Problem formulation for the environmental risk assessment of weed biological control agents: Insects and fungi versus weeds.

Dick Shaw, CABI Regional Coordinator Invasives/ Country Director

KNOWLEDGE FOR LIFE

CABI

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- Invasive non-native weeds and Japanese knotweed
- Inundative and classical biocontrol
- Case studies
    - Japanese knotweed mycoherbicide
    - Japanese knotweed psyllid
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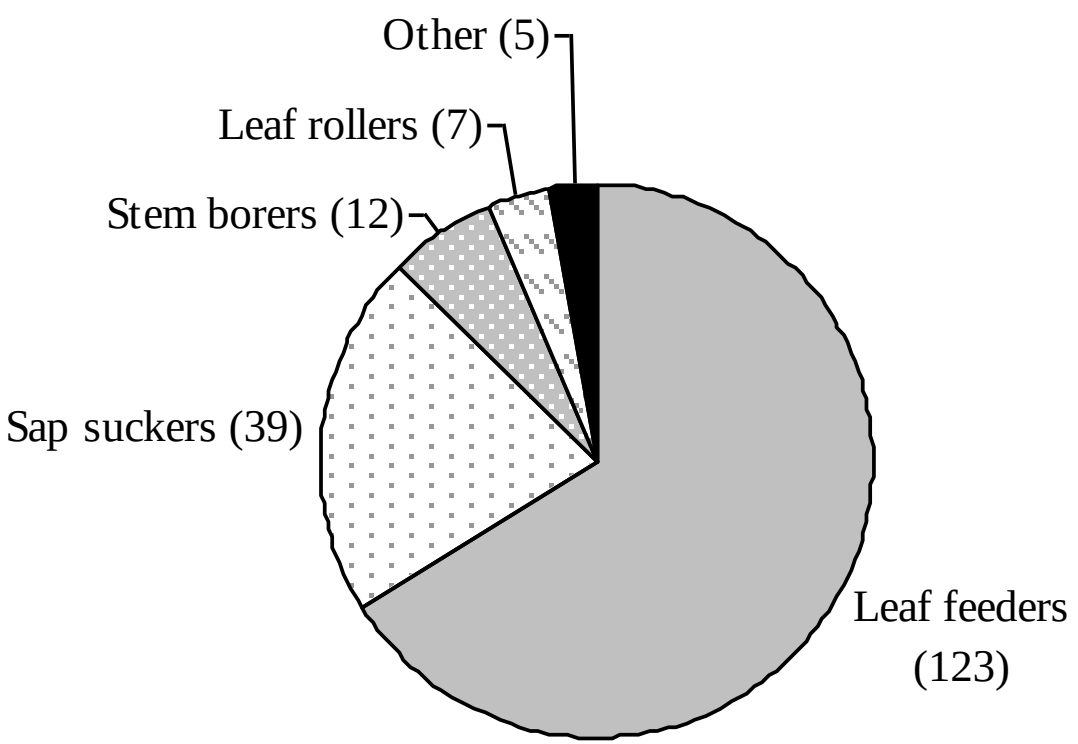
- Lab to field
- Conclusions


PRIVATE ROAD
NO PARKING
NO THROUGH

Many insects feeding on most parts

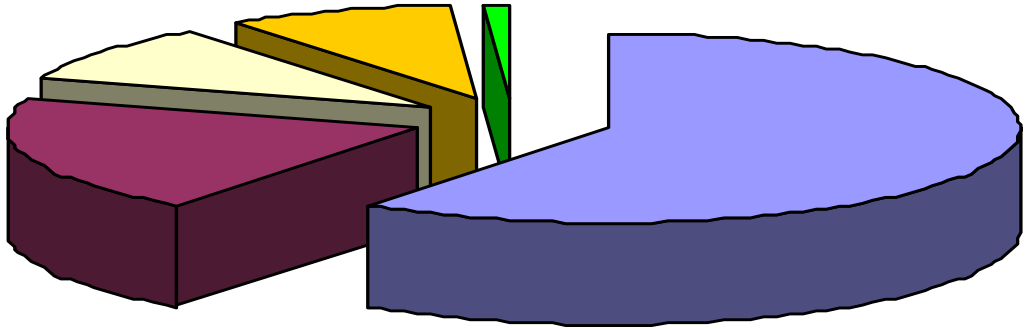


186 species of phytophagous arthropod recorded from Japanese knotweed in Japan. Plus 40 fungi

Unfair Advantage

- They arrived without the natural enemies that keep them in check in their native range. “Enemy Release Hypothesis”
- Those native species which do attack them do not cause enough damage
- **Some** of the many insects and diseases in the area of origin may be safely released as classical agents

