Benefits, safety and risks of classical biological control for the management of IAS

Norbert Maczey

What/who is CABI?

- Formerly the Commonwealth Agriculture Bureaux International
- **Not-for profit** intergovernmental organisation owned by its 46 member countries
- CABI includes four formerly independently working institutes


Anguilla


Australia


The Bahamas


Bangladesh


Bermuda


Botswana


British Virgin Islands


Brunei Darussalam


Burundi


Canada


Chile


China


Colombia


Cote d'Ivoire


Cyprus


DPR Korea


The Gambia


Ghana


Grenada


Guyana


India


Jamaica


Kenya


Malawi


Malaysia


Mauritius


Montserrat


Myanmar


The Netherlands*


Nigeria


Pakistan


Papua New Guinea


The Philippines


Rwanda


Sierra Leone


Solomon Islands


South Africa


Sri Lanka


St Helena


Switzerland

Tanzania

Trinidad & Tobago

Uganda

United Kingdom

Vietnam

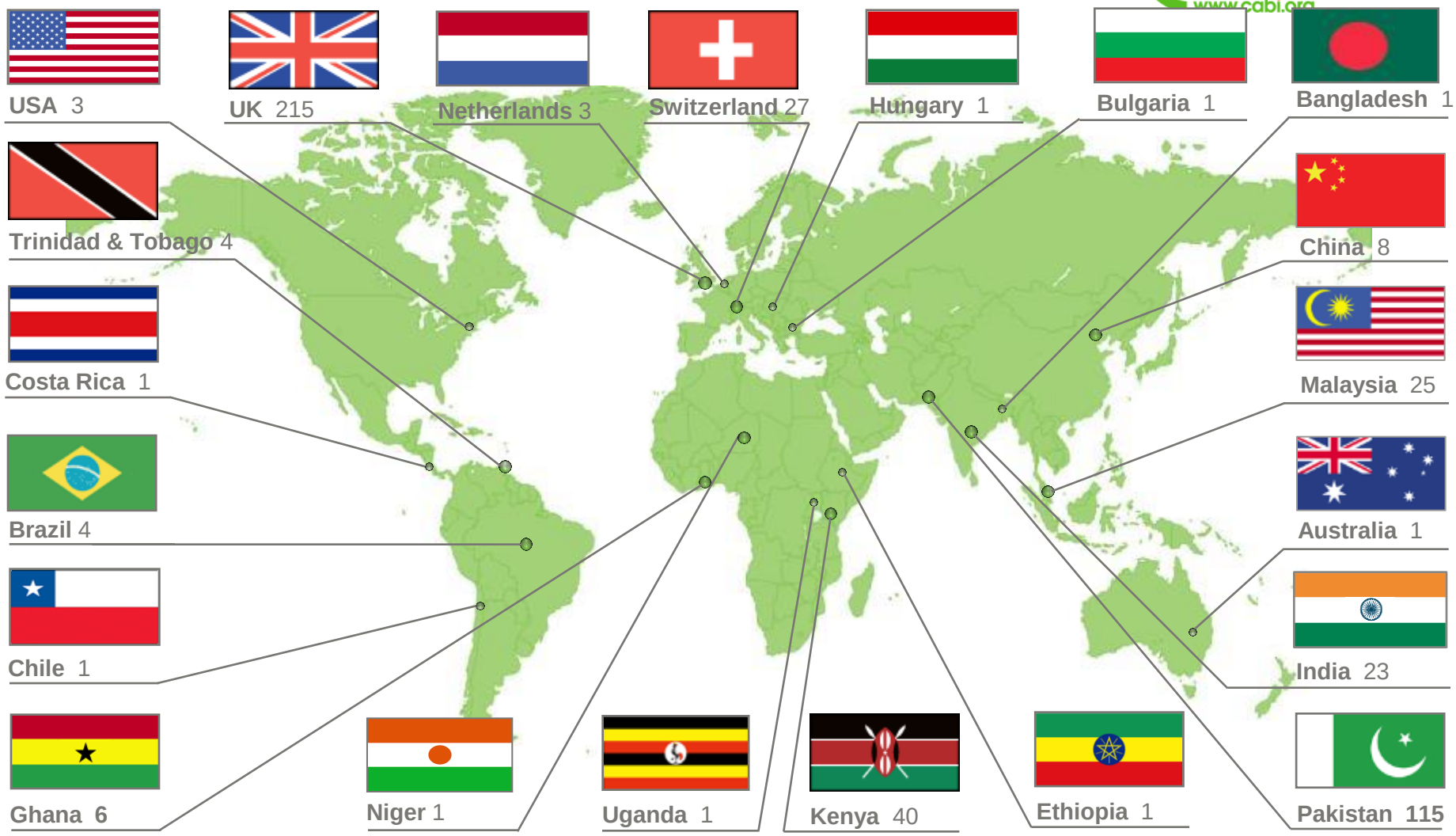
Zambia

Zimbabwe

* Associate Member

