

ASSESSING TIMBER HARVESTING IMPACTS TO RECREATION IN AREAS ADJACENT TO PARKS & PROTECTED AREAS: AN EXAMPLE FROM BRITISH COLUMBIA

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SUMMARY

A better understanding of the relationships between outdoor recreation and resource uses immediately outside parks may help to mitigate management concerns about increased outdoor recreation use inside parks. An example from a pilot study demonstrates how Recreation Impact Analysis (RIA) assessed the spatial and temporal impacts of timber harvesting on outdoor recreation opportunities outside Kokanee Glacier Provincial Park in the West Kootenays of British Columbia. Alternative forest management scenarios were examined to explore the temporal effects of spatial resource zoning and timber harvesting outside the park on outdoor recreation activities and opportunities. The maintenance of a diversity of outdoor recreation opportunities across multiple jurisdictions, especially in areas adjacent to parks, could serve to alleviate some of the visitor pressure that BC Parks faces, and may ease external development pressure on parks and protected areas.

1. INTRODUCTION

Two factors that influence the ecological integrity and recreation quality of parks and protected areas are increased human use and commercial resource activities in adjacent areas. Management of outdoor recreation in British Columbia (BC) is undergoing changes that may exacerbate these factors. The BC Ministry of Forests (BCMof) is withdrawing from the management of forest recreation sites (1), which had 51 million user days in 1993 (2). A possible consequence of this is an increase in park use, as people seek outdoor recreation opportunities that are supported by maintained facilities and services. This potential increase in visitor use may strain park resources already stretched to their limits; in 2000, there were 23.5 million park visitors (3). A better understanding of the spatial and temporal relationships between outdoor recreation and commercial resource use adjacent to parks may help to mitigate management concerns about increased outdoor recreation use inside parks by ensuring that a variety of outdoor recreation activities and opportunities are available on Crown land outside of parks.

In order to explore ways of assessing the relationships between outdoor recreation and timber harvesting, a pilot study was initiated to develop and apply a systematic and quantifiable method of incorporating outdoor recreation values into forest management modelling, using existing outdoor recreation databases. The method, Recreation Impact Analysis (RIA), also interprets the validity and implications of predicted outcomes and study results. RIA uses a series of Geographic Information System (GIS) overlays to identify the impacts of timber harvesting on mapped recreation resources across time. The remainder of the paper sets out the context of the pilot study, describes the methods followed, and discusses the results in terms of local implications and implications for practice and future research.

2. STUDY CONTEXT

The Lemon Landscape Unit (LU) was the focus of the Arrow Innovative Forestry Practices Agreement (IFPA), an interdisciplinary project that examined alternative forest management practices in the Arrow Forest District in BC.

2.1 Study Area

The Lemon LU is a 40,970.51 ha administrative unit located in the West Kootenays of southeastern BC and is representative of many of the ecological, social, and economic values and issues that local forest managers must address. The Lemon LU is bordered on the east by Kokanee Glacier Provincial Park

(6,140 ha of the park overlaps the landscape unit) and on the west by Slocan Lake and Valley. In addition to the outdoor recreation activities that are provided by the park and the lake, the landscape unit supports a variety of outdoor recreation activities that include ski touring (backcountry & cross-country), snowmobiling, camping, hiking, and gathering and collecting. The Slocan Valley contains a diverse population, and has been the focus of contention for many years regarding resource use and wilderness values.

2.2 Available Outdoor Recreation Data

Two province-wide resource inventories that are administered by the BCMoF were used as data sources for assessing outdoor recreation activity and opportunity occurrence in the study area: the Recreation Features Inventory (RFI) and the Recreation Opportunity Spectrum (ROS). The RFI is a descriptive tool that catalogues biophysical, cultural and historic landscape features and assesses their recreational value within a local context. The RFI describes recreation features that are present in a landscape and divides that landscape into discrete sub-components, called Recreation Feature Polygons (RFPs), based on biophysical features that have recreational value. The recreation activities that are identified in the RFI are based on their existing or potential occurrence in the RFP. Recreation activities that may not currently take place in a RFP but lend themselves to biophysical or human-developed features are included in the inventory - this permits resource managers to consider future recreation uses of an area. Up to eight activities may be described in the database but only the three most significant are mapped (4). The RFI used in this study was completed in 1994 (5).

