Invasive Species Management in the National Wildlife Refuge System

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Kudzu
Cache River, NWR

What IS an Invasive Species?

"Invasive Species"

"…an alien [*non-native*] **species whose introduction does or is likely to cause <u>economic</u> or <u>environmental</u> harm or harm to <u>human health</u>."**

(E.O. 13112, 3 February 1999)

HARM to….

- Economy
- Environment
- Human Health

Old World Climbing Fern
Near Hobe Sound NWR

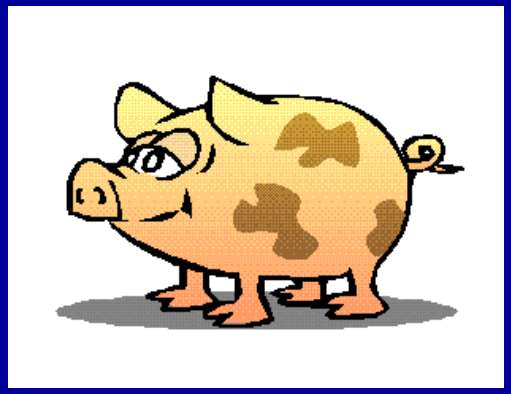
IMPACTS OF INVASIVE SPECIES ON THE NATIONAL WILDLIFE REFUGE SYSTEM

RESOURCE IMPACTS

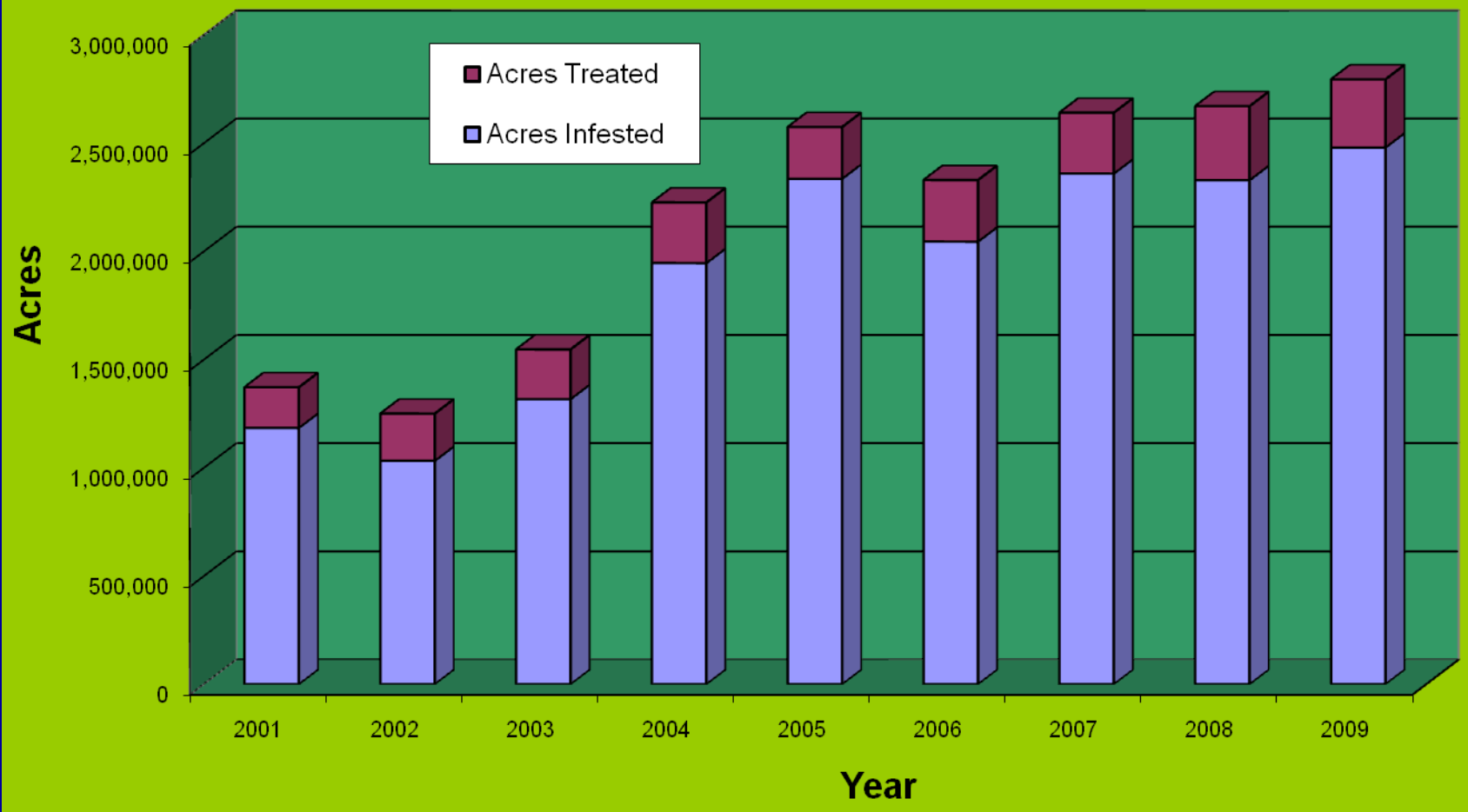
On-The-Ground Impacts:

