

A Strategy for Control and Utilization of Invasive Juniper Species in Oklahoma

***FINAL REPORT OF THE
“REDCEDAR TASK FORCE”***

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and

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for

**Dennis V. Howard
Secretary of Agriculture**

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INTRODUCTION

In response to the concerns expressed by the Oklahoma Farm Bureau, the Oklahoma Grazing Lands Conservation Association and others over the impact of the rapid spread of eastern redcedar and other junipers across the landscape, Secretary of Agriculture Dennis Howard, in cooperation with Secretary of the Environment Brian Griffin, established the “Redcedar Task Force.” Task Force members were selected from a list of state and local agencies and organizations that had already been involved with efforts to establish a “redcedar initiative.” A list of members of the “Redcedar Task Force” is included on page 2.

Eastern redcedar is by far the most common and widespread juniper present in Oklahoma. Other juniper species native to Oklahoma include Ashe juniper, oneseed juniper, Pinchot juniper and Rocky Mountain juniper. In general, eastern redcedar and Ashe juniper are the two species causing the most serious problems with infestation. As used in this report, the terms *redcedar* and *junipers* generally are intended to include all of the juniper species native to the state.

The Task Force was charged with exploring the issues and developing a long-term strategy to deal with the problems created by the juniper infestation, estimated to be expanding at 762 acres per day. The work of the Task Force was accomplished through five committees, charged with gathering pertinent information on their assigned area and making recommendations. The following committees were established during the first Task Force meeting on May 2, 2002:

- Wildland/Urban Interface Issues
- Ecosystems, Wildlife Habitat and Ecological Issues
- Air Quality and Human Health Issues
- Economics of Redcedar Control in Forest and Range Management
- Economic Opportunities and Beneficial Uses of Redcedar

The Task Force met again on July 15, 2002 and on September 17, 2002 to review and discuss reports of the various committees. The final strategy includes a brief overview of the juniper problem and the committee reports with their specific recommendations. The strategy is intended to provide a blueprint for action. It will be used to raise the awareness of key stakeholders and decision-makers in order to stimulate support for a comprehensive effort to slow and then control the spread of junipers in Oklahoma, as well as to explore the potential for economic development using junipers as the raw material. Ultimately, implementation of the strategy will help us reclaim our native rangelands and forests that have been overrun with junipers, maintaining productive lands and the benefits they provide to Oklahoma’s citizens.

ACKNOWLEDGEMENTS

The Task Force appreciates the efforts of Kurt Atkinson, Forestry Services Assistant Director, Oklahoma Department of Agriculture, Food and Forestry, and Marla Peek, Oklahoma Farm Bureau, for their assistance in organizing meetings of the Task Force and coordinating production of the final report. The Task Force also sincerely appreciates the efforts of the committee chairs – Terry Bidwell, Tim Cannon, Daryl England, John Hendrix and Richard McDaniel – for their willingness to serve and their leadership, as well as to others in the state who contributed to the work of the various committees.

REDCEDAR TASK FORCE MEMBERS

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EXECUTIVE SUMMARY

Increasing concern, primarily among owners of grazing lands, biology professors and range specialists, prompted Secretary of Agriculture Dennis Howard, along with Secretary of the Environment Brian Griffin, to create the “Redcedar Task Force” to examine the issue of Eastern redcedar and other juniper infestation in the state. Oklahoma’s native forests, rangelands, pastures and prairies are seriously threatened by an ongoing invasion of junipers. Ranchers and wildlife enthusiasts have been all too aware of the problem as redcedar and other junipers displace native pastures and degrade wildlife habitat. However, others are only now fully realizing that juniper infestation exponentially increases the risk of catastrophic wildfire and has negative impacts on human health.

The Task Force concluded that the negative impacts of juniper encroachment on our natural resources, native wildlife populations, the health of our citizens and our economic potential are unacceptable. Redcedar and other junipers must be properly managed. Without prompt and aggressive action, the invasion will continue to accelerate. Continued spread will ultimately result in catastrophic effects on public health and safety, followed by severe environmental and economic impacts in the future. It is the desire of the Task Force that this report will serve as a call for action and that appropriate measures must be implemented to manage the spread of junipers on public and private lands across Oklahoma.

The USDA Natural Resources Conservation Service (NRCS) estimates that eight million acres in Oklahoma are currently infested with at least 50 juniper trees per acre. The encroachment is increasing at an estimated rate of 762 acres a day or nearly 300,000 acres per year. In July of 2002, the NRCS State Technical Committee, consisting of a broad representation of agriculture and conservation organizations, named juniper encroachment the state’s number one natural resource concern. NRCS estimates that \$157 million is needed to address current conservation treatments involving juniper control.

Based upon current estimates, some form of juniper control is needed on an estimated 300,000 acres per year, *just to break even with the current rate of infestation*. To restore lands already suffering from encroachment, as well as to maintain lands free of further encroachment, landowners will need to aggressively treat 2 to 4 million acres per year. Economic losses from not managing juniper encroachment are projected to be \$447 million by 2013.

Prior to settlement of Oklahoma, juniper infestation was not a problem as the trees were primarily limited to protected alcoves and canyons that were rarely burned by fire. However, as people began to settle the plains, they controlled the naturally occurring wildfires that kept redcedar and other junipers in check.

Although the use of prescribed burning is the most cost-effective juniper control strategy today, it is not practiced widely because of long-standing social and legal concerns. Fire suppression, rather than the cautious use of prescribed burning, has been the rule for decades. Few landowners are skilled in the practice of prescribed burning. Lack of knowledge about how to conduct a prescribed burn, along with fear of burning up one’s own or a neighbor’s property are

enough reasons to keep many landowners from even considering it. Oklahoma's strict liability law also creates a disincentive for the landowner considering a prescribed burn.

The Task Force organized into five committees to address the range of issues associated with the encroachment of redcedar and other junipers: Wildland/Urban Interface Issues; Ecosystems, Wildlife Habitat and Ecological Issues; Air Quality and Human Health Issues; Economics of Redcedar Control in Forest and Range Management; and the Economic Opportunities and Beneficial Uses of Redcedar.

The *Wildland/Urban Interface Issues* committee examined the impacts of redcedar and other junipers on the wildland/urban interface areas of the state, the areas where people choose to live and interact with the natural environment. According to the State Insurance Department, the issue of juniper infestation with regard to these areas is a "sleeping giant" and an uncalculated risk. The committee recommended the broad implementation of *Firewise* in Oklahoma.

The *Ecosystems, Wildlife Habitat and Ecological Issues* committee examined the impacts of redcedar and other junipers on native ecosystems and natural resources in Oklahoma. The committee presented details about the state's five native species of junipers, and inventoried the problems related to juniper encroachment, including: displacement of native plant species; displacement of wildlife species; effects on livestock/forage production and water quality; and economic losses. The committee also looked at the ecological benefits of junipers, and the consequences of non-management of the species. The committee's major suggestions were to educate the public about the issue, to promote the use of prescribed fire to restore ecosystems, and to provide incentives for landowners to manage their lands, especially by amending the state's prescribed burning laws.

The *Air Quality and Human Health Issues* committee explored the potential impacts from juniper pollen and smoke from wildfires and prescribed fires on air quality and human health. The committee recommended tracking the impact of pollen from increased infestation of redcedar and other junipers on human health. The committee recommended the use of prescribed burning to limit the impacts of pollen and particulates to human health, and increased cooperation and education among agencies and the public about the appropriate timing of prescribed burning.

The *Economics of Redcedar Control in Forest and Range Management* committee examined the economics and costs to control, or alternatively not control, redcedar and other junipers. The committee outlined appropriate management treatments for ecosystem maintenance, ecosystem restoration, and the costs involved with the specific treatments, including prescribed fire, mechanical methods and herbicide application.

The *Economic Opportunities and Beneficial Uses of Redcedar* committee examined the beneficial uses of redcedar as a basis for an emerging forest industry that could contribute to economic development opportunities while also controlling its spread. The committee urged increased support for existing market and product development for redcedar in Oklahoma, including the need to support a statewide forest inventory to quantify the potential raw material for business development, and increased funding for basic research and capital investments.

SUMMARY OF TASK FORCE RECOMMENDATIONS

The Task Force's major recommendations are summarized below. The recommendations of all five committees were consolidated and condensed into four broad areas. The individual committee reports contain the specific detailed recommendations, which should be considered in their entirety to fully appreciate their context and the challenges that lie ahead for the State of Oklahoma.

RECOMMENDATIONS

(1) Increased Awareness about the Consequences of Juniper Encroachment and Control Options

The State needs to generate broad support for efforts to manage junipers by educating policy makers, natural resource managers, landowners, the insurance industry, fire departments, the general public and other stakeholders about the problems associated with the continuing encroachment and infestation of junipers across the state. We need to inform the public about the loss of native ecosystems, the harm to wildlife, increased fire danger, increased public health concerns due to pollen, the loss of farm, ranch and forest income, the loss of groundwater and other negative impacts, and the severe consequences of inaction.

We need to raise public awareness of the importance of fire as a natural process in our native plant communities, aggressively promote the use of prescribed burning to manage juniper species to help restore native ecosystems, and provide information and training to fire departments, conservation agencies, landowners and private contractors in prescribed burning.

(2) Implementation of *Firewise*

Firewise is a nationwide program designed to help people reduce their wildfire risk by creating defensible space around their homes and property. Adopting *Firewise* principles will help reduce the loss of life and property to wildfire, the risks to firefighters and the costs of fire suppression. Key stakeholders include state agencies, homeowners and neighborhoods, especially in the wildland-urban interface, landowners, communities, insurance companies, realtors and fire departments. The Oklahoma Department of Agriculture, Food, and Forestry and the Bureau of Indian Affairs are already promoting the program in Oklahoma. The Task Force recommends strong support for *Firewise* at the highest levels of government, and implementation of *Firewise* principles at all levels across the state.

(3) Increased Landowner Involvement

Landowners are the key to controlling juniper encroachment. The State needs to provide information, encouragement, incentives, training and assistance in organization. Legislation should be enacted to encourage more prescribed burning to control invasive species and restore native ecosystems. Actions that should be taken include: reduction of landowners' liability when conducting a prescribed burn; creation of a certified burner program; implementation of a fee-based prescribed burning service and vendor training program; tax credits or cost share

assistance to landowners in managing junipers; support for burn cooperatives and associations; creation of a prescribed fire council; and increased cooperation with and education of fire departments about the importance of prescribed burning. The State of Oklahoma should lead by example in managing junipers on state-owned land.

(4) Need for Further Research and Economic Development Activities

Further research and state support is needed in three main areas:

- (a) Increased costs from fire losses and insurance coverage. The potential property loss from fire due to failure to manage redcedar and other junipers in Oklahoma needs to be quantified. Insurance companies need to modify coverage to consider the need for more prescribed burning and implementation of the *Firewise* program.
- (b) Human health concerns. The State also needs to quantify the effects of juniper pollen on the health of Oklahomans, and make this information available to the public.
- (c) Redcedar product and market development. The Legislature should fund and urge increased support of existing programs for product and market development of junipers. Utilization of junipers for forest products helps control the spread while also stimulating local economies. Additional funds are needed to support activities in product research, marketing, forest inventory and small business development.

THE JUNIPER STORY IN PHOTOGRAPHS



Photo of the 2000 Oak Cliff Fire between Edmond and Guthrie, courtesy of Mark Zimmerman, The Edmond Sun



Volatile juniper trees increase the complexity and cost of wildfire control and significantly increase the danger to firefighters.

