Sagebrush Ecosystem Program
201 S. Roop Street, Suite 101
Carson City, Nevada 89701
Telephone (775) 684-8600
Facsimile (775) 684-8604

www.sagebrusheco.nv.gov

STATE OF NEVADA
Sagebrush Ecosystem Program

SAGEBRUSH ECOSYSTEM COUNCIL
STAFF REPORT
MEETING DATE: June 17, 2013

DATE: June 14, 2013

TO: Sagebrush Ecosystem Council Members

FROM: John Copeland, Forester III and Sagebrush Technical Team Member, Nevada Division of Forestry
Telephone: 777-684-8600, Email: jcopeland@sagebrusheco.nv.gov

THROUGH: Tim Rubald, Program Manager, State Lands,
Telephone: 775-684-8600, Email: timrubald@sagebrusheco.nv.gov

SUBJECT: Pinyon – Juniper Woodland in Nevada and some implications for Greater Sage-Grouse management

SUMMARY

This item gives the SEC background and information on current Pinyon-Juniper woodland extent in Nevada, important details concerning P-J woodland ecological dynamics and characteristics, reasons for expansion into sagebrush communities, the effects of P-J expansion on Greater Sage-grouse, and a description of tools most commonly used by land managers to effectively control expansion of the P-J woodland into the sagebrush ecosystem.

BACKGROUND

There are approximately 50 million acres of Pinyon – Juniper (P-J) woodland across the Western United States, of which about 17. 6 million acres of P-J woodland are found within the Great Basin. P-J woodlands currently cover 12% of Nevada, approximately 9.1 million acres. The occurrence of P-J within Nevada can further be divided to reflect landownership and/or management:

- BLM managed – 64%
- USFS managed – 26%
- Private landownership – 5%
- Other (DOD, NRC, USFWS, BIA, etc.) – 5%
  (NDF Forest Stewardship data, 2010; Mitchell and Roberts, 1999)

Over most of Nevada, the P-J woodland is dominated by two tree species, singleleaf pinyon pine (*Pinus monophylla*) and Utah juniper (*Juniperus osteosperma*). Pinyon pine is rare to absent from the mountain ranges north of the Humboldt and Truckee Rivers and is replaced by stands of Utah juniper. Western juniper (*J. occidentalis*)

replaces Utah juniper in the northwestern corner of Nevada and extends northward into the northern Great Basin and along the eastern slopes of the Cascade Range.

Singleleaf Pinyon (4,000 to 9,500 feet)tends to dominate the woodland in the upper and mid elevation bands of central and southern Nevada mountain ranges, while juniper(3,500 to 7,500 feet) is more abundant at the lower elevations and on rocky ridge tops, being better adapted to shallow soils, droughty conditions and lower precipitation. Both species are of relatively short stature, with mature trees generally less than 30 feet tall at maturity, with some individuals growing to 40 to 50 feet tall; pyramidal in shape when young, both species become rounded and often wider than tall with age. Both species can be long lived (+600 years).

P-J woodlands supply valuable cover and habitat for many species of birds, mammals, reptiles and invertebrates and are home to several endemic plant and animal species. Pine nuts and juniper berries provide important food sources for birds, mammals and insects. Humans have used pine nuts as a stable food source for several thousand years, have used the wood as a source for charcoal to support the mining industry during the 19th century; and, continue to use the wood as a source for heating, fence posts, and building materials.

From a historical standpoint, prior to 1860 about two thirds of the Great Basin landscape was treeless, or nearly so. Today less than one third of the landscape is treeless and more than 90 percent of the trees have established since the 1860's. (Miller, Tausch and others, 2008) Potential reasons for the expansion may include:

- Altered fire regimes
- Grazing
- Natural range expansion
- Recovery from past impacts
- Changing climate (Romme et al. 2009)

This continued woodland expansion is a challenge for land and wildlife managers, with two primary concerns being the continuing steady conversion of sagebrush habitat to woodland and increased risk of large area destructive wildfires that may convert woodlands to monocultures of invasive annual grasses and other weedy species.

