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Planting seedlings to regenerate critical shrub components in shrub-steppe; a viable tool for land managers

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Columbia Basin Landscapes Workshop April 2011

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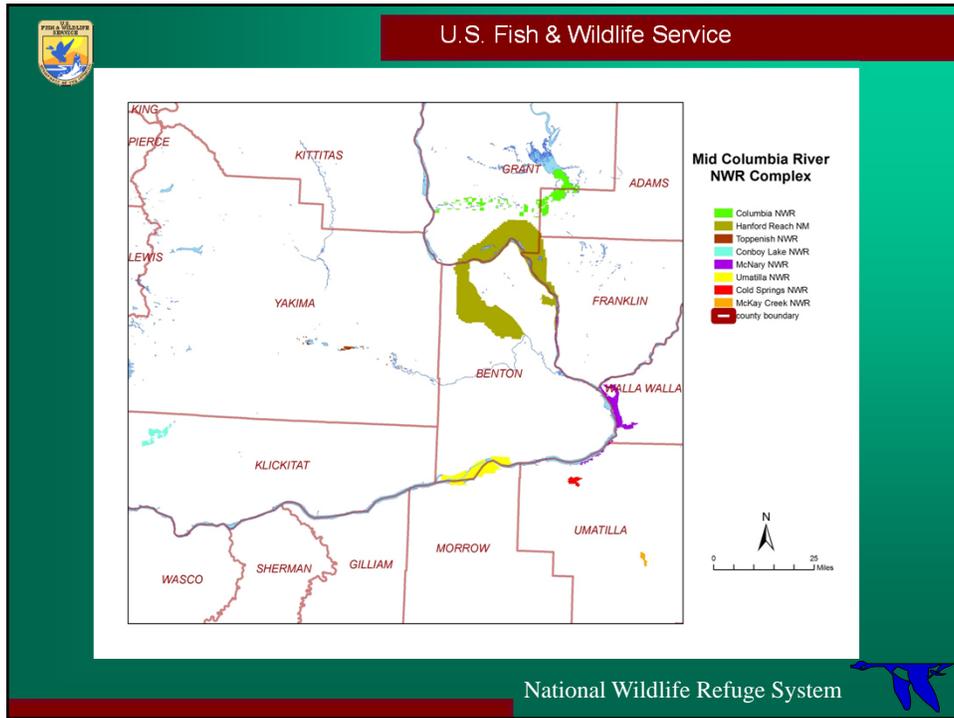
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Acknowledgements

- The Nature Conservancy of Washington – Jim Evans
- NIFC – Burned Area Emergency Response
- Project Leader – Greg Hughes, Jeff Howland
- U of W, Jon Bakker and Ryan Haugo

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Hanford Reach National Monument

Designated by Presidential Proclamation 7319, June 9, 2000

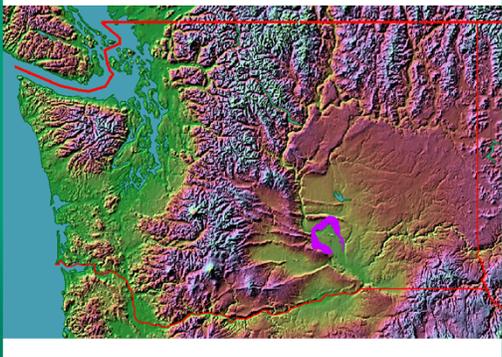
195,000 acres superimposed over the Department of Energy (DOE) Hanford Site

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Monument Environmental Setting

- Hottest and Driest part of Washington State
- Rain shadow of Cascade Mountains
- 6" precipitation annually on average
- Most precipitation comes in winter
- Elevation range from 350 - 3,660 ft.
- Soils are primarily alluvial silts and sands deposited during the Ice Age Floods



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Goals for Management of the Hanford Reach National Monument

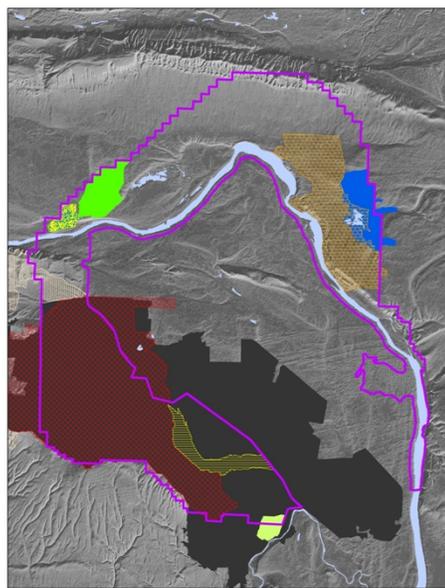
- Protect and restore the native habitats and biodiversity of the Hanford shrub-steppe ecosystem.
- Monitor, protect, and recover native plants and animals that are federally or state listed and any other species that are in any other way considered sensitive.