2.48 million acres of refuge lands are infested with invasive plants

There are **3,894** invasive animal populations on refuge lands



INVASIVE PLANTS ON REFUGES

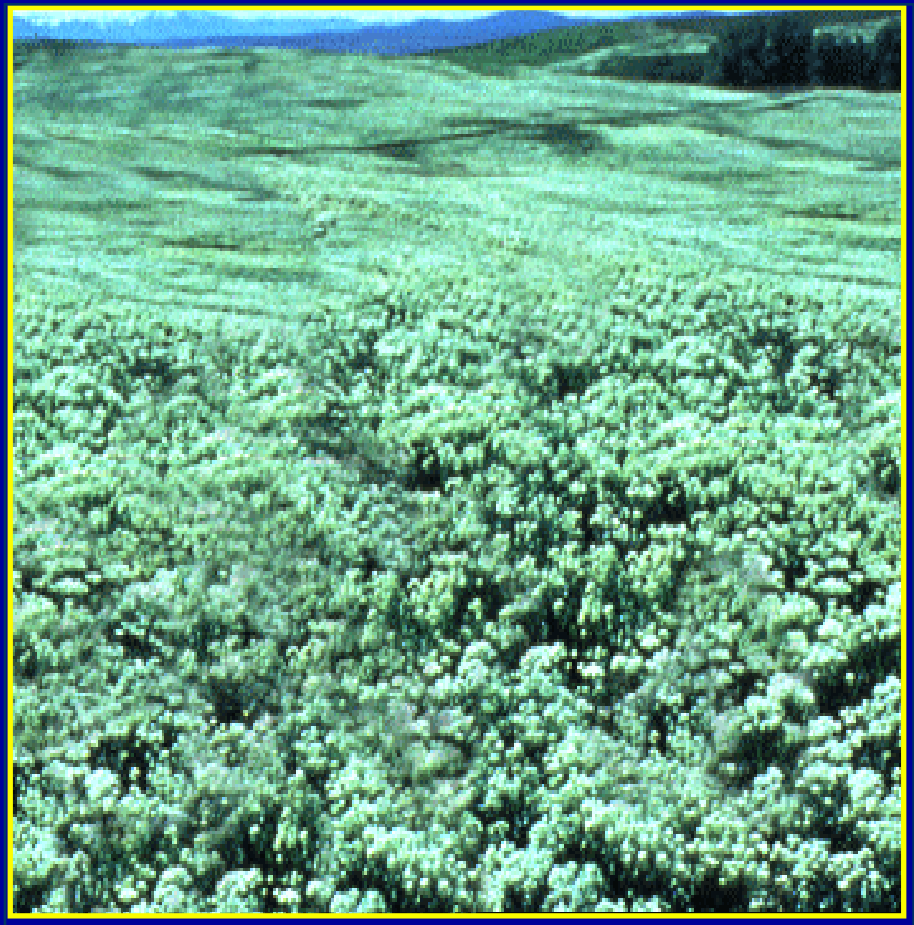


Find the albatross
in the Verbesina!
Midway NWR

Phragmites, salt cedar, & spotted knapweed

WILDFIRE

INVASIVE PLANT INFESTATION



Hoary Cress in Oregon

WHICH IS WORSE FOR THE ECOSYSTEM?

Giant Salvinia
Caddo Lake NWR

RESOURCE IMPACTS

General Management Impacts:

- Sept. 2008 GAO Report on Refuge Spending from 2002 – 2007:
  - Invasive Plants – Number One Threat to Wildlife Habitat
  - Invasive Plants – Number One Area of Increased Spending

Walrus Island, Pribilof Group

Before Foxes

After Foxes

Rat Island, Alaska Maritime NWR

Constrictor Snakes

Where did they come from?