A process of elimination



literature review

field observations

susceptibility studies

host range tests

suitable


Aphalara itadori


Mycosphaerella polygoni cuspidati

2 Categories of weed control

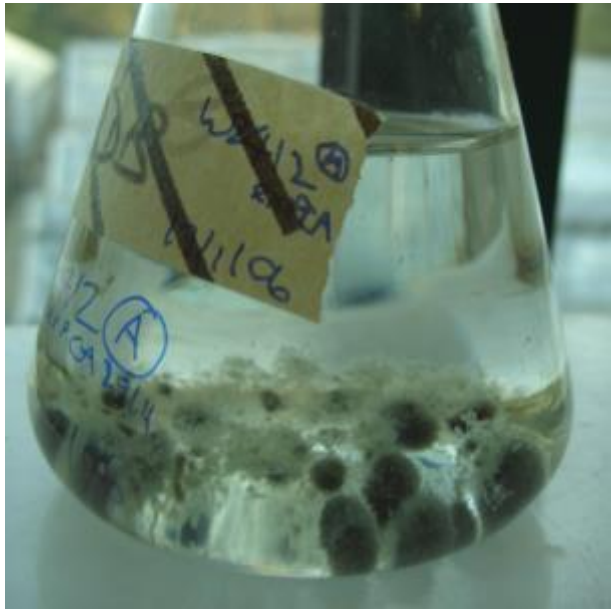
Inundative - a.k.a the “Mycoherbicide Approach” using normally native pathogens for repeated application

Classical - Using Co-evolved (highly specific) NEs from the area of origin of the plant to provide self-sustaining control after a single release.

The Inundative Approach

- Used in high value horticulture, agriculture, golf courses to reduce chemical input/ combat resistance
- Or where conflicts of interest would exclude classical natural control

Better described as **COMMERCIAL** as applied like a chemical product from a bottle with a **label** and a user and is **always formulated**.



- *Mycelial broth*

Knotweed mycoherbicide

- Failed host range testing as a classical agent due to risk to an important non-target plant species
- However, a mycelial preparation of a single mating type of Mycosphaerella **cannot** infect NTs
- UK and International Patent applied for in the name of UK Secretary of State
- UK Patent Application No. 1503510.8; https://www.ipo.gov.uk/p-ipsum/Case/ApplicationNumber/GB1503510.8
- Next Proof of Concept

- PRA complete and risk to environment close to zero but experimental license process proving hard to pin down
- Needs to be released from PH quarantine licence and then field trials need to be authorised

Inundative Weed biocontrol = Low Risk Substance?

<u>Products</u> authorised as a low-risk plant protection product provided no specific risk mitigation measures are needed following a risk assessment.

<u>Substance</u> not classified as:

- explosive
- corrosive
- sensitising chemical
- very toxic or toxic
- CMR substance
- endocrine disrupter
- neurotoxic or immunotoxic
- persistent (half-life in soil >60 days)
- bioconcentration factor >10

