Grantee Name: **Pit Resource Conservation District**
Project Title: **Cooperative Sagebrush Steppe Restoration Initiative/Implementation**

Period Covered by Report: **8/10/2006 – 8/31/2009**
Project End Date: **8/31/20 09**

A summary of the work performed over the course of the project/Compare actual accomplishments to the project goals in your proposal:

Our projects treated 4,436 acres and produced 48,717 tons of chips, broken down as follows:

Individual & Total Project Accomplishments/Deliverables

Project	Acres	Tons of Chips
Ash Valley Ranch I	1,156	15,028
Ash Valley Ranch II	479	1,916
Butte Creek	550	9,900
Gold Run	240	1,200
McClelland Ranch	637	10,829
South Knob Ranch	620	4,344
Stones Landing	500	5,500
Susanville Indian Rancheria	254	0
Total	**4,436**	**48,717**
Required Accomplishments	-2,000	-10,000
Over Achievement	2,436	38,717

We followed a strategy, as stated in our Project Description, of leveraging funds with numerous partners in order to treat more acres over a broad and varied landscape. A discussion of the benefits to Producers and the community that includes increased forage production, restoration of critical wildlife habitat, an improved water cycle and reductions in hazardous fuel loads, sediment transport and soil erosion is provided in our attached Vegetation Monitoring and Results paper.

What follows is a summary of our overall operation and our individual projects:

Project Planning

Planning for all our projects was accomplished during the course of implementing a previous NRCS Conservation Partnership Initiative Grant. A 2.1 million acre landscape level plan and 10 individual conservation plans were developed during the course of the project.

Capacity/Administration

Modoc and Lassen Counties provided us with $255,000 which funded the bulk of our administrative and capacity needs. One for the factors that influenced the Lassen County Board of Supervisors to support our project financially was that we ensured them that we would implement a substantial portion of our treatments within the various Wildland Urban Interfaces within the county. The counties support allowed us to put the NRCS investment to work on the ground for landscape scale restoration treatments. The county funds helped pay for the costs of our Project Director, Project Specialist, Pit RCD Business Manager, project accounting, cultural resource surveys and project related travel expenses.

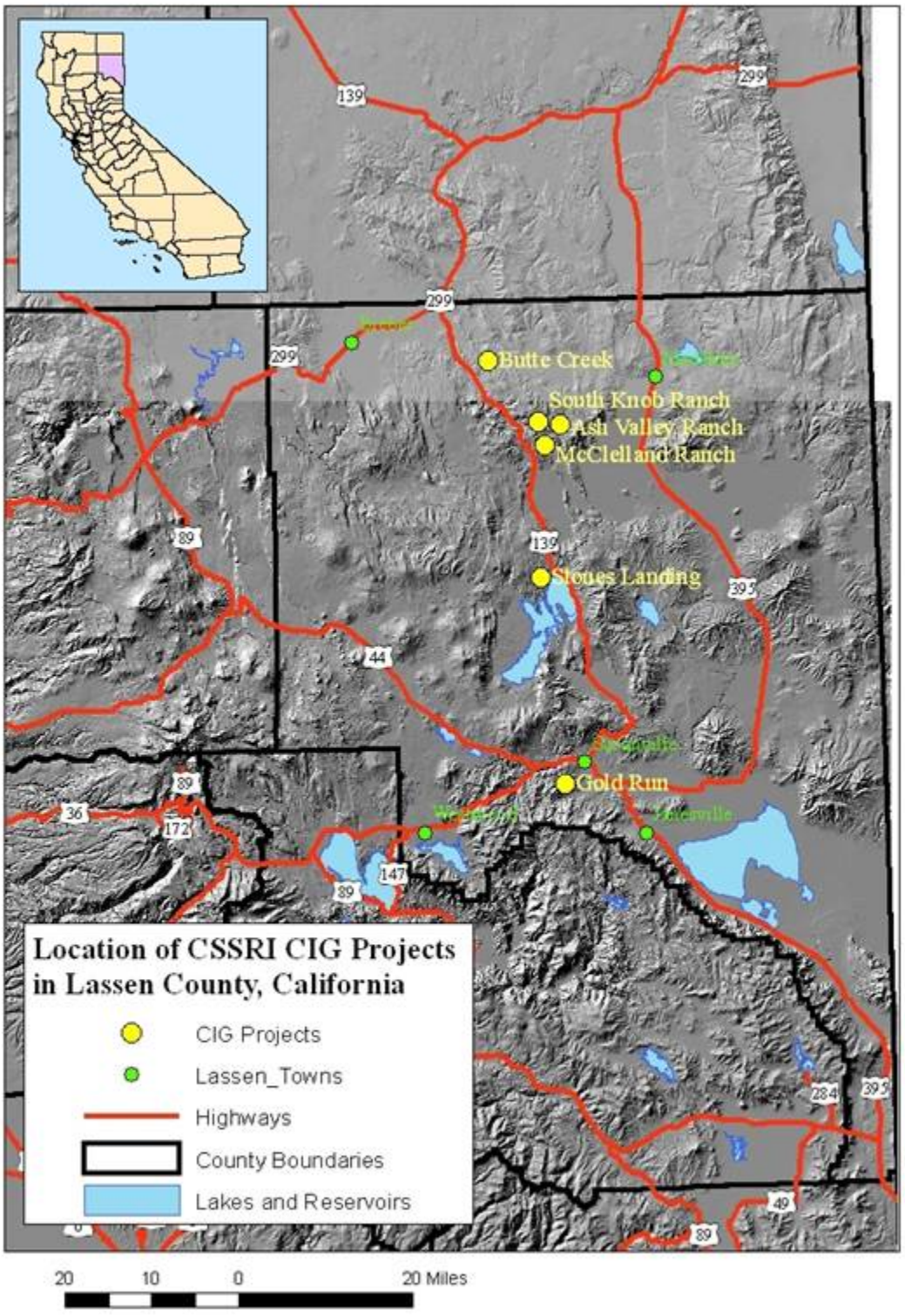
Numerous groups and individuals visited our sites to observe and learn about our treatments and prescriptions over the course of the project. They included our California NRCS State Conservationist, Ed Lincoln Burton, Oregon Department of Wildlife Resources, representatives of the Owyhee County Idaho Sage Grouse Working Group, a Sierra Nevada Conservancy Annual Meeting tour, U.S. Fish and Wildlife Service, our Congressman's representative, Representatives from Biomass Power Producing Facilities, University of California Cooperative Extension, BLM personnel from 2 Field Offices, USFS personnel from 4 National Forests, County Supervisors, Staff from the NRCS State Office, our local District Conservationist, and our NRCS Technical Contact from the Western Regional Office

