Moose Winter Habitat Evaluation and Enhancement Opportunities in the Bridge River System

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BC hydro

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EXECUTIVE SUMMARY

Hydroelectric development on the Bridge River system in the southern interior of British Columbia in the late 1940's resulted in the inundation and destruction of important wildlife habitats, particularly moose winter range and grizzly and black bear spring habitats. As winter habitat availability and quality is generally thought to be a limiting factor to moose populations, the loss of high value winter habitats in the riparian zone of the Bridge River valley following the impoundment has resulted in a significant loss in the moose population potential. Without the creation of replacement habitat and the protection and enhancement of suitable existing wintering areas, the ability of the local moose population to attain historic population potential is impossible.

The three primary issues concerning the protection, maintenance and enhancement of important moose winter habitats are cover, forage and access management. Browse enhancement can be accomplished through modified silvicultural practices and the application of prescribed burning on suitable sites. The maintenance of snow interception cover, particularly in areas where winter snowfalls are significant, is crucial to ensuring that existing and potential habitats are utilized. Access management has become an important moose management strategy, as development extends further into the province's forested lands. Uncontrolled vehicular access onto important moose winter ranges can result in excessive disturbance and hunter harvest, which may ultimately cause abandonment of these key habitats. The maintenance of an optimal balance of cover and forage, with limited disturbance, is crucial to maintaining habitat suitability for moose, and by extension, to maintaining a healthy, stable moose population.

Acknowledgements

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INTRODUCTION

Hydroelectric development on the Bridge River system in the southern interior of British Columbia in the late 1940's resulted in the inundation and destruction of important wildlife habitats, particularly moose winter range and grizzly and black bear spring habitats. During the critical winter months, moose are forced from higher elevations by restrictive snow depths and inadequate forage onto lower elevation swamps, meadows, and valley bottom riparian habitats, where forage is readily available and movements easier. A negative energy balance between forage intake and energy expended on metabolism, thermoregulation and locomotion lead moose to minimize daily movements during winter. Therefore, these important areas are subject to considerable pressure from aggregations of animals throughout the winter months (Renecker and Hudson, 1992; Pierce and Peek, 1984; Thompson and Vukelich, 1981; Gillingham and Klein, 1992). As winter habitat availability and quality is generally thought to be a limiting factor to moose populations, the loss of high value winter habitats in the riparian zone of the Bridge River valley following the impoundment has resulted in a significant loss in the moose population potential. Without the creation of replacement habitat and the protection and enhancement of suitable existing wintering areas, the ability of the local moose populations to attain historic population potential is impossible.

OBJECTIVES

To address and mitigate the loss of important moose seasonal habitats in the upper Bridge River system, this evaluation project was undertaken to 1) assess current winter range quantity and quality in the area surrounding the Carpenter and Downton reservoirs, 2) identify potential opportunities for the enhancement of existing habitat and/or the creation of new range in areas in the vicinity of the impoundment, and 3) evaluate the current status of wintering moose populations in the area. Geographic Information System (GIS) work will also be undertaken to estimate the land area of moose winter range lost as a result of the creation of the reservoirs. Based on the area of lost habitat and estimated potential animal densities, the unrealized economic value of the wildlife resource (i.e. moose) will be estimated.

STUDY AREA

The area of interest under this project was the upper Bridge River system, located approximately 150 km northeast of Vancouver, in British Columbia's southern interior. The study area centred around the Carpenter and Downton reservoirs. Riparian, wetland and timbered habitats in the Marshall and Tyaughton Creek drainages, the Hurley River valley and lower Cadwallader Creek were assessed (Figure 1).

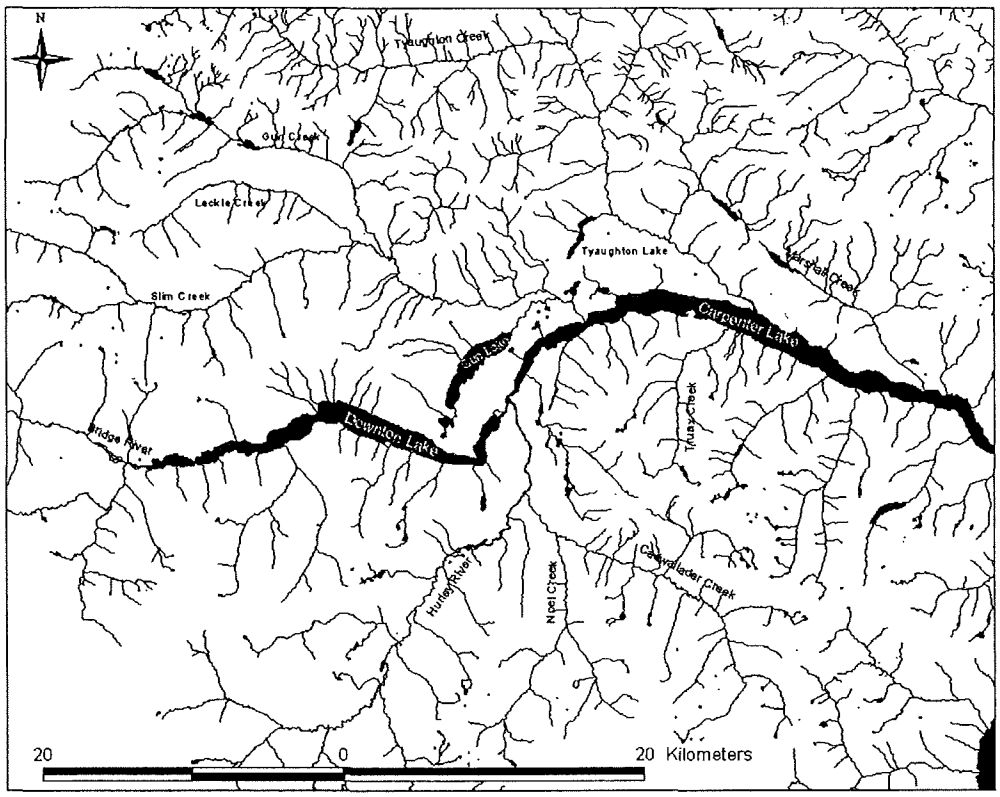

Figure 1. Bridge River system

METHODOLOGY

Moose Winter Range Identification and Assessment

A consultative process, involving Ministry of Environment, Lands and Parks (MELP) regional wildlife biologist Doug Jury and Fred Shields of the Stl'atl'imx First Nation, was initiated in an effort to identify both historical and currently utilized moose winter ranges within the study area. Known moose winter ranges presently mapped by MELP's Wildlife Section under the Lillooet Land and Resource Management Plan (LRMP) provided a template which was modified based on Mr. Shield's local knowledge and on new data collected during aerial habitat assessment surveys (Appendix 1). Surveys were conducted using a Bell 206B JetRanger helicopter, piloted by Doug Smallman of Cariboo Chilcotin Helicopters Ltd. Doug Jury and Fred Shields assessed existing moose wintering areas and identified sites for potential enhancement work, while Susan Lemke, contract biologist, contributed to habitat assessments, navigated and recorded habitat polygons of interest on 1:50,000 scale topographic maps.

