University of Nevada Cooperative Extension

Curriculum Material 10-10

Pinyon and Juniper Investigation

Nevada Youth Range Camp

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This curriculum is used at Nevada Youth Range Camp for teaching high school age campers about the role of pinyon and juniper trees in Nevada Rangelands and the role of fire and vegetation management in sustaining rangeland ecosystems growing these trees. The pages in this font are for the instructor only. The pages in this font, including all figures, are for the campers.

Setting the Stage

Set the stage for this investigation by quickly reviewing what will take place in the allotted time. In this investigation we will identify areas of woodland that have burned and other areas that have not. We will measure the vegetation and compare our data to make interpretations or test predictions. Additional data will tell us about some of the many ways fire and woodland trees affect rangeland vegetation, soil and water. The content of the investigation is further described below. Also tell the group how they will be involved (see below).

Rationale: The area growing pinyon pine and juniper trees is increasing in Nevada and the West. It occupies some areas where it has been for thousands of years and areas where other plants used to dominate. The land occupied by pinyon and juniper are among the most productive of Great Basin rangelands. These lands provide valuable habitat for many big game, other wildlife species, and livestock. They are the watershed for many streams. How these woodlands have been managed through the last century and a half has greatly affected their character today. In some cases, decisions made by our generation will affect these lands for all of the foreseeable future.

Content	**Description**
Observing the woodland environment	Record observations in an area where a burn edge cut through a pinyon/juniper woodland
Sampling the vegetation	Sample the cover by species on one side of the burn edge
Identifying phases in woodland succession	Use vegetation measurements and other observations to make interpretations about wildlife habitat, weeds and fire
Predicting understory response to management	Use understory vegetation to predict what would happen after a fire or by cutting the trees
Assessing watershed conditions	Predict how vegetation and ground cover differences would affect how rainfall and melting snow would affect soil erosion
Summarizing your findings	Describe what you have learned about the ecology of ecosystems where pinyon juniper trees grow.

Application
The concepts you learn about woodlands will help you appreciate their dynamic nature. Furthermore, you will be able to make and interpret your own observations in other areas where these trees occur on different soils and with various plant communities.

How you'll be involved
Working in small groups; collecting data on the kind and amount of plants, and ground cover; making observations related to fire, vegetation management, and watershed functions; group discussions of data and interpretations; and individual summary of findings.

Equipment needed:
- Task cards, one set for each learner
- 100-foot tape measure
- Stakes or pins to hold the tape taut from both ends
- Plant key to identify the plants on site
- Densiometer (optional)
- Laser pointer to locate dimensionless points for cover measurements (optional)
- Four equal-sized water bottles filled with water

Observing the Woodland Environment

Note to facilitator: Select an area where a fire has burned through a pinyon-juniper stand on an ecological site that had been invaded by pinyon and/or juniper trees. This could be an area where the trees were old and had crowded out the understory vegetation or an area where there was plenty of vegetation to come back after the fire without reseeding. However, the vegetation and interpretations from the two areas might differ considerably. The edge of the burn should be within a slope that extends far enough horizontally (# 100+ yards or meters) to permit sampling on both the burned and unburned sides without changing slope, aspect, or geologic parent material. Often such edges extend vertically up the slope because fires often burn uphill or because of fire lines put in to keep fires from spreading

Hand out TASK A Observing the Pinyon and Juniper Environment

Questions for discussion

1. What do you notice about this landscape?

2. Do you see any animals or evidence of animals? If so, where?

3. What seems to be the big story here?

Task A Observing the Pinyon and Juniper Environment

As individuals
As you approach the hillside in front of you, look for big differences between some parts of the land and others. Record your observations below.

Differences across this land include:

The landscape (slope, aspect, soils, rocks, etc.):

Plants:

Animals:

Air and Sunlight:

Questions for discussion

1. What did you observe? (Encourage everyone to contribute to this discussion)

2. It is sometimes possible to see the effects of history by reading the land, and especially its vegetation. What does the vegetation here tell you about the history of this place?

