1999 and is a category 3 restricted invasive plant under the Queensland Biosecurity Act 2014. No significant conflicts of interest identified, but this must be investigated further with targeted stakeholder engagement and a nomination for the weed to be endorsed as a target for biocontrol. Commence implementation planning for a new research program that includes a stakeholder engagement phase and nomination of the weed as a candidate for biocontrol research.
Management goals	The desired biocontrol management outcomes for *H. amplexicaulis* are articulated in management plans, such as the need to reduce the overall biomass of the weed in

Considerations	Summary and recommended outcomes for *Hymenachne amplexicaulis*
	wetland environments. Strong alignment of biocontrol prospects with overall management goals for this weed, commence implementation planning for new research program.
Biocontrol complementarity	Management of this weed through biocontrol could offer control without the environmental threats posed by other measures, especially herbicides in areas of ecological and cultural significance. It is worth noting however, that the complementarity of biocontrol with controlled burns would need to be assessed.
Knowledge gaps and research opportunities	Some key knowledge gaps identified can be readily resolved through targeted research during the implementation-planning phase. These include risk-assessment research on the sap-feeder, *I. variegatus*, which provides a starting point for testing to begin in the Australian context. There is also a need to clarify the taxonomy and invasion origin of the Australian weed populations and the USA populations on which *I. variegatus* was tested for biocontrol. *Hymenachne amplexicaulis* is also considered invasive in Florida, thus population genetics on weed samples used for host-specificity testing in Florida, on Australian invasive populations, and across its native range in South America, is a requisite step to confirm weed taxonomy before resources are invested into importing, rearing and testing any agent, including *I. variegatus*. The phylogenetic relationships among species in the genus, and the phylogenetic placement of the genus in the Poaceae family, also need to be resolved to develop a rigorous test list for risk assessment.
Investment complementarity	No formal investment in the biocontrol of *H. amplexicaulis* has been pursued in Australia. Commence implementation planning for new research program.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase II, risk assessment

Lead agency: CSIRO

Agencies involved/project participants: Fundación Para El Estudio de Especies Invasivas, Argentina (FuEDEI)

Identified research priorities for *Hymenachne amplexicaulis* biocontrol program: Identification and preliminary risk-assessment of a prospective candidate agent from the invasive distribution of a target weed is an uncommon starting point for a biocontrol project. This weed has been prioritised as a Phase II project due to the level of detail known about *I. variegatus*, as such several key research activities that would normally be undertaken in a Phase I project, such as nomination of the weed as a biocontrol target, molecular characterisation of native and invasive populations and bioclimatic modelling need to be undertaken. The priority for collection of the candidate agent, *I. variegatus*, should be from *H. amplexicaulis* populations that are genetically and climatically similar to Australian invasive populations.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Stakeholder engagement, literature review and drafting of nomination of *H. amplexicaulis* as a biocontrol target to EIC – STOP/GO.					
Molecular characterisation of *H. amplexicaulis* populations in both the					

invasive and native range to prioritise areas for exploration in South America.					
Bioclimatic distribution modelling to identify where best suited candidate biocontrol agents will be found in the native range.					
Development of a host test list using the decision support tool – PhyloControl.					
Engage native range research organisation (FuEDEI) to collaborate on exploration of *H. amplexicaulis* and collection of the sap-feeder, *I. variegatus.*					
Conduct native range exploration surveys of prioritised areas of the weed's native range, with a focus on collecting *I. variegatus.*					
Develop a laboratory culture of *I. variegatus* for export to Australian quarantine.					
Identify and catalogue arthropods and fungi from surveys using relevant taxonomists and molecular tools.					
Import *I. variegatus* into quarantine, establish a colony and commence host-specificity screening of up to 25 test list species.					
Provided risks to non-target plants are acceptable, submit application to Commonwealth regulators seeking approval to release *I. variegatus.*					

Key Outputs

- Nomination of *H. amplexicaulis* as a target for biocontrol compiled and submitted to the Environment and Invasives Committee for consideration. This is a STOP/GO output upon which all other outputs are dependent.
- Molecular characterisation of *H. amplexicaulis* in the native and invasive Australian range, with area of origin in the native range delimited.
- Bioclimatic modelling of *H. amplexicaulis* to determine the area of climatic similarity to focus native range exploration.

- A catalogue of candidate agents from native range exploration compiled, including putative species identification, genetic barcodes where relevant, observed impact on *H. amplexicaulis* and observed plant host-range associations on co-occurring hymenachne relatives.
- *Ischnodemus variegatus* imported into Australian quarantine and a culture established.
- Host-specificity screening of up to twenty-five close *H. amplexicaulis* relatives.

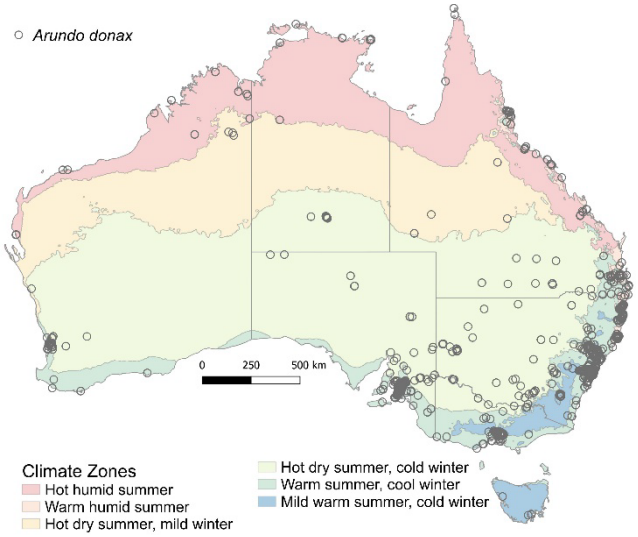
Expected outcomes after five years of RD&E investment

After five years of Phase II risk assessment, it is anticipated that, pending sufficient host-specificity, an application to release *I. variegatus* will have been submitted for approval. If this candidate agent is not sufficiently host-specific, opportunistic native range exploration research undertaken while collecting *I. variegatus* will have catalogued alternative identified arthropod or fungal candidates.

Identified stakeholders

Regions in Queensland, the Northern Territory and New South Wales where *H. amplexicaulis* is a priority for either asset protection or containment, private irrigation corporations and water management authorities.

Arundo donax (Giant reed)

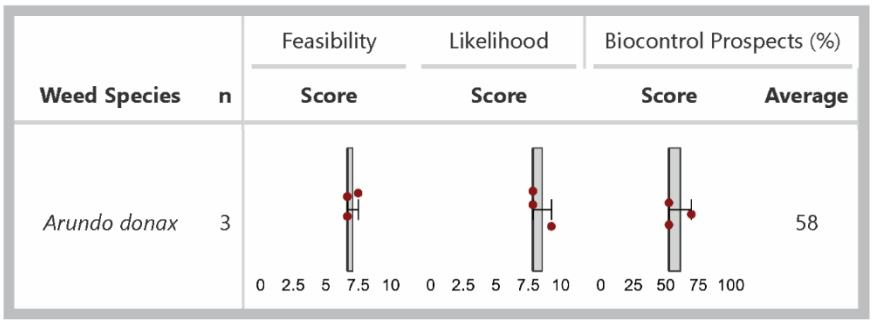


Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact score / 10	Invasiveness / 10	Weed threat / 100	Land use	Cultural weed
8.416	6.003	50.52	Conservation and natural environments	No

Biocontrol prospects assessment summary



Two agents successfully established in the USA could be risk assessed in Australia. Candidate agents include a shoot-tip galling wasp *Tetramesa romana,* and an armoured scale *Rhizaspidotus donacis.*

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Arundo donax*
Conflicts of interest	Moderate conflict identified. *Arundo donax* is listed as a pest plant regulated by general biosecurity duty under the NSW *Biosecurity Act 2015* with Regional Recommended Measures or Containment, Eradication and Asset Protection dependent on the area and size of infestation. *Arundo donax* is declared under the *Landscape South Australia Act 2019* throughout the whole of the State of South Australia. *Arundo donax* has been earmarked as a viable biofuel, biochar or carbon sequestration crop, with several interested parties in South Australian investigating options to grow the plant for these purposes under permit. Project initiation should include planning for a new research

Considerations	Summary and recommended outcomes for *Arundo donax*
	program that includes a stakeholder-engagement phase and nomination of the weed as a candidate for biocontrol research as a priority.
Management goals	Strong alignment of biocontrol prospects with overall management goals for the target weed. The desired management outcomes for this weed are well articulated in management plans. Commence implementation planning for new research program to builds on research in USA.
Biocontrol complementarity	There are existing control options (mechanical and chemical), but they have limitations. Mechanical options through large scale works risks damage to vulnerable riparian habitats. If used at a smaller scale, this involves manual work in difficult terrain. For herbicides, these usually require multiple applications to be successful, which increases the chances of off-target damage and plants missed. Given this, biocontrol is not just complementary it would be the preferred method, enhancing overall management outcomes (e.g. in environmentally sensitive riverine habitats).
Knowledge gaps and research opportunities	No significant knowledge gaps identified at this stage. Recommend commencing implementation planning for a new research program. Further knowledge on the host range of the two biocontrol agents (*T. romana* and *R. donacis*), their habitat suitability, and their impact on the two known clades of *A. donax* in Australia, will be revealed as part of pre-release testing in containment.
Investment complementarity	No existing research investments identified for *A. donax*. Commence implementation planning for new research program.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase II, risk assessment

Lead agency(s): New South Wales DPIRD

Agencies involved/project participants: USDA

Identified research priorities for *Arundo donax* biocontrol program: Population genetic analysis of invasive populations of *Arundo donax* in Australia should be undertaken to better understand the claims that it is clonal. Ecoclimatic modelling of both the weed and its potential biocontrol agents (including developmental threshold studies and degree-day modelling) will facilitate a better understanding of compatibility of the system throughout the invaded range. Two potential arthropod agents will be risk assessed concurrently, due to evidence from the USA of their synergistic impact.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Molecular characterisation of *Arundo donax* in the invasive range to understand its population genetics					
Ecoclimatic modelling of *A. donax* and its two biocontrol agents (*Tetramesa romana* and *Rhizaspidiotus donacis*) using Climex, to better understand their potential overlap in the invaded range.					

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Engage American research collaborators (USDA) to access biocontrol agents and the knowledge from their program in the USA.					
Import cultures of *T. romana* and *R. donacis* into Australian quarantine.					
Development of a host test list using the decision support tool – PhyloControl.					
Conduct host-specificity testing of *T. romana* and *R. donacis* in Australian quarantine.					
Conduct developmental threshold studies on *T. romana* and *R. donacis*, and degree-day modelling.					
If suitably host-specific, compile a release application for the candidate agents.					

