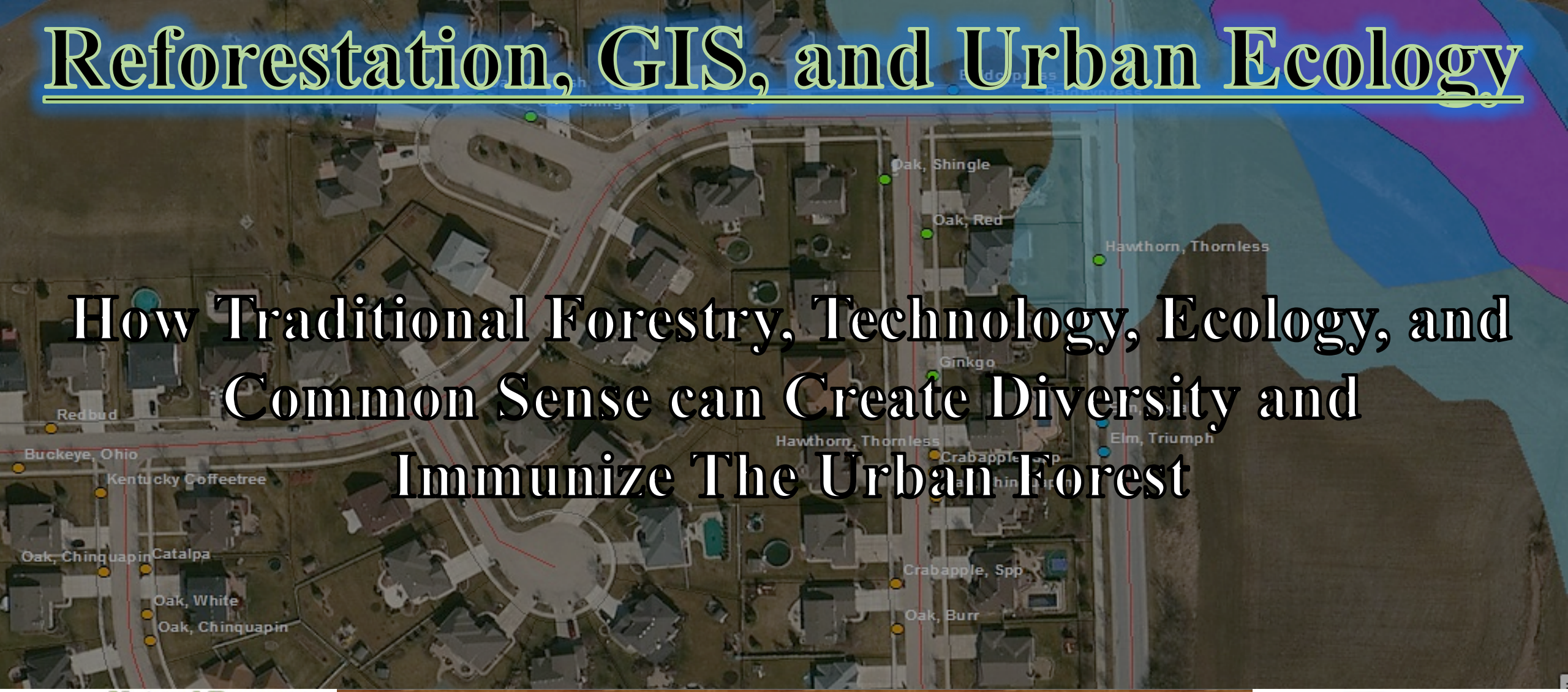
Reforestation, GIS, and Urban Ecology



How Traditional Forestry, Technology, Ecology, and Common Sense can Create Diversity and Immunize The Urban Forest

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Reforestation, GIS, and Urban Ecology

Phil Graf – Certified Arborist / Municipal Specialist

Steve Lane – Ecologist / GIS Coordinator

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Presentation Outline:

- Discuss Principles of Ecology and Traditional Forestry
- Examine how the term "Ecosystem" applies to the Urban Forest
- Look at Tree Adaptations to Site Conditions
- Think about Where These Site Conditions Occur in Urban Areas
- Look at how Deep These Species Requirements are Engrained
- Case Study of 2 large Post-EAB Reforestation Projects, with Successes and Challenges
- Discussion?

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Lessons in Forest Biology:

"It Depends…"

-Alan Dickman – Senior Instructor and Research Associate – University of Oregon

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Do Big Trees Cause Rain?

- Evapotranspiration from large trees brings significant amounts of water up from the soil and puts it into the atmosphere
- That water moves along in the upper atmosphere until it hits a cool air mass, or a mountain chain, where it cools and condenses
- That cooled and condensed water then falls to the ground as rain, therefore big trees cause rain
- But wait a minute, do they?

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Do Big Trees Cause Rain?

- How did that moisture get into the soil in the first place? No rain, no wet soil, no transpiration, no rain
- What was the weather like during that period? Low temperatures and overcast skies, no drive for evapotranspiration, no rain
- What tree species, and how many? One very large and water-stingy Eastern Redcedar does not cause rain.
- Is the moisture even going to hit a cool air mass or Mountain Chain?

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Do Big Trees Cause Rain?

- Think like a scientist and take all evidence into account
- The answer is “It Depends”, as is the answer to most things
- Large stands of trees, with naturally high transpirational pull, on wet soils, during periods of adequate temperature and sunlight, situated on the landscape so that the transpired moisture will eventually cool and condense DEFINITELY cause rain
- Nothing is ever simple, and that’s the point here

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Is The Urban Forest Really a Forest?

(Forestry)

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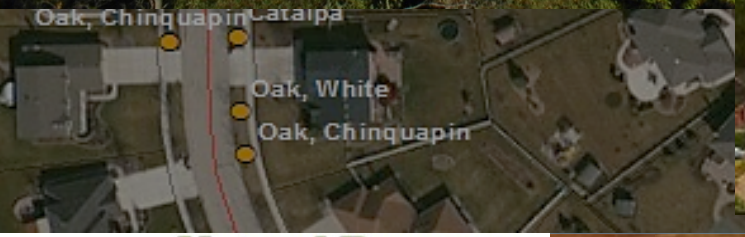
Well, it Depends, But I Think So…



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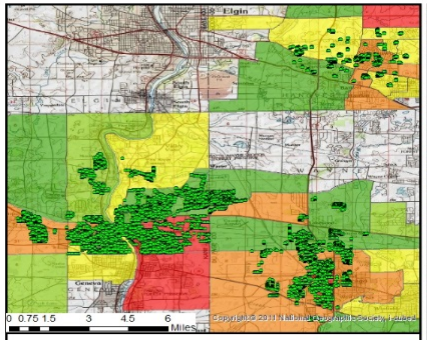
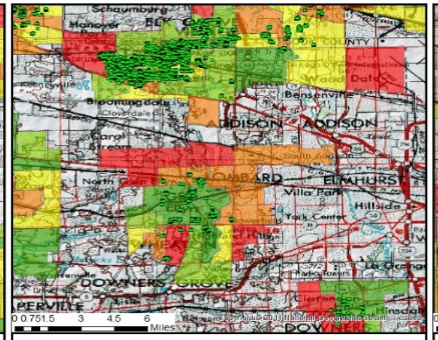
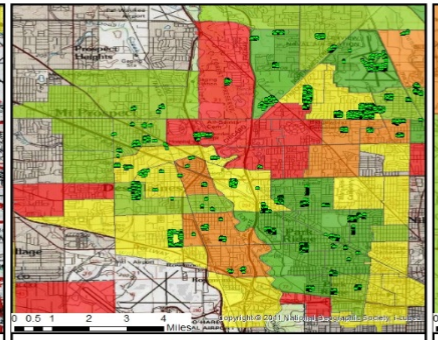


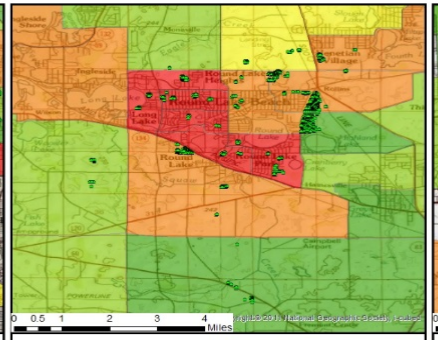
St. Charles, Streamwood, and West Chicago



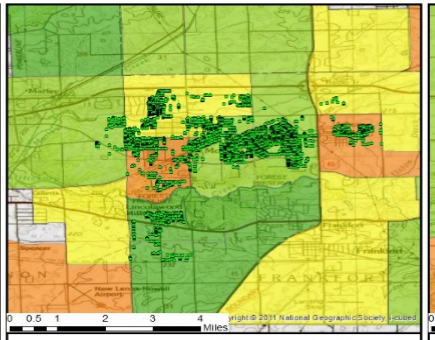
Roselle, Elk Grove, Glen Ellyn, and Clarendon Hills



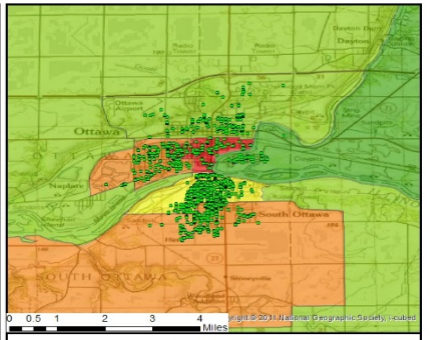
Des Plaines, Glenview, and Park Ridge



Round Lake and Round Lake Beach



Mokena



Ottawa (Illinois)

Legend

Tree Locations

Median Home Value

Value Index

- 0.44 - 0.75
- 0.76 - 0.90
- 0.91 - 1.05
- 1.06 - 1.20
- 1.21 - 1.92

Home Value Index	Tree Count	Average Tree Condition	Average Tree Size	Square Miles	Trees Per Square Mile
0.44-0.75	7,443	2.81	10.71	5.25	1417.48
0.76-0.90	14,910	2.93	10.19	9.22	1617.56
0.91-1.05	15,273	2.91	10.8	8.25	1851.45
1.06-1.20	17,537	3.07	9.24	31.13	563.29
1.21-1.92	18,991	2.96	9.19	22.48	844.70

Abstract

This project sought to determine if there was a correlation between Mean Home Values and the number of, size of, and condition of trees. Also examined was the average age of the buildings within a given area, to see if there was any evidence of further correlation.Data included tree information on over 70,000 trees from 12 municipalities, and the demographic data was Tract-Level Census from the American Community Survey (ACS) 2007-11. Home Value Index was a calculated value.

Mean Home Value Index Results

The results do not bear out any real sort of correlation, though there are several possible reasons for this. There appears to be a correlation betwen home values and tree count, but when the data is corrected for area (divided by square miles), this is no longer apparent. The analysis should be conducted again in order to correct for populated vs non-populated land mass. The best condition trees actually appear to be in the lowest home value areas, and tree size stays consistent across groups.

Methods

GIS-based Tree inventory data from over 70,000 trees was used to compare with Tract-Level Census Data. Trees were ranked in condition from from 1-5, according to a standard distribution (see example curve to right). Census data on Mean Home Values and Average Age of Buildings was categorized according to rank. Trees were then grouped into these census categories, and basic statistics were performed to see if there was any correlation between the total count and condition of trees, and the demographic variables. See the attached report for detailed discussion and results.