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Fire history map



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Recent Fire History *

Fire Name	Year	Total Acres Burned	USFWS Acres burned
24 Command	2000	163,884	78,732
Shooting Range	2003	1,391	507
Weather Station	2005	4,918	4,840
McLane	2005	6,850	6,068
Overlook	2007	21,233	21,083
MilePost 17	2007	4,708	4,708 (reburned)
Wautoma	2007	72,641	51,356 (reburned)
243	2008	1,387	1,387
Total		277,012	168,741 (with 56,064 reburned)

** Only includes fires over 300 acres*

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Burned Area Emergency Response

- Designed to prescribe cost effective post-fire stabilization to protect human life, property, and critical cultural and natural resources
- To promptly stabilize and prevent further degradation to affected resources on lands within the fire perimeter
- Protect and restore the ecological integrity and site productivity of shrub-steppe plant communities within the Monument

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Re-habilitation objectives

- Prevent the establishment of noxious weeds and non-native invasive species
- Limit erosion
- Stabilize soils
- Give existing native grasses a competitive edge
- Provide native grass seed to compete with non-natives
- Regenerate critical shrub layer

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Example: 24 Command Fire

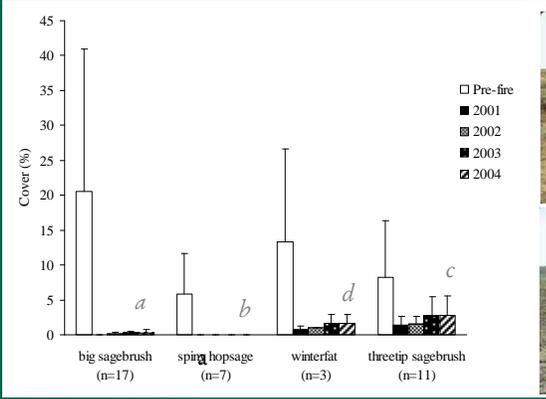
- National BAER Team
- Loss of life
- Loss of property
- 164,884 acres (258 sq. miles)



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Changes in Shrub Cover

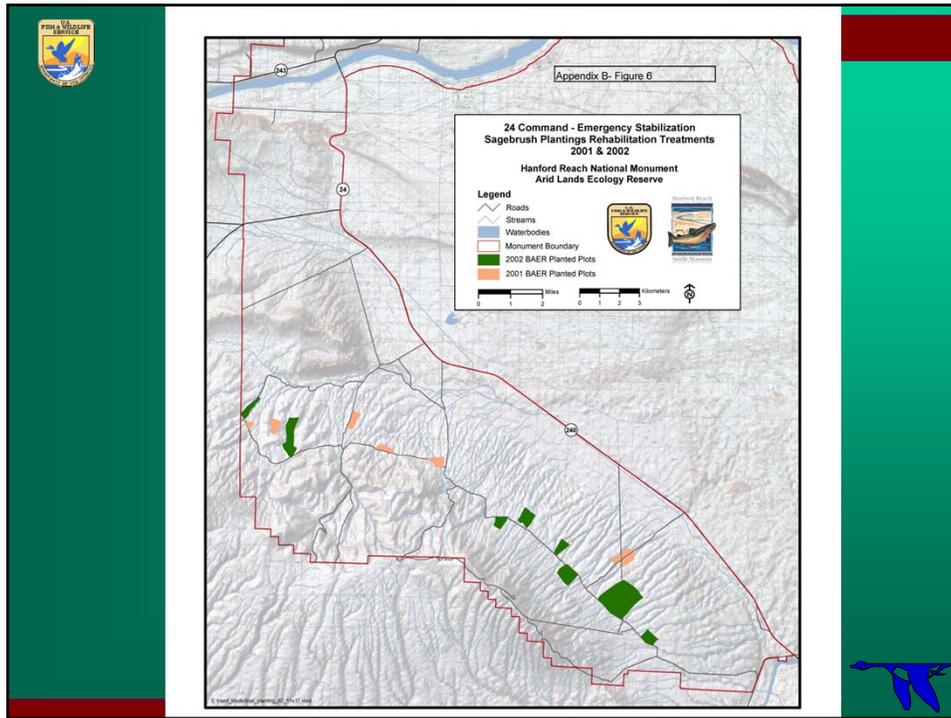


Species	Pre-fire	2001	2002	2003	2004
big sagebrush (n=17)	~21	~0.5	~0.5	~0.5	~0.5 (a)
spiny hopsage (n=7)	~6	~0.5	~0.5	~0.5	~0.5 (b)
winterfat (n=3)	~14	~1	~1	~1	~1 (d)
threetip sagebrush (n=11)	~8	~2	~2	~2	~2 (c)



Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*); spiny hopsage (*Atriplex* [= *Grayia*] *spinosa*); winterfat (*Eurotia lanata*); threetip sagebrush (*Artemisia tripartita*). Bars = 1 standard deviation. 2004 values with accompanying script letter are statistically lower than pre-fire values: a = $P < 0.0001$; b = $P < 0.005$; c = $P < 0.05$; d = $P < 0.10$.