Commercial property waiting to be developed is often home to unmanaged junipers. These volatile trees are already a fire hazard to this housing addition and elementary school in Edmond. If not controlled, they will quickly dominate the area.

Photo by Traci Morgan, courtesy of Oklahoma Farm Bureau



Juniper trees have overtaken this strip of land between the railroad and this manufacturing plant near Edmond, seriously compromising protection efforts in the event a wildfire occurs.

Photo by Traci Morgan, courtesy of Oklahoma Farm Bureau

Homeowners, who may appreciate the greenery and privacy juniper trees provide, are often unaware of the increased fire risk from these highly flammable trees growing near their homes.

Photo by Traci Morgan, courtesy of Oklahoma Farm Bureau





Small junipers starting to invade rangeland are just the beginning unless controlled while small.

As larger junipers continue to develop unchecked, they begin to impact forage production and wildlife habitat, such as on this tallgrass prairie site.

Photo courtesy of OSU Cooperative Extension Service (Circular E-947)



Large junipers have almost completely taken over this site, seriously degrading rangeland and wildlife values.



Crosstimbers post oak and blackjack oak forests become very susceptible to wildfire with an understory of juniper. Junipers will eventually displace this native forest habitat unless controlled.

Photo courtesy of OSU Cooperative Extension Service (Circular E-947)



INTRODUCTION TO COMMITTEE REPORTS

Each of the five committees independently researched its assigned issue and developed a report of its findings and recommendations. These reports are included in their entirety in the next section, rather than being condensed and consolidated into a more cohesive report. The specific recommendations from each of the committee reports have been consolidated in the Summary of Task Force Recommendations on page 5.

As a point of clarification, the term *redcedar* refers to the primary juniper species of concern in Oklahoma – the eastern redcedar (*Juniperus virginiana*). However, as it is used in this report, the terms *redcedar* or *junipers* generally include eastern redcedar and the other four juniper species that are native to the state.

Wildland/Urban Interface Issues

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The objective of this committee is to explore the impacts of eastern redcedar (*Juniperus virginiana*) and other junipers (*Juniperus spp.*) on the areas where people choose to live and interact with the natural environment, the so-called wildland/urban interface areas of the state.

Committee Recommendations for Key Stakeholders

Cities

- Encourage cities through the Oklahoma Municipal League and the councils of government to inspire their residents to reduce fire risk to their homes and the area around their homes through a voluntary program such as *Firewise*. This program could be spread locally through homeowners' associations.
- Recognize cities, communities and/or neighborhoods that implement the *Firewise* program.

Counties

- Urge county commissioners to pass a resolution encouraging county residents to implement the *Firewise* program.
- Distribute *Firewise* information in counties in a number of different places: county commissioners' offices, county extension offices, realtors' offices, insurance agents' offices and fire departments.

Insurance Companies

- Consider making wildfire another “cause of loss” to facilitate quantifying losses caused by wildfire.
- For companies who wish to participate, mail *Firewise* information with homeowner premium statements.
- Long term, consider developing premium discounts for homeowners who have implemented the *Firewise* program. Or perhaps homeowners could be placed into a different risk category in order to achieve a better premium rate. Homeowners’ associations could take on this project in order to receive a better rating for their entire neighborhood.
- The insurance industry as a whole needs to become familiar with prescribed burning needs and programs to overcome the misperception about the risks associated with burning.
- Encourage a licensed Oklahoma insurance carrier to provide insurance coverage for certified burners. Without appropriate insurance coverage, it is unlikely certified burners would be able to provide services to other parties. If an Oklahoma company were to provide insurance coverage for certified burners, it is likely they would utilize reinsurance to diffuse their risk. For primary insurance and for reinsurance, there would have to be a study of the risk potential before an actual rate could be adequately determined to apply to certified burners. The property damage liability issue would be the foremost concern with any primary and reinsurance carrier.

Real Estate and Loan Companies

- Put *Firewise* on a checklist of things to know before purchasing a home.
- Consider requiring a risk disclosure statement from the real estate owner to disclose wildfire risk to property prior to sale.

State

- Request a study to determine the costs of catastrophic fire to property owners and insurance companies. The State Insurance Department could ask insurers to examine their losses from the 2000 Logan County fire and make that information public. Estimate the costs to homeowners, insurance companies, fire departments and the state to fight catastrophic fires if no preventive action is taken in the future.
- Recommend that agencies implement the *Firewise* program on state property for risk management purposes.
- Request a Governor's proclamation supporting the *Firewise* program.

- Produce a joint public service announcement by the State Fire Marshal, State Insurance Department and Department of Agriculture, Food, and Forestry (ODAFF) advising homeowners of the importance of fireproofing the area around their homes.
- Encourage creation of a wildland/urban interface educational module for fire departments for their ongoing education needs.
- Consider promoting the concept of wildfire risk categories to real estate and financing companies.
- Encourage the State Insurance Department and others to link their websites to the *Firewise* website. (ODAFF is already linked to *Firewise*.)
- Educate property owners to reduce wildfire risks and encourage voluntary prescribed burning to manage fuel hazards. Research the feasibility and capital needs of ODAFF to implement a fee-based prescribed burning service and vendor training program. State and federal agencies and Oklahoma State University should work with the legislature to create a “certified burner” program in Oklahoma to address the tremendous amount of prescribed burning that is needed.
- Offer a tax incentive to landowners who manage their juniper problem.
- Create a state insurance pool for certified burners. Without appropriate insurance coverage it is unlikely certified burners would be able to provide services to other parties. In concept, certified burners would pay premiums, similar to insurance premiums, into a pool. The premiums would likely be determined and set by a casualty actuary. Profits realized by the pool (no losses over a period of time, usually annually) could be distributed back to the participants in the pool, or rates could be reduced accordingly, for the next term. The concept is similar to self-insurance, except the pool would have multiple participants and an administrator.

National

- Acknowledge actions being taken at the federal level and actions by other states to implement *Firewise* type programs. If possible, we recommend piggybacking Oklahoma's efforts onto the national initiative to implement *Firewise*. Apply for additional *Firewise* grants for Oklahoma.

Wildfire and the Wildland/Urban Interface – The National Picture

In the last few years, wildfires around the nation have been common fare on the evening news. The costs of wildfires in the United States have been in the billions of dollars annually. The costs of wildfires have been borne by persons directly affected through loss of property, to insurance companies and their policyholders, and to federal, state and local governments who have fought the fires.

Fuel from vegetation that has grown unchecked and complications from weather conditions like wind and drought have contributed to increased wildfire risk. Wildfires have heightened the debate about federal land management policy. President George W. Bush recently unveiled his healthy forest plan entitled *Healthy Forests: An Initiative for Wildfire Prevention and Strong Communities*. Several bills are pending in Congress that deal with national forest and wildfire prevention and suppression issues. National efforts are ongoing to implement the *Firewise* program. (The *Firewise* program was created for people who live or vacation in fire prone areas of North America. The *Firewise* program acquaints individuals with the challenges of living in wildland/urban interface areas, and provides information on how they can avoid or lessen the risk of wildfire loss. Oklahoma is a participant in the *Firewise* program.) Federal agencies are working to pool resources to implement fire prevention and suppression programs.

Junipers and the Wildland/Urban Interface – Status in Oklahoma

According to the 2000 census, the urban areas of the state continue to grow while rural areas have lost population. Urban population growth has not been in the heart of the cities, but rather outward, into the fringe areas surrounding the cities. Many city dwellers are choosing to move to the country, or at least to those areas that border the city. People are choosing to build homes on their own little piece of back-to-nature heaven, surrounded by trees, native vegetation and wildlife. Some city dwellers are buying rural land for recreational purposes like hunting and fishing while maintaining their primary residences in the city.

Homes built in the wildland/urban interface may or may not be under the jurisdiction of a city or town. Outside of city limits, building code restrictions that address fire and safety concerns may be nonexistent. Services such as fire protection may be provided by volunteers, rather than paid city personnel, resulting in increased emergency response time.

With the increase in juniper infestation within the wildland/urban interface, the potential for catastrophic wildfire is greatly increased. The costs of wildfire suppression to fire departments and the state are immense. The safety risk to firefighters is increased when redcedars and other junipers are involved. Rural residents may be unaware of the hazard created by surrounding their homes with attractive, yet highly flammable, juniper trees. Similarly, absentee landowners are less likely to manage junipers on their property, allowing them to propagate widely, displacing native vegetation and creating dangerous fuel loads that threaten their neighbors' lives and property in the case of a wildfire. Educating rural and rural/urban interface residents about junipers and their increased risk to wildfire is a big challenge.

Some policymakers and agencies have recognized the wildfire threat and are already implementing the *Firewise* program in Oklahoma, including Forestry Services of ODAFF and the Bureau of Indian Affairs (BIA). Forestry Services has a federal grant to produce *Firewise* kits to help educate fire departments about the program. More than 400 of these kits have been produced and delivered to fire departments in every county. A regional *Firewise* workshop was held in Norman in October 2002. *Firewise* information is presently being produced and distributed with support of ODAFF, the Civil Emergency Management Department and the BIA. Although thousands of copies of the *Firewise* brochure have been distributed, additional resources are needed to reach a much wider audience.

Many in the Oklahoma insurance industry consider the hazard created by the invasion of junipers in wildland/urban interface areas to be a “sleeping giant,” much like the mold issue which has cost insurance companies in other states millions of dollars. To date in Oklahoma, no research has been gathered on the financial impact of wildfires in the wildland/urban interface areas to insurance companies and their policyholders. The State Insurance Department knows junipers are a risk for wildfire, but at this time they are considered an “uncalculated” risk.

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- Moore, Howard E. 1981. Protecting Residences From Wildfires: a guide for homeowners, lawmakers, and planners. USDA, Forest Service, Pacific Southwest Forest and Range Experiment Station. General Technical Report PSW-50.
- Sweet, William R. 2002. Wildland/Urban Interface Program Strategy for the Southern States and National Forests, Draft. USDA Forest Service, Southern Region, Atlanta, GA.

Related Resources Available on the Internet

<http://www.state.ok.us/~okag/redflag/banguides.html>

Burning ban guidelines for Oklahoma

<http://www.state.ok.us/~okag/redflag/firewx.html>

Fire danger in Oklahoma

<http://www.firewise.org/>

Firewise – The *Firewise* program was created for people who live or vacation in fire prone areas of North America. The program acquaints individuals with the challenges of living in wildland/urban interface areas, and provides information on how they can avoid or lessen the risk of wildfire loss. Sponsors of *Firewise* include the: Department of Agriculture - Forest Service; U.S. Department of the Interior; Bureau of Land Management; Bureau of Indian Affairs; National Park Service; U.S. Fish and Wildlife Service; National Association of State Foresters; and National Fire Protection Association.

<http://www.interfacesouth.org/resources/assessment.html>

Interface South – Developed by the USDA Forest Service Southern Research Station and Southern Region to heighten awareness of and provide information about wildland-urban interface issues. Critical interface issues include fire, watershed management, wildlife conservation and management, land use planning and policy.

<http://www.iawfonline.org/links.html>

International Association of Wildland Fire (IAWF) – The IAWF is a non-profit, professional association representing members of the global wildland fire community. The purpose of the association is to facilitate communication and provide leadership.

<http://www.nwcg.gov/>

National Wildfire Coordinating Group (NWCG) – Its purpose is to establish an operational group to coordinate programs of the participating (federal) wildfire management agencies.

