Australian Government

Biosecurity Australia

Final Risk Analysis Report for the release of *Plectonycha correntina* for the biological control of *Anredera cordifolia* (Madeira vine)

November 2010

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Cover image: *Plectonycha correntina* on Madeira vine leaf (Courtesy: Bill Palmer, Biosecurity Queensland, DEEDI).

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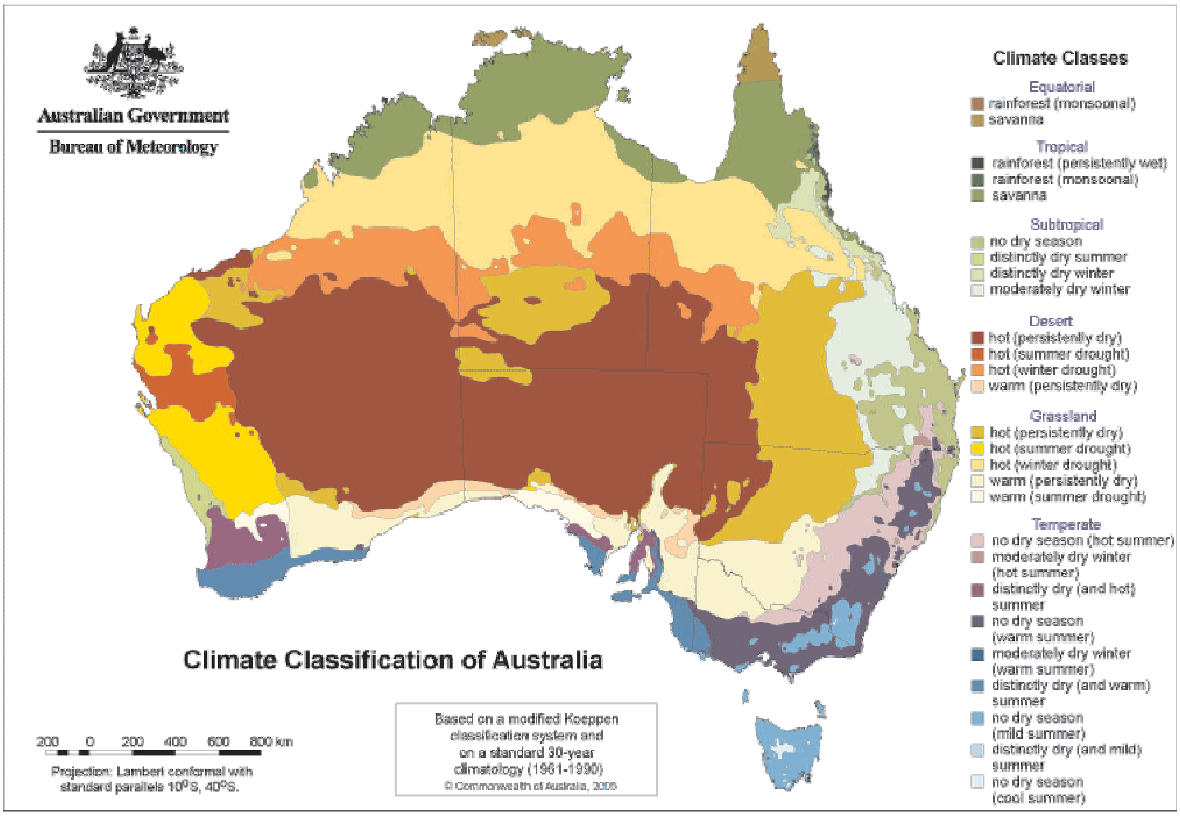

Acronyms and abbreviations

Term or abbreviation	Definition
ALOP	Appropriate level of protection
APPD	Australian Plant Pest Database (Plant Health Australia)
AQIS	Australian Quarantine and Inspection Service
BCA	Biological Control Agent
CABI	CAB International, Wallingford, UK
CMI	Commonwealth Mycological Institute
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry
FAO	Food and Agriculture Organization of the United Nations
IPC	International Phytosanitary Certificate
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
ISPM	International Standard for Phytosanitary Measures
NPPO	National Plant Protection Organization
NSW	New South Wales
NT	Northern Territory
Qld	Queensland
RA	Risk Analysis
Tas.	Tasmania
Vic.	Victoria
WA	Western Australia
WTO	World Trade Organisation

Abbreviations of units

Term or abbreviation	Definition
ºC	degree Celsius
ºF	degree Fahrenheit
kg	kilogram
km	kilometre
m	metre
µ	micrometre (one millionth of a metre)
ml	millilitre
mm	millimetre
ppm	parts per million
s	second

Summary

This risk analysis finalises an application from Biosecurity Queensland (Department of Employment, Economic Development & Innovation) to release the leaf feeding beetle *Plectonycha correntina* for the biological control of Madeira vine, *Anredera cordifolia*. In accordance with the IRA handbook 2007 (updated 2009), this risk analysis has been undertaken as a non-regulated analysis of existing policy.

This final risk analysis report recommends that the biological control agent should be released, subject to standard quarantine conditions associated with the import and release of biological control agents.

The report takes into account stakeholders' comments on the June 2010 draft risk analysis report. Comments were received from 7 stakeholders.

The report has identified no significant off-target effects or potential consequences that would be associated with the release of *Plectonycha correntina*. The risk is estimated to be negligible, which meets Australia's appropriate level of protection (ALOP).

1 Introduction

1.1 Australia’s biosecurity policy framework

Australia's biosecurity policies aim to protect Australia against the risks that may arise from exotic pests[1] entering, establishing and spreading in Australia, thereby threatening Australia's unique flora and fauna, as well as those agricultural industries that are relatively free from serious pests.

Risk analysis is an important part of Australia's biosecurity policies. It enables the Australian Government to formally consider the risks that could be associated with proposals to release a new organism into Australia. If the risks are found to exceed Australia’s appropriate level of protection (ALOP) then release will not be allowed.

For applications to release biological control agents, the proponent (applicant) submits a detailed application, including the results of host specificity testing. Based on the information submitted, risk analyses for biological control agents are undertaken by Biosecurity Australia. Consultation with stakeholders also occurs. Biosecurity Australia provides a recommendation based on the risk analysis to AQIS to allow release only if the risk is considered acceptable.

[1] A pest is any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2007b).

1.2 This risk analysis

1.2.1 Background

An application has been submitted by Biosecurity Queensland, Department of Employment, Economic Development & Innovation (DEEDI) to release a biological control agent (Appendix A). The biological control agent, *Plectonycha correntina* is a leaf feeding beetle proposed for the biological control of Madeira vine, *Anredera cordifolia* (Basellaceae). The applicant has followed the steps outlined in the Biosecurity Guidelines for the Introduction of Exotic Biological Control Agents for the Control of Weeds and Plant Pests (http://www.daff.gov.au/ba/reviews/protocol_for_biological_control_agents).

1.2.2 Scope

This report assesses the risk associated with the release of a biological control agent into the Australian environment. The primary risk with a release of this nature is the possibility of unwanted off-target effects on other species already present in Australia. Biosecurity Australia assesses the risk under the *Quarantine Act 1908*. A parallel process operates for the assessment of biological control release applications, with the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) also making a ruling under the *Environment Protection and Biodiversity Conservation Act 1999*. The recommendation in this risk analysis to release this biological control agent takes account of the afore-mentioned parallel process with DSEWPC. Consultation has been held with DSEWPC and they have notified Biosecurity Australia that they endorse the findings of this report.

Plants that are considered weeds are sometimes considered to have value. For example, as ornamental species, traditional medicine, feed for stock etc. Consideration of the benefits and therefore any concerns about eradication of the target weed species are out of scope of this analysis.

Biosecurity Australia will not commence an assessment to release a biological control agent unless the target has been approved by an appropriate government body. Madeira vine has been approved as a target for biological control by the Natural Resource Management Standing Committee (NRMSC) in 2006.

1.2.3 Contaminating pests

There are organisms that may arrive with imported biological control agents. These organisms may include parasitoids, mites or fungi. Biosecurity Australia considers these organisms to be contaminating pests that could pose sanitary and phytosanitary risks. These risks will be addressed by existing operational procedures, that apply to the importation and final release of biological control agents. These procedures include, detailed examination of imported material, confirmation of identity and breeding through one generation before release.

1.2.4 Consultation

On 15 June 2010, Biosecurity Australia Advice (BAA) 2010/19 informed stakeholders of the commencement of a risk analysis for the release of *Plectonycha correntina* for the biological control of Madeira vine. A draft risk analysis report was also released at this time for a 60-day stakeholder consultation period that closed on 16 August 2010. Written submissions received from 7 stakeholders were considered.

Six stakeholders supported release of the biological control agent and one stakeholder did not support release. Biosecurity Australia provided a response to the concerns of the stakeholder not supportive of release, and the stakeholder is now supportive of release.

2 Method for analysis

Biological control agents (BCA) intended for release are deliberately introduced, distributed, aided to establish and spread. Therefore it would be inappropriate to assess the probability of entry, establishment and spread using the processes described in ISPM 11 (FAO 2004). This BCA RA will focus only on off-target effects, as this is the only concern with regard to the release of biological control agents.

2.1.1 Australia's appropriate level of protection (ALOP)

The SPS Agreement defines the concept of an 'appropriate level of sanitary or phytosanitary protection (ALOP)' as the level of protection deemed appropriate by the WTO Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory.

Like many other countries, Australia expresses its ALOP in qualitative terms. Australia's ALOP, which reflects community expectations through government policy, is currently expressed as providing a high level of sanitary or phytosanitary protection aimed at reducing risk to a very low level, but not to zero.

3 Assessment of off-target risks

This section sets out the assessment of off-target risks that could be associated with the release of the biological control agent. As appropriate the methods followed those used for pest risk analysis (PRA) by Biosecurity Australia in accordance with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: *Framework for Pest Risk Analysis* (FAO 2007) and ISPM 11: *Pest Risk Analysis for Quarantine Pests, including analysis of environmental risks and living modified organisms (FAO 2004)*. The methodology for a commodity-based PRA is provided in Appendix B.

The risk relevant to release of a biological control agent consists of the combination of the probability of off-target consequences on non-target species and the potential magnitude of the consequences of any off-target impacts.

3.1 Stage 1: Initiation

Initiation commences when the applicant provides a submission proposing the release of the biological control agent.

The risk analysis area is defined as all of Australia given that once released there will be no control of spread of the agent other than environment constraints related to the biology of the organism.

3.2 Stage 2: Risk assessment

This assessment evaluates the probability of off-target effects and the potential economic consequences of these effects.