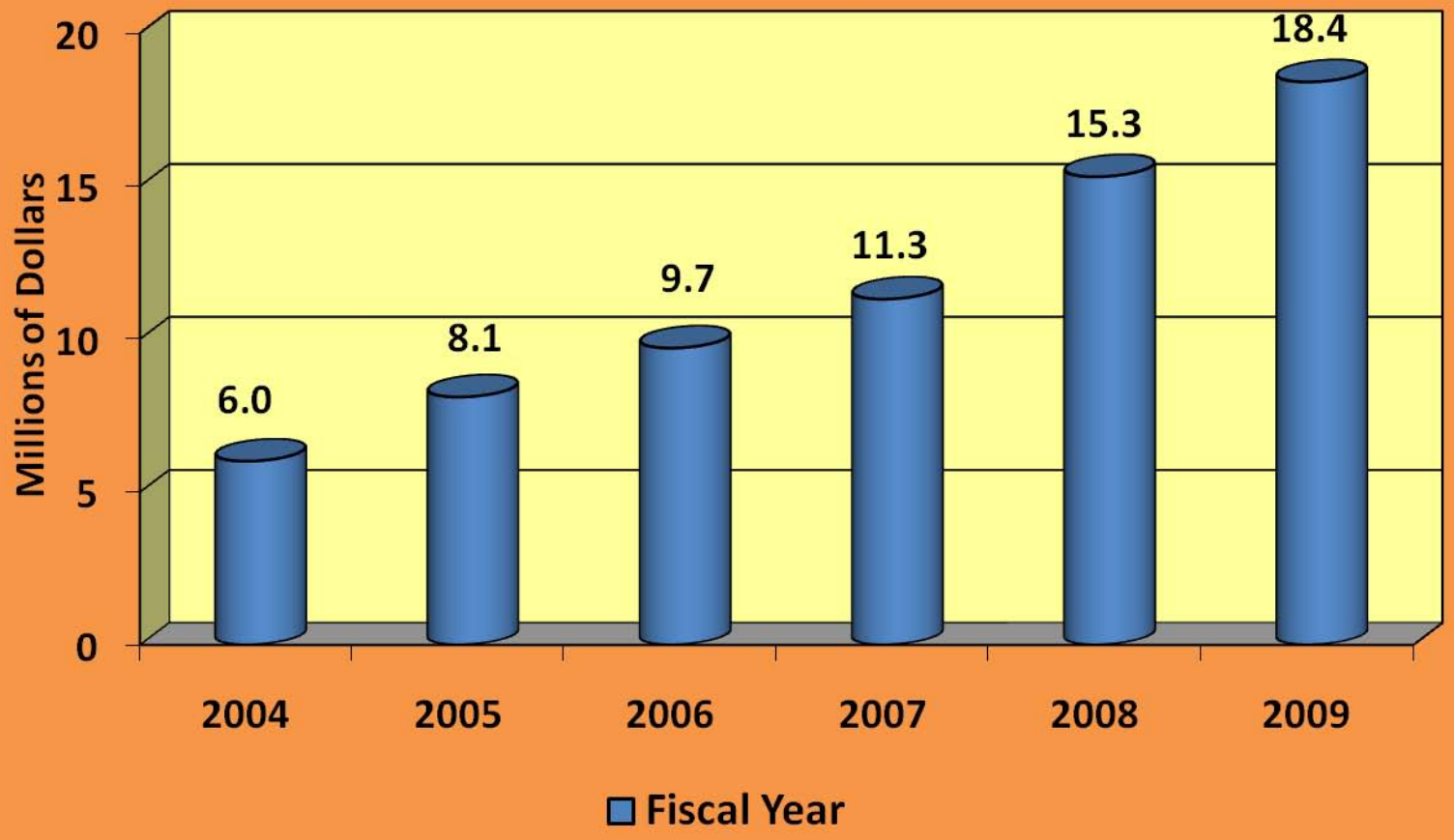
Release of unwanted pets!

Feral cats are major predators of wild birds and small mammals

There are approximately 100 million domestic and free roaming cats in the United States.

Combined, these cats kill billions of small mammals and millions of wild birds each year.