During the course of the project we made presentations to 3 International Soil and Water Conservation Society Conferences, 2 International Society for Range Management Conferences, the California Fire Alliance, the 2008 Cooperative Sagebrush Initiative Annual Meeting in Denver, Colorado, California Fire Safe Council Community Wildfire Protection Plan Workshop and 2009 International Wildfire Management Conference in Sydney, Australia. At all these meetings we emphasized our landscape scale treatment prescription, the strength of partnerships and the importance of leveraging the NRCS investment.

Individual Project Summaries

All our projects focused on the restoration of sagebrush steppe and eastside forest ecosystems through the removal of invasive western juniper *(Juniperus occidentalis)*. Our primary treatment technique was mechanical, using Licensed Timber Operators who used Timbcos, shears, skidders, chippers and grinders. Once the material was processed on site it was hauled in semi-truck vans to commercial wood biomass power plants where it was used as fuel for production of electricity. Most of our projects also had a hand treatment component where crews removed junipers that could not be treated mechanically or where hand crews removed smaller juniper or limbs that remained on stumps.

The results of our treatments for all these treatments are included in our Monitoring & Results report prepared by our Project Specialist.


Butte Creek
South Knob Ranch
Ash Valley Ranch
McClelland Ranch
Sloues Landing
Gold Run
Location of CSSRI CIG Projects in Lassen County, California
CIG Projects
Lassen_Towns
Highways
County Boundaries
Lakes and Reservoirs
20 10 0 20 Miles

Ash Valley I Photo Point Before Treatment

Ash Valley I Photo Point After Treatment

Ash Valley Ranch I

This is one of three projects that made up our largest landscape scale project we call South Knob, which spanned 3 adjoining ranches. The project is adjacent to approximately 3,400 acres of previously treated Bureau of Land Management and privately owned and managed land. It started in November of 2006 and was completed in August of 2009. 1,156 acres were treated. Partners we leveraged included the U.S. Fish and Wildlife Service through their Private Stewardship and Partners for Fish and Wildlife programs, additional EQIP Wildlife contracts, producer resources and CalFire Conservation Crews from Intermountain Camp. In addition to our juniper treatments 7 miles of wildlife friendly fencing were constructed, 5 ponds were enlarged, haul road improvements were made, a solar powered watering facility was constructed and a 250 acre dedicated wildlife exclosure was established. Treatments were primarily mechanical with hand crew follow up treatments and hand treatments in areas where cultural resources were present.