Enhancement Opportunities

Sites identified for possible enhancement were transferred from flight maps to 1:20,000 scale forest cover maps (1997). From this coverage, detailed attributes for each habitat polygon were determined, including vegetation species composition, stand age, and stand history. Biogeoclimatic zone and subzone classifications were also determined for each area. These data were then analysed to determine sites suitable for the application of specific moose habitat management techniques, including access management (road closures/rehabilitation), buffer zone retention adjacent to key wintering forage sites, silvicultural and stand tending activities, and browse regeneration/rejuvenation through burning or cutting.

Population Assessment

In concert with the evaluation of winter ranges, project staff had hoped to assess the status of the area's moose population. Unfortunately, due to delays in project start-up, early snow melt and conflicting personnel schedules, the conditions required for determining animal densities and assessing the general health of the herd were unsuitable during survey flights. A lack of sufficient snow cover makes animal sightability and track identification/quantification difficult, and moose tend to shift their activity to dense coniferous cover in late winter, perhaps to find relief from temperature extremes (Schwab and Pitt, 1991).

Economic Value of the Wildlife Resource

Using Geographic Information System (GIS) mapping technology, the original course of Bridge River prior to the impoundment of the Carpenter and Downton reservoirs was inferred from topographic features. Subtracting the area of the river itself from the total land area of the valley bottom, an estimate of the area of moose winter range lost was calculated (assuming approximately 50% of the valley bottom represented riparian winter habitat available to moose). Expected moose densities on limited, good quality winter habitat, and local First Nations historical knowledge of moose numbers, were applied to determine the number of animals potentially inhabiting the Carpenter/Downton winter range prior to impoundment. Based on expected population composition parameters, the annual hunting opportunities unavailable were calculated. The average value of resident and non-resident hunting per animal (from 'A Summary of the Economic Value of Wildlife Resources in British Columbia'; see literature cited) was then applied to expected annual bull harvests to determine the annual unrealized economic value of the resource.

RESULTS

Moose Winter Range Identification and Assessment

Three aerial habitat assessment surveys were conducted, March 1st, April 18th, and May 4th, for a total of 11.5 hours (2.7, 4.8 and 4.0 hours, respectively). The March 1st flight covered the northern side of Carpenter Lake, Marshall Creek, the Tyaughton Lake area and the Gun/Lajoie Lakes region. Due to inclement weather and high winds in the Hurley River area, the flight was aborted south of Gold Bridge. With ideal weather conditions, a larger area was evaluated during the second flight, including a more detailed assessment of the region previously surveyed. The Hurley River, historically the most productive known moose wintering habitat in the area, was covered extensively. Cadwallader Creek and Noel Creek south of Bralorne were also assessed. The final flight (May 4th) provided an opportunity to record important sites with photographs, and to correlate key forest cover attributes with final site visits.

The following descriptions and accompanying figures identify high value moose winter habitats and sites of interest for potential enhancement work in the upper Bridge River system.

Existing Moose Winter Ranges

Hurley River

The Hurley River valley is the most significant historical moose winter range in the area. The valley floor was logged beginning in 1982, with continuing harvest activity until the late 1980's, and silvicultural/stand tending work into the early 1990's. The lower Hurley River (defined here as south of the Gwyneth Lake plateau, southwest to the confluence of Lone Goat Creek) is located in the dry, cold Montane Spruce biogeoclimatic subzone (MSdc). The MS zone experiences cold winters and moderately short, warm summers; the MSdc has the highest precipitation, lowest seasonal temperatures and fewest growing degree days of the MS subzones within the Kamloops Forest Region (Lloyd, Angove, Hope and Thompson, 1990). The high precipitation regime translates into heavy winter snowfall, making the lower elevation riparian habitats on the valley floor of critical importance to the local moose population.

The riparian community adjacent to the Hurley River, composed of spruce/sedge meadows and shrub carrs, provides the forage values necessary for winter survival. However, the use of these sites may be dependent upon the availability of adjacent coniferous cover, which provides snow interception, protection from extreme weather and security from predators and disturbance. Several studies suggest that the spatial relationship between forage and shelter in late winter can be a critical and possibly limiting characteristic of moose habitat (reviewed by Thompson and Stewart, 1997). Past timber harvest operations in the lower

Hurley River have addressed this requirement in many instances through the retention of coniferous buffer strips adjacent to riparian habitat (Figure 2).

Figure 2. Lower Hurley River

Small mixedwood (i.e. conifer/deciduous) stands provide leaf litter and bark, which remain readily digestible during a period of poor forage quality (Renecker and Hudson, 1988). Many cut-blocks in the valley, logged approximately 15 years ago, are exhibiting excellent shrub regrowth; with the coniferous component now providing cover values, moose should utilize these sites throughout the winter.

The upper Hurley River, from Lone Goat Creek southwest to the river's confluence at Grouty Peak, is characterized by a transition from the Montane Spruce to the wet, mild Engelmann Spruce-Subalpine Fir (ESSFwm) subzone. Survey flights recorded a noticeable decrease in winter moose track abundance approximating this transition, an observation likely relating to increasing snow depths, which limit moose mobility and forage availability. Tracks were more common in the riparian complex adjacent to the river north of this transition zone, where good willow production is evident (Figure 3).

Figure 3. Upper Hurley River

Gwyneth Lake Plateau

The Gwyneth Lake cut-block complex, harvested between 1981 and 1987, exhibits attributes of good quality moose winter range; indeed, wintering moose have been sighted here on many occasions (D. Jury, personal communication). Mature spruce/sedge meadows surround the lake itself; these sites provide an optimal combination of cover and forage values (Figure 4). Scattered throughout the area are small pockets of wet shrub-dominated carr (associated with Gwyneth Creek drainage), interspersed with advanced coniferous regeneration (Figure 5). This contiguous mix of security and thermal cover values with important winter forage creates good quality habitat. Mixedwood stands of aspen and Lodgepole pine/Douglas fir are also present on this complex (Figure 6). These sites provide readily digestible winter forage in the deciduous component (e.g. leaf litter and bark), and key cover attributes in the coniferous.

