

# Weed Biological Control in California: Review of the Past and Prospects for the Future

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# Classical Weed Biological Control

- It involves introduction of natural enemies from their native range into an exotic range where their host plant has become invasive.
- The objective is for the exotic natural enemy to become self-sustaining members of the herbivore community in the new area of infestation.

# Biological control of diffuse knapweed

*Larinus minutus* - seedhead weevil



Diffuse knapweed damaged  
by *Larinus minutus* (left)  
undamaged plant (right)

Gary Brown, USDA-APHIS

# Biological control of diffuse knapweed

*Larinus minutus* - seedhead weevil



Hwy 197 MP 8 (Oregon) diffuse knapweed infestation, 8/1988



# Biological control of diffuse knapweed

*Larinus minutus* - seedhead weevil



Hwy 197 MP 8 (Oregon) after release of *Larinus minutus*, 9/2001

# Biological control of diffuse knapweed

*Larinus minutus* - seedhead weevil



Hwy 197 MP 8 (Oregon) after release of *Larinus minutus*, 9/2002

## Diffuse knapweed in western Colorado

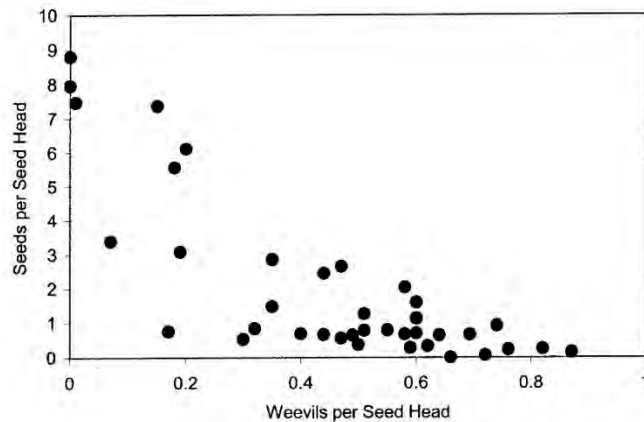


Figure 2. Relationship between seed and weevil production in seed heads of diffuse knapweed. Each point represents the mean value of seeds per seed head and weevils per seed head for 12 sites in the Colorado Front Range area collected during the 2001–2004 interval. ( $n = 38$ ; not all sites were sampled in all years.)

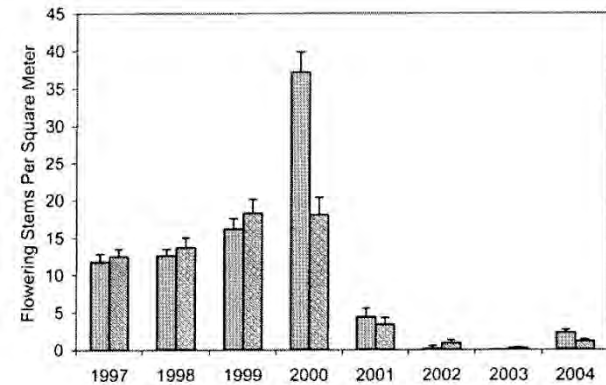


Figure 1. Flowering stem densities of diffuse knapweed at two monitoring sites where insects were released in 1997. Seed head weevils were relatively uncommon until 2000. Each bar represents the mean and one standard error of 30 samples taken from 1 m<sup>2</sup> quadrats at two sites over the eight year period. Data for the 1997–2001 interval were reported in [24].

