Eastern Red-cedar: Positives, Negatives and Management

THE SAMUEL ROBERTS NOBLE FOUNDATION

by Steven Smith

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Introduction

Eastern red-cedar (*Juniperus virginiana*) is a native evergreen tree. This now very common tree was once limited to rocky bluffs, deep canyons and other areas where fire historically did not occur. Since the beginning of European settlement in North America, fire has been suppressed, enabling eastern red-cedar to expand its range outside of these protected areas. Left unmanaged, it has spread across most rangelands in Oklahoma and Texas, forming dense stands in many locations. Unmanaged eastern red-cedar stands often dominate the landscape, creating monoculture-like plant communities with little plant and wildlife diversity.

This publication discusses the positives, negatives and management of eastern red-cedar. Eastern red-cedar history, expansion, ecology, uses and its effects on forage production, wildlife, rainfall and wildfires are briefly addressed. Management techniques used to control eastern red-cedar and technical guidance options available to resource managers are reviewed.

A small eastern red-cedar growing along an old fence line in Carter County, Okla. Note the mature eastern red-cedar in the background.

History and Expansion

In 1950, junipers covered an estimated 1.5 million acres in Oklahoma, and, by 1985, they infringed on approximately 3.5 million acres (Bidwell 1993). A survey conducted in 1996 found junipers covered an estimated 6 million acres in Oklahoma with at least 50 juniper trees per acre (Bidwell et al.1996). In 2002, the Natural Resources Conservation Service (NRCS) estimated approximately 8 million acres had at least 50 juniper trees per acre. The NRCS estimated $157 million was needed to combat the 8 million acres of juniper encroachment in 2002 (Drake and Todd 2002). Juniper encroachment in Oklahoma is currently projected at 762 acres per day (Bidwell et al. 1996). Using this estimate, Oklahoma is losing 278,130 acres per year to invading junipers. If this number stays constant, by 2015 approximately 11.6 million acres of juniper will occupy 26 percent of Oklahoma.

A study that examined aerial photos from 1956 to 1996 of northeastern Kansas indicated that native tallgrass prairie can be converted to a closed canopy of eastern red-cedar in less than 40 years (Briggs et al. 2002). Ganguli et al. (2008) reported eastern red-cedar encroachment increased faster on sites with good plant richness and diversity versus less productive sites. This study shows that healthy rangeland is susceptible to juniper encroachment.

Why has eastern red-cedar spread to this extent? There are two reasons: 1) lack of fire; and 2) transplanting trees to new areas.

Prior to European settlement of the Great Plains, rangeland fires were common. These fires were caused by lightning strikes and intentional ignitions by Native Americans. Once European settlement began, the frequency of fire was reduced due to settlers' fear of loss of life and property. When they did occur, fires that once burned tens of thousands of acres were now confined to a relatively small portion of the landscape because the Great Plains was divided into small farms, creating a patchwork of different land practices. In addition, the U.S. Forest Service began promoting fire suppression during the early 20th century with the "Smokey the Bear" campaign. This campaign was useful in educating the public about being cautious with campfires and the danger of wildfires; unfortunately, this campaign combined with liability concerns, lack of equipment, and lack of knowledge and skill caused many resource managers to stop using fire to manage native rangeland in many parts of the country.

The spread of junipers was also aided by many farmers and ranchers transplanting young junipers near their homes for windbreaks. After the Dust Bowl, the NRCS promoted juniper plantings to reduce wind erosion. This practice continues today. In 2001, 36 state and private nurseries produced 2,311,316 eastern red-cedar seedlings (Ganguli et al. 2008). Of the 2.3 million seedlings grown in 2001, 80 percent went to Great Plains states (Ganguli et al. 2008). This study showed Oklahoma and Texas nurseries produced an annual average of 85,000 and 23,500 eastern red-cedar seedlings, respectively. Nebraska led the nation with an annual average of 850,000 seedlings produced. Most of these seedlings were used to establish windbreaks and wildlife cover. Secondary uses include erosion control, living snow fences, shelterbelts and mine reclamation.

Ecology

Related Species

There are five species of junipers in Oklahoma. They include oneseed juniper (*J. monosperma*), redberry juniper (*J. pinchotii*), Rocky Mountain juniper (*J. scopulorum*), Ashe juniper (*J. ashei*) and eastern red-cedar. Ashe juniper and eastern red-cedar are the two most common species of junipers in the east three-quarters of Oklahoma and northeast quarter of Texas.