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Criteria used to select planting sites

- **Pre-existing understory characteristics with significant proportions of native vegetation**
- **Relatively large (>20 acres) (range from 30 – 600 acres)**
- **Sites bridge gaps between existing blocks of shrub-steppe habitat, or replace sagebrush in areas that had mature sage stands prior to the “24 Command Fire”**
- **Sites are near established roads to minimize disturbance to this Research Natural Area.**

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Nursery Stock Types and Treatments

- 10 cubic inch tublings
- 4 cubic inch tublings
- Bare Root Plants
 - Hydrogel
 - Mycorrhizae



Installation

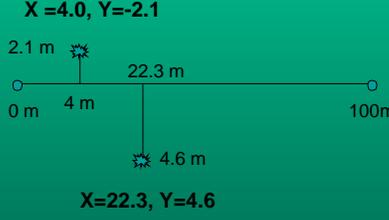
All plantings were installed by professional reforestation or restoration planting crews either using hoedad or narrow planting shovels




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Sagebrush Monitoring Field Technique

- Plants mapped at time “zero” immediately post-planting and considered “Healthy”
- 100 meter transect as baseline
- 10-12 meters wide (5-6 m each side of baseline)
- Encompassed ~100 plants per transect
- Origin point randomly selected within planting polygons
- Each plant recorded at X distance from origin and Y distance from central baseline



X =4.0, Y=-2.1

X=22.3, Y=4.6

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Data Recorded for each Mapped Sagebrush Plant

Condition	Description
Healthy	Plants generally robust. Stems flexible. Foliage supple, expanded; color mostly green and gray-green
Stressed	Live stems still flexible. If multiple stems one or more stems may be dead. Foliage somewhat dry and brittle, sparse, or incompletely expanded; color mostly gray, yellow-gray, or white.
Dead	Stems brittle, sometimes broken. Foliage white to brown and brittle where present, or lacking.
Missing	Category used during 1 st and 2 nd years to allow for human error, plants may be found after some growth. However, many dead plants break off, plants recorded as missing for > 2 years of monitoring added to dead.

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Environmental Variables recorded for each monitoring plot (02)

- Slope
- Aspect
- Heat Load Index
- Elevation
- Percent cover cheatgrass
- Percent cover Bluebunch wheatgrass
- Percent cover all perennial grasses
- Percent cover all grasses



