

## **2021 NCF-Envirothon Nebraska**

### **Forestry Study Resources**

#### **Key Topic #1: Conservation and Management of Forests**

1. Define agroforestry and describe its benefits for wildlife.
2. Describe different silviculture practices and explain how they can be used to meet a variety management goals.
3. Identify common methods of harvest and reforestation.
4. Explain how forest management can improve wildlife habitat.

#### **Study Resources**

Windbreaks and Wildlife – *Ron J. Johnson, Mary M. Beck and James R. Brandle. University of Nebraska-Lincoln, 1991* (Page 2 - 9)

Working Trees-Info Sheet: What is a Windbreak? – *USDA National Agroforestry Center, 2013* (Page 10 - 11)

Working Trees-Info Sheet: What is Silvopasture? – *USDA National Agroforestry Center, 2012* (Page 12 - 13 )

Forest Thinning Proves Excellent Management Tool flyer – *Sandy Benson, Nebraska Forest Service, 2013* (Page 14)

Inside Agroforestry newsletter – *USDA National Agroforestry Center, 2002* (Page 15 - 22)

**Study Resources begin on the next page!**





# Windbreaks and Wildlife

By Ron J. Johnson, Mary M. Beck and James R. Brandle,  
University of Nebraska-Lincoln

Windbreaks can support wildlife that add beauty and pleasure to our lives. They also sustain birds that eat insect pests, improve hunting opportunities, and provide a focal point for family outdoor activities. The world around us would be less appealing without the stimulation — the color, sounds, tracks, and mystery — of wild creatures; windbreaks help wildlife and in some areas are essential to survival of the wildlife we enjoy. You can add wildlife benefits to windbreak plantings whether your main goal is to shelter crops, livestock,

roads, or a home or farmstead.

This publication provides an overview of windbreaks and wildlife, and gives examples of trees, shrubs, and planting designs to consider. However, because adapted plant types and wildlife needs vary among areas, refer to local experts for details. Personnel from Cooperative Extension, state wildlife or forestry agencies, the Soil Conservation Service, and others can help or will know how to direct you to the needed information.



Nebraska Game and Parks Commission

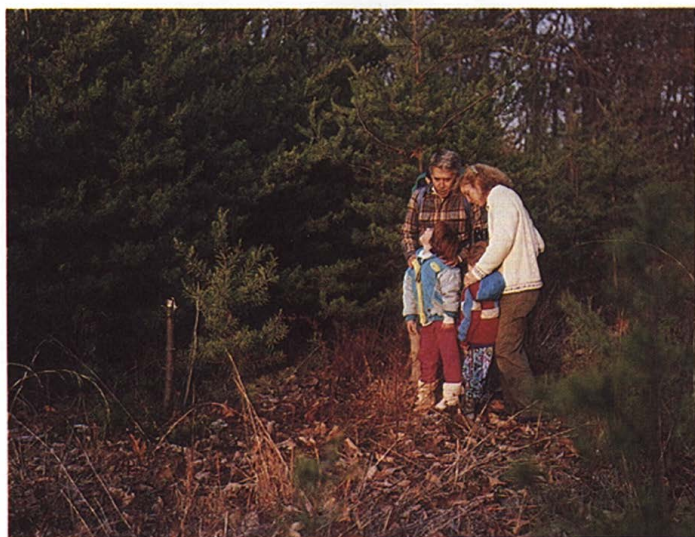
Cardinals and other non-migratory birds benefit from dense conifers that provide protection from cold winter winds.



# Why Include Wildlife in Windbreak Plans?

**Insect-eaters.** Many birds and predatory insects that live in windbreaks consume pest insects in the windbreak and in adjacent crop fields. One report estimates that birds consume about 260 pounds of insects per half-mile of windbreak each year. These insect-eaters are a natural biological control that may reduce crop losses and reliance on pesticides, aspects of possible economic significance for integrated agricultural systems.

**Windbreaks as an Investment in Recreation.** Studies in the Great Plains show that hunting pheasants or quail is usually more successful in areas with woody windbreak plantings. Windbreaks also benefit other game animals including cottontails, mourning doves, squirrels, and white-tailed deer. A 1985 survey by the U. S. Fish and Wildlife Service showed that, in the United States, adults spend about \$55 billion each year on wildlife-related recreation. In Kansas, researchers attribute more than \$30 million annually to hunting activities associated with windbreaks. The demand for outdoor recreation opportunities, such as hunting, wildlife observation, camping, photography, and hiking, is likely to continue to increase. Windbreaks can enhance these outdoor recreational opportunities.



Windbreaks provide opportunities for family outdoor activities.

**Families and Windbreaks.** Windbreaks on a farm or acreage can become a focal point for outdoor family activities. They provide aesthetic beauty to enhance the home or farm; a quiet setting for walks, bird watching, or overnight camp-outs together; a route for hayrack rides with wildlife to be seen; and a place for hunting or wildlife educational activities. An evening of television is soon forgotten but the memories of family adventures by the windbreak will last a lifetime.

## How Windbreaks Benefit Wildlife

**A Place to Nest.** Shelterbelts provide nesting habitat for a wide variety of birds (Table 1) and other wildlife species. At least 57 kinds of birds have been recorded using windbreaks in the United States during the breeding season. Mourning doves nest and call in windbreak trees but forage nearby for the seeds that they eat. Some birds such as the black-billed cuckoo ("rain bird"), house wren, gray catbird, and northern oriole conduct nearly all their activities within the windbreak. American robins, kingbirds, brown thrashers, and American goldfinchs sing and nest in windbreaks but forage both in and out of them. Other species, including squirrels and cottontail rabbits, nest in windbreaks, and white-tailed deer with fawns use them for cover.

**Food and Foraging sites.** Windbreaks provide food for wildlife as well as protective cover when they forage in adjacent areas. Foods potentially available in windbreaks include fruits, nuts, acorns, seeds, foliage, and insects or other invertebrates. Availability of these foods varies seasonally and depends largely on what's planted or growing in the windbreak. Trees and shrubs produce fruits and some hold them into winter, a time when food is often critical for survival but generally less available. Acorns, nuts, and other seeds from trees such as elm, maple, and ash are used by wild turkeys, pheasants, quail, squirrels, deer, and songbirds. Seeds may also be available from grasses or herbaceous plants growing in the windbreak or from wildlife food plots planted within or adjacent to the woody vegetation. Foliage such as leaves or other plant parts may provide food for browsing animals such as deer. Insects and other invertebrates are important foods for many birds, particularly during nesting periods, and for various small field mice and shrews. Windbreaks provide foraging sites that would otherwise be unavailable. For example, chickadees glean along branches, peeking in and under crevices in the bark looking for insects to eat. Windbreak species such as hackberry, hawthorn, black cherry, autumn olive, honeysuckle, and others serve as nectar sources and habitat for butterflies, honey bees, and hummingbirds.

Food availability near shelterbelts is also important for many species. In fact, pheasants generally don't use windbreaks, especially in winter, unless there is a nearby food source. Croplands, such as cornfields, that have waste grains, interspersed weed seeds, and insects are used by ring-necked pheasants, northern bobwhites, mourning doves, and others. Avoid autumn plowing of such croplands where possible and consider using cropping systems such as no-tillage that leave ground cover. Oldfield habitats or water sources near windbreaks can provide habitat requirements for some species.

Bird species	Reported shelterbelt uses		
	Feeding	Nesting season	Resting/Loafing
Gray partridge			•
Ring-necked pheasant		•	•
Northern bobwhite	•	•	•
Mourning dove		•	•
Black-billed cuckoo	•	•	•
Red-headed woodpecker	•	•	•
Downy woodpecker	•	•	•
Northern flicker	•	•	•
Eastern wood-pewee	•	•	•
Least flycatcher	•	•	
Western and Eastern kingbirds	•	•	•
Black-capped chickadee	•	•	•
American robin	•	•	•
Gray catbird	•	•	•
Brown thrasher	•	•	•
Warbling vireo	•	•	•
Indigo bunting	•	•	•
Dark-eyed junco	•	•	•
Common grackle	•	•	•
Northern oriole	•	•	•
American goldfinch	•	•	•
American kestrel		•	•
Sharp-tailed grouse	•		•
Hairy woodpecker			•
House wren	•	•	•
Eastern chickadee		•	
Northern mockingbird			•
Cedar waxwing	•	•	•
Yellow warbler	•	•	•
American redstart	•		•
Common yellowthroat	•	•	•
Yellow-breasted chat			•
Northern cardinal	•		•
Rose-breasted grosbeak	•	•	•
Rufous-sided towhee			•
Lark sparrow		•	
White-throated sparrow			•
Brown-headed cowbird			•
Orchard oriole	•	•	•

Table 1. Examples of birds that benefit from shelterbelts in the United States.

**Shelter From Predation - Escape Cover.** Windbreaks provide escape cover and refuge for many wildlife species. Pheasants often stay near windbreak cover while feeding in adjacent areas, and, during midday loafing periods, the woody vegetation offers refuge from people and overhead predators. In general, wider shelterbelts with a good vegetation layer near the ground offer better escape cover than do those that are more narrow and open. When planning wildlife escape cover, consider the surrounding land use. Be aware that in areas with no trees or other perches, tall deciduous windbreak trees may attract avian predators. In most situations, hawks and owls are welcome because they eat pest rodents and inspire joy and awe in many

who watch them. However, in areas where no other perches exist and where enhancing pheasants, quail, or partridge is the primary wildlife goal, shrubs or moderately-sized trees may be better alternatives.

**Shelter from weather.** Shelter from the wind is a critical aspect of wildlife survival in winter. An animal maintains warmth by avoiding exposure to the wind, ideally in a warm sunny spot, and by fluffing feathers or fur coats. Food is vital because it is the basic source of all body heat. An animal must balance the needs of finding food against the increased exposure to wind when foraging.



Windbreaks can provide both shelter and food. Shrubs and ground cover on the lee side allow animals to perch or rest out of the wind and, with many windbreaks, the lee side will have exposure to the sun. When food is available in or near the shelter, wildlife can find food without long exposure to cold wind. The combination of wind protection, food, and sun exposure can be a life saver for wildlife during critical winter times.

The quality of a windbreak for protection from weather extremes relates to several factors, including the wildlife species involved; severity of the weather; age, size (length and width), density, orientation, location, and vegetation composition of the windbreak; and food availability in or near the shelter. Animals in colder climates may require larger, especially wider, plantings.

Pheasants like the shade and microclimate at ground level in woody cover - during winter for daytime loafing or resting, and, in spring, for protection from heavy rains. Reports that windbreaks become winter "death traps" for pheasants because of blowing snow have largely been discounted. The problem is not windbreaks, but lack of sufficient ground cover anywhere, in or out of the windbreak. Studies have found that pheasants generally leave deciduous shelterbelts in response to high winds and heavy snow, but during winter they may roost in coniferous windbreaks. The key for winter pheasant protection is a wide windbreak with enough space for snow storage, adequate shelter near the ground, and a nearby food source.

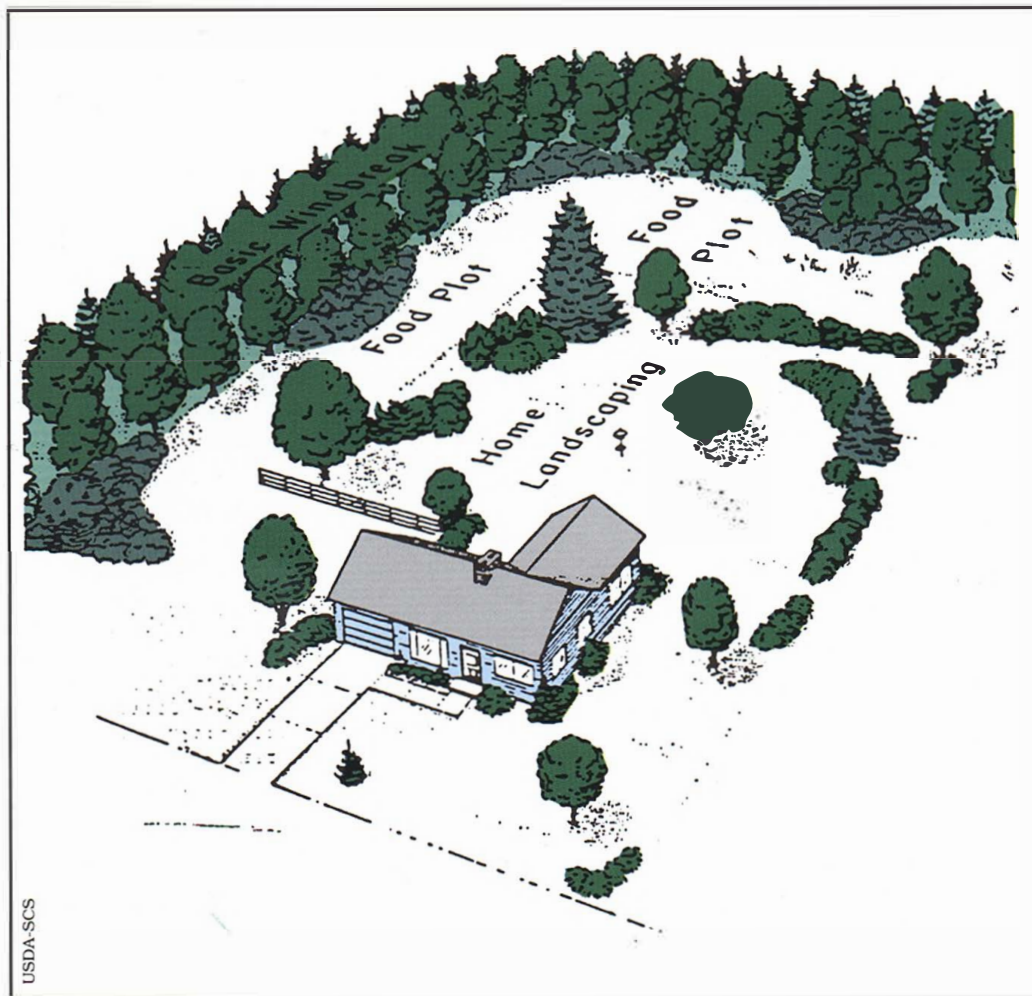


Figure 1. Planting food plots or fruit-bearing shrubs on the lee side of windbreaks provides food in an area protected from wind and possibly warmed by the sun, points that are particularly important in cold months.

**Travel Lanes.** Wildlife need to move about to find necessary food and other resources. The long, linear nature of windbreaks provides safe routes from one habitat to another. Species such as quail, pheasants, songbirds, rabbits, squirrels, and deer may use windbreaks as travel lanes between feeding sites, as protected cover at feeding sites, and as routes for safe dispersal. On a broader scale, they function as stopover points for migrating songbirds heading north for the summer or south for the winter, to the southern United States or even to South America.

### A Note of Caution for Grassland Wildlife

Some native grassland birds need large unbroken areas of grass habitat with few trees and shrubs. Examples include western meadowlarks, bobolinks, dickcissels, lark buntings, grasshopper sparrows, upland sandpipers, and greater prairie chickens. Although not as familiar as some species, these are important parts of grassland ecosystems, and some are in trouble, with significant declines. Although reasons for the declines are unclear, studies do show that, near woody cover, grassland birds can be at greater risk from predation by various bird and mammal predators and from brood parasitism by brown-headed cowbirds. Other prairie animals, such as the pronghorn antelope, also may be affected. Planting windbreaks in large unbroken areas of grasslands, although helping some wildlife species, may hinder others, so plant where needed but keep in mind the possible wildlife trade-offs.

## What to Plant

In choosing what to plant, think about what factors make a windbreak attractive to wildlife. For example, one Minnesota study of farmstead windbreaks found that most bird species primarily used the vegetation layer within two feet of the ground. The ground layer is critical in providing winter wind protection and is especially important for species that nest or feed on or near the ground. The canopy or upper layer provides many birds with sites for nesting; singing; and foraging for insects, tree seeds, and fruits.

For the best wildlife benefits, a shelterbelt should have a developed tree canopy, and an understory that includes shrubs and herbaceous plants that provide both food and cover. Grasses, especially sod-forming ones, compete with young trees and should be 3-4 feet away from them during the first five years after planting. However, during establishment, planting between rows, 3-4 feet from trees, a mixture of short- to mid-height bunch grasses, milo, or similar cover provides wildlife benefits and protection for soil and young trees.

Choice of specific plant types will vary among locations because of climate, soil, and other factors. Think about selection because some plant species provide more wildlife benefits than others, and a variety of species is necessary to provide the range of habitat needs of most wildlife.

Planting a variety of deciduous tree and shrub species will provide a habitat structure with a large selection of vertical and horizontal nesting and foraging sites. Oaks provide habitat structure and acorns produced are a top food choice for many game birds and mammals. Hackberry has branching characteristics that are preferred by many songbirds for nesting and foraging. Siberian elm is also a preferred tree for songbirds but is not a good choice for windbreaks. Crabapples are excellent nesting sites, and planting several varieties can provide both late summer and winter food. Some ash, cottonwood, maple, pine, and oak species, when mature, can provide sites for cavity nesters. Tall deciduous trees such as eastern cottonwood, maple, and ash are used by northern flickers, warbling vireos, and others for nesting, foraging, and singing. Tatarian and amur honeysuckle, chokecherry, plum, autumn olive, and other shrubs are used by American robins, brown thrashers, gray catbirds, and cardinals for nesting and feeding.

Conifers provide protected sites for early spring nesters, shelter for migrating songbirds, and winter roosting and loafing sites for pheasants. The fruits on eastern redcedar and Rocky Mountain juniper also provide a winter food source for songbirds and gamebirds, and the foliage provides browse for pronghorn antelope and deer. Features of possible concern in some situations include the thorns on hawthorn and buffaloberry, and possible house sparrow use of eastern redcedar, Rocky Mountain juniper, and maples if

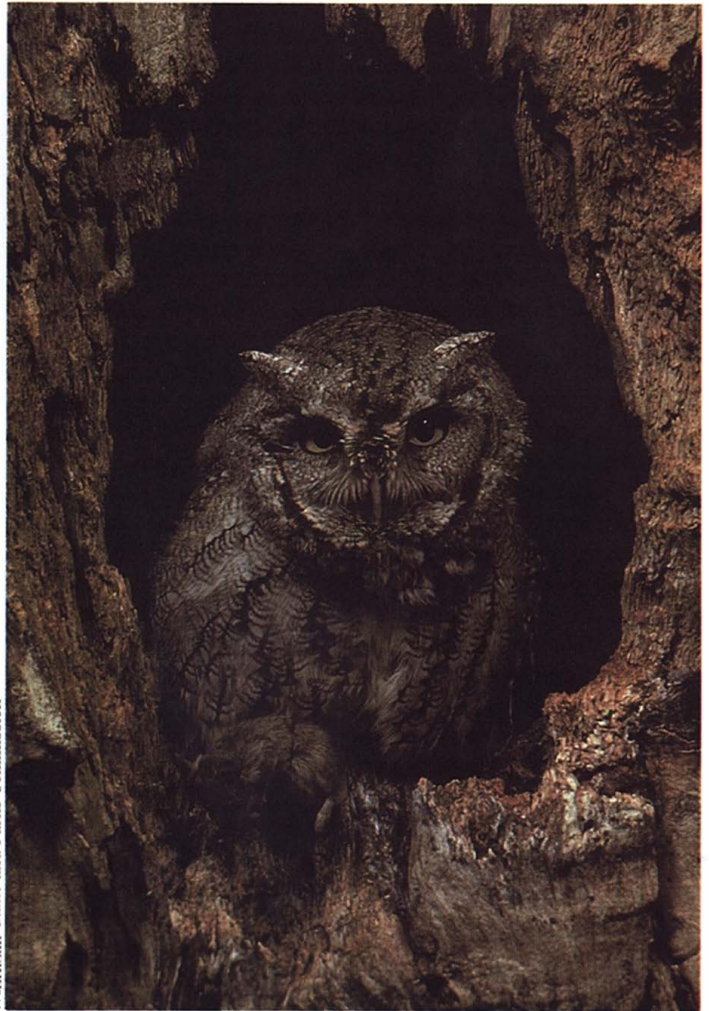
planted next to farm buildings. Blackbirds and starlings may roost in urban windbreaks in certain regions of the United States, especially in coniferous trees, but they are less likely to do so in open rural areas.

## Planting Designs With Wildlife in Mind

Windbreaks are planted to protect farmsteads, livestock, roads, or crops. The additional goal of providing wildlife benefits can be added without compromising the primary purpose. In developing a plan, select a design, plant materials, and location that meet your specific windbreak needs but include factors that benefit wildlife. Below are some designs with tips on improving them for wildlife.

