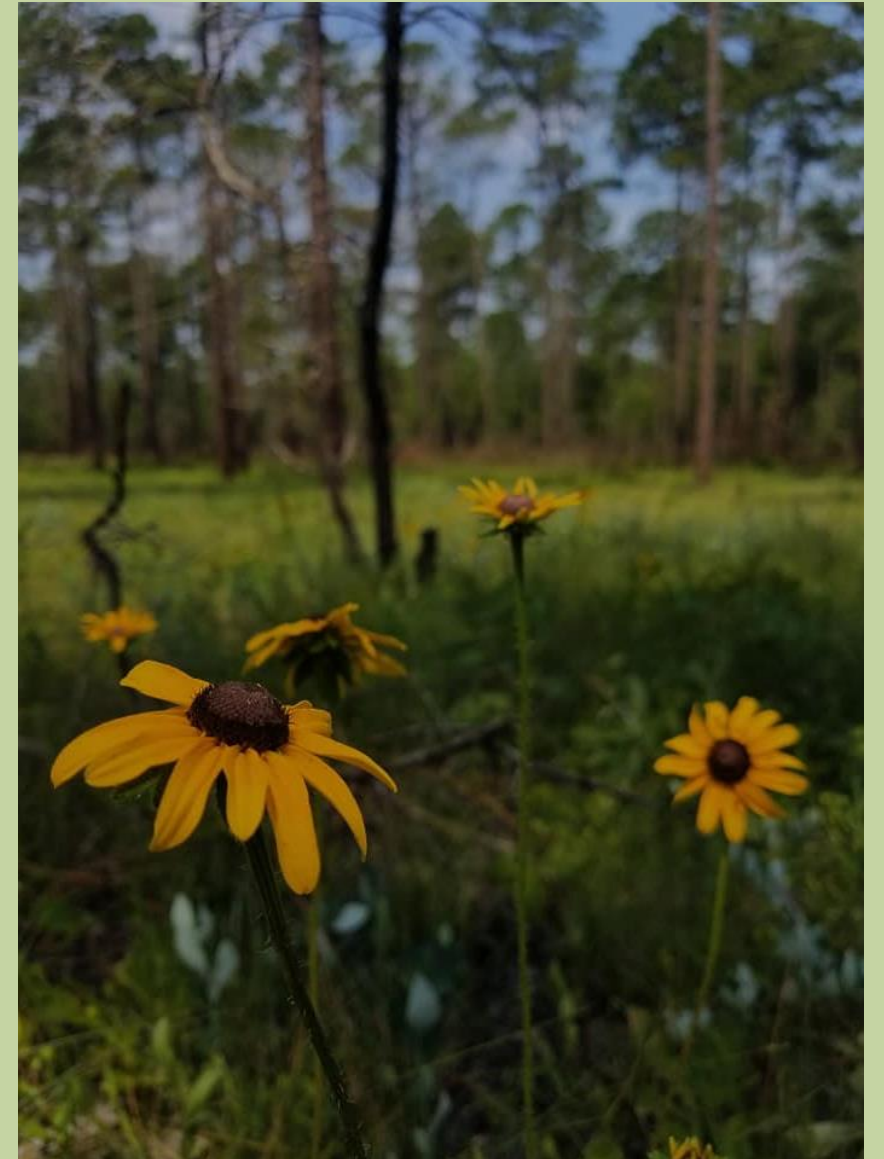
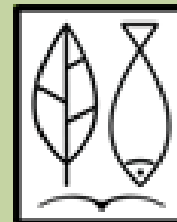


Ecological Restoration with Herbicides

Jonathan Smith & Ryan Wenzel
Sabine & Waters, Inc.

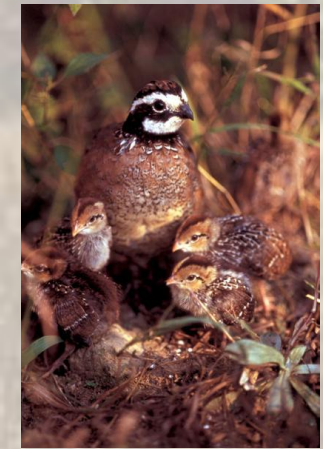


Why Longleaf?