our member countries

Global reach We have 480+ staff across 21 locations worldwide



3 themes

- Knowledge for Development
  - CABI is working to find the best ways to provide farmers, researchers and policy makers with the information they need
- Commodities
  - CABI works to solve a range of problems faced by smallholder farmers
- Invasive alien species
  - CABI is working to find affordable long-term solutions to invasive pests

Why are invasive species so important?

- Invasives can cause enormous damage in agriculture
  - (est. that 5% of global GDP is lost through invasives)
- Invasives can have a detrimental impact on native fauna and flora
  - (sometimes leading to the complete extinction of native species)
- Invasive can bring substantial health hazards
  - (*Heracleum mantegazzianum, Parthenium hysterophorus*)

The lighthouse keeper's cat
(and few more..)

Stephens Island (New Zeland)

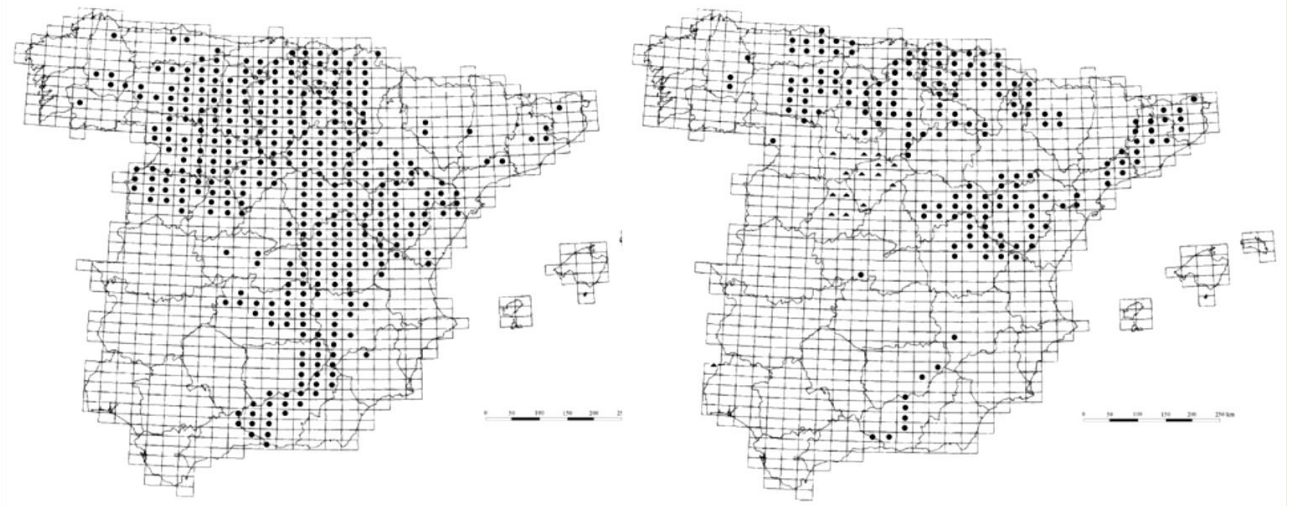
Xenicus lyalli

(Lyall's wren)