<http://www.oda.state.ok.us/frst.htm>

Oklahoma Department of Agriculture, Food and Forestry (Forestry Services Division) – The agency's mission is to enhance and protect Oklahoma's forests for all its citizens.

<http://www.oda.state.ok.us/redflag/forred.html>

Red flag fire alert page for Oklahoma – Shows which counties have a burning ban in effect and which are under a red flag fire alert.

<http://www.southernforests.org/default.htm>

Southern Group of State Foresters – The Southern Group of State Foresters is comprised of the state foresters for the 13 southern states, Puerto Rico and the Virgin Islands. The group serves as a coordinating body to facilitate forest resource issues and governing policies throughout the south. State forestry agencies are an information source for landowners, outdoor enthusiasts, forest industry, developers, communities and numerous other parties.

Ecosystems, Wildlife Habitat and Ecological Issues

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The objective of this committee is to explore the impacts of eastern redcedar (*Juniperus virginiana*) and other junipers (*Juniperus spp.*) on native ecosystems and natural resources in Oklahoma. Impacts of eastern redcedar are well documented throughout our state and have a direct effect on wildlife, water quality, native vegetation and livestock production. The committee's goals are to compile research pertaining to eastern redcedar and other junipers in Oklahoma with regard to their ecology and historical distribution, ecological and economical impact, perceived benefits, management and the future consequences of management apathy.

Committee Recommendations

Educate, Educate, Educate! Many people are unaware of the problems associated with juniper encroachment. The prevalent "trees are good" mentality may have led to acceptance of junipers in many areas where it did not naturally occur. We need an extensive education campaign to inform the public of the ecology, management, benefits and problems associated with eastern redcedar and other junipers.

- Share information about juniper problems and control with natural resource professionals, landowners, policymakers, general public, realtors, bankers and sportsmen.
- Lead by example. Develop and sign a MOU among all state and federal agencies in Oklahoma uniting together to control junipers across our state on public lands, parks, wildlife refuges, county roads and highway rights-of-way.
- Rangeland ecosystems developed under natural processes. Juniper and other brush species encroachment in rangelands is a problem. The problem is the result of removing a natural process -- fire -- from the rangeland ecosystem. Focus on increasing public awareness on the importance of prescribed fire as a natural process in our native plant communities.
- Television spots. Develop a television campaign to educate the people across the state on the problems associated with junipers, management options, agencies that can help, etc.
- Past and present history in local papers. Show photos of local rangeland areas without junipers and then show the same area today with juniper invasion. A small caption below pictures will detail problems with junipers in the area.
- Use state and federal information and education divisions/programs to increase awareness of the juniper problems across our state.
- Use highway signs to show juniper control projects completed by agencies and landowners when projects are completed.
- Use agency websites for additional outreach efforts.
- Develop brochures on juniper control and make them available to all state and federal agencies, landowners, bankers, realtors and sportsmen.
- Develop a “warm and fuzzy” campaign symbol (e.g., bobwhite quail) that has suffered from juniper invasion and that everyone can relate to.
- Increase awareness of wildfire damage as the result of juniper infestation to natural resource managers, policymakers, landowners, rural and urban residents and sportsmen.
- Educate natural resource managers, policymakers, landowners and the public on how to control eastern redcedar and other junipers.
- Enact a legislative directive to all state agencies concerning junipers.
- Emphasize that all treatments to reduce junipers are temporary. Long-term management goals should be emphasized to prevent reestablishment of junipers in treated areas.

Promote the Use of Prescribed Fire

- Promote the establishment of Prescribed Fire Associations throughout the state. Prescribed Fire Associations are beneficial for landowner training, equipment sharing, large-scale rangeland improvements, reducing landowner liability, reducing landowner operational expenses, etc.
- Increase prescribed fire training for all agency personnel, rural fire departments and landowners.
- Promote landowner prescribed fire workshops across the state through natural resource agencies.
- Have prescribed fire equipment available to landowners across the state.
- Work with insurance companies to promote a cost effective coverage plan for landowners and managers who are using prescribed fire as a management tool on their properties.
- Rewrite or Modify Oklahoma's Burning Laws. As currently written, Oklahoma's prescribed burning laws remain part of the problem, rather than the solution, to the problem of juniper infestation on Oklahoma rangelands. The law needs to be rewritten or modified to encourage the use of prescribed fire as an effective resource management tool.
- Develop prescribed fire demonstration areas in strategic locations across the state for field days and workshops for all state and federal agencies, landowners and land managers.
- Promote prescribed fire certification for people wanting to conduct prescribed fires. This could reduce liability, improve laws and promote public support for burning.
- Promote the use of private contracting and consulting for prescribed fire projects.
- Promote the benefits of prescribed fire for rangeland improvement, wildlife habitat improvement and native plant diversity.

Mechanical Treatment for Eastern Redcedar and Other Junipers

- Encourage agencies to make equipment available to landowners across the state for mechanical control of junipers.
- Educate all natural resource managers, landowners, and land managers on the timing, economics, residual by-products (pile-versus-don't pile), and USDA NRCS standard specifications of juniper control.
- Provide demonstration areas showing mechanical control of junipers in strategic areas.

Provide Incentives

- Educate all agency personnel, landowners and land managers on available incentive programs for juniper control and maintenance.
- Target priority areas for juniper control. Priority should be given within ecological regions that are in desperate need of juniper control. To extend funding, target funds first toward areas that currently have low densities of juniper. Then funds should be targeted towards the higher juniper tree densities.
- Apply through federal grant programs for funding to promote prescribed fire use and mechanical control of junipers in Oklahoma. Funding could promote fire associations, more burn equipment for rural fire departments and fire associations, and more equipment for mechanical control for land managers.
- Increase funding opportunities for juniper control through legislative appropriations, grants and all incentives and cost-share programs.

Background

Eastern redcedar is by far the most common and widespread juniper present in Oklahoma. Other juniper species native to Oklahoma include Ashe juniper (*Juniperus ashei*), oneseed juniper (*Juniperus monosperma*), Pinchot (redberry) juniper (*Juniperus pinchotii*) and Rocky Mountain juniper (*Juniperus scopulorum*). The descriptions and native ranges for each species excerpted from Little (1996) follow.

Ashe Juniper. “Shrub or small tree, scaleleaf evergreen, aromatic, becoming 20 feet tall and 8 inches in diameter, with trunk often branched from base and with broad rounded or irregular slightly pointed dense crown to base. Twigs are slender, gray and rough. The leaves are mostly paired or opposite in four rows forming crowded slender 4-angled twigs, scalelike, 1/16 inch long, dark green, mostly without gland dot, ending in blunt point, with tiny teeth on edges. The cones are berrylike, 5/16 inch in diameter, dark blue with a bloom, juicy, sweetish and resinous. Seeds usually one, 3/16 inch long, dark brown, pointed, slightly ridged. The bark is gray brown, fibrous and shreddy, fissured into long narrow scaly ridges. Wood is brownish and is slightly aromatic.

Scattered in grasslands on rocky limestone slopes of the Arbuckle Mountains in southern Oklahoma and near Salina in Mayes County in northeastern Oklahoma. May be suitable for ornamental plantings, but mainly used for fence posts. Also, it serves for fuel, but is limited in supply.” This species will not resprout from the roots and is susceptible to fire and mechanical control.

Oneseed Juniper. “Shrub or small tree, scaleleaf evergreen, aromatic, becoming 20 feet tall with few curved trunks to 6 inches in diameter and spreading rounded or irregular dense crown to base. Twigs are slender, gray or brown, rough with scattered dead leaves. The leaves are

paired or opposite in four rows (sometimes three), on short stout crowded twigs, scalelike, 1/16 inch long, mostly blunt, green, usually with gland dot, with tiny teeth on edge. The cones are berrylike, 1/4 inch in diameter, dark blue with a bloom, soft and juicy, sweetish and resinous. Male cones with pollen on separate trees. Seeds are one, 3/8 inch long, pointed, angled, and light brown. The bark is gray, fibrous and shreddy. Wood is light reddish brown with whitish sapwood, nonporous, lightweight and soft.

Common and dominant in pinyon-juniper woodlands on rocky slopes in the foothills of the Rocky Mountains, located in northwest Cimarron County in Oklahoma. Principal uses are fenceposts and for fuel.”

Pinchot (Redberry) Juniper. “Shrub or small tree, scaleleaf evergreen, aromatic, becoming 15 feet tall with few trunks to 4 inches in diameter, and broad rounded or irregular dense crown to base. Twigs are slender, gray, and rough. Leaves are mostly in 3s in 6 rows on slender twigs, scalelike, 1/16 inch long, color is yellow green, blunt, and with a gland dot. Cones are berrylike, 3/8 inch in diameter, reddish, hard and dry, and mealy. Male cones with pollen on separate trees. Seeds one or two, 3/16 inch long, pointed, angled, and light brown. The bark is light brown or gray, thin, and furrowed into scaly ridges. The wood is light brown with whitish sapwood, nonporous, lightweight, and soft.

Rare and scattered on local areas on rocky slopes, especially gypsum, and in grasslands in southwest and northwest Oklahoma. Very noticeable on the rocky summits of Antelope Hills in Roger Mills County. Used only for fence posts and fuel. It is distinguished by the reddish cones (berries). This is a hardy plant that will resprout from the stumps after cutting or burning.”

Rocky Mountain Juniper. “Shrub or small tree, scaleleaf evergreen, aromatic, becoming 20 feet tall with straight trunk 6 inches in diameter, and pointed conical dense crown of gray green foliage and often drooping. Twigs are slender, gray or brown, and rough. Leaves are paired or opposite in 4 rows forming slender 4-angled twigs, scalelike, 1/16 inch long, gray green, ending in long narrow sharp points, on leading shoots needlelike to 1/4 inch. Cones are berrylike, 1/4 inch in diameter, bright blue with whitish coat, juicy, sweetish, resinous, maturing second year. Male cones with pollen on separate trees. Seeds, usually two, grooved and angled. The bark is reddish brown, thin, fibrous and shreddy. The wood is deep red with thick, whitish sapwood, nonporous, aromatic, lightweight, and soft.

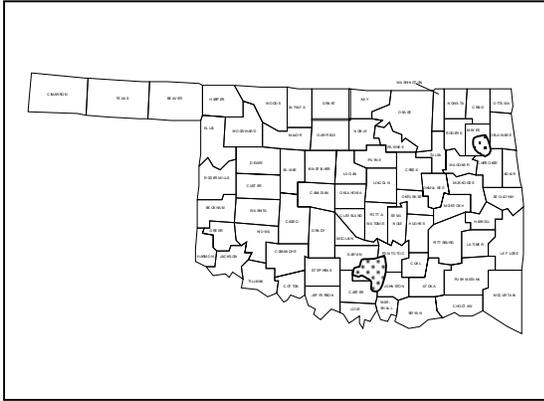
Rare and very local in juniper woodlands on rocky slopes, foothills of the Rocky Mountains in Cimarron County in northwest Oklahoma. Uses include fenceposts, fuel and cedar chests. Also used for shelterbelts and ornamental plantings.”

