



Friends of
Peninsula State Park
For Now and the Future

Final Results Report

6/7/2016

Seasonal and Regional Distributions of the Major Vectors, and their Associated Phoresy Rates for the Oak Wilt Fungus, *Ceratocystis fagacearum*, in Wisconsin.

Stephanie M Jagemann¹, Jennifer Juzwik², Patrick Tobin³, and Kenneth F Raffa¹,

¹University of Wisconsin-Madison, Department of Entomology, Madison, WI

²USDA Forest Service, North-Central Research Station, St. Paul, MN

³School of Environmental and Forest Sciences, University of Washington, Seattle, WA

Abstract:

Oak Wilt is a lethal disease caused by the fungus, *Ceratocystis fagacearum*. Short-distance spread occurs via root grafts, but long-distance spread is by sap beetle (Nitidulidae) vectors. Attempts to limit spread and impact of *C. fagacearum* are based on limiting cutting to periods of vector inactivity. However, we have limited information on these beetles' activity periods, responses to temperature, and frequency of carrying *C. fagacearum*. We sampled two predominant vector species in Wisconsin, *Carpophilus sayi* and *Colopterus truncatus*, to quantify seasonal and geographic abundance. We sampled populations at twelve oak stands across Wisconsin, and isolated fungi from beetles. In 2015, *Carpophilus sayi* peaked at the beginning and middle of the trapping period and *Colopterus truncatus* peaked only in the beginning. These trends shifted along a latitudinal gradient. Populations varied regionally, and beetles of each species were present at sites with no previously detected oak wilt. Most field locations contained beetles with viable fungal spores, although the frequency of association varied dramatically. Trap catches and temperature data will be used to construct preliminary degree-day models for *C. sayi* and *C. truncatus*. Future data collection will refine these models, and provide a basis for setting guidelines for oak cutting in Wisconsin.

Objectives of this study:

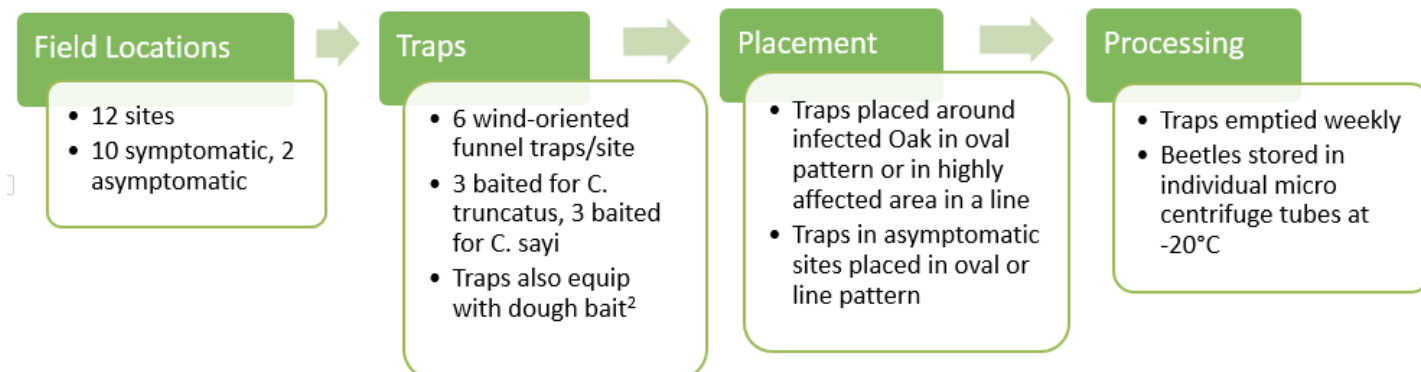
- Characterize the phenology, abundance, and distribution of the two major vectors of Oak Wilt fungus in Wisconsin.
- Quantify the association rates of these two vectors with *C. fagacearum*.
- Develop degree-day and threshold models of *C. truncatus* and *C. sayi*, to guide decisions about pruning and silvicultural practices.