Key Outputs

- Population genetics of *Arundo donax,* comparing this data to that available in GenBank to facilitate a better understanding of its invasion history.
- Development of an ecoclimatic model (CLIMEX) to better understand the potential distribution of the weed in Australia, as well as its prospective biocontrol agents (*T. romana* and *R. donacis*). This model will be strengthened through the development of a degree-day model for both agents.
- Importation and host-range testing of *T. romana* and *R. donacis* from the USA.
- Drafting of release applications, depending on the host-range testing results, and submission to the national regulator.

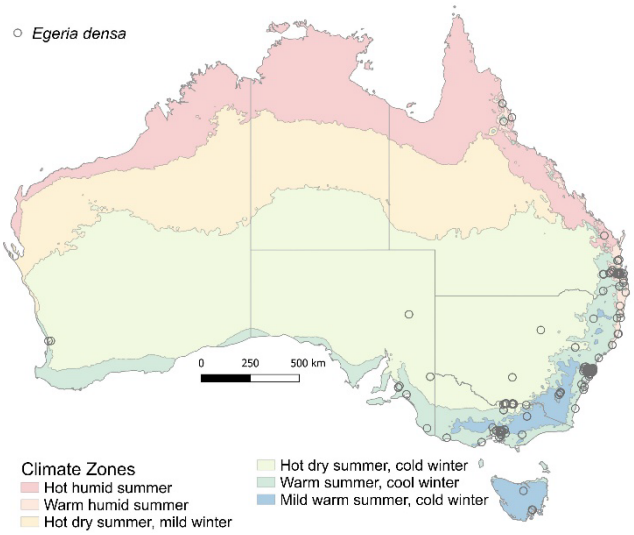
Expected outcomes after five years of RD&E investment

After five years of Phase II risk assessment investment, this project will generate a substantial knowledge base on the *A. donax* populations in Australia, as well as the potential of the two most promising biocontrol agents. Based on this, and the risk profile of the agents from detailed host-range testing, a decision will be made on whether a release application is submitted to the national regulator.

Identified stakeholders

Weed professionals in all affected states and territories.

Egeria densa (Dense waterweed)



Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact / 10	Invasiveness / 10	Weed threat / 100	Land use	Cultural weed
6.838	6.670	45.61	Water	No

Biocontrol prospects assessment summary

Weed Species	n	Feasibility Score	Likelihood Score	Biocontrol Prospects (%) Score	Biocontrol Prospects (%) Average
Egeria densa	3	0 2.5 5 7.5 10	0 2.5 5 7.5 10	0 25 50 75 100	63

Preliminary host-specificity testing of the leaf-mining fly, *Hydrellia egeriae,* for seven test plant species has been undertaken as part of a previous NSW Environmental Trust-funded project. Nomination of the weed as a candidate for biocontrol and refinement of a host-specificity test list are needed. Host testing of full list of non-target plant species is required to submit release application if *H. egeriae* is found to be sufficiently host specific.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Egeria densa*
Conflicts of interest	*Egeria densa* is a popular aquarium plant that is prohibited from sale in Tasmania, Western Australia, Northern Territory, South Australia and some regions of New South Wales. It is available for purchase in Queensland and areas of New South Wales not covered by the North West Regional Recommended Measure but in these areas *E. densa* is under a "general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose" or a "general biosecurity obligation". Project initiation should include planning for a new research program that focuses on developing host

Considerations	Summary and recommended outcomes for *Egeria densa*
	test list, completing host-specificity testing and nominating the weed as a candidate for biocontrol research as a priority.
Management goals	Strong alignment of biocontrol prospects with overall management goals for the target weed. Commence implementation planning for new research program to expand and complete host-specificity testing under quarantine conditions at the CSIRO.
Biocontrol complementarity	The existing control options (chemical and mechanical) are expensive and impractical to apply over a broad regional scale. Biocontrol will likely result in broadscale decline in *E. densa* growth in infested waterways and *H. egeriae* leaf-mining will target the weed's regenerative growth that follows chemical and mechanical control. Biocontrol can also be used safely in sensitive ecosystems where chemical application is undesirable.
Knowledge gaps and research opportunities	Some key knowledge gaps identified that can be readily resolved through targeted research during the implementation-planning phase. Recommend commence implementation planning for new research program that includes damage assessments of *H. egeriae* on weed populations under laboratory conditions.
Investment complementarity	No current research investments identified for *E. densa*. The NSW Environmental Trust invested in the first stage of research on the leaf-mining fly, *H. egeriae*. This investment finished in June 2024. There is no current investment available to develop a host test list, submit weed nomination, or to complete the host-specificity testing. Commence implementation planning for new research program.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase II, Risk assessment

Lead agency: CSIRO

Agencies involved/project participants: Fundación Para El Estudio de Especies Invasivas, Argentina (FuEDEI), Rhodes University South Africa

Identified research priorities for *Egeria densa* biocontrol program: This project focuses on the potential biocontrol of *E. densa* through the introduction of *H. egeriae* from Argentina. To achieve this, the project will involve further collections of *H. egeriae* in Argentina, or in South Africa where it has already been released, to replenish CSIRO cultures, followed by rigorous maintenance of healthy cultures under quarantine conditions in Brisbane. Comprehensive host-specificity testing will be conducted on non-target native and other important plant species to ensure the safety and specificity of *H. egeriae*. In parallel to host-specificity testing, *E. densa* will be nominated as a candidate for biocontrol. If *H. egeriae* is deemed sufficiently host-specific, a release application will be submitted. Supporting data will be generated through population genetic analysis of *E. densa* and phylogenetic analysis to strengthen the nomination document and release application.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29*	FY 29/30*
Submit nomination of *Egeria densa* as a target for biocontrol research.					
Development of a full host-specificity test list using decision support tool					

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29*	FY 29/30*
PhyloControl. Publication of list on DAFF website for public comment.					
Maintain quarantine colony of *Hydrellia egeriae* for host-specificity testing and reimport material from Argentina/South Africa to supplement the population as needed.					
Sourcing of test plants and host-specificity screening of up to 25 plant species.					
Draft a release application if *H. egeriae* is found to be sufficiently host specific.					

* Based on current project experience, a three-year program is projected to be enough time to complete leaf-mining fly, *H. egeriae* host-specificity testing. Translation of the program to Phase III mass rearing and release in the 2028/29 and 2029/30 FY will necessitate separate budget allocation and costing.

Key Outputs

- Nomination of *E. densa* as a target for biocontrol compiled and submitted to the Environment and Invasives Committee for consideration.
- Host test list developed and published in DAFF website for public consultation.
- Quarantine colonies of *H. egeriae* maintained, sourcing *E. densa* weed and additional insects imported from Argentina/South Africa to supplement the population as needed.
- Test plants sourced using the host test list guides focusing on areas where the target weed and non-target species have overlapping geographical distribution.
- Host-specificity screening of up to twenty-five non-target weeds closely related to the target weed completed.
- Dependent upon the host test results, an application to release *H. egeriae* will be submitted to regulators for approval prior to field releases.

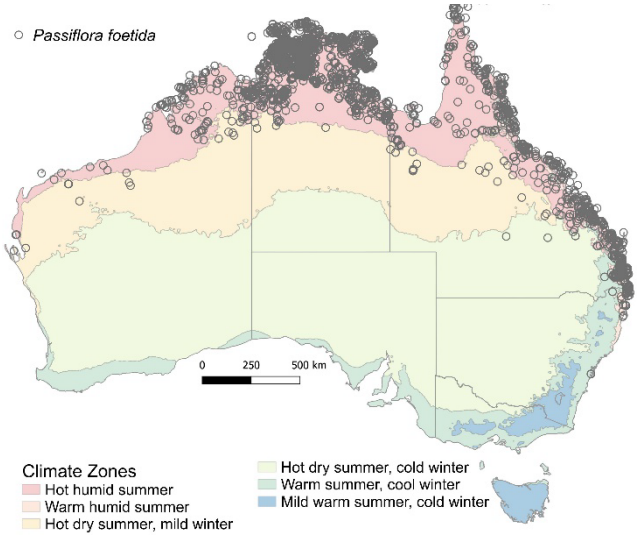
Expected outcomes after three years of RD&E investment

To have assessed the risk associated with *H. egeriae* to closely related native Australian plant species, resulting in permission to release a novel biocontrol agent for this weed.

Identified stakeholders

Regions in New South Wales, Queensland, Victoria and Tasmania where *E. densa* is a regional priority for either asset protection or containment, private irrigation corporations and water management authorities.

Passiflora foetida (Stinking passionflower)

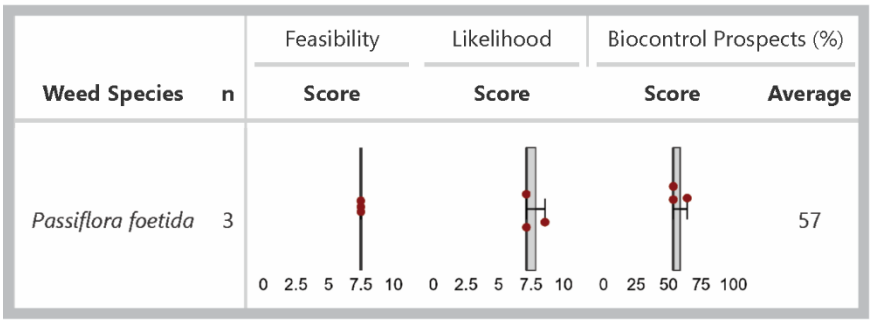


Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Not assessed for weed threat. A review of Healthy Country plans identified *P. foetida* as negatively impacting upon First Nations cultural values, but it was not nominated through the jurisdictional or open nomination process.