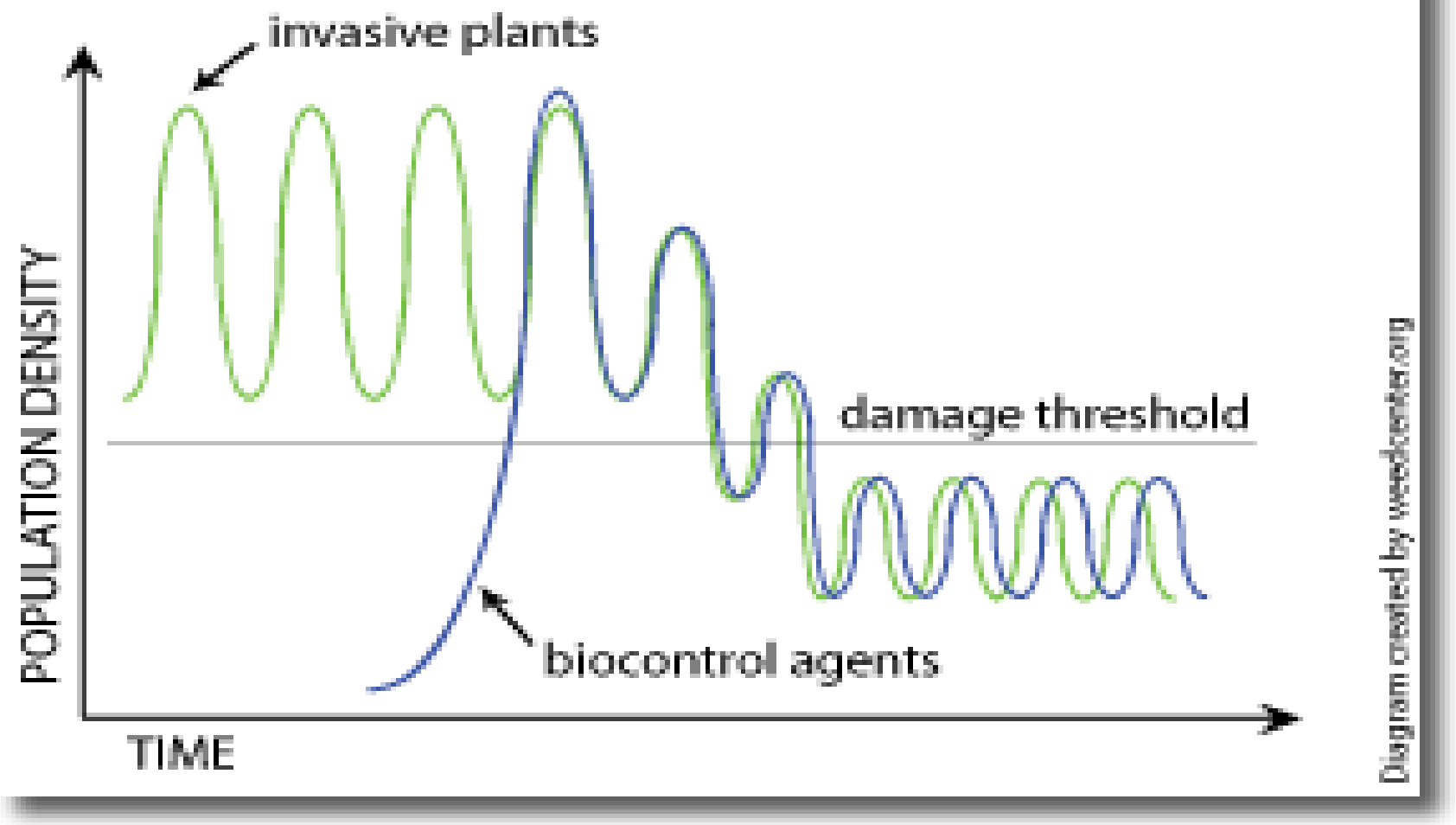
If not...

Safety requirements:

- Physical – chemical properties
- Analytical methods
- Toxicology
- Residues
- Environment: Fate and Behaviour
- Ecotoxicology
- Efficacy

Aphalara itadori

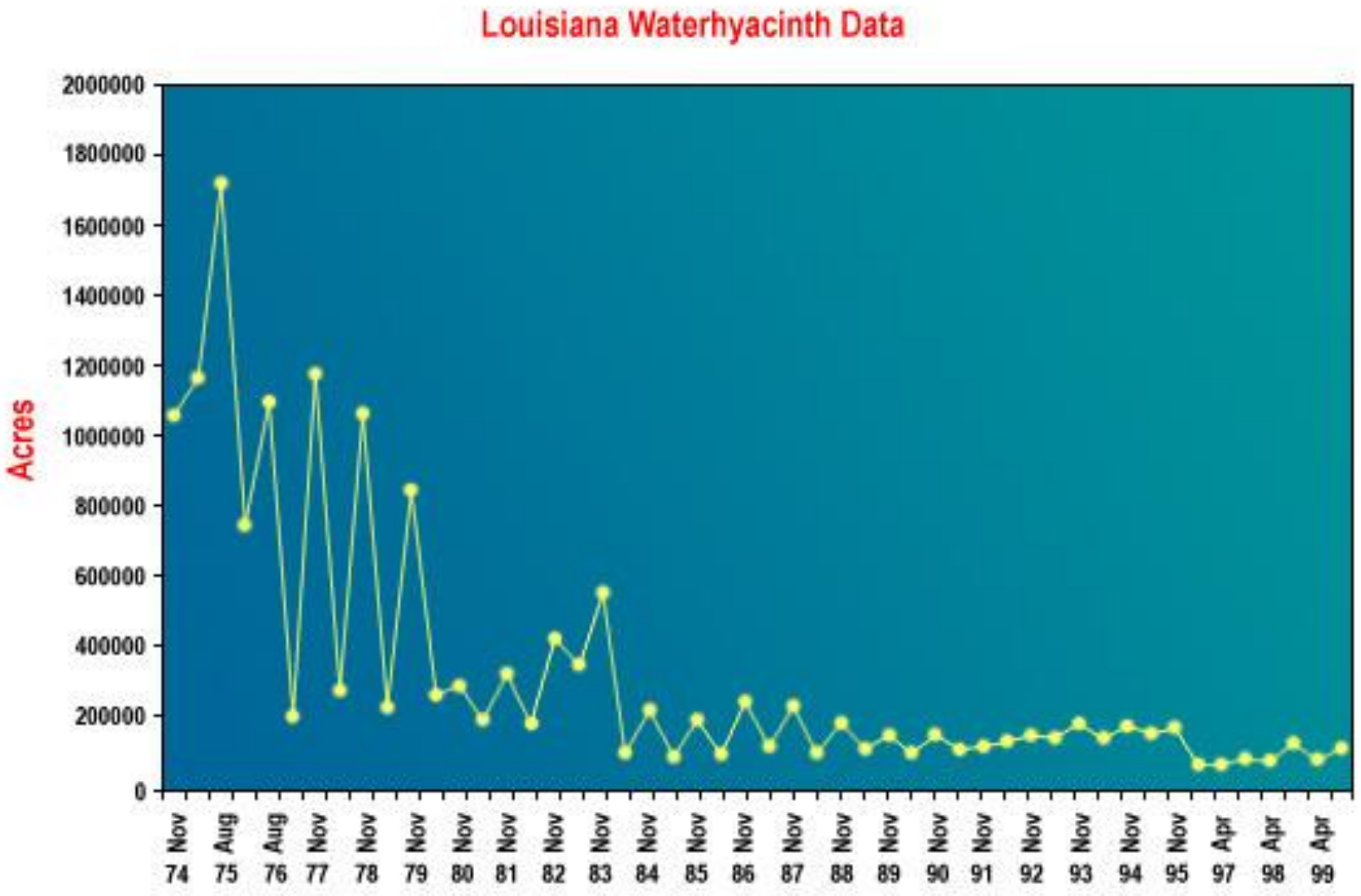
GENERALIZED MODEL OF BIOCONTROL OF INVASIVE PLANTS
(adapted from Luck et al. 1995)



