

Risks Associated With the Use of Exotic EPN

Ireland as a Case Study

Roy Enright, Aoife Dillon & Christine Griffin.

Department of Biology,
NUI Maynooth,
Co. Kildare,
Ireland.



NUI MAYNOOTH

Ollscoil na hÉireann Má Nuad

Use of Exotic Biocontrol Agents

Why ?

- *Superior characters over native types*
- *Commercial pressure to expand markets*

Need to consider possible impact on native biota

Why ? - *Environmental damage and public resistance to biocontrol.*

What is “Exotic” ?

In this discussion:

An organism is exotic if it belongs to a species not indigenous to the country in question.

Could be broadened to include:

- Non-indigenous strains of indigenous species.
- “Within country” movements

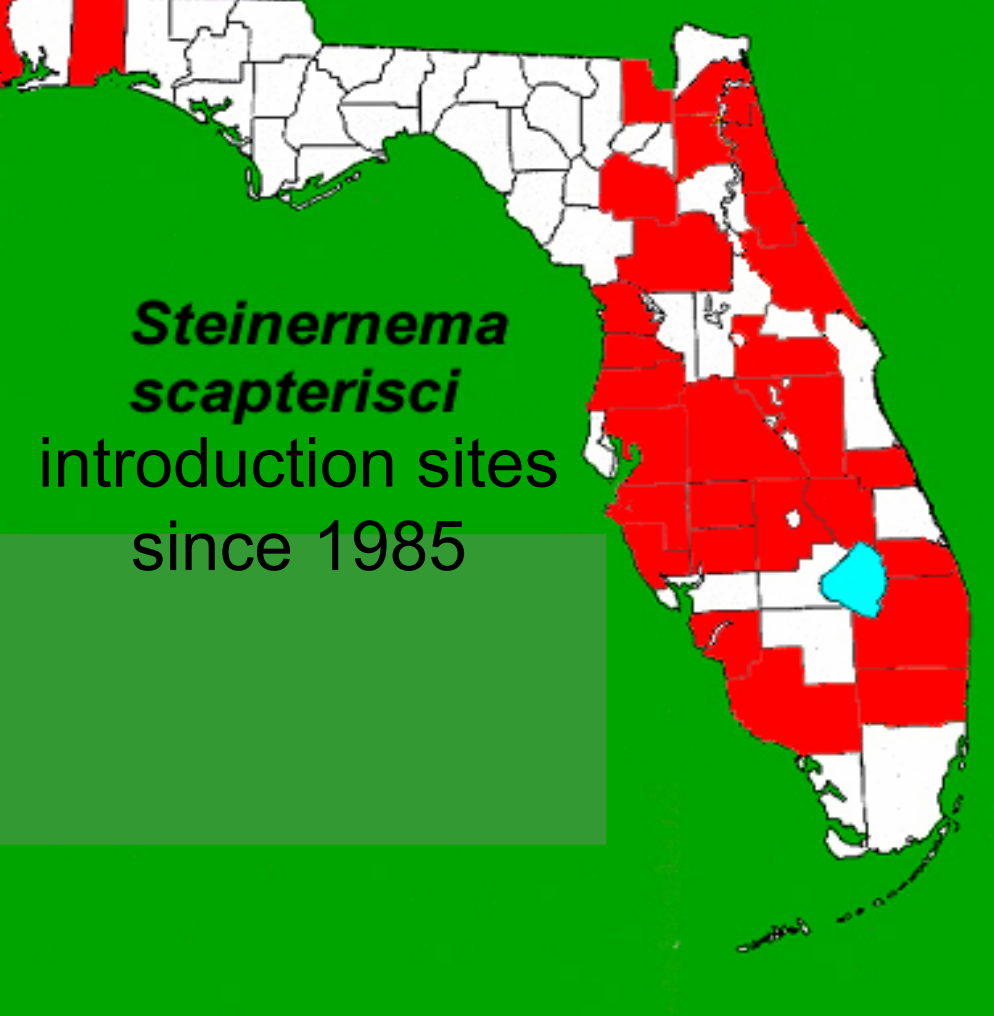
Questions relating to the release of exotic EPN

1. Establish at site of application?
2. Spread to and establish at new sites?
3. Effects on native biota?

Risks have to be assessed on a case by case basis.

