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Integrated Management of Timber and Deer: Interior Forests of Western North America

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Foreword

Resource managers in the United States and Canada must face increasing demands for both timber and wildlife. Demands for these resources are not necessarily incompatible with each other. Management objectives can be brought together for both resources to provide a balanced supply of timber and wildlife. Until recently, managers have been hampered by lack of technique for integrating management of these two resources. The goal of the Habitat Futures Series is to contribute toward a body of technical methods for integrated forestry in British Columbia in Canada and Oregon and Washington in the United States. The series also applies to parts of Alberta in Canada and Alaska, California, Idaho, and Montana in the United States.

Some publications in the Habitat Futures Series provide tools and methods that have been developed sufficiently for trial use in integrated management. Other publications describe techniques not yet well developed. All series publications, however, provide sufficient detail for discussion and refinement. Because, like most integrated management techniques, these models and methods have usually yet to be well tested, before application they should be evaluated, calibrated (based on local conditions), and validated. The degree of testing needed before application depends on local conditions and the innovation being used. You are encouraged to review, discuss, debate, and-above all-use the information presented in this publication and other publications in the Habitat Futures Series.

The Habitat Futures Series has its foundations in the Habitat Futures workshop that was conducted to further the practical use and development of new management techniques for integrating timber and wildlife management and to develop a United States and British Columbia management and research communication network. The workshop jointly sponsored by the USDA Forest Service and the British Columbia Ministry of Forests and lands, Canada was held on October 20-24, 1986, at the Cowichan lake Research Station on Vancouver Island in British Columbia, Canada

One key to successful forest management is providing the right information for decisionmaking. Management must know what questions need to be asked, and researchers must pursue their work with the focus required to generate the best solutions for management. Research, development, and application of integrated forestry will be more effective and productive if forums, such as the Habitat Futures Workshop, are used to bring researchers and managers together for discussing the experiences, successes, and failures of new management tools to integrate timber and wildlife.

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Abstract

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Timber and deer managers have struggled through years of increasing demands and growing conflicts in the interior of Western North America. Integrated management, supported by a sound research data base and effectively communicated to all users, is presented as the only viable approach to an increasingly complex resource future. Two examples of tools recently designed for managers in dealing with timber-deer habitat are discussed.

Keywords: Integrated management, timber management, wildlife habitat management, deer, mule deer.

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Introduction

The diversity of habitats supporting deer in the interior of Western North America poses a variety of conflicts and presents an amazing array of challenges for adaptive deer management. Recent conflicts in the management of deer in Western North America have involved habitat and land-use practices rather than the traditional problems of predation and harvest.

Mule deer *(Odocoileus hemionus)* are the most common deer species in the western interior. White-tailed deer *(Odocoileus virginianus)* , however, also occur across a significant portion of the West, having both biological and economic importance in some regions (fig. 1). For example, white-tailed deer comprise 71 percent of the legal deer harvest in northwestern Montana (Mussehl and others 1986). Habitat concerns generally are similiar for the two species; consequently, both are discussed here. For more specific comparisons and contrasts between the species, refer to the works of Wallmo (1981) and Halls (1984).

We have made three basic assumptions in this paper. The first was that forest land, particularly commercial forest land used for producing wood fiber, is the primary habitat for maintaining deer populations in the area to which this publication applies; other land uses such as agriculture and wilderness playa relatively minor role. Second, the maintenance of deer and deer habitat is a desirable management goal, as is forest management. Finally, although locally a winter or summer deer range may have particularly difficult problems needing resolution, we recognize successful deer management must consider habitat structure for all seasonal ranges that receive annual use.

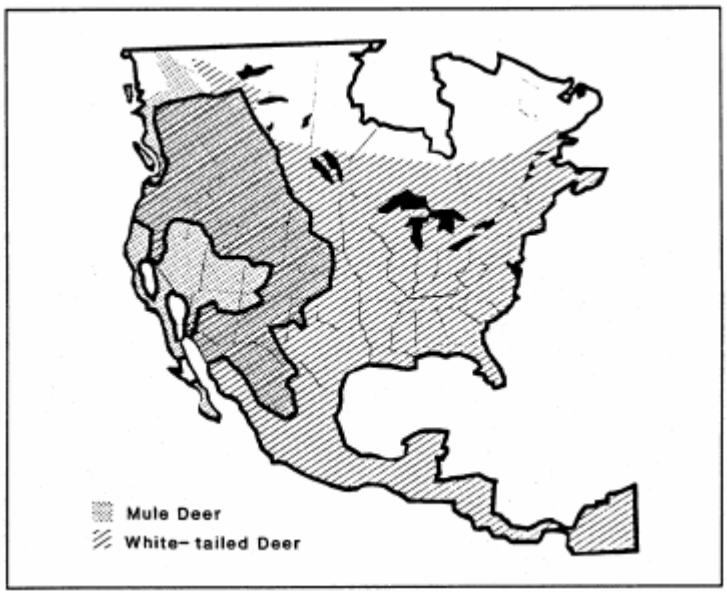


Figure 1—Approximate overlap in the distribution of white-tailed deer and mule deer (from Halls 1984).

Problem Analysis

What Is the Issue?

Summer and winter deer habitat values in interior forests are being affected by the conversion of natural old-growth stands to regulated second-growth stands. Resource managers generally have neither adequate habitat inventories nor predictive tools to assess the impacts of old-growth conversion.

Winter range is a major concern in the northern part of the western interior where mule and white-tailed deer are at distributional limits. Although some areas support relatively light snowpacks where deer can find adequate food and shelter in open or semiopen habitats, in other areas old-growth Douglas-fir *(Pseudotsuga menziesii* (Mirb.) Franco) and mixed-species forests provide deer both relief from deep snow and substantial sources of winter food. These forested winter ranges are at the center of resource conflicts.

