PRESCRIBED FIRE - A TOOL FOR THE CONTROL OF DWARF MISTLETOE IN LODGEPOLE PINE[1/]

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This paper deals with the application of fire management principles to satisfy land management needs. What is fire management? Briefly, fire management is the application of fire related knowledge to achieve specific land management objectives. In this case, the required fire related knowledge is mainly ecological and fuel - weather - fire behaviour relationships. The overall land management objective is to establish healthy, optimally stocked stands to maximize fiber production. On areas infested with lodgepole pine dwarf mistletoe (Arceuthobium americanum) Nutt. ex Engelm., the treatment therefore has two specific objectives: sanitation and stand establishment.

It is not the intent of this paper to discuss the pros, cons or economics of mistletoe control but to suggest some techniques after the politicing and decision making has been done. I am presuming that the land manager has decided to institute a policy of mistletoe control or at least is evaluating the costs of various treatments subject to selecting a treatment. Prescribed fire, previously suggested by a number of researchers (Baranyay and Smith 1972, Donoghue and Johnson 1975, Gottfried and Emby 1977, Kiil 1969, and others listed by Alexander and Hawksworth 1975), is merely one of a number of tools which may be appropriate to the job. In the case of lodgepole pine (Pinus contorta var. latifolia Engelm.), which is relatively easy to kill, and has a perpetual and ready supply of seed held in serotinous cones, fire has to be a strong candidate. If burning conditions are right, there is no cheaper way to cover an area than with fire; however, there may be either environmental or political restraints or unfavourable weather regimes that preclude operational use of fire.

Keep in mind, mistletoe elimination is an intermediate objective - the end objective is economical fiber production. With this in mind, cost comparisons of various treatments must include costs of stand establishment if the means of stand establishment are destroyed by the sanitizing treatment.

The specific area discussed in this paper is a triangular portion of the Interior plateau of British Columbia known as the Chilcotin, bounded on the east by the Fraser River, on the southwest by the Coast mountains and on the north by Highway 16. Latitudes 54°N and 51°N and longitude 122°W enclose the north, south and east sides, respectively. The terrain is gently rolling to flat, ranging in elevation from 700 to 1500 metres. Major drainages deeply dissect the plateau. The dominant forest cover on the plateau areas are multi-aged, multi-leveled stands of lodgepole pine, the result of extensive low intensity fires occurring at 20- to 40-year intervals. Each fire, in turn, thins the stand, prepares a seed bed, opens a varying number of serotinous cones and allows nonserotinous cones to open through increased exposure. The opened stand permits sufficient light to the forest floor to permit establishment of advanced regeneration which, in turn, is infected with dwarf mistletoe from the overstory remnants. Occasional small areas of denser, even-aged stands, indicating areas of higher fire intensities are scattered throughout the area. These even-aged, denser, more typical lodgepole pine stands tend to be free of mistletoe.

In general, these Chilcotin pine stands rank low on the spectrum of market value of lodgepole pine and because of the cold, dry climate (annual precipitation 429 mm ("16.5") growing sites are predominantly poor. However, the assigned site class based on height-age relationship of the current growth probably reflects to some extent the predominance of dwarf mistletoe. Notwithstanding, the generally

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low site classes suggest that forestry practices, especially those that require the longest term, such as sanitation and reforestation, should involve minimum investment.

Judicious use of prescribed fire offers exciting prospects for meeting low cost sanitation and reforestation objectives for a wide range of control programs. Some of these techniques, most of which are not new, are applicable to other areas; however, they are particularly appropriate to the Chilcotin because of three conditions, (a) there is restricted or controlled fire use but not fire prohibition, (b) the areas generally do not involve conflict in value of understory and overstory species, and (c) low to moderate sites prevail, suggesting minimum capital investment for reforestation and sanitation.

In the Chilcotin generally all multistoried pine stands are infected. These stands are clearly evident on aerial photographs. Infected stands range from advanced regeneration on previously logged areas to overaged decadent stands and undersized immature. Because of the prevalence of mistletoe, some priority for control must be established. Recommended priorities for initiating mistletoe control projects from the standpoint of operational feasibility, lowest cost and administrative acceptance are:

(1) merchantable stands - stands that are currently in demand by operators, no inducements necessary.

(2) marginally merchantable stands - stands that are not in demand by operators and inducements to harvest are required.

