Southern
Interior
Forest Region

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Forest Management Options for Interior Dry Forest Ecosystems: The Opax Mt. and Isobel Research Trials

1 INTRODUCTION

Interior Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) forests have had a long history of use, beginning with First Nations peoples and followed by European settlers in the mid-nineteenth century. These forests are found at lower elevations primarily in the Interior Douglas-Fir (IDF) biogeoclimatic zone, are relatively warm and dry and prone to droughty conditions in late summer (Lloyd et al. 1990; Meidinger and Pojar 1991). The first concerted effort to manage Douglas-fir–dominated forests for sustained timber yields began in the 1960's, and a wide diversity of harvesting and regeneration practices have been applied since then (Vyse et al. 1991). Forests dominated by Douglas-fir will likely experience a marked increase in harvesting in the near future as timber from stands attacked by the mountain pine beetle (*Dendroctonus ponderosae*) diminishes in quality and quantity. Most low elevation dry belt Douglas-fir forests have been partially harvested numerous times during the last century, but future entries will likely be conducted under heightened social expectations to maintain many values within stands and forests. To ensure timber, range, recreation, aesthetic, habitat for biodiversity, and other values are maintained, it is important that stand and landscape management prescriptions use the most current technical information.

The harvesting and stand regeneration treatments that have been implemented at the Opax Mountain (Mt.) and Isobel research sites, in combination with other installations in the Southern Interior, provide valuable

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information that can be used by forest managers to achieve stand and landscape objectives. We describe the objectives and treatments for the Opax Mt. and Isobel research sites to illustrate information that is currently, or will soon be, available to support operational decisions. Their proximity to Kamloops (20 km) makes these sites valuable demonstration areas.

2 THE OPAX MT. PROJECT

The Opax Mt. project was initiated in 1992 to evaluate the consequences of harvest intensity (from 14 to 62% of stand volume) and pattern (uniform individual tree selection to patch cuts ranging in size from 0.1 to 1.6 ha; Fig. 1) on dry Douglas-fir forests.

Studies include retrospective analyses to quantify historic natural disturbances, the evaluation of diverse ecosystem responses to experimental harvesting and site preparation treatments, and stand modelling to anticipate the likely long-term consequences of treatments. Experimental treatments represent different levels and patterns of harvesting, prescribed burning, mechanical site preparation, manipulating the abundance of coarse woody debris, tree planting, and tree seed additions (Fig. 2).

Livestock have been excluded since the beginning of the study, initially with riders, and more recently with a wire fence. Various topics are being investigated including tree regeneration, growth and yield, forest dynamics, biodiversity, soil productivity, microclimate, and natural disturbance ecology (Fig. 3). Our extension strategy includes peer-reviewed publications, public presentations, school visits, field tours, extension notes, and an interpretive trail with brochures in English and Shuswap. Over 1000 people from all over the world have visited the site.

Preliminary results for several studies were published in 1998 in workshop proceedings entitled “Managing the dry Douglas-fir forests of the Southern Interior” (Vyse et al. 1998), and a synthesis of the first five years of measurements was recently published (Huggard et al. 2005).

Key messages from these analyses are summarized below.