Douglas-fir is an important component of the wood supply for the forest industry, and significant amounts of this species occur on deer winter ranges. For example, approximately 30 percent of the Douglas-fir in the Cariboo Forest Region of the British Columbia interior is located on mapped mule deer winter ranges.

This situation has led to resource allocation conflicts. To meet the demand for high-value timber, forest managers have been harvesting old-growth Douglas-fir and mixed-species stands on winter ranges. These stands are often adjacent to other land uses, such as agricultural operations and residential developments, that conflict with deer management. Wildlife managers are concerned that deer populations will continue to decline as more old growth on winter ranges is harvested. In the long term, second-growth stands managed for optimum timber production may not provide adequate winter range values for deer (Armleder 1981, Mundinger 1984). Habitats providing uneven-aged, multilayered, and dead-and-down structural components (fig. 2) have only been adequately considered (Leckenby 1984) in silvicultural designs applied to about 20 percent of the forested lands in the Northwestern United States.

Figure 2—Mule deer use uneven-aged and multilayered forested habitat throughout much of their range. These habitats are threatened by the conversion of old-growth to regulated forest stands.

Several reasons exist for these conflicts. First, allowable cuts and quotas are often high so intensive management is necessary for maintaining production levels. Intensive management techniques, which include improved genetics, fertilization, thinning, and rapid reforestation, do not result in the structure and longevity of the mature stands that are most valuable to deer. Second, mature and overmature retentions for watershed, esthetics, and other nonwildlife reasons are not alone adequate for maintaining deer populations on commercial forest lands. Long-range forest management goals often cannot accurately predict anticipated increases in the demand for recreational use of deer resources. Finally, ecological understanding of the consequences of large-scale habitat modification is lacking.

These problems are not just confined to winter range; an example is the commercial harvest of aspen stands on summer range for mule deer in Colorado. Twenty-five percent of the commercial forest in that state is made up of aspen *(Populus* spp.) (Jones 1985) that also serves as diverse habitat for a variety of wildlife, including mule deer. Aspen communities provide forage and fawn-rearing habitat throughout the summer. During fall, aspen stands provide forage that is important in preparing deer for winter survival in lower-elevation pinyon-juniper *(Pinus* spp., *Juniperus* spp.) and sagebrush *(Artemisia* spp.) winter ranges. Large-scale clearcutting has been planned for overmature aspen stands considered to be decadent and in need of rejuvenation. Implied in such plans is that clearcutting will provide new successional habitats with more edge and diversity (Thomas 1979) resulting in a beneficial, or at worst, neutral effect on deer. Unfortunately, limited data exist to predict the actual benefits or impacts of aspen clearcutting on mule deer. Cooperation between resource managers is hindered by the lack of substantiating data.

Review of Historical Approaches to Problem Resolution

Large-scale timber harvesting has occurred only since the 1960's in the interior of British Columbia and since the 1950's in the northern interior of the United States. During this period, economic interests have dominated forest-management decisions. Consequently, large areas of Douglas-fir have been harvested, winter ranges have shrunk, and the impact on deer populations is estimated to have been considerable (Leckenby 1984, Cariboo Region Fish and Wildlife 1985).

As the value of remaining old-growth stands increases, the economic tradeoffs to preserve habitats have also increased dramatically. Wildlife managers have typically used the strategy of specifying boundary changes and deferrals on a case-by-case basis. As harvest rates increase, biologists have to deal with hundreds of timber sales each year. Companies and governmental agencies have hired biologists, but the work rapidly exceeds their ability to keep up by traditional methods. Frequent transfer of personnel has disrupted communications and generated mistrust. Undesirable results have been ascribed to predecessors, and current managers have not been held accountable for the status quo. Habitat data have not been current nor available to permit objective evaluations. Remote-sensing tools for inventory and monitoring have been expensive to develop and difficult to understand and implement.

Past approaches to the deer and timber conflict in the western interior of Canada and the Western United States have generally used two silvicultural systems. The first system is even-aged management (such as, clearcutting, seed tree, and shelterwood). The objective of this system is to harvest or remove all trees not desired for regeneration and encourage rapid establishment of second-growth stands. On most sites, this approach usually maximizes both short-term economic return on timber as well as rooted forage.

This system, however, also usually eliminates deer use on the cutovers, especially on winter ranges in deep snowpack zones, until conditions recover. Under this system, optimal old-growth stand conditions are never reached or persist only for a short period before merchantable second-growth is again harvested.

The second system is uneven-aged management with the objective of periodically removing some merchantable timber through selective harvesting while retaining some forest cover at all times. This approach depends on the skillful manipulation of the stand to harvest the desired volume and to retain a useful cover-component for deer. Retention of cover is especially critical on winter range, where any reduction in thermal and canopy cover can reduce the ability of the stand to meet deer needs in winter especially in deep snowfall zones. The problems with uneven-aged management are the costs of repeated entries into the stand, the difficulties of designing and administering this type of harvest, the slash accumulations that may impede deer movement, the risk of reducing canopy cover so cover values are compromised, and the potential silvicultural problems from retaining damaged trees in the stand. Despite these problems, uneven-aged management remains one of the most common systems for integrating timber and deer management objectives.

Management Context and Alternatives

Two dilemmas for resource managers in both Canada and the United States are (1) how to deal with apparent policy conflicts within public agencies charged with managing deer, deer habitat, or both and (2) how to deal with intermingled ownerships of both public and private lands.

