PROPOSED MANAGEMENT OF ASPEN HABITAT IN NORTHERN NEVADA

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Abstract: A simple method is described for evaluating the regenerative potential of aspen (Populus tremuloides) stands undergoing overstory deterioration. Sucker and sapling densities are obtained, and based on this information, treatments involving livestock restrictions or disturbances are proposed to insure regeneration. Disturbance treatments rejuvenate aspen stands by stimulating root suckering. No treatment is necessary if the sapling density is adequate (approximately 2,100/ha). Total basal area (m^2/ha) and density of overstory trees are also determined and function as indicators of the stage of deterioration. By comparing the overstory characteristics with treatment results, it may eventually be possible to better predict ability to rejuvenate aspen stands in various stages of deterioration.

INTRODUCTION

Conversion of aspen habitat to sagebrush (Artemesia spp.) sites is common in northern Nevada (Fig. 1). This is the result of aspen stands failing to regenerate during overstory deterioration. The reduction in the amount of aspen is critical in terms of the loss of habitat diversity in this otherwise monotypic Nevada landscape. The Nevada Department of Fish and Game also recognizes aspen deterioration as a serious loss of raptor nesting habitat (Oakleaf 1975, Oakleaf and Lucas 1976). Mule deer (Odocoileus hemionus) and numerous species of small non-game birds are undoubtedly also affected by the loss of aspen. Since aspen currently lacks commercial value in northern Nevada, it will largely be up to the wildlife habitat manager, not the forester, to reverse this trend.

In this paper, we describe a simple method for evaluating the regenerative potential of stands undergoing overstory deterioration. The method was developed during a recent aspen study in Humboldt County, Nevada. Based on the evaluation, we propose treatments to insure regeneration. Treatments include livestock restrictions and various types of disturbances. The proposed management only applies to aspen that lacks a coniferous understory, and this includes most of the aspen in northern Nevada.

An understanding of aspen deterioration and regeneration is possible when the following silvical characteristics of aspen are recognized: (1) aspen reproduction is primarily by root suckering; (2) as a result of root suckering, aspen occurs in clones of genetically identical individuals; (3) aspen is intolerant of shade and requires nearly full light for satisfactory survival and growth; and (4) the growth-initiating factors in an open deteriorating stand may be overridden by a phenomenon known as apical dominance (Farmer 1962). Apical dominance involves the production of auxin in aboveground stems and the translocation of the auxin into the roots where it inhibits sucker formation. The flow of auxin is interrupted only when most or all of the overstory trees in a stand are suddenly killed. This usually results in profuse root suckering as evidenced by the abundance of suckers that usually follows fire (Fig. 2), clear-cutting, or any other major disturbance (Shier 1975).

In the absence of a disturbance, an aspen stand reaches maturity and with advancing age, overstory deterioration ensues. It would seem that as an over-mature stand begins to open due to overstory mortality, sucker production would increase due to increased light penetration and reduced auxin level. However, this is frequently not the case. Shier (1975) developed a hypothesis to explain why regeneration is frequently unsuccessful in aspen stands undergoing overstory deterioration. He suggested that residual living stems maintain the auxin levels so sucker production continues to be inhibited. As the over-mature stems weaken and die, the root system dies back, and this also reduces the number of root suckers that can be produced. This hypothesis seems to be a reasonable explanation for the regeneration failure in many deteriorating stands.

Yet, some stands undergoing overstory deterioration are regenerating. Thus a need exists for evaluating the potential of deteriorating stands to regenerate. Shier (1975) reported that apical control may be weak or the level of growth-initiating factors high in some stands, and this may explain why some stands sucker profusely during overstory deterioration.

Fire suppression is considered to be a major factor contributing to the increased incidence of aspen deterioration in the western states (Gruell and Loope 1974, Shier 1975). This was based on the simple fact that the rejuvenating effects of fire on aspen are now less frequently realized. In northern Nevada, excessive livestock use is also contributing to the loss of aspen habitat. Livestock prevent regeneration and hasten deterioration by keeping suckers browsed down.

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MATERIALS AND METHODS

Deteriorating stands are visually identified by the following characteristics: (1) an open canopy, (2) abnormally large amounts of aspen residue (standing or fallen), and (3) sagebrush invasion. These stands can be easily identified from an airplane.

Data are collected during leaf-out so live stems can be easily distinguished from dead stems. This would generally be from June to October in northern Nevada.

Plot Sampling

Data are obtained from 0.005 ha circular plots (radius = 3.98 m) systematically located at constant intervals along a paced transect. The apparatus shown in Fig. 3 is used to delineate plots. The number of plots can vary

Fig. 1. A deteriorating aspen stand converting to a sagebrush site in northern Nevada. Healthy stands lack the sagebrush understory.