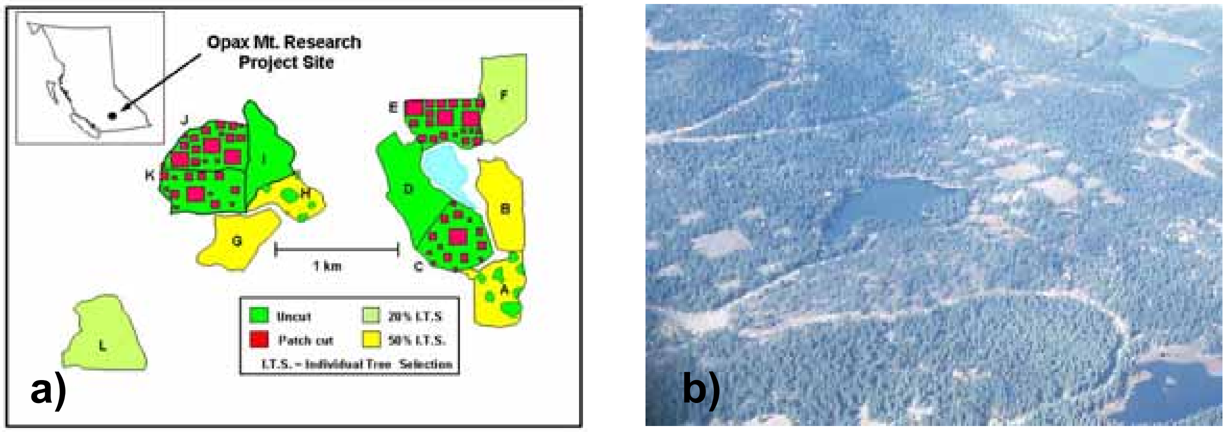

FIGURE 1 a) Location of the Opax Mountain Research Project and treatments applied at the site. Harvesting treatments include: 20% volume removal using uniform individual-tree selection (units F, L); 35% volume removal, where 75% of the treatment unit area has 50% volume removal using uniform individual-tree selection and 25% of the treatment unit area is retained as uncut reserves (units A, H); 50% volume removal using uniform individual-tree selection (units B, G); patch-cuts of 0.1, 0.4, and 1.6 ha over 20% of the treatment unit area (units C, K); patch cuts of 0.1, 0.4, and 1.6 ha over 50% of the treatment unit area (units E, J); and uncut controls (units D, I). b) Aerial view of the lower elevation set of treatments.

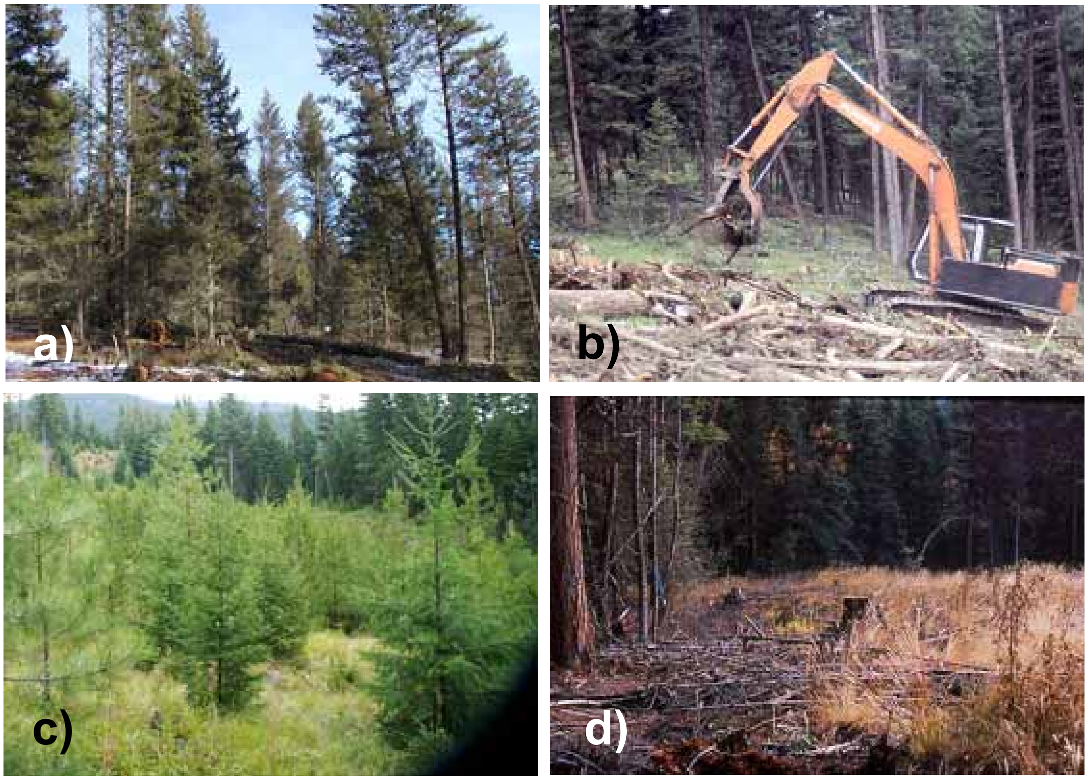

FIGURE 2 Examples of some of the experimental treatments at the Opax Mt. site. a) Uniform partial cut harvesting, b) manipulating downed wood abundance in a patch cut, c) a ten-year-old conifer plantation, d) 0.6 ha patch cut opening two years after harvest.

