



Soil Lichens of the NJ Pinelands

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The background of the slide is a photograph of a forest floor. It shows a dense layer of green moss and various types of lichen growing on the ground. There are also some dry, brown leaves and twigs scattered throughout. The lighting is natural, suggesting an outdoor setting.

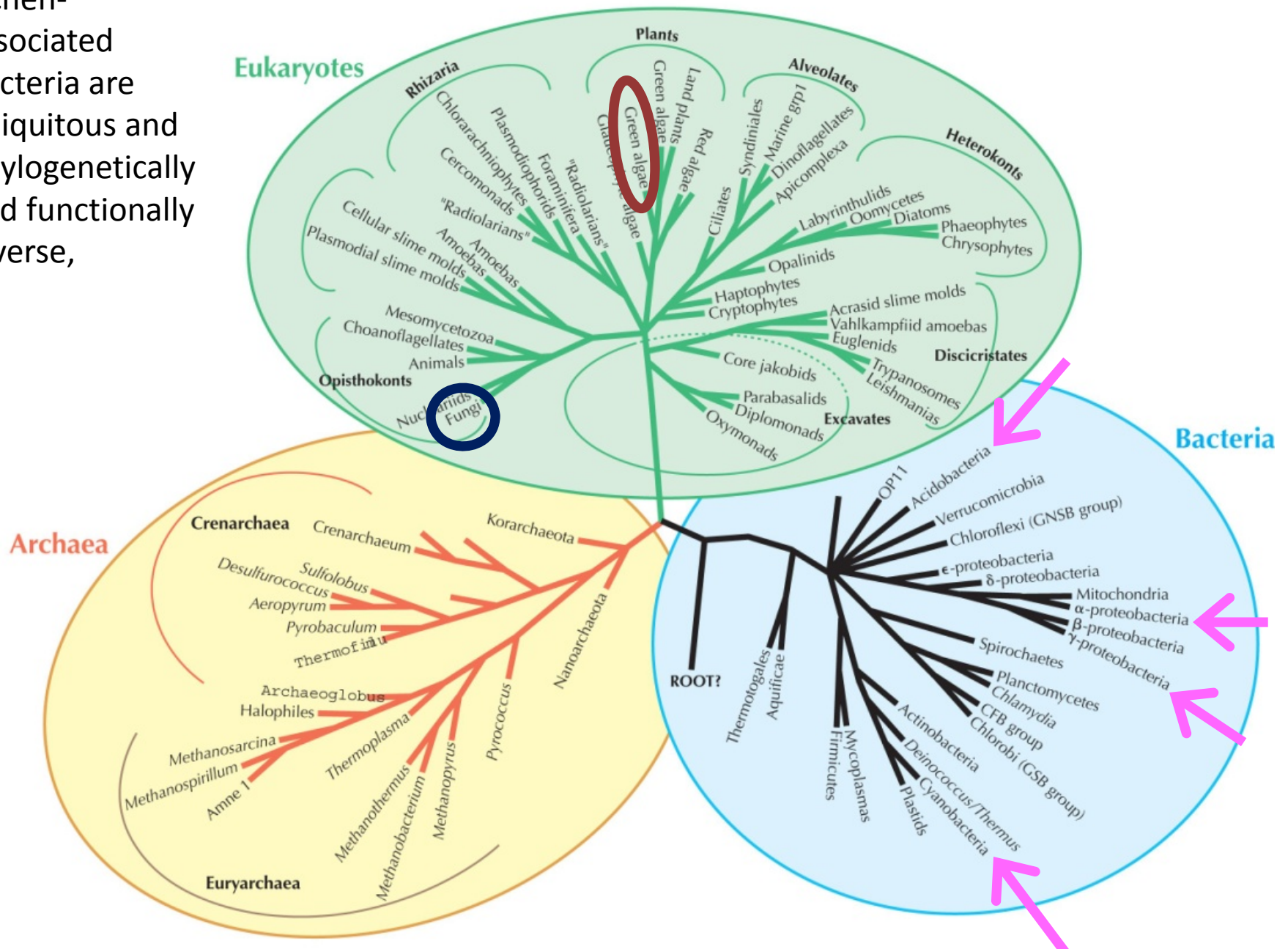
Talk Outline

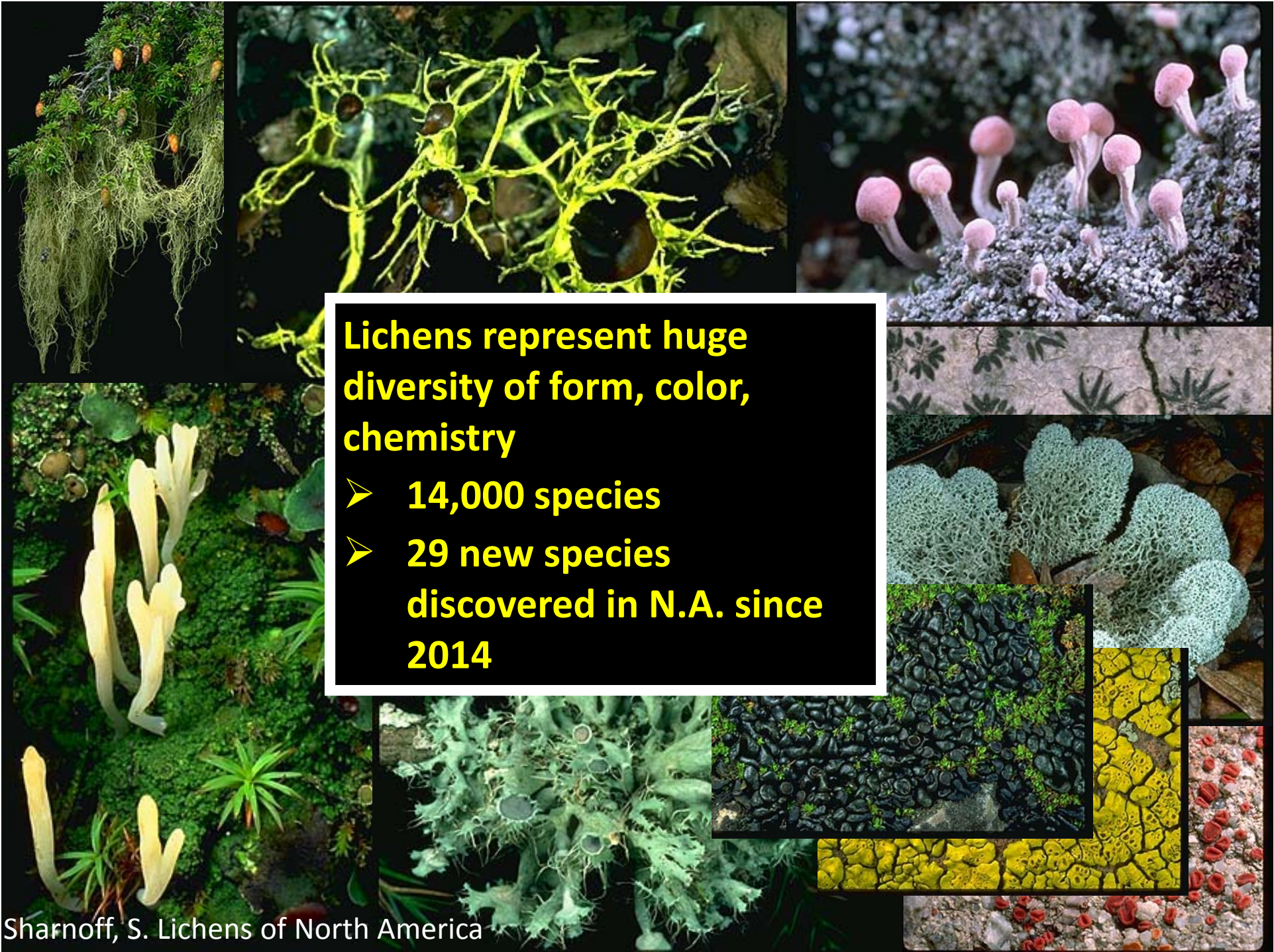
- 1. Lichens in general**
- 2. Lichens of NJ Pinelands – introduction**
- 3. Lichen communities of NJ Pinelands**
- 4. Lichen influence on forest soils**
- 5. Lichen: why should you care?**



Lichen: **composite organism** made of a **fungal species**, **photosynthesizing organisms** and **bacteria** coexisting in a **symbiotic relationship**.

Lichen-associated bacteria are ubiquitous and phylogenetically and functionally diverse,

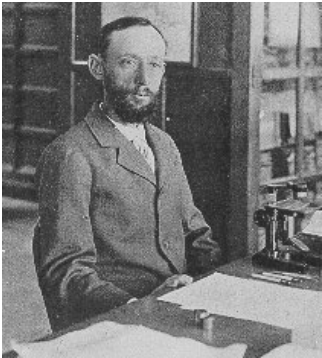




Lichens represent huge diversity of form, color, chemistry

- **14,000 species**
- **29 new species discovered in N.A. since 2014**

Lichens are well documented in NJ Pinelands...



- 1881 Britton
 - 209 lichens in Flora of NJ

- 1926 Harshberger
 - 11 Pinelands plant communities with lichens

- 1955 Moul and Buell
 - Prescribed burns in NJ Pinelands favor growth of moss/lichen



- 2001 Brodo:
 - Lichens of North America – anyone can find & study lichen

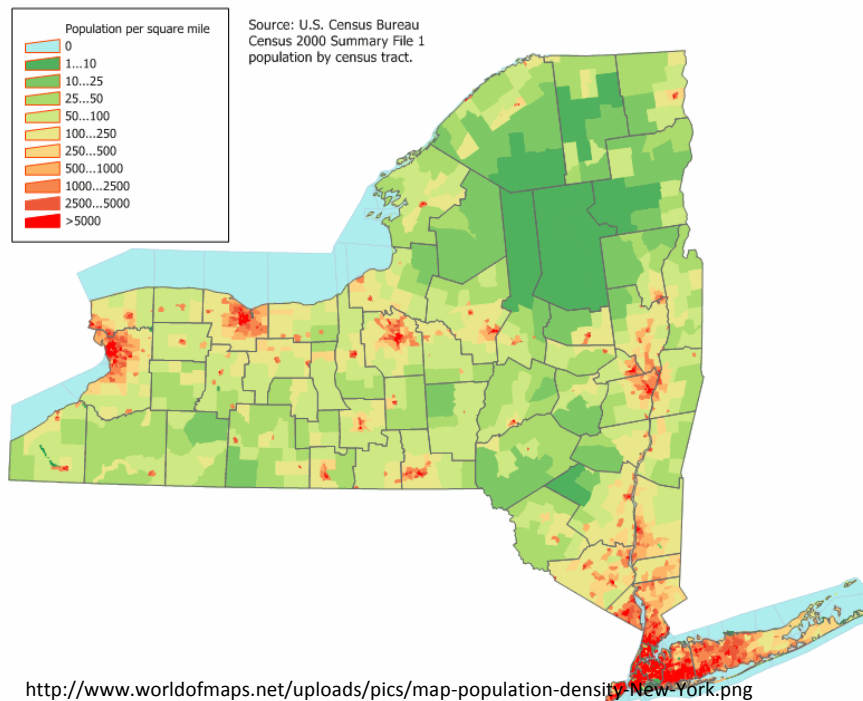


- 2006 Lendemer:
 - 190 species in Wharton State Forest alone
 - Lichen flora of NJ has more southern species at north edge of range than northern species at south end

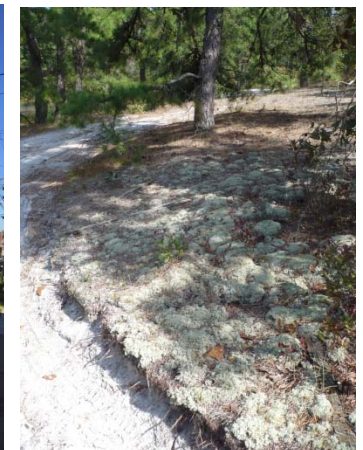
... so why should we continue to study NJ lichen populations?