Biocontrol prospects assessment summary



A sap-sucking mirid (*Engytatus passionarius*) and stem-galling weevil (*Philonis inermis*) are currently undergoing host-specificity testing in Australian quarantine. Several other candidates have been identified during native range exploration surveys in Brazil and Colombia.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Passiflora foetida*
Conflicts of interest	*Passiflora foetida* was endorsed as a candidate for biocontrol in Australia in 2018. No significant conflicts identified. Commence implementation planning for a host-specificity testing program for *P. inermis* and possible mass-rearing and release program for *E. passionarius* if it is found to be sufficiently host specific.
Management goals	The primary management goals are to reduce the abundance of existing *P. foetida* infestations, to mitigate current impacts on associated assets such as areas of cultural significance, high tourism value, overtopping of sandalwood plantations, smothering of desirable vegetation in native forests, riparian habitats, mine rehabilitation areas and pastures. Any biocontrol program should also aim to mitigate risk of ongoing invasion by suppressing seed output. Achieving these multiple biocontrol management goals

Considerations	Summary and recommended outcomes for *Passiflora foetida*
	may necessitate multiple biocontrol agents with complementary modes of feeding damage. Strong alignment of biocontrol prospects with overall management goals for the target weed. Commence implementation planning for ongoing research that builds on past work.
Biocontrol complementarity	There are limited existing control options, resulting in poor management outcomes for *P. foetida*. Investment in biocontrol RD&E is considered a key need to achieve desired management outcomes.
Knowledge gaps and research opportunities	No significant knowledge gaps identified. Commence implementation planning for new research program.
Investment complementarity	One existing investment identified that finishes in mid-2026. Ensure new investments support complementary research activities. Where appropriate, foster collaborations across complementary investment streams.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase II, risk assessment

Lead agency: CSIRO

Agencies involved/project participants: Indigenous Ranger Groups (depending on agent mass release protocols), Western Australia Department of Biodiversity, Conservation, and Attractions (DBCA), resource companies, Natural Resource Management groups, agricultural landowners

Identified research priorities for *Passiflora foetida* biocontrol program: Phase II risk assessment will prioritise the stem-galling *P. inermis* weevil which has only recently been imported into Australian quarantine; no host-specificity testing has commenced. It is known that *P. inermis* has a protracted lifecycle where the larvae take ~90 days to complete development in the gall, thus host-specificity testing will take some time to complete as exposed test plant species will need to be maintained in quarantine for this duration to rigorously assess the potential risk. The sap-sucking mirid, *E. passionarius,* is nearing the end of the risk-assessment process, which should be completed within the timeframe of the existing funded project and thus is not included in the scope of the research activities outlined below. The scope will also include development of mass-rearing protocols for *E. passionarius*, should it be approved for release, along with preliminary releases at nursery release sites across Queensland, the Northern Territory and Western Australia and the monitoring of establishment, spread and impact at these sites. A monitoring and evaluation network has been established in Western Australia during the current project in consultation with First Nations groups and the DBCA will be used for nursery release sites. Additional nursery release sites across the Northern Territory and Queensland will be identified with relevant stakeholders.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Maintain quarantine colony of *Philonis inermis* weevil for host-specificity testing and reimport material from Colombia to supplement the population as needed.					
Source test plants and commence host-specificity screening of up to 35 test list species.					

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Draft an application to release if *P. inermis* is found to be sufficiently host specific.					
Development of mass-rearing protocols for *E. passionarius* mirid if it is approved for release.					
Identification of nursery release sites in Queensland, the Northern Territory and Western Australia working with First Nations groups across northern Australia.					
Undertake *E. passionarius* releases, along with monitoring for establishment, spread and impact.					

Key Outputs

- Quarantine colonies of the stem-galling weevil, *Philonis inermis*, maintained and additional insects imported from Colombia to supplement the population as needed.
- Test plants sourced using the published phylogenetically informed host test list focusing on areas where the target weed, and non-target species, have overlapping geographical distribution.
- Host-specificity screening of up to thirty-five non-target weeds closely related to the target weed completed.
- If *P. inermis* is sufficiently host-specific, an application to release will be submitted to regulators.
- If the sap-sucking mirid, *Engytatus passionarius*, is found to be sufficiently host-specific in the currently funded project, commence development of mass-raring and release protocols if it is approved for release.
- Initial release and monitoring of establishment, spread and impact for *E. passionarius* at nursery sites across northern Australia.

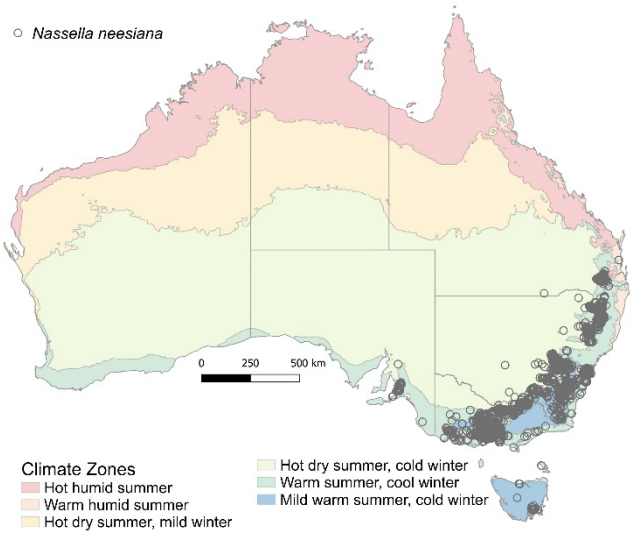
Expected outcomes after five years of RD&E investment

This weed may straddle Phase II risk assessment and Phase III mass rearing and release with two insect candidate agents, one of which is likely to have a release application submitted in FY 25/26 in the currently funded project. As such, the research program detailed above has focused on Phase II risk assessment of the stem-galling weevil, *P. inermis* with some preliminary Phase III mass rearing and release for *E. passionarius,* should it be found to be sufficiently host-specific and approved for release. By the end of five-years of the proposed RD&E investment, this weed should be in the mass rearing and release phase of the pipeline with up to two biocontrol agents, each impacting *P. foetida* growth in complementary ways, which will contribute to the overall management goal of reducing the weed's abundance and associated impacts on areas of cultural significance.

Identified stakeholders

Traditional Owners (including Indigenous Ranger Groups), Western Australia Department of Biodiversity, Conservation, and Attractions (DBCA), Western Australia Water Corporation, resource companies, tourism operators, NRM groups, agricultural industries (pastoralists, foresters).

Nassella neesiana (Chilean needle grass)



Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact score / 10	Invasiveness / 100	Weed threat / 100	Land use	Cultural weed
4.207	7.338	30.87	Production from dryland agriculture and plantations	Yes

Biocontrol prospects assessment summary

Weed Species	n	Feasibility Score	Likelihood Score	Biocontrol Prospects (%) Score	Biocontrol Prospects (%) Average
Nassella neesiana	3	0 2.5 5 7.5 10	0 2.5 5 7.5 10	0 25 50 75 100	59

The Chilean needle grass rust fungus (*Uromyces pencanus*) has been approved for release in New Zealand, risk assessment in an Australian context to be completed.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Nassella neesiana*
Conflicts of interest	Moderate conflict identified. *Uromyces pencanus* was found to develop on two native *Austrostipa* species (*A. compressa* and *A. macalpinei*). These species have recently been exported into New Zealand quarantine to be tested against the strain of the rust approved for release there. If different (negative) results are obtained to those in the original release application, then the application will be progressed with the Federal regulator. If approved, implementation planning for this research should commence.

Management goals	Strong alignment of biocontrol prospects with overall management goals for the target weed. The desired management outcomes for *N. neesiana* are well articulated in management plans. Commence implementation planning for new research program.
Biocontrol complementarity	Integration of grazing management, strategic chemical control, pasture rehabilitation, fire and cultural control methods can produce good results. However, herbicide resistance, spread of propagules through slashing, and difficulty in identifying *N. neesiana* when it is not flowering results in poor management outcomes. Investment in biocontrol RD&E is a key need to achieve desired weed management outcomes.
Knowledge gaps and research opportunities	Until the host range of *U. pencanus* is resolved in relation to its development on the native Australian *Austrostipa* species, implementation planning should not commence.
Investment complementarity	Investment currently provided by the NSW DPIRD to explore the risk of *U. pencanus* to the Australian native *Austrostipa* species. Further investment will be required to develop the project, should the risk be deemed to be low.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase II, risk assessment

Lead agency: New South Wales DPIRD

Agencies involved/project participants: Landcare Research, CSIRO

Identified research priorities for the *Nasella neesiana* biocontrol program: Population genetic analysis of invasive populations of *N. neesiana* in Australia to better understand the molecular diversity of the species. Ecoclimatic modelling of both the weed target and *U. pencacus* to better understand the compatibility of the system throughout the invaded range. Risk assessment of the rust to provide data addressing a stop/go point (low risk to two Australian native Stipas = proceed; high risk = stop). If risk acceptable, progress a paused release application with the federal regulator, followed by importation (from Argentina), molecular characterisation and release from quarantine.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Molecular characterisation of *Nassella neesiana* in Australia to understand its population genetics.					
Ecoclimatic modelling of the weed and its agent (*Uromyces pencanus*) using CLIMEX, to better understand their overlap in the invaded range.					
Complete host-specificity testing of *U. pencanus* on the two Australian native Stipa species (*Austrostipa compressa* and *A. macalpinei*) in containment in New Zealand.					
Pending outcome of host-specificity results from New Zealand: 1. If risk to native Stipas low, update and submit release application for assessment.					

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
2. If risk to native Stipas high, publish the findings and conclude project.					
Pending outcome of release application process: 1. If successful, proceed with importation of *U. pencanus* from Argentina. 2. If unsuccessful, cease research on project.					
Sign Material Transfer Agreement with Argentina and import single cell isolate into Australian quarantine.					
Conduct molecular characterisation of species while in containment.					
Apply for permission to release *U. pencanus* from quarantine – ready for next phase of biocontrol RD&E pipeline.					

Key Outputs

- Explore the population genetics of *Nassella neesiana* in Australia, comparing this data to that available in GenBank to facilitate a better understanding of its invasion history.
- Develop an ecoclimatic model (CLIMEX) to understand the potential distribution of the weed, and its potential agent (*U. pencanus*), in Australia.
- Assess the risk of *U. pencanus* through host-range studies conducted by Landcare Research.
- If risk to native Australian Stipas is high, publish the findings and conclude project.
- If risk to Australian native Stipas is low, import the rust fungus from Argentina, and;
    - Culture a single-cell isolate in Australian containment and perform a molecular characterisation.
    - Update and progress the release application (originally developed by AgVic) with the national regulator.

