Overview of Biological Control of Invasive Weeds – Historical Perspective and Appropriate Uses

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What is Biological Control?

- Manipulating natural enemies of weeds.
  - **Insects…**
  - Pathogens
  - Fish
  - Goats
  - Whatever else works!



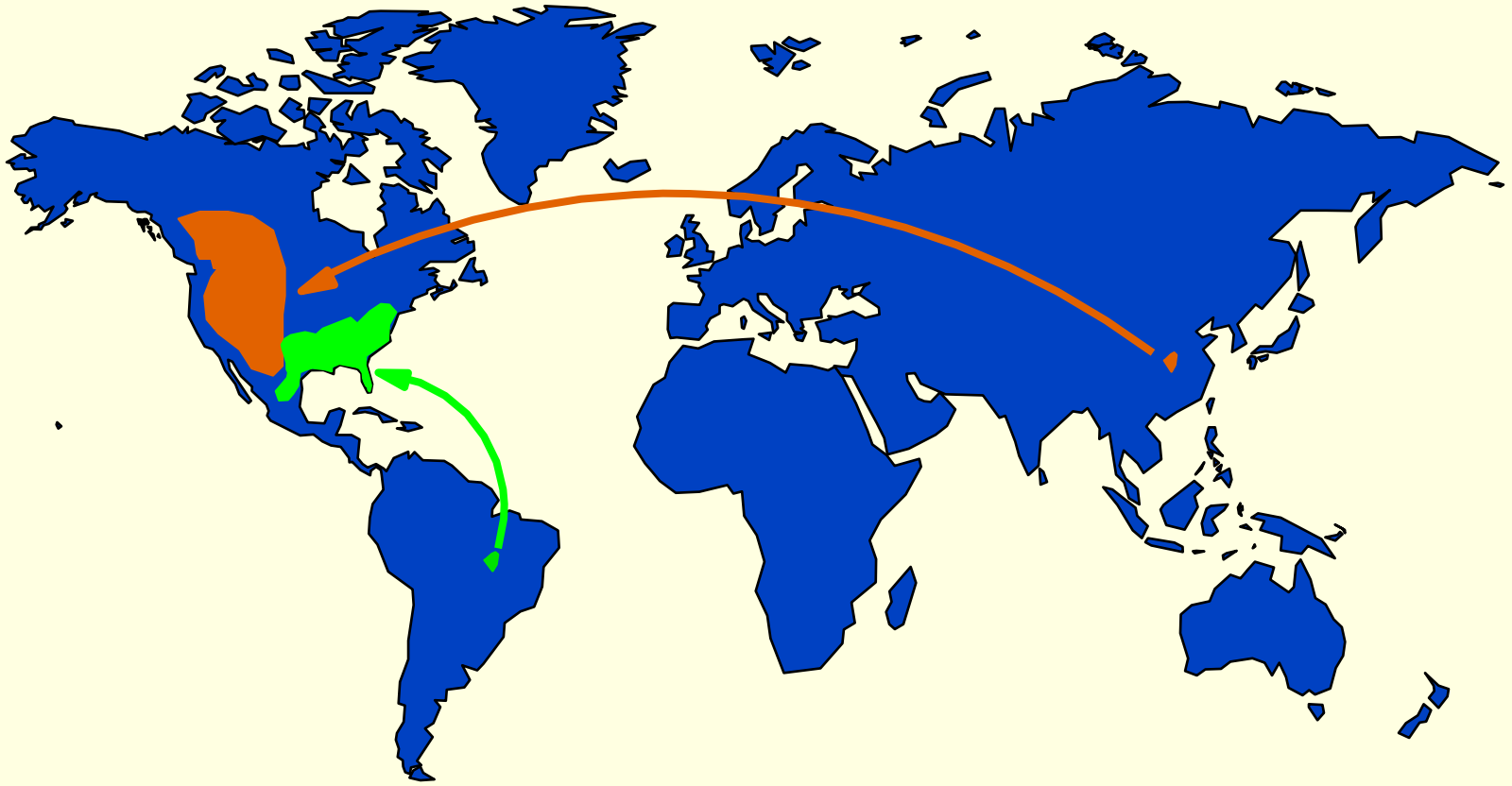



History

- Asa Fitch in 1855 – noted there were weeds with no natural enemies in the US.