FIGURE 3 Some of the studies being conducted at the Opax Mt. site. a) Conifer advanced regeneration, b) small mammal population dynamics, c) understorey flora, d) soil moisture in harvested gaps.

1. No single management option works for all values

- Initial forest conditions are highly variable.
- Uniform, moderate intensity partial cutting, and the "inverse-J" tree size distribution it creates, does not meet all stand management objectives.

2. There is a wide range of natural disturbance types that vary in occurrence frequency and stand structure impacts

- Historical conditions were highly variable in space and time; hence, it is unlikely that such conditions can be "mimicked" using any single treatment.
- A diverse and coordinated mosaic of treatments is most likely to succeed in maintaining multiple values in dry forest ecosystems.

3. Different responses between openings of <0.1 ha and >0.1 ha

- Diverse indicators show different responses in small and larger openings, suggesting some values benefit from larger openings.
- Patch cuts >0.1 ha represent a useful, and likely under-utilized, management tool for IDF forests.

4. Operational trials provide a learning opportunity

- Encompass more diverse conditions than encountered at any one site.
- Allow comparisons of treatments applied in different years.
- Information must be synthesized and distributed to realize full benefits.

3 THE ISOBEL PROJECT

The main objective of the Isobel project is to develop and apply prescriptions to maintain prolonged open canopy conditions in dry Douglas-fir (e.g., IDFxh) forests in a cost-effective manner, while maintaining a balance of timber, forage and ecological values. We are simultaneously evaluating management options including low retention harvesting, mechanical and prescribed fire site preparation, conifer planting, and livestock management (exclosures) for their efficacy in creating and maintaining the desired open canopy conditions.

Harvest treatments were applied in 2002–2003, livestock exclosures were erected in March 2004, and the final prescribed fire and conifer planting activities were completed in May 2006. Three levels of harvesting intensity were assigned and implemented January to March 2003: 0% (control), 50–60% and 75–80% merchantable volume removal, with four replicates of each harvest treatment dispersed across the study area. Average harvest block size is 20 ha, and the overall area for the research site is approximately 250 ha (Fig. 4). Pre-harvest timber cruise volumes ranged from 175–250 m^3/ha. The harvest was designed to remove stems across the merchantable diameter distribution, and to slash and leave stems less than 10 cm dbh in a 3-m radius around harvested trees (Fig. 5). Heterogeneity in tree diameters and harvesting logistics combined to create gaps in the harvested areas ranging from 10 m^2 following single tree removal to openings approaching 0.2 ha or larger, where groups of trees were harvested in the low retention treatment units.

Site preparation, conifer planting, and livestock management treatments have been established in a 2.5-ha area within each of the 12 harvest blocks (split-plot experimental design, Fig. 4). These smaller ground-level site disturbance treatments (Fig. 6), embedded within the different levels of overstorey removal, will help clarify the role of different management options in creating and maintaining desired vegetation conditions in dry Douglas-fir forest ecosystems. Clearly defined experimental treatments and extensive post-treatment monitoring are being used to evaluate the treatment effects on diverse indicators of timber, forage, fuels, and ecological conditions.