Range

Eastern red-cedar can be found from the Great Plains to the Atlantic coast. Its range stretches from the Gulf Coast to southern Ontario and Quebec, Canada (Little 1971). Average annual rainfall in its range varies from 15 to 60 inches, and average annual temperature varies from 40°F to 68°F (Lawson 1990). The average maximum temperature ranges from 90°F to 105°F, and the average minimum ranges from -45°F to 20°F (Lawson 1990).

Description

Eastern red-cedar is evergreen, meaning it does not drop its leaves during the fall and stays green yearround. Eastern red-cedar is considered a small to medium-sized tree, growing to 50 feet in height, usually with one main trunk. Crowns are usually conical and dense (Little 1996).

Leaves are aromatic, scale-like, opposite, awl-shaped and are 1/16 to 3/4 of an inch long (Little 1996). The leaves, especially juvenile leaves, often end in a long, narrow, sharp point (Little 1996). The bark is light reddish brown, thin, fibrous and shreddy. The heartwood can be dark or purplish red turning dull red or reddish brown, and the sapwood is whitish. The wood is nonporous, even-textured, moderately heavy and resistant to decay (Little 1996).

Eastern red-cedar grows on a wide variety of soils, ranging from wet, swampy land to dry rock outcrops. Eastern red-cedar can tolerate soil pH levels ranging from 4.7 to 7.8 (Lawson 1990). Eastern red-cedar is thought to be one of the least alkali-tolerant of the drought-hardy trees. Due to the high pH of the tree's foliage, soil pH tends to increase under the canopy due to the foliage being incorporated into the soil. This change in soil pH may also increase earthworm activity, enhancing organic matter incorporation (Lawson 1990).

Pollination

Eastern red-cedar is dioecious, meaning it has separate male and female trees. It is estimated that eastern red-cedar becomes sexually mature around 10 years old. Eastern red-cedar reproduction starts with male and female conelets developing in late summer and fall on the trees. Male conelets develop pollen grains and turn a yellowish brown, maturing during the winter. Female conelets

open up in late February to early spring when the male trees release their pollen. Eastern red-cedar pollination during late winter through early spring is a major cause of allergy problems. Pollen release peaks during March and April in Oklahoma.

Seed Production and Recruitment
Fertilization is complete by June. New seeds require approximately two months to mature. As the seeds mature, a greenish fleshy coat forms a protective berry-like cone around the seeds. These cones (berries) change colors from green to white to blue. Each cone contains one to four seeds. There are approximately 37,000 to 43,600 cleaned and dried seeds per pound (Lawson 1990). The high rate of seed production may be an adaption to eastern red-cedar's vulnerability to fire. Seeds remain on the female trees throughout the winter months, and most cones will drop during February and March. Horncastle et al. (2004) concluded birds consume the majority of the cones from the branches, and mammals consume the majority of the cones on the ground. Tunnell et al. (2004) found most seeds that were not consumed fell inside the canopy of the parent tree. They also noted seedling recruitment depends on seeds from the current year's seed crop.

A male tree exhibiting yellowish brown conelets with developing pollen during January in Carter County, Okla.

Mature seeds on a female tree still in their protective berry-like cones during January in Carter County, Okla.

Growth Rate
Research conducted in Oklahoma found eastern red-cedar in eastern Oklahoma grew to 6.5 feet in height in eight years, whereas trees in western and central Oklahoma required 10-14 years to reach the same height (Engle and Kulbeth 1992). Trees 28 to 29 years old ranged in height from 20.3 feet in western Oklahoma to 27.2 feet in eastern Oklahoma (Engle and Kulbeth 1992), resulting in an average growth rate of 1.6 to 2 feet per year in western and eastern areas, respectively. Crown area (ground area that the tree canopy covers) of 28-year-old trees ranged from 161.5 square feet in central Oklahoma to 430.5 square feet in eastern Oklahoma (Engle and Kulbeth 1992). The crown areas of 25-year-old trees increased 18 and 31 square feet per year in western and eastern Oklahoma, respectively (Bidwell 1993).

