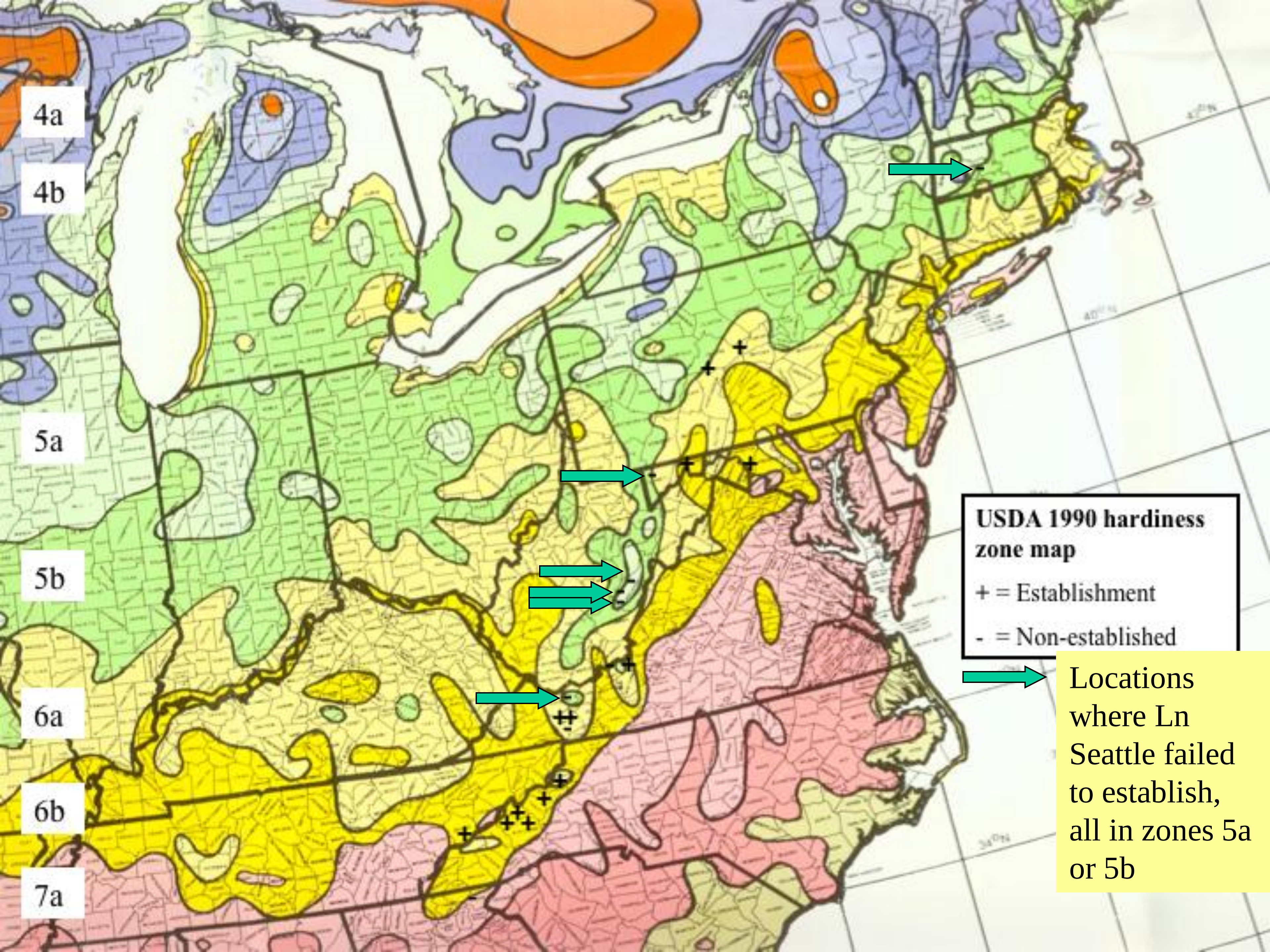
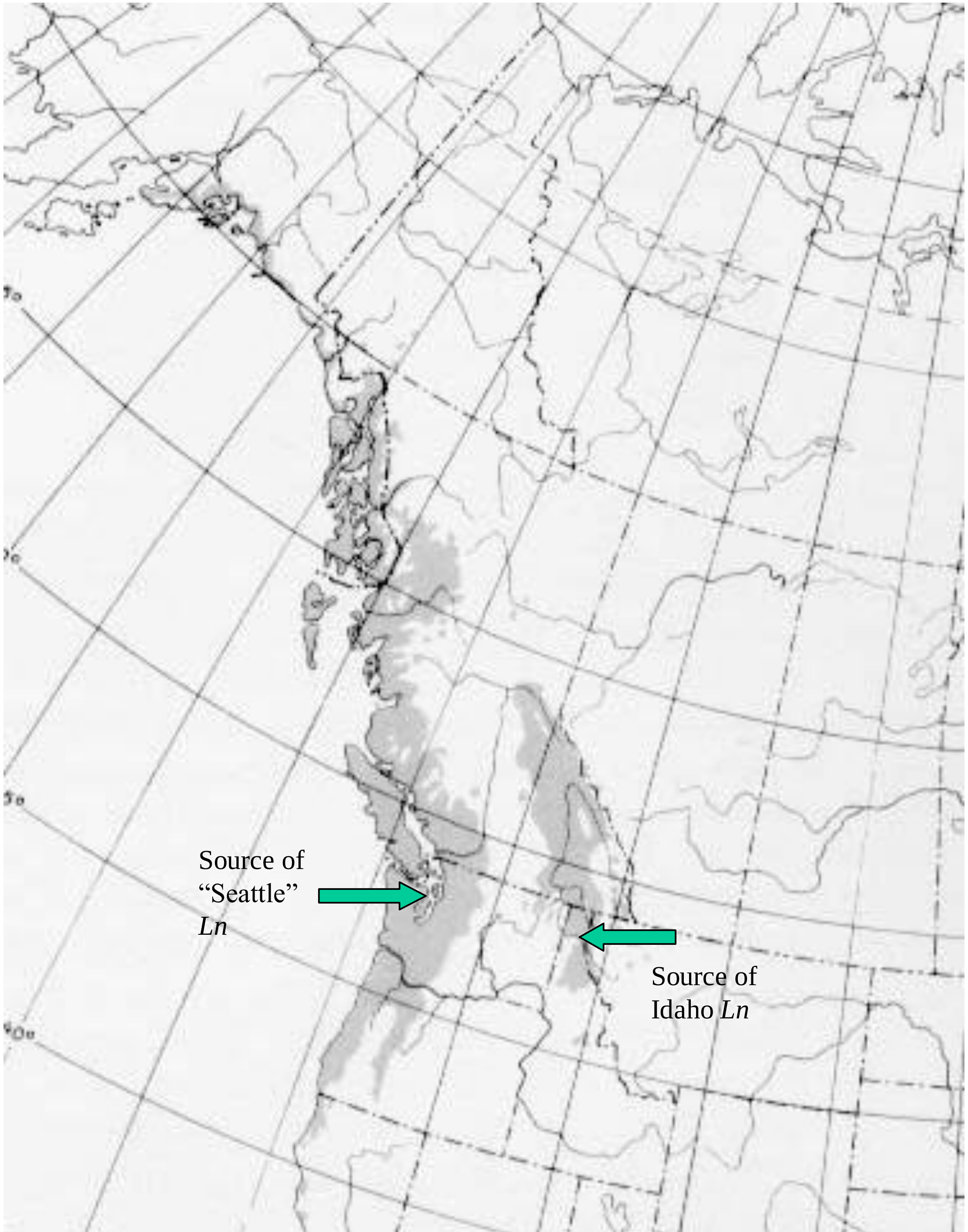
Tools for Use in Biological Control Projects