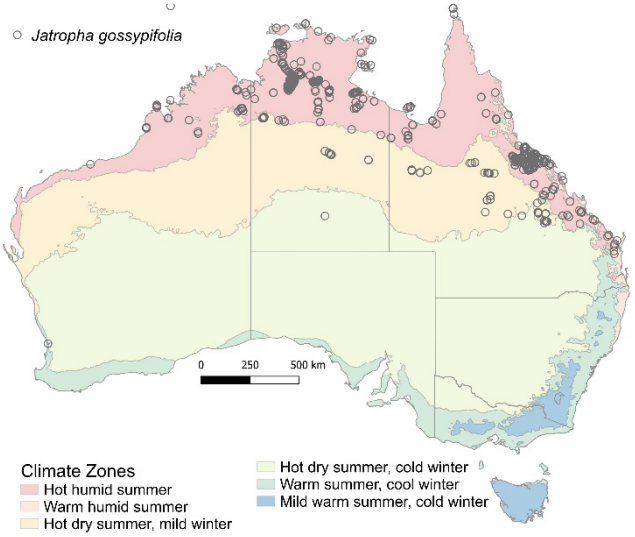
Expected outcomes after five years of RD&E investment

After five years of Phase II risk assessment investment, this project will have progressed the knowledge base of *N. neesiana* in Australia, as well as the potential of the rust, *Uromyces pencanus*. Based on this, and the risk profile of the agents from detailed host-range testing, a decision will be made on whether a release application is submitted to the national regulator.

Identified stakeholders

Relevant state and territory government agencies, land managers, regional councils and primary producers in Queensland, New South Wales, Victoria, South Australia and Tasmania.

Jatropha gossypifolia (Bellyache bush)

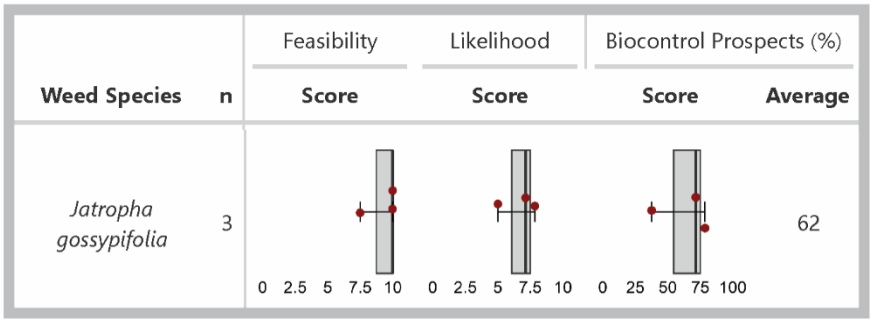


Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact score / 10	Invasiveness / 100	Weed threat / 100	Land use	Cultural weed
8.942	7.337	65.61	Production from relatively natural environments	Yes

Biocontrol prospects assessment summary



The leaf-mining moth, *Stomphastis thraustica*, was approved for release in 2022 whilst the leaf rust, *Phakopsora jatrophicola,* release application is in preparation. No national mass rearing and release program for these agents has been undertaken. *Prodiplosis hirsuta* gall midge has been identified for importation and host testing dependent on future funding. Additional agents that complement the approved *S. thraustica* are likely needed to impact the weed sufficiently.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Jatropha gossypifolia*
Conflicts of interest	*Jatropha gossypifolia* was approved as a target for biocontrol in 1999. There are no known conflicts of interest in Australia. Commence implementation planning for a host-specificity testing program, possible mass-rearing and release program if *P. hirsuta* midge is found to be sufficiently host specific, and mass rearing and release of the *P. jatrophicola* rust if approved for release.

Considerations	Summary and recommended outcomes for *Jatropha gossypifolia*
Management goals	The proposed agents will not reduce the abundance of the weed in the short term but will likely achieve landscape-scale reductions in invasion potential by reducing fruit set over multiple years to decades. Proceed with research-implementation planning.
Biocontrol complementarity	There are existing control options, but they may not always be effective, affordable and available, depending on land use, location, land manager experience and capacity. The addition of novel biocontrol agents will likely enhance overall management outcomes. Proceed with research-implementation planning.
Knowledge gaps and research opportunities	Weed population genetics of *J. gossypifolia* in Australia is an area that could be usefully researched, but this knowledge gap has not impacted biocontrol efforts thus far, and potential agents have already been identified. Proceed with research-implementation planning.
Investment complementarity	No existing research investments identified for bellyache bush. Commence implementation planning for new research program.

Five-year RD&E plan

Phase(s) of the weed biocontrol RD&E pipeline: Phases II & III

Lead agency: QDPI

Agencies involved/project participants: Fundación Para El Estudio de Especies Invasivas, Argentina (FuEDEI), Centre for Agriculture and Biosciences International, UK

Identified research priorities for *Jatropha gossypifolia* biocontrol program: Phase II risk assessment will focus on thorough host-specificity testing of the gall midge, *Prodiplosis hirsuta,* in a Brisbane quarantine facility. Preliminary testing conducted in Argentina has produced promising results. Host-specificity testing will focus on closely related non-target native and economically important plant species. If found to be sufficiently host specific, a release application for the gall midge will be submitted. A release application for the leaf rust, *Phakopsora jatrophicola*, will also be submitted. It was comprehensively tested by CABI (UK) and found to be highly host specific. In Phase III, mass rearing and release protocols will be developed for the two agents and nursery sites identified. Preliminary releases will be made of approved agent/s.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Prepare and submit release application for *P. jatrophicola* leaf rust.					
Import and establish a quarantine colony of *P. hirsuta* gall midge for host-specificity testing and reimport material to supplement the population as needed.					
Sourcing of test plants and commencement of host-specificity screening of up to 40 plant species.					

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Draft an application to release if *P. hirsuta* is found to be sufficiently host specific.					
Import and establish a culture of *P. jatrophicola* leaf rust if approved for release.					
Development of mass-culturing protocols for the leaf rust if approved for release.					
Identification of nursery release sites for the leaf rust.					
Undertake leaf rust releases, along with monitoring for establishment.					
Development of mass rearing protocols for *P. hirsuta* gall midge if approved for release.					
Identification of nursery release sites for the gall midge.					
Undertake gall midge releases, along with monitoring for establishment.					

Key Outputs

- Importation and colony establishment of *Prodiplosis hirsuta* gall midge.
- Host-specificity screening of up to 40 non-target species completed for *P. hirsuta.*
- If sufficiently host specific, a release application for *P. hirsuta* will be submitted to regulators.
- A release application for the leaf rust, *Phakopsora jatrophicola,* will be submitted to regulators.
- If approved for release, *P. jatrophicola* will be imported and mass-cultured.
- Preliminary releases of approved agent/s at nursery sites across northern Australia.

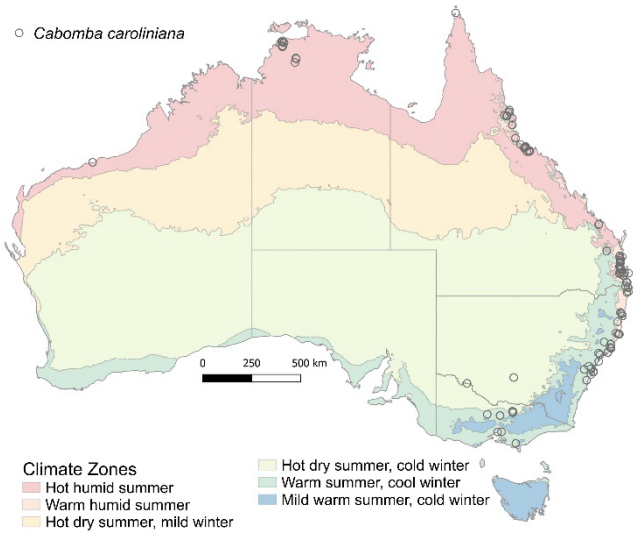
Expected outcomes after five years of RD&E investment

Thorough testing of *P. hirsuta* will have been completed and, if sufficiently host specific, a release application will have been submitted to regulators. A release application for the leaf rust, *P. jatrophicola*, will also have been submitted to regulators. Subject to their release approvals, mass-rearing and release of the agents will have begun across northern Australia.

Identified stakeholders

Relevant state and territory government agencies, land managers, regional councils and primary producers in Western Australia, the Northern Territory and Queensland.

Cabomba caroliniana (Cabomba)

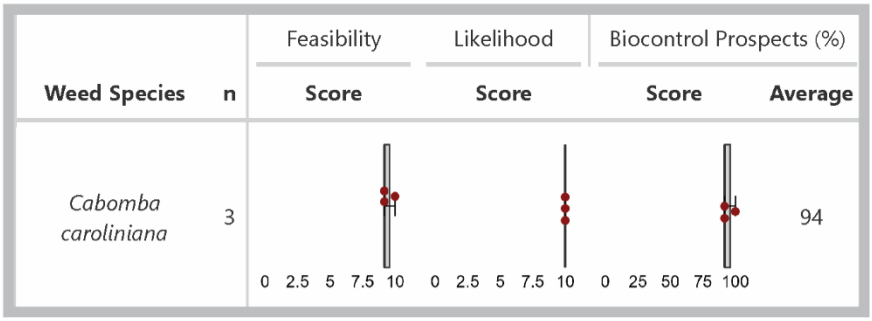


Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact score / 10	Invasiveness / 10	Weed threat / 100	Land use	Cultural weed
7.890	7.337	57.89	Conservation and natural environments	No

Biocontrol prospects assessment summary



The weevil, *Hydrotimetes natans*, was approved for release in 2021. Mass rearing and releases have commenced in Queensland and New South Wales at a small number of nursery sites but currently there is no national mass rearing and release program.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Cabomba caroliniana*
Conflicts of interest	*Cabomba caroliniana* was endorsed as a target for biocontrol in 2005 and in 2022 one agent, *H. natans*, was approved for release. To date, no conflicts of interest have been identified.
Management goals	Cabomba forms dense monocultures in aquatic ecosystems, which reduces the light available to native species through the water column. The primary management goal is to reduce the ecological impact of Cabomba by reducing mat densities, allowing light to reach submerged vegetation. This will minimise changes to the nutrient profile and

Considerations	Summary and recommended outcomes for *Cabomba caroliniana*
	limit deleterious effects upon aquatic flora and fauna. *Hydrotimetes natans* larvae cause severe damage in the form of necrosis of stem tissues due to larval tunnels. Under intense feeding, stems become disintegrated and detached from plants; these decaying stem fragments are not viable, thereby reducing the overall growth and biomass of the plant. This should also reduce the plant's ability to reproduce.
Biocontrol complementarity	There are several effective herbicides permitted for use on Cabomba, but herbicides are not permitted for use in potable drinking water ecosystems. Mechanical removal using harvesters can be effective in easily accessible areas, although the plants can quickly regrow after removal. Thus, these existing control tools (chemical and mechanical) are not effective at reducing *C. caroliniana* impacts at broad scales. *Hydrotimetes natans* will complement existing control by sustained reduction in weed density and reducing environmental impacts of chemical herbicide application.
Knowledge gaps and research opportunities	Additional field surveys may be required to identify other potential candidates. Research on how existing management techniques can be complemented by biocontrol is needed (e.g. integrated methods). *Hydrotimetes natans* can be difficult to rear, making it possibly unsuitable for community groups to assist in spreading the agent.
Investment complementarity	The NSW Environmental Trust is investing in mass-rearing and release of *H. natans* in New South Wales only, but there are no existing funding sources to support releases of this weevil elsewhere in Australia.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase III, Mass rearing and release

Lead agency(s): CSIRO

Agencies involved/project participants: New South Wales DPIRD

Identified research priorities for *Cabomba caroliniana* biocontrol program: While the weevil *Hydrotimetes natans*, was approved for release (2021), mass rearing and releases have only occurred at small number of nursery sites in New South Wales and Queensland. The focus of this Phase III mass rearing and release program now needs to shift towards a national mass-rearing and release program by establishing new mass rearing facilities and identifying new nursery release sites across the whole distribution of cabomba.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Engagement with New South Wales, Northern Territory, Queensland and Victoria stakeholders/research partners and water asset managers in these states.					
Establishment of new mass-rearing facilities (e.g. in the Northern Territory and north Queensland if needed) and supporting the rearing efforts in established mass-rearing facilities in Queensland and New South Wales.					