Pinyon – Juniper Woodland Expansion into Sagebrush Communities – Characterization. Definitions:

Phase I – Trees are present but shrubs and herbs are the dominant vegetation that influences ecological processes on the site;

Phase II – Trees are co-dominant with shrubs and herbs and all three vegetation layers influence ecological processes on the site; and

Phase III – Trees are the dominant vegetation and the primary plant layer influencing ecological processes on the site.

Numerous studies have documented the expansion of P-J woodlands into sagebrush communities (Adams 1975; Burkhardt and Tisdale1976; Cottam and Stewart 1940; Gedney and others 1999; Miller and others 2005; Miller and Rose 1995, 1999; Tausch and West 1988, 1995; Tausch and others 1981). In recent years, research has looked at woodland dynamics and new approaches to measure the extent that P-J woodlands have replaced or are encroaching sagebrush communities versus dynamics on sites that have supported woodlands in the past using woodland successional phases to characterize vegetation site dominance (Miller, Tausch and others, 2008).

Phase I of P-J woodland succession sees initial expansion of young trees into open sagebrush communities. Trees are present in small numbers, with shrubs, grasses and forbs the dominant vegetation. Phase II sees trees expanding actively and growing in number, height and crown cover; the brush/forb community and the trees are reaching a state of co-dominance. In Phase III is the point where trees have become the dominant vegetation and the primary plant layer influencing ecological processes on site.

If a wildfire occurs at some point before Phase III is reached, the original vegetation community has an opportunity to "take back" or return to the site via a successional pathway that is dependent upon the fire's surviving plant species, seed produced by the remaining shrubs, surviving grasses/forbs and/or their viable seed remaining in the soil seed bank. This return to the original community is also dependent on the native plants being abundant enough to out compete any on-site invasive annual grasses and like cheatgrass (*Bromus tectorum*) or medusahead grass (*Taeniatherum caput-medusae*) and perennial invasive weeds (skeleton weed, knapweeds, etc.) following the fire.

With time, and little or no fire, these invaded brush communities become Phase III woodlands, characterized by very little understory, the only evidence of the former plant community being skeletons of sagebrush and other woody brush species and a sparse population of herbaceous plants . At this point, run off from the soil surface spaces between trees increases, due to the loss of herbaceous ground cover. In turn, the increased rate and speed of soil erosion can trigger difficult to reverse changes to the biogeochemical cycles of the plant community. If a fire burns through the woodland at this point, the potential for the area to return to a sagebrush plant community is greatly reduced, particularly if cheatgrass, medusahead grass and/or perennial invasive weeds are present in the understory.

The continued expansion of woodland has become a primary threat to several sagebrush obligate wildlife species, such as sage-grouse and the pygmy rabbit. In the instance of sage-grouse, woodland expansion contributes to the loss of critical habitat for breeding, nesting, brood rearing and wintering habitat. It also increases raptor presence and predation associated with the coniferous trees. (Commons et al, 1999)

Pinyon – Juniper Woodland Expansion into Sagebrush Communities –
P-J encroachment is tied to areas where precipitation is dependably between 10 and 15 inches per year, which in the Great Basin tends to be the middle elevations of most mountain ranges. Below this precipitation range, a variety of brush species tends to dominate the landscape; which species dominance depending on soils, position in the landscape and amount of precipitation. Above this precipitation threshold, other conifers, deciduous tree species and brush species are better adapted to the soils, temperatures and precipitation, tending to limit the encroachment of P-J.
The sagebrush habitat most at risk to P-J encroachment is the mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) vegetation type. Typically this vegetation type occurs at mid to high elevations in the Great Basin in areas receiving at least 14 inches of moisture a year. Mountain big sage sites are floristically diverse, with the sagebrush growing with other shrub species and a variety of perennial grasses and forbs. This is also a vegetation type that sage-grouse utilize, particularly during the summer and fall of the year.

Before the settlement era in the Great Basin (prior to the 1850's and 60's)the fire return interval in most mountain sagebrush vegetation has been estimated to have been between 25 to 50 years, which would tend to keep encroaching P-J in a persistent Phase I successional pathway. Since settlement, grazing and fire exclusion in the mountain big sage vegetation have helped to change vegetation composition and dynamics, as well as extend the fire return interval (often >100 years), which allows the P-J to establish and to reach Phase II and III successional levels.

