

Disking and Mid- and Understory Removal Following an Above Average Acorn Crop in Three Mature Oak Forests in Southern Indiana



PURDUE
UNIVERSITY

Ron Rathfon, Extension Forester

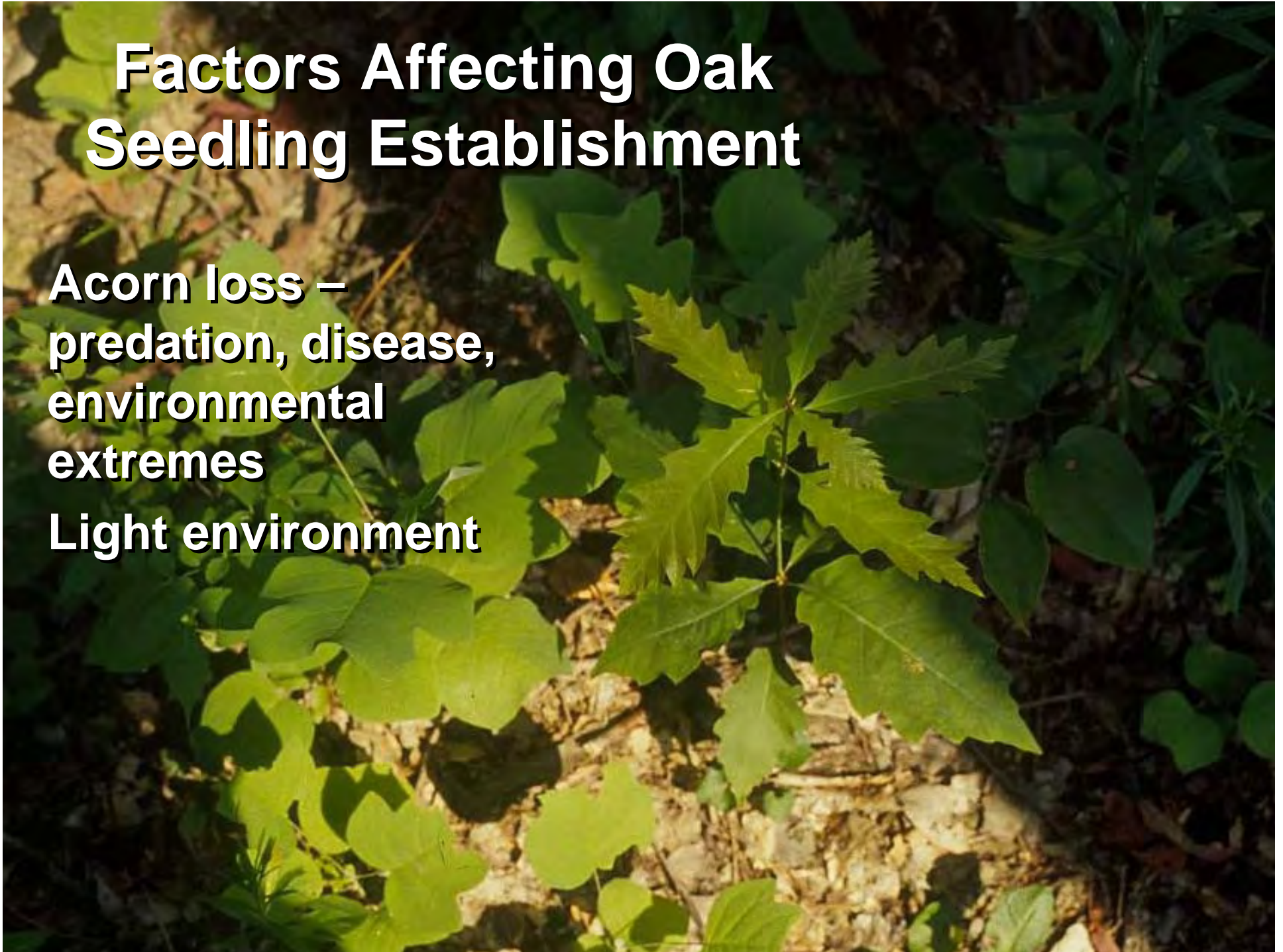
Nathan Lichti, Graduate Research Assistant

**Dr. Robert Swihart, Professor
Wildlife Ecology & Dept. Head**

Factors Affecting Oak Seedling Establishment

**Acorn loss –
predation, disease,
environmental
extremes**

Light environment





Objective

Improve oak seedling establishment through:

- 1. Disking in acorns**
- 2. Timely mid- and understory removal**

An aerial photograph of a rural landscape in Southern Indiana. The terrain is characterized by rolling green hills and valleys. A network of dirt roads winds through the fields. In the center, there is a small cluster of buildings, likely a farm or a small settlement. The overall scene is peaceful and scenic, typical of the agricultural region of Indiana.