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Identification of nursery release sites and conduct baseline monitoring of *C. caroliniana*, prior *to* releases of the weevil, *H. natans.*					
Releases of the weevil at up to ten nursery sites across four jurisdictions.					
Evaluation of weevil establishment and impact upon the weed at nursery sites.					

Key Outputs

- Engagement with water asset managers from various jurisdictions and identified potential nursery sites for *Hydrotimetes natans* releases.
- Support for establishing additional mass-rearing sites, providing expert advice to enable agent release in different jurisdictions, and support of rearing efforts in established mass-rearing facilities in Queensland and New South Wales.
- Cabomba weevil, *H. natans*, released at up to ten nursery sites across four jurisdictions and baseline monitoring continued in up to three release sites.
- Evaluation of *H. natans* establishment and impact on *C. caroliniana* at nursery sites and collection of biomass samples for ongoing monitoring in up to three sites.

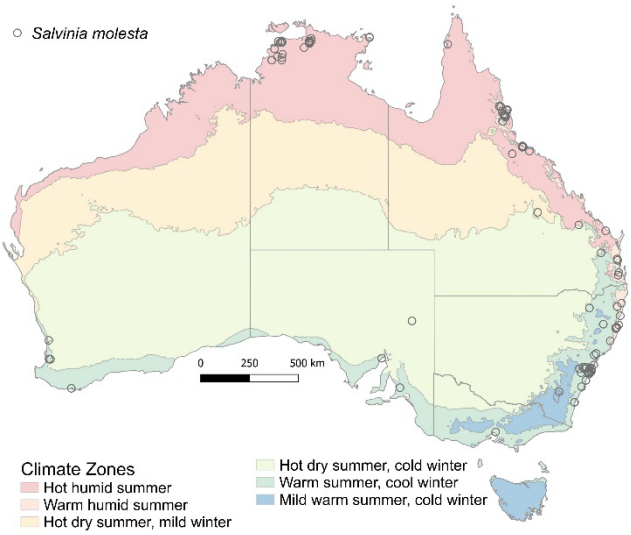
Expected outcomes after five years of RD&E investment

By the end of the five-year mass-rearing and release (Phase III, mass rearing and release) program, with associated monitoring for weevil establishment and impact at nursery release sites, it will be clear if this aquatic weed biocontrol system requires further investment in Phase III mass rearing and release or if the research can progress to Phase IV (monitoring and evaluation). This will be evident if the weevil, *H. natans*, is well established in the environment and at sufficient population densities that the ecological impact of cabomba is being mitigated.

Identified stakeholders

SeqWater, Gympie Regional Council, Tweed Shire Council, NT Weed Branch, Gold Coast Council and landholders in various jurisdictions.

Salvinia molesta (Salvinia)



Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact score / 10	Invasiveness / 10	Weed threat / 100	Land use	Cultural weed
8.416	6.003	50.52	Water	Yes

Biocontrol prospects assessment summary

The weevil *Cyrtobagous salviniae* identified as highly effective biocontrol agent but one that needs to be inundatively released (reintroduced at critical points in the season). All four assessors recommended a coordinated inundative release program at the national scale, including with First Nations rangers in the Northern Territory and elsewhere.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Salvinia molesta*
Conflicts of interest	*Salvinia molesta* has been a target for biocontrol since the late 1970s and was listed as a Weed of National Significance (WONS) in 1999. One of two established biocontrol agents, *Cyrtobagous salviniae*, has effectively controlled the weed at most release sites throughout the invaded range in Australia. Monitoring has revealed no adverse impacts on non-target organisms. No significant conflicts were identified.
Management goals	*Cyrtobagous salviniae* is effective in controlling salvinia, particularly in tropical and subtropical climates. Mass-rearing and release of the weevil at sunny sites with sufficient water depth typically led to significant reductions in weed cover. The weevil disperses poorly and benefits from mass rearing and introduction to new infestations. During flood events, or following adverse conditions, re-introduction of *C. salviniae* is

Considerations	Summary and recommended outcomes for *Salvinia molesta*
	sometimes required. This program will benefit from upscaling and national roll out to reach more invaded sites and in all affected states and territories.
Biocontrol complementarity	There are existing management tools (mechanical and chemical) for salvinia infestations, but they may not always be effective, affordable and available, depending on land use, location, land manager experience and capacity. Biocontrol is most cost-effective and environmentally sound. Persistent biocontrol will likely result in broadscale decline of *S. molesta*, reducing propagules and invasion load across its range. At sites where biocontrol needs to be complemented, integration with mechanical and chemical methods can be achieved to reduce adverse effects and costs.
Knowledge gaps and research opportunities	No significant knowledge gaps identified. The impact and establishment of the weevil has been well studied; however, scope remains to refine release strategies and predictions regarding control timelines. Comprehensive post-release monitoring will shed light on this.
Investment complementarity	Investment currently provided by the NSW Weeds Action Plan and Federal Government through a Federation Funding agreement, supports mass-rearing and release and post-release monitoring and evaluation of the weevil in New South Wales only. No other investments are available to support rollout of the release program at the national scale.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase III, Mass rearing and release

Lead agency(s): New South Wales DPIRD

Agencies involved/project participants: Northern Territory government, local governments, First Nations ranger groups

Identified research priorities for *Salvinia molesta* biocontrol program: Optimisation of mass-rearing techniques for *C. salviniae*, and knowledge sharing between project partners. Widespread release and monitoring of the long-term impacts of *C. salviniae* on salvinia populations throughout affected state and territories in Australia. Updating of biocontrol best practice guidelines.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Improved mass-rearing techniques and knowledge sharing among collaborators (NSW DPIRD, Northern Territory Government and First Nations People.					
Widespread release and monitoring of long-term biocontrol agent impacts on target weed populations in New South Wales, Queensland and the Northern Territory.					
Development of biocontrol best practice guidelines.					

Key Outputs

- More efficient mass-rearing of *C. salviniae* and widespread release on salvinia populations across New South Wales, the Northern Territory, and Queensland.
- Evaluation of long-term biocontrol agent impacts on target weed populations and flow-on benefits to water quality, biodiversity and other environmental values.
- Engagement with First Nations people, including Indigenous Ranger groups, to enhance the delivery of *C. salviniae* mass-rearing and release programs throughout Australia.

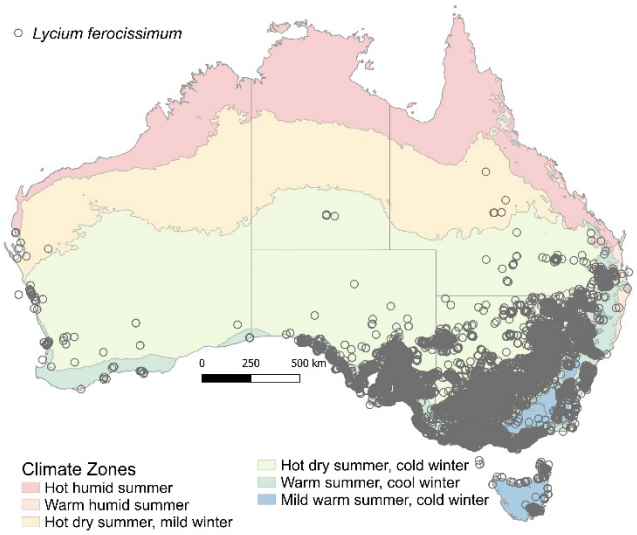
Expected outcomes after five years of RD&E investment

To have mass-reared and released *C. salviniae* across the distribution of salvinia in Australia (New South Wales, the Northern Territory, and Queensland). By the end of the five-year mass-rearing and release (Phase III mass rearing and release) program, there will be a good understanding of *C. salviniae* impacts on its weed target, as well as the flow-on effects to water system health.

Identified stakeholders

New South Wales, Queensland and Northern Territory Governments, First Nations groups (e.g., Indigenous Ranger programs engaged in Salvinia control), CSIRO, local governments, water and catchment management authorities, and Regional Weeds Committees.