From: Seastedt et al. (2005) Understanding invasions: the rise and fall of diffuse knapweed (*Centaurea diffusa*) in North America

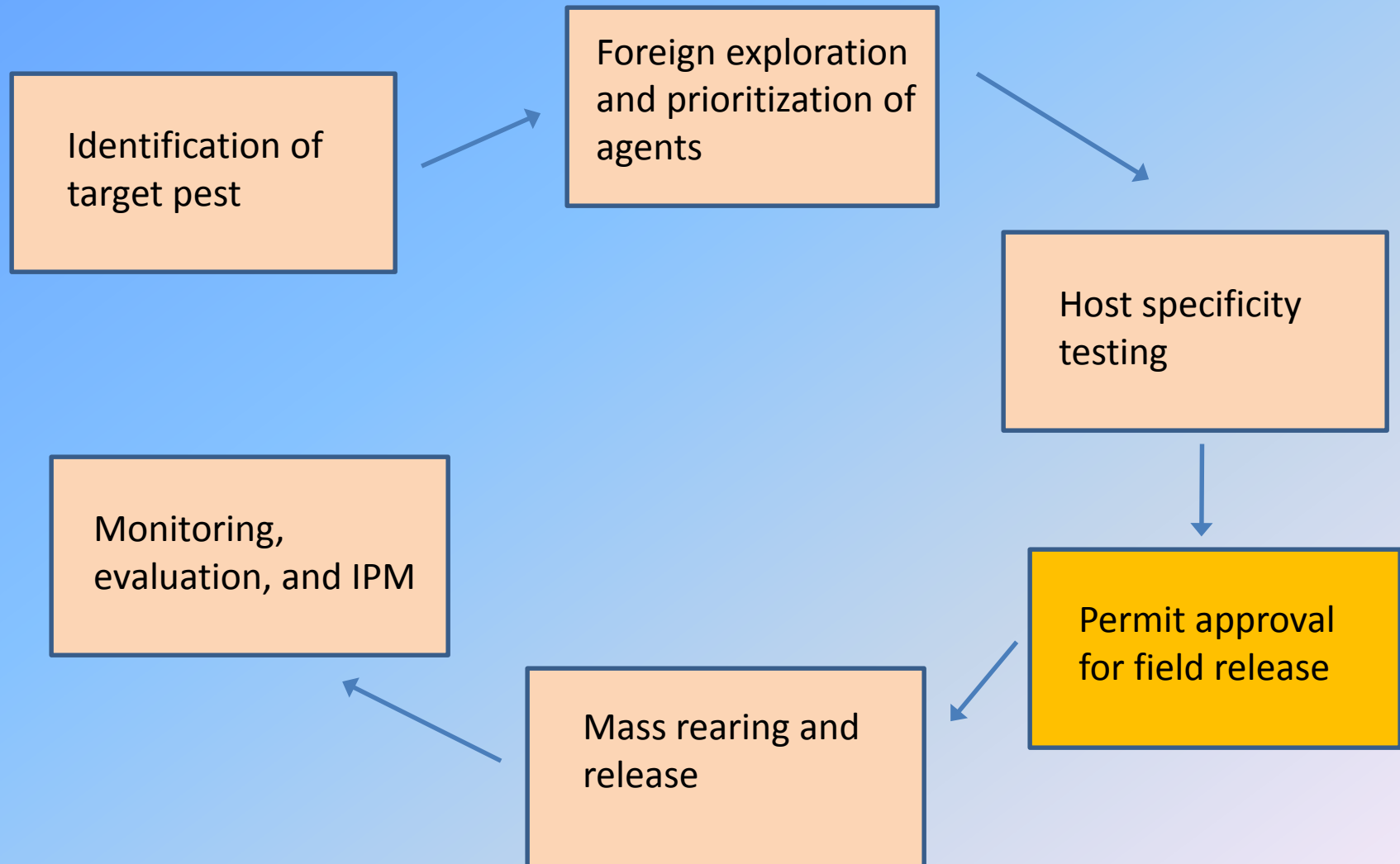


# Key to Effectiveness and Safety is High Host Specificity

- Substantially reduces or eliminates risks to non-target plants
- Concentrated feeding damage provides mortality needed to reduce target plant populations
- Required for a field release permit from APHIS



# Steps in a classical biological control program



## PPQ 526 Permits are required from APHIS for any of the following:

1. **Importation** of live Biological control organisms into the United States and its Territories ([Importation Permits](#))
2. **Interstate movement** of live Biological control organisms ([Interstate movement permits](#))
3. **Retaining** live biological control organisms in containment facilities after expiration of a permit ([Continued curation permits](#));
4. **The movement of any live biological control organism from the confines of a containment facility to any other containment facility, or**  
**for environmental release.**

