BIOLOGICAL CONTROL OF WEEDS

OREGON DEPARTMENT OF AGRICULTURE

NOXIOUS WEED CONTROL PROGRAM

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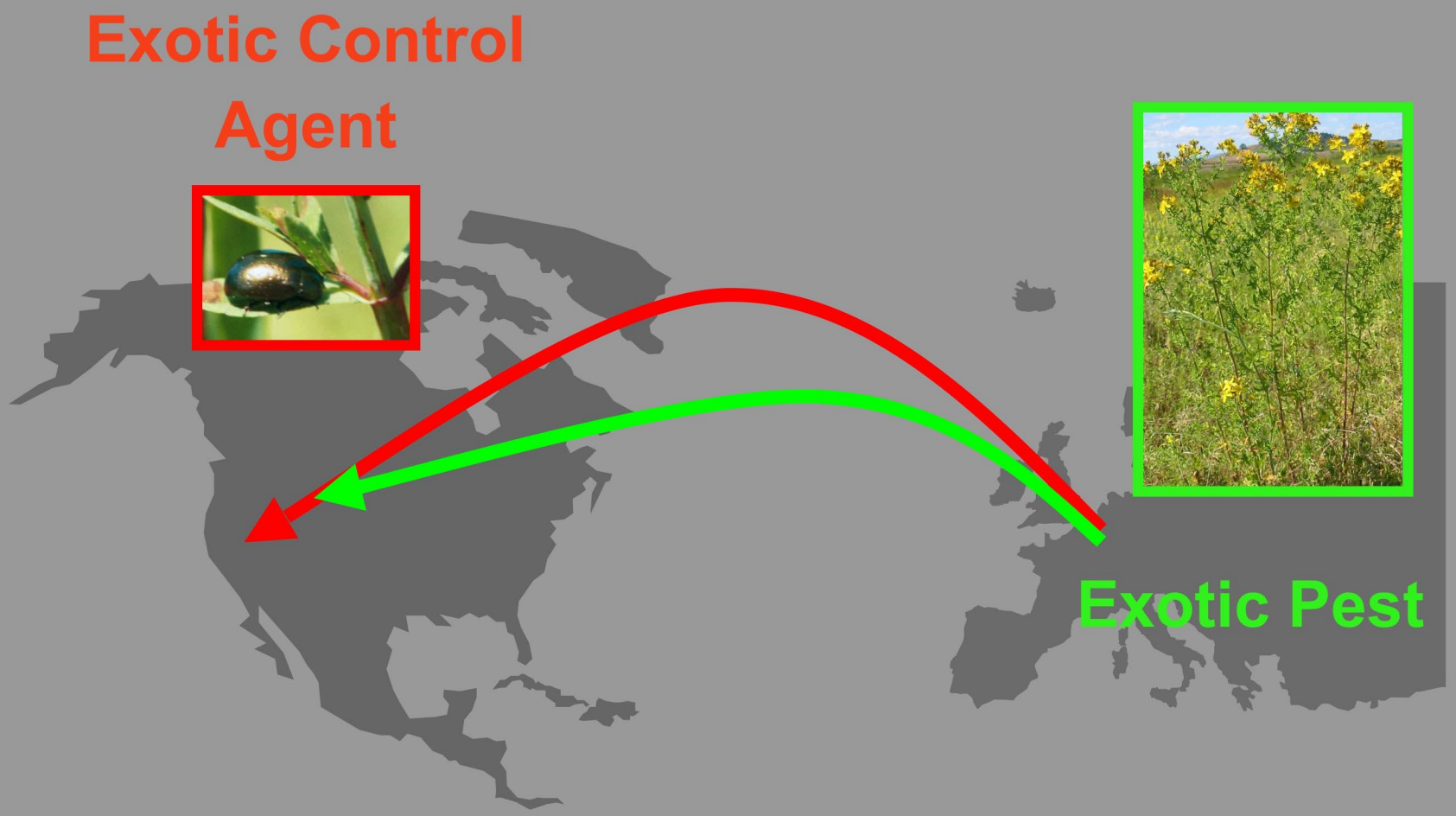
Oregon Department of Agriculture

BIOLOGICAL CONTROL OF WEEDS

What is classical biological control?

The purposeful introduction of selected natural enemies of a targeted weed.

Biological Control of Weeds



BIOLOGICAL CONTROL OF WEEDS

- **Foreign exploration** - search for natural enemies in target's homeland

BIOLOGICAL CONTROL OF WEEDS

- **Safety** - test prospective agents for host specificity Choice & No-choice testing

BIOLOGICAL CONTROL OF WEEDS

- **Documentation** - submit petition to TAG, EAs
- **Importation** - quarantine facilities, clean agents

BIOLOGICAL CONTROL OF WEEDS

BIOLOGICAL CONTROL OF WEEDS

How does biocontrol work?

By reducing the density and competitive ability the targeted weed.

Direct

Indirect

BIOLOGICAL CONTROL OF WEEDS

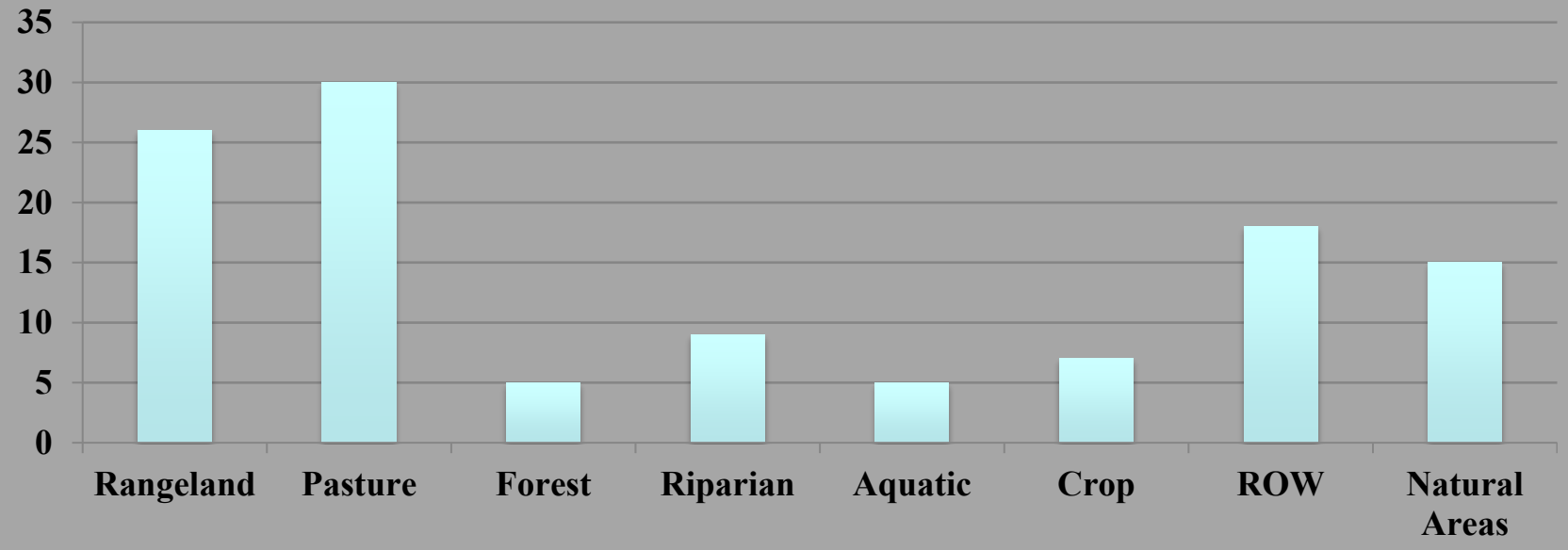
Who can do classical biological control?