Mean Building Age Results

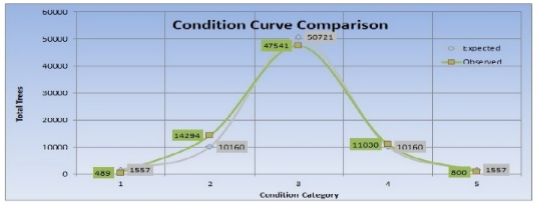
Initial results show a very strong correlation between the mean age of buildings in an area and the size of the trees in an area, though no correlation exists between the mean age of buildings and the count of condition of the trees. Though this intuitively makes sense at first, that older areas have larger trees, there is also an implication that tree care becomes a greater priority as an area has been settled for a longer period of time. The power in both of these analyses was that they compared variables across communties.

Mean Home Index Values

Mean Home Index Values range between 0.44 and 1.92. They were calculated as the Mean Home Value in a census tract divided by the Mean Home Value for each community in which the census tract was located. In the event that a tract spanned 2 communities, the Mean Home Index values were averaged.

The Urban Forest and You:

How Tree Count, Size, and Condition Relate to People and Place in Illinois



Mean Building Age

Mean Building Age was obtained from the US Census Bureau, and range between 7 and 75 years as the average age of the structures within each census tract. Data was roughly categorized by quantile, with small shifts to make the breaking points approximately every 10 years.

Legend

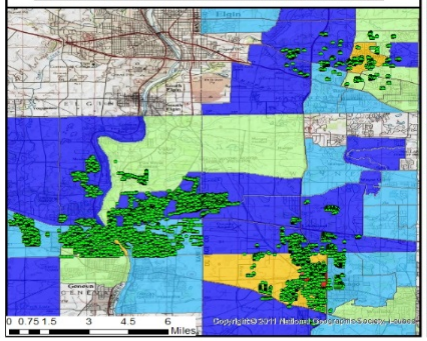
Tree Locations

Building Age Average (Yrs)

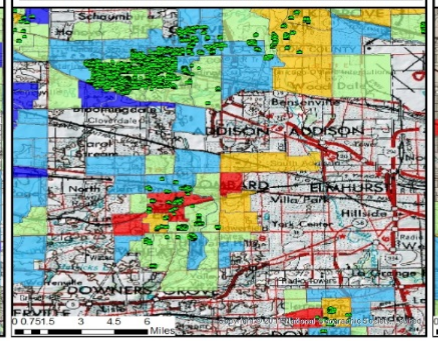
- 7 - 25
- 26 - 35
- 36 - 45
- 46 - 55
- 56 - 73

Median Building Age

	7-25	26-35	36-45	46-55	56+
Total Trees	21,854	23,454	14,051	10,894	3,901
Tree Condition	2.97	2.99	2.95	2.88	2.93
Average Tree Diameter	7.78	8.7	10.84	13.09	15.48



St. Charles, Streamwood, and West Chicago



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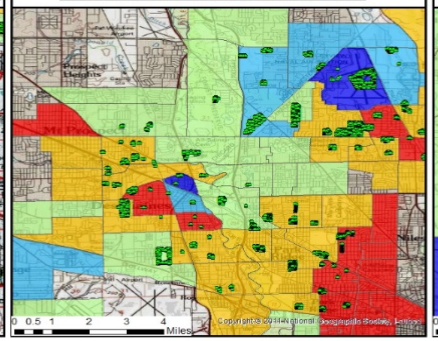

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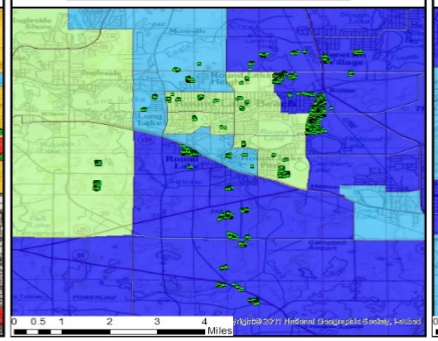

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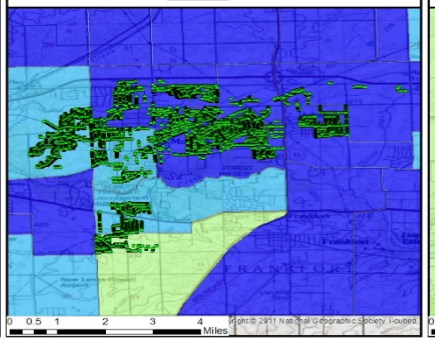
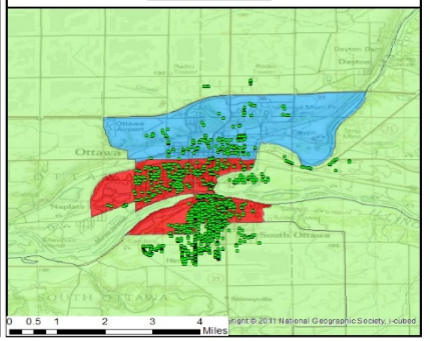
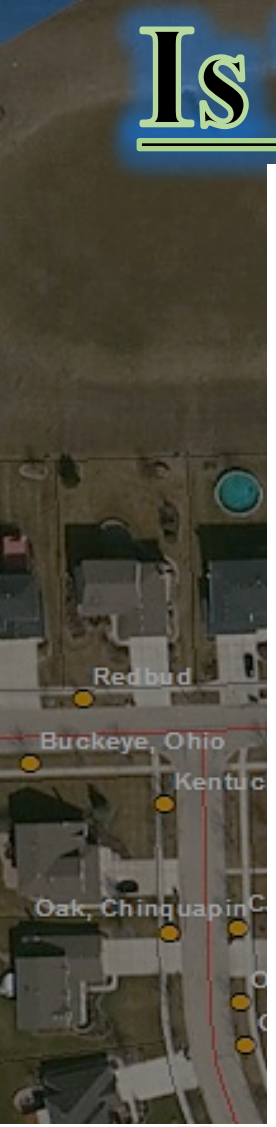


Mokena



Ottawa (Illinois)

Is The Urban Forest Really a Forest?



URBAN Forestry

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What is Ecology, and What is a Forest?

- Study of the Biotoic and Abiotic factors that exist in a discrete geographic area, as well as the INTERACTIONS between them.
- Biotic factors: Organisms (Plants, Animals, Bacteria, Fungi)
- Abiotic Factors: Rocks, Climate, Topography, Fire, Water
- Interactions: The power of ecology is in the interconnectedness of all of these things to create unique ecotypes.
- A Forest is one version of an Ecotype, like a Desert or a Tundra
- Urban Forestry is a sub-discipline of Ecology

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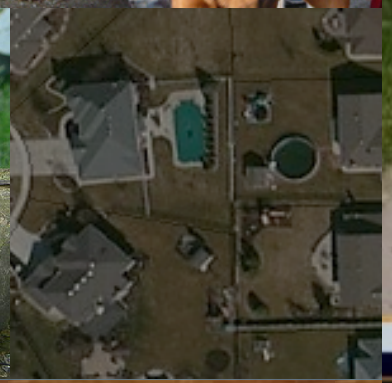
The Urban Forest Has Organisms:



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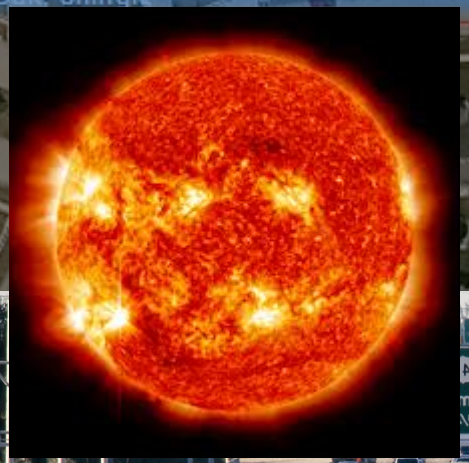
The Urban Forest Has Abiotic Stuff:



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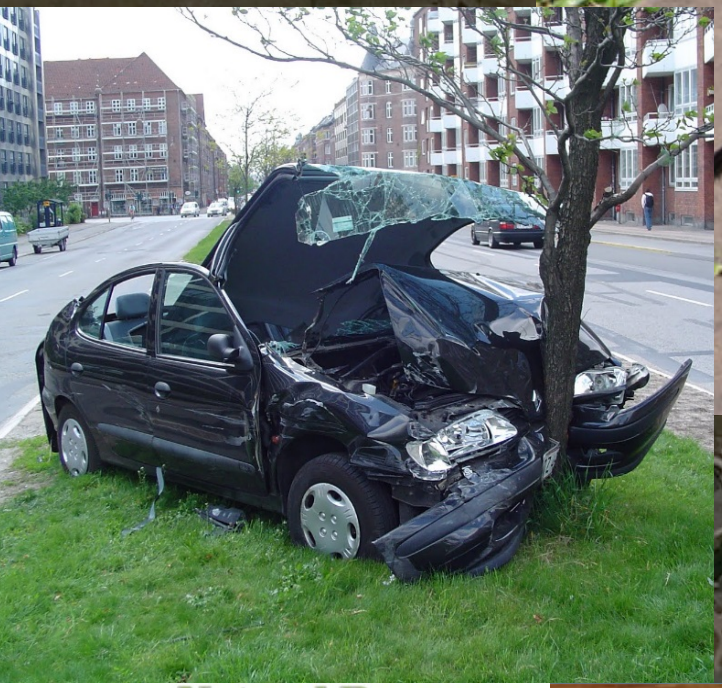
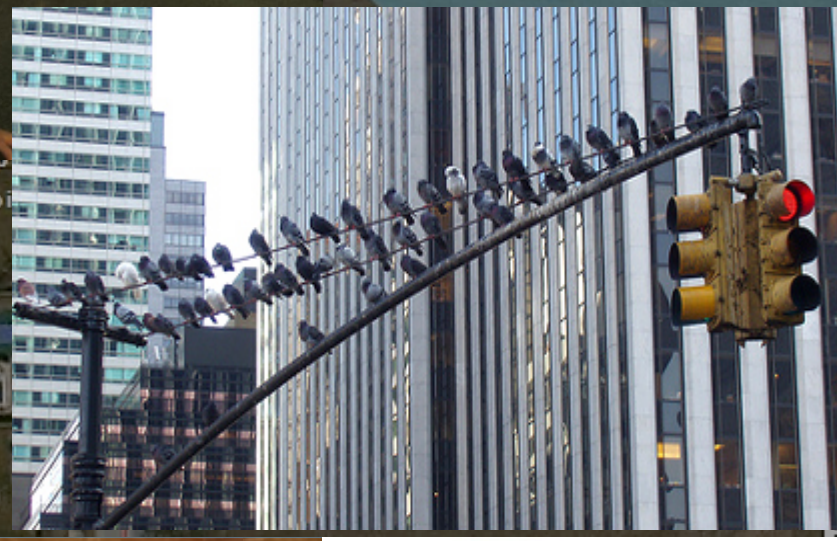
And All of These Things Interact:





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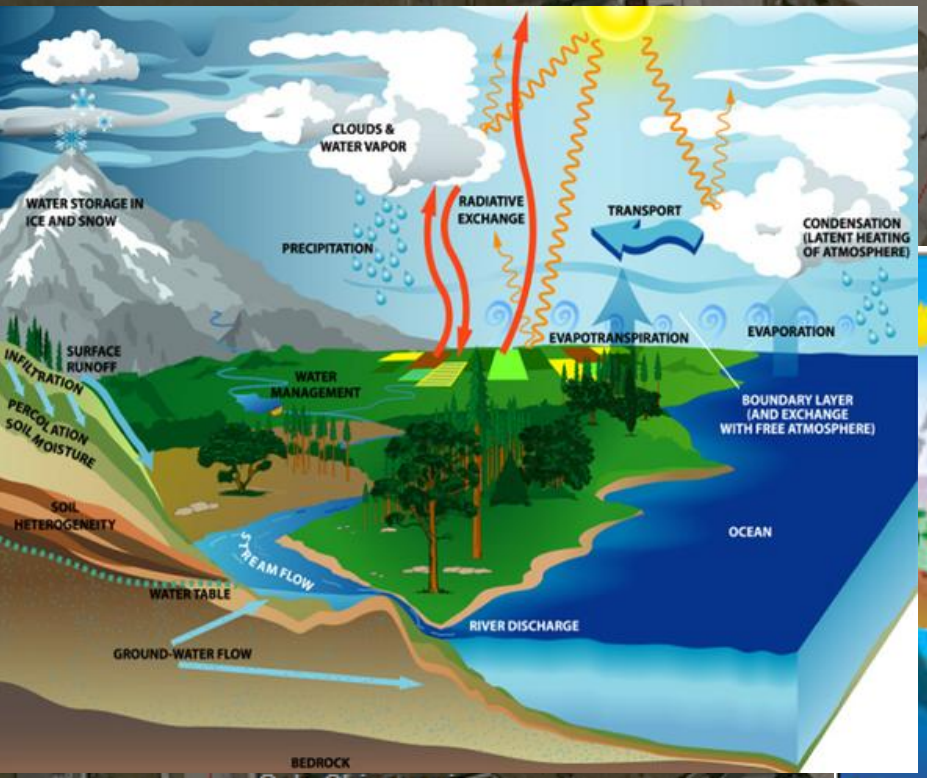
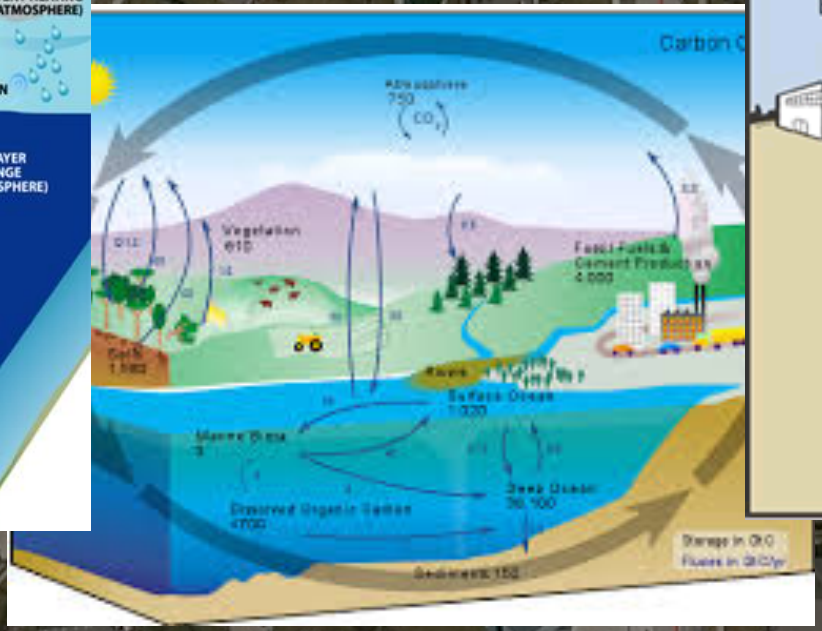
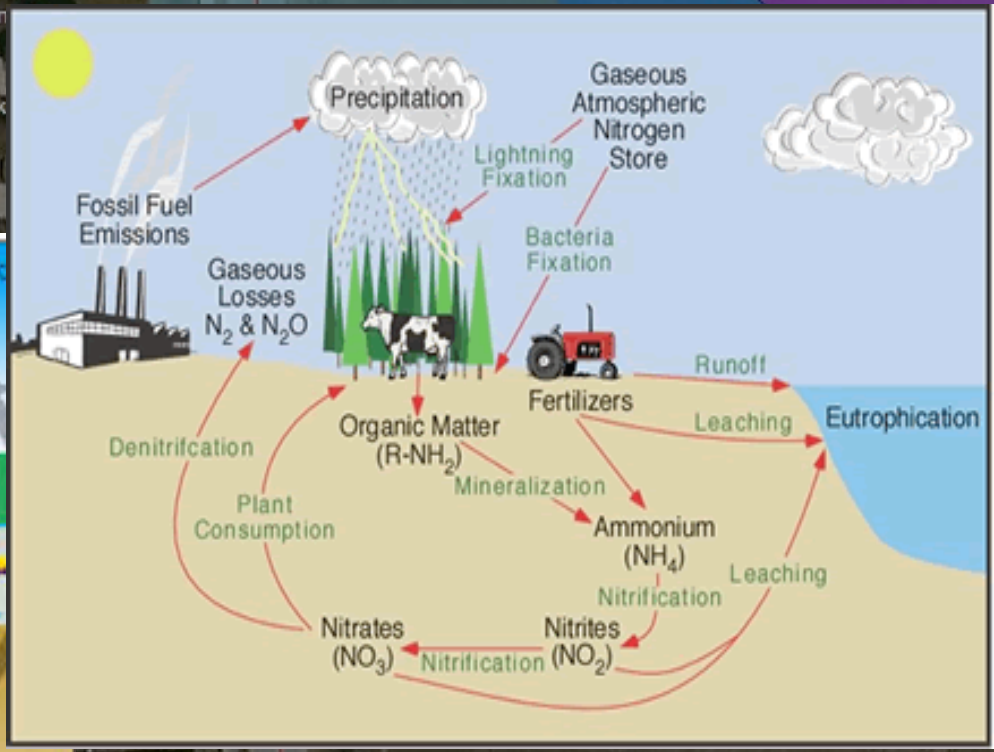
Think in Terms of Cycles and Systems:







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Barry Commoner's 4 Laws of Ecology

THE FOUR LAWS OF ECOLOGY . . .

1. Everything is connected to everything else,
2. Everything must go somewhere,
3. Nature knows best, **and always bats last!!**
4. There is no such thing as a free lunch.

Barry Commoner, *The Closing Circle*, 1971

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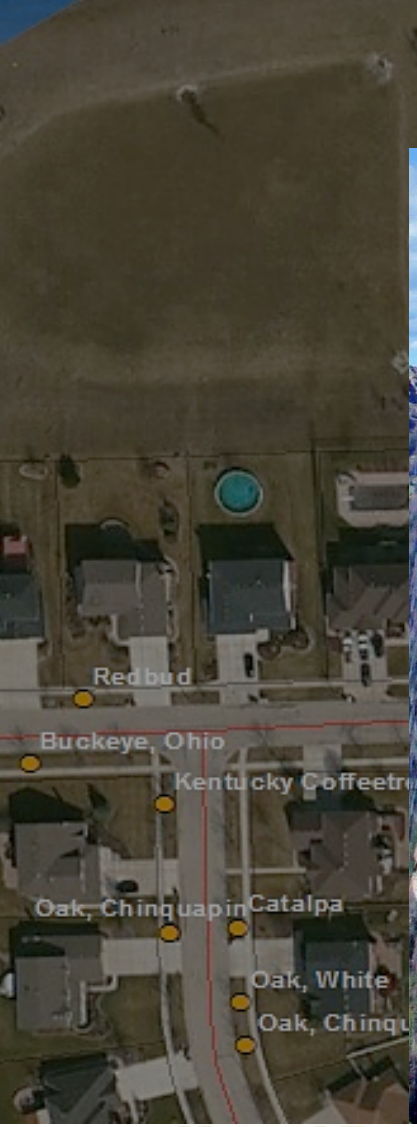
Mountain Pine Beetle:



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Try To Work With Nature, Not Against

- Urban Ecosystem can be harsh enough to begin with , so try to find points where you can cater to a tree's natural tendencies such as
- Soil Moisture Content
- Available Growspace (Above Ground / Parkway Width)
- Relative Shade / Light Levels
- Nutrient and Salt Loads in a given area
- And try to maximize diversity! This is a fundamental of all ecological systems, that high diversity yields high stability

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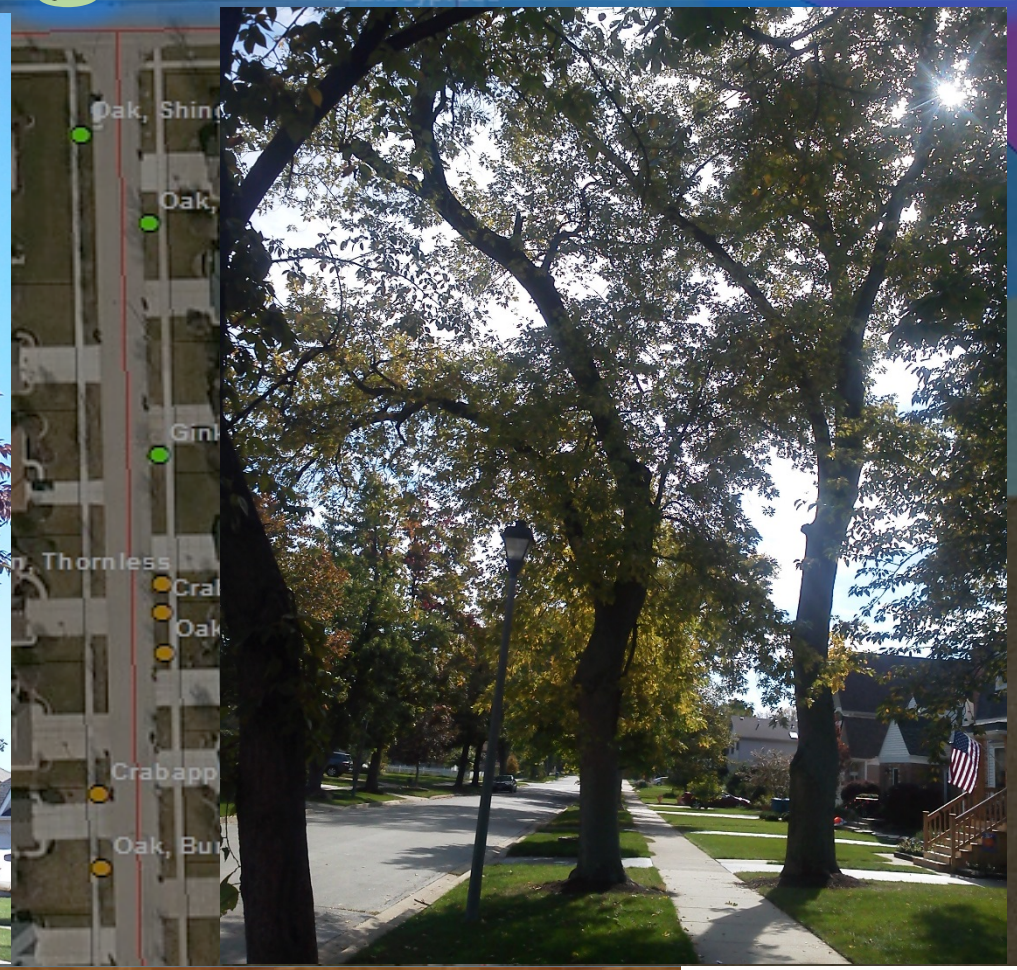
Some of These Things Are Obvious:



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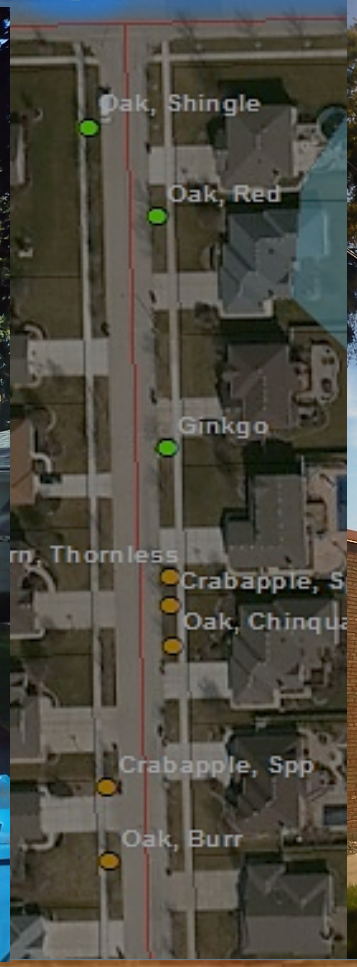