Diseases and Pests
Eastern red-cedar is vulnerable to damage by insects and fungi;

however, they seldom incur permanent damage. Bagworms and spruce spider mites eat the foliage (Lawson 1990). Eastern red-cedar is susceptible to bark beetles, boring insects, weevils, webworm, moths and sawflies. When weakened by stress or insects, eastern red-cedar is very susceptible to damage by root rot fungus (Lawson 1990). Fungus known as cedar apple rust is a major stem and foliage disease of eastern red-cedar (Lawson 1990). This fungus is also a problem for apple growers. Young trees are subject to frost-heaving and winter injury (Johnsen and Alexander 1974). White-tailed deer frequently use eastern red-cedar as rubs, damaging leaves, stems and trunks of small trees.

This is an example of unmanaged eastern red-cedar, allowing it to increase in size and number enabling it to dominate many pastures across its range.

Positives

Wildlife

Eastern red-cedar is a native species and can be beneficial to wildlife, depending on the amount present in a given area. For instance, dense stands of eastern red-cedar can provide thermal, screening and escape cover for a variety of wildlife species; however, vast acreages of eastern red-cedar can dominate space that would otherwise fulfill other habitat requirements.

At least 71 vertebrate species have been reported to utilize eastern red-cedar (Van Dersal 1938). Mammals that use eastern red-cedar to fulfill various habitat requirements include opossum, raccoon, fox, bobcat, mule and white-tailed deer, coyote, cottontail rabbit and feral hog. Birds that use eastern red-cedar to fulfill various habitat requirements include cedar waxwing, robin, northern bobwhite, ring-necked pheasant, blue jay, mockingbird, northern cardinal, American crow and European starling. Birds are considered to be the most efficient group of animals that disperses eastern red-cedar seeds.

Windbreaks and Visibility Screens

The growth form of eastern red-cedar makes it an excellent candidate species for windbreaks and visibility screens. Since the Dust Bowl, the NRCS and state natural resource departments have promoted eastern red-cedar for this purpose. Windbreaks help reduce wind erosion and provide winter energy savings of 10 to 40 percent to surrounding buildings (Quam et al. 1991). Windbreaks also provide wildlife and livestock protection from cold winter winds. Visibility screens can be used to block the view of an unpleasant site or stop people from seeing certain areas of a property. If a homeowner or resource manager would like to plant eastern red-cedar as a windbreak or visibility screen, I recommend each female tree be cut down and a new tree be planted once the sex of the trees can be determined.

Lumber

The wood from eastern red-cedar has several applications such as creating furniture and crafts, fence posts and particle board (Hiziroglu et al. 2005). Additionally, eastern red-cedar is cut for landscape mulch and chipped for burning in power plants.

Negatives

Allergies

Junipers are considered to be moderately allergenic and a major cause of seasonal allergies (Wodehouse 1971). The number of people negatively affected by juniper pollen is unknown. Unfortunately, it is not possible to identify the origin or species of juniper pollen (Levetin and Buck 1986); however, time of year that the pollen is released can be an indicator of the species responsible for the source of pollen.

Loss of Forage Production

Forage production under eastern red-cedar is very limited. Bidwell (1993) found shallow prairie soils capable of producing 3,000 pounds of forage per acre can have yields reduced by 50 percent with 250

Too large to be controlled with prescribed burns, these eastern red-cedar were cut using a skid loader and tree saw.

6-foot-crown-diameter eastern red-cedar trees per acre. Hendrix (2002) estimated $100 million was lost in annual forage production in Oklahoma due to juniper invasion and expected this amount to increase to $205 million by 2013. To combat this problem, many resource managers are cutting eastern red-cedar and leaving the fallen trees in the pasture. Bidwell (1993) looked at the loss of herbaceous production after eastern red-cedar were mechanically cut down and found that dead trees remaining on the ground still occupy about 70 percent as much area as they did when standing. Leaving cut trees where they fall can reduce access to forage for grazing livestock and wildlife. However, they can also protect native plants from overgrazing.

Rainfall Interception

Little is known about the effects an individual eastern red-cedar has on intercepting rainfall and water usage. However, research looking at interception of rainfall has been conducted on a similar juniper, Ashe juniper. Studies reported that the canopy and litter interception rates range from 40 to 79 percent (Owens et al. 2006). Of all rainfall events averaged together during Owens et al. (2006) three-year study, 35 percent of the rainfall was intercepted by the canopy, 5 percent was intercepted by the leaf litter, 5 percent ran down the trunk of the tree and 55 percent reached the soil surface. This study showed that during a rainfall event less than 0.1 inch, no rainfall reached the soil surface. During low intensity rainfall events (0.5 inch over a 19-hour period), the canopy of Ashe juniper intercepted more than 60 percent of the rainfall. In high intensity rainfall events (greater than 2.75 inches over a 15-hour period), the canopy of Ashe juniper intercepted more than 20 percent of the rainfall.

