Nursery Products: Essential to the Mission of National Wildlife Refuges

for the 2025 Forest and Conservation Nursery Meeting, Prairie Du Chein, Wisconsin by:

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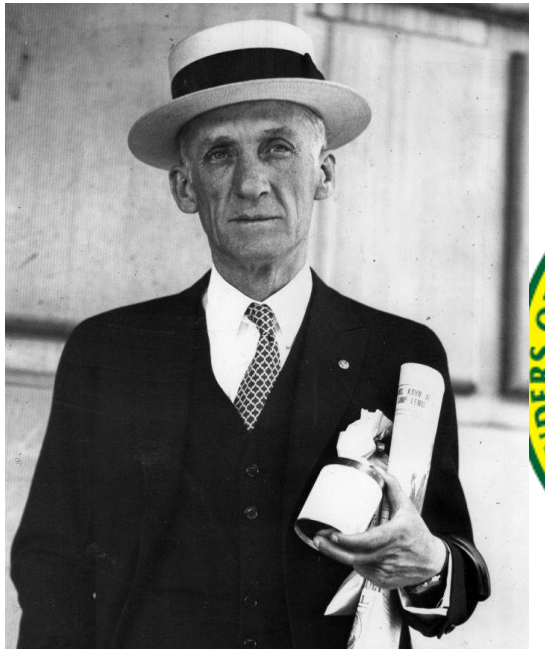
United States Fish and Wildlife Service
Midwest Region

M. Heim, Milwaukee J-S 2023

National wildlife refuges are established to conserve fish, wildlife, and plant resources and their habitats for the benefit of present and future generations of Americans

Upper Mississippi River National Wildlife and Fish Refuge

- Right here in the heart of the four-state Driftless Region
- Designated by Congress in 1924 in what is the largest-ever citizens movement to preserve public lands led by Will Dilg
- Nations longest and most visited National Wildlife Refuge
- Limitless recreation opportunities
- 111,000+ acres of bottomland forest



Will Dilg

National Wildlife Refuges in the Upper Mississippi River System

Floodplain Forest in UMRS

- 240,000 acres of habitat in UMR Refuge,
- 300,000 acres of floodplain forest across these 14 refuges
- Floodplain wildlife reliant on forest habitat
- Natural disturbance patterns include both small scale disturbances and large scale events:
  - Single tree death, gap scale, beaver
  - Reach/systemwide flood inundation

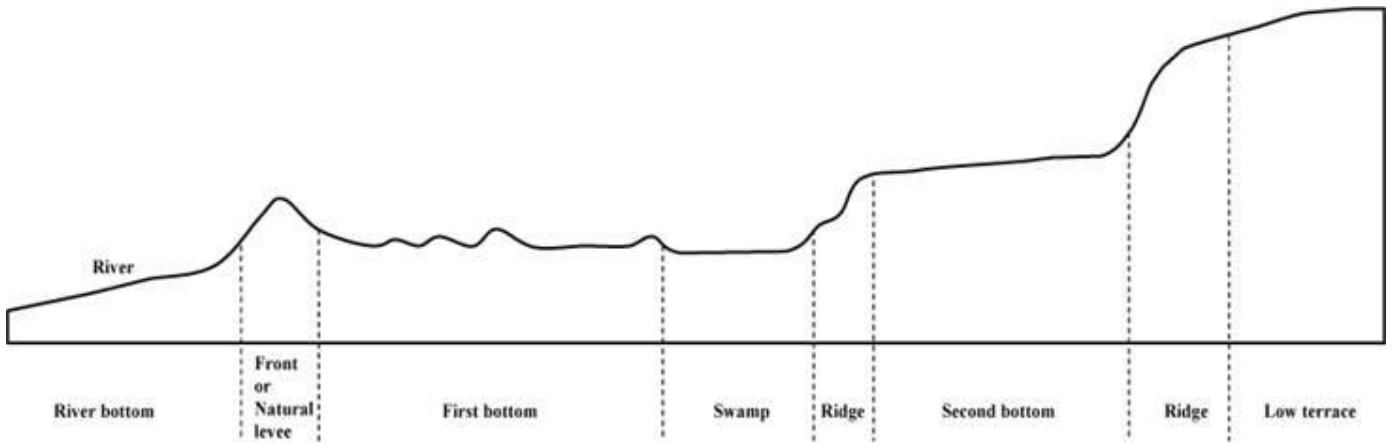
372,000 acres of floodplain habitat for American use across 14 National Wildlife Refuges for:

- Hunting
- Fishing
- Wildlife Observation and Photography
- Environmental Education and Interpretation

Defining the “Bottomland Forest”

A forested natural community that occurs along routinely-flooded streams; an ecosystem driven by “alluvial” processes:

- Seasonal surface-water based flood pulse drives system
- Hydric soils of varying textures; very wet at times and often very dry at times
- Plant and animal species adapted to variable soils and moisture, primarily wet
- Elevation-driven species assemblage
- Very productive system

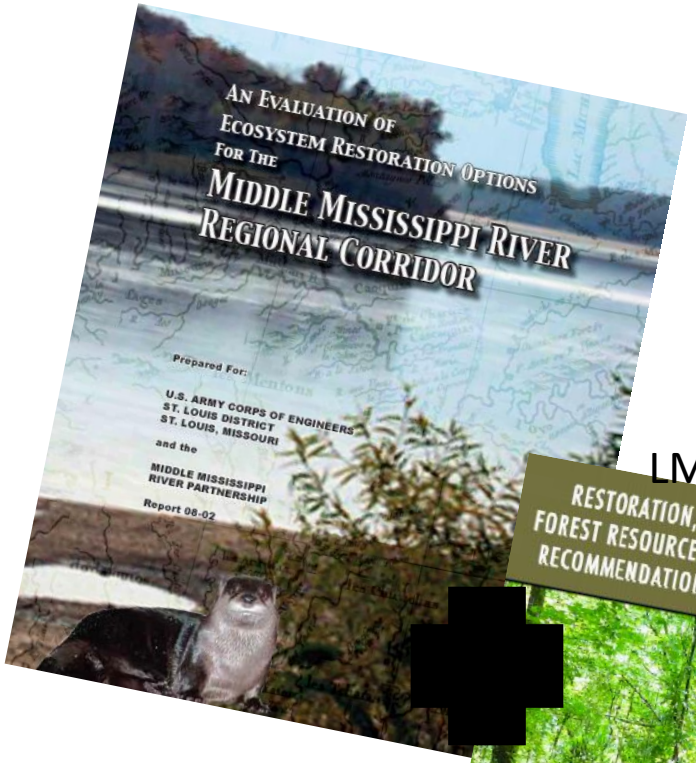


Synonyms:

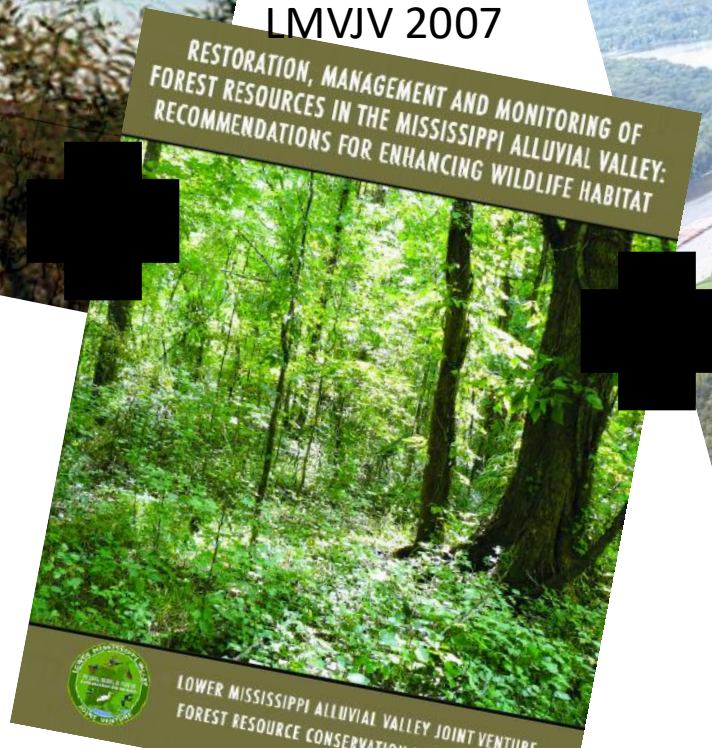
- **Bottomland hardwoods**
- **Bottoms**
- **Riverfront forest**
- **Floodplain forest**
- **Lowland forest**
- **Swamp**

Figure 1. Typical Cross-section of a Bottomland System (from USDA Forest Service 2008), with characteristic Wisconsin floodplain communities.