- Wildlife
- Recreation
- Aesthetics
- High quality timber
- Tradition
- Other economic interests

The most diverse ecosystem in North America

Longleaf Specialists and Residents...just a few



Degradation of an Ecosystem

- Elimination of fire
- Hardwood mid-story development
- Canopy closure
- Loss of herbaceous ground cover
- Wildlife species disappear



Slide adapted from AWF



Building Your Objectives for Restoration

- Many herbicide treatments aim to control woody plants and to favor herbaceous groundcover, much like fire does
- Historically, this was accomplished by land use and natural processes
- Today, it must be planned



Tools for Restoration

- Fire
- Mechanical
- Chemical
- Planting and Reintroductions



Prescriptions for Restoring Longleaf Pine Ecosystems in Varying Stages of Degradation

From Brockway, et al, 2005

	Moderately Degraded	Very Degraded	Highly Degraded
Overstory: Understory:	Longleaf Pine Native Plants	Other trees Native plants	Other trees Non-native plants
Xeric and subxeric sandhills:	Dormant season fire Growing season fire Mechanical removal and herbicide hardwoods	Mechanical harvest Growing season fire Herbicide sprouts Plant LLP seedlings	Roller-chop twice and burn Herbicide if needed Plant LLP seedlings Sow native understory seed
Montane and mesic uplands:	Dormant season fire Growing season fire Mechanical removal and herbicide hardwoods	Growing season fire Mechanical harvest to create canopy gaps Plant LLP seedlings	Growing season fire Harvest, chop, harrow Herbicide if needed Plant LLP seedlings Sow native understory seed
Flatwoods and wet lowlands:	Dormant season fire at 2-year intervals Growing season fire	Growing season fire Mechanical harvest Roller-chop once and burn Plant LLP seedlings	Roller-chop twice and burn Herbicide if needed Plant LLP seedlings Sow native understory seed



Example



Before



After



Accelerating Restoration Goals

- Herbicides, are a common tool to quickly reduce hardwood basal area and favor pine re/establishment
- Control invasive grasses before restoration and planting projects
 - bahiagrass
 - bermudagrass
 - cogongrass
- Quick return on investment...
- That investment is at a cost—4-8X more than burning alone
- Coupled with fire to be most effective and provide lasting results
 - More effective than burning alone in oak-dominated sites
- Preserves many desirable species in the understory—FUELS