Legislation often requires forest managers to integrate a variety of resource values into management decisions. Controversy develops when decisions must be made on what multiple uses will prevail in specific areas. Although the degree to which this must be done is often not specified, these requirements clearly preclude complete harvesting of all winter range for mule deer and the management of second growth solely for fiber production.

Application of management solutions can be hindered by land ownership. In the interior of the Western United States, public and private land ownerships are often intermingled in a widespread alternate-section "checkerboard" pattern, which requires both appreciation of differing management philosophies and careful coordination to resolve problems common to both ownerships. Private lands support substantial deer populations in the Western United States. For example, 62 percent of the mule deer and 68 percent of the white-tailed deer distribution in Montana occurs on private land (Mussehl and others 1986).

A mutually acceptable solution is needed for allowing public and private land managers opportunities to meet their respective mandates in considering both commodity and amenity resources. Two options exist: preservation and integrated management.

The Preservation Option—Key deer habitat could be protected by adopting a preservation strategy. This approach has the advantage of assuring professionals and the public that effective habitat exists on a site now without speculation on future management actions or successional developments.

Preservation has several distinct problems for managers:

1. Unless deer resources are extremely high, the value of standing timber precludes the preservation of large blocks of old-growth habitat.

2. Severe winters present the possibility that deer populations may be crowded into preserved islands of suitable habitat. Such crowding could contribute to habitat deterioration and substantial mortality.

3. Old-growth forests are not static. For example, many of these slow growing stands are threatened by Douglas-fir beetles *(Dendroctonus pseudotsuga);* large-diameter food and shelter trees could be lost without management to provide replacement stems.

4. Commitment from the landowner to retain identified stands in their present condition over the long term is difficult and in some cases impossible to get. If the preserved blocks are lost to fire, insects, diseases, or premature harvest before second-growth stands can provide replacements, the ability of the entire range to support deer is compromised.

These problems do not rule out the use of preservation in managing deer habitat. Permanent reserves of mature timber on key portions of winter range may be desirable and acceptable. If natural forces such as fire are controlled, management to maintain old-growth characteristics may be necessary. It is unlikely, however, that enough timber could be set aside as permanent reserves to meet the goals of wildlife managers.

The Integrated Management Option—Integrated management recognizes the goals of forest and wildlife managers and seeks to reach an acceptable compromise through the application of modified forestry practices. This approach has clear advantages:

1. Large tracts of timber are not permanently reserved from contributing to the wood supply, although some reduction in the allowable cut is likely.

2. Deer-habitat values are maintained; reduced slightly; or, in some cases, potentially enhanced.

This option requires supporting data showing deer-habitat values are not substantially eroded by integrated management (Arno and others 1987). Managers cannot wait, however, until complete evidence supporting this approach is available. Because wildlife habitat issues need reconciliation now, managers are willing to accept solutions that do not yet have complete supporting data, especially if the chances for success are high and if the consequences of taking wrong actions are less serious than maintaining the status quo. Typically, managers go with the present professional experience until research dictates a modification of current understanding.

Both preservation and integrated management for deer habitat are practiced on public and private lands. Public lands administered by Provincial, State, or Federal agencies are primarily managed in a multiple-use context whereby timber management can be modified to accommodate other public resource objectives, such as maintenance of deer habitat. Under this management philosophy, preservation is most appropriate when extended rotation and old-growth retention are required. Integrated management can be applied when stand conditions permit periodic removal of some merchantable volume.

Private forest lands are managed primarily for the production of wood fiber. Management philosophy on industrial timberlands can be described as "maintaining public expectations while meeting economic objectives" (Hicks 1985). Management actions that do not significantly limit the economic flexibility of private landowners are most likely to succeed. Integrated management techniques such as selective harvesting and short-term deferral to maintain existing values can be cost effective if maintenance of deer habitat is a management objective. Concurrently, second-growth stands can be intensively managed for a mix of timber and habitat values.

An integrated-management philosophy for resolving the mule deer and timber conflict on public land in eastern Oregon has been jointly endorsed by the Oregon Department of Fish and Wildlife and the USDA Forest Service. These agencies formally agreed to apply published structural, spatial, and size definitions of wildlife habitat (Thomas 1979) in the management of all National Forest lands. This action standardized evaluation of stand inventories for potential wildlife habitat and, therefore, may have reduced overall administrative costs because wildlife habitat was no longer defined ambiguously and because habitat quality was evaluated from readily available timberstand data. This level of management sophistication was adequate for designing and evaluating timber sales in a manner reasonably sensitive to wildlife habitat needs. Wildlife biologists, however, desired a more intricate and precise approach. The effects of this standardized-evaluation approach on mule deer have not been adequately evaluated.

Case Examples of Timber-Habitat Management Tools

Two examples of recently designed tools to aid managers in dealing with timber-deer habitat issues are presented next. Each is designed to meet a specific management need as was described in the problem analysis section of this publication. Because we wish to focus on management applications, the research on which these tools are based will not be described in detail. Interested readers are referred to the original publications.

Example 1. Handbook for Timber and Mule Deer Management Coordination on Winter Ranges in the Cariboo Forest Region, British Columbia.

This section describes the process used in developing a handbook as an integrated-management tool. The process should be of interest to managers and researchers who face the challenge of integrating management of timber and wildlife. The steps in the development and implementation of the handbook are presented in figure 3. References are made to these steps as the process is described in detail.

The handbook serves as a field guide for forest and wildlife managers and logging contractors (Armleder and others 1986) and provides information for coordinating mule deer and timber management on deer winter range in the Cariboo Forest Region of British Columbia. Although the principles contained in the handbook are widely applicable, the specifics may be valid only in the Cariboo.