At first, trained professionals, but later on, almost anyone can participate.

BIOLOGICAL CONTROL OF WEEDS

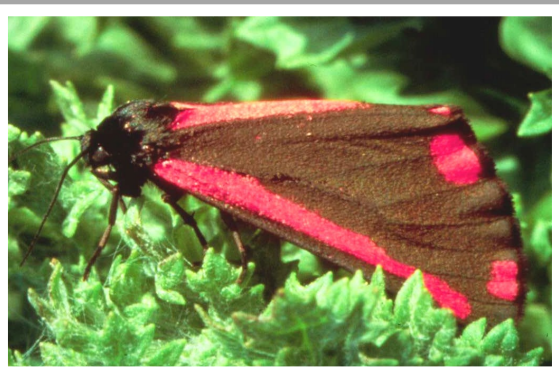
Where can we implement biocontrol?

Usually anywhere where the weeds will not be disturbed too much for at least 3 years.



BIOLOGICAL CONTROL OF WEEDS IN OREGON

- **Insects (71)**
  - beetles (41)
  - flies (15)
  - moths (14)
  - wasp (1)
- **Mites (3)**
- **Nematode (1)**
- **Pathogens (2)**



77 biocontrol agents since 1947

BIOLOGICAL CONTROL OF WEEDS
MONITORING

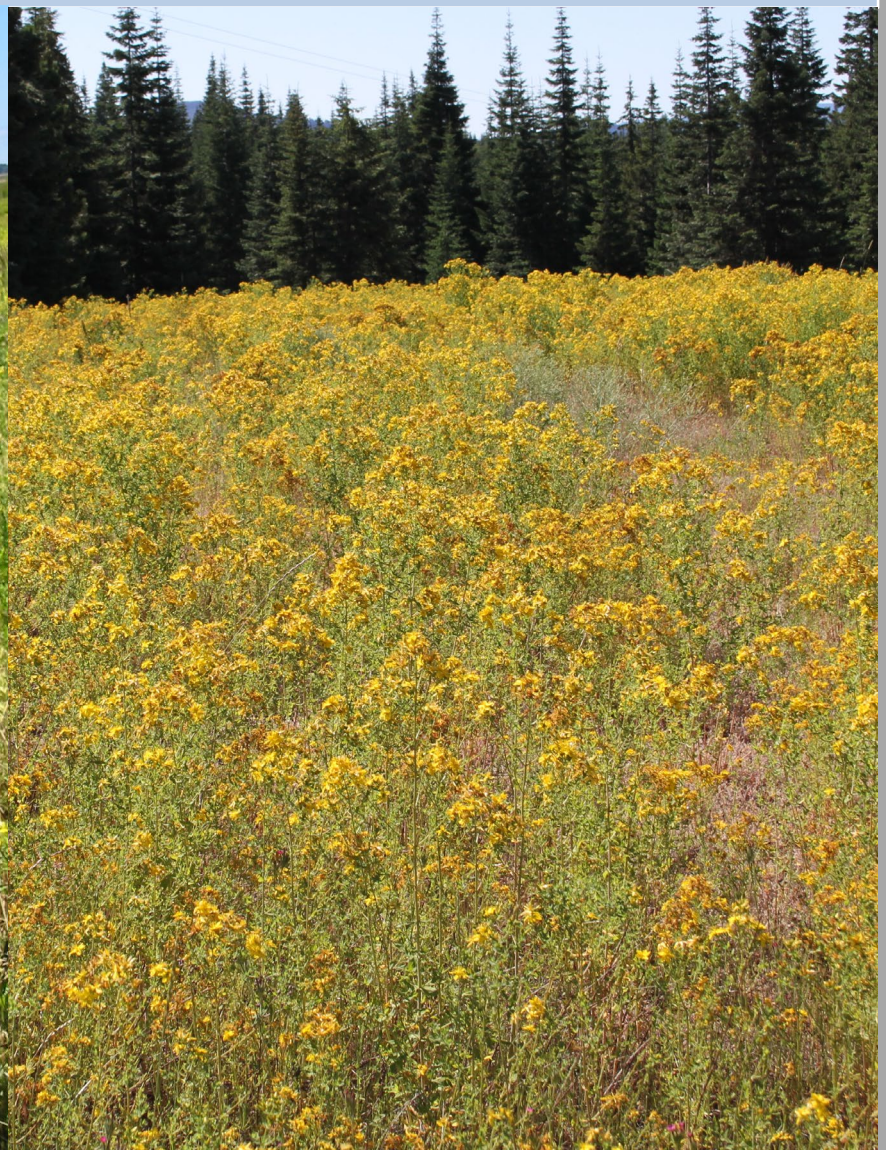
- Establishment
- Population build up (Abundance & Density)
- Spread
- Attack rate
- Damage level
- Distribution
- Impact on host
- Community changes
- Documentation

BIOLOGICAL CONTROL OF WEEDS
BENEFITS

- No harmful residues left in environment
- Host specific on target weed
- Self-sustaining populations
- Long-term control
- Attack is synchronized with target
- Economical on low value lands
- Searching ability to locate target
- Low rate of resistance to attack