Fig. 2. Profuse suckering in an aspen stand in northern Nevada. The overstory trees were not burned but were killed from the intense heat of a nearby range fire.

according to the size of the deteriorating stand, but for standardization and ease of calculation, it's recommended that five or ten plots be used. The interval between plots will also vary according to the size of the deteriorating stand. The interval is determined by pacing the selected transect and dividing the total number of paces by the number of plots.

The transect should extend across the full length of a representative and uniform part of the stand and should remain totally within the deteriorating stand. The boundaries of some stands are difficult to ascertain due to severe deterioration. In this case, it's necessary to look for fallen aspen residue to delineate the original stand. The transect course can be altered to remain within a stand.

Sapling Density

In this paper, saplings are defined as aspen stems that have grown beyond the reach of livestock and are less than 10 cm diameter at breast height (1.37 m). The minimum height of saplings is set at 1.50 m in both cattle and sheep areas. Sampson (1919) and Smith et al. (1972) found that aspen reproduction is generally safe from destructive browsing by cattle when leaders reach a height of 1.50 m. The same minimum height is used in sheep areas to maintain simplicity. The maximum d.b.h. of 10 cm for saplings was chosen because in northern Nevada stems less than 10 cm d.b.h. usually constitute reproduction while larger stems usually contribute to the overstory.

The number of live saplings in each plot are counted and summed and the density expressed as number/ha. More than one-half of the bole must lie within the plot to be counted. It should also be noted if the saplings tend to be evenly distributed.

Sucker Density

Suckers are defined in this paper as being aspen stems less than 1.50 m tall. The number of live suckers in each plot are counted and summed and the density expressed as number/ha. Numerous suckers arising from a common point often form clumps, and since only one sucker in a clump will probably develop into a tree (Shier 1975), a sucker clump is counted as a single sucker. It should also be noted if the suckers in a stand tend to be evenly distributed.

Overstory Characteristics

Overstory characteristics measured includes stem density and total basal area. Basal area is defined as the total cross-sectional area of the trees in a stand calculated from d.b.h. measurements (Davis 1954). Total basal area of the overstory trees in a stand is calculated from the d.b.h. of each stem within the plots that has a d.b.h. of 10 cm or greater. More than one-half of the bole must lie within the plot to be included. A diameter tape is used to obtain the d.b.h. measurements. The basal area of each stem is obtained from a basal area table (Davis 1954). These areas are summed, and the total expressed as m^2/ha. If two or more stems have the same above-ground origin, each stem with a d.b.h. of 10 cm or greater is treated as a separate tree.

RESULTS

A density of approximately 2,500 well-distributed saplings (of the size class previously defined)/ha will usually insure regeneration (J.R. Jones pers. commun.). Based on sapling densities of three deteriorating stands that are regenerating in the study area, the lowest acceptable sapling density was found to be approximately 2,100/ha. When the sapling density of a deteriorating stand is adequate, regeneration is occurring and a treatment is not required (Table 1).

Fig. 3. Plans and materials for the apparatus used to delineate aspen plots. The lower collar is secured into position at the desired height: the chain rotates from the upper collar.

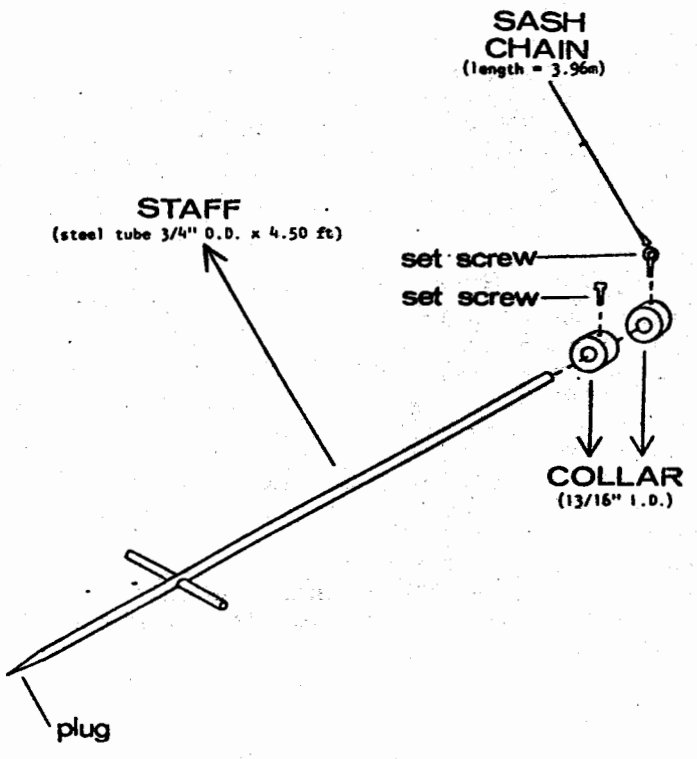

Table 1. Recommended treatments for aspen stands undergoing overstory deterioration in northern Nevada.

