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# Biological Control in Eucalypt plantations: Present status and challenges

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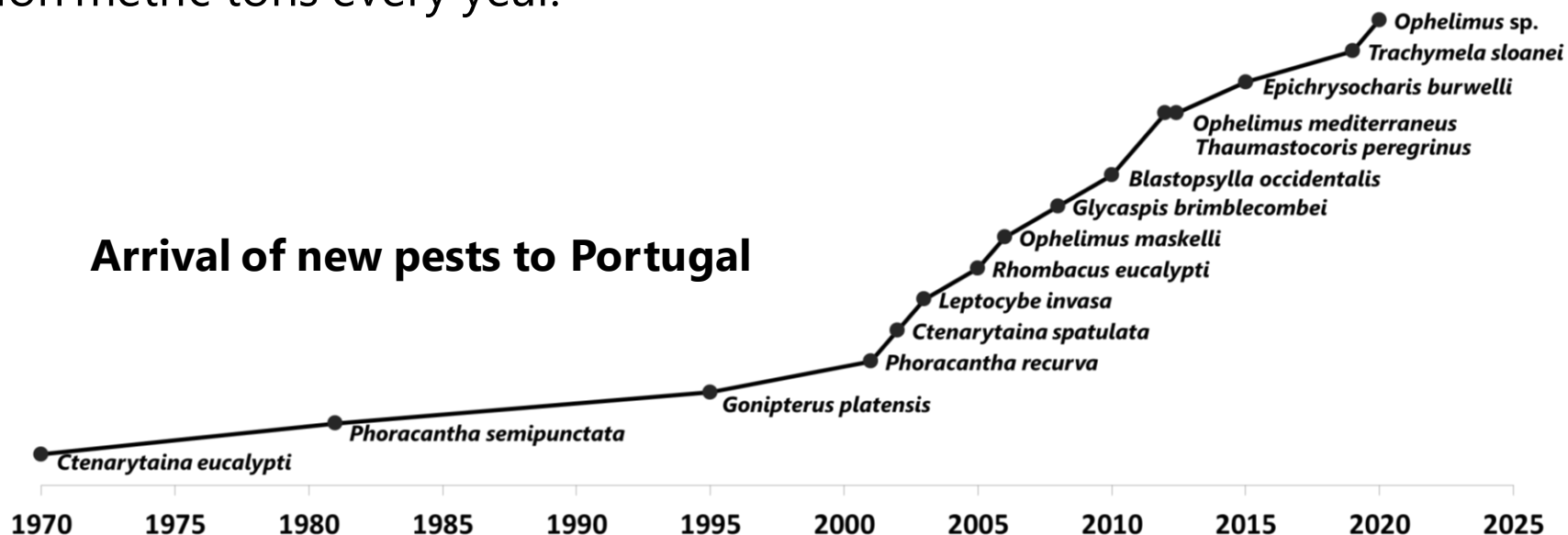
# Eucalypts and their pests

Eucalypts are non-native trees that benefited from the absence of pests for many decades after their introduction in Portugal.

In recent years, we have witnessed an increase in the number of new invasive eucalypt pests.

Free from the natural enemies that control them in their native habitat (mostly Australia), these new pests thrive and can cause wood losses in excess of one million metric tons every year.

## Arrival of new pests to Portugal








# Biological control of pests

Biological control is widely acknowledged as:

- ✓ being cost-effective
- ✓ having long-term effects
- ✓ being environmentally safe

Just like pests, some natural enemies arrived naturally in Portugal and keep their hosts partly or completely under control, with little to no human intervention.

**Eucalypt pests for which natural enemies arrived in Portugal accidentally**

	Pest	Natural enemy	Success
	Snout beetle ( <i>Gonipterus platensis</i> )	<i>Anaphes nitens</i>	Partial
	Longhorned borers ( <i>Phoracantha semipunctata</i> and <i>P. recurva</i> )	<i>Avetianella longoi</i>	Partial
	Blue gum psyllid ( <i>Ctenarytaina eucalypti</i> )	<i>Psyllaephagus pilosus</i>	Complete
	Red gum lerp psyllid ( <i>Glycaspis brimblecombei</i> )	<i>Psyllaephagus bliteus</i>	Partial
	Gall wasp ( <i>Ophelimus maskelli</i> )	<i>Closterocerus chamaeleon</i>	Partial

# Biological control in practice

For pests that are not yet under complete biological control, specific programs can be developed.