National Wildlife Refuge Habitat Management Plan =



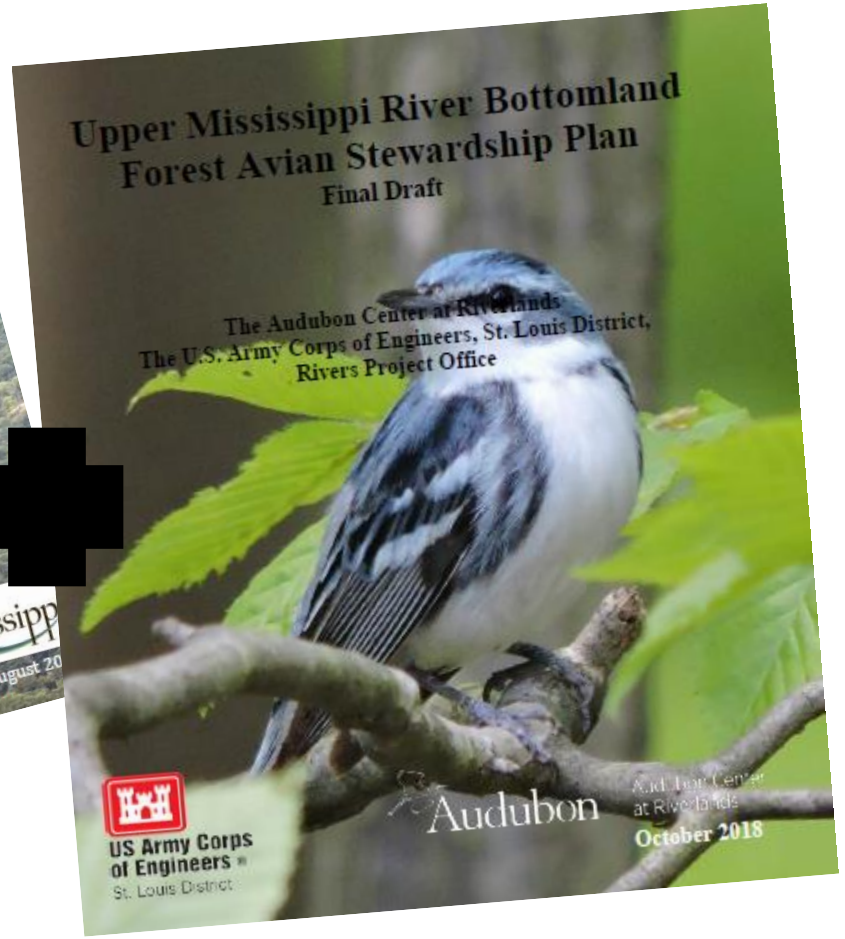
Heitmeyer 2008



LMVJV 2007

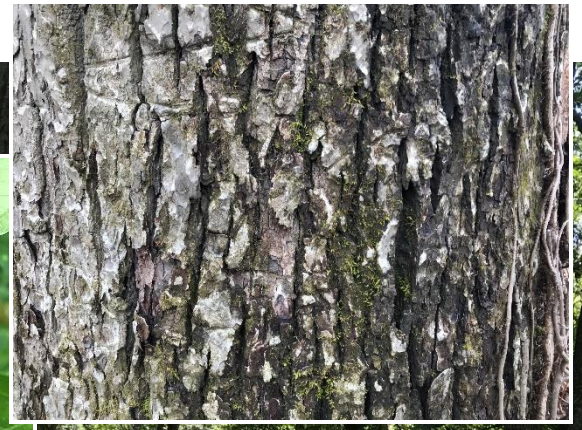
Guyon et al 2012

2018 Forest Avian Plan



National Wildlife Refuge Priority Resources of Concern

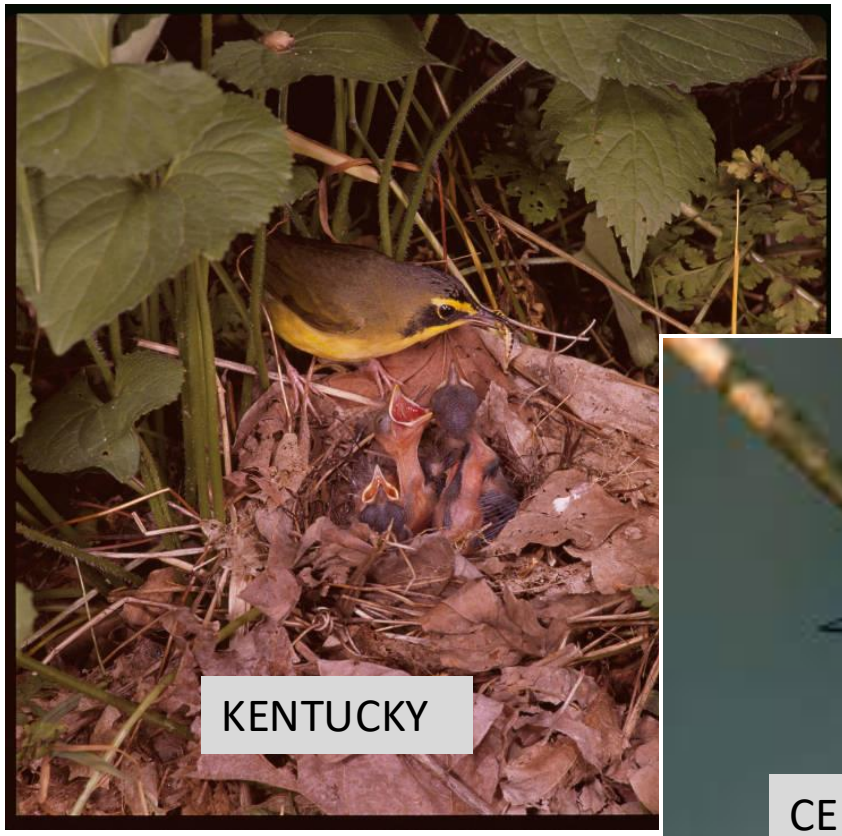
1. Floodplain Terrace Forest



All pics USFWS

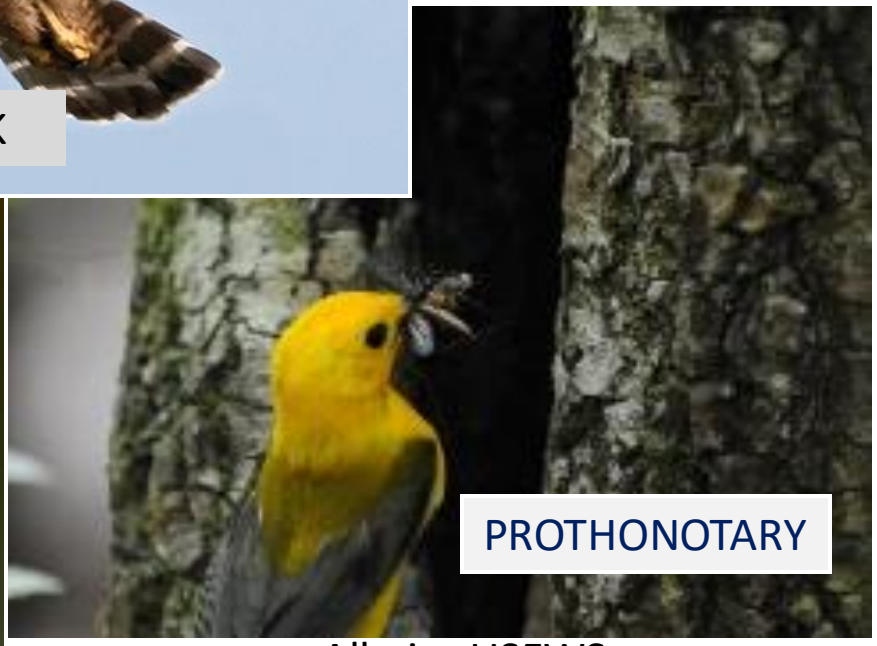
National Wildlife Refuge Priority Resources of Concern

2. Nesting Migratory Birds


KENTUCKY


CERULEAN


RED-SHOULDERED HAWK


PROTHONOTARY

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National Wildlife Refuge Priority Resources of Concern

2. Nesting Migratory Bird- forest characteristics

- Mature closed canopy forest with open midstory
- Large patch sizes

- Large diameter, Quercus-dominated forest
- Structural complexity
- Bottomland forest patches adjacent to upland forests

- Flooded even-aged forest (willow, maple-ash) with canopy heights ranging from 12-40m
- Canopy cover usually 50-80% with sparse ground cover vegetation

All pics USFWS

National Wildlife Refuge Priority Resources of Concern

3. Neotropical Migrant Passerines


TENNESSEE


CANADA


YELLOW-RUMPED


RUBY CROWNED KINGLET

Forest characteristics:

- Patch size > 250 acres
- Species richness
- Structural complexity

All pics USFWS

National Wildlife Refuge Priority Resources of Concern

4. Tree Roosting Bats

TRI-COLOR

INDIANA

NORTHERN LONG-EARED

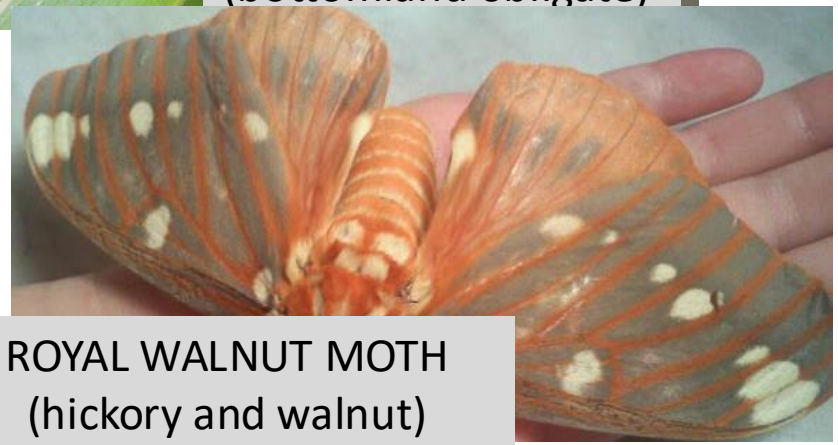
All pics USFWS

National Wildlife Refuge Priority Resources of Concern

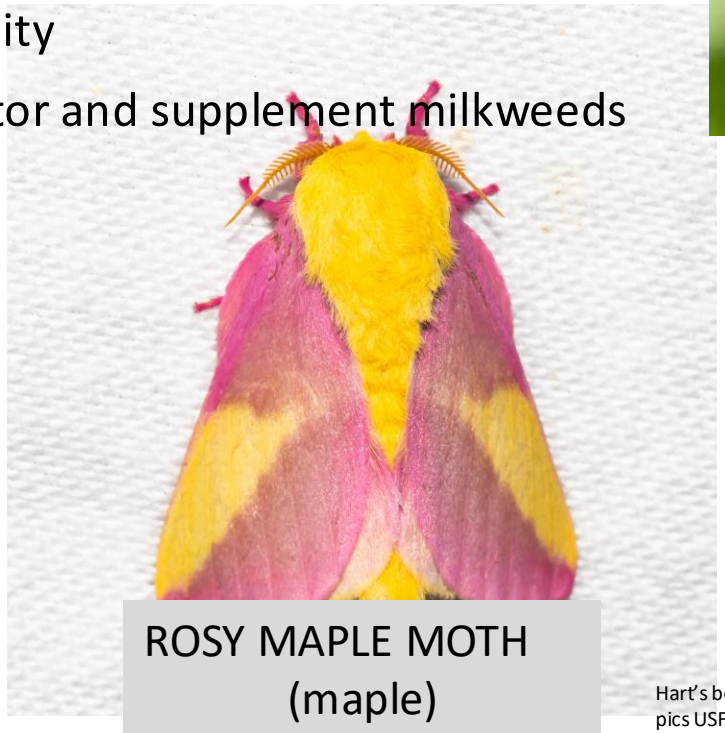
5. Native Invertebrate Pollinators

- Maintain stocking below “A” line
- At least 3 co-dominant tree species
- <10% invasive species cover
- Monitor and supplement herbaceous diversity
- Monitor and supplement milkweeds