3.2.1 Assessment of the probability of off-target effects

Given that the proposal is for deliberate release then the probability of entry, establishment and spread is assumed to be certain and therefore the assessment relates to the host specificity of the proposed agent.

A qualitative likelihood is assigned to the estimate of probability of off-target effects. Six descriptors are used: high; moderate; low; very low; extremely low; and negligible. Definitions of each descriptor are given in Appendix B, Table 1.1.

Appendix A gives details provided by the proponent of the host specificity testing that was carried out.

Host specificity testing methodology

Compilation of the host test list, followed a currently accepted methodology (centrifugal phylogenetic method). Host testing was sufficiently extensive, including no-choice testing using eggs and adults, choice testing and additional testing for *Basella alba*. An initial host test list was circulated to state and territory departments of environment and primary industries/agriculture, CSIRO, DSEWPC and the Department of Agriculture, Fisheries and Forestry (DAFF) for comment. Comments/suggestions were included in the final host test list. The above processes are important in establishing confidence that the outcomes of the host testing indicate all possible off-target effects.

Results of host specificity testing

Of the plant species tested, significant feeding and the ability to complete a life cycle, only occurred on the target species (*Anredera cordifolia*) and *Basella alba*. With regard to *Basella alba* the proponent states that although *Plectonycha correntina* could complete a life cycle on this plant “all attempts to maintain a culture on this plant through a second generation failed”. The conclusion was that the “only possibility of damage to *Basella alba* would be if overflow populations of adults from nearby, heavily infested Madeira vine flew onto it”.

On the basis of the work presented in Appendix A it is concluded that the probability of off-target effects is: **LOW** (the event is unlikely to occur).

3.2.2 Assessment of potential consequences to off-target species

The potential consequences of the off-target effects of the biological control agent have been assessed using the same methodology (Appendix B) as used in the import risk analyses for pests that may be associated with imported produce.

Criterion	Estimate and rationale
Direct	
Plant life or health	**Impact score**: B - minor significance at a local level. In host testing against 36 species selected from ten families *Plectonycha correntina* was only able to complete its lifecycle on the two species of Basellaceae tested, *Anredera cordifolia* and *Basella alba* (Appendix 1). Of these, the ability to complete subsequent generations was only demonstrated on the target species *Anredera cordifolia*. The target organism *Anredera cordifolia* is the only naturalised Basellaceae species in Australia and there are no indigenous species of this group present in Australia. Therefore the risks of off-target effects on indigenous flora are considered to be negligible. Overflow of insects from Madeira vine could result in some damage to *Basella alba,* which is in minor use as a leafy vegetable in warmer areas of Australia. The impacts on plant health and economic impacts of *Basella alba* are considered minor at the local level, as this species is not of economic significance.
Other aspects of the environment	**Impact score**: A No evidence of any potential consequences
Indirect	
Eradication, control etc.	**Impact score**: A No evidence of any potential consequences
Domestic trade	**Impact score**: A No evidence of any potential consequences
International trade	**Impact score**: A No evidence of any potential consequences
Environmental and non-commercial	**Impact score**: A No evidence of any potential consequences

Based on this assessment the potential consequences of off-target effects are: **NEGLIGIBLE.**

3.2.3 Estimating the off-target risk of release of the biological control agent.

The estimate of probability of off-target effects of **low** are combined with the estimate of potential consequences of **negligible** to provide an estimate of risk of **NEGLIGIBLE**.

The estimate of risk is the result of combining the probability of off-target effects with the outcome of overall potential consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 1.5 (Appendix B).

A risk estimate of '**negligible'** achieves Australia's appropriate level of protection.

4 Recommendation on release

Given that the estimate of risk is negligible, this biological control agent should be released subject to standard conditions to ensure that the released material is free of other organisms.

5 Stakeholder responses to draft risk analysis report

Written submissions were received from 7 stakeholders. The following stakeholders supported the release of *Plectonycha correntina* into the Australian environment;

- South Australian Minister for Environment and Conservation (SA Department of Environment and Natural Resources)
- Western Australian Minister for Agriculture and Food (WA Department of Agriculture and Food)
- Executive Director Biosecurity Victoria (Department of Primary Industries Victoria)
- Northern Territory A/Executive Director Primary Industries (NT Department of Resources)
- Director Exotic Species Regulation Section (Australian Department of Sustainability, Environment, Water, Population and Communities) (note: supported the risk analysis outcome, a decision on whether *P. correntina* will be added to the live import list is pending)
- New South Wales Department of Industry and Investment (Royce Holtkamp and John Hosking, Primary Industries)

The following stakeholder did not support release;

- Director, Conservation and Wildlife Branch (Parks and Wildlife Division, Northern Territory Department of Natural Resources, Environment, the Arts and Sport)

The above submission raised several concerns with the original application (Appendix A), rather than the risk analysis. In light of this it was considered appropriate that the applicant address these concerns. A letter from Biosecurity Australia was sent to the above stakeholder, containing information provided by the applicant addressing the concerns raised. The stakeholder subsequently responded supporting the release.

Biosecurity Australia is satisfied that all concerns raised have been satisfactorily responded to by the applicant. Therefore the risk analysis has not been altered from the draft recommendation to release *P. correntina*.

Appendices

A. Application to release the leaf feeding beetle *Plectonycha correntina* (Coleoptera: Chrysomelidae) for the biological control of Madeira vine, *Anredera cordifolia* (Basellaceae)

B. Pest risk analysis methodology

C. Biosecurity Framework

Appendix A Release application for biological control agent

Application to release the leaf feeding beetle *Plectonycha correntina* (Coleoptera: Chrysomelidae) for the biological control of Madeira vine, *Anredera cordifolia* (Basellaceae)

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18th December 2009

On 26 March 2009, the Department of Primary Industries and Fisheries was amalgamated with other government departments to form the Department of Employment, Economic Development and Innovation.

6 Contents

7 Executive summary

The South American plant known as Madeira vine, *Anredera cordifolia* (Ten.) Steenis (Basellaceae), is a serious environmental weed of south-eastern Queensland and northern New South Wales. This vigorous perennial climber or scrambling shrub forms dense mats that cover trees and shrubs and it is now a problem weed in rainforests, riparian lands, bush land remnants and conservation areas.

Its control by conventional means is problematic and therefore Madeira vine was approved as a target for biological control by the Natural Resource Management Standing Committee (NRMSC) in 2006.

The leaf feeding beetle *Plectonycha correntina* Lacordaire (Coleoptera: Chrysomelidae) was found in the native range of the plant and was considered a potential biological control agent after preliminary host testing in Argentina.

Appropriate tests and studies were undertaken at the Alan Fletcher Research Station to determine whether *Plectonycha correntina* might be safe to release in Australia for the biological control of Madeira vine.

A host test list of 37 plant species was compiled using the centrifugal phylogenetic method after first circulating a tentative list to representatives of all state governments, the Australian government entities Biosecurity Australia, the Department of Environment, Heritage, Water & Arts and CSIRO. A significant feature of the testing design was that Basellaceae contains no native Australian species and Madeira vine is the only member of the family naturalised in Australia.

All plants on the host test list were used for no-choice tests using both adults and eggs of *Plectonycha correntina.* These tests established that the insect could complete its life cycle on only Madeira vine or *Basella alba,* also a member of Basellaceae.

Further testing on Madeira vine and *Basella alba* established that *Basella alba* is a much inferior host to Madeira vine and four attempts to establish a culture on *Basella* alba all failed at the end of the first generation. The experimental evidence suggests that *Basella alba*, which is a minor, non-commercial garden vegetable, might be subjected to some feeding should it be growing near Madeira vine infested with *Plectonycha correntina* but this damage would be of little consequence.

The release of *Plectonycha correntina* for the biological control of Madeira vine is therefore recommended.

8 Information on the target, *Anredera cordifolia*

8.1 Taxonomy

Order: Caryophyllales

Family: Basellaceae

Tribe: Anredereae

Genus: *Anredera* Juss.

Species: *cordifolia* (Ten.) Steenis

Common names: Madeira vine, potato vine, lamb’s tail vine, sweet mignonette vine

Synonyms: *Boussingaultia baselloides, Boussingaultia cordifolia*

The family Basellaceae is native to tropical and subtropical areas of the Americas, south-eastern Africa, and Madagascar. Most species are succulent vines that occur in dry habitats. Four genera (*Anredera* Juss., *Basella* L., *Tournonia* Moq., and *Ullucus* Caldas) with a total of 19 species are recognised, of which two are further subdivided into subspecies (Eriksson 2007). The genus *Anredera* is a monophyletic group native to the Americas and containing 12 species (Eriksson 2007).

8.2 Description

Madeira vine, *Anredera cordifolia*, is a vigorous perennial climber or scrambling shrub, forming dense mats that cover trees and shrubs. Stems are up to 30 m in length with succulent, heart-shaped leaves (Vivian-Smith et al. 2007). A profusion of long, slender creamy-white perfumed inflorescences are produced, though seed production rarely occurs outside the native range. Reproduction is predominantly vegetative by aerial and subterranean tubers, the density of which can be up to 1500 m^{2}. Tubers are dispersed by water, animals, soil and garden waste movement.

8.3 Native range and centre of origin

Madeira vine is native to northern and central South America. It is found from southern USA to northern Argentina including lowland Bolivia, Paraguay, Uruguay and southern Brazil (Vivian-Smith et al. 2007). Fruit production and variation in the flower morphology is greatest in central South America (Bolivia, northern Argentina, Uruguay and southern Brazil) and it is likely this is the centre of origin of the plant.

8.4 Australian and overseas distribution

Madeira vine was originally introduced to Australia as an ornamental plant. It is a major environmental weed of coastal and sub-coastal areas from southern Queensland to New South Wales, where it threatens lowland subtropical rainforest remnants on rich alluvial floodplains (Floyd 1989). Records of Madeira vine extend from coastal and sub-coastal areas as far north as Cairns and as far south as Hobart along the eastern seaboard, as well as near Perth and Adelaide (Vivian-Smith et al. 2007). It is a problem weed in rainforests, riparian lands, bush land remnants and conservation areas. Madeira vine is also a major weed in the North Island of New Zealand, Sri Lanka and sub-tropical areas of South Africa. It is also listed as an invasive plant in parts of the United States including Hawaii and in some Pacific Island countries.

The potential distribution of Madeira vine in Australia has been estimated using the climate matching software CLIMEX (Figure 1). The model predicts that most of the eastern seaboard is climatically suitable. South-western Western Australia is also climatically favorable while the southern coasts of Victoria and South Australia and the northern coast of Tasmania might also support populations of the plant. Actual, reported infestations of Madeira vine are also given in Figure 1.