In the Great Basin there are approximately 100,000 + acres a year moving into Phase III woodlands. (Miller, Tausch and others, 2008) At this rate of encroachment, management of sagebrush habitats becomes a race between a (potentially) permanent loss of mountain big sagebrush habitat to P-J woodland versus how much Phase I and II woodlands can reasonably be treated each year before they reach Phase III. Land managers have to consider removal of trees from areas that historically have been sagebrush dominated as a priority activity.

Pinyon – Juniper Woodland Expansion into Sagebrush Communities – Greater Sage-Grouse Research
Sage-grouse are rarely found in P-J woodland habitat. The grouse inhabit a variety of sagebrush habitats – low and black sagebrush habitats, mountain big sagebrush-grass habitats, big sagebrush - mesic meadow habitats, Wyoming big sagebrush, etc…, and grouse move between these habitats seasonally in order to meet their reproductive, brood rearing and seasonal nutritional needs. A variety of research is presented here to demonstrate that sage-grouse avoid P-J woodland and sagebrush habitat that is encroached by P-J. For instance:
Removal, by cutting, of pinyon- juniper trees/shrubs in association with brush-beating to reduce height of mountain big sagebrush and deciduous brush resulted in doubling numbers of male sage grouse counted on treatment leks in years 2 and 3 post-treatment. (Commons 1999)

During both the breeding and summer seasons, Greater Sage-grouse preferred cover types with less than 5% juniper canopy cover compared to those same cover types with greater than 5% juniper canopy cover. Greater Sage-grouse were periodically observed shading under single trees or a small group of trees, but this still only occurred where tree canopy cover was less than 5%. Juniper trees may act as perch sites for raptors, which may be directly influencing Greater Sage-grouse avoidance of cover types with greater than 5% juniper cover. Juniper may also indirectly influence birds' avoidance of habitats through its influences on plant community compositional and structural changes, such as a reduction in the herbaceous understory (Burkhardt and Tisdale 1969, Knapp and Soule 1998, Miller et al. 2000). (In: Mark Freese, 2009 Thesis)

Sage-grouse avoided conifer at the 0.65 km scale (850m x 850m). Sage-grouse avoided mixed sagebrush/tree (≤40 trees/ha) at scales of 7.3 and 159.2 ha. Avoidance most supported when patch widths exceeded 200 m. (Doherty 2008)

There can be an age difference in how sage-grouse chose to avoid tree encroached habitat. During the spring, yearlings selected areas with more pinyon pine and juniper trees than did adults, though both selected for it less than it was available. Yearling females are less experienced at selecting nest sites and may be more tolerant of trees. (USGS 2010)

Pinyon – Juniper Woodland Expansion into Sagebrush Communities – Tools

There are several tools available to land managers that can be employed to remove P-J from the landscape. Most of the techniques have been in use since the late 1940's for range management, and more recently for fuels management and for habitat improvement projects.

Chaining – Cable or anchor chains pulled between two crawler tractors for the purpose of removing or thinning trees. The Ely Chain is a destroyer or cruiser-type anchor chain, 40 to 160 lb. per link with railroad rail pieces welded crossways to each link. Chaining was used extensively in the Great Basin during 1950's – early 1970's to convert large areas of woodland into areas better suited for livestock and grazing wildlife. Not employed much today, although it has been used on wildlife projects in Utah and Nevada where other techniques were considered too expensive. Cost per acre is low to moderate.

Chipper/forwarder – a driver operated wheeled or tracked piece of heavy equipment that mounts a heavy chipper, a grapple, and a chip container system to contain the chipped P-J materials for later use as a biofuel. Crews hand cut P-J into manageable lengths for the chipper forwarder which follows up by driving to the cut material, using the driver operated grapple to feed the chipper, which expels the chipped material into a roll on roll off container that will be off loaded from the forwarder and loaded on to a heavy truck to transport the chips from the project site to the point of use.

Terrain should be relatively flat to rolling and not rocky. Cost per acre is moderate to high. Impact to the site is low.

Cut and chip – P-J is hand cut by crews and the cut material is fed into a machine (the chipper) which contains an engine driven drum or disc mounted with heavy, sharp chipping knives that rotate at a high RPM. The chipped material is expelled from the machine and either harvested for use as a biofuel or is broadcast onto the soil surface and left in place to break down.

