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**“Role of fire in serpentine  
savanna (“barrens”) restoration”**

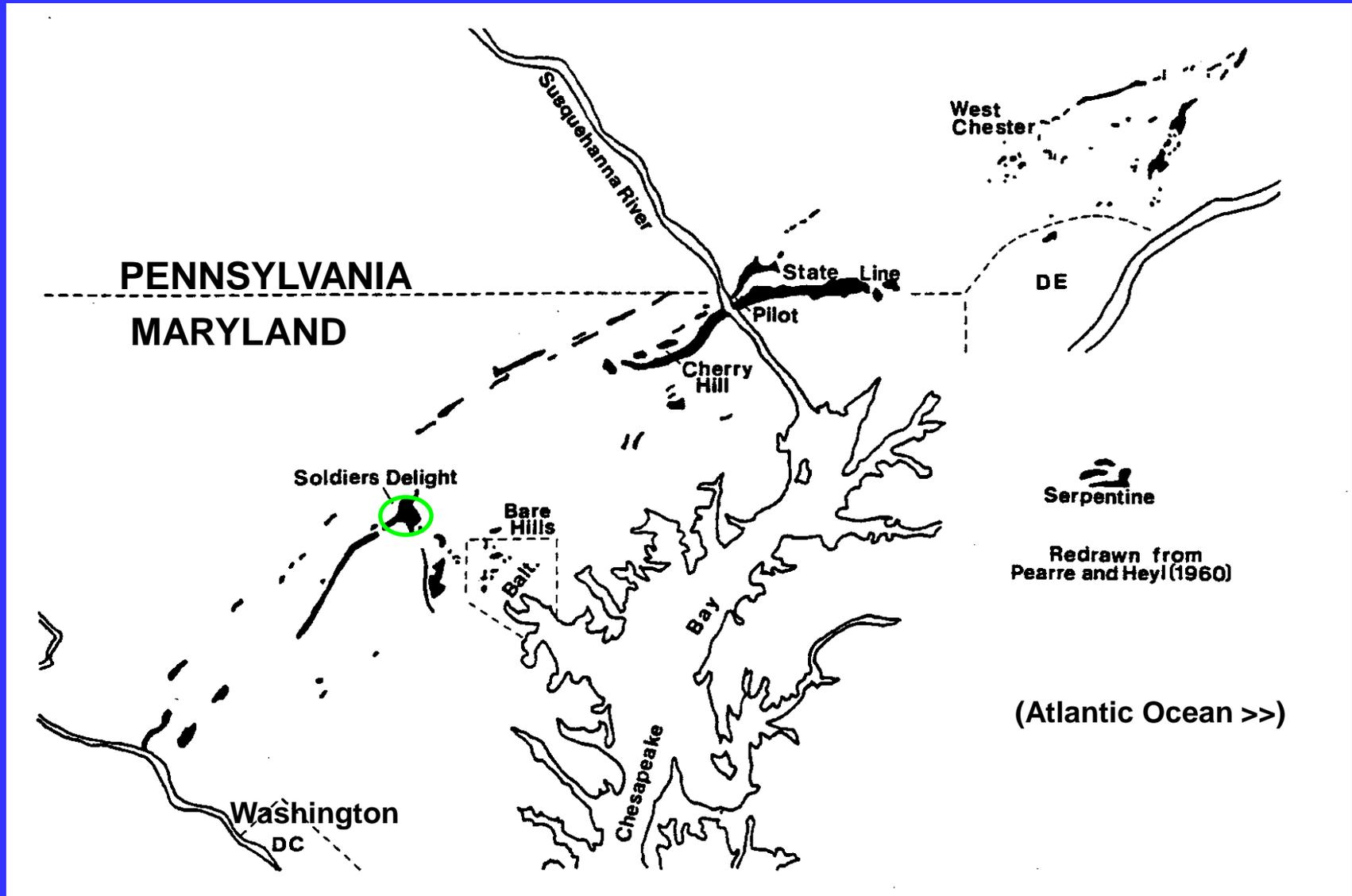
30 Jan 2014

# Serpentine Savanna Ecosystem



**Soldiers Delight  
Natural Environment Area**

# Distribution of Serpentine Bedrock (100,000 ha) in Piedmont of Maryland, Pennsylvania, & Delaware



# Soldiers Delight

*Natural Environment Area and Wildlands*

- **Largest remaining serpentine ecosystem in the Eastern United States**
- **Largest number of rare, threatened, or endangered species on State land (> 30)**

# Serpentine Savanna Ecosystem

## **Ecosystem Characteristics**

Bedrock and Soils

Biotic Components

## **Landscape History**

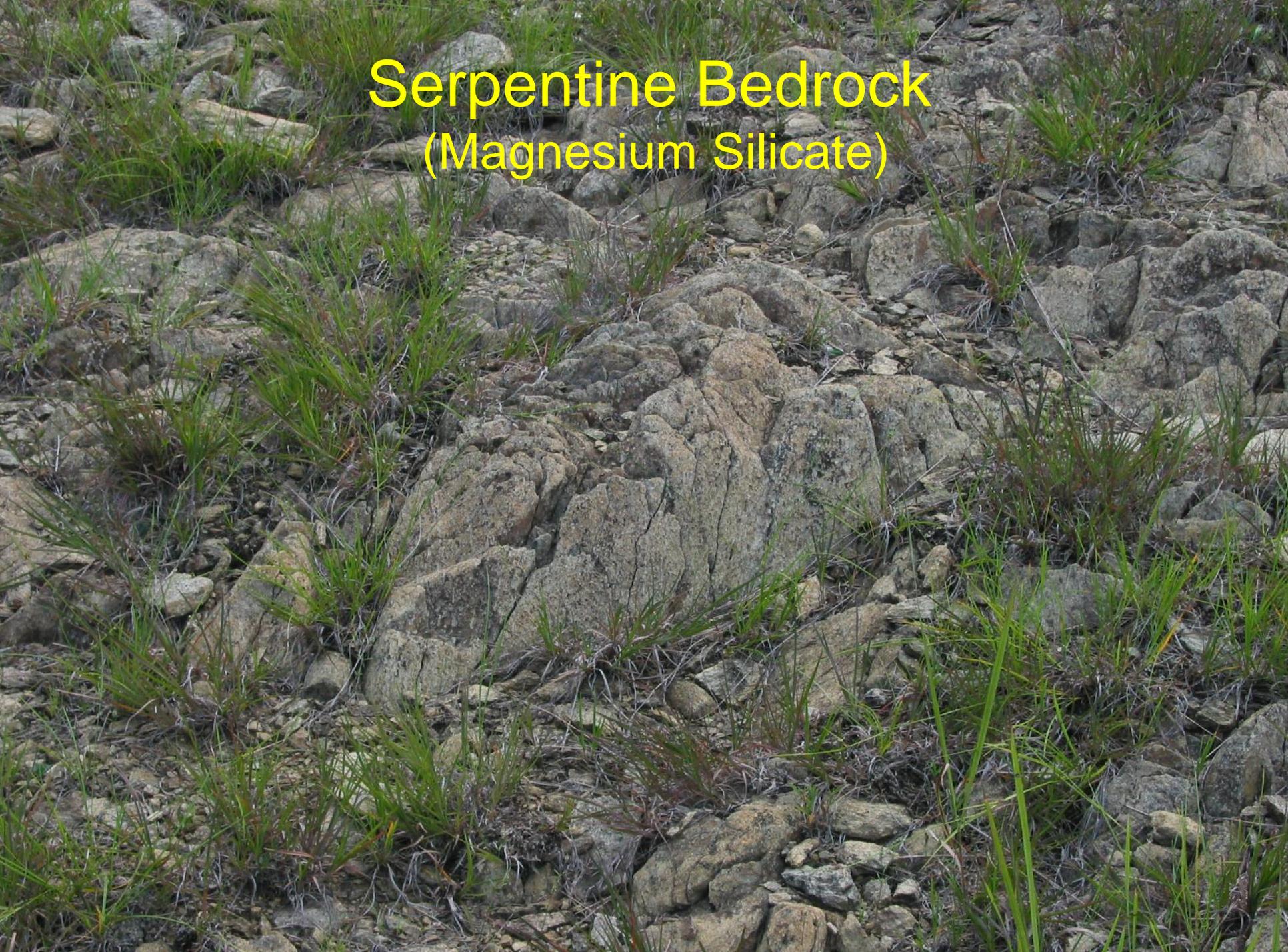
## **Ecosystem Restoration**

Research Phase

Implementation Phase

**Soldiers Delight**

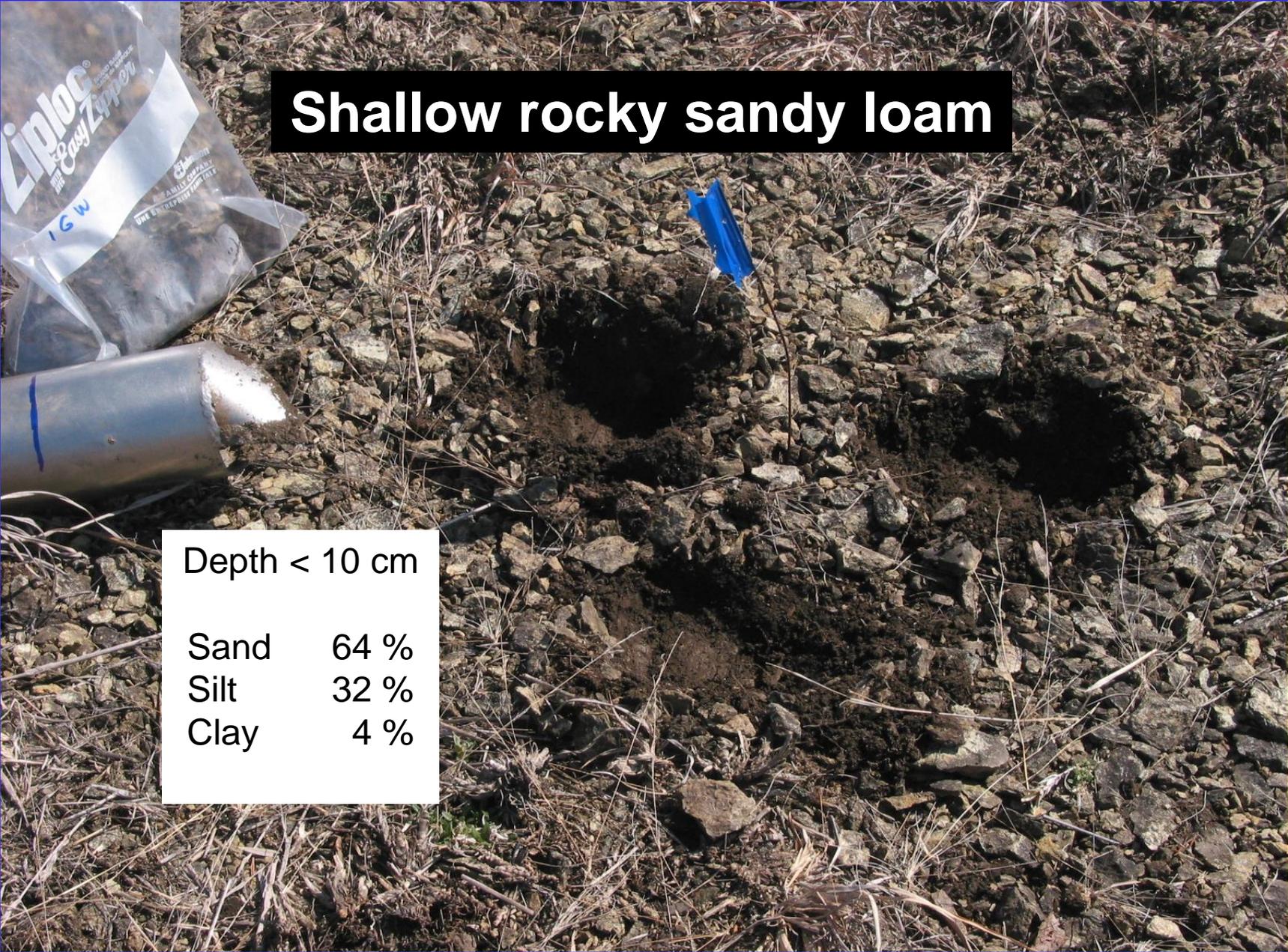
# Serpentine Bedrock (Magnesium Silicate)