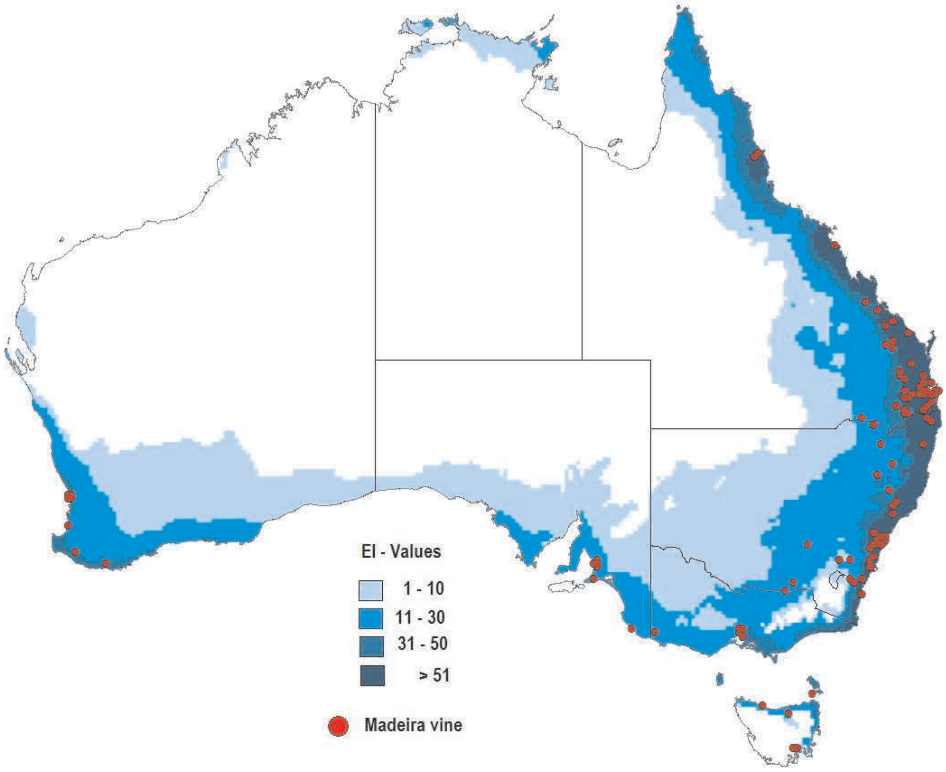

Figure 1 The potential distribution of Madeira vine in Australia, as predicted using the climate modelling software CLIMEX. EI values of >30 are considered very favourable while values <10 are considered climatically unfavourable. Locations for infestations of Madeira vine were obtained from the Australian Virtual Herbarium in November 2009.

8.5 Native and introduced related species

There are no indigenous Basellaceae species in Australia and Madeira vine is the only representative of the family that has become naturalised on this continent. However Ceylon or Malabar spinach (*Basella alba* L. or *Basella rubra* L.), a related species within the Basellaceae, is cultivated as a green leaf vegetable in gardens in south-eastern Queensland (Vivian-Smith et al. 2007). Another member of the family, *Ullucus tuberosus* Loz, is not present in Australia but has recently been reintroduced to New Zealand where it is being evaluated as a potential food crop (Busch et al. 2000).

The phylogenetic relationships among the Caryophyllales are presented in Figure 2. Until recently, Basellaceae was part of a clade with Halophytaceae, Cactaceae, Portulacaceae, Didiereaceae and Hectorellaceae (George 1984). This grouping has recently been rearranged (Stevens 2001 onwards). Portulacaceae is much reduced, with a number of genera assigned to other families. Basellaceae, Halophytaceae, Didiereaceae and Montiaceae form a clade, as do Cactaceae, Talinaceae (*Talinella* and *Talinum*, both usually part of Portulacaceae), Anacampseros etc (usually in Portulacaceae) and Portulacaceae (known as the ACTP clade). Within the ACTP clade, two species of *Talinum* (both introduced; one naturalised), and several *Portulaca* species (native and naturalised) also occur in the potential range of Madeira vine. Cactaceae contains only naturalized species in Australia (Telford 1984).

The relationships between families included in nodes [2], [3] and [4] (Figure 2) have yet to be fully resolved (Stevens 2001 onwards). Families include Aizoaceae (eight native genera), Nyctaginaceae (five native genera and ornamental *Bougainvillea*), Caryophyllaceae (25 native genera), Amaranthaceae (15 native genera[ii] and a number of serious weeds) and Chenopodiaceae (28 native genera). The Chenopodiaceae is an important family and includes 13 genera found in south-eastern Queensland and/or north-eastern NSW, including *Atriplex*, *Chenopodium* and *Sclerolaena*. Unlike the Flora of Australia, which acknowledges Chenopodiaceae as a familial unit (Wilson 1984) the Angiosperm Phylogeny Group included Chenopodiaceae within Amaranthaceae (Stevens 2001).

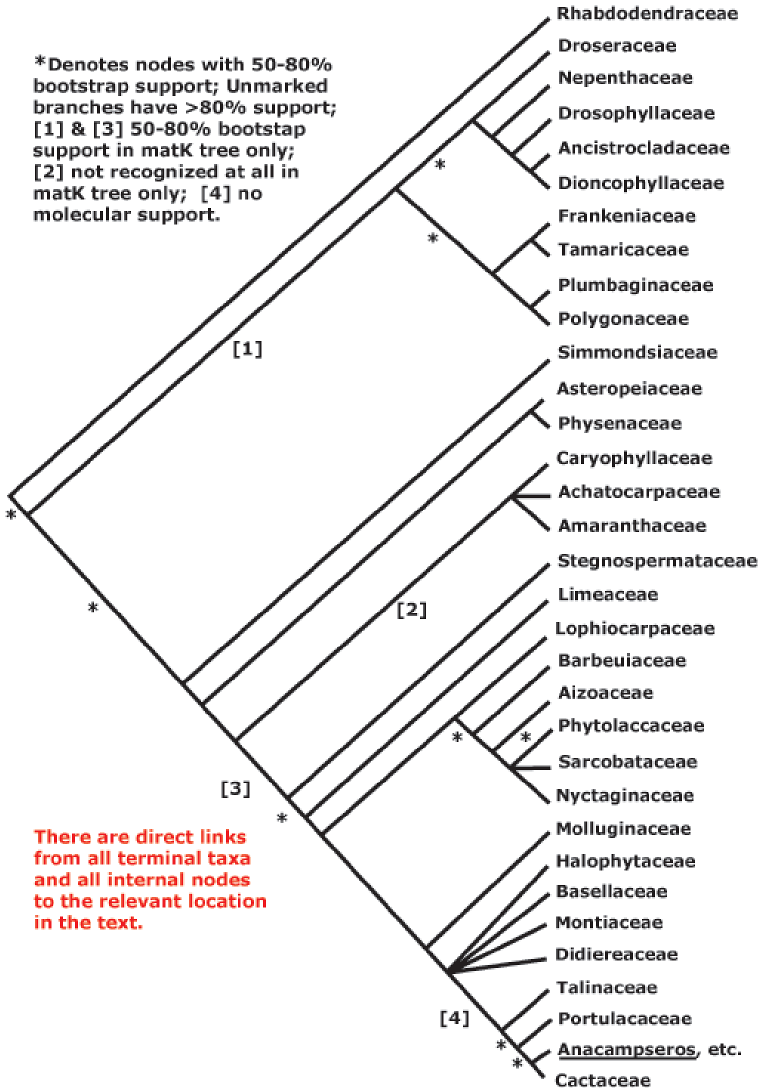

Figure 2 Phylogenetic relationships within the Caryophyllales, as interpreted by the *Angiosperm Phylogeny Group* (http://www.mobot.org/mobot/research/APweb/).

[ii] Not including Chenopodiaceae species

8.6 Approval as target species for biological control

Madeira vine was approved as a target for biological control by the Natural Resource Management Standing Committee (NRMSC) in 2006. The then Queensland Department of Natural Resources and Water was the sponsoring organisation.

8.7 Pest status

Madeira vine forms dense mats that cover the canopy strata, ultimately smothering supporting vegetation and threatens the biodiversity of riparian and rainforest communities.

Landcare and Bushcare groups, landholders and local government bodies are concerned about the increasing area of infestations and the difficulty in achieving control by conventional methods. Madeira vine is declared a class 3 pest under the Queensland *Land Protection (Pest and Stock Route Management) Act 2002* and has been prioritised as the fifth worst environmental weed in south-eastern Queensland (Batianoff and Butler 2002). It is also a declared noxious weed, category W4c, in several areas of NSW. Outside of Australia, Madeira vine is also a problem weed in the North Island of NZ and South Africa.

8.8 Other methods of control available

Chemical control methods are available. However application of herbicide to vines high up in host trees is impractical and there is a high risk of damage to non-target plants growing beneath the vines. Severed lianas left in the host tree die, but the aerial tubers remain viable, fall off and start to grow. Irrespective of whether the control methods are mechanical, physical or chemical, there is a need to treat infested areas repeatedly over a number of years because of the resilient nature of the aerial and subterranean tubers, which can remain viable after chemical treatment. This severely limits the size of areas that can be treated and makes management extremely difficult (Vivian-Smith et al. 2007). Landcare and Bushcare groups, landholders and local government bodies are concerned about the difficulty in achieving control by conventional methods. There is therefore a clear need for an effective biological control.

9 Information on the potential agent, *Plectonycha correntina*

9.1 Nomenclature

Class: Insecta

Order: Coleoptera
Family: Chrysomelidae
Subfamily: Criocerinae

Tribe: Lemiini

Scientific Name: *Plectonycha correntina* Lacordaire

The insect was identified by Dr. N. Cabrera (Facultad de Ciencias Naturales y Museo, La Plata, Argentina). Labelled specimens have been submitted to AQIS for inclusion in voucher collections.

9.2 Biology

A study of the insect's biology has been conducted in Argentina on behalf of South Africa (Cagnotti et al. 2007). Eggs are cylindrical in shape (0.80 ± 0.01 mm long; 0.30 ± 0.01 mm wide (mean ± 1SD)) and are yellowish in colour. Groups of eight to fifteen eggs are oviposited in two oblique rows, usually on the underside of leaves. There are four instars, the first three of which are gregarious (Table 3.1). Newly hatched larvae have a white egg-shaped body and a dark brown head and pronotum. Once they begin feeding they become covered in a transparent gelatinous substance which later incorporates frass and exuviae. Fourth instars disband and migrate to the lower sections of the host where their gelatinous cover is shed before burrowing into the soil.