### Overall Guidelines.

- Choose trees and shrubs that have wildlife benefits, but that are adapted to the local climate. Generally, native species are the best bet because they are adapted and familiar to wildlife (Table 2).



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Older and wider windbreaks provide homes for cavity-nesters such as this screech owl. Hawks and owls are predators that help keep nature's abundance in balance.



Plants <sup>1,2</sup>	Overall wildlife value	Nesting	Songbirds		Gamebirds		Fur & game mammals	
			Food	Cover	Food	Cover	Food	Cover
<b>Conifers</b> (Excellent winter cover, food, and nesting sites)								
Eastern redcedar	Excellent	•	<b>W</b>	<b>SW</b>	W	<b>SW</b>	B	<b>SW</b>
Rocky Mtn. juniper	Excellent	•	<b>W</b>	<b>SW</b>	W	<b>SW</b>	B	<b>SW</b>
Arborvitae	Good -Excel	•		<b>SW</b>		<b>SW</b>	B	<b>SW</b>
Spruce	Good	•		<b>SW</b>		<b>SW</b>		<b>SW</b>
Pine	Good - Excel	••	S	<b>SW</b>	S	<b>SW</b>	B	<b>SW</b>
Fir	Fair	•		<b>SW</b>		<b>SW</b>		<b>SW</b>
<b>Deciduous trees</b> (Nesting and foraging sites, food, canopy and habitat structure)								
Oaks	Excellent	•	W	S	<b>W</b>	S	<b>WB</b>	S
Osageorange	Excellent	••		<b>S</b>		S		S
Hackberry	Excellent	••	SW	<b>S</b>	W	S	B	S
Pecan	Fair		W	S	W	S	W	S
Black walnut	Fair		W	S		S	W	S
Mulberry	Fair	•	<b>S</b>	S	S	S	<b>S</b>	S
Ash	Good	•	W	S	W	S	B	S
Maple	Good	•	S	S	S	S	B	S
Siberian elm	Excellent	••	S	<b>S</b>		S		S
Cottonwood/poplar	Fair	•		S		S	B	S
Black cherry	Excellent	•	<b>S</b>	S	<b>S</b>	S	SB	S
Flowering crabapples	Excellent	••	<b>W</b>	<b>S</b>	<b>W</b>	S	WB	S
Hickory	Fair		W	S	W	S	W	S
Hawthorn	Good	••	W	<b>S</b>	W	S	B	S
Serviceberry	Good	•	S	S	S	S	B	S
<b>Tall shrubs</b> (Nesting sites, food, cover near ground)								
Russian olive	Good	•	W	S	W	S	W	S
Autumn olive	Excellent	•	W	SW	W	SW	W	SW
Honeysuckles	Excellent	••	W	<b>SW</b>	W	SW	WB	SW
Viburnums	Excellent	•	W	SW	W	SW	WB	SW
Shrub dogwoods	Excellent	•	S	SW	S	SW	B	S
Buffaloberry	Good		W	SW	W	SW		SW
Staghorn & smooth sumacs	Good		W	S	W	S	B	S
<b>Short shrubs</b> (Nesting sites, food, cover near ground)								
Fragrant sumac	Excellent	•	W	SW	W	SW	B	SW
American plum	Excellent	••	S	SW	S	SW	S	SW
Common chokecherry	Excellent	••	<b>S</b>	SW	<b>S</b>	SW	SB	SW
Chickasaw plum	Excellent	•	S	SW	S	SW	S	SW
Sargent crabapple	Excellent	•	W	S	W	S	WB	S
Cotoneaster	Good		S	S	S	S	S	S
Amur maple	Excellent	•	S	S	S	S	B	S
Coralberry & snowberries	Good - Excel		W	SW	W	SW	B	SW

<sup>1</sup>Bold letters or two dots indicate an especially good wildlife feature.

<sup>2</sup>Several plants in this list have a variety of species or cultivars, and some may have features that differ from those indicated. Also, there may be good plant selections for your area that are not included.

Table 2. Examples of windbreak plants that benefit wildlife and their primary wildlife values, which occur mostly during summer and fall (S), fall and winter (W), or include browse (B).

- Include a variety of trees and shrubs in the windbreak planting. This gives a more natural landscape appearance, improves wildlife values for more species, and reduces the chances of disease or insect pest problems.
- Where appropriate, select a site that connects to a larger habitat block such as a river corridor, woodlot, wetland, woody draw, or similar area.
- Consider planting a wildlife food plot or leaving grain fields unplowed. The cover reduces soil erosion and, on the lee side of windbreaks, wildlife have a food source in a sheltered spot.
- Consider planting or leaving herbaceous vegetation such as a mixture of grasses and legumes, grain, or stubble as a border, 20-50 feet wide, along the edges of windbreaks, but avoid competition with new plantings by keeping a clear area next to the trees. This provides nesting, loafing, and foraging cover for pheasants, quail, meadowlarks, and others. On the windward side, such cover also improves wind protection and shields newly-planted trees from desiccation and abrasion caused by blowing soil. Mowing, if needed, should be late in the season to avoid nesting wildlife (e.g. August) and limited to every 3-4 years to maintain standing cover for early-nesters.
- Consider adding a row of shrubs to the windward side to trap snow before it gets to the main windbreak and to improve wind protection near the ground.

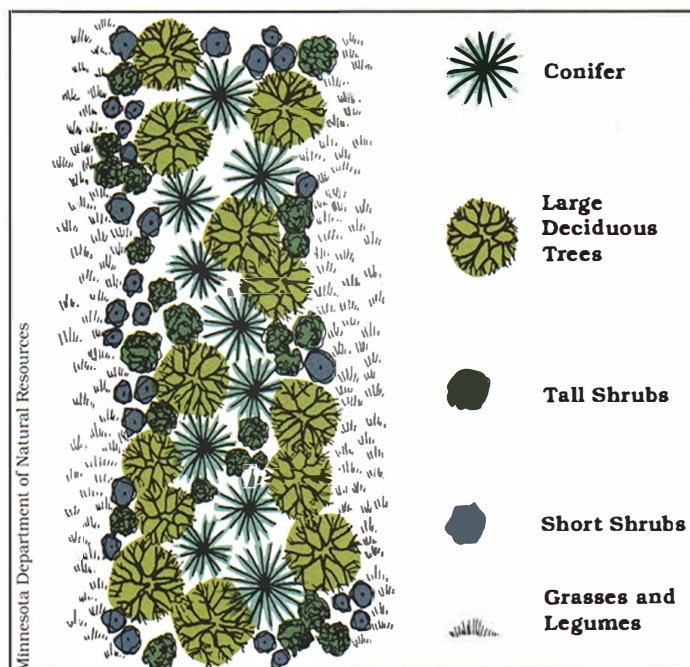
**Field Windbreaks.** These windbreaks are often planted across productive cropland to reduce wind erosion, distribute snow, conserve soil moisture, and increase net crop yields. They can provide benefits as travel lanes and as feeding, loafing, and/or nesting sites for birds such as pheasants, quail, mourning doves, and songbirds. To enhance the value of field windbreaks for wildlife:

- Choose a variety of trees adapted to the site and that have wildlife benefits, and plant them so there is a mix of tree types within and among rows.
- Alternate trees and shrubs within the row, or consider adding a shrub row immediately next to the tree row on the leeward side. Stagger the tree and shrub rows to better fill gaps. Shrubs will provide critical ground cover and add foraging and nesting sites near the ground.
- Where possible, add a row of shrubs around the field edges to connect the windbreak rows. These provide safe travel lanes plus additional foraging and nesting sites.

**Farmstead and Livestock Windbreaks.** Windbreaks with four or five rows are commonly used to protect farmsteads or livestock. Greater width may be necessary for wildlife protection in winter in northern climates. For example, eight-row windbreaks have been recommended for wildlife protection in Minnesota, and more than eight rows may be needed to provide ample winter protection in Manitoba and North Dakota.

In contrast, one- to three-row windbreaks are commonly used farther south in areas such as the Texas panhandle. In general, greater width provides better winter protection. An ample ground cover layer, availability of food resources, and connections with larger blocks of protective cover are also critical factors in winter survival for pheasants, quail, and other wildlife. If an established windbreak fills with snow or otherwise does not offer adequate winter habitat, consider adding the needed plantings to improve it. Below are some design tips for a five-row windbreak.

- On the windward side, often the north or west side, use two rows of evergreen trees such as eastern redcedar, Rocky Mountain juniper, or other native conifer species. Spruce and fir are recommended for more northern sites. Stagger the trees in the two rows so that all spaces are better occupied.
- For the middle row (or middle two rows), use tall deciduous trees such as those in Table 2. A variety of deciduous trees mixed through these rows provides more benefits to more wildlife species.
- Add a row of tall shrubs and a row of short shrubs on the leeward side. Planting a variety of shrub species with high wildlife values is the best approach (examples in Table 2).



*Windbreaks can be given a more naturalistic look and still provide excellent wildlife habitat and wind protection.*





Ron J. Johnson

Windbreaks provide habitat for game animals such as rabbits, quail and pheasants.

**How big should a windbreak be?** Larger windbreaks benefit more wildlife than do smaller ones, and some birds need a certain minimum size windbreak before they will use it. For example, insect-eaters such as brown thrashers, black-capped chickadees, least flycatchers, gray catbirds, and yellow warblers have size requirements for nesting territories — several rows in width and at least 1-3 acres. For mammals, little information is available on specific size needs in relation to territory or behavior, but they may not be quite as critical. Where wildlife winter shelter is a specific purpose of a windbreak, the size needed, especially width, will be greater than for other purposes. For example, shelterbelts in northern-most states may need as many as 20 rows of woody plants or be up to 300 feet wide and have adequate ground cover to ensure pheasant protection. Less width will suffice in the mid to southern states. Several windbreaks that are close together or are connected to larger habitat areas become larger overall and may meet minimum size needs.

### Older Windbreaks

As a windbreak grows, it will gradually become more complex in structure, with a well-developed understory and a variety of types and shapes of plants. Most wildlife will accept windbreaks after they are at least five years old; those over 40 years old are more likely to be accepted by hawks, owls, and cavity nesting birds. Throughout the life of a windbreak, maintaining good wind protection and cover near the ground are important characteristics for variety and abundance of wildlife, especially for pheasants, quail, and many songbirds.

**Wildlife Helpers.** With established windbreaks, consider adding rows of shrubs to benefit wildlife along the leeward edge or planting additional conifers or shrubs along the windward side. Other options include adding an adjacent herbaceous strip to provide nesting cover and additional shelter near the ground, or adding length to connect the windbreak to existing woodlots, river corridors, wetlands, or similar places used by wildlife.

**Snags.** Snags are trees that have died and possibly lost limbs or tops but are still standing. Snags are great for wildlife. If they're not where they pose a safety hazard and there is no other reason to remove them, consider saving them for wildlife; owls, woodpeckers, and chickadees use them as nesting and foraging sites. Another option is to top the snag, leaving a stump about 15 feet high to provide wildlife benefits yet allow sunlight through to other trees and understory plants.

**Nest Boxes.** Adding nest boxes to younger windbreaks will bring cavity nesters sooner and also will help in more mature windbreaks. Nest boxes attract and provide nesting sites for many desirable cavity nesters such as chickadees, woodpeckers, house wrens, American kestrels (sparrow hawks), and bluebirds.

### Be a Windbreak Detective

There is much we need to learn about wildlife in windbreaks and about how people interact with wildlife in relation to windbreaks. Your observations or notes of what you've seen and done may become important to you and to others interested in windbreaks. Here's a challenge: write yourself a windbreak wildlife notebook. You might note when the windbreak was established, what wildlife are seen in or near the windbreak, what they were doing, how wildlife use changes over the years, and how you and your family use the windbreak. If you can't see the wildlife, such as nighttime animals, look for tracks and possibly make plaster of Paris casts. Or listen for the many bird, insect, and other sounds in the windbreak. If you have a food plot, waste grain in a crop field, or other food source next to the windbreak, jot down what wildlife use it. You might also note what you think about wildlife in the windbreak. For example, are there obstacles or concerns that need new solutions? Are there fun, educational, or family experiences that others interested in windbreaks should be aware of? Use your wildlife windbreak notebook ideas for fair displays, speeches, or show-and-tell; and write the authors so we can improve future windbreak information.



Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Kenneth R. Bolen, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources  
Cooperating Agencies provide information and educational programs to all people without regard to race, color, national origin, sex or handicap.



This series of windbreak publications is jointly sponsored by the University of Nebraska, the USDA Soil Conservation Service, North Dakota State University, and the Forest Stewardship Program of The Nebraska Forest Service. Its goal is to encourage the proper management of all of our woodland resources.



# Info

## What is a windbreak?

# Working Trees



Vegetable crops in Alabama are protected by a Windbreak.

— NAC photo

**W**indbreaks are plantings of single or multiple rows of trees, shrubs or grass that protect crops, livestock, wildlife or people from wind's harmful consequences.

Historically, Windbreaks were planted for a single purpose, such as protecting homes from cold winds or soil from erosive winds. Today, Windbreaks are being used to address numerous

other problems and provide a variety of other benefits. When properly designed, located and managed Windbreaks can produce one or more environmental and economic benefits. It is important to remember that not all potential benefits can be realized from every Windbreak. In fact, some Windbreak purposes will require conflicting design characteristics.

## Benefits of windbreaks

**Improve income** — Whether a grain, vegetable, hay, vine or orchard crop, net yields can be increased by 10 to 20 percent in fields with Windbreaks. Livestock experience improved weight gains resulting in lower feed costs. Heating and cooling costs for the farmstead can also be reduced. In addition, income producing plants such as fruit trees, nut trees and woody florals can be incorporated into a windbreak without reducing the beneficial functions..

**Provide protection** — Windbreaks protect crops, facilities, livestock, people, soil and water from the damaging effects of wind and wind blown material. Windbreaks can create a more

comfortable working and living environment by providing protection from cold winter winds, hot summer winds and blowing and drifting snow.

**Store carbon** — A dense tree and shrub planting, including Windbreaks, will create net gains in carbon storage or sequestration. As the plantings mature this helps to rebalance the global carbon cycle.

**Enhance aesthetics** — Windbreaks generally add desirable plant variety that enhances the appearance of the landscape. Windbreaks also can screen undesirable views and provide opportunities for protecting and viewing wildlife.



# Considerations for windbreaks

**Vegetation** — Final selection of the species of trees and shrubs to plant will vary at each facility and farm site and should be based on: soil type, natural drainage, common wind conditions, annual precipitation, natural range of each woody species and site needs.

**Density** — The more solid or dense a Windbreak, the greater the wind speed reduction. However, less dense plantings provide protection to a greater distance. Density can be managed by the plant species chosen, the spacing within and between rows and the number of rows.



Windbreaks can increase net yields of many crops by 10 to 20 percent.

— NAC photo

**Orientation** — Windbreaks are most effective when oriented at right angles to troublesome winds. To allow for changes in wind direction, Windbreaks are often planted in multiple directions — in an L-shape or an arc. Avoid placement that may interfere with overhead lines, buried cable and road visibility.

**Height and Length** — The height determines how far downwind the protection will reach. For adequate protection the Windbreak must be taller than what is being protected. The length helps determine the total area that will be protected.

**Pest Control** — Because every tree counts in a Windbreak, it is important to regularly monitor for the presence of insects and diseases. Early detection and treatment is the most effective way to control pests. Wildlife and livestock can also cause damage that is best prevented with fences or other deterrents.

**Management** — Proper care of the Windbreak is critical to its long-term functioning. Windbreaks need regular maintenance and attention from the day they are planted. Practices such as weed control, protection from livestock and wildlife damage, corrective pruning, replanting, insect and disease control, and supplemental watering may be needed on a continuing or periodic basis.



Living snow fences can be an effective way to control blowing and drifting snow, reduce snow removal costs and accidents.

— NRCS photo by Craig Stange

## More information on the Web

USDA National Agroforestry Center [www.unl.edu/nac/windbreaks.htm](http://www.unl.edu/nac/windbreaks.htm)

The Center for Agroforestry [www.centerforagroforestry.org/practices/wb.php](http://www.centerforagroforestry.org/practices/wb.php)

Association for Temperate Agroforestry [www.aftaweb.org/windbreaks.php](http://www.aftaweb.org/windbreaks.php)

Natural Resources Conservation Service [www.nrcs.usda.gov/technical/standards/nhcp.html](http://www.nrcs.usda.gov/technical/standards/nhcp.html)



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Contact: USDA National Agroforestry Center, 402.437.5178 ext. 4011, 1945 N. 38th St., Lincoln, Nebraska 68583-0822. [www.unl.edu/nac](http://www.unl.edu/nac)

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First Edition May 2012

# Info

## What is silvopasture?

**Silvopasture** is the deliberate integration of trees and grazing livestock operations on the same land. These systems are intensively managed for both forest products and forage. Well managed silvopastures employ agronomic principals, typically including introduced or native pasture grasses, fertilization and nitrogen-fixing legumes, and rotational grazing systems that employ short grazing periods which maximize vegetative plant growth and harvest. Silvopastures are:



Cows in a loblolly pine silvopasture.

Sid Brantly - USDA/NRCS

- **Intentional** - The combinations of pastures, trees, and animals are purposefully managed to provide forage and timber products on a sustained basis. These are not individual practices that occur coincidentally together or are managed independently.

- **Intensive** - Silvopastures are intensively managed to optimize the production of the forest products and forages. Science based grazing, haying, fertilization, tree pruning and trimming and other cultural practices are planned in advance to compliment reforestation, tree protection, market cycles and work load.

- **Interactive** - The forest management, pasture management, and grazing management are conducted in harmony so as to enhance the production of multiple harvestable components, while also providing conservation benefits. The combination of the products realized usually exceeds the normal yield of either enterprise individually.

- **Integrated** - The trees, livestock and forage are functionally combined into a single management unit tailored to meet the landowner's objectives.

### Potential Benefits of Silvopasture

1. Cooler summer environment for livestock.
2. Shorter timber rotations due to forage fertilization and competition control.
3. High value timber products resulting from pruning and management of tree density.
4. Shaded, cool season forage plants can be more nutritious for livestock.
5. Diversification of income streams spreads out market risk and increases income opportunities.
6. Greater plant nutrient uptake efficiencies - the deep tree roots coupled with pasture plant roots acquire nutrients from a greater range of soil depths.



Goats in a walnut plantation silvopasture.

-NAC Photo

# Working Trees



## *Silvopasture is not the same everywhere*

Though many silvopasture principals are universal, some management requirements and benefits vary in different parts of the United States.

**Silvopasture in the Northwest** Douglas-fir, ponderosa pine, red alder, black walnut, black locust, maple, and poplar are options for silvopasture trees, depending on your particular farm and climate. Orchardgrass, tall fescue, and ryegrass with white clover or subterranean clover are likely understory options, depending on the soil type and forage needs. Well managed silvopasture trees in Oregon have been known to produce as much as 16% greater diameter growth than similar trees in a typical forest plantation setting.

**Silvopasture in the Southwest** Southwestern silvopasture types range from ponderosa pine, Douglas-fir, almond and other nut trees on the west coast to loblolly pine, longleaf pine, pecan and other hardwoods in Texas. Forage types range from annual, cool season grasses in the west to warm season grasses like Bermudagrass as you travel east. It has been noted that the warm season grasses seem to mature a little later in the silvopastures than in open pastures, slowing the cyclic digestibility decline as forages mature.

**Silvopasture in the Northeast** Black locust, black walnut, other hardwoods and even larch trees in the northern reaches have been used for silvopasture production in the northeast. Orchardgrass, tall fescue, eastern gamagrass, bluegrass, Kura clover, and reed canarygrass have shown promise as understory forage plants for silvopasture. Increases in farm profitability, animal performance, summer forage growth and market diversification have been demonstrated in silvopastures in the northeast.

**Silvopasture in Southeast** In the southeast region, loblolly pine, slash pine, and longleaf pine are utilized for silvopastures very effectively with bahiagrass and crimson clover understory forage. As you move north in this region, pecan, black walnut, black locust, and even white pine become more feasible, with tall fescue, orchardgrass, red clover and white clover serving as the forage base. Silvopastoralists cite improved farm economics due to efficiencies of soil nutrient uptake, livestock summer heat protection, and improved aesthetics as some of the major benefits afforded by silvopastures.

### Tips for Silvopasture Management

- Intensive rotational grazing, modest stocking, and careful monitoring of forage and trees is essential. "Typical" pasture management can result in overgrazed plants, damaged trees, and soil compaction. Hungry, mineral-deprived, or parasitized animals are highly likely to browse or damage trees.
- Grazing management needs to accommodate the susceptibility of seedling/saplings to browsing. In general, livestock are more likely to impact broadleaf trees than conifers (there are exceptions).
- Trees need to be pruned and thinned as needed in order to develop high-quality timber products. Open grown, unpruned trees have very low or no marketable timber value. Trees for fruit or nut production should be pruned according to horticultural standards.
- When selecting tree species for silvopasture; take care to evaluate the potential for livestock poisoning. Some animal species are intolerant of red maple (horses), black cherry, black locust, black and red oak.