Ash Valley II January of 2009-Juniper Uncut is on BLM Managed Land

Ash Valley II

This is a 479 acre project within the Ash Valley Wildland Urban Interface. Work began In January of 2009 and was completed in August. Partners we leveraged included the California Fire Safe Council, producer resources, CalFire Conservation Crews from Intermountain Camp and the Bureau of Land Management. CSSRI assisted BLM with a cultural resource survey and they in turn let a contract for a 900 acre project adjacent to ours, which is continuing. Treatments were about 60% primarily mechanical and 40% with hand crews along a stream corridor and areas where there was a low density of juniper.

Butte Creek Photo Point before Treatment

Butte Creek Photo Point after Treatment

Butte Creek Photo Point during Treatment Cutting

Butte Creek Photo Point after Treatment

Butte Creek

This was a 550 acre project within the Wildland Urban Interface southeast of the community of Adin, California. Work began in August of 2006 and was completed in January of 2007. Partners we leveraged included the California Fire Safe Council, Lassen County Resource Advisory Committee, CalFire Conservation Crews from Intermountain Camp and producer/landowner resources. Treatments were about 90% mechanical and 10% with hand crews along a stream corridor.

Gold Run during Treatment Cutting

Gold Run

This was a 240 acre project across two adjoining producer operations within the Susanville Wildland Urban Interface. Work began in August of 2007 and it was completed In January of 2008. Partners leveraged included the California Fire Safe Council, Lassen County Resource Advisory Committee, CalFire Conservation Crews from Antelope Camp and producer/landowner resources. Treatments were about 90% mechanical and 10% with hand crews around a spring and in ephemeral stream corridors. In this project we also flew on seed in order to out compete a non-native annual grass community (cheat grasses). The seed mix included mountain brome and blue bunch and Ephraim crested wheat grasses.

McClelland Ranch Photo Point before Treatment

McClelland Photo Point After Treatment

McClelland Ranch

This is another of the South Knob projects which covered 637 acres. Work began in October of 2007 and was completed in August of 2009. Treatments were entirely mechanical and also included haul road improvements, the enlargement of a spring fed pond, construction of 2 miles of wildlife friendly fencing and the construction of a solar powered watering facility. Leveraged resources included a U.S. Fish and Wildlife Service Private Stewardship Grant, an additional EQIP Wildlife contract and producer resources. The project was implemented on the producer's private land and BLM managed land that is part of his grazing allotment.

Portion of South Knob Ranch after Hand Treatment

South Knob Ranch

This is the third of the 3 South Knob projects. 620 acres were treated with a 60/40 split of mechanical and hand treatments along with the construction of a solar powered watering facility and haul road improvements. Leveraged resources included extensive use of CalFire Conservation Crews for Intermountain Camp, an additional EQIP Wildlife Contract and producer resources. The hand crew work focused on a 32 acre aspen grove on the producer's BLM grazing allotment and small junipers and shoots on juniper stumps that the mechanical process could not accomplish.

Stones Landing

This project lies within the Stones/Bengard Wildland Urban Interface. 500 acres were treated by mechanical methods. Leveraged resources included funding from the California Fire Safe Council, the Stones Bengard Community Service District, producer resources and the Lassen County Board of Supervisors.

Susanville Indian Rancheria

T This project lies within the Susanville Wildland Urban Interface on federally recognized Tribal land. he Susanville Indian Rancheria (SIR) Natural Resources Department (NRD) worked with CSSRI and utilized the plan developed with NRCS CPI funding to apply for and receive $254,000 in Bureau of Indian Affairs (BIA) Hazardous Fuel Reduction (HFR) funding to remove western juniper from of sagebrush steppe and grassland habitats. The SIR NRD employed the SIR Forestry Crew to implement hand treatments on 254 acres of tribal property directly north of the City of Susanville (within the Susanville WUI). Projects were implemented over a three year period 2007-09 and concentrated on areas adjacent to homes and roads in order to reduce the spread of wildfire in these areas while improving habitat conditions.

Tribal Fuel Crews Conducting Hand Treatments

Lessons learned:

Here are some of the important lessons that were learned during the course of our project (other important information is contained in our Monitoring and Results Report).