Exotic Invasive Weeds

- Weeds usually moved by humans that may be a problem because they have escaped their natural enemies.



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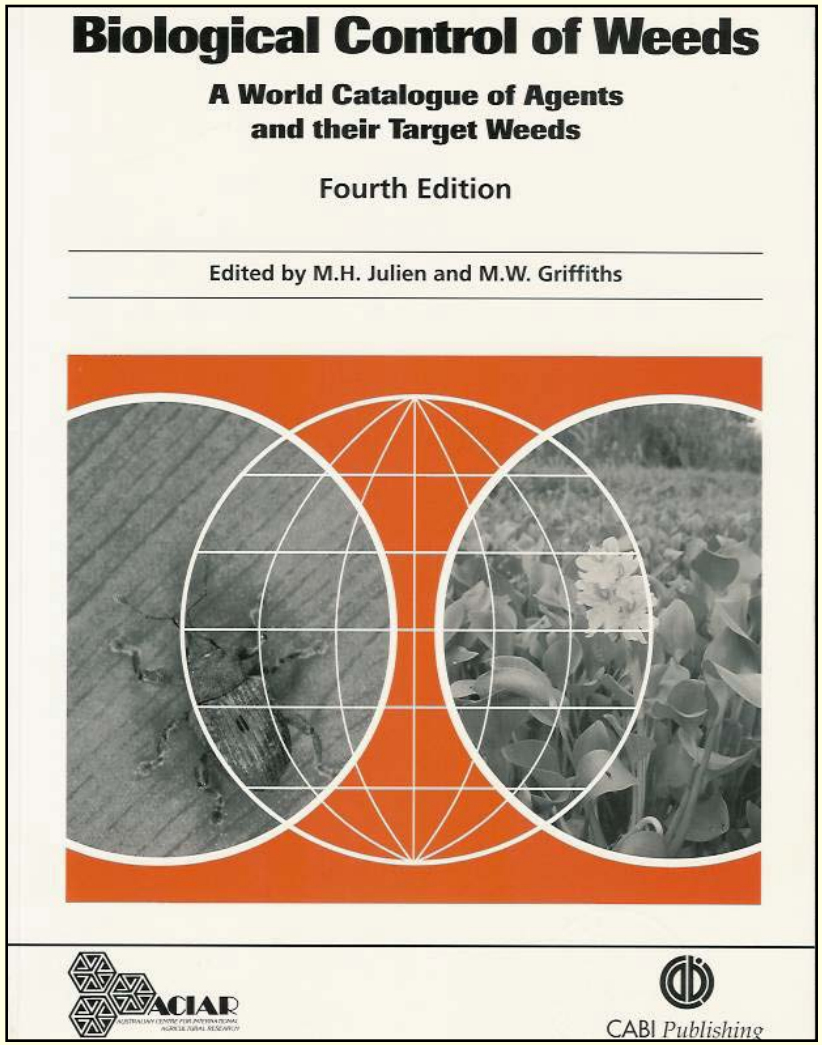
- Almost ½ of all targets have been in 3 plant families: Cactaceae, Asteraceae, and Mimosaceae.

Worldwide:
146 years of Weed Biological Control

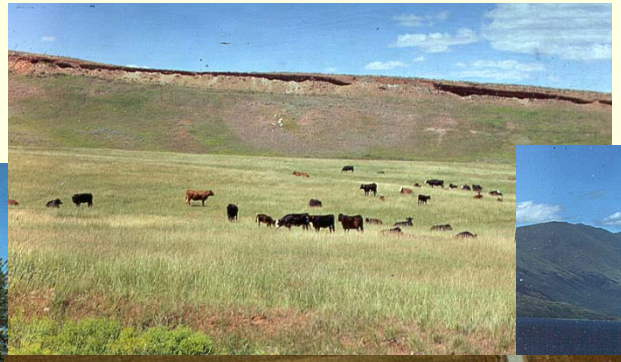
- **Planned releases** **1,150**
- **Specific agents** **365**
- **Weed species** **133**
- **Countries** **75**