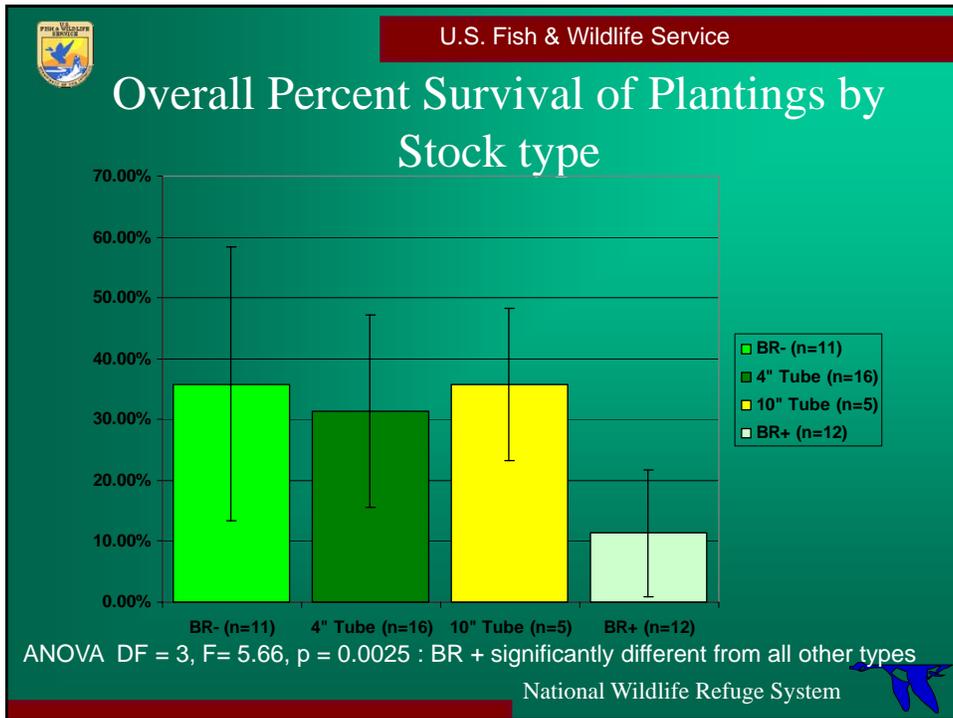
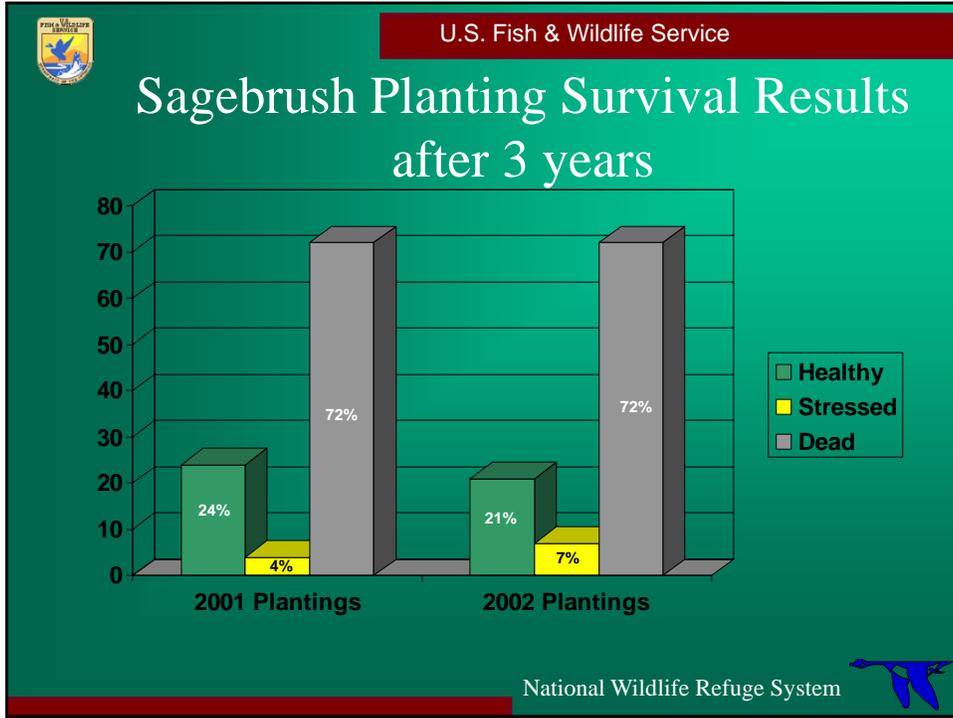
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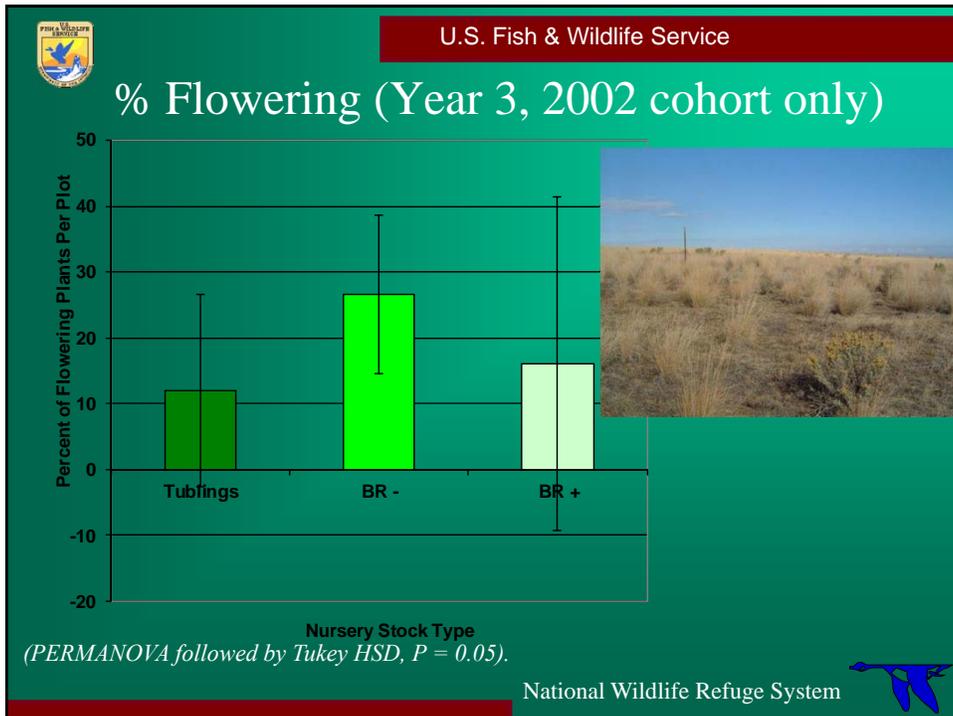