1. Our treatment prescription relied, in part, on skidding across the landscape rather than dedicating specific trails for skidding. Timber operators that preformed the work have been trained to use skid trails. It took an immense amount of effort to keep them from going back to their learned behavior.
2. We have seen consistent hydrological responses to our landscape scale treatments in the form of previously dry areas remaining saturated on and below the surface even under drought conditions in mid to late summer. We have also noticed anecdotal evidence that spring fed ponds seemed to be holding higher water levels after our treatments. Those implementing juniper restoration treatments should keep this in mind and plan accordingly. Work on ponds that are in need of cleaning or enlargement should be done prior to treatments. Hauling operations should be sequenced in recognition that some areas may become wetter after treatments.
3. Asking a Licensed Timber Operator if his fire pumper is on site may not give you the correct answer. You need to ask him, “Is the fire pumper on our XXX project site at this very moment?”
4. Some Licensed Timber Operators believe that if the water truck breaks down they are not required to water the roads.

Planning and Implementation of Western Juniper Control

General Technical Note

Juniper Invaded sagebrush-grassland site pre-treatment (2007)

Sagebrush-grassland site two-years post-treatment (2009)

Prepared for:

Natural Resource Conservation Service (NRCS)
with funding from the
Conservation Innovation Grants (CIG) Program

Prepared By:

David Lile
Livestock/Natural Resources Director
University of California Cooperative Extension, Lassen County

Tim Keesey
Biological Consultant
Cooperative Sagebrush Steppe Restoration Initiative

Tom Esgate
Project Director
Cooperative Sagebrush Steppe Restoration Initiative
TSP 03-1001, Certified Conservation Planner for USDA programs

November 2009

Contents

I) Introduction

If not managed properly, western juniper (*Juniperus occidentalis*) will become dominant on many perennial grass-sagebrush range sites, and has in fact already invaded millions of acres of rangeland in the western United States. Although impacts vary by site, juniper invasion often reduces rangeland values for livestock forage and wildlife habitat and can potentially impair soil health and watershed function (Bedell et al. 1993, Miller et al. 2005). Typically range improvement or wildlife conservation plans include juniper removal as a means to restore a more productive grassland or sagebrush-grassland site. Currently, the most common method (and by far the most acres) of juniper removal in northeastern California is through shearing and chipping operations where juniper is cut with logging equipment that generally consists of tractor mounted shears or saws and rubber tired skidders. Most harvested junipers are chipped for consumption as biomass fuel for energy production. While other juniper control strategies are discussed briefly in Section 8, this technical note is focused mainly on juniper control through shearing and chipping operations.

1) Management Objectives and Current Conditions

As with any other resource management activity, the land management objectives, in conjunction with an assessment of site potential, current range condition and plant composition are extremely important in developing an appropriate plan of action. Most importantly the size and density of juniper, the composition of understory vegetation, and the presence (or absence) of weedy annual grasses that may invade after disturbance, should be assessed on site.

Of the several potential factors that will determine the cost effectiveness of a juniper control project, there are two main ones. First is the inherent potential or ecological capability of the site, and the second is stage of juniper invasion and the corresponding density of the stand. The potential for range improvement, whether for livestock forage or wildlife, is almost always greater on relatively deep well-drained soils, as compared to very rocky, shallow, or heavy clay soils.

Miller et al. (2005) describe 3 phases of juniper encroachment where Phase I is characterized by relatively small scattered juniper invading into an intact understory, Phase II is an intermediate state, and Phase III is a fully expanded juniper stand, with little remaining understory. Usually, treating juniper in Phase I or early Phase II provides fast and cost-effective restoration, since the intact understory vegetation will immediately benefit from removal of juniper competition. Projects on Phase III sites are likely to require seeding to establish desirable understory and a number of years post-treatment for the establishment of a shrub community. However, on some locations, the volume of chip production on high-density juniper sites can help offset overall project costs.

Juniper begins to have a measurable negative effect on surrounding vegetation when canopy cover reaches 10%. At 20 % canopy cover, juniper competition with shrubs and grasses is pronounced (Miller et al. 2000). This should not discourage

treatment of juniper at lower cover densities as a preemptive action to maintain healthy rangelands. The key point being that there is no reason to wait until full juniper dominance to initiate management measures. Newer invasions are often the most cost effective to control.