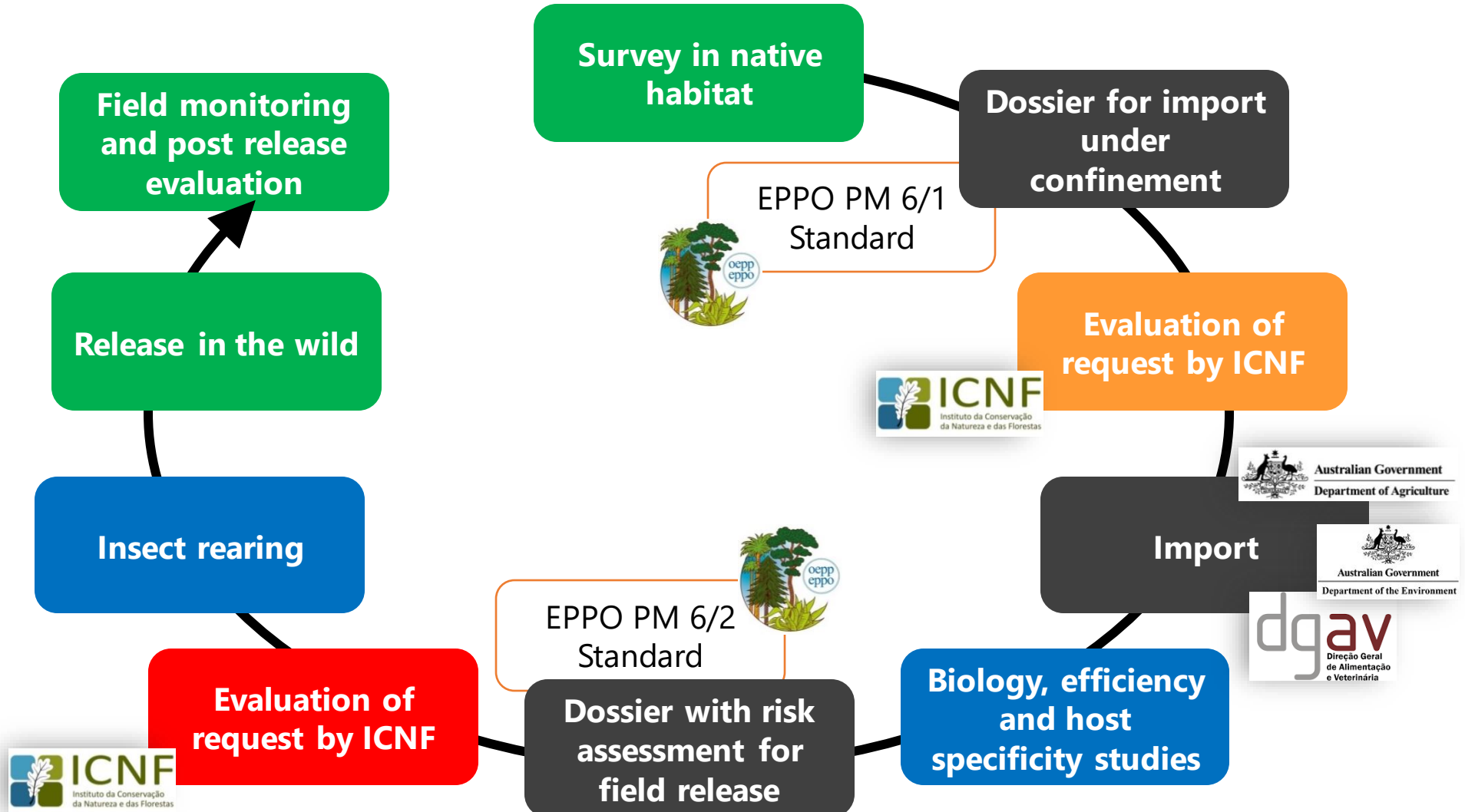
The introduction of non-native agents is called **Classical Biological Control** (CBC) and requires supervision and validation by competent authorities.

CBC programs typically involve five steps:

- 1 **identification** of biological control agents in the pests' native habitat
- 2 **import** of specimens for studies under quarantine conditions
- 3 studies on **efficiency** and **risk-assessment**, including non-target impacts
- 4 production and **release** in the wild
- 5 **post-release assessments**, to monitor establishment, efficiency, and non-target impacts



# Biological control in practice





# The snout beetle (*Gonipterus platensis*)

The **snout beetle** is the most important eucalypt pest in Portugal.

It feeds on leaves and twigs, and heavy infestation can lead to **complete wood yield losses**.



