Thinning, Fuel Manipulation and Prescribed Fire in Dry Forest Types

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ABSTRACT - As a result of past harvesting and years of fire exclusion, dry forest types that historically experienced frequent low intensity fires have undergone significant changes in stand structure and species composition. In order to return and maintain these stands in an ecologically healthy state, carefully planned harvesting, fuel treatment and prescribed fire must be implemented. In treating these stands it is important to consider all work that needs to be done as an integrated plan rather than separate operations.

Keywords: Thinning, Fuel Manipulation, Prescribed Fire, Underburn, Jackpot Burn, Nutrients

HOW WE GOT WHERE WE ARE

Past logging and approximately 90 years of effective fire suppression in the dry forest types of Western North America has caused significant stand structure and species composition changes. Prior to European settlement many of these stand types were open park-like stands composed of large diameter seral species such as ponderosa pine, western larch and some Douglas-fir (Lieberg 1899). This condition was maintained by frequent low intensity surface fires that killed young shade tolerant species such as Douglas-fir and true firs in the understory but generally did not kill the large trees in the overstory (Arno 1988). With settlement came widespread logging of these high quality and very accessible stands. This coupled with the beginning of effective fire suppression led to the establishment of dense regeneration, with a higher proportion of the more shade tolerant Douglas-fir and true Firs. With the absence of fire these stands frequently became overstocked and stagnated. Fuel accumulations increased as trees died from competition and environmental stresses. In this dry climate decomposition can take several decades.

In uncut or partially cut stands that still retain many of the trees present at the time of European settlement, shade tolerant species have formed dense understory layers that compete with the overstory for water and nutrients. This increased stress can lead to premature mortality in the large overstory trees and widespread insect and disease outbreaks (Wickman 1992). This dense understory also forms a very effective fuel ladder that allows a ground fire to climb into the crowns of the large overstory trees and kill them. These high fuel loadings and dense stand conditions have led to high intensity, stand replacing wildfire in stands where they were uncommon in the past (Arno and Brown 1991). In order to return these stands to a more historic and sustainable ecologic condition, active management including timber harvest and/or prescribed fire is required:

WHY THIN AND BURN

Thinning and understory removal accomplishes several objectives,

- Reduces stress and mortality in overstory trees

- Reduces fuel loading and the potential for stand replacing fire
- Returns species composition to a more historic condition by removing the more shade tolerant species
- Allows for fire to be safely re-introduced to the stand
- Provides wood fiber and revenue to the landowner
- Increases growth rates in the residual stand
- Can improve habitat for wildlife species that favor open grown stands of large trees

Prescribed fire serves several roles in restoring the health of these stands:

- Kills excess trees present in the understory
- Reduces fire hazard resulting from fuel accumulations and the added fuel from logging slash
- Improves forage for wildlife species and provides specialized habitat for species such as blackbacked woodpeckers that strongly prefer burned stands
- Provides site preparation for natural regeneration
- Restores fire to its ecological role in the ecosystem and may provide ecological benefits that we do not fully understand at this time

SO WHAT DO WE DO ABOUT THIS MESS

There are several methods of thinning, fuel manipulation and prescribed fire that can be successfully employed in managing these types of stands. No one practice is superior to another. All have various advantages and disadvantages in a given situation. It is wise to integrate fuel management and site preparation needs into the logging job as a comprehensive plan, rather than approach them as independent operations. The various methods that will be discussed are shown in Table 1.

Table 1. Fuel Treatment Methods

GROUND BASED METHODS

- Tree-length skidding and processing at the landing/ Burn landing piles
- Tree-length skidding/ Return slash to woods/ Underburn
- Tree-length skidding/ Return slash to woods as piles/ Jackpot Burn
- Tree-length skidding/ Return slash to woods and scatter/ No burning
- Process in woods/ Underburn
- Process in woods/ Pile/ Jackpot Burn
- Process in woods/ No burning

SKYLINE METHODS

- Tree-length yarding/ Process at landing/ Burn landing piles

- Process in woods/ Underburn
- Process in woods/ Pile/ Jackpot Burn
- Process in woods/ No burning

Nearly all of these methods have been employed on Montana Department of Natural Resources and Conservation (DNRC) timber sales in the recent years. In that time we have observed many of the trade-offs, operational considerations and problems that have arisen with the various methods. We have also learned what is required to successfully employ these practices.

Thinning is frequently done with a treelength logging system that removes the majority of the slash from the stand and creates large roadside landing piles where the trees are processed. While this system is very cost-efficient, it has a major drawback. Nutrients important for tree growth and health are concentrated in the foliage and small branches of trees. In treelength harvesting these important nutrients are removed from the site. This is a significant problem on many sites especially when soils are nutrient deficient to begin with. The lack of nutrients can lead to reduced growth and increased mortality in the stand (Bigger and Cole 1983), Avila et. al. 1996). To prevent nutrient depletion, it is often wise to retain slash at the stump or to return skid slash from the landing back to the harvest unit and distribute it throughout the stand. The slash load resulting from thinning can make it difficult to apply prescribed fire to a stand without causing unacceptable levels of mortality in the leave trees. In order to address these conflicting goals it is necessary to plan the entire operation carefully and consider harvesting, slash treatment, site preparation and burning as an integrated process rather than separate operations. The various slash treatment methods that can be employed and the benefits and costs associated with each method are presented in the Table 2.