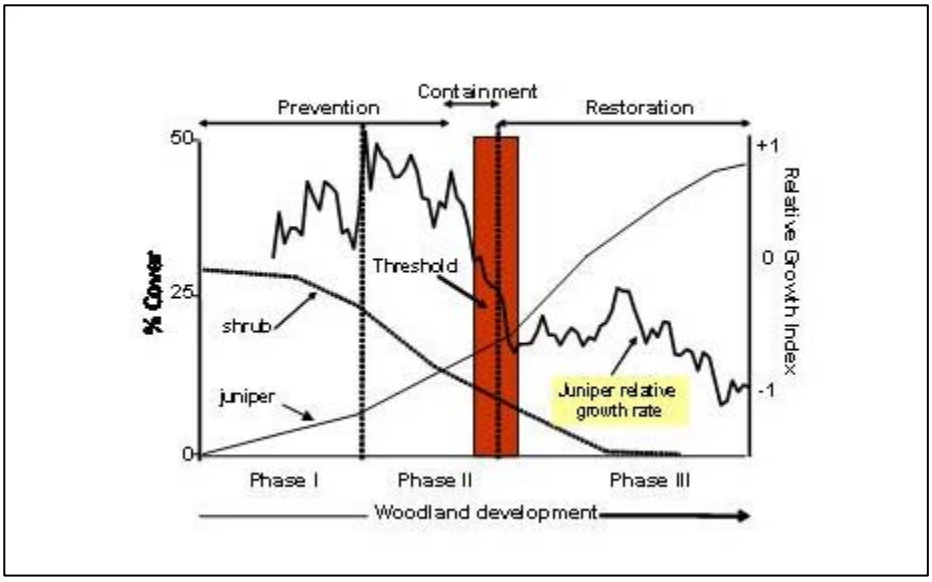


Figure 1: A conceptual model, from Miller et al. 2005 (fig. 21, pg. 25), illustrating the relationship between shrub canopy cover, tree canopy cover, relative growth rates (i.e ratio of annual ring width: mean ring width), and management strategies during the three phases of woodland development.

One of the primary objectives of treating western juniper in many western states is to improve greater sage-grouse (Centrocercus urophasianus) habitat (See Figure 2). Removing junipers from within a mile of sage-grouse lek sites is often identified as a priority and the most beneficial treatment for improvement of sage-grouse habitat followed by treatments in nesting habitat, brood-rearing habitat, and winter range.

There are several potential resource management objectives that can be achieved through the control of juniper. The more common resource objectives are listed below:

- Restore vegetative community and ecological function of sagebrush steppe range sites
- Improve habitat for sage-grouse, mule deer, pronghorn, and other sagebrush obligate species
- Improve forage production for livestock operations
- Reduce potential for upland soil erosion and improve hydrologic function
- Reduce fuel loads and potential for catastrophic fire events

For a more thorough discussion of resource management objectives and juniper removal consult:

Miller, R.F., T.J. Bates, F.B. Svejcar, and L.E. Eddleman. 2007. Western Juniper Field Guide: Asking the Right Questions to Select Appropriate Management Actions.

Figure 2: Greater sage-grouse *(Centrocercus urophasianus)* © 2009 Patricia Neely

2) Scope of Juniper Removal

Given the extensive rangelands that have been invaded by juniper at the expense of shrub and herbaceous plant communities, aggressive treatment is encouraged unless other significant resource values will be compromised.

Efforts should be made to return areas to healthy ecological site conditions. Ecological site descriptions, developed by the Natural Resource Conservation Service (NRCS), define and describe those plant communities or states that occurred in an area historically as a result of historical disturbance regimes. The ecological site is a product of all the environmental factors responsible for its development including soils, topography, climate and fire. An ecological site is recognized and described based on its ability to produce and support a particular plant community.

In most instances it is difficult to ecologically justify leaving juniper invading into sagebrush steppe rangelands, and therefore in many instances all juniper trees should be removed. In particular, on range sites near sage-grouse leks or where sage-grouse habitat is one of the main resource objectives, leaving only a few junipers will likely significantly reduce the value of the habitat.

Conversely juniper is a native species that is naturally occurring in many sites that have infrequent fire intervals and, as such, juniper woodlands should be maintained on appropriate ecological sites. Examples are rocky outcrops, rim-rock, shallow clay soils and other low productivity sites that would be generally

immune to natural wildfires hot enough to consume and kill trees. Such sites provide a natural area for juniper establishment, and therefore may harbor old-growth juniper that may justifiably be spared.

Old growth junipers are easily recognized by their rounded, unsymmetrical tops (rather than the inverted cone shape of younger trees) with open spreading canopies that can become relatively sparse with several dead limbs (*See* Figure 3). In addition, the trunks are of relatively large diameter, and the bark becomes deeply furrowed, fibrous, and distinctively reddish in color compared to the typical scaly gray bark on younger junipers.