Above Left: An active *C. fagacearum* fungal mat with asexual pressure pad. Center: *Carpophilus sayi*. Right: *Colopterus truncatus*.

Methods of Sampling of Spatial & Temporal Distributions and Beetle Abundance:

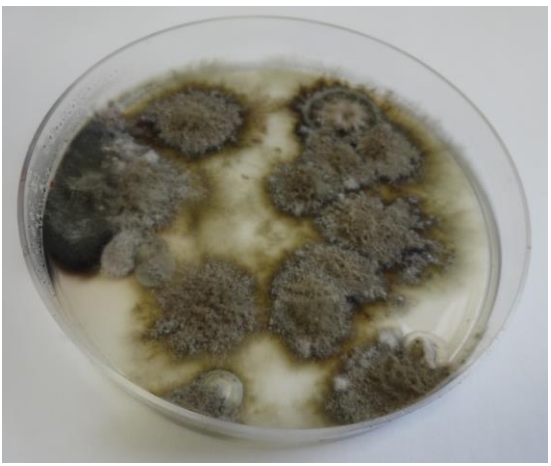
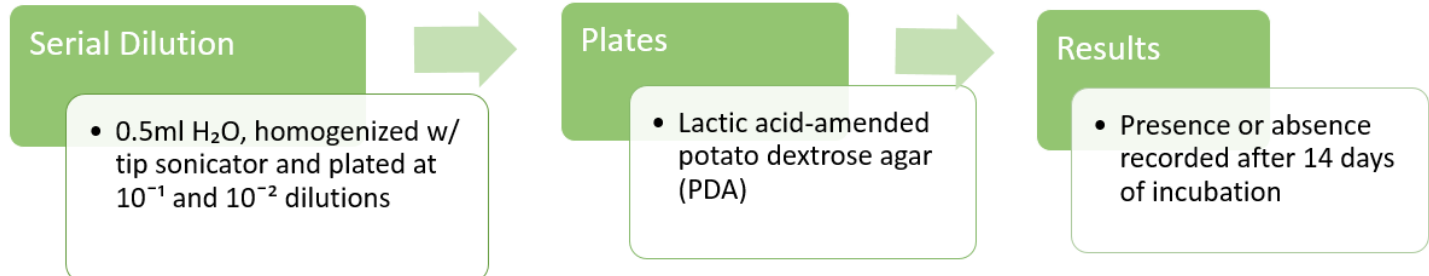
We sampled dispersing populations of *C. sayi* and *C. truncatus*, to quantify seasonal and geographic abundance. Trapping was done in 12 oak stands across Wisconsin, including Peninsula State Park. Beetles were sampled for *C. fagacearum*.



Each site, including Peninsula State Park, contained traps and a HOBO Tidbit Data Logger (shown below) that recorded temperature hourly.



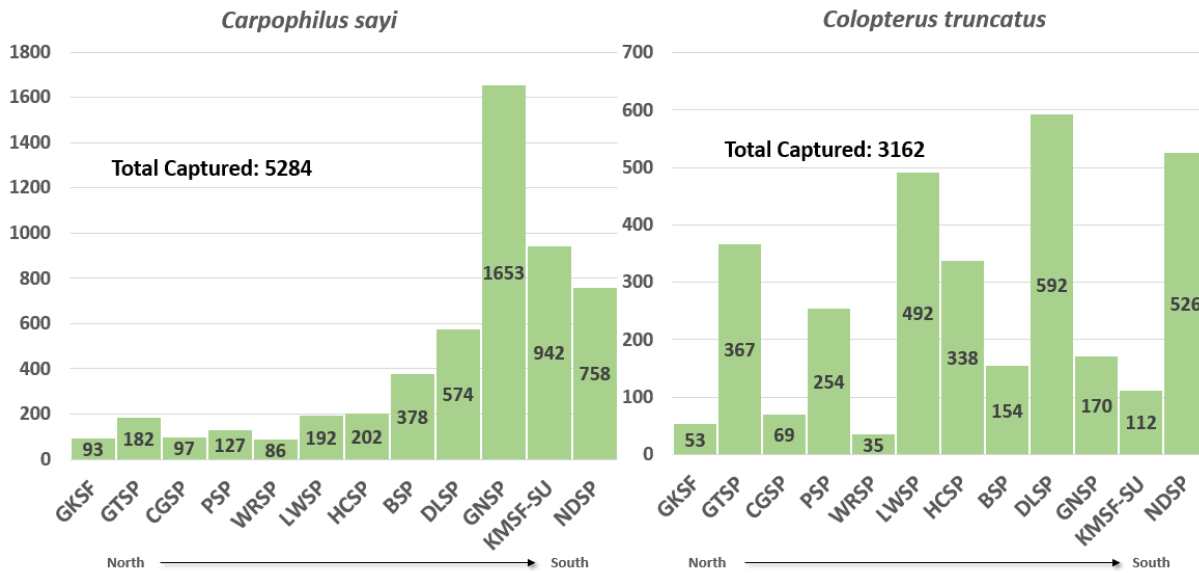
Methods of Fungal Cultivation from Beetles:



Left: An active laboratory culture of *C. fagacearum*.

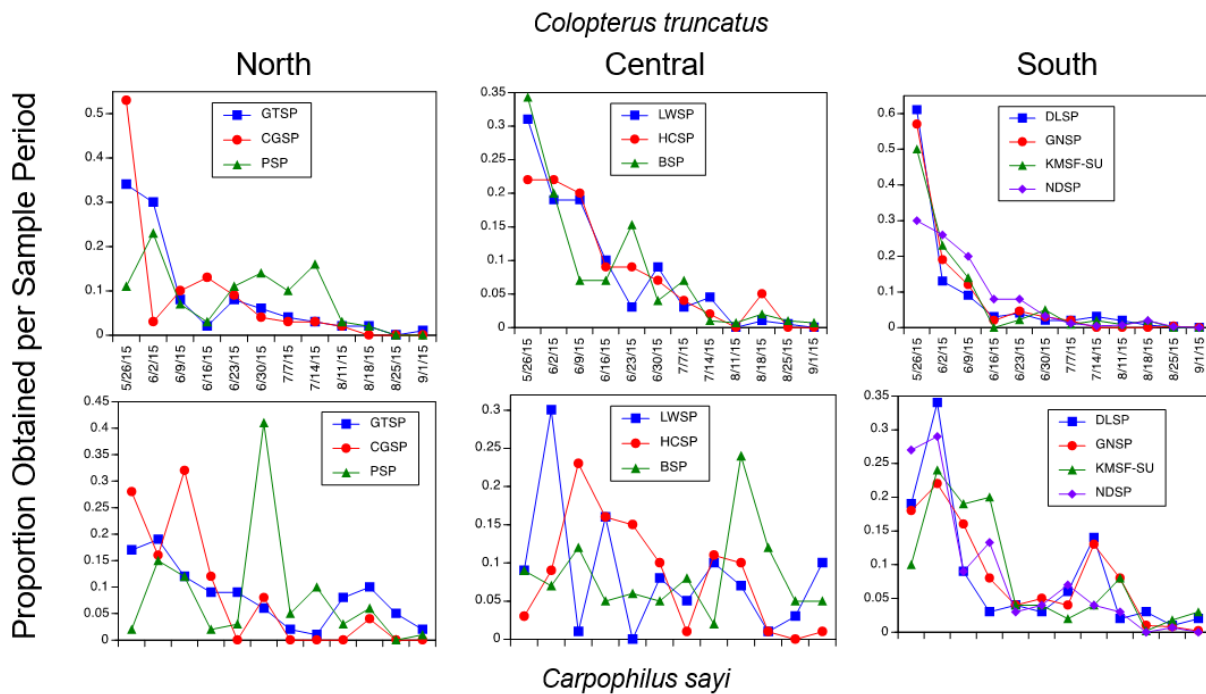
Results:

Seasonal Totals of Wisconsin Oak Wilt Vectors

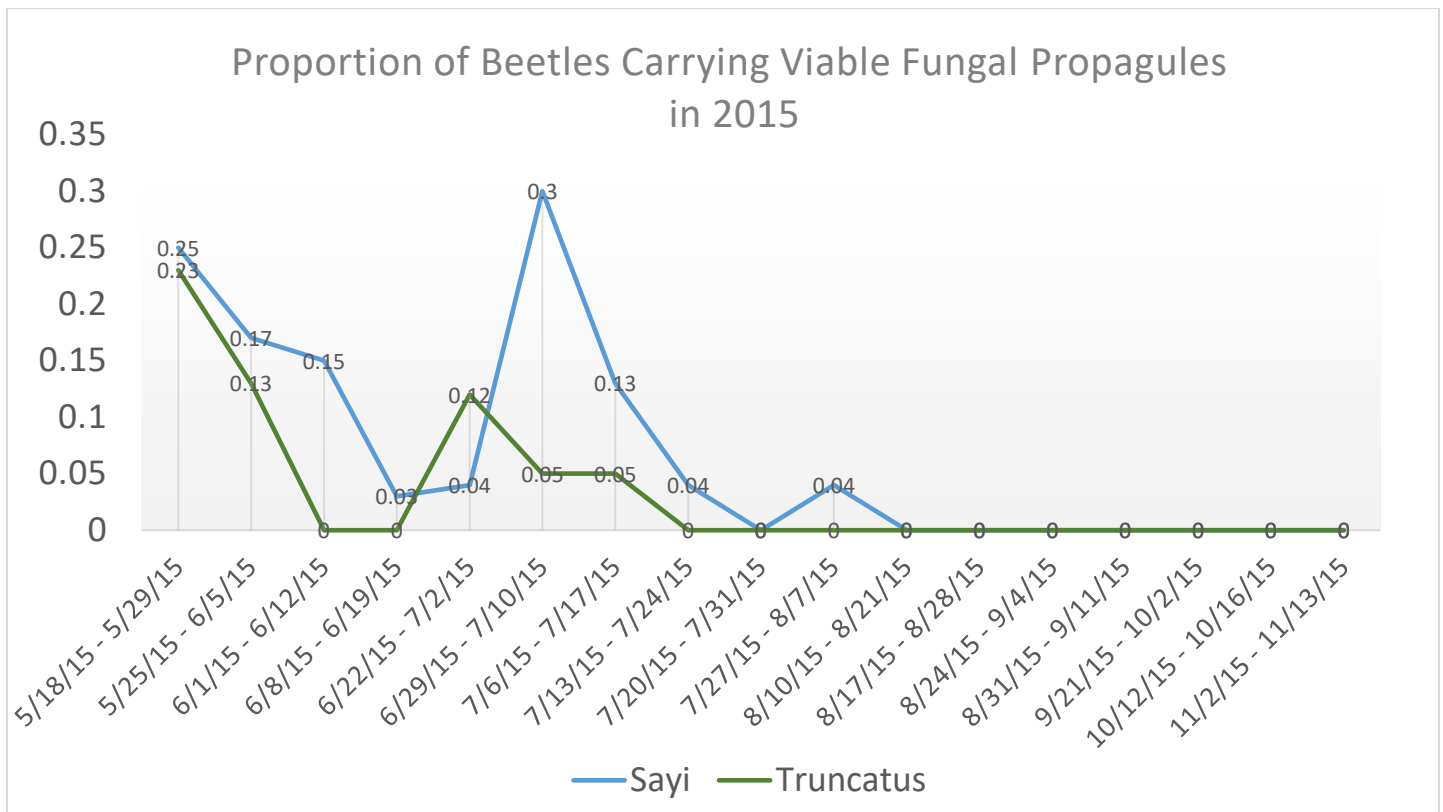


Populations varied regionally, and beetles of both species occurred in asymptomatic sites, Peninsula State Park and Council Grounds State Park.