3. How is the vegetation different from one side of the edge of the burn to the other side?

4. How could we become sure the differences in the vegetation are real and not an illusion?

Sampling the Vegetation

We are going to collect some data to check our observations. Range managers often measure the cover of shrubs and other plants. By doing this in two areas or at two different times they compare the vegetation to understand differences in management effects or to measure the trend in vegetation. They find comparable places that have the same, or nearly the same, elevation, slope, aspect and soil because such places should have the same vegetation unless it is changed by a disturbance such as fire, grazing, an insect infestation, etc. Line point intercept is a method for sampling the cover and determining the relative proportion of each species or life form.

Hand out Task B Vegetation Sampling by Point Intercept Cover

Task B Vegetation Sampling by Point Intercept Cover

Work in pairs and as a group.

On both sides of a fire edge, use a 100-foot tape to sample a representative area of vegetation using these rules:

Use column one to collect data for the first plant community you sample. Circle the appropriate heading, burned or unburned.
Start the tape at a random location about 50 feet away from the fire edge and stretch it across the hill at the same elevation if possible but generally away from the fire edge.
Do not move or place the tape so as to selectively avoid or to include any plant, group of plants, or bare area.
At each foot marker on the tape, locate the tick mark. At the upslope end of each tick mark, observe the type of cover found there using the categories of vegetation (by species), litter (or dead vegetation), rock (bigger than a pencil diameter), or bare ground.
Record the first hit only (uppermost thing observed at that point) if for example a bush leaf is over a grass leaf.
Tally your hits using the dot tally method.

. = 1	**:** = 2	**:.** = 3	**::** = 4	**I:** =5	L˙ =6	U =7	☐ =8	⍂ =9	☒ =10

Take turns observing what is at each next point.
If a densitometer is available, use it at the 25-, 50-, 75- and 100-foot marks to observe tree canopy.
When you finish data collection, calculate the total percent cover as the number of hits for each species, each group (grasses, forbs, shrubs and trees), for litter, rock and bare ground.
Circle the species name that has the most cover.
Circle the name of the group with the most cover.
How do you think the amount of each species will be different on the other side of the edge of the burn? ____

How do you think it will be the same? ___________________________

Repeat on the other side of the burn edge. Use column 2 for this plant community.
Go check your predictions by collecting the same kind of measurements on the other side of the burn edge. Be sure to start the tape about 50 feet past the edge of the burn.
Calculate the total cover for each species, each group (grasses, forbs, shrubs and trees), and for rock and bare ground.
In column 2, circle the species name that has the most cover
Circle the name of the group with the most cover.

Were your predictions correct? _________________________________

Comments ____

Task B Vegetation Sampling by Point Intercept Cover
(Instructions on back)

Species \ Circle b / u	1. burned / unburned	Total	2. burned / unburned	Total
Grasses: (by species)	Dot tally of cover hits		Dot tally of cover hits	
Total				
Forbs: (list by species)				
Total				
Shrubs: (list by species)				
Total				
Trees: (List by species)				
Total				
Litter or dead plant				
Rock				
Bare ground				
Total				

Questions and discussion

What are the big differences between the two areas (burned and unburned)?

What do you think could cause these differences?

How would you summarize the effect of fire (at least this fire) here and then (whenever it happened)?

Phases in Woodland Succession

Although some ecological sites have been dominated by pinyon and juniper trees for centuries, in many other locations these trees have recently spread into sites not usually dominated by trees. They expand from fire safe sites where they do not get burned during fire. They spread into land where returning fires had kept the vegetation in grasses, forbs and shrubs (and occasionally some young trees depending on how long it has been since fire). If fire does not periodically burn the vegetation in these locations, the trees can take over and dominate with their large size, shade and thirst for water. This causes many changes and managers refer to the stages in this process as Phases I, II, and III. Use Task C, Phases of Woodland Succession, to determine the phase for each of these areas.

Hand out TASK C Phases in Woodland Succession

Task C Phases of Woodland Succession
As a group
Examine figure 1 and use your vegetation sampling data from TASK B with the descriptions of phases I, II, and III to determine the phase for each area.