- **Degree of control:**
  - **1/3 Complete or substantial control**
  - **1/3 Partial control**
  - **1/3 No control**



Most Successes in Stable Ecosystems

Rangelands and Pastures



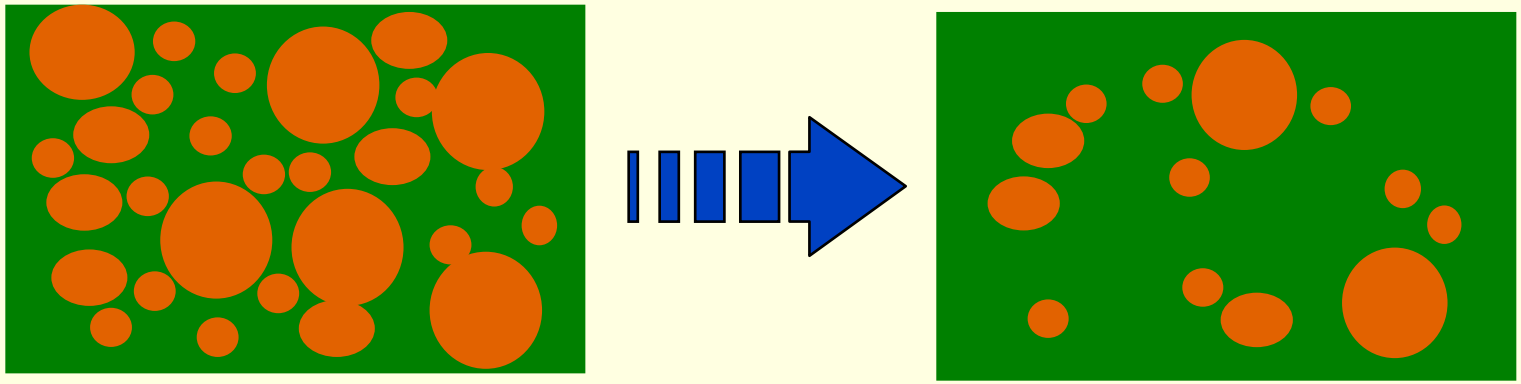
Forests

Aquatic Systems

Other Non-Cropland

What is Success?

1. Weed is reduced to low densities



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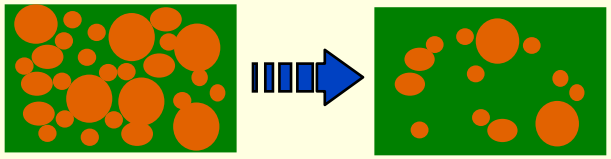
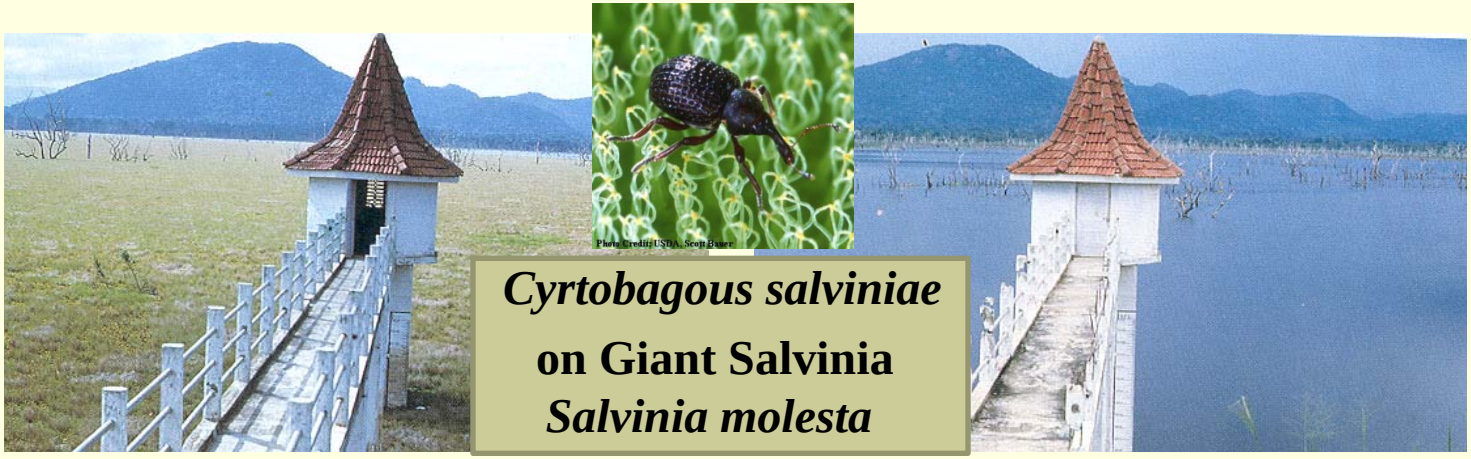