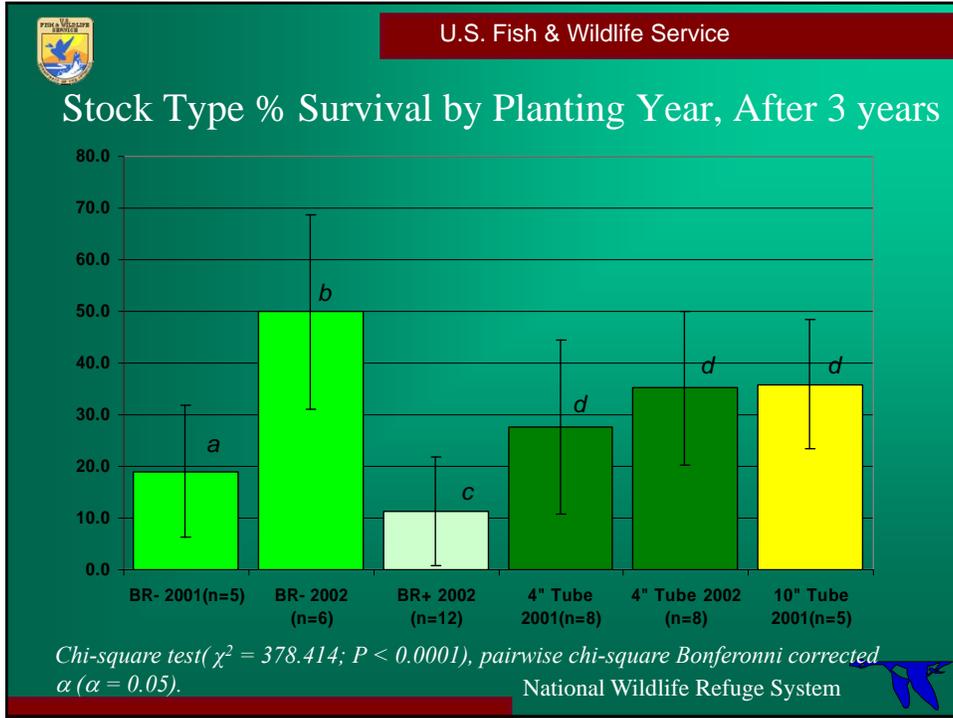
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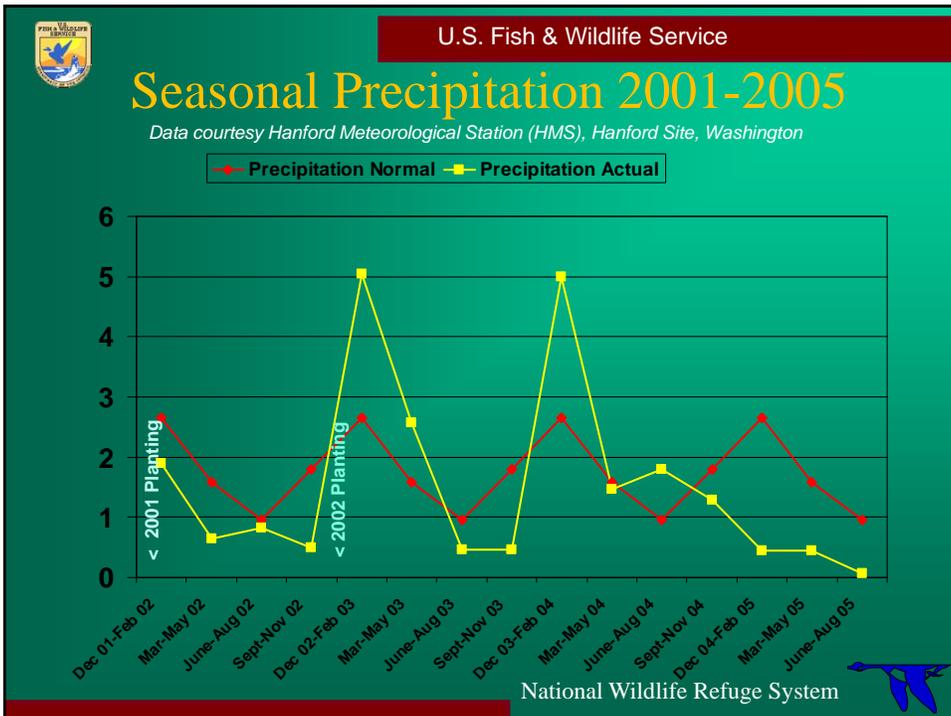
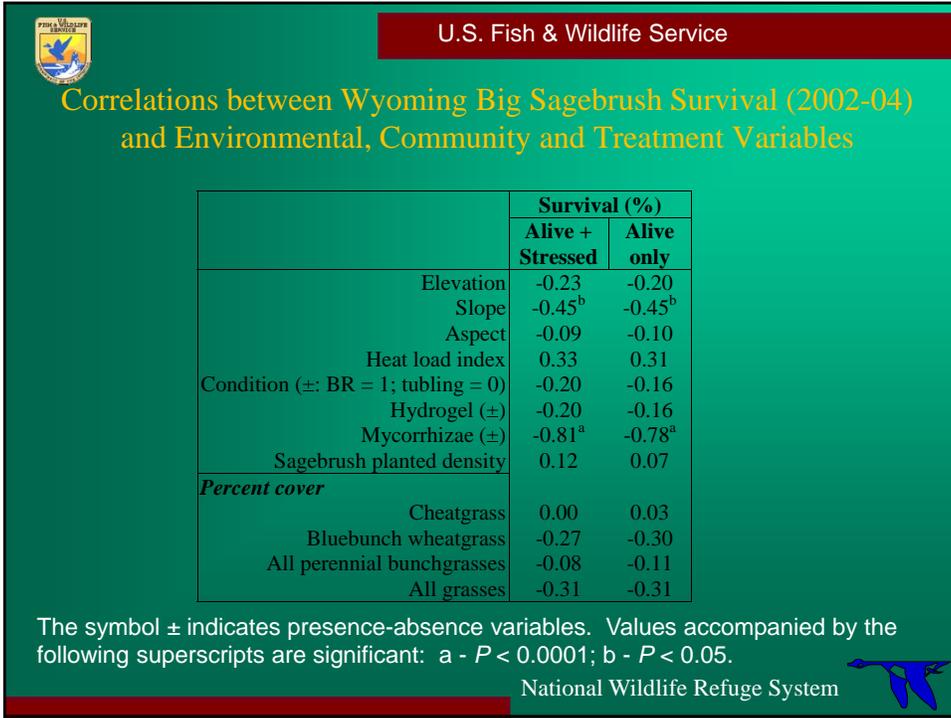
2001 Plantings vs. 2002 Plantings