1. Will exotic EPN establish?

- Must be pre-adapted to local conditions
 - Climatic conditions
 - Other environmental stresses
 - Soil type
- Host availability (temporal and spatial)



- *S. scapterisci* established in Florida
- A classical biocontrol agent for mole cricket
- Repeated introductions before establishment
- Hosts readily available



2. Will exotic EPN spread?

- EPN do not have characteristics of highly invasive species:
 - Limited powers of active dispersal.
 - Rapid decline post-application (*Smits, 1996*)
 - Abundant natural enemies

But:

- Passive dispersal by infected hosts, human activities etc. *S. scapterisci* spread by hosts.
- Little data on extent and likelihood of spread in medium - long term.

3. Effects of Exotic EPN on Native Biota?

- Direct effects on non-target species not currently affected by native EPN
- Competition with native EPN
- Community effects

Direct effects on non-target species not currently affected by EPN

Lack of natural host range information makes identification of vulnerable insect groups difficult

But:

- EPN tend not to wipe out host populations
- Reduction of target pests requires use of massive doses when the pest is at its most susceptible
- May be effects on non-target insect populations but these are likely to be limited (reviewed by *Bathon, 1996*) and unlikely to lead to even local extinction.

Competition with native EPN

Application of exotic EPN may suppress some native species (*Duncan et al., 2003; Millar & Barbercheck, 2001*) but no competitive exclusion has been observed.

But:

- EPN species often found co-habiting the same site, and may utilise the same host resources (*Peters, 1996; Bovien, 1937*).
- Factors allowing co-existence of EPN include:
 - different host ranges
 - division of host resources in time
 - different dispersal tendencies

Community Effects

If non-target effects and competition with native EPN are minimal there is unlikely to be significant changes to community structure.

However:

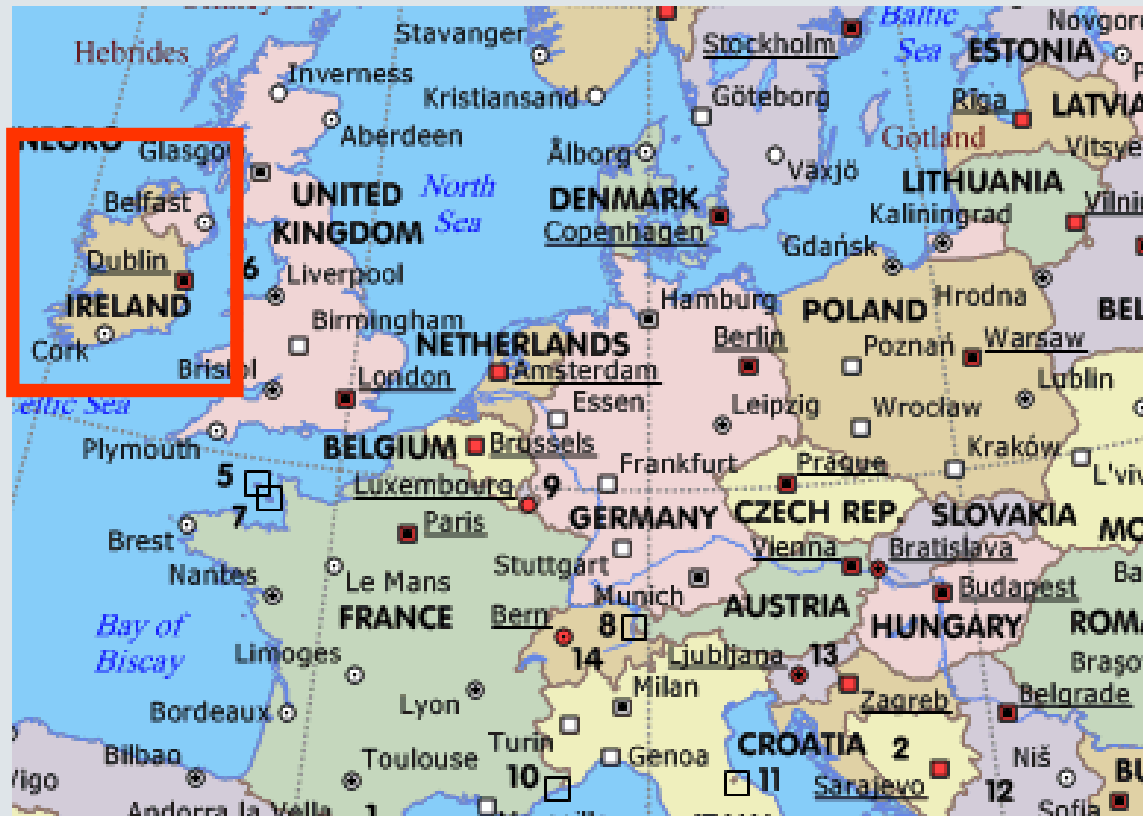
- Food-webs involving EPN may be complex and varied
- We have limited information on the role of EPN in regulating insect populations

Need more ecological information, including post-release studies, to help predict effects.