**Southern Indiana
Purdue Ag Center**

**SIPAC Disking Trial –
Total Basal Area
(ft²/acre)**

SPP	I	N	P	Grand Total
Overstory Basal Area				
White Oak	18	40	97	55
Red Oak	45	24	11	29
Black Oak	3	10	6	6
Oak Total	66	75	113	89
Other Hardwood	74	29	16	43
Total Overstory	141	104	129	132
Mid- and Understory	27	23	29	28
Total Basal Area	168	127	158	160

Stand Characteristics

Average across all 3 sites:

67% of overstory basal area is oak

57% of all basal area is oak



Stand Characteristics

**Across all 3
sites:**

**15 – 19% of basal
area was shade
tolerant midstory
trees**



Disking for Oak Seedling Establishment

Indiana:

□ 75% owned by
family forest owners
(NIPF)


□ Methods and
techniques adapted
to small ownerships
(< 500 acres)





John Hodges

UGA47980


A green John Deere 855 tractor is shown in a forest setting, pulling a two-row 6-foot disk harrow. The tractor is positioned on a path covered with fallen leaves and branches. The harrow has two rows of large, circular disks. The background consists of many thin tree trunks and some autumn-colored foliage.

**John Deere 855, 24 hp
diesel, 4x4
Two row 6 ft. disk**

Paired Transects

150 – 500 ft length

16 to 30 ft apart

- 
- **2ft x 2 ft sample plots, permanently marked**
 - **30 ft intervals**
 - **Sound acorns and advance reproduction**

- **6 ft wide**
- **3 to 6 inches deep**







Disking completed Nov. 1, 2005
17% - 26% of tract area disked



Midstory Removal

Light levels <2-5% cannot sustain oak seedlings

Our understory light levels 0.4 – 2%

Applied treatments June 29 – July 6, 2006

One acre treatment plots in each tract

Midstory Removal

Injection

1 per inch dbh

Pathway



Midstory Removal

Chainsaw Girdle and Felling
Pathway

Felled $\frac{1}{2}$ " - 5"

Girdle >5 "



Midstory Removal

A man wearing a green long-sleeved shirt, dark pants, and a backpack sprayer is standing in a forest. He is holding a spray wand and applying herbicide to the basal bark of a tree trunk. The forest floor is covered with fallen leaves and twigs. The background shows many thin tree trunks and green foliage.

Basal Bark

20% Garlon 4 in AX-IT

**Seedlings
inventoried
May, July,
August, and
October, 2006**

**Paired plots
1,111 1 m²
sample plots**



Results – Oct 2006





**No. acorns sampled by tract in Nov. 2005, within
3 days before disking**

558 4 ft² sample plots

I = 70089/acre

N = 71680/acre

P = 75973/acre

Tot = 72932/acre



**Lhotka and Zaczek (2003):
79,100 to 86,000 acorns/acre**

**Bundy et al. (1991):
61,100 acorns/acre**

**Steiner (1995):
RO acorn numbers ranged from 526 to
198,500/acre with an average of
41,800/acre across four consecutive
years and five widely separated stands
in Pennsylvania.**