The ROS was initially developed as a framework to assist outdoor recreation managers and policy makers address the allotment and management of outdoor recreation opportunities (6). In BC, the ROS identifies seven opportunity settings (or classes) along a continuum. The classes are: Primitive, Semi-Primitive Non-Motorized, Semi-Primitive Motorized, Roaded- Natural, Roaded-Modified, Rural and Urban. The factors that distinguish one ROS class from another are remoteness (accessibility), naturalness, and social experience. Remoteness is typically measured in terms of access and the size of the areas being considered (i.e., larger tracts of undisturbed forestland that are further away from roads are required for more primitive settings). For example, a primitive outdoor recreation opportunity would be found in an area of at least 5,000 ha that was more than 8 km from the nearest road, and would provide social experiences characterized by few interactions with other people and high opportunities for solitude (7). The ROS inventory used in this study was completed in 1994 (8).

2.3 Forest Management Scenarios

Initially two hypothetical forest management scenarios for the Lemon LU were developed to evaluate different approaches to forest management. The outcomes of these scenarios were assessed and used to inform the development of a third scenario that incorporated a range of ecological and social considerations into the management objectives.

The first scenario represented the status quo for forest management in the BC in 2000, and was based on rules from then-existing forest management practices, the BC Forest Practices Code (FPC). Outdoor recreation was not an operational consideration in this scenario. A second scenario was based on a zoning approach that concentrated timber harvesting on more productive forest areas and reserved higher elevation and backcountry areas for wildlife and other values, including recreation. This scenario did not conform to FPC regulations. As with the FPC Scenario, planning for specific outdoor recreation activities or opportunities was not explicitly incorporated in the Zoning Scenario design.

The impacts of timber harvesting under the FPC and Zoning scenarios on outdoor recreation activities and opportunities were assessed and mitigation strategies were considered for incorporation into the third scenario. The third scenario, the Tactical Plan, was developed with an emphasis on the management of non-timber values, including outdoor recreation; these values received higher consideration in the design than timber-related economic benefits. Under the Tactical Plan, a Semi-Primitive Non-motorized ROS setting reserve was established, and specific timber harvesting

prescriptions were identified for two outdoor recreation activity areas. These objectives were informed by assessments of the FPC and Zoning scenarios. The Tactical Plan was used to explore the enhancement of backcountry ski and snowmobile areas through the application of partial retention harvesting: 40% retention (partial cutting) was applied to the backcountry ski area to create ski trails from alpine areas to valley bottoms; and 20% retention was applied to the backcountry snowmobile area to create trails that would permit for alpine access from valley bottoms. Though not a focus of this study, the Tactical Plan also incorporated backcountry visual quality objectives that minimized the visual impacts of timber harvesting for backcountry recreation activities and view corridors in Kokanee Glacier Provincial Park.

The application of partial cutting may enhance the outdoor recreation activities by providing opportunities that did not exist before. The clearing of trees may improve access while retention of trees can contribute to a quality experience and user safety, as the trees act as anchor points for snow which can reduce avalanche risk; the remaining tree stands may also provide refuge areas should an avalanche occur. The design of partial cutting can vary: vertical valley to alpine group strip retention (much like creating traditional ski runs); ‘clumpy’ stand retention with vertical paths from valley-to-alpine (clear routes are discernible, but choice of route is available); or cross-slope trails and openings, and stand thinning retention (routes are present, but route-finding skills are required). However, site-specific harvest design was not explored in this landscape-level study. Some delay of forest regeneration techniques may be necessary to accommodate both outdoor recreation and successful silviculture practices.

Under the ROS, the Semi-Primitive Non-Motorized class (SPNM) is associated with wilderness outdoor recreation experiences in largely undeveloped areas. A SPNM Reserve, characterized by valley floor forest types, was set aside in the Tactical Plan to enhance the ecosystem diversity available for semi-primitive outdoor recreation opportunities. The Reserve area, 401.75 ha, also served to increase the connectivity between existing SPNM settings. The SPNM Reserve is an area that had recently been harvested; it is expected that the full benefits of this area will not be realized until after a full cycle of tree growth, which in the Arrow Forest District is approximately 105 years.