Loss of Wildlife Habitat

Many people have the misconception that trees equal wildlife habitat. This is not always the case, especially with eastern red-cedar. As eastern red-cedar encroaches into native rangeland, it changes the composition and structure of the plant community, which alters and reduces habitat for many wildlife species. Plant and animal grassland species must adapt, leave the area or perish. Dense stands of eastern red-cedar can form monocultures, decreasing or eliminating plant and animal species diversity. Most grassland birds have a negative reaction to increasing numbers of eastern red-cedar (Coppedge et al. 2001 and Chapman et al. 2004). These species evolved with wide open prairie habitats influenced by grazing and fire. As the amount of eastern red-cedar increased, diversity of grassland bird species decreased. Turkeys abandon traditional roosts when eastern red-cedar becomes dense underneath roost trees. In 2001, an estimated $52 million was lost in lease hunting opportunities due to juniper invasion (Hendrix 2002). An estimated $124 million will be lost by 2013 in lease hunting fees and other recreational activities if junipers continue to increase (Hendrix 2002).

Wildfire

Due to eastern red-cedar encroachment and the expansion of towns and cities, eastern red-cedar is becoming a common part of our everyday lives. Unfortunately, these silent trespassers can be a significant threat to personal property, specifically houses. Many people view these evergreens as a nice addition to the landscape on their property. Unfortunately, eastern red-cedar contains volatile oils that make it very flammable under the right conditions. A burning eastern red-cedar has the ability to spread embers several hundred yards, increasing the danger to other houses in the ▸

neighborhood. Drake and Todd (2002) estimated $107 million would be lost in Oklahoma to catastrophic wildfires by 2013 due to juniper invasion. This includes loss of property, cost of fighting wildfires and increase in insurance premiums.

Management Techniques

Prescribed Burning

Fire is the original control method of eastern red-cedar. Unlike many woody species that root sprout, top-killing eastern red-cedar with fire (or other means) kills the plant. With adequate fuel and proper prescribed burning conditions, fire kills most eastern red-cedar less than 4 feet tall. Unfortunately, many eastern red-cedars have grown so large that prescribed burning is no longer an effective or safe management tool. For many resource managers, prescribed burning is a maintenance tool to control new and young eastern red-cedars, but it is usually not the tool of choice for killing larger trees. Engle and Stritzke (1992) suggested large individual unburned trees in recently burned areas can be reignited in low humidity situations with a weed burner propane torch. Eastern red-cedar within 100 yards upwind of fireguards should not be ignited. Burning eastern red-cedar can throw embers a significant distance depending on the relative humidity and wind speed. Appropriate safety measures should be employed with any prescribed burn.

A resource manager should attend a prescribed burning workshop or course and gain experience helping skilled burn bosses before implementing prescribed burning as a management tool. Several of the organizations discussed in the Technical Guidance Section of this publication periodically host prescribed burning workshops. Private burn contractors are available for landowners who would like to implement this tool, but would prefer to have a professional conduct the burn. In 2002, the average cost to burn 160 to 640 acres on a property dominated by oak/hickory, oak/pine or post oak/blackjack oak forest habitat with no eastern red-cedar present was approximately $7 per acre. This same area with a solid stand of eastern red-cedar may cost roughly $25 per acre (Bidwell and Weir 2002). Prescribed burning associations offer a way to reduce expenses and gain experience. In 2009, there were 16 associations in Oklahoma, 11 in Texas, three in Kansas and Nebraska, and one each in Colorado and California (Weir 2009). These associations share equipment, labor and experience. Contact organizations discussed in the Technical Guidance Section of this publication for assistance in joining or developing a prescribed burn association. When fire is not an option, mechanical or chemical control methods can be used.

Mechanical

Since eastern red-cedar does not resprout, mechanical control is a useful option. Mechanical control methods are often used in combination with prescribed burning to treat eastern red-cedars that are too large for conventional prescribed burning or when

A skid loader equipped with a tree saw cutting down an eastern red-cedar that measured 22 inches in diameter at the ground level

Close-up of tree saw mounted on the front of a skid loader

they occur in fire and smoke sensitive areas. Mechanical methods allow a resource manager to selectively cut down trees with minimal damage to surrounding vegetation. For example, a manager may only want to cut female trees, leaving male trees for thermal or escape cover for wildlife and livestock.