Figure 4. Gwyneth Lake cut-block complex – Spruce/sedge meadow bordering Gwyneth Lake

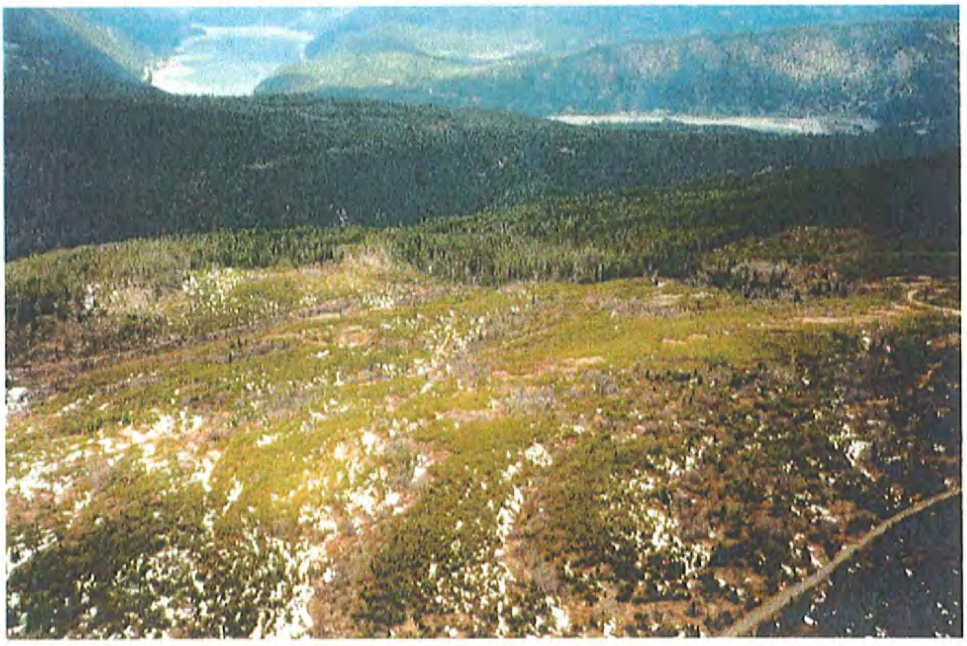

Figure 5. Gwyneth Lake cut-block complex – Vegetation associated with Gwyneth Creek drainage

Figure 6. Gwyneth Lake cut-block complex – Deciduous component

Ferguson Creek

The Ferguson Creek cut-blocks resemble the Gwyneth Lake complex in many respects. The site is a mosaic of regenerating coniferous cover (the area was logged between 1981 and 1985), shrub-dominated carrs associated with the creek and mixedwood stands of Lodgepole pine and aspen (Figure 7). The northern end of the complex has a component of red alder (*Alnus rubra*), which is not a preferred browse species for moose; therefore, greater use of the southern sections of the polygons may be expected, where predominantly *Salix* (willow) species occur.

Figure 7. Ferguson Creek cut-block

Marshall and East Creeks

Significant historically recognized moose winter ranges occur in the Marshall and East Creek drainages. Wintering animals have regularly been reported in the area between Marshall Lake and Liza Lake, and at the west end of Liza Lake (F. Shields, personal communication). These areas are comprised of contiguous coniferous (Lodgepole pine, Douglas fir) corridors adjacent to the wet shrub carr/sedge meadow sites associated with the lakes and creeks. This connectivity allows animals to travel efficiently and safely between key foraging sites in the riparian zone. Winter habitat is also found along the lengths of Marshall and East Creeks (as well as a number of other local streams, including Tyaughton and Gun Creeks); however, these areas, located in narrow, steep sided drainages, tend to be of very limited extent.

Lajoie and Gun Creek Area

The Plateau Ponds area, through which Lajoie Creek flows, consists of mature Douglas fir/Lodgpole pine stands, regenerating cut-blocks and riparian shrub carrs adjacent to the ponds. Logging activity on the plateau occurred during the late 1970's. Much of the area has been subject to insect and disease control measures during the past two decades. Advanced regeneration in harvested blocks is beginning to provide security and thermal cover for moose, while riparian and other moist sites of commercially non-productive brush offer winter forage (Figure 8).

The Pearson and Mowson Ponds area is an historically high quality moose winter range, being comprised of a mosaic of mature coniferous, mixedwood and riparian sites (Figure 9). The adjacency of these habitat components permits wintering animals to minimize energy expenditures in obtaining adequate forage.