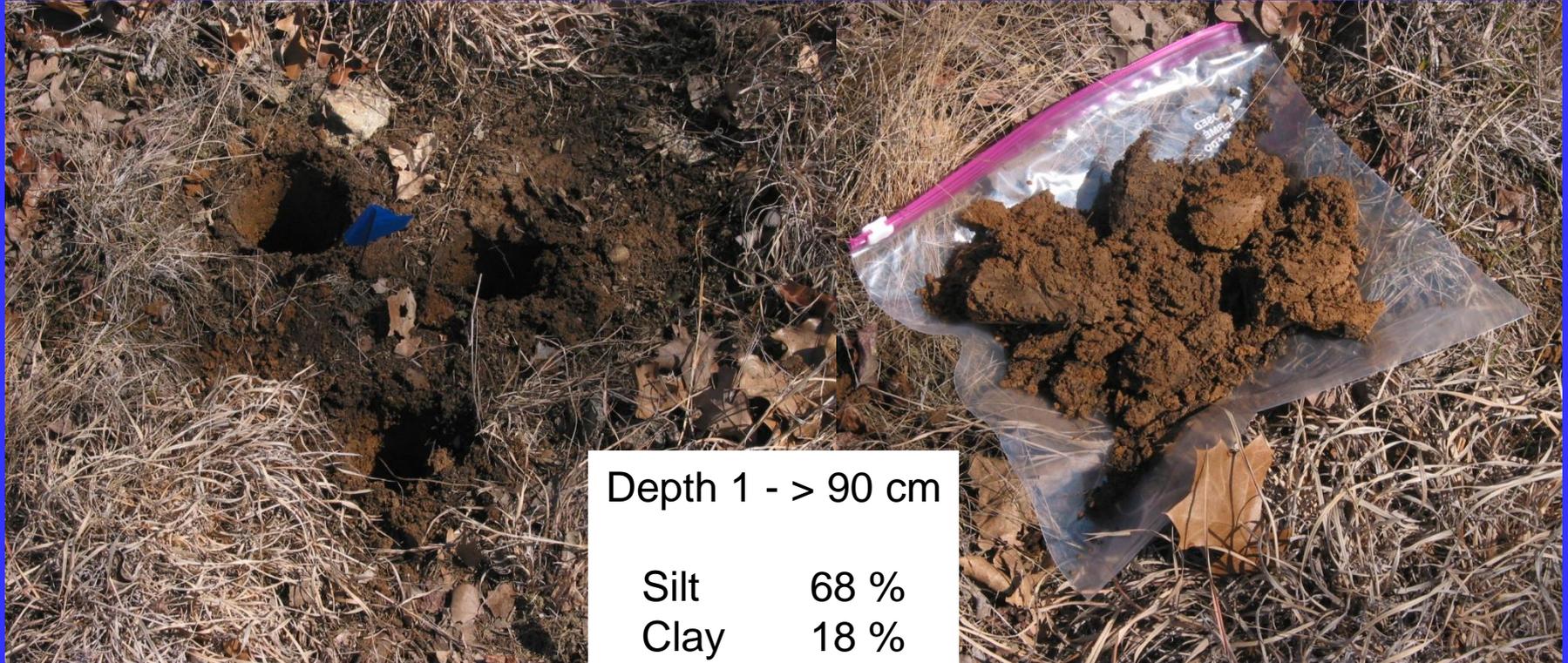
# Shallow rocky sandy loam

Depth < 10 cm

Sand	64 %
Silt	32 %
Clay	4 %



# Silt Loam

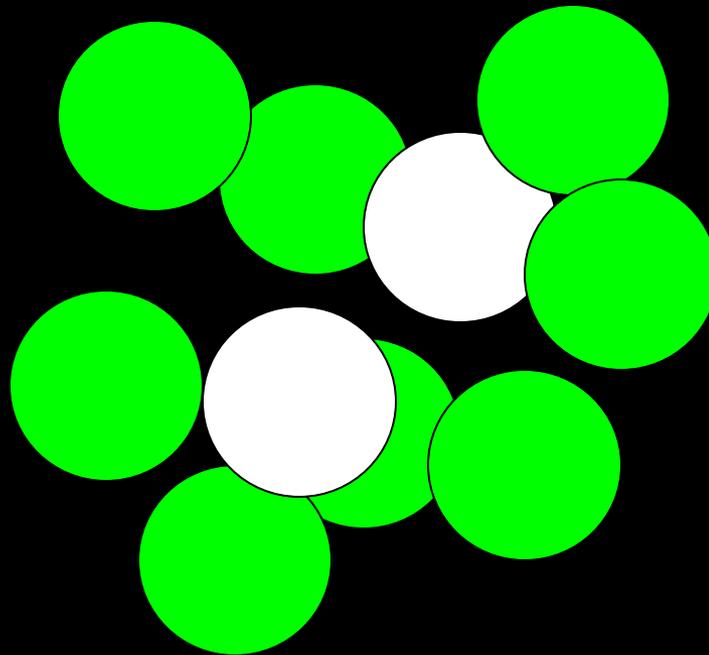


Depth 1 - > 90 cm

Silt	68 %
Clay	18 %
Sand	13 %

# Excessive Mg : Ca Ratio

$\geq 3 \text{ Mg}^{+2} : 1 \text{ Ca}^{+2}$





# Origin of Serpentine Savanna Ecosystem

✈️ 8,000 – 4,000 YBP

Hot & Dry Periods  
*Hypsithermal Interval*

Migration of prairie & savanna species  
American Indian fire cultures



# Serpentine Oak Savanna Ecosystem



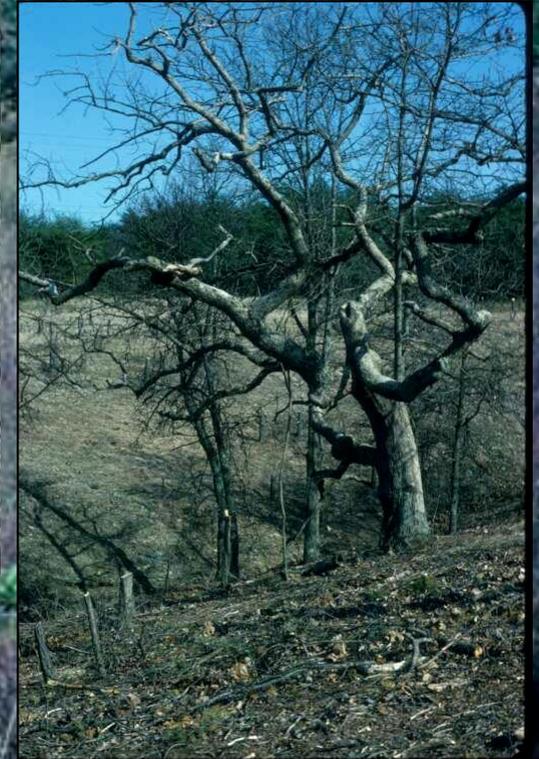
# Serpentine Oak Savanna Ecosystem



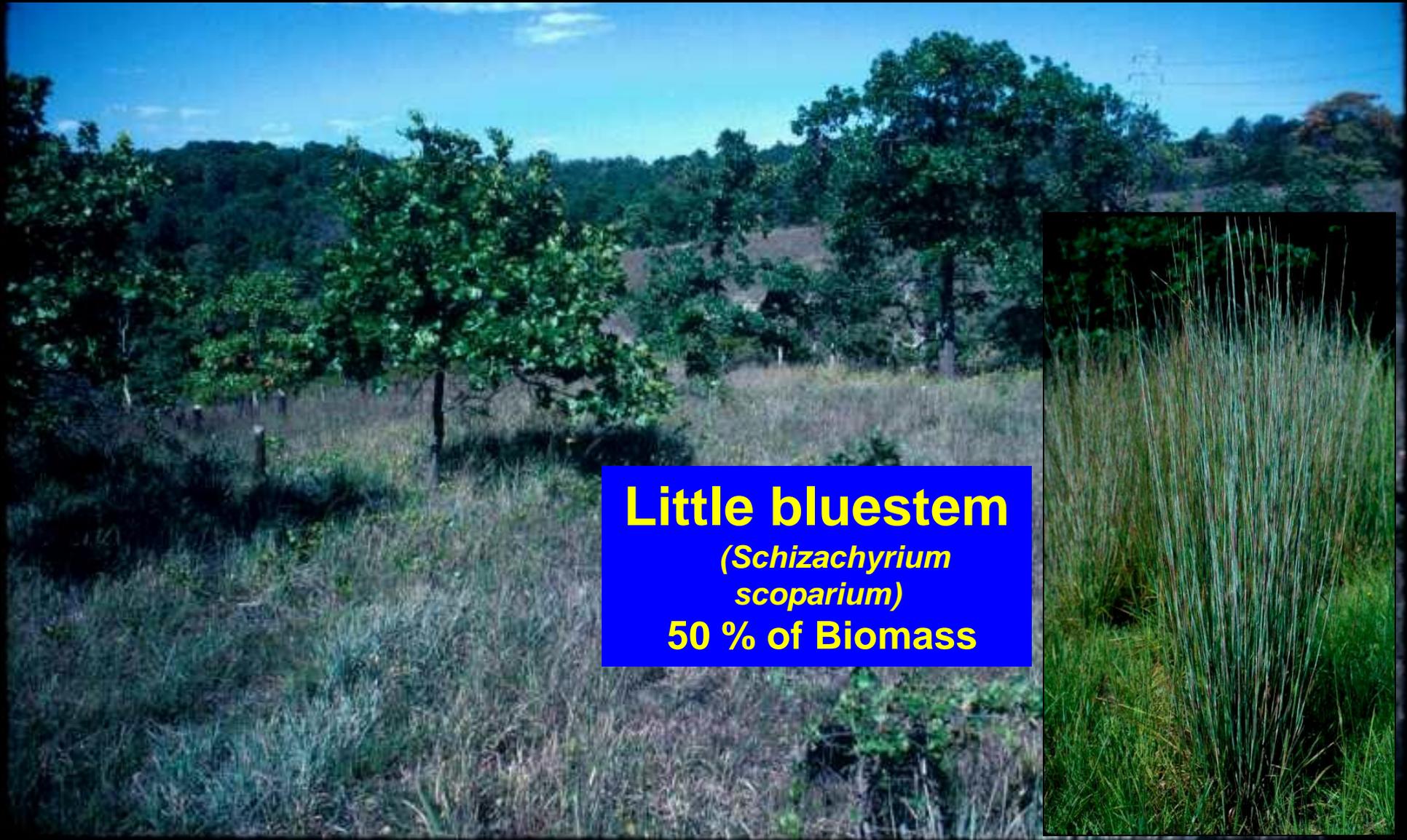
*Quercus marilandica*  
Black-jack oak



*Quercus stellata*  
Post oak



# Serpentine Oak Savanna Ecosystem



**Little bluestem**  
(*Schizachyrium  
scoparium*)  
50 % of Biomass





Indian Grass

(*Sorghastrum  
nutans*)

A photograph of a Virginia pine forest in the 1980s. The image shows a dense stand of trees on a hillside, with a mix of mature and younger trees. The ground is covered in dry grass and low-lying vegetation. The sky is clear and blue. The text is overlaid on the bottom right of the image.

**Virginia pine (*Pinus virginiana*)**  
(1980s)

**Pine – Greenbrier Forest  
1980s**



**Greenbrier  
(*Smilax rotundifolia*)**

# Serpentine Savanna Ecosystem

A photograph of a serpentine savanna landscape, showing a grassy field with scattered trees and a blue sky with light clouds. A large blue rectangular box is overlaid on the center of the image, containing white and yellow text.