Lichen populations decrease as human populations increase

- Example: New York City (Brodo, 1968)
- Long Island lichen diversity increases w/ distance from NYC

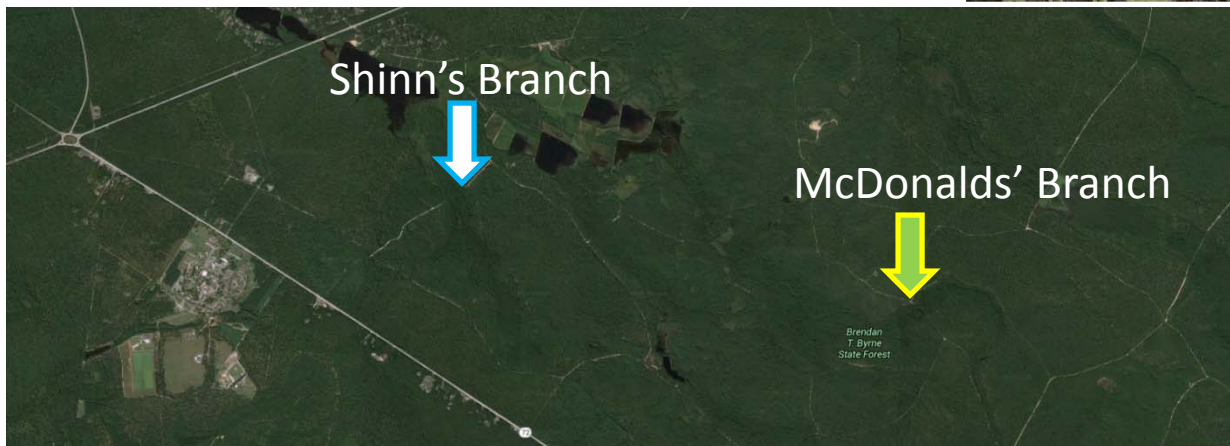


Example: NJ lichen diversity increases w/ distance to NJ TPK



... because lichens may be indicators of ecological stress

Lichen communities may reveal subtle habitat differences that are not apparent in vascular plant communities.



Chaenotheca hygrophila



Different lichen communities develop along a disturbance gradient

1. Highly used sand roads = no lichen:



2. Roads w/ low intensity use:
Tar lichen (*Placynthiella* sp.)
Pebble lichen (*Leimonis erratica*)



Different lichen communities develop along a disturbance gradient

3. Stable and undisturbed roadsides, forests

Thorn lichen (*Cladonia uncialis*)

Reindeer lichen (*Cladonia subtenuis*)



4. Protected areas with open canopies

Cladonia subtenuis

Cladonia submitis



Lichens are widespread in forest communities

(Ahti and Oksanen, 1990)

What ecological importance do lichens have in forests?



Fraser-Fort George, BC



Pellston, MI



Millville, NJ



Avon, NC



Brunswick, GA

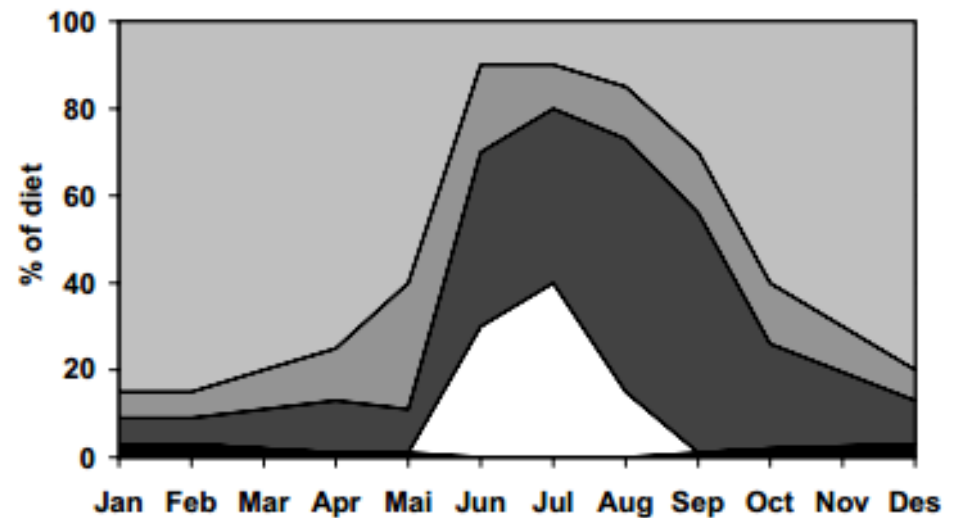


Lichens can be important for grazing animals in the tundra



Generalised reindeer diet based upon rumen samples from Fennoscandian ranges with wild or semi-domestic reindeer

Lichen rich winter pastures



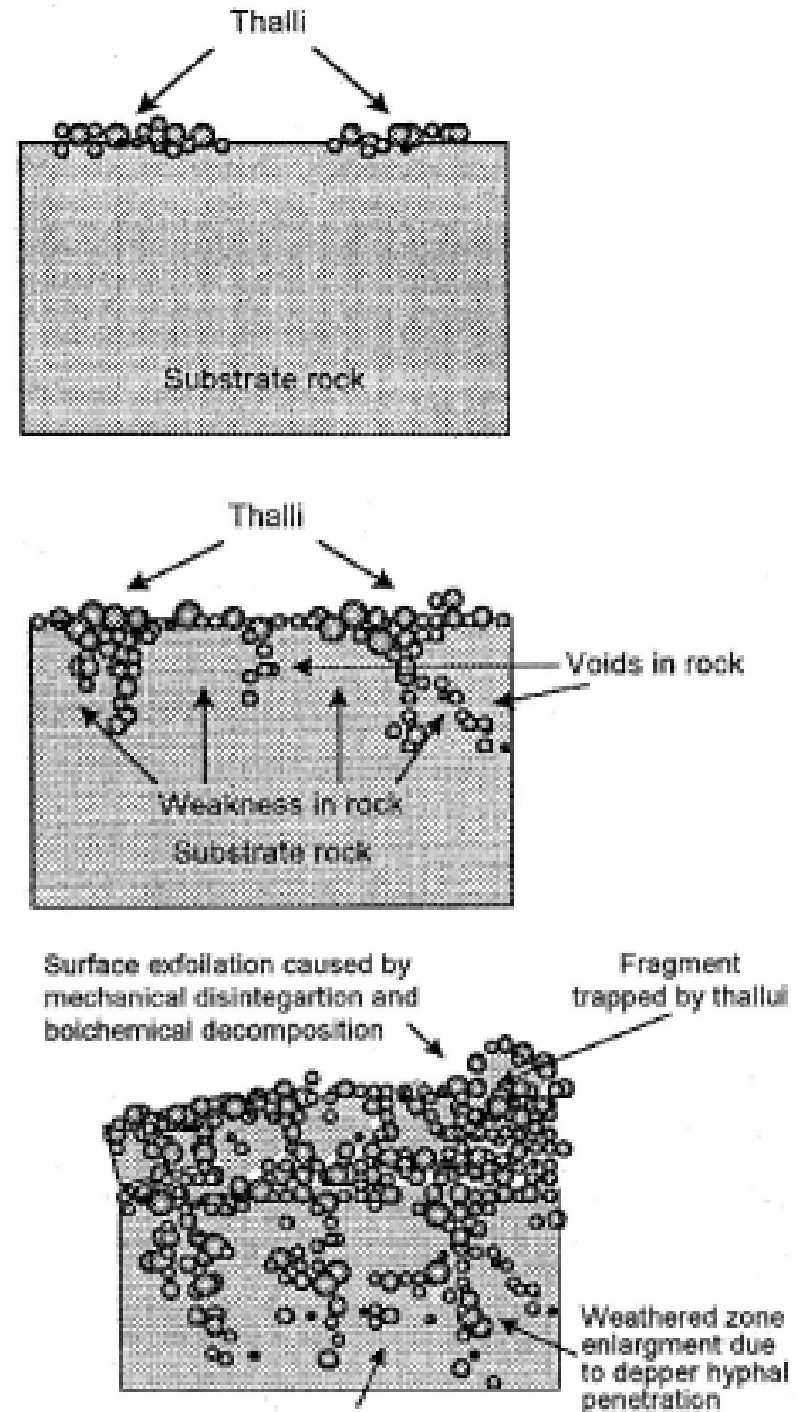
Russian Arctic Tundra: W. Gold: faculty.washington.edu

Heggberget et al. ,2002

Lichens can be important for soil formation

- Lichens can tolerate the high light intensity, low water availability, and low nutrient availability on bare rock
- After lichens establish, they make the surface more permeable for water, more able to retain organic matter, and more accessible to plant roots.

Chen, Bloom, Beyer, 2000; Catena 39:121-146



Lichens can be important for erosion prevention and moisture retention in deserts



Belknap et al., 2005



What functional importance do lichens have in temperate forests?

The background of the slide is a photograph of a forest floor. It shows a dense layer of green moss and various types of lichen growing on the ground. There are also some dry, brown leaves and twigs scattered throughout. The lighting is natural, suggesting an outdoor setting.

Talk Outline

1. Lichens in general
2. Lichens of NJ Pinelands – introduction
3. **Lichen communities of NJ Pinelands**
4. Lichen influence on forest soils
5. Lichen: why should you care?

Lichen mats all seem similar (but so do forests from far away)

Research

Question 1:

How do lichen mats differ across the NJ pinelands?