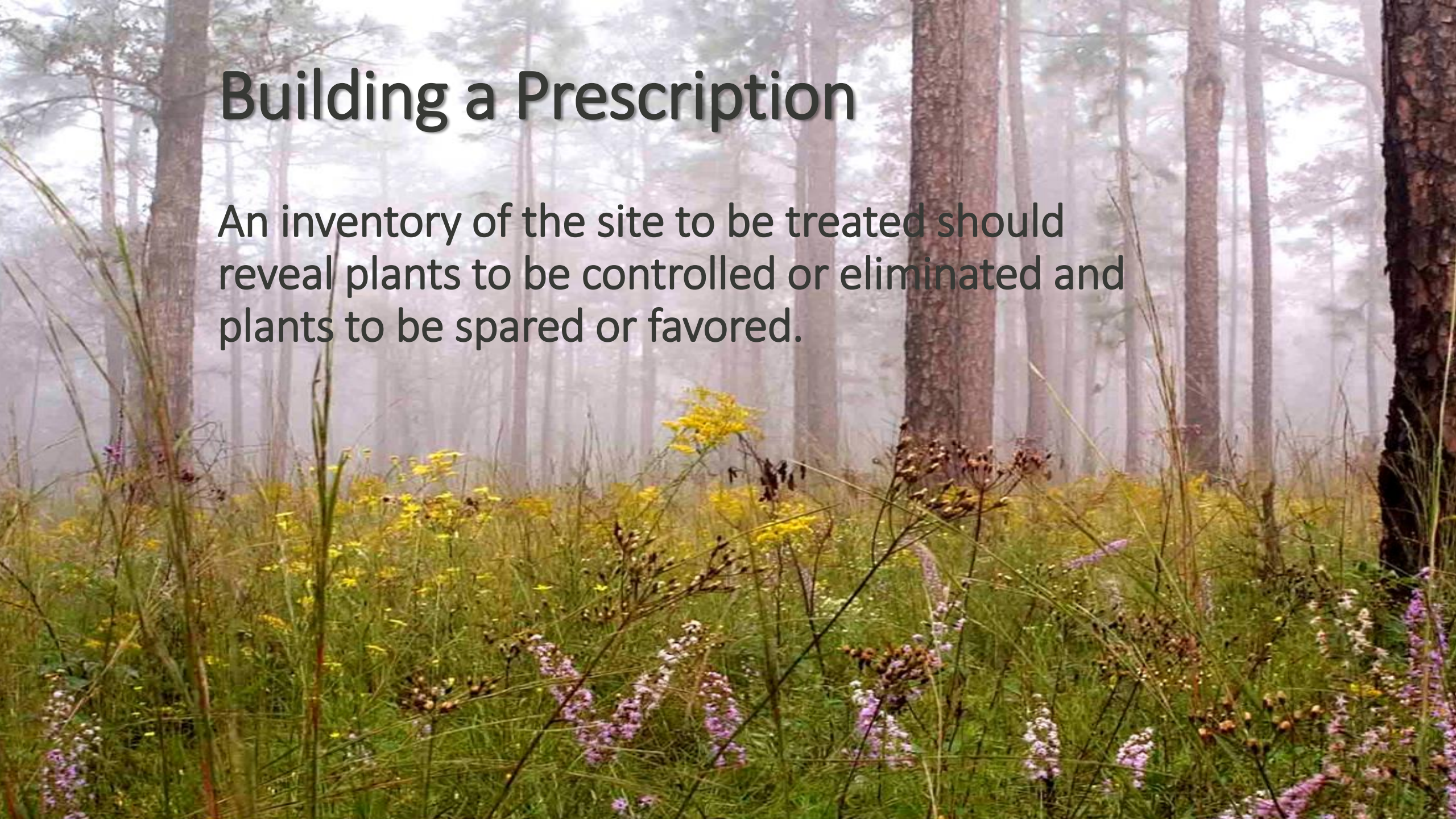
Accelerating restoration goals— But...

- Likely to see a decline in species richness in year 1, then a rebound
 - Wide range of responses by off-target species
 - Application technique matters
 - Rates matter—consider lower effective rates
- Effects on native understory species are still not always widely understood or known
- “Non-target” species may still be affected, especially in year 1
- Balance “control vs keep” goals in your prescription



Building a Prescription

An inventory of the site to be treated should reveal plants to be controlled or eliminated and plants to be spared or favored.



Herbicides Work Selectively

****Check your particular formulation****

****Always follow the label****

- Knowing what to save is as important as what to eliminate
- And using the right tool for the objectives

For instance...



Hexazinone Products (Velpar)

- **Eliminate or control:**

- **Oaks**
- **Blackberry**
- **Vines**
- **Blackgum**
- **Sweetgum**

- **Have limited effect on:**

- **Broomsedge**
- **Beautyberry**
- **Vacciniums**
- **Pines**
- **Dogwood**
- **Hollies**
- **Expect some legume injury***
- **Wiregrass***



Imazapyr products like Arsenal and Chopper...

- **Eliminate or control**
 - **Many perennial grasses**
 - **Pokeberry**
 - **Vines, like wild grape**
 - **Oaks**
 - **Vacciniums**
 - **Persimmon**
- **But have limited effect on:**
 - **Many legumes**
 - **Croton**
 - **Wax myrtle**
 - **Blackberry/dewberry**
 - **Hickory**
 - **Black Gum**



Glyphosphate products like Accord or Roundup...