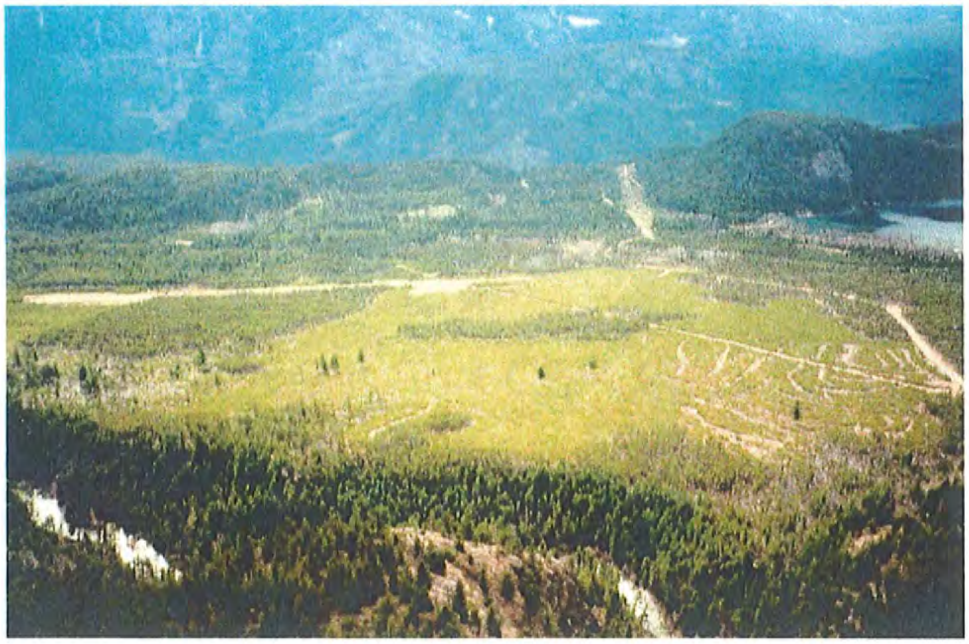

Figure 8. Gun Lake cut-block

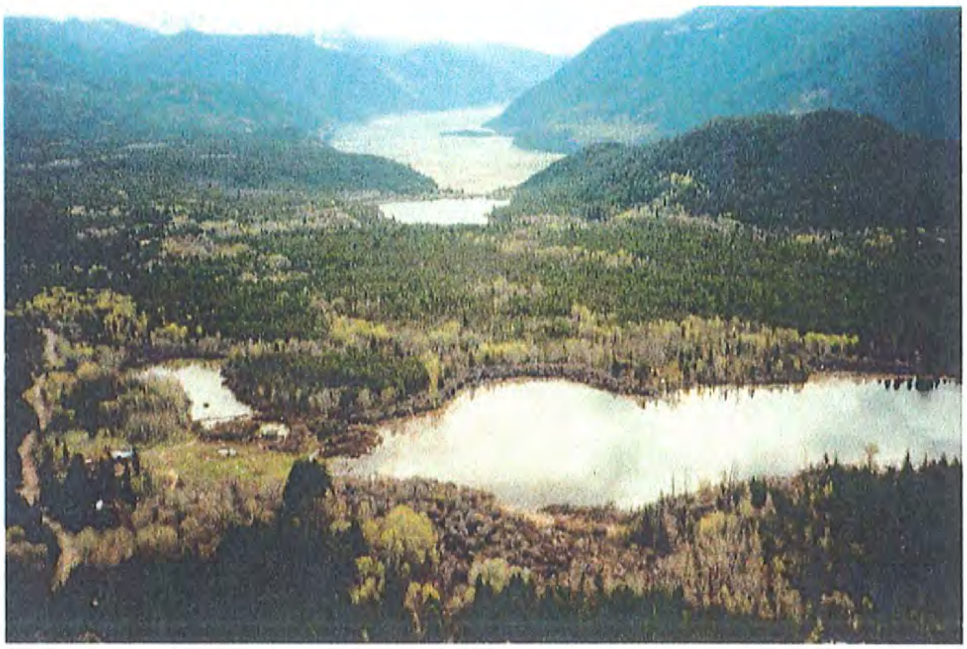

Figure 9. Pearson and Mowson Ponds

Upper Bridge River

Much of the upper Bridge River riparian zone is unavailable to wintering moose because of high snow depths, which restrict mobility and render forage unavailable. However, tracks were observed in the riparian zone at the west end of Downton Lake and up the Bridge River for approximately 2.5 km. In years of below average snowfall (as was 1999/2000) or during early winter, riparian habitat in this section and further up the river may be utilized as well.

Potential Moose Winter Ranges

Liza Lake Area

Timber harvesting in the area south of Liza Lake has created new, quality moose winter range in Lodgepole pine/Douglas fir cut-blocks logged in the early 1980's (Figure 10). Despite common moisture deficits on sites in the dry, cool Interior Douglas Fir (IDFdk2) subzone, these polygons have developed a productive shrub layer and advanced regeneration in the coniferous component appears to have reached the stage where it will provide adequate cover (security and thermal) values for wintering moose. Recent brushing and weeding treatments (1994) do not appear to have reduced forage productivity on these sites.

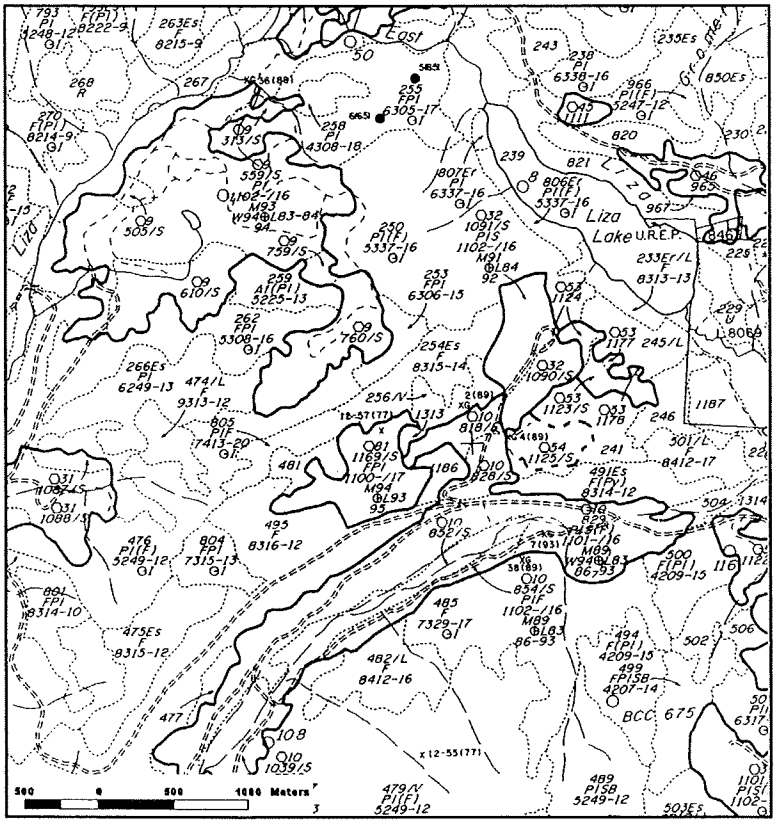

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Figure 10. Liza Lake cutblocks

East Downton Lake

An extensive cut-block located on the north shore of Downton Lake, immediately west of Lajoie Lake has the potential to, or may currently, support wintering moose. The polygon, which was selectively logged between 1978 and 1980, exhibits stands of mature Douglas fir with an extensive aspen component (Figures 11 and 12). Deciduous stands, mature coniferous growth, a well-developed shrub layer and a south aspect combine on this site to produce what appears to be quality moose winter habitat, providing forage and cover values. Future surveys, conducted earlier in the winter, will be necessary to confirm use of this habitat.

