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Proceedings, Western Juniper Forum '97

EDITORS

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The information provided in this proceedings is in the form of extended abstracts or short notes. The intended audience is forest and range managers with responsibility for managing lands where western juniper grows; corporations, small businesses, entrepreneurs, and community groups with an interest in developing and marketing western juniper products; and local governments interested in encouraging job creation or promoting ecosystem health. It is not intended as a primary source of new scientific information, though some of the information contained here is of scientific value. It should generally be considered preliminary and observational in nature. Authors were responsible for obtaining technical review of their work prior to submission of abstracts and notes for this publication. The views expressed in each paper are those of the author and not necessarily those of the sponsoring organizations or the USD A Forest Service.

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Bend, Oregon
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Scott Leavengood and Larry Swan, Editors

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ABSTRACT

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This proceedings is a compilation of 30 articles on various aspects of the management and commercialization of western juniper. The topics are split between commercial and industrial topics, and science and management topics. Presenters were asked to provide abstracts, not full papers, and to include who to contact for more information or a copy of the complete paper, or when and where the information or study was expected to be published.

Keywords: Western juniper, western juniper proceedings, western juniper marketing and utilization, western juniper biology and management.

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PROCEEDINGS INTRODUCTION

The one-day, *Western Juniper Forum '97* took place April 21st, 1997, in Bend, Oregon. The purpose of the Forum was to encourage information exchange, and expand and improve communication between those interested in the management and commercialization of western juniper.

The Forum was divided into two combined sessions *{Setting the Stage* and *Wrap-Up)* and seven concurrent sessions. The concurrent sessions were split between commercial and industrial topics, and science and management topics. Fifteen manufacturers displayed a full range of western juniper products.

More than 140 people attended *Western Juniper Forum '97.* Close to 50 percent were scientists or from government agencies. Another 50 percent of the people represented private businesses or private landowners and there was a smattering of representatives from economic development and environmental organizations.

Presenters were not requested to provide full papers - only abstracts, who to contact for more information or a copy of the complete paper, and where and when the information or study was expected to be published. The questions used to structure presentations are included at the beginning of each session where relevant.

The Steering Committee for *Western Juniper Forum '97* consisted of Larry Swan, U.S. Forest Service, Scott Leavengood, Oregon State University Extension, Bill Breedlove, Western Juniper Industry Facilitator, and Candice Richard, Klamath County Economic Development Association.

The Steering Committee extends its sincere thanks to the Federal sponsors and Hessel Equipment whose cash contributions kept registration costs affordable for everyone, Jerry Haugen (U.S. Forest Service) for his accurate and thorough notes, *Forum '97* exhibitors and presenters who collectively drove thousands of miles at their own expense to help out, and finally, to all those who attended and participated. The contagious enthusiasm and dedication of those who study, manage and work with western juniper are what made this meeting a success. In the words of one participant it "gives hope that maybe we'll do it right the first time."

SETTING THE STAGE: WHAT HAS CHANGED AND WHAT HAS REMAINED THE SAME SINCE THE 1993 WESTERN JUNIPER FORUM?

Presented by: Larry Swan, U.S. Forest Service

Background

As most of you know, this is not the first time a western juniper conference has been held in the Bend area. During the last 20 years, four major western juniper conferences or field days have taken place, one in this very same room. The first two were conference formats (1977 and 1984), and the third was a field day (1987). *Proceedings* or *Summaries* were compiled and distributed (Martin, Dealy, and Caraher, 1978; Bedell 1984; Oregon Agricultural Experiment Station 1987). The emphasis of these meetings and field day was on the ecology and management of western juniper.[1]

[1] Ecology and management of western juniper have also been major topics at two conferences outside of Oregon: Reno, NV (1987), and more recently, Provo, UT(1997).

A very different western juniper conference took place in September 1993 - the format changed to a "forum" atmosphere, where interaction between the speakers and the participants was a central objective, and topics covered were expanded to include commercialization issues, which attracted a much more diverse audience. More than 130 people attended and an informal set of notes were taken and distributed by Haugen (1993). Due to its success and continued relevance, the format used at the 1993 "forum" is used again for today's meeting.

As context and introduction to today's session, I will attempt to compare and contrast commercialization and management progress and issues since the 1993 Western Juniper Forum. This will be a much-abbreviated version of what has actually happened and is currently in progress.

The outline for my talk is based on my personal experience in dealing with under-utilized or non-commercial forest products species over the last six years. There are basically 11 separate, but interconnected activity categories:

- Inventory (Resource Itself and Industry Infrastructure)
- Private Business Interest and Motivation
- Markets and Products Distribution Channels
- Science (Biology and Forest Products Technology and Processing)
- Harvest

- Management (Private, Public, and Non-Profit)
- Primary Processing
- Secondary Processing
- Technology Transfer
- Public Awareness, Input, and Involvement
- Government Agency Awareness, Input, and Involvement

I use an engine analogy to give some idea of what must happen within and between these categories to make the commercialization process work.

In the case of an engine, all cylinders must work together and be timed just right to make it run smoothly. Efficiency and speed are lost if one or more cylinders are not working together. Over time, if a problem or oversight is not corrected, the engine breaks down.

The same principles apply to the process of commercializing a new species while trying to accomplish management objectives. If one of the above categories are neglected or not integrated with the rest, the whole process will eventually breakdown.

Inventory

A 40-year veteran of the Forest Products Industry raised fundamental questions about western juniper inventory at the 1993 Western Juniper Forum:

- How much is there?
- Where is it?
- What is the quality?
- How accessible is it?

Similar questions were raised by biologists. I will devote some time to this issue because of its link to all aspects of management and commercialization.

It quickly became evident after the 1993 Western Juniper Forum that no one had ever tried in an integrated manner to determine just what the right questions were for a western juniper inventory. Funding was obtained from the State of California and U.S. Forest Service, and a contract issued for a *Western Juniper Inventory Methodology Plan.*

It appears there are low-cost, data collection field methods and criteria, which can provide information pertinent to many of the major inventory questions identified by commercial and biological interests (based on results of the investigations conducted for the *Western Juniper Inventory Methodology Plan* [Artemisia Systems 1997]). The issue then becomes "How do you convince government agencies to collect the "right" data in a way that will allow statistical comparisons?"

The government agency charged with large-scale, forested land inventories is the U.S. Forest Service. Inventory data for California and Idaho have been published (Bolsinger 1989; Chojnacky 1991). According to Don Gedney, retired inventory scientist for the Pacific Northwest Forest and Range Experiment Station, data gathered in the late

1980s for Eastern Oregon have not yet been published and no date has been set for when the data will become available to a wider audience. Discussions are already underway though, concerning a follow-up inventory for Oregon. Chuck and Don are here today and can address any questions you may have.

There is another large-scale inventory effort that should be mentioned - the *National Forested Lands Survey*. This inventory, also undertaken by the U.S. Forest Service, assesses the objectives, management actions, and management timelines of private woodland owners.

Western juniper woodlands were included for the first time because of input from both state and Federal scientists after the 1993 Juniper Forum. Unfortunately, no analysis has been completed and none is planned (Birch personal communication). I have taken an initial look at the charts and tables, but due to statistical sampling methodology and limitations, it will take someone better qualified than I to analyze and interpret the wealth of information available. Anyone interested?

Private Business Interest and Motivation

During the last six years, I have personally worked with at least 50 different private companies in western juniper manufacturing and marketing trials. Bill Breedlove, Western Juniper Industry Facilitator, has worked with at least 50 more. There is no lack of interest; however, working capital and marketing expertise are often limited.

There has been a substantial increase in private business interest, beyond simply trying out a substitute species in existing markets or manufacturing processes. A little more than 12 months ago, there were probably 10 manufacturers of western juniper products. Now there are more than 35 manufacturers (primary and secondary) who process western juniper on at least a part-time basis. In addition, juniper lumber production probably averaged 3,000-5,000 board feet per month a year ago, and it now averages at least 12,000 board feet per month. This kind of production is of course tiny by current industry standards, but I like the looks of the growth curve.

Markets and Products/Distribution Channels

Along with an increase in manufacturer interest and involvement has come an increase in markets and distribution channels. The emphasis during the last couple of years has been on finding niche specialty markets for solid wood products. Product lines now range from high-end rustic roundwood furniture to doors, and a full line of available products is now on display here. Store displays are a success story that have come out of the work subsidized by Oregon lottery dollars and the U.S. Forest Service. A full line of store display products is now in use in over 35 Pendleton Woolen Mill retail stores nationwide.

One of the major issues facing the industry is the lack of fiber markets. It is estimated that over 80 percent of the standing inventory of western juniper cannot be economically made into acceptable lumber with current technology. The continuous supply of logs necessary for a fiber operation would make the costs of obtaining sawlogs more economical and increase supply reliability. During the next year, the Western Juniper Industry Steering Committee will be taking a hard look at animal bedding markets. Oregon State University is an active partner in addressing the many issues involved in entering established markets with a new species.

(Special Note: A market research-oriented report was completed since *Western Juniper Forum '97* and is now available - *Western Juniper Furniture Market Research and Design Project* [Swan 1997b].)

Science

Research projects related to western juniper woodland ecosystem science have increased from between 5-10 in 1993, to more than 20 today. Short synopses of many of these will be presented during the concurrent sessions today. Key issues highlighted at the 1993 Forum are starting to be addressed by these studies, including wildlife and watershed responses to treatment, fire history of juniper woodlands, and aspen/bitterbrush vegetation communities treatment and response.

One thing I find interesting is that Rick Miller, OSU, has enlisted the support of individual agency offices in two states to support many of these studies. This is in contrast to five years ago when Oregon State University was the primary source of whatever funding could be squeezed out for work in western juniper woodlands.

Considerable progress has been made in defining the physical and mechanical properties of western juniper wood, as well as its drying and manufacturing characteristics. Ed Burke, University of Montana, is not here today, but deserves most of the credit for undertaking the basic wood science studies, mostly without any funding. He actually put his first sample collection trip on his family credit card, hoping to get reimbursed later. This is the kind of initiative that goes unnoticed most of the time, but is greatly appreciated by those who know.

Real progress also has been made in drying western juniper. Mike Milota, Oregon State University, was involved in completing the basic drying studies. Full production trials were later conducted, involving commercial-size kilns (40,000 board feet) and substantial public investment. Mike also completed moisture meter correction factors - something that is taken for granted for other species, which had never been done for western juniper (Leavengood and Swan 1997b).

Harvest

Harvest was an important issue in 1993, and continues to be a critical factor today. The cost of harvesting averages two to three times more than that of other commercial species. A *Harvest Systems Comparisons Project* was recently completed and although results were promising, much work remains to be done (Swan 1997a). The crux of the issue is how to thin western juniper economically and in a manner that leaves the landowner or land manager the option of leaving slash evenly scattered? This project will be discussed more thoroughly later today.

A pull-through delimber, provided by Hessel Equipment, one of the sponsors of this Forum, is on display outside. This particular delimber model showed more promise to reduce costs than just about anything else tried during the last six years.

Management

In the early 1990s, Federal subsidies for western juniper woodland and other rangeland habitat improvement projects were reduced. Private landowners continued to thin juniper woodlands, but on a greatly reduced scale. Some people estimate the acres treated have dropped from the "low tens of thousands" per year in Eastern Oregon to "below ten thousand acres" per year.

There has been a slight upward trend in total woodland acres treated due to private and government partnership projects since 1993. Fred Otley and Jim Buchanan will discuss a good example from the Steens Mountain area this afternoon. Their emphasis is on thinning juniper before it has out-competed its understory and thereby eliminating prescribed burning as a low-cost treatment option. Five dollars an acre for prescribed burning versus $50 dollars an acre for mechanical or manual treatment is the kind of cost spread that gets your attention!

No real progress has been made on the million plus acres of 20 percent plus canopy cover in Oregon, Idaho, and California, where the understory is greatly reduced or sparse, and more expensive treatment options are necessary.

Primary and Secondary Processing

There will be plenty said about primary and secondary processing today in various concurrent sessions. Two recently completed studies should be mentioned since they were designed specifically to address issues brought-up in the 1993 Forum: Can you debark juniper effectively? How does storage affect lumber recovery? (Leavengood and Swan 1997a).

Debarking was considered important because of the chip market requirements. Most of the wood products industry thought you could not debark juniper sufficiently to meet specifications for even "dirty chips," like those suitable for something like hardboard (less than 3 percent bark content). Several debarkers were tried and all worked

well enough to meet those specifications. Whether or not a particular debarker is economical for a particular operation is another story.

Log storage study results were not nearly so clear, mainly due to the design of the study. It appears that if you follow standard recommendations, such as using logs within 30 days of harvest or at least end-coating to prevent or reduce end-checking, recovery will improve.

Between 1993 and 1996, the chip market hit a historic high point. Several operators actually tried to make a living chipping juniper. It appears that if prices were ever again to reach at least $70-$80/bone dry ton, it may be feasible to chip juniper. Unfortunately, prices have not recovered, and even if they were to recover, other species are readily available at less cost.

More extractive oils recovery and market research have been performed since the 1993 Forum. A project was conducted in collaboration with The Confederated Tribes of the Warm Springs Reservation and with the assistance of Oregon lottery dollars (Yesnofski 1996). It does not appear that economics will permit competition with oil derived from other juniper species, but there does appear to be niche market opportunities. Work continues on this topic in collaboration with Joe Karchesy and others at Oregon State University.

A couple of problem-oriented, technical investigations have been completed since 1993, and probably should be mentioned because of their impact on commercial operations: Wood borers and air-dried lumber; problems with certain polyurethane finishes and certain wood fillers; and design adaptations needed because of inherent strengths and weaknesses of juniper. Information about these investigations is available in the 1996 and 1997 issues of the *Western Juniper Newsletter.*

Technology Transfer

A complex web of cooperation is involved in research, field trials, and the transfer of information to those who want and need it, both in terms of rangeland science and management, and wood science.

The main research and technology transfer agents for western juniper woodland science and management continue to come from Oregon State University's (OSU) Department of Rangeland Resources, and the OSU Extension Service. Most of you in this room are personally acquainted with many of the players, such as Lee Eddleman, Rick Miller, Clint Jacks, Tim Deboodt, John Buckhouse, and Steve Fitzgerald.

There are now more than 20 woodland science research projects underway as compared to 5 to 10 in 1993. Funding has not kept up with commercialization fund-raising efforts, but it has increased from the single digit thousands to tens of thousands. One reason for this increase is the approach Lee Eddleman, Rick Miller, and John Buckhouse have taken in working directly

with individual Federal agency offices in two states, rather than relying solely on grants or state money.

There is also an informal network of demonstration sites, which you will hear about today. These sites, often tied to on-going research projects, have expanded from around 5 to close to 10. Training sessions for government personnel appear to happen every year, but management training sessions for private landowners are scheduled much less frequently.

More funding is available for projects with direct commercial application than scientific research through state and federal economic development programs. A noticeable effect is that studies and field trials in the discussion phase in 1993 have been completed and results are now available (see partial list under *References).*

Another major change since 1993 is that additional personnel are involved with technology transfer, including Scott Leavengood, OSU Wood Products Extension Agent, based in Klamath Falls, and Bill Breedlove, Western Juniper Industry Facilitator (Bill's role is funded through Oregon lottery dollars).

Information is also now available to people through a well-received, semi-annual *Western Juniper Newsletter.* This newsletter is obviously filling a need. When the first issue was published in 1996, there were about 150 people on the mailing list; now there are over 800. Each newsletter has articles on topics ranging from management to marketing, which reflect the integrated approach being taken by the Western Juniper Commercialization Steering Committee.

Scott Leavengood also helped to create and maintain a non-commercial western juniper Internet site at *www. orst. edu/dept/kcoext/juniper/juniper. htm.* There is another western juniper web site devoted to private business (www. *westernjuniper. org),* which is hot-linked to the OSU site. Scott reports adding at least one person per week to the mailing list because of the web site. At least 20 information requests have been generated as a result of the year-old site, including some from foreign countries. Many of the unpublished reports in this *Proceedings* are available on the website *www.orst. edu/dept/kcoext/iuniper/juniper. htm.*

Public and Government Agency Awareness, Input, and Involvement

This particular area is critical to management and commercialization success, and a tough one to plan and maintain. Based on my personal experience, a full-time liaison is necessary to do an adequate job, however, the liaison role has probably received less attention than any of the other categories discussed today. There has been progress though.

Media attention is usually easy to attain, maybe too easy. The *Juniper Newsletter*

seems to be helping, and elected officials awareness about juniper issues and commercialization is greatly improved since 1993. Input into commercialization issues by the forest products industry appears good, and based on the focus of current rangeland science research, input from public and other scientists is evidently being heard.

Probably one of the most significant indicators of support for the efforts of the ad hoc Western Juniper Steering Committee, is that *Western Juniper Forum '97* has 10 sponsors, compared to just one in 1993. Forum sponsors include all major federal land-managing units in Eastern Oregon (BLM and U.S. Forest Service), the Modoc National Forest in California, and Hessel Equipment.

Conclusion

I want to emphasize the unique, integrated approach to commercialization taken by the ad hoc Western Juniper Steering Committee. It encompasses everything from biology to marketing. As far as I know, it is the only public and private collaborative regional partnership effort of its type in the United States. Other partnerships take on specific issues or segments of a problem, but this group has tackled the "whole enchilada."

This has been quite a lengthy discussion of what has changed and what has remained the same since 1993.I hope I have as much progress to report at the next Juniper Forum!

Questions and Answers

Q: Is there a Juniper Association?

A: The idea has certainly been discussed. At this point, the industry is looking for ways to make money to support one, instead of forming one and having to find ways to support it after the fact. The association envisioned would include all the players, not just industry by the way.

Q: What is being done with silviculture to improve juniper tree form?

A: Byron Cheney, from the Crooked River National Grasslands, has been looking at this. He may talk about it during his presentation today. Also, there are on-going informal trials involving juniper response to pruning (limbing lower branches). Other than that, I do not have anything to report. Anyone else know of anything?

Q: One of our watershed councils is getting pressure to stop harvest of juniper. Is anyone working on getting a consensus on juniper management?

A: Nothing organized is happening. In some areas we lack definitive answers to serious questions about how much to remove. Although research is underway, peer-reviewed publication of research results is not as far advanced as all of us would like to see.

Q: Does the *Juniper Newsletter* show or list how to find the demonstration sites?

A: No...but it's a good idea for an article. Are you interested?

Q: Will there be another Forum next year?

A: Probably not unless someone wants to volunteer to head it up. The need and interest are obviously there, a lot more help would be necessary though.

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Science and Management Abstracts

Session I

***Moderator*: Steve Fitzgerald,**
Oregon State University Extension Service, Redmond, Oregon

WESTERN JUNIPER WOODLANDS: IS MINE LIKE YOURS?