Eastern Redcedar. “Small to medium-sized scaleleaf evergreen, aromatic tree, becoming 30 feet tall with straight trunk 18 inches in diameter and pointed conical dense crown, becoming irregular. Twigs are slender, gray, rough with bases of dead leaves. Leaves are paired or opposite in 4 rows forming slender 4-angled twigs, scalelike, 1/16 inch long, ending in long narrow sharp point, dark green, with gland dot, on leading shoots needlelike to 3/8 inches. The cones are berrylike, 1/4-3/8 inches in diameter, dark blue with a bloom, soft, juicy, sweetish and resinous. Male cones on separate trees, oblong, 1/8 inch long, pale yellow, producing pollen in

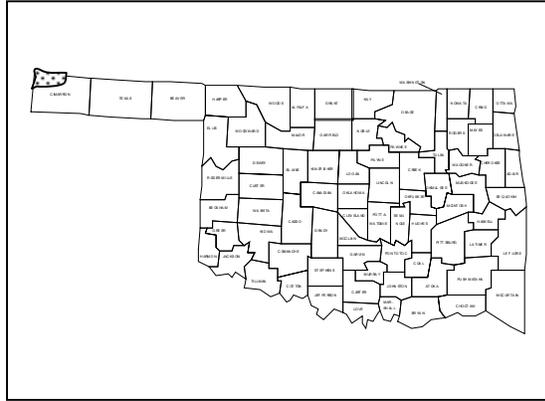
early spring. Seeds one or two, less than 1/8 inch long and pointed. The bark is reddish brown, thin, fibrous and shreddy. The wood is dark or purplish red turning to dull red or reddish brown, with thin whitish sapwood, nonporous, fine-textured, with pencil odor, moderately heavy, hard, and resistant to decay.

Common and widespread, especially in rocky soils and on limestone outcrops, nearly throughout Oklahoma, except in the panhandle. Uses are fenceposts, cedar chests, wardrobes, cabinetwork, flooring, carving, novelties and formerly pencils. Planted for shelterbelts and ornamentals, with small wild plants used for Christmas trees. Special products are cedar-leaf oil for medicine and cedar wood oil for medicine and perfumes.”

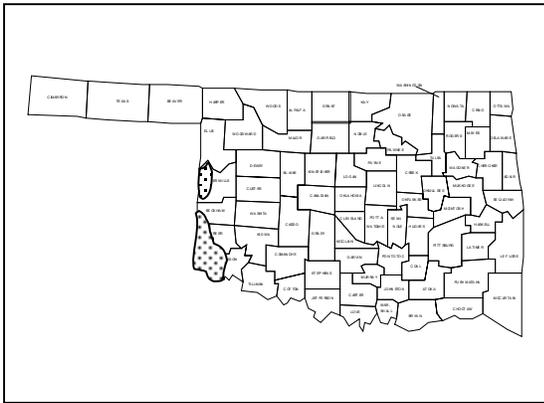
Native Ranges of Oklahoma's Juniper Species



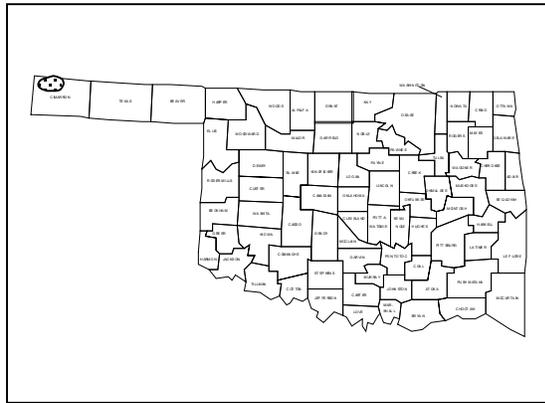
Ashe juniper



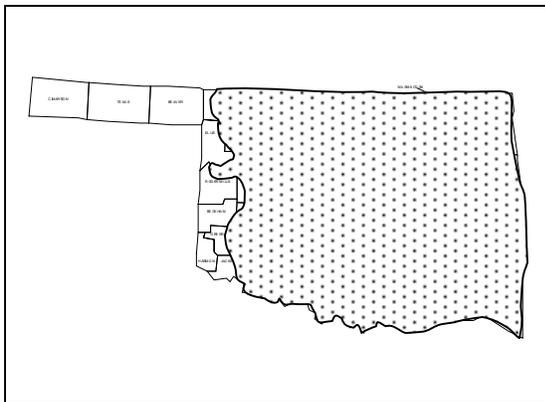
Oneseed juniper



Redberry juniper



Rocky Mountain juniper

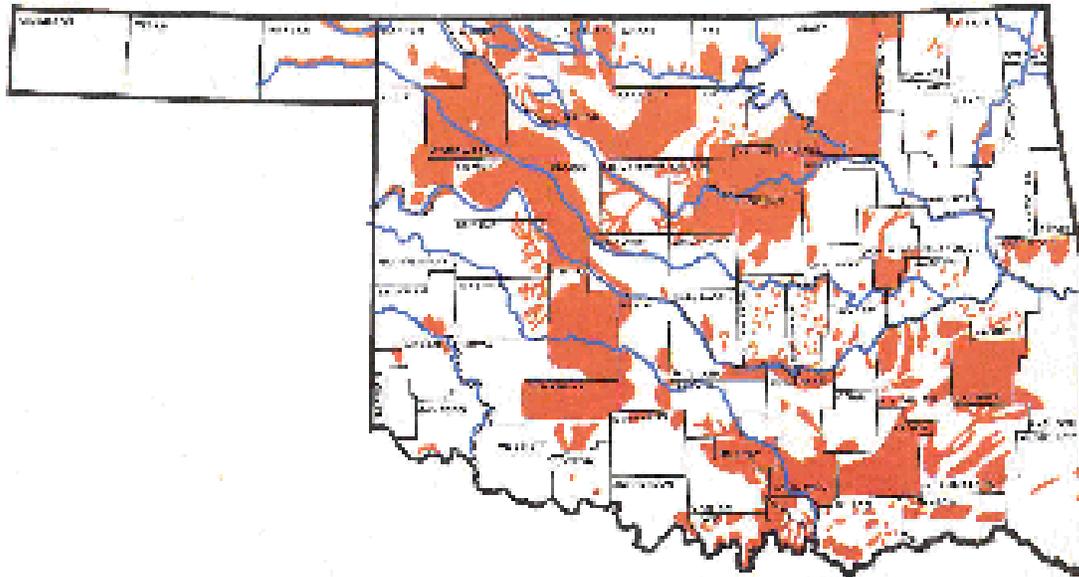


Eastern redcedar

Source: Little 1996

Eastern redcedar is the most common and currently the most invasive of the junipers in Oklahoma, thus most of the remaining discussion will be focused on this juniper species. Historically, eastern redcedar existed in river and creek drainages and rocky outcroppings. Dr. David W. Stahle, a professor at the University of Arkansas-Fayetteville, noted that Oklahoma contains eastern redcedars that have been dated from 500 to 1,000 years old, which are also some of the oldest trees in the entire south central United States. Many years of fire suppression and seedling plantings have resulted in the expansion of this woody species from its historic range. In 1950, eastern redcedar was considered a problem on almost 1.5 million acres of rangeland in Oklahoma, and by 1985, this had increased to over 3.5 million acres (Stritzke and Bidwell 1989).

Currently, the USDA Natural Resources Conservation Service has estimated that eastern redcedar has invaded an estimated 8 million acres of prairies and crosstimbers habitat in Oklahoma and the amount of infestation will double every 18 years. It is estimated by 2013 that



Eastern redcedar and Ashe juniper in Oklahoma in 1994. Shaded portions of the map represent areas where eastern redcedar and Ashe juniper were concentrated and were compiled from county maps provided by survey respondents.

eastern redcedar will have invaded an estimated 12.6 million acres in Oklahoma (Oklahoma State University Rangeland Ecology and Management 2001). Oklahoma State University and the USDA NRCS completed this inventory of junipers in the fall of 1994 (Bidwell et al. 1996).

Problems of Juniper Encroachment

Displacement of Native Plant Species

- The invasion of junipers into the native plant community reduces biological diversity by reducing the number of living organisms, their functions and interactions (Bidwell et al. 1996).
- The dramatic increase of juniper has led to the reduction in patch size and fragmentation of plant communities creating ecosystem dysfunction (Coppedge et al. 2002).

- In riparian zones, invasive exotic plants can cause a multitude of problems, including undesirable changes in stream flow dynamics, biological diversity, wildlife habitat and forage production (Cooper 1998).

Displacement of Wildlife Species

- Invasion of junipers into native plant communities changes habitat structure and composition resulting in some wildlife species displacement (Bidwell et al. 1996).
- Juniper infestation in turkey roost sites has been known to displace the entire turkey flock (Smith 2001).
- Grassland bird abundance and richness approached nonexistence with only 25% juniper cover present (Coppedge et al. 2002).
- At current invasion rate of eastern redcedar and Ashe juniper, Oklahoma could be losing up to 5,680 bobwhite quail coveys per year (Guthery 2001).
- Research has shown that junipers are a dominant factor in the displacement of grassland birds and songbirds from the native prairie and only three junipers per acre will displace some birds from their habitat (OSU Rangeland Ecology and Management 2001).
- Invasion of junipers in rangeland has the potential to increase predation on grassland birds (Harmon, personal communication).

Livestock/Forage Production

- A juniper tree with a six-foot crown diameter on a shallow prairie range site will reduce forage by about six pounds (Stritzke and Bidwell 1989).
- Junipers will reduce forage production if left untreated. For example, a range site with the potential to produce 4,000 pounds per acre of forage may become infested with 200 juniper trees per acre. If not managed, this area can increase to 470 trees per acre in ten years and would produce less than 2,200 pounds per acre of forage in the tenth year (Engle and Stritzke 1992).
- The invasion of junipers into native rangeland shades out forage for wildlife and livestock and reduces stocking rates and carrying capacity (Bidwell et al. 1996).
- Increase of juniper canopy in pastures will reduce pasture visibility and increase labor during livestock handling (Weir, personal communication).

Water Quality

- Juniper encroachment degrades watershed quality by increasing the amount of bare soil and increasing the potential for erosion (Thurow and Carlson 1994).
- Junipers have an extensive root system and access a greater volume of soil water than herbaceous plants, and are “water wasters” when the supply of soil water is not limited (Thurow and Carlson 1994).
- Riparian areas play an important role in improving water quality, protecting the streamside environment, reducing flood damage, filtering contaminants and providing wildlife habitat. Invasive plants compete aggressively with indigenous species and may drastically change ecological communities and reduce natural diversity within the riparian zone (Cooper 1998).

Economic Losses

- In 2001, an estimated \$52 million was lost in lease hunting due to juniper invasion (OSU Rangeland Ecology & Management 2001).

- Annually the loss of forage production is estimated to be \$100 million in the year 2001 (OSU Rangeland Ecology & Management 2001).
- In 1996, state residents and nonresidents spent \$1.3 billion on wildlife-associated recreation in Oklahoma. Of this total, trip-related expenditures were \$377 million and equipment purchases totaled \$854 million. The remaining \$61 million was spent on licenses, contributions, land ownership and leasing, and other items and services (U.S. Dept. of Fish & Wildlife and U.S. Dept. of Commerce 1996). The economic losses in Oklahoma could be severe as the result of habitat deterioration from juniper invasion if left untreated.