Cost of Invasive Species Management



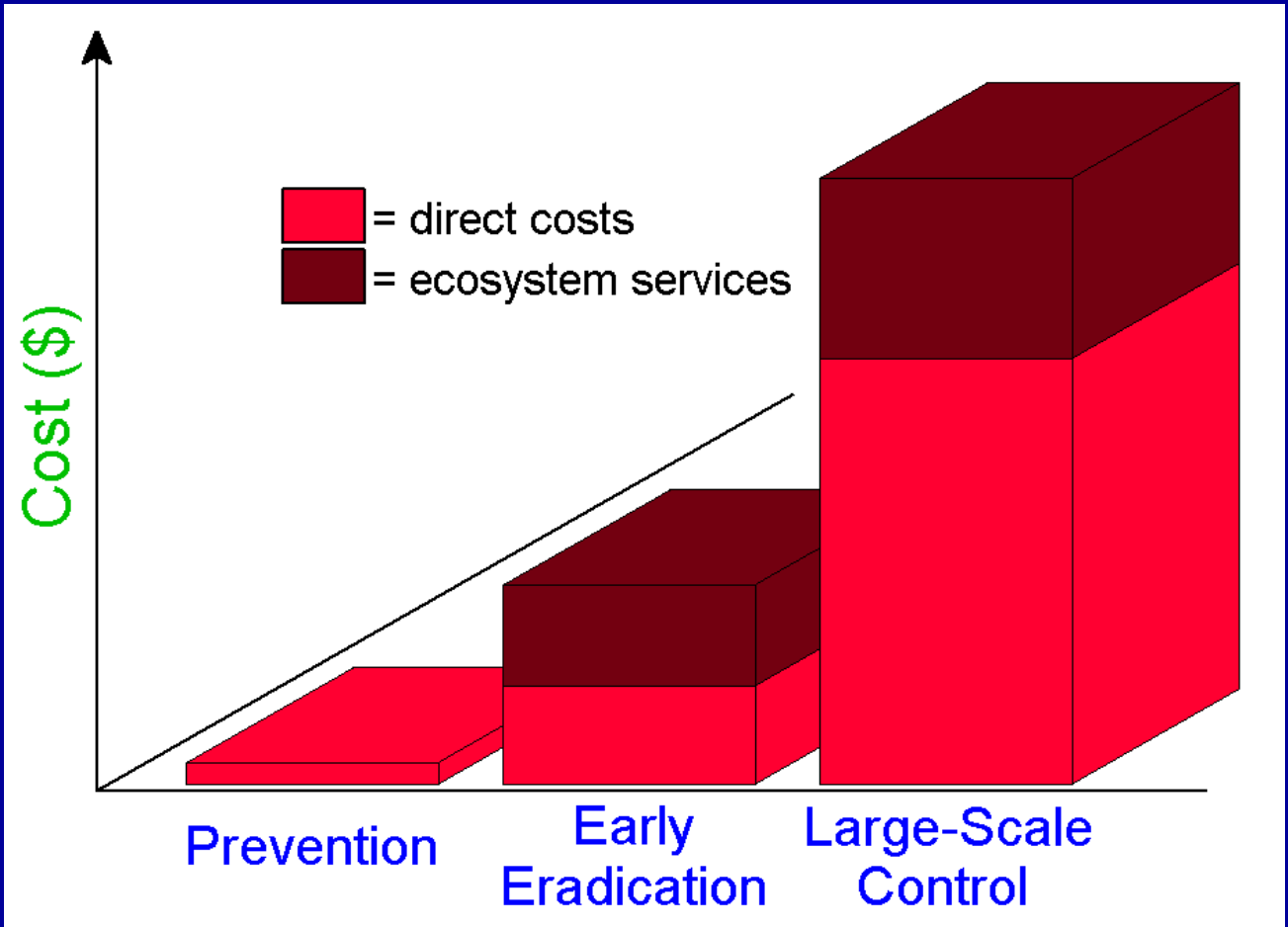
Strategies & Successes In the National Wildlife Refuge System

Water Chestnut
Silvio O Conte NFWR

Investing in

PREVENTION

saves money later!