Read chs 13, 14

1. Climate matching- to select collection locations (separate lecture by guest)
2. Molecular tools-to aid in identification, detection of origin, and matching released and recovered material (separate lecture by guest)
3. Quarantine-to safely maintain natural enemy colonies for study before release
4. Methods for natural enemy colonization in the field


4a
4b
5a
5b
6a
6b
7a
USDA 1990 hardiness zone map
+ = Establishment
- = Non-established
Locations where Ln Seattle failed to establish, all in zones 5a or 5b



Range of western hemlock, *Tsuga heterophylla*, in the western U.S. and Canada Note the gap between coastal and inland distribution of western hemlock, corresponding to regions with maritime and continental *L. nigrinus* populations. This gap provides the opportunity for genetic differentiation to fit local climates in the two regions.

Quarantine and Colonization

1. Shipping and handling
2. Establishing quarantine colonies
3. Petitioning for release
4. Field colonization for establishment

In the Quarantine Lab

Shipping

Handling in quarantine

Establishing laboratory colonies for study

Insects collected overseas usually are shipped to the quarantine laboratory

Preventing loss requires: (1) quick shipping, (2) avoidance of heat and dryness, (3) knowing the rules of how to clear customs

Imported natural enemies must go to an official, approved quarantine laboratory

USDA insect biocontrol quarantine lab in Newark, NJ

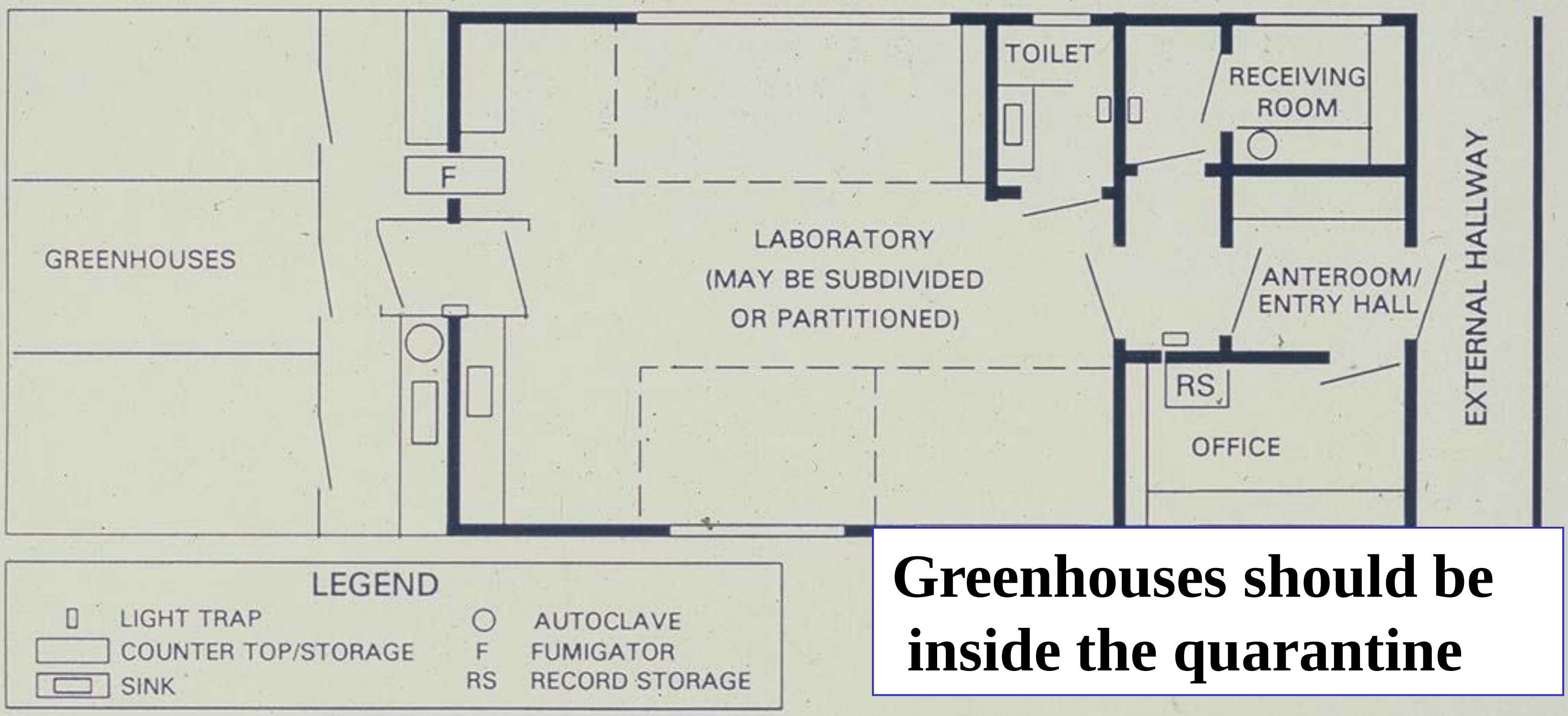
The quarantine officer, a critical position

Opening packages inside quarantine:

1. **Check contents to see nothing is broken**
2. **Look for unwanted organisms**
3. **Place BC agents in other cages, with food and water**
4. **Destroy packaging in autoclave or furnace**

Use of ice packs is standard to prevent overheating

Quarantine laboratories are essential a box within a box, with strict management rules and a strict manager (quarantine officer)



Greenhouses should be inside the quarantine

Fig. 9.1. (a) Layout of a quarantine facility includes an anteroom, secure doors between the quarantine hallway and the external hallway, and an airlock separating the hallway from a primary receiving room where packages are first opened upon receipt. Additional rearing rooms may be included in the quarantine suite (after Fisher 1978). (b) Photograph of an existing quarantine building.