2.4 Timber Modeling Methods

Harvest scheduling information was derived from FPS-ATLAS, “a spatial, forest-level planning model... [that is] a time-step, rule-based simulation model designed to schedule [timber] harvest units according to a wide range of spatial and temporal constraints” (9). This model provided harvest polygons and harvest scheduling out to two forest rotations. The harvest scheduling is based on growth and yield modeling and ecological productivity predictions from FORECAST, a stand-level forest growth model (10).

3. RECREATION IMPACT ASSESSMENT

RIA is based on a series of overlays of significant outdoor recreation activity and opportunity polygons with the spatial extent of timber harvesting activities scheduled over time by FPS-ATLAS. ArcView 3.2a, a commercially available GIS (11), was used for all spatial calculations in this analysis. Activities that took place within the boundaries of Kokanee Glacier Provincial Park are not considered in this analysis. As a result, the area of the park that overlapped the boundaries of the Lemon LU was subtracted from the overall area of the LU for a working area of 34,830.51 ha. The activities that were considered in this study included ski touring, snowmobiling, camping and picnicking, hiking and gathering.

3.1 Timber Harvesting Impacts on Outdoor Recreation Activities

The attribute data of the RFPs were used to establish baseline area calculations for individual recreation activities. The three most significant recreation activities were isolated from each RFP so that the resultant polygons represented the spatial extent of recreation activity occurrence on the landscape for each significance level (e.g., Snowmobiling1, Snowmobiling2, Snowmobiling3). These polygons were then merged by activity to create a new generalized polygon that identified the spatial extent of the activities; the total area of activity occurrence was calculated. The occurrence of the recreation activity polygons was calculated as a proportion of the Lemon LU less the area of Kokanee Glacier Provincial Park. These area calculations only take into account that part of the forest landbase on which the outdoor

recreation activity has been identified as significant. Viewsheds, or buffers outside the outdoor recreation polygons, were not considered in the pilot.

The harvest polygons from the FPS-ATLAS model and RFPs were manipulated in ArcView 3.2a. Private land was excluded from this analysis, as commercial timber harvesting did not directly impact it. FPS-ATLAS provided harvest schedule information for six harvest entries: Year 0 (the initial harvest entry), Years 5, 25, 55, 105, and 215.

The stage at which reforestation efforts are typically visually acceptable to visitors, called visually effective green-up, in the Lemon LU was assumed to be 28 years (12). Once visually effective green-up has been achieved, it is reasoned that the effect of timber harvesting on the outdoor recreation experience will be mitigated by visual conditions. Harvest years 0-28 were selected, combined, and isolated for each harvest entry period that was modeled in FPS-ATLAS. Year 0 indicates the harvest year, Year 28 indicates the last year that major aesthetic signs of timber harvest activity would be evident from the harvest entry period being examined.

The timber harvest blocks that were derived from FPS-ATLAS were overlaid on the RFPs to identify the area of recreation activity polygons that were physically impacted by timber harvesting; this represents a best case (minimum impact), as there are no viewshed effects considered. The total timber harvest physical impact on a recreation activity was calculated for each timber harvest period by summing the areas of overlaid polygons. The percent of timber harvest impact for each harvest period was also calculated. The cumulative area and percent of timber harvest impact on recreation activities by management scenario was calculated by summing the area and percent impact for all harvest entry years (i.e., 0, 5, 25, 55, 105, 215) for each forest management scenario. It is recognized that not all recreation activities are equally affected by timber harvesting, and that some activities may be enhanced by certain harvesting activities (e.g., road-building and clearing), as discussed below.

3.2 Timber Harvest Impacts on Recreation Opportunity

The same FPS-ATLAS polygons that were used to calculate the timber harvest impact on recreation activities were used to examine the impact of timber harvesting on recreation opportunity. Although the ROS data was taken from most recent RFI, the inventory is not necessarily current, as it does not account for timber harvesting activity or road construction after 1994. As a result, some existing ROS zones may be overestimated.

