Selection of non-target species for risk assessment of biological control agents: Testing a decision support system

Jacqui Todd, Barbara Barratt, Leah Tooman, Louise Malone

Overview

- Why we developed this system in New Zealand

- An outline of the system:
  - A database of information on invertebrates
  - A basic model to prioritize non-target species

- Validating the system for use with entomophagous biological control agents (BCA)

Why develop the system?

- Introduction of new organisms to New Zealand – risk assessment required
  - Hazardous Substances and New Organisms Act (HSNO)
    - "safeguarding…air, soil, water, ecosystems"
    - "sustainability of all native and valued flora and fauna"
- Must consider the risk posed by the new BCA to non-target species, including invertebrates
- Many species to choose from, 90% species endemic
- Many criteria to consider (risk, effects on ecosystems, value of species, etc)

Automated decision-support system

- PRONTI (Priority Ranking of Non-Target Invertebrates) decision support system

- 2 components:

  1. Database (Eco Invertebase) published information

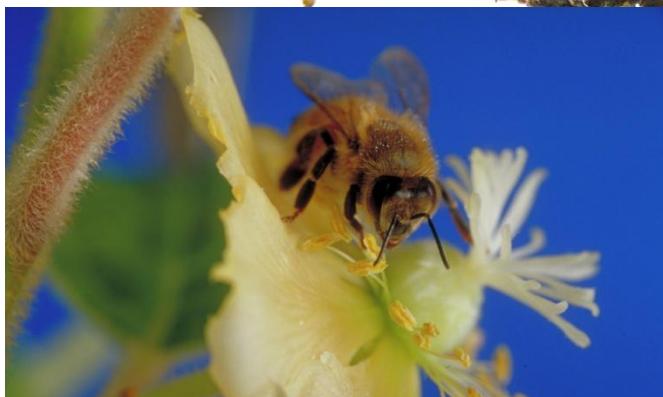
  2. Basic model to prioritize species for testing with the new BCA

Information in the Eco Invertebase

Each non-target species:

- Taxonomy
- Known food species
- Known predators & parasitoids
- Distribution
- Biomass
- Mobility
- Reproductive rate
- Anthropocentric value
- Collectability and testability

"Unknown" is an option



Information in the Eco Invertebase

Information on the new agent:

- Taxonomy and physiology
- Abundance, distribution, mobility and effectiveness in area of origin and other regions
- Known food species and relationships between them (e.g., taxonomic)
- Target life stages attacked, mobility and distribution
- Target species and target ecosystem/s

Information in the Eco Invertebase

Potential interaction with each non-target species:

- Relationship with target (e.g., taxonomic, phylogenetic, food preferences)
- Presence in target ecosystems or regions
- Presence in target plant-based community
- Information on previous host range tests OR likelihood of non-target being attacked
- Likelihood of avoiding BCA (e.g., activity period, toxicity, suppression of parasitoids)
- Likelihood of interbreeding with BCA
- Likelihood of indirect effects (e.g., competition for food)

Prioritization of species

» 5 selection criteria:

1. Potential adverse effects ➢ Measurement
2. Potential level of exposure ➢ of risk
3. Potential for environmental impacts ➢ Regulatory
4. Anthropocentric value ➢ requirement
5. Testability of the species ➢ Research requirement

- ➢ Scores applied to the information
- ➢ Scale 1 - 10
- ➢ “Unknown” score 5

Example of scores

Exposure criterion:

	Score
• Invertebrate known to mix closely with BCA target	10
• Invertebrate in same community and niche may overlap	9
• Occur in same community but different niche	7
• Probably occurs in same community	6
• Same food web as target	4
• Sometimes occurs in same community	3
• Possibly occurs in same community	2
• Not known to occur in same community	1
• Unknown	5

Priority ranking of non-target invertebrates

- PRONTI model combines the scores:

- $\left(\frac{\text{Hazard x Exposure}}{\text{Species Resilience}}\right)$ x (Status + Value + Testability)

- Where:
  - Hazard x Exposure = the risk to the species
  - Species' Resilience = species' ability to mitigate the risk
  - Status = ecological importance of the species (biomass + food web links)
  - Value = how much the species is valued by people
  - Testability = how easy the species is to work with

Priority ranking of non-target invertebrates

- PRONTI scores used to rank non-target species
- Species with highest scores at the top of the list = prioritized for testing with the BCA
- Uncertainty around each species' score is indicated

Priority ranking of non-target invertebrates

Benefits:

- Conducted independently for each BCA
- Scores easily altered for each BCA application
- Database of information can be updated
- Flexible and adaptable process
- Transparent assumptions

Costs:

- Compiling information can be time consuming

Validating the PRONTI system: 3 NZ case studies

1. *Polistes chinensis*
   - » Proxy generalist predator
   - » Identified in New Zealand in1979
   - » Hypothetical Target = lepidopteran pests of kiwifruit
   - » PRONTI risk predictions = identified prey species in this habitat

Todd et al, in press, Biological Control

Validating the PRONTI system: 3 NZ case studies

2. *Cotesia urabae*
   - » Specialist parasitoid
   - » Introduced into New Zealand in 2011
   - » Target = forestry pest
     Uraba lugens
   - » Comparison PRONTI with traditional methods of species selection
   - » PhD study testing the differences currently underway


Image: Geoff Allen


Image: Scion

Validating the PRONTI system: 3 NZ case studies

3. *Microctonus aethiopoides (Moroccan)*
   - » Weevil parasitoid
   - » Introduced 1982
   - » Target = pest of forage plants
     Sitona discoideus
   - » Comparison PRONTI with traditional methods of species selection
   - » Would PRONTI have enabled a better assessment of potential risks?

Summary

- PRONTI – an automated decision support system for non-target species selection
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  - Database of published information on New Zealand invertebrates
  - PRONTI model uses that information to rank species for testing
- Validation of PRONTI for use with biological control agents is underway
- Suggestions welcome!

Thank you!

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B3 Science Solutions for BETTER BORDER BIOSECURITY www.b3nz.org