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Migration And Species Requirements:

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Change In Species Composition:

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Looking For Clues in Nature:

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Moisture Level: Most Important Factor

- Soil Texture: Important because of moisture retention and how it affects drainage
- Soil Fertility / Salinity: Directly influenced by the overall moisture content of the soil by how mobile salts and nutrients are, and in what redox state they exist
- Soil Oxygen content: Directly influenced by waterlogging, and important in root compaction
- Some trees simply cannot tolerate drought

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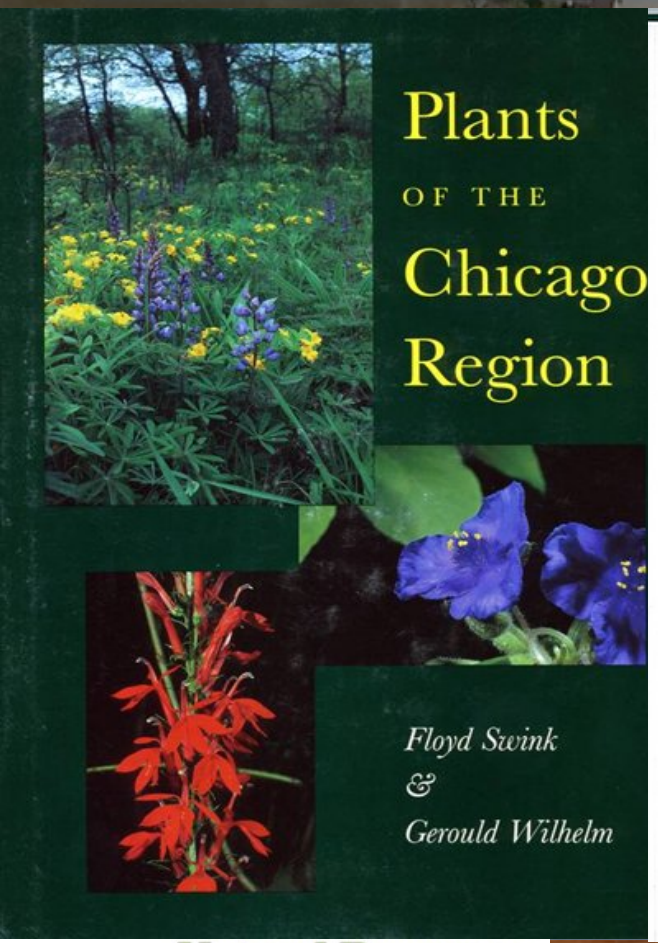
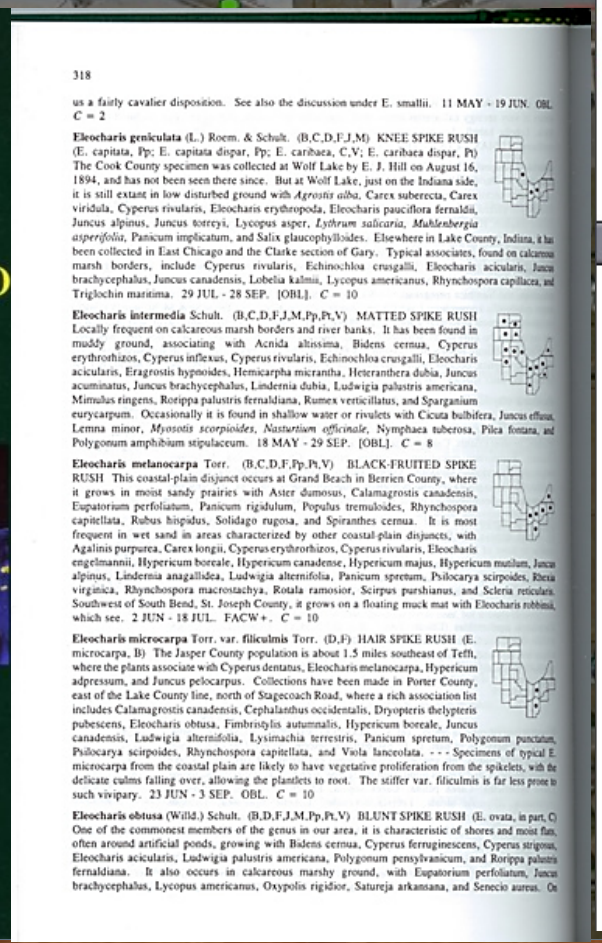
Resources That Stress Wetland Status:





318

us a fairly cavalier disposition. See also the discussion under E. smallii. 11 MAY - 19 JUN. OBL. C = 2

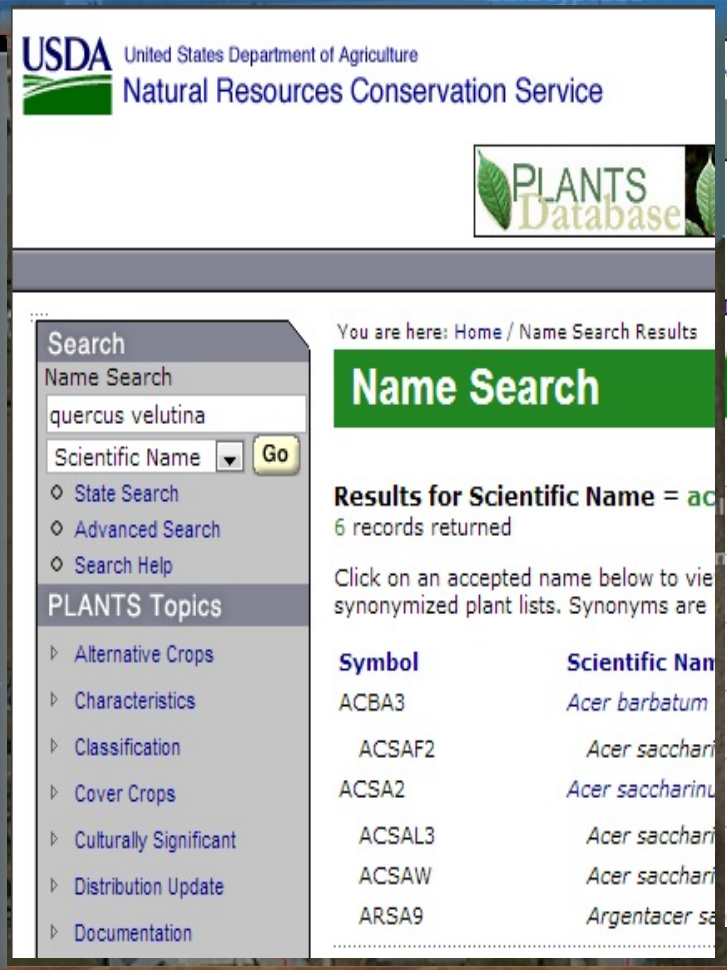
Eleocharis geniculata (L.) Roem. & Schult. (B,C,D,F,J,M) KNEE SPIKE RUSH (E. capitata, Pp; E. capitata dispar, Pp; E. caribaea, C,V; E. caribaea dispar, Pt) The Cook County specimen was collected at Wolf Lake by E. J. Hill on August 16, 1894, and has not been seen there since. But at Wolf Lake, just on the Indiana side, it is still extant in low disturbed ground with *Agrostis alba*, Carex suberecta, Carex viridula, Cyperus rivularis, Eleocharis erythropoda, Eleocharis pauciflora fernaldii, Juncus alpinus, Juncus torreyi, Lycopus asper, *Lythrum salicaria*, *Muhlenbergia asperifolia*, Panicum implicatum, and Salix glaucophylloides. Elsewhere in Lake County, Indiana, it has been collected in East Chicago and the Clarke section of Gary. Typical associates, found on calcareous marsh borders, include Cyperus rivularis, Echinochloa crusgalli, Eleocharis acicularis, Juncus brachycephalus, Juncus canadensis, Lobelia kalmii, Lycopus americanus, Rhynchospora capillacea, and Triglochin maritima. 29 JUL - 28 SEP. [OBL]. C = 10

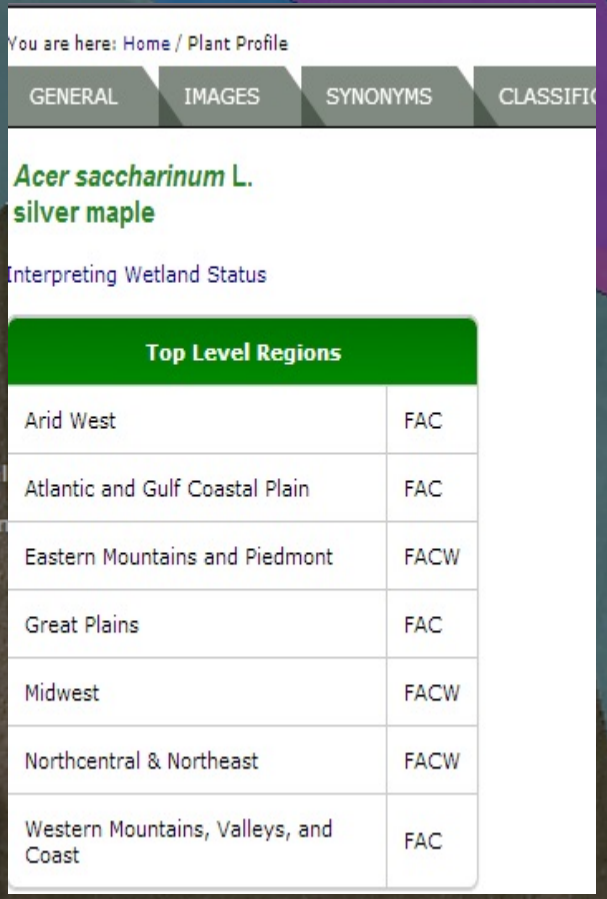
Eleocharis intermedia Schult. (B,C,D,F,J,M,Pp,Pt,V) MATTED SPIKE RUSH Locally frequent on calcareous marsh borders and river banks. It has been found in muddy ground, associating with Acnida altissima, Bidens cernua, Cyperus erythrorhizos, Cyperus inflexus, Cyperus rivularis, Echinochloa crusgalli, Eleocharis acicularis, Eragrostis hypnoides, Hemicarpha micrantha, Heteranthera dubia, Juncus acuminatus, Juncus brachycephalus, Lindernia dubia, Ludwigia palustris americana, Mimulus ringens, Rorippa palustris fernaldiana, Rumex verticillatus, and Sparganium eurycarpum. Occasionally it is found in shallow water or rivulets with Cicuta bulbifera, Juncus effusus, Lemna minor, *Myosotis scorpioides*, *Nasturtium officinale*, Nymphaea tuberosa, Pilea fontana, and Polygonum amphibium stipulaceum. 18 MAY - 29 SEP. [OBL]. C = 8

Eleocharis melanocarpa Torr. (B,C,D,F,Pp,Pt,V) BLACK-FRUITED SPIKE RUSH This coastal-plain disjunct occurs at Grand Beach in Berrien County, where it grows in moist sandy prairies with Aster dumosus, Calamagrostis canadensis, Eupatorium perfoliatum, Panicum rigidulum, Populus tremuloides, Rhynchospora capitellata, Rubus hispidus, Solidago rugosa, and Spiranthes cernua. It is most frequent in wet sand in areas characterized by other coastal-plain disjuncts, with Agalinis purpurea, Carex longii, Cyperus erythrorhizos, Cyperus rivularis, Eleocharis engelmannii, Hypericum boreale, Hypericum canadense, Hypericum majus, Hypericum mutilum, Juncus alpinus, Lindernia anagallidea, Ludwigia alternifolia, Panicum spretum, Psilocarya scirpoides, Rhexia virginica, Rhynchospora macrostachya, Rotala ramosior, Scirpus purshianus, and Scleria reticularis. Southwest of South Bend, St. Joseph County, it grows on a floating muck mat with Eleocharis robbinsii, which see. 2 JUN - 18 JUL. FACW+. C = 10