Patchy Distribution

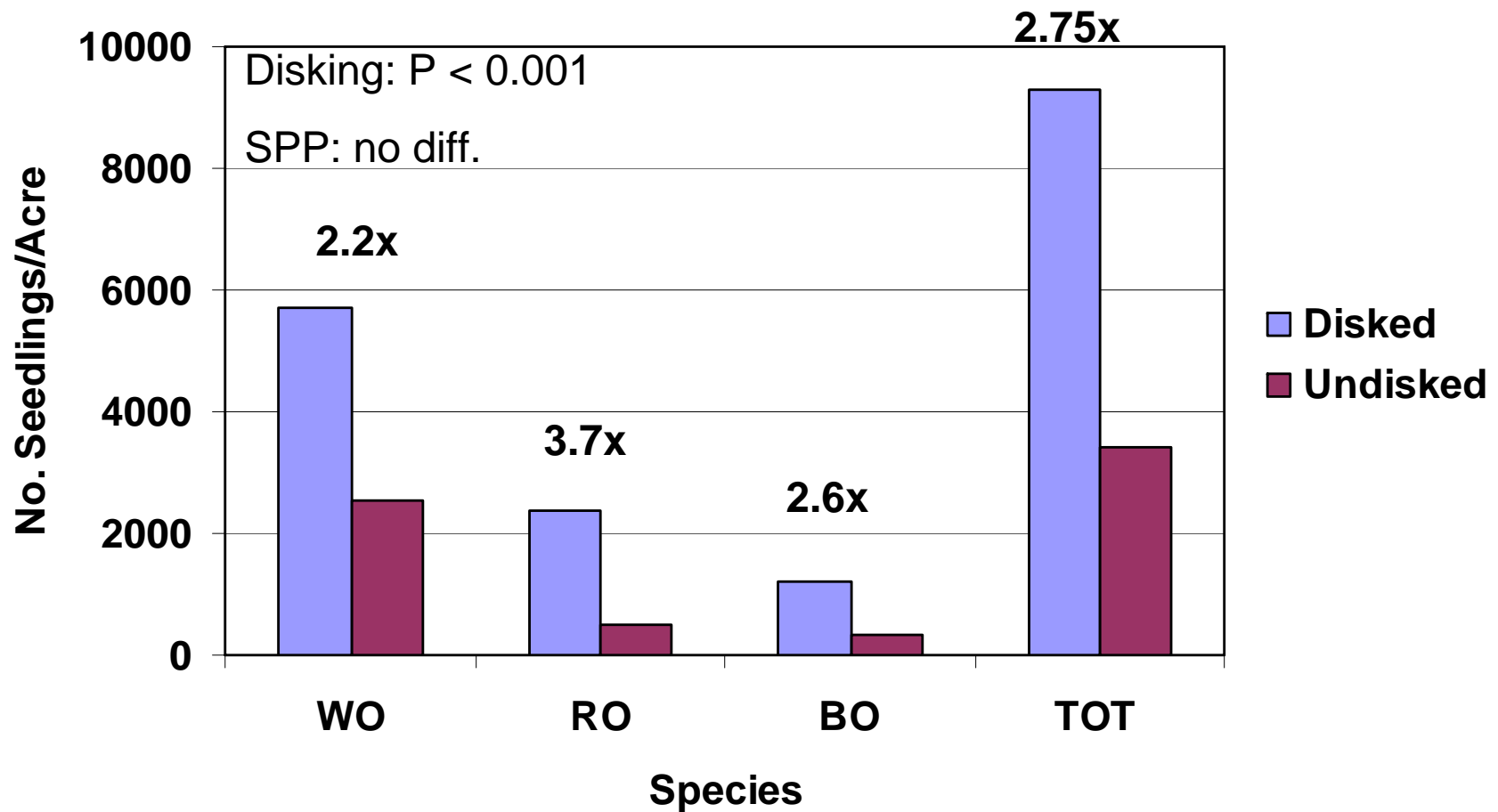
20% sample plots had 0 acorns

>50% sample plots had 3 or less

>20% sample plots had 10 or more

Disking Results – Oct 2006

Oak Seedlings Disked vs. Non-disked