Presented by Tim DeBoodt, Oregon State University Extension Service, Prineville, Oregon

There is increasing interest in management of landscapes referred to as "juniper woodlands." Based on countless hours of conversation with numerous private citizens and public land managers, it is my experience that visions of what should happen are profoundly affected by exposure to particular sites. Communication becomes difficult and conflicts arise when reference points differ.

Are We Talking About the Same Thing?

Not all western juniper woodlands are alike. Differences in soil types, slope, aspect, precipitation, understory vegetation and current management practices influence how a stand has developed and how it will respond to management activities. Current research is focusing on how these factors interact and influence a specific site. Shared terminology and concepts are needed to facilitate discussion and communication. Rick Miller and Jeff Rose, with the help of others and the Eastern Oregon Research Center in Burns, Oregon, are developing terminology and concepts that will enhance our ability to communicate with each other, and classify woodlands and their successional stages based on identifiable characteristics. These characteristics include canopy cover, leader growth of dominant trees, degree of crown lift (die-off of lower branches), potential berry production, tree recruitment, growth of young trees, and condition of the shrub layer. The *Key Characteristics Table* (at end of this section) offers a preliminary description of this classification system.

Old Growth and Tablelands Classification

In addition to the woodland development stages illustrated below, classification systems for old-growth and juniper tablelands are also being developed. These stands have unique attributes. For example, old growth stands are mainly found on shallow soils underlain by fractured bedrock. Old growth can also be found on deeper soil sites, such as Juniper Mountain in Lake and Harney Counties, and the pumice soils of the Mazama ecological province in Central Oregon. Old growth trees are considered to be those established prior to 1870 (Anglo settlement). These trees often have flat tops, massive irregular trunks, deeply furrowed bark, and few large basal limbs. A bright yellow-green lichen also becomes abundant. Although exact age is difficult to determine due to rot, trees between 500-800 years are not uncommon. Juniper tablelands are another type of woodland not well studied. The tablelands occur on extensive flats (less than 5 percent slope) with low sagebrush as the dominant shrub. Trees that are greater than six feet in

height typically were established before 1870. The soils are shallow, rocky, and are high in clay. Plant diversity is greater in the interspaces, but understory cover is greatest under the tree canopy. The potential canopy cover at full occupancy is estimated at about 20 percent. Establishment and growth rates are slower than on mountain big sagebrush and aspen sites.

A common classification system that is easy to understand and that illustrates site conditions is an important tool for those who have to manage or want to provide input about the management of western juniper woodlands.

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Table 1—Key Characteristics: Western Juniper Woodland Successional Stages

Key Characteristics	***Early Transitional***	***Mid Transitional***	***Late Transitional***	***Closed Stand***
Tree Canopy	Open;canopy cover <5%; expanding	Canopy cover 6-20% actively expanding;	Canopy cover 21-35%;. canopy expansion greatly reduced	Canopy cover >35%; canopy expansion stabilized
Leader Growth *(Dominant Trees)*	Good terminal & lateral growth	Good terminal & lateral growth	Good terminal growth reduced lateral growth	Good to reduced terminal growth; no lateral growth
Crown Lift (lower limb die-off) *(Dominant Trees)*	Absent	Absent	Reduced lateral growth of lower limbs	Present (for Productive sites)
Potential Berry Production	Low	Moderate to High	Low to Moderate	Scarce to Low
Tree Recruitment	Active	Active	Reduced; limited to within drip line	Absent
Growth *(Understory Trees)*	Good terminal & lateral growth	Good terminal & lateral growth	Greatly reduced terminal & lateral growth; reduced ring growth	Absent: some mortality; greatly reduced ring growth
Shrub Layer	Intact	Nearly intact to showing mortality around dominants	>40% Mortality	>85% Mortality

OVERVIEW OF JUNIPERS IN THE WORLD, AND IN THE U.S. WEST; RECENT INVENTORIES OF WESTERN JUNIPER AND PLANS FOR OREGON

Presented by Charles Bolsinger and Don Gedney, USDA Forest Service, PNW Research Station, Portland, Oregon

Junipers grow around the world in the Northern Hemisphere. More than 35 species and numerous varieties of tree and shrub junipers exist. Most of the taller junipers are native to distant lands, and many, unlike ours, have been decimated or eliminated in the wild.

Canary Island juniper *(J. cedrus)* was so desirable for lumber that only trees inside the volcanic crater on the island of Palma survived. *J. excelsa* exceeds heights of 100 feet and diameters of three-feet, and ranges from the Balkans and the Caucasus to Syria and Lebanon. This juniper is widely-used for building, crossties, poles, and furniture, and is thought by some to be the Biblical "Cedar of Lebanon," rather than *Cedrus libani,* whose wood is inferior. Several species of juniper grow in Asia and uses include construction, carvings, medicine, and incense.

Over a dozen species of juniper grow in the United States. One or more species of juniper occur in every state with the exception of Hawaii. In the Western United States, junipers typically occupy the life zone between desert or steppe, and closed forests on moister sites. In many places, junipers co-exist with pinyon pine. For example, Utah juniper often grows with singleleaf pinyon in California, Nevada, and western Utah. In several states, area estimates of pinyon and juniper type are combined.

The total area of the pinyon and juniper type trees exceeds 50 million acres, and occur in islands and stringers from Edwards Plateau in Texas (Ashe juniper) to Oregon (western juniper) and from the Mexican border (alligator, California, drooping, one-seed, and Pinchot junipers) to Canada (Rocky Mountain juniper).

Recent inventories by the Forest Service show that western juniper occupies 3.7 million acres in stands with crown closure of 10 percent or more. Ninety-seven percent is in Oregon (62 percent) and California (35 percent), and the remaining 3 percent are in Idaho and Nevada. Scattered junipers in productive and subalpine forests of other species are not included in the inventories. One notable example is the Sierra juniper, a subspecies of western juniper, which often grows with California red fir and Jeffrey pine near upper timberline. It can attain enormous sizes (a tree 152 inches dbh and 86-feet-tall grows in the Stanislaus National Forest).

Total volume of western juniper trees 3 inches and larger at root collar to a stem or branch diameter of 1.5 inches outside bark (ob) is estimated at 1.4 billion cubic feet, with 1.2 billion cubic feet in Oregon and California. Mainstem volume from a 1-foot stump to a 4-inch top ob in these two states totals 664 million cubic feet, giving a mainstem-to-total-tree-volume ratio of 0.57.

A type map and estimate of juniper area in Oregon were made in 1936. Juniper type has increased by a factor of five since then. We approximate that juniper has expanded by a factor of 10) by adding areas with less than 10 percent closure, and an estimate of seedling stands, most of which did not exist in 1936.

This brings the area of juniper to more than 5 million acres, on par with Douglas-fir, the Oregon state tree. In some counties, such as Wheeler and Grant, juniper is now present on most land that is not farmed or growing pine or fir timber.

Juniper favors certain geologic formations and soils, which along with elevation, frost zones, and marine air, influence stand structure and define the species' range. Something is now changing though.

Small junipers fill openings between old trees, making dense, uneven-aged stands out of formerly open one-aged stands. Fire exclusion does not totally explain this phenomenon because many stands lacked sufficient ground fuel to carry fire before the recruitment of young trees. In northern Oregon, young junipers dot the landscape miles from older juniper trees. It appears that juniper would spread even further north if it were not for the agricultural zone. Junipers are now showing up in untilled strips in the wheat belt, and along fences near corn and watermelon fields near Hermiston.

Information on change in juniper in Oregon since the 1930s will soon be published, along with maps, statistics, and details on site class, stand age and structure. We plan to begin a new inventory in 1999. One of the desired objectives is to locate and quantify juniper recruitment across eastern Oregon. In many areas, young junipers are no taller than associated sagebrush, rabbitbrush and bitterbrush. Juniper is difficult to detect using conventional remote sensing methods.

We hope to collect more information on species diversity and gather data to model possible juniper futures under various assumptions. The methods to achieve these objectives are labor intensive and expensive, and we are looking for partners to help share the cost.

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Informal Notes

By Jerry Haugen, U.S. Forest Service

Some additional *"Juniperus trivious"*:

- Texas has the most species
- Oregon has three species
- Washington has four species
- California has four or five species
- There are 48 to 50 million acres of juniper and piny on woodlands in the U.S.

Much of the biomass of western juniper is in the branches. For example, the biomass of juniper in Oregon (calculated down to 1.5 inches in limbs) is estimated at 794 million cubic feet. When only the main stem from a 4 inch top (with a one-foot stump) is estimated, the volume in Oregon is about 441 million cubic feet.

Western Juniper Inventory in Eastern Oregon—The overall inventory involved 69,000 total photo points 0.85 miles apart. Of these, about 10,000 have juniper. Each point is now geo-referenced so it can be linked to other data in a geographical information system. A 1936 type map, which showed juniper, was used to show change over time. When published, the Eastern Oregon report will include predictions for the future, area and volume statistics by owner, and mensurational data by tree and plot characteristics.

Specific results follow:

BLM Lands:	800,000 acres and 180,000 cubic feet
Private:	1,100,000 acres and 200,000 cubic feet
NFS:	150,000 acres and <20,000 cubic feet
Other Public:	150,000 acres and <20,000 cubic feet

Juniper woodlands were included if they had a crown cover of 10 percent juniper or more. Juniper savannah has crown cover less than 10 percent and that cover is often in seedling and sapling sizes. The 1936 type map used crown cover over 5 percent and units had to be a minimum of 20 acres to be mapped.

The 1988 inventory picked up juniper in Wasco County that existed in 1936, but was missed for unknown reasons. Results show 2.2 million acres or more than a 500 percent increase from 1936. This increase is attributed primarily to the lack of fire. As crown density rises, species richness and diversity decline, but different animals react differently. Initially thermal cover is helpful, but later density reduces forage.

In the future we can expect to see 5-to-6 million acres because the savannah types will become more covered. The Eastern Oregon report will include statistics by county as well as site index curves.

WESTERN JUNIPER IN THE INTERIOR COLUMBIA BASIN: LANDSCAPE TRENDS AND MANAGEMENT DIRECTION

Presented by Mike "Sherm" Karl, USDA Forest Service, Walla Walla, Washington

The geographic extent of western juniper in the interior Columbia Basin and portions of the Klamath and Great Basins (i.e, the Basin) has expanded from about 1 percent of the Basin (1850 to 1900 period) to about 2.3 percent (circa 1990).

Data were gathered using historical data and remote sensing, and mapping to a 1 km^2 resolution. Midscale (4 ha) resolution data, collected for the historical (1930s to 1960s) and current period (1985 to 1993), support the broadscale (1 km^2) data, for western juniper expansion in eastern Oregon and southwest Idaho.

Mean patch size of the juniper cover type has increased from historical to current, suggesting an increase in connectivity of western juniper. The structure of western juniper patches has become more homogeneous from historical to current. The dominant structure being the "stem exclusion" structure, characterized by an open canopy juniper stand with below ground restriction of both further seedling recruitment and further increase in canopy cover.

Management direction for western juniper emphasizes use of prescribed burning or cutting (with slash left on site, but bole removal permitted) for control of western juniper in the "active management" alternative in the draft Environmental Impact Statement (EISs) for the Interior Columbia Basin Ecosystem Assessment Project. These methods work particularly well where understory native vegetation is declining in abundance or nearly all understory vegetation has been lost.

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WESTERN JUNIPER MANAGEMENT: A RESOURCE CONSERVATION ORGANIZATION'S PERSPECTIVE

Presented by Tim Lillebo, Oregon Natural Resources Council, Bend, Oregon

Presenter did not submit a written summary. The following are informal notes taken at the session.

Informal Notes

By Jerry Haugen, U.S. Forest Service

Western juniper is a new area of interest for many people including conservation groups so we need to determine what values were there in the past and what values are there now. The Eastside Ecosystem Assessment has now accomplished this in a big picture sense.

The forest is more than just wood, it also offers wildlife, recreation, water and other resources. Oregon Natural Resources Council (ONRC) wants to make sure that whatever is done recognizes effects upon these resources. A broad look is needed before embarking on large-scale activities. Everything about juniper should be laid out in one document. There have been many changes in the way conifers are managed and perhaps we can get juniper management right the first time.

Old growth juniper offers wildlife values such as homes for cavity nesters, but more study is needed to determine which species are dependent on this type of habitat. The conservation community is less knowledgeable about these issues, but it is still learning. Even wildlife experts do not know what wildlife needs are relative to old growth because more research is needed to determine how much should be preserved and where.

Restoration areas, where nature is emulated, could include native grass seeding along with other management. Grazing seems to have had some effect in removing grass, which lead to less fire and expansion of juniper. Prescribed fire is another area of interest and some efforts have gotten interesting results. Historic burn patterns seem desirable. All of this information needs to be lined out in a comprehensive overview.

ONRC has proposed a Juniper Grassland Reserve of 30,000 acres on BLM lands within the triangle formed by Sisters, Bend and Redmond. Some restoration work may be necessary, but the reserve should be managed to mimic nature and further studies could be done there.

A series of reserves in other soil types is also desired. The effects of off-road vehicles and other activities need to be determined, and a management plan, probably using a lot of fire, needs to be developed. Thinning and grass seeding are also proposed. No response has yet been received from BLM on this proposal.

ONRC believes there are a number of areas for further research:

- What are the effects of juniper harvest on the cryptobiotic layer?
- Why does bunchgrass sometimes stay only in a ring around a juniper and other times there is no bunchgrass around the juniper, but it exists farther away?
- Are rabbits affecting juniper?
- Juniper encroachment seems to correlate to grazing, climate change and perhaps other things. What are these relationships?

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Science and Management Abstracts

Session II

Field Research Updates:
What's Going on Where, and When Will It Be Published?

<u>Moderator</u>: Steve Fitzgerald,
Oregon State University Extension Service, Redmond, Oregon

Each presenter was asked the following questions:

1. Research Project Name and Location?
2. Purpose?
3. Results or Preliminary Results?
4. Publication Schedule and Publication?
5. Implications for Management?
6. Who to Contact for More Information?

FIRE AND JUNIPER EXPANSION IN THE CHEWAUCAN BASIN, OREGON

Presented by Jon Bates, Oregon State University, Eastern Oregon Agricultural Research Center, Burns, Oregon

Research Purpose

The study was designed to (A) document the establishment pattern and age distribution of western juniper; (B) assess plant community structure and diversity in woodlands; and (C) document pre-and post-settlement fire intervals and fire size (see fig. 1).

Preliminary Results

Western juniper expansion began between 1875 and 1885, and rates peaked in mountain big sagebrush communities between 1905 and 1915. Juniper expansion has been steady since 1915.

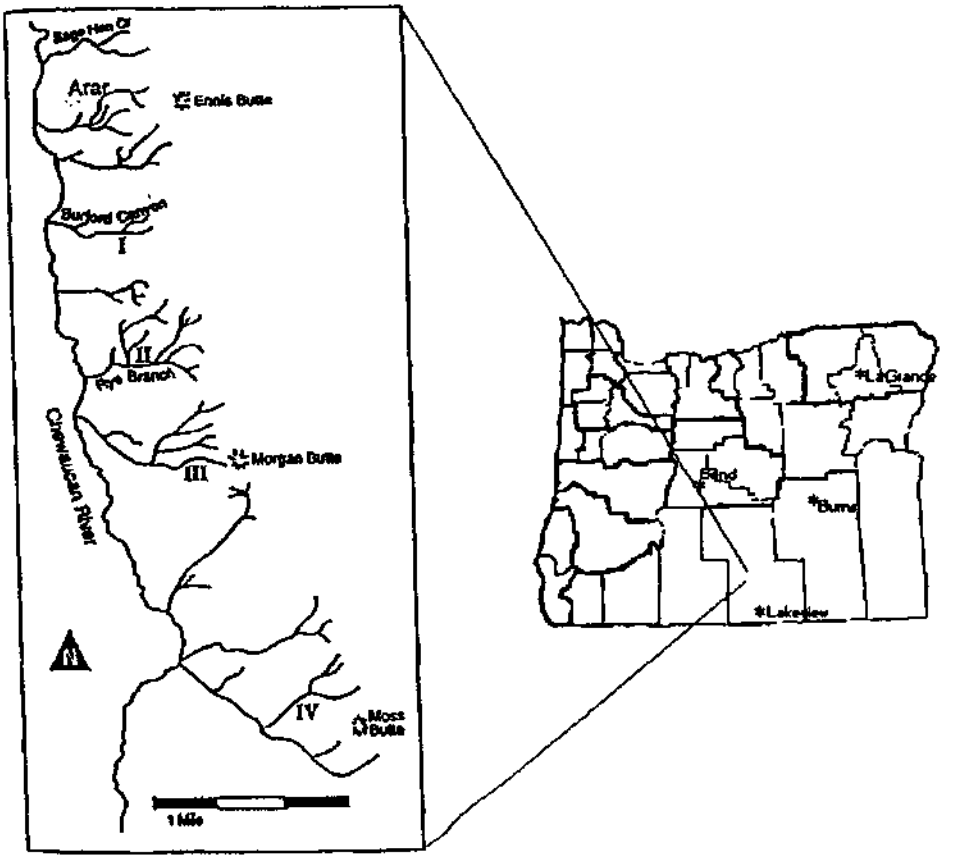
Mountain big sagebrush sites dominated by juniper had average tree densities of 185 per acre, canopy cover exceeding 50 percent, and trees averaging 86-years-old. Understory cover and diversity in these closed stands have declined.

Open stands of juniper in mountain sage communities had tree densities averaging 45 trees per acre, canopy cover of about 5 percent, and trees averaging 63-years-old. Understory cover in open juniper stands is sufficient for fires to carry and achieve a good kill of juniper.

Fire return intervals of 40-50 years in mountain sagebrush communities, and 80-100 years on low sagebrush sites is probably sufficient to prevent juniper invasion. The fire record spans 1520-1996. Fires occurred in the basin about every 11 years prior to 1903. On individual study sites, fire intervals ranged from 16 to 22 years. Half the fires between 1654 and 1903 were large fires. No fires have occurred on the study sites since 1903.

The lack of fire appears to be a major factor for the expansion of juniper in sagebrush and aspen communities the past 100 years. A combination of prescribed fire and juniper cutting will be necessary to restore sagebrush grasslands and aspen stands in the basin.

Figure 1—Study Area and locations of the Four Fire Scar Locations, I-IV, and the Low Sagebrush



Management Considerations

Mountain big sagebrush communities—(A) Where the understory is in good condition and the shrub layer intact, fire will return these sites to a grassland community. The majority of trees will be killed, particularly those less than 12-feet-tall; (B) Fire in closed stands with little understory and lack of a shrub layer will be difficult to burn except under severe conditions. Cutting some trees a year prior to burning will increase the probability of fires carrying under moderate burning conditions. Reseeding may be necessary if perennial plant density is less than one per 10 square feet; (C) Mountain big sagebrush sites on south slopes tend to have a severely depleted understory and signs of surface erosion. Management on these sites is generally limited to cutting and leaving the slash. The slash will increase protective groundcover and provide safe sites for establishment of grasses and forbs. Reseeding is usually necessary.