*Author: Sid Brantly, Grazing Land Specialist, Kentucky NRCS*

### More information on the Web

USDA National Agroforestry Center: <http://nac.unl.edu/silvopasture.htm>

USDA Natural Resources Conservation Service: <http://efotg.sc.egov.usda.gov/references/public/AL/tg381.pdf>

Cornell University: [www2.dnr.cornell.edu/ext/info/pubs/MapleAgrofor/Silvopasturing3-3-2011.pdf](http://www2.dnr.cornell.edu/ext/info/pubs/MapleAgrofor/Silvopasturing3-3-2011.pdf)

University of Florida IFAS Extension: <http://edis.ifas.ufl.edu/fr139>



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Contact: USDA National Agroforestry Center, 402.437.5178 ext. 4011, fax 402.437.5712, 1945 N. 38th St., Lincoln, Nebraska 68583-0822. <http://nac.unl.edu/>

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First Edition May 2013

# Forest thinning proves excellent management tool

By Sandy Benson

Forest Fuels Management Specialist,  
Nebraska Forest Service

Thinning is an excellent management tool for forest landowners to use to improve forest health and productivity and to reduce wildfire hazard. Thinning reduces tree density and competition between trees in a forest stand. It enhances tree vigor and selectively encourages fewer, higher-quality trees that may provide periodic income, as well as other benefits such as wildfire protection, increased grazing capacity, and enhanced wildlife habitat.

**Cooler weather makes the work more pleasant and** reduces the spread of certain insect pests. September marks the beginning of one of the best times to thin ponderosa pine forests.

The 2012 drought severely stressed our forests, making the trees susceptible to insects and disease. Large swaths of dead and dying ponderosa pine are visible in many locations, especially on the hillsides above the Niobrara and Snake rivers. Of particular concern is the Ips bark beetle, which has recently killed a large number of ponderosa pines. The beetle breeds in green pine slash (tops and branches left after logging or storms), then moves into the bark of living trees to finish the cycle. After the first of September there isn't enough time for the insects to complete another breeding cycle before first frost.

**When thinning, visualize what the forest will look like** after the job is done. Ponderosa pine likes to grow in open, park-like stands with plenty of space between groups of trees. In pre-settlement times, periodic low-intensity lightning fires kept tree density down and the forests were very well adapted to fire because of the healthy spacing between trees. Today, we can use thinning to recreate those conditions.

The forestry term for tree spacing is "basal area." This is the cross-sectional area of a tree trunk, measured at 4.5 feet above ground. The term is used to describe the total number of square feet per acre occupied by tree trunks. Ponderosa pine grows best in stands where the basal area is about 60-80 sq. ft. In our unmanaged, overgrown forests in the Niobrara watershed, the density is often 120 sq. ft. or more. A thinned pine forest will have a basal area from 40-60 sq. ft. in which healthy, quality trees are left in groups, with plenty of space between. Grouping the trees protects them from the wind.

**Eastern redcedar has encroached on many ponderosa** pine forests. If a pine stand has a cedar understory, it's often easiest to start thinning by removing some of the cedar first. This removes ladder fuels and allows us to see the pines.



*Doak Nickerson, a forester with the Nebraska Forest Service, marks trees to retain on a thinning project near Valentine. Unmarked trees will be removed to improve forest health and increase safety from wildfire hazards. Photo by Michelle Garwood*

Choose to retain healthy trees with a single, pointed top and straight trunk (no fork), full foliage with dark green color, and free of insects, disease, and damage from animals, logging, weather, or fire. Retain larger trees (greater than 10 inches in diameter) while maintaining a good mix of small and large trees. This helps protect forests from pests that target only a certain age of tree. Uneven-aged management sustains forest cover, provides income at more frequent intervals, minimizes regeneration costs, and provides many wildlife habitat and recreational benefits.

**Retain a good mix of tree species (pine, hardwoods) in** order to provide diversity for wildlife and forest utilization. Character counts with trees, too. Keep some trees that have a unique appearance, historical significance, old growth qualities, visual/noise barrier, and wildlife habitat (snags).

Don't damage trees you wish to retain. Gouges from equipment or from falling trees will make the "keeper" trees more susceptible to insects and disease. Pile slash from the project in open areas at least 30 feet away from the trees you want to keep. Burning slash can produce enough heat to kill any overhanging trees. Up to 75 percent cost share assistance is available to landowners for forest thinning projects.

For information, contact the Nebraska Forest Service, at 402-472-2944, or find your district forester on our website: [nfs.unl.edu/nfs-districts](http://nfs.unl.edu/nfs-districts)





# Inside agroforestry



## FIRE & Silvopasture

### Patrick Shaver

Rangeland Management Specialist  
NRCS Grazing Lands Technology Institute  
Corvallis, Oregon

Silvopasture systems attempt to optimize the production of both wood products and forage. Where did these concepts and ideas come from?

Grazing animals and fire played major roles in the development and maintenance of naturally occurring savannahs throughout North America. A savannah is defined as a vegetative cover type comprised of open-grown trees or shrubs with an understory composed primarily of grasses and grass-like plants. Savannahs were typically void of dense woody undergrowth made up of shrubs and young trees that are commonly found in the fire-protected forests and woodlands of today. Silvopasture systems create a vegetative structure, similar to the historical savannahs, that can carry a ground fire but does not have the heavy fuel loads that often

lead to destructive crown fires. Grazing animals and fire are increasingly used today in the development, maintenance and management of silvopasture systems.

There are several production and conservation reasons for using fire in silvopasture management:

**1. Wildfire fuels management** – This objective is becoming more and more important and common. As wildfires across the country become larger and harder to contain, fuels management is becoming a very important objective of silvopasture management. The main objective of fuels management is to control the amount, structure and distribution of fuels available for wildfires. By managing these characteristics of available fuels, the frequency and severity of wildfires can be greatly reduced. The reduction of fuel loads, developing discontinuities in the fuel beds and eliminating ladder fuels are the main goals in silvopasture fuels management schemes.

see **FIRE** on page 7

### Inside

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TAKING STOCK OF  
SOUTHERN SILVOPASTURE

# 4



# 6

EQUIP YOUR LAND AND  
WATER WITH **EQIP**



# NAC Director's Corner

A commentary on the status of agroforestry  
by Center Director, Dr. Greg Ruark

## Silvopasture is on the moooooooooove!

This issue of *Inside Agroforestry* again visits the topic of silvopasture. In the past few years the demand for and recognition of silvopasture has grown tremendously, especially in the southeastern United States, where southern pine and forage systems composed of both cool and warm season grasses are being successfully blended on the land. This growth is due to several factors: **1)** numerous workshops have been conducted to train natural resource professionals and landowners in the region along with **2)** specific effort to train faculty at the 1890 Universities; **3)** two cost-share programs in the new Farm Bill, the Environmental Quality Incentives Program (EQIP) and the Forest Land

Enhancement Program (FLEP), can be used to foster the adoption of silvopasture; **4)** silvopasture systems are increasingly valued by landowners for their potential to diversify on-farm income by providing for an annual income from grazing, while trees are grown for long-term profits; **5)** managed silvopasture systems are at a low risk for catastrophic fire due to their low understory fuel loads and the low stocking density of trees which are often arrayed in widely spaced rows; and **6)** regional markets for high quality veneer and sawtimber softwood logs continue to expand.



## 3rd Annual 1890 University Faculty Training Workshop on Agroforestry

To date, three 1890 faculty agroforestry workshops have been held at Alabama A&M University. The first workshop was held in June 2000 and provided a general overview of all agroforestry practices. The following year focused on the technical design of riparian forest buffers for water quality. The third workshop was held this June and focused on the technical design of silvopasture systems, that combine timber production with livestock grazing of understory forage. Silvopasture is especially attractive to minority and limited resource farmers in the Southeast who are looking for ways to generate an annual income from grazing, while producing high quality timber for long-term profits.

This year, 27 individuals participated, including faculty from twelve of the eighteen 1890 universities and staff from the Alabama Farmers Federation, the Alabama

Workshop participants received both classroom instruction and hands-on field examples.



Forestry Commission (Outreach Foresters), Auburn University, and the U.S. Forest Service. Many of the participants at this year's workshop noted the increasing demand for goat products in the Southeast due to the influx of immigrants from cultures where goats are a primary source of food and other products. Faculty from eight of the 1890 institutions agreed to jointly write and submit a research grant proposal to study the potential of silvopasture systems for goat production.

The workshops are designed to enable 1890 university faculty to incorporate agroforestry technology into their teaching, research, and extension efforts. Participants

are provided a detailed technical workbook, videotapes, and a CD ROM with corresponding Power Point slide presentations. Funding is provided to defray the cost of participation.

*This year's workshop was designed and coordinated by the USDA National Agroforestry Center. Additional funding was provided by the USDA Forest Service, Washington Office of Civil Rights; USDA Natural Resources Conservation Service, USDA Forest Service, Southern Research Station; USDA Forest Service, Region 8, State & Private Forestry; and the USDA Cooperative States Research Education and Extension Service, Sustainable Agriculture Research and Education.*







**Silvopasture combines forage and livestock production, maximizing the yield of both enterprises.**

# Silvopasture

## Gaining Momentum in the South

### Kimberly Stuhr

Technology Transfer Specialist, NAC  
Lincoln, Nebraska

People are learning and silvopasture use is growing! This year the National Agroforestry Center (NAC) and its conservation partners provided technical training to over 300 natural resource professionals. Trainees included staff from Natural Resources Conservation Service (NRCS), State and County Extension, State Forestry and Conservation Agencies, 1890 Universities, Conservation Districts, Non-Government Organizations (NGOs), private consultants, and landowners.

According to Jim Robinson, NAC NRCS Agroforester, "The objectives of these workshops are to increase silvopasture awareness and to encourage professionals to incorporate silvopasture into their courses, research, extension efforts, and ultimately on the ground."

Robinson continues, "The workshops are fine examples of how NAC works in partnerships. The workshop's are designed and coordinated by NAC with funding sup-

port from several groups. The bulk of the funding is used to defray the meeting cost of workshop participants." Technical training was primarily held in Alabama, Florida, Georgia, and South Carolina. At each site, professionals from the local area assisted with training. Included among NAC's silvopasture cooperators are: University of Florida-Gainesville, Florida Cooperative



Extension Service, Auburn State University, Grazing Lands Conservation Initiative, NRCS from South Carolina, Alabama, Florida and Georgia, Clemson University, Georgia Forestry Commission, and

Louisiana State University Hill Farm Research.

Over 250 landowners attended three workshops and a tour on silvopasture. The good word is getting out to landowners. These meetings were held in Alabama, Mississippi, Louisiana, and Texas and were sponsored by a wide array of organizations. For example, the Mississippi workshop was co-sponsored by NRCS, Southeast RC&D, Mississippi Cooperative Extension, US Fish and Wildlife Service, Appropriate Technology Transfer for Rural Areas (ATTRA), Federal Land Bank, Soil and Water Conservation Districts, US Forest Service and Commissioners from nine counties, and rural fire protection. The Federation of Southern Cooperatives in Epps, Alabama, the Stephen F. Austin University and Piney Woods RC&D in Nacadoches, Texas, sponsored the other workshops.

Grazing Lands Conservation Initiative sponsored a July tour for landowners and technical assistance staff from various agencies at the Louisiana State University (LSU) Hill Farm Research Station near Homer, Louisiana to see a working silvopasture system.





“It’s got everything that a normal veneer plant has,” says Will Possinger, Jr., of Lincoln Industrial Corporation, Inc. in Port Angeles, Washington. He continues, “It’s efficient to operate even while other mills have shut down.” Possinger is the owner of this one-of-a-kind mill and has received a lot of positive response from interested producers. He is proud of the mill, which has quickly become a model for others.

Currently, good quality hybrid poplar is being used for high-valued molding, paneling, and furniture stock. While low-quality poplar is being sold for \$30 or less per green ton for pulp. This new veneer mill can take low-quality, unpruned logs and produce veneer sheets. Possinger says that the price for veneer is down right now, but typically four-foot veneer sells for \$140 to \$200 per green ton.

## A VENEER MILL ON WHEELS

BY GARY KUHN, NAC NRCS AGROFORESTER, SPOKANE, WASHINGTON

**EASY ACCESS AND THE  
HIGH QUALITY TREES  
GROWN IN SILVOPASTURE  
SYSTEMS MAKE  
HARVESTING OR  
THINNING USING A  
PORTABLE VENEER MILL  
AN ATTRACTIVE OPTION**



The portable veneer mill produces peeled four-foot-wide veneer at the harvesting site and eliminates the need for long distance trucking of raw material. The mill can easily peel cottonwood, hybrid poplar, Douglas fir, ponderosa pine, larch, and hemlock. It is constructed on a 26-foot semi-truck trailer and is ideal for entering poplar plantations and silvopasture sites. It handles logs as small as five-inch diameter cut to four-foot lengths, producing 48-inch by 54-inch veneer. The mill recovery rate ranges from 60 to 75 percent. The remaining core, after peeling, can be used for fencing, firewood, handicrafts, or ground for fiber products. According to Possinger, under normal conditions, the Pacific Northwest consumes 240 loads of veneer core per day.

Currently, the veneer panels that this portable mill produces are shipped to a company in Eugene, Oregon to produce finished red alder products. The waste from the veneer production is used for corrugated cardboard, and can be used for bulk fuel and pellet fuels.

Questions on mill operation and production capabilities should be directed to Doug Erickson, Erickson Products, Port Angeles, Washington, phone (360) 452-3680 email [coya@olyphen.com](mailto:coya@olyphen.com).





# Cattle, Trees and Leo Hollinger

## A Winning Combination

**Joan Love Smith**

USDA Natural Resources Conservation Service, Auburn, Alabama

He is a cattleman. He is a tree farmer. He is a sportsman, a conservationist, and a gardner. He is an innovator who likes to explore different ways to do things. He is Alabama farmer Leo Hollinger.

Leo was one of the first cattlemen in Alabama to integrate trees with livestock through silvopasture. This practice can provide multiple benefits to landowners if managed properly. Trees in a livestock operation can reduce the stress on livestock and maintain forage production. A landowner who includes trees in the forage system can produce additional income from the land by selling timber, Christmas trees, or nut and fruit crops; or from commercial wildlife or recreational opportunities provided by the trees.

Sid Brantly, NRCS Regional Grazing Land Coordinator and Raleigh Wilkerson, ALFA Director for Bee, Sheep, Goat, and Ratites (ostriches, emus, etc), has worked with Hollinger to get his silvopasture operation up and running. They visited the research farm at Louisiana State University (LSU) where they found that silvopasture could be profitable and could enhance the aesthetics and value of the property.

"When we returned," Hollinger explains, "I planted 40 acres of pine seedlings in our pasture. Next year I will plant 25 or 30 acres and I will continue to plant until all my open land is in pines. The trees are genetically improved second-generation loblolly pine developed by a local paper company to fit our particular site. Once we get into production and the trees are marketable, we expect a good cash flow because we will have trees ready to thin or harvest every year or every other year

depending on the growth and the markets. With wide spacing and good fertilization, we expect faster growth than what we would get on a regular plantation. The trees will be shorter than in a traditional pine plantation, but they will be fatter."

"Our pasture is predominantly common Bermuda and Tifton 9 Bahia grass with a lot of volunteer rye grass and crimson clover," Hollinger continued. "We plowed the field and attempted to establish the Bahia grass by overseeding with a conventional planting drill. We will graze the pasture until the end of February, then plant trees, then cut some hay from it, hoping that the clover will reseed to continue the process. The trees are planted in rows 32 feet apart."



**"Once we get into production and the trees are marketable, we expect a good cash flow because we will have trees ready to thin or harvest every year or every other year depending on the growth and the markets," – Leo Hollinger**

Hollinger is convinced that having trees in his pasture is much better than open pasture for what he wants to do. "It is going to be real pretty out here in 10, or 15, or 20 years. It will look like a park," he explains. "I plan to remove trees to create 32 foot by 32 foot spacing and they will really do some growing."

Conservationist Leo Hollinger explains "To my way of thinking, these wide row spaced pine trees with the grass between them will be better for wildlife. The grass is going to hold more soil in place. The water coming off the grass will be cleaner than if we had just a solid stand of real thick pine trees with pine straw on the ground."

Wildlife habitat is a major objective of Hollinger's. Turkey and deer are plentiful on the property and he trades turkey and deer hunting rights on his land for duck hunting rights on land owned by some of his friends. He also is looking toward some non-consumptive uses such as wildlife viewing and photography. Pastures and trees are located for ease of viewing the species as they cross the land. He does not plan to exclude hunting but will take advantage of this additional use of his natural resources.

To provide a little spending money for the children and to help them experience the benefits of farming, Hollinger has planted watermelons in alleys between rows of pine trees (alley cropping).

Leo Hollinger and his wife, Jeannie, a county extension agent, enjoy their life in the country. They have a wonderful family, a beautiful home, and their land. Their legacy is one of good stewardship – to leave their land better than they found it and to pass it on to their children and grandchildren.

*Reprinted from: Grazing Lands Round-Up, Volume 8, July 2000.*





# Are You EQIP'd?

## EQIP Helps Producers Use Silvopasture Technology to Protect Forests and Water

**Frank Gariglio**  
NRCS Forester, Lewiston, Idaho

Ranchers and forest landowners should look seriously at how they can utilize the Environmental Quality Incentives Program (EQIP) for silvopasture systems. EQIP is a voluntary USDA conservation program to treat identified soil, water, and related natural resource concerns on eligible land. It provides technical and financial assistance with up to 75 percent cost-share on conservation practices. A landowner may also receive incentive payments for implementing land management conservation practices important to improving and maintaining the health of natural resources in the area.

Eligible land includes cropland, rangeland, pasture, private non-industrial forestland, and other farm or ranch lands. Sixty percent of EQIP dollars must be spent on livestock related issues. EQIP's authorized budget of \$6.1 billion over six years starts with \$400 million in fiscal year 2002 and increases to \$1.3 billion in fiscal year 2006. The decision on which practices will be funded is made locally.

### An Idaho Example

As we in the western United States are very much aware, maintaining forest health, protecting watershed and riparian areas, and reducing fire hazards is a priority on public lands. Since watersheds don't follow clear property lines, these issues also impact private landowners. It only makes sense that private landowners are also dealing with the same issues and are trying to implement resource management systems to achieve similar objectives.

In 1999 a project area was designated to apply many of the same solutions that the public land management agencies use. The

Soldiers Meadows Project began with an area water assessment publication. In 2000, because of the large amount of Nez Perce Tribe ownership, this watershed received funding utilizing EQIP dollars that were set aside for tribal use. The project was set up as a geographic priority area. The local Natural Resources Conservation Service (NRCS) office began developing Resource Management System (RMS) plans and awarding contracts that year.

This 50,000-acre "watershed" is composed of the upper drainage of several streams that eventually empty into Idaho's Salmon, Snake, and Clearwater Rivers. The area consists of forestland on a high elevation plateau, owned and operated primarily by the Idaho Fish & Game, Nez Perce Tribe, and private non-industrial landowners. The Soldiers Meadows area of Idaho is characterized by gentle topography and historically large amounts of old growth ponderosa pine forests. In the early 1900s, this area was one of the first to have large-scale logging. Over the years preferential and frequent harvesting resulted in a shift to late seral species (Douglas-fir, grand fir) in most of the stands and a loss of genetic diversity. Additionally, nearly a century of fire exclusion has added tremendous fuel loads to this area.

The "Maloney Creek" fire, the largest private-land wildland fire in Idaho in 2000, burned to the southern boundary of the project area. That event raised the level of awareness in the project area to the threat of wide spread forest fires. Threats of large-scale, high intensity wildland fires could adversely impact the hydrologic function of the lower stream reaches of all the water-courses that originate in the Soldiers Meadows area, severely impacting efforts to restore native steelhead and salmon runs in the lower portions of the streams. The water-

shed planning committee recognized these problems and the opportunities available to restore health and diversity of the forest and capitalize on the grazing resources using silvopasture technology. Today, almost 25 percent of the eligible lands in the area are under EQIP contract.

Mike McCann is a private landowner in the treatment area. Mike manages almost 3,000 acres of forestland for livestock grazing and timber production goals. Through EQIP contract financial assistance and with NRCS technical guidance, Mike is actively restoring his forests with tree planting and thinning. He commonly applies pre-commercial thinning and tree harvesting on a block of land and immediately seeds the area to a grass mixture for cattle grazing. By following these guidelines, Mike controls the spacing, species selection, and vigor of his forest trees while at the same time increasing livestock production opportunities. This silvopasture application reduces the fire danger and increases opportunities for short and long-term economic return from livestock and tree production.