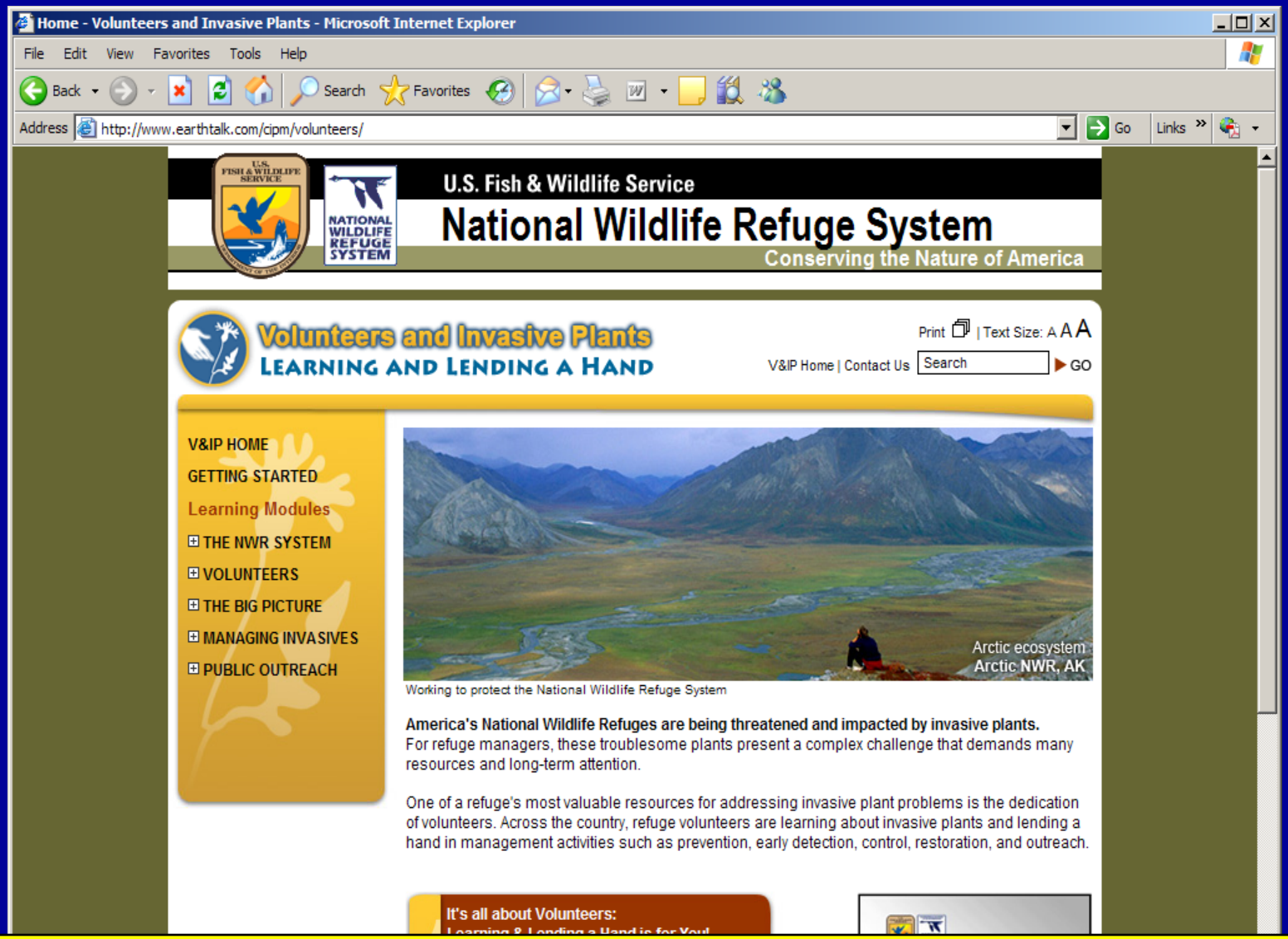
Pathways

…are the means by which invasive plants move into a clean, or uninfested, area.

Charles M. Russell NWR Montana Weed Wash

- A portable wash system was rented
- Over 40 hunter vehicles were washed as they entered and left the Refuge
- Volunteers gave over 100 hours of time

EDUCATION & OUTREACH

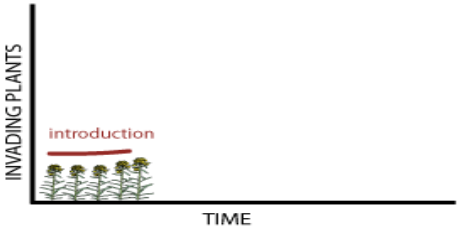


www.fws.gov/invasives/volunteersTrainingModule

INTRODUCTION PHASE

The number of invading plants in an area is small during the introduction phase and may not be detected by managers. Plant numbers may not increase for a long time. This period is referred to as the "lag time."

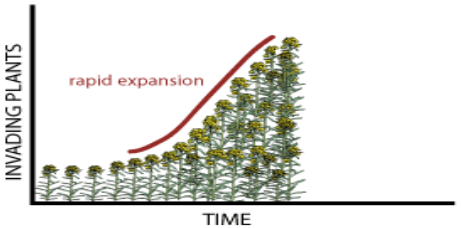
Environmental factors play an important role in whether or not the invading plants survive and become established. A plant community with more resources such as nutrients, water, and sunlight will provide a more suitable habitat for new plants than an area where resources are limited.



COLONIZATION PHASE

After the introduction phase and a lag time, an explosive period of expansion may occur. During the colonization phase, the invading plants are more easily detected by managers.

Expansion during this phase is thought to be more the result of plant species' biological traits (such as the ability to propagate vegetatively or grow rapidly) than environmental factors.



NATURALIZATION PHASE

When an invading plant species establishes a new self-perpetuating population and is integrated into the plant community, it is considered "naturalized." During this phase, expansion has slowed and the population is relatively stable.

The NWR System: Volunteers and Invasive Plants - Windows Internet Explorer

U.S. Fish & Wildlife Service
National Wildlife Refuge System
Conserving the Nature of America

Volunteers and Invasive Plants
Learning and Lending a Hand

The National Wildlife Refuge System
Its History

The National Wildlife Refuge System was not created in one action, but was the result of more than a century of land management and wildlife protection decisions.

Read about the beginning of the National Wildlife Refuge System:
Pelican Island and the Start of the Wildlife Conservation Movement (97 KB PDF)

Paul Kroegel, the first game warden on Pelican Island, with a nesting brown pelican. Photo credit: O Nelson/USFWS

TIMELINE

Click on a link in the timeline to learn about events leading to the establishment of the Refuge System and more recent developments.