A low-cost version of the handbook accompanies this paper. The original is spirally bound with waterproof paper stock and some color illustrations and is intended for field use.

Ecological Understanding—Before a successful management tool can be developed, researchers must understand the ecological requirements of deer and how their habitat is affected by timber management. All possible questions need not be answered at scientific levels of acceptability, however, before the development of the tool proceeds. In this example, research continued after development began on the management handbook. In time, the scientific evidence supporting or refuting recommendations would become available to managers.

A basic qualitative model of mule deer habitat relationships is presented in the first section of the handbook and will not be repeated here. The model was included in the management tool because education and understanding are prerequisites to support new strategies and techniques.

The handbook deals specifically with the conflict of harvesting old-growth timber on mule deer winter range. To survive the winter and meet the demands of gestation, deer require suitable food and shelter. These basic requirements are supplied largely by the forest cover on winter range (fig. 4).

The conflict on winter range relates to how the sources of food and shelter shown in figure 4 are altered through typical diameter-limit timber harvesting. This harvesting system removes all stems over a minimum diameter (typically 35-40 centimeters) and consequently eliminates for deer both the canopy that intercepts snow and the major source of winter food (that is, Douglas-fir litterfall). Additionally, thermal and security cover values are reduced by the removal of stems and the damage caused to advance regeneration.

Development of an Integrated Management System—A committee comprised of forest and wildlife managers as well as researchers was established to ensure the development of a practical management system that would be acceptable to all users. This committee reviewed progress and provided the operational perspective throughout the development of the integrated management system.

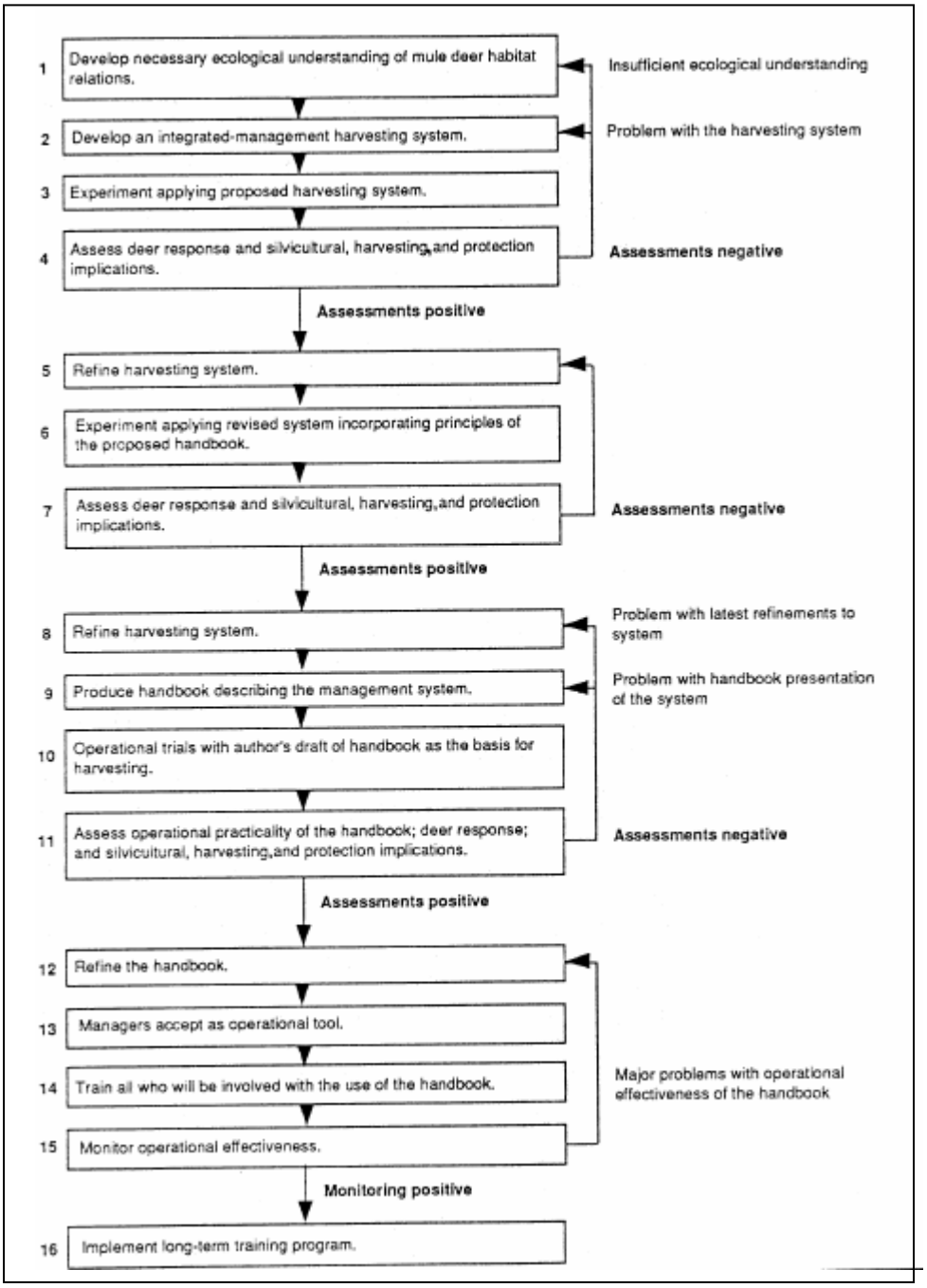


Figure 3— The steps for developing and implementing an integrated management tool: "The Handbook for Timber and Mule Deer Management Co-ordination on Winter Ranges in the Cariboo Forest Region" (Armleder and others 1986).