BIOLOGICAL CONTROL OF ST. JOHNSWORT

Hypericum perforatum



BIOLOGICAL CONTROL OF

ST. JOHNSWORT

Chrysolina hyperici – leaf beetle

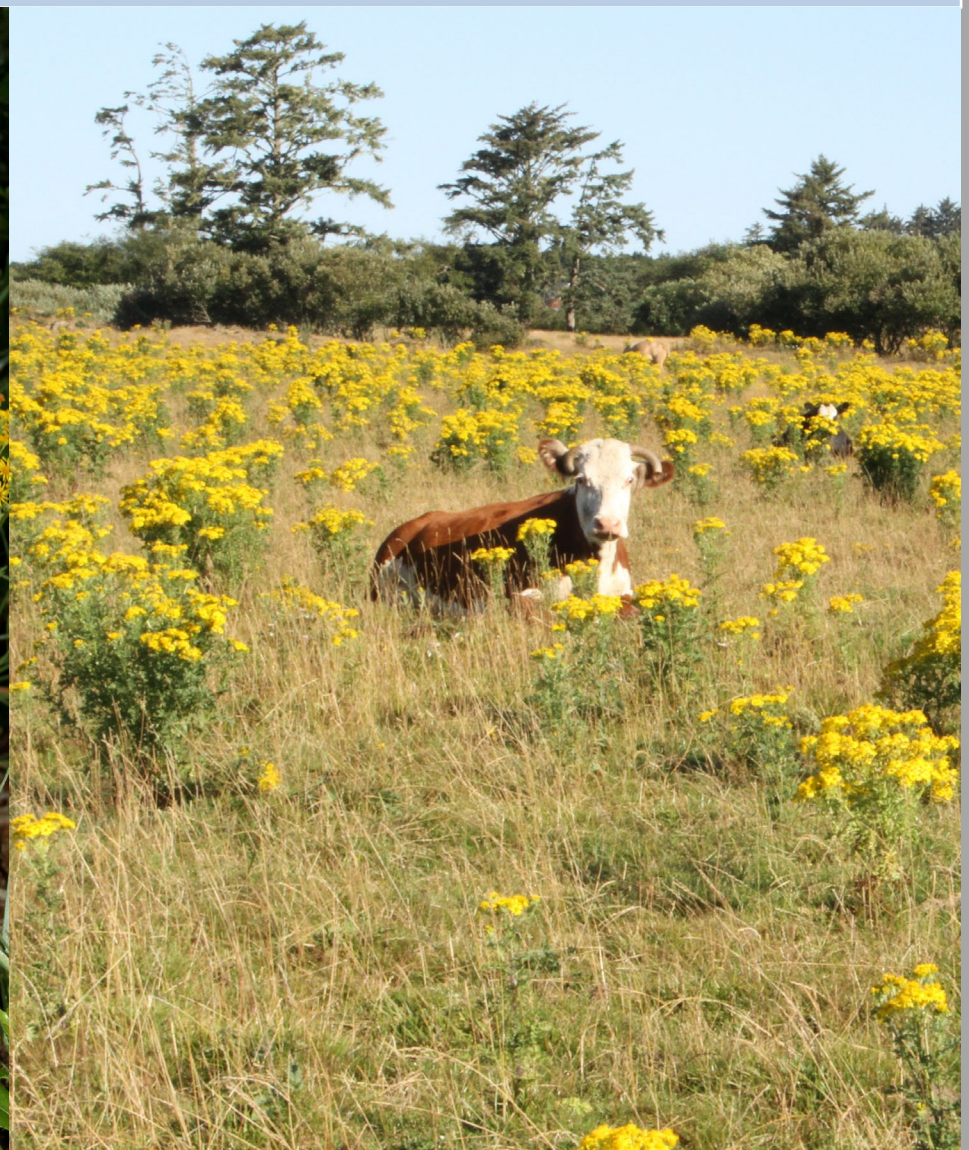
BIOLOGICAL CONTROL OF

ST. JOHNSWORT

Chrysolina quadrigemina – leaf beetle

BIOLOGICAL CONTROL OF TANSY RAGWORT

Senecio jacobaea = (Jacobea vulgaris)



BIOLOGICAL CONTROL OF

TANSY RAGWORT

Tyria jacobaeae – cinnabar moth

BIOLOGICAL CONTROL OF

TANSY RAGWORT

Longitarsus jacobaeae – flea beetle

BIOLOGICAL CONTROL OF
TANSY RAGWORT
Senecio jacobaea = (Jacobea vulgaris)

BIOLOGICAL CONTROL OF

TANSY RAGWORT

Longitarsus jacobaeae – flea beetle

BIOLOGICAL CONTROL OF TANSY RAGWORT

Longitarsus jacobaeae – flea beetle

BIOLOGICAL CONTROL OF MEADOW KNAPWEED

Centaurea pratensis (jacea x nigra)

BIOLOGICAL CONTROL OF MEADOW KNAPWEED

Centaurea repens (jacea x nigra)