Volunteers In Action: Volunteers and Invasive Plants - Windows Internet Explorer

http://www.fws.gov/invasives/volunteersTrainingModule/volunteers/volunteervoices.html

Regardless of the type of volunteer, they all have something in common: volunteers want to help protect the natural and cultural resources of refuges.

IN THEIR OWN WORDS

Volunteers speak better on volunteering than anyone else. Find out what volunteers around the country have to say about their experience. Why do they do it? What do they get out of it? What challenges do they face?

INDIVIDUALS	FRIENDS GROUPS	INTERNS
Minnesota Valley NWR	Friends of Alaska Refuges	Bon Secour NWR
View story	View story	View story

Eastern Neck NWR

The Move - The Big Picture: Volunteers and Invasive Plants - Windows Internet Explorer

http://www.fws.gov/invasives/volunteersTrainingModule/bigpicture/onthemove.html

NATURAL PATHWAYS

Plants have always spread and increased their geographic range by moving along natural pathways. The diagram below shows three major natural pathways along which plant material such as seeds, spores, and other reproductive parts move.

ATMOSPHERIC	OCEANIC	RIVERINE
blowing in the wind	floating in the current	floating downstream

Natural pathways are not nearly as important as human-created pathways in the global spread of invasive plants, but they do play a small role.

For example, Old World climbing fern *(Lygodium microphyllum)* was first found in a plant nursery in the late 1950s. It is likely that this species was introduced, that is, moved along a human-created pathway. But, it also can spread along a natural pathway: atmospheric currents or wind. Old World climbing fern has infested many remote and pristine areas in Florida

Enrolled leaf tissue on this Old World climbing fern leaflet contains the spores.

Photo credit: P Greb/USDA ARS (left), A Ferriter/S Florida Water Mgmt.