Prediction:

Lichen mats differ according to land use differences



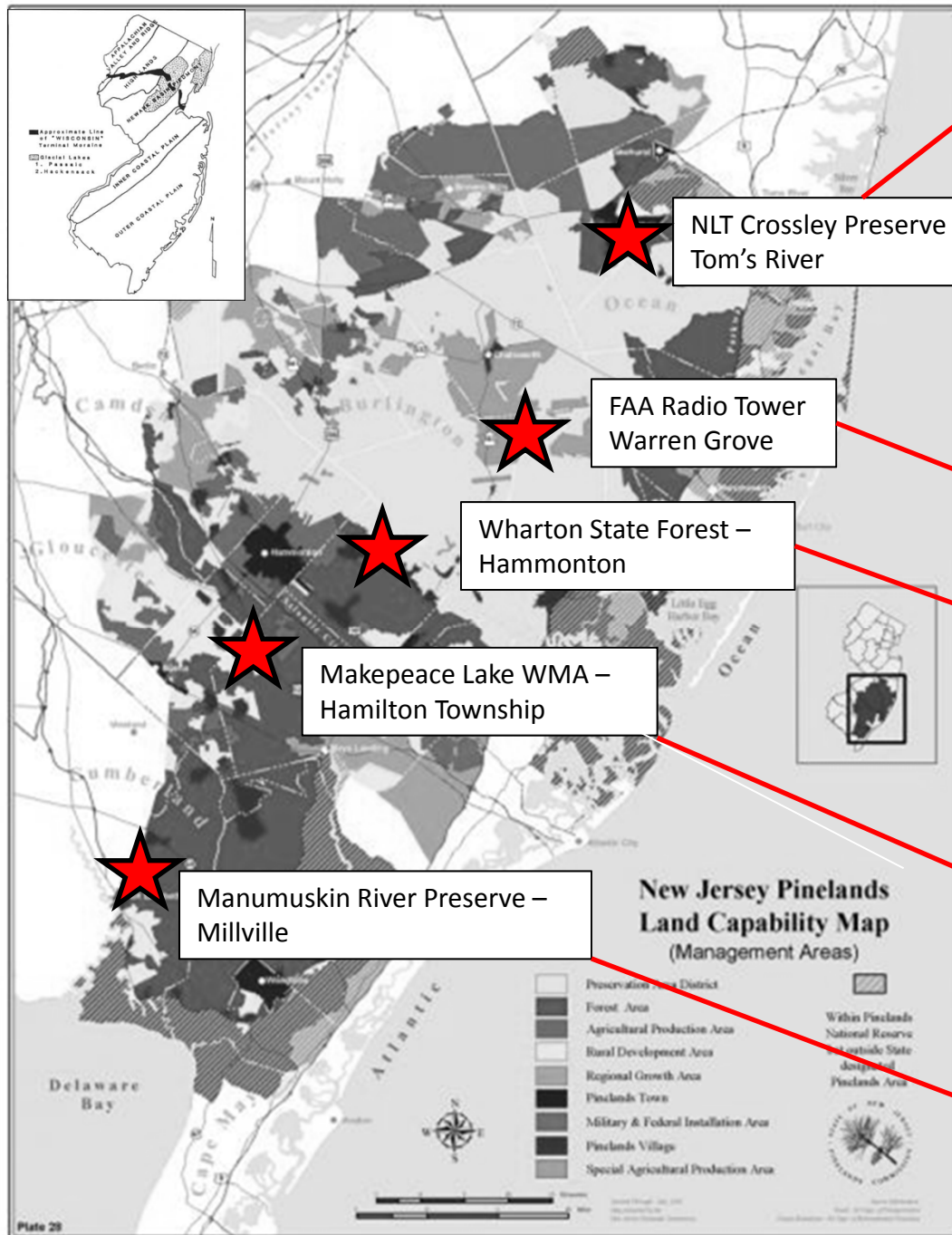
Famartin, 2014:
Apple Pie Hill, Wharton State Forest, NJ
Wikimedia commons



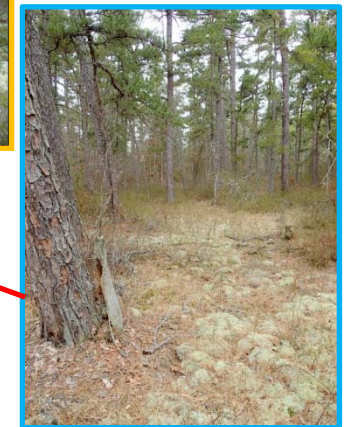
Umamah, 2014
Amazon Rainforest, Brazil
Lozells Primary School Blog



Jason and Nikki Wynn, 2012:
Charles C. Deam Wilderness, Indiana
Gone with the Wynns



Study 1: Are lichen communities different across NJ?



Crossley Preserve



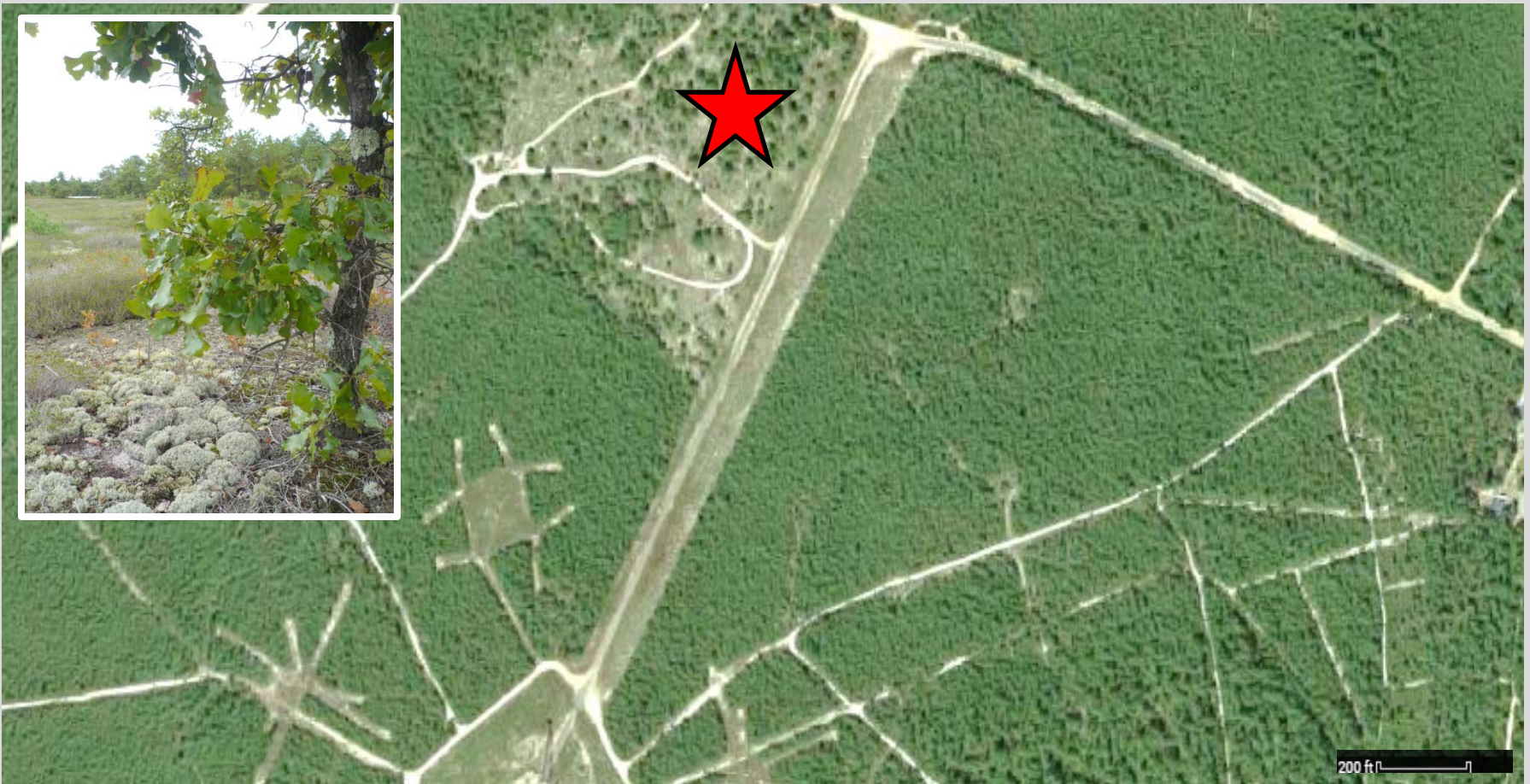
- Natural Land Trust preserve, Edge of Extensive development, North end of Pinelands



Warren grove FAA Tower



- East edge of Pinelands, sparse population, near bombing range



Wharton State forest Pleasant Mills Church



Heart of pinelands (Wharton State Forest, near Nescochague Creek, Batsto village, and Blueberry Fields.