Best employed on small project sites or in areas where equipment can't be used effectively. Costs tend to be low to moderate, depending on distance crews need to haul cut material to access chipper.

Cut and scatter – crews cut down trees with chainsaws, cut limbs from downed trees, then scatter limbs over the landscape. This works well when target trees are Phase II and still have some distance between crowns, the trees are over six feet tall, and have multiple trunks or a large number of lateral branches. Cost tend to be relatively low per acre, often depending on distance from duty station and from access roads

Cut in place – crews cut down trees with chainsaws and leave trees without further cut down. This works well for smaller, younger trees in a Phase I stand (less than 6 feet tall). Cost per acre is low.

Cut, pile and burn – crews cut trees into manageable lengths, pile the biomass, and then return to the project site when the material has cured to a point where it will readily burn. This technique is often used in late stage Phase II or in Phase III stands of P-J, and is used where cut materials must be burned in order to control overwintering insects or because of certain fungal diseases that might be spread via insects or wind. Cost per acre tends from low to moderate.

Herbicide – chemical products applied to foliage or via bark injection to kill P-J. Not used extensively on federal lands in Nevada, Utah or Arizona, this technique is used in the southwest, particularly on private lands in SE New Mexico and west Texas. Cost per acre for hand application can be fairly low.

Mastication – mechanical treatment of P-J that uses heavy equipment to shred or chip entire trees, leaving the debris scattered on the soil surface. Modern equipment can operate efficiently on slopes that range from flat to upwards of 35%. Equipment can be tailored to the needs of each project, with smaller mastication equipment used in Phase I projects and larger, heavier equipment better employed where woodland is thicker and the trees larger. Cost per acre can be quite low on large, relatively flat projects with good access; or, costs can be prohibitive when project sites have poor access and steep slopes.

Prescription fire (Rx fire) – planned use of fire to accomplish management objectives in a variety of fuel/vegetation types. For woodland sites in Phase I or II, remaining understory is critical to successful employment of fire and to eventual restoration to a

sagebrush site following the fire. Seed and resprouting shrubs/grasses/forbs are needed to repopulate the burned site following the fire.

Fire is carried in the understory between trees in less dense areas and requires horizontal fuel continuity to carry fire with enough intensity to damage or kill trees. Sites with large amounts of annual grasses in the interspaces between trees have this continuity but are not good candidates for Rx burning as they are very likely to return as a monoculture of annual grasses rather than shrub/grass/forb.

Tree shear – hydraulically operated equipment attached to a tractor, skid steer, tracked vehicle or dozer that cuts and lays down small diameter P-J (12" or less). Trees are either laid down for a forwarder or left in place to eventually break down. Cost per acre is low to moderate, depending on project access, general terrain features and slope.

Feller-buncher – tracked vehicle tool used to cut (feller) and gather (buncher) tree stems, then lay them down in piles on the site for collection by a forwarder or a grapple truck. This equipment has not been used extensively in the Great Basin, but should be looked at closely, particularly on steep slope projects. Cost likely to be moderate to high.

Ideally the landscapes of the Great Basin should be managed for a mosaic of vegetation types and stand densities that enhance ecosystem function, watershed health, wildlife habitat, and reduce the risk of catastrophic wildfire. The human environment (resource use, cultural and social needs, recreation, view sheds, etc.) must also be considered when examining all management actions.

Appropriate forest management and sound silvicultural tools should be used in P-J ecosystems to manage ecosystems where these species are the persistent and dominant vegetation type. In persistent P-J sites, management options might include thinning for stand health and fire resistance, or producing a sustained woodland cover that supports wildlife habitat and human needs. Land managers can implement these types of practices while considering and planning for potential changes that may come about due changing weather patterns, increased atmospheric CO_2, insect and infective agents, and other biotic/abiotic factors that may present themselves in the future. (Intermountain Society of American Foresters 2013)

FISCAL IMPACT

None at this time.