2. Remains at low densities



Cyrtobagous salviniae

on Giant Salvinia

Salvinia molesta

What is Success?

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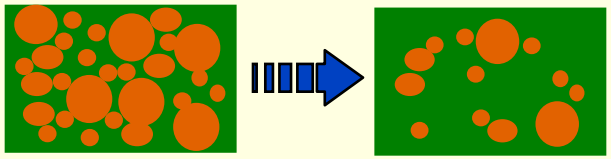
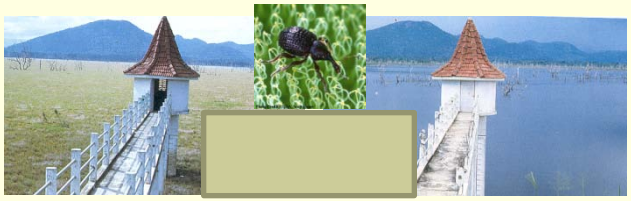
2. Weed remains at low densities





3. Weed returns when protected from agent

Types of Weed Biological Control

- **Classical/Introduction**
- Augmentation
- Conservation

Usually Government Sponsored

- In the public interest
- Can take up to 20 years
- Can be expensive –
  $450K to $1M/agent
- Can be sustainable

Steps in Classical/Introduction Biological Control

- **Target Identification**
  - "To Be or Not to Be a Weed" that IS the question!
  - Economic vs. Ecological vs. Ornamental

➢ Invasive weeds are relatively easy to justify!

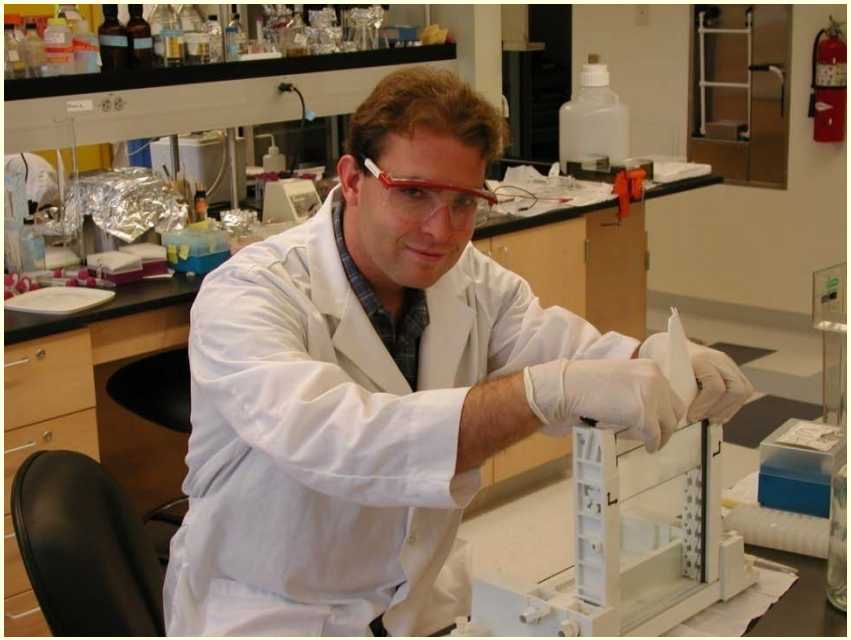
Reduce diversity of natives

Reduce forage and habitat

Displace rare species

Steps in Classical/Introduction Biological Control

- **Target Identification**
- **Determine the origin of weed if possible.**
  - Morphological differences - can be difficult.
  - Genetic comparisons
  - Most invasive weeds are not as genetically diverse as native counterparts.