www.fws.gov/invasives/volunteersTrainingModule

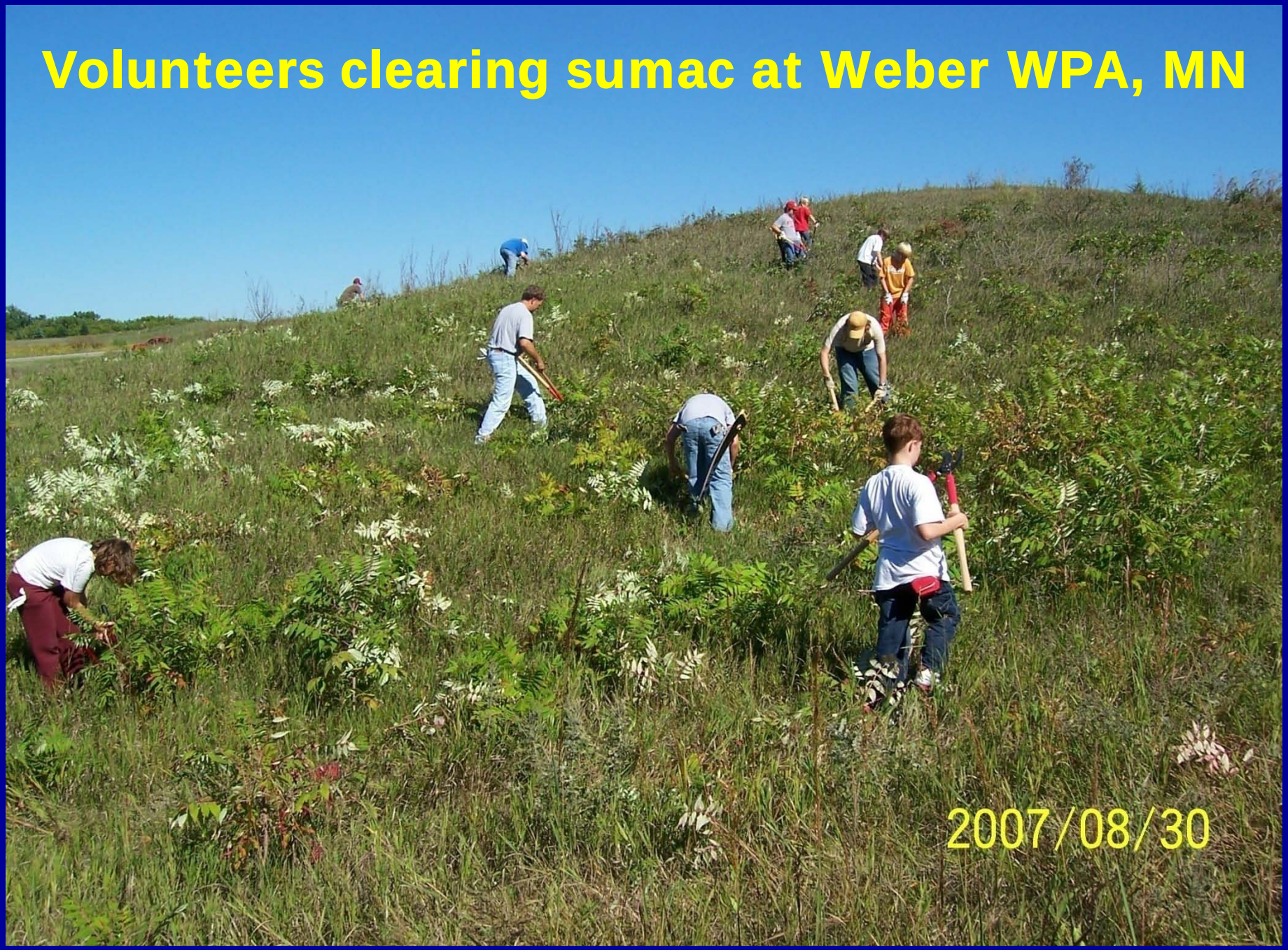
ENGAGING VOLUNTEERS

From 2005-2009: 5,600 volunteers contributed over 86,800 hours to management of more than 415,000 acres of refuge lands = $7 an acre!

Competitive Allocation Program

- 56 projects in 2005
- 60 projects in 2006
- 61 projects in 2007
- 50 projects in 2008
- 52 projects in 2009

Volunteers clearing sumac at Weber WPA, MN



INVASIVE SPECIES STRIKE TEAMS

- Modeled after wild land firefighting
- Rapidly respond to new invasive plant infestations
- Provide technical assistance to Refuges

GMC

Purple Loosestrife Montezuma NWR

Tamarisk Paul's Lake, Muleshoe NWR

Controlling Spotted Knapweed

Parker River NWR

PARTNERSHIPS

Giant Gambian Pouch Rat
Grassy Key, FL

CAPACITY BUILDING

NCTC Course:
Field Techniques for Invasive Plant Management (WLD2139)

Online Training for Staff

www.fws.gov/invasives/staffTrainingModule/

States were made seven years later, following resolution of concerns surrounding nontarget feeding impacts on other plant species (Blossey 1997). One agent under consideration was not proposed for introduction because it exhibited a wider host range (Blossey and Schroeder 1995).

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Effects of Biocontrol on Invasive Plants

Impacts of Natural Enemies on Host Plants

Classical biocontrol agents are by definition "exotic, usually coevolved" natural enemies of the target invasive plant. The natural enemies of plants include herbivorous vertebrates (e.g., domestic livestock and fish) and invertebrates (e.g., insects, mites, and nematodes), fungal pathogens (e.g., rusts), and bacterial and viral diseases. Insects and mites are most commonly imported for classical biocontrol, whereas nematodes, diseases, and generalist herbivorous vertebrates are less common.

Flea beetles feeding on leafy spurge foliage. Photo credit: N Rees/USDA ARS, www.forestryimages.org

The level of mortality or injury inflicted on the host plant in its native environment is an important consideration when evaluating a natural enemy's potential effectiveness as an imported biocontrol agent. Natural enemies can injure or kill their host plant directly, or can weaken the plant so that it is less competitive in its environment. Direct damage occurs when natural enemies suck out plant fluids, defoliate, eat seeds, and bore into roots and shoots. Insect enemies may indirectly affect their host by exposing the plant to secondary pathogen infections that can further weaken the plant (Wilson and McCaffrey 1999).

Some plants have developed mechanisms to counteract the action of the coevolved enemy (Trumble et al. 1993). Compensatory effects may occur when a plant damaged by a biocontrol agent increases relative growth rates and competitive effects, induces the production of chemicals that might harm neighboring plants, or stimulates the release of root exudates (i.e., Callaway et al. 1999).

Plant populations are typically regulated by a complex of natural enemies (Frick 1974), such as moths, beetles, wasps, and flies that all feed on or live within a plant. Releasing a single biocontrol agent may not have the same effects on its host plant compared to the full gamut of natural regulators that occur in the plant's native environment.

Even though all invasive plants may have coevolved natural enemies that regulate their populations within their native range, approved biocontrol agents are available for only a few invasive plant species in the United States. The complex of natural enemies associated with the target plant in its

Impacts of Chemical Methods - Chemical Methods: Management Methods - Managing Invasive Plants - Windows Internet Explorer

http://www.fws.gov/invasives/staffTrainingModule/methods/chemical/impacts.html

MANAGEMENT METHODS
- Physical
- Chemical
  - Introduction
  - Impacts
  - In Practice
  - Review & Resources
- Biological Control
- Prescribed Grazing
- Prescribed Burning

Effects of Herbicides on Human Health and Environment

How Herbicides Work

Herbicides kill or suppress plants by interfering with essential plant processes such as photosynthesis. All of the interactions between an herbicide and a plant from application to the final effect are referred to as the *mode of action*. Understanding the mode of action of an herbicide is essential in selecting the proper herbicide, diagnosing herbicide injury symptoms, preventing herbicide resistance problems, and avoiding nontarget environmental impacts.