Getting ready to release a new species

Determining safety (by estimating host range– in later lecture)

Petitioning for release

Successful establishment

Petitioning for Release

Weed biocontrol agents

- **-must prove host specificity is adequate for safety (note role of interagency review committee)**

Insect biocontrol agents

- **-preparation of an EA**
- **-finding of no jurisdiction by APHIS**
- **-fish and wildlife laws**
- **-obligations under NEPA**

Assessing Changes of an Agent to Establish

Does the host meet the natural enemy's needs?

Is climate suitable for the natural enemy?

Will the natural enemy's diapause needs be met?

Case of *Cotesia rubecula* strains

Vancouver strain-maritime

Yugoslavian strain- continental but wrong latitude

Chinese strain-well adapted to photoclimatic regime

Microctonus rubecula is a solitary parasitoid of *Pieris rapae* introduced to the United States

Releasing natural enemies effectively

Items to consider

1. Cage vs free releases
2. Combinations
3. Timing release to occurrence of host and time of day
4. Use of mechanized release methods

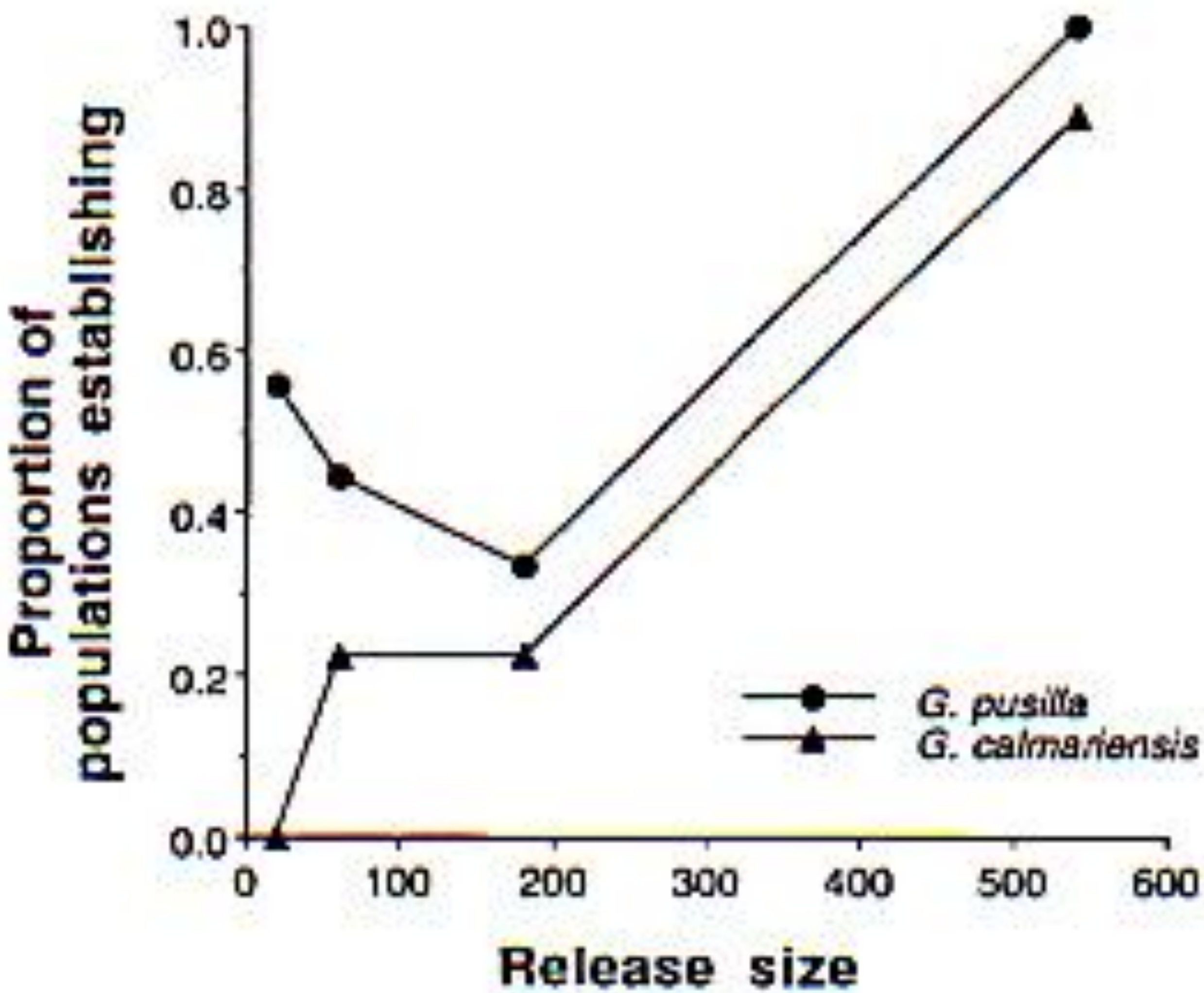
Sleeve cages are useful for confining parasitoids of scales or other tree-infesting insects

