

## Monitoring Deer Impacts in Ann Arbor:

### A Pilot Study of Red Oaks as Sentinel Seedlings November 2015–September 2016

Jacqueline Courteau, Ph.D.  
Biologist/Ecologist, NatureWrite LLC  
October 2016

## How can we assess deer impacts?

- Enclosures: pairs of fenced, control plots
- Browse damage surveys: assess browse on existing vegetation
- Inventories: Periodically assess all plant species, track changes over time
- **Sentinel seedlings\*/bioassay/phytometer: Plant & track as standard yardstick**

\* Experimental indicators of browse intensity

## How are deer affecting natural areas in Ann Arbor?

- Need for site-specific local baseline data
- For 2015-2016, sentinel seedling method for standardized comparison, using red oak as sentinel species
  - Method used for 3+ years in other studies
- Separate enclosure study of trillium set up spring 2016; preliminary results 2017

## Why use sentinel\* seedlings?

(Blossey/Cornell 2014; Latham/Swarthmore 2012; etc.)

- Standardized indicator across sites, years
- Clear metric: % of seedlings browsed by deer
- Quick baseline; can be repeated annually or biannually to gauge trends
- Straightforward data analysis

\* Experimental indicators of browse intensity

## Why use red oaks as sentinels?

- Naturally occur in ALL city natural areas assessed
- Represents
  - key ecological community (oak/hickory forest)
  - key ecological functions (tree & forest regeneration, habitat, food source for many species)
- Declining oak regeneration of concern in MI, Northeast US
- Michigan genotype nursery stock, acorns readily available
- **Intermediate** deer browse preference

## Do deer eat red oaks?

- **Intermediate** browse preference
  - Not highly preferred
    - Preferred foods include lily species, northern white cedar
  - Considered “moderate” rather than “high” food value, but still a source of winter food (MI DNR)
  - Often browsed in winter or spring when other foods not plentiful

### How does deer browsing affect red oak seedlings?

- Many species can tolerate moderate amounts of browsing BUT...
  - On tree seedlings, deer typically browse buds, the key growing portions
  - Browse damage makes seedling more susceptible to drought, insects, shading
  - Repeated or intensive browse (damage to >50% of buds) can lead to mortality (Winchcombe)
- Tree regeneration declines if deer browse intensity is too high

### What are sustainable levels of deer browsing?

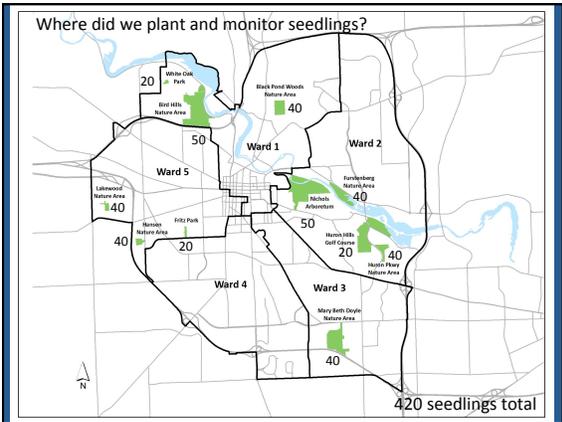
- Blossey (2014) :
  - An individual oak seedling may need 10–20 years to grow out of reach of a deer under a forest canopy, and even longer to get into the canopy. In many instances, seedlings/saplings need to spend extended periods in the understory waiting for their chance to grow should the overstory be damaged (or harvested). Considering this early life history, more than an occasional browsing event on oak sentinels (damage to >3 of 20 [15%] seedlings) in any given year would indicate deer populations in the area are too high to achieve forest regeneration.