Eichornia crassipes – Water Hyacinth

Neochetina eichhorniae
Mottled water hyacinth weevil
Copyright 1997 USDA-ARS

The real sequence of events



Graph courtesy of APHIS

Is It Safe?

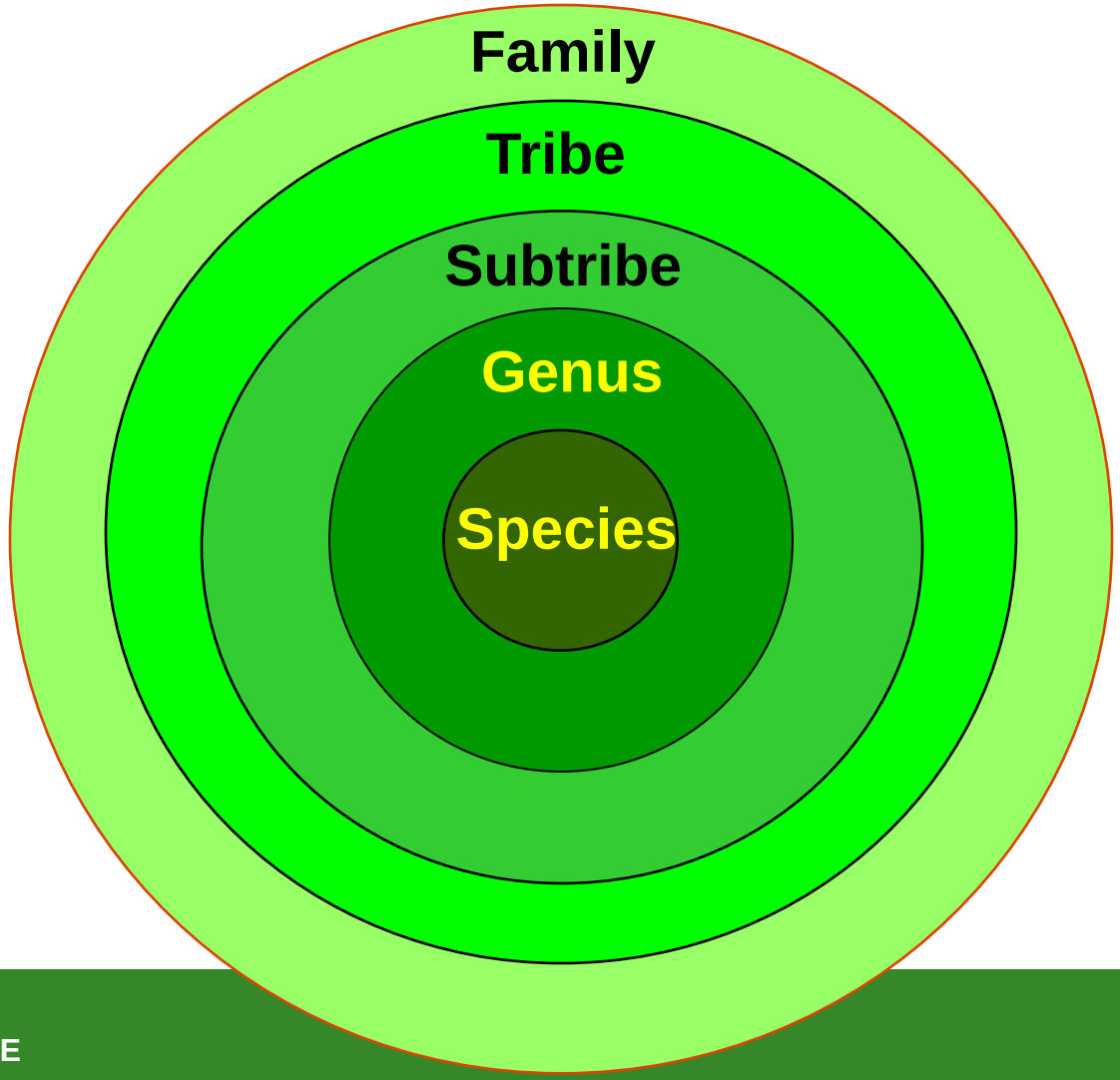
Over more than a century there have been >1,500 introductions of >450 different BCA species vs. 175 weeds around the globe.