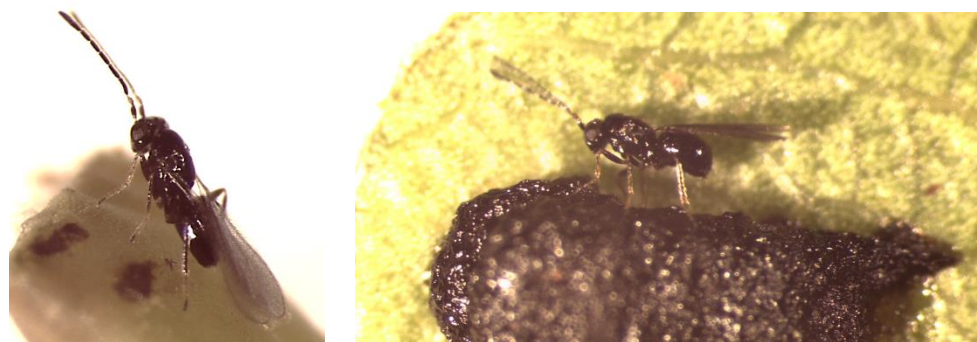
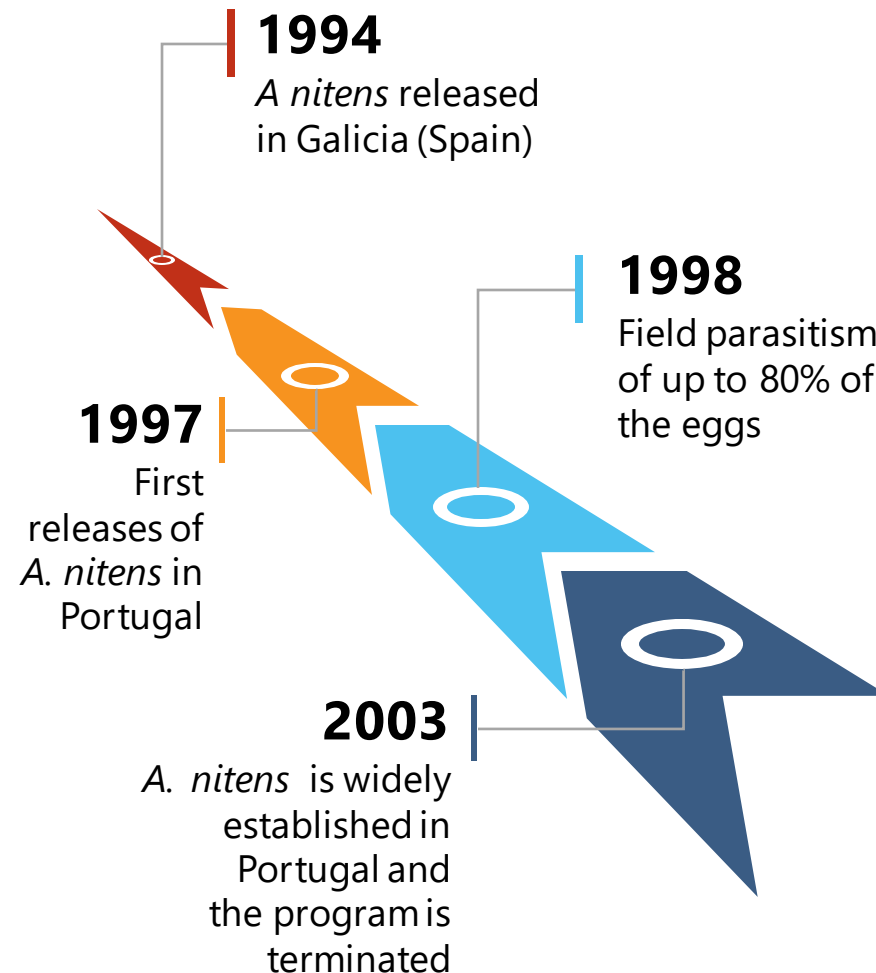
# The snout beetle (*Gonipterus platensis*)

## *Anaphes nitens*

This 1 mm long insect parasitoid lays its eggs inside the snout beetle's own eggs, killing the developing pest larva.


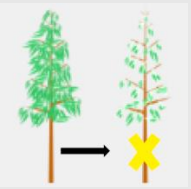


*Anaphes nitens* dispersed naturally from Spain, where it was introduced.

Between 1997 and 2003, around 300,000 insects were reared and released in Portugal to aid natural establishment.