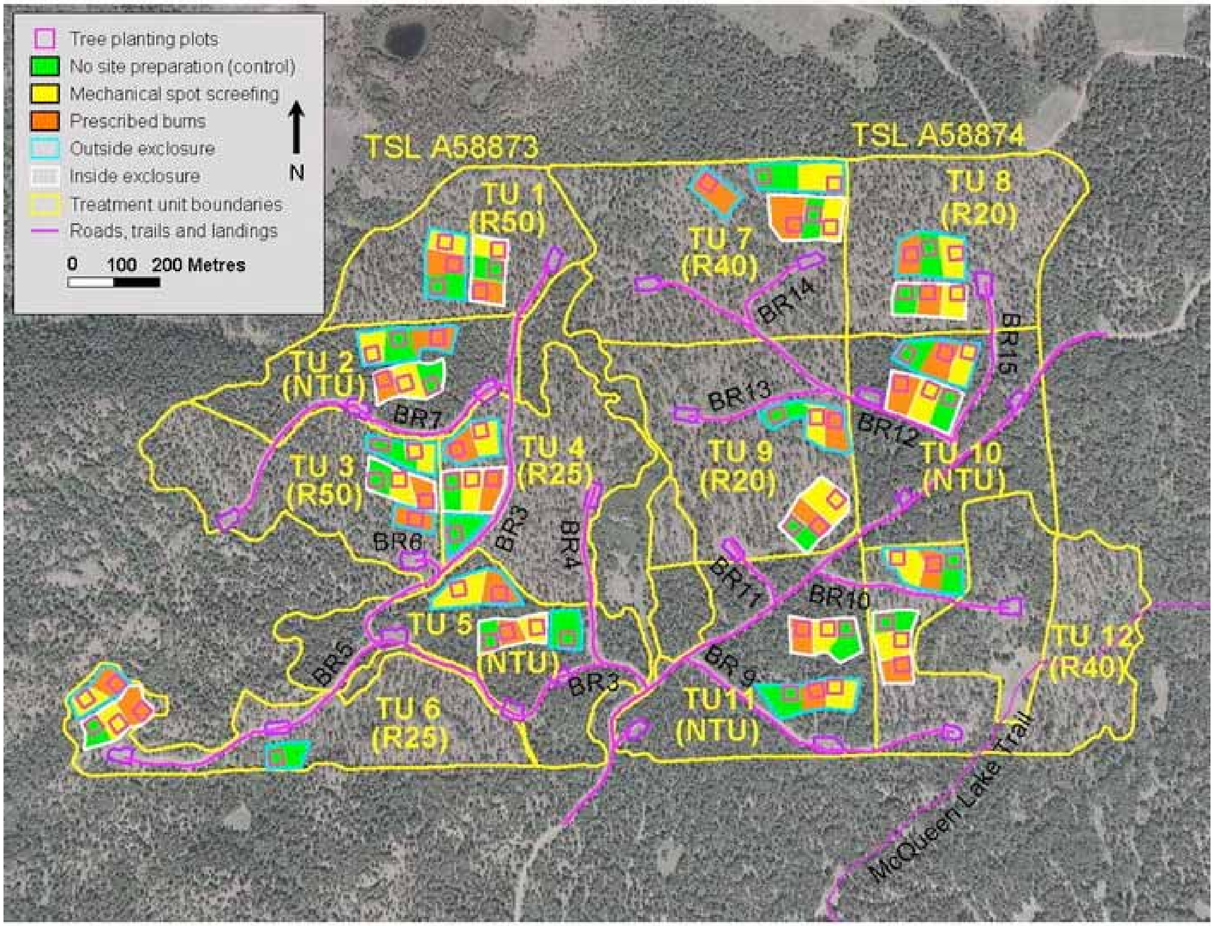

FIGURE 4 An overview of the Isobel site following harvesting in the winter of 2002–03. Harvesting intensity ranged from 100% retention (Treatment Units [TUs] 2, 5, 10, 11) to 20% of initial basal area (TUs 8, 9). NTU indicates Non-Treatment Unit with no overstorey harvesting, R20 indicates 20% of initial basal area retained, R25 indicates 25% of initial basal area retained, etc. Within each TU, one set of site preparation treatments was applied in an area exposed to livestock grazing, and one set within a fenced exclosure. Within each of the 72 site preparation treatment areas, growth and survival of planted conifers are being evaluated in 0.1 ha plots.