%Acorns to Seedlings

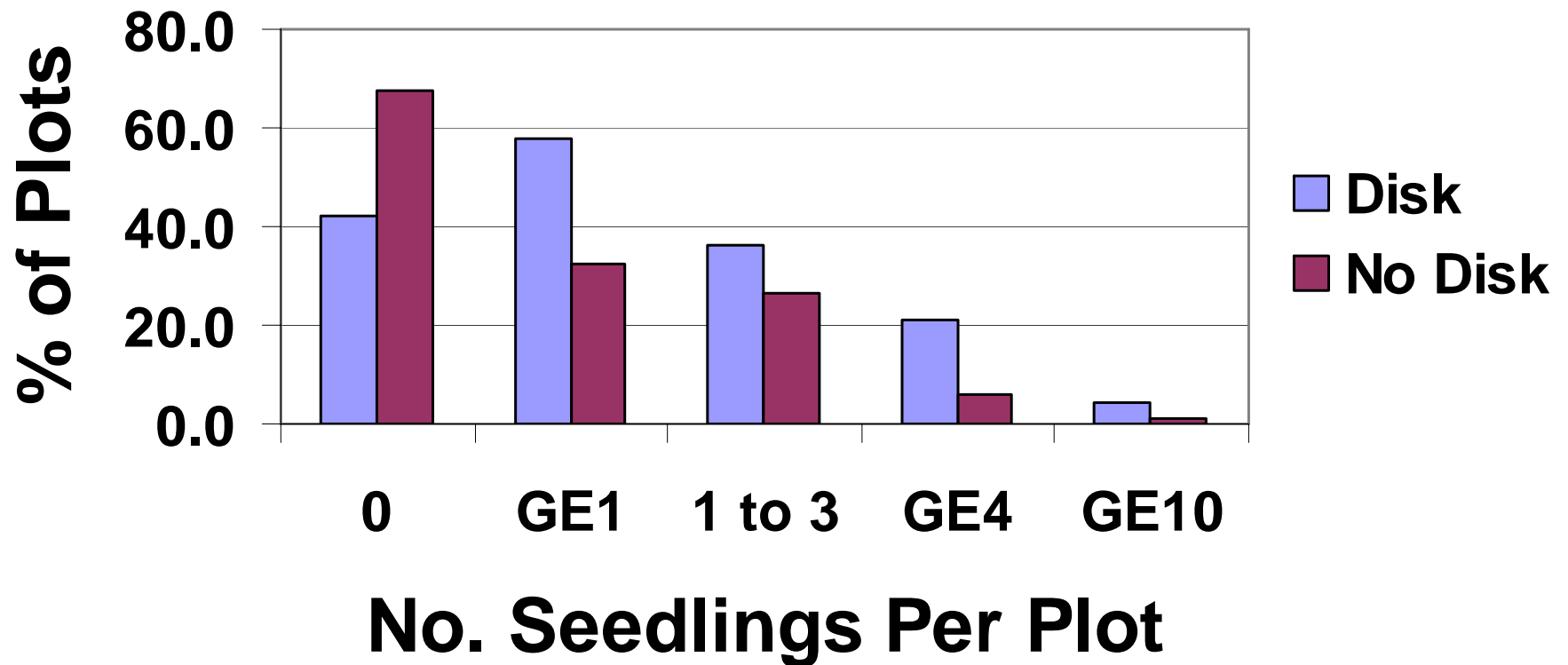


13% disked
5% non-disked

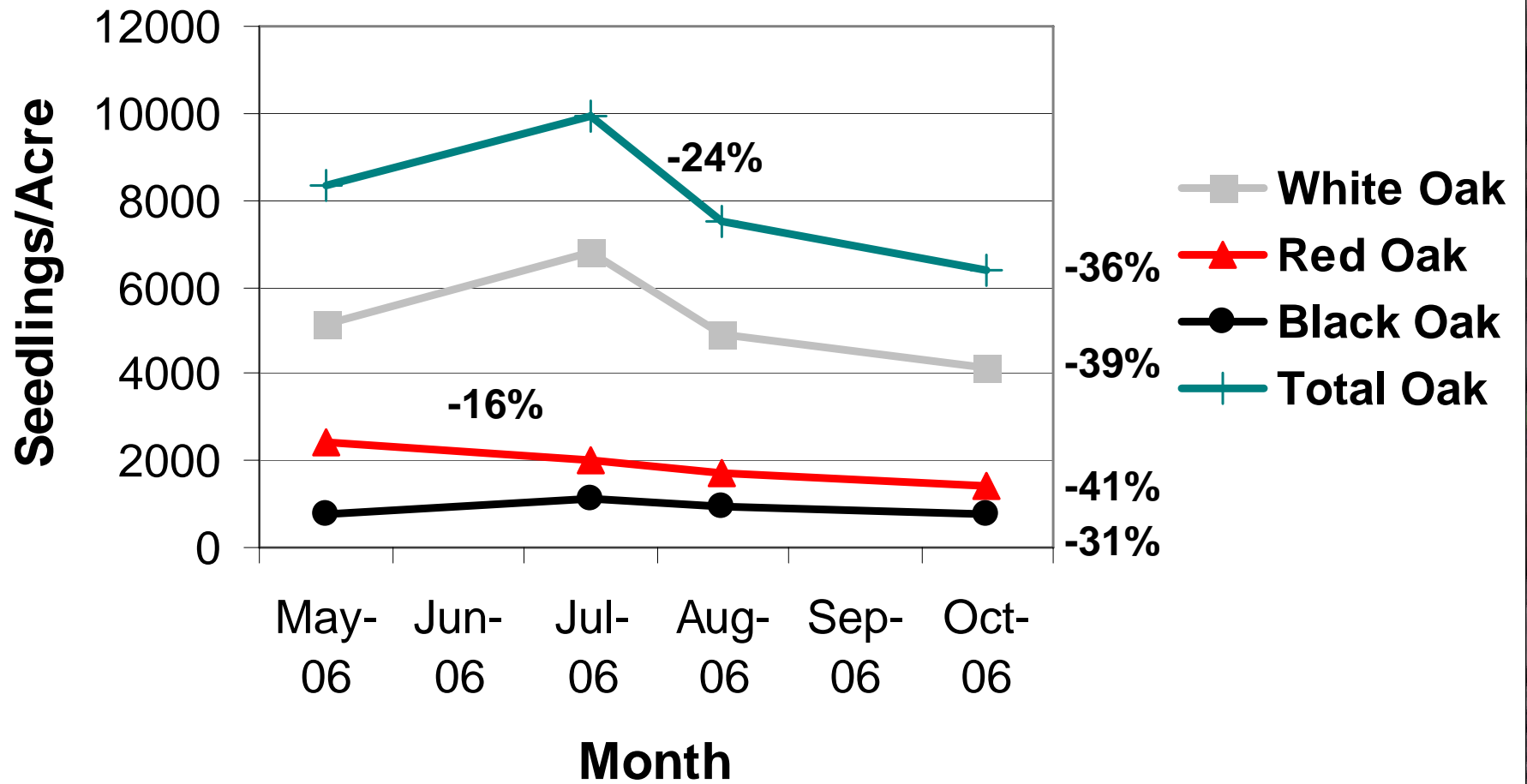


Patchy Distribution

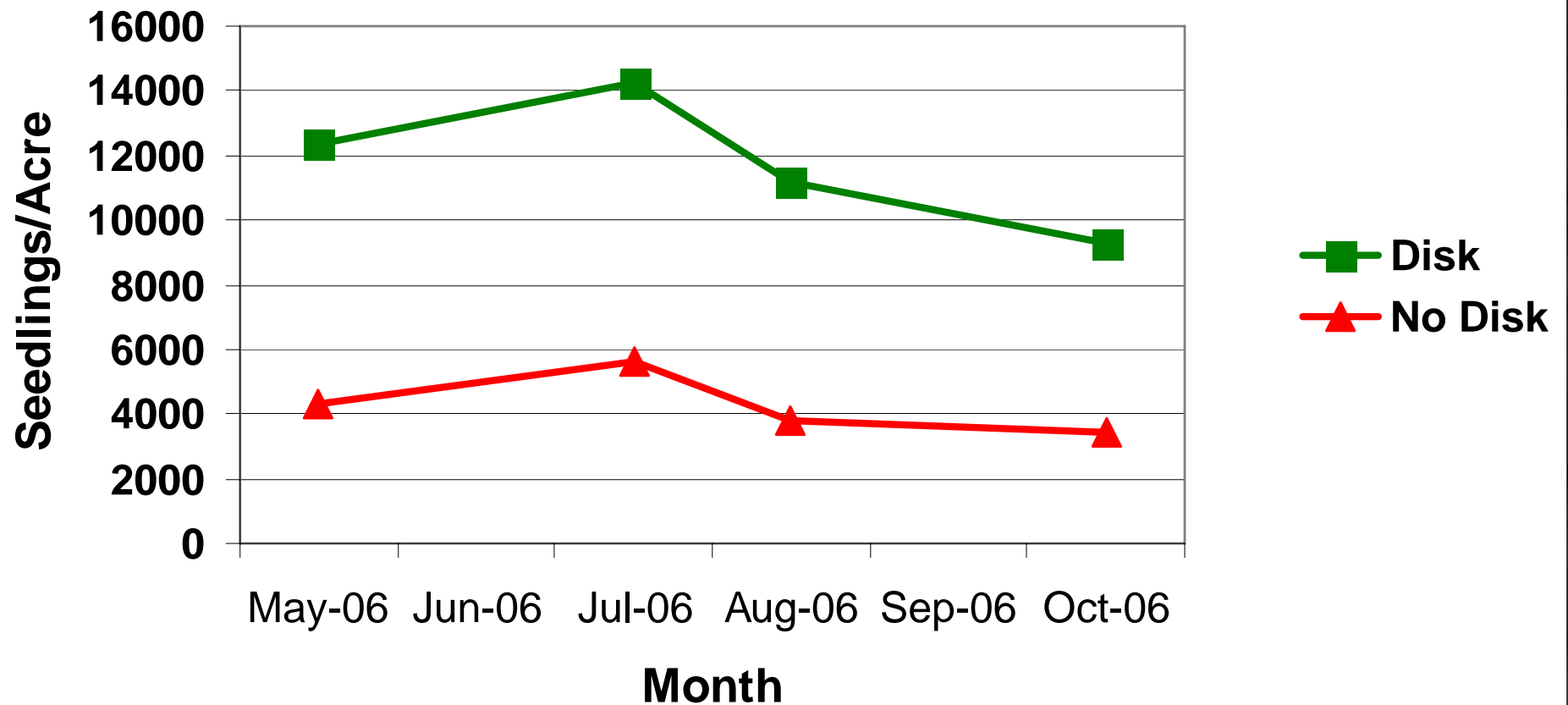
Plot Stocking/Seedling Distribution - Oct 2006



Oak Seedling Attrition by Species - Year 1



Attrition by Disking Treatment - Year 1



Oak Seedling Damage Agents

SILVAH Deer Impact Index:

low – moderate (2 – 3)