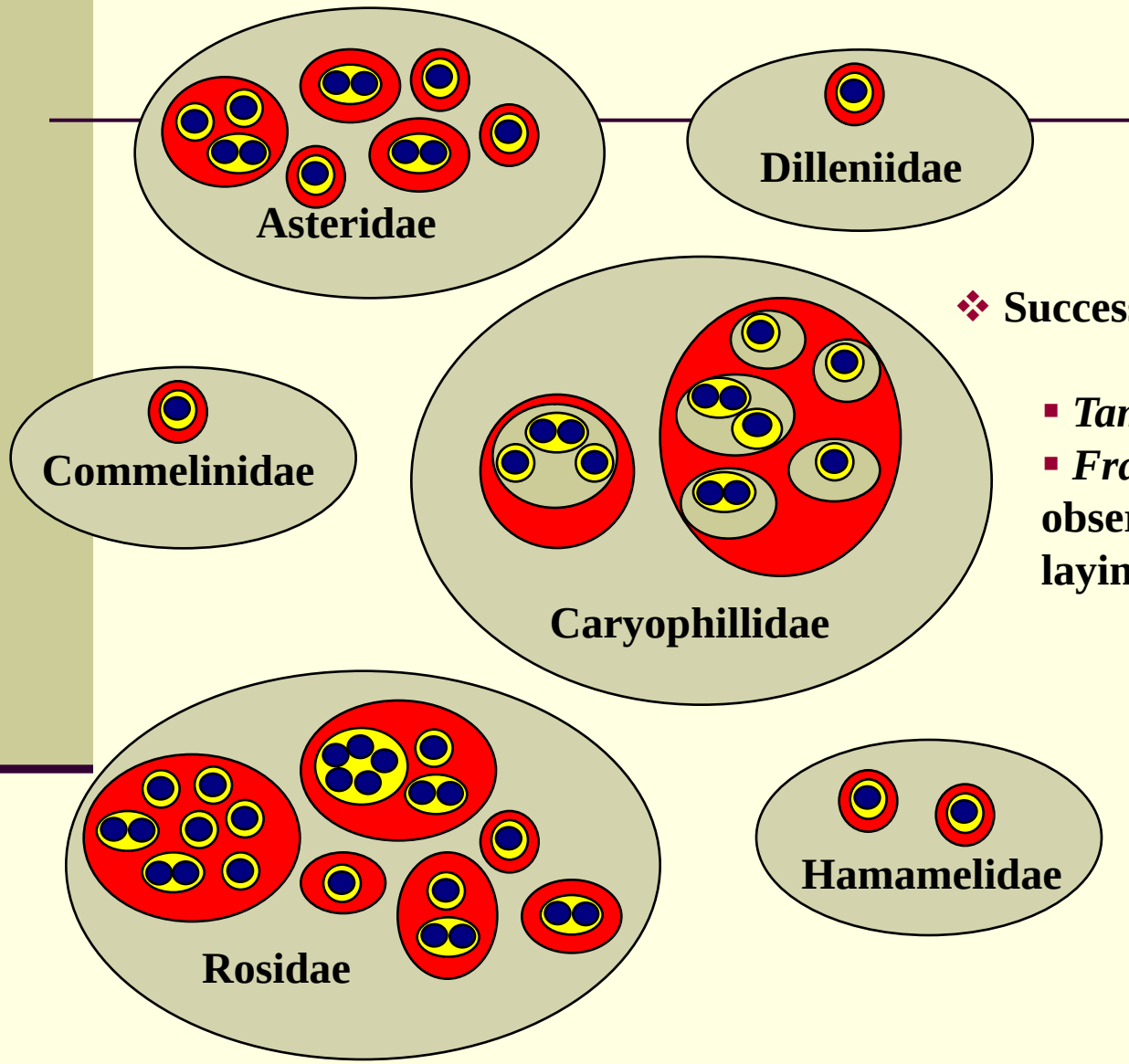
Steps in Classical/Introduction Biological Control

- **Target Identification**
- **Determine the origin of weed if possible**
- **Go to site of origin and collect agents.**
  - **Ecoclimatic similarities (Rainfall, temperatures)**