Seasonal Distribution of Nitidulids in Wisconsin



In 2015, *Carphophilus sayi* peaked at the beginning and middle of the trapping period; *Colopterus truncatus* peaked only in the beginning. These trends shifted along a latitudinal gradient. Peninsula State Park (PSP) can be seen in upper left and lower left graphs.



Most sites yielded beetles with viable fungal propagules, although the frequency of association varied dramatically. Peninsula State Park was not included in this graph because it was one of two field sites with no known oak wilt, and tested negative for oak wilt throughout the 2015 field season.

Conclusions from 2015 Field Season:

- More *Carpophilus sayi* than *Colopterus truncatus* captured overall.
- *Carpophilus sayi* more abundant in southern than northern Wisconsin; *Colopterus truncatus* evenly distributed throughout state. Both sites without known Oak Wilt contained both species, but in fewer numbers than sites with known Oak Wilt. However, the asymptomatic Peninsula State Park contained relatively high numbers of *C. truncatus*.
- *Colopterus truncatus* peaked at the beginning of the season and decreased as the season progressed. *Carpophilus sayi* peaked in the beginning and toward end of field season.
- All of the ten field sites with known Oak Wilt tested positive for *Ceratocystis fagacearum* spores. Incidence of *C. fagacearum* on beetles varied between sites, with the state's worst yielding positive beetles at 5 of 17 weeks. 7 of the 17 weeks tested were within current Oak Harvesting Guidelines.
- Two field sites tested positive for fungal spores outside of Wisconsin's current Oak Harvesting Guidelines. The two sites without known Oak Wilt did not yield any beetles carrying viable *C. fagacearum* spores.

- Peninsula State Park did contain both beetle species, but tested negative for *C. fagacearum* presence.

Future Work:

Trapping will be done for the 2016 field season (currently underway at Peninsula State Park) Trap catch and temperature data from 2015 and 2016 will be used to construct threshold and degree-day models for *C. sayi* and *C. truncatus*. These will be used to refine guidelines for oak harvesting in Wisconsin.