Browse almost non-existent

31 out of 2728 or 1%

No observed mortality

David Cappaert

UGA2146033

Oak Seedling Damage Agents

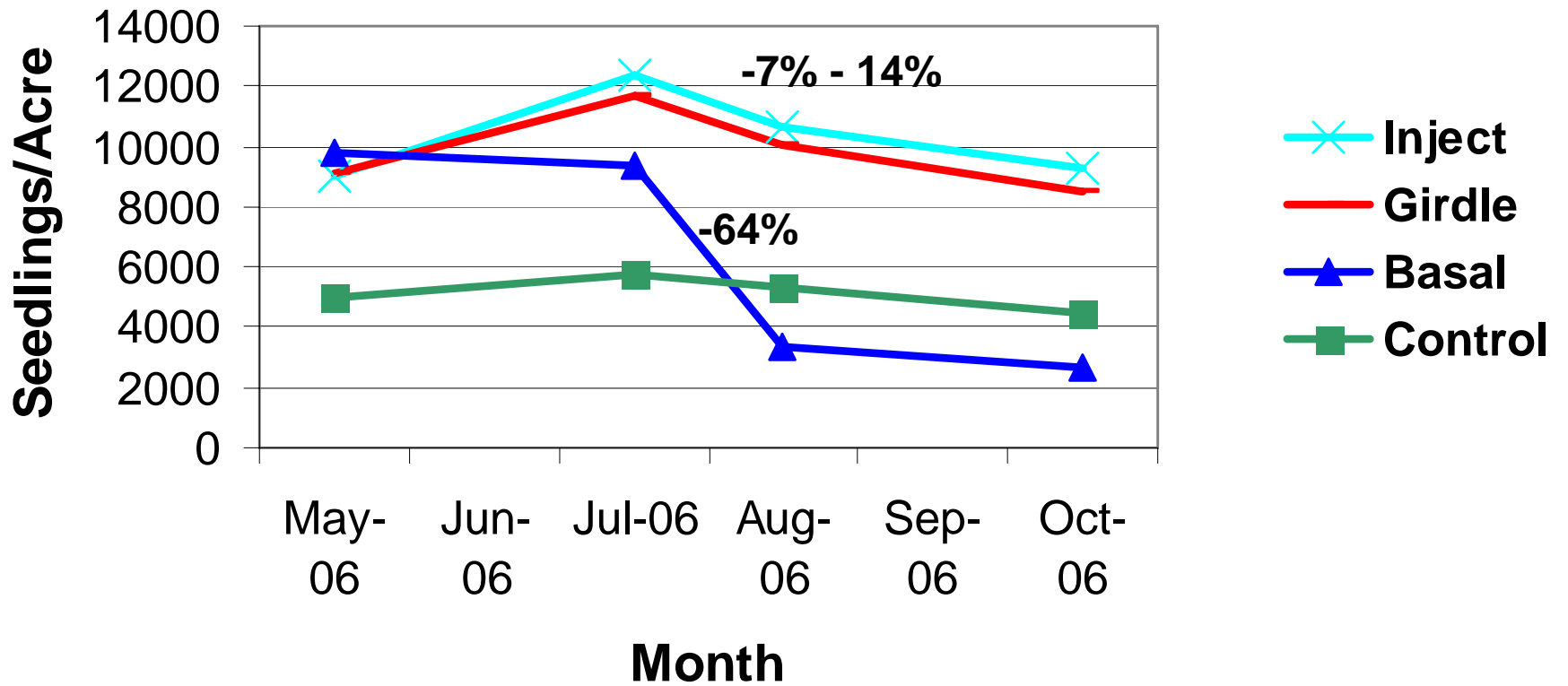
Herbicide Damage

Of 700 dead
seedlings
tallied, 411 or
59% killed by
herbicide
exposure



Oak Seedling Damage Agents

Oak Seedling Attrition by Midstory Removal Treatment



Oak Seedling Damage Agents

Herbicide Damage

Volatilization of
triclopyr at
temp.
exceeding 85°F
– 90°F



Oak Seedling **Damage Agents**

**Herbicide
Damage**

**Many resprouted
2nd growing
season**



Oak Seedling Damage Agents

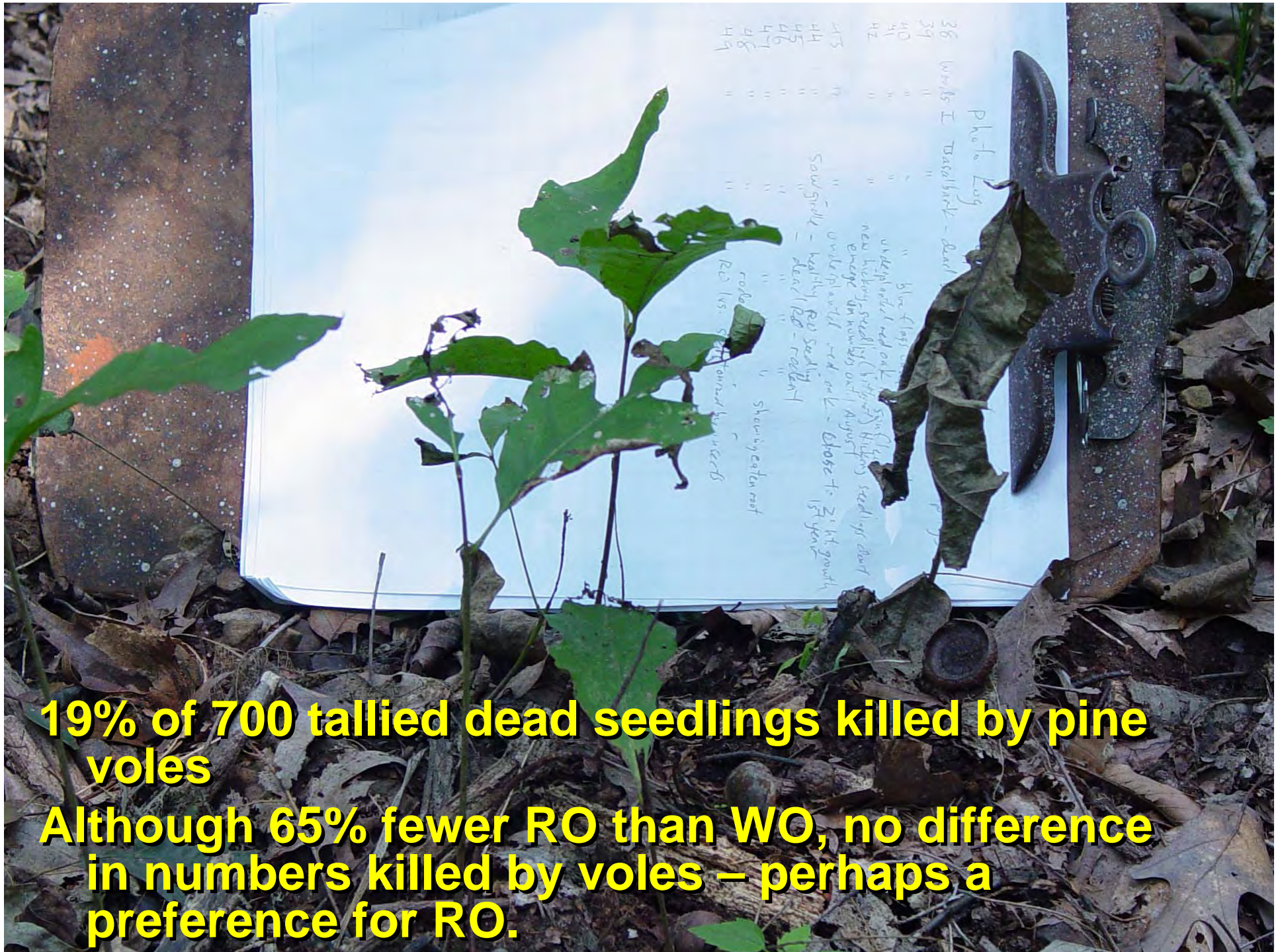
Pine Vole (*Microtus pinetorum*)
Damage



Oak Seedling Damage Agents

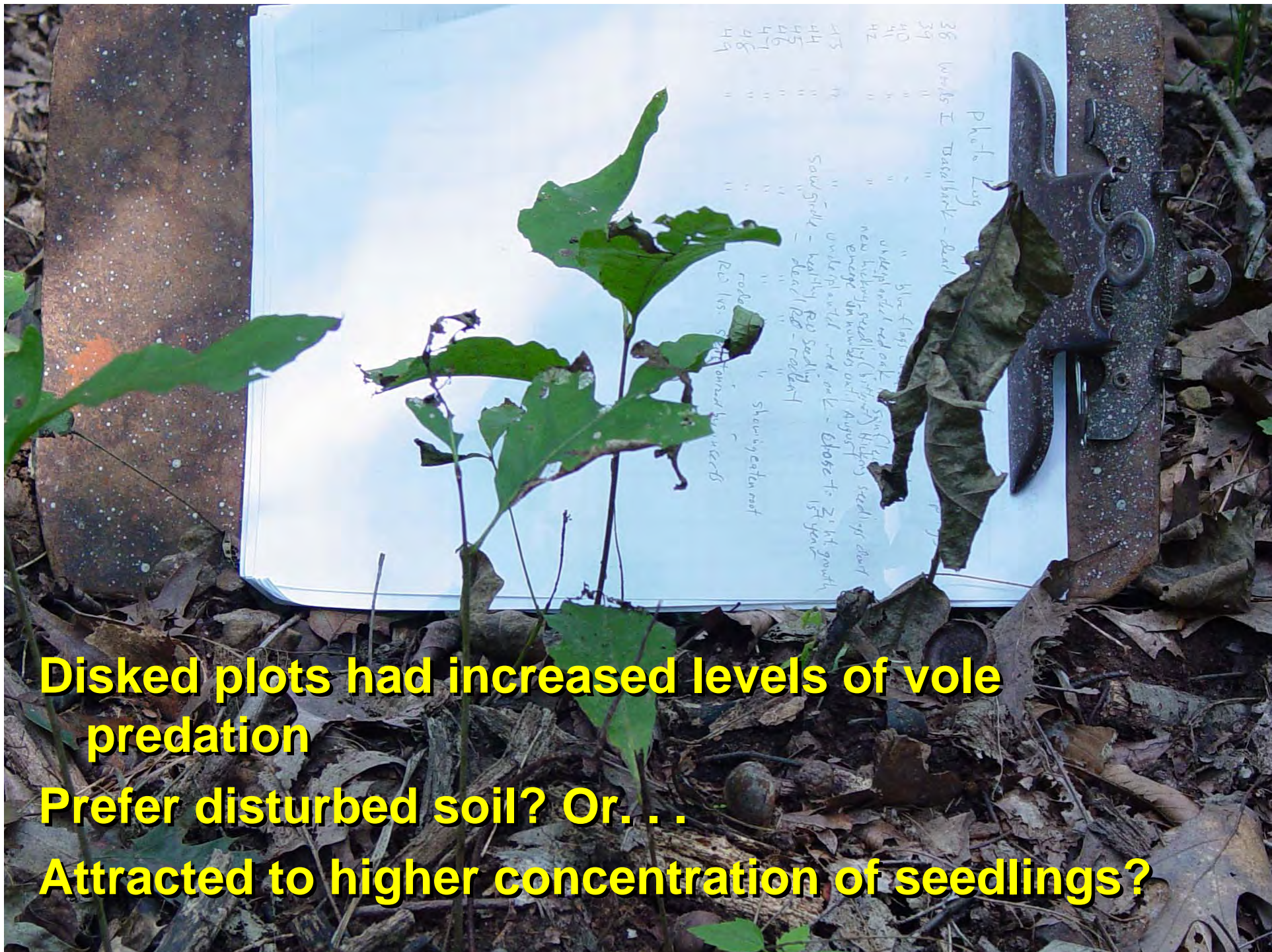


**Pine Vole (*Microtus pinetorum*)
Damage**



19% of 700 tallied dead seedlings killed by pine voles

Although 65% fewer RO than WO, no difference in numbers killed by voles – perhaps a preference for RO.



Disked plots had increased levels of vole predation

Prefer disturbed soil? Or...