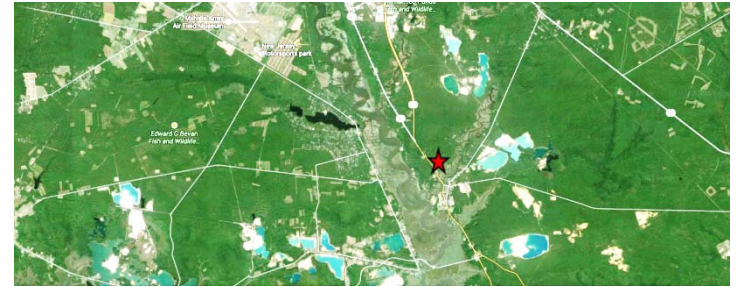
Makepeace Lake



- 10,000 acre NJDEP Wildlife Management Area, Former Cranberry Bogs,



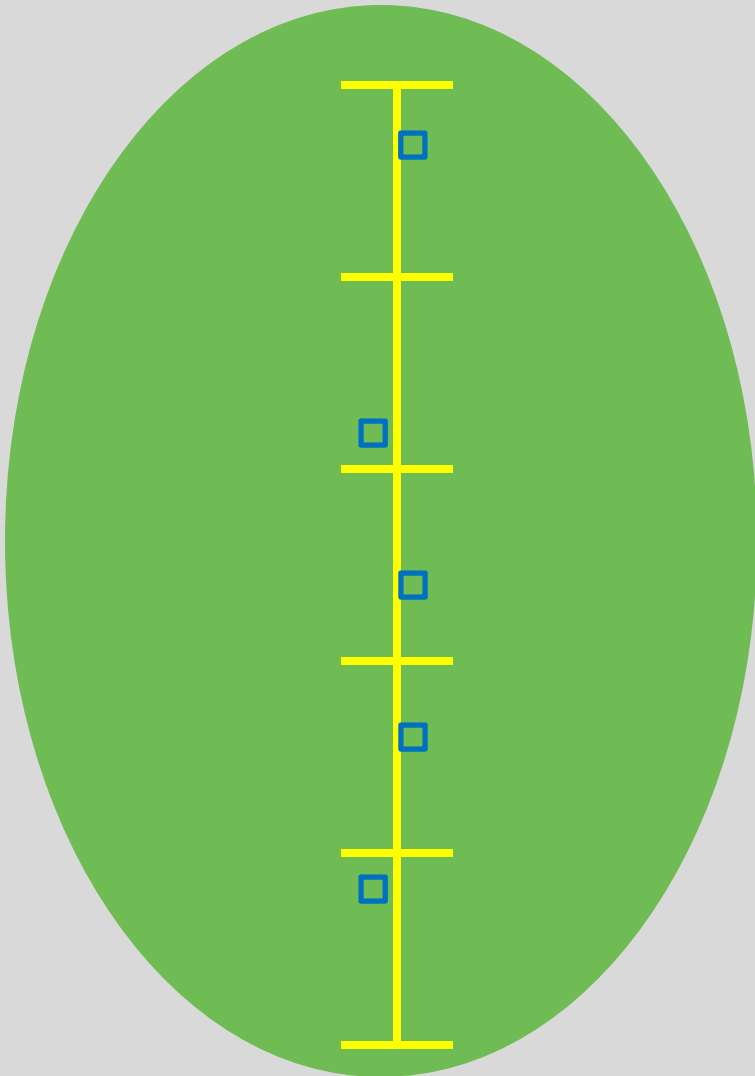
Manumuskin river preserve



- Manumuskin River Preserve



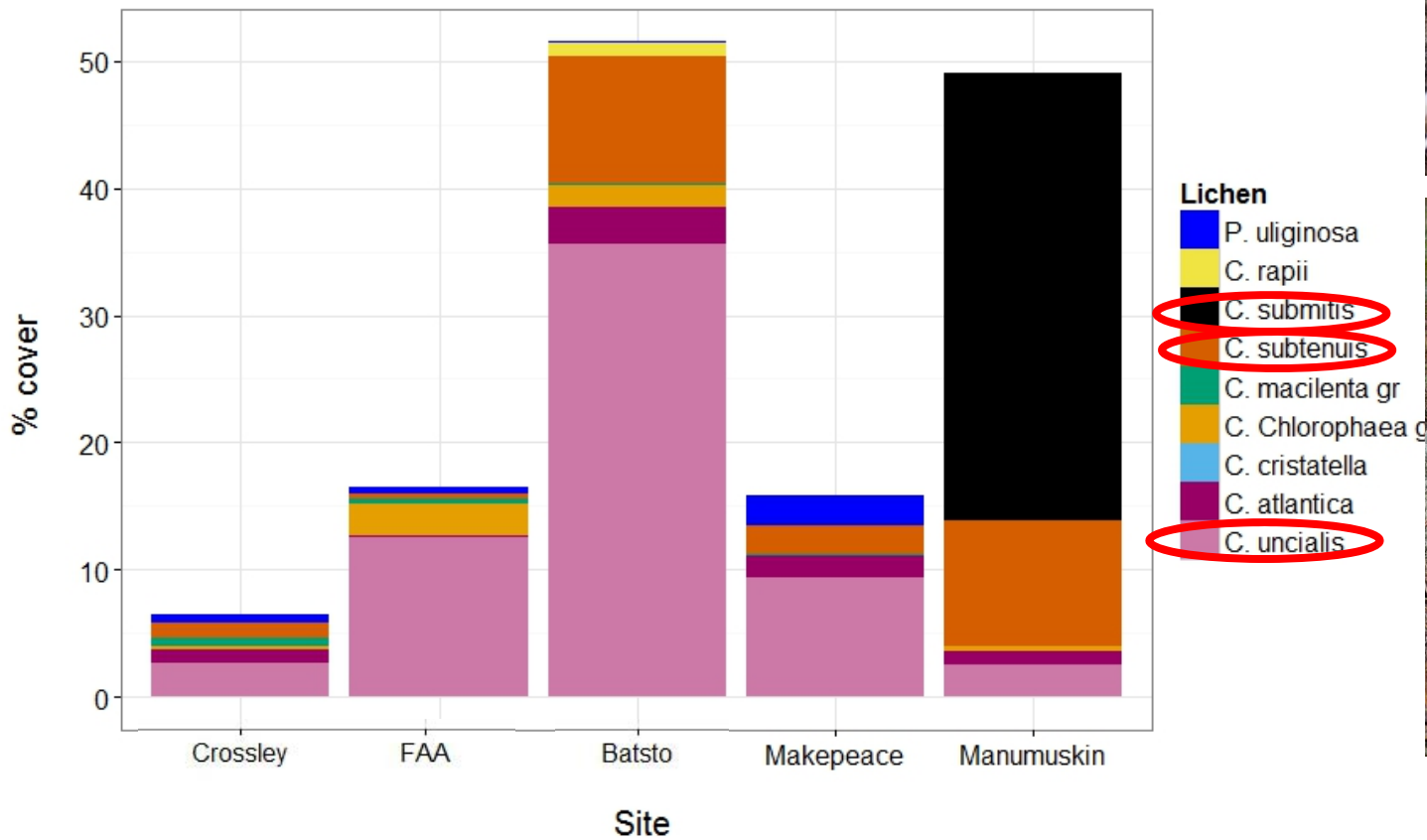
Community study method



- Two 50m transects at each site
- 1m² quadrats
- assessed % cover of:
 - Lichens
 - Plants
 - Moss
 - Bare ground

Results: 9 species make up most of the lichen mats across NJ

Lichen Cover at Each site



Many kinds of “reindeer lichen” on soils



- Dull light green, branches bent mostly one way

- *Cladonia rangiferina*

- Dull light green, branches going all directions.

- Branching in 2s, stalks under .7 m wide

- *Cladonia subtenuis*

- Branching in 3s/4s, .5-.8 mm wide,

- *Cladonia arbuscula*

- Branching in 3s/4s, wrinkled stalks .7-2mm wide

- *Cladonia submitis*

- Shiny, yellow-green

- Densely branched cushions with holes between branches

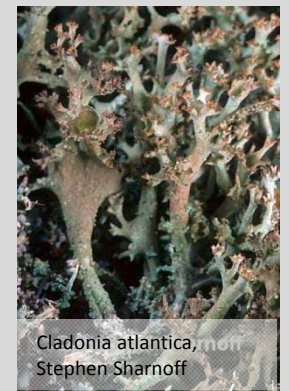
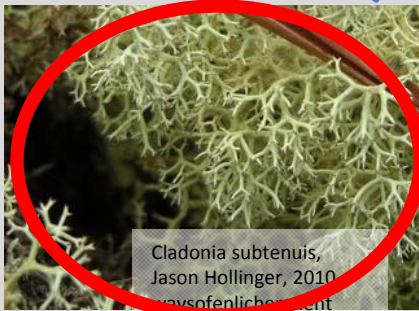
- *Cladonia uncialis*