Low sagebrush sites—Juniper will increase slowly in low sagebrush communities. Understory response to tree removal has not been established. If cutting is used to thin trees on these sites, a suggestion has been made that pre-settlement trees and some replacement trees be left to maintain structural diversity and provide cavities for wildlife.

Publications

A paper on the fire history and woodland chronology is being submitted to *Ecology*. Publication is expected in 1998.

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UNDERSTORY SUCCESSION AND NITROGEN DYNAMICS IN RESPONSE TO JUNIPER CUTTING

Presented by Jon Bates, Oregon State University, Eastern Oregon Agricultural Research Center, Burns, Oregon

Research Purpose

The study assessed understory response and soil nitrogen (N) dynamics after tree cutting in a western juniper woodland at Steens Mountain in southeast Oregon (see fig. 2).

Results and Implications

The site prior to juniper dominance was a mountain big sagebrush and Thurbers needlegrass community. Because of juniper dominance, 95 percent of the mountain big sagebrush had died, and understory cover was less than 5 percent. The understory biomass was about than 40 lbs/acre (equivalent to 38 acres/AUM). Nitrogen tied up in aboveground juniper biomass and needle litter was 143 lbs/acre (equivalent to 12.5 percent of total soil N, 0-4"). In 1991, juniper trees in eight, 1-acre-sized plots were cut to measure understory response and N availability. Eight, 1-acre-sized plots were left uncut for comparative purposes.

Density, cover, and diversity were significantly greater in the cut treatment than in adjacent uncut woodlands two years after cutting understory biomass. Biomass on the cut plots averaged 300 lbs/acre (5 acres/AUM) and was primarily composed (greater than 90 percent) of native perennial bunchgrasses. The results indicate that bunchgrass densities of two plants per 1 acre were sufficient for perennial grasses to dominate after juniper cutting. The positive response by the understory was due to increased soil moisture availability and reduced competition for available soil N in the cut treatment. Leaf water potentials were less negative and plant N concentration was greater in the cut treatment than in the woodland.

Soil N availability and mineralization were greater in the cut treatment in 1992. Dry soil conditions in 1992 meant that most available N went unused by plants. In 1993, available soil N levels did not differ between treatments, however, N uptake by understory plants was significantly greater in the cut treatment. The improved N status of the understory in the cut treatment was not due to an increase in soil N availability, but by the elimination of juniper competition for available soil N. The results also indicated that there is little concern that cutting will lead to increased N losses via leaching or denitrification.

Cut trees left on the site had several impacts. Soil water storage was increased under slash due to reduced evaporative loss and lower moisture demand by plants. Species

characteristic of intercanopy zones were reduced under cut trees while species characteristic of canopy zones and whose seeds are wind dispersed increased under cut trees.

Vegetation surveys are continuing in this study.

Publications

Papers are being submitted to *Ecological Applications, Soil Science Society of America Journal,* and *Great Basin Naturalist.* Publication is expected in 1998.

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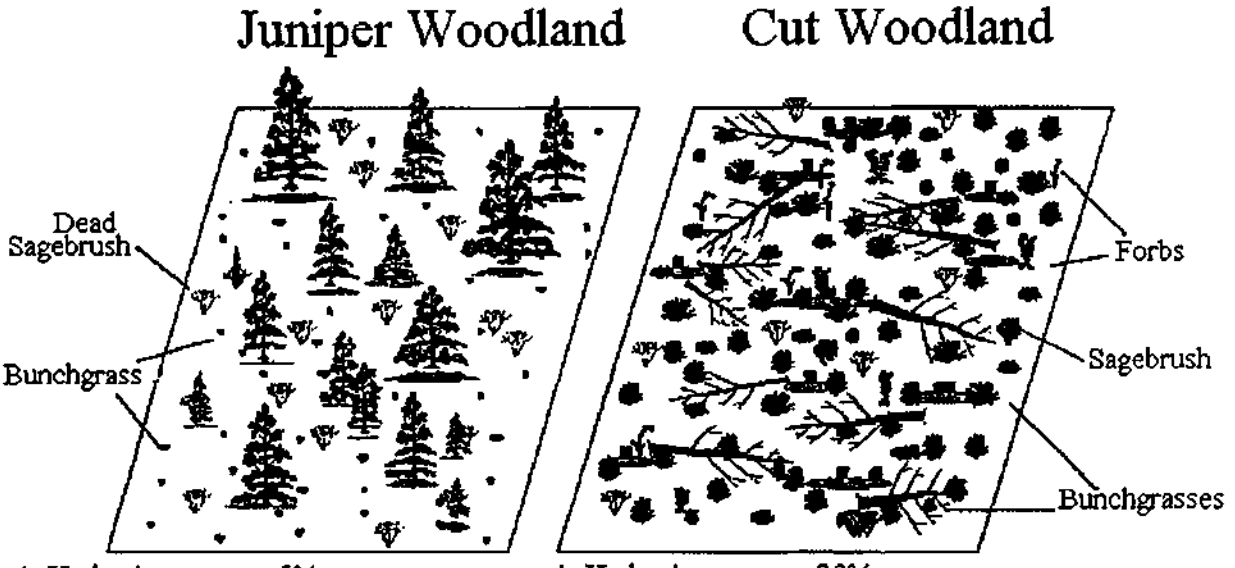
Figure 2—Steens Mountain Project With Some Results From 1993



SMALL MAMMAL AND BIRD INVENTORIES

Presented by Jon Bates, Oregon State University, Eastern Oregon Agricultural Research Center, Burns, Oregon

Research Purpose

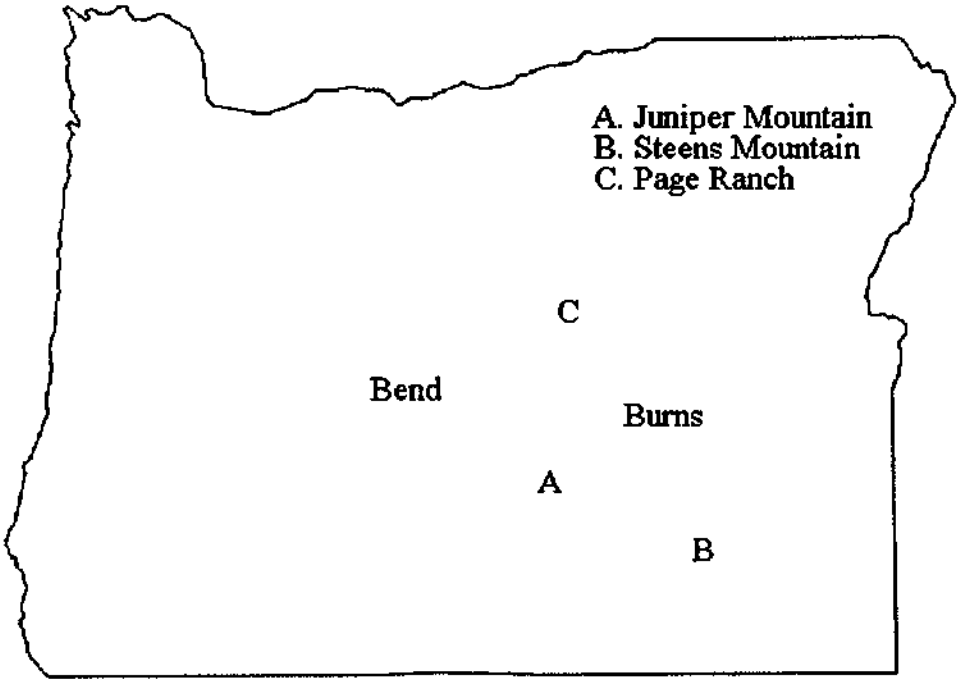
These studies are designed to assess small mammal and bird populations and diversity in cut and uncut juniper woodlands, mid-to-late transitional juniper woodland, and shrub steppe and old growth juniper stands at Page Ranch, Grant County; Krumbo Ridge, Steens Mountain, Harney County; Juniper Mountain, Harney and Lake Counties, all in Oregon.

Preliminary Results and Implications: Small Mammals

Page Ranch (1993, 1995-96)—Sampling began in 1993, the first year after cutting and was a late transition woodland of about 40 percent canopy cover. There were no treatment differences in small mammal species abundance the first year. Significantly more captures were made in cut plots in 1995 and 1996, and the diversity of small mammals were greater in the cut treatment.

White-footed deer mice were the most abundant species on this site and on the

Figure 3—Location of Small Mammal and Bird Surveys



Krumbo Ridge and Juniper Mountain study plots.

Krumbo Ridge (1350 m) (1995-96)—Woodlands were mid-to-late transitional. Cutting of trees began in fall 1994 and was completed in spring 1995. There were no differences in small mammal populations between the cut and uncut treatment in 1995 and 1996. The lack of differences between years and treatments may be due to the short lapse between cutting and sampling.

Juniper Mountain (1400 m) (1996)—Old growth woodlands were compared to adjacent shrub steppe. Significantly more Great Basin pocket mice were captured in the shrub steppe, otherwise no differences were observed between the two communities. Some bias was introduced since methods excluded wood rats, and their nests were common in the old growth.

Small mammal populations appear to respond well after cutting juniper woodlands in mid-to-late successional stages. This is probably due to increased structural diversity and cover provided by downed trees, and an improved food supply brought about by greater understory production.

Bird Census

Bird data have not been analyzed, but indications are that the largest differences in avian populations occur where structural diversity is greatest, especially on Juniper Mountain and Krumbo Ridge. Thresholds of vegetation change where bird populations and diversity are affected are not well identified.

Publications

These studies are continuing to take in more sites and include some invertebrates (e.g. butterflies). Some data can be found in the 1996 "Annual Report of Preliminary Results and Progress." (History, Ecology, Management of Western Juniper Woodlands and Associated Shrublands.) [Miller and others.]

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OTHER WESTERN JUNIPER PROJECTS AT THE EASTERN OREGON AGRICULTURAL RESEARCH CENTER

Additional western juniper research projects are being conducted by the Eastern Oregon Agricultural Research Center. They include:

A.) **Fire history of mountain big sagebrush communities in northeastern California.**

Work started in 1996. In 1997, further collection and cross-dating of samples is planned along with the location of additional areas with the potential for fire history reconstruction.

B.) **Development of juniper stands in aspen and bitterbrush plant communities.** At the same time investigate age structure of aspen and bitterbrush stands.

C.) **Vegetation response on large scale juniper cuts on Steens Mountain.**

Pre-cutting vegetation data were taken in 1994, and post-cutting data were taken in 1996. Additional measurements are planned in 1997. Data includes plant density, cover, and diversity.

D.) **Woodland classification based on a soil water availability index, plant community type (dominant understory components), and maximum possible juniper cover for a closed stand.**

E.) Cedar Creek prescribed burn in northeastern California. Pre-fire data were taken in 1995. Post-burn data taken in 1996, and monitoring is ongoing.

These projects were made possible by the interest and financial contributions of the Burns and Lakeview BLM Districts in Oregon; the BLM Alturas Resource Area, California; Modoc National Forest, Alturas; Fremont National Forest, Paisley Ranger District; North Cal-Neva Resource Conservation and Development; and the Oregon Field Office of the Nature Conservancy.

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GENETIC STRUCTURE AND RELATIONSHIPS AMONG POPULATIONS OF UTAH AND WESTERN JUNIPER: EVIDENCE FROM NUCLEAR RIBOSOMAL AND CHLOROPLAST DNA

Presented by Robin J. Tausch,
USDA Forest Service, Intermountain Research Station, Reno, Nevada

Restriction fragment length polymorphisms in nuclear ribosomal (nrDNA) and chloroplast DNA (cpDNA) were used to examine genetic structure and relationships among 14 populations of Utah *{Juniperus osteoperma)* and western juniper *{Juniperus occidentalis)* from the western Great Basin and eastern Sierra Nevada. Genetic variation is high within and among populations of both species, with mean heterozygosity and Gst based on nrDNA variation being 0.74 and 0.19 respectively. Differences in population heterozygosity and differentiation compared between species and subspecies are attributed in part to variation in population size, density, and mating system.

Comparisons of observed heterozygosity and the number of alleles to those expected under neutral mutation/infinite alleles model suggest that nrDNA alleles in most populations are selectively neutral. Thus, high levels of intrapopulation genetic variation in nrDNA overall do not appear to result from the influence of diversity-producing selection. Partitioning of genetic variation among subpopulations indicates that levels of gene flow have not been sufficient enough to appreciably influence population genetic structure at the nrDNA locus.

Cluster analysis of nrDNA allele presence/absence data and the geographic distribution of chloroplast hplotypes are consistent with previous hypotheses of gene flow between populations of Utah juniper and each of the two subspecies of western juniper in the western Great Basin. Two groups of Utah juniper cluster with the nearest subspecies of western juniper rather than with each other. These results corroborate isozyme-based population genetic studies and paleoecological data, which predict high levels of intra- and inter-population genetic variation in relict conifer populations of the Great Basin.

Current patterns of genetic variation and the relationships they suggest are likely the consequence of complex interactions involving historical biogeography, population demography, and life-history characteristics. In response to changing climate and topographic variability, numerous zones of sympatry have probably existed ephemerally over geologic time. These results suggest complex patterns of

gene flow between populations of Utah and western juniper in the western Great Basin that warrant further study.

Informal Notes

By Jerry Haugen, U.S. Forest Service

Several middens were located in western Nevada dating back 30,000 years. Evidence of juniper was found in every layer, indicating an amazing ability to adapt to a range of climates. Several multi-state transects from the Blue Mountains to Sonora Pass found similar juniper regardless of elevation.

Growth was measured over two years. The lower elevation juniper grew a little more, and there was no difference between species regardless of different environmental conditions. All of the trees stopped growing within a few days of each other at the end of their growth season. Transpiration and water use showed no difference regionally. Carbon use was different from north to south, independent of species.

Research on genetics, using DNA fingerprinting, revealed that northern *{Juniperus occidentalis var. occidentals)* and southern (*Juniperus occidentalis var.australis)* are similar. Hybridization increased to the west. One tree in northern California has all but one of the genetic markers found in the whole study. The generations of juniper involved are insufficient to explain the distribution. Understanding today's genetic distribution requires an understanding of the climate over the last million years.

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GAS EXCHANGE OF *JUNIPER US OSTEOPERMA* AND *JUNIPERUS OCCIDENTALS* ACROSS LOCAL AND REGIONAL ENVIRONMENTAL GRADIENTS IN THE GREAT BASIN

Presented by Robin J. Tausch, USFS Intermountain Research Lab, Reno, Nevada

Few studies have investigated the diurnal patterns of ecophysiological characteristics of plants along multiple levels of environmental gradients. An understanding of adaptation among modern juniper species along environmental gradients will increase our knowledge of how plant species cope with environmental change.

Our goal was to determine how the differences in ecophysiological characteristics of juniper relate to differences in environmental conditions. We obtained diurnal measurements of leaf gas exchange and xylem water potential (Ψ) from *Juniperus occidentalis* and *Juniperus osteosperma* during fall 1994, spring, summer, fall 1995 and summer 1996 from elevational and latitudinal gradients in the Great Basin.

Assimilation (A_d), transpiration (E_d), leaf conductance (g_d), intercellular CO_2 concentration (c_{id}) and water use efficiency (WUE_d) were calculated on a per day basis. Data for A_d, E_d, g_d, c_{id}, and WUE_d were analyzed using a 2×5 repeated measures experimental design. Analysis of Ψ used a 2×5×2 split-split plot design. Overall, we found no significant difference between local environmental gradients for A_d, E_d, g_d, C_{id}, WUE_d or Ψ. Time of year was significant for all AOVs, and Ψ time of day was significant for the Ψ analysis of variance.

In general, the three more northern mountain ranges (Juniper Mountain, Virginia Mountains, and Monitor Range) were not significantly different from each other and the three more southern ranges (Spring Range, Snake Range, and Sonora Pass) were not significantly different from each other, but the group of northern ranges was significantly different from the group of southern ranges.

A_d defined two regional groupings for the six mountain ranges with overlap between the Monitor Range and Sonora Pass. No other gas exchange or environmental variables of leaf temperature and light quality completely explain the groupings. Interestingly, these groupings cut across known species boundaries each group had one range with *J. occidentalis* and two ranges with *J. osteosperma*. During the fall 1994, which was at the end of a multi-year drought period, the mountain ranges were not significantly different from each other.

We cannot completely reject our null hypothesis: environment appears to explain some of the differences in leaf gas exchange (e.g. seasonal changes), but not others. For example the grouping of Sonora Pass *(J. occidentalis)* with the Spring Mountains and the Snake Range *(J. osteosperma)* indicate similarities in A_d exist between species, even though Sonora Pass was climatically more similar to the northern plots. Nonetheless, the grouping of mountain ranges by A_d is especially interesting because the grouping does not appear to be related to environment and cuts across species boundaries. One possible explanation for this grouping is genetic control. Analysis of DNA fingerprint data from another portion of the larger project (Randall G. Terry, personal communication) shows a general N-S change in genotype over this study area.

Results will be submitted for publication in the summer of 1997.

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RELATIONSHIP OF HYDROGEN AND OXYGEN STABLE ISOTOPES IN CELLULOSE AND DROUGHT SEVERITY

Presented by Robin J. Tausch, USFS Intermountain Research Lab, Reno, Nevada

Change in environment such as global warming will undoubtedly affect the distribution of vegetation. The responses of plants to climate change are influenced by changes in key climatic characteristics, and drought severity is often one of these key climatic characteristics for Great Basin vegetation.

As part of a larger study to examine the effects of environment on Utah and western junipers, *Juniperus osteosperma* and *J. occidentalis,* the primary goal of this project was to determine if the hydrogen and oxygen isotopes in cellulose and xylem water were predictably related to drought severity.

Samples of juniper twigs were collected from 10 sites located across geographic and topographic environmental gradients. Cellulose and xylem water were extracted from these samples, then processed for D/H and $^{18}O/^{16}O$ isotopic composition. Weather data from official weather stations were extrapolated to the study sites using a mountain climate simulator, and drought severity for the study sites was calculated as the difference between potential evapo-transpiration (PET) and precipitation. The results suggest that the slope of the relationship between δD and $\delta^{18}O$ for cellulose and xylem samples at a study site is a reliable index of drought severity.

Preliminary isotope results for western juniper and Utah juniper along the three transects in the Great Basin are published in ESA 1995 Annual Meeting. For western juniper, the Sonora Pass 2000m plot had the greatest $\delta D:\delta^{18}O$ slope(6.971), but that of the Sonora Pass 2600m plot was the lowest (0.721). The Juniper Mtn. study plots in Oregon have similar slopes for both 1600m and 2000m elevations (1.678 and 1.523 respectively). The climate model results for 1995 show the inverse trend for Sonora Pass: the study plot at Sonora Pass 2000m has the lowest integrated value of PET-PPT (14.404), but the Sonora Pass 2600m has the greatest value. Drought severity, as measured by PET-PPT, were similar for the two Juniper Mtn. plots.