- Any non-target effects are predictable by the vigorous safety testing
- Guided by an International code of conduct ISPM 3
- 8 examples of “non-target” effects
- Most of these predicted by the science then, or would have been predicted by the science now

cf Europe pest control: >300 releases of 176 BCA species against crop pests **outside the glasshouse**

Centrifugal phylogenetic method:

Species more closely related to the target weed are more likely of being attacked than more distantly related ones



Starvation Tests

Choice Tests

Oviposition Tests

Development Tests

Testing Biotrophic Fungi

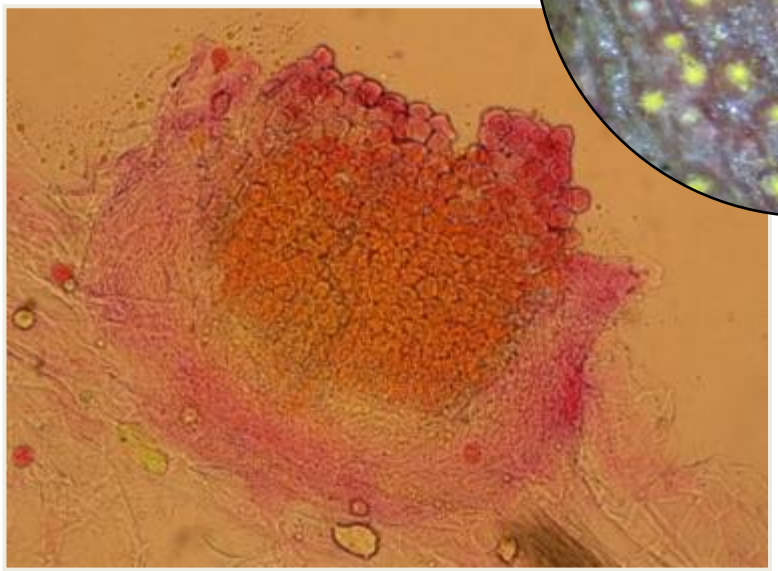
Dew Chamber

- Constant dew period at perfect temperature for 48 hours
- Optimum conditions for infection
- Very high inoculum load
- Precautionary principle