## APHIS Environmental Compliance Process

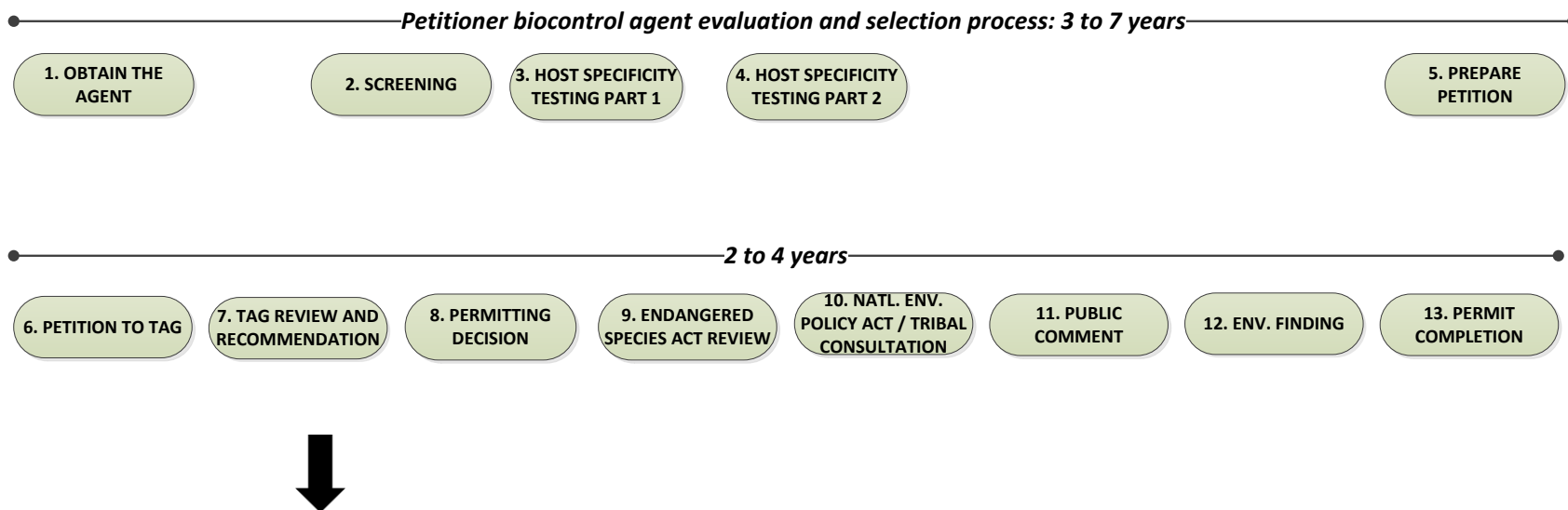


The Environmental Compliance process is rooted in the writing of the APHIS permit.

This is the “federal action” which triggers the compliance with two Acts:

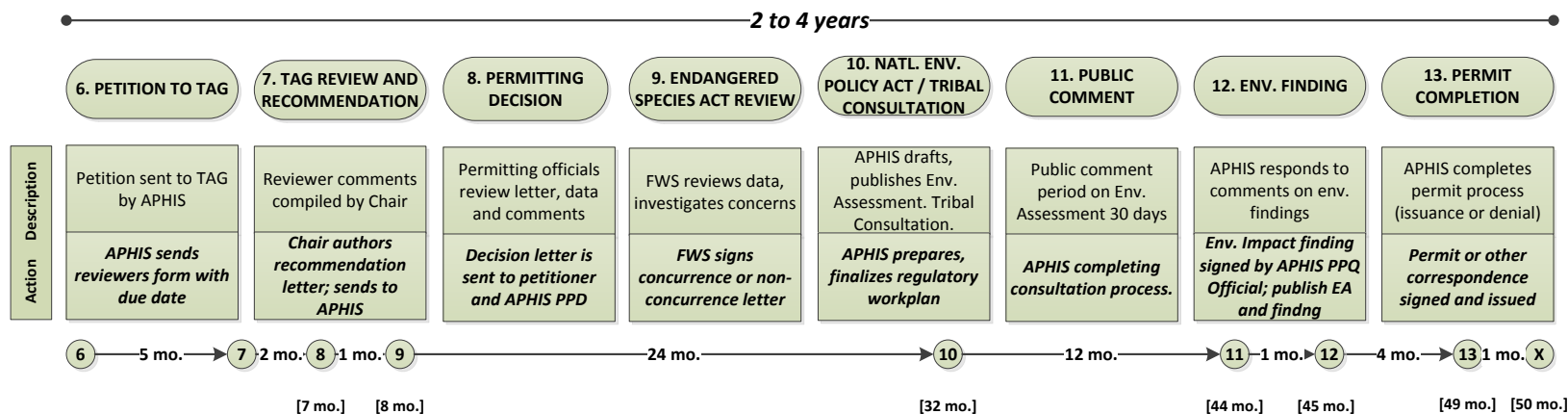
- The Endangered Species Act (ESA)  
(specifically “Section 7” Interagency Cooperation)
- National Environmental Policy Act (NEPA)

## Overview of the Process (Flowchart) to Evaluate Proposed Release of Weed Biocontrol Agents Under APHIS Permit





# APHIS Environmental Compliance Process



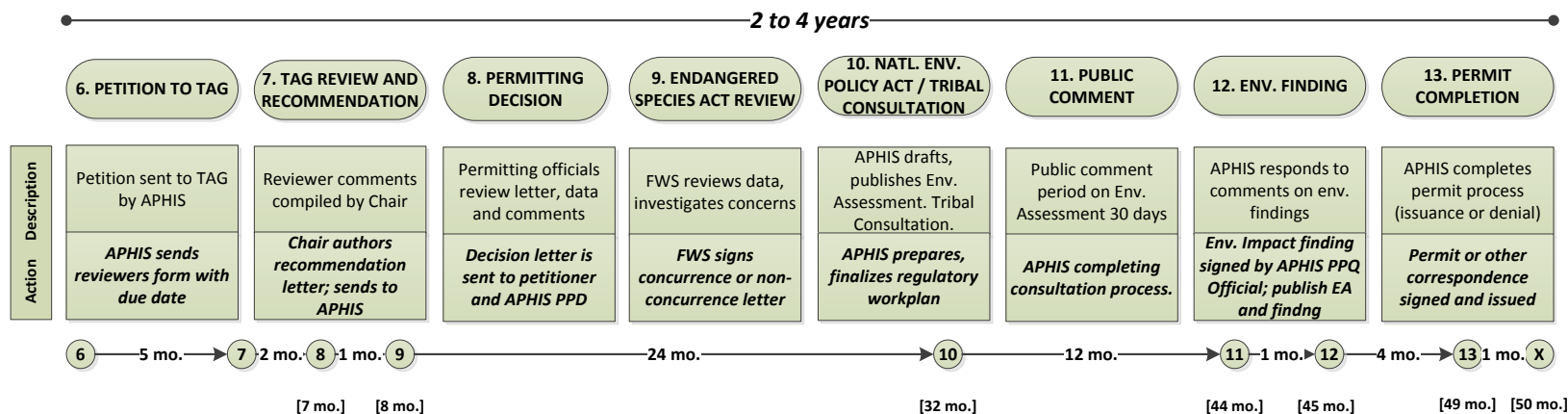
# Permitting of Weed Biocontrol Agents

## USDA APHIS PPQ

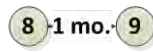
### TAG Committee Membership

- Canada: Agriculture & Agri-Food Canada
- Mexico: SAGARPA-SENASIA-DGSV
- U.S. Army Corps of Engineers
- USDA APHIS
- USDA Agricultural Research Service
- USDA Forest Service
- USDA National Institute of Food and Agriculture
- USDA Natural Resources Conservation Service
- U.S. Environmental Protection Agency
- USDI Bureau of Reclamation
- USDI Bureau of Land Management
- USDI Bureau of Indian Affairs
- USDI National Park Service
- USDI US Fish & Wildlife Service
- USDI US Geological Survey
- The National Plant Board
- Weed Science Society of America