- **Eliminate or control**
 - **Most grasses**
 - **Many broadleaves**
- **Have limited effect on:**
 - **Hollies**
 - **Wax myrtle**
 - **Gallberry**
 - **Dogwood**
 - **Cherry**
 - **Hickory**
 - **Greenbriar**



Products Containing Triclopyr, like Garlon...

- **Eliminate or control**
 - **Most woody and waxy-leaved species**
 - Gallberry
 - **Yaupon**
 - Titi
 - **Many broadleaves**
 - **Oaks**
- **But have little effect on**
 - **Many grasses**
 - **Many legumes**
 - **Black cherry**
 - **Eastern red cedar**



Oust (sulfometuron methyl) and Escort (metsulfuron)...

- Eliminate or control
 - Most broadleaves and grasses
 - Legumes
 - Kudzu
 - Palmetto
 - Honeysuckle
 - Blackberry
- But are ineffective in controlling
 - Broomsedge
 - Johnsongrass
 - Bermudagrass
 - Croton
 - Sweetgum



Banded vs Broadcast Application



Hack and Squirt

- Hack and Squirt



- 1 hack for every 3 inches DBH
- 1 milliliter of solution per hack

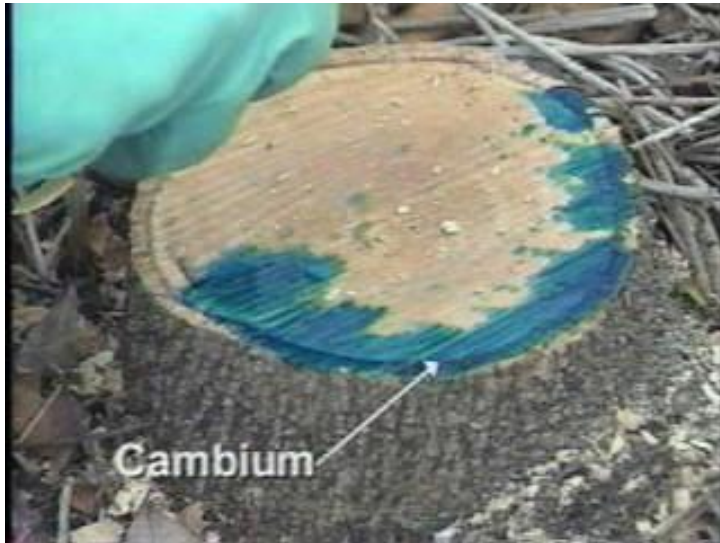


Basal Bark



Cut Stump

- Freshly Cut



Benefits of Native Warm Season Grasses (NWSG):

- Structure:
 - Nesting & Screening
 - Fawning Cover
 - Winter Cover
- Fuel to promote frequent fire
- Limited Food Value-some more than others