Mike's relationship with the USDA serves as a model for other landowners in the project area. The other contract holders (both private and Tribal owners) are also applying pre-commercial thinning and tree planting, but Mike is specifically addressing timber and livestock production in a very intensive way. Mike is also putting in cross fences, water developments, and other practices.

This project is a joint effort between the Natural Resources Conservation Service, the Nez Perce Soil and Water Conservation District, Idaho Fish & Game, Idaho Department of Lands, and the Nez Perce Tribe (Forestry and Land Services Departments).



# Fire

continued from page 1

**2. Maintenance of tree densities** – Prescribed burning may be applied to enhance or retard reproduction of targeted tree species. When natural reproduction is desired, fire can be an effective tool in timing and completeness of regeneration.

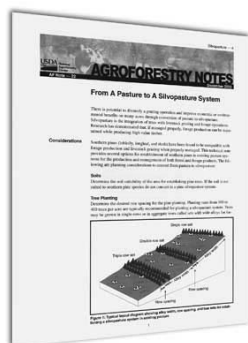
**3. Management of unwanted woody and herbaceous plants** – One of the most common objectives for using prescribed burning is the control of unwanted vegetation. Prescribed fire, when properly planned and applied, can effectively suppress or kill unwanted plants in established tree stands. Most unwanted woody plants can be controlled by the use of fire. Most non-sprouting species can be killed by a fire that will not harm the existing established trees. Sprouting species can be managed to minimize competition and enhance production of established species. The need for herbicides and mechanical treatments to control unwanted vegetation can be greatly reduced through the use of fire. When combined with a grazing management plan, both unwanted woody and herbaceous plants can be managed effectively and economically.

**4. Management of insect and disease pests** – Insect and disease pests on trees, forage and livestock can be managed in a very similar way as are unwanted plant pests. The use of prescribed fire, timed to the life cycle of the insect or disease, can be a very effective control method. This may be especially true when combined with grazing management that breaks parasite and host organism cycles. Chemical and mechanical methods to manage pests can be greatly reduced when combined with fire.

**5. Forage quantity and quality improvement** – Another common objective of prescribed burning is improvement of forage quality. Prescribed burning is often used to remove old decadent growth. This allows the fresh new growth to be readily available to the grazing or browsing animal. When applied with a planned grazing management scheme that provides proper timing of grazing after the fire, both forage quantity and quality are improved. The performance of the grazing animals is also improved by more and better forage.

**6. Improvement of grazing distribution** – Prescribed burning can be used to remove vegetative barriers to grazing and browsing animals, making more area accessible to the animal. Prescribed burning can also be used to erase the “land memory” of past grazing or browsing patterns by making forages of the same species, equally palatable.

All of the above conservation and production objectives may be integrated into an overall plan of grazing and wood product harvesting. The proper planning and application of prescribed burning relies on the development of prescription parameters that take the environmental conditions and vegetation characteristics to achieve the desired results. Prescriptions must be specific to the objectives and situation of the landowner. Assistance should be obtained in the development and application of prescribed burns. Assistance may be available from your local Natural Resources Conservation Service (NRCS) office, County Extension Service office, state forestry agency and/or USDA Forest Service, US Fish and Wildlife Service, and non governmental organizations such as The Nature Conservancy or Audubon Society.



## Coming Soon: Two New Silvopasture Agroforestry Notes

NAC staff are working with Oregon State University on the production of two new *Agroforestry Notes* that will join the Silvopasture series.

The first of the *Notes* will present operational experiences with afforesting pastures in the more humid maritime zone. The second *Note* will emphasize conversion of forested land into silvopasture in the more arid ponderosa pine and mixed conifer zone of the interior western US and Canada.

Watch for these *Notes* in your mailbox in 2003.



## 8th North American Agroforestry Conference Agroforestry and Riparian Buffers for Land Productivity and Environmental Stability

June 23-25, 2003  
Oregon State University, Corvallis, Oregon

Conference emphasis is on opportunities for sustainable crop production in managed riparian buffers and planted forests (nontimber forest products) in the Pacific Northwest. Sessions will be on silvopasture, alley cropping, hybrid poplar, and specialty forest products. A one-day symposium is focused on design and use of riparian forest buffers to enhance stream function and stability. Contributed papers can cover all five temperate agroforestry practices. A full-day field tour to the Willamette Valley will visit landowners who are successfully using agroforestry practices. A pre-conference tour will visit agroforestry practitioners in Central Oregon. Full and partial (daily) registration rates are available.

Co-sponsored by the Association for Temperate Agroforestry (AFTA) and Oregon State University College of Forestry. The North American Agroforestry biennial conference has been held since 1989.

Once details are finalized, the first conference announcement and call for papers will be circulated by e-mail. To add your name to the contact list, e-mail Miles Merwin, AFTA President, at [mm1@onemain.com](mailto:mm1@onemain.com)

Additional information will be posted on AFTA's website:  
[www.missouri.edu/~afta/Whats\\_New](http://www.missouri.edu/~afta/Whats_New)

# Upcoming Events

## October 25-26, 2002

*Special Forest Products Production and Marketing Conference.* Cape Girardeau, MO. Contact: Julie Rhoads, 573-882-3234, [RhoadsJ@missouri.edu](mailto:RhoadsJ@missouri.edu).

## November 5-7, 2002

*Excellence in Conservation Planning, SWCS Northern Regional Conference.* Nebraska City, NE. Contact: Rob Glidden, 308-334-5655.

## November 10-14, 2002

*American Society of Agronomy Crop Science & Soil Science.* Indianapolis, IN. Contact: David Kral, 608-273-2021, [dkral@agronomy.org](mailto:dkral@agronomy.org).

## February 2-7, 2003

*International Society for Range Management.* Casper, WY. [www.rangelands.org](http://www.rangelands.org).

# Editor's Note

Due to wild fire suppression costs, NAC's budget has been restricted for the remainder of fiscal year 2002. Consequently, no Summer *IA* was produced. Instead you are receiving this special Fall newsletter in early October and a Winter issue this winter. We then plan to return to our usual production schedule of Spring, Summer, and combined Fall / Winter newsletters.

*Inside Agroforestry* is published quarterly by the USDA National Agroforestry Center.  
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[www.unLedu/nac](http://www.unLedu/nac)

## Mission

The USDA National Agroforestry Center (NAC) is a partnership of the Forest Service, Research & Development (Rocky Mountain Research Station) and State & Private Forestry and the Natural Resources Conservation Service. The Center's purpose is to accelerate the development and application of agroforestry technologies to attain more economically, environmentally, and socially sustainable land-use systems. To accomplish its mission, the Center interacts with a national network of partners and cooperators to conduct research, develop technologies and tools, establish demonstrations, and provide useful information to natural resource professionals.

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Opinions expressed in *Inside Agroforestry* are those of the author and do not necessarily represent the policy of the USDA Forest Service and the USDA Natural Resources Conservation Service.

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# Inside Agroforestry | Fall 2002

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## **2021 NCF-Envirothon Nebraska**

### **Forestry Study Resources**

#### **Key Topic #2: Forest Health and Society**

5. Describe the effects of climate change on forest health.
6. Identify common forest pests and diseases, including their life cycles and how they spread.
7. Explain the importance of urban forests and describe how their management differs from a traditional forest.

#### **Study Resources**

Understanding and Assessing Climate Change Implications for Nebraska - Impacts of Climate Change in Nebraska: Forestry p 48-49 – *Deborah J. Bathke, Robert J. Oglesby, Clinton M. Rowe and Donald A. Wilhite, 2014* (Pages 24 - 27)

Red Flag Warning: Critical fire weather conditions brochure – *Nebraska Forest Service, 2017* (Pages 28 - 29)

What is EAB? – *Nebraska Department of Agriculture, 2009* (Page 30)

The Seed Newsletter: Trying to Define Sustainable Landscapes – *Justin Evertson, 2009* (Page 31 - 34)

Herbicide Damage to Trees – *Laurie Stepanek, Justin Evertson and Kyle Martens, 2018* (Page 35 - 37)

**Study Resources begin on the next page!**





# Understanding and Assessing Climate Change Implications for Nebraska





# **Understanding and Assessing Climate Change: Implications for Nebraska**

A Synthesis Report to Support Decision Making  
and Natural Resource Management  
in a Changing Climate

**Lead Authors: University of Nebraska–Lincoln**

**Deborah J. Bathke**

Department of Earth and Atmospheric Sciences

**Robert J. Oglesby**

Department of Earth and Atmospheric Sciences and the School of Natural Resources

**Clinton M. Rowe**

Department of Earth and Atmospheric Sciences

**Donald A. Wilhite**

School of Natural Resources

*The NCA report describes landscape fragmentation as a negative aspect of current land use trends, yet spatial diversity is a key characteristic of Great Plains natural ecosystems and perhaps holds clues for future farming more sustainable than current wide-scale monocultures. Different crops can be planted in the best specific niches for available resource use, livestock can be integrated with crops to utilize both improved forages and crop residues, spatial diversity can provide new and resilient production, and perennial polycultures of cereals and legumes are future opportunities.*



Ken Dewey, University of Nebraska–Lincoln

*Center-pivot irrigation of a corn field in Nebraska. Increasing high temperature stress and more variable rainfall will add to the demand for irrigation in future decades.*

## FORESTRY

---

### Key Messages

NCA report, Chapter 7, 2014

1. Climate change is increasing the vulnerability of many forests to ecosystem changes and tree mortality through fire, insect infestations, drought, and disease outbreaks.
  2. U.S. forests and associated wood products currently absorb and store the equivalent of about 16% of all carbon dioxide (CO<sub>2</sub>) emitted by fossil fuel burning in the U.S. each year. Climate change, combined with current societal trends in land use and forest management, is projected to reduce this rate of forest CO<sub>2</sub> uptake.
  3. Bioenergy could emerge as a new market for wood and could aid in the restoration of forests killed by drought, insects, and fire.
  4. Forest management responses to climate change will be influenced by the changing nature of private forestland ownership, globalization of forestry markets, emerging markets for bioenergy, and U.S. climate change policy.
- 

### Commentary:

#### *Impacts of Projected Climate Changes on Nebraska's Tree and Forest Resources*

*Dr. Scott J. Josiah, State Forester and Director  
Nebraska Forest Service, University of Nebraska–Lincoln*

*According to the USDA Forest Service, forests in Nebraska occupy approximately 1.5 million acres, with an additional 1.5 million acres of nonforest land with trees. Nebraska's forests are unique in that they generally exist on the eastern, western, or southern edges of their native ranges, and grow under stressful conditions more conducive to prairie ecosystems than to forests. These tree and forest resources provide critically important economic and ecosystem services.*

*Changes in Nebraska's climate, projected in the National Climate Assessment report (NCA, 2014), will have, and arguably are having, substantial and negative impacts on the state's tree and forest resources. Increased incidence and severity of drought and severe weather events, and higher day and night temperatures, will seriously affect the health, vitality, and resilience of individual trees and urban and rural forest ecosystems.*



More intense droughts compounded by higher temperatures and excessive forest fuel loads have already damaged trees and forests across the state, substantially increased the risk to life and property because of catastrophic wildfires, and reduced sequestration and storage of atmospheric carbon. Large wildfire events have increased in frequency and size over the past 50 years (Figure 7.1). Repeated intense and uncharacteristic wildfires occurring in the Ponderosa pine forests of the Pine Ridge in northwestern Nebraska have reduced forest cover from 250,000 acres to less than 100,000 acres since 1994. These forests burned so intensely that nearly all living trees were eliminated across large landscapes, converting former forests to grassland. Intense wildfires driven by projected increases in temperature and drought will gravely threaten Nebraska's remaining pine forests. Given that these forests represent the easternmost extension of Ponderosa pine in North America, their loss would eliminate unique genetic adaptations to low elevation, hotter conditions.

Higher temperatures, especially those at night, combined with drought reduce carbohydrate reserves essential for vigorous growth and pest resistance, often for several years. The population of pests (such as the Mountain Pine Beetle, *Dendroctonus* species) that were limited by very cold temperatures is now achieving much higher overwintering success because of warmer winters. Nebraska's pine forests lost thousands of trees in the 2000s from Mountain Pine Beetle attacks, which were part of a massive outbreak devastating forests across 35 million acres in North America. Engraver beetles (*Ips* species) are currently attacking and killing heat- and drought-stressed pines across the Pine Ridge and Niobrara Valley. Increasing temperatures and drought also negatively affect urban forests, disproportionately killing nonnative tree species (such as white pine and spruce) that are poorly adapted to these changing conditions. Reduced vigor and increased mortality of trees in urban areas will further decrease the capacity of urban forests to mitigate higher urban temperatures, compromising human health.

Nebraska has historically experienced a wide range of severe weather events. The predicted increased frequency and intensity of such events will clearly and negatively

impact trees and forests statewide. The unprecedented flooding of 2011 along the Missouri River inundated 26,000 acres of bottomland forest in Nebraska for nearly the entire growing season. Large-scale mortality occurred, as few native riparian forest species are adapted to such long periods under water. Other severe weather events common to the Plains (tornados, straight line winds, ice and early winter snow storms, early fall and late spring freezes, etc.) already damage Nebraska's trees and forests. An increase in frequency and intensity of these events will likely substantially increase these losses. The loss of windbreaks and forested riparian buffers from more frequent severe weather events will increase soil erosion, impair air and water quality, and decrease crop yields and quality across Nebraska.

Options to address the challenges of climate change for Nebraska's trees and forests are limited. Increasing

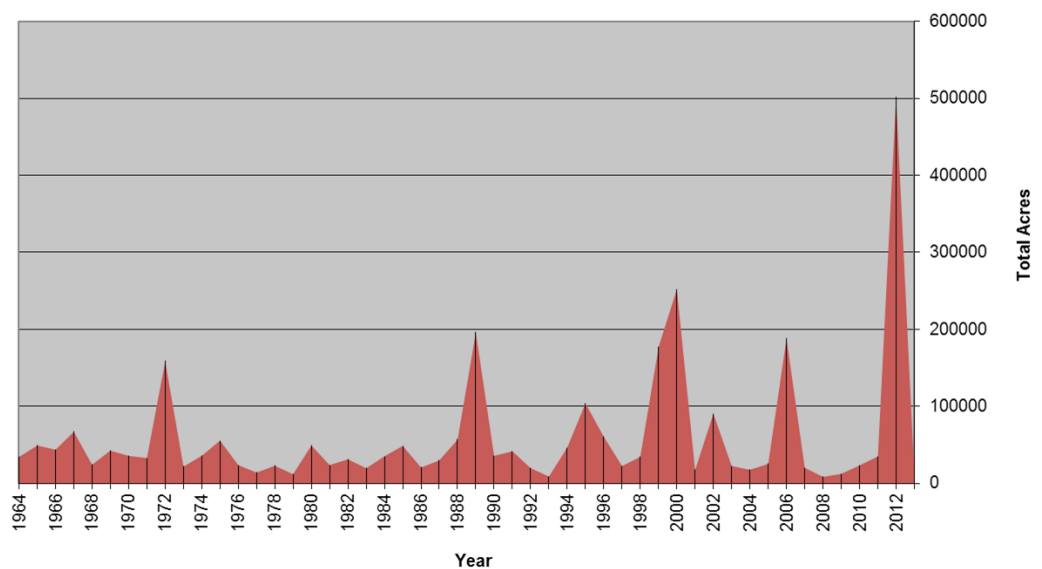
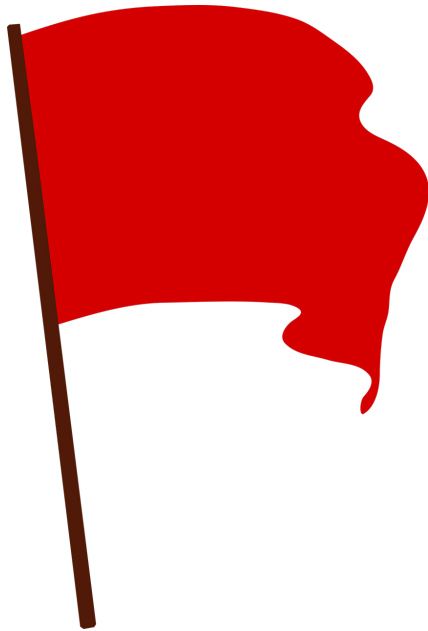


Figure 7.1. Nebraska wildfire acres burned in 50 years of history, 1964-2013.

species and seed source diversity will enhance resilience of urban and conservation plantings. Thinning coniferous forests reduces competition for water, improves tree vigor, protects remaining islands of live forest stands isolated by previous wildfires, and decreases the risk of catastrophic crown fires. Developing new products and markets for wood, especially for bioenergy applications, creates market drivers that support expanded forest thinning operations, and offsets the use of fossil fuels and further releases of ancient CO<sub>2</sub>. Large-scale tree planting campaigns will be increasingly needed to replace trees and forests damaged or killed by severe weather events and more stressful climate conditions aggravated by climate change.

## REDUCE RISKS

- If planning a prescribed burn, immediately cancel the planned operations; DO NOT burn on a red flag day
- If pulling a trailer, make sure no chains are dragging; sparks from dragging chains can ignite a fire
- Dispose of cigarettes properly; DO NOT drop lit cigarettes on the ground or throw them out the window
- NO fireworks
- Be especially aware when using fire arms or target shooting



- Avoid mowing the lawn on red flag days:
  - If you must mow the lawn, mow before 10 a.m. when grass is moist
  - Watch the area for at least an hour after mowing to make sure a fire does not start
- Avoid leaving equipment on areas with dry vegetation
- Avoid parking vehicles on dry vegetation, it is best to park on bare soil or paved surfaces
- Make sure chainsaws and other equipment have spark arresters
- Pay attention to trail or park closures:
  - If the area is closed, it is closed for a reason, please respect the closure
- Pay attention to other restrictions such as **no open fires**
- Avoid using charcoal or gas grills on red flag days



## CONTACT US

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PO Box 830815 E: [trees@unl.edu](mailto:trees@unl.edu)  
Lincoln, NE 68588 W: [nfs.unl.edu](http://nfs.unl.edu)

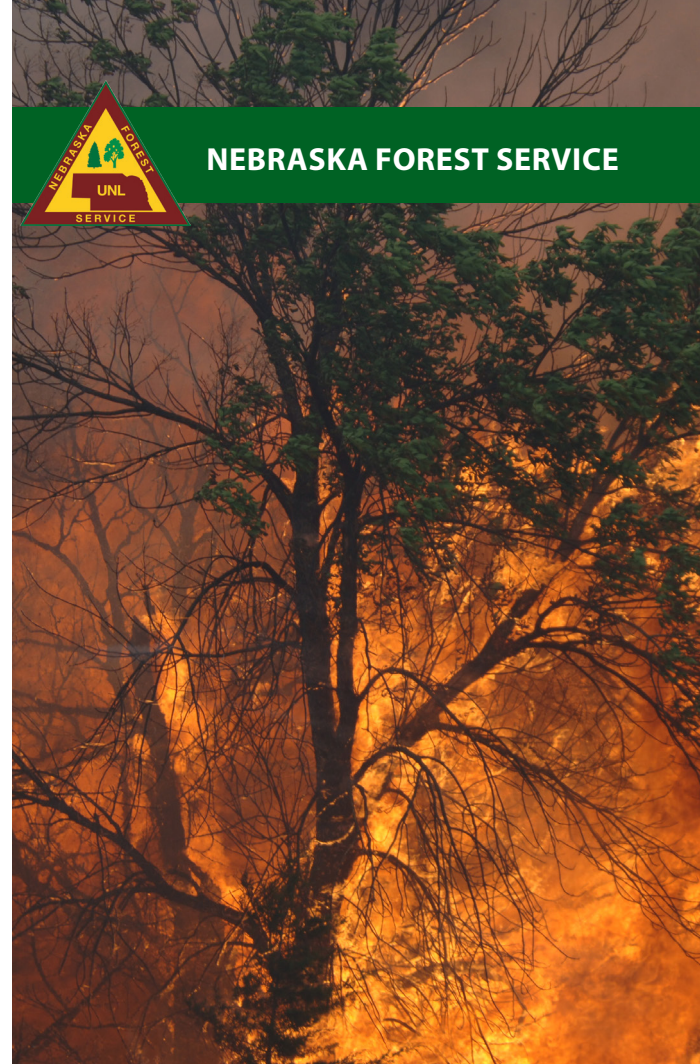
Updated by: John Erixson and Diana Marcum

For more information please visit [nfs.unl.edu](http://nfs.unl.edu)

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NEBRASKA FOREST SERVICE



# Red Flag Warning: Critical fire weather conditions

More information: [www.nfs.unl.edu](http://www.nfs.unl.edu)

Photo credits: NFS

WF 04-2017-09



## RED FLAG WARNING

A red flag warning is issued by the National Weather Service when the expected weather conditions can lead to ideal wildland fire conditions. These exist when conditions are right for combustion or ignition of a wildfire and the rapid spread of the fire can be expected.