RECOMMENDATION

No recommendations are presented with this staff report. This staff report is presented as a staff product designed to inform the SEC of some of the more important factors related to P-J encroachment and expansion dynamics as they affect the sagebrush ecosystem. An understanding of these issues and some of the potential tools to be used to control that expansion may be of assistance to the Council as they

further develop the conservation crediting system and look at mitigation activities as they might affect the efforts to conserve the Greater Sage-grouse in Nevada.

POSSIBLE MOTION

No motion is proposed with this staff report

Attachments:

Document references

jjc:TR

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Adopted 02/15/2013

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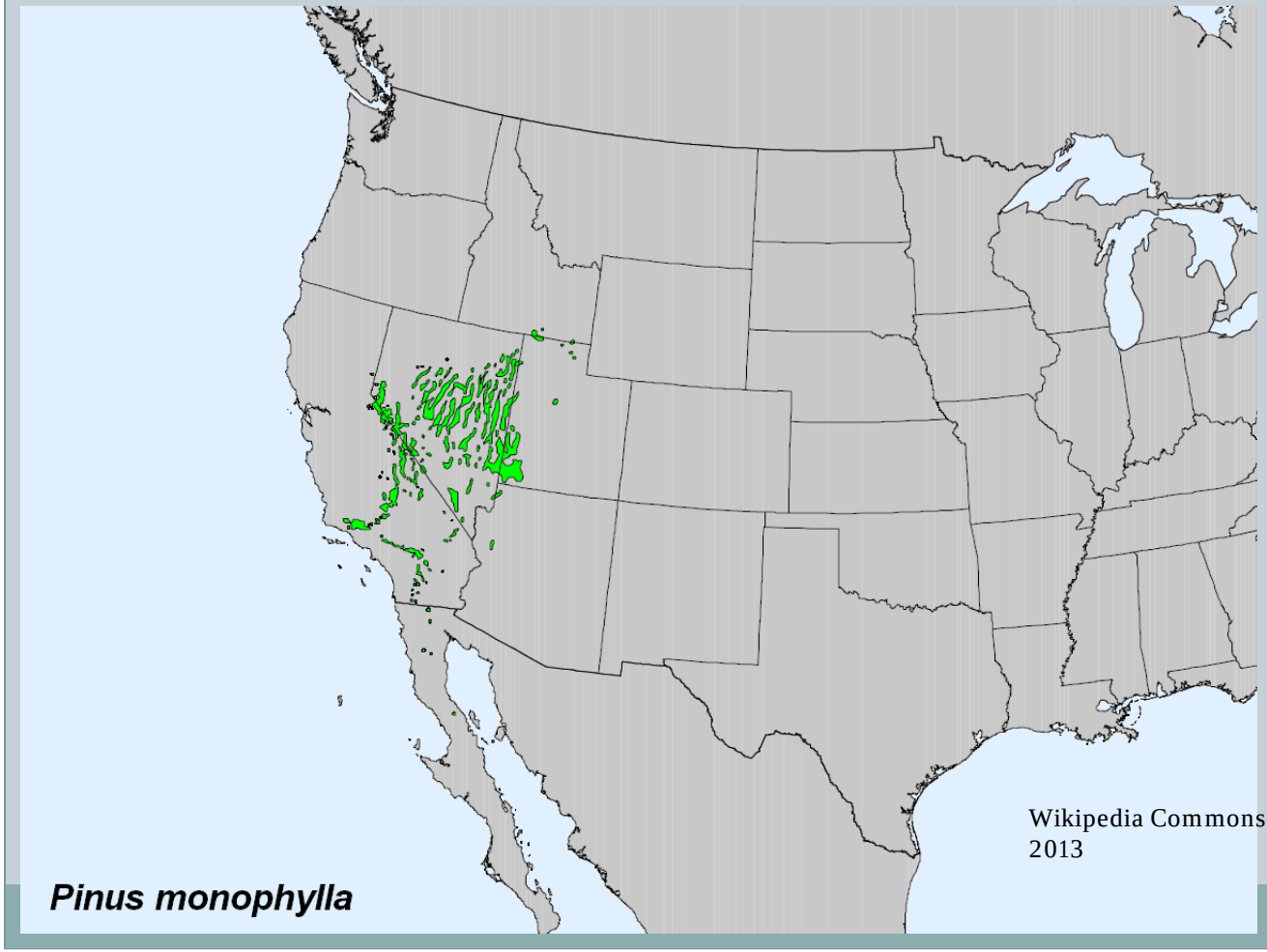
Pinyon Juniper Expansion into Sagebrush Communities