- Flattened mats of slender branches, .5-1.5 mm wide

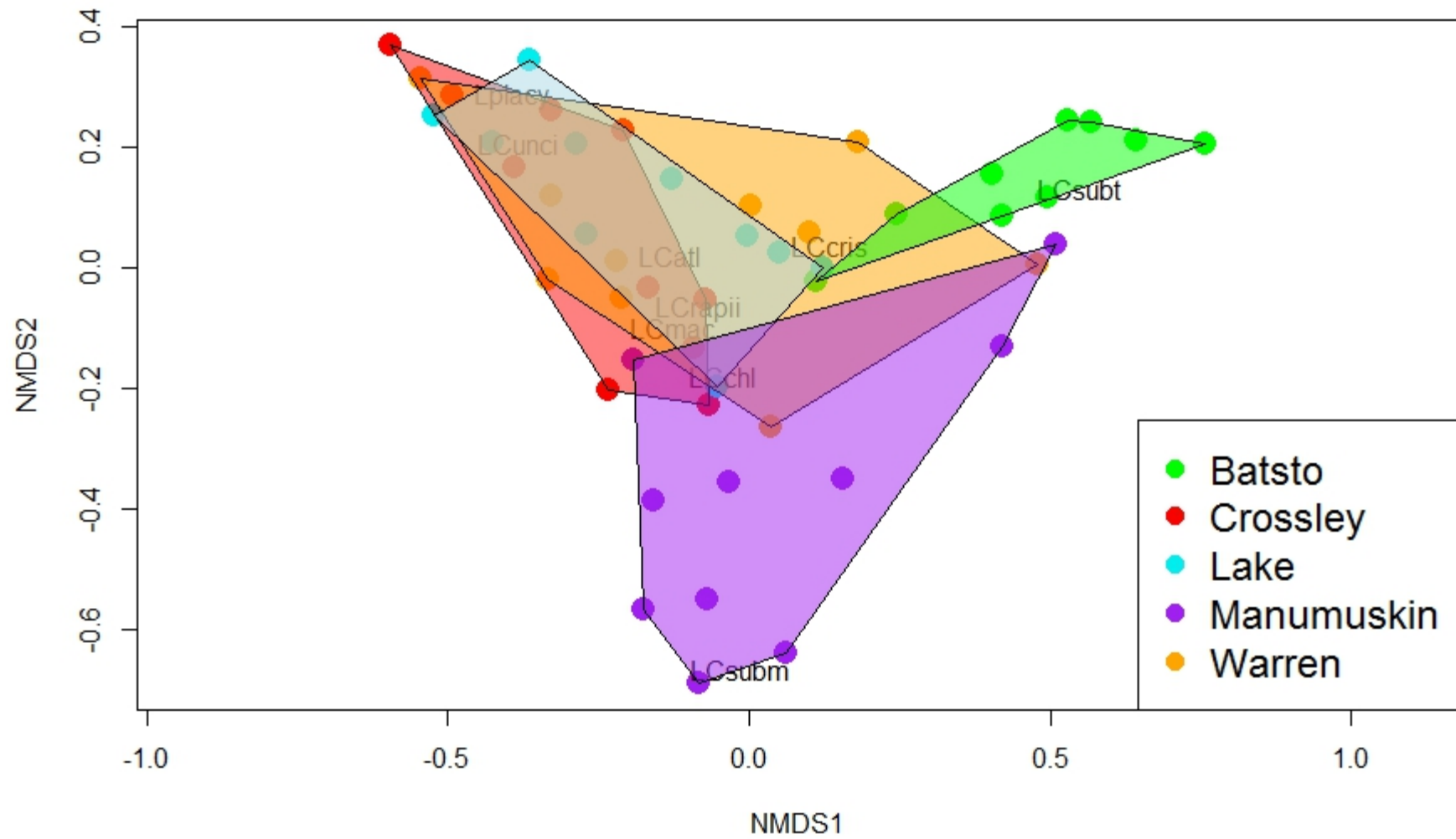
- *Cladonia dimorphoclada*

- Brown-green w/ lots of small side branches

- *Cladonia atlantica*



Comparison of lichen communities at 5 Pinelands sites



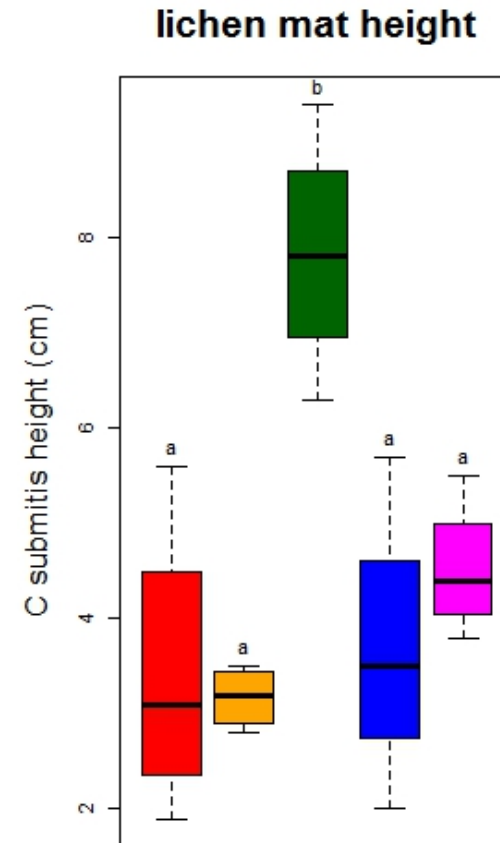
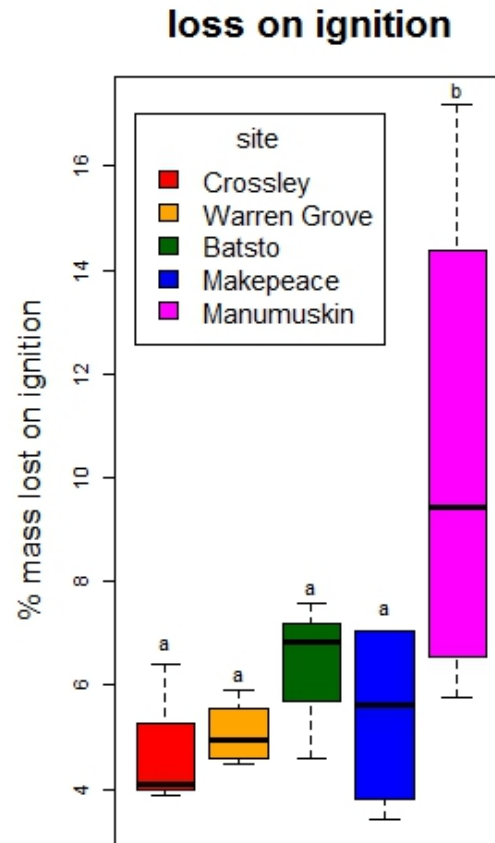
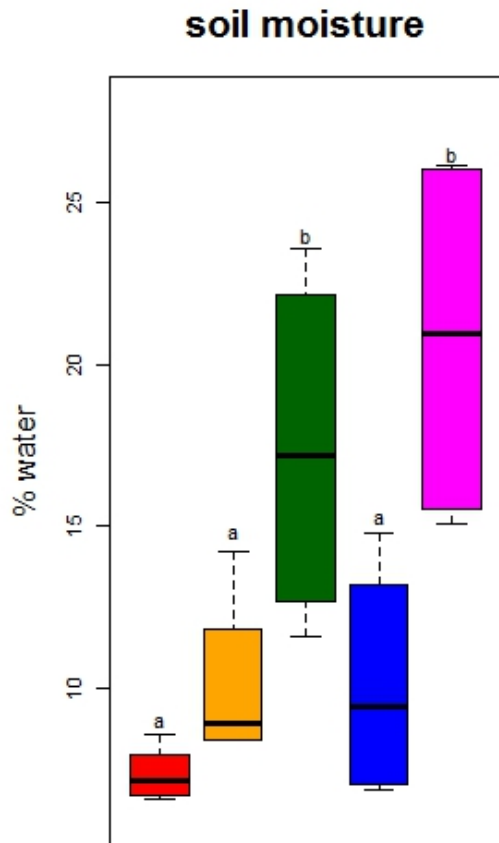
Why is manumuskin community different?

- All have sandy soils
- Well drained, low nutrient, low PH
- Lakewood Sand, Woodmansie sand, Lakehurst Sand, Evesboro Sand



L-R: © Mark Schoneveld, PPA; <http://theeastshadwest.blogspot.com/2010/08/along-south-jersey-roads.html>, Mark Betz, the Jersey I know

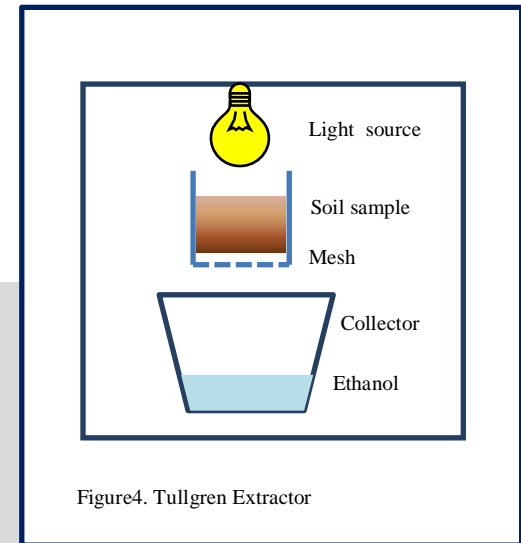
Manumuskin R.P. has more organic matter and more soil moisture



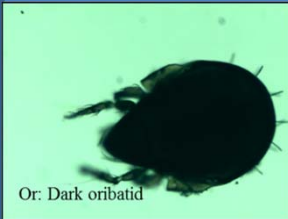
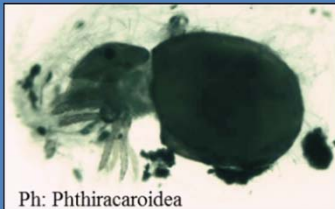
Soil properties: Summer 2013

Sampling Details: Arthropods

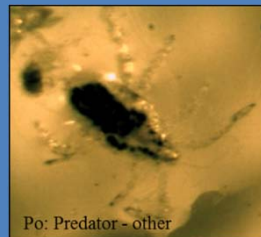
- Soil sampling using Tullgren Extractor in Dighton Lab
- Organisms identified to morphogroups



Oribatids:



Predators:



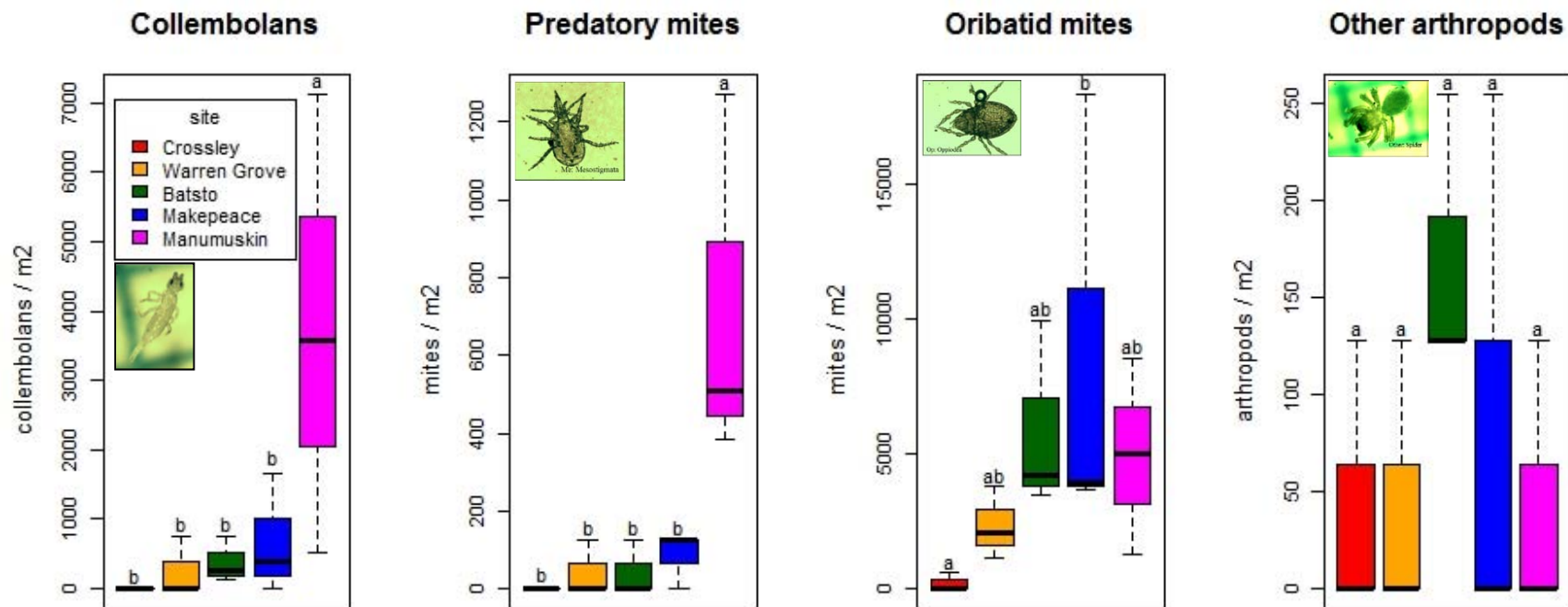
Other



Collembolans



Soils under lichens at Manumuskin R.P. lichens harbor higher densities of microarthropods



Soil animal abundance under lichen mats

Conclusions:

lichen mats are influenced more by moisture and soil organic matter than by land use

- Where lichen mats grow, they seem to be robust to historic disturbances.
 - But this disturbance gradient was small (lichens don't grow at all in ATV tracks).
 - New question: what intensity of disturbance can the lichens survive?
- Natural Land Trust's Manumuskin River Preserve has distinct lichen mats distinct from those in the rest of NJ. They have different lichens, the soils have more organic matter and support more predatory mites.
 - New question: What drives this difference? Geography? Soil type? Air moisture? If so, are other sites on the Delaware bay similar to Manumuskin?

The background of the slide is a photograph of a forest floor. It shows a dense layer of green moss and various types of lichen growing on the ground. There are also some dry, brown pine needles and leaves scattered throughout. The overall scene is a natural, somewhat overgrown forest floor.