A warning is issued when conditions are expected within the next 24 hours.

A red flag warning is an advisory to be careful, little things can go terribly bad, quickly when it relates to fires.

All residents and visitors need to be extremely cautious during periods of high fire danger. One spark can lead to a large, damaging wildfire.

## FIRE WEATHER WATCH

A fire weather watch looks out past the next 24 hour period. This forecast typically looks out 24 - 72 hours for weather conditions favorable for fire combustion and the rapid fire spread.

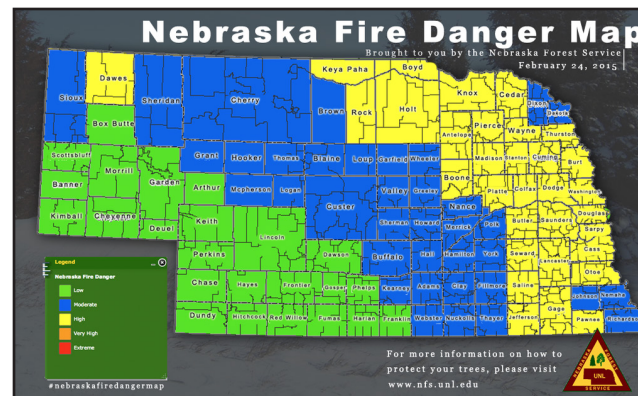
Watches and warnings are issued to assist firefighters and to alert the general public about the conditions, and the possible result in ignition and rapid expansion of a wildfire.

In the Fall and Spring, when forest fuels and grasses are cured, dry conditions exist. When the fire danger rating is high combined with wind, low humidity and warm temperatures, a warning or watch may be posted.

---

## FIRE DANGER MAP

The Nebraska Forest Service along with the National Weather Service maintain an interactive map of the fire danger. The map can be viewed at [nfs.unl.edu](http://nfs.unl.edu)



## FIRE WEATHER

Lack of rain, high rain and warm temperatures can lead to the issuance of a red flag warning. Several components are considered in a Fire Weather Forecast, these include:

- Humidity:
  - Less than 20% humidity increases the probability of ignition; lower the humidity, the greater the chance fire fuels will ignite
- Wind:
  - Sustained winds over 15mph will cause fires to rapidly expand; small sparks become large quickly
- Temperature:
  - 75° F and above

When these conditions exist, ignition is easier and the fires are ore difficult to control. A dramatic increase in wildfire activity can be expected.



## What is EAB?

[Home](#) / [Animal and Plant Health Protection](#) / [Plant Health](#) / [Entomology and Apiary](#) / [Emerald Ash Borer](#) / [What is EAB?](#)

### EAB Description and Life-cycle

The emerald ash borer is a small, metallic wood-boring beetle, in the same genus as the Bronze Birch Borer (*Agrilus anxius*). Adults are approximately 1/2 inch long and 1/8 inch wide, and have a metallic green color. Larvae are cream-colored, flattened, and grow to approximately one inch in length. Typically, EAB requires a one-year life cycle. Adult beetles emerge in the spring and can be found from mid-May to early August. The adult EAB exits the tree through a distinctive, D-shaped exit hole, about 1/8 inch in size. After mating, females lay their eggs on the bark surface and in bark cracks. Larvae hatch in the summer and tunnel into the ash tree, feeding on the phloem and outer sapwood. The larvae create very distinct, S-shaped serpentine galleries under the bark, which disrupts the movement of water and nutrients through the tree. Full-grown larvae over winter in chambers in the sapwood. They pupate in April and May, before emerging as adults



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A MEMBER PUBLICATION OF  
**NEBRASKA  
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FALL 2009

SUSTAINABLE LANDSCAPES FOR HEALTHY HOMES & COMMUNITIES

# Trying to Define Sustainable Landscapes

Justin Evertson, Nebraska Statewide Arboretum, Inc.

Ask a dozen people to define sustainable landscapes and you’ll likely get a dozen different answers. I know because, in a very unscientific survey, I asked several friends and relatives to describe what they thought a sustainable community or home landscape was. The people I asked ranged widely in age and philosophies—and were certainly not all tree-huggers. Their responses were revealing and often humorous:

A nurseryman from the Panhandle clearly sees a day in the not-too-distant future when the cost and scarcity of potable water will force a new way of landscaping that requires significantly less irrigation.

A couple from suburban Omaha wants desperately to create a more natural landscape, but feels pressured to continue to blend into their highly manicured neighborhood. They hope to see a day when native plantings and a bit of wildness are more accepted in affluent neighborhoods.

A neighbor who takes great pride in keeping his lawn lush, green and tightly-cropped rather enjoys the effort and says he wouldn’t mind mowing every day. He even offered to come mow my yard.

A nine-year-old nephew is most interested in exploring the wet drainage-way near his home for frogs, turtles and bugs—especially anything he can scare his sister with.

A brother from the Panhandle hopes people will return to growing more of their own food and start creating landscapes that better celebrate the subtle beauty of the western high plains.

A young woman and avid runner advocates for trails and pedestrian-oriented landscapes that offer diverse experiences.

A couple who is very conservative in their political beliefs is working hard to create a lasting, sustainable legacy with their home acreage. They’ve already planted prairie grasses, a buffalograss lawn and numerous trees and shrubs, both for their own pleasure and that of

the wildlife they strive to attract. They help dispel a myth that sustainable landscapes are only for prairie-hugging liberals.

Almost everyone, regardless of socio-economic status, seems to recognize that we need to live more sustainably, to conserve fuel, reduce and recycle waste, cut down on pollution, conserve water, etc. The debate about sustainability seems to lie more in the details of how to achieve these common goals, rather than whether the goals themselves are valid.

This leads us to the topic at hand: sustainability of community landscapes. Three common themes seem to emerge. First, community landscapes are people-oriented and must be planted and managed with that primary purpose in mind. Second, sustainable landscapes should generally help conserve natural resources, especially water. And third, our planted landscapes should benefit the natural world around us. With these basic goals in mind, there are several topics and recommendations that deserve greater discussion and consideration as we strive for sustainability.

**Water Use.** Statistics show that municipal water use in Nebraska can increase by more than 200 percent during the growing season, with the bulk of this increase going to landscape irrigation. In Lincoln, there are days when more than 50 million gallons of water



Human life is dependent on a wide and healthy web of wildlife, including the insects within our own yards (*Bringing Nature Home*, Doug Tallamy).

are pumped from the Platte River to meet this demand. Almost everyone agrees that water will not remain cheap and plentiful forever. Indeed, in recent years, both the Platte and Republican Rivers ran dry during the summer. Presently the state of Nebraska is embroiled in several highly emotional and expensive water-re-

lated issues, including a lawsuit filed by the state of Kansas over the lack of flow from the Republican River. It seems very obvious that we need to reduce the amount of irrigation used to maintain our planted landscapes.

Trying to Define continued inside

## The Nebraska Statewide Arboretum’s Next 30 Years—Sustainable Landscapes and You

Dick Meyers, NSA, Inc. Board President

What do the Nebraska Statewide Arboretum, sustainable landscapes, and you have in common? The future. If you’ve been a long-time member of the Arboretum, you know that our mission as an organization has evolved over time. We started out 30 years ago as an organization devoted primarily to the expansion of tree species diversity in communities across the state. NSA’s unique vision of affiliate arboretum sites that spanned the diverse soil and climate landscape of the state was a vision focused initially on expanding tree species diversity through testing, demonstration, and education. It was and remains an innovative vision. But the organization’s leadership early on recognized that vision was too narrow.

The organization’s mission was expanded in a major way with the implementation of the Green Space Stewardship Initiative—a partnership between the Nebraska Statewide Arboretum and the Peter Kiewit Foundation. That partnership initiated a program of community landscape grants that in 20 short years transformed public landscapes in virtually every community of the state. The significantly revised mission, to fund the development of progressive community landscapes, has become the core mission of the Arboretum today. In that mission, the Nebraska Environmental Trust, the Nebraska Forest Service and The Peter

Kiewit Foundation remain strong partners.

By now, most of you know that NSA lost its university funding. For 30 years, university funding has given it the luxury of a stable budgetary base from which to develop and refine the ideas and programs that have made it such an impressively transformative organization for Nebraska. We’re sad about losing university funding, but our work is far from over, so keep on reading—

### because that’s where sustainable landscapes and you come in...

You don’t need to own a crystal ball to predict that big changes are coming to your landscape in the very near future. Those of us in western Nebraska have just come through the longest and most severe drought in living memory. It has challenged agricultural irrigators, municipal water systems and urban homeowners alike to find ways to conserve the most precious substance in our state and on the planet—clean water. Those of us living at ground zero of the drought have seen firsthand how poorly prepared we are to create the sustainable landscapes of the no-longer-distant future. By “we” I mean garden center operators, landscape designers, landscape managers, and master gardeners, as well as the state’s homeowners. Specifically, this collective we does not know the

NSA’s Next 30 Years continued inside

## INSIDE

PERENNIAL PERSEVERANCE

TIPS FOR SUSTAINABLE LANDSCAPES

SUSTAINABILITY—THINK GRANDCHILDREN



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# Perennial Perseverance

Karma Larsen, Nebraska Statewide Arboretum, Inc.

In asking gardeners about sustainable perennial beds, I turned up a spade-ful of worms! “Gardens are incredibly complicated,” said Harlan Hamernik, “even in the smallest, most protected environment, one plant grows and shades another, one is in bloom while another is dying back. A good gardener is aware of all those changes and keeps the focus on plants that are in their prime, cutting back and filling in as needed.”

“Bomb-proof” is the word John Royster, landscape architect for Big Muddy Workshop, used for hostas, peonies, daylilies and roses—plants that remain in place and slowly expand over time. Still, he said “there’s no such thing as a no-maintenance plant or landscape.”

Steve Nosal believes it’s the gardener and not the garden that makes the difference, “what makes a garden long-lived is the dedication of the gardener to keep it going.” Nosal has overseen Lincoln parks for several decades and has come to define a perennial as a plant that survives 3-7 years rather than 10-15 years.

### 10-20-30 Years and Counting

For sustainability, it’s hard to beat garden columnist Jan Riggenschbach’s front yard in Iowa’s loess hills: “Requiring no mowing and no hoeing, my front yard attracts major interest with a minor plant—*Vinca minor*, that is. This lush, dark-green groundcover has virtually maintained itself for 30 years, providing four seasons of flowing foliage while concealing a spectacular springtime surprise: It’s underplanted with hundreds of spring-flowering bulbs, such as daffodils and hyacinths. The bulbs, like the vinca, were chosen for their undemanding habits and resistance to pests. The flowers leap up through the vinca, whose dark leaves provide a handsome contrast. At the same time, the vinca itself is covered with dainty purple flowers. Soon, the



Riggenschbach’s “lawn” of *Vinca minor* underplanted with spring bulbs. Gilman Park Arboretum in Pierce has proven a good testing ground for long-lasting perennial combinations.



Borders with perennial geraniums, pasque flower, roses, lily and iris are long-lived and low-maintenance (photo courtesy Kit Dimon).

bulbs’ dying foliage fades into the vinca, as visitors continue to marvel at the yard that takes care of itself.”

Riggenschbach also recommends “slow-to-establish perennials that are there for the long haul and never need dividing. A few of my long-time favorites—gas plant, *Baptisia*, baby’s breath and prairie dropseed—have sailed through all kinds of conditions, including both drought and heavy rains, year in and year out.”

Gary Zimmer, curator of Gilman Park Arboretum in Pierce, cares for several perennial gardens planted 13 years ago: “Some things are very sustainable and others definitely are not! In the xeriscape garden, shrubs shaded out blanketflower, flax, prairie coneflower and blue fescue but a combination of May Night salvia, yarrow, false indigo, prairie dropseed, Blaze little bluestem and Indiangrass looks even better than in its second and third year. In the wildflower and ornamental grass garden, Indiangrass and maidengrass overtook everything but snowdrops, sedge, obedience plant, poppy-mallow and goldenrod. And Magnus coneflower took over most of the park entrance garden, but Goldsturm *Rudbeckia*, balloonflower, Fireworks goldenrod, candytuft and Blue Wonder catmint look better every year.”

In Lincoln, Master Gardener Kit Dimon wrote: “We have several beds with ornamental grasses that have been in at least 10 years: Korean feather and Karl Foerster reed grass; *Miscanthus*, Hameln *Pennisetum*, little bluestem, switchgrass and blue oat grass—which works well against rocks and with *Rudbeckia* and

*Echinacea*. Other long-lasting perennials include: catmint, Joe-pye weed, butterfly milkweed, perennial geraniums, pasque flower, lily, iris, aster, *Salvia*, *Heuchera*, *Boltonia* and *Coreopsis*. For shrubs, *Hydrangea* and shrub roses are long-lived, as are the grape and *Clematis* vines that hide lattice under our deck (Dick Campbell’s idea). And most of my 10-20 year-old groundcovers are still going strong: *Vinca*; *Pyracantha*; *Epimedium*; *Ajuga*; plumbago; sweet woodruff; *Lamium*; *Cerastium* and thyme.”

Another Lincoln gardener, Linda Hillegass, said her recommendations for long-lived shade plants include: hosta, *Epimedium*, variegated Solomon’s seal, meadowsweet and a variety of ferns. For sun, Hillegass has roses that “trace back to a rose brought over by my great-grandmother when she immigrated to the U.S. from Germany” and peonies from another great-grandmother. She also recommends Siberian irises, “the tall bearded ones have to be divided every three or four years, but Siberians just go on and on,” catmint, creeping veronica and daylilies (“Good luck killing them!”)

In Omaha, the peony display at Joslyn Castle dates back to the early 1900s and the rose garden at Memorial Park’s Rose Garden celebrated its 50<sup>th</sup> anniversary this year. Omaha Rose Society President Anita Eckley said the perennial plantings around the Presbyterian church and old bank in Bellevue are 10-15 years old. These historic landscapes include daylilies, coneflowers, peonies, columbine, salvia, malva, Russian sage,



They just keep getting better: sedum, prairie dropseed, hardy hibiscus, daylily, butterfly bush and sumac (Jan Riggenschbach’s garden).

Joe pye weed, hibiscus, beebalm, garden phlox and self-seeding cosmos and cleome. While looking to old gardens to see what grows best, Eckley said, the focus in Omaha is on new gardens underway by the Gifford Park Association, Dundee-Memorial Park Association and Men’s Garden Club.

### Garden Heroes

From South Dakota, garden writer Cathie Draine wrote “Any plants that manage to stay alive for a decade or keep a semblance of the original planting here in South Dakota are TRUE GARDEN HEROES to me!”

Draine uses long-lived groundcovers to protect exposed, rocky slopes. For keeping grasses out, she recommends lamb’s ear, prairie smoke, sedum and Queen Charlotte viola—“a perfectly shaped violet as lovely in form as a prize-winning African violet.” She has high praise for her 20-year-old planting of Karl Foerster reed grass, loves Mongolian Gold shrub clematis and leadplant and finds the species *Penstemons*—*strictus*, *barbatus*, and *hirsutus*—“too wonderful for words.” Along with perennial geraniums, pasque flower and buttercup, they’ve been in place in her yard for 10 years or more.

It’s obvious there are some very old plants still going strong in gardens throughout the Great Plains. On the other hand, gardeners said, it can be helpful to have just enough temperamental, short-lived ones to make space for that next new plant on the wish list!

## Editor’s Note: Not what we do but why we do it

Karma Larsen, Nebraska Statewide Arboretum, Inc.

Every evening in mid-August, a barn spider spun its web on our arbor. With a flashlight I could watch the meticulous process, watch the glimmering filament move from abdomen to leg to existing structure. Thanks to Charlotte, the whole world slowed down and fell into place for a few minutes every night.

We decided to do this publication on sustainable landscapes several months ago and I’ve been mentally wrestling with it ever since. I knew all the problems, knew it was too big, full of conundrums, knew that what was sustainable to one person wasn’t to another. I knew it couldn’t be rightly looked at without examining ourselves, knew we couldn’t talk about sustainability without being willing to give something up.

One of the primary questions sustainability poses is one of ownership, since that ultimately guides any decisions about a particular resource. Here at NSA, we’ve had to consider the sustainability

of our own organization. We’ve also had to rethink ownership. We work with a lot of communities and many different individuals and organizations, so the issue of ownership gets a little blurry.

But one of the essential things sustainability reveals is that we truly “own” almost nothing and, more importantly, it reminds us that the value of all the things we cannot own—fresh air, sunlight, woodlands, prairie—are worth more than any words can express or any dollar amount can begin to reflect.

If we do our work well, the true “owners” of the work we do will be the generations to come who walk beneath the trees we planted, stop to pay attention to a flower they had never seen before, bring their children to a public garden they remember from their own childhood. If those of us in environmental organizations do our work well, no organization or individual will own any of it, but all of us will have had the privilege of holding that fragile filament in our hand for one brief moment before we pass it on.



**The Turfgrass Lawn.** When it comes to the landscape, the elephant in the room is the turfgrass lawn. It is the single most intensively managed component of the landscape and receives the bulk of all inputs: labor, water, fertilizer and pesticides. In the Great Plains, municipal water systems are often designed at three to four times the basic flow needed to supply drinking—primarily to keep our lawns green. Add to that the millions of pounds of fertilizer and pesticides applied to lawns along with the near constant mowing and it is clear that landscape sustainability will be derived in large part through changes in how the lawn is managed. Lawn is vital to the function of the community landscape but we can minimize our lawns and choose lower-input turfgrass—and researchers have developed new cultivars and management strategies to help us do just that.

**Stormwater Management.** Until recently, management of stormwater was an afterthought in the development of most landscapes. Landscapes were designed and graded to push stormwater as quickly as possible to nearby drainageways and streams—leading to drainageway erosion, overtaxed stormwater systems and significant non-point source

pollution of local rivers and streams. Omaha is dealing with a \$1.5 billion problem in trying to better manage its stormwater. Sustainable landscapes help manage stormwater by slowing, storing and filtering as much water as possible.

**Use of Native Plants and Plant Communities.** Many of our planted landscapes are created in pursuit of an aesthetic ideal aimed at “taming” the land. As a result, landscape plants are chosen primarily for ornamental characteristics rather than their broader role in the landscape. Do they provide food or habitat for wildlife? Help build soil? Help conserve water? Do they provide a sense of place? Plants introduced from other countries and regions often dominate our planted landscapes, making them surprisingly homogenous across the country. Some of these plants have become invasive pests. Using regionally native plants adapted to our soil and climate will help make landscapes more sustainable.

**Biodiversity.** Sustainable landscapes can and should be diverse and support a wide range of wildlife, especially insects. Many people see insects in the landscape as pests that need to be eliminated, but the vast majority are either benign or beneficial and they help support a wide range of other beneficial wildlife including birds,

demonstration sustainable landscapes in highly used public spaces in communities around the state.

—And we could wait until then to consult and collaborate with the managers of the state’s large public landscapes like schools, city parks, cemeteries, manufacturing plants and shopping malls, to help them make the changes needed in these typically large, expensive—and often very unsustainable—public landscapes.

Or we can do it now. The Board of Directors of Nebraska Statewide Arboretum, Inc. has decided we should do it now.

**Now for the fun part—sustainable landscapes and you...**

I predict that Nebraska’s sustainable landscapes of the not-so-distant future will be more diverse and colorful, have greater year-round interest than the turf-dominated landscapes of today, support healthier and more diverse wildlife, and actually be less work to develop and maintain. But there is much work to do as these major changes to our landscapes get underway and we find and test new plants and combinations and how to best manage them. Some of this work is already underway in arboretums across the state. A great deal more of that work will be getting underway in the next few years.

But it’s likely that much of this work will take place in YOUR landscape or garden. If you are a member of NSA, Inc. there’s a good chance you’re the first one on your block to try new plants, to experiment with new plant combinations, to try new landscape design concepts. Your love of plants, your delight in trying new plants and new plant combinations, your willingness to have your home landscape look different from your neighbor’s, will make a significant contribution to the collective process of creating Nebraska’s new sustainable landscapes. In fact, the job can’t be done without you. We need your love of plants, your willingness to try 10 potential new plants to find the two really good landscape plants even your neighbor can grow successfully, your willingness to share your experience with our staff, your friends and neighbors, and anyone else who will listen.