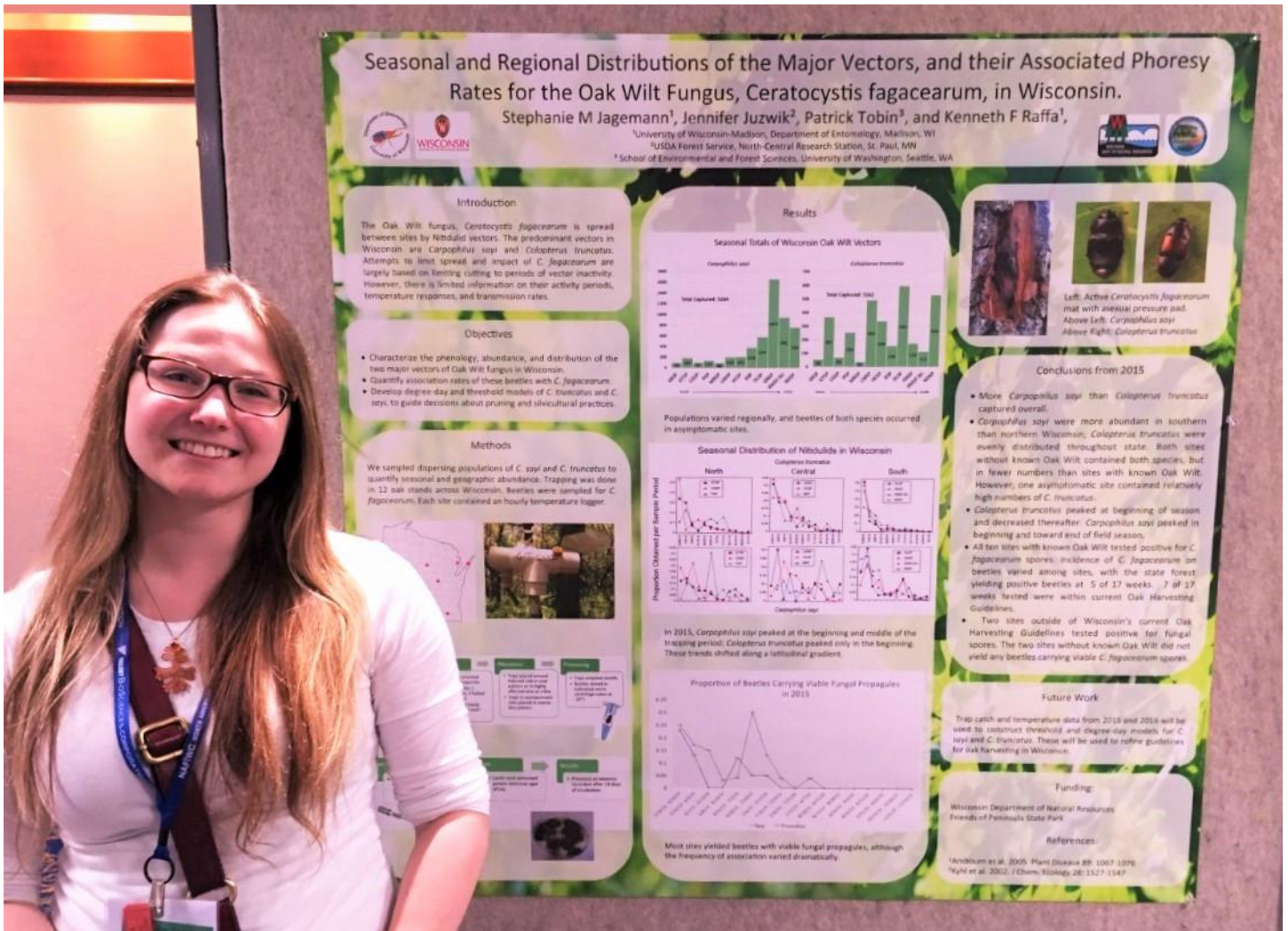
Funding:

Wisconsin Department of Natural Resources and the Friends of Peninsula State Park Research Grant.



References:

- ¹ Ambourn et al. 2005. Plant Disease 89: 1067-1076
- ² Kyhl et al. 2002. J Chem. Ecology 28: 1527-1547



Above: A photo of myself, Stephanie Jagemann, presenting my 2015 research at the North American Forest Insect Work Conference in Washington DC, on June 1st, 2016.

Seasonal and Regional Distributions of the Major Vectors, and their Associated Phoresy Rates for the Oak Wilt Fungus, *Ceratocystis fagacearum*, in Wisconsin.

Stephanie M Jagemann¹, Jennifer Juzwik², Patrick Tobin³, and Kenneth F Raffa¹,



¹University of Wisconsin-Madison, Department of Entomology, Madison, WI

²USDA Forest Service, North-Central Research Station, St. Paul, MN

³School of Environmental and Forest Sciences, University of Washington, Seattle, WA



Introduction

The Oak Wilt fungus, *Ceratocystis fagacearum* is spread between sites by Nitidulid vectors. The predominant vectors in Wisconsin are *Carpophilus sayi* and *Coloaterus truncatus*. Attempts to limit spread and impact of *C. fagacearum* are largely based on limiting cutting to periods of vector inactivity. However, there is limited information on their activity periods, temperature responses, and transmission rates.

Objectives

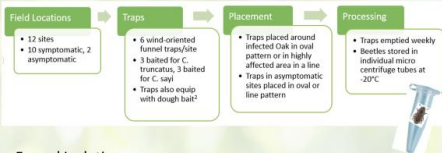
- Characterize the phenology, abundance, and distribution of the two major vectors of Oak Wilt fungus in Wisconsin.
- Quantify association rates of these beetles with *C. fagacearum*.
- Develop degree-day and threshold models of *C. truncatus* and *C. sayi*, to guide decisions about pruning and silvicultural practices.