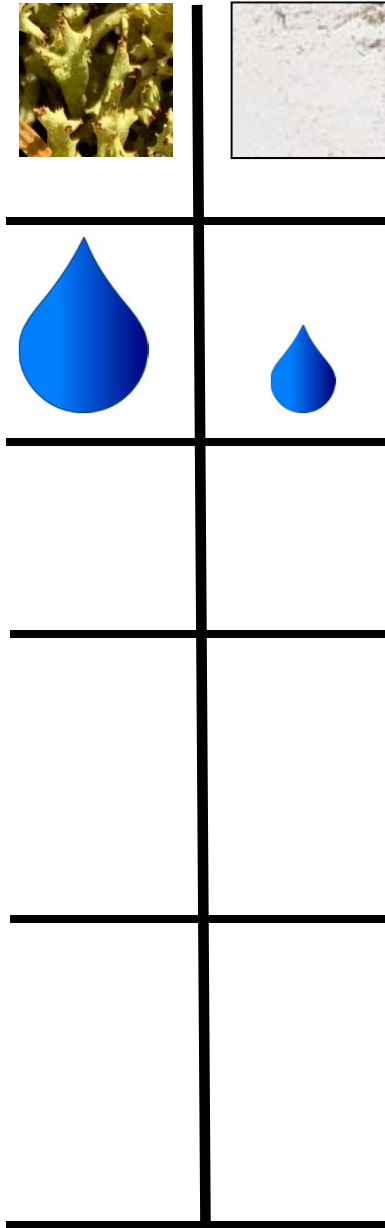
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Study 2: How do soil lichens influence soil properties?



LICHEN vs. BARE



Lichens may be influential in:

– soil moisture retention

(Chamizo et al., 2013)



Soil moisture probe
Chamizo et al., 2013

LICHEN vs. BARE



Lichens may be influential in:

– soil moisture retention

(Chamizo et al., 2013)

– soil nutrient patterns

(Knops et al., 1996)



Soil moisture probe
Chamizo et al., 2013



Lichen removed trees
HastingsReserve.org

LICHEN vs. BARE



Lichens may be influential in:

- soil moisture retention

(Chamizo et al., 2013)

- soil nutrient patterns

(Knops et al., 1996)

- provision of arthropod habitat

(Root et al., 2007)



Soil moisture probe
Chamizo et al., 2013

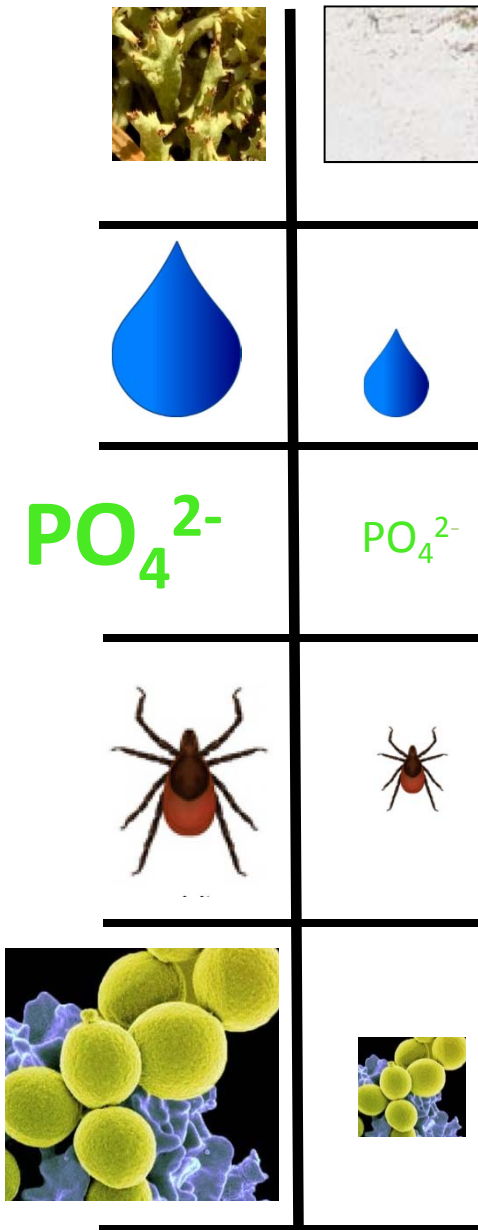


Lichen removed trees
HastingsReserve.org



Flavopermelia caperata,
Lichen arboring arthropods

LICHEN vs. BARE



Lichens may be influential in:

- soil moisture retention
(Chamizo et al., 2013)
- soil nutrient patterns
(Knops et al., 1996)
- provision of arthropod habitat
(Root et al., 2007)
- Soil microbial community activity
(Sedia and Ehrenfeld, 2006)



Soil moisture probe
Chamizo et al., 2013

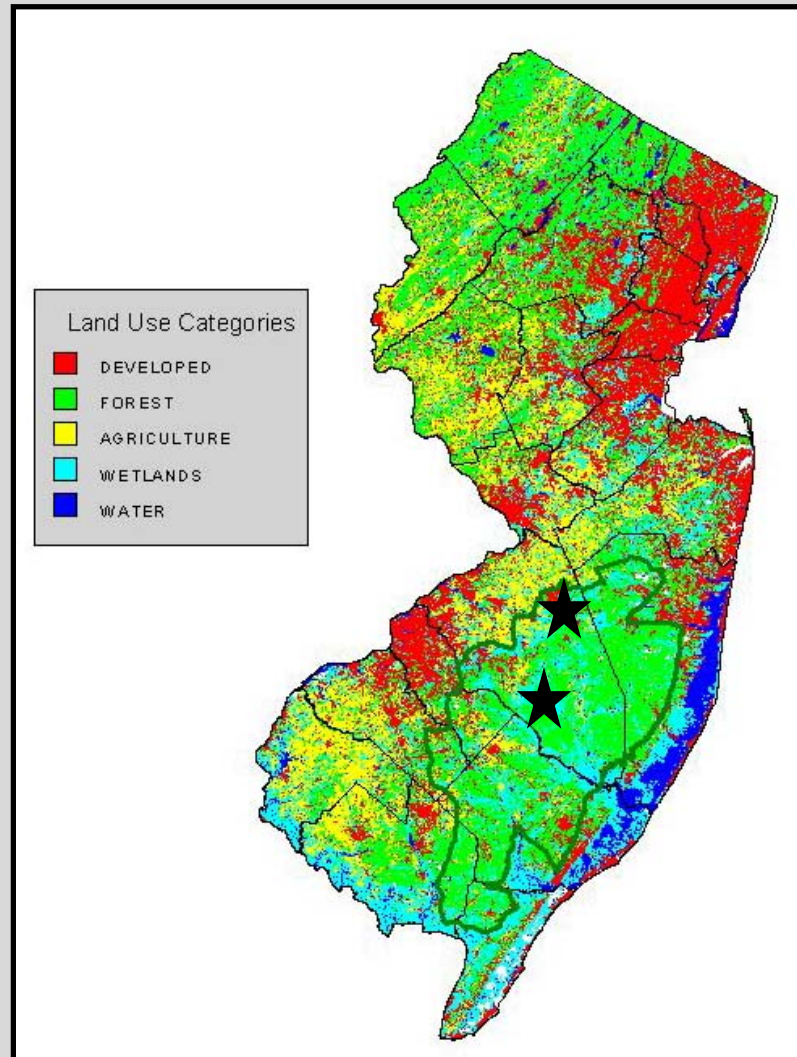


Lichen removed trees
HastingsReserve.org



Flavopermelia caperata,
Lichen arboring arthropods

How do soil lichens influence soil properties?



Daivd Tulloch, Department of Lanscape Architecture, Rutgers University



Brendan Byrne State Forest



Wharton State Forest

Transplant study

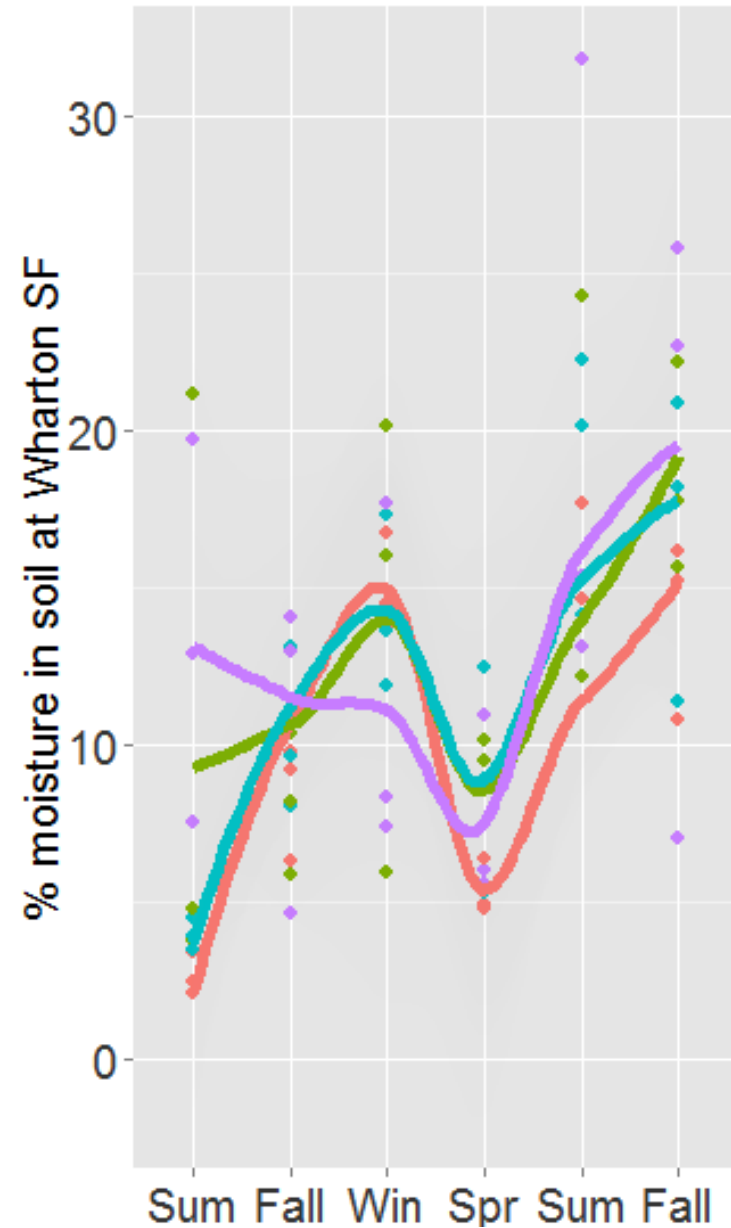
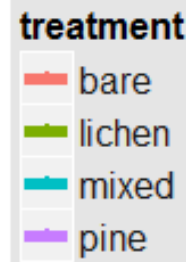
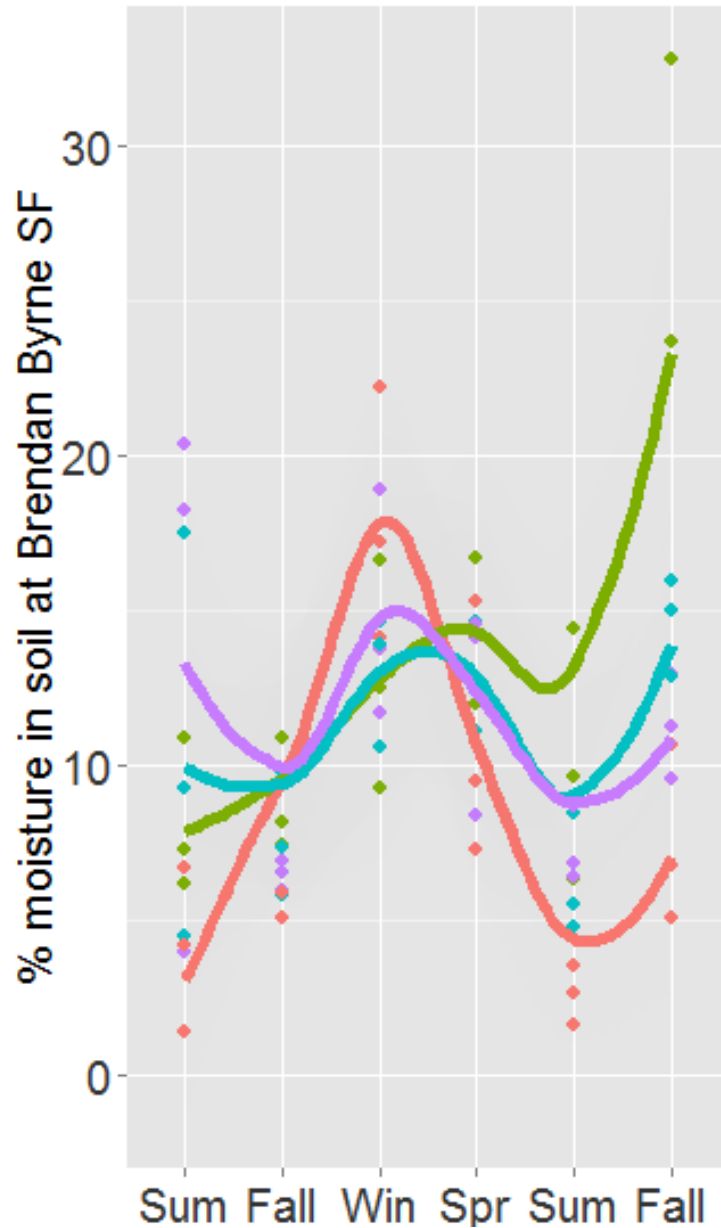