### How was the study done?

- Seedlings planted in pairs, one protected by fence
  - Allow small mammals access
  - Assess condition, survival when protected from deer
  - Preliminary report shows data for unfenced seedlings only
- Research protocol similar to Blossey 2014
- GIS collaboration with Jason Tallant/UM

### How did we select study sites?

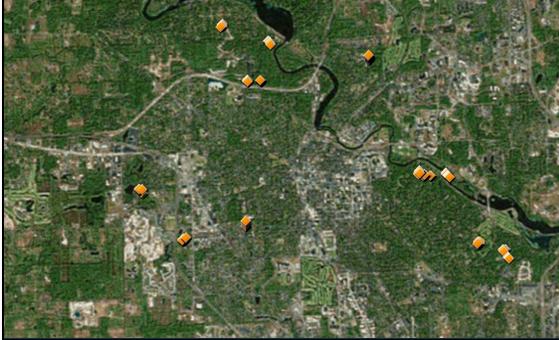
- Key parks with large natural areas, high diversity
- Range of large and small parks
- Areas with range of deer density estimates (based on 2015 aerial survey, staff observations)
- Aim: geographic representation across city
- Consultation with NAP staff



### Where and how many sites?

- 370 seedlings planted 10 city natural areas
- 50 seedlings planted in separate study contracted by the Arb, which agreed to share data
- ½ seedlings protected by small fences
  - 210 seedlings unfenced (open)
  - 210 seedlings fenced
- 4 out of 5 city wards
  - Natural areas not evenly distributed

## Ann Arbor Study Sites, 2015-16



## Where did experimental seedlings come from?

- 12-18" bare root red oak seedlings, MI genotype
  - Coldstream Farm nursery, Free Soil, MI
- Seedlings shipped after dormant, 11/15
- 20-70 seedlings planted per park
  - Depended on park size, time constraints

## Where were seedlings planted within sites?

- Selected in consultation with NAP staff
- Usual minimum 5 m from trail (preferably more)
- Consistent slope position OR range along slope
- Mature oak forest with relatively open understory so deer, researchers can find them
- Unfenced seedlings not marked with flags or tags
  - Deer can learn visual cues
  - Less aesthetic interference for park visitors

## What more should we know about planting methods?

- Seedling pairs roughly 5 m apart along transects
  - Randomly 2-5 m either direction from transect
  - Unfenced seedlings not marked or tagged to minimize cues to deer
- Location, data, photos linked on ArcGIS collector



## When were seedlings planted and monitored?

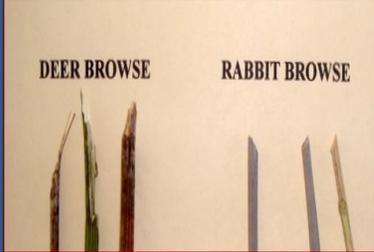
- Planting: Nov 30–Dec 16 2015
- Monitor 1: Jan 6–Feb 5 2016
- Monitor 2: Mar 14–April 6 2016
- Monitor 3: May 29–Aug 1 2016
- Monitor 4: Aug 4–Sept 21 2016
- Monitor 5: TO COME  
Nov–Dec 2016

### What was monitored?

- Seedlings were relocated, assessed for condition, survival, browse damage
- If browsed:
  - Identity of browser (deer, rabbit/woodchuck, chipmunk/squirrel, vole)
  - Description of damage: # branches browsed, leaf damage, height of browse
  - Photo
- Notes on other factors: insect damage, wilt (likely related to drought)

### How can you distinguish deer browse from browse by other animals?

**DEER BROWSE**



Deer: No incisors; edges are shredded, not cleanly angled

**RABBIT BROWSE**



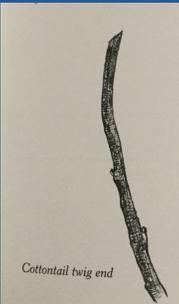
Rabbit: Incisors leave cleanly angled mark, 45°