Thanks for being a part of the Nebraska Statewide Arboretum’s first 30 years. I hope you’ll continue to be a part of this great organization because the FUN part, in fact maybe the most important part, is just beginning!



Rain gardens help filter and decrease runoff. Top: Staff from Fireworks and NSA install a rain garden behind the restaurant. Bottom: Newly-installed rain garden will help manage parking lot runoff near NSA display gardens.



bats, reptiles and amphibians. Sustainable landscapes that are biologically diverse strike a more natural balance and minimize the impact of diseases and insect pests.

**Pesticide and Fertilizer Use.** People regularly rely on chemical pesticides and fertilizers to help keep their lawns green and lush, and to treat for insects and diseases on other landscape plants. The safety and efficacy of many of these chemicals are being evaluated because they pose health concerns or can cause serious environmental damage when improperly used. The EPA has banned many common pesticides in recent years and will no doubt be banning more. It seems imperative that we use them as sparingly and carefully as possible.

**Tree Selection and Planting.** Trees are often selected for ornamental value with little thought to their broader function in the landscape. Shading, wind protection, longevity and climate tolerance take a back seat to spring flower and fall color. In addition, many communities have become dominated by only a few species of trees, thus increasing the potential for significant tree loss from newly emerging and fast-moving diseases, insects and weather events. New diseases and insects could claim millions of community and farmstead trees across the state in the coming years. Community forests that are more diverse and well-managed are much more sustainable.

**Maintenance.** There’s no way around it—community landscapes require regular maintenance: mowing, trimming, pruning, brush clearing, tree trimming and removal, snow plowing, sweeping, raking, mulching, replanting, etc. Plants grow, it’s what they do, and nearly all plants in the landscape eventually need to be controlled. However, there is no law that says all lawns have to be mowed at 3” or that every stray blade of grass needs to be trimmed or that leaves need to be blown off sidewalks. Gas-powered maintenance equipment, especially mowers, trimmers and blowers, are constantly at work during the growing season and they have become a major source of air and noise pollution. A goal of sustainable landscaping should be to reduce the use of gas-powered maintenance equipment. This can be done partly by de-emphasizing high-maintenance lawns and by using equipment that requires less fossil fuel.

**Human Involvement.** Although sustainable landscapes may require less lawn care, that does not mean they necessarily require less maintenance. Indeed, humans may actually need to become more involved with such things as weeding, direct watering of plants, sweeping (instead of blowing) debris from sidewalks, mechanical control of insect pests, cutting or burning of ornamental and nat-

ural grasses, and management of various types of groundcovers, from shrubs and perennials, to lawns and native grasses. More human contact in maintenance would have the added benefit of helping to reconnect more people to the natural world.

It seems fairly clear that there is a disconnect between our appreciation of the natural environment and awareness that our own landscapes are part of that environment. Most people find beauty and comfort in natural areas and many are attracted to such places for recreation and retreat. And yet the green spaces of our communities are primarily thought of as canvasses to be manipulated in any way we desire, often without regard for the broader natural context in which they reside. We work tirelessly and at great cost to impose our will on Mother Nature. The natural world is kept away, at least to the edge of town. We go days or weeks without really interacting with it. Many of us are less active, obesity rates are rising and many of our children seem to prefer staying inside and playing video games. Could it be that we need more nature in our lives?

Most community planners agree that to be more sustainable, community landscapes must convey a more natural form. Native plants and plant communities that attract a wide range of insects and other wildlife are an important part of the equation. A great book that helps convey this message is Doug Tallamy’s *Bringing Nature Home*. In it, he describes how plants and animals are intimately connected to each other and how important they both are to our daily lives, even within our own backyards. Though we seem to reject it in much of what we do, Tallamy says our survival as a species is dependent on this interaction. I encourage anyone exploring sustainability to read this book and to welcome native plants and wildlife into their landscapes.

Sustainable landscapes mean different things to different people. One person might develop a prairie-inspired landscape, another a woodland, a third might take a more traditional approach, and someone else might let Mother Nature take its course and enable the wild side of things. Whatever the final look, our landscapes should be maintained in ways that benefit both humans and the natural world around us.

At the Nebraska Statewide Arboretum, we’re working to show that sustainable landscapes can be a visually attractive source of pride and enjoyment—in the present and also far into the future. Developing sustainable landscapes is not a complicated endeavor; its basic principals are easily understood and relatively easily achieved. The hardest part may be to just relax and let a little more nature into the mix. What are we waiting for?

plants needed to create sustainable landscapes, doesn’t know their adaptive capacities, doesn’t know how to combine them in ways that are aesthetically pleasing and also ecologically viable, and perhaps finally, doesn’t know how to best build and maintain these landscapes.

So although a significant part of NSA’s annual funding has been cut, the need for the Nebraska Statewide Arboretum, has never been greater—the need for its already established network of affiliate sites, for its vision, its accumulated plant knowledge and experience, its connection to community leaders, funding sources and landscape activistse. It will take all the organizational knowledge and capacity created over the first 30 years of the Arboretum’s history to effectively address the immensity of the landscape issues our state is likely to face in the next 30 years—perhaps in the next 10 years. That’s the reality the staff, board, and membership of NSA must be prepared to face. That’s why we’re excited about the future of the Arboretum.

Back to the crystal ball. What’s going to force these dramatic changes in our landscapes? The list is truly daunting.

Try the potential loss of 50 percent less municipal water for lawn and landscape irrigation within 10 years. Try a relatively permanent change to a 5 or 10 degree warmer climate, how does even that small change affectsw hich plants survive and thrive?. Try soaring costs to heat and cool homes, businesses and public buildings.

Three looming issues, one or more of which our state is almost certain to face in the very near future. Any one of which could force dramatic changes in the way we design our landscapes, the plants we use, the size of lawns and the types of grass we grow in those lawns, the construction and maintenance practices for lawns and landscape plants.

We could wait until these issues are upon us in three, or five, or ten years, and then figure out what to do.

—We could wait until then to apply for grants to test heat- and drought-tolerant plants at arboretum sites across the state’s diverse climate and soil landscape.

—We could wait until then to develop an extensive database of plant experience from affiliates, from previously funded community landscape projects all across the state and from NSA member gardens and landscapes all across the state.

—We could wait until then to create



# Tips for Sustainable Landscapes

## Water conservation

- ❧ Don't overwater! Use drip irrigation if possible, and carefully monitor any irrigation systems used. Frequent, shallow watering makes plants susceptible to wind, drought and temperature extremes and results in shallow roots that are vulnerable in dry periods.
- ❧ Reduce the amount of impermeable surfaces by using plants, porous pavement or other permeable surfaces for driveways, sidewalks and patios.
- ❧ Water early in the day to prevent moisture loss and avoid disease problems.
- ❧ Use rain gardens, bioretention cells, swales, vegetated filter strips, permeable surfaces, green roofs, underground tanks or rain barrels to conserve water wherever feasible.
- ❧ Redirect downspouts away from pavement and onto planted areas.
- ❧ Protect slopes with groundcovers.



Arboretums in Gering (above) and Chadron (top right) use prairie natives for drought-tolerant, low-maintenance landscapes.



What kind of a world are we leaving to our grandchildren... to their grandchildren? (photo courtesy Gerald Hopp)

Sustainable development—  
“Development that meets the  
needs of the present without  
compromising the ability of  
future generations to meet  
their own needs”

(World Commission on Environment  
and Development)

- ❧ Install underground tanks to collect rainwater from rooftops and hard-scaping and use for watering later.
- ❧ Mulch rain gardens with shredded hardwood or shredded bark mulch, which are less likely to wash away than lighter weight mulches.

## Turfgrass and Lawn

- ❧ Lower your expectations; accept some mid-summer dormancy or drabness and apply only enough water to keep the lawn alive but not lush, realizing it will green up again in fall.
- ❧ Limit turfgrass lawn to where it is truly needed for play and activity. Trees, shrubs and perennials use approximately half as much water as turf.
- ❧ Avoid using turfgrass on slopes, in deep shade or in other difficult areas.
- ❧ Convert the lawn to more drought-tolerant species like fescue, buffalograss, blue grama or other warm season grasses that require only minimal watering once established.
- ❧ Reduce the use of fertilizers and consider using natural alternatives. Many turf professionals now recommend fertilizing only in the fall.
- ❧ Consider using non-grass plants as turf where foot traffic is not anticipated. Yarrow, sedum, clover, sedges and many other plants have shown great potential.
- ❧ Modify weed management strategies. Spot spray or hand-pull as many weeds as possible. Broadcast spray for perennial weeds only in fall when kill rate is better and there is significantly less harm to surrounding landscape. Never use ground sterilants or products containing dicamba that can move through the soil and harm non-target plants.
- ❧ Aerate lawn regularly to improve water infiltration.
- ❧ Use a hand-powered mower to decrease emissions—and get exercise!

- ❧ Leave grass clippings on the lawn and use mulching mowers to return residue to the soil (lawn clippings emit as much methane as manure in public landfills).
- ❧ Set mower higher in summer months and mow less frequently to protect grass from heat, conserve moisture and decrease stress of regrowth.

## Landscape Plants

- ❧ Group woody plant materials. Trees are used to growing close together and protecting one another from extreme weather. You can create the same environment by massing plants together in large mulched areas to provide better growing conditions, protect from mower blight and minimize irrigation.
- ❧ Right tree, right place, right way. For maximum growth and vigor, select a good quality tree to match your site, avoid utility lines and plant it at the correct depth.
- ❧ Regularly inspect trees for potential insect and disease problems.
- ❧ Use 3” of mulch on planting beds to conserve water, decrease temperature fluctuations, reduce weeds and increase organic matter. For trees, keep mulch away from the trunk and mulch to the dripline.
- ❧ Only fertilize for known deficiencies. Excess nitrogen encourages top growth at the expense of root health.
- ❧ To minimize maintenance, use shrubs that look best unpruned.
- ❧ Compost garden waste and use it on-site to improve soil and save on disposal fees and transporting costs.
- ❧ Carefully prune trees while still young to develop good branch structure.



- ❧ Get a second opinion before attempting to control insects and disease problems that may have little impact on the health of the tree.

## Landscape Design

- ❧ Use deciduous trees and shrubs south and east of buildings for summer shade and evergreens to decrease winter winds from north and northwest. Conifers are most effective for wind resistance planted away from buildings at a distance of 1-3 times the height of the trees. Correctly placed trees can lower air conditioning bills 15-50 percent and heating bills 25-40 percent.
- ❧ Include a diversity of plants, including native plants, for hardiness, pest and disease resistance and to provide food and shelter for wildlife.
- ❧ Include edible plants—vegetables, fruits, nuts—in the landscape.
- ❧ Plant groundcovers on hard-to-mow slopes to prevent soil erosion and decrease maintenance.
- ❧ Group plants with similar needs for moisture, care, exposure, soil type.
- ❧ Integrate designed/developed landscapes with the natural landscape.
- ❧ Landscape “vertically” to increase shade and create milder microclimate.
- ❧ Use recycled and/or local source hardscaping—wood, brick, stone,

## Sustainability—Think Grandchildren

Bill Ahlschwede, Animal Scientist,  
Gardener and Grandfather

For years, even decades, I have been frustrated by talk of sustainability. The word seemed like jargon with a wide range of meanings. A colleague used to say “The word is not the thing.” To think about sustainability, I think we need to look beyond the word, beyond the jargon.

In this era of short-term gratification and short-term economic strategies, sustainability reminds us to take a longer look, to think about what things will be like for our grandchildren and their grandchildren. What will planet earth be like at the end of this century?

It is apparent to me that many in our community, state, and nation are working toward sustainability. I see rain barrels to retain water and reduce soil erosion; hybrid cars to reduce gasoline use; bicycles to save gas and car miles; reusable grocery bags; neighborhood recycling centers; urban gardens; farmers’ markets; energy-saving appliances... the list is endless. Each entry in the list has its own name, its own following, its own impact, and its own vocabulary. Hence, my confusion about the word sustainability; or is it “green,” the new word for some parts of sustainability?

Most of the efforts are interrelated. Efforts to save fossil fuels, for instance, usually also have an impact on air and soil. Reducing soil erosion serves as an example of this interrelationship and it’s basic to meeting current and future

food needs. Corn farmers have increasingly turned to minimum- and no-tillage systems that save fuel, reduce erosion, increase the amount of organic matter in the soil, increase moisture-retention and sequester s more carbon. The effect an individual homeowner can have on soil erosion is miniscule compared to that of farmers. Yet collectively, the efforts of city dwellers to reduce runoff from rain and melting snow, grow their own vegetables, plant shade trees, and buy locally grown produce can offer the same benefits. Many small steps together can lead to large strides.

Many of the efforts toward sustainability that I see and practice involve small reductions in the standard of living. Small, fuel-efficient cars are not as comfortable as larger, heavier vehicles, and if operated in ways to maximize fuel-efficiency, increase travel time. Though the resulting lettuce, tomatoes, peppers and eggplant are delicious, raising vegetables in my backyard takes time and work. Composting rather than sending household waste to the landfill takes time and effort. My buffalograss lawn is not as green as many lawns in the neighborhood, particularly in winter and early spring, but it requires little mowing and no water or fertilizer to maintain a dense sod.

I’ve decided not to worry about the word sustainability, but to live better rather than larger, and to think in terms of my grandchildren and even farther ahead to what the world will be like for their grandchildren.

## Resources

- NebGuide 1405A “Landscape Sustainability” by Steven Rodie and Anne Streich
- Bringing Nature Home*, Doug Tallamy
- City Sprouts “sustain communities through gardening,” [omahasprouts.org](http://omahasprouts.org)
- Green Omaha Coalition, [greenomahacoalition.org](http://greenomahacoalition.org)
- Joslyn Institute for Sustainable Communities, [www.ecospheres.com](http://www.ecospheres.com)
- Lincoln Green by Design, [www.lincolngreenbydesign.org](http://www.lincolngreenbydesign.org)
- Nebraska Environmental Trust, [www.environmentaltrust.org](http://www.environmentaltrust.org)
- Nebraska Rural Initiative, [ruralinitiative.nebraska.edu](http://ruralinitiative.nebraska.edu)
- Omaha by Design, [www.omahabydesign.org](http://www.omahabydesign.org)
- Sustainable Sites Initiative, [www.sustainablesites.org](http://www.sustainablesites.org)
- Sustainable Urban Landscape Information Series, [www.sustland.umn.edu](http://www.sustland.umn.edu)
- UNL College of Architecture, [archweb.unl.edu](http://archweb.unl.edu)

## Mission Statements

**Nebraska Forest Service**, “Improving peoples’ lives by protecting, utilizing and enhancing Nebraska’s tree and forest resources,” [nfs.unl.edu](http://nfs.unl.edu)

**Nebraska Statewide Arboretum, Inc.** “Sustainable landscapes for healthy homes & communities,” [arboretum.unl.edu](http://arboretum.unl.edu)



AN AFFILIATE OF THE UNIVERSITY OF NEBRASKA-LINCOLN



NEBRASKA FOREST SERVICE

# Herbicide Damage to Trees

WEDNESDAY, APRIL 18, 2018

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Herbicides can be effective tools for controlling unwanted weeds in the landscape. However, in recent years, the Nebraska Forest Service has seen a significant increase in unintended herbicide damage to trees and other landscape plants. You can assist us in documenting damage across Nebraska. Please note the NFS is not a regulatory agency.

SUBMIT A DAMAGE REPORT ([REPORT-HERBICIDE-DAMAGE](#))

## Table of Contents

- [Damage symptoms \(#pub-section-88\)](#)
- [Sources of herbicide exposure \(#pub-section-89\)](#)
- [Steps you can take \(#pub-section-90\)](#)
- [Learn more \(#pub-section-91\)](#)
- [Watch the video \(#pub-section-501\)](#)

## Damage symptoms

Damage symptoms vary with the type and concentration of herbicide, the plant exposed and its stage of growth, and environmental factors. Common symptoms may include:

- Deformed foliage: leaf cupping, curling, twisting, puckering, strapping (narrow, elongated growth)
- Twisted, curled or stunted stem and branch growth
- Clusters of stunted shoots or leaves
- Discolored foliage: yellow, white, reddish, purplish, or abnormally light or dark green
- Leaf scorch (leaf edges turn tan to brown), flecking, or complete browning and death of leaves
- Defoliation (leaves or needles drop from the tree)
- Branch dieback or death of entire tree



Trees leafing out with new spring growth are particularly sensitive to herbicide drift. Visit [driftwatch.org](https://ne.driftwatch.org) (<https://ne.driftwatch.org/map>) for locations of growing operations near you.



Damage from weather, insects, and diseases can be confused with herbicide damage. Your local extension office, the Nebraska Forest Service, or the Nebraska Department of Agriculture may be able to assist with identifying herbicide injury.

## Sources of herbicide exposure



Root uptake by trees can also occur with many lawn herbicides, particularly those for control of clover, violets and other tough broadleaf weeds.

**Drift:** Herbicides can move through the air from the site of application to nearby areas, causing damage to trees and other plants.

Possible sources of drift include the use of 2,4-D and dicamba in spring in an effort to control dandelions and other weeds in home lawns and for control of winter annual weeds in crop fields. These herbicides can be particularly damaging to tender foliage emerging in spring, especially on sensitive trees such as oaks, redbud, honeylocust, Kentucky coffeetree, elms, and maples.

Many formulations of dicamba and 2,4-D are quite volatile. This means the herbicides can form a gaseous vapor during or following application— sometimes even days later. Warmer temperatures (typically above 85 degrees) increase volatility, and may result in the vapor moving long distances from the application site on warm spring and summer days.

**Root uptake:** Tree damage can also occur through root uptake from herbicides that move through the soil. These include herbicides used to control roadside vegetation or to keep the ground “clean” around buildings, along fence lines, and on sidewalks, driveways and gravel strips. Many are labeled for control of “brush

and woody weeds” and can cause significant damage to trees. Even trees located some distance from the application site may be affected since tree roots can extend well beyond the canopy of the tree. Dicamba, picloram (Tordon), bromacil (Hyvar), and prometon (Pramitol) are just a few common examples.

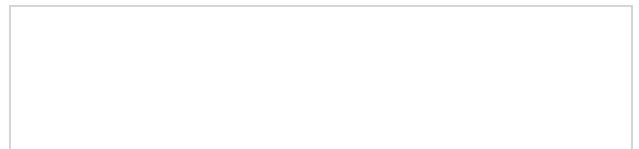
Another “bare-ground” herbicide, glyphosate (Roundup), controls most weeds when applied to the foliage. Glyphosate is generally inactive in soils; however, some Roundup products contain different or additional active ingredients, which may be picked up by roots. Check the label!

Root uptake by trees can also occur with many lawn herbicides, particularly those for control of clover, violets and other tough broadleaf weeds. Care must be taken to apply the appropriate rate when used in landscapes with trees.

## Steps you can take

To lessen the likelihood of herbicide damage to your trees and those of your neighbors, follow these guidelines:

- Read and follow ALL herbicide label directions, particularly restrictions that help limit drift, vaporization, and runoff. Look for precautionary statements regarding trees.



- Be aware of surrounding properties with sensitive vegetation including parks, gardens, windbreaks, landscape nurseries, orchards, vineyards, organic farms, and native woodlands and other natural areas. Visit **Driftwatch.org** (<https://ne.driftwatch.org/map>) for locations of growing operations near you.
- Most damage occurs in spring when trees and other plants are leafing out with susceptible new growth. Try to shift weed control to fall when many weeds are more easily controlled and damage to trees is reduced.
- Monitor temperature, wind speed, and wind direction. Avoid spraying on warm, windy days.
- Adjust sprayer nozzles to a coarser spray to reduce drift.
- Be especially careful using herbicides that control “woody brush” or include trees or shrubs on the list of weeds controlled.
- Keep in mind the extensive reach of tree root systems—often well beyond the canopy edge.
- Use extreme caution when treating stumps located near desirable trees. Over-application may contaminate the soil around the stump. Alternatively, the chemical may move into the soil from the stump roots.
- When possible use alternate methods of weed control such as cultivation, mulching, use of cover crops, and mowing weedy tree sprouts.
- Though trees can sometimes be killed relatively quickly by unintended herbicide damage, some of the worst damage builds slowly over several growing seasons. Trees often can recover from light and occasional damage, but repeated damage year after year will almost certainly shorten the lifespan of our most important trees.
- Become familiar with the more common herbicides and how they may be safely used. Homeowner herbicides include 2,4-D, dicamba, triclopyr, MCPP, and glyphosate. Professional herbicides include these plus imazapyr, picloram, bromacil, prometon, tebuthiuron and many others.



Herbicide uptake by this tree's root system is the likely cause of its decline.