These two kinds of data suggest that there is a higher drought severity in the Sonora Pass 2600m in 1995. For Utah juniper, the isotope analyses show that high elevation study plot in the Spring Mtns. has a higher $\delta D:\delta^{18}O$ slope value than the lower elevation plot.

The climate model results show the inverse trend, and both techniques suggest that in 1995 the low elevation plots in the southern Great Basin had a higher drought severity

than the higher elevation plots. For the Virginia Mtn., both slopes of the stable isotope and the difference PET-PPT were similar. Both of elevation study plots in Snake Range show a very low slope for isotope ratio $\delta D{:}\delta^{18}O$. Also, the climate model integrated data show very high values (30.501 and 27.743).

Comparing these two techniques for drought severity, there is a non-linear relationship between isotope data ($\delta D{:}\delta^{18}O$ slope) and water deficit values ($Area_{PET-PPT}$). The results of regression analysis are:

$$\text{Water Deficit (AreapET-ppi)} = 12.19e^{0.022\,slope(\delta D:\delta 18O)} - 18.66e^{0.565\,slope(\delta D:\delta 18O)}$$

The correlation coefficient (R^2) is 0.75 and $P < 0.05$.

Our technique of stable isotope analysis is an efficient method to indicate the drought severity pattern cross Great Basin. The results suggest that the ratio of the juniper leaves $\delta D{:}\delta^{18}O$ is a reasonable index of drought severity. For 1995, both N-S transacts follow a climate gradient that primarily reflects increased drought severity from the northern to southern, but the E-W transect appears to be contrary to the historical drought gradient.

The results will be submitted for publication in the fall of 1997.

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GROWTH OF UTAH AND WESTERN JUNIPER ALONG THREE CROSS-BASIN TRANSECTS

Presented by Robin J. Tausch, USFS Intermountain Research Lab, Reno, Nevada

The rapid change in climate and atmospheric CO^2 that is predicted for the near future will likely affect vegetation, including the pinyon-juniper woodlands and associated plant communities of the Great Basin.

To survive the projected future changes in climate, aridland vegetation must either migrate to follow favorable climate or adapt to the new conditions. Adaptation and hybridization appear to be important mechanisms for many Great Basin tree and shrub species. Western and Utah juniper *(Juniperus occidentalis and Juniperus osteosperma)* and their hybrids grow in different, but overlapping ranges of environmental conditions. Western juniper is found in the wetter, cooler end of the spectrum and Utah juniper on the dryer, warmer end. Hybrids appear to occupy a climatically intermediate position. Thus, juniper represent an ideal model system to study the various processes by which plants adapt or acclimate to climate change.

The primary goal of this portion of the research project is to determine the relationships between the modern environment and growth of juniper. To accomplish this goal, we measured the growth of junipers along three transects that cross the Great Basin. Field study plots were established on 18 mountain ranges located along three transects that cross the Great Basin. The first transect represents an east-west transect of Utah juniper and includes plots located in seven mountain ranges. The other two transects run north to south and parallel the west side of the Great Basin. The westernmost of these transects focuses on western juniper, and the other focuses on Utah juniper.

Six ranges were selected on each range and at even 200-meter elevation intervals over the elevational extent of juniper's distribution. Plots consisted of 12 trees that were greater than or equal to 0.5 m tall, regardless of maturity class. To measure plant growth, a circular area of approximately 10 cm in diameter was painted with a light-colored latex spray paint on the north-, east-, south-, and west-facing sides of the tree. Cumulative twig growth was measured periodically by randomly selecting two twigs on each side of the tree and measuring the amount of twig growth that protruded beyond the painted foliage.

To date, preliminary data analysis has been completed on only a subset of the mountain ranges. In general, leaf and twig growth of juniper occurred during a two-month period that begins in early summer. For example, in both 1994 (a dry year) and 1995 (a wet year), twig growth began in late- May or

early-July and was completed by early August.

By the end of the second season of growth measurements, cumulative growth at lower elevations were greater than that for higher elevations for two mountain ranges that had western juniper, that is, Juniper Mountain and Sonora Pass. For Utah juniper, differences between elevations were small, except for the Virginia Mountains. Although cumulative growth of Utah juniper at 1600m and 2200m in the Virginia Mountains was similar through mid-July 1995, growth at the higher elevation occurred to a greater extent during late-summer 1995. The absence of growth during the winter is consistent among all plots analyzed to date. Growth rates of western juniper as well as Utah juniper were at or near zero for the 1994-95 winter growth period.

The effects of a very dry year (1994) versus a wet year (1995) are especially evident from the growth rates of Utah juniper. With few exceptions, growth rates during the summer 1995 were larger than those during summer 1994. Often, growth rates during the summer 1995 were at least two times greater than those of summer 1994, and the differences between these two years were up to almost an order of magnitude at mid-elevation plots in the Virginia Mountains. Differences between summer growth rates were not as large for western juniper as they were for Utah juniper. For example, growth rates in summer 1994 were equal to or greater than those in summer 1995 for the highest elevation plots in Sonora Pass and for all elevations in Juniper Mountain. However, growth rates during spring 1995 were generally greater than those during summer 1994 for western juniper trees at both Sonora Pass and Juniper Mountain. Thus, the effects of drought may largely be on the spring growth period for western juniper, whereas drought affects growth during both spring and summer for Utah juniper.

Two publications are anticipated from this research. The first publication will focus on a six year data set from the Virginia Mountains and will be submitted towards the end of 1997. A second publication will contrast these results with the three year data set from the remaining mountain ranges and will be submitted in summer of 1998.

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INFLUENCE OF WESTERN JUNIPER INVASION AND DEVELOPMENT ON NUTRIENT ACCUMULATION PATTERNS IN SAGEBRUSH/GRASS ECOSYSTEMS

Presented by Arthur R. Tiedemann, Forestry Sciences Laboratory, Wenatchee, Washington

Research Purpose

The primary hypothesis to be tested in these studies is that invasion of western juniper into sagebrush/grass ecosystems is accompanied by a significant increase in total aboveground biomass, primarily in trees, and a significant increase in concentrations and amounts of organic C and nutrients in soil-plant systems occupied by juniper compared to systems without juniper.

Hypothesis la—Nutrient redistribution and accumulation in juniper soil-plant systems and their major components (biomass, forest floor, and soil) are a linear function of elapsed time since tree establishment.

Hypothesis 1b—Nutrients are accumulated in the juniper soil-plant system at the expense of nutrient capital of intercanopy areas by virtue of absorption by the lateral root system of juniper and a more favorable microclimate for accumulation of organic matter. Depletion of the nutrient capital of intercanopy areas is a linear function of age since invasion.

Hypothesis 1c—Nutrient accumulation by litterfall and a microenvironment more favorable for accumulation and maintenance of organic matter and nutrients in the area beneath juniper canopies results in changes in availability of nutrients in that location and these changes are a function of time since juniper establishment.

Progress to Date

We have already published results of research related to hypothesis lc. (Reference: Tiedemann, A.R. and J.O. Klemmedson. 1995. *The influence of western juniper development on soil nutrient availability.* Northwest Science 69: 1-8.)

In this study, we assessed availabilities of nitrogen (N), phosphorus (P), potassium (K) and sulfur (S) in the upper 15 cm of soil from beneath western juniper canopies and adjacent open areas. Nitrogen availability was the same in areas under juniper canopies as in open areas and there was no change in availability with age. Availability of phosphorus in open areas was reduced with advancing tree age. In canopy soils, P increased with increasing tree age to 81 -years-old and then declined with the oldest tree class at 160-years-old.

The most striking effect of juniper was an increase in availability of S in canopy soils with advancing juniper maturity. From a management perspective, the low inherent availabilities of soil N and S observed in this study suggests that any efforts at productivity enhancement should include fertilization with these two elements.

Manuscripts in Progress

Klemmedson, J.O. and A.R. Tiedemann. *Influence of western juniper development on distribution of forest floor and soil nutrients.*

Tiedemann, A.R. and J.O. Klemmedson. *The Influence of Western Juniper Development on Biomass and Nutrient Distribution in Trees and Understory Vegetation.*

Klemmedson, J.O. and A.R. Tiedemann. *A nutrient budget for soil, forest floor, and vegetation in a developing chronosequence of western juniper.*

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Informal Notes

By Jerry Haugen, U.S. Forest Service

What are the implications of management schemes on productivity? Given that we are dealing with nutrient limited sites, careful management is required. The hypothesis was that the invasion of juniper into sage and grass ecosystems brings an increase in biomass (trees), and an increase in carbon and mineral nutrients. Five classes of trees, from age 36 to 160, at each of five sites (25 trees) were used in the study. Understory vegetation was measured, as was the soil down to 30 cm. The soil, mazama ash, was only about 40 to 50 cm deep. The trees were then harvested and broken into their components.

It was found that nitrogen and sulphur are very limited. The oldest trees reduced available phosphorus, but generally phosphorus increased with the age of trees. As trees age they improve sulphur availability. The kilogram per square meter of litter rises with tree age, under the canopy.

The recommendation is to add nitrogen and sulphur if management is desired. Nitrogen in the forest floor is up to 1000kg per hectare under old trees. In age class one, (36 years) 60 percent of the tree's biomass is in the bole and 40 percent in the foliage. In age class five (160 years), 80 percent of the biomass is in the bole and 20 percent in the foliage. Most of the nitrogen can be found in the leaves.

CAMP CREEK PAIRED WATERSHED STUDY

Presented by Michael Fisher, Big Summit Ranger District on the Ochoco National Forest

The research area is located in the Camp Creek drainage approximately 20 miles northeast of Brothers, Oregon, and 40 miles southeast of Prineville (see fig. 4). The two watersheds drain into the west branch of Camp Creek, which drains into the South Fork of the Crooked River.

This study is designed to provide a physical and ecological analysis of paired watersheds in the semi-arid western juniper (*Juniperus occidentalis)* woodlands of Central Oregon.

Instrumentation and monitoring was accomplished in each watershed as the preliminary portion of a longer term project designed to address the question of "what impact does landscape-level treatment of western juniper have on erosional processes, hydrology, and vegetation."

Instrumentation was setup to assist in the comparison and calibration of water flow out of the watersheds. Ground-water is also being monitored in order to attempt to quantify any effect that western juniper may have on the this element of the watershed. The project will entail a five-to-seven year calibration period of the watersheds. This will be followed by removal of the juniper overstory in one of the watersheds. The calibration began in 1995, and expected removal treatment should take place in the next two to three years (1999-2000).

To date, analysis shows the watersheds to be similar in size, percent juniper cover, grass and bare soil cover, topography, and precipitation frequency and intensity. Differences were obtained relative to erosional processes, area of different soil types and channel discharge. Further monitoring and calibration should provide greater insight into the comparison of these components of the study.

This study is intended to address the concerns of public and private land managers with regards to western juniper treatment and its impact on hydrology, both surface and subsurface on a watershed scale.

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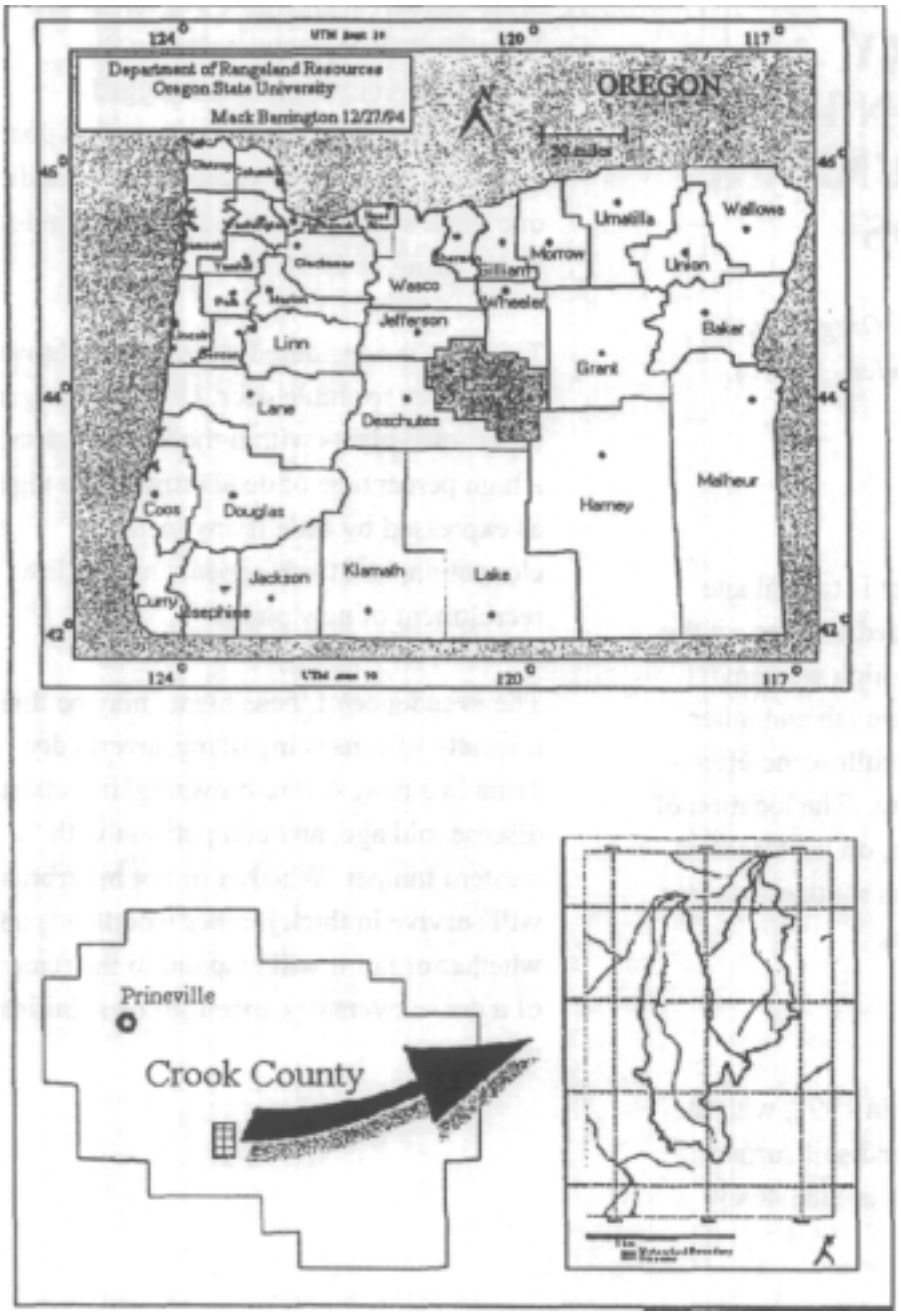
Figure 4—Study Location



CYRUS BUTTE SITE: IMPROVING UNDERSTORY VEGETATION IN WESTERN JUNIPER WOODLANDS

Presented by Clint Jacks, Oregon State University Extension Service, Madras, Oregon

Research Purpose

The purpose of the project is to evaluate means and materials needed to improve the understory vegetation on high western juniper densities on bitterbrush and other understory plants, and to follow the effects of tree cutting and burning. The location of the project is Cyrus Butte, on the Crooked River Grasslands 12 miles south of Madras, Jefferson County, Oregon.

Methods

The project was initiated in 1991, with the collection of vegetation and soil surface baseline data on seven plots each 40x50 meters in size.

Seven permanent sample plots were located in each of the seven plots. At each sample plot stems of eight bitterbrush plants were tagged and leader growth for the year measured. An additional 69 older bitterbrush plants were tagged in the uncut woodland. In late winter of 1992, trees were cut on six plots. On three plots trees were left whole and on three plots trees were slashed and limbs scattered. One plot was left uncut. Vegetation density and cover on the permanent sample plots and tagged bitterbrush stems were remeasured in post-treatment years. One whole-tree plot and one slash-scattered plot were burned in the early spring of 1994.

This area is considered an important browse winter area for mule deer. However, larger bitterbrush plants within the woodland show a high percentage of dead crown, low vigor as expressed by little if any leader elongation, and there appears to be a low recruitment of new plants.

The decadence of these plants may be due to a variety of causes including several dry years in a row, severe browsing, insects and disease, old age, and competition with western juniper. Whether or not bitterbrush will survive in thick juniper woodlands and whether or not it will respond to the removal of a dense overstory appear to be significant questions.

Results (Not Published)

Bitterbrush—

1991- Essentially no bitterbrush leader growth took place. Average growth per tagged stem was less than 1 inch, and each stem had 10 or more spur-shoots that potentially could elongate.

1992- Moisture conditions were better and leader growth averaged 4 inches per stem in the woodland and approximately 10 inches on the treated plots.

1993- Very wet year with leader growth averaging 35 inches per stem on woodlands and 36 inches in the cut plots.

1994- Precipitation near normal, woodland leader growth averaged less than 1 inch and the cut plots averaged 8 inches per stem.

Young bitterbrush plants, basal stem of 0.2 to 1.0 inches in the woodlands produced nearly 60 inches of leader growth per tagged stem in 1993, while plants with a high percentage of dead canopy averaged 24 inches of growth. This same young age class had fallen to about 1 inch in 1994 in the woodland, but was still at about 13 inches in the cut plots. From 1991 to 1994, 20 percent of the woodland plants died and an additional 31 percent of the tagged stems died. In cut plots about 10 percent of the plants have died and an additional 18 percent of the tagged stems have died. In the burned plots approximately 54 percent of the bitterbrush plants appeared dead in 1994 following the early spring burn.

Understory plants—From 1991 to 1994, perennial grasses increased from 4.3 to 7.3 percent in uncut, 8.2 to 24 percent in cut and scatter, and 6.5 to 13 percent in cut-scatter and burn. Annual grasses showed no increase in uncut plots, 0.7 percent increase in cut and scatter, and 0.1 to 1.2 percent increase in cut-scatter and burn. Perennial forbs went from 0.6 percent to 0.3 percent in uncut, 0.2 percent to 1.3 percent in cut and scatter and 0.3 percent to 0.6 percent in cut-scatter and burn. Annual forbs showed very little increase.

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Informal Notes

By Jerry Haugen, U.S. Forest Service

Clint's work is a take-off on the previous studies at Combs Flat. He is looking at worst-case scenarios and less productive lands with much less understory. The 15 demonstration plots are 15 miles north of Madras. Canopy ranges from 18 to 30 percent, 2 percent understory and 1 percent

native bluegrass. The plots were established from 1992 to 1994. The base year, 1992, was dry with 4 inches of precipitation and 1993 had 14 inches of precipitation.