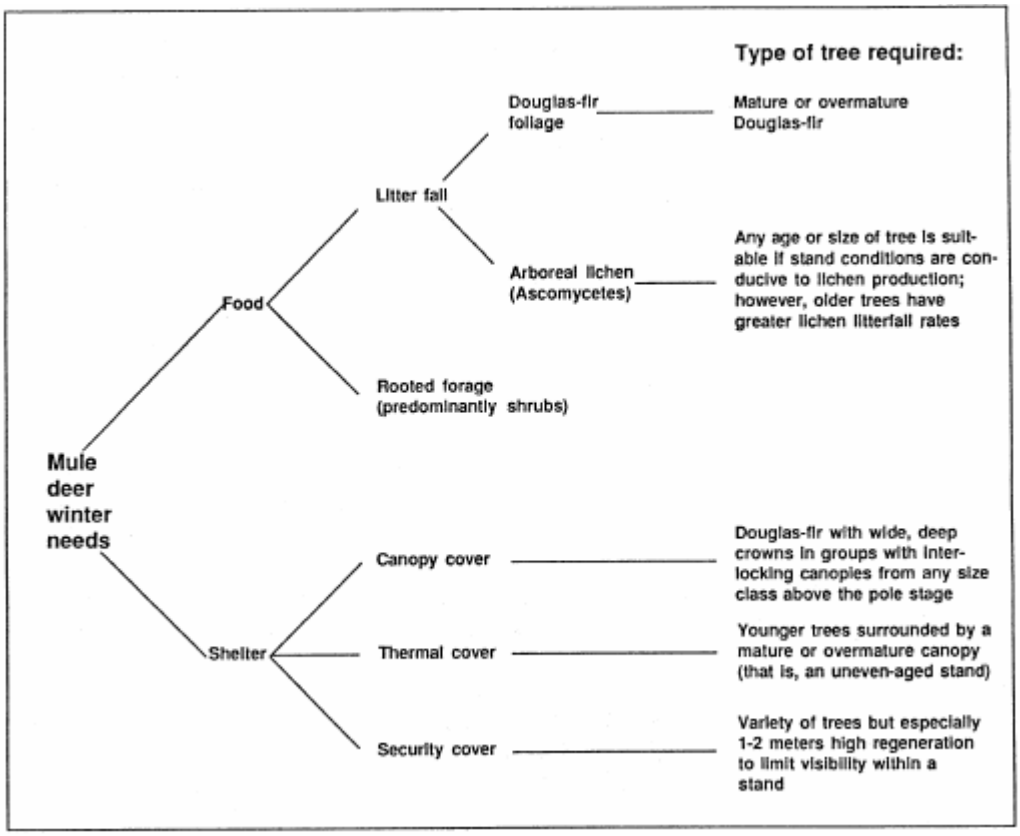


Figure 4— Type of trees required on winter range of mule deer in the Cariboo Forest Region of British Columbia (Armleder and Dawson 1987).

Given the requirements of mule deer and the problems associated with diameter-limit harvesting, researchers determined that a successful integrated management system for winter range must maintain trees that

- are able to intercept snowfall to reduce snow depths,
- are capable of supplying litterfall as a major food source over winter, and
- an provide thermal and security cover.

An uneven-aged management system was designed that would meet these requirements and reflect silvicultural considerations. This system creates and maintains a full range of age classes within a stand, producing multiple layers and sufficient stems in each class to replace those stems in the next oldest class as growth, mortality, and harvesting proceed. The ecology and the structure of most Douglas-fir stands on winter ranges in the Cariboo Forest Region are amenable to uneven-aged management. To meet the specific requirements of deer, uneven-aged management of winter range must have the following characteristics:

A. Harvesting should remove only low volumes with each pass to maintain substantial cover at all times.

B. As many mature and overmature Douglas-fir as possible should be maintained in microhabitats that are most important to deer.

C. Harvesting must be "clean" to discourage Douglas-fir beetles.

D. Steps should be taken (such as, juvenile spacing) to promote and to maintain an uneven-aged stand.

Experimentally Applying the System—This modified uneven-aged harvesting system was then tested on a mule deer winter range. The scale of the harvest was small (25 hectares), and it was carefully controlled by marking all trees to be cut. Site selection for the experiment was influenced by its suitability for future demonstration and training.

Assessment—The main objective of this first harvest was to assess the mule deer response to this type of habitat manipulation. This was done with track transects and by relocating radio-collared deer. Of secondary interest were the implications to forest management, specifically-silviculture, protection, and harvesting (including economics). These were assessed by foresters and, in the case of the logging, the contractor. The results were encouraging and are reported elsewhere (Armleder and Thomson 1984).

Refining the System—Although the assessments were basically positive, refinements to the system were necessary. Certain management realities could not be ignored if the proposed management system was to be accepted operationally:

A. Extremely low-volume harvesting may be uneconomical (the first harvest removed only 13 percent of the merchantable volume).

B. Marking trees for harvest would be costly and impractical (the first harvest was done as a mark-to-cut).

C. Single-tree selection meant inefficient harvesting and difficulties in preventing damage to residuals.

The revised management system recognized these constraints and included the following:

A. Low-volume selective harvesting was recommended (up to 20 percent of the merchantable volume can be removed in each pass).

B. The system was tailored to the snowpack zone in which a specific winter range is located.

C. The condition of the present stand (such as, age, volume, diameter distribution, and crown closure) must be recognized when recommending treatments.