BIOLOGICAL CONTROL OF

SPOTTED & MEADOW KNAPWEED

Larinus obtusus – seed head weevil

BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE

Lythrum salicaria

BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE

Lythrum salicaria

BIOLOGICAL CONTROL OF
PURPLE LOOSESTRIFE
Lythrum salicaria

BIOLOGICAL CONTROL OF

PURPLE LOOSESTRIFE

Galerucella calmariensis & pusilla leaf beetles

BIOLOGICAL CONTROL OF

PURPLE LOOSESTRIFE

Galerucella pusilla – leaf beetle

BIOLOGICAL CONTROL OF

PURPLE LOOSESTRIFE

Hylobius transversovittatus – root weevil

BIOLOGICAL CONTROL OF

PURPLE LOOSESTRIFE

Nanophyes marmoratus – seed capsule weevil

BIOLOGICAL CONTROL OF

PURPLE LOOSESTRIFE

Galerucella calmariensis & pusilla leaf beetles

BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE

Galerucella calmariensis & pusilla leaf beetles

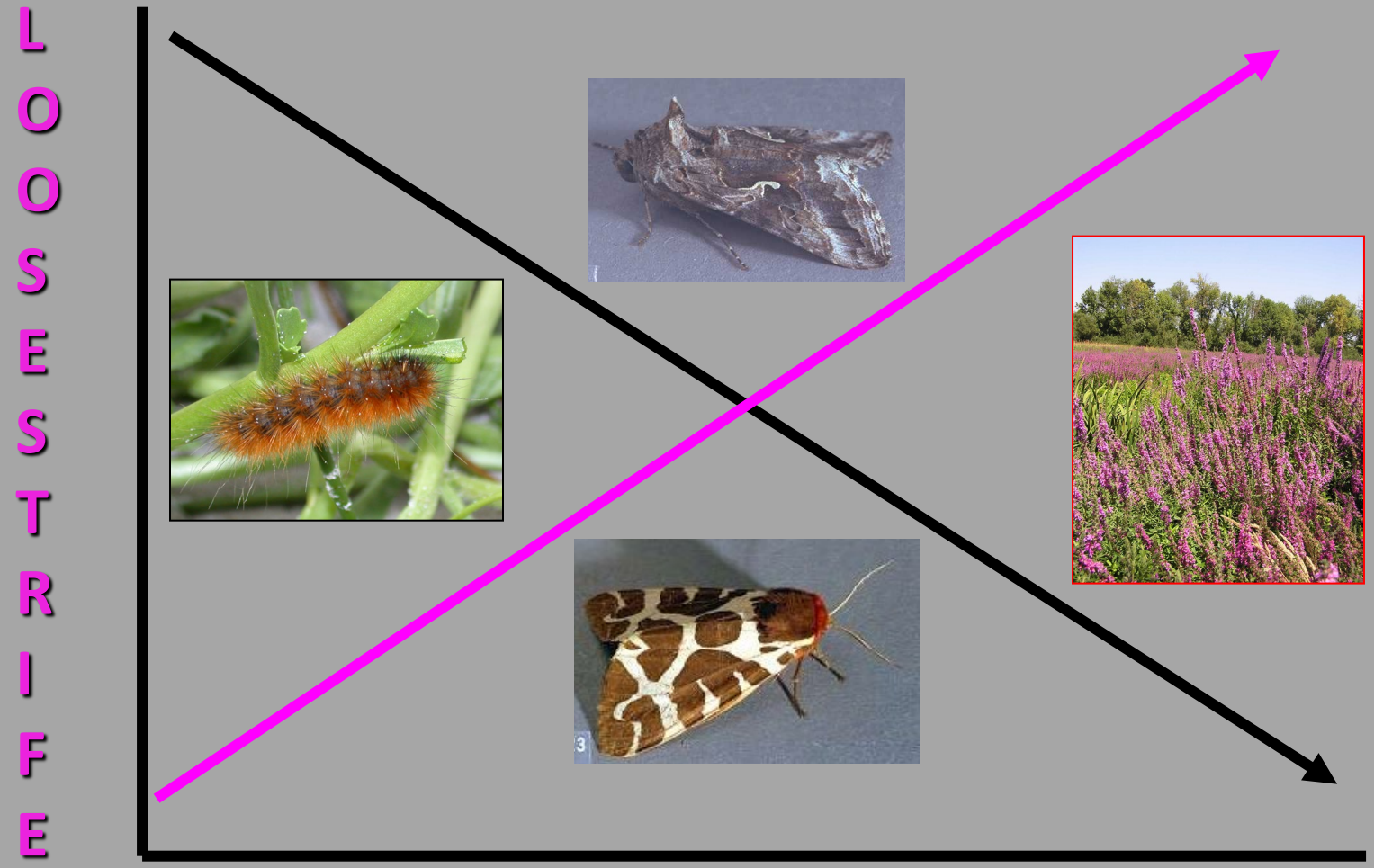
BIOLOGICAL CONTROL OF

PURPLE LOOSESTRIFE

Galerucella calmariensis & pusilla leaf beetles

BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE

Lythrum salicaria



BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE

Galerucella calmariensis

2007

Oaks Bottom

2015

Photos – M. Peters

BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE

Galerucella calmariensis

Oaks Bottom 2007

Photo – M. Peters

Timeline

Aug 7 5:18 PM Reports of GACA flying all over
Aug 8 Agencies notified, PDX, APHIS
Aug 9 History of site given – no problem before
Aug 10 News stations pick up story KPTV & ODA
APHIS responds to homeowners, ODA gets blame, “Perfect Storm”
Aug 13 Town hall forum agencies, die-off noticed
Aug 14 Beetles dying en masse
Aug 17 Few beetles observed, last complaint on crape myrtle, last news story
Aug 24 Monitoring ends

BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE

Galerucella calmariensis

Oaks Bottom – Salix, Polygonum, Solanum

BIOLOGICAL CONTROL OF

PURPLE LOOSESTRIFE

Galerucella calmariensis – nontarget impact

BIOLOGICAL CONTROL OF

PURPLE LOOSESTRIFE

Galerucella calmariensis - nontarget impacts


Hawthorne


Oak


Ranunculus


Rose


Trailing blackberry

BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE

Galerucella calmariensis

Oaks Bottom

BIOLOGICAL CONTROL OF
RUSH SKELETONWEED
Chondrilla juncea

BIOLOGICAL CONTROL OF

RUSH SKELETONWEED

Cystiphora schmidti – gall midge

BIOLOGICAL CONTROL OF

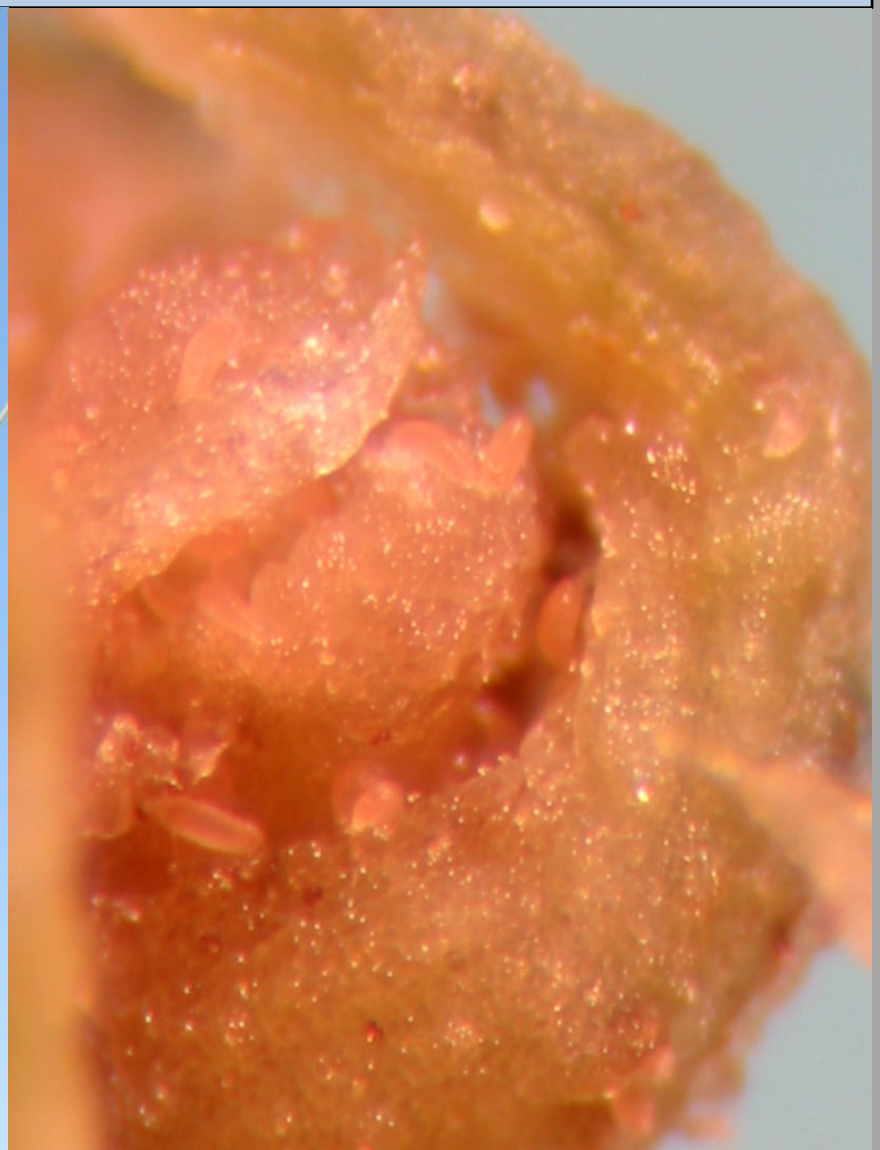
RUSH SKELETONWEED

Eriophyes chondrillae – gall mite

BIOLOGICAL CONTROL OF

RUSH SKELETONWEED

Eriophyes chondrillae – gall mite



BIOLOGICAL CONTROL OF

RUSH SKELETONWEED

Puccinia chondrillina – rust fungus

BIOLOGICAL CONTROL OF

RUSH SKELETONWEED

Bradyrrhoa gilveolella – root-boring moth

BIOLOGICAL CONTROL OF

RUSH SKELETONWEED

Bradyrrhoa gilveolella – root-boring moth

BIOLOGICAL CONTROL OF

RUSH SKELETONWEED

Bradyrrhoa gilveolella – root-boring moth

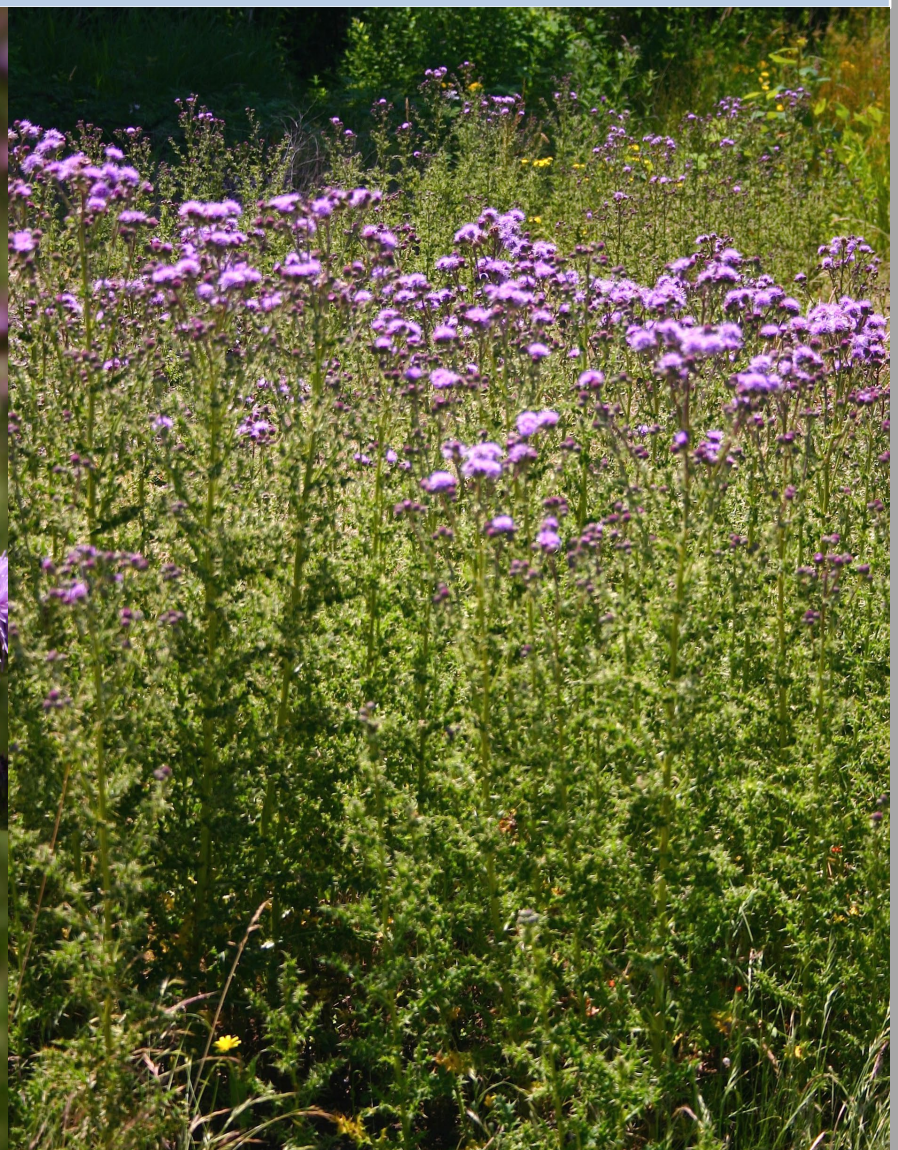
BIOLOGICAL CONTROL OF

RUSH SKELETONWEED

Bradyrrhoa gilveolella – root-boring moth

BIOLOGICAL CONTROL OF CANADA THISTLE

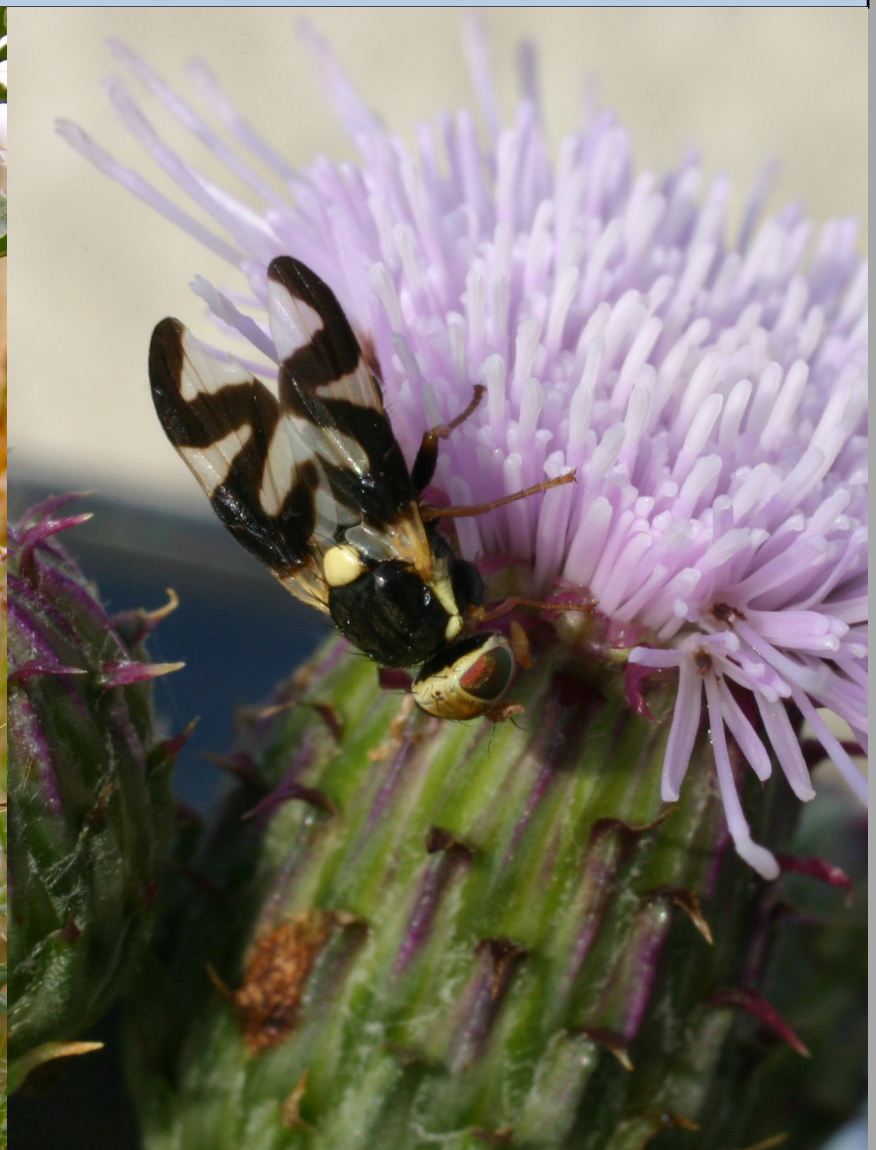
Cirsium arvensis



BIOLOGICAL CONTROL OF

CANADA THISTLE

Urophora cardui – stem gall fly



BIOLOGICAL CONTROL OF SCOTCH BROOM