Eleocharis microcarpa Torr. var. **filiculmis** Torr. (D,F) HAIR SPIKE RUSH (E. microcarpa, B) The Jasper County population is about 1.5 miles southeast of Tefft, where the plants associate with Cyperus dentatus, Eleocharis melanocarpa, Hypericum adpressum, and Juncus pelocarpus. Collections have been made in Porter County, east of the Lake County line, north of Stagecoach Road, where a rich association list includes Calamagrostis canadensis, Cephalanthus occidentalis, Dryopteris thelypteris pubescens, Eleocharis obtusa, Fimbristylis autumnalis, Hypericum boreale, Juncus canadensis, Ludwigia alternifolia, Lysimachia terrestris, Panicum spretum, Polygonum punctatum, Psilocarya scirpoides, Rhynchospora capitellata, and Viola lanceolata. - - - Specimens of typical E. microcarpa from the coastal plain are likely to have vegetative proliferation from the spikelets, with the delicate culms falling over, allowing the plantlets to root. The stiffer var. filiculmis is far less prone to such vivipary. 23 JUN - 3 SEP. OBL. C = 10

Eleocharis obtusa (Willd.) Schult. (B,D,F,J,M,Pp,Pt,V) BLUNT SPIKE RUSH (E. ovata, in part, C) One of the commonest members of the genus in our area, it is characteristic of shores and moist flats, often around artificial ponds, growing with Bidens cernua, Cyperus ferruginescens, Cyperus strigosus, Eleocharis acicularis, Ludwigia palustris americana, Polygonum pensylvanicum, and Rorippa palustris fernaldiana. It also occurs in calcareous marshy ground, with Eupatorium perfoliatum, Juncus brachycephalus, Lycopus americanus, Oxypolis rigidior, Satureja arkansana, and Senecio aureus. On





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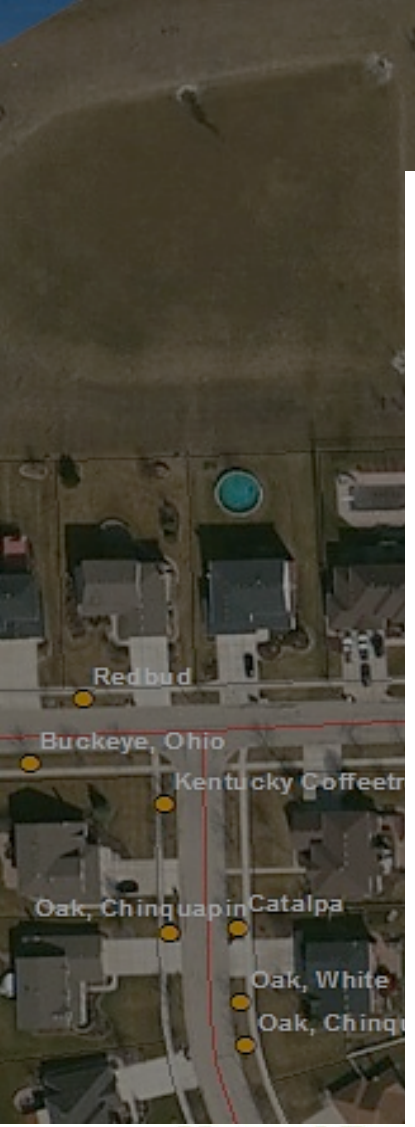
Wetland Indicator Status:

Table 1. Wetland indicator status ratings and their rating categories, as described in the National List of Plant Species that Occur in Wetlands (Reed 1988).

Indicator status (abbreviation)	% Occurrence in wetlands
Obligate (OBL). Occur almost always under natural conditions in wetlands.	99
Facultative Wetland (FACW). Usually occur in wetlands but occasionally found in non-wetlands.	67–99
Facultative (FAC). Equally likely to occur in wetlands and non-wetlands.	34–66
Facultative Upland (FACU). Usually occur in non-wetlands but occasionally found in wetlands.	1–33
Upland (UPL). Occur in wetlands in another region, but occur almost always under natural conditions in non-wetlands in the region specified.	1



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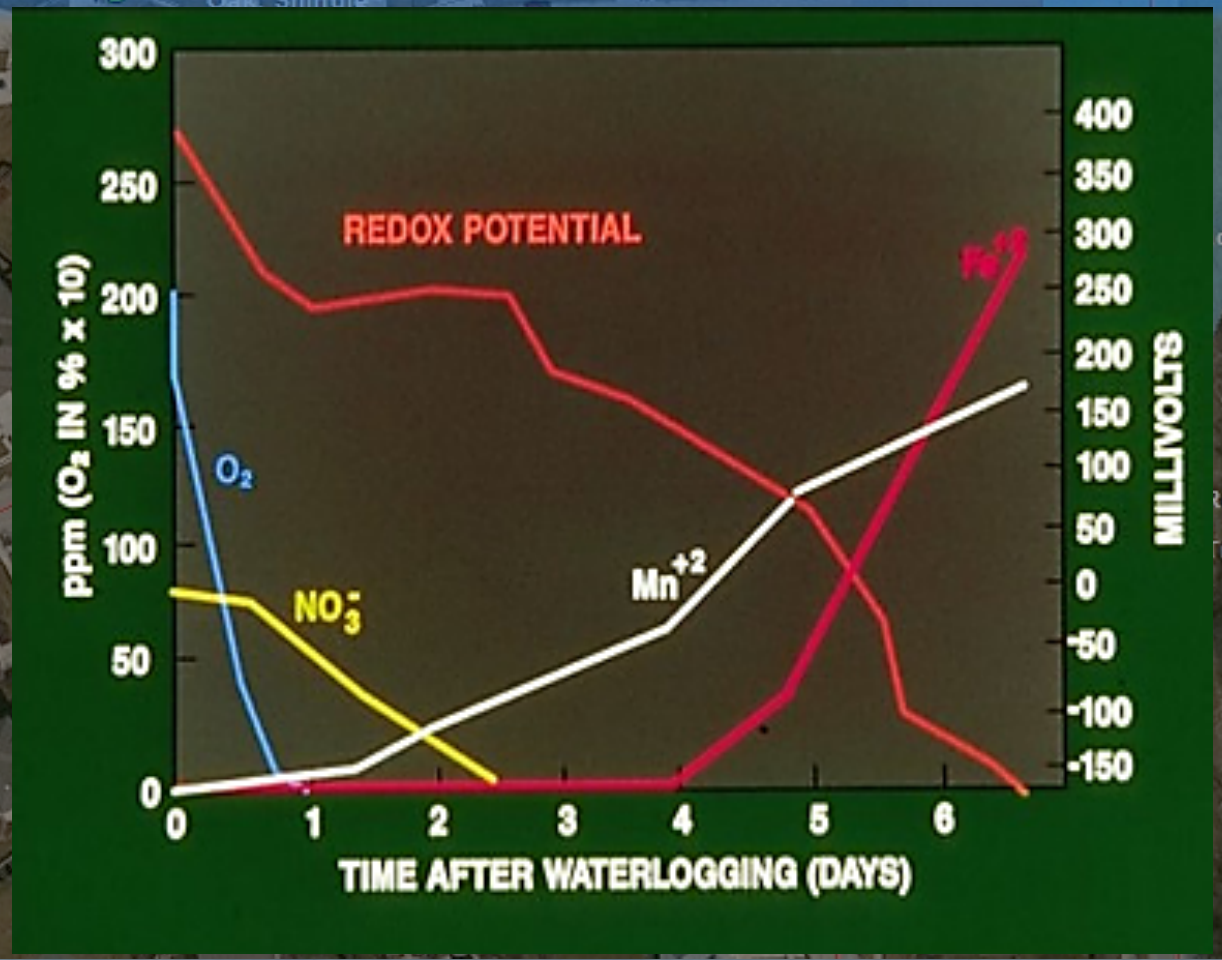
Redox Potential / Nutrient Availability:



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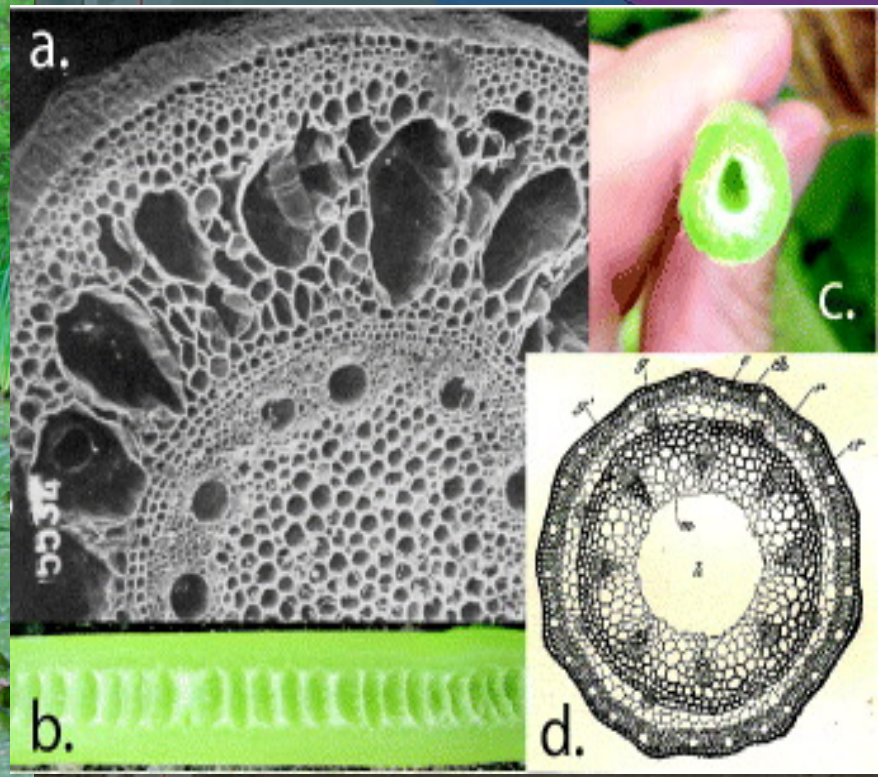
Some Plants Are Adapted To Wet Soils:



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Evidence of Redox From Air Pockets:

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Parkways are Disturbed and Modified!:

- That may be true, but water always has, still does, and always will respond to gravity, by way of topography, even on a small scale