Disease transmission to native species

Austropotamobius pallipes

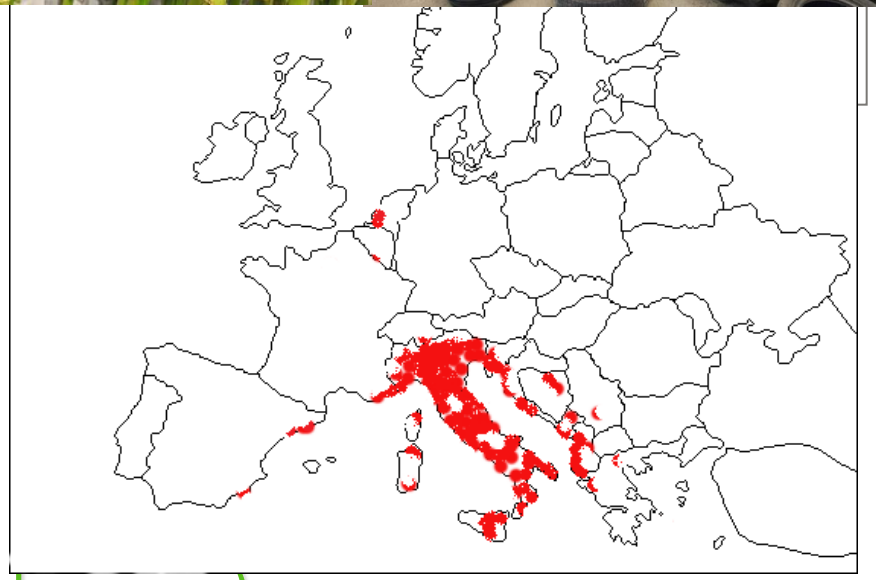
Procambarus clarkii - invasive



Alonso et al. (2000)

Human health impacts

The tiger mosquito



Aedes albopictus

Tropical diseases vector (malaria, dengue…)

Info cedida por D. Roiz

Assessment of best suitable management

- Prevention (international standards)
- Eradication
- Containment
- Control
  - short term
  - long term

Unfair advantage

Impatiens glandulifera
monoculture on the river Torridge
North Devon

- Non-native plant species arrived in the exotic range without the natural enemies that keep them in check in their native range.
- Those native species which do attack them do not cause enough damage

The Enemy Release hypothesis

Crysomelid beetles feeding on *Impatiens glandulifera* in Pakistan

In their introduced range exotic plants should experience

‘a decrease in regulation by herbivores and other natural enemies, resulting in an increase in distribution and abundance’

(Keane and Crawley, 2002)

Evolution of Increased Competitive Ability Hypothesis

Gorse (*Ulex europaeus*) on New Zealand

‘The success of invasive plants results from a shift in biomass allocation patterns. In the absence of herbivores and plant pathogens, selection favours genotypes with improved competitive abilities and reduced resource allocations to natural enemy defence.’

(Blossey and Nőtzold 1995)

Mikania micrantha **invading native forest on Neiling Ding island National Nature Reserve, GuangDong, China.**

Biological control

Augmentative control of *Azolla filiculoides* with weevil *Stenopelmus rufinasus*

Three main types

Inundative- The mass production and periodic release of large numbers of biocontrol agents to control a pest

Conservation- modification of the environment or existing practices to protect and enhance specific natural enemies or other organisms to reduce the effects of pests

Classical (CBC)- the utilisation of co-evolved natural enemies in the regulation of host populations; use of pathogens (fungi) & insects to control weeds and introduced arthropods

Classical Biological Control

Advantages

- Inherently safe
- Cost effective
- Target specific
- Practical
- Environmentally benign
- Efficacious
- Sustainable
- Proven track record

Disadvantages

- Can have long lag-phase
- Long research phase
- Need for opinion of wide range of stake holders
- Potential conflicts of interest
- Doesn’t always work
- Non-commercial
- No eradication

Classical biological control

Fallopia japonica

Pushing through tarmac in Berkshire

Biological Control of Invasive Alien Weeds

www.cabi.org

Rubber Vine (*Cryptostegia grandiflora*)

Native Eucalyptus forest, Northern Queensland, Australia

Rubbervine weed (*Cryptostegia grandiflora*)

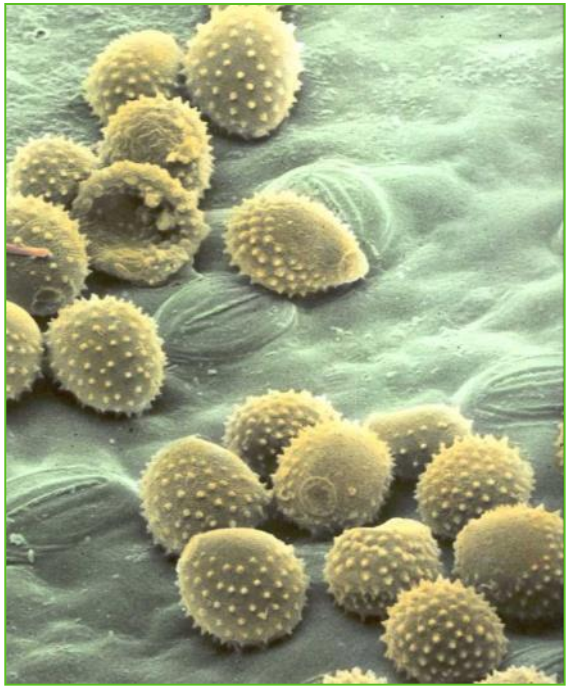
40,000 km^2 invasion (area twice the size of Wales)