D. Group selection of trees for harvest is recommended.

E. The harvesting criteria are microhabitat specific.

F. The system advocates trained fallers to select trees for harvest.

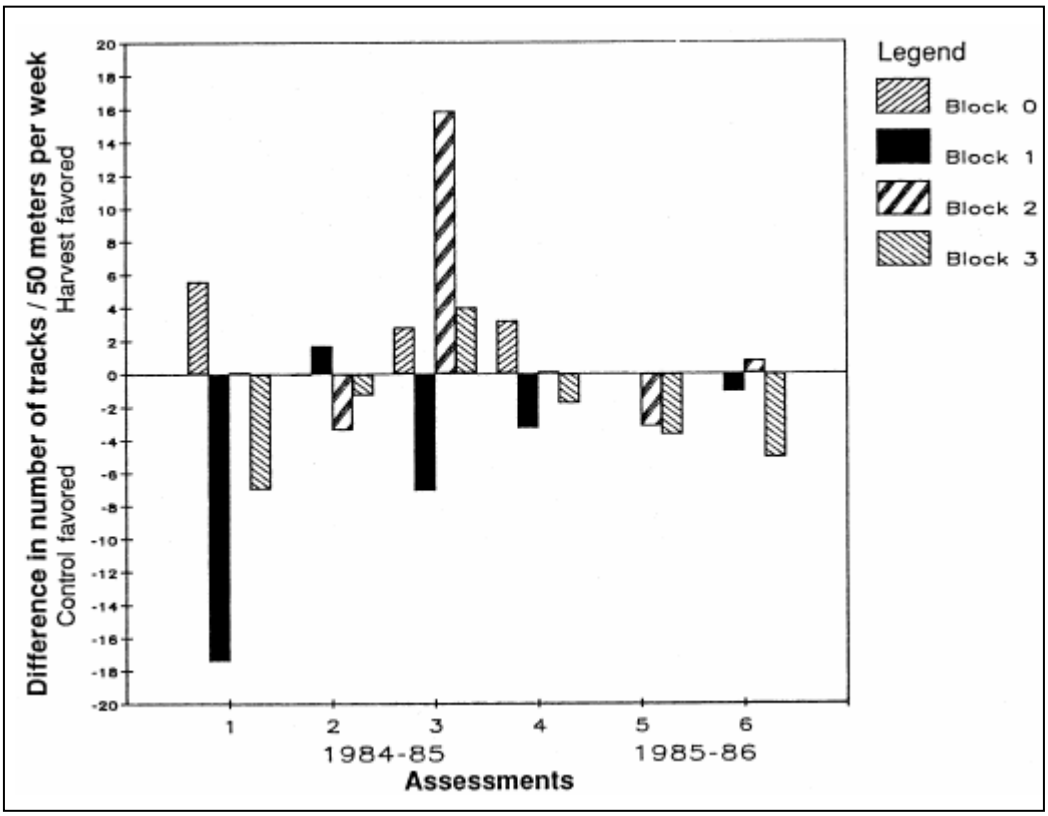


Figure 5—Mule deer response to low-volume selective harvesting measured by the difference in number of tracks/50 meters per week between a paired harvested and control block during 1 assessment. Assessments were taken several times over 2 winters on 4 paired harvested and control blocks.

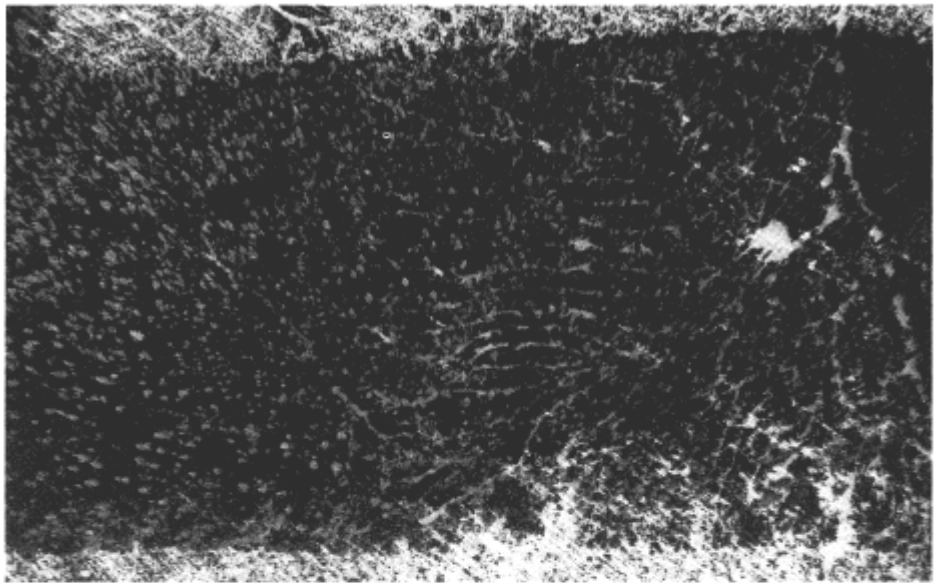
Further Experimental Testing—These steps mirror the previous three with some important differences:

A. The harvesting experiment was conducted on three times the previous area (three replicates totaling 75 hectares). The large area improved the ability to test deer response and to evaluate the harvesting on an operational scale.

B. More, attention was given to the forest management implications, although deer response was still examined closely.

C. More emphasis was placed on soliciting the reaction of potential users (foresters, wildlife biologists, and logging contractors) of the management system.