Benefits of Redcedar

- Small amounts of junipers can be beneficial for woodland wildlife. Juniper stands that are very dense can provide thermal and loafing cover for wildlife. The value of junipers for wildlife habitat is very limited. The value depends on the amount of other cover present. Small areas of junipers may be an important cover resource for wildlife (Stritzke and Bidwell 1989).
- Junipers used in windbreaks can cut home heating costs, reduce the amount of dust entering a home and protect a home from snow drifting (U.S. Dept. of Ag.).
- Research at the Harve Montana Experiment Station has shown a herd of cattle protected by windbreaks gained 35 pounds more per animal during a mild winter and lost 10.5 pounds less during a severe winter than did unprotected cattle (U.S. Dept. of Ag. 1976).
- Junipers in windbreaks will reduce wind erosion, increase soil moisture, provide livestock and wildlife protection, provide some wildlife species an additional food resource, reduce the drying effect of wind on soil and plants, and prevent the abrasive action of rapidly moving soil particles on young tender plants (U.S. Dept. of Ag.).
- Redcedar and other junipers have economic value when harvested for wood products.
- Some individuals may perceive the evergreen nature of eastern redcedar and other junipers as aesthetically pleasing in native range settings, or as ornamentals. We need to emphasize that there are other plants (native and noninvasive exotics) that can be used in windbreaks and ornamental plantings instead of invasive juniper species.

Consequences

- Doing nothing is not an option for natural resource managers, landowners and policymakers. Time is not on our side with this invasive species. Doing nothing to control juniper will eventually reduce the health of our ecosystems in Oklahoma.
- The consequences of juniper expansion are predictable. Oklahoma State University has projected the economic impact of the juniper infestation if left untreated in Oklahoma by 2013 (Oklahoma State University Rangeland Ecology and Management 2001) as follows:

• Catastrophic wildfire	\$107 million dollar loss
• Cattle forage	\$205 million dollar loss
• Lease hunting	\$107 million dollar loss
• Recreation	\$17 million dollar loss
• Water yield	\$11 million dollar loss

- Oklahoma State University also estimated that 12.6 million acres of prairies, crosstimbers and forest will be infested with junipers by 2013. This means that 28% of the landscape in Oklahoma will be infested with junipers in just eleven more years.
- Degraded wildlife habitat will have consequences in many ways. In the future, many wildlife species of concern may become listed if wildlife habitat continues to decline. Listing wildlife species as threatened or endangered is not what wildlife managers want to do. For some species habitat decline may increase restrictions for landowners and managers if junipers are left untreated.
- Cost increases for everyone if junipers are left untreated.
- The cost of controlling juniper increases as the canopy density increases from low to high.
- Uncontrollable wildfire as the result of high juniper infestation affects everyone. The loss of property, costs of fighting wildfires, increase in insurance premiums and the loss of life may be the direct result of wildfires made worse by juniper encroachment.

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Air Quality and Human Health Issues

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The objective of this committee is to explore the impacts on human health of eastern redcedar and other juniper pollen, and the smoke derived from wildfires and prescribed burning.

Committee Recommendations

- We recommend the use of prescribed burning to control redcedar and other junipers to limit the impact of pollen and particulates to human health. The Legislature should consider providing greater incentives to landowners to use fire as a land management tool.
- We recommend the Oklahoma Health Department work with allergy clinics, physicians and others to implement a tracking mechanism to quantify the effects of redcedar and other juniper pollen on the health of Oklahomans.
- We recommend the Oklahoma Department of Environmental Quality (ODEQ) continue to work with other state and federal agencies in Oklahoma on the timing of prescribed burning as agencies practice juniper control on public land and as information is provided to the public on the optimum time to burn.

Overview

Redcedar and other junipers can affect human health and air quality negatively in two ways: one, if no control is practiced, the increasing number of junipers creates additional pollen which causes allergic reactions and asthma type health problems in humans; and two, when junipers are burned, the resulting fire will have pollutants as by-products that can negatively affect human health.

In recent years, policymakers have weighed the benefits of prescribed fire to restore wildland ecosystems against the detrimental health and air quality effects from both controlled and

uncontrolled burning. Even the U.S. Environmental Protection Agency (EPA) recognized the importance of prescribed fire in 1998 by establishing an interim air quality policy that addresses how best to achieve national clean air goals while improving the quality of wildland ecosystems through the increased use of fire. This policy is still in effect (U.S. EPA 1998).

In Oklahoma, some landowners in production agriculture and forestry utilize controlled burning and prescribed fire. However, many rangeland experts say that Oklahoma's strict liability law and social uneasiness with fire have severely limited the practice of controlled burning and prescribed fire in the state, and the lack of fire is a contributor to the spread of junipers in Oklahoma.

Human Health Concerns Due to Pollen

In the past few decades, juniper pollen has been one of the primary culprits for an increase in human allergic reactions in Oklahoma. Dr. Estelle Levetin, a professor of biology specializing in mycology and botany with the University of Tulsa, has been tracking pollen counts attributed to the junipers since 1987. Her research documents an annual increase in pollen counts attributed to junipers for the past 13 years (Levetin 2002). In Oklahoma, the amount of juniper pollen peaks during March and April of each year. Ashe juniper, common in southern Oklahoma, and eastern redcedar are closely related species, and their pollen is similar. Individuals allergic to Ashe juniper are likely to be allergic to eastern redcedar, as well.

The number of Oklahomans negatively affected by redcedar and other juniper pollen is unknown. While some people may test positive for an allergic reaction to redcedar or Ashe juniper, many people don't seek the help of an allergist, opting instead to use over-the-counter medications to control their allergic reactions, or seeking treatment for their symptoms through their primary care physician.

The National Allergy Bureau (NAB) is the section of the American Academy of Allergy, Asthma and Immunology's Aeroallergen Network that is responsible for reporting current pollen and mold spore counts to the media. Oklahoma has three certified stations to report pollen and mold spore counts—two in Oklahoma City and one in Tulsa. The NAB began issuing its report in 1992. There are about 81 counting stations in the United States and 4 in Canada.

According to information gathered from the *University of Tulsa's Aerobiology Lab* website (<http://pollen.utulsa.edu>) and the *Fire Effects Information System* website, summer is the only season where some level of pollination does not occur for the junipers discussed in this report.

Human Health Concerns Due to Poor Air Quality Caused by Smoke from Burning

Smoke from wildland burning is admittedly a concern for human health. Burning vegetation causes emissions of many different chemical compounds, including gases and particulate matter. The quantities and components of these chemical compounds depend in part on the types and volume of fuel, the moisture content, and the temperature of combustion.

The practice of prescribed wildland burning to reduce the available fuel load, and therefore the risk from uncontrolled burning or wildfire is a public policy decision that seems to be gaining momentum nationally. Prescribed or controlled burning limits the area burned, the time at which the burning takes place, the conditions under which the burn occurs, and therefore the amount of smoke produced. From a human health perspective, prescribed burning can be viewed as a tradeoff between the potential temporary negative impact to human health from smoke, versus the positive long-term impacts of decreasing pollen counts by stopping the unchecked spread of redcedar and other juniper species and by controlling the smoke from uncontrolled burning.

The negative impacts of smoke on human health are well documented. However, the negative effects of prescribed burning can be minimized by controlling the amount of fuel burned at one time and by preparing the public. In Oklahoma, there are many tools available to persons who wish to burn wildlands in a human health and safety conscious manner, as outlined below.

Tools Available To Protect Human Health And Safety

State Burning Laws. Oklahoma law describes lawful and unlawful burning and the requirement for conducting a “prescribed burn.” The process to conduct prescribed burning includes a requirement to complete a prescribed burning notification plan and to notify adjacent landowners, rural fire departments, and/or the Forestry Services Division of the Oklahoma Department of Agriculture, Food and Forestry (ODAFF) in a timely manner of a person’s intent to burn. These provisions are included in O.S. Title 2, Article 16, Sections 16-24.1, 16-25, 16-28 and 16-28.2.

Firewise Program. *Firewise* is a national program designed to help people reduce their wildfire risk by creating defensible space. ODAFF Forestry Services and the Bureau of Indian Affairs (BIA) are implementing the *Firewise* program in Oklahoma. Forestry Services used federal funds to produce *Firewise* kits to help educate fire departments about the program. More than 400 of these kits have been produced and delivered to fire departments in every county. Oklahoma sponsored a regional *Firewise* workshop in Norman in October 2002. *Firewise* information is presently being produced and distributed with support of ODAFF, the Civil Emergency Management Department and the BIA.

USDA Natural Resources Conservation Service (NRCS) Prescribed Burning (Code 338). The NRCS has a prescribed burning conservation practice for wildland burning. This practice requires a written burn plan and appropriate equipment and personnel to conduct the burn. The plan must consider wildlife needs, existing fire barriers, notification of adjacent landowners, fire departments and public safety officials, weather factors, location of utilities and smoke impacts.

Prescribed and Certified Fire Instruction at Oklahoma State University (OSU). OSU is the only location in the nation where a prescribed and certified fire course is offered to NRCS employees. The course, which has been taught for six years, certifies NRCS employees to write fire and burn plans. OSU also teaches a weeklong course for the NRCS and the U.S. Army Corps of Engineers that covers all aspects of prescription burning. OSU offers an advanced prescription-burning course, as well.

Air Quality Conditions. EPA requires ODEQ to provide a daily air quality index (AQI) for metropolitan areas with a population greater than 350,000. In Oklahoma, the AQI is provided for Oklahoma City, Tulsa and Lawton. The AQI is based upon the previous day's monitored concentrations of the criteria pollutants. The index is valuable to alert people of potential air quality problems and to track trends: www.deq.state.ok.us/AQDnew/AQIndex/AQI.htm.

ODAFF WebPages Regarding Burning and Fire Danger. ODAFF Forestry Services issues red flag fire alerts when fuel and weather factors create unsafe burning conditions and also advises the Governor on outdoor burning bans. Information on current red flag alerts, burning bans or general fire danger conditions, is available at these sites:

<http://www.state.ok.us/~okag/redflag/banguides.html> -- Burning ban guidelines for Oklahoma.

<http://www.state.ok.us/~okag/redflag/firewx.html> -- Fire danger in Oklahoma.

<http://www.oda.state.ok.us/redflag/forred.html> -- Red flag fire alert page for Oklahoma. This site shows which counties have a burning ban in effect and which are under a red flag fire alert.

Assessment of Weather Conditions. Current and forecasted weather conditions may be obtained from the National Weather Service (www.srh.noaa.gov/oun/) or Oklahoma MESONET (<http://okmesonet.ocs.ou.edu/>). MESONET access is free to Oklahoma schools, universities, and vocational-technical colleges, other in-state educational organizations, and Oklahoma local and state agencies. A small monthly fee is charged to all other users. The MESONET provides agriculture-specific data, including dispersion indices and burn advisories.

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Subchapter 3, Air Quality Standards and Increments

Appendix E, Primary Ambient Air Quality Standards

Appendix F, Secondary Ambient Air Quality Standards

Subchapter 13, Open Burning

Subchapter 41, Control of Emission of Hazardous Air Pollutants and Toxic Air Contaminants

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Economics of Redcedar Control in Forest and Range Management

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The committee's objective is to examine the economics and costs associated with controlling and not controlling the infestation of eastern redcedar and other junipers in Oklahoma.

Fundamental Elements to Recognize

The juniper problem resulted from and continues to increase because of the following:

- inadequate public attention given to the environmental hazard created by junipers;
- inadequate education of the general public to the problems associated with juniper and the benefits of prescribed burning;
- lack of enabling programs (as opposed to direct incentive payment programs) for land managers; and
- liability statutes that limit prescribed burning.