# APHIS Environmental Compliance Process



# Environmental Compliance Process



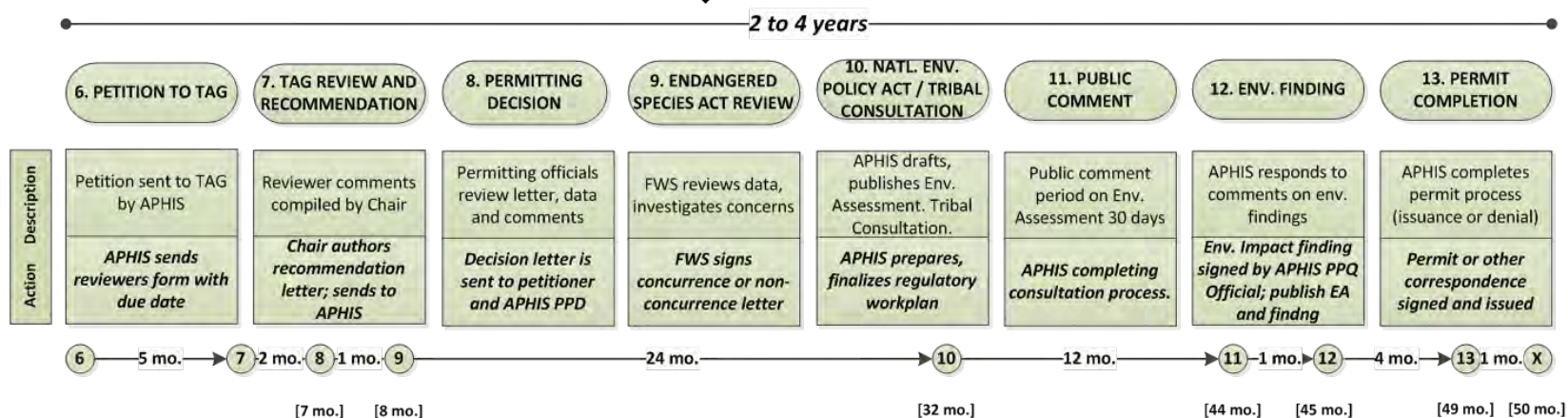
[7 mo.] [8 mo.]

## 8. APHIS Permitting Decision

- APHIS Permitting group reviews documents focusing on information/ comments relevant to the **Environmental Compliance Process**, agricultural practices, other economic plants.
- APHIS Permitting sends **Decision Letter** to petitioner which confirms the decision to proceed with the Environmental Compliance process needed to write a permit to release. The letter outlines the steps in the process and probable time lines.