EPN in Ireland

Biodiversity in Ireland

- Ireland has low biodiversity
- Contributing factors: island, small size, position on edge of Europe & glacial history



Indigenous EPN in Ireland

Irish Species:

H. downesi, *S. feltiae* and *S. affine*

Compared to Britain:

H. downesi, *H. megidis*, *S. feltiae*,
S. affine, *S. kraussei*, *S. carpocapsae*



St. Patrick driving the nematodes from Ireland

EPN used in biocontrol in Ireland

exotic species



H. megidis Vs vine weevil in ornamentals & strawberry



S. feltiae Vs sciarid fly in mushrooms.



H. downesi, *H. megidis*, *S. feltiae* and *S. carpocapsae* currently in trial v's pine weevil in reforestation

Will exotics establish in Ireland?

- Exotic *H. megidis* and *S. carpocapsae* currently in use
- Both native to Britain so may be preadapted to Ireland

But:

- Neither is widespread in Britain.
- *S. carpocapsae* epizootic in Britain in 1970s (*Georgis & Hague, 1981*), but hasn't been isolated since.

Competition with Irish EPN ?

S. carpocapsae

S. carpocapsae is an ambusher and targets different hosts to native EPN. Unlikely to be direct competition.

H. megidis

- *H. megidis* and *H. downesi* are closely related (Adams et al., 1998) and have similar biology.
- Both have at least one natural host in common; *Phyllopertha horticola* (Enright, unpub.; Peters, 1996)
- However, both species co-exist at a site in Denmark (Griffin et al., 1999).

Persistence and Spread of EPN used against Pine Weevil in Reforestation



Treatments

S. carpocapsae – Exotic sp.

H. megidis – Exotic sp.

S. feltiae – Exotic strain

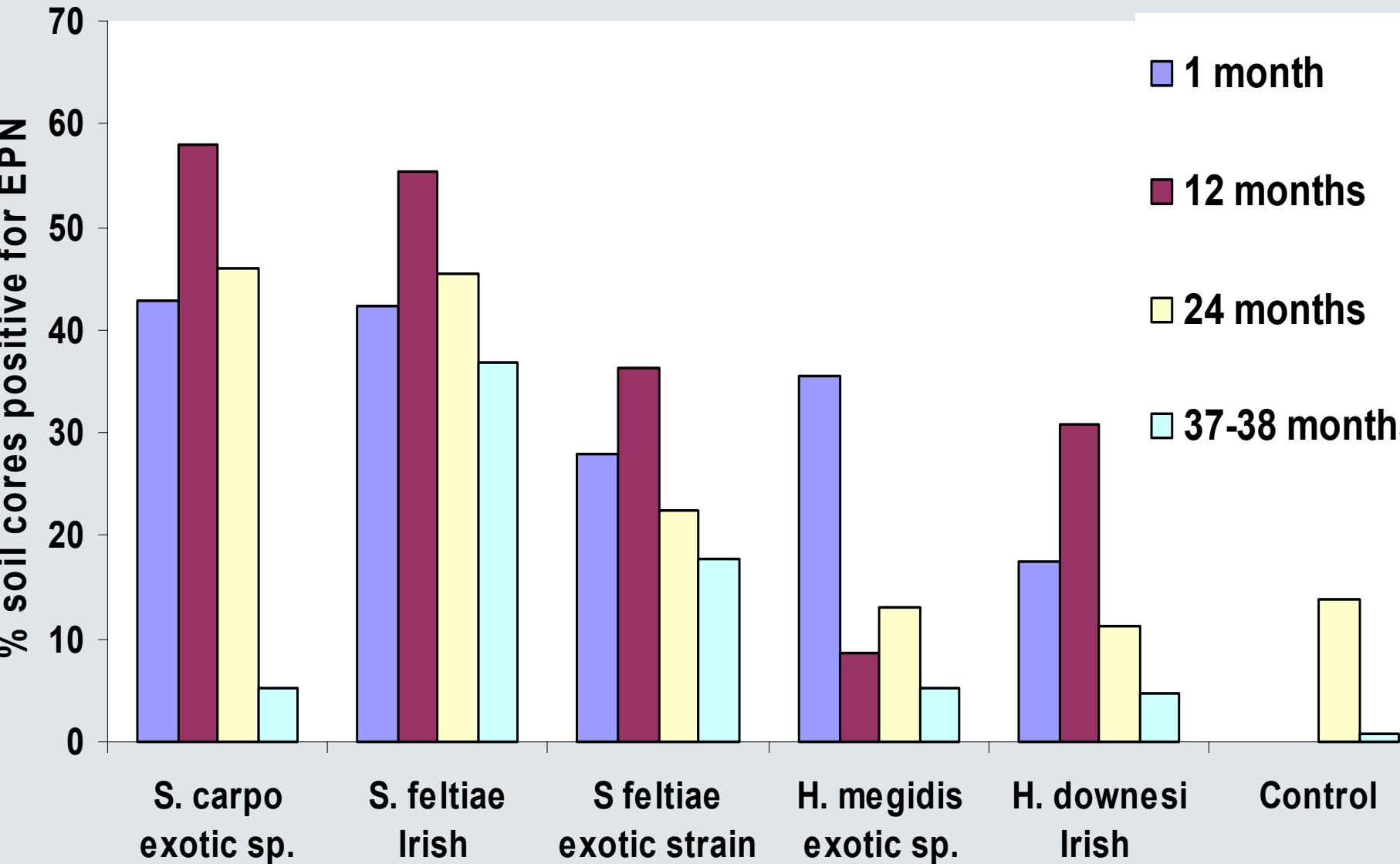
S. feltiae – Indigenous sp.