Committee Recommendations

- We recommend establishing prescribed fire associations throughout the state to facilitate landowner led prescribed fires. The Oklahoma Department of Agriculture, Food and Forestry (ODAFF), Oklahoma State University (OSU) and U.S. Department of Agriculture–Natural Resources Conservation Service (NRCS) should provide leadership.
- We recommend passing a new prescribed fire law, similar to the Oklahoma Livestock Activities Liability Limitation Act passed in 1999 (O.S. Title 76, Section 50.1), to limit landowners' liability when conducting a prescribed burn.
- We encourage the Governor of Oklahoma to make the juniper invasion a priority issue for his administration. Some things the executive office could do include: create a prescribed fire council; proclaim a prescribed burning month; and issue news releases regarding prescribed fire and agriculture, water quantity, wildlife, threatened and endangered species, the wildland/urban interface, public health issues such as allergies due to junipers, public safety issues and the *Firewise* Program.

- We recommend that invading junipers, including redcedar, be removed from all land owned or operated by the state of Oklahoma. Our state lands should be good examples of land management.
- We recommend that Oklahoma provide a state certification program in “prescribed burning.”

The Cost of Not Controlling Junipers

Oklahoma has 17 million acres of prairie, shrubland, crosstimbers forests and other forests. Of these 17 million acres, in 1994 there were 6.3 million acres with at least 50 juniper trees per acre, and 2.5 million acres with at least 250 trees per acre, for a 37% loss of native ecosystem. In 2001, 8 million acres had at least 50 trees per acre and 5 million acres had at least 250 trees, for a 47% loss of native ecosystem. In 2013, 12.6 million acres will be infested with at least 50 trees per acre, and 8 million acres will be covered with at least 250 trees per acre, creating a 74% loss of native prairies, shrublands, cross timbers forests and other forested ecosystems (Oklahoma State University Rangeland Ecology and Management 2001).

According to the Oklahoma NRCS, at the current invasion rate, Oklahoma is losing an estimated 762 acres to junipers per day with 50 or more trees per acre. The loss of prairies, shrublands and crosstimbers forests is nearly 300,000 acres per year. Oklahoma is losing 5,000 coveys of Bobwhite quail per year because of habitat degradation due to eastern redcedar and other junipers. Only three juniper trees per acre displace sensitive prairie songbirds (Oklahoma State University Rangeland Ecology and Management 2001).

The annual economic loss in an average year in 2001 for catastrophic wildfire, loss of cattle forage, loss of wildlife habitat (lease hunting), recreation, and water yield was estimated to be \$218 million. If no preventative control steps are taken to control invading junipers, the annual economic loss in an average year in 2013 is expected to be \$447 million (Oklahoma State University Rangeland Ecology and Management 2001).

Other economic losses more difficult to quantify from juniper infestation include potential loss of endangered species, poor water quality, sedimentation in water reservoirs, and degraded air quality resulting in compromised human respiratory health.

To summarize, social and economic losses will continue to rise as the result of doing nothing to control invading junipers. Next, we will explore the various methods and costs involved in juniper control.

The Cost of Controlling Redcedar and Other Junipers

The invasion of redcedar and other fire intolerant junipers into prairies, shrublands, and forests is a direct result of fire suppression. Redcedar and other juniper encroachment is an indicator of poor land management and ecosystem dysfunction. At its July 18, 2002 meeting in Oklahoma City, the State Technical Committee for NRCS cost-share programs identified juniper encroachment as the number one conservation concern in Oklahoma. An NRCS survey, the

results of which were presented at this meeting, estimates that \$157 million is currently needed to address conservation land treatment needs to control redcedar and other junipers. The best management practices (BMPs) described on the following pages can be applied throughout Oklahoma and surrounding states. The prescriptions will fit most land management goals and are supported by research. Currently, a variety of state and federal cost-share program funding is available to assist qualifying landowners with juniper control.

From research reports and experience with a variety of control methods, we compiled a list of treatment options or BMPs for controlling redcedar and other juniper species. These treatments and their costs are described in the tables that follow. The overriding BMP is to prevent juniper encroachment by using frequent, low-cost **ecosystem maintenance** methods, such as prescribed fire. In contrast, **ecosystem restoration**, converting stands of redcedar and other junipers back to native plant communities, requires intensive high-cost inputs.

No single practice is ideal for every parcel of land, but fire is a natural event that is necessary if the land is to remain healthy. Prescribed fire is the most environmentally appropriate and cost-effective practice for maintaining ecosystems in prairies, shrublands, and forests. For **ecosystem restoration**, prescribed fire is still the most appropriate practice, but usually must be combined with other practices such as mechanical treatment. However, the type of fire used to **restore ecosystems** (high intensity) is usually more difficult to apply and may carry greater risk than fire used to **maintain ecosystems** (low intensity).

In the tables following, we list BMPs by the habitat type, level of encroachment (i.e., tree density and size), and spatial scale (i.e., land area in acres) of the target area. The lower levels of encroachment (e.g., for prairie and shrubland habitats, the “no juniper” and “<6’ tall <250 trees/acre”) can be thought of as **ecosystem maintenance** methods. Greater levels of encroachment can be thought of as **ecosystem restoration** methods.

Other Considerations for the BMPs That Follow

Fire and Mechanical – If possible, burn before mechanical treatment. This will reduce spot fire risks and mechanical costs.

Piling Brush – Do not pile junipers after cutting. Leave trees where they lay after cutting to facilitate the fire that will follow. Burning juniper piles gives off firebrands that travel hundreds of feet downwind and will cause spot fires.

Reseeding – Once junipers are cut and/or burned, it is **not** necessary to reseed the area. Native grasses, forbs, legumes and woody plants will recover rapidly with adequate rainfall.

Grazing Management – None of the control options listed below will work without proper grazing management. The plant community cannot be restored or maintained without a proper stocking rate for livestock and periodic fire. Fire cannot be used without the availability of adequate fine fuels (dead grass and forbs) to carry the fire.

Prairie and Shrubland Habitats - BMPs

Levels of Encroachment	Scale of Target Area for Restoration (Acres)			
	160 acres or less	160 - 640 acres	640 - 5,000 acres	5,000 - 40,000 acres
Recommended Treatment and Cost/Acre				
No junipers	Fire A \$10	Fire A \$7	Fire A \$5	Fire A \$3
<6' tall <250 trees/acre	Fire B \$10 Mech A \$25 Mech G \$20 Herb \$40	Fire B \$7 Mech G \$20	Fire B \$5 Fire C \$10 Fire E \$15	Fire B \$3 Fire C \$10 Fire E \$15
6' to 20' tall 250 trees/acre	Fire F \$15 Fire G \$20 Mech B \$50 Mech C \$40 Mech D \$90 Mech E \$11 Mech F \$21	Fire F \$12 Fire G \$17 Mech B \$50 Mech C \$40 Mech D \$90 Mech E \$11 Mech F \$18	Fire G \$17 Fire C \$10 Fire E \$15	Fire G \$15 Fire C \$10 Fire E \$15
>20' tall >250 trees/acre	Fire D \$25 Mech F \$21	Fire D \$25 Mech F \$18	Fire D \$20 Mech F \$16	Fire D \$20 Mech F \$16

Treatment Options ^a	Specific Treatment Descriptions ^b
Fire:	A – Prescribed fire
	B – Prescribed burning with hand ignition to kill residual trees
	C – Helicopter Ignition with helitorch
	D – Helicopter Ignition with helitorch & paraquat
	E – Helicopter Ignition with ping-pong machine (DAID)
	F – Prescribed burning with hand ignition followed by individual tree ignition
	G – Prescribed burning with hand ignition followed by mechanical
Mechanical:	A – Hand tool (lopper, bow saw, axe, chain saw)
	B – Tractor or bobcat with hydraulic clipper
	C – Cedar hydraulic saw
	D – Bulldozer (pie shaped saw, push blade)
	E – Two bulldozers with 6 ft. ball and two 100 ft. anchor chains
	F – Mechanical E with follow-up using Fire A
	G – Mow or Shred
Herbicide:	Velpar or picloram (individual tree treatment)

^a After all initial treatments, prescribed burning should be repeated every 3 to 5 years to maintain the site.

^b Reseeding after treatment is unnecessary, cost prohibitive, and usually destructive.

Oak-hickory, Oak-pine, and Post Oak-blackjack Oak Forest Habitats - BMPs

	Scale of Target Area for Restoration (Acres)			
Levels of Encroachment	160 acres or less	160 – 640 acres	640 - 5,000 acres	5,000 - 40,000 acres
	Recommended Treatment and Cost/Acre			
No junipers	Fire A \$10	Fire A \$7	Fire A \$ 5	Fire A \$ 3
Understory junipers	Fire B \$10 Mech A \$25 Herb \$40	Fire B \$7	Fire B \$ 5 Fire C \$10 Fire E \$15	Fire B \$ 5 Fire C \$10 Fire E \$15
Midstory junipers	Fire F \$15 Fire G \$20 Mech A \$25 Mech B \$50 Mech C \$40	Fire F \$12 Fire G \$17 Mech B \$50 Mech C \$40	Fire G \$17 Fire C \$10 Fire E \$15	Fire G \$15 Fire C \$10 Fire E \$15
Overstory junipers	Fire D \$25 Mech A \$25 Mech F \$21 Mech G \$100	Fire D \$25 Mech F \$18 Mech G \$75	Fire D \$20 Mech F \$16	Fire D \$20 Mech F \$16

Treatment Options ^a	Specific Treatment Descriptions
Fire:	A – Prescribed burning
	B – Prescribed burning with hand ignition to kill residual trees
	C – Helicopter Ignition with helitorch
	D – Helicopter Ignition with helitorch & paraquat
	E – Helicopter Ignition with ping-pong machine (DAID)
	F – Prescribed burning with hand ignition followed by individual tree ignition
	G – Prescribed burning with hand ignition followed by mechanical
Mechanical:	A – Hand tool (lopper, bow saw, axe, chain saw)
	B – Tractor or bobcat with hydraulic clipper
	C – Cedar hydraulic saw
	D – Bulldozer (pie shaped saw, push blade)
	E – Two bulldozers with 6 ft. ball and two 100 ft. anchor chains
	F – Mechanical E with follow-up using Fire A
	G – Selective dozing followed by Fire A
Herbicide:	Velpar or picloram (individual tree treatment)

^a After all initial treatments, prescribed burning should be repeated every 3 to 5 years to maintain the site.

Riparian Zone Habitats - BMPs

Levels of Encroachment	Recommended Treatment and Cost/Acre
No junipers	Fire A \$10
<6' tall <250 trees/acre	Fire B \$10 Mech A \$25
6' to 20' tall 250 trees/acre	Mech G \$100
>20' tall >250 trees/acre	Mech G \$150

Treatment Options ^a	Specific Treatment Descriptions
Fire:	A – Prescribed burning
	B – Prescribed burning with hand ignition to kill residual trees
	C – Helicopter Ignition with helitorch
	D – Helicopter Ignition with helitorch & paraquat
	E – Helicopter Ignition with ping-pong machine (DAID)
	F – Prescribed burning with hand ignition followed by individual tree ignition
	G – Prescribed burning with hand ignition followed by mechanical
Mechanical:	A – Hand tool (lopper, bow saw, axe, chain saw)
	B – Tractor or bobcat with hydraulic clipper
	C – Cedar hydraulic saw
	D – Bulldozer (pie shaped saw, push blade)
	E – Two bulldozers with 6 ft. ball and two 100 ft. anchor chains
	F – Mechanical E with follow up using Fire A
	G – Remove cut trees from riparian zone; follow with Fire A
Herbicide:	Velpar or picloram (individual tree treatment)

^a After all initial treatments, prescribed burning should be repeated every 3 to 5 years to maintain the site.