# The snout beetle (*Gonipterus platensis*)

## Economic benefit of *Anaphes nitens* over 20 years

Scenario		Losses (million €)
Biological control		648
Eucalypt replacement		2,546
Insecticide applications		2,451
Wood imports		7,164

With *A. nitens*, losses due to the snout beetle were estimated at almost **650 million €**, but without the natural enemy, losses would be **4 to 11 times higher!**

At a total cost of 1.1 million €, the program to accelerate the establishment of *A. nitens* had a **return of 67€ for every 1€ invested.**



Ecological Economics

journal homepage: [www.elsevier.com/locate/ecocon](http://www.elsevier.com/locate/ecocon)

Analysis

Economic Outcome of Classical Biological Control: A Case Study on the *Eucalyptus* Snout Beetle, *Gonipterus platensis*, and the Parasitoid *Anaphes nitens*

Source: Carlos Valente<sup>a,\*</sup>, Catarina I. Gonçalves<sup>a</sup>, Fernanda Monteiro<sup>a</sup>, João Gaspar<sup>a</sup>, Margarida Silva<sup>a</sup>, Miguel Sottomayor<sup>b</sup>, Maria Rosa Paiva<sup>c</sup>, Manuela Branco<sup>d</sup>



# The snout beetle (*Gonipterus platensis*)

## *Anaphes inexpectatus*

While *Anaphes nitens* is extremely effective in controlling the snout beetle in most regions in Portugal, it's only partly successful at higher altitude.

Field surveys in Australia, starting in 2008, uncovered a complex of natural enemies attacking the snout beetle.

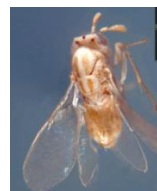
Among these, ***A. inexpectatus* readily parasitized the beetle's eggs and was selected for further studies.**



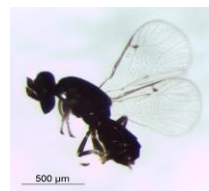
### Other egg parasitoids



*Anaphes tasmaniae*



*Centrodora damoni*



*Euderus* sp.

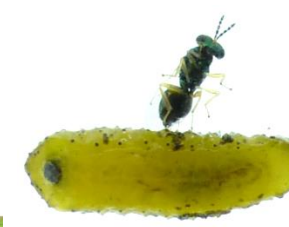


*Cirrospilus* sp.

### Larval parasitoids



*Anagonia* cf. *lasiophthalma*



*Entedon magnificus*



*Oxyserphus* sp.

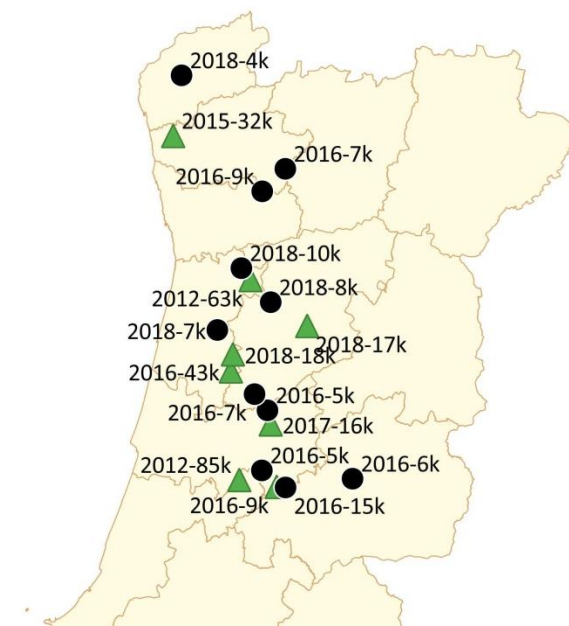
# The snout beetle (*Gonipterus platensis*)

## *Anaphes inexpectatus*

After several years of studies under quarantine, the parasitoid was considered not to pose risk for native fauna and the environment and its release was authorized.

To date, 400,000 insects have been released in 19 locations where the snout beetle causes important damage, and **recovered in 8 of them**.

While *A. inexpectatus* seems to be establishing, **parasitism remains low**, usually under 3%.



Release points (tags indicate year of first release and number of insects released; ▲: insects recovered; ●: insects not recovered)

# The snout beetle (*Gonipterus platensis*)

## *Anagonia* cf. *lasiophthalma*

This insect is about 1 cm in length and parasitizes the larvae of the snout beetle.

It belongs to a group of parasitoids that sometimes attack multiple hosts, leading to the risk of impacts to local insect fauna.

Genus *Anagonia* was mostly unknown, but **behavior and biology studies have revealed that they may be host specific.**

While much work is still ahead before field releases can be considered, *Anagonia* looks promising, especially because it **attacks a stage of the snout beetle that currently has no natural enemies.**





# The bronze bug (*Thaumastocoris peregrinus*)

The bronze bug feeds on the surface of leaves, causing **discoloration and defoliation**.