## Learn more

To learn more about potential herbicide damage to trees and other non-target plants contact your local UNL Extension Office or visit this [website \(https://cropwatch.unl.edu/5-things-know-avoid-herbicide-drift\)](https://cropwatch.unl.edu/5-things-know-avoid-herbicide-drift).

Growers of specialty crops can register at [Driftwatch.org \(https://ne.driftwatch.org/map\)](https://ne.driftwatch.org/map) to raise awareness of their operation to surrounding applicators.

- **Diagnosing and Preventing Herbicide Injury to Trees** (<https://pace.oregonstate.edu/courses/sites/default/files/resources/pdf/diagnosing-and-preventing-herbicide-injury-to-trees.pdf>)
- **Diagnosing Herbicide Injury on Garden and Landscape Plants** ([https://www.extension.purdue.edu/extmedia/id/id\\_184\\_w.pdf](https://www.extension.purdue.edu/extmedia/id/id_184_w.pdf))
- **Precautions for using dicamba herbicides in dicamba-resistant soybeans** (<https://www.extension.purdue.edu/extmedia/WS/WS-55-W.pdf>)

*Photo courtesy: University of Nebraska-Lincoln, Pesticide Safety Education Program.*



## **2021 NCF-Envirothon Nebraska**

### **Forestry Study Resources**

#### **Key Topic #3: Tree Physiology and Ecology**

8. Describe forest stand dynamics, including density and succession.
9. Apply stand management to reforestation and other forestry practices.
10. Explain how trees grow, and how this growth changes with the seasons.

#### **Study Resources**

Forestry Facts: Forest Succession – *Jeff Martin and Tom Gower, 1996* (Page 39 - 42)

Why Leaves Change Color – *SUNY College of Environmental Science and Forestry*  
(Page 43 - 45)

Redcedar, Eastern (webpage) – *Nebraska Forest Service* (Page 46 - 48)

**Study Resources begin on the next page!**



# FORESTRY FACTS



**UW**  
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COLLEGE OF  
AGRICULTURAL  
& LIFE SCIENCES  
UNIVERSITY OF WISCONSIN-MADISON

Department of Forest Ecology and Management • School of Natural Resources

No. 78

November, 1996

## Forest Succession

Jeff Martin and Tom Gower

Succession is the natural replacement of plant or animal species, or species associations, in an area over time. When we discuss forest succession, we are usually talking about replacement of tree species or tree associations.

Each stage of succession creates the conditions for the next stage. Temporary plant communities are replaced by more stable communities until a sort of equilibrium is reached between the plants and the environment. The following sequence is usually observed if sufficient time passes and no disturbance occurs:

<u>Plant Community</u>	<u>Description</u>
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<b>Grass-forb:</b>	Forbs, grasses and shrubs dominate the site. Seedlings may be present.
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<b>Shrub-seedling:</b>	Trees tend to share and then begin to dominate the site. The intolerant species (see Forestry Fact No. 79, Tolerance of Tree Species) grow rapidly and dominate over tolerant species.
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<b>Sapling-pole:</b>	Trees eventually overtop and out-compete the forbs and shrubs. The intolerant trees continue rapid height growth while the tolerant trees occupy their respective niche.
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<b>Young:</b>	Growth is still rapid. Tree-to-tree competition may be severe resulting in competition caused mortality. Any intolerant individuals that drop behind may die and their growing space may be occupied by tolerant trees.
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<b>Mature:</b>	Competition caused mortality continues. Both intolerant and tolerant trees may share the main canopy. In mixed conifer stands there may be a distinct layering of intolerants and tolerants.
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<b>Climax:</b>	A relatively stable plant community which has a dominant plant population suited to the environment. Tolerant species dominate the site and the climax species will reproduce successfully under their own shade. These species will maintain the community under the current climatic conditions. Intolerant trees cannot reproduce.
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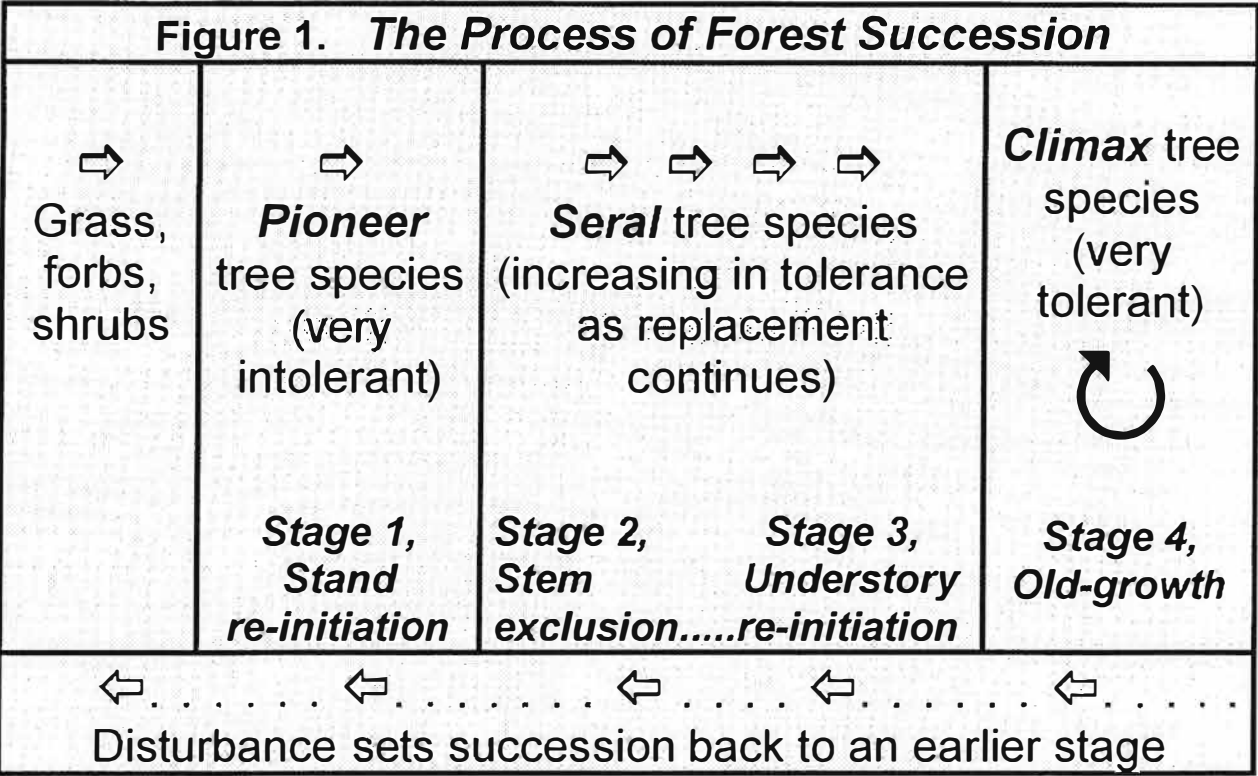
**Disturbance**

The rate of natural succession is affected whenever a disturbance such as fire, a windstorm, pests or management activities occurs on the site. The more severe the disturbance, or the more often disturbances occur, the slower will be the natural process of succession.

Following a major disturbance, **pioneer species**, such as aspen or jack pine, will become established in open areas under full sunlight. Eventually, in the absence of further disturbance, these pioneer species will be replaced by **seral species** that will

occupy the site through a series of successional stages, leading ultimately to a plant community comprised of **climax** species.

Forest successional stages are closely tied to the tolerance of various tree species (see Forestry Fact No. 79, Tolerance of Tree Species, for more information). For example, very tolerant species such as sugar maple, beech and hemlock are climax species on many sites in Wisconsin where they are capable of normal growth. However, sugar maple does not typically grow on dry, sandy soils



and therefore cannot replace jack or red pine on such sites.

## Other Stand Changes

In addition to the well-studied changes in species composition during succession, there are other changes, in the structure and function of the stand, that are also taking place. Although the changes are subtle and continuous, ecologists have developed relatively simple stand development classification systems to classify forests according to their stage of succession. Figure 1 illustrates the four basic stages of stand development recognized for even-aged forests, and shows how they relate to the typical forest plant communities.

**Stand re-initiation** denotes the beginning of succession. Woody and foliage biomass steadily increase during this stage. Another important characteristic of this stage is that resources that influence tree growth (e.g. light, water and nutrients) are abundant relative to the other stages of stand development.

The second stage, **stem exclusion**, marks the onset of intense inter- and intraspecies competition for limiting resources, resulting in mortality or self-thinning. Foliage mass reaches a maximum near the onset of this second stage - this is noteworthy because foliage is the tissue that carries on photosynthesis and is the primary tissue regulating the growth of the forests. Foliage mass remains relatively stable or decreases by 10-30% in the older stages of stand development and this decline may be responsible for decreased forest growth in older forests (see the next section).

The third stage, **understory re-initiation**, is characterized by renewed growth of the understory in response to gaps in the canopy caused by tree mortality.

The fourth stage is referred to as **old-growth**; managed forests seldom reach this stage because the growth of these forests is often 10-70% less than young forests in the stand re-initiation or stem exclusion stages.

## Succession and Nutrition

Foresters and ecologists have long-known that the growth of forests decreases as they age; however, the causes for the age-related decline have remained a mystery until recently. What is emerging is an interesting story that suggests the decline in forest growth, and other age-related functional changes, are because of the changes in stand structure.

Most notable is the dramatic changes in the nutrient cycles of forests during succession because of the changes in litter quality. Except for forests growing in heavily polluted areas, forests derive the bulk of their annual requirement of nutrients from minerals released from decomposing leaves, branches, stems and roots.

During the early stages of succession a high proportion of the litter is comprised of leaf tissue which, compared to branches and stems, is more easily decomposed by decomposers because of its greater nutrient concentration. In the later stages of succession however, the annual production of tissue falling to the forest floor is comprised of more woody tissue (e.g. branches and stems resulting from the self-thinning stage). Woody tissue decomposes slower than foliage by a factor of 10 to 100, resulting in nutrients being sequestered (locked up) for decades in the branches, twigs and stems.



Numerous studies have shown that nitrogen may limit growth in mature conifer forests while several recent studies suggest that calcium and potassium may limit growth of mature northern hardwood forests. The steady decline in nutrient availability during succession adversely affects leaf photosynthetic rates and causes trees to grow more fine roots and less foliage and stem wood.

A second possible cause for the decline in tree growth during succession is related to greater constraints of transporting water to the top of the tree and end of the long branches in mature trees. Just as it is more difficult to suck water through a long versus short straw, trees have a more difficult time providing water to the very tops of the canopy of mature trees. To compensate for the inefficient plumbing, large trees have a more conservative water balance. If water transport up the stem cannot keep pace with water loss from the canopy (this process is called transpiration) the tree suffers irreparable water stress. Therefore, to avoid permanent damage mature trees restrict the opening of the pores on leaves (stomata) where carbon dioxide is absorbed into the leaf for photosynthesis, and water is lost from the leaf to the atmosphere.

In summary, it seems likely that nutrient and water transport constraints may be responsible for the decline in tree growth during succession and both of the constraints are directly or indirectly related to changes in the structure of the forest during succession.

## **Impact on Forest Management**

Understanding forest succession is very important when we make forest management prescriptions. On some sites it is often easier to work with the natural progression and maintain one of the late successional stages than it is to maintain an early stage.

When harvests are prescribed, heavier cuts cause, in general, greater disturbance to the natural succession process than do light selection cuts. Therefore, if you are hoping to regenerate certain species naturally following a harvest, it is important to know what successional stage these species typically occupy; and, what type of harvest will generate the desired conditions for stand establishment.

What can woodland owners do to minimize the decline in forest growth in aging stands? The most obvious solution is to reduce the rotation length of the forest. Another option might be to fertilize the forest to prevent a nutrient limitation; however, this approach is not inexpensive and in many cases would not be cost-effective. Finally, landowners can minimize the reduction in growth by managing forests such as northern hardwoods (sugar maple, yellow birch, basswood and hemlock) on an uneven-aged basis. Uneven-aged management, while not appropriate for all species, does maintain a balance of healthy, vigorous trees and a smaller number of mature trees.

## Why Leaves Change Color (esf.edu)

**Why Leaves Change Color**...as featured on weather.com

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### **The Splendor of Autumn**

Every autumn we revel in the beauty of the fall colors. The mixture of red, purple, orange and yellow is the result of chemical processes that take place in the tree as the seasons change from summer to winter.



During the spring and summer the leaves have served as factories where most of the foods necessary for the tree's growth are manufactured. This food-making process takes place in the leaf in numerous cells containing chlorophyll, which gives the leaf its green color. This extraordinary chemical absorbs from sunlight the energy that is used in transforming carbon dioxide and water to carbohydrates, such as sugars and starch.

Along with the green pigment are yellow to orange pigments, carotenes and xanthophyll pigments which, for example, give the orange color to a carrot. Most of the year these colors are masked by great amounts of green coloring.

### **Chlorophyll Breaks Down**

But in the fall, because of changes in the length of daylight and changes in temperature, the leaves stop their food-making process. The chlorophyll breaks down, the green color disappears, and the yellow to orange colors become visible and give the leaves part of their fall splendor.

At the same time other chemical changes may occur, which form additional colors through the development of red anthocyanin pigments. Some mixtures give rise to the reddish and

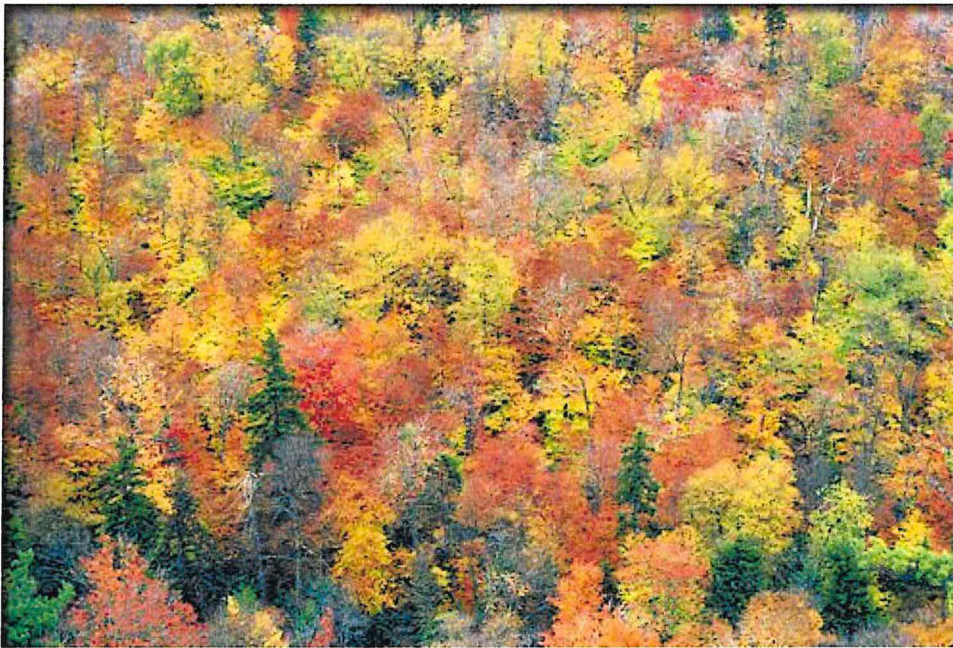


purplish fall colors of trees such as dogwoods and sumacs, while others give the sugar maple its brilliant orange.

The autumn foliage of some trees show only yellow colors. Others, like many oaks, display mostly browns. All these colors are due to the mixing of varying amounts of the chlorophyll residue and other pigments in the leaf during the fall season.

### **Other Changes Take Place**

As the fall colors appear, other changes are taking place. At the point where the stem of the leaf is attached to the tree, a special layer of cells develops and gradually severs the tissues that support the leaf. At the same time, the tree seals the cut, so that when the leaf is finally blown off by the wind or falls from its own weight, it leaves behind a leaf scar.



Most of the broad-leaved trees in the North shed their leaves in the fall. However, the dead brown leaves of the oaks and a few other species may stay on the tree until growth starts again in the spring. In the South, where the winters are mild, some of the broad-leaved trees are evergreen; that is, the leaves stay on the trees during winter and keep their green color.

### **Only Some Trees Lose Leaves**

Most of the conifers - pines, spruces, firs, hemlocks, cedars, etc. - are evergreen in both the North and South. The needle- or scale-like leaves remain green or greenish the year round, and individual leaves may stay on for two to four or more years.

### **Weather Affects Color Intensity**

Temperature, light, and water supply have an influence on the degree and the duration of fall color. Low temperatures above freezing will favor anthocyanin formation producing bright reds in maples. However, early frost will weaken the brilliant red color. Rainy and/or overcast days tend to increase the intensity of fall colors. The best time to enjoy the autumn color would be on a clear, dry, and cool (not freezing) day.

Enjoy the color, it only occurs for a brief period each fall.

Text prepared by Carl E. Palm, Jr.



# Redcedar, Eastern CONIFEROUS

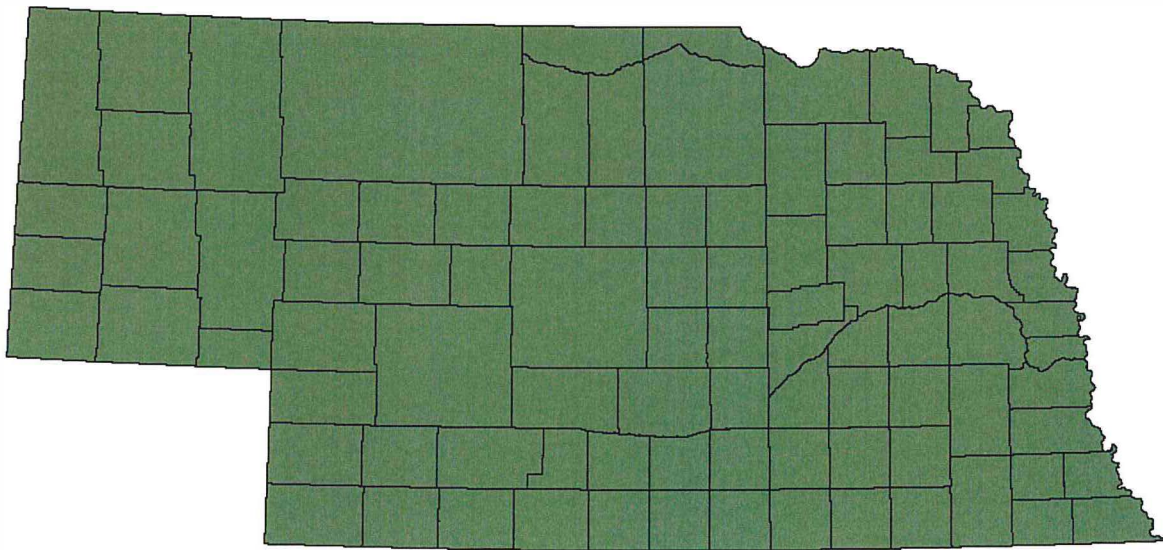
*Juniperus virginiana*

Origin:

Eastern redcedar is a native tree that has long been used in windbreaks, shelterbelts, and conservation plantings across the Great Plains. Due to lack of management and naturally-occurring wildfires, it has rapidly spread into grasslands and riparian forests. Redcedar should be used with caution and planted only where needed for quick sheltering or where little else will grow. Management plans/practices should be in place prior to planting.

## Where To Grow

This species has a wide distribution and is found on many types of soil ranging from acid sands to those derived from limestone. It does best on dry soils in full sunlight but is tolerant of both wet and salty soils. Redcedar grows faster than most other junipers and is moderately long-lived. Red cedars are often used as ornamentals or as shade trees and, becoming quite attractive as they mature and reveal their shredded bark. Old farmsteads and cemeteries often include grand old redcedars.



Suitable to plant throughout the state. Plans for long-term management of new seedling growth must be developed.

## Size at Maturity

Tree Height	Tree Spread
30-60'	25-35'

## Tree Characteristics

Redcedar can take on many forms but it is typically pyramidal tree becoming rounder in age. Fruits pale-blue with whitish bloom, fleshy 'berries' (cones), 1/4 inch diameter, ripening the first season with 1 to 2 seeds in each cone; flowers small, cone-like on end of short twigs, male and female borne on separate plants. Green to gray-green scale-like leaves are awl-shaped and sharp-pointed and often take on a bronze color in winter. The reddish-brown bark becomes shreddy with age.