Cytisus scoparius

BIOLOGICAL CONTROL OF

SCOTCH BROOM

Exapion fuscirostre – seed weevil

BIOLOGICAL CONTROL OF

SCOTCH BROOM

Exapion fuscirostre – seed weevil

BIOLOGICAL CONTROL OF

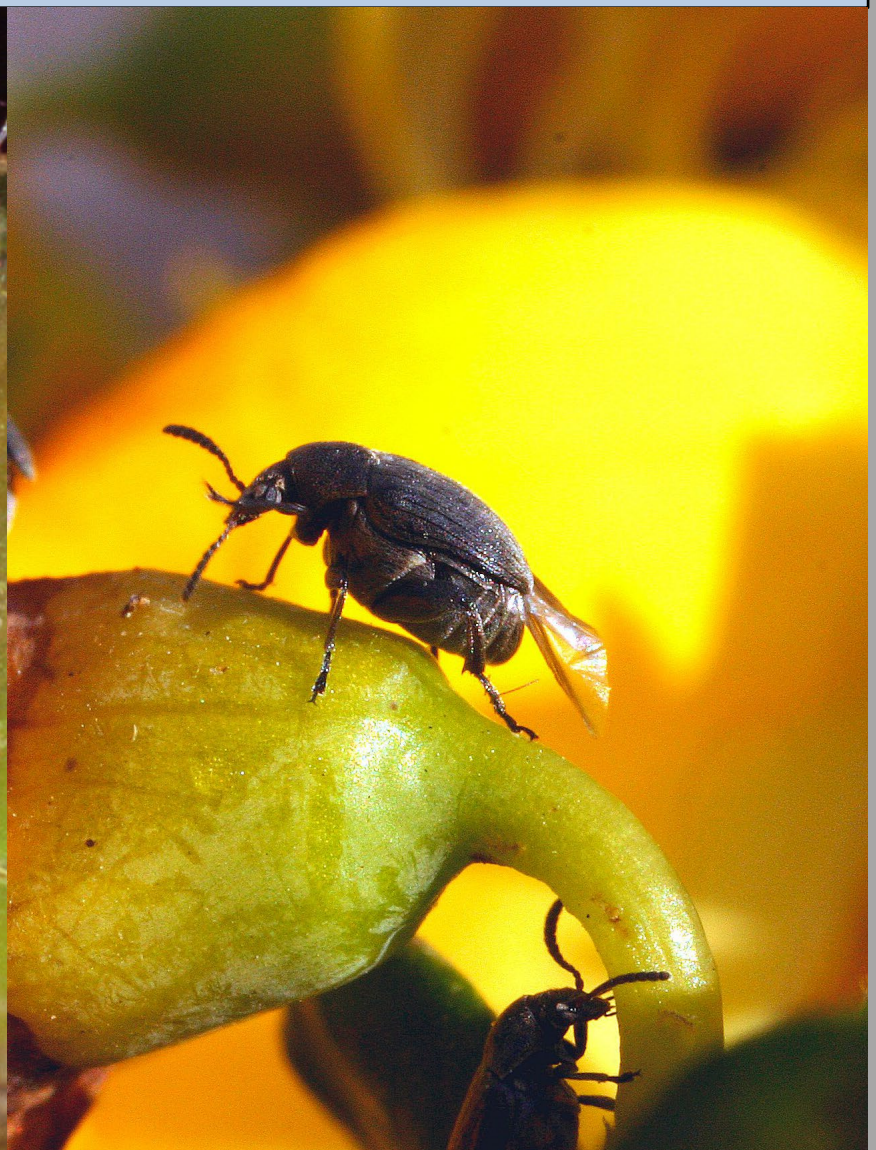
SCOTCH BROOM

Bruchidius villosus – seed beetle

BIOLOGICAL CONTROL OF

SCOTCH BROOM

Bruchidius villosus – seed beetle



BIOLOGICAL CONTROL OF

SCOTCH BROOM

Bruchidius villosus – seed beetle

BIOLOGICAL CONTROL OF

SCOTCH BROOM

Aceria genistae – bud gall mite

BIOLOGICAL CONTROL OF

SCOTCH BROOM

Aceria genistae – bud gall mite

BIOLOGICAL CONTROL OF

SCOTCH BROOM

Unknown pathogen- Phytoplasma?

BIOLOGICAL CONTROL OF

SCOTCH BROOM

Selenophoma juncea – pathogen

BIOLOGICAL CONTROL OF

SCOTCH BROOM

Selenophoma juncea – pathogen

BIOLOGICAL CONTROL OF WEEDS IN OREGON

Pacific Northwest Weed Management Handbook

http://pnwhandbooks.org/weed/

Pacific Northwest Weed Management Handbook

login

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All PNW Handbooks

Weed Management Handbook

Pacific Northwest Weed Management Handbook

This handbook is designed as a quick and ready reference for weed control practices and herbicides used in various cropping systems or sites in Idaho, Oregon, and Washington.

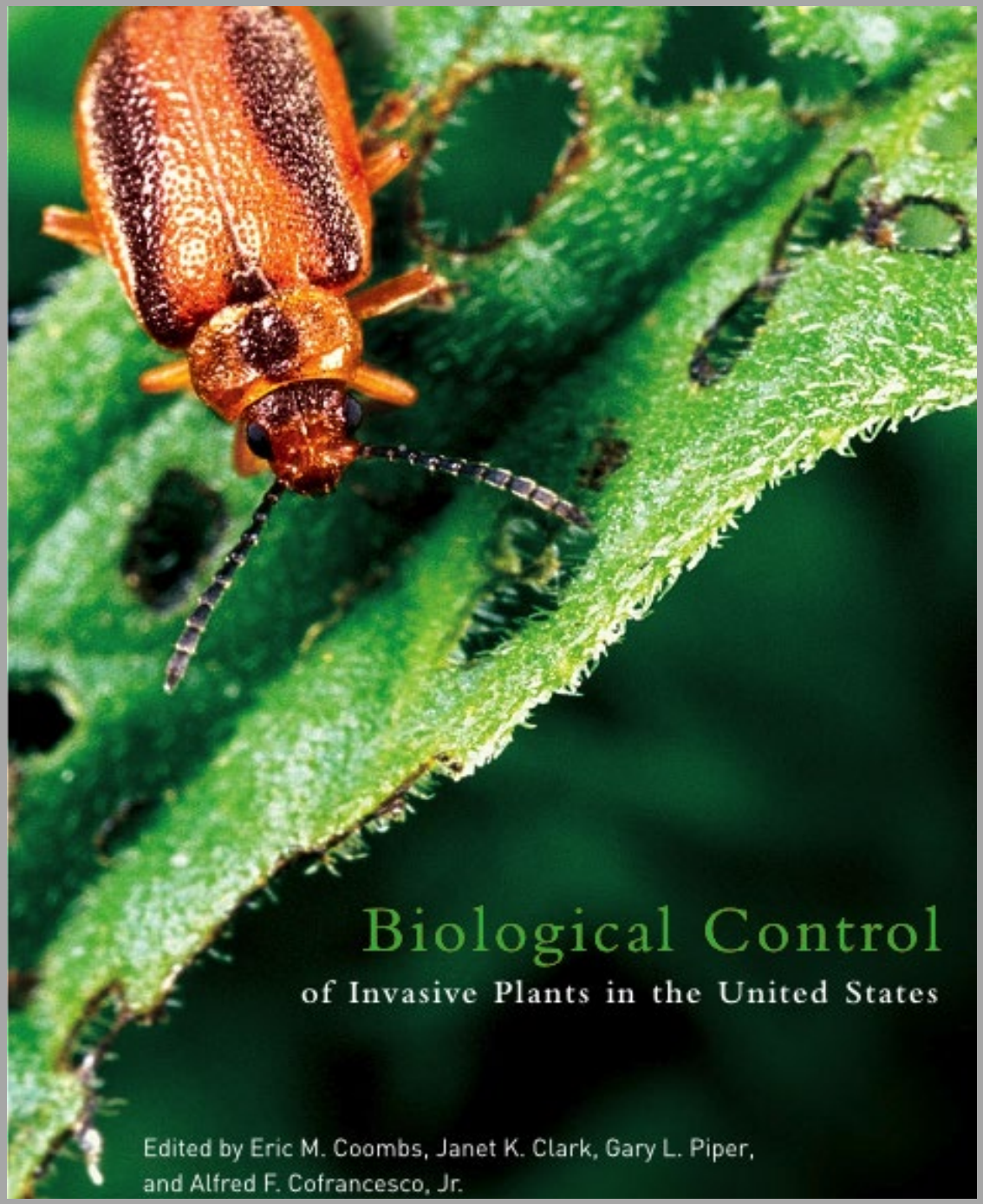
This handbook will be useful to Extension agents, company field representatives, commercial spray applicators and consultants, herbicide dealers, teachers, and producers.