Outside sage-grouse habitat, leaving juniper trees can be considered to meet very specific objectives, such as livestock shade, wildlife cover, etc, although most juniper-infested ranges have an abundant supply of juniper or other vegetation necessary to meet such objectives. When leave trees are desired, they should be varied in size and spatial distribution. Small clumps and/or strips of leave trees coordinated with landscape features, are more likely to be useful and will appear more natural than trees equally distributed across the landscape.

In most cases, the removal of other tree and shrub species important for wildlife habitat should be avoided. These include aspen *(Populus tremula*), oak *(Quercus sp.),* bitterbrush *(Purshia tridentata),* and mountain mahogany (*Cercocarpus ledifolius).*

Figure 3: Old Growth Juniper

3) Soils and Site Selection

Soils with at least 18" of available rooting depth, that are free from excessive stones and cobbles will have the greatest site potential for forage production and rangeland restoration and therefore should warrant a high priority for treatment. Sites with shallower soils may still be treated to meet specific objectives.

Sites with greater than 30% slope may not be suitable for mechanical harvesting and reseeding and may be at greater risk of rill erosion.

There has been much interest in, and many anecdotal reports of, increased spring flow and water yield following juniper removal. This is a commonly stated objective of juniper projects, yet a difficult one to predict and quantify. Deboodt et al. (2008) documented increases in soil moisture and spring flow on paired watershed study in Oregon. However, Kuhn et al (2008) concluded that due to the semi-arid environment where juniper occurs, a significant watershed-scale increase in water yield resulting from widespread juniper treatment in the Klamath Basin would be unlikely. While additional research may shed more light on this issue hydrologic responses are more likely to be observed near or within the project site on-site and effect on soil or surface water yield may vary significantly from site to site.

Figure 4: Juniper resprouting from the axis of a lower limb that was not completely removed (Photo Courtesy of Rick Miller.

4) Stump Treatment/ Removal of Green Limbs

Chipping operators or hand fallers should strive to keep stumps as low as feasible for the given site, equipment, and size of juniper. Of greatest importance is that stumps are not left with remaining green limbs. Stumps that have branches with green limbs can be expected to regrow, while stumps without green limbs will not (*See* Figure 4). Removal of green limbs can be accomplished in one of three

ways: 1) the original cut can be placed below any living branches or multiple machine cuts can be made; 2) remaining branches can be removed with a chainsaw leaving only the bare stump; 3) freshly cut stumps can be treated with proper application of imazapyr to chemically kill the remaining branches. Herbicide applications must be applied according to label and should simply thoroughly wet the cut surface of the stump within 3 – 4 days after the juniper has been cut. The presence of the stump itself is not a significant ecological issue, as long as it is not able to regrow.

5) Skidding Considerations

In most situations mechanical juniper harvest can be completed without an expansive network of skid trails to the chipping site. Junipers can generally be skidded across the landscape such that ground disturbance is dispersed rather than concentrated on trails that are prone to compaction, rutting, etc. When seeding is warranted, such landscape skidding may increase the success of broadcast seedings by providing better opportunity for seed/soil contact.

Skidding across frozen or snow covered ground can further reduce soil and vegetative impacts. When mechanically harvesting on frozen soil one must temporarily suspend operations once the soil begins to thaw so as to avoid creating ruts and compacting soil within the project site.

6) Understory Vegetation/Reseeding Options

Juniper removal releases rangeland sites from soil moisture competition and provides soil disturbance to allow establishment of new desirable plant species. However the same circumstances can also allow for invasion or increased dominance of weedy annuals. Whether the newly established plants are desirable or weedy will depend on site conditions and appropriate management.

An on-site evaluation for potential establishment of invasive annual grasses such as cheatgrass *(Bromus tectorum)* and medusahead *(Taeniatherum caput-medusae),* should be part of the pre-project plan development. Annual grass invasion following juniper control is most likely on sites lower than 5000 feet elevation that lack adequate perennial understory, or currently have an on-site or nearby stand of annual grasses. On sites where annual grass invasion and/or lack of desirable perennial species exist, seeding of adapted perennial grasses with relatively high seedling vigor will be required. On sites heavily infested with cheatgrass or medusahead, chemical suppression of the annual grass component may be warranted to allow perennial seedlings to establish.

If perennial bunchgrass densities are equal or greater than 2 plants per square meter, reseeding may not be necessary after juniper treatment (Eddleman, 2002). This threshold can be used with the most confidence at higher elevations or on north facing slopes with productive soils. On lower or drier sites where annual grass invasion appears likely, even sites that meet the 2 plants per square meter may benefit from seeding of perennials.