# The bronze bug (*Thaumastocoris peregrinus*)

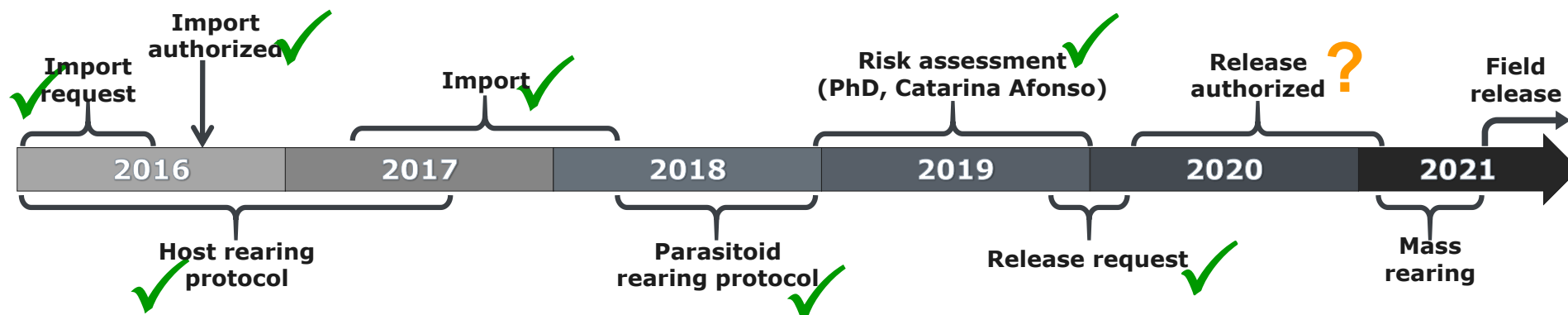
## *Cleruchoides noackae*

This 1 mm long insect lays its eggs in the bronze bugs' eggs, killing the developing pest.

It has been **successfully used in South Africa and South America**. The studies already done in these countries gave us a head start, and we focused on assessing the risk of non-target impacts on local insect fauna, which were negligible.



We are currently **awaiting feedback** from ICNF on the field release request.





# The tortoise beetle (*Trachymela sloanei*)

The tortoise beetle is a recent arrival in Portugal (2019). Currently expanding from the Southeast, it feeds on many different eucalypts and **poses a serious threat**.



# The tortoise beetle (*Trachymela sloanei*)

## Natural enemies?

Efficient natural enemy of the tortoise beetle are **currently unknown**.

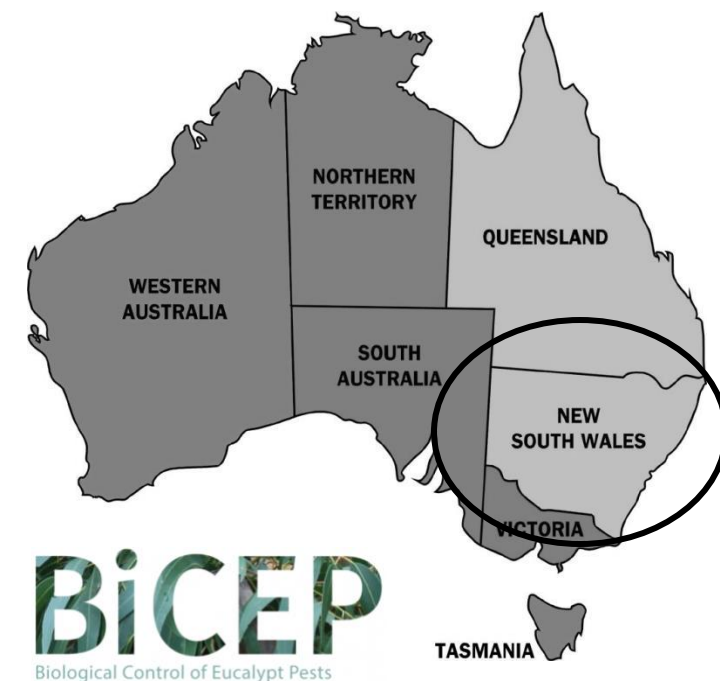
The egg parasitoid ***Enoggera reticulata*** attacks a related *Trachymela* species and was successfully used in South Africa. The parasitoid was released against the tortoise beetle in California, but **failed to establish**.

The tortoise beetle was described from insects collected in New South Wales (Australia).

This area is therefore a good candidate for field surveys, which are already being arranged through the BiCEP program (**B**iological **C**ontrol of **E**ucalypt **P**ests).

**Biological Control of a Newly Introduced Pest, the Eucalyptus Tortoise Beetle, *Trachymela sloanei*.**

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