Recommendations are based on research results from the Agricultural Experiment Stations and Extension Services of Oregon, Idaho, and Washington. A few suggestions are included from research conducted in other states, and from U.S. Department of Agriculture research centers. In all cases, authors make every effort to list only registered herbicides, and to ensure that the information conforms to product labels and company recommendations.

Downy brome (*Bromus tectorum*) in eastern Oregon wheat. Downy brome is one of the most competitive and difficult-to-conrol grass weeds in eastern Oregon winter wheat production systems.
Photo by Andy Hulting, © Oregon State University.

Revision and Availability The handbook is updated quarterly. Individual sections are revised once each year; revision dates are listed at the start of each section. Most sections are also available as PDF documents on the weed handbook website: http://pnwhandbooks.org/weed

Some sections may include additional online content, such as photos and links to related websites, publications, and other resources.



To order:
Univ. of Arizona Press

Phone: 1-800-426-3797

$45.00 + S&H

In this book, leading experts review the discipline of biological control of invasive terrestrial and aquatic plants.
Topics addressed include ecology, safety testing, nontarget impacts, and the processes of identifying, introducing, distributing, and monitoring biological control agents.

This book also provides information about 39 target plants in the continental United States and 94 agents, including their origin, biology, habitat, impacts, and distribution.
The book concludes with information about invasive plants targeted for biological control in the future.

BIOLOGICAL CONTROL OF NOXIOUS WEEDS IN OREGON

A guide to common biological control agents found in Oregon.

Oregon Department of Agriculture

WHAT IS BIOLOGICAL WEED CONTROL?

Invasive noxious weeds in Oregon cost millions of dollars in economic and environmental damage. Biological control is a tool vegetation managers employ to help naturally suppress weed infestations. This pamphlet shows many of the common biological agents you may encounter in Oregon.

Classical biological control is the use of selected natural enemies to control targeted weeds. Most of our worst noxious weeds originated from other continents. Prospective biocontrol agents are thoroughly tested to ensure they will be safe to release in North America. Once approved, they are released at nursery sites where they can establish resident populations. Surplus bioagents are later harvested and released at other infestations throughout Oregon. It may take several years for their populations to build up and start impacting the target weeds.

Biocontrol agents rarely control entire infestations. The goal is to weaken weeds so desirable vegetation can compete and suppress the weeds below an economically or environmentally damaging level. Biocontrol works best when integrated with land management practices that improve desirable competitive vegetation. Even after control, some weed infestations may rebound. Generally resident biocontrol agent populations regain control after several years. Biological control requires a long-term commitment to weed management and may not be suitable at all infestations.

Biocontrol agents affect weeds by either directly impacting plant tissues through their removal or destruction, or indirectly by causing galls, which interfere with tissue functions and stress the plants.

Benefits of biological control include: a host specific to target weed, self-perpetuating populations, synchronization with target weed lifecycle, ability to locate host plants in variable environments, and economic feasibility on low-value lands.
Some of the disadvantages include: slow rate of impact, control dependency on minimum weed density, fluctuating availability of agents, and limited efficacy in variable environments.

It is important to make sure the correct species of biocontrol agents are released, to use the most effective species, and to document the release and establishment of weed biocontrol agents.

Since 1947, 77 species of biocontrol agents have been released in Oregon against 32 species of targeted weeds. A total of 67 species are established. The majority of the bioagents are insects (71), three mites, one nematode, and two pathogens. Successful projects can generate 15:1 benefit to cost ratios. There are a number of non-approved natural enemies found some weeds. Biocontrol agents are listed here under host weed, type of agent, and scientific name.

Generally, the Oregon Department of Agriculture (ODA), the USDA Animal Plant Health Inspection Service (APHIS), and cooperators can provide needed biocontrol agents at no cost. Whenever approved biocontrol agents are shipped across state lines, a PPQ 526 permit from APHIS is required. Parties interested in implementing biocontrol are encouraged to contact ODA or APHIS to determine the availability and need for biocontrol agents of specific weeds.

NONTARGET IMPACTS

Most weed biocontrol agents are safe to use throughout Oregon. However, the thistle seedhead weevil *Rhinocyllus conicus* (see below) was found to attack native thistles a decade after its introduction in 1979. It is therefore not recommended for use as a biocontrol agent of thistles. ODA curtailed redistribution of this weevil in 1989 due to its impact on native thistles. USDA APHIS restricted interstate movement of the weevil in 2000. Current protocols for host specificity testing would have prevented the introduction of this weevil. The weevil is widespread and commonly found on bull, Canada, Italian, milk, musk, and slenderflower thistles. It has however, significantly controlled weedy thistles at various locations in Oregon.

Adult weevil and egg sites (brown bumps) on thistle bracts (R).

KEY TO BIOCONTROL AGENT STATUS

The following general information is provided for each biocontrol agent.

YEAR: Year of introduction.

DISTRIBUTION: Distribution of agent in host infested counties.
Widespread >50% Limited <50%

ATTACK RATE: Percent of plants attacked.
Heavy >70% Medium >30% Light >10% Slight <1%

CONTROL: Observed reduction of weed density or seed production.
Poor little change <10% Fair noticeable change >10%
Good significant control <90% Excellent >90% control

COLLECTABILITY: Availability of agents for redistribution.
Mass—available for mass collection.
Limited—available in limited numbers or difficult to collect.
N/A—not available at this time.

RELEASE AMOUNT: Recommended minimum number to establish a new colony.

TIMING: Optimum time of year to redistribute.

LIFE STAGE: Life stage of biocontrol agent best suited for collection and establishment.

METHOD: Preferred method to collect agents from well-established populations.
Sweep net—heavy duty canvas net to dislodge agents from vegetation, can be used in conjunction with a racquet.
Aerial net—lightweight net for fragile flying insects.
Aspirate—special aspirator to suck insects into a vial.
Beating sheet—knock insects of plants with a racquet onto canvas sheet and collect with aspirator.
Hand pick—collect by hand.
Light trap—UV light to attract night flying insects to white sheet or funnel trap.
Vacuum—motorized vacuum to suck insects from plants.
Harvest—collect infested plant materials (i.e. galls, seed heads, roots which can be released or rear agents out).

DALMATIAN TOADFLAX
Linaria dalmatica

DALMATIAN TOADFLAX STEM WEEVIL
Mecinus janthiniformis

Year: 2001 Distribution: Widespread
Attack rate: Heavy Control: Excellent
Collectability: Mass Release No. 100
Timing: May–Jun Method: Sweep net/racquet
Stage: Adult Comment: Stand reductions at many sites, a sibling species *M. janthinus* attacks yellow toadflax.