H. downesi – Indigenous sp.

Control: Water

- Developing weevils in stumps targeted.
- 3.5 million IJs applied to each stump
- Randomized blocks

Persistence of applied EPN



Persistence & spread of EPN

- Decline in exotic EPN after 38 months probably due to reduction in abundance of *Hylobius* larvae.
- Very little spread to control stumps (2 - 5 m from nearest treated stump)
- No nematodes detected at site perimeter after 24 months

Non-target effect observations

- Clusters of infected *Hylastes* sp. adults, pupae and larvae were frequently observed – Pest!
- A few infected carabid larvae in *S. carpocapsae* treatments
- The beneficial *Bracon hylobii* weevil parasitoid was never found infected despite being susceptible in lab.

Conclusions

- Assess possible introductions on a case by case basis.
- Cost – benefit analysis:

Risks associated with introduction of exotic species need to be weighed against the risks of leaving the target unchecked or using an alternative control strategy.

Thank you

Pine weevil research is being funded by INTERREG



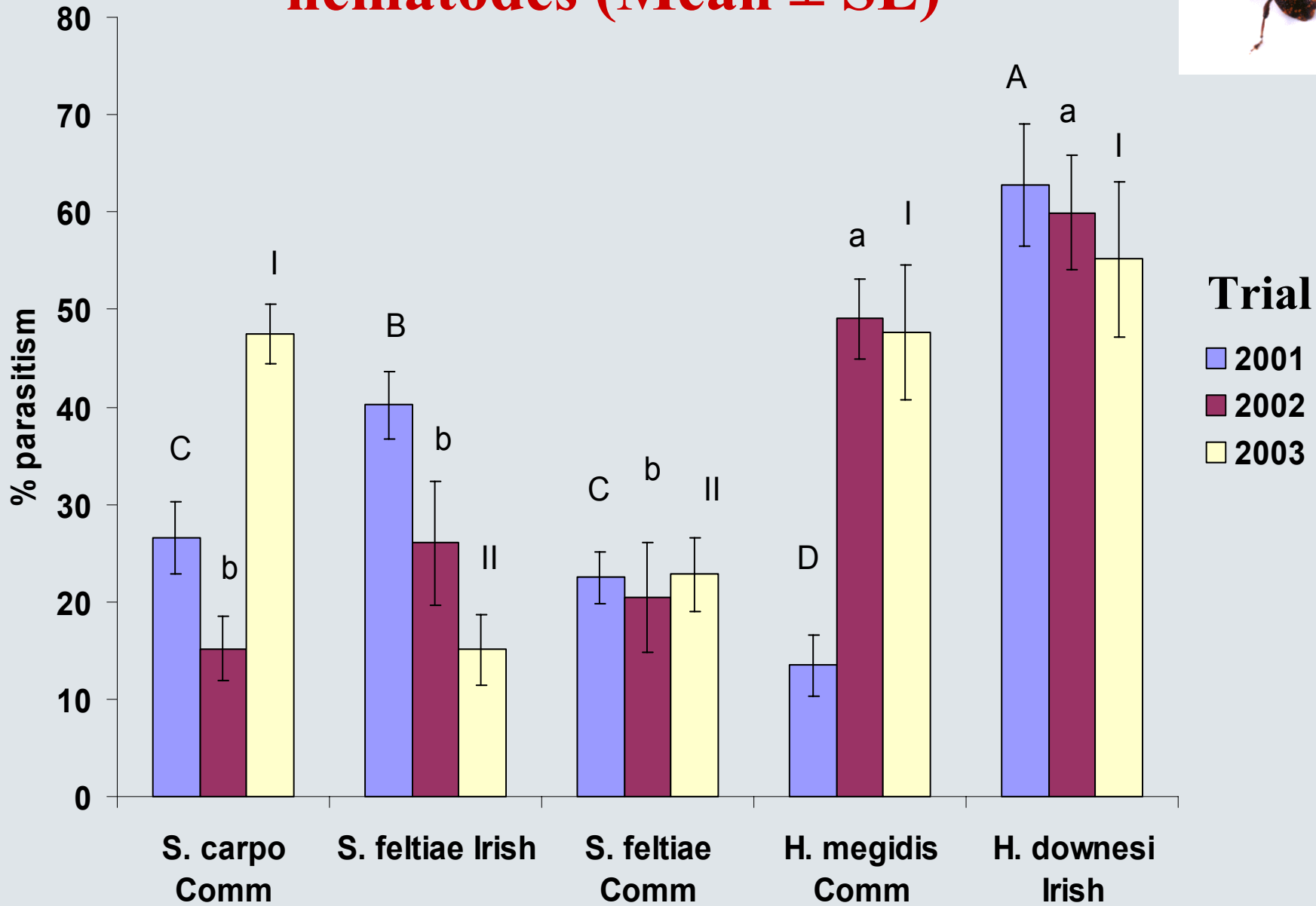
Assessment of parasitised insect



**Bark stripped
from ✂ stumps
to a
distance of 40cm**



Percentage of *H. abietis* killed by nematodes (Mean \pm SE)



- Most EPN-host associations are relatively balanced and long lasting (*Peters, 1996*)
 - Even following rare epizootics associated with pest outbreaks the pest recovers

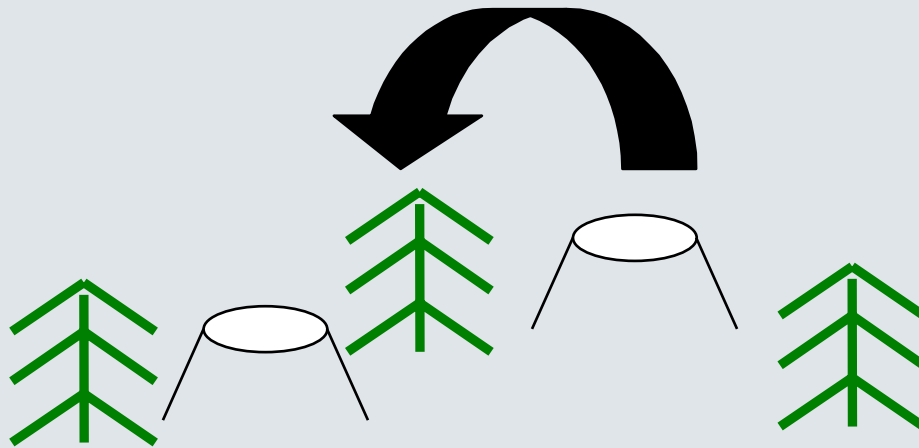
In order to get a significant impact on non-target require high densities of IJs to coincide in space and time with susceptible instars

Trials of EPN v's Pine Weevil



Reforested Site

Adults emerge from cut stumps and feed on young trees



Larvae develop in stumps

But:

- Passive dispersal by infected hosts, human activities etc. *S. scapterisci* spread by hosts.
- Little data on extent and likelihood of spread in medium - long term. Evidence for multiple *S. feltiae* colonization events of a newly formed sand island (< 200 years old) (*Rolston, unpublished*).