Table 2. Slash Treatment Methods

	RETAIN NUTRIENTS	PROVIDE SITE PREP	REDUCE HAZARD	RETURN FIRE TO THE ECOSYSTEM	IMMEDIATE SLASH TREATMENT COST
TREE LENGTH BURN LANDINGS	NO	NO	YES	NO	LOW
RETURN SLASH or PROCESS IN WOODS UNDERBURN	YES	YES	YES	YES	HIGH
RETURN SLASH or PROCESS IN WOODS JACKPOT BURN	YES	YES	YES	PARTIALLY	MEDIUM
RETURN SLASH or PROCESS IN WOODS NO BURN	YES	NO	NO	NO	LOW

FUEL MANIPULATION

Many landowners do not wish to apply a true underburn to their land. They may lack the expertise, equipment, manpower, funding or liability insurance needed to carry out a prescribed burn. They may also wish to minimize the possibility of fire damage to the stand and potential of escape fire. For these landowners, thinning, fuel concentration and some type of jackpot burning may serve their needs well. Landing slash can be backhauled to the stand by grapple skidding equipment on their return trip to the woods and deposited in clean, compact burnable piles that are away from leave trees. If a cut to length system is employed the slash mat can be piled by a forwarder equipped with a brush blade or by other equipment following completion of forwarding on a trail. These piles can then be burned under conditions that will not allow for fire spread between the piles. This method retains nutrients in the stand, reduces fuel loadings, provides a limited amount of site preparation and protects leave trees from fire damage. However, it does not completely emulate the natural role of fire in the ecosystem. On sites that require cable yarding the return skidding of slash is not a viable alternative; therefore slash must be retained at the stump. Where it is feasible to mechanically cut cable units, slash can be bunched as the tree is processed with a single grip harvester. If a feller-buncher is used for falling, a log processor with leveling capabilities and the ability to operate on steep slopes can concentrate the slash into piles as the trees are processed. During yarding these piles may be scattered as logs are pulled through them. This will make the piles more difficult or impossible to burn under moist conditions or require additional spot piling with an excavator following yarding. These piles can then be burned when conditions allow.

Harvest units that have been thinned with the slash piled as described in the preceding paragraph may also be burned under drier conditions. This will allow for fire to spread between the piles as a true underburn. Since the fuel has been concentrated in piles away from leave trees it greatly reduces the potential damage to them as a result of burning. If slash is scattered in the stand and not concentrated, greater mortality can be expected. Small diameter leave trees are easily damage or killed if slash is not concentrated away from them. This especially true on steeper ground. Regardless of the fuel arrangement it is always critical to limit the intensity of the fire and to burn the units slowly. Fire should be allowed to back down the slope or set in narrow strips and allowed to burn uphill for only a short distance before burning into a previously burned strip that has been allowed to cool down. Many good leave trees have been killed by overzealous burning crews that put production ahead of leave tree protection.

If prescribed fire is not a critical component of the silvicultural treatment being applied to the stand and slash loads from harvesting do not present an unacceptable risk, slash can be returned to the woods and scattered with skidding equipment, processed in the woods and scattered or crushed down with a cut to length system.

OPERATIONAL CONSIDERATIONS

Return skidding of slash creates several special considerations in logging operations.

- Return skidding needs to be kept current with log skidding. A common problem encountered is that loggers will cold deck skidded treelengths ahead of the processor. This means that treelengths are not being brought in when the slash is accumulating at the landing. Rather than being able to backhaul slash on the return trip to the woods, skidders must make a special trip back to the unit to deposit the slash and not bring any trees into the landing. This is not a cost effective practice.

- In order to keep slash backhaul concurrent with skidding, a logger is often forced into hot logging. Hot logging can cause logistical problems as landings become congested resulting in machine delays and decreased production. Problems also arise if the skidder breaks down. When this happens the processor and the loader may quickly run out of wood. To avoid this problem, some loggers skid enough wood into future landings to keep the operation going without the skidder until it can be repaired.

- Slash may not be distributed evenly. Slash frequently tends to be concentrated near the landing and little if any makes it back to the far end of the unit. This is especially true if the skidder is making a special trip to return slash rather than backhaul it when going out for another drag. Work needs to be closely administered to avoid this problem.

- Slash is placed against leave trees or directly below them on steep ground. When these piles are burned, leave trees are frequently killed. Loggers need to understand the reason for the extra work of return skidding slash and appreciate the consequences if it is not done properly. Again, close administration will help to insure the work is done properly.

CONCLUSIONS

Millions of acres of dry forest types in the west are far outside their historic range of conditions as a result of past logging and fire exclusion. On the majority of these acres, careful thinning with the emphasis on the residual stand and application of prescribed fire are required to restore these stands to a more ecologically sound state. This does not mean cut all the big trees and light the slash at the bottom of the hill. What it does mean is cutting lots of small trees and retaining many of the most valuable trees on the site. It also means a significant amount of extra work to retain nutrients on the site and to carefully apply prescribed fire. Implementing these practices will enable us to maintain these stands in an ecological healthy condition and at the same time extract a sustainable and substantial amount of wood fiber.

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