A more conservative interpretation of the affected area is taken for timber harvesting effects on ROS designation than was taken for outdoor recreation activities. The ROS is based on remoteness, naturalness, and social experience factors. As the Evidence of Humans element of the SPNM and Semi-Primitive Motorized (SPM) settings is fairly strict (7), this notion was carried over into this analysis. There is still evidence of timber harvest impacts in the first 28 years after timber harvesting, as a regenerating harvested stand is noticeably different from the adjacent natural stands. Therefore, a full rotation period (105 years) was used to determine the effects of the harvesting scenarios on Semi-primitive Non-motorized areas. Only three timber harvest entries were examined: Year 0 (the initial harvest entry period), and Years 105 and 215.

ROS polygons were isolated and baseline area calculations for primitive and semi-primitive areas were identified. The harvest polygons were overlaid and clipped to the outdoor recreation polygons; the resultant clipped polygons represented outdoor recreation areas that were affected by timber harvesting. Area calculations were performed with ArcView 3.2a. Cumulative impacts, by area and percentage, were assessed. The mean, minimum and maximum impacts were calculated for SPM and SPNM opportunities at the three harvest entry periods.

4. RESULTS

4.1 Timber Harvest Impacts by Activities

Of the three management scenarios that were developed for the Lemon LU, it appears that the Tactical Plan had the highest physical impact on most recreation activities (Table 1). The exception to this is skiing, where the Zoning Scenario had the highest physical impact. The Forest Practices Code Scenario had less cumulative impact than the Tactical Plan for all recreation activities but more cumulative impact than the Zoning Scenario for camping and picnicking, hiking, and snowmobiling. However, the Zoning Scenario had more cumulative impact than the Forest Practices Code Scenario for gathering and skiing activities.

Activities	Cumulative Impact (%)		
	Zoning	FPC	Tactical Plan
Camping	29.57%	36.42%	44.39%
Gathering	75.74%	72.06%	84.20%
Hiking	43.92%	44.87%	54.00%
Skiing	45.47%	35.38%	36.40%
Snowmobiling	66.25%	71.10%	89.89%

As noted above, the impacts of modeled timber harvesting impacts on outdoor recreation activities varied by management scenario. Based on the cumulative impacts of modeled timber harvesting, the least affected activity was camping and picnicking in the Zoning Scenario; the most affected activity was snowmobiling in the Tactical Plan. However, this pattern does not hold for the other scenarios or outdoor recreation activities.

4.2 Timber Harvest Impacts by ROS Category

No Primitive or Roaded-Modified ROS settings were identified in the Lemon LU. Three discrete SPNM polygons were identified and accounted for 7.83% of the landscape unit. Three discrete SPM polygons were identified that accounted for 4.01% of the landscape unit (Table 2).

ROS Category	Area (Ha)	% Of Total Area (34,830.51 ha)
SPNM	2727.07	7.83%
SPM	1,397.19	4.01%
Roaded Natural	30,067.40	86.32%
Rural	912.13	2.62%
Unclassified	5,423.46	15.57%
Source: (6)		

While the SPNM and SPM polygons did not appear to meet the BCMoF standard for remoteness and size, their identification as such may be a result of these areas being relatively secluded, as per the override permitted by the BCMoF (7). Neither the SPNM or SPM areas were contiguous; however, Kokanee Glacier Provincial Park provided connectivity for the SPNM polygons.

In terms of timber harvesting impacts on recreation opportunity categories, the Zoning and FPC Scenarios had an appreciably smaller impact on SPM and SPNM recreation opportunities than the Tactical Plan did. The impact of timber harvesting on SPNM recreation opportunities was greater for all

scenarios than for SPM opportunities. However, the impact of timber harvesting under the Zoning and FPC Scenarios was less than that of the Tactical Plan (Table 3).