Figure 11. Downton Lake Douglas fir/aspen mosaic

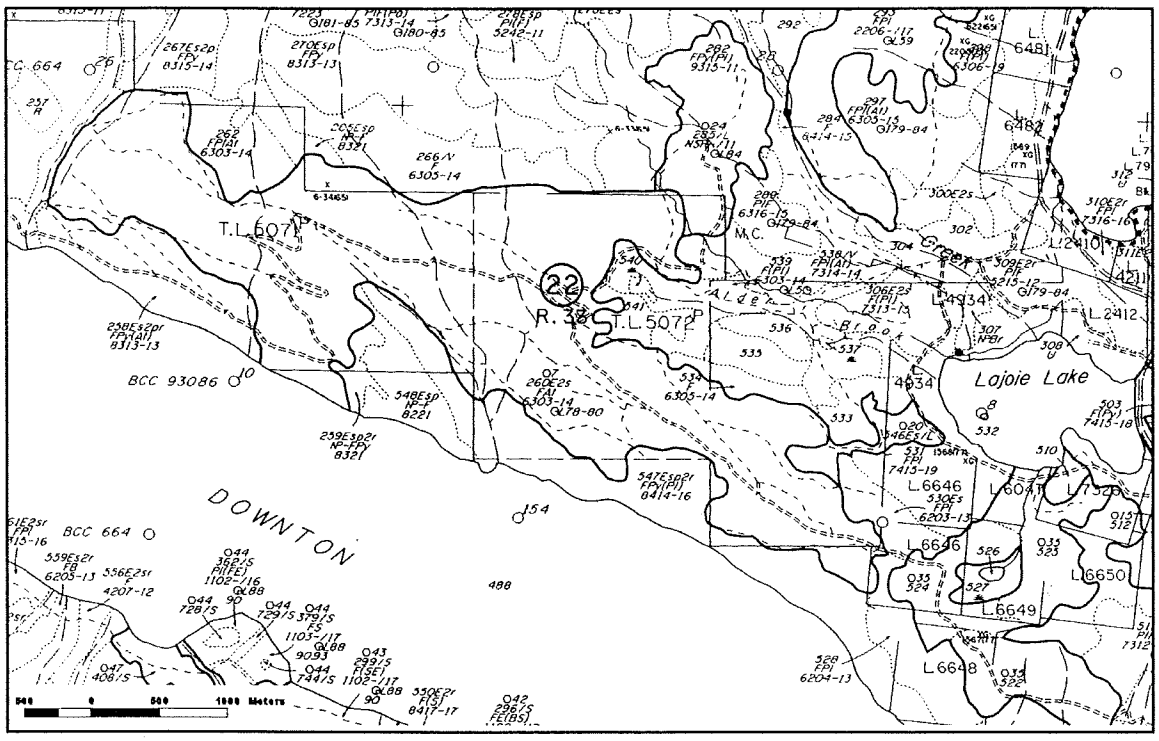

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Figure 12. East Downton Lake mixed conifer/deciduous polygon

Pearson Ridge/Tyaughton Lake

A small cut-block located southeast of Tyaughton Lake may be capable of supporting wintering moose for brief periods (Figures 13 and 14). Due to delays in survey flights, an evaluation of current winter use of the block was not possible. However, based on regional knowledge of the habitat elements characteristic of moose winter range, this site contains the necessary components. The site occurs in the IDFdk2 biogeoclimatic subzone at an elevation of 1125 m, where Lodgepole pine and Douglas fir predominate. Poor growing conditions have resulted in commercially unsatisfactory restocking in the regenerating coniferous component. These conditions have allowed shrubs to become established, providing important winter forage for ungulates, and moose in particular. A significant aspen element present on the site may also contribute to winter diets. Despite poor restocking results, the advanced coniferous regeneration has reached sufficient height to provide security and thermal cover for wintering moose.

Figure 13. Tyaughton Lake cutblock

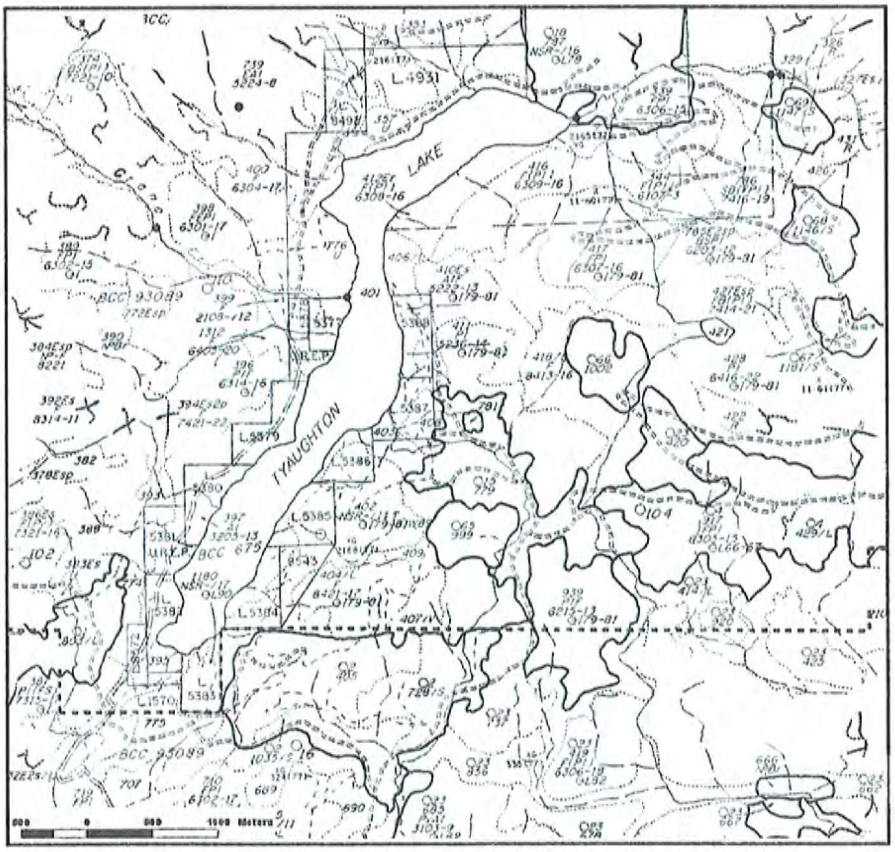

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Figure 14. Tyaughton Lake cutblock complex

McDonald Creek

A small Douglas fir/aspen stand and adjacent willow polygon of considerable extent occur on the slope to the northeast of McDonald Lake (Figure 15). Due to the steepness of the terrain, the mixedwood stand is littered with windfall. Located on a west aspect, this IDFdk2 site occurs on a steep grade in a confined valley, where moisture deficits are likely not as common as on other sites in this subzone, as indicated by the extent of shrub growth. Although it is unclear whether these sites are utilized by moose, it is suspected that, while foraging in the narrow riparian strip located along McDonald Creek itself, animals may travel the short distance to the eastern slope to browse on fallen aspen and willow.