Five IDF management issues are being evaluated in relation to the site treatments at the Isobel site: 1) conifer regeneration; 2) grass, forb, and shrub species composition and dominance; 3) understorey productivity; 4) forest fuels; and 5) timber growth (Fig. 7). Responses to the harvesting treatments are being monitored at 170 0.03 ha permanent sample plots systematically distributed across the site. Thirty 1 m^2 vegetation plots have been established to monitor vegetation and tree regeneration responses to the site preparation treatments (no site preparation, mechanical spot screefing, prescribed fire) and livestock management (inside and outside exclosure) embedded within each of the 12 harvest, for a total of 2160 monitoring plots across the 72 treatment areas. Over 43,000 Douglas-fir, ponderosa pine, and lodgepole pine seedlings have been planted and will be monitored for five years to assess early survival and growth in relation to

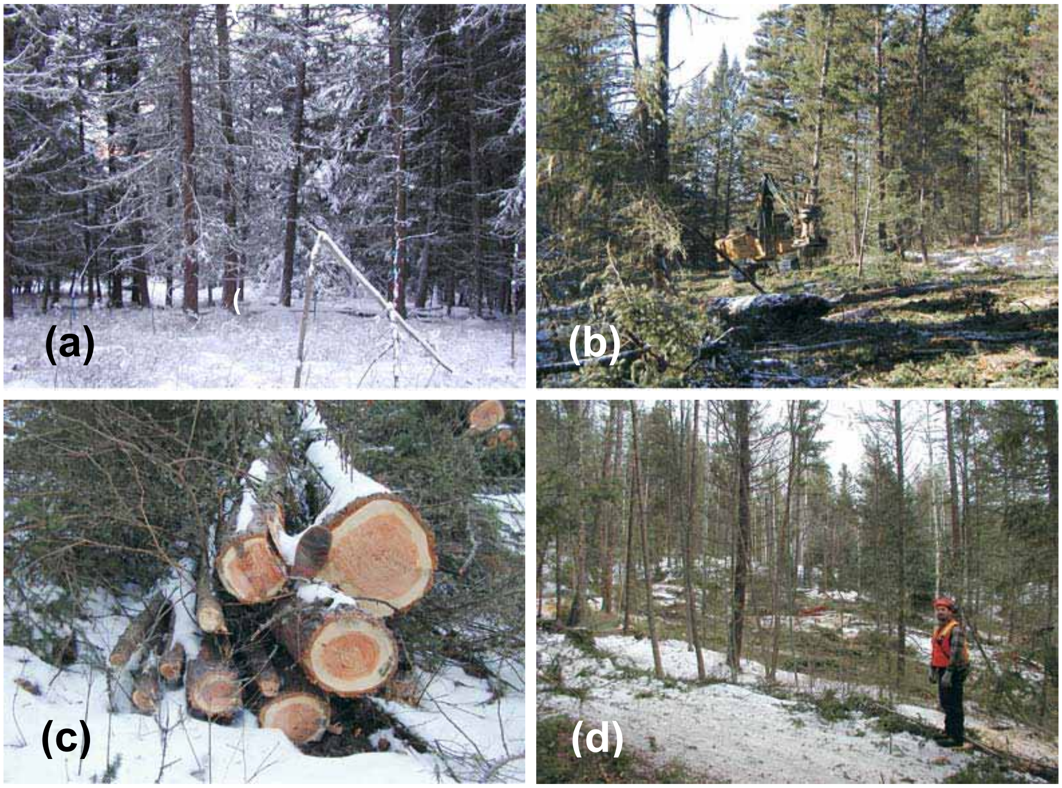

FIGURE 5 Harvesting treatments at the Isobel site. a) Pre-treatment conditions, b) uniform partial cutting in TU12, c) diameter profile of harvested stems, d) post-harvest conditions in TU12.

FIGURE 6 Site preparation, livestock management, and conifer planting treatments at the Isobel site. a) Prescribed fire, b) mechanical spot screefing, c) effect of livestock management on understorey vegetation, d) planted Douglas-fir, lodgepole pine, and ponderosa pine seedlings following prescribed fire.

understorey light conditions and browsing by deer (*Odocoileus hemionus*) and small mammals. A transplant experiment using approximately 1500 rough fescue (*Festuca campestris*) plugs from a nearby donor site will aid in evaluating its establishment and growth with respect to understorey light conditions, livestock grazing, and interspecific competition (competing vegetation manipulated using mechanical spot screefing, prescribed fire and herbicide).