# Environmental Compliance Process



## 9. Endangered Species Act Review (USFWS)



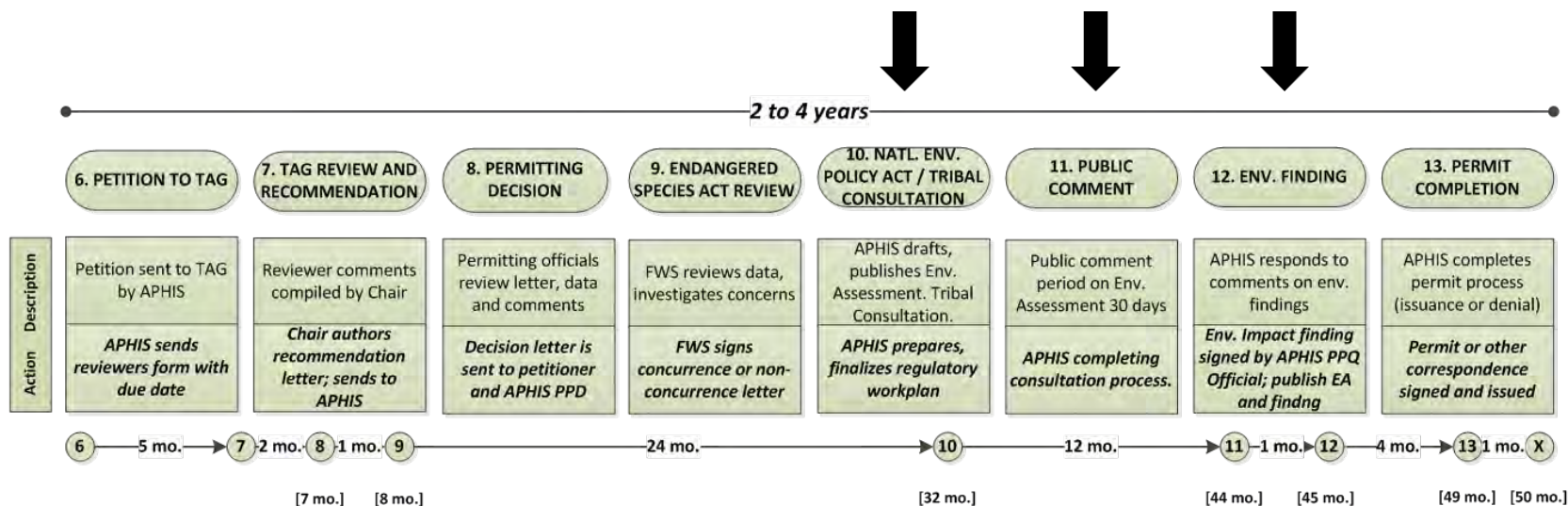
- APHIS PPD Environmental and Risk Analysis Services (ERAS) prepares a Biological Assessment (BA) using information in the Petition
  - Initiates informal “Section 7” consultation with the U.S. Fish and Wildlife Service: this seeks a **concurrence** that the release of the new biological control agent will not “adversely affect” any threatened or endangered species or designated critical habitat.
- BA typically does not restrict release or movement of the biological control agent within the continental United States.
- **The informal consultation has no specific time frame, and may involve review by any of the local field offices of the US F&WS.**

# Current Status of Permitting Process

2012 - 2016

- 19 field release petitions submitted
- 14 recommended by TAG for approval
  - 1 withdrawn by petitioner (for further testing)
  - 2 permits issued in 2016
  - 4 approved by USFWS and
  - 4 under review by USFWS (to be completed by December 2017)
  - 3 BA in preparation

# Environmental Compliance Process





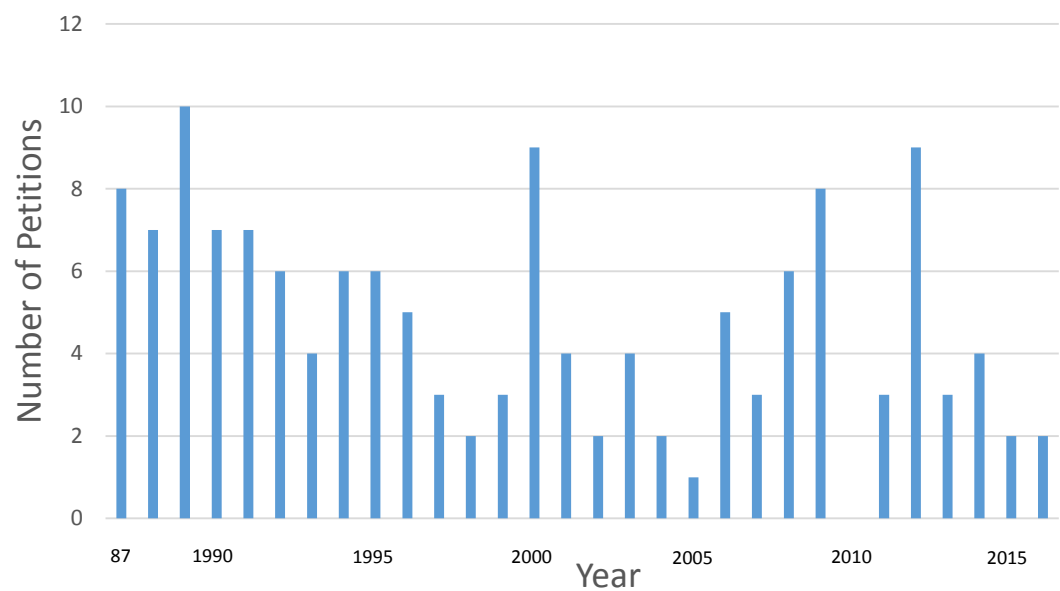
## 13. Permit Completion !