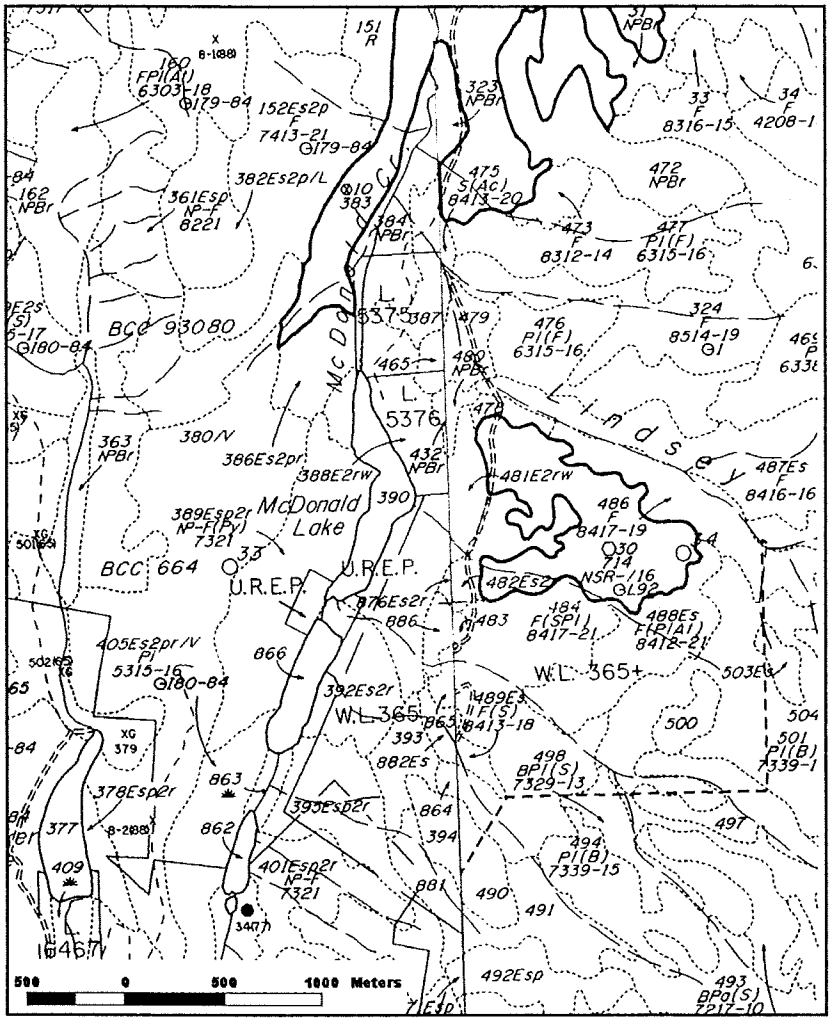

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Figure 15. McDonald Creek conifer/deciduous mosaic

Mead Lake

Timber south of Mead Lake (north of Blackbird Creek) has been under attack by mountain pine beetle since 1984. These stands, located in the MSdc subzone at approximately 1375 m in elevation, are dominated by Lodgepole pine and contain a very sparse understory of scattered shrubs (Figure 16). Adjacent mixed conifer stands (spruce, fir and pine) at higher elevation in the Engelmann Spruce – Subalpine Fir dry, very cold (ESSFdv) subzone are influenced by high snow cover (i.e moisture), which maintains a dominant shrub understory. Moose may make use of the pine-dominated stands, despite limited forage availability, as mobility in winter is not limited by high snow depths. The higher elevation sites (<1525 m) may permit animals access to abundant forage under canopy closure values which provide adequate snow interception cover.

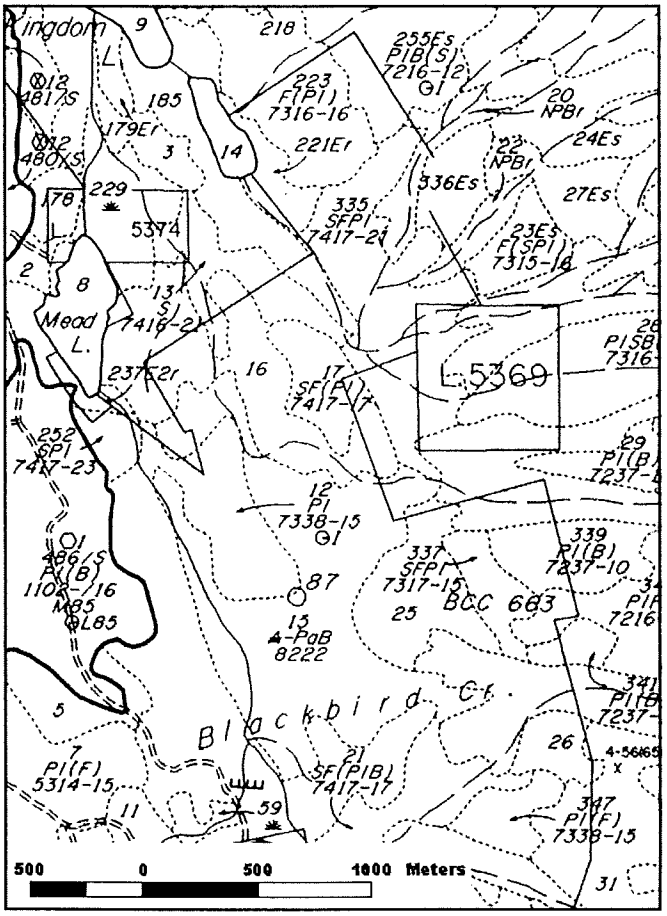

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Figure 16. Mead Lake timber stands

Cadwallader Creek

A recently harvested polygon located on the south side of Cadwallader Creek, between Noel Creek and McKinley Creek, is currently showing potential as moose winter habitat (Figure 17). The block was logged between 1990 and 1992, and has been left to regenerate naturally. Poor coniferous regeneration on the site has resulted in the block being designated 'not satisfactorily restocked'; however, the shrub understory component has thrived, providing abundant forage. Winter snowfalls in the area are significant; this may preclude winter use by moose or delay utilization until coniferous regeneration attains sufficient height to provide snow interception cover.