Adults emerge after 20 days (Table 1). They average 5.2 (± 1.0) mm long and 2.1 (± 0.3) mm wide and are black with a reddish brown pronotum and elytra. Black spots may or may not occur on the elytra. As with larvae, adults are found on the underside of leaves. Following a pre-oviposition period of 6.1 (± 1.4) days, females lay an average of 555 (± 292) eggs.

Table 1 Life stage duration and larval head capsules width of *Plectonycha correntina* on *Anredera cordifolia* (Cagnotti et al. 2007).

Stage	*n*	Life stage duration (days)		Head capsules width (mm)	
		Mean ± SD	Range	Mean ± SD	Range
Egg	20	5 ± 0.4	5-6		
L I	20	2.3 ± 0.5	2-3	0.33 ± 0.01	0.31-0.34
L II	17	2.4 ± 0.5	2-3	0.46 ± 0.01	0.46-0.48
L III	17	2.2 ± 0.4	2-3	0.66 ± 0.02	0.65-0.70
L IV	17	3.1 ± 0.3	3-4	0.95 ± 0.01	0.94-0.96
(Prepupa + Pupa)[1]	15	19.8 ± 1	19-21		
Adult	8	75.6 ± 39.8	20-130		

[1]: time inside the cocoon.

9.3 Native range

The full native range of *Plectonycha correntina* is not known other than it is known only from South America where it has been reported from Argentina, Paraguay and Uruguay (Monrós 1947). Recent collections, related to this project, have been made in Missiones Province and the city of Buenos Aires, Argentina and also in Paraná Province, Brazil.

9.4 Related species

Plectonycha is a neotropical genus containing six species. All are reported to be restricted to basellaceous hosts (Monrós 1947 and 1959; cited in Cagnotti *et al.* 2007). The congeners of *P. correntina* Lacordaire, 1845, listed in Monrós (1959), are as follow:

Plectonycha atrolineata Pic, 1944

Plectonycha meditabunda Monrós, 1948

Plectonycha tenuicollis Lacordaire, 1845

Plectonycha vorax Monrós, 1948

Plectonycha xibixibi Monrós, 1952

Little is detail is known about the hosts for these species though there is a reference in Jolivet and Hawkeswood (1995) that they were "...on *Boussingaultia* and other Basellaceae in tropical America." *Boussingaultia* is a synonym of *Anredera.*

9.5 Proposed source of the agent

Plectonycha correntina was collected from *A. cordifolia* growing on house fences in Lujan and Hurlingham, Buenos Aires, Argentina. Cultures were maintained at the USDA-ARS South American Biological Control Laboratory where host studies were conducted between 2002 and 2004. The insect was then transferred to the quarantine facilities at the ARC-Plant Protection Research Institute at Pretoria, South Africa. After several generations had been reared there the insect was imported in September 2007 into the quarantine at Alan Fletcher Research Station where the laboratory colony was maintained on potted plants of Madeira vine for the duration of experimentation.

9.6 Mode of action

Both larvae and adults feed on leaves. Mature larvae are particularly voracious feeders.

9.7 Potential for control

Large reductions in photosynthetic area promote the utilisation of stored resources, potentially depleting these. The short lifecycle and high fecundity of *Plectonycha correntina,* combined with voracious larval feeding is conducive to producing large populations capable of inflicting such damage.

9.8 Non-target organisms at risk

Host testing studies involving *Plectonycha correntina* have been conducted at the USDA-ARS South American Biological Control Laboratory, on behalf of the Plant Protection Research Institute in South Africa (Cagnotti et al. 2007). A total of 16 plant species (including the target weed) were included in the host testing. Four basellaceous species (*Basella alba, Ullucus tuberosus, Anredera krapovickasii* and *Anredera cordifolia*) supported complete larval development; larvae died within 96 hours on all other species. Similar results are reported later in this report for the Australian testing. *Anredera cordifolia* and *Basella alba* are the only two species of the family that occur in Australia. All results indicate that while it is possible to rear this insect through a generation on *Basella alba,* this host is clearly inferior to Madeira vine and cannot sustain populations into succeeding generations. The only possibility of damage to *Basella alba* would be if ‘overflow’ populations of adults from nearby, heavily infested Madeira vine flew onto it. *Basella alba* is grown in south-eastern Queensland as a vegetable but is not commercially important. The bulk of the crop is grown by individual householders and it is sold mainly through weekend suburban markets (W. Senaratne, DEEDI, personal communication). Growers were alerted to the intention to release insects which might feed on *Basella alba* by placing an article in the *Asian Foods Newsletter* but no response was received from any grower or marketer.

Significant feeding and development through to prepupal stage was also observed on the Australian native *Neopaxia australasica* (Montiaceae). Again it was established that the plant could not possibly sustain a population of the insect. Further, *Neopaxia australasica* is basically an alpine or montane species of southern Australia (Wimbush and Costin 1979) and would not usually be growing close to Madeira vine. The climate where *Neopaxia australasica* grows would not suit *Plectonycha correntina.*

9.9 Possible interactions with existing biological control agents

There have been no previous agents released against Madeira vine and therefore there can be no interactions with existing biological control agents.

9.10 Host specificity studies

9.10.1 General summary

Comprehensive host specificity testing was conducted in the quarantine facilities at the Alan Fletcher Research Station (27 Magazine St, Sherwood, Qld). No-choice tests were conducted on 37 plant species selected by the centrifugal phylogenetic method. Both adults and eggs were exposed to these plants. It was shown that the insect could be reared through a complete life cycle only on the closely related *Basella alba* but it was also evident that this plant was a less suitable host than Madeira vine and all attempts to maintain a culture on this plant through a second generation failed. Adults could also feed to some degree on several of the other plant species but this feeding was clearly much less than that on its natural host. Additional testing was undertaken to compare *Basella alba* and Madeira vine as hosts.

9.10.2 The host test list

The test list was compiled using the centrifugal phylogenetic method (Wapshere 1975). The centrifugal phylogenetic method proposes that taxa closely related to the target weed are well represented in the test list while those more distantly related have fewer representatives. A tentative host test list was first circulated to representatives of all state governments, the Australian government entities Biosecurity Australia and the Department of Environment, Heritage, Water & Arts and to the CSIRO. Several suggestions from these reviewers were adopted in the final list (Table 2). Table 2 retains conventional family groupings rather than those proposed by the Angiosperm Phylogeny Group with Amaranthaceae and Chenopodiaceae separated and Talinaceae included in Portulacaceae.

The 37 species listed in Table 2 are all members of order Caryophyllales, to which Madeira vine also belongs. Madeira vine is a member of the Basellaceae which contains no native Australian species. All representatives of the family found in Australia, of which only Madeira vine is naturalised, have been included in the test list. Within the closely related ACTP clade (see section 3.5), the two *Talinum* species found in Australia (exotic) and a number of other Portulacaceae also occur in the potential range of Madeira vine; the test list includes representatives of both.

The remaining species included in the test list are from other related families. Amaranthaceae and Chenopodiaceae are particularly well represented.

9.10.3 No-choice tests using adults

A no-choice test was conducted primarily to measure the responses of the adult beetles. Ten unsexed, newly emerged and unfed beetles were placed in a cage containing one potted plant. All the plants listed in Table 2 were tested in this fashion and the plants were tested in batches of six. Each batch always contained one cage with an *Anredera cordifolia* plant which acted as a control. In most instances each plant species was replicated three times. After 10 days, the adults were removed from the cage. Those adults still alive were counted. The numbers of egg masses oviposited by the beetles were also counted and an assessment of the amount of feeding was made. All plants with egg batches were retained to allow eggs to hatch and immatures to develop. When all development was completed, all beetles of this next generation were counted.

Adults survived 10 days on many of the test plants but generally less well than on Basellaceae (Table 2). However they fed on only a few species from the Aizoaceae, Cactaceae, Caryophyllaceae, and Portulacaceae. In most instances feeding was little more than exploratory. Significant feeding occurred only on *Anredera cordifolia, Basella alba, Neopaxia australasica, Portulaca australis, Portulaca oleracea* and *Talinum paniculatum*. Egg masses were oviposited only on *Anredera cordifolia, Basella alba, Neopaxia australasica, Portulaca australis* and *P. oleracea.* Immatures did not develop through to next generation adults on any plant other than the target weed, *Anredera cordifolia.*

Table 2 No-choice tests using either unfed adults or eggs being exposed to the plants

	No-choice tests using adults (4.10.3)					No-choice tests using eggs (4.10.4)		
Plant Species	Reps	Mean % adult survival	Adult feeding [1]	Mean no. of egg masses	Mean no. of F1 adults	Reps	Larval feeding [1]	Mean % eggs developing to adult
Basellaceae								
**Anredera cordifolia* (Ten.) Stennis	23	80.0	+++	18.2	61.4	16	+++	33.8
**Basella alba* L.	4	82.5	+++	5	0	3	+++	26.7
Aizoaceae								
**Aptenia cordifolia* (L.f.) Schwantes	3	13.3	-	0	0	3	-	0
Carpobrotus glaucescens (Haw.) Schwantes	3	60.0	-	0	0	3	-	0
Tetragonia tetragonioides (Pall.) Kuntze	3	60.0	+	0	0	3	-	0
**Trianthema portulacastrum* L.	3	3.3	-	0	0	3	-	0
Amaranthaceae								
**Alternanthera dentata* Stuchlik ex R.E. Fr.	3	40.0	-	0	0	3	-	0
Alternanthera denticulata R.Br.	3	10.0	-	0	0	3	-	0
**Amaranthus tricolor* L.	3	0.0	-	0	0	3	-	0
Deeringia amaranthoides (Lam.) Merr.	3	6.7	-	0	0	3	-	0
Deeringia arborescens (R.Br.) Druce	3	30.0	-	0	0	3	-	0
Gomphrena cunninghamii (Moq.) Druce	3	6.7	-	0	0	3	-	0
Ptilotus exaltatus var. *semilanatus* (Lindl.) Maiden & Betche	2	40.0	-	0	0	2	-	0