4 litter types:

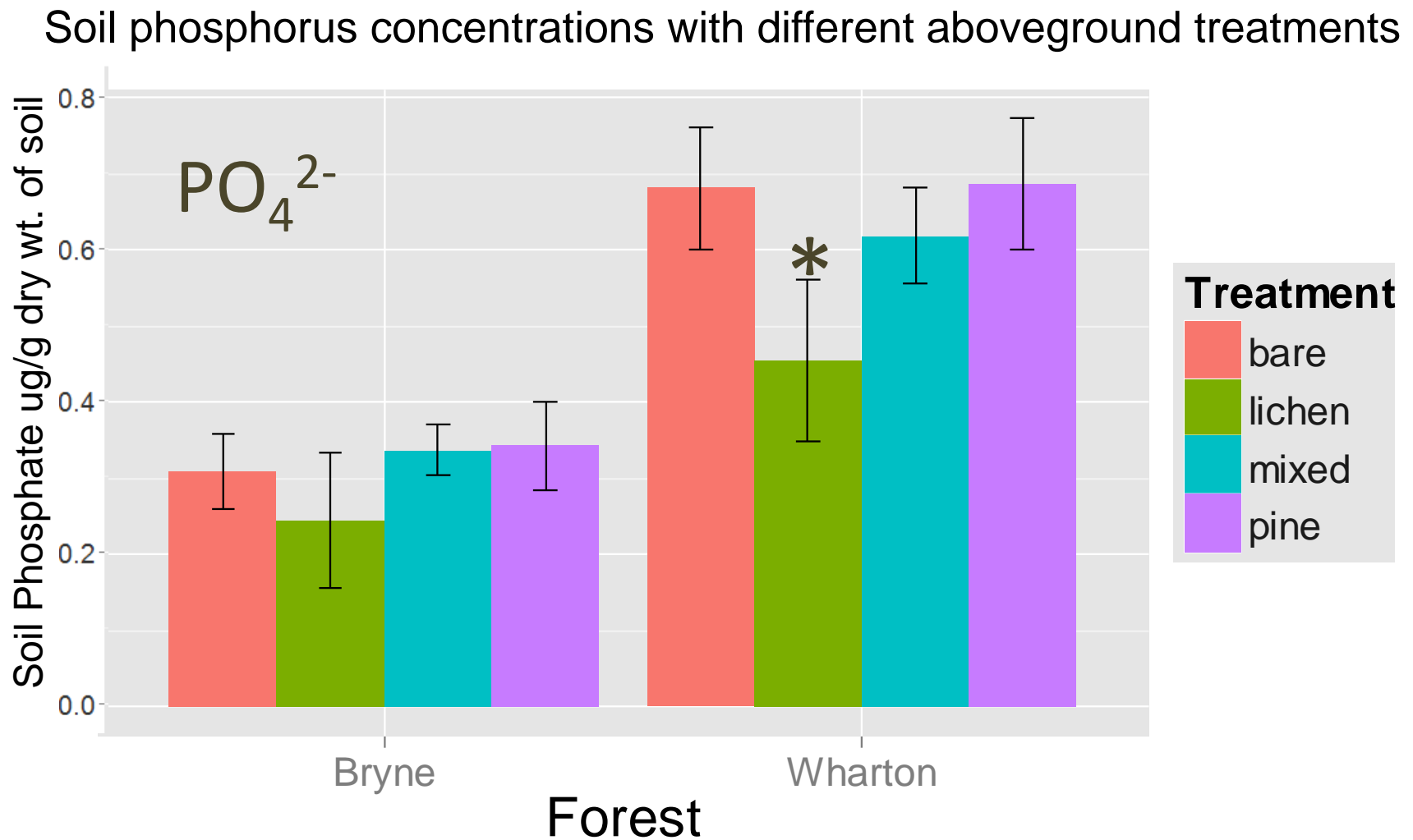
- lichen
- bare
- pine
- mixed

- 0.5m² Transplant blocks established Jan 2012 at 2 forests
- Soil homogenized, plants removed, 500g litter added
- Soils sampled to 5cm w/ 5cm diam soil core

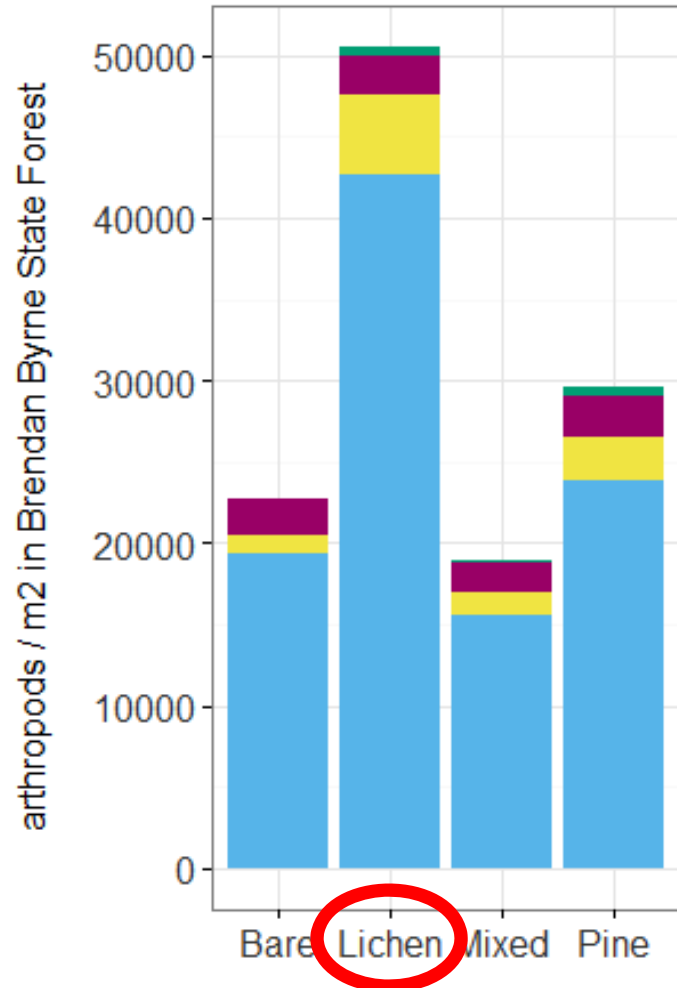
No significant lichen influence on soil moisture: lichen influence takes time to accumulate



After 1.5 years, lichens decrease phosphorus availability



Significant predatory mite difference in fall 2014



Arthropods

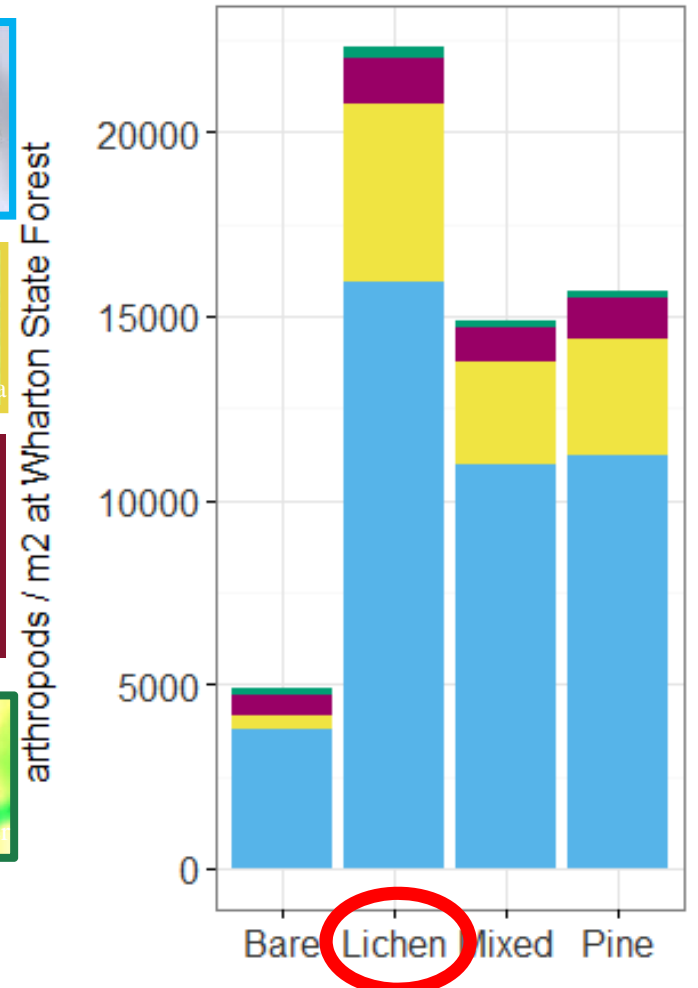
- Oribatida
- Mesostigmata
- Collembola
- Other