**Ecosystem Characteristics**  
**Bedrock and Soils**  
**Biotic Components**

**Landscape History**

**Ecosystem Restoration**

Research Phase

Implementation Phase

**Soldiers Delight**

## Landscape History

*Historian William Bose Marye*

1886 – 1979

*(pronounced “Marie”)*

**“The Great Maryland Barrens” 1955**

**“The Old Indian Road” 1920**

**(Maryland Historical Magazine)**



*F. W. Porter III*

**1975. From backcountry to county: the delayed settlement of western Maryland**

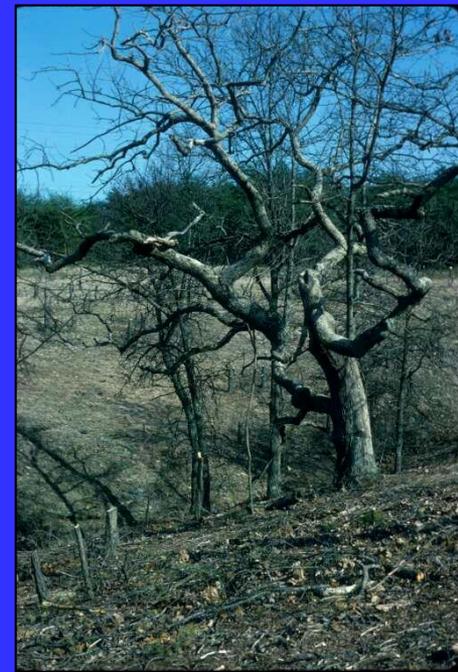
**1979. The Maryland frontier, 1722-1732...**

**Pre-settlement (<1730) descriptions** (Marye 1955):

*“a Vast Body of **Barrens** ... what is called so, because there is **no wood [timber]** upon it”*

*“... **extensive treeless spaces** in the wilderness ...”*

*“**Soldiers Delight** was an **immense barrens**”* (Marye 1920)



“... the **Indians** ... until 1730 or 1731, to improve this portion of their Great Park [York Barrens, PA] for the purpose of hunting, fired the copse or bushes as **often** as their convenience seemed to call for it”  
(Marye 1955)

“It was the custom of the Indians in the **autumn** to set fire to and burn the barrens of York [PA] and Baltimore [MD] Counties (Marye 1955)



**White-tailed Deer**  
(*Odocoileus virginianus*)

1730

# American Indian Extirpation by European Diseases Beginning of Ecosystem Collapse



1730

# American Indian Extirpation by European Diseases Beginning of Ecosystem Collapse



“No” Fire & Warm and Wet Climate

Many Barrens Became Forested

# American Indian Fires replaced by English Livestock Grazing $\geq$ 1730



**“The name of ‘Graziers Delight,’ 892 acres, surveyed ... on Soldiers Delight, October 8, 1771, implies that the barrens of Soldiers Delight were a favorite range for stock”  
(Marye 1955c)**

**“... lands which lay within easy distance of the Barrens, were considered to be more valuable on that account”  
(Marye 1955c)**

# Soldiers Delight *ca.* 1910

Shreve, F. 1910. Plant life of Maryland. Johns Hopkins University Press. Baltimore, Maryland.



**“Fig. 1 –VIEW SHOWING SERPENTINE BARREN WITH BLACK JACK AND POST OAK...”**

FIG. 1 —VIEW SHOWING SERPENTINE BARREN WITH BLACK JACK AND POST OAK, SOLDIER'S DELIGHT, BALTIMORE COUNTY.

**No Grazing > 1930s**

**Serpentine-tolerant Tree Species  
in the Surrounding Landscape**

Virginia pine (*Pinus virginiana*)

(Red cedar *Juniperus virginiana*)



**1980s**  
**50 years after grazing**

**Virginia pine invasion and expansion**

# Serpentine Savanna Ecosystem

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**Ecosystem Restoration**

**Research Phase**

**Implementation Phase**

**Soldiers Delight**

**Charlie Robertson**  
MD Forest Service

**Spring Rx Burn**



Research Area 1

**Research Burn – Charlie Robertson (MFS)**



**Little bluestem**



**Indian grass**



**Big bluestem**



**Insects**



**Wildflowers**





Control

Research Area 2



Cleared-and-Burned

Cleared only

# Heavy equipment impact to silt loam soil

Bedrock



Silt loam

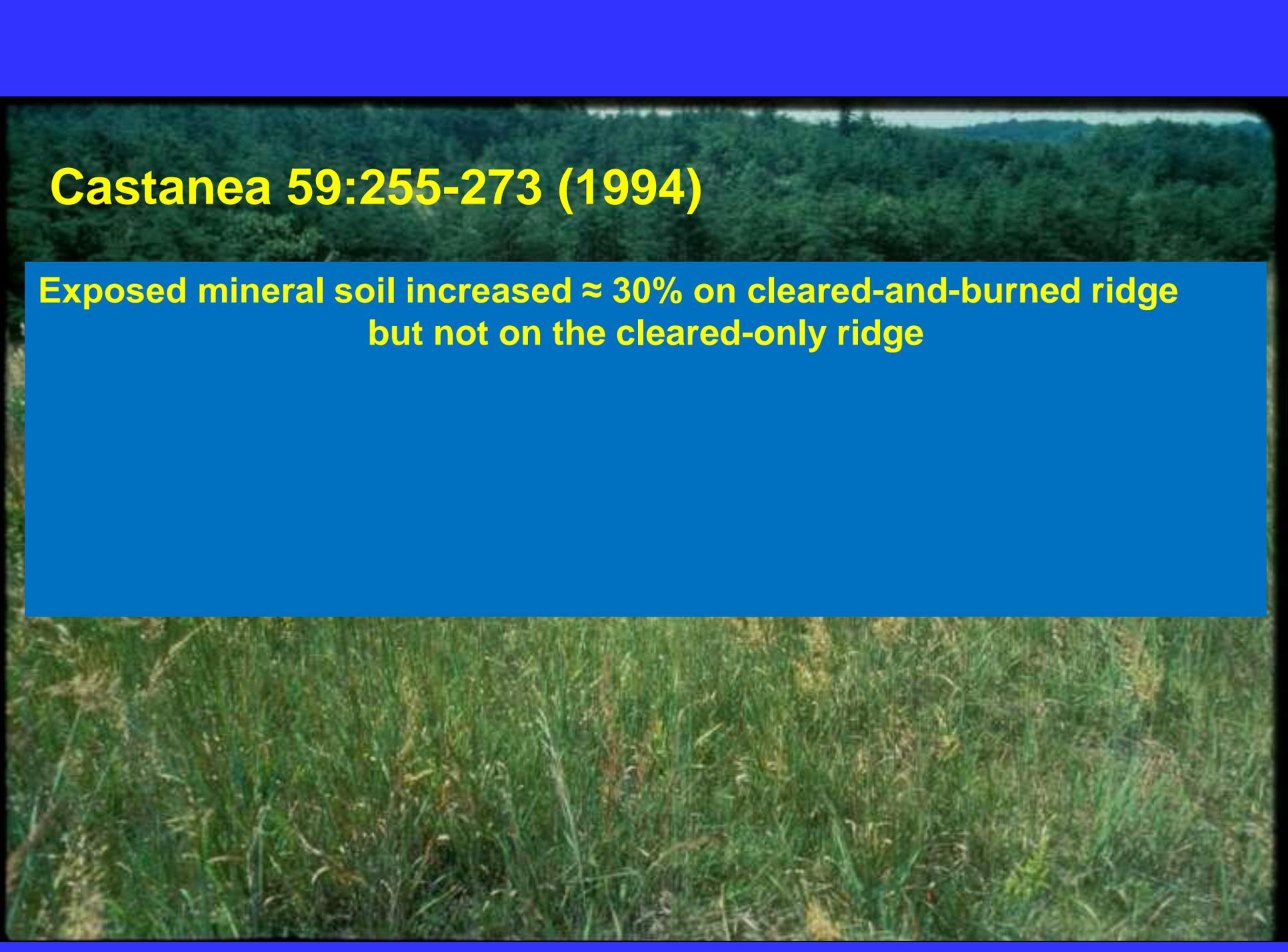


**Cleared Nov 1989**  
**Burned Nov 1990**  
**Burned Nov 1991**  
**Plots sampled 1989-1992**

Head-fire effect

Back-fire effect



The image shows a landscape with a dense forest of green trees in the background. In the foreground, there is a field of tall, green grasses. A blue rectangular box is overlaid on the image, containing text.

## Castanea 59:255-273 (1994)

Exposed mineral soil increased  $\approx 30\%$  on cleared-and-burned ridge  
but not on the cleared-only ridge

**Serpentine  
chickweed**



*Cerastium arvense* var. *villosum*

***Symphyotrichum depauperatum*  
Serpentine aster**



***Talinum teretifolium***



**Fame flower**





## **Castanea 59:255-273 (1994)**

**Exposed mineral soil increased  $\approx 30\%$  on cleared-and-burned ridge  
but not on the cleared-only ridge**

**Little bluestem cover did not change on any ridge**



**Federally Endangered**

***Sandplain gerardia***

*(Agalinis decemloba (A. acuta))*



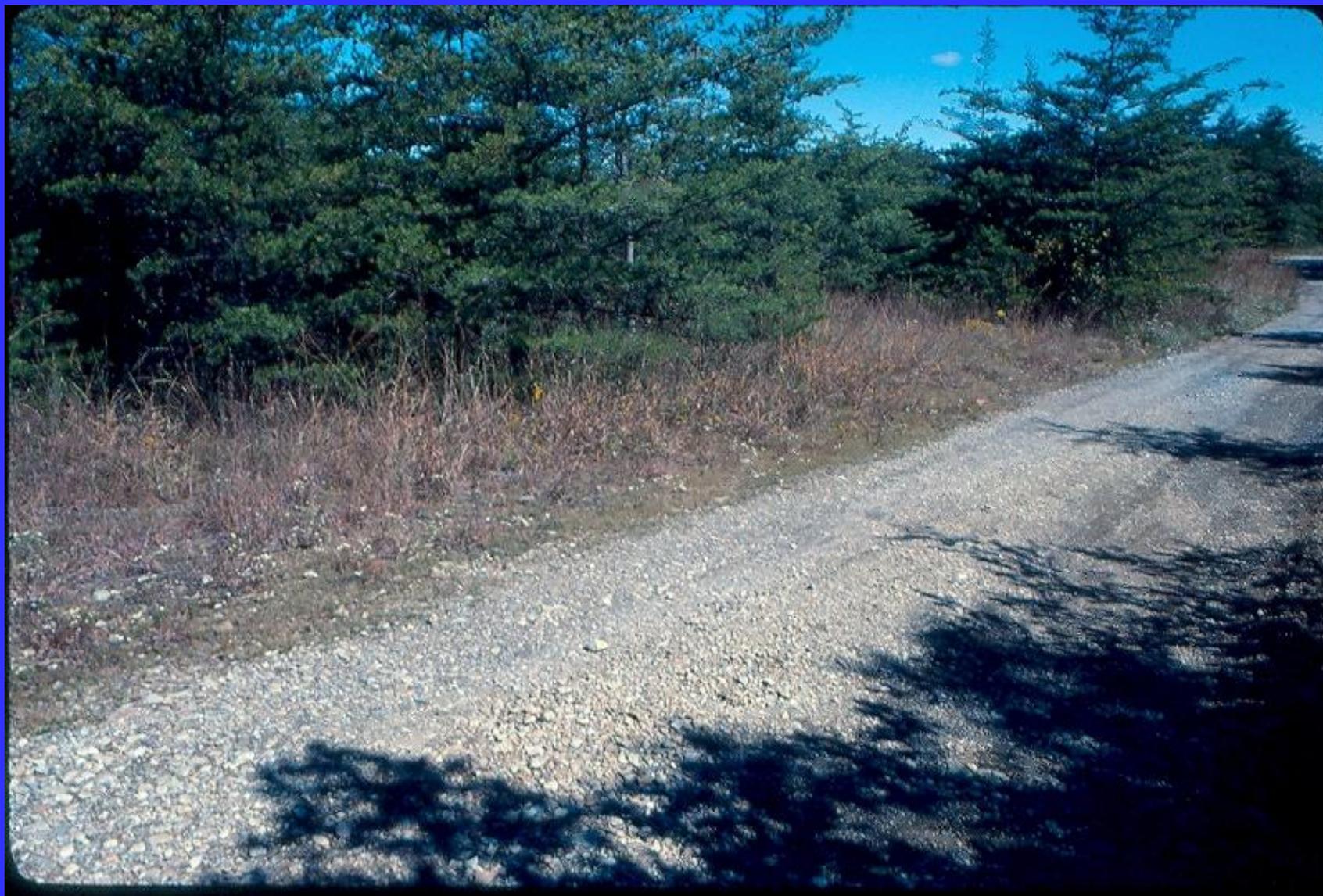




Little bluestem

Sandplain gerardia

Sep 1989



Research Area 3



Cleared Only

Cleared-and-burned

Nov. 1990, 1991, 1999

Nov. 1991



A landscape photograph showing a field of young trees and a dirt road under a clear blue sky. The foreground is a mix of green grass and dry, brownish vegetation. A dirt road curves from the right side towards the center. In the background, there is a dense line of trees, including some taller, darker evergreens. The sky is bright blue with a few small white clouds.