Himalayan balsam

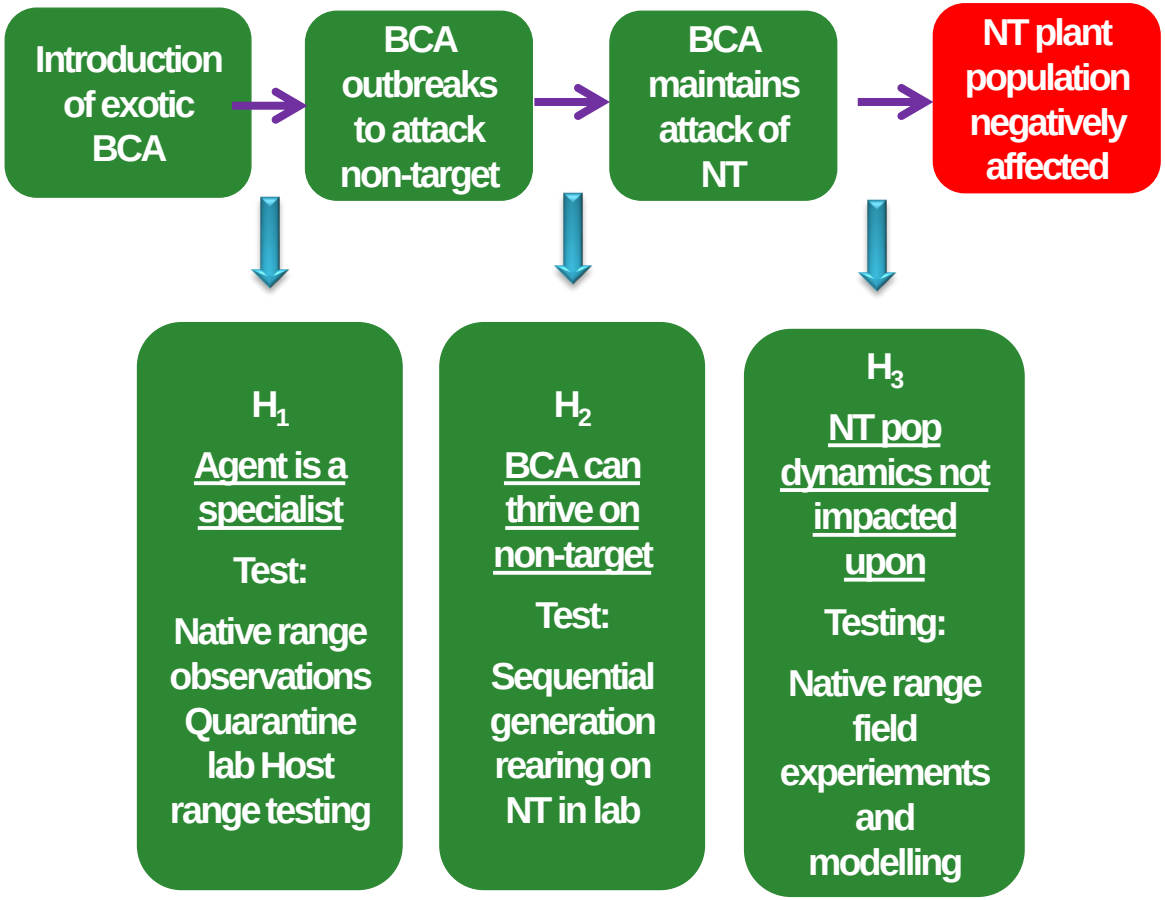
Himalayan balsam seedling infected with rust aecia