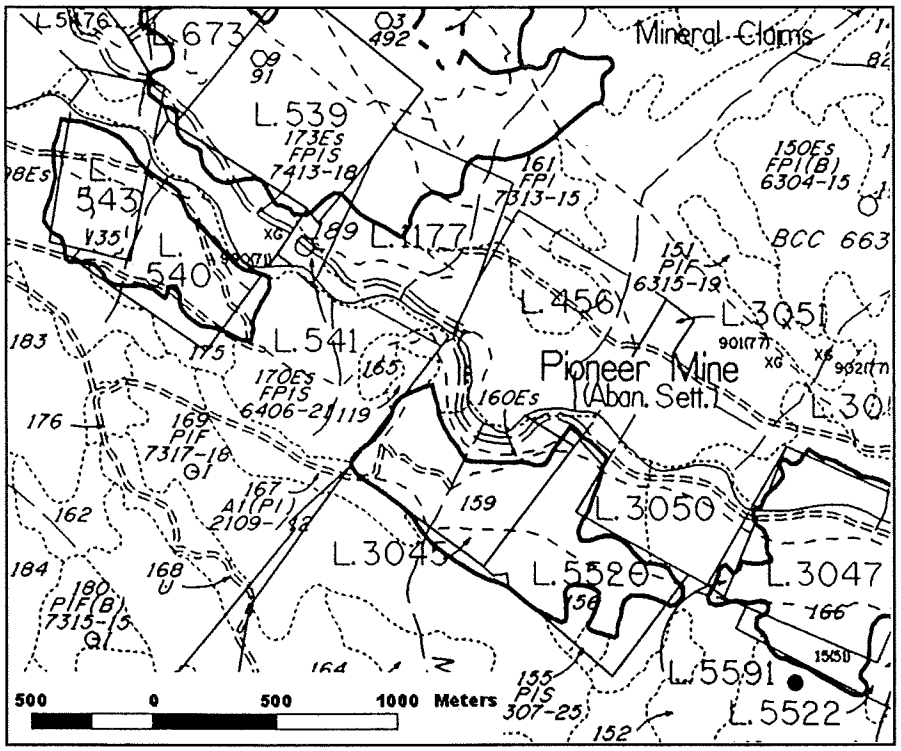

Figure 17. Cadwallader Creek regenerating cutblock

West Downton Lake

A polygon consisting primarily of aspen and willow has been noted on the north side of Downton Lake, approximately 1 km east of the confluence of Bridge River (Figure 18). The brush component on the site is very mature, despite the fact that the slope appears to be a snowchute. Use of this stand by moose was indeterminate; the steepness of the terrain may limit or preclude its use, particularly in winter.

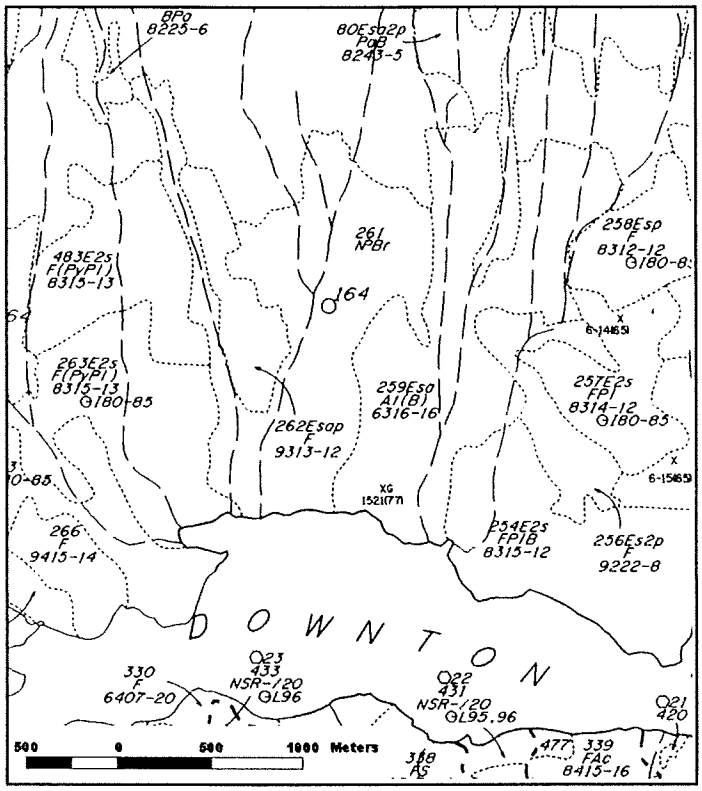

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Figure 18. Upper Downton Lake non-productive brush polygon

Economic Value of the Wildlife Resource

The extent of high quality riparian habitat lost with the creation of the Carpenter and Downton Lake reservoirs was calculated to be approximately 30 km^2. Based on interviews with local First Nations band members and wildlife officials, this habitat may have been capable of supporting 200-500 wintering moose (B. Gates, personal communication in Regional Consulting Ltd., 2000). A stable or increasing moose population exhibits a composition ratio approximating 60 bulls per 100 cows, and 40 calves per 100 cows. Assuming that 30% of the bull population would be of age 1+ and, therefore, susceptible to hunter harvest, an annual harvest of 9-23 animals could reasonably be estimated (a sustainable bull harvest rate of 25%). Applying the 1998/99 estimated average value of resident and non-resident hunting per animal in the Cariboo Chilcotin region ($1,400 and $1,130, respectively), the total economic value of moose per year would be approximately $11,385-$29,095.

Currently, Regional Consulting Ltd. is completing a related project under the Bridge/Coastal Fish and Wildlife Strategy, assessing the footprint impacts of hydroelectric development in the Bridge River system. The firm is using GIS to digitize the riparian zone which existed in the Bridge River system prior

to impoundment from map coverage produced in the 1920's and 1930's. This data can be applied in the calculation of a more accurate estimate of the area of important wildlife habitats lost in the area.

RECOMMENDATIONS

Protection and Enhancement of Existing Important Moose Winter Ranges

The moose population of the Hurley River valley was seriously impacted when timber harvest operations commenced in the early 1980's. With road access into the area, the population was subjected to heavy hunting pressure. A significant increase in hunter effort was documented from 1979 through 1983, coinciding with the period of road construction and timber harvest operations (B.C. Environment, unpublished data), and subsequent moose harvests from the valley were reportedly high (D. Jury, personal communication).

Access management on key winter habitats has become one of the most important moose management strategies. Once adequate cover and forage are values are present, access issues must be addressed. Minimizing the extent of open road, achieved through road blockages and/or road rehabilitation, has been stressed in regional forest management guidelines as an effective tool in maintaining habitat suitability. In addition, the maintenance of visual screening cover (vegetative and topographical) between open roads and important moose foraging habitats is critical to minimizing disturbance. Human disturbance may lead to altered behaviour which can negatively impact an animal's ability to forage effectively (Lemke, 1998). During the critical winter months, when energy expenditures may be greater than intake, this ability may determine survival. Access management strategies should be implemented on all currently utilized important moose winter ranges. Future timber harvest operational plans for sites on or adjacent to winter habitats should include guidelines for road closures or rehabilitation and security cover retention.

Silvicultural and stand tending activities can play a key role in creating or maintaining key habitat values on harvested sites. Juvenile spacing and pruning, for example, may enhance browse production on moose wintering grounds. The result of these techniques is the release of the understory shrub layer, as more light is admitted and additional space for growth is created. Similarly, cut-blocks replanted at minimum stocking standards, or at variable planting densities (i.e. planted patches with intermittent openings) tend to develop a more productive brush component, which translates into increased quantities of browse for moose. Not satisfactorily restocked blocks may mimic these conditions. To be utilized by moose, however, these sites must also provide appropriate cover. Advanced coniferous regeneration provides both security and snow interception/thermal cover values on harvested blocks. Spacing and pruning of coniferous regeneration have been carried out on a number of the Gwyneth Lake cut-blocks (in 1995), which should aid in maintaining a healthy shrub component. These treatments, however, should be restricted to areas at least 20 m distant from important foraging areas, such as riparian zones.