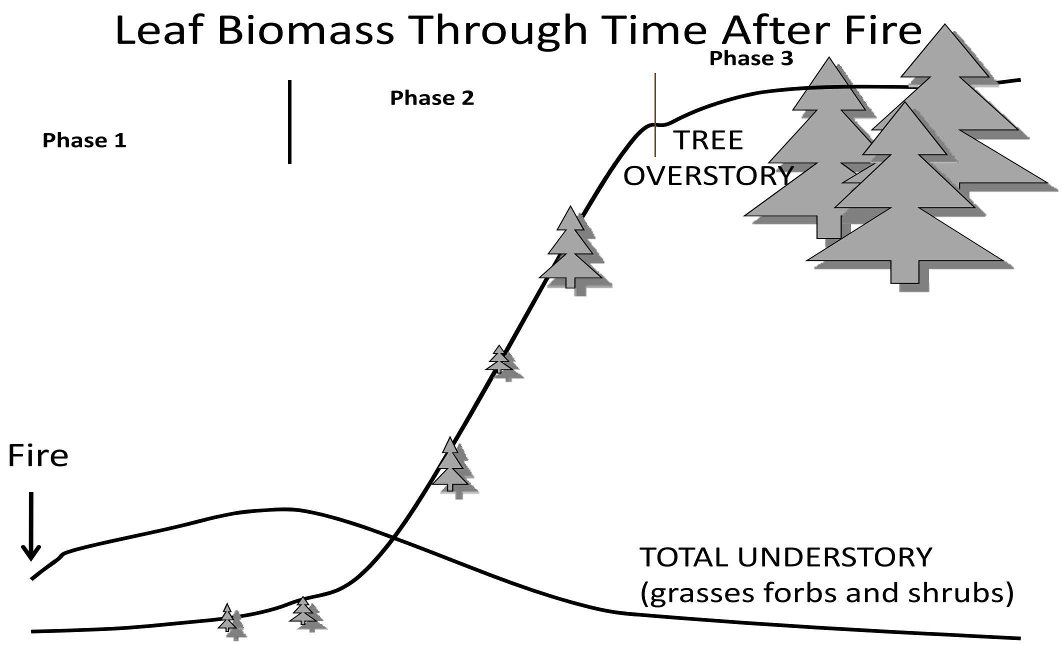

Figure 1. The relative amount of leaf biomass in understory (grasses, forbs and shrubs) and overstory (trees) in the several decades after fire as tree expansion progresses from phase I through phase II to phase III.
Phase I – Small trees are present but shrubs, grasses and forbs dominate the vegetation that influences ecological processes (hydrology, nutrient cycles and energy capture) on the site.
Phase II – Trees co-dominate with shrubs, grasses and forbs, and all three vegetation layers influence ecological processes. Trees grow fast (have pointed tops) and bigger trees may produce many berries or pine nuts.
Phase III – Trees are the dominant vegetation and the primary plant layer influencing ecological processes on the site. Tree growth slows (tops become rounded) while seed production declines.

In what phase is the burned area? _________________________________

In what phase is the unburned area? _______________________________

When some trees have attained the size of Christmas trees, many more tree seedlings are hiding under the shrubs and Phase II is beginning. Can you find any tree seedlings under shrubs in the burned area? _______

When tree cover exceeds 60 percent of the total plant cover (tree cover/total plant cover * 100 = ____) most shrubs are dying or dead and Phase III is beginning. Can you find the skeletons of shrubs in the unburned area? _______

Questions for discussion:

Discuss any questions from Task C that have not been discussed.

1. Cattle and horses often eat or prefer primarily grasses. Because fire and overstory vegetation dramatically influence understory vegetation, where would you expect most cattle foraging to occur in this vicinity?

2. Sheep often prefer other food plants (especially certain forbs or shrubs). Where would you expect most sheep foraging to occur in this vicinity?

3. Big game like mule deer and elk like to eat browse (shrubs) and herbaceous vegetation (grasses and forbs). Deer and elk also like to find shade in hot weather and hide from predators and hunters in thick cover. Which area would they prefer?

4. Describe the landscape having ideal habitat for deer and elk.

5. Other species rarely enter a woodland, relying on sagebrush and/or grassland habitats. Still others rarely leave woodland habitats. Describe the landscape having ideal habitat for the largest diversity of wildlife species.