13 1 mo. X

[49 mo.] [50 mo.]

- Once FONSI is signed, PPQ finalizes the Environmental Assessment incorporating comments and necessary adjustments if needed.
- PPD RAD publishes Notice of Availability of the Final Environmental Assessment and FONSI in the Federal Register.
- Upon this finding, PPBP completes the permitting process and **issues a permit** 😊 allowing the removal of the biocontrol agent from containment facilities for release into the environment.
- APHIS Permitting issues additional permits as needed and approved for movement and release in individual states infested by the weed.

Field Release Petitions Submitted to APHIS



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# What's Been Permitted?

## Agents recently permitted by APHIS

Cape ivy, *Delairea odorata* (Patrick Moran, USDA-ARS)

– *Parafreutreta regalis* (stem gall fly) Permit issued in 2016





Cape ivy (*Delairea odorata*)  
along coastal California





# What's Been Permitted?

## Agents recently permitted by APHIS

Giant reed, *Arundo donax*

(John Goolsby and Patrick Moran, USDA-ARS)

– *Lasioptera donacis* (leaf mining fly), permit issued







***Arundo* along the Rio Grande River in Texas**

Photo by John Goolsby,  
USDA-ARS



# USDA-ARS Scientists working on *Arundo* biocontrol



John  
Goolsby

Patrick  
Moran

# *Lasioptera donacis*, Arundo leafminer



- Larvae feed in leafsheath channels
- Causes rapid leaf death and defoliation
- Defoliator needed to open plant canopy to allow for native vegetation to compete
- Adult fly places spores of saprophytic fungi (*Arthrinium arundinis*) on leafsheath to start infection
- *A. arundinis* found worldwide, Texas accession to be used for release on Rio Grande



# Arundo leafminer

Photos by John Goolsby, USDA-ARS



Fly larva feeds on leaf sheath causing defoliation



# What's on the Horizon?

Agents recently recommended for approval by TAG & USFWS



Hoary cress (*Lepidium draba*)  
*Aceria drabae* (gall mite)

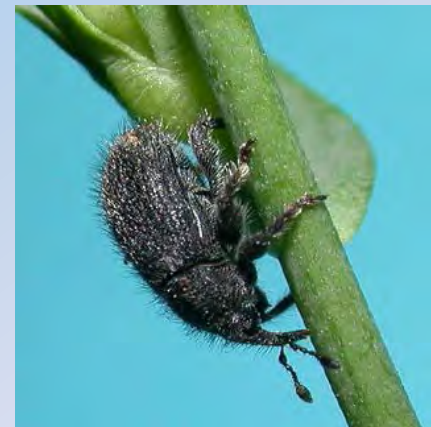


# What's on the Horizon?

Agents recently recommended for approval by TAG & USFWS



Yellow Toadflax  
(*Linaria vulgaris*)  
*Rhinusa pilosa* (gall weevil)





# What's on the Horizon?

## Agents under review by US Fish & Wildlife Service

- A psyllid species on Japanese knotweed (concurrence approved)
- A thrip species on gorse
- A root fly on invasive hawkweeds
- Two agents (a thrip and a calophyid (related to psyllids) species) on Brazillian peppertree (Florida)

