3.5 Can Predictive Models Help to Identify the Most Appropriate Non-target Species for Host-specificity Testing?

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Selecting non-target species (NTS) for the assessment of risks posed by an entomophagous biological control agent (EBCA) can be challenging. To help with this task, we investigated the protocols that had been developed for selecting NTS previously (e.g., Van Driesche and Reardon, 2004; Kuhlmann *et al*., 2006; van Lenteren *et al*., 2006), and used them to develop a computer-based tool called PRONTI (Priority Ranking Of Non-Target Invertebrates; Todd *et al*., 2015). The aim was to develop a tool that could assess many NTS simultaneously, and, through a transparent and consistent process, prioritise them for testing with each proposed agent (Fig. 3.5.1).

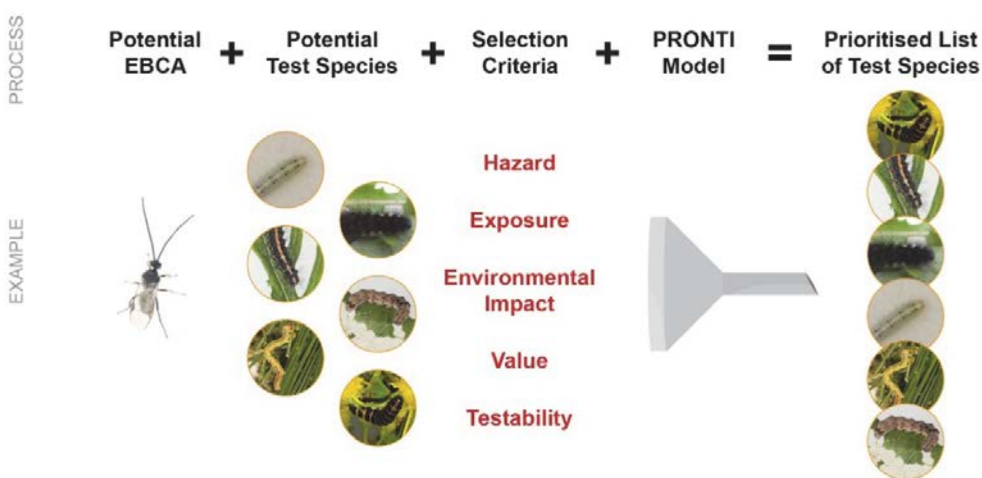

Fig. 3.5.1. The PRONTI model acts like a funnel, prioritising test species using five selection criteria. The example is for the agent, *Cotesia urabae*, released to target the lepidopteran Eucalyptus pest, *Uraba lugens*.

PRONTI has two parts: a database of information on New Zealand's invertebrate taxa (the Eco Invertebase), and the following equation, which ranks the taxa in the database with those taxa obtaining the highest PRONTI scores prioritised for testing with the EBCA:

$$PRONTI\ SCORE = \frac{H \times E}{R} \times (S + V + T)$$

Each parameter in the equation is a score obtained by each NTS: H represents the hazard posed by the agent to the NTS; E is the potential exposure of each NTS to the agent; R represents the resilience of each NTS to the risks posed by the agent; S represents the status of the NTS in the ecosystem (i.e., biomass and food web links); V is the anthropocentric value of the NTS; and T represents the testability of the NTS.

We have used two parasitoid EBCA previously released in New Zealand to test the PRONTI tool: the Moroccan strain of *Microctonus aethiopoides* Loan (Hymenoptera: Braconidae), released in 1982 to control *Sitona discoideus* Gyllenhal (Coleoptera: Curculionidae), and *Cotesia urabae* (Austin & Allen) (Hymenoptera: Braconidae), released in 2011 to control *Uraba lugens* Walker (Lepidoptera: Nolidae) (Barratt *et al*., 2016; Todd *et al*., 2016). For each test, we compared the prioritised list of species produced by PRONTI with the list of test species that were selected using conventional methods prior to the agent's release.

For the test with *M. aethiopoides*, 82 NTS with data in the Eco Invertebase were ranked by PRONTI. Five of these species were those that had been selected for assessment with *M. aethiopoides* prior to its release in New Zealand in 1982. For this test, we used only data on *M. aethiopoides* that were available in 1982 to rank the species: data on the NTS that have been attacked by *M. aethiopoides* since its release were not included. The ten species prioritised by PRONTI are given in Table 3.5.1. Seven of the NTS in the top ten are amongst those that have been attacked by *M. aethiopoides* following its release, suggesting that, if PRONTI had been available pre-release, better predictions of non-target attack might have been made. Of the five species on the original list, only two species, *Rhinocyllus conicus* Frölich (Coleoptera: Curculionidae) and *Longitarsus jacobaeae* Waterhouse (Coleoptera: Chrysomelidae), were in the top 30 on the PRONTI list (Barratt *et al*., 2016).

For the test with *C. urabae*, we used PRONTI to rank 90 NTS for which data had been entered into the Eco Invertebase. This included the nine species originally selected for host range testing with *C. urabae* prior to its release (Berndt *et al*., 2009). The PRONTI list and the original list were very similar, with five NTS in the top nine on both lists (Todd *et al*., 2016). Post-release laboratory testing has shown that two of these species, *Tyria jacobaeae* (L.) and *Nyctemera annulata* Boisduval (Lepidoptera: Erebidae), can be parasitized by *C. urabae* (Avila *et al*., 2016), suggesting that the placement of these two species at the top of both lists was appropriate. We do not know if these species have been attacked by *C. urabae* in the field.

PRONTI has advantages, such as its ability to rank many NTS simultaneously, and its provision of a body of information that can be used to both understand each NTS ranking and to justify more objectively the selection (and rejection) of NTS for pre-release testing. It is also useful for regulatory agencies to have access to a system that is objective, consistent and reliant on published information on which to base decision-making. However, we also conclude that the time investment needed to enter data into the Eco Invertebase needs to be balanced against the objectivity provided by PRONTI when deciding which method of species selection to use.

Table 3.5.1. Top ten species ranked for testing with *Microctonus aethiopoides* using the PRONTI (Priority Ranking Of Non-Target Invertebrates) tool. The amount of uncertainty in the data used to calculate the PRONTI Score is also determined by the model. Table adapted from Barratt *et al*., 2016. Curc = Curculionidae.

Species Name (Family: Subfamily)	Species origin	PRONTI Score	Uncertainty (%)
Nicaeana cervina (Curc: Entiminae)	Endemic	17273	8
Irenimus duplex (Curc: Entiminae)	Endemic	15445	21
Irenimus aemulator (Curc: Entiminae)	Endemic	15211	20
Irenimus stolidus (Curc: Entiminae)	Endemic	14785	16
Naupactus cervinus (Curc: Entiminae)	Self-Introduced	14431	24
Irenimus aequalis (Curc: Entiminae)	Endemic	14335	13
Irenimus albosparsus (Curc: Entiminae)	Endemic	13732	19
Irenimus egens (Curc: Entiminae)	Endemic	13584	10
Steriphus diversipes lineatus (Curc: Cyclominae)	Self-introduced	13295	28
Catoptes cuspidatus (Curc: Entiminae)	Endemic	11451	23

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