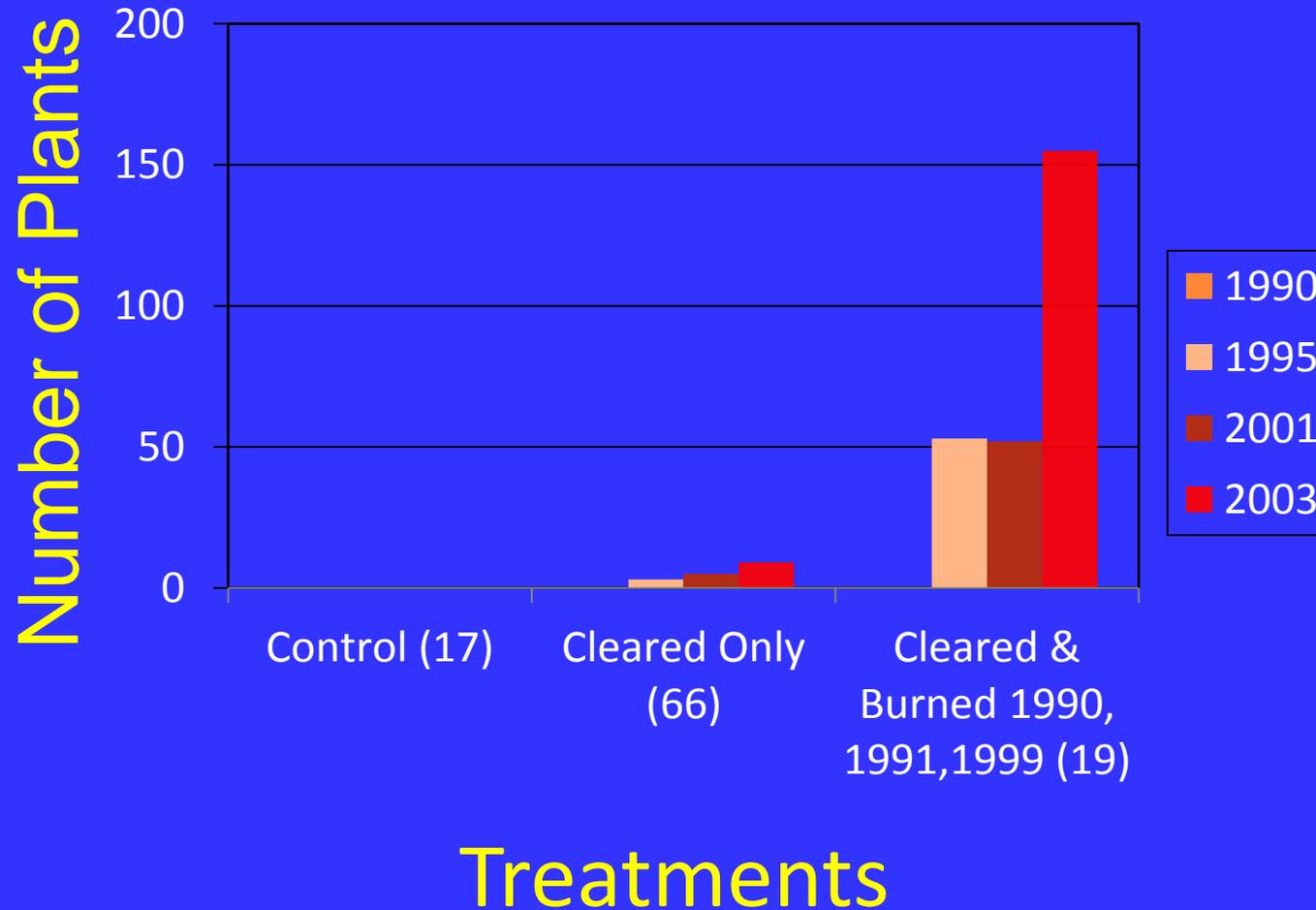
Fall fire effects on microclimate in herbaceous layer  
Irradiance levels  
Drought stress

Fire effect on seed dispersal

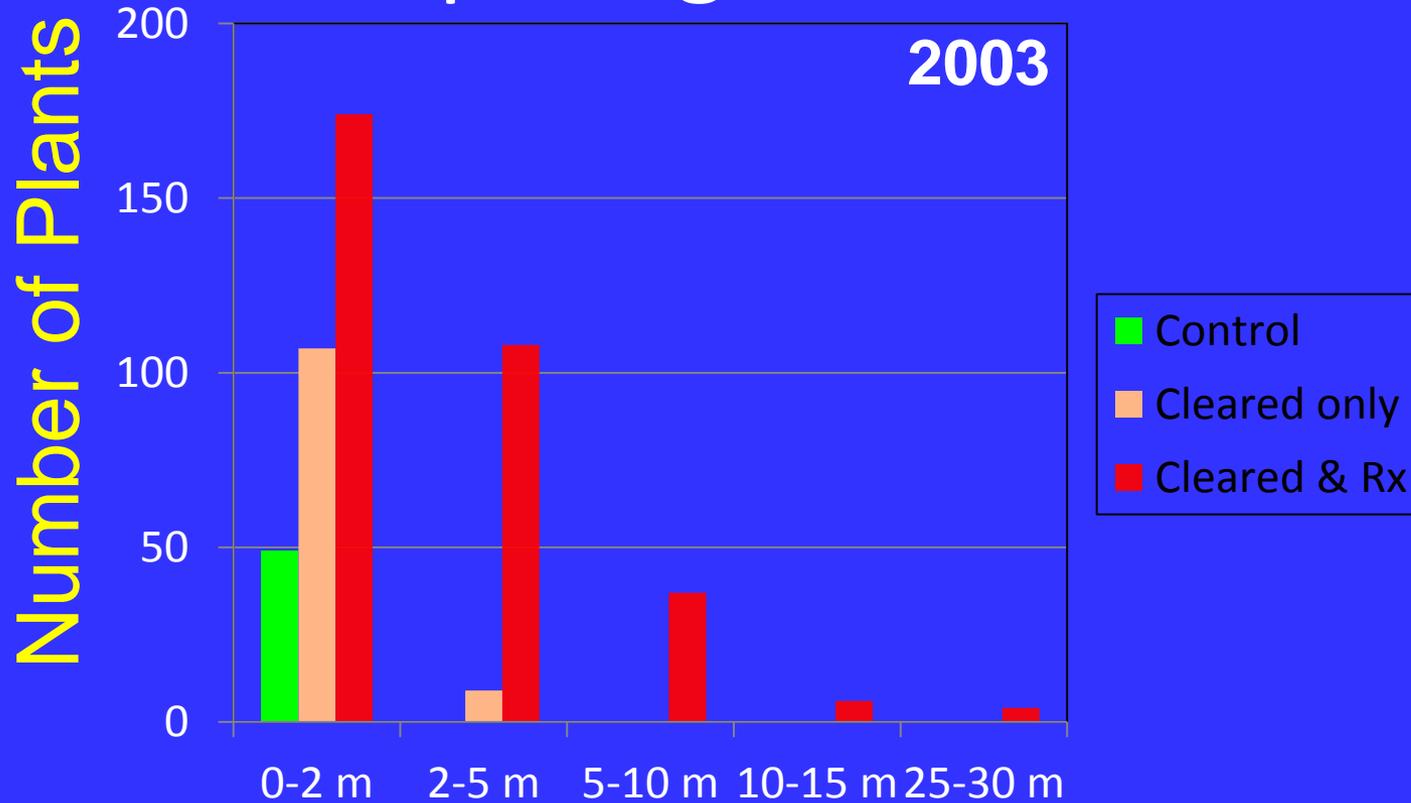
Sep 1989



# Sandplain gerardia



# Sandplain gerardia



Distance from Road



**Inhibition of seed dispersal by standing biomass**

**Seed dispersal from the roadside**

# Serpentine Savanna Ecosystem

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**Ecosystem Characteristics**  
**Bedrock and Soils**  
**Biotic Components**