HART’S GROUND BEE
(bottomland obligate)



ROYAL WALNUT MOTH
(hickory and walnut)



ROSY MAPLE MOTH
(maple)

RED ADMIRAL
(nettles)

LUNA MOTH
(hickory and walnut)

Hart’s bee credit: Angella Morehouse
pics USFWS

Characteristic Tree Species:

- Silver maple (Acer saccharinum)
- Cottonwood (Populus deltoides)
- Swamp white oak (Quercus bicolor)
- Hackberry (Celtis occidentalis)
- River birch (Betula nigra)
- Black walnut (Juglans nigra)
- Bur oak (Q. macrocarpa)
- Willow oak (Q. phellos)
- Pin oak (Q. palustris)
- Bitternut hickory (Carya cordiformis)
- Overcup oak (Q. lyrata)
- Ohio buckeye (Aesculus glabra)
- Kentucky coffeetree (Gymnocladus dioicus)
- American elm (Ulmus americana)
- Green ash (Fraxinus pennslyvanica)

Drawings: Paul Nelson, MDC

Characteristic Flowering Plants:

- Cardinal flower
- Obedient plant
- Wood nettle
- Cutleaf coneflower
- Blue phlox
- Buttonbush
- Swamp milkweed
- Sedges
- Ontario aster
- Wildryes





All pics USFWS

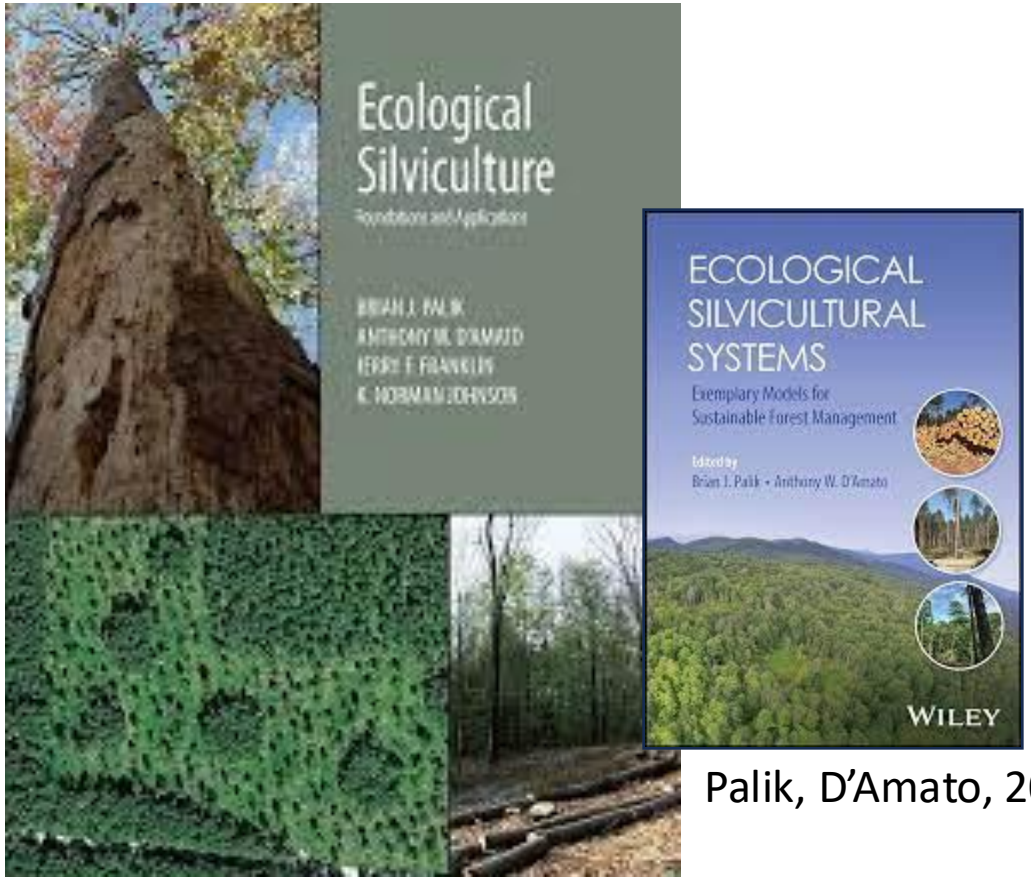
Ecological Forestry - Ecological Silviculture

An approach to forestry that applies an understanding of the structure, function, and dynamics of natural forest ecosystems to achieve integrated outcomes:

- Environmental
- Economic
- Social

It is divergent from the traditional **agricultural systems model**, and is based on natural development models and specific **natural disturbance systems**.

Conserves native biodiversity and ecological productivity by emulating natural processes and using them as a guide