Steps in Classical/Introduction Biological Control

- **Target Identification**
- **Determine the origin of weed if possible**
- **Go to site of origin and collect agents**
- **Determine if the potential agents will attack any other plants**

Host specificity tests



- **Successful Development on**
  - ***Tamarix* spp. Least on *T. aphylla***
  - ***Frankenia* spp. Variable – never observed heavy defoliation or egg laying.**

Examples:

Willows
Mesquites
Seepwillow
Arrowweed
Cottonwood
Acacia
Sunflower

Grapes
Lettuce
Soybean
Almond
Pecan
Walnut
Tomato
Wheat
Plum

Steps in Classical/Introduction Biological Control

- **Target Identification**
- **Determine the origin of weed if possible**
- **Go to site of origin and collect agents**
- **Determine if the potential agents will attack any other plants**
- **Mass rearing and release**

Evolution of Weed BioControl

- Driven by Public Concern
  - Will it eat my tomatoes?

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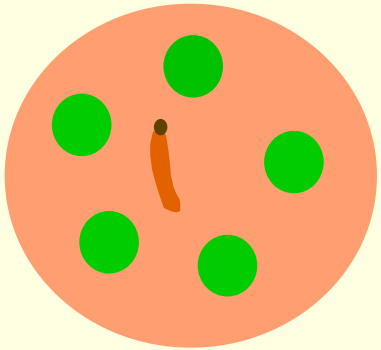

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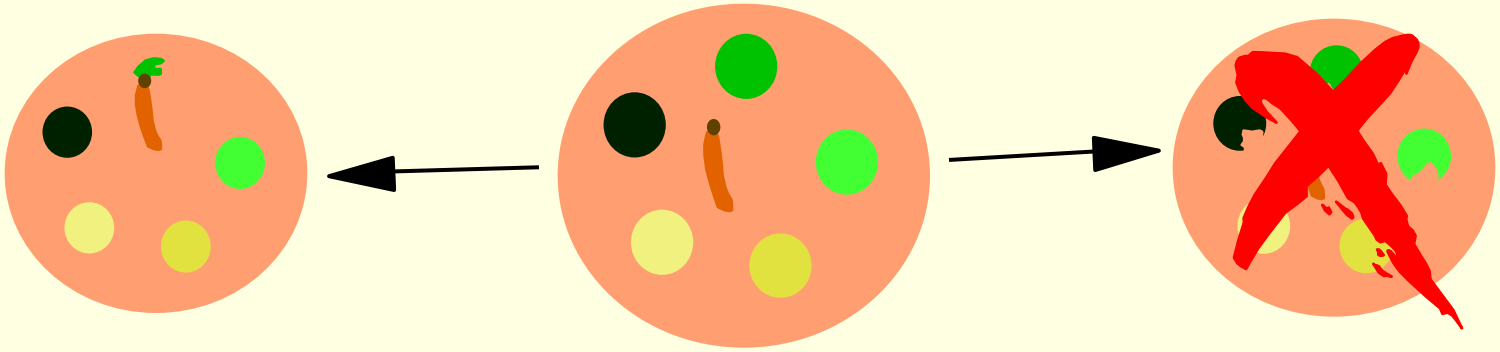
    - Choice tests



Evolution of Weed BioControl

- Driven by Public Concern
  - Will it eat my tomatoes?
  - Will it eat native plants?
    - Only 8 examples of non-target damage
    - None from releases in US/Aust after 1969
    - Concerns over T&E species

Evolution of Weed BioControl

- Driven by Public Concern
  - Will it eat my tomatoes?
  - Will it eat native plants?
  - Number of agents?
    - 55 agents released on first 3 projects
    - Recent review (McFadyen 2003)

16 weeds	1 agent
13 weeds	2 agents
2 weeds	3 agents
1 weed	6 agents

Evolution of Weed BioControl

- Driven by Public Concern
  - Will it eat my tomatoes?
  - Will it eat the native plants?
  - Number of agents?
  - Ecological implications?
    - Not just economics
    - Invasive weeds destroy native ecosystems
    - No such thing as zero risk

Evolution of Weed BioControl

- Liability
- Legislation – next talks……..