FIELD BINDWEED
Convolvulus arvense

FIELD BINDWEED GALL MITE
Aceria malherbae

Year: 1999
Distribution: Widespread
Attack rate: Heavy
Control: Good
Collectability: Mass
Release No. 1000
Timing: Jun–Sep
Method: Harvest
Stage: All
Comment: Mostly in Northeastern Oregon, use about one sandwich bag of infested plant material.

FIELD BINDWEED MOTH
Tyta luctuosa

Year: 1998
Distribution: Limited
Attack rate: Light Control: Poor
Collectability: Limited
Release No. 50
Timing: Jun–Sept
Method: Aerial net Stage: Adult
Comment: Flush adults and sweep net, one to two adults per vial. Mostly in Willamette Valley.

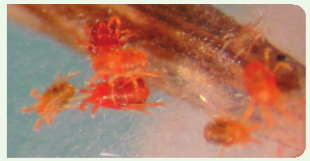
GORSE
Ulex europaeus

GORSE SEED WEEVIL
Exapion ulicis

Year: 1956 Distribution: Widespread
Attack rate: Heavy Control: Good
Collectability: Mass Release No. 100
Timing: Apr–May Method: Sweep net/racquet
Stage: Adult Comment: No need for redistribution.

GORSE SPIDER MITE
Tetranychus lintearius

Year: 1994
Distribution: Widespread
Attack rate: Light
Control: Poor
Collectability: Limited
Release No. 500
Timing: Aug–Sep
Method: Harvest infested plant material
Stage: All
Comment: Ineffective due to predatory mite.



FOR MORE INFORMATION

Oregon Department of Agriculture (ODA)
Noxious Weed Control Program
635 Capitol St. NE
Salem, OR 97301
www.oregon.gov/ODA
(503) 986-4621

ODA biocontrol projects
http://go.usa.gov/39rkG

Biocontrol release form
http://go.usa.gov/39rkz

USDA APHIS PPQ
Airport Business Center
6135 NE 80th Ave. Suite A-5
Portland, OR 97218
(503) 326-2814

USDA APHIS PPQ permit
http://go.usa.gov/39r8W

Information compiled by:
Eric M. Coombs, Oregon Department of Agriculture; Wyatt Williams, Oregon Department of Forestry; and Colin Park, United States Department of Agriculture, Animal Plant Health Inspection Service.

Created: June 2015

DIFFUSE KNAPWEED
Centaurea diffusa

MEADOW KNAPWEED
Centaurea jacea x nigra = C. moncktonii

SPOTTED KNAPWEED
Centaurea stoebe = C. maculata

SULFUR KNAPWEED ROOT MOTH
Agapeta zoegana

Year: 1987
Distribution: Widespread
Attack rate: Heavy
Control: Good
Collectability: Limited
Release No. 50–100
Timing: July
Method: Light trap Stage: Adult
Comment: Hard to collect in sufficient number.

BROAD-NOSED KNAPWEED SEED HEAD WEEVIL
Bangasternus fausti

Year: 1989
Distribution: Widespread
Attack rate: Heavy
Control: Good
Collectability: Mass
Release No. 100
Timing: Jun–Jul
Method: Sweep net/racquet Stage: Adult
Comment: Best when flowers are in bud stage.

KNAPWEED PEACOCK SEED FLY
Chaetorellia acrolophi

Year: 1993
Distribution: Limited
Attack rate: Light Control: Fair
Collectability: Limited
Release No. 100 Timing: Jun–Jul
Method: Aerial net Stage: Adult
Comment: Gently sweep during bud stage, aspirate from net, best at moister sites.

KNAPWEED ROOT WEEVIL
Cyphodeonus achates

Year: 1993
Distribution: Limited
Attack rate: Heavy
Control: Fair
Collectability: Mass
Release No. 50–100
Timing: Aug–Sept
Method: Hand pick
Stage: Adult
Comment: Collect adults under rosettes, disperse upon release.

LESSER KNAPWEED FLOWER WEEVIL
Larinus minutus

Year: 1992
Distribution: Widespread
Attack rate: Heavy
Control: Excellent
Collectability: Mass
Release No. 100
Timing: Jun–Jul Method: Sweep net/racquet
Stage: Adult Comment: Best at 20% bloom, best control on diffuse knapweed.

BLUNT KNAPWEED FLOWER WEEVIL
Larinus obtusus

Year: 1942
Distribution: Widespread
Attack rate: Heavy
Control: Excellent
Collectability: Mass
Release No. 100
Timing: Jun–Jul
Method: Sweep net/racquet
Stage: Adult
Comment: Best at 20% bloom, abundant on meadow knapweed.

KNAPWEED SEED HEAD MOTH
Metzneria paucipunctella

Year: 1981
Distribution: Widespread
Attack rate: Light Control: Fair
Collectability: Limited
Release No. 200
Timing: March
Method: Harvest seed heads
Stage: Larva/pupa
Comment: Displaced by seed head weevils, ineffective, parasitized.

KNAPWEED ROOT BEETLE
Sphenoptera jugoslavica

Year: 1980
Distribution: Widespread
Attack rate: Heavy
Control: Fair
Collectability: Limited
Release No. 100
Timing: Jun–Jul Method: Sweep net Stage: Adult
Comment: Low density, hard to collect, larva most commonly encountered.

GREEN KNAPWEED SEED FLY
Terellia virens

Year: 1993
Distribution: Limited
Attack rate: Medium
Control: Good
Collectability: Limited
Release No. 100
Timing: Jun–Jul Method: Aerial net Stage: Adult
Comment: Gently sweep during bud stage, aspirate from net, best at moister sites.

BANDED KNAPWEED SEED GALL FLY
Urophora affinis

Year: 1975 Distribution: Widespread
Attack rate: Heavy Control: Good
Collectability: Mass Release No. 100
Timing: Jun–Aug Method: Aerial net
Stage: Adult Comment: Little need for redistribution, produces hard gall.

UV KNAPWEED SEED GALL FLY
Urophora quadrifasciata

Year: 1975
Distribution: Widespread
Attack rate: Heavy
Control: Good
Collectability: Mass
Release No. 100
Timing: Jun–Aug
Method: Aerial net
Stage: Adult
Comment: Little need for redistribution, produces soft gall.

LEAFY SPURGE
Euphorbia esula

BLACK LEAFY SPURGE FLEA BEETLE
Aphthona lacertosa

Year: 1993
Distribution: Widespread
Attack rate: Heavy
Control: Excellent
Collectability: Mass
Release No. 500
Timing: Jun–Jul
Method: Sweep net
Stage: Adult
Comment: Mixed with similar species *A. czwalinae*, best at wetter sites.

BLACK-DOT LEAFY SPURGE BEETLE
Aphthona nigriscutis

Year: 1989
Distribution: Widespread
Attack rate: Heavy
Control: Excellent
Collectability: Mass
Release No. 500
Timing: Jun–Jul
Method: Sweep net
Stage: Adult
Comment: Best at dry site, often mixed with other species *A. cyparissiae* and *A. fava*.

REDHEADED LEAFY SPURGE BORER
Oberea erythrocephala

Year: 1982
Distribution: Widespread
Attack rate: Heavy
Control: Good
Collectability: Mass
Release No. 100
Timing: Jun–Jul
Method: Sweep net
Stage: Adult
Comment: Look for dying upper stems, attacks larger plants.


THANK YOU !