**Landscape History**

**Ecosystem Restoration**

Research Phase

**Implementation Phase**

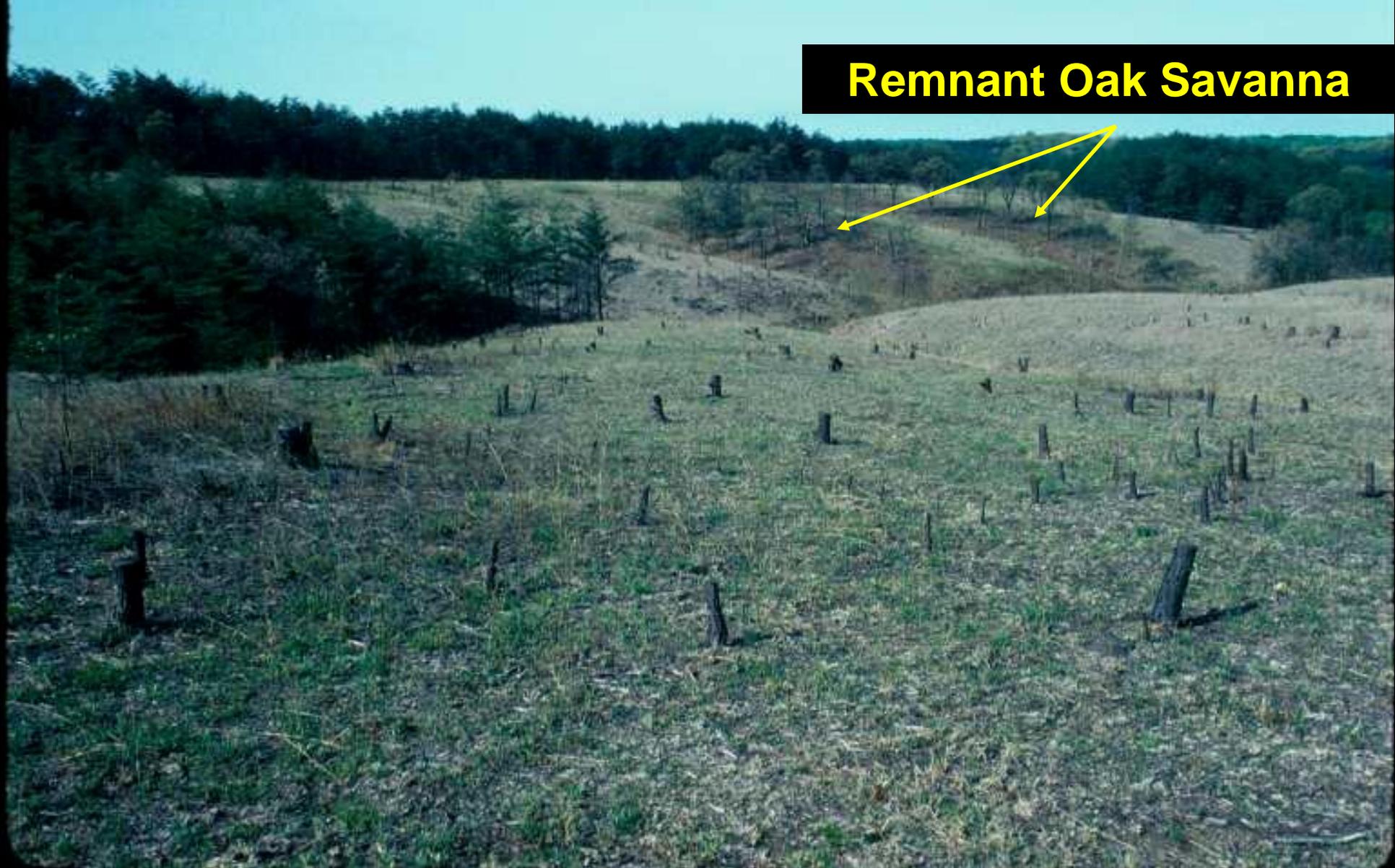
**Soldiers Delight**



**Cleared Winter 1991/92**



# Remnant Oak Savanna





# Old-growth Post Oak







May 1992

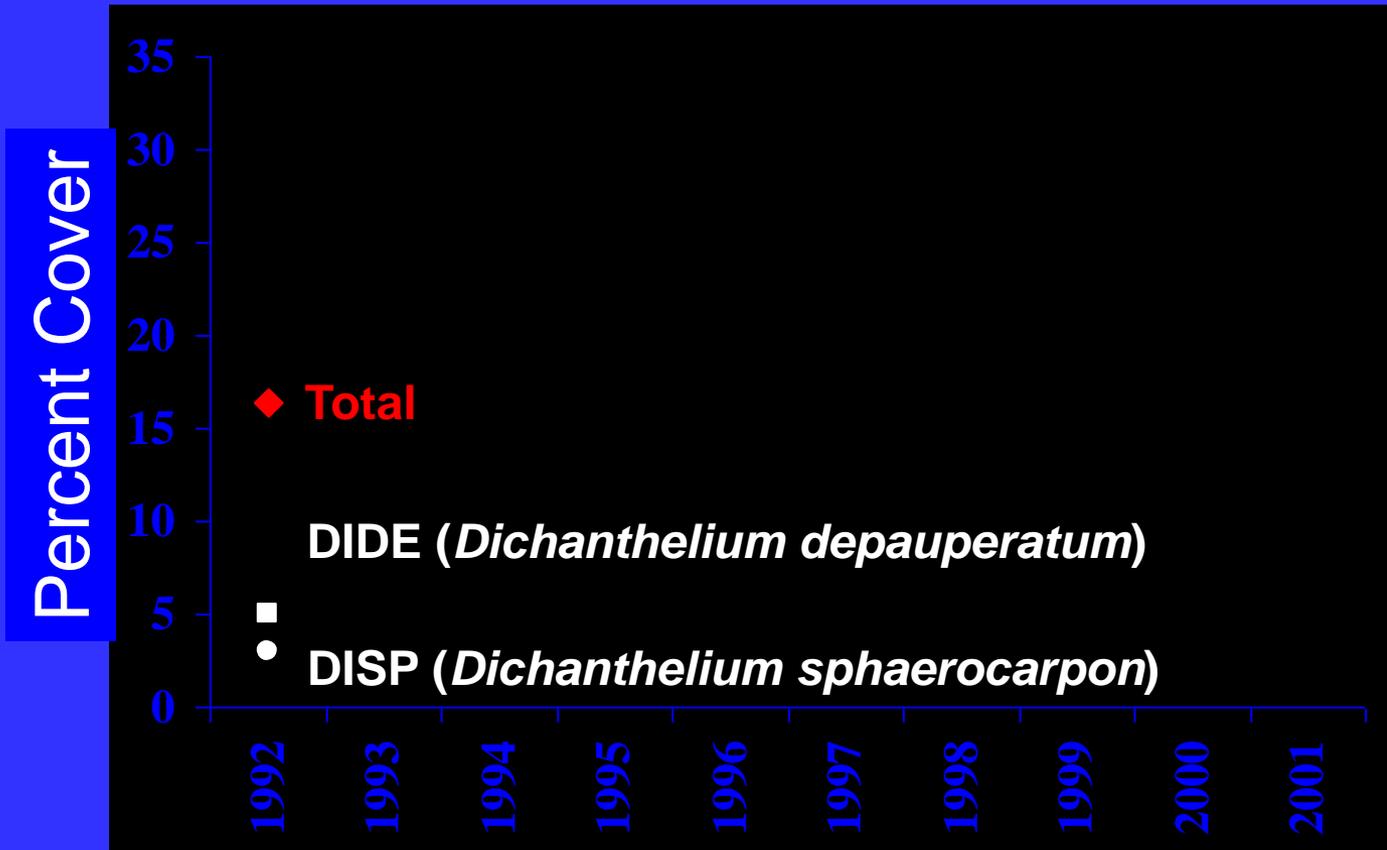


Upper Transect

*Dichanthelium sphaerocarpon*



# Oak Savanna



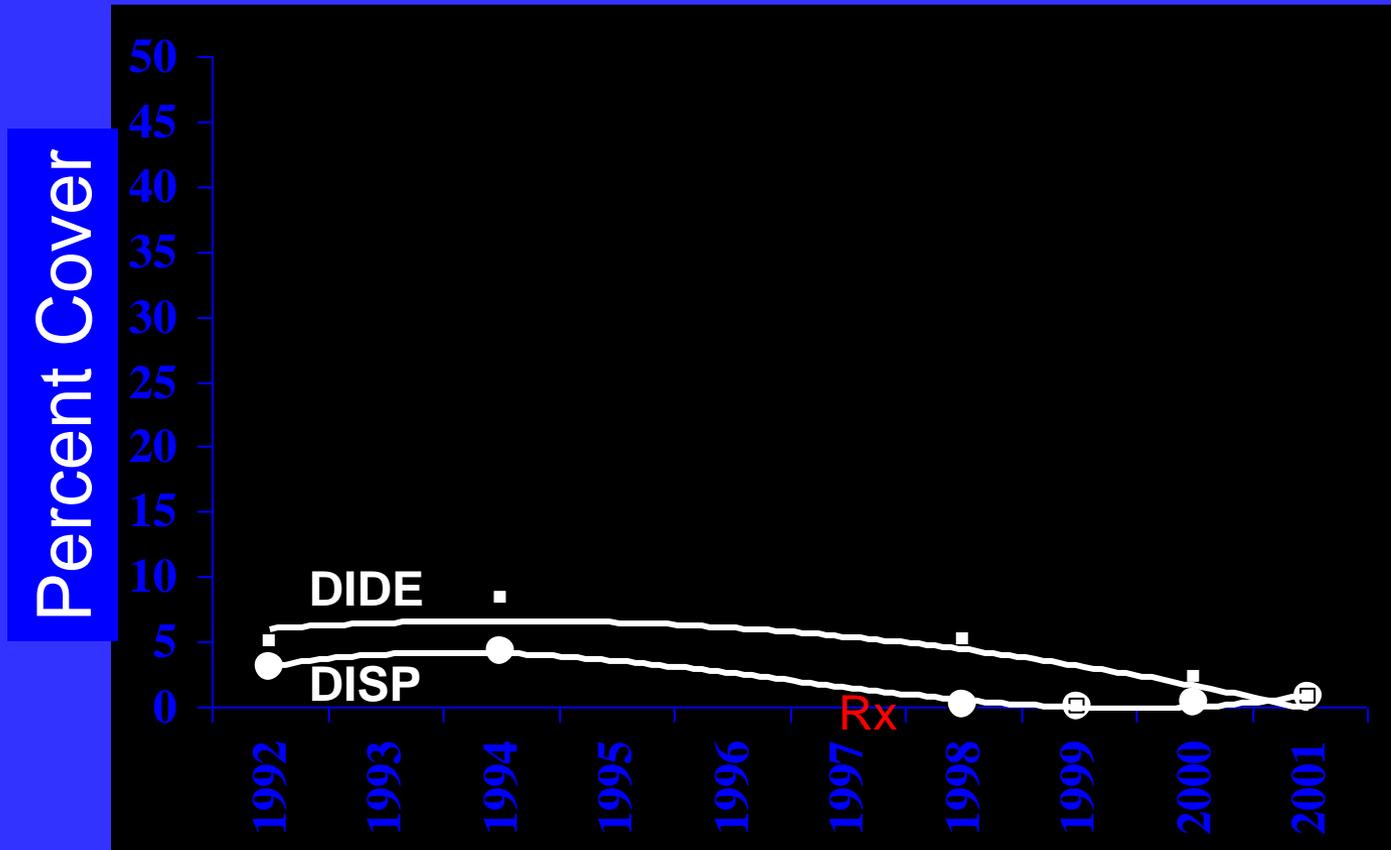
Oct 1997



Nov 1997

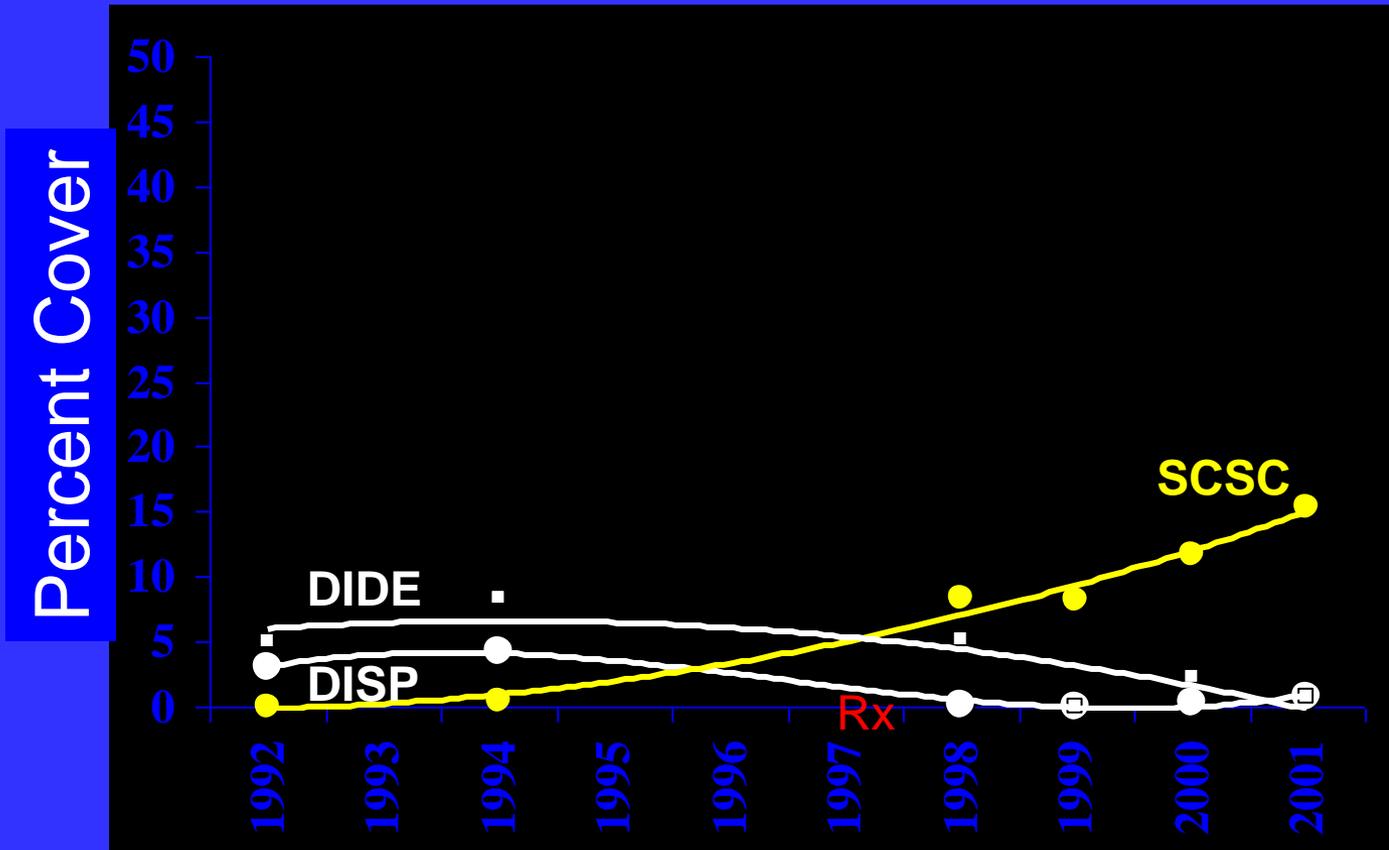


# Oak Savanna



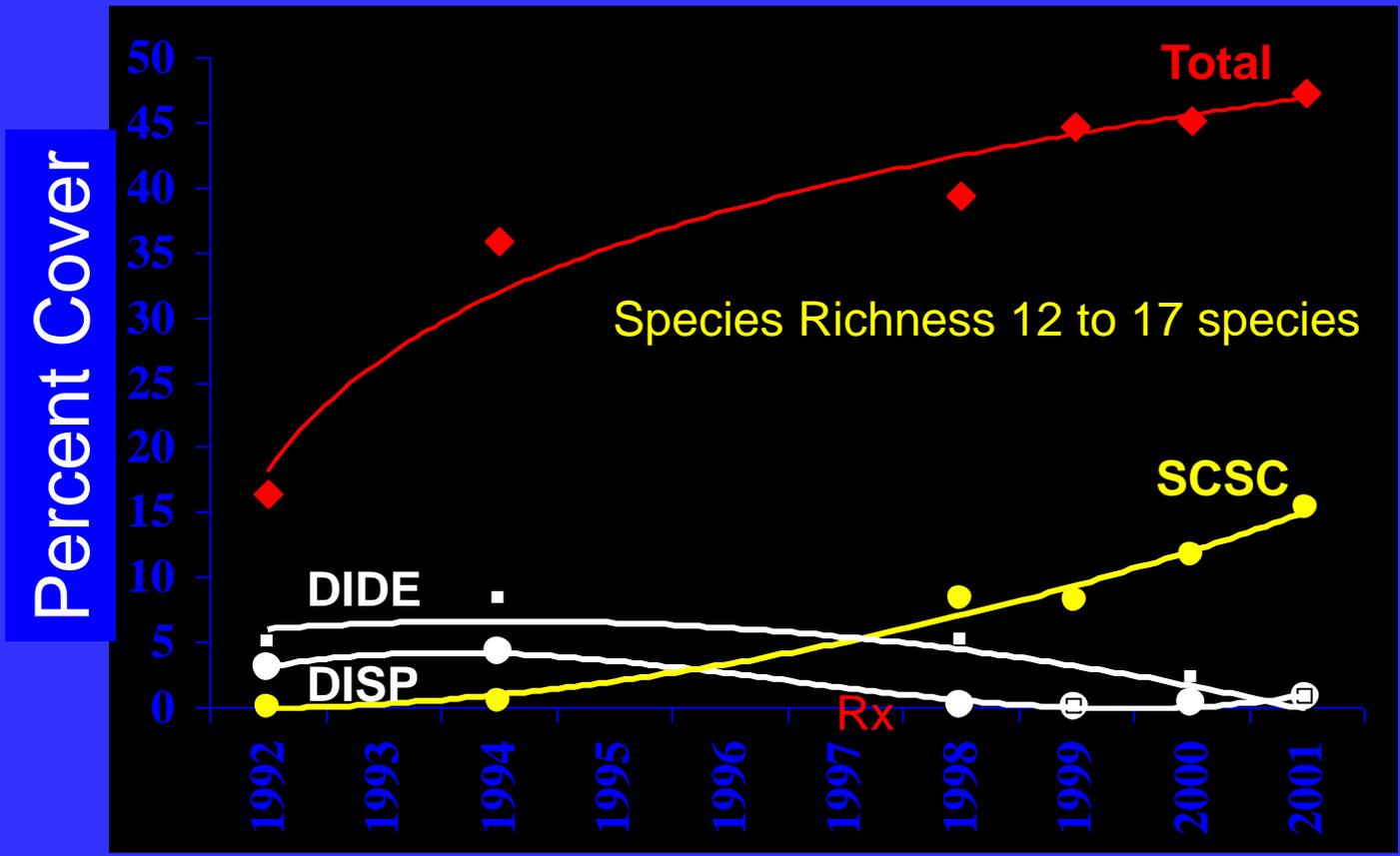