Factors affecting quality of release

Items to consider

1. Number of agents released
2. Agent quality (age, mating status, fed, pre-exposed to hosts?)
3. Agent stage used for release

Relationship between number released and probability of establishment for two *Galerucella* beetles for purple loosestrife BC



Selecting and Protecting Release Sites

1. **Physical security (avoid pesticides, fire, flood, crop destruction or harvest)**
2. **Host supply (enough and continuous, or supplement)**
3. **Management (clear long term agreement)**
4. **Microclimate (suitable?)**
5. **Assess to other infested areas for dispersal (not too isolated)**

Release of *Cotesia rubecula* in MA

Chinese insect released to battle cabbage butterfly

WILLIAMSTOWN — A small, dark-colored insect from China has been released at Caretaker Farm in Williamstown in what a University of Massachusetts scientist hopes will be a successful biological control campaign against the cabbage butterfly.

The release is part of the state's Integrated Pest Management (IPM) program, in which researchers are developing non-chemical methods of battling pests which afflict agricultural crops and nursery stock.

The cabbage butterfly is a common pest of all members of the cole crop family, including broccoli, cabbage and brussels sprouts. The small, white butterfly lays its eggs on the stalks and leaves of these vegetables and the larvae feed upon the host plant.

This is not the first U.S. introduction of natural parasites aimed at the cabbage butterfly. That was done nearly 100 years ago, but, according to UMass biological control specialist Roy Van Driesche, scientists introduced an insect that was not specialized for the cabbage butterfly.

Working with biological control experts in China, Van Driesche has imported an insect (technical name: *Apanteles rubecula*) which is much better suited to attack the cabbage butterfly.

The small, wasp-like insect is a better way to fight cabbage butterfly, Van Driesche said, because it is more specialized for the plant and it kills the larvae at an earlier growth stage than the parasite introduced 100 years ago.

Attempts to introduce *Apanteles rubecula* in the U.S. have not been successful to date, Van Driesche said. But he thinks that is because the insects were imported from regions that did not have a good "photo-periodic match" with the areas where they were introduced. Insects use the length of the day as a trigger to go into their form of hibernation, called diapause, which enables them to survive winters.

If they are placed at a distinctly different latitude from their native region, they can be "fooled" into diapause at the incorrect time, which results in the insect's demise.

Van Driesche, whose work is funded by the state Department of Food and Agriculture, said the insects he has imported are from Beijing, which is located at a similar latitude to Massachusetts and thus should provide a good "photo-periodic match."

The project got its start when Van Driesche read about *Apanteles rubecula* in a Chinese biological control journal. He began corresponding with Chinese scientists and arranged to have a population imported. After spending the required time at the U.S. Department of Agriculture's quarantine facility in Newark, Del., the insects were transported to Van Driesche's lab in Amherst. He released about 200 to 300 of the insects at Caretaker Farm.

Jeffrey L. Carlson, chief of the State Pesticide Bureau, said the Department of Food and Agriculture is committed to biological controls as a component of the IPM program.

"The use of natural predators and parasites to combat pests already has been proven to be effective and we think the potential for further advances is enormous," Carlson said. "We believe IPM is and will be a very useful technique as we seek to protect our groundwater from chemical contamination. Dr. Van Driesche's aggressive research is a critical element in the IPM program."

Over the past several years, the Department of Food and Agriculture and the Cooperative Extension Service at the University of Massachusetts have developed IPM programs that have significantly reduced pesticide use on potatoes, strawberries, cranberries, sweet corn, and apples.

In addition to greater reliance on biological controls, IPM encourages extensive scouting before spraying to determine if pest populations are great enough to warrant the application of chemicals.

“Free release”

Natural enemies may be released without cages by liberating them in the right habitat when they are likely to find host

Cocoons of *Cotesia rubecula* are placed on collard plants where the host *Pieris*

“Cage release” cages can be used to confine natural enemies locally over a known set of hosts

After release, sampling is used to detect reproduction of the natural enemy in the field

Here we see the cocoon of *Cotesia rubecula* next to the dead larva of its host *Pieris rapae*