ROS Category	Cumulative Impact (%)		
	Zoning	FPC	Tactical Plan
SPM	0.50%	0.73%	4.24%
SPNM	2.81%	2.79%	16.84%

4.2.1 Semi-Primitive Motorized Opportunities

Opportunities for Semi-Primitive Motorized recreational experiences were supported on 4.01% of landscape. The cumulative impacts of timber harvesting on SPM opportunities under the Zoning Scenario were 0.50% (7.00 ha). The mean disturbance size under this scenario was 0.87 ha and both the maximum disturbance size (4.14 ha) and the minimum disturbance size (less than 1 ha) occurred in the initial harvest entry. The impacts of the FPC Scenario on SPM opportunities were not much larger, affecting 0.73% (10.20 ha) of the SPM landbase. The mean disturbance size of harvesting under the FPC Scenario was 0.93 ha, with minimum disturbance sizes of less than 1 ha occurring in Years 1 and 105. The maximum disturbance size of 4.14 ha occurred in the initial harvest entry. The Tactical Plan had the largest cumulative impact on SPM opportunities with 4.24% (59.26 ha) of the SPM affected by timber harvesting. The mean size of disturbance in the Tactical Plan was 3.18 ha and the maximum disturbance (25.66 ha) occurred in Year 105; all harvest entries had minimum disturbance sizes of less than 1 ha. Years 105 and 215 demonstrate a relatively large impact of timber harvesting on SPM opportunities by the Tactical Plan (2.15% and 1.62% respectively).

4.2.2 Semi-Primitive Non-Motorized Opportunities

Semi-Primitive Non-Motorized opportunities were supported on 7.83% of landscape under the Zoning and FPC Scenarios, and 3,128.82 ha (8.98%) of landscape under the Tactical Plan; this discrepancy is a result of SPNM reserve areas being set aside in the Tactical Plan. The minimum disturbance size for all scenarios was less than 1 ha for all timber harvest entries.

The cumulative impacts of timber harvesting on SPNM opportunities under the Zoning Scenario was 3.26% (88.81 ha); the mean disturbance size was 3.29 ha and the maximum disturbance size, 26.15 ha, occurred in the initial harvest entry. The FPC Scenario had a cumulative impact of 3.24% (88.32 ha), a mean disturbance size of 3.15 ha, and a maximum disturbance size of 26.15 ha in the initial timber harvest entry. In spite of the larger size of the SPNM landbase in the Tactical Plan, this scenario had the largest cumulative impact on SPNM opportunities, 19.19% (600.31 ha). The mean size of disturbance in the Tactical Plan was 7.23 ha, and the largest impact, 103.07 ha, occurred in Year 215.

The SPNM Reserve was a 401.75 ha polygon located in low-elevation, productive forestland. This site was selected because it represented landscape forms and forest types that were not represented in the other SPNM polygons. While this area is not immediately adjacent to other SPNM polygons, it should be noted that the immediate area surrounding the Reserve is not productive forestland and was not scheduled for harvesting in the Tactical Plan, but does provide connectivity between high-elevation SPNM areas. As a result, the SPNM Reserve area may be considered to be connected to the adjacent SPNM polygons, as well as to Kokanee Glacier Provincial Park.

5. DISCUSSION

It must be noted that stand- and forest-level timber harvesting models, indeed all models, are not exact; they are based on assumptions and can only forecast possible outcomes. Uncertainty in forest models arises as a result of the limitations of modeling natural disturbance events like fire and insect outbreaks,

and changing social, political, and economic conditions. This caution of uncertainty holds for modeling the impacts of timber harvesting on outdoor recreation. However, assessing these impacts is useful as a heuristic tool to examine the spatial and temporal relationships of timber harvesting on the recreation landscape.

No matter what management assumptions were made, there is little doubt that timber harvesting has an impact on outdoor recreation activities -- least affected is camping in the Zoning Scenario. Some of this impact may be beneficial to outdoor recreation opportunities, for example the Tactical Plan's possible impact on skiing and snowmobiling (i.e., larger area without mitigation by retention). It may be a useful exercise to develop a weighting mechanism for physical impacts by sensitivity of activity in the future. However, it ought to be noted that the Zoning Scenario had a larger physical impact on backcountry ski touring than the Tactical Plan did, even though the latter attempted to enhance skiing opportunities in a particular area. The Tactical Plan had the largest impact on outdoor recreation on four of the five activities. This leads to a question: were assumptions made regarding outdoor recreation in the Tactical Plan too narrowly conceived? It was expected that the Tactical Plan would have the greatest impact on skiing and snowmobiling opportunities, but not on camping, gathering, and hiking. This suggests that a more holistic approach is necessary, and that a narrow focus on one or two activities should be avoided. Areas that support a diversity of activities should be identified as significant recreation resources, and be carefully considered in forest management.