6. Sage grouse depend on a variety of sagebrush habitats, bare leks, nesting with shrub and tall herbaceous cover, brood rearing with cover and forbs, meadows, and a variety of kinds of sagebrush for fall and winter forage. Large trees can be a problem because raptors perch and watch for sage grouse movement. Describe the fire management strategy that would optimize for sage grouse.

7. Many species of wildlife depend on sagebrush habitat. In which phase(s) would they thrive?

8. Many birds eat juniper berries. In which phase(s) would they thrive?

9. Many birds and small mammals eat pinyon seeds (pine nuts). In which phase(s) would they thrive?

Fire and Management (15 min)
As woodlands move from phase II into phase III, fuel increases dramatically. For a time and in certain weather conditions, the loss of understory plants makes fire less likely because it does not easily spread from one tree to another. As woody fuel from trees continue to increase, the risk of a hot canopy fire increases.

When a fire burns, the response of the vegetation depends on the heat of the fire and the understory vegetation from before the fire. Fires that are too hot may kill seeds and plants like bunchgrasses that normally survive fire. If a fire kills the understory perennials, the site becomes open to invasive species like cheatgrass and noxious weeds.

Because many wildlife species prefer habitats with sagebrush, or other shrubs and with a strong herbaceous layer, land managers often treat expanding pinyon and juniper stands before it is too late:

Phase I - fire OK but not needed yet and habitat is good.
Phase II - fire is needed and time is growing shorter, only a few decades left.
Phase III – too late for fire, other methods needed

Once the invasive species (weeds) dominate, restoration of native plant communities becomes very difficult or impossible. If native species will not respond after fire (or any other treatment), managers seed desired species that are adapted to the area to help keep out weeds.

You have seen how a fire in 1982 responded here. Would this area respond the same way if burned this year?

Would it respond the same way in other places nearby?

To learn about this, we'll do TASK D as a group."

Hand Out TASK D Predicting Understory Response to Treatments

Task D Predicting Understory Response to Treatments
As a group observe and discuss the following photos Figures 2-5 that show how time changes vegetation and what eventually happens after fire or fire exclusion and fire.

Figure 2. This 1971photo of Upper Underdown Canyon, Shoshone Range (west of the Toiyabe Range) shows a lot of area in Phase I. The dark vegetation is mostly pinyon or juniper trees of various sizes. Some on the ridge is mountain mahogany. (All photos used by permission from Robin Tausch)