Cactaceae								
* *Hylocereus undatus* (Haw.) Britton & Rose	3	40.0	-	0	0	3	-	0
**Pereskia aculeata* Miller	3	20.0	+	0	0	3	+	0
Caryophyllaceae								
Stellaria flaccida Hook.	3	3.3	+	0	0	3	+	0
Chenopodiaceae								
Atriplex semibaccata R.Br.	3	0.0	-	0	0	3	-	0
**Chenopodium ambrosioides* L.	3	30.0	-	0	0	3	-	0
Chenopodium carinatum R. Br.	3	13.3	-	0	0	3	-	0
**Chenopodium pumilio* R.Br.	3	0.0	-	0	0	3	-	0
Einadia hastata (R.Br) A.J.Scott	3	0.0	-	0	0	3	-	0
Molluginaceae								0
Glinus lotoides L.	3	0	-	0	0	3	-	0
Glinus oppositifolius (L.) A.DC.	3	36.6	-	0	0	3	-	0
Macarthuria neocambrica F. Muell.	3	13.3	-	0	0	3	-	0
Nyctaginaceae								
Boerhavia dominii Meikle & Hewson	3	0.0	-	0	0	3	-	0
**Bougainvillea glabra* Choisy	3	0.0	-	0	0	3	-	0
Pisonia aculeata L.	2	0.0	-	0	0	1	-	0
Pisonia umbellifera (J.R.Forst. & G.Forst.) Seem.	3	0.0	-	0	0	3	-	0
Phytolaccaceae								
Monococcus echinophorus F.Muell.	3	13.3	-	0	0	2	-	0
**Rivina humilis* L.	3	6.7	-	0	0	3	-	0
Portulacaceae								
Calandrinia pickeringii (A. Gray) Hershk.	3	26.7	+	0	0	3	+	0
Calandrinia polyandra Benth.	1	0.0	-	0	0	1	-	0
Neopaxia australasica (Hook.f.) O.Nilsson	8	32.5	++	0.6	0	9	++	0
Portulaca australis Endl.	4	27.5	++	0.3	0	3	++	0
**P. oleracea* L.	3	40.0	++	0.3	0	3	+	0

**Portulacaria afra* (L.) Jacq.	3	0.0	-	0	0	6	-	0
**Talinum paniculatum* (Jacq.) Gaertn.	3	66.7	++	0	0	3	+	0

* denotes exotic species

[1] + minor exploratory feeding; ++ moderate feeding; +++ severe feeding and similar to that seen on *Anredera cordifolia*

9.10.4 No-choice tests using eggs

A similar procedure to that described in 4.10.3 was employed except that 20 eggs were attached to the plants instead of introducing adults. Eggs were allowed to hatch and the plants were tended until either larvae had died or had all developed through to adults. Assessment of larval feeding and counts of emerging adults were made.

In these tests (Table 2), *Plectonycha correntina* could only complete its development from egg to adult on *Anredera cordifolia* and *Basella alba.* For almost all other plant species, larvae died as neonates without any significant feeding. Some larval development and feeding was observed on *Pereskia aculeata, Stellaria flaccida, Calandrinia polyandra, Neopaxia australasica, Portulaca australis, Portulaca oleracea* and *Talinum paniculatum*. The most significant feeding and development occurred on *Neopaxia australasica.* Nine replicates for this plant were undertaken but on no occasion did the insect complete its life cycle.

9.10.5 Additional studies for *Basella alba*

Additional studies were undertaken with *Basella alba* which was confirmed in the previous studies to be a host for *Plectonycha correntina.* These studies compared *Anredera cordifolia* and *Basella alba* as hosts.

An experiment was undertaken using 6 replicates each of *Anredera cordifolia* and *Basella alba.* Each replicate consisted of one potted plant housed inside an insect cage. Twenty eggs were attached to the foliage of each plant. The plants were tended until all insect individuals had the opportunity to develop and emerge as adults. As adults emerged they were counted, weighed and the development time noted. At the end of the experiment, the number of emerging adults, the mean weight of females and the mean development time were calculated. Appropriate mathematical transformations were made before the data were tested for significant differences by the two tailed t-test.

The results (Table 3a) showed that while the development times were similar for both host plants, *Anredera cordifolia* produced more adults and heavier females than did *Basella alba.*

A second experiment involved placing a mating but unfed pair of adults on each of 12 individually enclosed cuttings of *Anredera cordifolia* and 12 cuttings of *Basella alba.* Some of these replications were ultimately discarded when no oviposition occurred (deaths of females, capture of two males etc). The pair of insects on each plant was maintained until death of the adults. During the experiment the numbers of egg batches, the numbers of eggs per batch, the total egg production, the percentage eclosion of eggs and the time of death of each adult were recorded.

The results (Table 3b) showed that numbers of egg batches and total egg production were significantly less on *Basella alba*, while the numbers of eggs per batch, the percent eclosion and survival of the adults were similar.

Four attempts were also made to establish a colony on *Basella alba* to see whether this plant could support populations of *Plectonycha correntina* for further generations and to estimate rates of increase or decrease between generations. No attempt was successful in establishing a second generation.

Table 3 A comparison of *Anredera cordifolia* and *Basella alba* as hosts after exposure to either eggs or adults.

(a) Twenty eggs attached to each plant

Plant	No of reps	Mean no. of adults developing	Mean adult female weight (mg)	Mean development time (days)
Anredera cordifolia	6	8.7	10.7	33.5
Basella alba	6	4.0	8.8	32.6
Significance		p< 0.05	p< 0.01	NS

(b) A mating pair of adults placed on each plant

Plant	No of reps	Mean no of egg batches	Mean no. of eggs per batch	Mean total egg production	Mean % egg eclosion	Mean adult survival (days)
Anredera cordifolia	8	66.0	11.9	771	67.5	127.1
Basella alba	7	31.6	10.1	300	80.5	127.5
Significance		p< 0.05	NS	p< 0.01	NS	NS

9.10.6 Choice tests

A preference or choice test was conducted for four plant species *Anredera cordifolia, Basella alba*, *Aptenia cordifolia* and *Pereskia aculeata*. These four species were selected because the beetles had fed to some extent on them in previous testing. The trial was set out in a latin square design within a 1.8 x 1 m cage so that plants were approximately 10 cm apart and did not touch. Fifty adults were released into the cage and allowed to feed and oviposit for 4 days. The beetles on each plant were counted daily and the mean number calculated. After four days the insects were withdrawn, the plants dissected, any eggs counted and an assessment made of feeding activity. The adult and egg data were transformed (log x + 1) and then analysed using the general linear model for latin squares but after 'rows' and 'columns' effects were found to be non-significant, the data were analysed as a single factor randomised ANOVA.

Anredera cordifolia and *Basella alba* were similarly preferred in this test for feeding and oviposition and both these plants were preferred over *Aptenia cordifolia* and *Pereskia aculeata* on which very little activity occurred. However there was a significant difference between *Anredera cordifolia* and *Basella alba* for adult habitation with the former preferred (Table 4).

Table 4 A choice test for *P. correntina* using four potential hosts.

Plant species	Mean no. of adults[1]	Mean no. of eggs[1]	Feeding [2]

Anredera cordifolia	4.5 a	249 a	+++
Basella alba	2.3 b	104 a	+++
Pereskia aculeata	0.2 c	9 b	+
Aptenia cordifolia	0.0 c	0 b	-

[1] Means within columns followed by different letters differ ($p<0.05$). Statistical analysis undertaken on transformed data.

[2] + minor exploratory feeding; ++ moderate feeding; +++ severe feeding and similar to that seen on *Anredera cordifolia*

10 Proposed release procedure

10.1 Release from quarantine

Plectonycha correntina is presently being cultured very satisfactorily within the quarantine facility at the Alan Fletcher Research Station. Specimens of this culture have already been deposited with AQIS as voucher specimens. After receiving approval from AQIS and DEWHA, adults from this culture will be removed from the quarantine after careful inspection to confirm identity and to ensure that no other phoretic arthropod or pathogen is taken from the quarantine. Once removed from quarantine, the insects will be placed on Madeira vine in non-quarantine glass houses to initiate a mass rearing phase.

Should the culture be lost before approvals are granted or any detrimental signs appear as a result of genetic bottlenecks, the insect will be recollected in South America and reared through at least one generation in quarantine before being released. Voucher specimens will be submitted to AQIS and the identity of the collected material will be confirmed by an authority on the group.

10.2 Distributing in the field

Plectonycha correntina will be distributed to selected sites throughout the weed's range in Australia. Climate matching software (CLIMEX) will be used to ensure that some sites have as similar climate to the insect's native range as possible. Release sites will be recorded with their GPS coordinates. It is hoped that community groups such as Landcare, Bushcare and schools may contribute to this distribution.

10.3 Establishment and evaluation

Release sites will be monitored for some years after releases to ascertain whether the insect has established. Should the insect be found to have established, assessments will be made on its effects on the weed and also any non-target effects, in the most unlikely event they occur.

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12 Appendices – Selected Readings

The following selected readings are attached:

Cagnotti, C., Mc Kay, F. and Gandolfo, D. 2007. Biology and host specificity of *Plectonycha correntina* Lacordaire (Chrysomelidae), a candidate for the biological control of *Anredera cordifolia* (Tenore) Steenis (Basellaceae). *African Entomology* 15(2): 300-309.

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Appendix B Method for pest risk analysis

This section sets out the method used for the pest risk analysis (PRA) in this report. Biosecurity Australia has conducted this PRA in accordance with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: *Framework for Pest Risk Analysis* (FAO 2007) and ISPM 11: *Pest Risk Analysis for Quarantine Pests, including analysis of environmental risks and living modified organisms (FAO 2004)*.

A PRA is 'the process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it'(FAO 2009). A pest is 'any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products'(FAO 2009).

Quarantine risk consists of two major components: the probability of a pest entering, establishing and spreading in Australia from imports; and the consequences should this happen. These two components are combined to give an overall estimate of the risk.

Unrestricted risk is estimated taking into account the existing commercial production practices of the exporting country and that, on arrival in Australia, AQIS will verify that the consignment received is as described on the commercial documents and that its integrity has been maintained.

Restricted risk is estimated with phytosanitary measure(s) applied. A phytosanitary measure is 'any legislation, regulation or official procedure having the purpose to prevent the introduction and spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests'(FAO 2009).

A glossary of the terms used is provided at the back of this report.

PRAs are conducted in three consecutive stages: initiation, pest risk assessment and pest risk management.

Stage 1: Initiation

Initiation identifies the pest(s) and pathway(s) that are of quarantine concern and should be considered for risk analysis in relation to the identified PRA area.

The pests assessed for their potential to be on the exported commodity (produced using commercial production and packing procedures) are listed in the document. This list does not present a comprehensive list of all the pests associated with the entire plant, but concentrates on the pests that could be on the assessed commodity. Pests that are determined to not be associated with the commodity are not considered further in the PRA. Contaminating pests that have no specific relation to the commodity or the export pathway have not been listed and would be addressed by Australia's current approach to contaminating pests.