Aecial cup containing chains of aeciospores

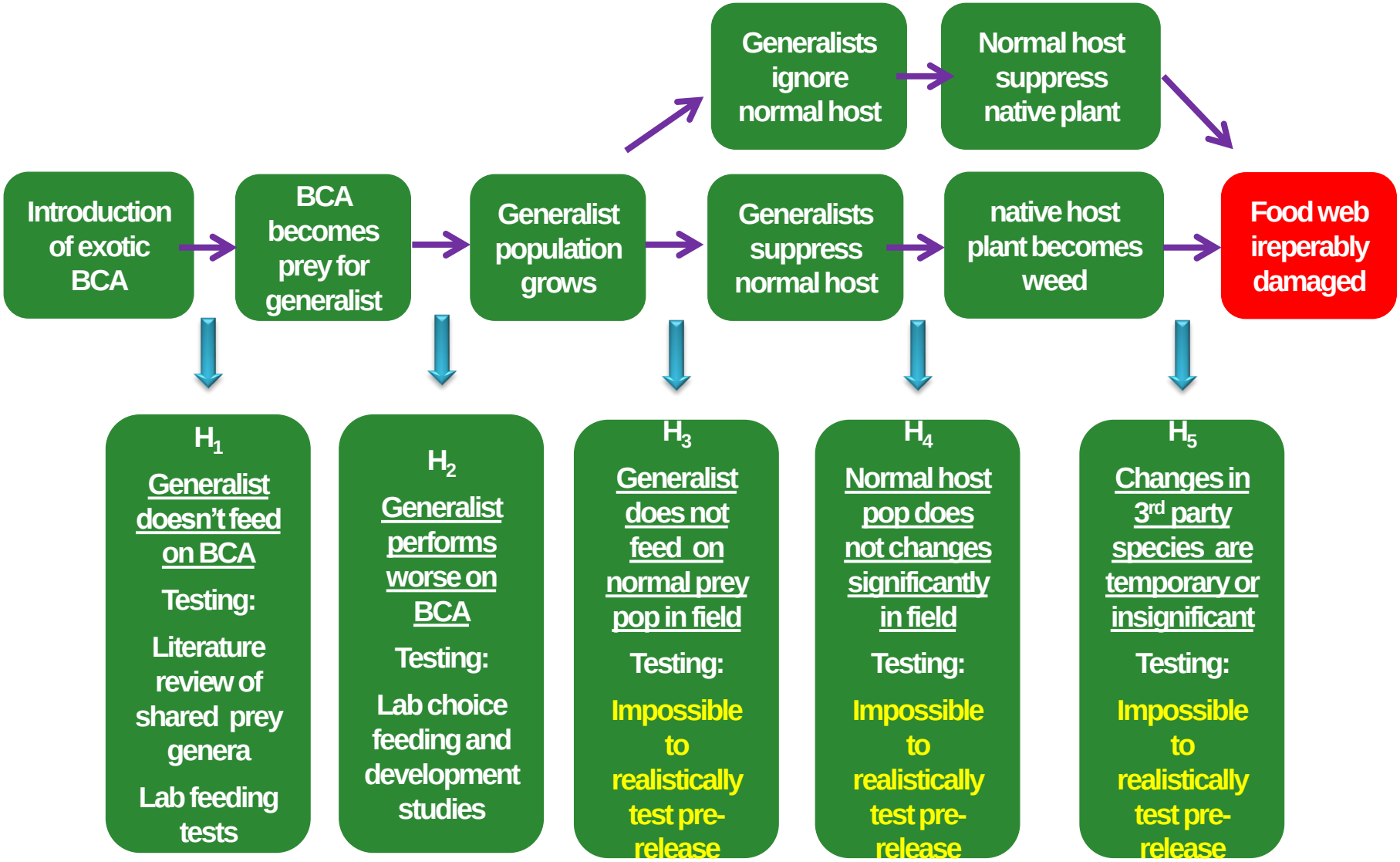


Mostly done in quarantine

Problem formulation: CBC – Direct effects



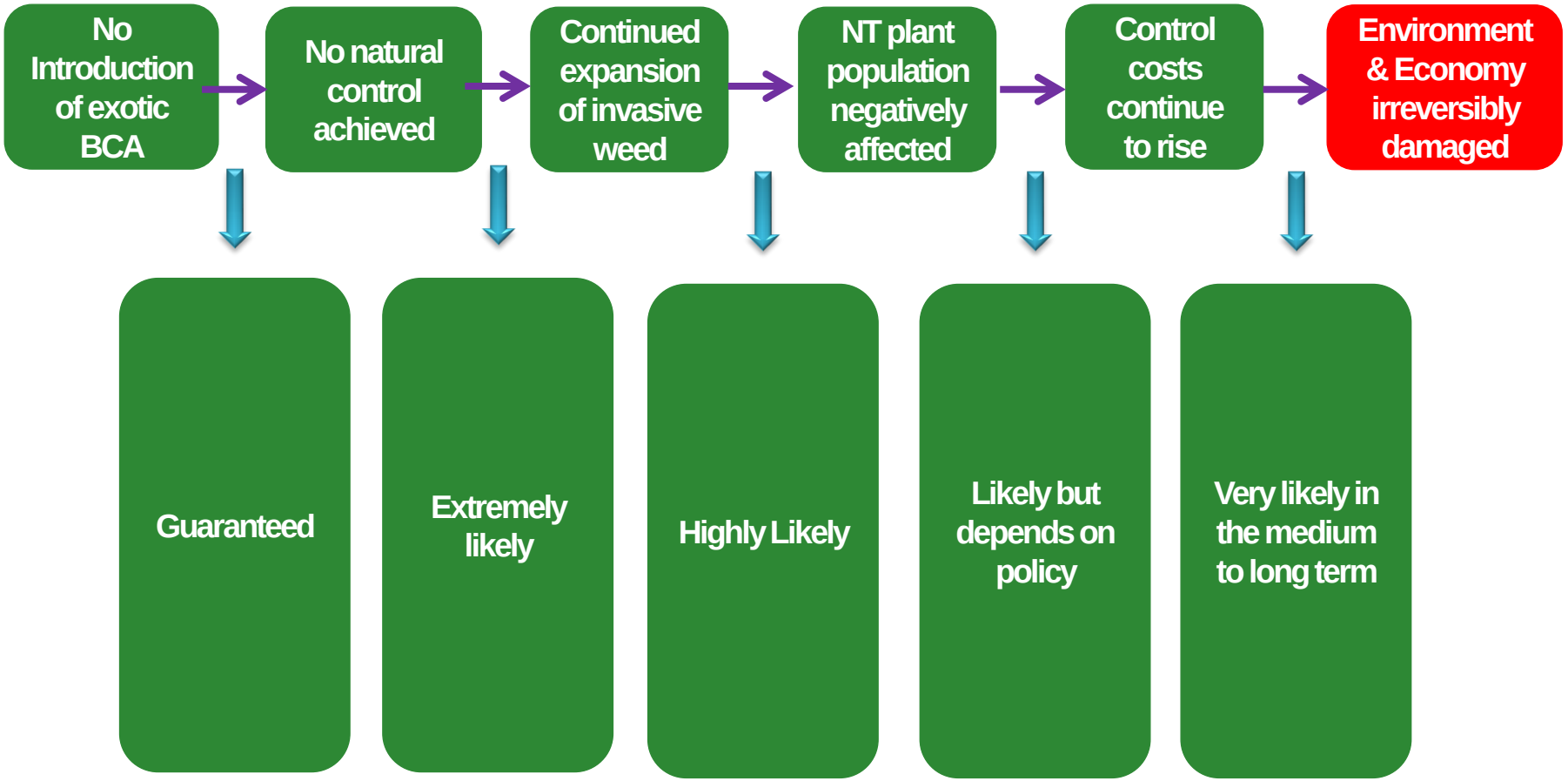
CBC– Indirect effects (Apparent Competition)