Palik, D'Amato, 2023

Palik, D'Amato, Franklin, Johnson 2021

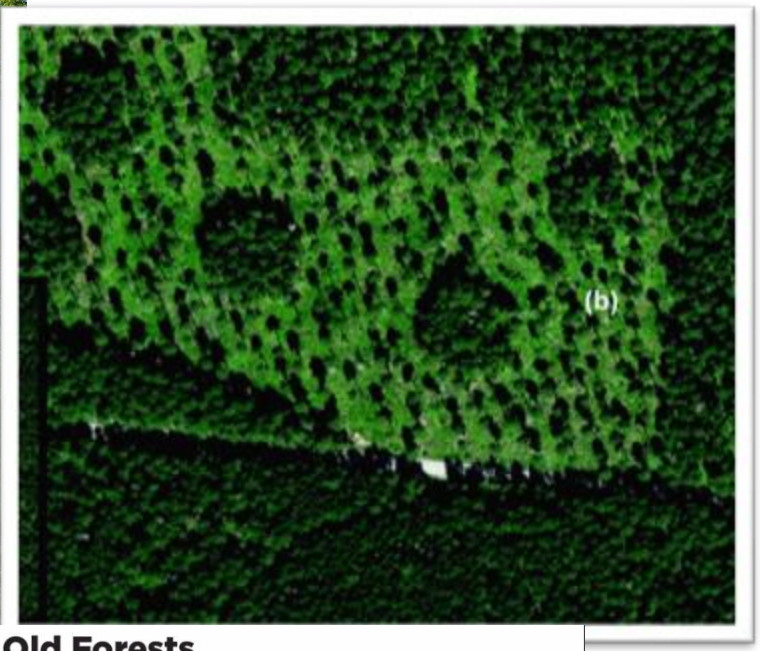
Ecological Silviculture System

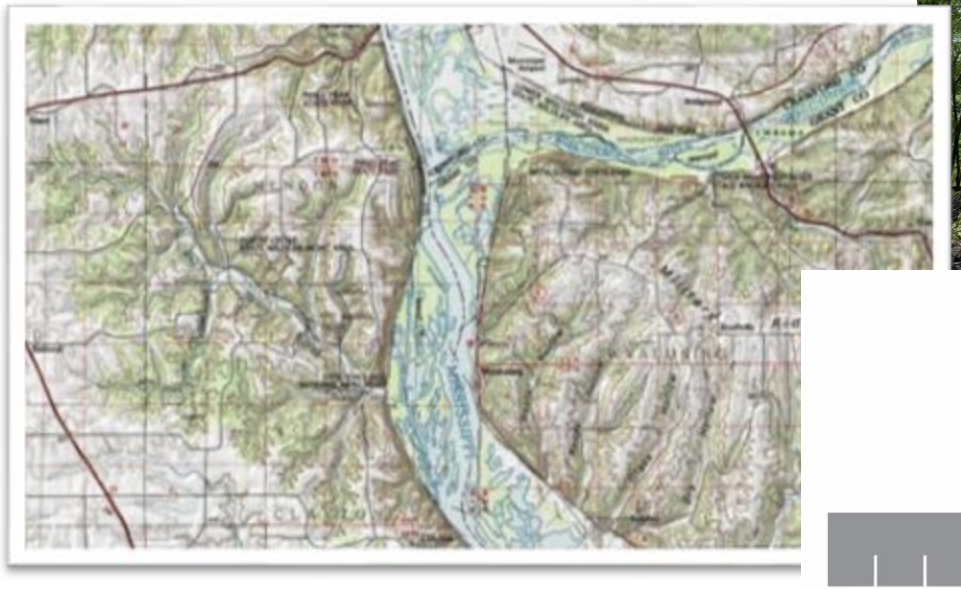
The sequence of treatments for restoring and sustaining composition and complex structure of forests; informed by natural disturbance and development; incorporates foundational ecological principles, with a goal of reducing the disparity between natural and managed ecosystems

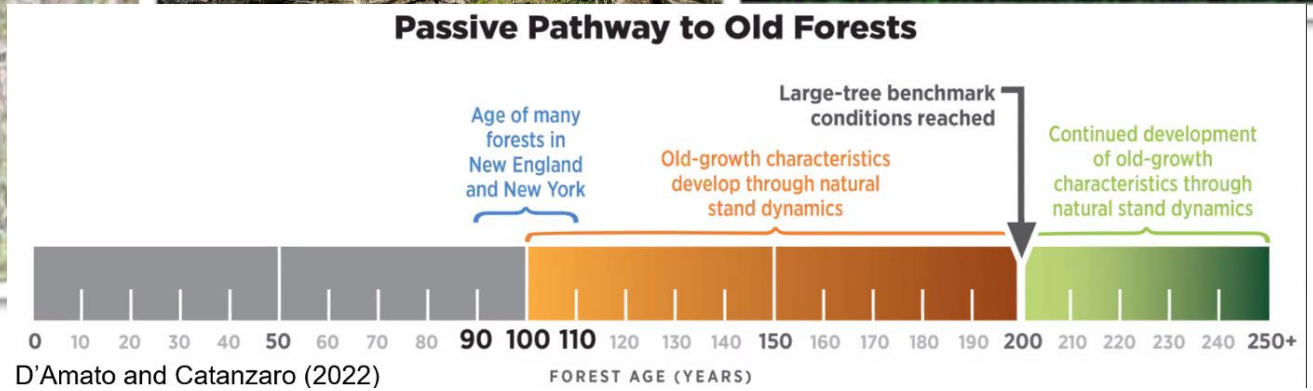
Ecological Silviculture

Foundational Principles:

1. Continuity
2. Complexity/Diversity
3. Timing
4. Context







D'Amato and Catanzaro (2022)

Application to Bottomland Forest Ecosystems

Natural Disturbances Archetypes:

- Infrequent severe disturbance
- Frequent low-severity disturbances
- Gap-scale wind disturbance
- **Mixed severity disturbance**

Forest Loss in the Upper Mississippi River System

Overall historic loss:

By the time scientists began monitoring the upper Mississippi floodplain forests, a combination of agriculture, urbanization, and river control efforts (including lock and dam construction) had destroyed nearly half the forest that had been present in 1891.

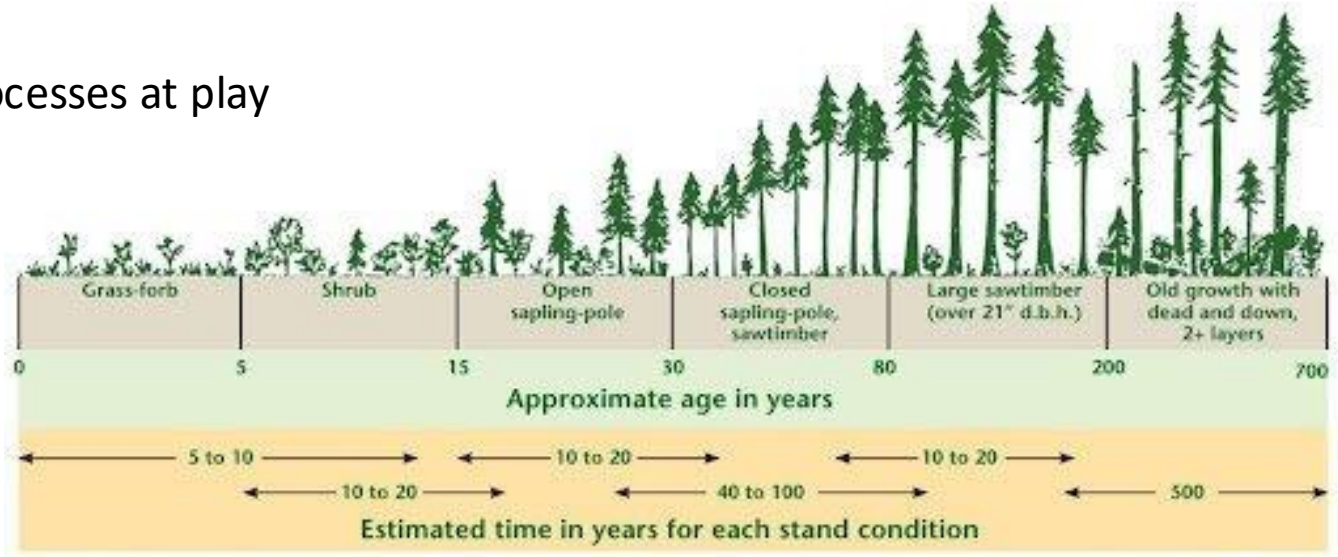
Causes of add'l decline:

- **Prolonged flooding:** Increased water levels and longer flood durations, exacerbated by climate change driven precipitation events and other factors, are drowning trees.
- **Climate change:** Altered precipitation patterns and increased runoff are contributing to higher water levels and longer flood durations.
- **Agricultural and urban land use changes:** These continue to impact floodplain forests by affecting hydrology.
- **Tree diseases and invasive plants:** New and thriving pests such as EAB, elm disease and reed canary grass contribute to forest habitat loss.

SUCCESSION: Forest Development Patterns

- The process of change in species that make up an ecological community over time
  - Henry Cowles (1899) Frederick Clements (1916) Henry Gleason (1926)
- Predictable Forest Development Stages
  - Preforest Stage
  - Forest Canopy Closure Stage
  - Young Forest Stage
  - Mature Forest Stage

Pathways depend upon species present and processes at play



Secondary Natural Disturbance: Gap and Wind-scale disturbance Historic vs. modern

- <u>Tree mortality and recruitment drives complexity through space and time</u>

- Loss of species richness without action
- Resultant loss in successional function in MAE
- Decline in available food resources for wildlife without action
- Severe reduction in native plant occupancy
- Arrested succession where NNIS plants are dominant

Arrested succession

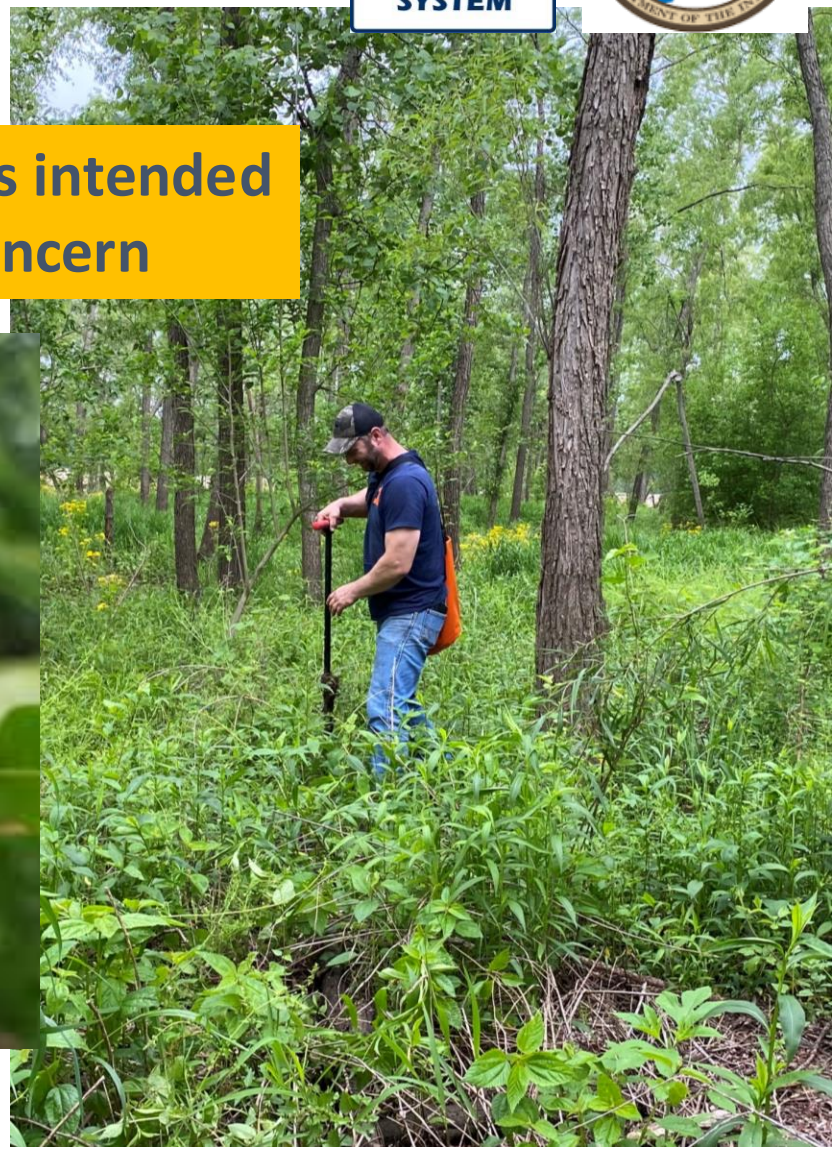
- Extended “Preforest” stage seemingly uncharacteristic for the site productivity and climate
- Prevents woody species establishment
- Primarily exotic invasive species, but native too
- European perennial pasture grasses (RCG)
- Japanese hops, also a feature of woody NNIS

Refuge Forest Management Objectives

Manage Floodplain Forest to meet Primary Forest Variables intended to provide suitable habitat for Priority Resources of Concern

- TREE SPECIES RICHNESS
- TREE DIAMETER SIZE CLASS DISTRIBUTION
- TREE AGE CLASS DISTRIBUTION
- FOREST STRUCTURAL DYNAMICS
- SHRUB RICHNESS AND DENSITY
- WILDLIFE HABITAT FACTORS
  - ROOST TREES
  - GROUND FLORA
  - CANOPY STRUCTURE

Viceroy on Cottonwood



Mimic natural disturbance regimes through silviculture

Gap-scale event emulation with Prescription snag development

- Builds forest structural complexity
  - Manage light and legacy
- Release of desirable regeneration
- Variable for multiple objectives
- Apply over/with artificial regen if needed
- Deadwood: tree roosting bat and saproxylic beetle habitat

Artificial Regeneration

STOCK TYPES:

1. CONTAINERIZED (ROOT-PRODUCTION METHOD® (RPM))
2. BAREROOT
3. DIRECT SEED

PLANTING LAYOUT:

- Traditional open canopy grid planting
- Underplanting/Enhancement
- Cluster
  - Establish cohort
  - Enhance species richness
  - Restore block size
  - Build adaptive resilience