The tests involved two management techniques:

- cut the trees and scatter the slash
- cut the trees, but leave them whole

It was found that the best grass growth came with about 50 percent of the area covered in slash in areas with the greatest amount of soil disturbance. Seeding was done after punching holes in the soil. Seeds established in the loose soil that sloughed into those holes. The whole tree approach got less grass growth because there was not enough slash to spread around.

On even worse sites in Warm Springs, transplanted seedlings were compared to seeding. This test got 90 percent survival under slash when transplanted and 55 percent when seeded. The transplants are probably not worth the cost because similar results can be achieved with seeding.

A third series of tests was performed at Cyrus Butte on north slopes in high density juniper with dying bitterbrush. Again the two approaches were:

- cut the trees and scatter the slash
- cut the trees, but leave them whole

None of the plots were seeded, but some were burned.

In 1991, the base year, no leader growth was seen on the bitterbrush with 5-to-6 inches of rain. With more rain in 1992, 4 inch leader growth was seen in woodlands, but 10 inches in cut over areas. During the course of the study, 20 percent of the bitterbrush died in the woodlands, 10 percent in cut areas, and 54 percent in burned areas.

ASHWOOD DEMONSTRATION AND RESEARCH PLOTS

Presented by Clint Jacks, Oregon State University Extension Service, Madras, Oregon

Research Purpose

The purpose of this project was to evaluate the means and materials needed to improve understory vegetation in western juniper woodlands that no longer have a productive and protective cover of perennial herbaceous plants. The project's second objective was to follow vegetation changes over an extended time period to determine long-term effects of cutting western juniper on degraded sites 18 miles north of Madras on private land, Jefferson County, OR.

Methods

Demonstration plots were established in 1991 with a collection of baseline information for each plot. Treatment was then applied in 1992, 1993 and 1994. Plots received a combination of: surface treatment, consisting of using a cut juniper roller or tree drag or no surface treatment; broadcast seeded or no seed treatment; and junipers cut without being delimbed, trees cut and limbs scattered, or no treatment.

In 1994, two additional plots were added that included thinning the juniper stand. The seed mix included Sherman Big bluegrass at 0.5 lb. per acre, Goldar Bluebunch wheatgrass at 7.2 lb per acre, Critana Thickspike wheatgrass at 2.4 lb. per acre and Rosana Western wheatgrass at 2.6 lb. per acre.

Research plots were established in 1991. They consisted of a series of 3 × 10 meter plots. After baseline data was collected, treatments were applied in 1992 and 1993 with: 1) seed or no seed treatment; 2) no punch or punch; and 3) slash cover at 0 percent, 25 percent, 50 percent, or 75 percent. Seed mix was the same as in demonstration plots.

Results

1992 was a dry year, and 1993 was a wet year. Baseline data in 1991 indicates tree cover of 18-30 percent, total understory cover 2 percent and native bluegrass cover at just over 1 percent. Results are not published; data are still being collected.

Demonstration Plots

Good seedling establishment occurred in 1992 (dry year) where juniper trees were cut and limbs scattered, or cut and left whole, soil surface disturbed with a tree drag and seeded; establishment occurring under slash or under the fallen whole-tree. Total percent cover, where treatment consisted of seeding, dragging and falling, leaving whole trees was 6 percent perennial, 4.3 percent native

blue grass and 1.4 percent annual grass with 23 percent bare ground.

For drag, seeded and slash treatment, cover was 4.4 percent perennial grass, 2.6 percent native bluegrass and 0.6 percent annual grass with 12 percent bare ground. In wet years, establishment occurred both under slash and in interspaces, but was favored with site disturbance by roller punch or tree drag. Roller punch sites did not have enough disturbance for seedling establishment in the dry year.

Research plots showed significantly greater (2X) establishment at 50 percent and 75 percent slash cover for the drought year 1992 planting. In the wet year, there was an equally high establishment for 0 percent, 25 percent, and 50 percent, but slash cover had less establishment with 75 percent. Punch hole density in the research plots was about 50 percent higher than in the demonstration plots, and showed greater establishment in dry year.

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UNDERSTANDING THE BIOLOGY AND ECOLOGY OF WESTERN JUNIPER

Presented by Tim DeBoodt, Oregon State University Extension Service, Prineville, Oregon

Research Purpose

The purpose of this study is to better understand the ecology and biology of western juniper and how it interacts within its environment at two sites: Combs Flat, Prineville, Oregon, and South Maury Mountain, Crook County, Oregon. Re-establishment of herbaceous understory is also a part of this project.

Results

Sites just outside of Prineville were first treated in 1982. Sites were monitored pre-treatment, trees cut and removed from treatment sites, and monitoring conducted post-treatment in both treated and control areas. Additional sites were added through the years since looking at treatment technique (cut and scatter tree limbs) and reintroduction of herbaceous material, primarily grasses.

Soil depth and restricting layers play a crucial role in determining tree competition with herbaceous and shrub understory. In sites where soil depth is limited or a restricting layer occurs, greater vegetative differences occur between treated and untreated plots. Summary of results from one trial is as follows:

A) Idaho fescue declined in cover with cutting and clearing but not in the cut and slash treatment;

B) native bluegrass plant cover was always less on cut plots than on uncut plots;

C) perennial forb cover was approximately two times greater on cut plots than uncut plots;

D) perennial forbs responded strongly to the very wet year of 1993 reaching 7 percent cover in several plots including both cut and uncut (note: Forb component was probably measured after the spring peak in most years and is likely an underestimate);

E) there was in general a higher percentage (average about 50 percent more, excluding moss and lichen cover) of bare soil in uncut versus cut plots; and

F) shrub cover shows a steady increase over time in cut plots and a general decline in uncut plots.

Estimated carrying capacity for cattle, over the years and between blocks, was 2 to more than 10 times greater on cut plots versus uncut plots. The 2X figure was for the very wet 1993 year in one block, otherwise, the value was 5-to- more than 10X. The Prineville site estimated carrying capacities

(AUM, animal unit month) in normal precipitation years are:

Uncut	15 - >20 Acres per AUM
Cut	3-4 Acres per AUM

Grass species planted for revegetative effort were: GOLDAR Bluebunch wheatgrass, SECAR Bluebunch wheatgrass, NORDAN Crested wheatgrass, EPHRAIM Crested wheatgrass, RUSH wheatgrass, CRITANA Thickspike wheatgrass, ROSANA Western wheatgrass, SHERMAN Big bluegrass, MAMMOTH Wildrye, TEGMAR Intermediate wheatgrass, CANBAR Canby bluegrass, and PAIUTE Orchardgrass.

Seeding rates varied depending on seed size; from five seeds per sq. foot (Mammoth wildrye) to 210 seeds per sq. foot (Sherman Big bluegrass). Each species was broadcast seeded and trees were then cut and limbs scattered in mid-winter 1988 and 1989. Results were measured in 1995. Plant cover and density were highest in the 1989 planting for all species over 1988. In the 1988 planting, Goldar bluebunch wheatgrass had the highest percent cover (4.1) while the seed mix of Tegmar, Canbar and Paiute had the greatest plant density (11.9 plants per sq. meter). In the 1989 planting, Rush wheatgrass had the highest plant cover (7.7 percent) and the grass mix had the greatest plant density of 34.1 plants per sq. meter.

Publications

Bedell, T.E., L.E. Eddleman, T. Deboodt, and C. Jacks. 1993. *Western Juniper - Its Impact and Management in Oregon Range lands.* EC 1417. Oregon State University Extension Service. 15 pgs.

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Science and Management Abstracts

Session III

Three Real-Life Scenarios:

What Went Right, What Went Wrong, and
What Would I Do Differently?

Organizer: Larry Swan, USDA Forest Service,
Winema National Forest, Klamath Falls, Oregon

Each presenter was asked to answer the following questions:

1. What was there before treatment?
2. Why did you choose this particular parcel to treat?
3. What did you want to accomplish and why?
4. How did you go about implementing your project?
5. What were the results?
6. What worked well and not so well, and why?
7. What would you do differently?

STEENS MOUNTAIN COOPERATIVE PRESCRIBED BURNS AND JUNIPER CUTS (A BEGINNING)

Presented by Fred Otley, Otley Brothers, Inc., Diamond, Oregon, and Jim Buchanan, Bureau of Land Management, Andrews Resource Area, Burns, Oregon

The areas treated are approximately 5 to 10 miles southeast of Diamond, Oregon, in the Steens Mountain. The elevation varies from approximately 4,800 feet to 7,100 feet within the project areas. Fire was introduced on approximately 2,500 acres. In excess of 200 acres were cut. Most of the area treated has north and east aspect, with some west aspect.

In the burn areas, juniper trees were from 100 to 300 trees per acre with most trees under 10 feet in height. The sites were mostly mountain big sagebrush-Idaho fescue plant communities with some low sagebrush-Idaho fescue communities included. These were at an early-to mid-stage of woodland development as defined by Miller (1996.) Shrubs were beginning to die, and in some areas, were all decadent and/or dying. The forb component was limited but there were 10-12 percent grasses. Groundcover averaged 75-85 percent with 15-25 percent bare ground.

Areas that were cut were in a mid-to-late stage of woodland development with little shrub understory, few forbs, and usually 8-10 percent Idaho fescue and other grasses. Tree density was up to 500 trees per acre and average height was 15-20 feet.

Treatment areas were selected because of the potential to produce a diverse native plant community and where diversity had already diminished. The purpose of reintroducing fire was to create a mosaic of habitats; increase structural diversity, which would improve habitat for many wildlife species; increase the forage base for livestock and wildlife; and improve watershed conditions. The resulting mosaic of plant communities in various seral stages would increase the efficiency of the ecosystem to cycle available water and nutrients. These sites were progressing to a later stage in woodland development when prescribed fire would no longer be effective in changing the community.

NEPA documentation and public input were accomplished one to two years previous to completing on-the-ground work. A cooperative agreement was developed with Otley Brothers, Inc., and partnerships established with Oregon Department of Fish and Wildlife (ODFW), Eastern Oregon Agricultural Research Center (referred to in this section as "Research Center), and Rocky Mountain Elk Foundation. The Research Center continues intensive monitoring of treatment areas as well as providing scientific data for the BLM and landowner to base decisions.

All juniper cutting was done by volunteers or contract, with contract costs running between $50-$60 per acre. The burns were done in the fall, usually during October, with a crew consisting of a fire boss, seven or eight people from the fire crew, Fred Otley, and approximately five people from our Resource Area (BLM). Prescribed burns were designed to use roads, topography, and differences in vegetation cover to provide for control. This allowed minimum black-lining and equipment, which in turn has held down average costs to $4.00-$5.00 per acre. Much of the ignition was done with drip torches and travel by All Terrain Vehicle (ATV). Weather conditions are variable on the Steens with the mountain influencing wind patterns. This required on-site information and test fires to see if objectives could be accomplished.

Results have been favorable. A mosaic of plant communities has been established, structural diversity increased, forage base for livestock and wildlife increased, and watershed conditions improved. Monitoring studies indicate an increase in herbaceous cover and number of native species (especially forbs) on treated sites. Most of the burned area attained between 50-70 percent reduction in juniper density. Grasses have increased cover within three years. In the second and third year, the shrub component began to increase.

Aspen stands have recovered more slowly than other communities because of limited size and high palatability to elk and deer. We have rested areas from livestock use, but elk and deer prefer aspen saplings. BLM has a short season for prescribed burning on the Steens; we cannot begin until there are no suppression needs throughout the state. We are often "weathered-out" with few days possible to burn.

The BLM will not burn certain shallow soils or slopes in excess of 30 percent, depending on soil depth and texture. The agency also has concerns with cutting or burning juniper within riparian zones.

Partnerships have been invaluable. The Research Center provides annual reports and data as needed, Fred and his family constructed fire lines, provided cost sharing, and are a constant source of information. In the future, a helitorch will be used for ignition in a mountain sagebrush-Idaho fescue community that is now a mature woodland due to lack of fire. It will also be used to ignite aspen stands to attempt to create the heat needed to regenerate aspen suckers. Plans are being developed to protect the stands from deer and elk grazing to accelerate recovery.

Spring burns will be tried on areas previously cut to lessen fuel loads, reduce possibility of soil sterilization, and compare vegetation response with areas that have cut trees left in place. Decision-making authority to ignite prescribed burns is being examined for delegation to the local Fire Management Officer. More precutting will be conducted to allow fire to carry into sites which are in a later stage of woodland development.

The reintroduction of fire into areas in the Steens Mtns. has increased since beginning work with the Otleys in 1991. Last year, a 1500 acre burn began a 10-to-15 year project to burn 60,000 acres on the west slope. Next year another 30,000-acre area will have treatment begun.

At this rate, it would take over 100 years to reintroduce fire to the Steens, however, much of the mountain has only 15-30 years until woodland communities develop to a stage of maturity where fire will no longer be a viable alternative. At least it is a beginning!

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JUNIPER MANAGEMENT - CROOKED RIVER NATIONAL GRASSLAND (CRNG)

Presented by Byron L. Cheney, Crooked River National Grassland, Madras, Oregon

Presentation Outline

1. CRNG encompasses 110,000 acres in Jefferson County, Oregon.

2. CRNG burns up to 3000 acres per year and cuts or thins up to 100 acres per year of juniper.

3. Juniper Woodland Management Objectives:
   a. Improve forage for livestock and wildlife
   b. Maintain grass-forb-shrub successional stage
   c. Maintain openness and low vegetation in antelope winter range
   d. Maintain or improve understory vegetation for groundcover

4. Prescribed fire is a cost-effective way to control smaller junipers. However, older juniper stands reach a threshold where they become difficult to burn; too much bare ground and not enough understory vegetation to carry the fire. In these areas we have clearcut junipers to improve forage, and maintain or improve understory vegetation. It should be noted that clearcut treatments are not normally applied - most of these occurred when juniper was still considered a "weed."

5. Began later to leave the larger, older trees for wildlife. Older trees tend to be the ones with hollow centers that provide cavities for wildlife.

6. At one point we were leaving all trees greater than 15 inches dbh, and just thinning out the smaller trees - trying to mimic what natural fire may have done. More recently, we began a demonstration project where we are thinning juniper using a "stand improvement" approach (select best trees to leave; prune lower limbs; vary spacing; and use spacing which allows understory response).

7. Benefits of Current Thinning Prescription
   a. Faster growth on the leave trees.
   b. Improved forage conditions.
   c. More groundcover and healthier understory vegetation.
   d. Some wood products harvested from thinned trees (mainly posts or firewood).
   e. Improved nutrient recycling by scattering limbs of thinned trees.
   f. Leave trees have greater potential to be used for wood products in the future.

8. Sales and Uses of Juniper to Date
   a. Personal use firewood
   b. Commercial firewood

c. Decorative limbs
d. Juniper boughs
e. Posts and poles
f. Small trees for landscaping

Informal Notes

By Jerry Haugen, U.S. Forest Service

The Crooked River National Grassland Management Plan calls for burning up to 3,000 acres per year, usually in August. There are a few problems with this. First, burn crews are often elsewhere fighting fires. Second, it is not politically expedient to be starting fires when fire fighting is in the news. The dilemma is that humidity of less than 20 percent is needed for best results.

Usually the area to be burned is rested from cattle grazing and use for a year to build up enough fuel to carry the fire. As mentioned by others, western juniper woodland development eventually causes loss of ground vegetation and the opportunity to thin by using fire. One option is to cut the juniper and leave the slash for two to three years and then burn it.

Byron noted that stumps are found high on the hills above old homesteads. Apparently the homesteaders had to go that far to find trees for their use.

The Grasslands offer firewood in designated places. One commercial sale of 600 cords of juniper was attempted, but got no bidders. Generally bidders are looking for 25 cord lots and could not deal with 600 cords at once. Decorative limbs are sold with permits. Live trees are removed for landscaping by being pulled with a chain and a pick-up. There is some interest in material for log homes, but the logs are not typically long enough.

RESULTS FOLLOWING JUNIPER CUTTING IN A KEY CIRCLE 5 RANCH SUB-BASIN

Presented by Louis Randall, Circle 5 Ranch, Bonanza, OR

Treatment Area Description

The treatment area is located within a 80-100 acre sub-basin on the Circle 5 Ranch. The sub-basin is situated on a southeast aspect at about 4200 ft. elevation. It is bordered to the north and northeast by rimrock. There were about 50 to 100 juniper trees per acre on the lower slopes of the basin, which were treated first, and about 25 to 75 juniper trees per acre on the upper slopes. Western juniper woodlands, averaging 25 to 75 trees per acre surround it.

Slopes average 15 to 20 percent on the lower end of the sub-basin, with a few benches midslope, and in excess of 35 percent starting about two-thirds of the way up the sub-basin slopes. A few remnant ponderosa pines are located near the toe of the rimrock, and a perennial spring is located at the outlet of the basin which eventually drains into the Lost River.

Juniper trees average 30 to 40 feet in height, and are about 12 to 18 inches in diameter at breast height (DBH). The age of juniper trees at the stump averages between 70 to 80 years, with a few older ones higher up on the slope (around 300 years and some may be older). The groundcover consisted of scattered sagebrush and cheatgrass and was about 20 percent bare ground before treatment.

Why Was This Particular Parcel Chosen For Treatment?

The reason this particular parcel was chosen was because the spring is located at the outlet to the sub-basin. It was the best spring on the Circle 5 Ranch, and it went dry in 1992. The landowner, Louis Randall, said it had never gone dry in his memory, and he has been on the same ranch since 1932.

According to Randall, the original homestead for this ranch was located right next to the spring, and people who had lived there prior to him coming into the area could not remember the spring going dry. Significant use of the spring was made in the late 1800s and early 1900s, based on evidence of ditching for flood irrigation of nearby fields. He could not recall seeing any juniper, besides a few scattered ones higher on the slopes, when he first arrived.

What Did You Want to Accomplish?

Wanted the spring to produce water again, and based on the evidence Randall saw on Doc Hatfield's ranch around 1988, he was fairly sure he would get some response.

How Was the Project Implemented?

The project began in the fall of 1993 by pushing over about 10 acres of juniper with a dozer. The trees were cut up for firewood and most of the limbs were left. Have been cutting 5 to 10 acres per year since then, sometimes using ranch employees and by letting people come in and cut firewood.

Just letting people come in and cut firewood did not work as well because they simply took the best trees. Randall found the average cost for using his own employees is about $200 per acre. He suspects that cost would rise to about $400 to $500 per acre if he had to pay someone to clear the juniper in the manner he wants. So far a total of about 40 acres has been cleared. Some of the slash has been piled, but the majority of it has been simply left scattered.

Treatment Results

The spring came back following treatment and has been getting better each year. Currently seeing about 250 gallons per minute (April 1997) and groundcover has increased. Bunchgrass is coming back where the limbs were scattered and less than five percent of the bare ground is visible. The area was never fenced, but was not grazed during the first year after the treatment. Currently have between 40 and 50 head of cattle on a 5,000-acre parcel that includes the sub-basin, which even now is not grazed very heavily.