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Economic Opportunities and Beneficial Uses of Redcedar

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The objective of this committee is to consider the beneficial uses of eastern redcedar (*Juniperus virginiana*) and other junipers (*Juniperus spp.*) as a basis for an emerging forest industry that will contribute to economic development opportunities while also helping control its spread.

Committee Recommendations

- We strongly support the redcedar research and product development efforts of Oklahoma State University (OSU), encourage the Food and Agricultural Products Research and Technology Center at OSU to select redcedar as a priority project and urge the legislature to provide additional funding support for these efforts.
- We strongly support the need for a statewide forest inventory using current Forest Inventory and Analysis methods, and urge the legislature to provide additional state resources to the Department of Agriculture, Food and Forestry (ODAFF) to match federal funding available for this purpose.
- ODAFF Forestry Services formerly developed a very effective program in forest utilization but funding difficulties have prevented the agency from maintaining this capability. The committee recommends that the legislature support this important program to continue development of redcedar and other forest product industries.

- Further research is needed to clearly define the best and most appropriate juniper-based manufacturing processes and their integration with each other. The Oklahoma Alliance for Manufacturing, a State of Oklahoma program, should be encouraged to assist in such efforts.
- Marketing assistance to small and startup businesses, especially ones with a new product line, is of paramount importance. The Oklahoma Department of Commerce and ODAFF could be appropriate leads in this area.
- A major source of funds needs to be set aside for worthy business opportunities. The State of Oklahoma has these types of funds in place presently, such as the Technology Business Finance Program. The committee urges the legislature to provide additional funding support through these programs to support juniper-based business opportunities.

Introduction

Eastern redcedar (*Juniperus virginiana*) is a tree species that will elicit an opinion from almost anyone in the State of Oklahoma. This tree is native to the state, however, in the last hundred years it has expanded its claim on the land and is currently a serious invader. The U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) estimates that there may be currently as many as 8 million acres with stands of juniper on them in the state (Oklahoma State University Rangeland Ecology and Management 2001). This doesn't speak to the age, density, or number of redcedars on this acreage, however, it can be assumed that if it is within this 8 million acres it probably has an appreciable amount of redcedars that are most likely in a young or brushy stage. Furthermore, by some accounts, this acreage is expanding or increasing by up to 300 thousand acres per year (Ibid). Although a large effort is being mounted to control redcedar by mechanical means and by prescription of fire, a 300 thousand acre increase per year is a formidable amount to try to control through costly methods such as burning and cutting alone.

During the last ten years it has been a recurring theme to try to ease the pressure of the invading redcedar by finding economic uses for it as an alternative to labor and capital intensive clearing of the land. Eastern redcedar has a long history as a valuable lumber commodity. Its deep red heartwood has been valued for its rot resistance and for its beauty for over 3,000 years. The uses for this wood range from the lowly fence post for the sod-buster farmer on the prairie when a well preserved post was unheard of, to the modern day shoe trees and novelty items that use the heartwood of the tree for its beauty; modern applications such as these probably have a retail value that rivals any wood in a similar market.

Eastern redcedar is fairly fast growing, but it rarely attains great size and is usually accompanied by numerous limbs yielding many knots in the wood. This aspect of the lumber, however, is not as degrading as it first appears. Within the industry, knots are considered one of the attractive features of redcedar lumber. This lumber is rarely used for its structural strength, but rather for its beauty and for its anti-fungal and anti-microbial qualities in resisting rot. The presence of the dark, tight or sound knots in its wood does not pose a problem. Furthermore, the heartwood of a mature tree can be processed for the oil content, yielding cedar oil, which is used in perfumes as a fixative and is fairly valuable.

The problem we face is the economic marketability of redcedar and other junipers. The major drawback is that the primary use for junipers is dependent upon a large amount of heartwood in the tree. The vast majority of junipers that are growing are young and brushy and have small amounts of heartwood compared to its sapwood, limbs and needles. So where we have a very economically beneficial tree in its mature stage, in its present invasive and young stage we have a material that has little market value. In order to overcome this problem and to utilize the most plentiful resource that we have, we must develop markets and products to fill those markets.

Currently the size and value of the juniper market in the state is unknown. In 1993, Tim Cannon, at that time Utilization Forester for the Oklahoma Department of Agriculture - Forestry Services, estimated that the total sales of redcedar lumber approached five million dollars in 1992. This represents a small amount of money on a statewide economic scale, but is an indication of the potential of the market if stimulated and developed.

The Tree

Eastern redcedar is one of the most widely distributed conifers in the eastern United States and is found in virtually every state east of the 100th meridian or the Grand Prairie (Great Plains). It ranges from Canada to Mexico and is currently spreading across most of the prairie states through the central part of North America. Its natural wide distribution tells of its ability to grow under extreme and highly variable climatic conditions, as well as a range of soil, topographic and altitude variables. It will grow on areas ranging from dry rock outcrops to swampland. Like most any species it grows best on deep, moist, well-drained sites where its height may reach as much as 60 feet in 50 years. It is this ability to withstand variations in soils and climatic extremes and its ability to thrive on soils that are low in nutrients that are major contributors to its spreading in the Oklahoma area. It is spreading onto abandoned farmland, pastureland and land that has been over cropped and misused.

Eastern redcedar is a dioecious species, meaning it has male and female plants, and the trees reach sexual maturity at about 10 years of age. The seed is borne in a green to greenish-white to whitish-blue cone appearing like berries on the tree and are usually found in heavy amounts, but only on the female trees. Each fruit will contain between 1 and 4 small brownish seeds. Mature trees produce some seeds nearly every year but good crops occur only every two to three years. Eastern redcedar will not reproduce naturally by sprouting or suckering, and if it is cut off near the ground level it will not reappear from that single plant. Fire is also very deadly to the small plants as the oil-soaked leaves are a natural combustible material and the bark is thin enough that it does not protect the cambial layer from ground fires. Few insects cause serious damage to the tree, although the roots are susceptible to nematode attack.

Eastern redcedar displays a great diversity in phenotypic characteristics such as tree form, color and crown shape. This is important in that this high variability in genetic material makes it an excellent candidate for the production of different varieties used in the landscape business and potentially important for development of varieties for commercial applications and uses.

Possible Product List For Eastern Redcedar and Other Junipers

The following list of potential products is divided into two main categories. First, there are solid wood or lumber products made from the reddish heartwood that are dependent upon larger older trees that contain a significant amount of heartwood. The second list is for whole tree use or products that have the possibility of using smaller trunks, a larger ratio of sapwood to heartwood or have larger amounts of limbs.

Solid Wood Products/Large Tree Usage

Posts	Siding
Lumber	Fencing
Fence panels	Veneer and veneered panels
Novelty items	Caskets

Fiber Products/Whole Tree Usage

Particleboard	Fiberboard
Plywood faced panels	Wood flour
Mulch	Animal bedding/litter
Shavings	“Cedar oil” for perfume
“Cedar oil” for insect repellent	“Cedar oil” for wood preservative
Wood/plastic composites for window and door sills, or decking	Down hole loss circulation material in the drilling industry

Another potential opportunity for use of the whole tree or at least for the woody component is in the biomass industry. Here again a considerable amount of research is needed to determine whether the characteristics of our junipers are conducive to commercial use in this developing field. A 1993 study on the pinyon pine and juniper stands of eastern Nevada (Morris 1993) reviewed the potential opportunities to use biomass very similar to Oklahoma’s junipers for pellet fuels or electric power. The study revealed limitations in using these fuels for pellets because of the high ash content, although additional research is needed to support this conclusion. For power generation, the study estimated that a typical 6-megawatt power plant using biomass fuels would require 45,000 bone dry tons of wood harvested from 2,000 to 2,500 acres annually. If Oklahoma already has several million acres of juniper and it is expanding by 762 acres per day, the magnitude of the utilization challenge becomes readily apparent.

Economic Stimulus of the Industry

Three fundamental things need to occur to move the use of redcedar and other junipers forward as a widely consumed raw material: (1) products need to be developed, (2) markets for those products need to be developed and (3) capital needs to be made available in sufficient amounts to encourage the formation of businesses to begin the risky process of moving the raw product from the fields to the consumer. Support for the product development must include ongoing basic research to identify the unique components and properties of redcedar and other junipers. In addition, a comprehensive inventory of redcedar and other junipers needs to be undertaken to describe the extent, size, concentration and condition of the resource. These relationships are shown in Figure 1, Oklahoma Redcedar Economic Stimulus Model.

The research into products and processes needs to be given direction and focus. We suggest that further investigation be concentrated in the most promising technologies and products and that a priority list be developed for all agencies to work from. We have developed a model that uses parameters of costs and returns to prioritize top research efforts. This is not to say that these are the only avenues to pursue - only that priority is given to the identified products and processes. The process of prioritization is illustrated in Table 1. The Commercialization Attractiveness Index (CAI) is based on estimated startup capital inputs and research capital inputs, divided by annual net expected incomes. This is multiplied by the probability of success and then divided by the square root of the estimated number of years to implement the production of the product.

CAI =

$$\frac{[\text{Startup Capital (Millions of \$)} + \text{Research Investment (Millions of \$)}] \times \text{Probability of Success}}{\text{Annual Expected Income (Millions of \$)}} \div \sqrt{\text{Time to Implement (Years)}}$$

Some barriers are also identified for each product. In Table 1, the far right column is the CAI. A higher number indicates a higher attractiveness level of the product. It is recognized that this is just one of many such possible analysis tools and is for comparison of the products listed. We suggest that three or four products be chosen to develop and research. Several items show no research needs. These are products that are ready to go to the product technology transfer stage or are already on the drawing boards for actual companies and would benefit from capital assistance. This allows a staged approach to business development with some products in each stage of assistance and growth, research, technology transfer and startup requiring capital.