UPDATE REPORT TO THE SAGEBRUSH ECOSYSTEM COUNCIL – JUNE 17, 2013

Single Needle Pinyon Pine - Distribution

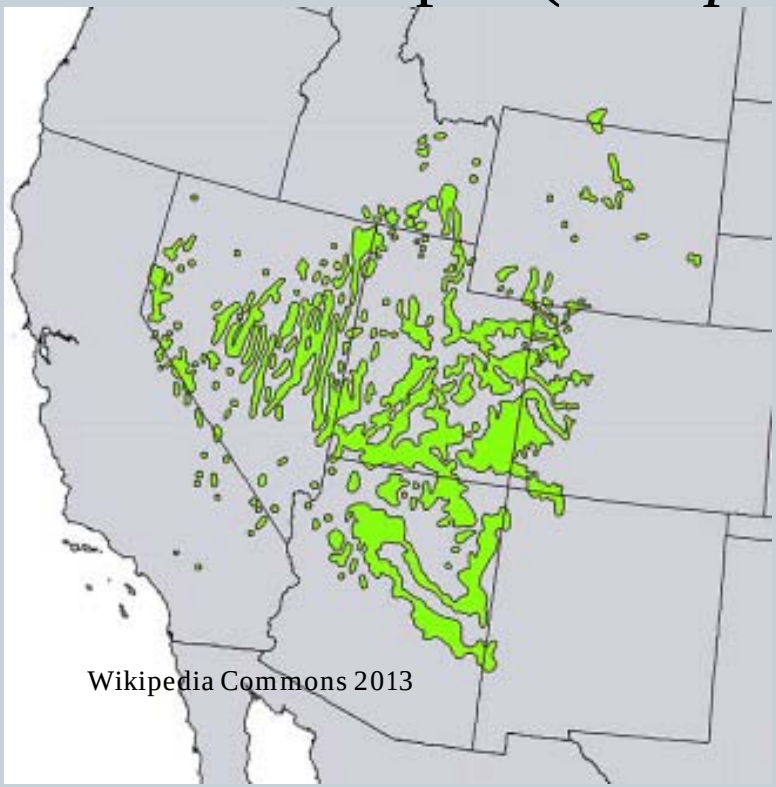
- Single needle pinyon pine (*Pinus monophylla*)



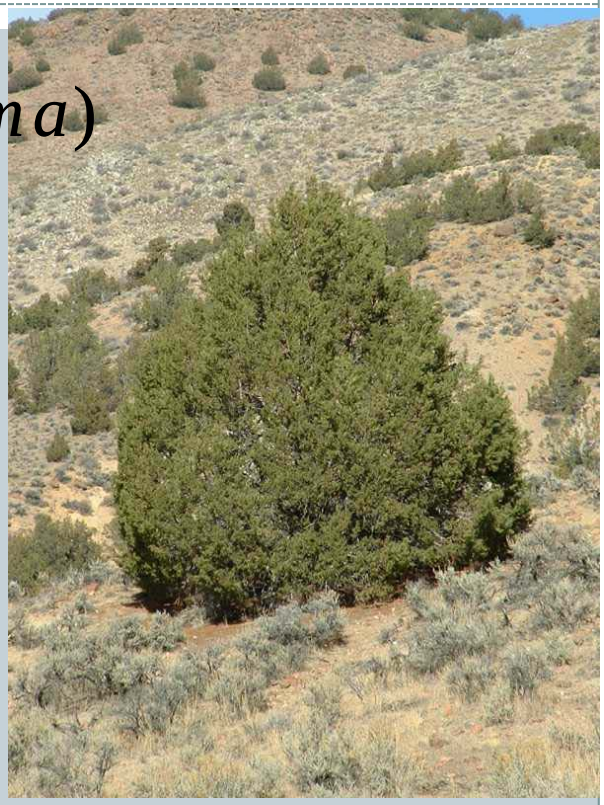
The only species of pinyon in Nevada, it's found extensively throughout the state's southern and central mountain ranges; it is replaced by Utah juniper and western juniper north of a line roughly defined by Truckee River and Humboldt River.