Artificial Regeneration

Stressors and Barriers

- Productive site potential
- Exotic species
- Soil extremes
- Mammals: deer, voles, beaver
- Costs
- Accessibility
- Timing

Mitigate ecosystem-altering stressors and changes

Direct actions required:

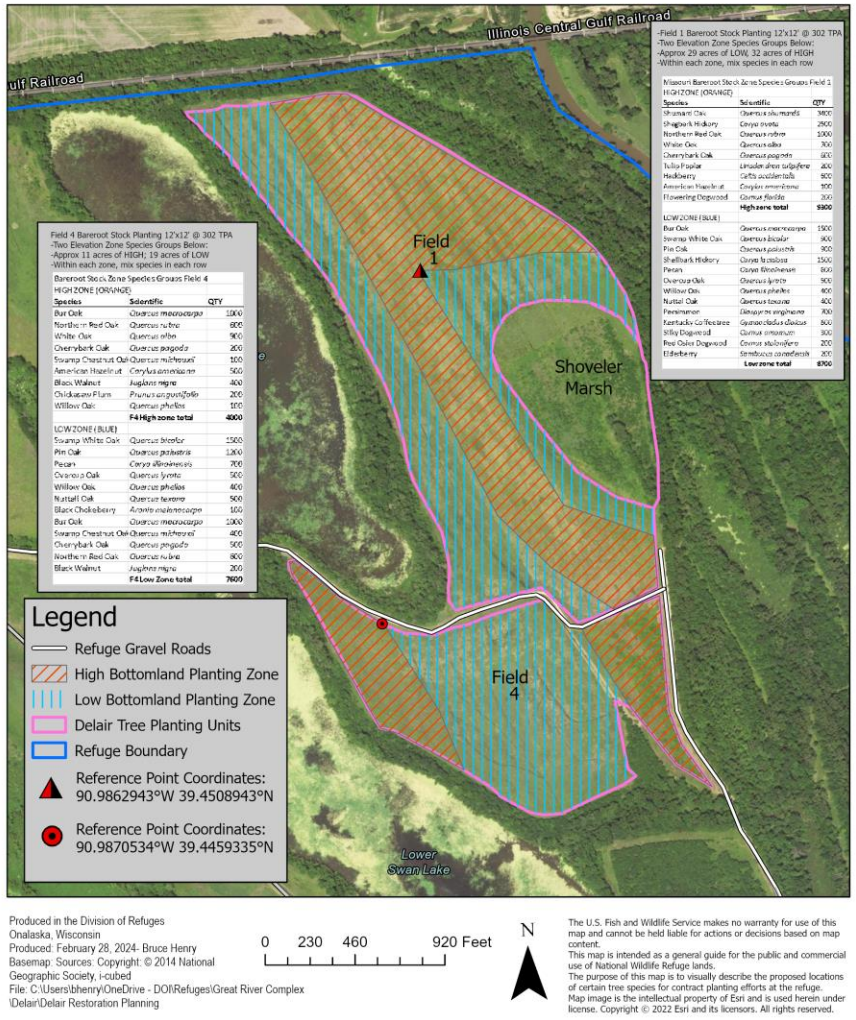
- Control exotic invasive plant populations
- Plant appropriate stock types into RCG
- Replace buckthorn/honeysuckle with elevation-appropriate trees and shrubs
- Build adaptation and resilience into system through **assisted migration**

Heat/Flood Resilient Tree Species:

- Pecan
- Overcup oak
- Sweetgum
- Persimmon
- Sycamore
- Shellbark hickory

Old Field Afforestation

- Every National Wildlife Refuges in Mississippi River system
- Variable-scale increase in patch size for dependent wildlife
- Mixed mesophytic and bottomland species focused
- White oak planted where hydrogeomorphic and flood inundation models guide success
- Woodland, savanna, forest
- Over 1 million acres of forest
  Have been restored in the Mississippi Valley in past 30