The identity of the pests is given in the pest list. The species name is used in most instances but a lower taxonomic level is used where appropriate. Synonyms are provided where the current scientific name differs from that provided by the exporting countries NPPO or where the cited literature uses a different scientific name.

For this PRA, the 'PRA area' is defined as Australia for pests that are absent, or of limited distribution and under official control. For areas with regional freedom from a pest, the 'PRA area' may be defined on the basis of a state or territory of Australia or may be defined as a region of Australia consisting of parts of a state or territory or several states or territories.

For pests that had been considered by Biosecurity Australia in other risk assessments and for which import policies already exist, a judgement based on the specific circumstances was made on the likelihood of entry of pests on the commodity and whether existing policy is adequate to manage the risks associated with its import. Where appropriate, the previous risk assessment was taken into consideration when developing the new policy.

Stage 2: Pest risk assessment

A pest risk assessment (for quarantine pests) is: 'the evaluation of the probability of the introduction and spread of a pest and of the likelihood of associated potential economic consequences'(FAO 2009).

In this PRA, pest risk assessment was divided into the following interrelated processes:

Pest categorisation

Pest categorisation identifies which of the pests with the potential to be on the commodity are quarantine pests for Australia and require pest risk assessment. A 'quarantine pest' is a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled, as defined in ISPM 5: *Glossary of phytosanitary terms* (FAO 2009).

The pests identified in Stage 1 were categorised using the following primary elements to identify the quarantine pests for the commodity being assessed:

- presence or absence in the PRA area
- regulatory status
- potential for establishment and spread in the PRA area
- potential for economic consequences (including environmental consequences) in the PRA area.

The results of pest categorisation are set out in the document. The quarantine pests identified during pest categorisation were carried forward for pest risk assessment.

Assessment of the probability of entry, establishment and spread

Details of how to assess the 'probability of entry', 'probability of establishment' and 'probability of spread' of a pest are given in ISPM 11 (FAO 2004). A summary of this process is given below, followed by a description of the qualitative methodology used in this IRA.

Probability of entry

The probability of entry describes the probability that a quarantine pest will enter Australia as a result of trade in a given commodity, be distributed in a viable state in the PRA area and subsequently be transferred to a host. It is based on pathway scenarios depicting necessary steps in the sourcing of the commodity for export, its processing, transport and storage, its use in Australia and the generation and disposal of waste. In particular, the ability of the pest to survive is considered for each of these stages.

The probability of entry estimates for the quarantine pests for a commodity are based on the use of the existing commercial production, packaging and shipping practices of the exporting country. Details of the existing commercial production practices for the commodity are set out in the document. These practices are taken into consideration by Biosecurity Australia when estimating the probability of entry.

For the purpose of considering the probability of entry, Biosecurity Australia divides this step of this stage of the PRA into two components:

- **Probability of importation**: the probability that a pest will arrive in Australia when a given commodity is imported
- **Probability of distribution**: the probability that the pest will be distributed, as a result of the processing, sale or disposal of the commodity, in the PRA area and subsequently transfer to a susceptible part of a host.

Factors considered in the probability of importation include:

- distribution and incidence of the pest in the source area
- occurrence of the pest in a life-stage that would be associated with the commodity
- mode of trade (e.g. bulk, packed)
- volume and frequency of movement of the commodity along each pathway
- seasonal timing of imports
- pest management, cultural and commercial procedures applied at the place of origin
- speed of transport and conditions of storage compared with the duration of the lifecycle of the pest
- vulnerability of the life-stages of the pest during transport or storage
- incidence of the pest likely to be associated with a consignment
- commercial procedures (e.g. refrigeration) applied to consignments during transport and storage in the country of origin, and during transport to Australia.

Factors considered in the probability of distribution include:

- commercial procedures (e.g. refrigeration) applied to consignments during distribution in Australia
- dispersal mechanisms of the pest, including vectors, to allow movement from the pathway to a host
- whether the imported commodity is to be sent to a few or many destination points in the PRA area
- proximity of entry, transit and destination points to hosts
- time of year at which import takes place
- intended use of the commodity (e.g. for planting, processing or consumption)
- risks from by-products and waste.

Probability of establishment

Establishment is defined as the 'perpetuation for the foreseeable future, of a pest within an area after entry' (FAO 2009). In order to estimate the probability of establishment of a pest, reliable biological information (lifecycle, host range, epidemiology, survival, etc.) is obtained from the areas where the pest currently occurs. The situation in the PRA area can then be compared with that in the areas where it currently occurs and expert judgement used to assess the probability of establishment.

Factors considered in the probability of establishment in the PRA area include:

- availability of hosts, alternative hosts and vectors
- suitability of the environment
- reproductive strategy and potential for adaptation
- minimum population needed for establishment
- cultural practices and control measures.

Probability of spread

Spread is defined as 'the expansion of the geographical distribution of a pest within an area' (FAO 2009). The probability of spread considers the factors relevant to the movement of the pest, after establishment on a host plant or plants, to other susceptible host plants of the same or different species in other areas. In order to estimate the probability of spread of the pest, reliable biological information is obtained from areas where the pest currently occurs. The situation in the PRA area is then carefully compared with that in the areas where the pest currently occurs and expert judgement used to assess the probability of spread.

Factors considered in the probability of spread include:

- suitability of the natural and/or managed environment for natural spread of the pest
- presence of natural barriers
- potential for movement with commodities, conveyances or by vectors
- intended use of the commodity
- potential vectors of the pest in the PRA area
- potential natural enemies of the pest in the PRA area.

Assigning qualitative likelihoods for the probability of entry, establishment and spread

In its qualitative PRAs, Biosecurity Australia uses the term 'likelihood' for the descriptors it uses for its estimates of probability of entry, establishment and spread. Qualitative likelihoods are assigned to each step of entry, establishment and spread. Six descriptors are used: high; moderate; low; very low; extremely low; and negligible (Table 1.1). Descriptive definitions for these descriptors and their indicative probability ranges are given in Table 1.1. The indicative probability ranges are only provided to illustrate the boundaries of the descriptors. These indicative probability ranges are not used beyond this purpose in qualitative PRAs. The standardised likelihood descriptors and the associated indicative probability ranges provide guidance to the risk analyst and promote consistency between different risk analyses.

Table 1.1 Nomenclature for qualitative likelihoods

Likelihood	Descriptive definition	Indicative probability (P) range
High	The event would be very likely to occur	0.7 < P ≤ 1
Moderate	The event would occur with an even probability	0.3 < P ≤ 0.7
Low	The event would be unlikely to occur	0.05 < P ≤ 0.3
Very low	The event would be very unlikely to occur	0.001 < P ≤ 0.05
Extremely low	The event would be extremely unlikely to occur	0.000001 < P ≤ 0.001
Negligible	The event would almost certainly not occur	0 ≤ P ≤ 0.000001

The likelihood of entry is determined by combining the likelihood that the pest will be imported into the PRA area and the likelihood that the pest will be distributed within the PRA area, using a matrix of rules (Table 1.2). This matrix is then used to combine the likelihood of entry and the likelihood of establishment, and the likelihood of entry and establishment is then combined with the likelihood of spread to determine the overall likelihood of entry, establishment and spread.

For example, if the probability of importation is assigned a likelihood of ‘low’ and the probability of distribution is assigned a likelihood of ‘moderate’, then they are combined to give a likelihood of ‘low’ for the probability of entry. The likelihood for the probability of entry is then combined with the likelihood assigned to the probability of establishment (e.g. ‘high’) to give a likelihood for the probability of entry and establishment of ‘low’. The likelihood for the probability of entry and establishment is then combined with the likelihood assigned to the probability of spread (e.g. ‘very low’) to give the overall likelihood for the probability of entry, establishment and spread of ‘very low’.

Table 1.2 Matrix of rules for combining qualitative likelihoods

	High	Moderate	Low	Very low	Extremely low	Negligible
High	High	Moderate	Low	Very low	Extremely low	Negligible
Moderate		Low	Low	Very low	Extremely low	Negligible
Low			Very low	Very low	Extremely low	Negligible
Very low				Extremely low	Extremely low	Negligible
Extremely low					Negligible	Negligible
Negligible						Negligible

Time and volume of trade

One factor affecting the likelihood of entry is the volume and duration of trade. If all other conditions remain the same, the overall likelihood of entry will increase as time passes and the overall volume of trade increases.

Biosecurity Australia normally considers the likelihood of entry on the basis of the estimated volume of one year’s trade. This is a convenient value for the analysis that is relatively easy to estimate and allows for expert consideration of seasonal variations in pest presence, incidence and behaviour to be taken into account. The consideration of the likelihood of entry, establishment and spread and subsequent consequences takes into account events that might happen over a number of years even though only one year’s volume of trade is being considered. This reflects biological and ecological facts, for example where a pest or disease may establish in the year of import but spread may take many years.

These considerations have been taken into account when setting up the matrix. Therefore any policy based on this analysis does not simply apply to one year of trade. Policy decisions that are based on Biosecurity Australia's method that uses the estimated volume of one year's trade are consistent with Australia's policy on appropriate level of protection and meet the Australian Government's requirement for ongoing quarantine protection. Of course, if there are substantial changes in the volume and nature of the trade in specific commodities then Biosecurity Australia has an obligation to review the risk analysis and, if necessary, provide updated policy advice.

Assessment of potential consequences

The objective of the consequence assessment is to provide a structured and transparent analysis of the likely consequences if the pests or disease agents were to enter, establish and spread in Australia. The assessment considers direct and indirect pest effects and their economic and environmental consequences. The requirements for assessing potential consequences are given in Article 5.3 of the SPS Agreement (WTO 1995), ISPM 5 (FAO 2009) and ISPM 11 (FAO 2004).

Direct pest effects are considered in the context of the effects on:

- plant life or health
- other aspects of the environment.

Indirect pest effects are considered in the context of the effects on:

- eradication, control, etc
- domestic trade
- international trade
- environment.

For each of these six criteria, the consequences were estimated over four geographic levels, defined as:

- **Local**: an aggregate of households or enterprises (a rural community, a town or a local government area).
- **District**: a geographically or geopolitically associated collection of aggregates (generally a recognised section of a state or territory, such as 'Far North Queensland').
- **Regional**: a geographically or geopolitically associated collection of districts in a geographic area (generally a state or territory, although there may be exceptions with larger states such as Western Australia).
- **National**: Australia wide (Australian mainland states and territories and Tasmania).

For each criterion, the magnitude of the potential consequence at each of these levels was described using four categories, defined as:

- **Indiscernible**: pest impact unlikely to be noticeable.