Utah Juniper - Distribution

- Utah Juniper (*Juniperus osteosperma*)



Utah juniper occurs throughout Nevada but is replaced by western juniper in the northwestern corner of the state.



Pinyon Juniper Woodland – How much and where?

- Statistics:
  - 50 million acres Pinyon – Juniper woodland (P-J) in the western U.S.
  - 17.6 million acres of P-J woodland in the Great Basin
  - 9.1 million acres in Nevada
    - BLM manages 64% of P-J woodland
    - USFS manages 26 % of P-J woodland
    - Private ownership – 5%
    - Other ownership – 5% (BIA and tribes, DOD, NRC Test Site, etc.)

NDF Forest Stewardship Data, 2010

P-J Factoids

- **Long lived and slow to reach reproductive age– both species live up to 600 + years**
- **Fire intolerant – Light to moderate fires will kill most trees**
- **Birds and rodents are responsible for the majority of seed dispersal in both species**
- **Seedlings are slow growing. They expend energy to produce extensive root systems that can support above ground growth.**

P – J Habitat Requirements

- 10 – 15 inches of moisture per year is ideal
- Historically, P-J found growing in scattered stands and areas where fire would be infrequent:
  - Ridges
  - Rocky areas
  - Isolated mid slope areas above Wyoming big sagebrush communities and below mountain big sage communities and higher mountain conifer/aspen communities
  - Juniper was found in similar locations, but will grow at lower elevations than pinyon. Utah juniper has higher drought tolerance and can grow in higher pH soils.

Fire

- Fire's Former Role
  - **P-J woodland species are sensitive to fire, with most trees being killed outright by moderate intensity fires and young trees being highly susceptible to light intensity fires**
  - **Mountain big sagebrush ecosystems (MBS) may have had fire return intervals of 25 to 50 years prior to the 1860's.**
  - **Wyoming big sage brush communities likely experienced fire on a 75 – 100 year fire return interval.**

Conifer Encroachment

Western juniper encroachment in Modoc County, CA

Conifer Encroachment:
In the absence of fire, conifers expand into sagebrush communities.

Phase I – trees are present but shrubs and herbs dominate and influence ecological processes on the site

Phase II – trees co-dominate with shrubs and herbs; all three influence ecological processes on the site

Phase III – trees dominate the vegetation and influence ecological processes on the site

(Miller, Tausch and others, 2008)

Sage Grouse and P-J

Sage-grouse are a sagebrush obligate species, and use a variety of sagebrush habitats in order to meet their reproductive, brood rearing and seasonal nutritional needs. They rarely use P-J woodland, although they may transit through it to migrate from one seasonal habitat to another.

Sage Grouse and P-J

- During breeding and summer seasons Sage-grouse preferred cover types with <5% juniper canopy cover compared to the same cover types with >5% canopy cover. (Burkhart & Tisdale 1969)
- Conifers may act as perch sites for raptors which may directly influence bird avoidance of woodland habitats. (Knapp & Soule 1998)
- Young grouse may utilize treed habitat more than adults. Yearling females are less experienced at selecting nest sites and may be more tolerant of trees. (USGS 2010)

Bodie Hills 2008

P-J Woodland Control

- Each year about 100,000 acres of Great Basin P-J woodland transitions from Phase II to Phase III (Miller, Tausch et al 2008)
- Modern P-J woodland treatments include:
  - Hand cutting
  - Prescription fire
  - Mechanical treatment
  - Herbicide application

  Most treatments have been employed in the Great Basin since at least the early 1950's.