One of the indirect benefits from this project is that the deer, which had been plundering the ranch's alfalfa sheds in December and January, are now found up in the cut area browsing on the freshly cut juniper foliage.

What Worked in Your Particular Situation and Why?

Concentrating on a small, but critical, sub-basin with a usually excellent spring.

What Are You Planning to Do Differently?

"I will control the woodcutters better, if they are ever let on the property again," said Randall. Also, "I wouldn't wait so long!" In fact, Randall is looking at a couple of other sub-basins where he thinks he could obtain similar results. The other two basins each have a history of a perennial spring and would appear to require clearing 30 to 40 acres of juniper.

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Industry Topics
Abstracts and Informal Notes

Session I

Primary and Secondary Processing Updates and Other "Non-Commodity" Wood Products Industries

<u>Moderator:</u> ***Dennis Brock,***
Northwest Wood Products Association, Bend, Oregon

WESTERN JUNIPER HARVEST SYSTEMS COMPARISONS PROJECT

Presented by Larry Swan, USDA Forest Service, Winema National Forest, Klamath Falls, Oregon

Project Need and Purpose

Western juniper *(Juniperus occidentalis)* is the most under-utilized wood fiber resource in Oregon. A number of factors contribute to this situation, but probably the biggest barrier to the commercial use of juniper is harvest costs.

Juniper trees have numerous and large limbs, and average volume per acre is much less than current commercial species (such as ponderosa pine or fir). The terrain is often rocky and road systems are primitive. Other major barriers to large-scale use and commercialization of juniper include distance from potential markets, lack of industry infrastructure specific to juniper, and market acceptance.

The purpose of this project was to identify and assess harvest systems that already have been tried in western juniper woodlands, what might work that has not been tried, and conduct harvest trials with the best available systems identified. Harvest trial results were evaluated in terms of direct site impacts, production, and production costs. Loggers and landowners with juniper harvest experience were consulted, as well as a harvest systems researcher.

The harvest trials project site was located on property owned by the Lost River Ranch, about six air miles southwest of Bonanza, Oregon. Total project area was about 14.7 acres. Most of the site was considered "above average" for juniper stands with commercial potential.

Average tree height was 33.4 feet, average age at stump height was 89-years-old, and the average diameter at breast height was 12.6 inches. Tree density ranged from 25 to 160 per acre, and the volume per acre ranged from 220 ft^3 to 1,175 ft^3. Tree canopy prior to harvest ranged from less than 10 percent in the least dense area to over 60 percent in the densest area. For the most part, groundcover consisted of a thick carpet of cheat grass *(Bromus tectorum). A* shrub layer was virtually absent and there was very little juniper in the seedling/sapling size class.

Western Juniper Harvest Systems

At least seven individuals with commercial western juniper harvest experience, as well as a harvest systems researcher, were interviewed to determine what has been tried, what worked, what did not work, and what has not been tried that might work. Ten different options involving all phases of a juniper harvest operation were considered for field trials based on their input.

The two options, which appeared most promising for reducing harvest costs, were pull-through delimbers and forwarders. A forwarder could not be tested due to insufficient volume and equipment availability.

Harvest Trials Methodology

Baseline data was not available about average cycle times and production for the operational phases involved with juniper harvest. This prevented comparisons between potential harvest system options and made it imperative to obtain baseline data using the most commonly used western juniper harvest system chainsaws and a grapple-equipped rubber-tired skidder.

Harvest operation phases studied included delimbing prior to falling (a technique used in juniper to reduce cost and risk to falters), falling with chainsaws, delimbing with chainsaws, mechanical delimbing, and skidding. Three different pull-through delimbers were examined in the mechanical delimbing phase.

Two variables were used to evaluate direct site impacts of the harvest systems investigated: 1) Soil bulk density changes; and 2) ability to distribute slash (limbs and other logging debris) evenly about the site. A third variable, success of grass seeding, could not be evaluated because of project and report time lines. A total of nine exclosures were erected after harvest to provide control plots for monitoring site response.

Harvest Trials Results

There was no significant production difference between a harvest system which used chainsaws to delimb juniper and a system which used a pull-through delimber. Both systems averaged about 1.7 tons of juniper per hour at an estimated cost of $27-$29 per green ton. The production results were considered on the "low end" by both the logging systems researcher and the logging contractor. The logging contractor reports that a production increase of 10 to 20 percent can be expected as a shovel operator becomes more familiar with the pull-through delimber. **(Special Note:** The logging contractor recently revised this estimate to around 40 percent, based on additional production experience with the delimber.) Performance of the three pull-through delimbers used in these trials differed substantially. The skidder pull-through delimber was least effective with juniper. Limb size and length hindered proper loading and actuation of a set of hydraulic knives.

There were various reasons why one shovel pull-through delimber performed better with juniper than the other. They included: Larger, heavier, and taller platform; longer knives; and self-centering head. All three pull-through delimbers appeared suitable and capable of delimbing trees with smaller limb diameters and lengths.

A total of 398 trees were removed from the project site, which represented roughly two-thirds of the total standing before harvest

(average 82 trees per acre pre-harvest and 27 trees per acre post-harvest).

There was very little difference in bulk densities before and after harvest operations, even though post-harvest sampling was biased towards high impact areas, such as landings and skid trails. Surface organic matter actually increased due to needle cast from whole tree skidding, and redistribution of mechanically delimbed slash from a central landing. Slash was better distributed in the area that was delimbed with chainsaws (average cover 65 percent) than those areas where trees were whole-tree skidded to a central landing, mechanically-delimbed, and slash redistributed back out into the unit (average cover less than 15 percent).

Implications

Inventory—Research conducted for this project highlighted the sparse and often incompatible nature of western juniper inventory data. It will be difficult to convince companies to invest significant amounts of capital without better inventory data. The key questions are: 1) How much is there?; 2) What is the quality?; 3) Where is it located?; and 4) How accessible is it (considering physical, geographic, legal, and social factors)?

Existing Juniper Harvest Systems—Western juniper harvest is expensive (averaging $25-$30 per green ton). There was not one piece of equipment identified that will solve all or most of the cost and production issues associated with western juniper. It appears that incremental production increases and cost reductions may be possible through use of different arrangements of conventional systems. Economies of scale and consistent production will also significantly affect costs.

A paper exercise was conducted to determine potential economies of scale through use of a forwarder. Actual field trials were not conducted with a forwarder because of the volume and acreage required. It is estimated that a harvest operation using a forwarder would require at least 1,500-2,000 acres per year of medium- to high-density juniper woodlands (50-150 trees per acre, averaging 12-14 inches diameter at breast height). The high volume needs of such an operation probably preclude the use of a forwarder in the majority of juniper woodlands.

Slash Dispersal—The ability to evenly disperse juniper slash is critical in meeting the goal of improving rangeland habitat through commercial harvest. This is difficult to accomplish effectively and economically using a harvest system that relies on a rubber-tired skidder and grapple. Several methods were tried to improve slash dispersion, but none worked very well.

Options to improve slash dispersal were discussed with various government personnel and private industry. Analysis suggests that more limbs can be left on-site without major modification of systems

already in use, or a significant negative impact on costs and production.

Mechanical Harvest Impacts on Juniper Woodlands—Concern has been expressed about the impact of mechanical harvest on soil types found in western juniper woodlands. Based on the results of this project, minimal impacts are expected on dry clay loam and clay soils. These soil conditions are encountered most frequently in late summer and early fall, when soil moisture is historically at a minimum.

Harvest Equipment Specifically Designed for Juniper—Several loggers with extensive commercial juniper harvest experience believe what is needed is a piece of harvest equipment which will delimb juniper "on the stump" and cut it. Advantages of such a system include reduced labor costs, and improved personal safety and slash dispersal. Costs would have to be comparable to a shovel/pull-through delimber combination ($75-$80,000). There is currently no way to estimate production because there is no equipment like this on the market.

Summary

This project established a number of "firsts":

First Summary of Potentially Utilizable Western Juniper Volume and Acreage Inventory Data—Published and unpublished data about potentially utilizable juniper volume and acre estimates from Oregon, California, and Idaho were summarized in one table.

First Pre- and Post-Harvest Soil Investigations—Bulk density was evaluated before and after commercial harvest operations in western juniper woodlands.

First Systematic Collection and Analysis of Conventional Harvest System Data—Baseline data was gathered about average production of a conventional harvest system in western juniper.

First Evaluation of Post-Harvest Slash Dispersal—The effectiveness of a grapple-equipped skidder was evaluated in terms of its ability to redistribute juniper slash from a central landing where juniper was mechanically delimbed.

First Written Evaluation of Use of Pull-Through Delimbers in Juniper Harvest—Two shovel pull-through delimbers and a skidder pull-through delimber were used in a western juniper woodland harvest operation, and data recorded for baseline time/economics calculations.

First Juniper Harvest Systems Production and Costs Comparison Table—Based on the information gathered for this project, a table was prepared showing cost and production estimates for various combinations of conventional harvest system operational phases in western juniper woodlands. Also included in the table are cost and production estimates for mechanical delimbers and a forwarder.

Publication

Swan, Larry 1997. *Final report - western juniper harvest systems comparisons project.* Unpublished report. On file USDA Forest Service, Winema National Forest, and Oregon State University Extension Service, Klamath Falls, Oregon, (available at the western juniper web page— *http://www.orst.edu/dept/kcoext/juniper/harvest.htm).*

Questions and Answers

Q: Could you use a rotosaw that is backed into the tree?

A: There is a tractor attachment that you back into a tree....sort of like a rotosaw, but more heavy duty, like for stump grinding. According to the one person I know who has one, it works fine on trees up to about 14 inches at the base.

Q: Could you use hydraulic trimmer saws to delimb juniper?

A: We have not tried hydraulic trimmer saws, and I'm not sure I would know one if I saw one. If you can, send me a photo and any literature you have on them, or tell me where to go to find out more.

Q: Can you selectively harvest a site?

A: There's a couple of ways to answer this question. I'm assuming you mean cutting only the trees that will make the best sawlogs. It's possible on a small-scale basis, but not economical on a larger-scale and may not be the best way to rehabilitate rangeland habitat. Let's talk at break to make sure I understand where you're headed with that question.

Q: Could you use mechanical processors in a mixed juniper/conifer stand?

A: I would assume since the juniper in mixed conifer stands has better shape and usually fewer limbs, it can be done. I've heard through the grapevine that mechanical processors have harvested juniper, usually in conjunction with pine and fir harvest.

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WESTERN JUNIPER LOG STORAGE PROJECT

Presented by Scott Leavengood,
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Larry Swan, USDA Forest Service, Winema
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Western juniper *(Juniperus occidentalis)* product trials in 1992 and 1993 revealed a potential problem with excessive end-splitting during drying and remanufacturing. Splitting reduces raw material recovery and may cause reductions in quality and value of finished products. It was theorized by academicians and manufacturers that the problem might in part be caused by "raw material handling," e.g., excessive log storage time and improper log storage methods.

The Western Juniper Commercialization Steering Committee Oregon obtained lottery funding to study the effects of differing log storage methods (end-coated vs. non end-coated) and storage duration on product recovery and value. The sample set consisted of 25 logs: eight were left as a control, eight were end-coated on both ends as well as all knots over 3 inches, and nine were simply coated on both ends. All logs were harvested in early October 1995 from the same site and classified as "sawlogs" by a local mill with experience sawing juniper. A representative sample of the "green" logs was then sawn into lumber, dried, and remanufactured into finger-joint blanks. The remaining logs were sawn, dried, and remanufactured into finger-joint blocks after 250 days of storage.

Recovery figures for the lumber and finger-joint blanks were calculated for both storage periods. Lumber recovery[1] values were approximately 1.66 (that is, the lumber recovered was 1.66 times the volume predicted by the gross log scale) for logs stored 30 days. Lumber recovery for logs stored 250 days was approximately 1.43. Therefore, lumber recovery was approximately 20 percent greater for logs stored for 30 days than for logs stored for 250 days. The finished product recovery in the form of finger-joint blanks was 53 percent for lumber sawn from logs stored 30 days, and 44.7 percent for lumber sawn from logs stored for 250 days. The slight decrease in finished product recovery is likely insignificant.

Specific data comparing the effects of log storage on end-coated versus uncoated material was unattainable; it was impossible to distinguish end-coated versus uncoated logs after 250 days due to weathering. End-coating probably contributed to a better than expected lumber recovery; however, to what extent could not be determined.

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[1] Where BF=board foot:

$$\text{Lumber recovery} = \frac{\text{BF lumber}}{\text{BF log scale}}$$

$$\text{Finished product recovery} = \frac{\text{BF finger-joint blocks}}{\text{BF lumber}}$$

References

Leavengood, Scott and Larry Swan 1997. *Final report - western juniper log storage and debarking project.* Unpublished report. On file Oregon State University Extension or USDA Forest Service, Winema National Forest, Klamath Falls, OR (also, available at the western juniper web site—*http://www.orst.edu/dept/kcoext/juniper/logstor. htm).*

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WESTERN JUNIPER DEBARKING PROJECT

Presented by Scott Leavengood, Oregon State University Extension Service, Klamath Falls, Oregon, and Larry Swan, USDA Forest Service, Winema National Forest, Klamath Falls, Oregon

The vast majority (approximately 80-90 percent) of western juniper *(Juniperus occidentalis)* trees is unsuitable for saw logs. Markets for fiber and other products must be pursued to economically harvest and process juniper on a large-scale. One potential market for juniper is as chips for hardboard and medium-density fiberboard, which generally require a bark content of less than three percent.

The stringy and fibrous nature of western juniper bark, as well as log form, concern many in industry who have considered chipping juniper. A common belief is that juniper cannot be debarked effectively or efficiently with existing sawmill or "in-the-woods" debarkers.

The purpose of this project was to gather information about the effectiveness and economic efficiency of commonly available debarking equipment on western juniper. This information will assist chip producers and sawmills in analyzing and selecting the most economical and efficient method for their particular operation and markets.

Three different types of debarkers were used in these trials: Ring, chain flail, and rosserhead. A total of about 90 logs were run through three ring debarkers at two different mills, about 10 logs were run through a chain flail, and about 19 logs were run through two different rosserheads at two different mills.

Contrary to common industry belief, all three types of debarkers performed effectively on juniper logs. Bark content of chips averaged below two percent, well within industry standards for such fiber products as hardboard and medium-density fiber board.

Economic efficiency is another issue. If a mill does not already have a ring or rosserhead debarker installed, end-product market price range (such as chips) and costs of getting the product to market, must be closely examined. Portable mills probably will not be able to justify the capital investment for debarkers. For "in-the-woods" operations, chain flail debarkers also operate effectively and economically on western juniper.

References

Leavengood, Scott and Larry Swan 1997a. *Final report - western juniper log storage and debarking project.* Unpublished report. On file Oregon State University Extension, Klamath Falls, and USDA Forest Service, Winema National Forest, Klamath Falls, OR. Also on the website *www.orst.edu/dept/kcoext/juniper/debarh. htm.*

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WESTERN JUNIPER OIL DISTILLATION AND MARKETING PROJECT

The Confederated Tribes of the Warm Springs Reservation of Oregon Business and Economic Development Branch

Presented by Joe Yesenofski, Management Consultant, Portland, OR, and Robert Seidel, The Essential Oil Company, Lake Oswego, OR

Abstract Editor Larry Swan, U.S. Forest Service

Project Purpose and Organization

The purpose of this project was to distill essential oils from western juniper *(Juniperus occidentalis)* leaf, bole wood, and dried berries, and to determine if viable business opportunities exist for western juniper distillation operations.[1]

The project was organized into four phases:

1. Collection, Distillation, and Essential Oil Analysis
2. Essential Oil Production Cost Analysis
3. Market Research
4. Business Opportunity Identification

A set of related, but separate, distillations were conducted in the fall of 1996 for a project still underway. Distillations were conducted with the same operator and equipment, and were focused on obtaining leaf and heartwood oil for further market research (Swan personal communication).

Collection, Distillation, and Essential Oil Analysis

Collection—Leaf and bole wood samples were obtained from a low-density juniper woodland on a flat near the town of Warm Springs, OR (average 10-20 trees per acre). Based on the stand characteristics recorded for the first six samples, age range was 65-160 years (average 110 years), height range was 25-40 feet (average 31 feet), and base diameter range was 20-30 inches (average 24 inches). The sample was purposefully biased towards trees with extensive crowns and darker green foliage. Trees were sampled with and without a green berry crop.

Trees utilized for bole wood were fallen and bucked into short lengths (approximately 15 inches) at the harvest site. Bucked log rounds were covered and stored for varying lengths of time before further processing. The rounds were split, chipped, placed in burlap bags, and covered and stored from one to four days before distillation.

[1] In the essential oil business, "leaf refers to needles or foliage. "Bole wood," as used in this report, refers to the mixture of sapwood and heartwood which results when the whole log is chipped.

Trees utilized for leaf samples were fallen, clipped, and the resulting material bagged at the harvest site. Juniper leaf samples were stored from one to five days before distillation.

Juniper berries were dropped from the sampling program due to predicted low recovery potential for green berries and lack of sufficient dried berries on the ground to sample.

Distillation—Raw material was steam-distilled at zero pressure in a 23 cubic feet, top-loading retort. A total of 13 batches were run through the system, nine batches were leaf and four were bole wood. Distillation residue was returned to the harvest site and scattered as mulch.

Leaf oil yield by weight averaged 0.206 percent for samples harvested and distilled in June, July, and August, and 0.405 percent for samples harvested and distilled in October and November (almost a 100 percent increase). Bole wood yield by weight for this project averaged 0.138 percent for the earlier period and 0.420 percent (one sample) for the later period (approximately 300 percent increase). Seasonal variation in both oil content and improved processing techniques is one of a number of possible reasons for these differences.

Other key distillation phase observations include:

- Trees laden with immature berries appeared to yield significantly less oil from leaf material than trees that had sparse berries.

- A properly "tuned" steam/retort /condenser system should yield 80 percent oil recovery in three hours. Minimum oil yield from leaf material with such a system is expected to be 0.40 percent. A leaf oil yield of 0.50 percent to 0.75 percent can be expected with more experience and properly prepared raw material. Oil yields of 1.0 percent to 1.5 percent are projected in a 20 to 40 psi pressure system, based on previous work by Kurth and Ross (1954).

- There are 300 to 350 gallons of run-off distillate waters for each gallon of oil produced.

Essential Oils Analysis—Three samples of juniper leaf oil and one sample of leaf oil distillate water were analyzed using a gas chromatograph.[2] The crude leaf oil is colorless or pale greenish-yellowish with a characteristic balsamic odor. The leaf oil is somewhat unique in that its aroma is very similar to the aroma of the living tree.

[2] Interpretation of gas chromatograph readings have been questioned by Joe Karchesy, Oregon State University, based on previously published western juniper gas chromatograph results and his personal experience and research (Swan personal communication).