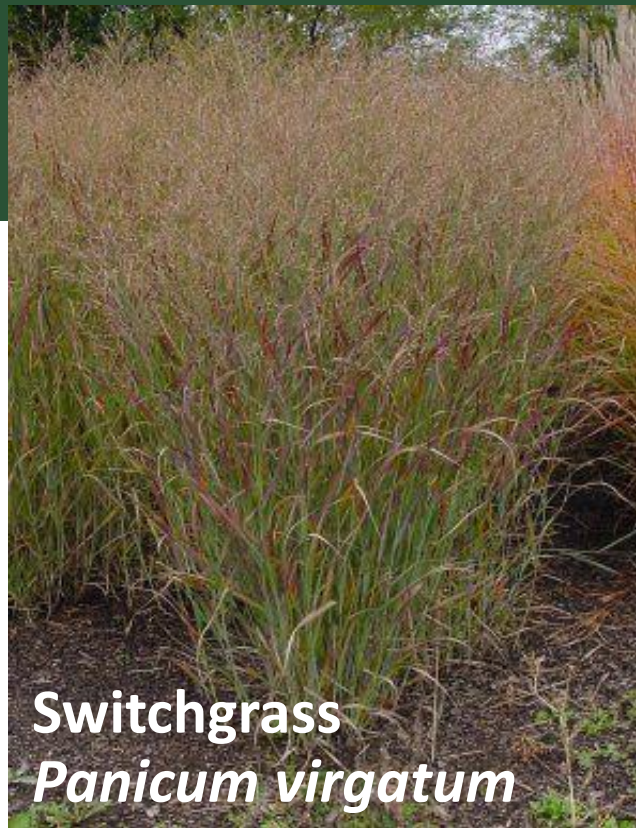


Pink Muhly
Muhlenbergia capillaris





Little Bluestem
Schizachyrium scoparium



Switchgrass
Panicum virgatum



Indiangrass
Sorghastrum nutans

Wildlife Uses:

- Seeds consumed by wild turkeys, bobwhite, small mammals, and songbirds
- Provides cover throughout the year for small mammals and juvenile bobwhite and wild turkey



Wiregrass

Aristida stricta

Wildlife Use:

- Cover for small & large mammals, ground nesting birds, and herptofauna
- Provides important nesting sites/materials for bobwhite and other grassland birds
- Provides forage for gopher tortoises



Benefits of Native Forbs/Legumes:

- Structure for brooding, roosting and screening
- Important food source
- Promote healthy **insect** communities

- Legumes especially important:
 - Nitrogen fixer
 - Hardy, seed-winter food source
 - High protein & mineral content
 - Great for pollinators





Partridge Pea

Chamaecrista fasciculata

Wildlife Uses:

- Seeds important food for northern bobwhite, wild turkey, and small mammals
- Moderate forage for deer
- Host plant for several species of butterflies



Florida Ticktrefoil

Desmodium floridanum

Wildlife Use

- Seeds important food for northern bobwhite, turkey, dove, small mammals, and other songbirds
- High preference deer forage



Spurred Butterfly Pea

Centrosema virginianum

Wildlife Use

- Seeds important food for bobwhite quail, many songbirds
- Moderate to high preference deer forage



Native Lespedeza Wildlife Use

- Narrowleaf lespedeza (*L. angustifolia*)
- Hairy lespedeza (*L. hirta*)
- Creeping lespedeza (*L. repens*)
- Slender lespedeza (*L. virginica*)

- Likely the most important Bobwhite Quail seed producers in the SE
- Some species are preferred forage for deer



Wild Plums & Wildlife Use

- Common Wild Plums
- Chickasaw plum: *Prunus angustifolia*
- American plum: *P. americana*
- Hog plum: *P. umbellata*



- Quail– provides excellent escape and nesting cover
- Songbirds – Several feed on plums including mockingbird, brown thrasher, and gray catbird
- Also deer, black bear, gray fox, raccoon, and opossum



Blackberries

Rubus spp.

Wildlife Uses

- Important group of plants to numerous wildlife in SE
- **Soft mast** available from spring-summer
- Plants are used by game mammals, gamebirds, and songbirds
- Important browse for deer and Eastern Cottontail
- Provide excellent escape cover and nesting sites for quail



Vaccinium and *Gaylussacia* spp.

Blueberries and Huckleberries

Wildlife Uses

- Variety of fruiting species provides wildlife food sources for the majority of the growing season
- Deer, black bear, wild turkey, bobwhite quail, scarlet tanager, robin, cardinal, bluebird, brown thrasher, Eastern bluebird, blue jay, mockingbird, cardinal, Eastern towhee & many other songbirds