Lycium ferocissimum (African boxthorn)

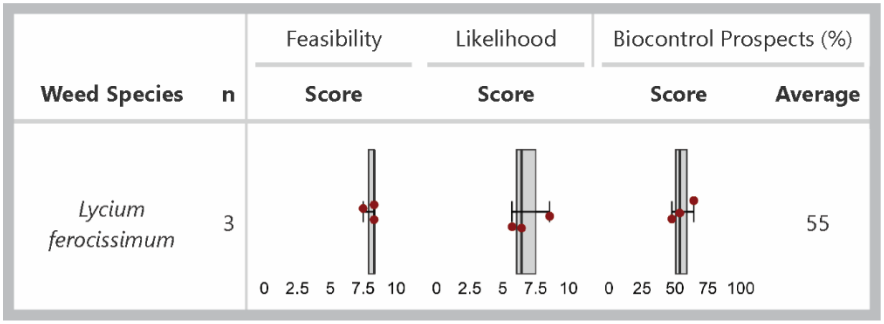


Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact score / 10	Invasiveness / 10	Weed threat / 100	Land use	Cultural weed
7.894	6.667	52.63	Production from relatively natural environments	Yes

Biocontrol prospects assessment summary



Leaf rust, *Puccinia rapipes* approved for release in 2022. Mass rearing and releases commenced in New South Wales but no current national release program. No investment available to support release in any other Australian jurisdiction.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Lycium ferocissimum*
Conflicts of interest	*Lycium ferocissimum* was endorsed as a target for biocontrol in 2016. Release of the rust fungus *P. rapipes* in 2022-2023 and subsequent monitoring has revealed no adverse impacts on any environmental values. No significant conflicts identified. Commence implementation planning for a new mass rearing and release program.
Management goals	Biocontrol agent is not a bioherbicide and will not completely remove the weed altogether at the fine scale. It will not reduce the abundance of the weed in the short term but will likely achieve landscape scale reductions in invasion potential by reducing

Considerations	Summary and recommended outcomes for *Lycium ferocissimum*
	fruit set over multiple years to decades. Recommend commencing implementation planning for new research program that includes a stakeholder-engagement phase, to develop guidelines for integrating *P. rapipes* into existing weed control programs.
Biocontrol complementarity	There are existing control options (chemical and mechanical), but they are expensive and impractical to apply over at the broad regional scale, and *L. ferocissimum* is frequently able to regenerate following control. Biocontrol will likely result in broadscale decline in the weed's growth and fruit set, leading to reduced invasion risk across its range. Biocontrol can also be used safely in sensitive ecosystems where chemical application is undesirable, or in areas where complete removal of the plant is undesirable (e.g. where the plant offers habitat to threatened fauna).
Knowledge gaps and research opportunities	No significant knowledge gaps identified at this stage. Recommend commence implementation planning for new research program. Further knowledge on the habitat suitability of *P. rapipes* and its impacts on the host weed will be revealed as part of post-release monitoring and evaluation in the field.
Investment complementarity	Investment currently provided by the NSW Environmental Trust to support mass-rearing and release and post-release monitoring and evaluation of *P. rapipes* in New South Wales only. No other investments are available to support rollout of the release program at the national scale.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase III, Mass rearing and release

Lead agency(s): CSIRO

Agencies involved/project participants: Agriculture Victoria, New South Wales DPIRD

Identified research priorities for *Lycium ferocissimum* biocontrol program: This project aims to implement a national-scale expansion of the rust fungus (*Puccinia rapipes*) mass-rearing and release program. The fungus had been widely distributed across New South Wales between 2023 and 2024, with support from the NSW Environmental Trust. It is well-established in New South Wales but cannot spread quickly to other states without assistance. For this national project, extensive releases of *P. rapipes* will be conducted throughout Victoria, Tasmania, South Australia, Western Australia and southeast Queensland in collaboration with community, industry, and government stakeholders. It will be mass-cultured at CSIRO pathogen laboratories in Canberra, then packaged into biocontrol agent release kits and distributed to registered participants. To empower community involvement, on-ground workshops led by CSIRO researchers will be conducted in Victoria, Tasmania, South Australia and Western Australia. Concurrently, CSIRO will establish fixed monitoring plots in these same states for controlled releases of *P. rapipes*. Over four years, the establishment and impact of the fungus on the host weed will be rigorously monitored and evaluated at these monitoring sites. Furthermore, the project will investigate the potential for integrating the fungal release with existing herbicide control methods. The project will partner with First Nations peoples as desired to release *P. rapipes* at sites of biocultural value, aligned with their land management practices.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Create ALA Biocontrol Hub page on existing portal, used as ongoing repository of community-led					

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
biocontrol agent release and observation data.					
Registration and support for community, industry and government stakeholder participation in biocontrol agent release and monitoring program, with focus on Tasmania, Victoria, Queensland, South Australia and Western Australia.					
Mass-culturing and delivery of biocontrol agent release kits to community participants.					
Workshops with community, industry and government partners in Tasmania (supported by Landcare Tasmania), Victoria, South Australia (supported by Landscapes SA) and Western Australia.					
Establishment of fixed monitoring plots and experimentally controlled releases of the biocontrol agent in Tasmania, Victoria, South Australia and Western Australia.					
Repeated surveys of existing monitoring plots in New South Wales.					
Data analytics to evaluate outcomes of biocontrol for *L. ferocissimum* populations and environmental values.					
Presentation of research findings at domestic and international conferences.					
Development of integrated best practice management guidelines.					

Key Outputs

- Viable *Puccinia rapipes* culture under laboratory conditions.
- Mass-rearing pipeline to scale production of *P. rapipes* for national-scale release.
- User-friendly biocontrol agent release kits and release guidelines for distribution to participating stakeholders.
- Nationwide release, establishment and spread of *P. rapipes* across ACT, Victoria, Tasmania, South Australia, Western Australia, and Queensland (noting ongoing mass-rearing and release program already underway in New South Wales).

- De-identified database of release locations, reposited in the Atlas of Living Australia's Biocontrol Hub.
- Series of training workshops in biocontrol agent release, monitoring and evaluation with diverse range of stakeholders across all Australian jurisdictions and sectors, including partnerships with First Nations people and communities in on-ground delivery of *P. rapipes*.
- Array of fixed monitoring sites across Victoria, Tasmania, South Australia, Western Australia and Queensland at which the biocontrol agent will be released and monitored over time for fungal establishment and spread, host plant condition, and recovery of desirable vegetation.
- Integrated weed management plan.
- Collaborative releases with First Nations peoples and communities at sites of biocultural significance under threat from *L. ferocissimum*.

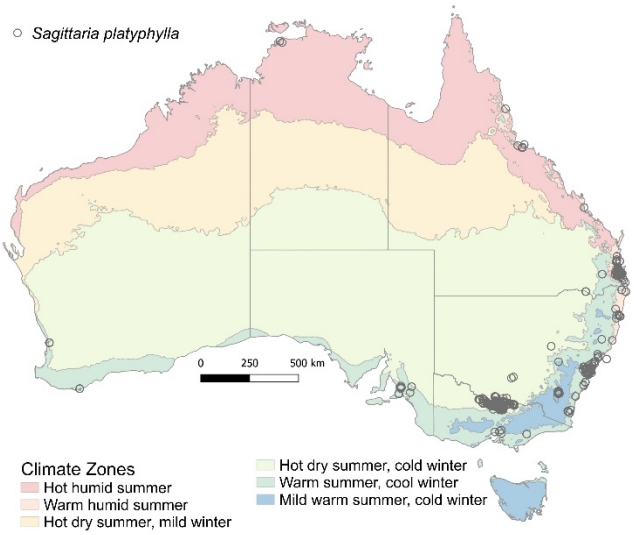
Expected outcomes after five years of RD&E investment

A successful national biocontrol program utilising *Puccinia rapipes* would result in the widespread and sustained establishment of the rust fungus across all target regions. This would be evidenced by measurable reductions in *L. ferocissimum* invasion pressure through increased plant mortality and decreased vigour, as documented through long-term monitoring at fixed sites and community-driven observations. The program would foster strong stakeholder engagement, including partnerships with First Nations communities, facilitated by comprehensive training and user-friendly release kits. A robust, publicly accessible database of release and monitoring data (de-identified), housed within the Atlas of Living Australia, would support ongoing research and adaptive management. Integrated weed management plans, informed by analysis of fungal effectiveness and synergistic effects with other control methods, would guide land managers in optimising control strategies. Ultimately, the program's success would be reflected in reducing invasion pressure of the target weed, the recovery of native ecosystems and the protection of bioculturally significant sites threatened by *L. ferocissimum*.

Identified stakeholders

Key stakeholders to be represented at the project implementation planning phase include CSIRO, Agriculture Victoria, Biosecurity Tasmania, Landscape Boards SA, Queensland Department of Primary Industries, Western Australia Department of Primary Industries and Regional Development, Landcare (at state and national levels). Once launched, it is anticipated that local government biosecurity officers, members of land management groups (e.g. arm networks, 'friends of' conservation groups, catchment management and regional weed management networks etc) and hundreds of private landholders will register their interest to receive the biocontrol agent release kits and undertake broadscale releases of *P. rapipes* with the CSIRO. The CSIRO will engage with First Nations peoples and communities, including Indigenous Ranger groups, in the co-design and release of the fungus, aligned with the weed management aspirations of those local communities, to reduce the threats of *L. ferocissimum* to biocultural values.

Sagittaria platyphylla (Delta arrowhead)



Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact score / 10	Invasiveness / 10	Weed threat / 100	Land use	Cultural weed
6.049	6.670	40.35	Water	No

Biocontrol prospects assessment summary

The fruit-feeding weevil, *Listronotus appendiculatus*, was approved for release in 2020 and would benefit from a national mass rearing and release program, as it has only been established so far at a few nursery sites.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Sagittaria platyphylla*
Conflicts of interest	No significant conflicts of interest identified. Commence implementation planning.
Management goals	A biocontrol agent will not remove the weed altogether or reduce biomass or abundance at the local scale, as herbicide does. The weevil, *L. appendiculatus,* could achieve landscape scale reductions in invasion potential by reducing fruit set over multiple years to decades. Recommend commencing implementation planning for new research program that includes a stakeholder-engagement phase, to develop guidelines for integrating the weevil into existing *S. platyphylla* control programs.
Biocontrol complementarity	There are existing control options (chemical and mechanical) but *S. platyphylla* is frequently able to regenerate following control, and they are expensive, impractical and damaging to apply at the broad regional scale. Biocontrol could result in broadscale

Considerations	Summary and recommended outcomes for *Sagittaria platyphylla*
	decline in fruit set, leading to a reduction in invasion risk across its range. Biocontrol can also be used safely in sensitive ecosystems where chemical application and mechanical control is undesirable.
Knowledge gaps and research opportunities	Key knowledge gaps include understanding the most effective methods of establishing *L. appendiculatus* in the field including most successful life stage, number of individuals released and number of releases per season, as well as weather and climatic conditions most conducive to establishment. These can be readily resolved through targeted research during the implementation-planning phase with findings from releases in the early years of the project used to refine techniques used in the later years. Monitoring for establishment and impact can co-occur with release activities.
Investment complementarity	Investment currently provided by the NSW Environmental Trust, irrigation companies and one Landcare group to support mass-rearing and release at limited sites in Victoria and New South Wales. No other investments are available to support rollout of the release program at the national scale.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase III, Mass rearing and release

Lead agency(s): Agriculture Victoria

Agencies involved/project participants: New South Wales DPIRD

Identified research priorities for *Sagittaria platyphylla* biocontrol program: Research priorities for *S. platyphylla* focus on optimizing the release of fruit-feeding *L. appendiculatus* weevils, including identifying the most effective life stage, optimal number of individuals, and suitable climatic conditions for establishment. Targeted studies in the initial project years will refine release techniques, while ongoing monitoring will assess establishment and impact. Engaging with waterway managers and stakeholders is crucial for selecting nursery sites, and mass-rearing efforts will support weevil supply across Victoria and New South Wales. Additionally, evaluations of weevil spread and impact on *S. platyphylla* will be conducted at designated monitoring sites.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Update Sagittaria page on ALA Biocontrol Hub portal for repository of agent release and monitoring data for community participation.					
Engagement with waterway managers and key stakeholders to identify nursery sites.					
Mass-rearing conducted by AgVic and NSW DPIRD for supply of *L. appendiculatus* weevils to nursery sites in Victoria, New South Wales and other states as requested.					
Release of *L. appendiculatus* at up to 20 nursery sites across Victoria and New South Wales.					