Mechanical methods include chain saw, bow saw, lopping shear, axe, skid loader or tractor equipped with shear or saw, chaining or cabling, and bulldozer. Hand tools are very selective, but are labor intensive. Skid loaders or tractors equipped with shear or saw are selective and are most effective on trees with basal diameter (width of trunk at ground level) of 3 to 20 inches and cause minimal disturbance. Trees should be cut off at ground level to prevent future hazards such as hitting them with equipment or vehicles, or people and livestock tripping over them. Bulldozers can be used on any size eastern red-cedar, but are most effective on dense stands of larger trees. Unfortunately, bulldozers can cause significant soil disturbance. Bulldozers typically uproot the tree leaving a hole from the displaced root ball or break the trunk off several feet above ground. Depending on the level of disturbance, the area may need to be leveled and revegetated. In 2010, the average cost was approximately $75 per hour for a skid loader with shear or saw and $100 per hour for a bulldozer.

Chemical

Chemicals approved for controlling eastern red-cedar include hexazinone (Velpar® and Pronone Power Pellets®), tebuthiuron (Spike®) and picloram (Tordon®). Velpar® and Tordon® are liquids that can be applied to the soil under the tree. Tordon® can also be applied to the foliage of an individual tree to reduce herbicide exposure to desirable plants. Labels for Velpar® and Tordon® recommend not using the chemicals on eastern red-cedar larger than 15 feet tall. Spike® and Pronone Power Pellets® are pellets that are placed under and near the tree. Pellets are activated by a sufficient amount of rainfall, which dissolves them and moves the herbicide into the soil where it can be absorbed by the roots. All of these chemicals can injure or kill nontarget woody plants in the immediate area. These chemicals are best used when only the target species will be exposed to the herbicide. When using herbicides, always read and follow the label instructions. Chemical treatment averages 5 cents to $2.50 per tree, depending on the size of the tree and chemical used.

Technical Guidance

Resource managers are not alone in their efforts to manage eastern red-cedar. Various levels of professional assistance (both free and for-profit) are available across the entire range of the eastern red-cedar. For example, some professionals provide onsite recommendations to help individual resource managers achieve their goals. Other consultants provide technical guidance and can be contracted to implement the recommended management practices.

Federal and state agencies provide free technical guidance and often have cost-share programs available to assist in the control or promotion of eastern red-cedar. On the federal level, there are two agencies available to assist resource managers. The NRCS and the United States Fish and Wildlife Service Partners for Fish and Wildlife Program provide technical guidance and potential cost-share programs.

State wildlife, natural resource, forestry and extension agencies (e.g., Oklahoma Department of Wildlife Conservation, Texas Parks and Wildlife Department, Oklahoma Forestry Services, Texas Forest Service, Oklahoma Cooperative Extension Service, Texas AgriLife Extension Service) have biologists on staff to assist resource managers with eastern red-cedar management. These agencies also provide technical guidance and some provide cost-share programs.

Summary

Eastern red-cedar is a native tree, but it has vastly expanded its range due to changes in land use and management practices. This species has both positive and negative attributes; however, its tendency to dominate the landscape often creates management challenges. Eastern red-cedars less than 4 feet tall are easily controlled with fire, chemical and mechanical means. Trees larger than 4 feet are more difficult and costly to control. Resource managers must decide the role that eastern red-cedar should play on their property. ■

Online Resources

Natural Resources Conservation Service
www.nrcs.usda.gov
Oklahoma Cooperative Extension Service
www.oces.okstate.edu
Oklahoma Department of Wildlife Conservation
www.wildlifedepartment.com
Oklahoma Forestry Services
www.forestry.ok.gov
Texas AgriLife Extension Service
texasextension.tamu.edu
Texas Forest Service
texasforestservice.tamu.edu
Texas Parks and Wildlife Department
www.tpwd.state.tx.us
The Samuel Roberts Noble Foundation
www.noble.org
United States Fish and Wildlife Service Partners for Fish and Wildlife Program
www.fws.gov/partners ▸

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THE SAMUEL ROBERTS NOBLE FOUNDATION

The Samuel Roberts Noble Foundation
2510 Sam Noble Parkway
Ardmore, Oklahoma 73401
Phone: (580) 223-5810
www.noble.org