Draft Handbook—The assessments to this point were encouraging with respect to deer response and forest management implications. For example, no major changes in deer use occurred as a result of the low-volume selective harvesting (fig. 5). This contrasts with the sharp decline in deer use observed during periods of deep snow on areas of high-volume removal. The next requirement was to put the system into a package that would effectively communicate to managers and contractors. The field handbook format was chosen. After a couple of initial drafts, which were reviewed by representatives of the user groups, an author's draft was produced in the final size and format.



A

B

Figure 6—Area selectively logged according to the criteria in the handbook for management of mule deer winter range: A. Aerial view showing the harvested area on the right half and the control on the left half of the photograph. B. Ground view of area after logging showing minimal damage to regeneration and residuals.

Operational Trials—Application of the handbook during harvesting was tested next (fig. 6). Two new mule deer winter ranges were chosen, and new contractors did the logging (table 1). Neither these operational trials nor the previous experimental harvesting were subsidized. The, level of instruction to the contractors and managers was limited to the handbook and brief onsite training. These new trials, thus, tested the latest version of the harvesting system and the clarity of the handbook as a means of communicating the system to the contractors and managers.

Table 1—Experimental harvests In 1983 and 1984 and operational trials In 1985 on winter ranges In the Cariboo Forest Region In British Columbia designed to test the biological, technical, and managerial soundness of the Integrated approach to habitat management for mule deer

Year of harvest	Winter range study area	Area harvested	Replicates	Winters when mule deer response was assessed
		Hectares		*Number*
1983	Knife Creek	25	1	4
1984	Knife Creek	75	3	3
1985	Big Lake	65	4	3
1985	Tree Farm License 5	33	2	3

Assessments and Refinements—The operational productivity of the harvesting system was examined in more detail at this point. Contractors were asked to supply daily productivity reports on each piece of logging equipment. Analyses of these reports revealed that contractor familiarity with the system greatly influenced productivity. After the first few days, productivity increased significantly. Perhaps the best measure of the operational viability of the system was that all contractors were quite willing to continue harvesting in this manner.

Assessments revealed weaknesses in the handbook as a communication tool. Because the handbook applies to a multiple audience (including forest managers, wildlife managers, and logging contractors), modifications were made to clearly direct each audience to the most applicable points. Other minor changes to content and format were also made.

Biological assessments of the deer response to the harvesting system continue with these operational trials. As with the previous experiments, these tests will be conducted over several winters to examine mule deer reaction to a range of winter conditions (table 1). Only minor refinements were required to the harvesting system at this stage.

Managerial Acceptance—At this point, the forest and wildlife managers responsible for winter range for mule deer in the Cariboo Forest Region endorsed the integrated-management system, and the handbook describing it, as an operational guide to their staff. This was a relatively easy step because the key managers were involved in the process from the beginning. The tool was designed for their specific management problem and the final product was influenced, throughout its development, by their concerns.

Initial Training—The handbook was designed to "stand by itself," that is, completely communicate all pertinent aspects of the integrated-management system. However, this does not make training redundant. A training program provides an excellent platform to introduce and describe this new management tool to the users. Involvement by representatives of both forest and wildlife management agencies in the training process serves to emphasize the mutual support for the approach and sends the clear message that the handbook is to be used. Opportunity is provided to supply background information and supporting data to the recommendations presented in the handbook. The training program includes field tours of the experimental areas and the operational trials to show how the principles and concepts are applied on the ground.

Monitoring—Monitoring the operational effectiveness of the integrated-management tool is essential because it is the only method to ultimately determine if the tool contributes to the successful resolution of the management problem. As experience, understanding, and management climate change, the way opens for adaptive management to refine to the system in the future. Cooperation is needed between managers and researchers for this to work. Feedback from managers will be encouraged, and researchers will be prepared to examine their specific concerns.

Long-term Training—A long-term training program will ensure that new managers and contractors are introduced to the system. Training should continue at least until the system becomes the established and the widely accepted method of managing winter range for deer and timber. Additionally, long-term training allows the products of adaptive management to be introduced to the users.

Questions Arising From The Case Study—This handbook and the research that led to its development were designed from the start to help solve a resource management problem. To this end, the primary users, forest and wildlife managers, were involved from the start so that the handbook would have their support at the implementation stage. We are at this stage now. Will the management system and the handbook become the standard way of dealing with mule deer-timber management on winter ranges in the Cariboo Forest Region? If it does, we will have succeeded in integrating the management of two vital resources. If it does not, we will investigate whether the system, the tool, or the technology transfer failed, and we will adapt the experience to other resource conflicts.

Example 2. Implementation and Refinement of Handbooks for Coordination of Timber, Grazing, and Mule Deer Habitat In Managed Forests and Rangelands of the Pacific Northwestern United States.

Two recent handbooks for integrated management, "Wildlife Habitats in Managed Forests" (Thomas 1979) and "Wildlife Habitats in Managed Rangelands" (for introduction, see Maser and Thomas 1983) have received considerable attention by researchers and managers in the Northwestern United States. These handbooks can be used to predict the consequences of contemplated management alternatives on wildlife. Since their introduction, these tools have become practical and available to managers. This case example will focus on the implementation, refinement, and testing of these tools.