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Evaluation of agent establishment and spread at nursery sites.					
Monitoring for *L. appendiculatus* impact at fixed monitoring sites.					
Trials to optimise integration of biocontrol into integrated weed management plans for *S. platyphylla*.					

Key Outputs

- Engaged with water asset managers from various jurisdictions and identified potential nursery sites for *L. appendiculatus* releases.
- Supported establishment of additional mass rearing sites by providing expert advice to enable agent release in different jurisdictions and supported the rearing efforts in established mass rearing facilities in Victoria and New South Wales.
- *Listronotus appendiculatus* weevils released at up to 20 nursery sites each year across Victoria, New South Wales and Queensland.
- Weevil establishment assessed annually at each release site and more intensive monitoring conducted at up to six longer-term study sites.
- Updated integrated weed management toolkit for *S. platyphylla* that maximises the effectiveness of biocontrol with other management techniques.

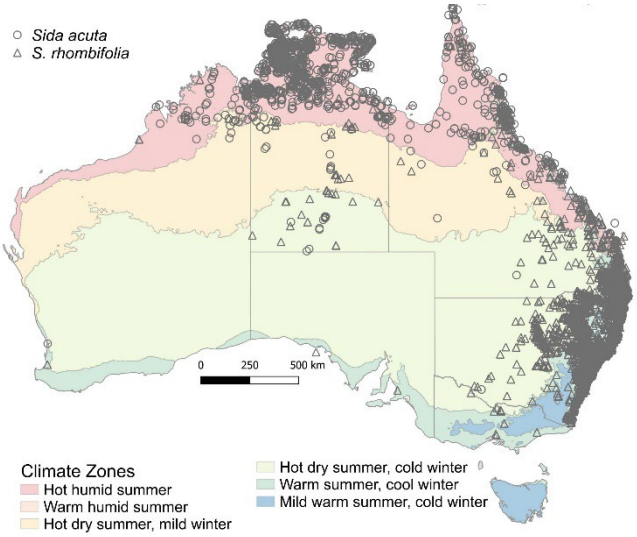
Expected outcomes after five years of RD&E investment

To have released *L. appendiculatus* in significant numbers across the distribution of *S. platyphylla* in Australia (Queensland, New South Wales and Victoria). By the end of the five-year mass rearing and release (Phase III) program, with associated monitoring for weevil establishment and impact at nursery release sites, it will be clear if this aquatic weed biocontrol system requires further investment in Phase III (mass rearing and release) or if the research can progress to Phase IV (monitoring and evaluation).

Identified stakeholders

Irrigation companies, natural resource managers of waterways, regional weed coordinators, Landcare facilitators and extension personnel, weed officers and Landcare groups.

Sida acuta and *Sida rhombifolia* (Spinyhead sida and Paddy's lucerne)



Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Not assessed for weed threat. A review of Healthy Country plans identified *S. acuta* and *S. rhombifolia* as negatively impacting upon First Nations cultural values, but it was not nominated through the jurisdictional or open nomination process.

Biocontrol prospects assessment summary

		Feasibility	Likelihood	Biocontrol Prospects (%)	
Weed Species	**n**	**Score**	**Score**	**Score**	**Average**
Sida acuta	3	0 2.5 5 7.5 10	0 2.5 5 7.5 10	0 25 50 75 100	44
Sida rhombifolia	3	0 2.5 5 7.5 10	0 2.5 5 7.5 10	0 25 50 75 100	41

A highly effective biocontrol agent (*Calligrapha pantherina*) has established in the Australian environment but requires augmentative releases to boost control efficacy of existing populations that can fluctuate significantly, influenced by seasonal changes and variable densities of the host weed. There is a need to develop a biocontrol manual for *S. acuta* and *S. rhombifolia*, to guide insect rearing and release activities by stakeholders, including First Nations peoples and communities.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Sida acuta* and *Sida rhombifolia*
Conflicts of interest	*Sida* spp. are historic biocontrol target weeds. *Sida acuta* is a declared weed in Western Australia and the Northern Territory and both species are considered environmental weeds in Queensland. Both weeds have been nominated for the National Weed Biological Control Pipeline Strategy as weeds of cultural significance for First Nations' people. They are both aggressive colonisers of natural and disturbed areas and pastureland. These species have no social, cultural, economic, political or environmental value therefore implementation planning for a new research program can commence immediately.
Management goals	*Sida* spp. negatively impact pastureland because they are unpalatable to livestock and can outcompete productive pasture grasses. Likewise, in natural areas, *Sida* spp. smother and outcompete native and desirable species. Once established in an area, they can be difficult and costly to eradicate. To minimise the deleterious effects of these weeds, management goals should seek to impede plant growth to make them less competitive with other desirable plant species. Further reductions to plant seed production would make these species less effective at colonising new areas and less persistent in established populations. *Sida* spp. have also been nominated as priority weeds of cultural significance to First Nations people. Management goals should be aligned with those of First Nations people to ensure the cultural impact of these weed species is mitigated. Further stakeholder consultation should seek to set these goals to direct future research.
Biocontrol complementarity	Individual *Sida* spp. plants can be managed using herbicide treatments or slashing, but this can be cost-prohibitive over large areas and long periods of time. The leaf-feeding chrysomelid beetle, *C. pantherina,* can heavily defoliate plants during the wet season and has been found to be especially effective in the most severe *S. acuta i*nfestations of the Northern Territory. This species is not, however, drought resistant, resulting in large population die-backs each dry season and ineffective control during this time. New biocontrol agents that are drought resilient and offer year-round weed suppression should be sought.
Knowledge gaps and research opportunities	The genus *Sida* is historically large and poorly circumscribed, and many Australian native species have often been excluded from molecular phylogenies. Consequently, the relationships between the invasive *Sida* spp. and many native species are unknown. *Sida acuta* and *S. rhombifolia* are pantropical species with poorly understood native ranges and population genetics. The original native range surveys for biocontrol agents were conducted in Mexico but this has not been confirmed as a match for Australian invasive populations. Two of the biocontrol agents originally released in Australia in the late 1980's and early 1990's (two stem boring *Eutinobothrus* spp.) did not establish for unknown reasons. Future research should seek to: (1) sample native Australian *Sida* spp. and include them in a broader phylogeny of the genus (2) investigate the population genetics of invasive *Sida* spp. and match them to their native range and (3) survey populations of *Eutinobothrus* spp. to determine their existence and impact in Australia.
Investment complementarity	There are no currently funded biocontrol programs targeting *Sida* spp. in Australia, although the Queensland and Northern Territory state governments are involved in ad hoc rearing and redistribution of *C. pantherina.* The New Zealand government has nominated *Sida* spp. as targets for biocontrol in Samoa, Tonga and Niue and have

Considerations	Summary and recommended outcomes for *Sida acuta* and *Sida rhombifolia*
	previously collaborated with Queensland DPI on this initiative. More funding is needed to achieve the research goals proposed for targeting *Sida* spp. in Australia. If there are aligning management goals, any future funding should seek collaborations with the New Zealand government. There should also be strong collaborations with Australian First Nations people to ensure that management goals are effectively addressing the cultural impact of these species. Implementation planning can commence for a new research program immediately and should seek collaborations with the New Zealand government and Australian First Nations people to address multiple management goals.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase III, Mass rearing and release

Lead agency(s): CSIRO

Agencies involved/project participants: QDPI, Northern Territory Government, identified First Nation Groups

Identified research priorities for *Sida acuta and Sida rhombifolia* biocontrol program: This research will prioritise collaboration with First Nations communities to develop culturally appropriate and sustainable biocontrol strategies for *Sida acuta*. Further, the co-development of a user-friendly biocontrol manual and training program, tailored for Australian conditions and incorporating culturally sensitive modules, is crucial for empowering stakeholders, including First Nations communities, in insect rearing, release, and monitoring activities. Optimising augmentative release strategies through controlled experiments and establishing long-term monitoring sites in diverse ecological zones, including areas of biocultural significance, will maximise control efficacy and facilitate ecological recovery. *Sida rhombifolia* has a predominantly eastern Australian distribution relative to *S. acuta* and *C. pantherina* has not established well on this species across this distribution. This project will assess if climatic factors are driving the establishment success of *C. pantherina* across both *S. acuta* and *S. rhombifolia* in Australia. This will help determine if proactive community-based releases that will be undertaken for *C. pantherina* on *S. acuta* in the Northern Territory are feasible to pursue for *S. rhombifolia* in eastern Australia.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Formation of coordinated group, including with First Nations representatives, that will work on project co-design.					
Co-design of augmentative release strategies for existing biocontrol agent, based on the ecology of *S. acuta* in northern Australia.					
Establish community-based insectaries for mass-rearing and release of the leaf beetle, *C. pantherina.*					
Monitor and evaluate outcomes of community-led releases of the leaf beetle.					

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30
Evaluation of *C. pantherina* persistence and performance on *S. rhobiifolia* populations in eastern Australia.					
Laboratory assessments of the beetle's climatic tolerance – data used to parameterise species distribution modelling.					
Species distribution modelling of *C. pantherina*.					
Participatory monitoring program to assess proactive inundative agent release.					