Whether or not the site is seeded, grazing management following juniper removal should be carefully planned and applied to promote perennial grass establishment and expression by allowing for seed production and seedling establishment. There are no set-in-stone grazing guidelines, but rather a thorough on-site evaluation of the herbaceous plant community and its capacity to achieve desired state in the presence of grazing is warranted. In the majority of cases, some level of grazing rest or deferment may be required to achieve restoration goals. The amount of time will depend on the condition of the understory prior to treatment, resilience of the site, and climate conditions (Miller et al 2005).

Selection of species for reseeding should be consistent with land use objectives and the soil/site capability. Where livestock grazing is the primary use, a well adapted, grazing tolerant species such as intermediate wheatgrass *(Thinopyrum intermedium)* should be used. In areas with specific wildlife objectives, shrub species such as big sagebrush *(Artemesia tridentata)* (for sage-grouse) or bitterbrush (for deer) and forbs may be included in the seed mix. See UC-ANR publication 8163, Dryland Pastures: Their Establishment and Management in the Intermountain Region of Northern California (Wilson et al, 2005) for more detailed information on reseeding and management of newly established stands.

7) Controlling Small Junipers

Many juniper sites include substantial number of small juniper poised to reestablish dominance after an initial treatment. Where an on-site evaluation determines that small junipers exist in densities that will negatively impact understory community within a 20 to 30 year time frame, control measures should be included. They can be controlled most efficiently and selectively with spot applications of herbicides, most notably hexazinone (Lile et al 2004). Hexazinone (Velpar L or Pronone Power pellet) should be placed at the base of the juniper, according to label directions, in fall or early spring when precipitation can move the herbicide into the root zone. In certain circumstances, hand treatments using pulaskis or chain saws, or prescribed burning can also be effective tools for removing them.

8) Post Treatment Noxious Weed Monitoring

Treated areas should be monitored for the establishment of noxious weeds for three years following treatment. The removal of juniper trees will reduce competition for soil resources and in some circumstances result in a release of weedy species (Miller et al. 2005). The highest risk levels for weed invasion are in warmer lower elevation sites. Noxious weeds should be treated annually to avoid the development of infestations. Effective weed control treatments will vary depending on the species of weed detected.

9) Other Juniper Control Options

Chaining/Bull-Dozing

Relatively high cost is one of the limiting factors to the use of heavy equipment methods, which are not commonly used for control of juniper. Chaining or bull-dozing are generally effective at removing larger juniper although the smaller ones are often missed or may simply bend rather than break as the chain passes over. Soil disturbance can be rather high with heavy equipment operations so the potential for annual grass invasion must be carefully considered. Even where the risk of weed invasion is considered to be low, seeding might be considered as an opportunity in light of the disturbed soil.

Hand Cutting – Chainsaws

Generally this method is most useful on relatively small sites, unless a very large inexpensive labor force (i.e. conservation crew) is on-hand. Downed juniper can be left in place to be used as fuel for a future prescribed fire. However, care should be exercised not to create fuel loads so high as to kill desirable grasses and/or sterilize the soil. Alternatively, the boles can be removed for firewood or posts and limbs can be scattered to provide some microhabitat for perennial seedlings. If limbs are scattered, care should be taken that limbs are not piled so deeply as to inhibit germination and growth of new seedlings.

The reported benefit to broadcast seedings from scattering limbs has been somewhat inconsistent. The best results have occurred in wet years, while no beneficial effect was recorded in dry years. Native bluebunch *(Pseudoroegneria spicata)* and introduced intermediate wheatgrasses were species that responded positively to scattered limbs and slash. However, given the high cost per acre of scattering slash, feasibility may be restricted to highly erodable soils or slopes and/or where labor costs are low (Eddleman 2002).

On project sites lacking adequate shrub cover, another option for handling removed limbs is the construction of wildlife brush piles that can provide at least an interim source of hiding and thermal cover. Relatively large brush piles (15 – 20 feet in diameter and at least 5 feet high) may be more heavily used by song birds and quail and have longer-term value (Gorenzel et al. 1995). Piles should be constructed of branches in varying sizes placed in a fashion that provides protection, but allows some interior spacing for access by small birds and rodents. Piling limbs over an elevated structure such as an existing stump or downed tree may help maintain interior spacing. Piles are more likely to be used if they are within 200 feet of other cover sources. Common sense dictates that pile placement and spacing should be such as not to create a fire hazard.