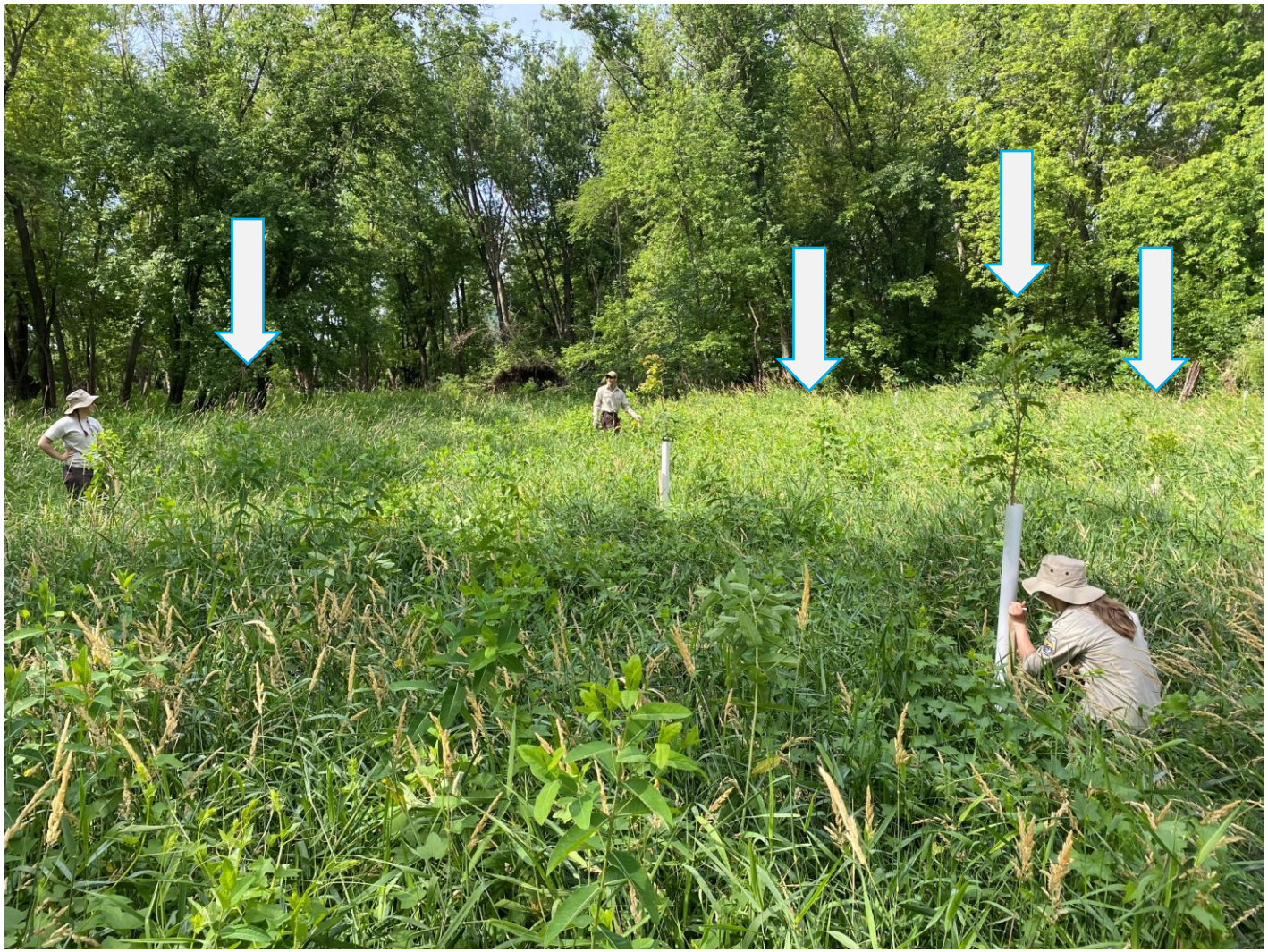


Old Field Afforestation

- Soils and competing vegetation determine stock type

Gap Planting

- Applied to accelerate preforest “arrested succession”
- Repairs patch continuity and enhances age-structure
- Most National Wildlife Refuges in Mississippi River system; varied applications
- Less than 2 acres
- Mixed mesophytic and bottomland species focused, some adaptive
- Species selected where hydrogeomorphic and flood inundation models guide success
- Systematic grid layout most likely but clusters are being attempted

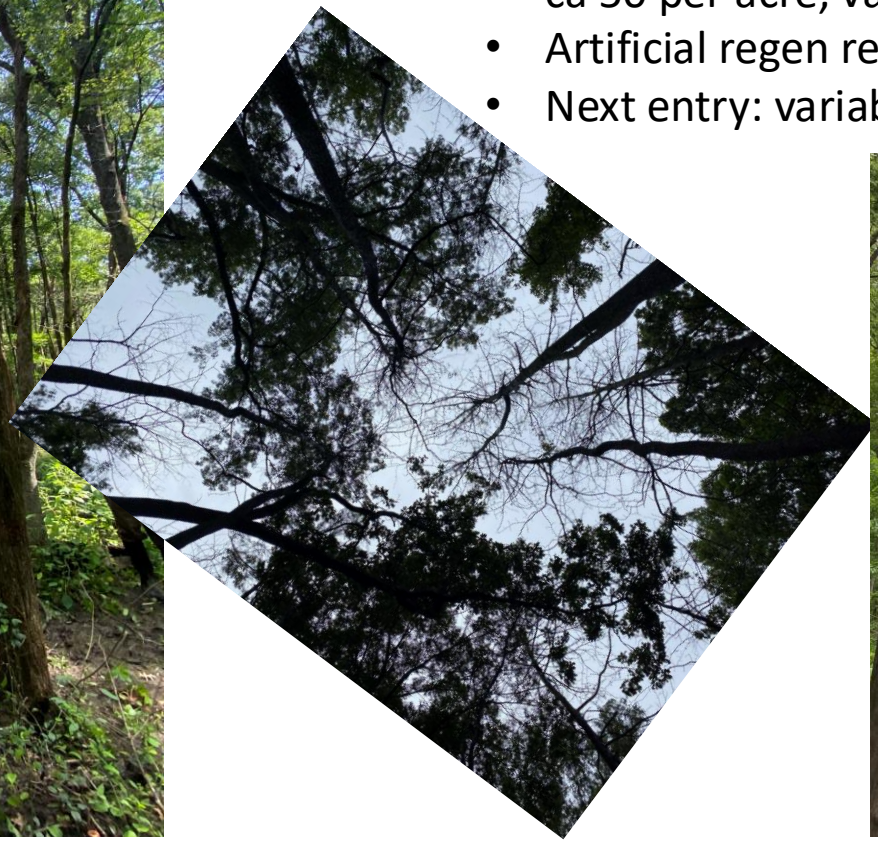


Forest enhancement through artificial underplanting

Gap-scale event emulation with Prescription Snag Creation

- Middle Mississippi River NWR, Rockwood, IL
- Previous condition: single species overstory
- Develops rich species assemblage (>14 sp)
- Builds forest structural complexity by variable thinning
- ca 400 per acre, variable clusters 20-50 at 3x3
- Artificial regen required to obtain necessary richness

Forest enhancement through artificial underplanting



Gap-scale event emulation with Prescription Snag Creation

- Mingo NWR, Puxico, MO; UPM NWFR, Clinton IA
- Previous condition: single species overstory
- Builds forest structural complexity by variable thinning
- ca 50 per acre, variable grid
- Artificial regen required to obtain necessary richness
- Next entry: variable selection harvest

Community restoration with white oak

Invasive species removal with white oak bareroot install

- Trempealeau NWR, Trempealeau, WI
- Installed after basal bark black locust control
- Develops desirable regeneration component
- ca 100 per acre, variable clusters 5-10 at 3x3
- Applied with artificial regen to acquire species

Topographic enhancement and point bar emulation

Dredge material placement with bareroot regen planting

- Upper Mississippi River NWFR, Cordova IL, Lansing IA
- UMRR HREP Projects possible with USACE partnership
- Organics and clays placed upon sand base, mixed variably
- Bareroots installed after novel soil settling
- Mimics structure of point bar meander succession
- Applied with artificial regen to acquire species

Topographic enhancement and point bar emulation

Dredge material placement with bareroot regen planting

- Upper Mississippi River NWFR, Cordova IL, Lansing IA
- UMRR HREP Projects possible with USACE partnership
- Organics and clays placed upon sand base, mixed variably
- Bareroots installed after novel soil settling and covercrop
- Mimics structure of point bar meander succession
- Applied with artificial regen to acquire species
- Direct seeding and natural regen also utilized

Bank protection and stabilization

Scour zone reshaped and planted with prairie cordgrass

- Upper Mississippi River NWFR, Cordova, IL
- Installed in high energy scour zone to stabilize soil
- Develops desirable regeneration component
- ca 4800 per acre, 3x3
- Applied with containerized stock
- Timing essential for establishment

Current white oak restoration and management in Midwest

- Wisconsin: white oak retention focused active forest management at Necedah NWR
- Wisconsin: replacing invasive black locust with white oak in Trempealeau NWR's mesic sand savanna
- Illinois: bottomland old field afforestation plantings at Great River NWR that include white oak
- Range wide: technical guidance to PFW biologists on white oak-specific woodland restoration on private lands
- IL, IA, MO, WI: Prescribed fire programming on many refuges slowly improving conditions for white oak