Essential Oil Cost Production Analysis

Assumptions were made concerning raw material costs, equipment (zero-pressure system), yield, operation and maintenance costs, and capital investment. The estimated production cost of leaf oil is $360 per gallon for a high-volume operation (one-ton retort capacity) and $925 per gallon for a low-volume operation (250 lbs. retort capacity).

The key determinant appears to be the relatively low yield estimate used (0.40 percent to 0.45 percent) because of a zero-pressure system. The economic profile of bole wood was not projected due to low yields and the current market price of a competing product: Eastern redcedar *(Juniperus virginiana)* at $60 per gallon. Production costs could change significantly if markets are found for the distillate waters.

Market Research

A list of potential applications were developed for juniper leaf oil based on distillation results and production cost analysis. These applications included aromatherapy, mood scents, room fresheners, scent masks, insect repellents, soaps and candles, cosmetics and fragrances, lotions and cremes, and naturopathic remedies (using the antibacterial properties of juniper for example). Small samples of juniper oil and, in some cases, distillate waters were sent to prospective buyers, along with gas chromatography results.

Prospective buyers were identified and contacted in the following markets segments:

- **Industrial:** Companies that supply essential oils to product manufacturers in bulk form; typically 400 lb. (45-gallon) drums.

- **Large Commercial:** Companies that principally broker and distribute oil in drum lots to oil blenders and large third-party manufacturers.

- **Specialty Commercial:** Companies that distribute and often blend a wide variety of essential oils, often on a regional basis. They generally purchase relatively small lots of oil (one to five pounds) and produce specialty products for aromatherapy, naturopathic medicine, and scent products for niche markets.

- **Single Entrepreneur/Retail:** This segment consists of local entrepreneurs who distill small quantities, which they use to create retail products for local and regional distribution.

Manufacturers and distributors of competitive or similar oils were also contacted, such as western redcedar, eastern redcedar, Alaska yellow-cedar, cypress, and balsam fir.

The market research performed for this project indicates no potential for western juniper leaf or bole wood oil in the **Industrial Sector.** The bottomline is that

the market price of eastern redcedar, with which juniper would have to compete, is $7.50/lb. at the industrial distribution level ($60 per gallon). This market segment is simply not feasible to pursue at this point given what is known about juniper oil yield and production costs.

Feedback from the **Large Commercial** sector was similar, although at least the potential price that might be obtained for leaf oil was higher ($25/lb.). Leaf oil yields would have to be in excess of 0.90 percent to be competitive in this market segment.

There appears to be good market potential in the **Specialty Commercial** segment. Feedback from potential customers indicate willingness to pay an estimated $60/lb. for juniper leaf oil in relatively small quantities (average one to five pounds). A business break-even point is predicted for this market at 0.5 percent yield; at 1.0 percent yield business viability is assured down to prices as low as $25/lb. Single entrepreneurs or small businesses who produce specialty aromatherapy and scent products principally for the local and regional market, would also be prospective customers.

Business Opportunity Identification

A profitable commercial business based on distillation and sale of juniper bole wood oil is highly unlikely. In contrast, the numbers for a business dedicated to distillation of juniper leaf oil do look promising, particularly if yields can be increased from an estimated business break-even point of 0.5 percent. Calculations do not include potential revenue from distillate waters (if a market is created or found).

There also appears to be good potential for single entrepreneurs with a small distillation operation (250 lbs. capacity) to distill and sell specialty juniper retail products, especially if based on a large volume of small, pre-packaged products. A high degree of marketing and distribution expertise and knowledge would be necessary, as well as an adequate supply of working capital during business start-up.

References

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Yesenofski, Joe 1996. *Final report - A Juniper distillation and marketing project.* Unpublished report. On file Oregon State University Extension Office, Klamath Falls, and The Confederated Tribes of the Warm Springs Reservation, Warm Springs, OR.

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WESTERN JUNIPER DRYING PROJECT SUMMARY: 1993-1996

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The purpose of this project was to address the common industry perception that western juniper *(Juniperus occidentalis)* is difficult to dry. During the course of the Western Juniper Commercialization Project trials in 1993 and 1994, it became obvious that years of anecdotes about how difficult it was to dry juniper were hindering manufacturer willingness to conduct manufacturing trials and test market value-added juniper products. Further impetus to explore the drying issue was provided by a potential problem identified during juniper manufacturing trials in 1993: low product recovery due to excessive checking, splitting and warping[1] during remanufacturing.

Drying tests and trials were conducted between 1993 and 1996 to:

A) Test and refine existing dry kiln schedules;
B) develop moisture meter correction factors;
C) test dry western juniper in different types of kilns, both by itself and with ponderosa pine;
D) explore alternative drying techniques to minimize splitting and warping due to inherent growth stresses; and
E) test a "saw-dry-rip" program currently utilized in the hardwood industry to reduce splitting and cracking.

Dried material from the different phases of the project was remanufactured and put into service by a variety of secondary manufacturers. Impressions and observations were then monitored.

The following is a brief summary of drying-related results:

A) **Dry Kiln Schedules:** Published juniper drying schedules appear to work well. The final trial was a full kiln charge (about 40,000 board feet) in a standard commercial kiln. Although the kiln operator indicated some anxiety about what would happen, no problems were encountered.

B) **Moisture Meter Correction Factors:** Moisture meter correction factors for western juniper are small, but significant. At 10 to 12 percent, true moisture content averages almost 2 percent above what resistance- and capacitance-type meters would read if calibrated or set for pine.

[1] The terms "splitting" and "checking" are often used interchangeably. A check is defined as "a lengthwise separation of the wood that usually extends across the rings of annual growth and parallel to the wood rays" (Dry Kiln Operator's Manual, 1991), whereas splitting often results from the extension of a check and extends across the full thickness of the piece. Warp is a broad term that encompasses any distortion in the "shape" of a board and includes bow, crook, twist, cup, and diamonding.

Kiln operators need to be aware of these correction factors to dry juniper to customer specifications.

C) **Different Kilns/Single Species and Mixed:** Juniper was successfully dried in three different steam kilns, a dehumidification kiln, and a vacuum kiln. No problems were encountered when kiln drying juniper by itself. Juniper can also be successfully dried with pine, however, minor modifications of pine drying schedules are needed to prevent over-drying. It should be noted that moisture content targets were consistently exceeded by about 2 percent when juniper was dried with ponderosa pine (for example, if target moisture content was 8 to 10 percent, juniper would average 10 to 12 percent). Project trials also indicate that juniper air-dried well. Air-dried material needs to be carefully prepared (e.g. trim all bark) to reduce the possibility of woodborers. Treatment with an insecticide, such as Bora Care® or Tim-bor® may be needed.

D) **Alternative Drying Techniques:** Two alternative drying techniques were tested to evaluate their potential to relieve growth stress in juniper: High temperatures and steaming, and pre-steaming. Based on results from early project tests and trials, growth stress is considered the primary cause of the splitting and warping observed in dried material. Neither technique tested showed potential for reducing the splitting or warping sometimes observed in dried juniper. Full-scale trials were not conducted.

E) **Saw-Dry-Rip Program:** Tests were conducted to determine if juniper would warp less if ripped after drying rather than before drying. Results support previous research and experience with hardwoods: Less warpage will occur if kiln dried lumber is properly conditioned and ripped after drying, rather than before drying. Unfortunately, other tests have shown that drying narrower boards will result in less checking. Therefore, manufacturers may have to choose the lesser of two evils: dry wide boards to minimize warp or dry narrow boards to minimize checking.

Reactions of secondary manufacturers who tried the material were mixed, especially if they were accustomed to dealing with only one species. Those who had experience and markets for other niche species were open to further trials with juniper if there was assistance in finding and exploring new markets.

Based on the results of tests performed during the three-year period covered by this project, it appears that checking and splitting in juniper can be reduced by: 1) Careful choice of logs to minimize large knots, spiral grain, and taper; 2) careful treatment of logs after harvest, such as end-coating and sawing logs as soon as possible after felling; 3) minimizing material with large knots (over ½-inch) and pith; 4) drying thinner, narrower, and shorter boards; 5) use

of moderate kiln schedules (lower initial temperatures, higher initial relative humidities, and longer times); and 6) finger-jointing and emphasis on products, which require shorter, narrower, and thinner lumber than commonly produced in the Pacific Northwest.

References

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OTHER "NON-COMMODITY" WOOD PRODUCT INDUSTRIES: EASTERN REDCEDAR INDUSTRY

Panel Discussion

Moderator
Scott Leavengood, Oregon State University Extension Service, Klamath Falls, Oregon

Panelists
Bill Breedlove, Western Juniper Industry Facilitator, Klamath Falls, Oregon
Brent McGregor, Rocky Mountain Timber Products, Sisters, Oregon
Don Prielipp, Consultant, Redding, California
Glenn Burleigh, Burls by Burleigh, Powell Butte, Oregon
Mike Kilpatrick, Juniper Plus, Mt. Vernon, Oregon

Moderator (Leavengood): This group visited Missouri eastern redcedar producers. Eastern redcedar is actually a juniper *(Juniperus virginiana).* Visits to a mature industry using juniper trees should reduce the tendency to "reinvent the wheel."

The characteristics of redcedar that were investigated included log length, knot size, taper, rot, and harvest procedures.

Moderator: Other comparisons between redcedar and western juniper? Will the type of system used for redcedar work here for western juniper?

Speaker (Kilpatrick): Redcedar provides "bread and butter" money to the local people and the harvesting is done by hand. Trees are small and most are milled. The society and economy of Eastern Oregon are very different from the Southeast.

Redcedar is almost a weed, most are cut before maturity. The large mature trees have been gone since the 1920s, and most of those were made into pencils.

With western juniper, there are many large mature trees and even the short logs can be large and heavy.

Moderator: The short logs of redcedar are made into short boards. Is there a market for short boards in this area?

Speaker (Kilpatrick): People in this area need education on what is a good western juniper log. The redcedar industry includes products like specialty products, paneling, and cants for birdhouses. Western wood industry is based on lumber. It is a large-scale industry and requires more volume than just pickup loads. Mills are not set up to process eight-foot logs.

Speaker (Prielipp): The length of the log is determined by market needs. Short-length logs are better for high taper trees. The 42-inch length of redcedar is common for closet

lining. The best guess as to why 42 inches was chosen was based on many people having 1953 International pickups with a bed width of 42 inches. The average diameter of redcedar logs is between 6 and 8 inches.

Moderator: (displayed an overhead showing Whittaker Farms Sawmill, Bradleyville MO log prices) - Would this type of pricing be reasonable here?

Speaker (Breedlove): Here, 5 tons of logs are needed to recover 1000 board feet of lumber and the landowner may get $5 per ton in a good market and for juniper with good form.

Moderator: Redcedar mills are small-scale circular saw mills. Would small mills work here?

Speaker (Kilpatrick): Small mills won't happen here. OSHA would shut down mills like the redcedar mills.

Moderator: Would western juniper have a similar market as redcedar? Does western juniper have other niche uses?

Speaker (Breedlove): We need to discover more markets for western juniper. People need to accept juniper as a possible substitute. We need to find a market for by-products. A niche market perhaps? Having a market for leftovers makes commercialization more viable.

Speaker (Kilpatrick): Oregon can't expect to compete with the redcedar industry. They are established and have old machines to produce their products at low cost. Laser-engraving is an option for western juniper.

Eastern redcedar has established markets across the country. Even in Oregon, redcedar products are stamped with Oregon names and sold here.

Speaker (Prielipp): Why were they (redcedar) able to make the market? In the 1920s there were many producers making chests, caskets, paneling, flooring, and more. These producers formed the Eastern Redcedar Association based in Chicago. There was much promotion on the virtues of "Redcedar." The texture, color, odor and insect repellent qualities were promoted. This image has carried over until now. Redcedar is considered a "special" or nearly sacred species.

In the 1960s, larger business consumed many of the small ones. These large industries didn't support the Eastern Redcedar Association and it was disbanded.

Speaker (McGregor): I was impressed by the industry, the creativity of the people and their successful marketing. Here, there is too much expense tied up in processing to develop a similar industry. An older woodworker told me that redcedar was "mellower" and easier to work.

Moderator: Full utilization of residuals is important. Redcedar has markets for

residuals. Shavings are used mainly for poultry bedding.

Speaker (Prielipp): There is no single product in the redcedar industry that will carry the load. The same applies to western juniper.

Products in the Redcedar Industry include:

- **Bark:** Sold as mulch for soil condition and topping, and by the pickup load.

- **Lumber Products:** Established market exists.

- **Shavings:** Big flaky shavings are used 100 percent in the poultry bedding market.

- **Sawdust and Small Shavings:** Used for oil extraction. The very small, fine materials are used to run the boiler that ran the distillation. The recovered shavings from distillation are packaged in small bags and sold as small animal bedding. There is more demand than supply for shavings.

How can we develop a market for these products here? Currently, western juniper is a small-scale, artisan industry. Missouri and Arkansas have a cottage industry for redcedar.

The scale of industry in the southeast is "Can I survive this week?" The scale here in the west is "How many truckloads per day?" The desire in Oregon and Northern California is to be a commercial industry. Commodity or specialty products? Specialty products have the best chance for western juniper.

To have a commercial industry for western juniper, we have to make sure the infrastructure lives. We need to treat everyone fairly. We need a reliable supply of sufficient quantity in a timely manner, and we need markets for the by-products.

Speaker (Kilpatrick): To have an industry in western juniper, we have to attain full utilization. We don't have an established infrastructure.

Speaker (Prielipp): I would like a self-reliant, self-disciplined small industry.

Reference

Leavengood, S. and L. Swan. 1994. Summary of Missouri eastern redcedar industry study (September 26-29, 1994). Unpublished document. On file, Oregon State University Extension Service, Klamath Falls, OR. 45pp.

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Industry Topics
Informal Notes

Session II

Product Introductions and Marketing Workshop

Moderator: ***Dennis Brock,***
Northwest Wood Products Association, Bend, Oregon

OTHER "NON-COMMODITY" WOOD PRODUCT INDUSTRIES: OREGON MYRTLEWOOD

Presented by John Shreck, The Oregon Connection (formerly House of Myrtle-wood), Coos Bay and Brookings, Oregon

The Oregon Connection produces 150 items made of myrtlewood. The wood ranges from light blonde to dark. The items include golf putters, turned items, decorative items, grandfather clocks, and flooring. Shreck's focus is the niche cottage industry. He requires logs to be a minimum of 60 inches in length. His mill has a 42-inch circular saw. The spotted owl and fish restoration issues have affected pricing for logs. A nature-based area, such as Oregon, needs prudent resource management. Shreck processes 4,000 to 6,000 board feet at a time. The cost is about $.85 per board foot to mill the logs inhouse. Shreck pays between $.42 to $.43 per board foot for the wood. A cottage industry might be able to get better yield using short pieces.

Q: Is it practical to haul logs to existing small-scale mills?

A: One possibility is small portable sawmills for small operators. The cost of these portable sawmills ranges from $6,000 to $20,000.

Other cost considerations:

- Don't debark if it is not necessary. Shreck doesn't debark myrtlewood.
- Use small pieces of wood. Shreck uses wood down to a 2 inch cube for a candleholder.
- A market is needed for falldown and by-products.

Other miscellaneous comments:

- The name change to "The Oregon Connection" was to generate interest in all of Oregon, not just the Southern Coast. Trying to get more tourist dollars is best for the entire state.
- Shreck plans to expand into western juniper products.
- A good specialty market for his products is the corporate gift and incentive market because they buy in quantity.
- He strives for the most quality in the product: color and grain are important, not maximum utilization of the wood. There can be a market for even very small pieces of quality wood for jewelry.

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PRODUCT INTRODUCTIONS: INFORMAL PRODUCT REVIEW BY WESTERN JUNIPER MANUFACTURERS AND EXHIBITORS

Presented by Bill Breedlove, Western Juniper Industry Facilitator, Klamath Falls, Oregon

1. Mike Connolly, Connolly Wood Products (Bend): Produces custom millwork, doors, flooring, cabinet doors.

2. Brent McGregor, Rocky Mountain Timber (Sisters): Produces high-end, rustic furniture and has a table and chair on display.

3. Glenn Burleigh, Burls by Burleigh (Powell Butte): Makes high-end, rustic furniture. Has a bed and nightstand on display.

4. Ron Horvat, R.H. Forest Products (Vancouver, B.C.): Runs a flooring mill in British Columbia and is hopeful for the juniper industry. Western juniper will compete with Australian cypress, but western juniper is homegrown, aromatic, and they get an attractive translucent effect with an oil-base finish. This effect makes the wood look different from different positions on the floor. By this time next year, expect to process 24,000 board feet per year.

5. Mike Bryant, Clearwater Drilling (Bend): Produces lamps. Has two on display. He doesn't experience many problems working with western juniper. Needs wood with some white sapwood. Dead wood presents some problems.

6. Matt Madson, Burl Arts (Orick, CA): Has 15 years experience. His "calling card" is rustic phones. He has phones and furniture in 30 countries. He used to work with redwood burls and roots. Was introduced to western juniper by Brent McGregor. He prefers to work in lighter woods because of the fashion trend drifting to lighter woods.

7. Steve Walter, Walters Personalization Services (Bend): Does custom laser engraving on a variety of surfaces including wood, metal, glass and leather, and he can do custom artwork. He has products in the Capitol Building Gift Shop in Salem and in Sunriver. He produced the western juniper wood business cards.

8. Tim Coe, The Wood Shed (Mitchell): Had no products to display because he sold them all. His business has increased 280 percent since 1994 and was involved with Howard McGee in shipping western juniper logs to Taiwan.

9. Cynthia King, The Herb Shed (Mill City): Brought several products. People need to "experience" her products to

appreciate them. She specializes in Native Forest Remedies using juniper and cedar. She is located in Mill City, Oregon and attends the Saturday Market in Eugene. Her juniper products include:

- Juniper Spray
- Juniper and Sage Antiseptic Spray
- Juniper and Sage House Cleaner (good for killing mold)
- Juniper Salve (good for arthritis, rheumatism, sports injuries)
- Juniper and Sage Foot Powder (anti-fungal)
- Juniper Vinegar (Juniper berries have meat tenderizing properties)

10. Al Bailie, Artistry in Wood (Paisley): Was unable to attend, but had pen and pencil sets and card holders on display.

11. Elden Meeder, Juniper Creations (Burns): He is a freeform wood artist but was unable to attend.

12. Milo Medlock, Anchor "M" Lumber (Spray): Mainly in the lumber business. His great granddaughter made some fancy items from western juniper. He will be sawing some juniper in the next few weeks.

13. Rod Andrews, Rainier Wood Products (Sweethome): Was involved in drying projects.

14. Gary Berglund, Burnich Frame and Moulding (Missoula, MT): Was given some western juniper for product development. Produced a picture frame molding, which has been well received by people who have seen it.