The single biggest threat to natural ecosystems + parks in tropical Australia

Cost to QLD beef industry $AUS18 million

The Agent

Maravalia cryptostegiae



Successful long term control

Classical biological control

Orthezia insignis

Biological Control of Invasive Alien Insects

www.cabi.org

St Helena -gumwoods

- Scale insect
- *Orthezia insignis*
- Massive populations
- Sooty mould
- Killing gumwoods
- Out of control

- The hero:
  Hyperaspis pantherina
- Host specific coccinellid
- Successful elsewhere,
  so called “off-the-shelf”
- Very successful

Risks of classical biological control and the need for adequate Pest Risk Assessments

Conflict of interest

Ulex europaeus

- Classical biological control not always the answer
- With some species there is a conflict of interest-some like the plant- some don't

Himalayan balsam- bee keepers like
river managers dislike

Buddleja- Gardeners like
Developers/rail network dislike

Rhododendron- Gardeners like
Land managers dislike

Rhinocyllus conicus

Cirsium spp

Non-target effects

- *Rhinocyllus conicus* non-target impacts threaten native thistle species in N. America
- Released in North America in 1968 to control exotic thistles like Musk thistle (*Carduus nutans* L
- Now reducing seed production by multiple native North American thistle species (*Cirsium* spp.)

Strong, D.R. (1997) Fear no weevil? Science 277:1058–1059)

Tamarisk- salt cedar

- Tamarisk species occupy over 1 million acres in N. America
- Displaces biodiversity/high water consumption/increases erosion and sedimentation
- Biocontrol programme identified leaf beetle *Diorhabda elongata* host specific- approved for release 1996
- Biocontrol programme halted due to indirect effects on rare South-western willow flycatcher

Critical Issues in CBC

Berberis microphylla

- Selection of suitable control agents
- **Host specificity of any exotic natural enemy critical; host range testing**
- Risk assessment for the introduction of any potential classical biocontrol agent
- Weighting remaining risks
- Approval for release
- Release and post release monitoring

Host specificity testing

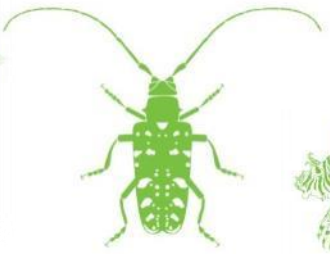
Inside CABI's quarantine facility in the UK

- Selection of suitable test organism for host range testing (phylogenetic relationship; occurrence of closely related species in target area)
- Experiments conducted in a series of replicated tests with the target and non-target species

Invasive species compendium

- An encyclopaedic reference tool of invasive plants and animals
- Over 1,500 datasheets
- Bibliographic database of nearly 75,000 records
- Extensive glossary, a taxonomic framework and access to statistics
- Library of over 1000 full text documents and links
- **Open Access model**
  www.cabi.org/isc

35% Plants



30% plant and environmental pests (terrestrial)

15% aquatic animals

15% animal pathogens

5% terrestrial vertebrates

Who is the alien?

Who is the alien?

- Orange Hawkweed (Pilosella aurantiaca)
- Arrow-leaved Marigold (Caltha sagittata)

Who is the alien?

Who is the alien?

- Diddle-dee (Empetrum rubrum)

- Catsear (Hypochaeris radicata)

Who is the alien?

Who is the alien?

- Pig Vine (Gunnera magellanica)
- Creeping thistle (Cirsium arvense)

Who is the alien?

Who is the alien?

- Dandelion (Taraxacum officinale)

- Gorse (Ulex europaeus)

Thanks to our collaborators

And thanks to our sponsor

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ありがとう kiitos thank you gracias zikomo
tak asante
urakoze ke itumetse
danke terima kasih dhanyawaad

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