**Figure 1 Oklahoma
Redcedar
Economic Stimulus
Model**

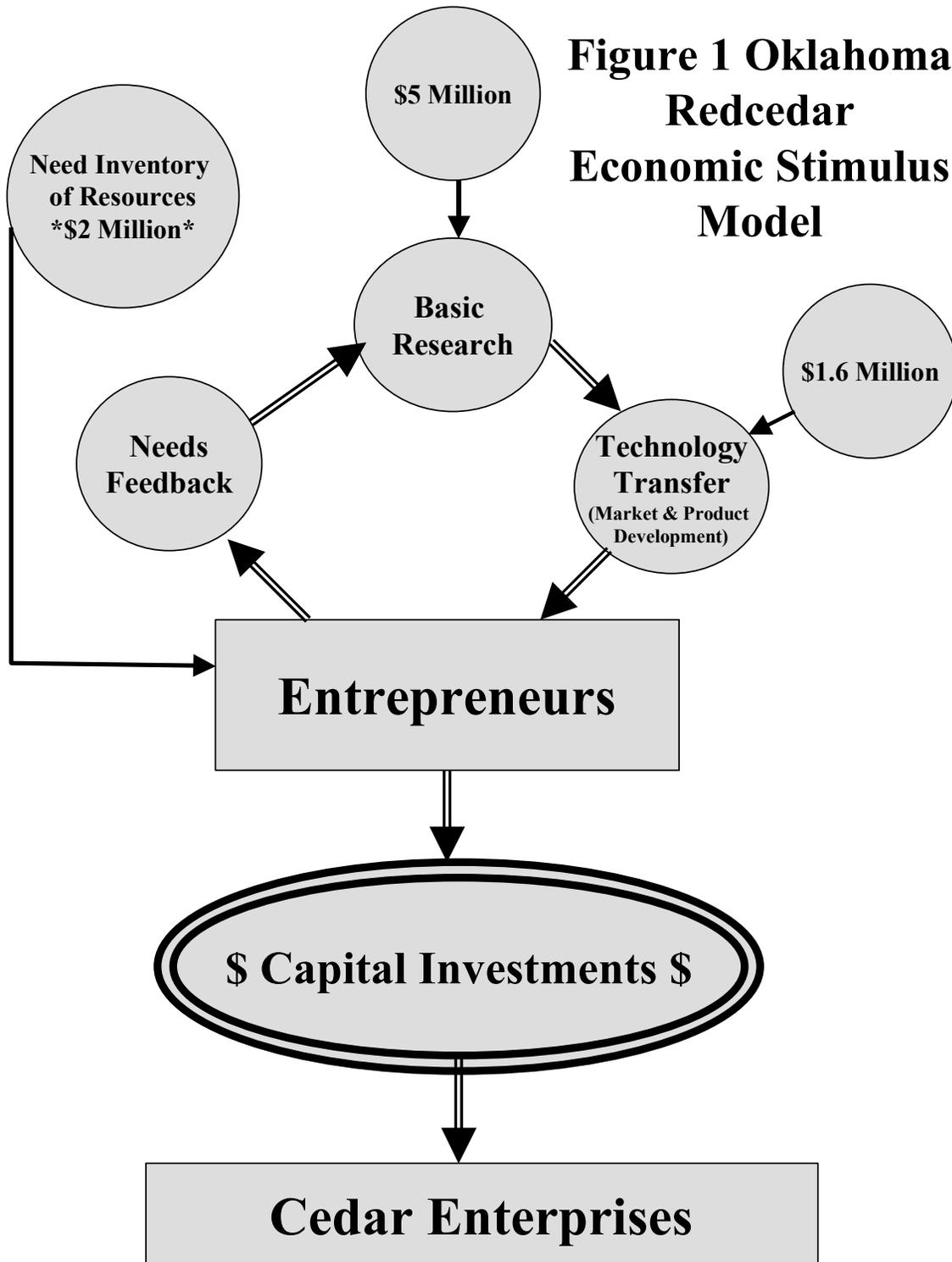


Table 1

Oklahoma Redcedar Commercialization Attractiveness Indexing							
"Use" Whole Tree	Startup Capital (In Millions)	Research Investment (In Millions)	Annual Net Expected Income (In Millions)	Probability of Success	Time to Implement (In Years)	Barriers	Commercialization Attractiveness Index
Particleboard	7.00	0.50	1.00	85%	5	established companies	2.47
Wood Flour	1.00	0.00	0.25	90%	1	established companies	3.60
Mulch	1.00	0.00	0.25	95%	1	established companies	3.80
Cedar Oil for Perfume	1.00	0.10	0.20	70%	2	established companies	2.43
Cedar Oil for Preservative	2.00	0.50	0.40	70%	4	unproven technology	1.58
Wood/Plastic Composite	2.00	0.00	0.25	80%	2	established companies	4.53
Large Tree							
Paneling	1.00	0.00	0.25	80%	2	established companies & raw materials	2.26
Lumber	0.50	0.00	0.10	80%	2	established companies & raw materials	2.83
Commercialization Attractiveness Index = (((Startup Capital+Research Investment)/Annual Net Expected Income)xProbability of Success)/(Time to Implement) ⁵							

Research

We are fortunate to have research already underway in Oklahoma at OSU’s School of Agriculture and Agricultural Experiment Station under the guidance of Dr. Salim Hiziroglu, Department of Forestry. Dr. Hiziroglu is presently conducting research into the production of particleboard and chipboard using eastern redcedar wood chips and whole tree chips. This represents a long overdue effort and needs to be recognized and further supported. OSU, with its nationally recognized strength in agricultural product development, seems to be a natural entity to lead research and product development. OSU’s Food and Agricultural Products Research and Technology Center could be a great asset in research and product development if the University and Center will take eastern redcedar on as a priority project and funding is made available from the legislature and matched with other funds, such as grants through various federal programs.

Another basic research need for the development of businesses is an accurate inventory of the resource. Presently, we have some good estimates of acreage, but little knowledge of the amounts and types of juniper trees involved. To apply for any business loan or assistance, one of the first requirements is to be able to reassure people that are far removed from agriculture that the raw resource is available. Knowledgeable estimates of size and availability of redcedar and other junipers within a given radius of a proposed plant is of paramount importance. Whether the goal is making particleboard or lumber, or instituting a burning and clearing program, it is important to be able to point with some confidence to areas of raw material concentration.

An excellent vehicle for such a survey may lie with the Forest Inventory and Analysis (FIA) program undertaken by the USDA Forest Service in cooperation with the State Forester. Inventories have been conducted in Oklahoma about every 7 to 10 years since 1936, but only in the eastern counties (Miller, et al 1993). A very general inventory was extended to the central and western counties of the state in 1990, but the level of detail achieved was not adequate for

the development of business plans, and considerable changes have occurred in the past 12 years. The U.S. Forest Service is committed to a statewide forest inventory using current FIA methods for Oklahoma's next inventory. Depending upon funding, it is hoped that the project can begin in 2003. However, additional state resources are needed to help match federal funds and crews for the inventory to be conducted in a timely manner. This report supports the importance of this effort.

Technology Transfer

Technology Transfer in this discussion refers to the dual needs of developing a product and the process of producing that product from the research information that is developed and the marketing of those products. This process can also be referred to as commercialization of a product. The development of a product is often difficult to separate from the research that developed the process of production or the product itself. However, special attention is needed to clearly define the best and most appropriate manufacturing processes and their integration with each other. This is especially important in a product line from a whole tree resource, such as redcedar and other junipers, because more than one final product is often produced. For instance, the sawing of lumber produces, in addition to lumber, sawdust that can be refined into wood flour and sawdust and slabs (outside pieces of the tree) that can be processed for "cedar oil." Slabs and bark can be processed into mulch, and center cuts can make posts, shavings, etc. Of course not all products mentioned can be produced in the same manufacturing line, but the most economical mix needs to be defined for each possible production facility. The Oklahoma Alliance for Manufacturing, a State of Oklahoma program, could be of great assistance in such decisions.

Marketing is one of the most important facets of successful businesses. Assistance to small and startup businesses, especially ones with a new product line, is of paramount importance. These needs should be recognized and appropriate agencies tasked with assistance to the business owner. The Oklahoma Department of Commerce and ODAFF Forestry Services could be appropriate leads in this area. ODAFF Forestry Services formerly developed a very effective program in forest utilization but funding difficulties have prevented the agency from maintaining this capability. The committee recommends that the legislature support this important program to continue development of juniper and other forest product industries.

Capital Needs

The most critical need for a new or startup business is usually capital. Manufacturing businesses, such as would be needed to produce juniper-based products, are not typically successful with the shoestring approach where the business starts with personal capital in one's garage and grows as profits are reintroduced to the business. Land, buildings and equipment purchases for even a modest venture such as a small sawmill can run over \$100,000 and particleboard plants begin in the multi-million dollar range. Venture capital sources are a traditional resource for the startup and high-risk business. This source of capital has been on a roller coaster ride in the last couple of years with the technology bubble investments. In the best of times, venture capitalists' enthusiasm for agricultural-related products is low. A major source of funds needs to be set aside for worthy business opportunities. The State of Oklahoma has these types of funds in place presently, such as the Technology Business Finance Program,

administered in part through the Oklahoma Center for Applied Science and Technology (OCAST). This might serve as a model for a fund administered through ODAFF.

Leverage - Collaborators

There are a great number of potential collaborators on this project and for each stage of its development. OCAST, the Oklahoma Alliance for Manufacturing Excellence and the research arm of OSU are some of the collaborators for research and inventory needs. Likewise, ODAFF and the USDA Forest Service are natural partners for inventory, as well as product development and marketing. The Oklahoma Department of Commerce should also be able to play an important role in marketing. A lead agency needs to be identified that is willing to coordinate these opportunities.

Estimated Research, Technology and Startup Investment Capital Needs

RESEARCH

Forest Resource Inventory - Support the Forest Inventory and Analysis program of USDA Forest Service and ODAFF to conduct a statewide forest inventory - 2 million dollars

Basic Research - 5 scientists for 5 years - 5 million dollars

TECHNOLOGY TRANSFER

Product and Market Development - 4 people for 5 years - 1.6 million dollars

STARTUP INVESTMENT CAPITAL

4 million dollars per year for the first 5 years - cash will return flow after that

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GLOSSARY

Conflagration: A large and destructive fire, usually aggravated by strong winds that carry firebrands over natural and manmade barriers.

Controlled burning: Fire used for land management purposes (e.g., range or forest improvement) for which advance preparations are made to limit the spread of fire onto adjoining lands. Controlled burns do not satisfy the definition of “prescribed burning” under state statute.

Crosstimbers: A term applied to the broad area of Post Oak and Blackjack Oak intermingled with prairie savannah that stretches across central Oklahoma into Kansas and Texas.

Defensible space: An area, typically 30 feet or more in width, between improved property and a potential wildfire where the combustibles have been removed or modified to reduce fire risk.

Ecosystem maintenance: In the context of this report, the application of specific practices to maintain natural vegetation and prevent encroachment or invasion of junipers.

Ecosystem restoration: In the context of this report, the conversion of juniper woodlands (dense stands of large trees) to land cover that is similar to natural vegetation.

Fire hazards: Those elements in the combustion process that actually burn or that cause a fire to burn faster or hotter than normal. Fire hazards fall into three broad categories: fuels (type, arrangement, volume and condition), weather and topography.

Fire risks: Those factors that increase the likelihood that a fire may start or that the damages from a fire are greater than expected.

Fire fuel: All combustible material, including vegetation and structures, which may be consumed by a fire.

Firewise: A national program designed to show homeowners, developers and communities how to reduce wildfire risk to their properties through creation of defensible space.

Fuelbreak: An area, usually a long strip strategically located, where vegetative fuels are eliminated, reduced in volume or maintained so as to reduce fire intensity if a fire burns into it.

Greenbelt: An irrigated, landscaped and regularly maintained fuelbreak, usually put to some additional use (like a golf course, park, playground, trail system).

Prescribed burning: (from Oklahoma Statutes Title 2, Article 16, Section 16-2) The controlled application by the owner of croplands, rangelands or forestlands of fire to naturally occurring vegetative fuel under specified environmental conditions and following appropriate precautionary measures, which causes the fire to be confined to a predetermined area and accomplish land management objectives. Any person conducting a prescribed burn shall comply with the provisions of Title 2, Section 16-28.2 of the state statutes.

Section 16-28.2 requires:

- 60 days prior notice by the landowner to adjacent landowners, either orally or in writing;
- notice shall include proposed date and location of the burn and the telephone number of the landowner;
- a completed prescribed burning notification plan submitted to the nearest rural fire department, and, if in a designated forest protection area, to the nearest ODAFF Forestry Services representative;
- notification to the rural fire department that a prescribed burn will be conducted within 48 hours, and, if in a designated forest protection area, notification to the nearest ODAFF Forestry Services representative within the time period required by Section 16-28.

Prescribed Fire Association: An organization of landowners, the members of which pool their equipment and resources to conduct prescribed or controlled burning on members' properties. These associations may also be referred to as "burn cooperatives."

Wildfire: An uncontrolled fire, usually spreading through vegetative fuels but occasionally consuming structures in the fire path.

Wildland/urban interface: That line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.