The problem of false positives from the Lab

- Native range field observations give a good indication of agent host range BUT the key non-targets are not normally present, can occasionally get permission to plant them.
- Insect host range studies start with no-choice/starvation tests and reveal the **FUNDAMENTAL** host range not the **REALISED** host range post release. This is normally much larger
- Quarantine lab studies are precautionary and give a worst case scenario
- E.g rubbervine in Australia where 40,000km^2 of ecosystem have been saved by a rust fungus that attacked a rare native plant in the lab but didn't in the field in outbreak conditions.

Doing nothing



EFSA now has experience with CBC

STATEMENT

EFSA Journal

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Statement on the assessment of the risk posed to plant health in the EU territory by the intentional release of biological control agents of invasive alien plant species

EFSA Panel on Plant Health (PLH)

Abstract

Classical biological control has been successfully used in various continents to manage many invasive alien plants originating from Europe, but this approach is still not widely adopted in Europe, despite its advantages (sustainable, effective, efficacious, good safety record) compared to chemical and manual control of weeds. Following the publication in April 2015 of the EFSA PLH Scientific Opinion on the risk posed to plant health in the EU by the intentional release of the bud-galling wasp *Trichilogaster acaciaelongifoliae* for the control of the invasive alien plant *Acacia longifolia*, the EFSA PLH Panel is publishing this statement on the procedure to follow should similar requests be made in future. Ideally what is required for an EFSA Opinion on a risk assessment of a BCA release is: (i) host specificity tests of a plant list agreed in advance by an appropriate body; (ii) a risk assessment for plant health produced using a standardized template for the whole of the EU or at the least for an appropriate bio-climatic area within the EU; and (iii) consideration of benefits. This process could be facilitated by an expert working group that would be available to advise the applicant at regular intervals. The role of EFSA is best suited to providing a peer review of a weed BCA risk assessment for the EU considering that peer review of applications prepared by researchers specialized in a particular BCA is the procedure adopted for BCA risk assessment in the countries that have much experience with using exotic BCAs of weeds. Following the appropriate International Standard for Phytosanitary Measures (ISPM) 3 and European and Mediterranean Plant Protection Organization (EPPO) Phytosanitary Measure (PM) 6/1 standards will help the releasing authority manage the process. Post-release, as per EPPO PM 6/2, all appropriate safety procedures should be put in place.

- Experts should **review** the risk assessment
- This is an intention to release not a product for sale
- Needs to be quick
- Needs to include benefits

Conclusions

- Biocontrol is an option for even the worst invasive weeds
- Classical biocontrol is finally growing in Europe
- EU Invasive Species Regulation should drive CBC
- Current safety testing means that we are more likely to reject a good agent than release a dangerous one
- The regulation for biologicals is not ideal and if we are to have alternatives to chemicals then low-risk products need an easier passage
- There is a need for balance i.e risk:benefit because with invasive species…

DOING NOTHING IS NOT A LOW RISK OPTION

Risk of doing the wrong thing:
Water Hyacinth in the Guadiana river in Spain

Wiser to spend 5% of that budget on finding a cold tolerant strain of the legendary Neochetina biocontrol agent so there is a back up plan when it comes back?

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Schweizerische Eidgenossenschaft
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