Key Outputs

- Engaged with First Nations communities from various jurisdictions to co-design and implement an augmentative release program for *Sida acuta* in northern Australia.
- Develop and document a best practice biocontrol release strategies for *S. acuta* in northern Australia that incorporates cultural practices, values and knowledge.
- Sustainable, community-based insectaries for mass-rearing and release of *C. pantherina*.
- Determine the potential efficacy and applicability of *C. pantherina* proactive inundative release on eastern Australian populations of *S. rhombifolia.*

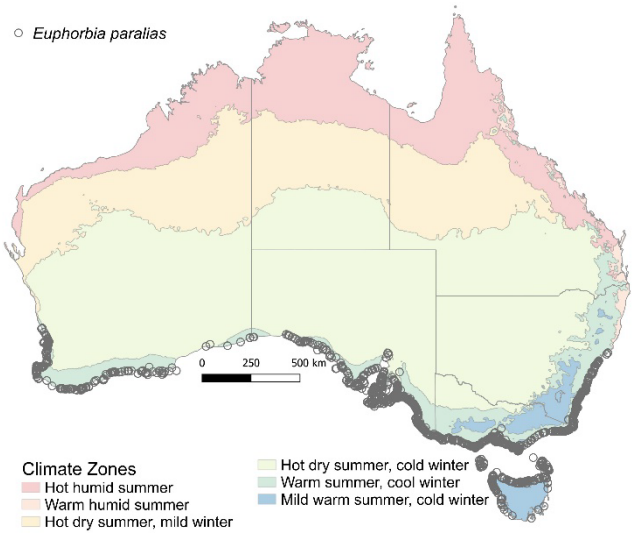
Expected outcomes after five years of RD&E investment

The project will result in enhanced control of *Sida* species through establishing sustainable, community-based insectaries for the mass-rearing and release of *C. pantherina*. A key outcome will be empowering local communities to better manage this cultural weed through the integration of traditional ecological knowledge, ensuring culturally appropriate and sustainable weed management practice. Through optimising augmentative release strategies and a deeper understanding of the insect's climatic limitations, the project will result in improved biocontrol efficiency, ultimately reducing the weed's invasion potential and impact across the landscape.

Identified stakeholders

Research will be supported by other community, industry and government stakeholders, including weed managers at the Department of Lands, Planning and Environment, Northern Territory Government. First Nations peoples and communities interested to participate in co-designing and delivering on the project will be identified as part of the project planning phase.

Euphorbia paralias (Sea spurge)

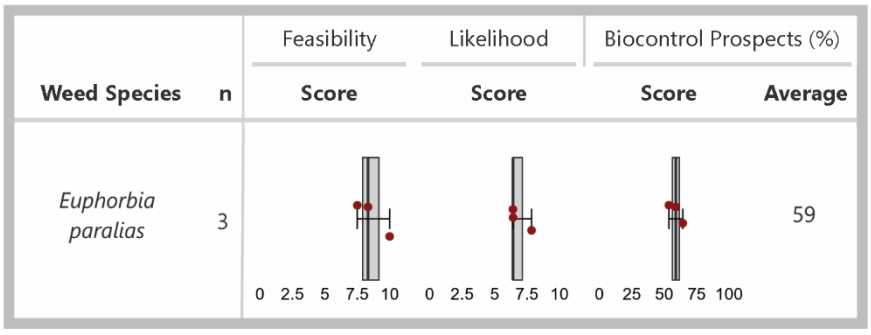


Outcomes of weed biocontrol prioritisation

Weed threat assessment summary

Impact score / 10	Invasiveness / 10	Weed threat / 100	Land use	Cultural weed
6.312	6.003	37.89	Conservation and natural environments	Yes

Biocontrol prospects assessment summary



The rust fungus, *Venturia paralias,* was approved for release in November 2020 and would benefit from a national mass rearing and release program as it has only been released at sites in New South Wales, Victoria and Tasmania (release sites needed in South Australia and Western Australia). The fungus has limited capacity for long distance spread and can only be further distributed to South Australia and Western Australia with human assistance.

Biocontrol contextualisation summary of outcomes

Considerations	Summary and recommended outcomes for *Euphorbia paralias*
Conflicts of interest	*Euphorbia paralias* was endorsed as a candidate for biocontrol in 2010. Release of the foliar blight fungus, *Venturia paralias,* in 2021-2024 in New South Wales, Victoria and Tasmania and subsequent monitoring has revealed no adverse impacts on any environmental values. No significant conflicts identified. Commence implementation planning for an expanded mass-rearing and release program, focused on South Australia and Western Australia.

Considerations	Summary and recommended outcomes for *Euphorbia paralias*
Management goals	*Venturia paralias* does not completely remove the weed at the fine scale, as a would herbicide, but it has been shown to gradually reduce *E. paralias* stand density, and open space for nesting shorebirds, over several consecutive years. It will likely achieve landscape scale reductions in invasion potential by reducing fruit set over multiple years. Recommend commencing implementation planning for new research program that includes a stakeholder-engagement phase, to develop guidelines for integrating the rust fungus into existing control programs.
Biocontrol complementarity	Whilst manual pulling can effectively reduce *E. paralias* populations in the short to medium term over a broad spatial scale, such efforts cannot be sustained in the long term and weed populations can regenerate once manual efforts have ceased. Biocontrol with the fungus can reduce overall stand density and reproductive output of the plant, reducing ongoing invasion risk across coastlines.
Knowledge gaps and research opportunities	No significant knowledge gaps identified at this stage. Recommend commence implementation planning for new research program, focused on South Australia and Western Australia.
Investment complementarity	No existing research investments identified for *E. paralias* biocontrol. Commence implementation planning for new research program.

Five-year RD&E plan

Phase of the weed biocontrol RD&E pipeline: Phase III, Mass rearing and release

Lead agency(s): CSIRO

Agencies involved/project participants: CSIRO, Parks Victoria, Biosecurity Tasmania, Tasmania Parks and Wildlife Service, Wildcare Tasmania's Sea Spurge Remote Area Teams, Landscape Boards SA, Western Australia Department of Primary Industries and Regional Development, Western Australia Department of Biodiversity, Conservation and Attractions and Landcare (at state and national level)

Identified research priorities for *Euphorbia paralias* biocontrol program: This project aims to implement a national-scale expansion of the *E. paralias* foliar blight fungus (*Venturia paralias*) mass-rearing and release program. The fungus had been widely distributed across Tasmania and Victoria between 2021 and 2023, with support from the NSW Environmental Trust. Small-scale experiments were undertaken in southern NSW with support from local governments to optimise release methods. However, no broad scale community-based releases of the fungus in NSW were undertaken for the Environmental Trust-funded project as local managers prioritised removing the weed completely from infested beaches with no desire at that time for integration of the biocontrol agent into their control regimes. *Venturia paralias* is well-established in those two states but cannot spread throughout Western Australia or South Australia without assistance. For this national project, extensive releases will be conducted throughout South Australia and Western Australia, in collaboration with community, industry, and government stakeholders. The project will also conduct further releases at priority sites in Tasmania and Victoria and continue discussions with NSW weed managers regarding potential biocontrol releases in areas where sea spurge control has proved is challenging. Further releases will be made in priority sites across Tasmania and Victoria where it has not previously been established. It will be mass-cultured at CSIRO pathogen laboratories in Canberra, then packaged into biocontrol agent release kits and distributed to registered participants. To empower community involvement, on-ground workshops led by CSIRO researchers will be conducted. Concurrently, CSIRO will establish fixed monitoring plots in both South Australia and Western Australia for experimental releases. Over four years, the establishment and impact of *V. paralias* on the host weed will be rigorously monitored and evaluated at these sites. Furthermore, the project will

investigate the potential for integrating the fungal release with existing control methods, such as manual removal and herbicide application. The project will partner with First Nations peoples as desired to release *V. paralias* at sites of biocultural value, aligned with their land management practices.

Key research activities	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30[1]
Create ALA Biocontrol Hub page on existing portal, used as ongoing repository of community-led biocontrol agent release and observation data.					
Registration and support for community, industry and government stakeholder participation in biocontrol agent release and monitoring program, with focus on South Australia and Western Australia (participants from all parts of Australia will be eligible).					
Mass-culturing and delivery of biocontrol agent release kits to community participants.					
Workshops with community, industry and government partners in South Australia and Western Australia.					
Establishment of fixed monitoring plots and experimentally controlled releases of the biocontrol agent in South Australia and Western Australia.					
Repeated surveys of existing monitoring plots in Tasmania and Victoria, and new monitoring plots in South Australia and Western Australia.					
Data analytics to evaluate outcomes of biocontrol for *E. paralias* populations and environmental values.					

[1] Based on prior project experience, a four-year program is projected to adequately cover national releases of the biocontrol agent, along with monitoring its establishment, spread, and impacts on the target weed. Any additional monitoring required for the 2029/30 FY will necessitate separate budget allocation and costing.

Key Outputs

- Maintenance and mass-rearing of a viable *Venturia paralias* culture at the CSIRO laboratories in Canberra.
- Production and distribution of biocontrol agent release kits to participants across all jurisdictions in Australia, with a focus on South Australia and Western Australia.
- Successful introduction and establishment of *V. paralias* in target areas of South Australia and Western Australia.

- Measurable spread and establishment of the fungus at a landscape scale.
- Collaboration with community, industry, and government stakeholders to release the fungus, enabled by on-ground workshops and partnerships.
- Establishment of fixed monitoring plots in South Australia and Western Australia (in addition to the set already established in Tasmania and Victoria), along with collection of data on agent establishment, spread and impacts on the target weed and associated environmental values.
- Guidelines for integrated *Euphorbia paralias* control programs.

Expected outcomes after four years of RD&E investment

The desired outcome of the *V. paralias* biocontrol program is to achieve widespread, sustainable control of sea spurge across Australia, particularly in South Australia and Western Australia. This will be accomplished through the establishment of a robust mass-rearing and distribution pipeline at CSIRO, ensuring a consistent supply of viable fungal cultures for nationwide release. Successful establishment and spread of *V. paralias* at a landscape scale will be facilitated by strong community engagement, collaborative partnerships, and targeted releases. Rigorous monitoring across all targeted regions will provide critical data on fungal establishment, impact on weed populations, and overall environmental benefits. The program will also lead to the development of practical guidelines for integrating the biocontrol agent with existing management strategies, ultimately reducing sea spurge invasion potential and fostering ecological recovery.

Identified stakeholders

Key stakeholders to be represented at the implementation planning phase of this national project include those already participating in the previous project undertaken in Tasmania and Victoria (funded by the NSW Environmental Trust – i.e., CSIRO, Parks Victoria, Landcare, Biosecurity Tasmania, Tasmania Parks and Wildlife Service, Wildcare Tasmania's Sea Spurge Remote Area Teams). The new project will also involve Landscape Boards SA, Western Australia Department of Primary Industries and Regional Development, Western Australia Department of Biodiversity, Conservation and Attractions and Landcare (at state and national level). Once launched, it is anticipated that local government biosecurity officers and members of land management groups (e.g. Coastcare, 'friends of' conservation groups, catchment management and regional weed management networks) will register their interest to receive the biocontrol agent release kits and undertake broadscale releases of *V. paralias* with the CSIRO.

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