In most cases, mechanical tree removal is restricted in areas of archaeological significance. Hand cutting with chainsaws can be an effective way of treating these areas without disturbing cultural resources. Consultation with local Native

American tribes should be conducted and concurrence obtained from appropriate state historic preservation authorities when required.

Prescribed Fire

Fire, the most natural way to control juniper, can be very effective where fuel loads will permit. Where ladder fuels are available, and fire can reach and consume junipers, fire can be very cost effective. Fire is most likely to yield a positive response where the range site and plant community are still in good condition. Where little desirable understory exists, the chances of reclaiming the site simply through burning are much less promising. In certain sites where closed canopy juniper has restricted the understory community, prescribed fire is infeasible unless preceded by some method of cutting where the downed material is left in place. On sites where the objective is to remove juniper, but leave an intact sagebrush community, prescribed fire would not be the best choice.

Chemical

As of now the only reliable means of chemical control of uncut juniper is limited to control of small trees up to 6 feet in height. Hexazinone (such as Velpar L or Pronone Power Pellet) used with spot applications in late fall or early spring has proven to be very effective and easily applied for the control of small trees. It is important that these products are applied in the appropriate dose (as per label) directly to the base of the tree. The Velpar liquid should not be applied on frozen ground but early enough in the spring such that precipitation can move the herbicide from the soil surface into the root zone. Similarly, pellets need adequate precipitation to dissolve the pellet and transport the chemical into the soil and thus should be applied from late fall to very early in the spring. Appropriately applied, hexazinone treatments can selectively remove a new infestation of juniper while leaving the remaining plant community intact.

Chemical control of previously cut stumps with remaining green limbs using imazapyr (Arsenal or Chopper) can also be successful and cost effective compared to follow-up limbing with chainsaws.

Attempts at using other herbicides for juniper control have had mixed results and are not recommended at this time. Always be sure to carefully follow the label directions and check with the County Ag Commissioner regarding permits and appropriate use of herbicides.

10) Monitoring

Efforts should be made to monitor the effects of juniper control projects and document how well resource objectives are met. This should include permanent photo points at the very least. Simple vegetation monitoring transects can help quantify change over time. There are many different methods for measuring changes to vegetation and the objectives of the project will drive which methods are best for the project (BLM Interagency Tech Guide, 1996)

Citations

Bedell, T. E., L. E. Eddleman, T. Deboodt, and C. Jacks. 1993. Western juniper, its impact and management on Oregon rangelands. Oregon State University Extension Service, EC 1417.

Bureau of Land Management. 1996. Sampling Vegetation Attributes: Interagency Technical Reference. BLM National Applied Resource Sciences Center, BLM/RS/ST-96/002+1730. 163 p. http://www.blm.gov/nstc/library/pdf/samplveg.pd.

DeBoodt, T.L, M.P. Fischer, J.C. Buckhouse, and John Swanson. 2009. Monitoring Hydrological Changes Related to Western Juniper Removal: A Paired Watershed Approach. The Third Interagency Conference on Research in the Watersheds. Estes Park, CO.

Eddleman L. 2002. Establishment and development of broadcast seeded grasses under western juniper slash. *In* Range Field Day Progress Report, Department of Rangeland Resources, Oregon State University and EOARC. Range Sciences Report #5. Prineville, OR.

Gorenzel, Paul W., Sonke A. Mastrup, and E. Lee Fitzhugh. 1995. Characteristics of brushpiles used by birds in northern California. The Southwestern Naturalist 40(1):86-93.

Kuhn, Timothy J., Kenneth W.Tate, David Cao, and Melvin R. George. 2007. California Agriculture, 61(4):166-171.

Lile, D. F., D.L. Lancaster, R.G. Wilson. 2004. Juniper control strategies in northeastern California. Proceedings 25th Vegetation and Forestry Management Conference. Redding CA.

Miller, R.F., T J. Svejcar, and J.A. Rose. 2000. Impacts of western juniper on plant community composition and structure. Journal of Range Management. 53:574-585.

Miller, R.F, J.D. Bates, T.J. Svejcar, F.B. Pierson, L.E. Eddleman. 2005. Biology, ecology and management of western juniper. Technical Bulletin 152. Oregon State University, Agricultural Experiment Station.

Wilson, R., D. Lile, D. Drake, S. Orloff, D. Lancaster, H. George, R. Delmas and A. Bower. 2005. Dryland Pastures: Establishment and Management in the Intermountain Region of Northern California. University of California, ANR publication 8163.