15. John Brandis III, Superior Hardwoods (Philomath): Produces hardwood plywood and has experimented with western juniper. His goal is to market Pacific Northwest woods including juniper, alder and walnut. Has experienced problems with low recovery (15 percent). He needs better selection and grading and better communication with log suppliers. He is sure the process will improve. He sent his logs back East to be sliced because he works with a mill in that area that was already set up for him.

16. Robert Seidel, Essential Oil Co. (Lake Oswego): Has sample products on display including, incense (made from wood and leaf oil), hunters mask spray (made from leaf oil), and Juniper Soap. He could have customers in Europe for western juniper oil, but has no supply available.

17. Mike Kilpatrick, Juniper Plus (Mt. Vernon): Produces solid wood paneling and has worked with western juniper for 20 years. He has his own land, sawmill, and logger, and they do the processing themselves. He also produces custom boards for cabinets. He does not have a problem making things out of western juniper. It is a problem to sell it because he does not have a market.

18. Bend Spirits (Bend): Makes a superior Cascade Mountain Gin and uses western juniper berries for flavoring.

19. John Shreck, The Oregon Connection (Coos Bay and Brookings): Displayed several items including turned pieces that had been painted. Juniper is a good medium for painting and he sees it becoming part of his product line.

MARKETING WORKSHOP

Facilitated by Dick Handley, Business Consultant, Medford, Oregon

Panel Members:
Mike Connolly, Connolly Wood Products, Bend, OR
Ted Napier, Oregon Log Homes, Sisters, OR
Cynthia King, The Herb Shed, Mill City, OR
Lance Romine, Lineshack Log Cabins, Prineville, OR
Brent McGregor, Rocky Mountain Timber Products, Sisters, OR
Don Prielipp, Wood Products Industry Consultant, Redding, CA
Dennis Brock, Northwest Wood Products Association, Bend, OR
MerrieSue Carlson, OR. Econ. Develop. Dept, Brand Oregon Program, Salem OR

Panel Questions:

What have I tried in marketing my western juniper products?

What has worked?

What did not and why do I think it did not?

What kind of marketing assistance do I need?

What would help my business grow?

Mike Connolly, Connolly Wood Products

Mike attended the '93 Western Juniper Forum where he met Larry Swan and Bill Breedlove. They gave him 20-6 in. by 6 in. cants to make something from.

He began by thinking of using it the same as Tennessee Cedar (eastern redcedar). When he started to process the cants though, the City of Bend fined him $50,000 for air pollution and Mike had to buy a $183 billion bond for potential allergy problems...which he went on to add, was only a billion less than the proposed tobacco industry settlement.

When he began to see the beauty in the wood, he realized he shouldn't be limited in his thinking. Mike has tried about a "100 different products," but seems to be centering in on architectural doors, cabinet doors, and paneling. The types of products he makes with juniper appear especially well-suited for the log and timber frame home market. He wants to make what people want to buy.

Mike thinks we need to build the image of western juniper as a "wood of choice." We need to look for and be able to bring out the beauty in the wood.

Products made by the linear foot have not turned out well for him. Mike thinks we need to look for applications that use lengths less than eight feet, and maybe less than six feet.

Mike's daughter, Colleen, has produced a series of attractive and informative brochures about Connolly Wood Products' western juniper product line.

Q: What would help you increase your juniper business?
A: Networking with people such as architects, designers, and artists.

Q: What is your yearly consumption of western juniper?
A: We are planning to use juniper for 25 percent of our total raw material needs - we expect to use 12,000 - 15,000 board feet this year, mostly for doors and flooring.

Q: What problems have you encountered?
A: We have problems getting boards with good grain and length. We make a lot of waste and need to find homes for it.

Q: Whom do you buy from?
A: The Western Juniper Industry Facilitator (Bill Breedlove) helps us out.

Ted Napier, Oregon Log Homes

Ted works with a facility in Maupin, which turns logs and can manufacture 8-inch cants. He has the ability to make juniper log homes and has already sold two. One of the houses will be on the Oregon Coast. He expects a growing market, and has samples in their showroom.

Lance Romine, Lineshack Log Cabins

Lance and his partners have experimented with western juniper and are developing a product. They took a log home kit to the Log Home Show in Seattle where it was well received. They came home with "Best in Show." The markets are there, and juniper's number one feature is its uniqueness. They plan to use juniper for the majority of their business due to the good reception at the home show. They have a 3,500 square foot juniper home nearly complete.

Brent McGregor, Rocky Mountain Timber Products

[Brent read a prepared statement. The following is a summary of that statement, which was published in a past issue of the *Western Juniper Newsletter.]*

I'm a rustic woodworker and want to start out by saying that I haven't met anyone who has gotten rich working with juniper! There's a lot of work involved with juniper, but I think that the attraction many feel for the wood is because it has character: Wrinkles, bark seams and twists, and beautiful color bands and grain patterns. These are all positive and workable elements for a furniture builder such as myself. I came to Central Oregon back in 1984, wanting in the worst way to work with juniper, but I didn't know how to go about it. I had spent time in Alaska, and logged and built log homes in Wyoming. I always seemed attracted to the crooked trees though, instead of the straight ones.

I started out in Oregon by taking on a contract with BLM. I had the rights for one year to all the juniper I could use from a 500-acre project. I only managed to find 200 trees solid enough to mill with my mobile dimension saw, and then I couldn't figure out what to do with the stuff. I still have piles of the lumber lying around. It was at that time that I started looking at ways I could make a living out of the forked limbs and crosscut sections.

When I started out, I not only didn't know anyone else in Central Oregon working with twisted and burled limbs and logs, I didn't know anyone anywhere doing this type of work. I had to learn almost everything myself, like places to harvest the wood, how to debark and dry it, what tools and joinery worked best, how to sandblast and sand it, and what type of finish to use. I made some disasters, which I still have hanging in my shop, but I learned from those mistakes.

There is no one right way to market a product. Marketing tactics are going to be as different as the personalities of the people who make the product. I know one furniture builder who doesn't want to meet his clientele, so he sells everything through galleries. I know others who put thousands of miles on the road for the show circuit.

When I was first getting started, I called *Log Home Guide Magazine* about placing an ad. After hearing what I did, they asked me to write a story about my new business and send in a few photos. I happened to tell this to the editor of our local paper, who I was talking to about an ad. He knocked-out an article for me in less than an hour, along with photos. The story was published and what do you know, a check came in the mail from a doctor in Wisconsin who wanted a log bed like the photo in the magazine. This blew me away...I sold something to someone I never spoke with before and that lived far away!

I love what I do. There are days I walk into the shop and never want to come out. As

time went on, I got up my nerve and took in a glasstop juniper table to a local gallery. That was a good move, because several local residents saw it and ordered one. But I knew I probably couldn't sell enough of this unique furniture locally to make a living. So I put together a brochure with the help of my brother, who is a talented graphic artist.

It seemed to me people treated me differently once I had a brochure. People felt more confident that my business was for real. I mailed my brochures to everyone I could think of, throughout the country. Dan Mack, a noted furniture builder in New York City, saw one and included me in a book he was writing. That book, and mention in others, led to more exposure.

I took out a small advertisement in *Log Home Magazine,* which landed me my first really big job - several pieces of furniture for a modern day camp near the Adirondacks in New York. And from an article on rustic furniture in *Town and Country Magazine,* where I didn't even rate a photo, I sold two 20-foot Ryder Van loads for an amazing log home in Park City, Utah.

I like to deliver my own furniture and have traveled cross-country to do it. Luckily, I have a partner like Kara who will go with me. I like to meet the people who buy my furniture and see where it is going. I have stayed in touch with some of my clients and have formed long-lasting friendships with some of them.

About 80 percent of my sales are done in my shop and showroom I constructed for my furniture. I find for me that my own "two cents worth" goes a long ways to making a sale. I'm not afraid to offer ideas, and I'm fortunate that most people now search me out instead of me going out and finding them. It's a thrill to have someone fly thousands of miles in their Lear jet, so we can meet and talk about what kind of furniture they want.

Last year, Kara and I put a lot of time in on a booth for a log home show. We won "best of show" for our booth and attracted a lot of attention. This year I'm trying the Internet. I'm in the second month of my home page and just got my first inquiry last week from a motel being constructed in Barrow, Alaska. Only time will tell if this will work, but I'm willing to try it out for awhile.

I'm now working on an incredible home in Washington. It has over 11,000 square feet, 400 tons of river rock, and beautiful log work. The more juniper I put into the house, the more they want. Thirteen years ago I could never have imagined that I would be working on a project like this. Now I can't wait to see what the next 10 years will bring.

Panel Question: What kind of industry do you want?

Don Prielipp, Wood Products Industry Consultant

Sharing of information is critical, but we need to identify what categories need to be

communicated. The Western Juniper Group does well sharing and communicating technology issues. Resource availability and how to extract the resource at a reasonable cost need more work. Marketing is also an issue. Can a group label be developed to represent both entrepreneurs and commercial producers?

Don has a long-term association with the pencil industry and gave some background.

California Cedar Products makes pencil slats mainly from incense-cedar. Juniper was tested for pencil slats and worked OK. Pencils are made from the shop grade component of the log and may present an opportunity for the western juniper industry. The pencil industry looks at 8-inch cuttings and grades accordingly.

The pencil industry is experiencing a shortage of incense-cedar and is looking in Wisconsin, Russia, Africa, Mexico, South America, and China for alternative species. They are not looking in Oregon because most of what they need is on public lands. The pencil industry cannot make credible business plans based on assumptions about raw material coming from public lands - there are too many unknowns.

Dennis Brock, Northwest Wood Products Association

Dennis's image of juniper has changed dramatically - from being a "water sucking weed" to a useful product. He feels there is room for both cottage industry and commercial producers.

The juniper industry needs to develop total fiber utilization through networking. This is a different approach than with fir and pine. Artisans may not need the same infrastructure - waste is not a big problem for them.

Cynthia King-Atiyeh, The Herb Shed

Cynthia wants to see an industry based on diverse markets and uses for all of the tree. Maybe form a co-op for secondary products. Diversification takes effort.

MerrieSue Carlson, Oregon Economic Development Dept., Brand Oregon Program

MerrieSue is Project Manager for Brand Oregon, which provides marketing resources for companies wanting to use Oregon imaging in their products.

Brand Oregon was an idea that started when Goldschmidt was Governor. He said that Oregon is a special place and needs to be noticed.

Using "Oregon" in a name, logo, or label gives small, emerging companies a jump-start in the marketplace, especially those dealing in natural resource, value-added products such as rustic furniture. Large companies, like Mentor Graphics, don't depend on "Oregon" to sell their products.

Examples of industries developing logos and names using Oregon's positive image include Seafood Oregon and Oregon Brewers Guild.

MerrieSue's objective is to enhance programs that are already developing. This summer, Brand Oregon will complete a tool kit identifying different resources having to do with Oregon. For example, they will list an inventory of photobanks of Oregon photos. Many people can use these photos, paying a fee to the owner, rather than having to hire their own photographer at a greater cost. The tool kit will also list award-winning businesses that successfully integrate the Brand Oregon concept, as well as explain how and why they were recognized.

Admittedly, it is hard for new businesses to come up with a plan and cash to pay for the design and manufacture of a logo or label. What you are trying to do is reach out to people and teach them about Oregon and your product...build awareness that builds on the existing brand strength of Oregon.

You have to think of ways to cooperate and collaborate in marketing juniper and associating juniper with Oregon. Brand Oregon can perhaps help with an "Origin Campaign" for the Western Juniper Industry.

Western Juniper Forum '97
Closing Session

CLOSE-OUT NOTES COMBINED SESSION

Closing Remarks

Session Moderators were asked if they had any closing or summary remarks, based on what they heard at the sessions they moderated.

Steve Fitzgerald (OSU Extension Forester, Redmond) Science and Management, Session I (General Topics) and Session II (Field Research Updates)

Steve noted that there remains a lot that is unknown about the science and management of juniper. Results of studies presented appear to lead to useful recommendations, but overall there remain a lot of unanswered questions. Steve warned that all studies have limitations and must be interpreted. He indicated special concern about extrapolating research results about nutrient balances in juniper woodlands to the extent that you may not want to burn at all.

Dennis Brock (Northwest Wood Products Association [formerly WPCC, Inc], Bend) Industry Topics, Session I (Primary & Secondary Processing Updates; Other Non-Commodity Wood Product Industries) and Session II (Product Introductions)

Dennis summarized by listing five main points:

1. Steady supply is needed.
2. What does the industry want to be when it grows up? Specialty, cottage, large? Maybe continue to be all-inclusive?
3. Networking is critical.
4. One of marketing messages is that juniper is "wood of choice."
5. In terms of marketing, there is no one "right way."

There is solid growth and potential for more. Key to development has been the Steering Committee's emphasis on networking and communication.

Dick Handley (Marketing Consultant, Medford) Marketing Workshop

Dick remarked that from a marketing standpoint, a plan is needed so that everyone can keep moving forward.

Scott Leavengood (OSU Wood Products Extension, Klamath Falls) Program Co-Chair

Scott noted that the emerging juniper industry needs to fully utilize its raw material in order to become broad and diverse like the eastern redcedar industry. He emphasized like Dennis that communication is critical. There were 150 people on the Western Juniper mailing list three years ago and there are over 800 now. The newsletter is a good means of communication, but needs funding and contributions of articles and ideas.

Larry Swan (U.S. Forest Service, Klamath Falls) Program Co-Chair and Management/Science Session III (Real-Life Scenarios)

Larry highlighted several issues facing the continued growth and sustainability of a western juniper industry based on sound science:

- Biological and physical western juniper woodlands research must continue and stay focused on peer-reviewed issues and needs; funding should not be provided without commitments and timelines to publish in peer-reviewed publications;

- Scientists who oversee large-scale inventory must hear from the people who need the data; data categories relevant to issues and questions already raised should be included; data should be comparable across jurisdictional and ownership boundaries; remote sensing or sampling techniques to characterize the millions of acres of juniper not picked-up by normal remote sensing methods must be implemented;

- Rural small business needs for working capital and marketing expertise need to be addressed;

- Fiber markets must be established in order to make a dent in the one million plus acres which have 20 percent canopy cover or more, and where fire is no longer an option;

- Harvest costs remain a critical factor; new and cost-effective equipment configurations are needed to address terrain limitations, juniper limb sizes and quantity, and slash dispersal;

- Watershed treatments and public/private cooperative management plans appear to make more sense and are more economical than everyone doing their own thing;

- Processing issues will continue to arise because juniper is "the new kid on the block"; grading rules will be an issue over the next year or two as the industry matures;

- Technology transfer and communication tools, such as the Internet and the *Western Juniper Newsletter*, require funding support and a broader base of contributors; there is a lot more going on than anyone of us can know about, much of which may be directly relevant to our business or land management goals; more demonstration sites are needed closer to population centers;

- A plan and liaison is needed to assist in heightening public and government agency awareness, soliciting input and ensuring involvement - informal efforts need to be supplemented by a more formal approach.

Subgroups

Sign-ups were solicited for subgroups suggested during the Forum. Subgroups suggested including the following:

Science and Management Web Site Expansion—Preliminary Purpose: Formulate proposal to expand existing web sites to facilitate information exchange, research, public dialogue, and NEPA compliance. Contact: Larry Swan, U.S. Forest Service (541/883-6714; FAX 541/883-6709; e-mail /s=L.Swan/oul=R06F20A@mhs-fswa.attmail.com).

Harvest Methods and Equipment—Preliminary Purpose: Continue seeking ways to reduce harvest costs, increase production, and scatter slash on-site. Also may seek funding to development equipment specific to challenges of delimbing and scattering western juniper slash. Contact: Larry Swan, U.S. Forest Service (see contact information above).

Trade Show Training—Purpose: Asking for expression of interest in receiving training about how to choose the appropriate trade show, prepare for it, and display, as well as follow-up contacts and leads. Will probably attend one to two shows, depending on personal finances and market grant award. Contact: Bill Breedlove, Western Juniper Industry Facilitator (Voice Mail and Fax 541/850-4317).

Myrtlewood Industry Review—Purpose: Learn from experiences of Oregon myrtlewood industry by visiting with myrtlewood industry representatives, and touring plant and retail locations. Potential commercial ventures are expected to be explored. Will take place on Oregon Coast in vicinity of Coos Bay. Contact: Bill Breedlove, Western Juniper Industry Facilitator (see contact information above).

Oregon State Legislator Briefings—Purpose: Provide constituent briefings to state legislators who have requested more information or a briefing about the status of the Western Juniper Commercialization Project. The Project has received significant support and funding from Regional Strategy Boards and Oregon Lottery dollars. **Contact:** Bill Breedlove, Western Juniper Industry Facilitator (see contact information above.)

Lumber Grading Rules—Purpose: Refine existing draft grading rules for western juniper lumber. Contact: Bill Breedlove, Western Juniper Industry Facilitator (see contact information above).

Newsletter Article Contributors and Writers—Purpose: Seeking contributors of photos and short articles relating to western juniper science and management, harvest, manufacturing, and marketing. Personal experiences are welcome. Articles can vary in length from less than a paragraph to a page (with graphics). Some editing is normally necessary to fit the space available and ensure consistent grammar. Contact:

Scott Leavengood, OSU Extension
(541/883-7131; FAX 541/883-4582; e-mail
Scott.Leavengood@orst.edu).

Management Demonstration Projects—
Purpose: Highlight design, execution, and monitoring of on-the-ground juniper management projects which exemplify implementation of field science results. Public access, at least on a call-ahead basis, is needed. Proximity to population centers and a good transportation system are helpful. Contact: Larry Swan, U.S. Forest Service (see contact information above).

Open Microphone

- *Experiment with a buyer/seller conference or forum where buyers present their needs to producers.*

- *Use the World Forestry Center (Portland) to display the wide range of juniper items - from research to products.*

- *Ranchers are in the healthy vegetation business. They need to communicate the need for riparian and upland areas to be treated and they need to know the kind of trees industry needs.*

- *The industry has a lot going for it including quality products, this forum, juniper and state promotion.*

- *This forum brings mostly industry and technical groups together, but want to see more landowners. Suggest meetings for landowners in other parts of the state.*
- *BLM folks need better access to the information presented here today.*

- *Demand will increase as we get product samples out. We need to have more products and raw materials available in the future.*

Leavengood, Scott; and Swan, Larry; 1998. Proceedings, western juniper forum '97: Proceedings of a meeting; 1997 April 21; Bend, OR. Gen. Tech. Rep. PNW-GTR-432. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 97 p.

This proceedings is a compilation of 30 articles on various aspects of the management and commercialization of western juniper. The topics are split between commercial and industrial topics, and science and management topics. Presenters were asked to provide abstracts, not full papers, and to include who to contact for more information or a copy of the complete paper, or when and where the information or study was expected to be published.

Keywords: Western juniper, western juniper proceedings, western juniper marketing and utilization, western juniper biology and management.

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