As the Lemon LU is a heavily roaded and heavily used landscape unit with no Primitive areas and few Semi-Primitive areas, it might be prudent to maintain current SPM and SPNM opportunity polygons and exclude them, and their buffer areas, from the timber harvest landbase. The SPNM Reserve appears to provide the connectivity that was desired. However, the fact that this reserve area does not come online for 105 years may be of some concern if there is current high demand for SPNM settings in the area.

Aesthetic considerations in timber harvesting have generally been accepted as standard practice in BC (13). If we can accept that harvest blocks can have form (i.e., design), then a logical extension may be function. Certainly the practice of timber harvesting is a function, but can the conception of function be extended beyond immediate timber considerations? For example, can functions like outdoor recreation opportunities be enhanced through the application of design while still maintaining the function of timber harvest and the form of visual design? Outdoor recreation and timber harvesting need not be at loggerheads; indeed, as the pressure of economic and social interests for forested landscapes increases (due to increased population and scarcity of resources) there will be a need for co-operation among these two resource uses. The application of different harvesting techniques in a 'backcountry' ski area in the Lemon LU in the Arrow Forest District attempted to explore this idea and find ways to lessen experience impacts of physical disturbance. Three options for 40% retention patterns are described below.

5.1 Vertical Valley to Alpine Group Strip Retention

The result of this approach would be much like creating traditional linear downhill ski runs suitable for beginner skiers. However, this option may be prone to snow avalanches, as openings would not have snow anchors. Additionally, the resulting ski run may not provide sufficient challenge for skiers and does not lend itself to a 'backcountry feel'. Additionally, aesthetic considerations may preclude the linear result that this option prescribes.

5.2 'Clumpy' Stand Retention with Vertical Routes From Valley to Alpine

This option would create non-linear ski runs that might be suitable for intermediate skier as clear paths would be present, but skiers would have a choice of route. This approach would provide anchors for snow avalanches as stand clumps also break up linear paths, and provide safety areas. There would be some degree of challenge under this approach and some aesthetic considerations addressed, as linear paths are mostly eliminated.

5.3 Stand Thinning Retention

This approach would provide paths, but route-finding skills and an ability to manoeuvre quickly and in controlled manner would be necessary for skiers; this option would be appropriate for advanced skiers. This prescription would provide anchors for snow avalanches and safety areas, but the resulting routes would be narrower and more dispersed. Aesthetic considerations are also addressed, as the ski paths could be linear or non-linear.

The application of the above treatments would need to be evaluated carefully for avalanche hazards, and ecological and operational concerns.

6. CONCLUSIONS

Forest management planning outcomes are different when outdoor recreation is considered. The experience of this pilot study suggests that outdoor recreation values can be incorporated into modeling efforts through the development of management scenarios. It is also possible to interpret the impacts of timber harvesting on outdoor recreation activities and opportunities using resource inventories that are readily available in BC. The consideration of outdoor recreation values does not necessarily clash with utilitarian values. In fact, the availability of merchantable timber may increase, which may give forest managers more choice for harvesting, including social values in sustainability.

The method for assessing the impacts of timber harvesting on outdoor recreation activities and opportunities could be improved by two refinements that have directed continued research efforts. The spatial extent of recreation activities is relatively stable; however, the recreation setting, or opportunity, is sensitive to change. The current method that RIA employs to assess the impacts of timber harvesting to ROS classes is not dynamic and can only assess the impact of timber harvest relative to initial conditions. Recent modifications to FPS-ATLAS permit the identification of activated and deactivated roads; this will permit the addition of dynamic ROS classification and assessment of impacts to recreation opportunity by time period. Secondly, the identification of impact thresholds could inform forest managers when timber harvesting activities threaten outdoor recreation activities and/or opportunities. The development of a weighting mechanism for physical impacts by sensitivity of activity should help to clarify when timber harvesting activities may contribute to outdoor recreation experiences (through increased access, or the development of new opportunities), and when they might detract from desired experiences.

The provision of a range of outdoor recreation activities and opportunities outside of parks and protected areas through improved planning and modelling by landscape managers, especially in areas adjacent to parks, could serve to alleviate some of the visitor pressure that BC Parks faces, and could ease external development pressure on parks and protected areas.

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