<ul style="list-style-type: none"> • Planted 173,348 plants • 9 polygons, 500 acres • 18 monitoring transects installed • Monitored 1992 individual plants • Approximately 1% of total planted 	<ul style="list-style-type: none"> • Planted 717,403 plants • 13 polygons, 1600 acres • 26 monitoring transects installed • Monitored 2880 individual plants • Approximately 0.5% of the total planted
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Bare root Stock: a closer look

- 2001 Stock had a significant germination problem in the nursery
- Resulted in those plants that did germinate being very large (less dense in beds)
- Larger BR stock was more difficult to plant
- First year post-planting for 2001 plants was below normal precipitation over each season

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Bare root stock : a closer look, continued

- 2002 Bare root stock met specifications for size coming from the nursery
- 2002 BR stock were easier to plant
- Extremely wet years following 2002 planting helped plants establish
- The poor survival of BR + mycorrhizae was a curious result



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Exploring BR + Mycorrhizae

- Because Wyoming big sagebrush forms mycorrhizal associations, inoculation should enhance or not adversely affect survival
- Plants from several plots of BR + & BR - treatments were sampled and root examined in a laboratory
- All roots were colonized with mycorrhizae, and those in treatment plots had higher level of colonization
- A non-mycorrhizal brown fungus (unknown origin) was present on all roots of these samples

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Conclusion: Poor Survival of BR + Mycorrhizae

Extremely wet years following 2002 plantings, combined with the application of mycorrhizal gel in addition to hydrogel, may have restricted oxygen to plant roots and decreased survival of BR + mycorrhizal treatment

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Pros and Cons: Tubling Stock

PROS	CONS
<ul style="list-style-type: none"> • 10" tublings do not survive significantly better than 4" tublings • 4" tubling costs are comparable to bare root plants • Consistent production • Somewhat easier for planting crews to install • Potentially less dependent on initial precipitation • Survival is less variable than BR 	<ul style="list-style-type: none"> • Plants are initially very small • Small size makes monitoring effort more intensive • Fewer flowering plants after 3 years • Longer time frame to re-establish functional structural habitat