- **Minor significance**: expected to lead to a minor increase in mortality/morbidity of hosts or a minor decrease in production but not expected to threaten the economic viability of production. Expected to decrease the value of non-commercial criteria but not threaten the criterion's intrinsic value. Effects would generally be reversible.
- **Significant**: expected to threaten the economic viability of production through a moderate increase in mortality/morbidity of hosts, or a moderate decrease in production. Expected to significantly diminish or threaten the intrinsic value of non-commercial criteria. Effects may not be reversible.
- **Major significance**: expected to threaten the economic viability through a large increase in mortality/morbidity of hosts, or a large decrease in production. Expected to severely or irreversibly damage the intrinsic 'value' of non-commercial criteria.

The estimates of the magnitude of the potential consequences over the four geographic levels were translated into a qualitative impact score (A–G)[3] using Table 1.3[4]. For example, a consequence with a magnitude of 'significant' at the 'district' level will have a consequence impact score of D.

Table 1.3 Decision rules for determining the consequence impact score based on the magnitude of consequences at four geographic scales

		Geographic scale			
		Local	District	Region	Nation
Magnitude	Indiscernible	A	A	A	A
	Minor significance	B	C	D	E
	Significant	C	D	E	F
	Major significance	D	E	F	G

The overall consequence for each pest is achieved by combining the qualitative impact scores (A–G) for each direct and indirect consequence using a series of decision rules (Table 1.4). These rules are mutually exclusive, and are assessed in numerical order until one applies.

[3] In earlier qualitative IRAs, the scale for the impact scores went from A to F and did not explicitly allow for the rating 'indiscernible' at all four levels. This combination might be applicable for some criteria. In this report, the impact scale of A-F has changed to become B-G and a new lowest category A ('indiscernible' at all four levels) was added. The rules for combining impacts in Table 1.4 were adjusted accordingly.

[4] The decision rules for determining the consequence impact score are presented in a simpler form in Table 1.3 from earlier IRAs, to make the table easier to use. The outcome of the decision rules is the same as the previous table and makes no difference to the final impact score.

Table 1.4 Decision rules for determining the overall consequence rating for each pest

Rule	The impact scores for consequences of direct and indirect criteria	Overall consequence rating
1	Any criterion has an impact of ‘G’; or more than one criterion has an impact of ‘F’; or a single criterion has an impact of ‘F’ and each remaining criterion an ‘E’.	Extreme
2	A single criterion has an impact of ‘F’; or all criteria have an impact of ‘E’.	High
3	One or more criteria have an impact of ‘E’; or all criteria have an impact of ‘D’.	Moderate
4	One or more criteria have an impact of ‘D’; or all criteria have an impact of ‘C’.	Low
5	One or more criteria have an impact of ‘C’; or all criteria have an impact of ‘B’.	Very Low
6	One or more but not all criteria have an impact of ‘B’, and all remaining criteria have an impact of ‘A’.	Negligible

Estimation of the unrestricted risk

Once the above assessments are completed, the unrestricted risk can be determined for each pest or groups of pests. This is determined by using a risk estimation matrix (Table 1.5) to combine the estimates of the probability of entry, establishment and spread and the overall consequences of pest establishment and spread. Therefore, risk is the product of likelihood and consequence.

When interpreting the risk estimation matrix, note the descriptors for each axis are similar (e.g. low, moderate, high) but the vertical axis refers to likelihood and the horizontal axis refers to consequences. Accordingly, a ‘low’ likelihood combined with ‘high’ consequences, is not the same as a ‘high’ likelihood combined with ‘low’ consequences – the matrix is not symmetrical. For example, the former combination would give an unrestricted risk rating of ‘moderate’, whereas, the latter would be rated as a ‘low’ unrestricted risk.

Table 1.5 Risk estimation matrix

Likelihood of pest entry, establishment and spread	Negligible	Very low	Low	Moderate	High	Extreme
High	Negligible risk	[redacted]	Low risk	Moderate risk	High risk	Extreme risk
Moderate	Negligible risk	[redacted]	Low risk	Moderate risk	High risk	Extreme risk
Low	Negligible risk	Negligible risk	[redacted]	Low risk	Moderate risk	High risk
Very low	Negligible risk	Negligible risk	Negligible risk	[redacted]	Low risk	Moderate risk
Extremely low	Negligible risk	Negligible risk	Negligible risk	Negligible risk	[redacted]	Low risk
Negligible	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Negligible risk	[redacted]

Consequences of pest entry, establishment and spread

Australia's appropriate level of protection (ALOP)

The SPS Agreement defines the concept of an 'appropriate level of sanitary or phytosanitary protection (ALOP)' as the level of protection deemed appropriate by the WTO Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory.

Australia expresses its ALOP in qualitative terms. Australia's ALOP, which reflects community expectations through government policy, is currently expressed as providing a high level of sanitary or phytosanitary protection aimed at reducing risk to a very low level, but not to zero. The band of cells in Table 1.5 marked 'very low risk' represents Australia's ALOP.

Stage 3: Pest risk management

Pest risk management describes the process of identifying and implementing phytosanitary measures to manage risks to achieve Australia's ALOP, while ensuring that any negative effects on trade are minimised.

The conclusions from pest risk assessment are used to decide whether risk management is required and if so, the appropriate measures to be used. Where the unrestricted risk estimate exceeds Australia's ALOP, risk management measures are required to reduce this risk to a very low level. The guiding principle for risk management is to manage risk to achieve Australia's ALOP. The effectiveness of any proposed phytosanitary measure (or combination of measures) is evaluated, using the same approach as used to evaluate the unrestricted risk, to ensure it reduces the restricted risk for the relevant pest or pests to meet Australia's ALOP.

ISPM 11 (FAO 2004) provides details on the identification and selection of appropriate risk management options and notes that the choice of measures should be based on their effectiveness in reducing the probability of entry of the pest.

Examples given of measures commonly applied to traded commodities include:

- options for consignments – e.g., inspection or testing for freedom from pests, prohibition of parts of the host, a pre-entry or post-entry quarantine system, specified conditions on preparation of the consignment, specified treatment of the consignment, restrictions on end-use, distribution and periods of entry of the commodity
- options preventing or reducing infestation in the crop – e.g., treatment of the crop, restriction on the composition of a consignment so it is composed of plants belonging to resistant or less susceptible species, harvesting of plants at a certain age or specified time of the year, production in a certification scheme
- options ensuring that the area, place or site of production or crop is free from the pest – e.g., pest-free area, pest-free place of production or pest-free production site
- options for other types of pathways – e.g., consider natural spread, measures for human travellers and their baggage, cleaning or disinfestation of contaminated machinery
- options within the importing country – e.g., surveillance and eradication programs
- prohibition of commodities – if no satisfactory measure can be found.

Risk management measures are identified for each quarantine pest where the risk exceeds Australia's ALOP.

Appendix C Biosecurity framework

Australia's biosecurity policies

The objective of Australia's biosecurity policies and risk management measures is the prevention or control of the entry, establishment or spread of pests and diseases that could cause significant harm to people, animals, plants and other aspects of the environment.

Australia has diverse native flora and fauna and a large agricultural sector, and is relatively free from the more significant pests and diseases present in other countries. Therefore, successive Australian Governments have maintained a conservative, but not a zero-risk, approach to the management of biosecurity risks. This approach is consistent with the World Trade Organization's (WTO's) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement).

The SPS Agreement defines the concept of an 'appropriate level of protection' (ALOP) as the level of protection deemed appropriate by a WTO Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory. Among a number of obligations, a WTO Member should take into account the objective of minimising negative trade effects in setting its ALOP.

Like many other countries, Australia expresses its ALOP in qualitative terms. Australia's ALOP, which reflects community expectations through Australian Government policy, is currently expressed as providing a high level of sanitary and phytosanitary protection, aimed at reducing risk to a very low level, but not to zero.

Consistent with the SPS Agreement, in conducting risk analyses Australia takes into account as relevant economic factors:

- the potential damage in terms of loss of production or sales in the event of the entry, establishment or spread of a pest or disease in the territory of Australia
- the costs of control or eradication of a pest or disease and
- the relative cost-effectiveness of alternative approaches to limiting risks.

Roles and responsibilities within Australia's quarantine system

Australia protects its human[5], animal and plant life or health through a comprehensive quarantine system that covers the quarantine continuum, from pre-border to border and post-border activities.

Pre-border, Australia participates in international standard-setting bodies, undertakes risk analyses, develops offshore quarantine arrangements where appropriate, and engages with our neighbours to counter the spread of exotic pests and diseases.

At the border, Australia screens vessels (including aircraft), people and goods entering the country to detect potential threats to Australian human, animal and plant health.

The Australian Government also undertakes targeted measures at the immediate post-border level within Australia. This includes national co-ordination of emergency responses to pest and disease incursions. The movement of goods of quarantine concern within Australia's

[5] The Australian Government Department of Health and Ageing is responsible for human health aspects of quarantine.

border is the responsibility of relevant state and territory authorities, which undertake inter- and intra-state quarantine operations that reflect regional differences in pest and disease status, as a part of their wider plant and animal health responsibilities.

Roles and responsibilities within the Department

The Australian Government Department of Agriculture, Fisheries and Forestry is responsible for the Australian Government's animal and plant biosecurity policy development and the establishment of risk management measures. The Secretary of the Department is appointed as the Director of Animal and Plant Quarantine under the *Quarantine Act 1908* (the Act).

The Biosecurity Services Group (BSG) within the Department takes the lead in biosecurity and quarantine policy development and the establishment and implementation of risk management measures across the biosecurity continuum, and:

- through Biosecurity Australia, conducts risk analyses, including IRAs, and develops recommendations for biosecurity policy as well as providing quarantine policy advice to the Director of Animal and Plant Quarantine
- through the Australian Quarantine and Inspection Service, develops operational procedures, makes a range of quarantine decisions under the Act (including import permit decisions under delegation from the Director of Animal and Plant Quarantine) and delivers quarantine services
- coordinates pest and disease preparedness, emergency responses and liaison on inter- and intra-state quarantine arrangements for the Australian Government, in conjunction with Australia's state and territory governments.

Roles and responsibilities of other government agencies

State and territory governments play a vital role in the quarantine continuum. The BSG works in partnership with state and territory governments to address regional differences in pest and disease status and risk within Australia, and develops appropriate sanitary and phytosanitary measures to account for those differences. Australia's partnership approach to quarantine is supported by a formal Memorandum of Understanding that provides for consultation between the Australian Government and the state and territory governments.