Sapling Density*	Sucker Density*	Recommended Treatment
Adequate	-	None
Low	Low	Disturbance
Low	Moderate	Livestock Restrictions

*When saplings or suckers tend to be unevenly distributed, use the low classification regardless of the actual density.

Sucker density is a consideration only when the sapling density of a deteriorating stand is low. If both the sapling and sucker densities are low, the potential for the stand to regenerate is poor, and a disturbance treatment is recommended to rejuvenate the stand (Table 1). When a low sapling density and moderate sucker density are encountered, further livestock restrictions need to be considered as a means to allow more suckers to reach sapling stage (Table 1).

Data to serve as a basis for classifying sucker densities as low or moderate were limited. Based on sucker densities of two northern Nevada stands that produced an abundance of suckers during deterioration a sucker density of approximately 6,200/ha was used as the value differentiating between low and moderate sucker densities. A high sucker density would be expected to occur only after a major disturbance.

Suckers and saplings will tend to be evenly distributed in a stand when regeneration is successful (Table 1). Sagebrush invades the intervening spaces where reproduction is unevenly distributed.

Lower basal areas and stem densities reflect a more advanced stage of deterioration. The value of obtaining these measurements will not be realized until deteriorating stands are actually treated. By comparing these data with treatment results, it may eventually be possible to better predict our ability to rejuvenate aspen stands in various stages of deterioration. A particular kind of disturbance might also be shown to be more effective at a certain stage of deterioration.

DISCUSSION

The proposed management plan for aspen habitat in northern Nevada involves the following procedures:

1. Visually identify stands undergoing overstory deterioration
2. Evaluate the potential of each deteriorating stand to regenerate
3. Implement the recommended treatment
4. Continue to monitor all treated stands to determine if further livestock restrictions are needed.

Livestock restrictions might include fencing individual deteriorating stands or resting the pasture that contains the deteriorating stand(s). We do not recommend permanent fencing of each deteriorating stand because this could eventually result in a maze of fences. Instead, we suggest that minimum investment fences be used and then removed. Any restriction should extend over a period of time that will allow a sufficient amount of reproduction to grow beyond the reach of livestock; this may involve a period of several consecutive years.

Potential disturbance treatments include prescribed burning, herbicidal spray, and clear-cutting (Brinkman and Roe 1975, Gruell and Loope 1974, Jones 1973, Shier 1975). Burning has potential because the sagebrush in some deteriorating aspen stands would probably carry a fire. Burning would also kill competing brush. In some cases, healthy aspen stands surrounding the deteriorating stand could function as natural firebreaks. A recommended herbicide treatment is an aerial application during late summer of 2,4-D at a rate of 3.36 kg/ha with a water carrier (J.R. Jones pers. commun.). The use of herbicides could be reduced by allowing wildfires to return to aspen and by using prescribed burning or clear-cutting in place of sprays.

Optimum time for treatment of deteriorating aspen stands would undoubtedly be during the earlier stages of deterioration. Shier (1975:11) reported, "When all that remains of a stand are a few scattered, widely spaced stems, the roots necessary for producing a uniformly dense stand of suckers are not present. Root density has probably declined to such an extent that, after

the clone is treated, regeneration will consist of small groups of suckers in the vicinity of stumps or dead stems." Based on his information, rejuvenating an aspen stand in an advanced stage of deterioration would probably be difficult if not impossible.

A special situation exists when several deteriorating stands occur in a small area. When this occurs, it would seem to be more practical to disregard the evaluation of each stand's potential to regenerate and to apply a disturbance treatment to the entire area. This would simplify matters and probably reduce treatment costs.

Consideration must be given to minimizing deleterious effects to other resources when treating deteriorating aspen stands. For example, fewer nesting raptors and songbirds would be encountered during a late summer spray. In high erosion areas, the use of sprays or clear-cutting, instead of burning, would leave most ground vegetation intact to hold the erodible soils.

A current need in aspen management is to study the comparative effectiveness of each type of disturbance treatment on stands in both early and advanced stages of deterioration. This would provide additional information needed to improve management of aspen habitat.

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