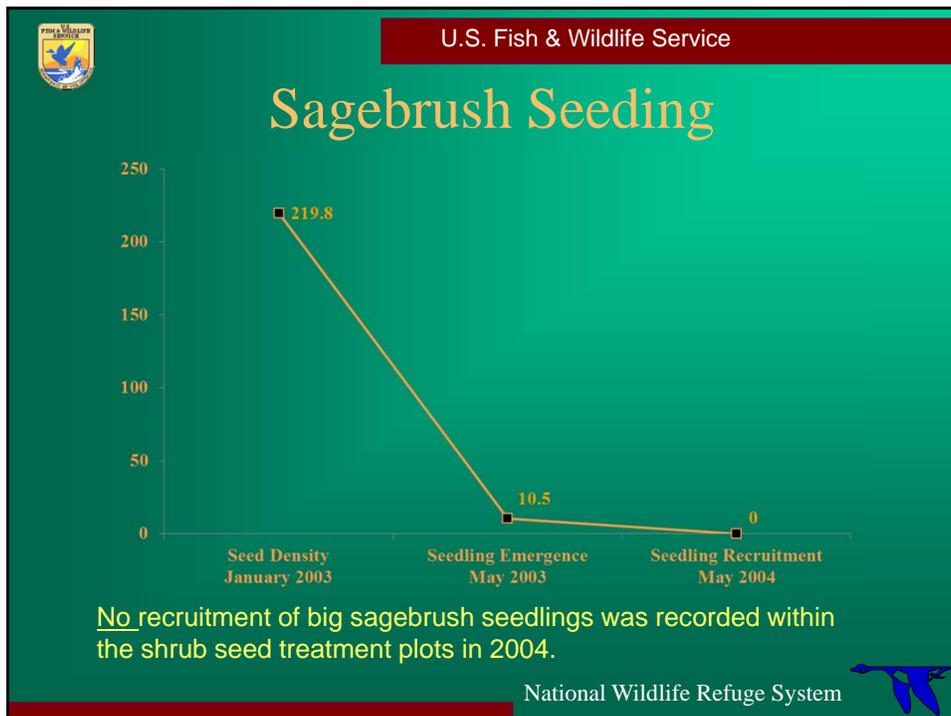
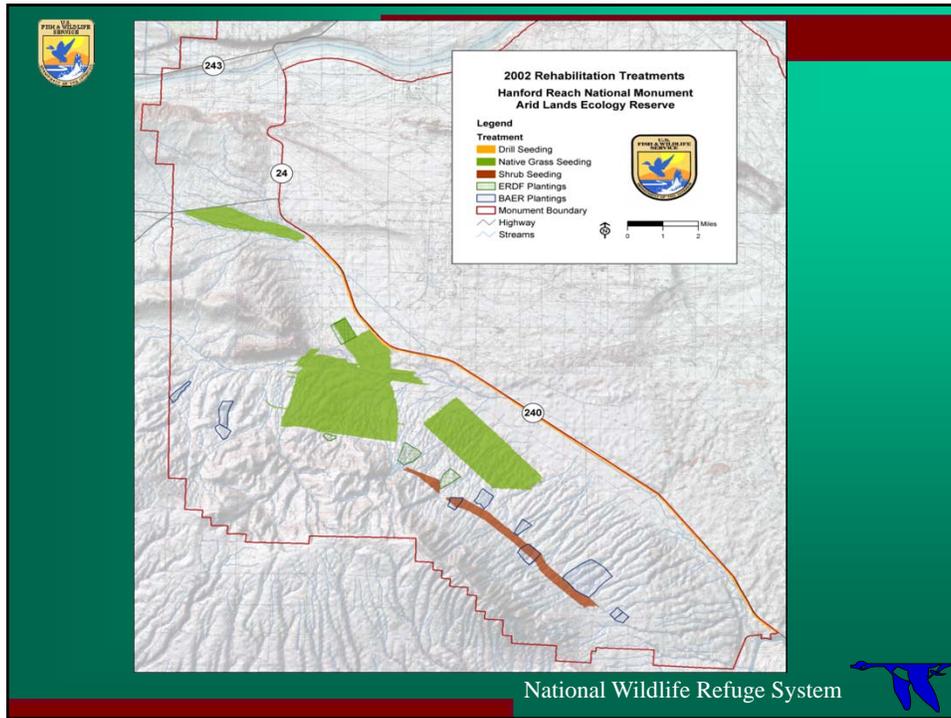
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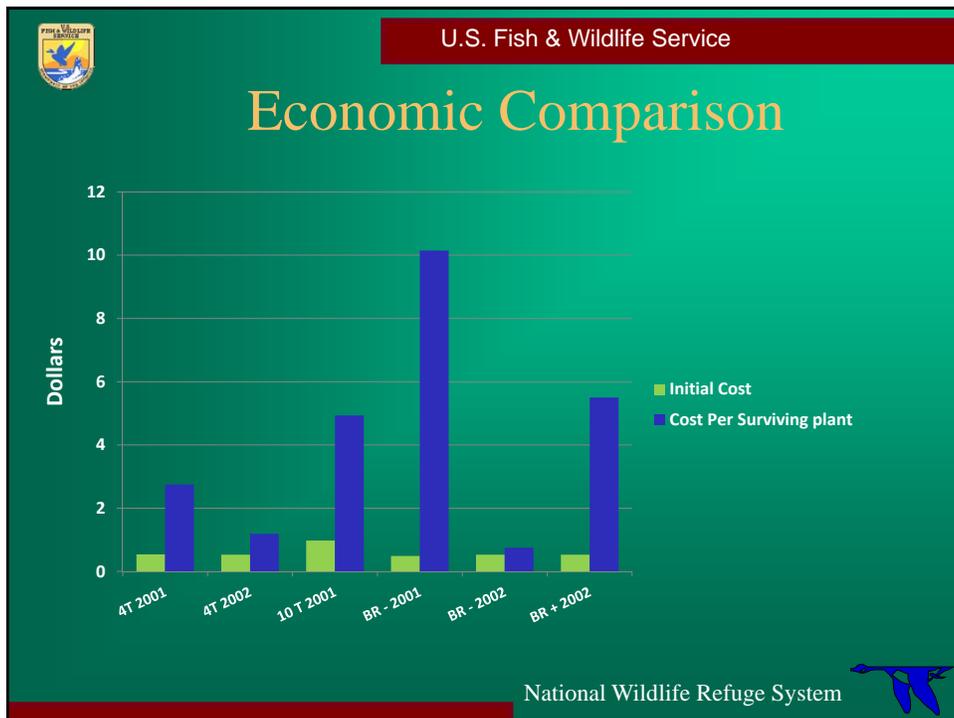
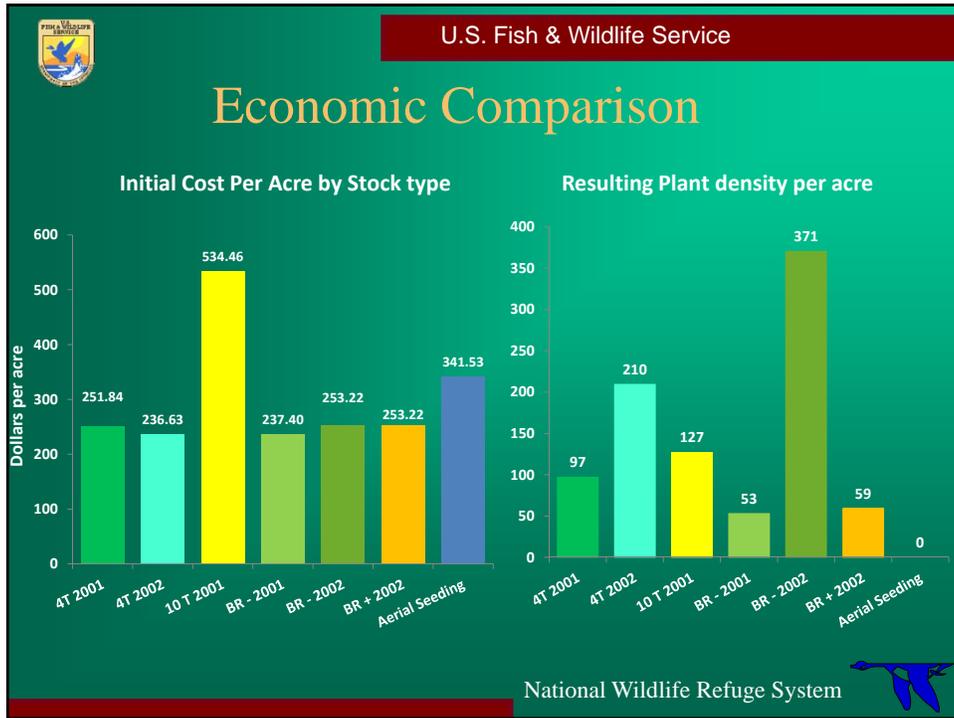
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Pros and Cons: Bare root Stock