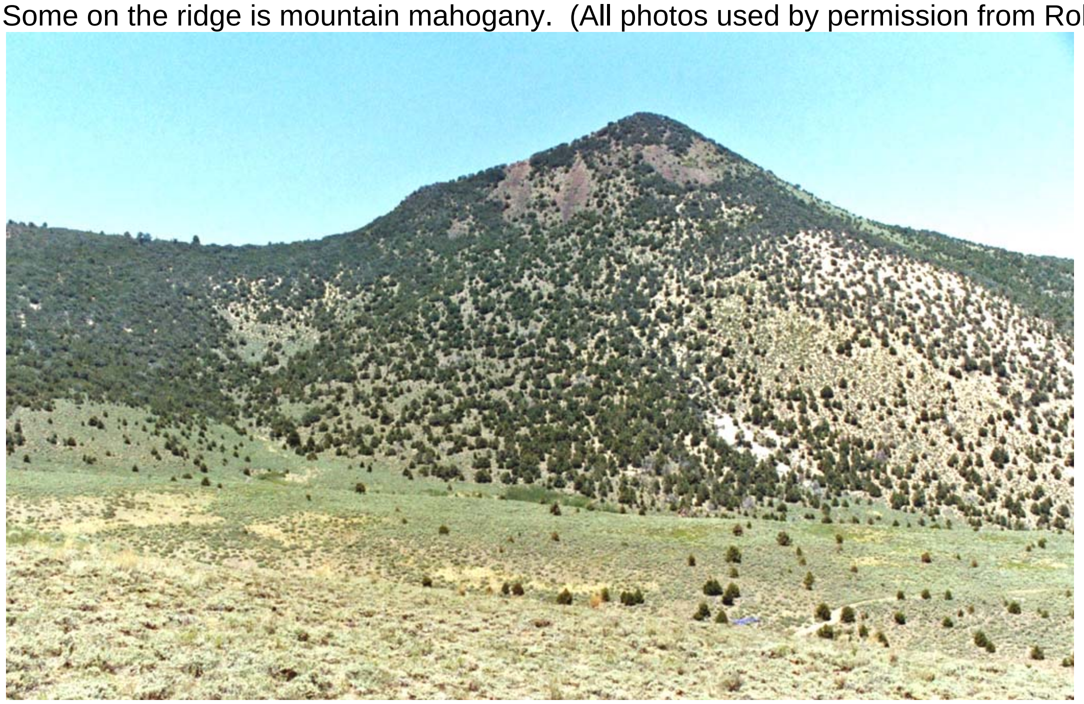

Figure 3. The same area as figure 2 in 2007. Phases II and III have become much more common across the landscape.

Figure 4. Phase I and early phase II, when it burns, often returns to bunchgrasses, perennial forbs, and then shrubs.

Figure 5. Late phase II and Phase III has more fuel, produces more heat, and has weaker understory vegetation. Fire leaves bare soil for annuals like prickly poppy and introduced weeds.

Answer the following questions for both burned and unburned areas in this table.	Burned	Unburned
Flame height is often one to three times higher than the vegetation. At twice the height, what is the expected flame height for a fire on either side of the burn edge? (Answer in either feet or meters.)		
Would such a flame height reach from tree to tree, from shrub to shrub, or from shrub to tree if wind bent the flames over so they were horizontal? . (yes, no, or maybe)		
When wind does not lay flames out horizontally, trees or shrubs must be close to touching or have fuels (live or dead vegetation) between them and ladder fuels underneath them for fire to move from one to another. Are such fuels here to carry the fire? (yes, no, or maybe)		
Under trees, the litter often burns in a hot wildfire. If the litter burned here, what percent of the currently living perennial bunchgrasses would this likely kill? (____%)		
If a wildfire kills so much of the perennial vegetation that it leaves big bare areas, seeding is often used for emergency site stabilization. Would this be needed here? (yes, no, or maybe)		
To avoid having the fire kill the perennial plants, a mechanical treatment is often used to prepare the site (kill the trees and increase moisture for the understory). However, on steep slopes limitations of the equipment and the threat of erosion often force treatments to be modified or done by hand. What's the slope? (____%)		
Perennials showing slowed or stopped reproductive effort is another indication that a mechanical treatment is needed. Are plants producing flowers or seeds? (a little, some, or a lot)		
For good understory recovery after mechanical treatments, tall perennial bunchgrasses should be close enough together for their roots and the roots of seedlings growing from their seeds to meet underground. Managers may check to see if a person can step from one tall perennial bunchgrass (not Sandburg's bluegrass) to another. Are they close enough here? . (yes, no, or maybe)		
When the perennials are not this close, a seeding may be needed after even a mechanical treatment. Based on the distance between tall perennials, would a seeding be needed here? (yes, no, or maybe)		
Without a seeding, what plant species that would survive the fire are present to grow quickly? (list the three most common plants)		

Note: You may want to go back and forth between the two areas to answer these questions.

Questions and discussion

Discuss the questions and answers from group observations on TASK D

Watershed Interpretations

The job of a watershed is to capture, store and safely release the water from precipitation and snowmelt. Safely means that water does not run off the site fast enough to carry soil with it. Watershed scientists have learned that falling raindrops act like little bullets when they hit bare soil. They send loosened soil particles in all directions. This makes it easier for running water to wash them away. If the soil puddles (soil particles settle together, filling pores) water becomes less able to soak into the ground. Water running off the soil surface may form rills as it erodes soil. This can be especially bad when the rills can become long before they run into a root crown, debris dam or dense litter.

Which area, burned or unburned, do you predict is better at capturing and storing water from precipitation?

Which area, burned or unburned, do you predict is better at protecting the soil from erosion?

We will use Task E to collect some data to answer these questions.

Hand out Task E Watershed Interpretations.

Work together to complete Task E. Make predictions individually (questions 1-3), but perform the experiments and record observations together. Then discuss the answers to the questions (5-13) before asking everyone to answer question 14 by themselves.