Stand structure modelling using TASS (Tree and Stand Simulator) was used to develop harvesting prescriptions that had a high likelihood of creating the desired open canopy conditions, and to project the likely development of the stand (Fig. 8). Stand modelling applications such as TASS have potential as decision support tools to assist in the development of management systems to achieve various desired conditions, and to project the likely long-term stand structure consequences of treatments such as those applied at Opax Mt., the Isobel site, and other trials that have been implemented in dry Douglas-fir stands in the Southern Interior.

Results from the post-harvest monitoring work at the Isobel site are very preliminary, but suggest the following:

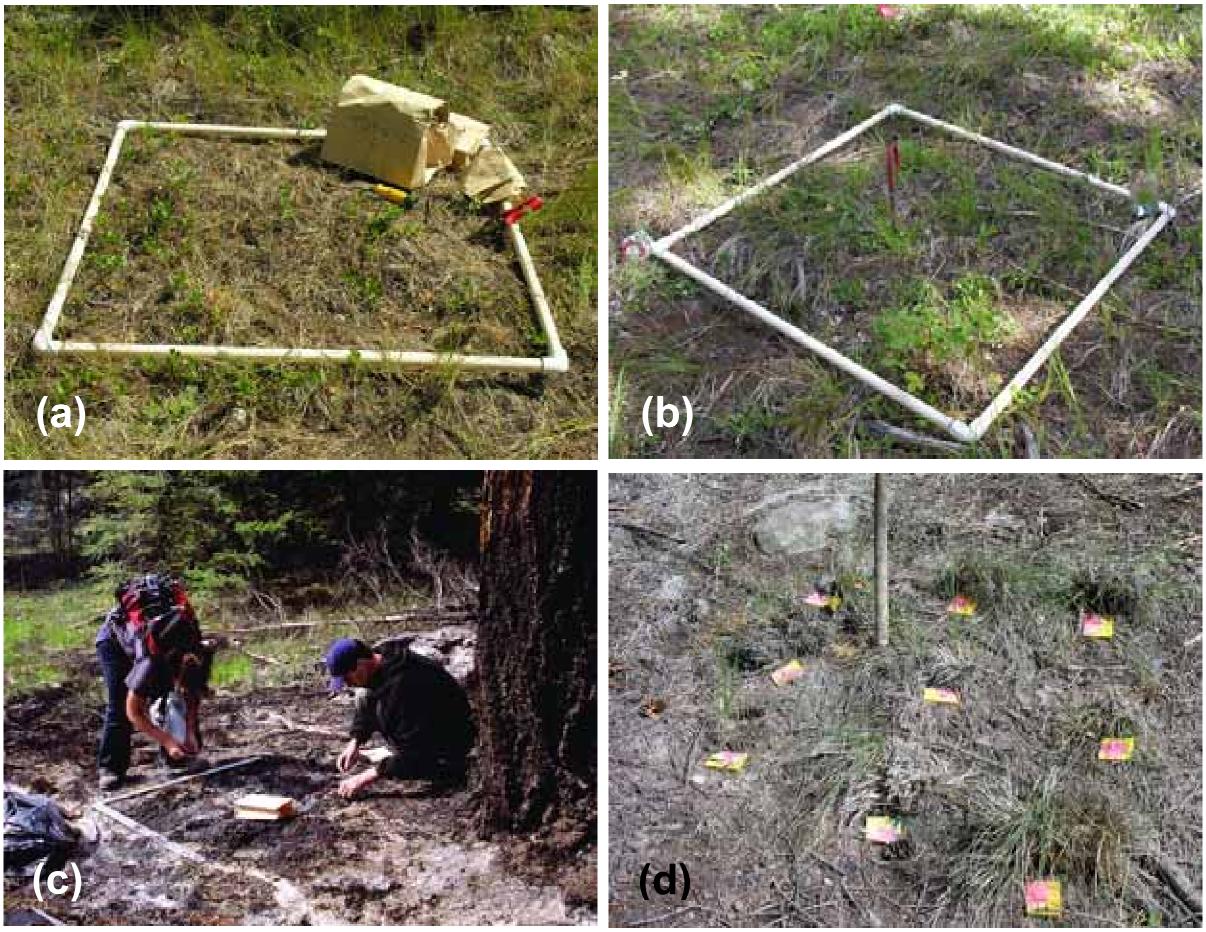

FIGURE 7 Some of the monitoring activities at the Isobel site. a) Understorey productivity relative to understorey light conditions, b) grass, forb, and shrub species composition, c) pre- and post-treatment forest fuels, d) survival and growth of rough fescue with respect to site preparation and understorey light conditions.