Castanea 70:287-297 (2005)

# Oak Savanna



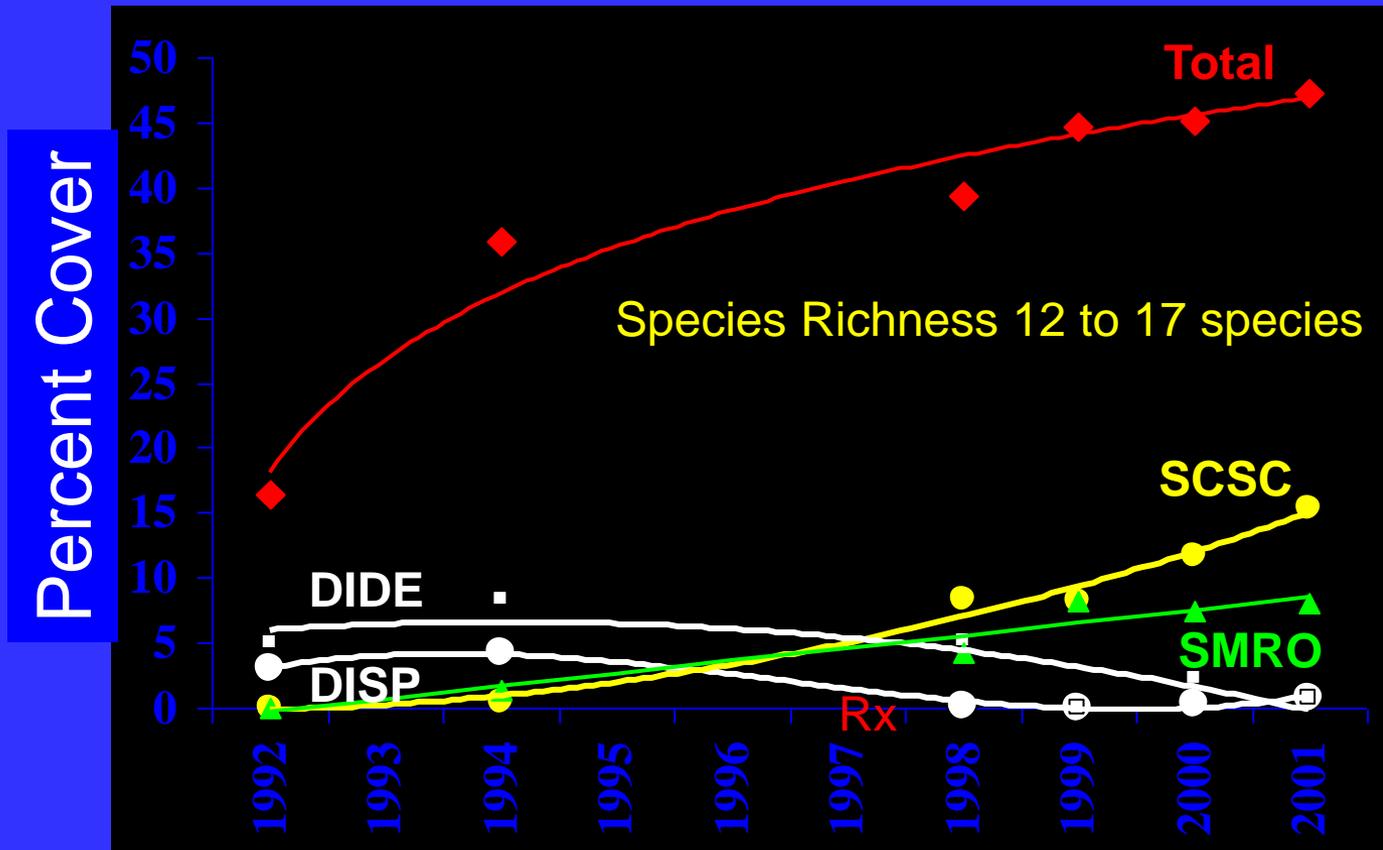
Castanea 70:287-297 (2005)

# Oak Savanna



Castanea 70:287-297 (2005)

# Oak Savanna



Castanea 70:287-297 (2005)

Sep 1998



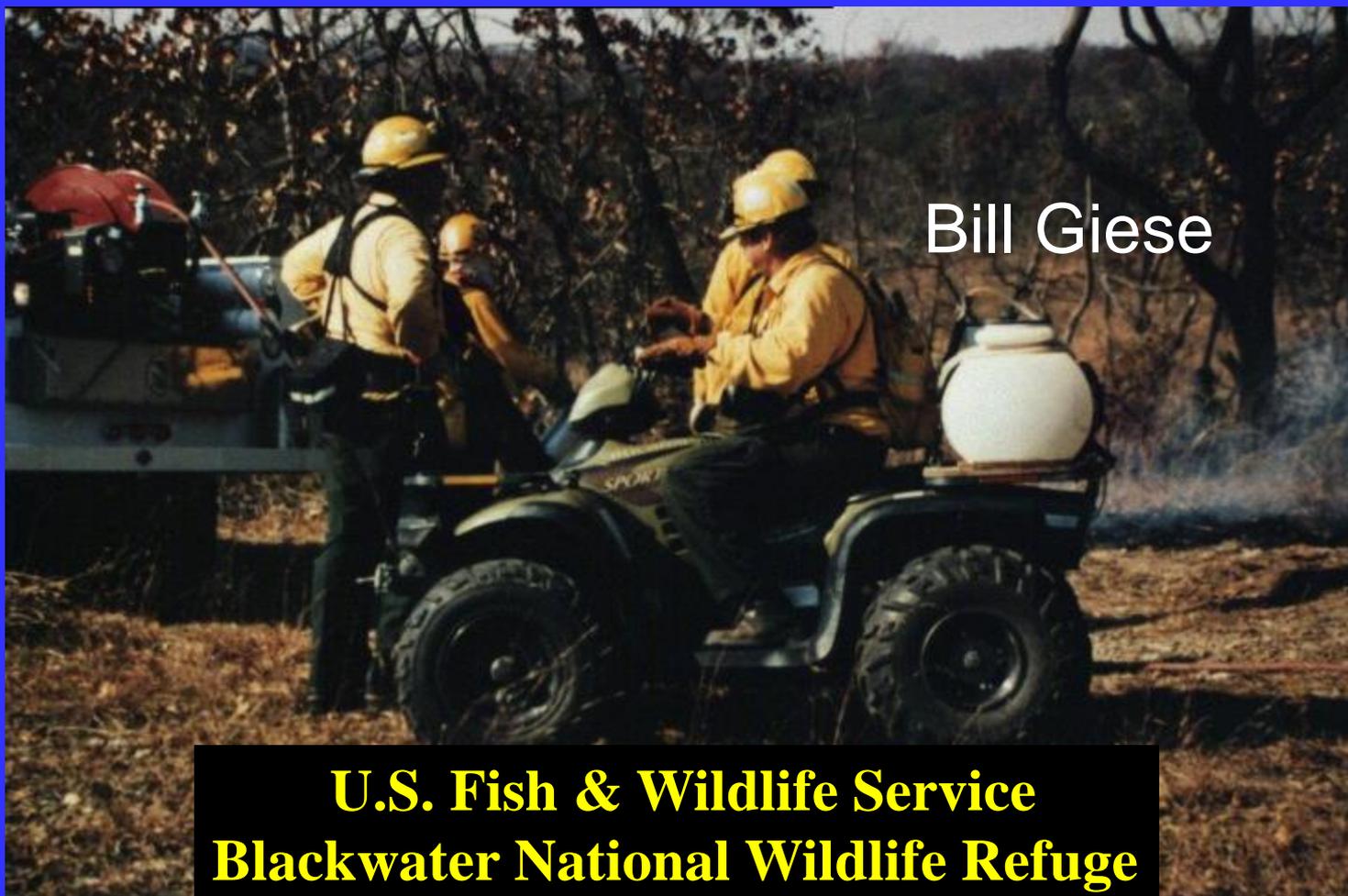
Sep 2010

Rx: Nov 1997  
Nov 2004



Greenbriar





Bill Giese

**U.S. Fish & Wildlife Service  
Blackwater National Wildlife Refuge**

Photo by Jim Dudley

Nov 1999



Pine savannas and woodlands > clearing





**Pine – Greenbrier Forest**

Greenbrier  
(*Smilax rotundifolia*)