**VOLE CHEWING**

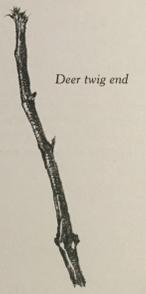


Vole: Small toothmarks (1 mm), bark gnawed or stem chewed through

### Rabbit vs. deer browse marks

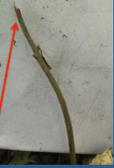


Cottontail twig end



Deer twig end

ARB 1038N



Deer browse: shaggy

ARB 1034

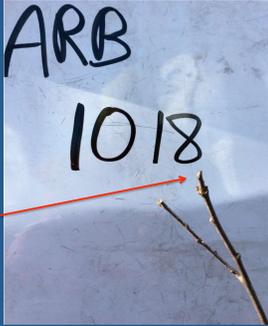


Rabbit browse: angled

ARB 1018

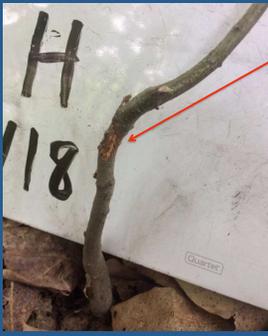


ARB 1018



Before and after deer browse

H 118



H 118



Voles chew bark, gnaw through stems at or below ground (may leave stem behind)

### What questions did the pilot study address?

- What proportion of seedlings were browsed by deer?
- How did deer browse compare to other sources of seedling damage?
  - Small mammals (rabbits, squirrels, chipmunks, and voles), insects

### What else does this study show? (To be included in final report)

- What was the overall mortality rate? Was deer browse linked to higher mortality?
- When did deer browse the most (how did browsing vary through the winter and growing season)?
- What other factors affected seedlings? (How do deer impacts compare?)

### What proportion of seedlings were browsed by deer?

- Overall, 54% of unfenced seedlings were browsed by deer at least once.
  - Browse damage ranged from 20%–90% across sites
  - Median proportion of seedlings browsed: 60%
  - Some seedlings browsed repeatedly by deer

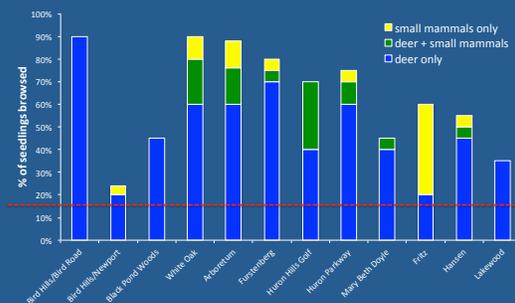
### What proportion of unprotected seedlings were browsed by deer?



### How did deer compare to other mammalian browsers?

Browser identity	# seedlings browsed	% of all browsed seedlings
Deer only	100	76%
Deer + small mammal	14	11%
Small mammal only	12	9%
Other/not clearly identifiable	5	4%
<b>Total seedlings browsed (of 210)</b>	<b>131</b>	

### How did deer compare to other mammalian browsers across parks?



### What else affected the tree seedlings?

- Insect damage notable May-June
  - Most seedlings had <10% leaf area damaged
  - 8% of seedlings had 50% or more leaf area removed
- Drought
  - April-July below average rainfall each month
  - Many seedlings (and other plants on site) showed drought stress
  - Seedlings in poor condition doubled over summer

### What lessons can we learn from this study to revise monitoring in future?

- Sentinel seedlings offer clear metric for gauging browse intensity across sites
- More parks? Cooperate with A2 public schools for geographical coverage (Pioneer Woods, Skyline)?
- Fences not needed
- Use 1<sup>st</sup> year seedlings in plant tubes rather than bare root (lower mortality)
- Choose sites in October or May when vegetation visible
- Add species to include range of more and less preferred

### Acknowledgments

- David Borneman & NAP staff  
Research support, site maps & observations
- Jason Tallant, University of Michigan  
GIS collaboration & data collection technology
- Bob Grese & UMBGNA staff  
Contracted similar study at Arb, shared data
- Bernd Blossey, Cornell University; Don Waller, University of Wisconsin; Tom Rawinski, USFS  
Research methods, data interpretation
- Data consultant: Dr. Mary Anne Evans
- Field assistants: Alexa Bandeian, Minali Bhutt, Joanna Thelen, Moriah Young