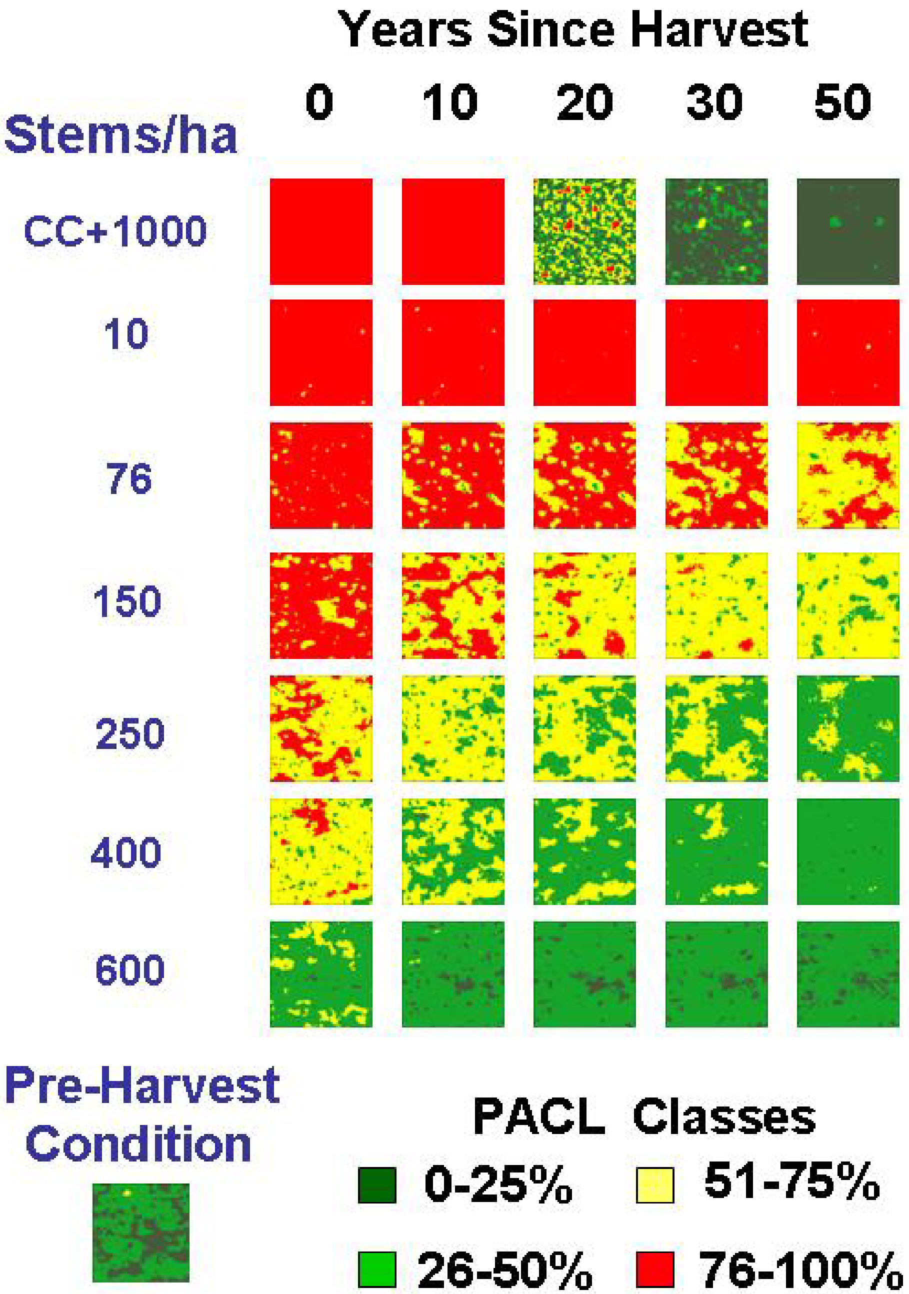

FIGURE 8 TASS model run projections of the likely effect of stand density on understorey light conditions. Red indicates very open, high understorey light conditions; dark green indicates shady conditions. Stems/ha (range: 10–600) indicates the number of residual stems per hectare following partial cutting; cc+1000 indicates clearcutting followed by planting 1000 seedlings/ha. Changing understorey light conditions are a function of tree growth, crown expansion of residual stems, and regeneration. Percent above canopy light (PACL) conditions range from 0 (total darkness) to 100 (e.g., 1 m above the tallest tree in the stand) and reflect an array of sensors spaced at 1 m intervals 0.5 m above ground in the 125 × 125 m stand (15,625 locations). The pre-harvest ground-level light condition is indicated in the lower left of the figure. Red, or a mix of red and yellow, represents the conditions most likely to maintain a highly productive understorey and may promote the establishment of a bunchgrass-dominated community.

1. Conifer regeneration

- The growth and survival rates of planted seedlings were greatest in areas with high ground-level light conditions where more than 60% of the merchantable timber was removed, and where livestock were excluded.
- There has been little natural regeneration in the two years following harvest.
- Feeding damage by deer and voles affected planted conifers in all harvesting treatments, but recovery from browsing appeared to be greatest where little residual canopy remained.

2. Understorey species composition

- Species generally fell into three main groups following harvest: increasers such as pinegrass (*Calamagrostis rubescens*); decreasers such as rattlesnake plantain (*Goodyera oblongifolia*); and species such as common snowberry (*Symphoricarpos albus*) whose response appears to be more closely associated with site factors such as soil moisture than understorey light.