Nov 1999

Photo by Jim Dudley



Nov 1999

Photo by Jim Dudley



Nov 1999

Photo by Jim Dudley



Nov 1999

Photo by Jim Dudley



Nov 1999

Photo by Jim Dudley



Nov 1999

Photo by Jim Dudley



Nov 1999

Photo by Jim Dudley

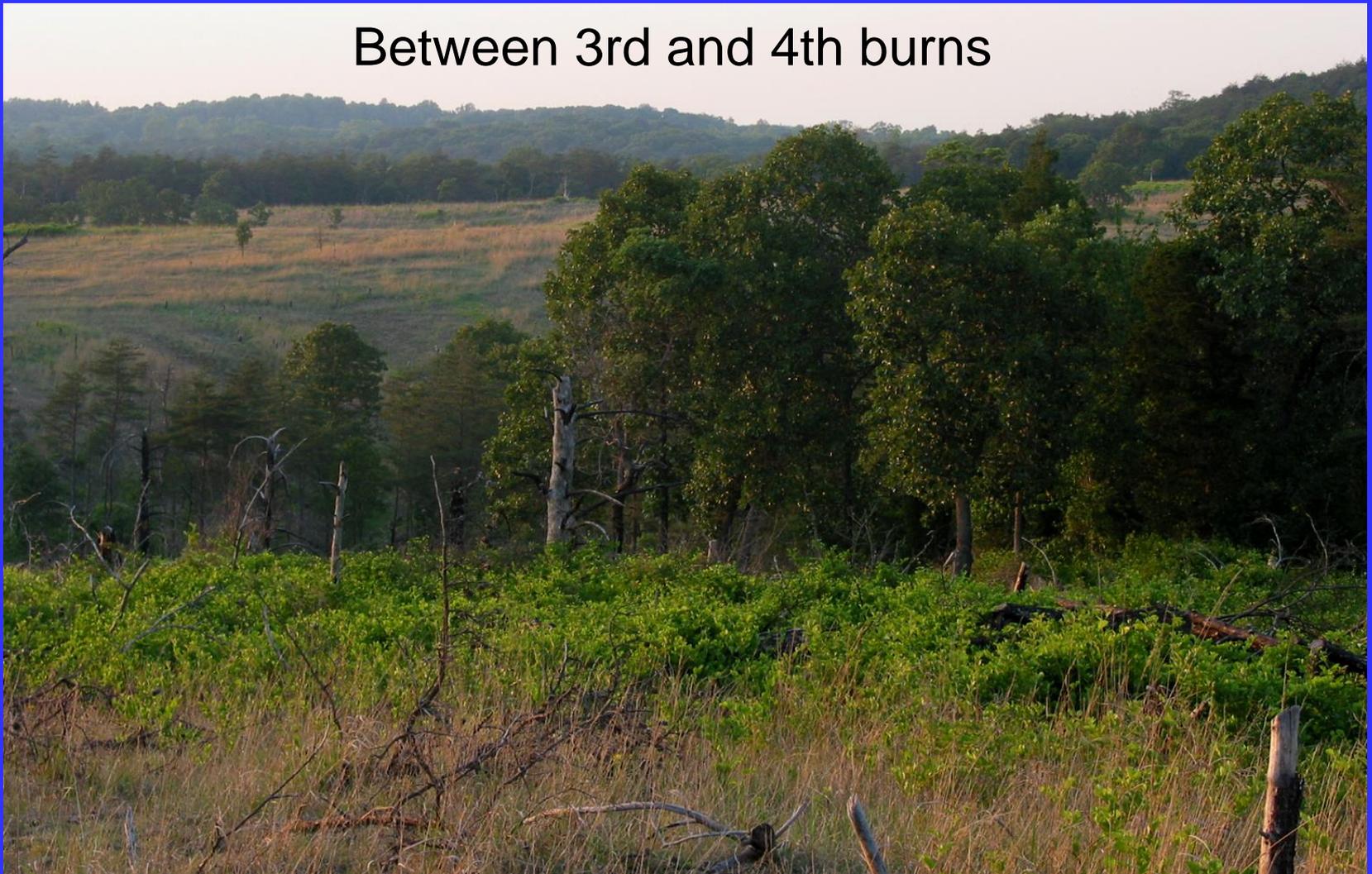


Burned: Nov. 1999  
Nov. 2005  
April 2010  
May 2013

Nov 1999

Photo by Jim Dudley

Between 3rd and 4th burns





Nov 1999

Photo by Jim Dudley



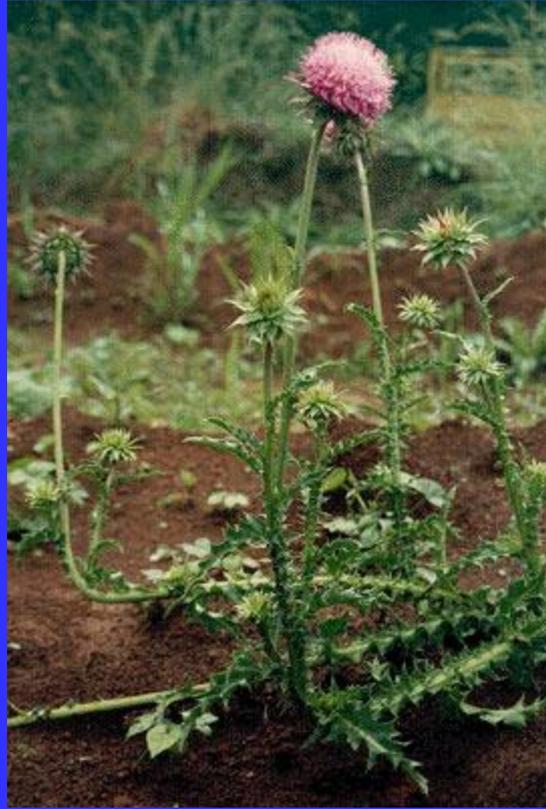
Sep 2013



Sep 2013



**Mullein**



**Thistles**



**Mile-a-minute-vine**



**Tree-of-heaven**

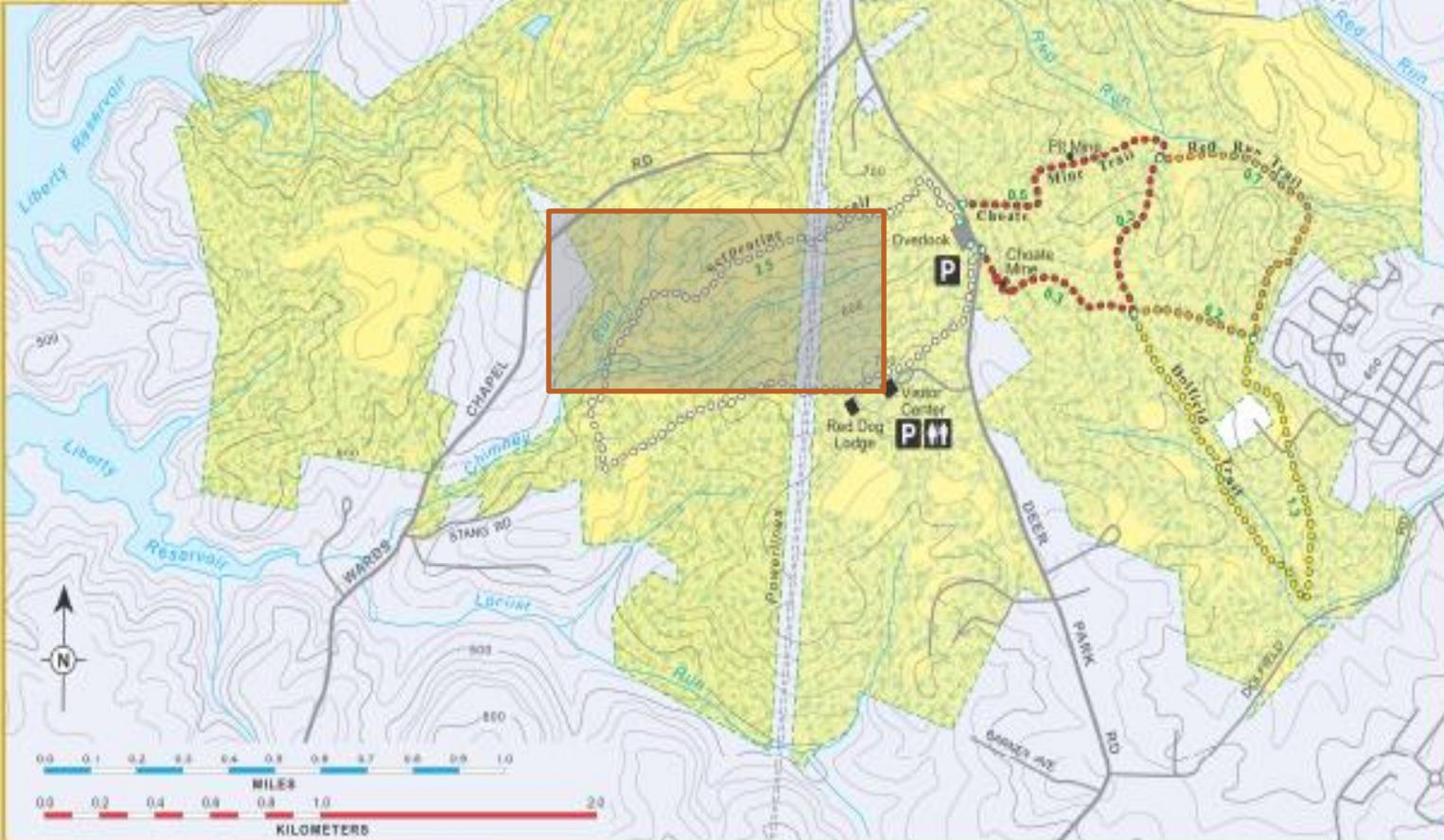
# Pine-greenbriar forest or greenbriar patches