(3) non-merchantable stands - stands that are definitely not merchantable now, nor in the forseeable future either because of extreme decadence, small diameter or slow growth rate.

Operational areas have been selected to provide combined research and demonstration units to evaluate the effectiveness and operational feasibility of fire use to achieve the dual purpose of sanitation and regeneration.

Merchantable stands (stands that are currently in demand)

From an operational standpoint, elimination of mistletoe from merchantable stands presents an absolute minimum of problems. The key to fire use in these stands is fuel management. Traditionally, at least in the Chilcotin, lodgepole pine stands are clear cut using feller - bunchers and full tree forwarding with grapple or choker equipped rubber-tired skidders. Topping and limbing is done either manually or by machine on the landing. This type of logging is favoured and has been advocated by fire protection interests and, except on winter logged areas, generally results in more than sufficient stocking. Waste piles at the lands are subsequently ignited during the late fall and allowed to burn out through the winter. This method is an extremely effective way of fuel hazard abatement; in fact, so effective that prescribed burning can only be accomplished in extreme burning conditions. The problem of burning these areas is accentuated by summertime grazing, which prevents the development of sufficient grass to aid fire spread. The objective of fuel hazard abatement was admirably accomplished and, if the silvicultural implications of nutrient removal can be accommodated, the practice should be continued where burning is not necessary. The acceptance of the broadened role of protection to include insect and disease, however, brings this fuel management practice of hazard abatement into conflict with requirements for the use of fire for mistletoe control. Thus the first task after acceptance of responsibility for a control program is to designate the specific area of each cutblock where control is necessary. Both the general and specific zoning of possible mistletoe areas can be achieved from aerial photos. The presence of open, fire thinned stands is almost a guarantee of mistletoe presence. The essential ingredient dictating the need for post logging sanitation is the presence of advanced regeneration. Remember these are not homogenous stands, and localized areas within a cutblock will support denser, even-aged stands that are mistletoe free or are too dense to permit advance regeneration. Such areas should be designated and ground checked prior to logging, because they will be difficult to distinguish from the remainder of the cutblock after the area is logged. If designated prior to cutting, they can be isolated by guards or roads integrated into the logging plan. Of course, the common sense perimeter measures recommended for mistletoe areas should be observed.

The key to achieving a fuel complex that favours fire use is to be aware of the requirement prior to selling the timber. At this time, the contract can be written to ensure that limbing either by hand or by mechanical means is done prior to forwarding. After about four weeks, the red foliaged lodgepole pine slash provides a fuel complex that will provide excellent fire coverage with minimum drying. This allows a land manager in virtually any climatic regime to achieve good sanitation with a minimum of ignition effort. A wide latitude of burning conditions are also avail-

able, dependent on the need for seedbed exposure requirements and fire control. Summer night burns, when adjacent timber stands will not carry fire, involve a minimum of ignition effort and low control costs. Treatment costs of less than $10 per acre should be expected. Fuel complexes that favour fire use can be created with lower costs because only useable material is forwarded. Savings in energy, landing expansion and cleaning and finally the need to burn landing piles is eliminated. Fire guard construction must be specified in the contract and completed while machines are still on the operation. Perimeter guards, one cat blade wide are sufficient for control. If care is exercised to ensure vehicular access, savings in perimeter mop up and patrol, using porta tankers will be possible. One pass, drivable construction is possible with a D7 or larger dozer at a rate of about 1 km (.6 miles) per hour; this equates to a cost of about $50/km ($80/mile). Mop up efforts will be minimized if waste from guard construction is pushed to the outside of the area and kept as low as possible. A clean inner perimeter will virtually eliminate hang fires at these critical locations.

Although excellent mistletoe sanitation can be achieved on currently logged areas by these simple techniques, there is a strong possibility that the seed in slash-borne cones will be destroyed and planting will be required. We know that fast spreading, short residence time fires can leave surviving seed both in slash and on advanced regeneration. Of question is whether it is operationally feasible. That is, is there sufficient latitude in fire behaviour between complete seed mortality and adequate stocking and good fire coverage to be operationally feasible. In the case of winter logging, where mineral seedbed is lacking, the longer fire residence period required to provide mineral soil suggests that all slash-borne seed will be destroyed.

There are, however, other alternatives for stand establishment; a seed tree cut followed by burning, or seeding of clear cut broadcast burned areas will be less costly than planting.

In any event, even with a token mistletoe control policy, the low cost of fire sanitation on future harvest areas must receive highest priority and should be conducted as routine procedure.