The mode of action involves

- **contact and absorption** contact, penetration, and movement of the herbicide into the plant through the cuticle or epidermal root tissue
- **translocation** movement of the herbicide to the site of action
- **site of action** specific location within the plant where the herbicide exerts toxicity at the cellular level
- **mechanism of action** specific biochemical or biophysical process that is affected by the herbicide

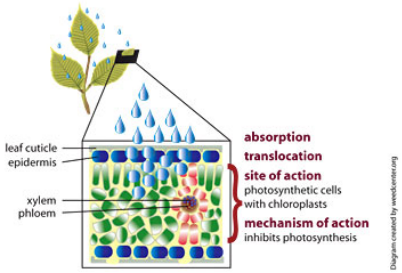

Diagram of leaf cross-section showing mode of action of a foliar-active, systemic herbicide (e.g., atrazine) that inhibits photosynthesis. In this example, the herbicide is applied to and absorbed through the leaf, is translocated to the chloroplasts (site of action), and subsequently inhibits photosynthesis (mechanism of action).

The terms *mode of action* and *mechanism of action* are often used interchangeably. However, mechanism of action refers to the plant's specific biological process that is interrupted by the herbicide, whereas mode of action is a general term referring to all of the plant-herbicide interactions

Contact and Absorption

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- impact
- skills, training, and equipment required
- labor and cost
- target populati carbohydrate a

Nature of the Method

- Some physical methods may be applied selectively with a relatively low impact on other species and the environment. Other methods, however, may affect all plants in the treated area and even impact surrounding biotic and abiotic ecosystem components. Selective methods have the advantage of minimal impacts on nontarget species. However, they are labor intensive and time consuming, and often need to be repeated, so they are most appropriate for small, localized infestations and/or ecologically sensitive situations. These methods also might be appropriate following more broadscale treatments.

  Nonselective methods will impact all plants-undesirable and desirable-within their range. However, their advantage is that they treat larger areas more quickly

While hand pulling may not be a feasible option for physical removal of

www.fws.gov/invasives/staffTrainingModule

Links to Online Trainings ....

Invasives Species - U.S. Fish and Wildlife Service

U.S. Fish & Wildlife Service

Invasive Species

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What's New

Fire Management and Invasive Plants – A Handbook (1.3 MB PDF)

Online Training Helps Volunteers Fight Invasive Species

Online Training Helps Refuge Staff Manage Invasive Species

What are Invasive Species?

Invasive species are organisms that are introduced into a non-native ecosystem and which cause, or are likely to cause, harm to the economy, environment or human health. It is important to note that when we talk about a species being invasive, we are talking about environmental boundaries, not political ones. In addition to the many invasive species from outside the U.S., there are many species from within the U.S. that are invasive in other parts of the country.

The U.S. Fish and Wildlife Service is the only agency of the U.S. Government whose primary responsibility is the conservation of the nation's fish, wildlife, and plants. Because of our responsibilities, the Service is very concerned about the impacts that invasive species are having across the Nation. Invasive plants and animals have many impacts on fish and wildlife resources. Invasive species degrade, change or displace native habitats and compete with our native wildlife and are thus harmful to our fish, wildlife and plant resources.

Pathways that contribute to the spread of invasive species. What you see in the video above represents a 24-hour observation of aircraft travel on the earth's surface. Every dot of moving light represents an aircraft carrying people and goods. And, every dot represents potential for the intentional or unintentional movement of plant or animal species that may be travelling with those people and their goods, species that could become invasive once they establish in a new environment.

Internet | 100%

www.fws.gov/invasives

INVENTORY & MONITORING

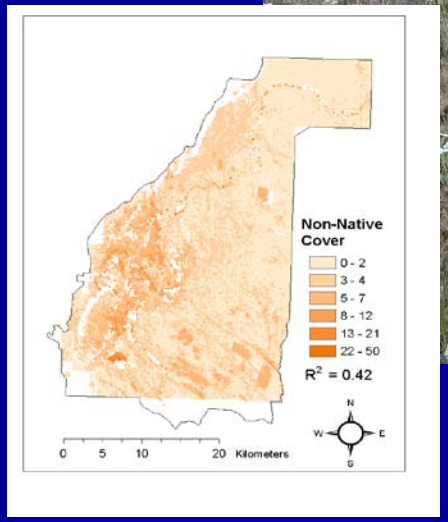
Baseline inventory to know what's out there and help prioritize areas

Monitoring to detect and record change over time as well as treatment efficacy

San Pablo Bay NWR

Challenges: Location location location!

Predictive Modelling



Hart Mt NWR

Plot-based vegetation sampling

RESTORATION