PROS	CONS
<ul style="list-style-type: none"> • Plants are larger, multi-branched at installation • Can establish very well with the right conditions and treatment • Larger plants easier to see and monitor • More plants flowering after 3 years • Shorter time frame to re-establish functional structural habitat 	<ul style="list-style-type: none"> • Somewhat inconsistent production in nursery beds (variable size and numbers) • Slightly more difficult for planting crews to install correctly • Survival during establishment depends upon adequate and well timed precipitation • BR survival variable, more unpredictable than tublings

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Conclusions After 3 Years Monitoring

- Plantings placed 241,000 surviving seedlings across 768 acres
- Densities ranged from 111 to 556 plants/ha (45 to 225 plants/acre)
- Most planted seedlings in 2005 were vigorous and expected to develop a shrub component *in excess* of what would have established without active planting
- As surviving plants become reproductive, natural establishment should begin to augment plantations

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Wrap up

- **Out planting of nursery grown stock is more reliable than direct seeding as a method for restoring shrubs to the landscape**
- **Development of high-quality shrub-steppe habitat with intact native understory vegetation and microbiotic crusts favors planting over seeding**
- **Planting can have a comparable cost when compared to seeding, especially if several years of seeding are required to establish shrubs from seed**

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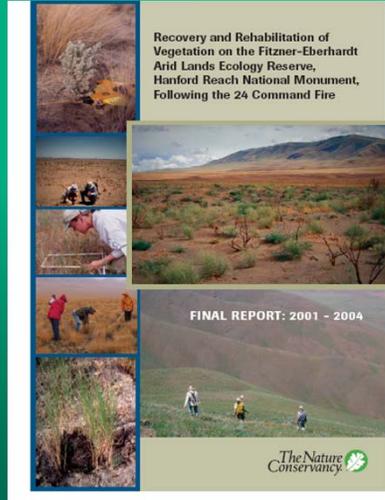


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Post-fire monitoring reports

<http://www.fws.gov/hanfordreach/fire.html>

- Implementing rehabilitation as experiment = adaptive management
- Established permanent vegetation monitoring plots
- Monitoring based on Pre and Post fire condition
- Longer-term monitoring is essential and needed in arid landscapes
- Publication is being prepared by UW, TNC and USFWS



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