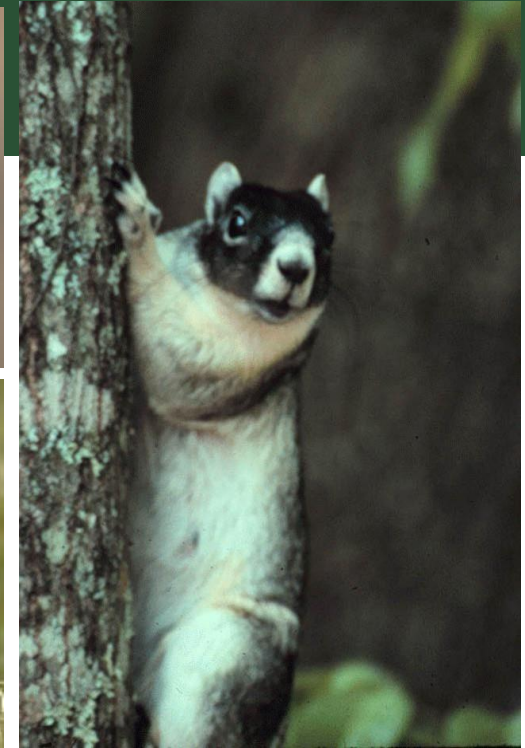
Scrub Oaks: Bluejack, Sand Post, Blackjack, Turkey Oak Wildlife Uses

- Acorns readily used by deer, turkey, black bear, squirrel, and numerous other wildlife species
- In the shrub layer, provide cover to quail, turkey, small mammals
- Can be maintained in desirable abundances with fire and/or herbicide



Wildlife Habitat Principles

- Shelter from predators
- Breeding habitat
- Nesting and rearing habitat
- Food sources for juveniles and adults, life stages in between
 - Fruiting plants
 - Legumes
 - Mast
 - Healthy insect population



Northern Bobwhite

- Habitat conditions are **frequent fire-dependent**
- Open canopy, very low basal areas (20-30)
- If not possible on entire stand, consider areas for lower BA densities
- If not achieved by fire, consider herbicide treatment to jump-start restoration of structure



Northern Bobwhite



Improved habitat conditions
= Smaller home ranges
= Reduced predation
= Greater covey success



Habitat Requirements



Common Herbicide Treatments and Impact on Quail Habitat

- **Oust XP – Sulfometuron methyl**

- Effective on grasses, including panicums, broadleaf weeds including ragweeds
- Effective on legumes
- Weak on pasture grasses, beautyberry

NWSG important for nesting, brooding, and as primary fuel for prescribed fires. Legumes are an important food source

- **Arsenal/Chopper Gen2 – Imazapyr**

- *Rubus* (blackberry, dewberries) and woody legumes fairly tolerant
- May be weak on ragweeds
- Effective on perennial grasses, many broadleaves, oaks, vacciniums

Vacciniums provide fleshy fruit food source throughout summer season; grasses important to habitat structure. Legumes remain.

- **Velpar – Hexazinone**

- blueberry somewhat tolerant, also legumes, sumac
- Targets oaks, some *rubus* spp.
- Also for control of *Sericea lespedeza* (non-native invasive)

Preserves legumes long-term, though initial reduction may be seen; Reduce oak and woody spp in pockets to preserve habitat needs

- **Arrow – Clethodim**

- grass selective, control of Bermuda and Bahia

Control pasture grasses to favor natives and bring back understory diversity, pine establishment



Red-cockaded Woodpecker

- Textbook longleaf specialist
- Habitat
 - Little to no midstory
 - Maintained with frequent fire
- RCW habitat is habitat for suite of other species
- RCW habitat is a well-maintained, highly functioning, **longleaf ecosystem**



Photo credit USFWS Eric Spadgenske



Red-cockaded Woodpecker

- Habitat best maintained with fire
- Hexazinone (Velpar) can be effective on larger diameter oaks in the mid-story outside the reach of fire
- Mechanical mid-story treatment
- Garlon basal bark treatments on woody spp. within cluster areas
- Use extreme caution with imazapyr products beneath mature longleaf!