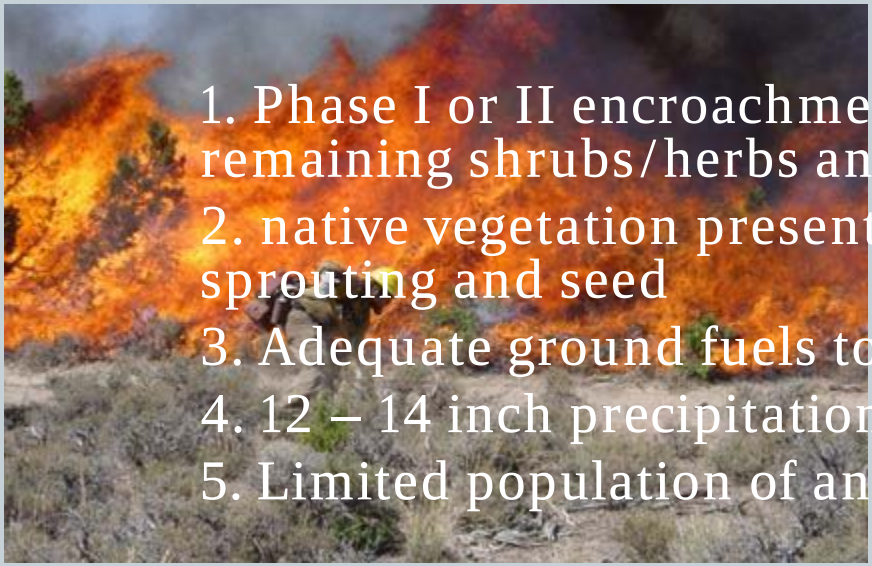
Treatments

Hand treatments:

- hand cutting with or without scattering limbs
- hand cutting and piling for burning
- hand cutting and chipping

P-J Treatments - Rx Fire

Prescription Fire can be a tool to reduce conifer encroachment if certain conditions can be met.



1. Phase I or II encroachment; Phase III may not have enough remaining shrubs/herbs and seed bank
2. native vegetation present in understory for re-sprouting and seed
3. Adequate ground fuels to carry fire through stand
4. 12 – 14 inch precipitation zone to stimulate regen.
5. Limited population of annual grasses in understory

Planning is key; understanding fuel models and fire behavior plus adequate manpower and fire apparatus.

P-J Treatments - Herbicide

- Herbicides are better for use on smaller trees (less than 6 feet tall); Phase I
  - Tebuthiuron – Spike 80w
  - Picloram – Tordon 22K

  Hand applied to foliage and allowed to flow down stem to root zone where they are translocated to the plant.

  The usual cautions apply. Ground water contamination can occur with the two herbicides listed above.

P-J Treatments - Mechanical

Equipment mounting mowing and mastication tools can remove entire trees, leaving chips scattered on the landscape, such as this 2004 project in the Double Springs Area of Douglas County, NV.

P-J Treatments - Mechanical

Common mastication equipment consists of a mastication head and a wheeled or tracked vehicle to mount it to. The skid steer unit pictured here is ideal for Phase I sites but doesn't accommodate larger trees (>7" diameter or so) found on Phase II and III sites.

P-J Treatments - Mechanical

P-J Treatments - Mechanical

- Cost per acre can be expensive - move in/move out costs, terrain, stand densities, etc.
- Best used in relatively flat terrain (0 to 25% slope), good access, Phase II and III sites
- Steep terrain may limit type of equipment used; very steep terrain is better for hand crews and adapted yarding equipment if material must be removed.
- Feller-bunchers and tree shears can be used to cut trees and lay them down and can work if fairly steep terrain
- Forwarder chippers can be used to chip trees into bins for sale or use of biomass
- Mastication leaves everything on the ground as a mulch. The mulch can inhibit shrub and grass growth from seed.

P-J Treatments - Mechanical

- Chaining has been used in the west since the late 1940's
- Large, heavy naval chain is pulled between two dozers
- Effective in mature stands , uprooting trees and scarifying soils
- Young trees bend rather than break
- Can be effective on Phase 3 sites; chain, seed, then chain again to cover seed.

P-J Guidelines

- Phase I and II can be most productive sites to treat
- Phase III sites may not have enough remaining native shrubs and herbs to regenerate without extensive rehabilitation efforts
- Invasive annuals can overwhelm a site if there isn't enough native plants left for re sprouting and seed.
- Sage Grouse and other sagebrush obligate species avoid P-J encroached areas
- Treatments can be as simple as crews cutting and leaving young trees on the ground or as complex as use of equipment to remove the biomass from the site.
- Rx fire is best employed on sites with adequate precipitation and residual native plants in the understory able to provide seed and resprouting following the fire.