Attracted to higher concentration of seedlings?



57% of estimated mortality unaccounted for.

Pine voles implicated



57% of estimated mortality unaccounted for.

Pine voles implicated



Cost

A photograph of a hand holding a green leaf over a forest floor covered in brown leaves. The text is overlaid on the image.

Cost

For treating $\frac{1}{4}$ of tract area:

Prep time 0.4 – 0.8 hr/acre

Disk time 0.4 – 0.6 hr/acre

Total Time 0.8 – 1.4 hr/acre

Labor @\$25/hr: \$20.00 – \$35.00/acre

Fuel @\$4.25/gal diesel: \$0.81 – \$1.23/acre

Total: \$20.81 – \$36.23/acre

Disking Preparation

- **I.d. stands**
 - Ready to regenerate
 - Adequate # seed trees, well distributed
 - Less disturbed, well-developed shade-tolerant midstory and open understory
 - Minimal ground level obstacles
 - Favorable topography
- **Scout acorn crop**
- **In-house equip and labor ready to respond**
- **Prep. equip by mid-October**
- **Flag disk lanes**
 - Avoid obstacles & adverse terrain
 - Include acorn bearing trees
- **Clear disk lanes**
- **Scout to determine when acorn dispersal complete**

Management Implications

- Will long term survival justify effort?
- Will survival rates match or exceed prior experience (Loftis, Beck, Crow)?
- How long will voles be an important predator?
- What is spatial and temporal extent of pine vole impact on oak regeneration dynamics?
- Can pine voles be managed during significant oak seedling establishment events?

A photograph of a person's hand reaching into a forest floor. The ground is covered with brown, dried leaves and some green plants. The hand is positioned near the center of the frame, with fingers slightly curled. The background is a dense layer of forest floor debris.

Management Implications

- Disking greatly increases oak seedling establishment
- Important to provide adequate light through timely midstory removal
- Basal bark, provided quicker kill of midstory, but volatilization precludes its use in summer.
- Pine voles may be important, but uncontrollable factor in 1st year.