Gopher Tortoise

- Federally listed as “Threatened” west of the Mobile and Tombigbee Rivers in AL
- Candidate for listing in eastern range
- Major push from states to permanently conserve the tortoise and suitable habitat



Gopher Tortoise

- “Keystone” species
- Occupies open habitats with abundant groundcover
- Frequently burned woodlands preferred
- As fire exclusion/suppression continues, burrows are more common on roadsides and field edges



Eastern Wild Turkey

- Longleaf resident, **adaptable** to variety of habitats
- Fire-maintained stands benefit turkey populations
 - Food production
 - Seed, fruit, mast
 - Insect food sources, esp. following growing season burns



Eastern Wild Turkey



- Prefer open stands, more tolerant than quail
- Cover for protection
- Provide good visibility
- Yet still enough low cover to hide crouching poults and provide valuable seeds, fruits, and insects to consume



White-tailed Deer

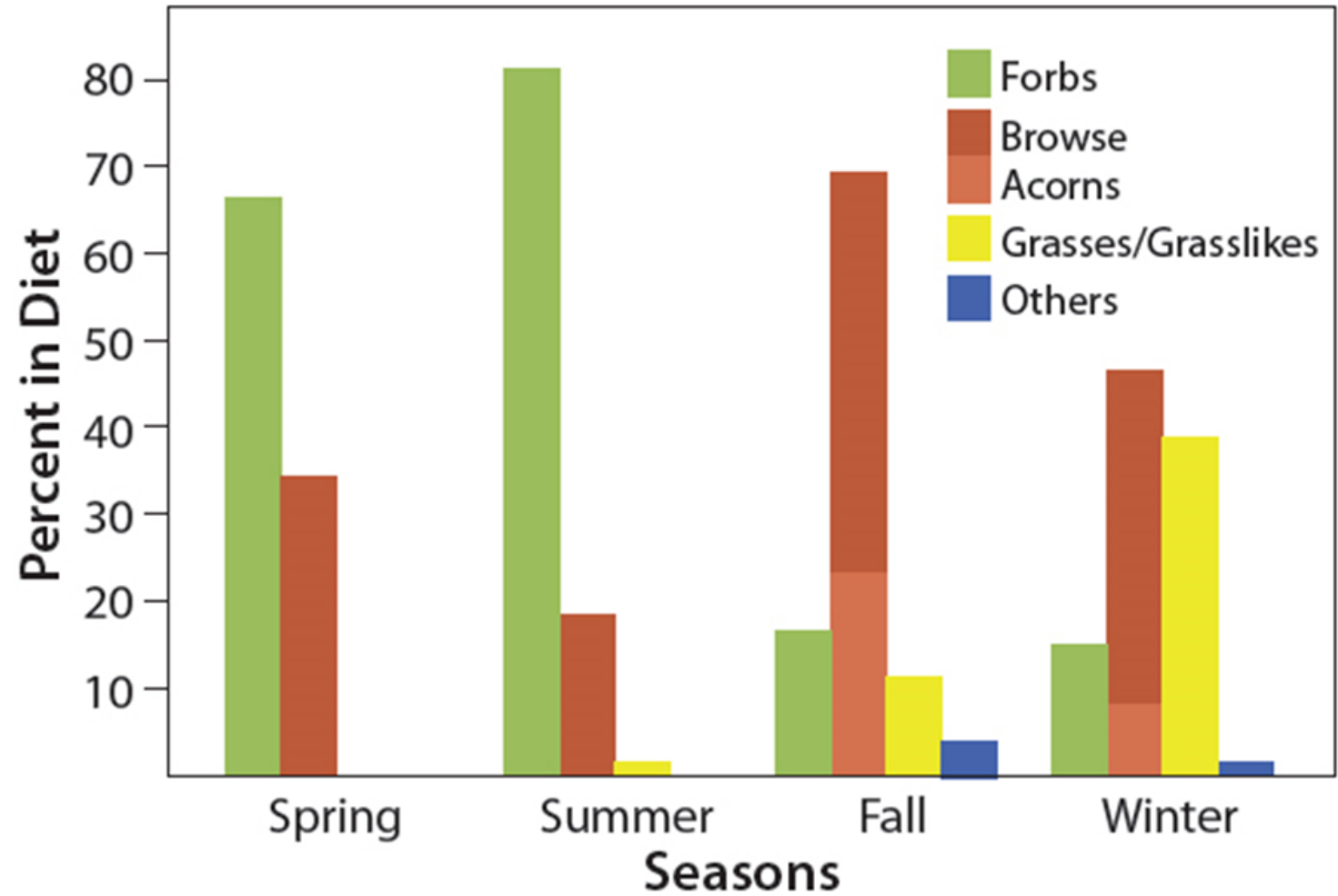
- **Generalist** species, herbivore
- Utilizes a variety of habitat conditions
- Feed on new growth, fruits in spring and summer
- Fall acorns an important food source
- Longleaf provides for all of these habitat needs