Oribatida

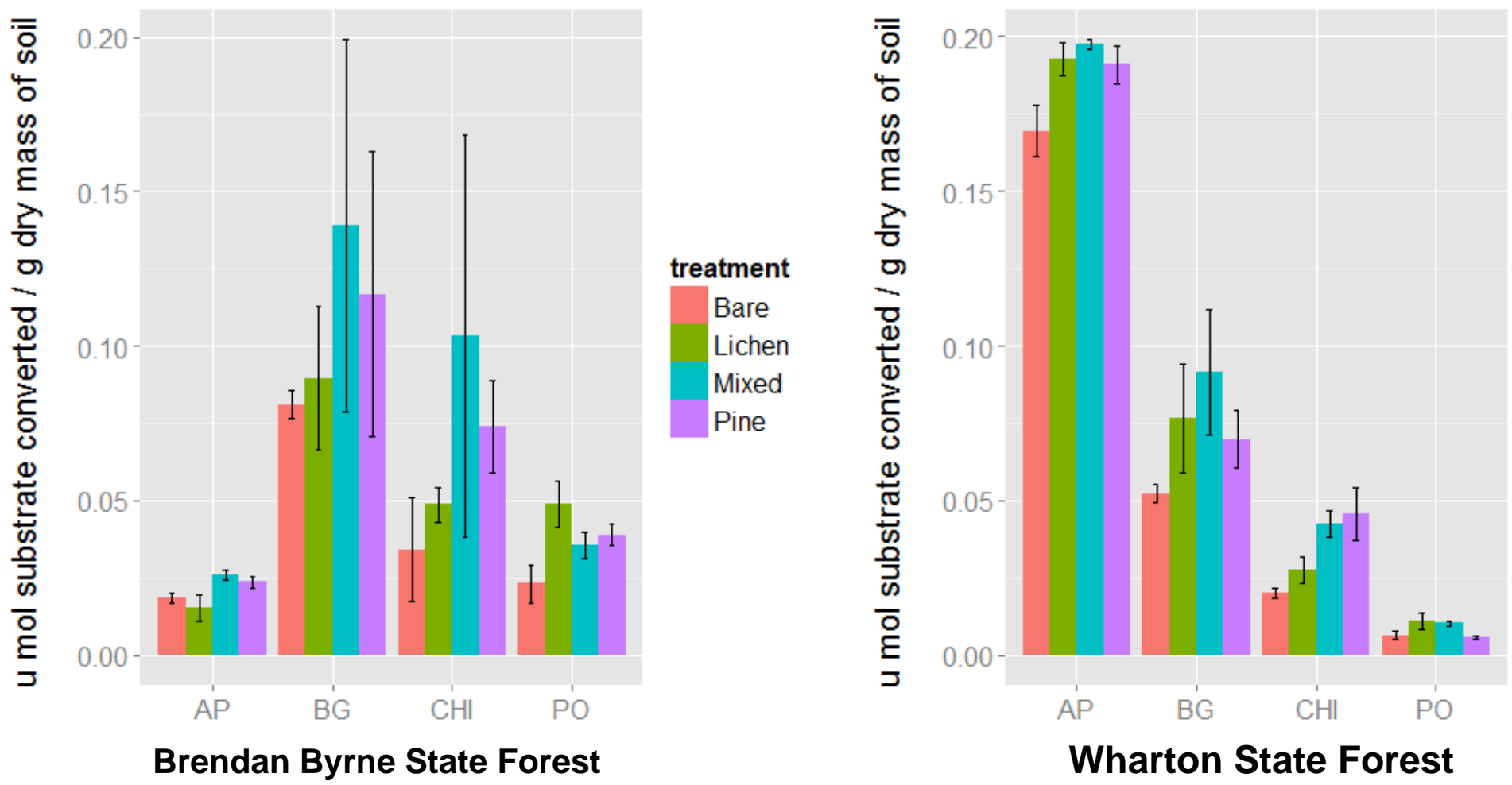
Mesostigmata

Collembola

Other

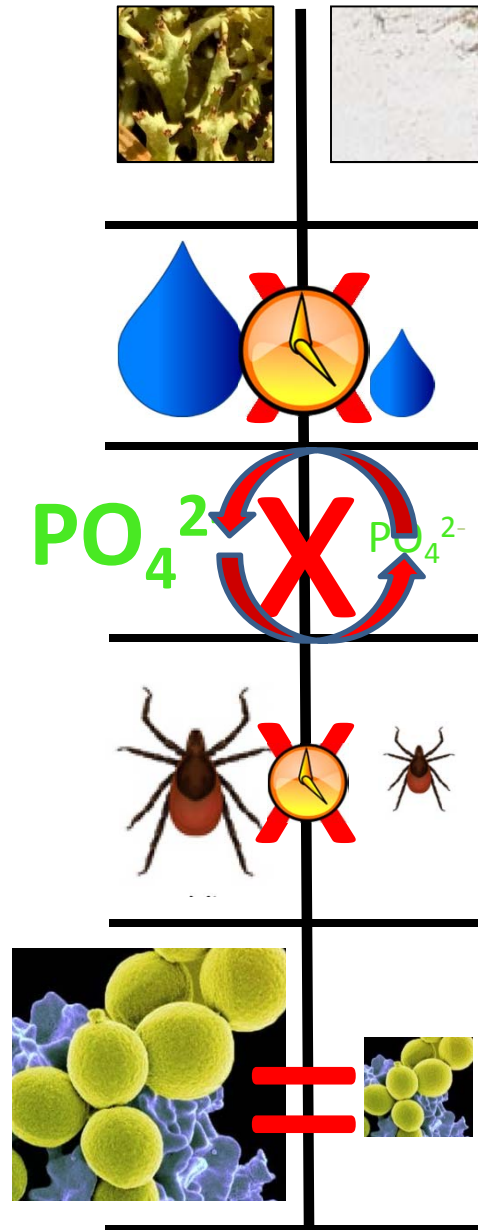


No significant influence of soil cover on enzyme activity



Conclusion: Study 2

LICHEN vs. BARE



Lichen
Influence
takes >1.5
years to
manifest, and
depends on
initial soil
conditions

Lichens: Next steps



Lichen-rich oak bark

- How do insect-mediated changes in forests alter lichen communities?
- How do lichen communities recover after fires?



Lichen-poor pine bark

Lichens: why should you care?

- Lichens are part of the suite of organisms that make the Pinelands unique
- Areas with diverse lichens might superficially look similar to other habitats, but the lichens indicate subtle habitat differences



Lichens: Next steps

- How many lichen hotspots are there in the Pine Barrens?
- How does the NJ Pinelands flora compare to the flora of other pinelands?



Consortium of
NORTH AMERICAN LICHEN HERBARIA


Photos by F. Bungartz

Cladonia ochrochlora Florke [↗](#)
 Go to Encyclopedia of Life...
 Family: Cladoniaceae
 [*Cladonia coniocraea* var. *ochrochlora*
 (Florke) Oxner, [more](#)]


Greater Sonoran Desert Lichen Flora

Nash, T.H., Ryan, B.D., Gries, C., Bungartz, F., (eds.) 2001.
 Lichen Flora of the Greater Sonoran Desert Region. Vol 1.
 Tempe, AZ


Primary thallus: squamulose, persistent; squamules: 5-10 mm long, 2-5 mm wide, irregularly, crenate-lobate, esorediate or granularly sorediate **podetia:** 15-52 mm tall, up to 4 mm wide, greenish gray, unbranched or sparingly dichotomously branched, subulate, developing cups at the apices; cups: shallow, irregular, 1-3 mm wide, corticated interiorly **surface:** corticated below, usually completely sorediate in the upper half of their length; cortex: smooth, continuous from basal portions upwards, thinning above, becoming chinky-areolate and giving rise in places to discrete soralia; soralia: 0.5-1 mm diam., soredia: farinose to granular, but corticate patches and squamules (up to 5 mm long) sometimes occurring among soredia **Apothecia:** infrequent. on cup margins. pale to dark




Stephen Sharnoff




Jason Hollinger




Gary Perimutter



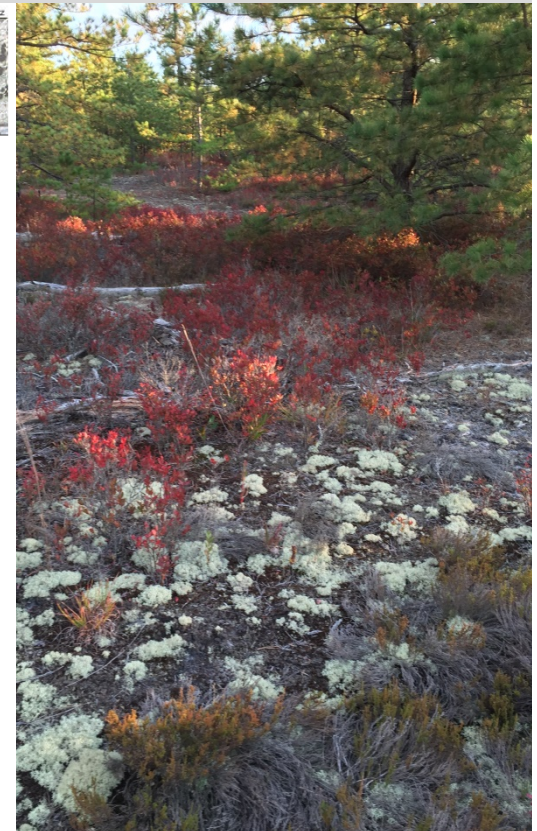
Stephen Sharnoff



Stephen Sharnoff



Open Interactive Map



Thanks!

- Dighton Lab, Dennis Gray & Ken Clark
- J. Russel Juleg & Special Pinelands Plant Class
- Andrews Foray & Walter Bien
- Rutgers Pinelands Research Station
- Pinelands Commission
- James Lendemer

Philadelphia  Botanical Club



The New Jersey NATURAL LANDS TRUST

PINELANDS PRESERVATION ALLIANCE

Protecting and Exploring New Jersey's Pine Barrens



THE NEW YORK
BOTANICAL GARDEN



THE GARDEN CLUB
of AMERICA