## Wildlife Benefits

Red cedar and other junipers are important to wildlife throughout the country. Winter food and protection is particularly important for pheasant, mule deer, and whitetail deer. Their twigs and foliage are eaten extensively by hoofed browsers, but the chief attraction to wildlife is the bluish-black berry-like fruit. The cedar waxwing is one of the principal users of red cedar berries, but numerous other birds and mammals, both large and small, make these fruits an important part of their diet. In addition to their wildlife food value, cedars provide important protective and nesting cover. Chipping sparrows, robins, song sparrows, and mockingbirds use these trees as one of their favorite nesting sites. Juncos, myrtle warblers, sparrows of various kinds, and other birds use the dense foliage as roosting cover. In winter, their dense protective shelter is especially valuable.

## Utilization

Some redcedar is harvested for saw logs and fence posts. Shavings can be used for livestock and pet bedding. Studies are underway analyzing redcedar biochar as a soil amendment (improving profile and water capture, retention) and a feed additive for cattle (reducing methane emissions).

## Additional Considerations

Changes in land management over several decades allowed eastern redcedar to escape its typical habitat and move rapidly into grasslands and riparian forests. The tree still possesses benefits for multi-row or single-row windbreak plantings. However, landowners must plan to actively manage new seedling growth on their property for the life of the planting.



## Related species

- **Rocky Mountain Juniper** (*Juniperus scopulorum*).

## Interesting Facts

For numerous Native American Tribes, the red cedar tree symbolizes the tree of life and is burned in sweat lodges and in purification rites. The distilled oil of the red cedar has been officially listed as a reagent in the U.S Pharmacopoeia since 1916.

## **2021 NCF-Envirothon Nebraska**

### **Forestry Study Resources**

#### **Key Topic #4: Forestry Tools**

11. Apply the fundamentals of tree measurement to field scenarios.
12. Determine the volume of a tree using common forestry tools and tables.
13. Identify common trees with and without use of a key, and describe the uses of common tree species.

#### **Study Resources**

Tree Scale / Log Scale – *Nebraska Forest Service* (Page 50)

Lesson 6: Measuring Trees - *Kevin Zobrist, Virtual Cruiser Vest, Washington State University Extension, 2008* (Pages 51-57)

**Study Resources begin on the next page!**





# TREE SCALE (DOYLE) Volume in Board Feet

DBH* (inches)	Number of 16-foot logs							
	1/2	1	1 ½	2	2 ½	3	3 ½	4
10	8	14	17	20	21	22	-	-
12	18	29	36	43	48	53	54	56
14	32	48	62	75	84	93	98	103
16	40	72	94	116	132	149	160	170
18	60	100	132	164	190	215	232	248
20	84	135	180	225	261	297	322	346
22	112	174	234	295	344	392	427	462
24	128	216	293	370	433	496	539	582
26	162	266	362	459	539	619	678	737
28	200	317	434	551	650	750	820	890
30	242	376	517	658	778	898	984	1069
32	288	441	608	776	922	1068	1176	1283
34	312	506	700	894	1064	1235	1361	1487
36	364	581	808	1035	1234	1434	1583	1732
38	420	655	912	1170	1402	1635	1805	1975
40	450	740	1035	1330	1594	1858	2059	2260

\* DBH = Diameter Breast Height (4½ feet above ground)



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Lincoln, NE 68583-0815

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[nfs.unl.edu](http://nfs.unl.edu)

# LOG SCALE (DOYLE) Volume in Board Feet

DIB** (inches)	Log Length (feet)					
	6	8	10	12	14	16
8	6	8	10	12	14	16
9	9	13	16	19	22	25
10	14	18	23	27	32	36
11	18	25	31	37	43	49
12	24	32	40	48	56	64
13	30	40	51	61	71	81
14	38	50	62	75	87	100
15	45	60	76	91	106	121
16	54	72	90	108	126	144
17	63	84	106	127	148	169
18	74	98	122	147	171	196
19	84	112	141	169	197	225
20	96	128	160	192	224	256
21	108	144	181	217	253	289
22	122	162	202	243	283	324
23	135	180	226	271	316	361
24	150	200	250	300	350	400
25	165	220	276	331	386	441
26	182	242	302	363	423	484
27	198	264	331	397	463	529
28	216	288	360	432	504	576
29	234	312	391	469	547	625
30	254	338	422	507	591	676
31	273	364	456	547	638	729
32	294	392	490	588	686	784
33	315	420	526	631	736	841
34	337	450	562	675	787	900
35	360	480	601	721	841	961
36	384	512	640	768	896	1024
37	408	544	681	817	953	1089
38	433	578	723	867	1011	1156
39	459	612	765	918	1072	1225
40	486	648	810	972	1134	1296

\*Based on the formula:  $V = (D - 4)^2 L / 16$

\*\*DIB = Diameter Inside Bark (small end of log)

# Lesson 6: Measuring Trees

## Review and Introduction

In Lesson 4 and Lesson 5, you learned how to establish either a **fixed plot** or a **variable plot**. With your plot established and your “in” trees tallied, now it is time to measure the trees in the plot as representative samples of the trees in your **stand**.

## Learning Objectives:

By the end of this lesson, you will be able to:

1. Measure tree **diameter at breast height (DBH)**
2. Measure total tree height
3. Determine the **live crown ratio**
4. Determine tree age

## Materials Needed:

1. **Diameter tape** or **woodland stick**
2. **Clinometer** or woodland stick
3. **Increment borer** (optional)
4. Data recording sheets

## I. Getting Started

You will need to record data about the trees in your plot. We suggest downloading and printing a plot data recording sheet to help you organize your data. You can print a sheet for each plot that you plan to do, and they can even be printed on waterproof paper (available from forestry suppliers) to create durable, all-weather plot cards. The data recording sheet with this lesson was specifically designed for use with the **LMS Inventory Wizard** software (which will be covered in Lesson 8), but it is useful even if you do not plan to use the software.

First record tree species for each tree in your plot. Books on tree identification are commercially available and may also be available at your local library. Your Local Extension Forester is another good source for tree identification resources, some of which may be available at no charge from your local Extension Service.

## II. Measuring tree diameter

After recording tree species, the next step is to measure the diameter of each tree. **Diameter** is the width of a circle or cylinder; in this case the stem of the tree. Tree stems have **taper** (they are slightly cone-shaped), such that they are wider at the base and narrower further up. Thus, diameter will vary based on how high up on the stem of the tree you measure it.

A standardized height for measuring tree diameter has been established. This is known as **breast height**, which is defined as 4.5 feet (54 inches) above the ground, on the uphill side of the tree.

Use a measuring tape to figure out how high up breast height is on you. Memorize this spot (e.g. the next to the top button on your shirt or coat<sup>1</sup>) so that as you stand next to a tree, you know where to measure diameter.

### Using a diameter tape

We will talk about two ways to measure **diameter at breast height (DBH)**. The most accurate way is to use a special measuring tape known as a diameter tape. A diameter tape is calibrated such that **circumference** measurements are automatically converted to diameter (i.e. the measurement units have been divided by the constant **Pi** so that you do not have to do the mathematical conversion from circumference to diameter). Thus while you are physically measuring the circumference of the tree, you are reading the measurement in diameter units.<sup>2</sup> If you do not have a diameter tape, you can use a regular cloth measuring tape and divide your circumference measurement by Pi (3.14) to convert to diameter.

To measure DBH, wrap the diameter tape around the tree at breast height, making sure the tape is level and not twisted. Most diameter tapes will give you diameter to the nearest 1/10th inch. The diameter measurement is read where the tape overlaps with the zero marker (*Figure 6-1*). If the tree is large, it is helpful to work with a partner to wrap the tape around the tree. Many diameter tapes also have a nail or hook on the end that you can stick into the tree to hold the end of the tape in place while you wrap it around.



Figure 6-1: To measure DBH, wrap a diameter tape around the tree at breast height, making sure the tape is level and not twisted. The diameter measurement is read where the tape overlaps with the zero marker. In this case, the DBH of this tree is 34.0 inches.



Watch a video clip of how to use a diameter tape:  
[mms://www.ruraltech.org/virtual\\_cruiser/dbh.wmv](https://www.ruraltech.org/virtual_cruiser/dbh.wmv)



### III. Measuring tree height

After recording diameter for each tree, the next step is to measure tree height. Unlike with diameter, you may not need to measure the height of every tree in the plot if you are going to be using the **Landscape Management System (LMS)** computer program (Lesson 8 and Lesson 9) with your inventory data. However if you plan to manually compute variables such as tree volume per acre (Lesson 10), you may need to measure every tree height.<sup>3</sup>

If you are using LMS, in general you should plan to measure a minimum of one tree height per plot. As with other aspects of inventory sampling, it is desirable to be systematic when selecting a tree to take a height measurement. One method is to start from either north or whatever direction you were traveling to reach your plot, go clockwise around your plot and select the first “in” tree to use for your height measurement. The tree should be representative of your plot in terms of species and size. For instance, if your plot is predominantly comprised of large, dominant conifers and the first tree you come to is a suppressed hardwood or a tree with a broken top, do not use that tree for your height measurement. Rather, keep moving clockwise until you find the first tree that is adequately representative of the trees in your plot.

If you have several key species present in your plot, you may wish to work your way around the plot and select the first adequately representative tree of each species. If you wish to compute **site index** (see Lesson 7), make sure you include height measurements for several **dominant trees** of whatever species you wish to compute site index for.

#### Using a clinometer

As with DBH, we will talk about two different ways to measure height. The first way is to use a tool called a **clinometer**. A clinometer is a vertical angle gauge that measures the slope from your eye to either the top or bottom of the tree. Looking with one eye into the hole of the clinometer, you will see a graduated scale showing the slope measurements. The scale will move up or down as the clinometer is tilted up or down. Different clinometers measure slopes in different units, so it is important to consult the instructions for your clinometer to confirm what units are being measured. Commonly clinometers list the slope in degrees on the left half of the scale and in percent on the right half of the scale. The steps described below correspond to **percent slope** measurements. By definition, percent slope is the distance up or down per 100 feet of horizontal distance. Thus a reading of 30% means a height or depression of 30 feet, when measured at 100 feet horizontal distance.

When measuring the height of a tree, you will need to move away from the tree to a place where you can see the top. While you can choose any distance at which you can see the top of the tree and the clinometer reading is not off the scale (usually 150%, though accuracy may deteriorate beyond 120% or so), because you are working in percent a distance of exactly 100 feet will greatly simplify the calculation to determine tree height. For trees that are tall enough such that 100 feet is not far enough back to accommodate the scale of the clinometer (or to see the top of the tree), you will have to move back further to obtain an accurate reading. For very short trees, you may only need to move back 50 or 75 feet.

You can measure your distance away from the tree using a cloth measuring tape or a retractable **logger's tape**. When choosing a spot from which to measure a tree, if you are on a slope try to stay on the same level as the tree. If you go significantly uphill or downhill from the tree, your distance measurement (and subsequent height measurement) will not be accurate.

#### Quick steps – Measuring tree height with a clinometer

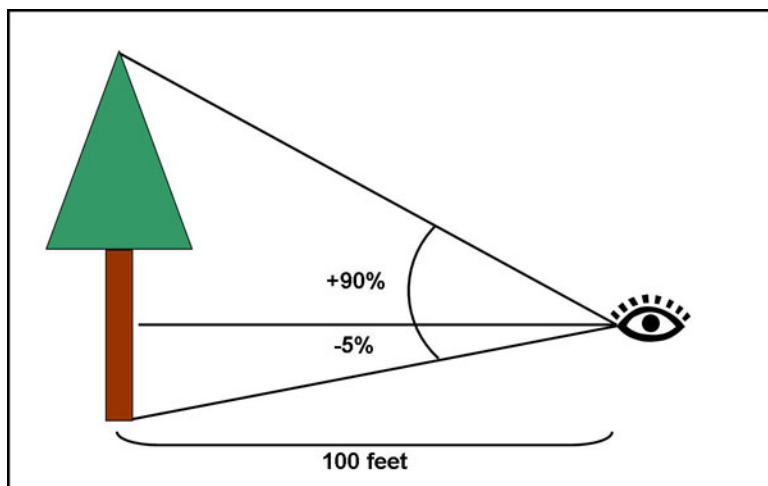
1. Move back a measured distance from the tree, preferably 100 feet.
2. Looking at the top of the tree with one eye and through the clinometer with the other, line up the marker in the clinometer with the top of the tree and read the value on the percent scale.
3. Repeat this for the bottom of the tree. If the percentage to the bottom is on the negative part of the scale, add it to the percentage from Step 2; if it is positive, subtract it.
4. Multiply the combined percentage by the distance back from the tree to determine total tree height.

Example:

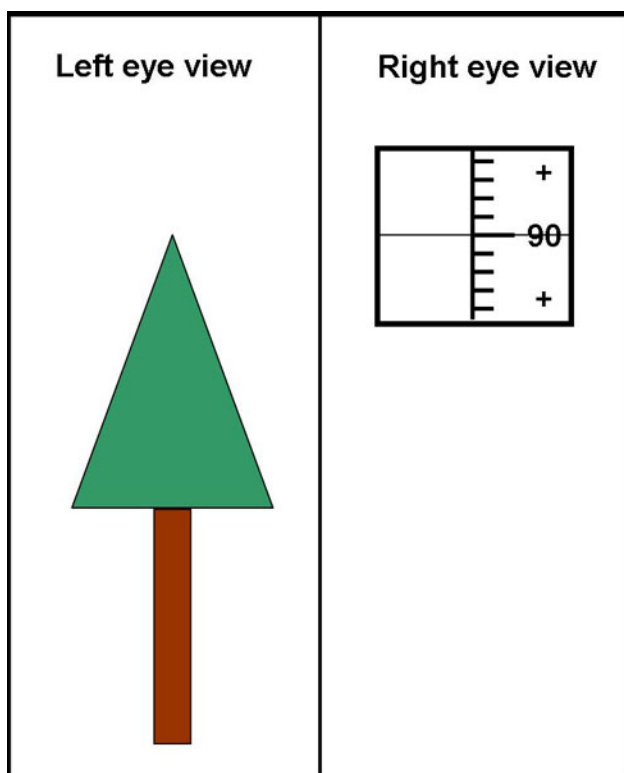
- Distance from tree = 100'
- Tree top reading = +90%
- Tree bottom reading = -5%
- Combined reading =  $90\% + 5\% = 95\%$
- Tree height =  $95\% \times 100' = 95'$

Once you have measured the distance from the tree, you can use the clinometer to measure the slope between your eye and both the top and bottom of the tree (*Figure 6-3*). Looking into the clinometer with one eye (you cannot actually look through the clinometer) and sighting the top of the tree with your other eye, visually line up the horizontal marker in the clinometer with the top of the tree (*Figure 6-4*). It may take some practice to get your eyes to work together for this. Once the horizontal marker in the clinometer is lined up, read the corresponding value on the percent scale. Now repeat this procedure for the bottom of the tree.<sup>4</sup>

Assuming the angle to the top of the tree reads a positive value, if the angle to the bottom of the tree reads a negative value, you add the bottom value to the top value to get the total percent slope. In the case where the angle to the bottom of the tree also reads a positive value, such as when you are standing downhill from the tree (*Figure 6-5*), you would instead subtract the bottom value from the top value to get the total percent slope.

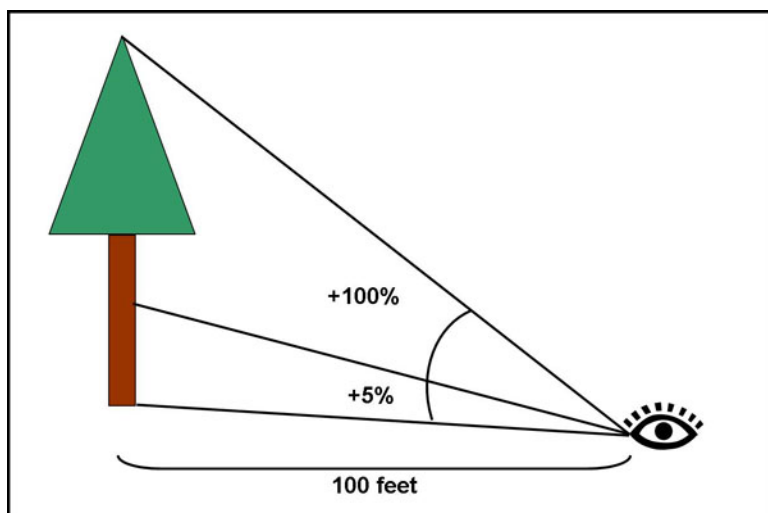


**Figure 6-3:** A clinometer measures the percent slope between your eye and both the top and bottom of the tree. In this case the clinometer reads 90% up and 5% down, for a total of 95%. Since the tree is 100 feet away, the height of the tree is  $0.95 \times 100 = 95$  feet.



**Figure 6-4:** When using a clinometer, look into the clinometer with one eye and look at the top of the tree with the other. Line up the horizontal marker in the clinometer with the top of the tree and read the value (in this case 90%).





**Figure 6-5:** When standing downhill from the tree, the clinometer may read up to the bottom of the tree rather than down. In this case the 5% up to the bottom of the tree would be subtracted from the 100% up to the top of the tree for a total of 95%. Since the tree is 100 feet away, the height of the tree is  $0.95 \times 100 = 95$  feet.

The total percent slope is equal to vertical distance (i.e. the total height of the tree from top to bottom) divided by the horizontal distance away from the tree. Since we know the horizontal distance and the total percent slope, we can solve for tree height by multiplying the percent slope (expressed as a decimal) by the horizontal distance (*Figures 6-4 and 6-5*). This is why being exactly 100 feet away makes for the simplest calculation—a total slope of 95% (0.95 if expressed as a decimal) means the tree is 95 feet tall (e.g. *Figure 6-4*). When using horizontal distances other than 100 feet, such as in brushy conditions, it may be helpful to have a hand calculator to assist with the calculation.



**Watch a video clip of how to measure tree height with a clinometer:**  
[mms://www.ruraltech.org/virtual\\_cruiser/clinometer.wmv](https://www.ruraltech.org/virtual_cruiser/clinometer.wmv)

### Using a woodland stick

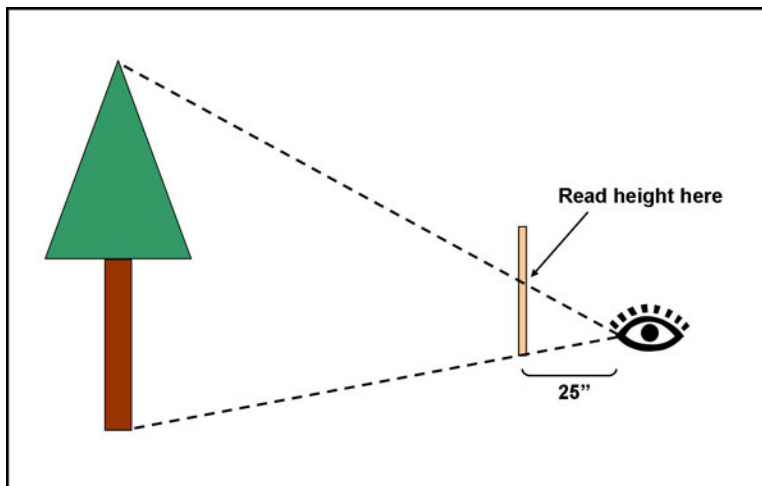
You can also measure tree height using a woodland stick. This is an inexpensive option if you do not have a clinometer, though it is not as accurate. Similar to using a clinometer, you will need to use a cloth tape or logger tape to measure back from the tree a specified distance. With the woodland stick, though, this is a fixed, prescribed distance, usually 66 feet or 100 feet depending on your region and the stick you are using. Find the side of the woodland stick that is marked for tree height, and with this side facing you, hold the stick vertical. The stick should be 25 inches away from your eye, which is a comfortable arm's reach for an average person. Keeping the stick straight, visually line up the bottom of the stick with the bottom of the tree (*Figure 6-6*). Now, keeping your head still, move your eyes to the top of the tree and read where it falls on the stick (*Figure 6-7*).



**Figure 6-6:** When measuring height with a woodland stick, hold the stick 25 inches from your eye and keep the stick vertically straight.

### Quick steps – Measuring tree height with a woodland stick

1. Stand the prescribed distance away from the tree (usually 66' or 100' depending on the woodland stick).
2. Hold the stick vertically, 25 inches from your eye
3. Visually line up the bottom edge of the stick with the bottom of the tree
4. Moving your eyes (not your head!) read where the top of the tree falls on the stick



**Figure 6-7:** When measuring height with a woodland stick, visually line up the bottom of the stick with the bottom of the tree and then, moving your eyes and not your head, see where the top of the tree falls on the stick and read the corresponding height value.



*Watch a video clip of how to measure tree height with a woodland stick:*  
[mms://www.ruraltech.org/virtual\\_cruiser/woodland\\_stick\\_tree\\_height.wmv](mms://www.ruraltech.org/virtual_cruiser/woodland_stick_tree_height.wmv)