Task E Watershed Interpretations (as a group)

Predictions:

1. Soil cover is needed to break the fall of a raindrop. To estimate cover, range managers often check for soil protection at many points. You did this for Task B. Which area had more ground cover? ____________________

2. Which area had more bare ground, burned or unburned? ____________________

3. When water does not soak into the soil rapidly, it may run off. Which area do you predict will produce more runoff or where will water flow on the soil surface farther?

   ____

Test:

Use a water bottle to test your prediction. Apply a known and equal amount of water to the soil surface quickly (simply turn a full water bottle upside-down when it is just a few inches above the soil surface) in both the burned and unburned areas. Do this first in an interspace between trees or shrubs and then under a canopy. Avoid trails where soil compaction may limit infiltration.

Record observation (time, distance, erosion and hydrophobic soils) on the back of this task card.

4.) Fill in the following table (1-4 with observed data then 5-9 as an average):
Record distance in inches or centimeters depending on your tape.
Record relative amount of soil moved (much (water turned muddy) to little (water clear)).
Evidence of hydrophobic or water repellant soil includes water beading on soil surface or running off as if soil was waxed (yes, no, or maybe).

1.) Burned canopy Seconds to soak in ______ Distance water ran ______ Amount soil moved ______ Hydrophobic soil ________	3.) Unburned canopy Seconds to soak in ______ Distance water ran ______ Amount soil moved ______ Hydrophobic soil ________	5.) Average canopy Seconds to soak in ______ Distance water ran ______ Amount soil moved ______ Hydrophobic soil ________
2.) Burned interspace Seconds to soak in ______ Distance water ran ______ Amount soil moved ______ Hydrophobic soil ________	4.) Unburned interspace Seconds to soak in ______ Distance water ran ______ Amount soil moved ______ Hydrophobic soil ________	6.) Average interspace Seconds to soak in ______ Distance water ran ______ Amount soil moved ______ Hydrophobic soil ________
7.) Burned average Seconds to soak in ______ Distance water ran ______ Amount soil moved ______ Hydrophobic soil ________	8.) Unburned average Seconds to soak in ______ Distance water ran ______ Amount soil moved ______ Hydrophobic soil ________	9.) Overall average Seconds to soak in ______ Distance water ran ______ Amount soil moved ______ Hydrophobic soil ________

Results:

5. Where (interspace or canopy) did the water soak into the soil more quickly? _____________
6. Where (interspace or canopy) did water flow for the longest distance? __________________
7. Where (burned or unburned) did the water soak into the soil more quickly? ______________
8. Where (burned or unburned) did water flow for the longest distance? __________________
9. Where did soil move the most? ____
10. Sometimes soil becomes hydrophobic (water repelling). Were any of your infiltration, runoff, or erosion observations influenced by water repellency? _____Notes -____________
11. When water runs off in a rainstorm, it may flow until it comes to a debris dam or pile of litter which may slow it down long enough to soak in. Which area has the longest distances in interspaces where water could flow? ______________
12. Now relate the above to observations elsewhere in the burned and unburned areas: If you see any evidence of water erosion in the burned area, describe it ________________
    ____
13. If you see any evidence of water erosion in the unburned area, describe it ______________
    ____
14. The job of a watershed is to capture, store and slowly release (without excess soil loss) the water from precipitation or snowmelt, how would you summarize what you have observed about watershed (water catchment) functions in this area?
    ____

Questions and discussion

How did you summarize what you learned today about water catchments?

Which area best protects the soil from erosion?

How could loss of topsoil affect what happens to rain or snowmelt in the future?

After collecting data on the burned and unburned areas, look for another area where the watershed characteristics may be worse. Often, a place has a number of areas that have burned at various times. Look around for an area on the same soil type that represents some other successional stage, OR the same successional stage but a different slope aspect. Go there to observe any indicators of runoff or erosion such as pedestalled plants, rill erosion and sediment deposited behind debris dams, etc.

Note:
If there is time, the increment borers could be used to determine the age of bigger trees in the two unburned areas.

Summary

1. Describe in one sentence what you think about the fire ecology of pinyon and juniper woodlands.

2. What does this make you think about the policy (from 1910 to about the 1990's) of putting out all fires on public land?