Pine savannas and  
woodlands > clearing



# Soldiers Delight Natural Environment Area



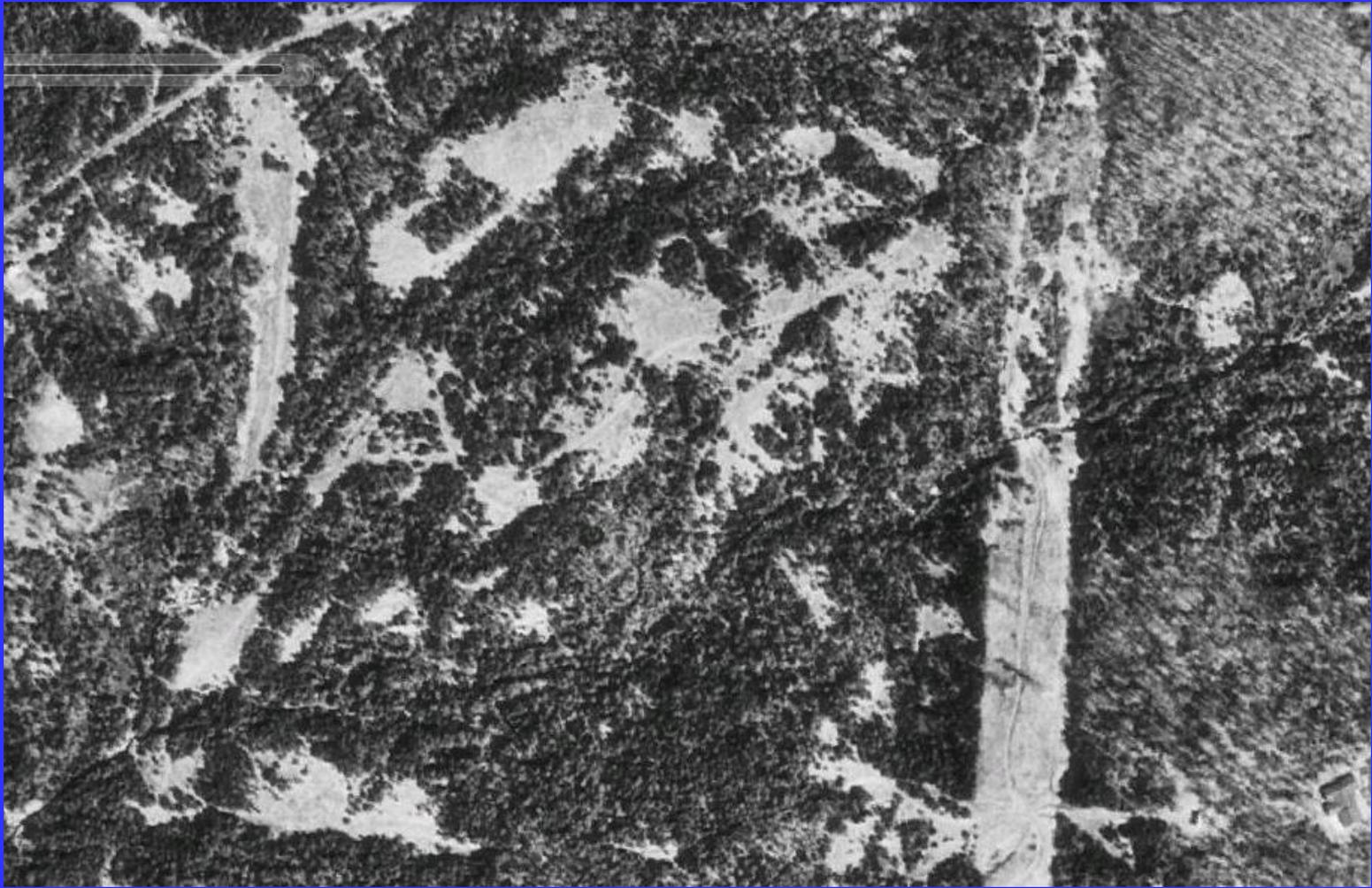
**LEGEND**

- ⋯⋯⋯⋯ Serpentine Trail
- ⋯⋯⋯⋯ Choate Mine Trail
- ⋯⋯⋯⋯ Red Run Trail
- ⋯⋯⋯⋯ Dollfield Trail
- Major Road
- Minor Road
- - - NEA Boundary
- P** Parking
- PM** Restrooms
- Stream
- Water Body
- Intermediate Contour
- Index Contour
- 20 ft. contour interval
- 0.4 ○ 0.1 Mileage (10th)
- Tree Covered
- Open Vegetation
- Non-NEA

The boundaries for Soldiers Delight NEA are approximate.

This map was designed and rendered by Thomas D. Rabehorst, Director of Instructional Cartography, UMBC Department of Geography & Environmental Systems, ©2005





1993



2002



2002



Nov 1999

Photo by Jim Dudley



Nov 1999

Photo by Jim Dudley



Nov 1999

Photo by Jim Dudley



Nov 1999

Photo by Jim Dudley



2005



2005



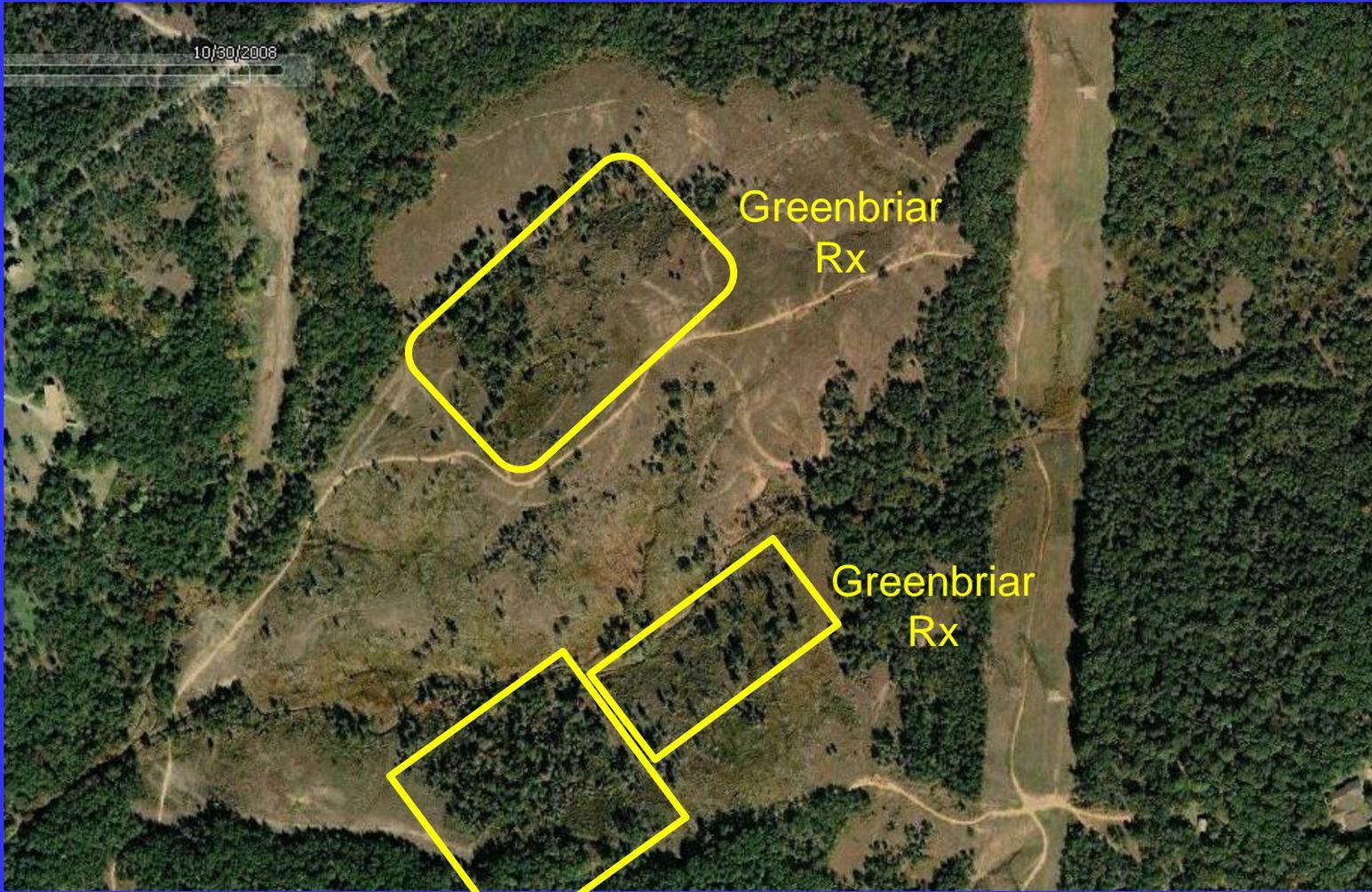
2008



Pine-Greenbriar  
Rx Unit (on hold)

2014

10/30/2008



Greenbriar  
Rx

Greenbriar  
Rx

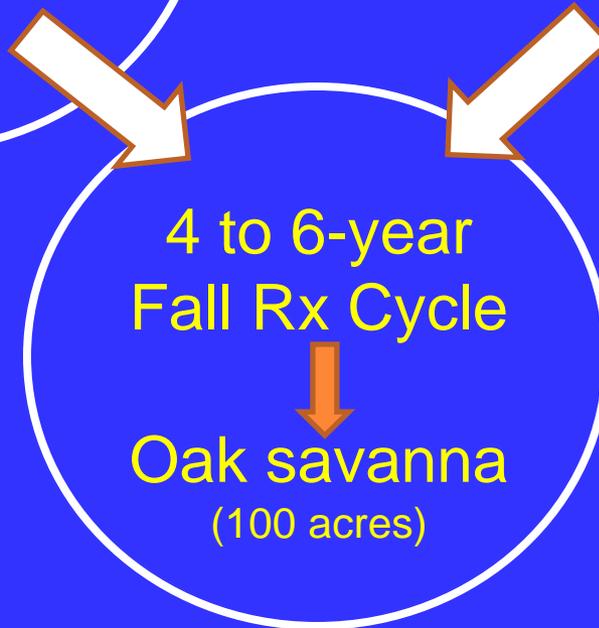
Pine-Greenbriar  
Rx Unit (on hold)

2014

# Pine-greenbriar forest or greenbriar patches

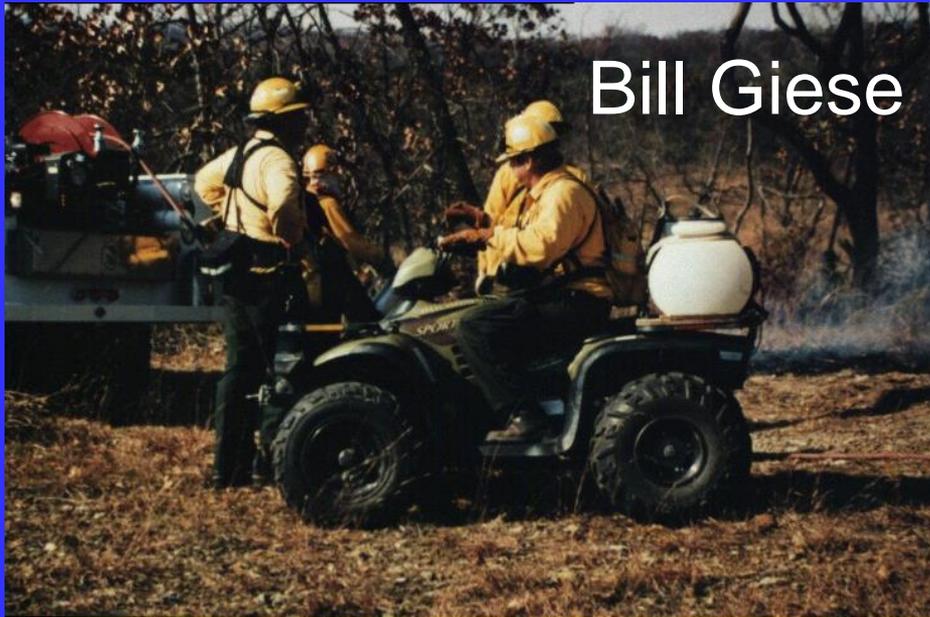


Pine savannas and  
woodlands > clearing  
(300 acres)



# Climate Change Serpentine Savanna - Hypsithermal Interval





Bill Giese

AmeriCorps NCCC  
The Nature Conservancy  
MD Forest Service  
MD Conservation Corps

**U.S. Fish & Wildlife Service  
Blackwater National Wildlife Refuge**



Pat Farr

*Wayne Tyndall, State Restoration Ecologist  
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