- Approximately 80% of the transplanted rough fescue plugs survived from 2005–06, with growth in 2005 and 2006 greatest on sites that had protection from livestock grazing, were in high understorey light conditions, and where prescribed fire was applied prior to the transplant.

3. Understorey productivity

- Annual understorey productivity was the greatest in treatments with the lowest post-harvest basal area.

4. Fuels

- Prescribed fire removed between 30 and 60% of the downed wood, and from 25–60% of the total fuels in the treated areas.
- Low and moderate severity prescribed fire stimulated the growth of grasses and forbs, and created conditions where up to 50% of the stems that survived the fire were attacked by Douglas-fir bark beetle (*Dendroctonus pseudotsugae*) in some treatment areas.

4 REFERENCES

Huggard, D.J., A. Arsenault, A.Vyse, and W. Klenner. 2005. The Opax Mountain silvicultural systems project: preliminary results for managing complex, dry Interior Douglas-fir forest. B.C. Min. For., Victoria, B.C. Extension Note No. 72.

Lloyd, D., K. Angove, G. Hope, and C. Thompson. 1990. A guide to the site identification and interpretation for the Kamloops Forest Region. B.C. Min. For., Victoria, B.C. Land Manage. Handb. No. 23.

Meidinger, D. and J. Pojar (editors). 1991. Ecosystems of British Columbia. B.C. Min. For., Victoria, B.C. Special Rep. Ser. No. 6.

Vyse, A., R.A. Smith, and B.G. Bondar. 1991. Management of Interior Douglas-fir stands in British Columbia: past, present and future. *In* Symposium proceedings. Interior Douglas-fir: the species and its management. D.M. Baumgartner (editor). Washington State Univ., Dept. Natural Resource Sciences, Pullman, Wash. pp. 177–185.

Vyse, A., C. Hollstedt, and D. Huggard (editors). 1998. Managing the dry Douglas-fir forests of the Southern Interior: workshop proceedings. April 29–30, 1997. Kamloops, B.C. B.C. Min. For., Res. Br., Victoria, B.C. Work Pap. 34/1998.

5 ACKNOWLEDGMENTS

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<http://www.for.gov.bc.ca/hfd/Pubs/RSI/FSP/EN/RSI_EN05.htm>.