Woody browse species, such as willow, eventually grow out of reach of foraging moose, who prefer the soft, new growth found at twig ends. These decadent stands can be rejuvenated through mechanical means by cutting or knocking down with heavy machinery, or through burning. The applicability of prescribed burning on forested sites will be evaluated on a site by site basis, in consultation with the Ministry of Forests (see below). In general, fall burning can be most effective in stimulating new growth from decadent browse species on moist sites.

Protection and Enhancement of Potential Moose Winter Ranges

Liza Lake Area

Harvested stands in the Liza Lake area will continue to attract wintering moose, provided current forage and cover values are maintained, and disturbance is minimized (see above for access management guidelines). Browse quality and quantity may eventually decline as shrub growth becomes mature and/or grows out of reach of feeding moose. Cutting or knocking down decadent brush with machinery will promote new twig growth, providing a renewed source of quality browse.

East Downton Lake

Rejuvenation of the brush component of the Downton Lake cut-block may enhance the value of this site as moose winter habitat. The shrub layer appears overmature, with much decadent material. Burning, cutting or knocking down these mature plants will stimulate the growth of much higher nutritional value to ungulates.

Pearson Ridge/Tyaughton Lake

The utility of this small cut-block complex as moose winter range will be dependent, in large part, on access restrictions which will reduce the impacts of human disturbance. Currently, cover values area adequate; however, browse production may not be sufficient to sustain even a small number of animals over the winter. The location and moisture regime associated with this site (i.e. near human settlements at Tyaughton Lake and a dry site) will likely restrict the use of prescribed burning to promote browse. Cutting or crushing may be more applicable on this site. Maintaining corridors of mature coniferous growth between this area and the extensive winter range in the Gun Creek area should make this area available to moose as an intermittent winter foraging site.

McDonald Creek

The steepness of the northeast slope of McDonald Creek may limit the value of deciduous and shrub stands to wintering moose. As stated above, animals foraging in the riparian zone along McDonald Creek may occasionally use this site; however, enhancement efforts would likely be more productively and effectively applied in other areas.

Mead Lake and Cadwallader Creek

The polygons identified in the Mead Lake and Cadwallader Creek areas may, in future, benefit from the use of prescribed burning to promote browse production. These sites are relatively moist, where fall burning would be easily managed. Currently, these areas appear to be producing good quality browse. The Cadwallader Creek cut-block, which has failed to regenerate to target stocking levels will continue to produce abundant forage for some time; however, the Mead Lake site is characterised by high conifer densities. Thinning of this site may release the abundant shrub understory to produce even greater quantities of suitable browse for moose and other ungulates.

West Downton Lake

The topography associated with the deciduous polygon at the west end of Downton Lake, as with the site described at McDonald Creek, may seriously limit the utility of this area to moose. In addition, high snow pack and the location of the stand in the path of snowslides make it unlikely that the site is used to any extent, despite its proximity to the historically utilized riparian habitat on the Bridge River. However, should future winter surveys indicate that the area is used, a prescribed burn may be applicable. The isolated nature of the area would eliminate any concerns over smoke pollution which can arise, and successful browse enhancement would draw moose to a habitat where they could forage undisturbed.

Burn Plan Program

The suitability of sites for prescribed burning for browse enhancement, including those identified in this report, will be determined in consultation with Ministry of Forests staff and consultant Bruce Morrow of Sage Forestry (Kamloops), who is currently evaluating the applicability and efficacy of controlled burns in promoting browse on ungulate habitats in the Bridge River area.

CONCLUSION

The three primary issues concerning the protection, maintenance and enhancement of important moose winter habitats are cover, forage and access management. Browse enhancement can be accomplished through modified silvicultural practices, such as juvenile spacing and pruning, which will not affect the annual allowable cut (AAC) or operability, and in some cases my actually release conifer growth. The application of prescribed burning on suitable sites can also stimulate browse production. The areas identified in this report should be assessed on a site-by-site basis, and, where feasible, be considered for inclusion in the burn plan program currently being developed by Sage Forestry Ltd. The maintenance of snow interception cover, i.e. ≥50% crown closure, particularly in the Downton Lake, upper Hurley River and Cadwallader Creek areas where winter snowfalls are significant, is crucial to ensuring that existing and potential habitats are utilized. Deep snow restricts mobility, limiting access to potential sources of important winter forage. Access management has become an important moose management strategy, as development extends further into the province's forested lands. Uncontrolled vehicular access onto important moose winter ranges can result in excessive disturbance and hunter harvest, which may ultimately cause abandonment of these key habitats.

The maintenance of an optimal balance of cover and forage, with limited disturbance, is crucial to maintaining habitat suitability for moose, and by extension, to maintaining a healthy, stable moose population.

LITERATURE CITED

Gillingham, M.P. and D.R. Klein. 1992. Late-winter activity patterns of moose (*Alces alces gigas*) in western Alaska. Canadian Journal of Zoology. 70: 293-299.

Lemke, S.L. 1998. Upper Deadman River Moose Habitat Study: Results and Recommendations. Unpublished data. British Columbia Ministry of Environment, Lands and Parks. 64 pp.

Lemke, S.L. 1999. Management Unit 3-31 Stratified Random Block Moose Survey. Unpublished data. British Columbia Ministry of Environment, Lands and Parks. 41 pp.

Lloyd, D., K. Angove, G. Hope and C. Thompson. 1990. A Guide to Site Identification and Interpretation for the Kamloops Forest Region. B.C. Ministry of Forests Research Branch. 398 pp.

Pierce, D. Hohn and James M. Peek. 1984. Moose habitat use and selection patterns in north-central Idaho. Journal of Wildlife Management. 49(4): 1335-1343.

Regional Consulting Ltd. June 2000. Bridge/Coastal Fish and Wildlife Habitat Restoration Program Report.

Reid, R. 1999. A Summary of the Economic Value of Wildlife Resources in British Columbia. Report. Ministry of Environment, Lands and Parks, Wildlife Branch. Victoria

Renecker, Lyle A. and Robert J. Hudson. 1992. Habitat and forage selection of moose in aspen-dominated boreal forest, central Alberta. Holarct. Ecol. 11: 111-118.

Schwab, F.E. and M.D. Pitt. 1991. Moose selection of canopy cover types related to operative temperature, forage and snow depth. Canadian Journal of Zoology. 69: 3071-3077.

Thompson, Ian D. and Milan F. Vukelich. 1988. Use of logged habitats in winter by moose cows with calves in northeastern Ontario. Canadian Journal of Zoology. 59: 2103-2114.

APPENDIX 1

Lillooet LRMP Known Moose Winter Ranges