Image: The Times Democrat



White-tailed Deer



Slide adapted from UGA



Using Herbicides to Create and Maintain Wildlife Habitat can do the following:

- Reduce or eliminate invasive, non-native plants
 - Restoring native populations and associated wildlife
- Create snags, dead and down woody material
- Change shrub-dominated areas to early successional, grassy, or herbaceous-grassy dominated communities
- Release longleaf from grass stage
- Keep woody and herbaceous growth within reach of browsing animals



In Summary

- No single herbicide or mix to achieve quality wildlife habitat
- Identify what you have first –
- Then get control of stand – hardwoods, non-natives, invasives
- Give and Take – Trade-offs are inevitable—even if you do nothing
- Herbicides **MOST** effective when paired with **prescribed fire**
- More herbicide options for site preparation—less so in restoration context. Informed decision-making is key to restoring function.



References

- Brockway, Dale G.; Outcalt, Kenneth W.; Tomczak, Donald J.; Johnson, Everett E. 2005. Restoring longleaf pine forest ecosystems in the southern U.S. In: Restoration of Boreal and Temperate Forests, Stanturf, John A.; Madsen, Palle; eds., Chapter thirty-two, CRC Press, Boca Raton, 2005, p. 501-519
- Jose, S. , Ranasinghe, S. and Ramsey, C. L. (2010), Longleaf Pine (*Pinus palustris* P. Mill.) Restoration Using Herbicides: Overstory and Understory Vegetation Responses on a Coastal Plain Flatwoods Site in Florida, U.S.A.. Restoration Ecology, 18: 244-251. doi:[10.1111/j.1526-100X.2008.00440.x](https://doi.org/10.1111/j.1526-100X.2008.00440.x)
- Kaeser, Melanie J., and L. Katherine Kirkman. “The Effects of Pre- and Post-Emergent Herbicides on Non-Target Native Plant Species of the Longleaf Pine Ecosystem.” *The Journal of the Torrey Botanical Society*, vol. 137, no. 4, 2010, pp. 420–430. *JSTOR*, www.jstor.org/stable/25790863.
- Knapp, B.O., Walker, J.L., Wang, G.G., Hu, H., Addington, R.N., 2014. Effects of overstory retention, herbicides, and fertilization on sub-canopy vegetation structure and functional group composition in loblolly pine forests restored to longleaf pine. *For. Ecol. Manage.* 320, 149–160.
- Steen, D. A., Conner, L. M., Smith, L. L., Provencher, L. , Hiers, J. K., Pokswinski, S. , Helms, B. S. and Guyer, C. (2013), Bird assemblage response to restoration of fire-suppressed longleaf pine sandhills. *Ecological Applications*, 23: 134-147. doi:[10.1890/12-0197.1](https://doi.org/10.1890/12-0197.1)
- Van Lear, D.H., W. D. Carroll, P. R. Kapeluck, and R. Johnson. 2005. History and restoration of the longleaf pine-grassland ecosystem: implication for species at risk. *Forest Ecology and Management* 211:150– 165.
- Walker J.L., Silletti A.M. (2007) Restoring the Ground Layer of Longleaf Pine Ecosystems. In: Jose S., Jokela E.J., Miller D.L. (eds) *The Longleaf Pine Ecosystem*. Springer Series on Environmental Management. Springer, New York, NY



Questions?