Depending on the nature of the good being imported or proposed for importation, Biosecurity Australia may consult other Australian Government authorities or agencies in developing its recommendations and providing advice.

As well as a Director of Animal and Plant Quarantine, the Act provides for a Director of Human Quarantine. The Australian Government Department of Health and Ageing is responsible for human health aspects of quarantine and Australia's Chief Medical Officer within that Department holds the position of Director of Human Quarantine. Biosecurity Australia may, where appropriate, consult with that Department on relevant matters that may have implications for human health.

The Act also requires the Director of Animal and Plant Quarantine, before making certain decisions, to request advice from the Environment Minister and to take the advice into account when making those decisions. The Australian Government Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) is responsible under the *Environment Protection and Biodiversity Conservation Act 1999* for assessing the environmental impact associated with proposals to import live species. Anyone proposing to import such material should contact DSEWPC directly for further information.

When undertaking risk analyses, Biosecurity Australia consults with DSEWPC about environmental issues and may use or refer to DSEWPC's assessment.

Australian quarantine legislation

The Australian quarantine system is supported by Commonwealth, state and territory quarantine laws. Under the Australian Constitution, the Commonwealth Government does not have exclusive power to make laws in relation to quarantine, and as a result, Commonwealth and state quarantine laws can co-exist.

Commonwealth quarantine laws are contained in the *Quarantine Act 1908* and subordinate legislation including the Quarantine Regulations 2000, the Quarantine Proclamation 1998, the Quarantine (Cocos Islands) Proclamation 2004 and the Quarantine (Christmas Island) Proclamation 2004.

The quarantine proclamations identify goods, which cannot be imported, into Australia, the Cocos Islands and or Christmas Island unless the Director of Animal and Plant Quarantine or delegate grants an import permit or unless they comply with other conditions specified in the proclamations. Section 70 of the Quarantine Proclamation 1998, section 34 of the Quarantine (Cocos Islands) Proclamation 2004 and section 34 of the Quarantine (Christmas Island) Proclamation 2004 specify the things a Director of Animal and Plant Quarantine must take into account when deciding whether to grant a permit.

In particular, a Director of Animal and Plant Quarantine (or delegate):

- must consider the level of quarantine risk if the permit were granted, and
- must consider whether, if the permit were granted, the imposition of conditions would be necessary to limit the level of quarantine risk to one that is acceptably low, and
- for a permit to import a seed of a plant that was produced by genetic manipulation – must take into account any risk assessment prepared, and any decision made, in relation to the seed under the Gene Technology Act, and
- may take into account anything else that he or she knows is relevant.

The level of quarantine risk is defined in section 5D of the *Quarantine Act 1908*. The definition is as follows:

> reference in this Act to a *level of quarantine risk* is a reference to:
>
> (a) the probability of:
>
> (i) a disease or pest being introduced, established or spread in Australia, the Cocos Islands or Christmas Island; and
>
> (ii) the disease or pest causing harm to human beings, animals, plants, other aspects of the environment, or economic activities; and
>
> (b) the probable extent of the harm.

The Quarantine Regulations 2000 were amended in 2007 to regulate keys steps of the import risk analysis process. The Regulations:

- define both a standard and an expanded IRA,
- identify certain steps, which must be included in each type of IRA,
- specify time limits for certain steps and overall timeframes for the completion of IRAs (up to 24 months for a standard IRA and up to 30 months for an expanded IRA),
- specify publication requirements,
- make provision for termination of an IRA, and
- allow for a partially completed risk analysis to be completed as an IRA under the Regulations.

The Regulations are available at www.comlaw.gov.au.

International agreements and standards

The process set out in the *Import Risk Analysis Handbook 2007 (update 2009)* is consistent with Australia's international obligations under the SPS Agreement. It also takes into account relevant international standards on risk assessment developed under the International Plant Protection Convention (IPPC) and by the World Organisation for Animal Health (OIE).

Australia bases its national risk management measures on international standards where they exist and when they achieve Australia's ALOP. Otherwise, Australia exercises its right under the SPS Agreement to apply science-based sanitary and phytosanitary measures that are not more trade restrictive than required to achieve Australia's ALOP.

Notification obligations

Under the transparency provisions of the SPS Agreement, WTO Members are required, among other things, to notify other members of proposed sanitary or phytosanitary regulations, or changes to existing regulations, that are not substantially the same as the content of an international standard and that may have a significant effect on trade of other WTO Members.

Risk analysis

Within Australia's quarantine framework, the Australian Government uses risk analyses to assist it in considering the level of quarantine risk that may be associated with the importation or proposed importation of animals, plants or other goods.

In conducting a risk analysis, Biosecurity Australia:

- identifies the pests and diseases of quarantine concern that may be carried by the good
- assesses the likelihood that an identified pest or disease would enter, establish or spread
- assesses the probable extent of the harm that would result.

If the assessed level of quarantine risk exceeds Australia's ALOP, Biosecurity Australia will consider whether there are any risk management measures that will reduce quarantine risk to achieve the ALOP. If there are no risk management measures that reduce the risk to that level, trade will not be allowed.

Risk analyses may be carried out by Biosecurity Australia's specialists, but may also involve relevant experts from state and territory agencies, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), universities and industry to access the technical expertise needed for a particular analysis.

Risk analyses are conducted across a spectrum of scientific complexity and available scientific information. An IRA is a type of risk analysis with key steps regulated under the Quarantine Regulations 2000. Biosecurity Australia's assessment of risk may also take the form of a non-regulated analysis of existing policy or technical advice to AQIS. Further information on the types of risk analysis is provided in the *Import Risk Analysis Handbook 2007 (update 2009)*.

Glossary

Term or abbreviation	Definition
Additional declaration	A statement that is required by an importing country to be entered on a phytosanitary certificate and which provides specific additional information on a consignment in relation to regulated pests (FAO 2009).
Appropriate level of protection (ALOP)	The level of protection deemed appropriate by the Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory (WTO 1995).
Area	An officially defined country, part of a country or all or parts of several countries (FAO 2009).
Area of low pest prevalence	An area, whether all of a country, part of a country, or all parts of several countries, as identified by the competent authorities, in which a specific pest occurs at low levels and which is subject to effective surveillance, control or eradication measures (FAO 2009).
Biological Control Agent (BCA)	A natural enemy, antagonist or competitor, or other organism, used for pest control (FAO 2009).
Biosecurity Australia	The unit, within the Biosecurity Services Group, responsible for recommendations for the development of Australia's biosecurity policy.
Biosecurity Services Group (BSG)	The group responsible for the delivery of biosecurity policy and quarantine services within the Department of Agriculture, Fisheries and Forestry.
Certificate	An official document which attests to the phytosanitary status of any consignment affected by phytosanitary regulations (FAO 2009).
Consignment	A quantity of plants, plant products and/or other articles being moved from one country to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of one or more commodities or lots) (FAO 2009).
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO 2009).
Endangered area	An area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss (FAO 2009).
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO 2009).
Establishment	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2009).
Fresh	Living; not dried, deep-frozen or otherwise conserved (FAO 2009).
Host range	Species capable, under natural conditions, of sustaining a specific pest or other organism (FAO 2009).
Import permit	Official document authorising importation of a commodity in accordance with specified phytosanitary import requirements (FAO 2009).
Import risk analysis	An administrative process through which quarantine policy is developed or reviewed, incorporating risk assessment, risk management and risk communication.
Infestation (of a commodity)	Official document authorising importation of a commodity in accordance with specified phytosanitary import requirements (FAO 2009).
Inspection	Official visual examination of plants, plant products or other regulated articles to determine if pests are present and/or to determine compliance with phytosanitary regulations (FAO 2009).
Intended use	Declared purpose for which plants, plant products, or other regulated articles are imported, produced, or used (FAO 2009).
Interception (of a pest)	The detection of a pest during inspection or testing of an imported consignment (FAO 2009).
International Standard for Phytosanitary Measures (ISPM)	An international standard adopted by the Conference of the Food and Agriculture Organization, the Interim Commission on phytosanitary measures or the Commission on phytosanitary measures, established under the IPCC (FAO 2009).
Introduction	The entry of a pest resulting in its establishment (FAO 2009).
Lot	A number of units of a single commodity, identifiable by its homogeneity of composition, origin etc., forming part of a consignment (FAO 2009).
National Plant Protection Organization (NPPO)	Official service established by a government to discharge the functions specified by the IPPC (FAO 2009).

Term or abbreviation	Definition
Official control	The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests (FAO 2009).
Pathway	Any means that allows the entry or spread of a pest (FAO 2009).
Pest	Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2009).
Pest categorisation	The process for determining whether a pest has or has not the characteristics of a quarantine pest or those of a regulated non-quarantine pest (FAO 2009).
Pest free area (PFA)	An area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained (FAO 2009).
Pest free place of production	Place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period (FAO 2009).
Pest free production site	A defined portion of a place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this conditions is being officially maintained for a defined period and that is managed as a separate unit in the same way as a pest free place of production (FAO 2009).
Pest risk analysis (PRA)	The process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it (FAO 2009).
Pest risk assessment (for quarantine pests)	Evaluation of the probability of the introduction and spread of a pest and of the associated potential economic consequences (FAO 2009).
Pest risk management (for quarantine pests)	Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 2009).
Phytosanitary certificate	Certificate patterned after the model certificates of the IPPC (FAO 2009).
Phytosanitary measure	Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO 2009).
Phytosanitary regulation	Official rule to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests, including establishment of procedures for phytosanitary certification (FAO 2009).
Polyphagous	Feeding on a relatively large number of hosts from different genera.
PRA area	Area in relation to which a pest risk analysis is conducted (FAO 2009).
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO 2009).
Regulated article	Any plant, plant product, storage place, packing, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved (FAO 2009).
Restricted risk	Risk estimate with phytosanitary measure(s) applied.
Spread	Expansion of the geographical distribution of a pest within an area (FAO 2009).
SPS Agreement	WTO Agreement on the Application of Sanitary and Phytosanitary Measures (WTO 1995).
Stakeholders	Government agencies, individuals, community or industry groups or organizations, whether in Australia or overseas, including the proponent/applicant for a specific proposal, who have an interest in the policy issues.
Systems approach(es)	The integration of different risk management measures, at least two of which act independently, and which cumulatively achieve the appropriate level of protection against regulated pests (FAO 2009).
Unrestricted risk	Unrestricted risk estimates apply in the absence of risk mitigation measures.

References

FAO (2004) *International Standards for Phytosanitary Measures (ISPM) no. 11: pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms*. Secretariat of the International Plant Protection Convention, Food and Agricultural Organization of the United Nations, Rome, Italy.

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