# What's New for California?

## Accidental introductions into California

- Scotch broom, *Cytisus scoparius*
  - *Aceria genistae* (gall mite)
  - *Asphondylia pilosa* (flower bud gall fly)
  - *Bruchidius villosus* (seed beetle)
- Dalmatian toadflax, *Linaria genistifolia* ssp. *dalmatica*
  - *Mecinus janthiniformis* (stem weevil)
- Canada thistle, *Cirsium arvense*
  - *Larinus planus* (seed head weevil)
- Musk thistle, *Carduus nutans*
  - *Cheilosia corydon* (root & stem fly)

# Scotch broom natural enemy

*Aceria genistae* - broom gall mite



Photos from Eric Coombs, Oregon Dept. of Agriculture



Galls stunt growth and can result in plant mortality

# Scotch broom natural enemy

*Aceria genistae* - broom gall mite

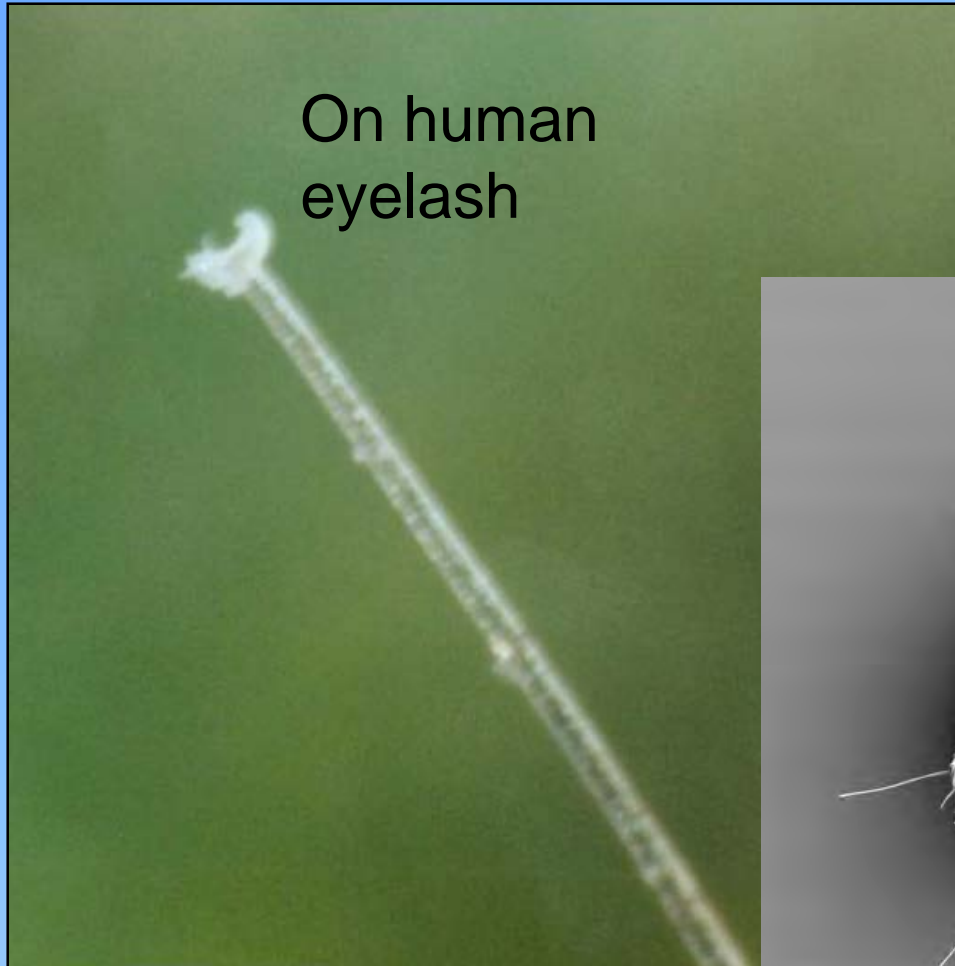
Photos from Eric Coombs, Oregon Dept. of Agriculture





# *Aceria salsolae* (Russian thistle mite)

On human  
eyelash



**scanning electron  
micrograph**



# Scotch broom natural enemy

*Aceria genistae* - broom gall mite



Photos provided by Jennifer Andreas, Washington State University