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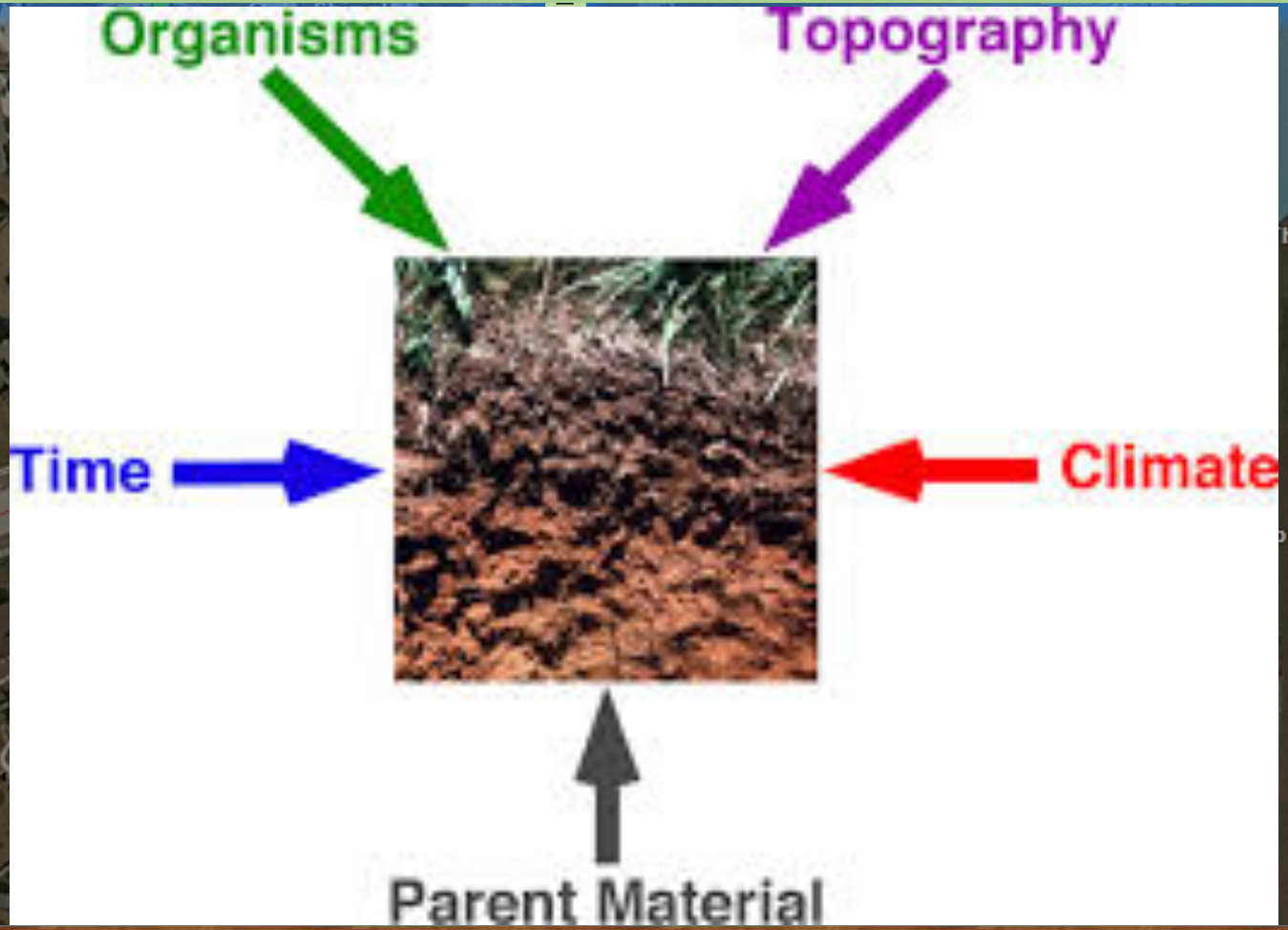
And Soil Development is Constant:



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Vegetation History/Ecosystem Dynamics:

“Native to When?”

-Cathy Whitlock – Fire Ecologist
and Palynologist – University of Oregon

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Extracting Fossilized Pollen:

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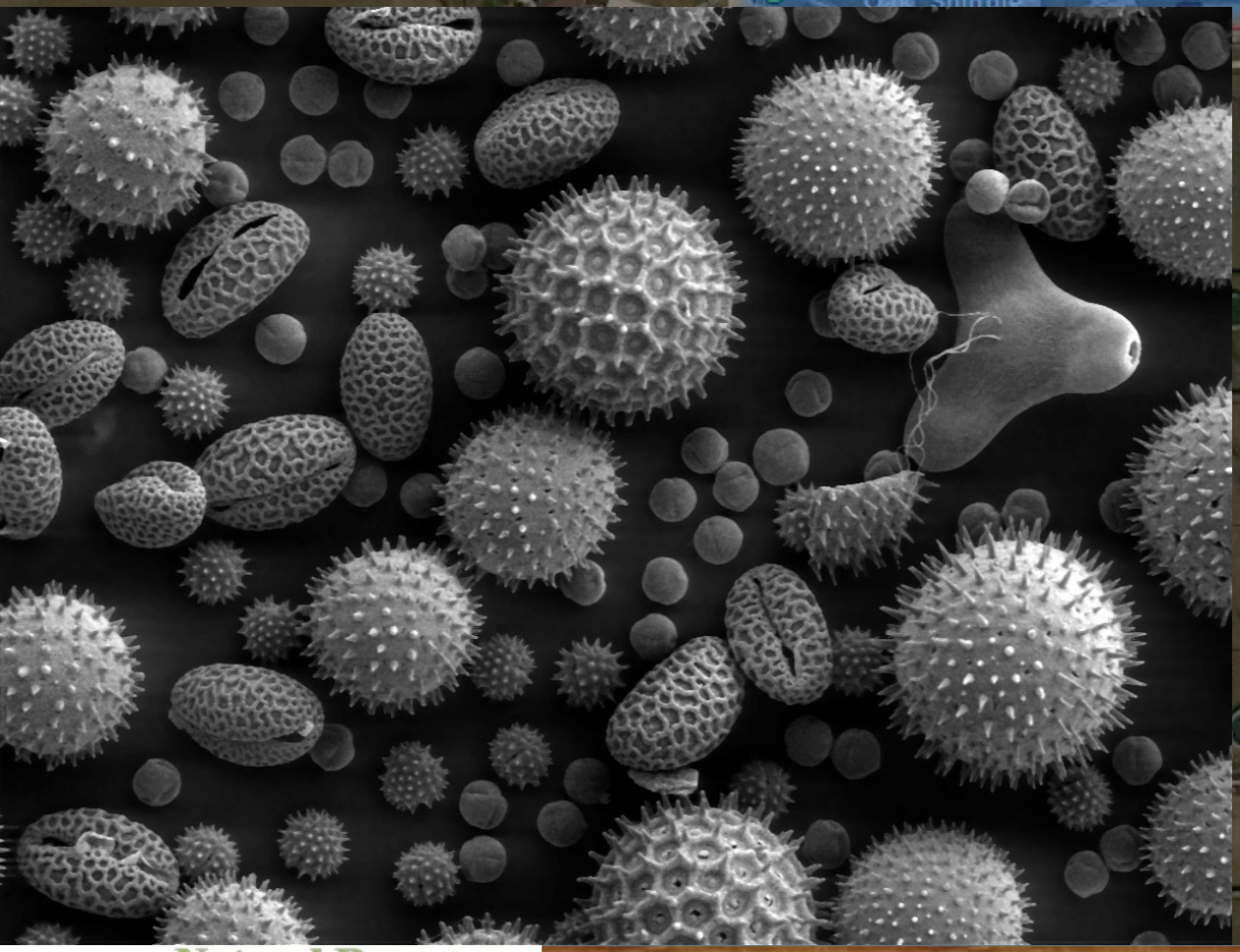
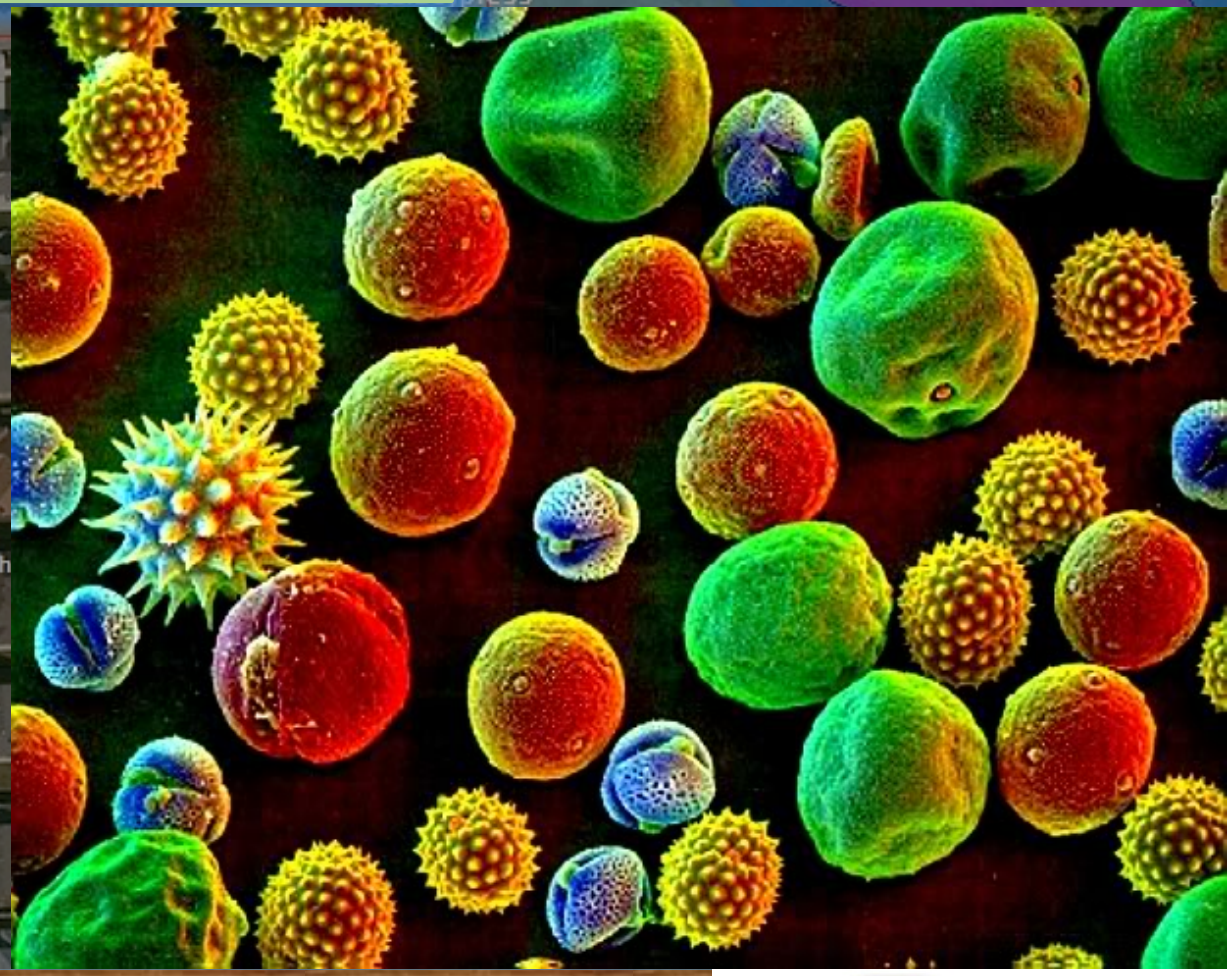
The End Result:





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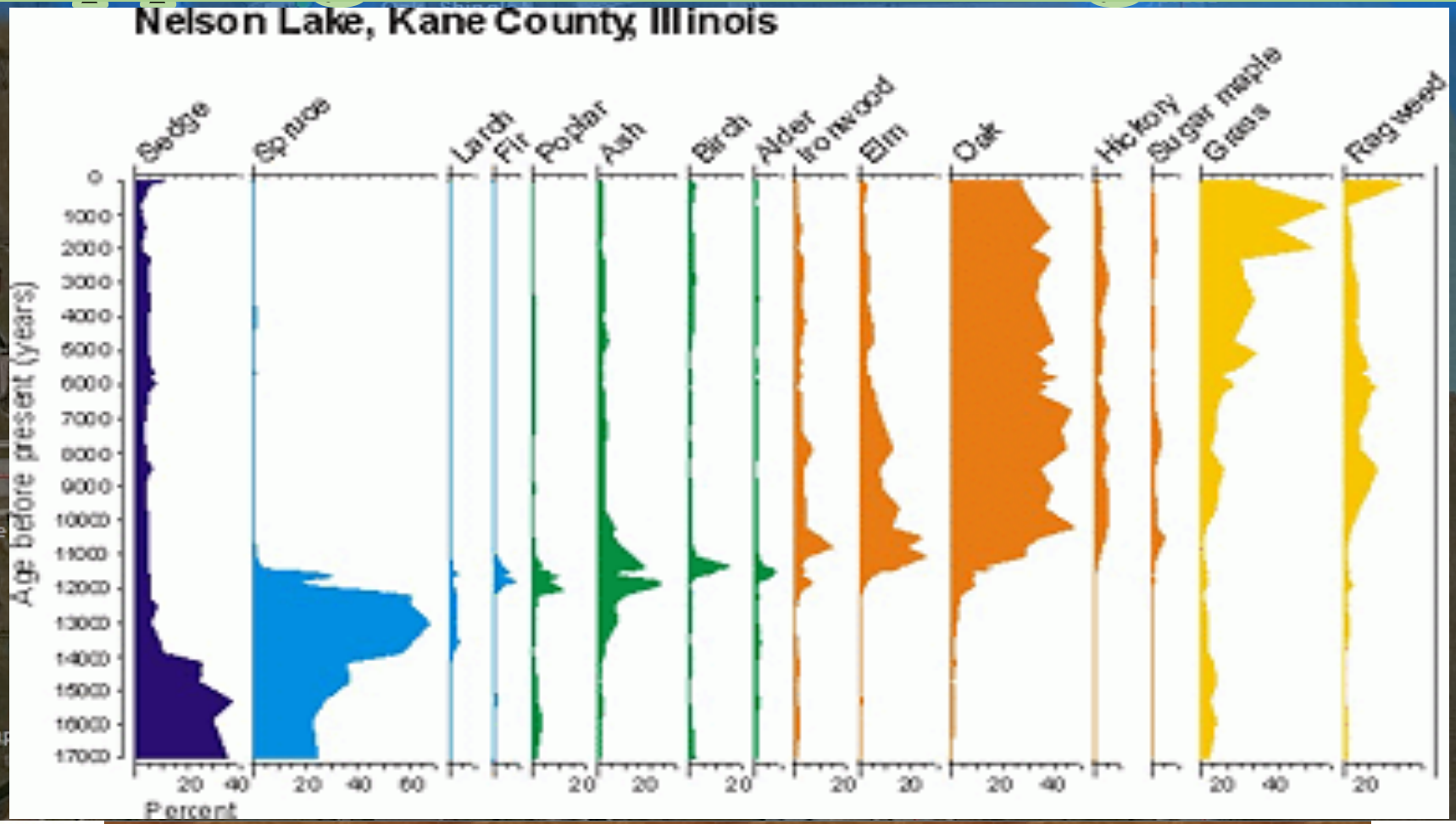
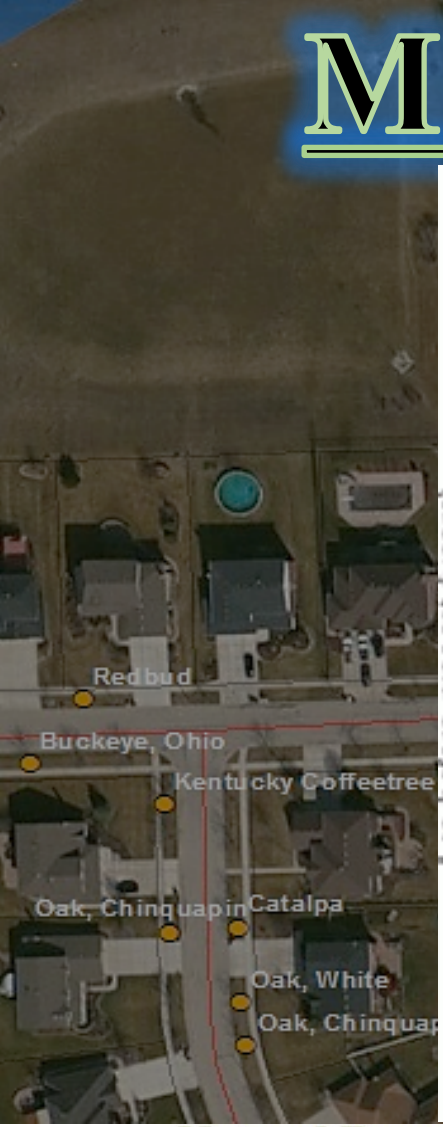
Mapping Pollen Through Time:





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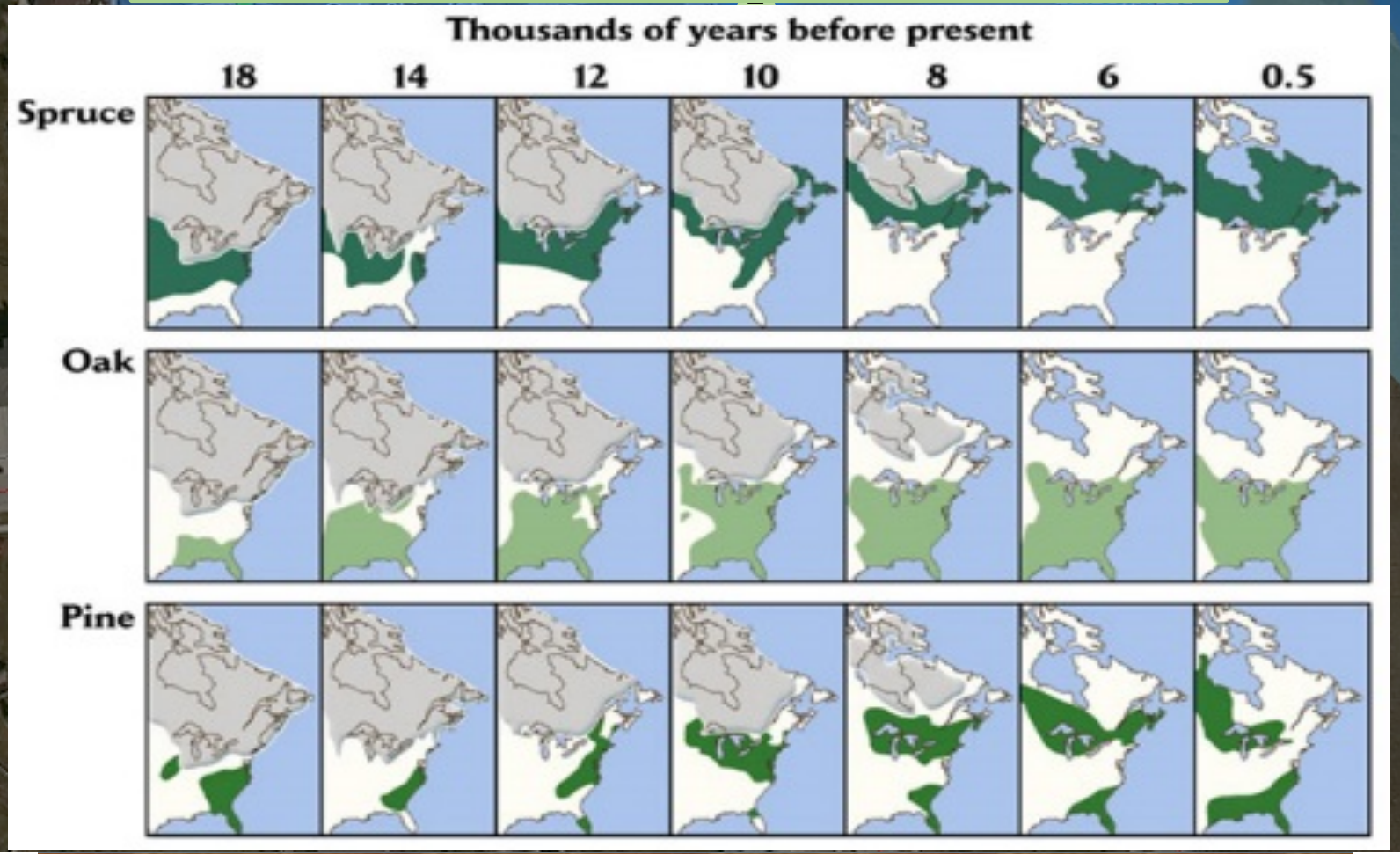
Over Multiple Sites:



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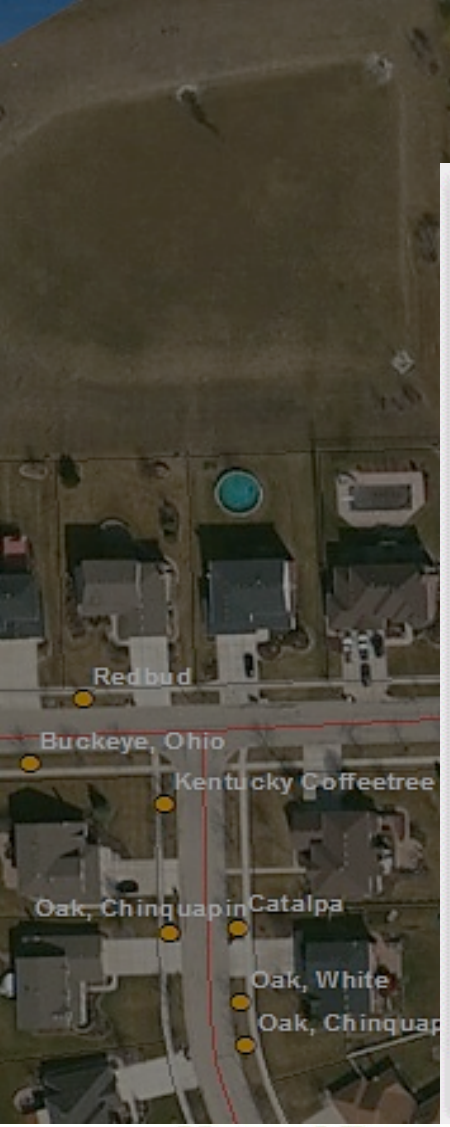
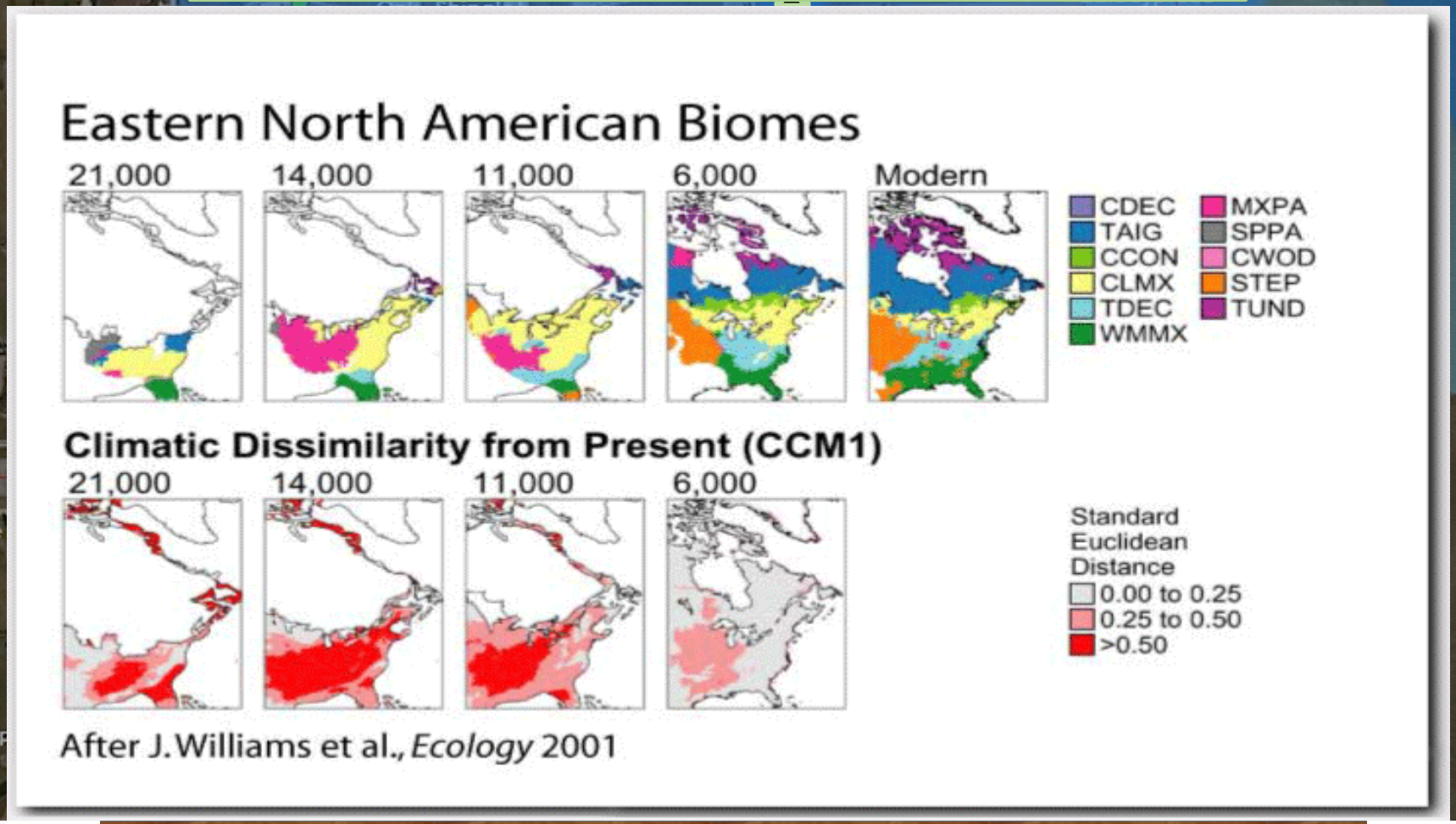
Over Multiple Sites:





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Reforestation Case Studies:

- Get Tree Data and Resident Requests From Village
- Analyze Existing Tree Species Diversity and Create Species List
- Planting Site Survey Looking at Specific Site Characteristics
- Slot Tree Species to Create Idealized List Based on Species Req’ts
- Bid Project, Get Feedback from Winning Bidder
- Revise Species List to Accommodate Available Species
- Provide Planting Contractor with Routes, Maps, and Support
- Update Tree Data, Get Ready for Next Year

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Resident Requests / Input:

- Can be Tremendously Valuable in Maintaining Public Relations
- Can be a Complete Nightmare When the Rubber Hits the Road
- Instant Expert: Just Add Internet
- Open Comment Period
- 50/50 cost share
- Paid Size Upgrades
- Allow Homeowner to Purchase and Install
- EDUCATION + OUTREACH = UNDERSTANDING!!!! (Mostly…)

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Species Analysis / List Creation:

Species	Count	Avg. DBH	Avg. Condition	Species	Count	Avg. DBH	Avg. Condition
HONEYLOCUST	457	13.94	2.84	LINDEN-AMERICAN	78	17.67	3.18
PINE-AUSTRIAN	383	11.59	2.87	HAWTHORN-SPP	74	8.14	3.00
ASH-GREEN	350	15.70	3.55	ALDER-SPP	73	10.12	3.00
SPRUCE-SPP	342	8.63	2.98	DOUGLAS FIR	57	6.98	3.00
APPLE-CRAB SPP	300	9.20	3.03	OAK-SWAMP WHITE	56	7.98	3.00
MAPLE-SILVER	203	17.63	3.09	SPRUCE-BLUE	50	8.46	3.02
MAPLE-RED	181	6.75	3.22	OAK-RED	46	13.54	2.67
MAPLE-NORWAY	176	11.00	3.06	MAPLE-AMUR	45	16.60	3.16
PINE-SCOTCH	162	11.75	2.90	COTTONWOOD	42	25.64	2.88
BIRCH-RIVER	114	12.85	2.96	OAK-PIN	39	12.90	2.38
SERVICEBERRY-SPP	113	7.60	2.96	PINE-WHITE	39	8.92	3.00
LINDEN-LITTLELEAF	82	13.61	2.77	ELM-HYBRID	38	3.08	3.03
PEAR-CALLERY	81	7.10	3.07	HACKBERRY	38	10.26	2.82
ASH-WHITE	78	13.44	2.92	MAPLE-SUGAR	33	14.39	2.67

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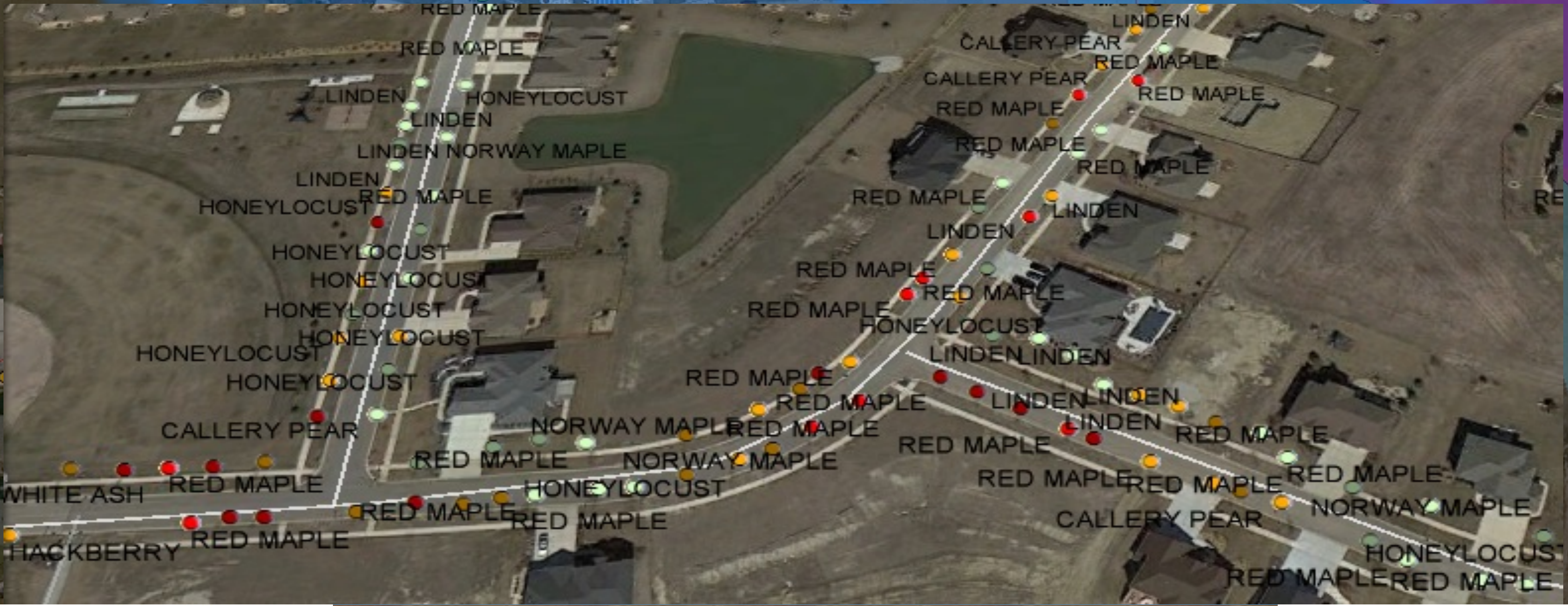
Species Analysis: Spatial Diversity:



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Planting Site Survey:

- Available Growspace: Above and Below Ground
- Soil Moisture: Upland / Lowland, even on Small Scale
- Nutrient or Salt Loading: High, Low, None?
- Light Level: Shady, Sunny, Intermediate?
- Trying to Predict the Future: Its Impossible, but you can at Least Attempt to Visualize What a Site Might Look Like in 30 Years, and how it's Surroundings will Impact the Tree Down the Line
- ALWAYS USE COMMON SENSE!! Just Because Map Shows Hydric Soils Doesn't Mean They're There!!!

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Slot Trees According to Sites:

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Get Feedback and Revise:

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Planting Lists / Maps:

- GIS Software has been instrumental in Supplying Planting Contractors with Essential Information
- Google Earth Maps
- Routed Planting with Exact Planting Locations
- Ability to Supply Information in Whatever Format Contractor is Most Comfortable with
- In a relatively "Low-Tech" Field (Hey, Arborists and Nurserymen Alike!), Google Earth Maps have Proven to be not only Successful, but even POPULAR with Planting Contractors we've Worked with

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Google Earth Map:

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Successes:

- Increased Overall Planting Efficiency
- True Maximum Species Diversity!!!!!!
- No Grey Area When it Comes to Locations
- Ability to Explain Exactly Why a Tree Was Chosen for a Specific Site to Homeowners / Residents
- Clear Message About Changing the Way we Will Manage the Urban Forest for Long-term Cost Savings and Decreased Risk
- Creates Stability Over the Long Term!!
- IT HAS TO BE Better than the Old Paradigm, right?

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Challenges:

- Getting Residential Population to Fully Understand and Buy in to a Program that is New, Unfamiliar, and May Feel Restrictive at Times
- Making the Program Feel Familiar and Unrestrictive
- Unknown if Long-Term Success can be Achieved by this Methodology, even Though the Process is Sound
- Combatting the Vast Quantities of Bad Information Available Through the Internet and Other Sources
- Funding – There's Certainly an Argument to be Made that the Money Spent Doing this Could have Been Spent on Tree Purchase

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Milan's Vertical Forest:

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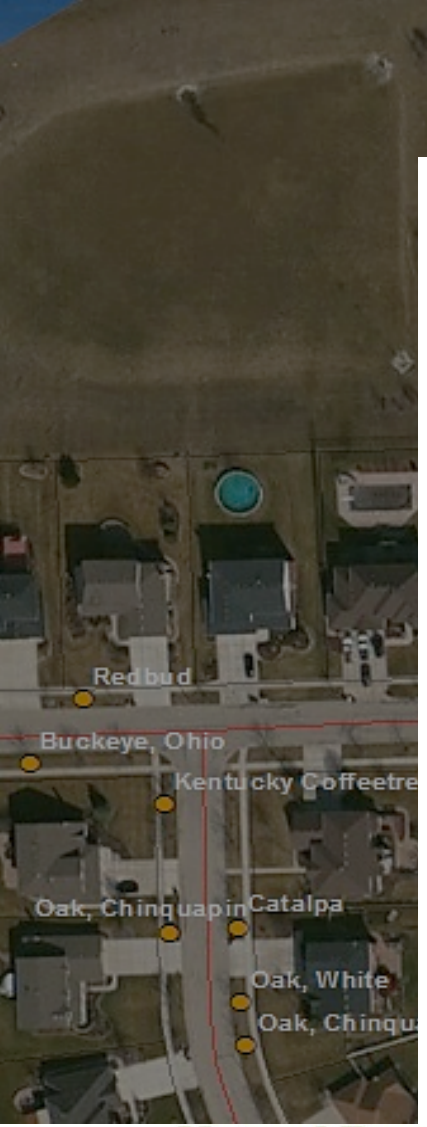
Seattle's Food Forest:



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Thanks!!:

URBAN Forestry

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