Methods

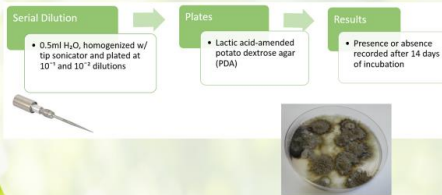
We sampled dispersing populations of *C. sayi* and *C. truncatus* to quantify seasonal and geographic abundance. Trapping was done in 12 oak stands across Wisconsin. Beetles were sampled for *C. fagacearum*. Each site contained an hourly temperature logger.



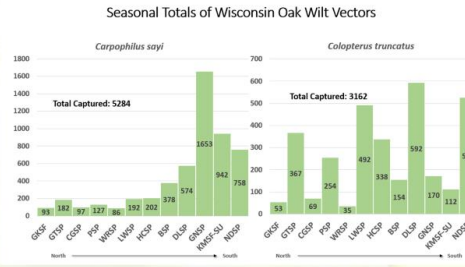
Insect Sampling



Fungal Isolation

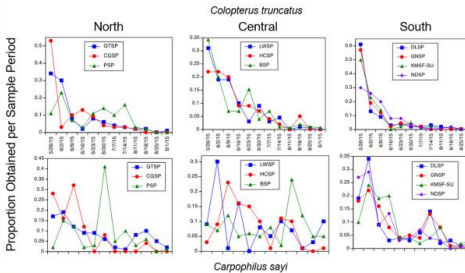


Results



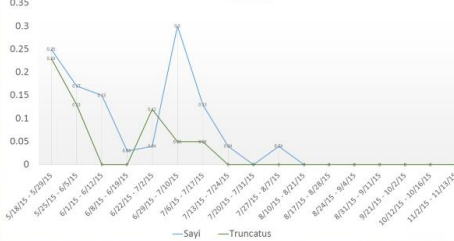
Populations varied regionally, and beetles of both species occurred in asymptomatic sites.

Seasonal Distribution of Nitidulids in Wisconsin



In 2015, *Carpophilus sayi* peaked at the beginning and middle of the trapping period; *Coloaterus truncatus* peaked only in the beginning. These trends shifted along a latitudinal gradient.

Proportion of Beetles Carrying Viable Fungal Propagules in 2015



Most sites yielded beetles with viable fungal propagules, although the frequency of association varied dramatically.



Left: Active *Ceratocystis fagacearum* mat with asexual pressure pad.
Above Left: *Carpophilus sayi*
Above Right: *Coloaterus truncatus*

Conclusions from 2015

- More *Carpophilus sayi* than *Coloaterus truncatus* captured overall.
- *Carpophilus sayi* were more abundant in southern than northern Wisconsin; *Coloaterus truncatus* were evenly distributed throughout state. Both sites without known Oak Wilt contained both species, but in fewer numbers than sites with known Oak Wilt. However, one asymptomatic site contained relatively high numbers of *C. truncatus*.
- *Coloaterus truncatus* peaked at beginning of season and decreased thereafter. *Carpophilus sayi* peaked in beginning and toward end of field season.
- All ten sites with known Oak Wilt tested positive for *C. fagacearum* spores. Incidence of *C. fagacearum* on beetles varied among sites, with the state forest yielding positive beetles at 5 of 17 weeks. 7 of 17 weeks tested were within current Oak Harvesting Guidelines.
- Two sites outside of Wisconsin's current Oak Harvesting Guidelines tested positive for fungal spores. The two sites without known Oak Wilt did not yield any beetles carrying viable *C. fagacearum* spores.

Future Work

Trap catch and temperature data from 2015 and 2016 will be used to construct threshold and degree-day models for *C. sayi* and *C. truncatus*. These will be used to refine guidelines for oak harvesting in Wisconsin.

Funding:

Wisconsin Department of Natural Resources
Friends of Peninsula State Park

References:

- ¹Ambourn et al. 2005. Plant Disease 89: 1067-1076
²Kyhl et al. 2002. J Chem. Ecology 28: 1527-1547

Above: A copy of the presented poster.