Marginal stands: stands that are not in demand and inducements to harvest are necessary.

The main difference between these stands and the merchantable stands is that extra cost either in stumpage allowance or direct subsidies may be required to induce harvest. Marginality may be due to low volume, small diameter, or decadence. These stands should receive second priority for treatment except if they occur on a particularly good growing site. If this is the case, then sanitation and rehabilitation should be initiated as soon as practical. If the growing site is favourable, then logging should be induced with subsidies if necessary and the fuel management practice suggested for the merchantable stands followed. Presumably the better growing sites are better able to show economic returns on the higher reforestation cost but greater success expected from planting.

If these marginally commercial stands are on poor to medium sites, then a least-cost treatment that accomplishes both sanitation and reforestation should be attempted.

Fire can be applied to accomplish both objectives in a variety of methods subject to constraints on condition and intended use of the harvested wood. If the stand is basically sound and processing includes chipping, then fire scorched wood must be minimized. In this instance, a seed tree cut leaving 20 to 30 trees per hectare will serve as the seed source. The fuel management practice of limbing on the area will provide fuel for good fire coverage to sanitize and adequate heat to liberate seed from the serotinous cones. This fire prescription must call for exposure of about 60% mineral soil and be of sufficient intensity to kill the seed trees. If mortality of seed trees is not achieved, they must be felled within three years.

If decadence is prevalent and long butting is required or if processing does not include chipping of mill waste, then underburning the stand using a controlled intensity surface fire will provide sanitation, seedbed and seed. Regulation of fire intensity is achieved by strip head fires and varying and distance between subsequent strips. The fire intensity required is dependent on the quantity of seed necessary to provide the desired stocking and the position of the cone crop relative to the flame zone. If the distance between the flame zone and the cones is large, little seed will be liberated; if the distance is small, a near maximum amount of seed will be liberated. Further stocking control can be exercised during the logging operations. If judged to be understocked, then tops can be left on the area; if satisfactorily stocked by the fire, then tops should be removed to reduce additional liberation of seed from slash-borne cones. Fire prescriptions for this procedure

must ensure that about 60% of the area has exposed mineral soil if winter logging follows the burn. If the area is to be logged in the summer, then the exposure of mineral soil by machinery precludes the need for mineral soil exposure by fire. In this case, the prescription merely requires spread indices that will ensure good coverage and adequate intensities to affect the cone zone.

Non-merchantable stands: Stands that are definitely not merchantable now, nor in the future.

Treatment of these stands would be included in the most intense level control program. Not only does treatment of these areas incur full direct costs of control to the agency, they also involve the area of most uncertainty. Who can say for certain that a stand will not be merchantable or at least marginally merchantable in ten years' time? In some cases of extreme decadence or extremely heavily infected young stands, there may not be much doubt, but there will be instances of both types of stands that will be in a gray area. However, I started out by saying I wasn't going to deal with the "treat - don't treat" question. I repeat, we are in the treatment selection phase. It is assumed that the full cost of treating these areas will have to be borne by the land management agency without any immediate return. With this in view, not only should the worst stands be treated first to give as much leeway for error in future merchantability estimates but, also, the best growing site should receive priority. Treatment of these areas need not consider damage to material; however, it is important that the one shot effort achieve dual objectives of sanitation and restocking to desired levels. To achieve these objectives in both decadent and immature stands, the controlled intensity surface fire mentioned for marginal stands is used. Prescriptions must provide for sufficient fire residence time to provide either a very thin residual of organic material or exposed mineral soil to ensure a receptive seedbed. Most importantly, however, the prescription must achieve a high kill rate even at the risk of overstocking. Strip head fires serve as the seed release mechanism; but, in cases of young stands, flame length might have to be restricted to only two or three metres. The post burn microclimate of areas treated in this manner will be considerably less severe than that of logged areas. Shade will be provided by the remaining snags and, in addition, to immediate nutrient release from the fire, the needle cast will provide further nutrient and protection to the freshly fallen seed.

This treatment attempts to duplicate the effects of wildfires with two important exceptions. The modified intensity provides stocking control, and follow-up by hand felling crews removes the surviving trees to eliminate the source of infection to the new stand.

The cost of rehabilitation of these stands is relatively low if all objectives are satisfied and if 50 to 70 hectare blocks are treated. Cost of treatment will be most sensitive to the amount of hand felling required to remove residuals.

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