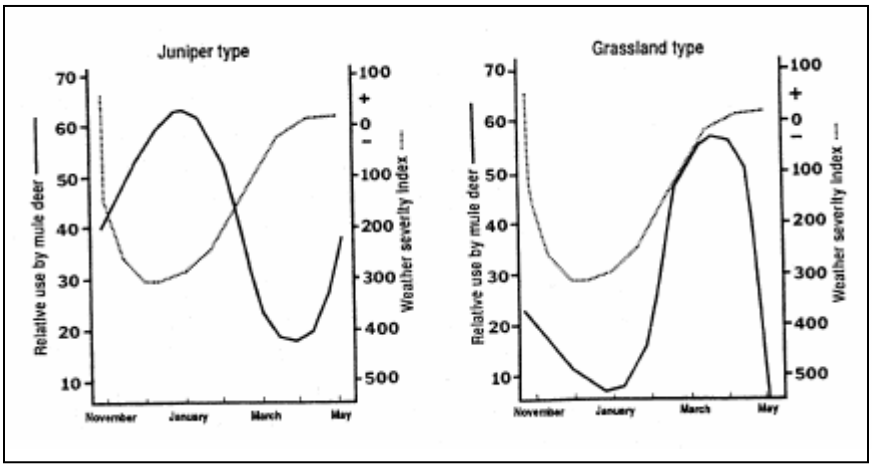


Figure 7—Deer use of cover area (for example, juniper communities) was greatest when weather severity indices were most negative (greatest stress), and use of forage areas (for example, grasslands) was greatest when weather severity indices were most positive (least stress).

Model of Mule Deer Habitat Relations—A complex physiological-nutritional-vegetational model is the foundation for the recommendations on cover and forage needs for deer in both "Wildlife Habitats in Management Forests" and "Wildlife Habitats in Managed Rangelands." Specifically, this model permits calculation of habitat effectiveness, thermal cover effectiveness, and forage quality-quantity effectiveness—all reflecting relations of deer and elk to the structure and composition of their habitats.

The model predicts energy exchanges of ruminants with cover and forage elements of their habitats and was developed from published animal physiological and vegetation structural relations (Brody 1945, Geiger 1966, Hobbs and others 1982, Holter and others 1975, Leckenby 1977, Moen 1973, Reifsnyder and Lull 1965). Predictions of this model include, for example: (1) reduction of the canopy closure of a stand from 70 to 20 percent will reduce available long-wave radiation (used to reduce thermoregulatory stress) by 70 percent, (2) loss of reradiation from the trees (as occurs after clearcut logging) is estimated to cause about a 1.3-fold increase in energy requirements on an average winter day, (3) a reduction in forest cover from 70 to 20 percent would increase the exposure of deer to incoming short-wave radiation from 13 to 40 percent of that available in the open, and (4) thermoregulatory stresses from the greater exposure to solar radiation reduces production (for example, reduces lactation and fattening rates).

This model was validated by observed thresholds of habitat use by mule deer (fig. 7) and elk with changing weather severity and forage availability and by comparing environmental temperatures with animal distribution and behavior (Leckenby 1977, 1978; Leckenby and others 1982; Leckenby and Adams 1986; Parker and Robbins 1984; Parker and others 1984).

Implementation—After cover and forage structure and size criteria were shown to be biologically supported, procedures were needed to map and tally wildlife habitat components (thermal cover, hiding cover, and forage areas) defined in guidelines adopted by the Forest Service and the Oregon Department of Fish and Wildlife (Leckenby and Schrumpf 1977, Leckenby and others 1985) (figs. 8, 9, 10). Satellite digital data and computer processing procedures were developed for inventorying, mapping, and monitoring thermal cover, forage areas, and plant communities.

These remote sensing and computer processing procedures were applied in Oregon to inventory cover and forage stands in areas from 200 hectares to 1.2 million hectares (all with a minimal spatial resolution of 0.4 hectares). The procedures have also been used to assess change (monitor availability and distribution of cover and forage) over periods of 1, 5, and 6 years. The spatial resolution mentioned is not the minimum possible; it was the limit in our applications because we chose to use the 0.4 hectares resolution of the readily obtainable multispectral scanner classifications.

Individual sessions and workshops were developed to train managers to use the tools (fig. 11). Agencies began developing computer systems and a cadre of computer-oriented biologists who could undertake the habitat evaluations. Relative costs of training personnel were low because participating biologists became expert, after 2 days of intensive training. Relative costs of hardware were low because the computer systems were already being purchased for other applications. Pertinent software was available at no cost.

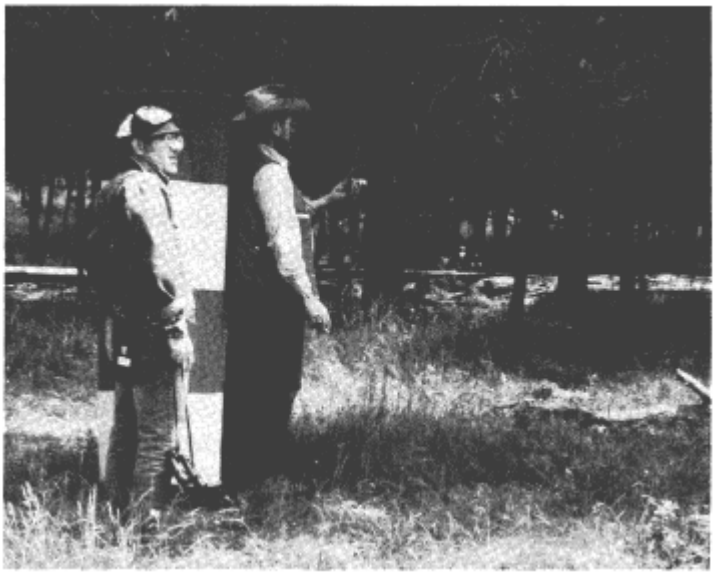


Figure 8—Stand height, crown closure, and the distance at which 90 percent of the hanging target is hidden by vegetation is being measured in field plots. These measurements helped satellite-image interpreters identify thermal cover, hiding cover, and forage areas on the Landscape images.

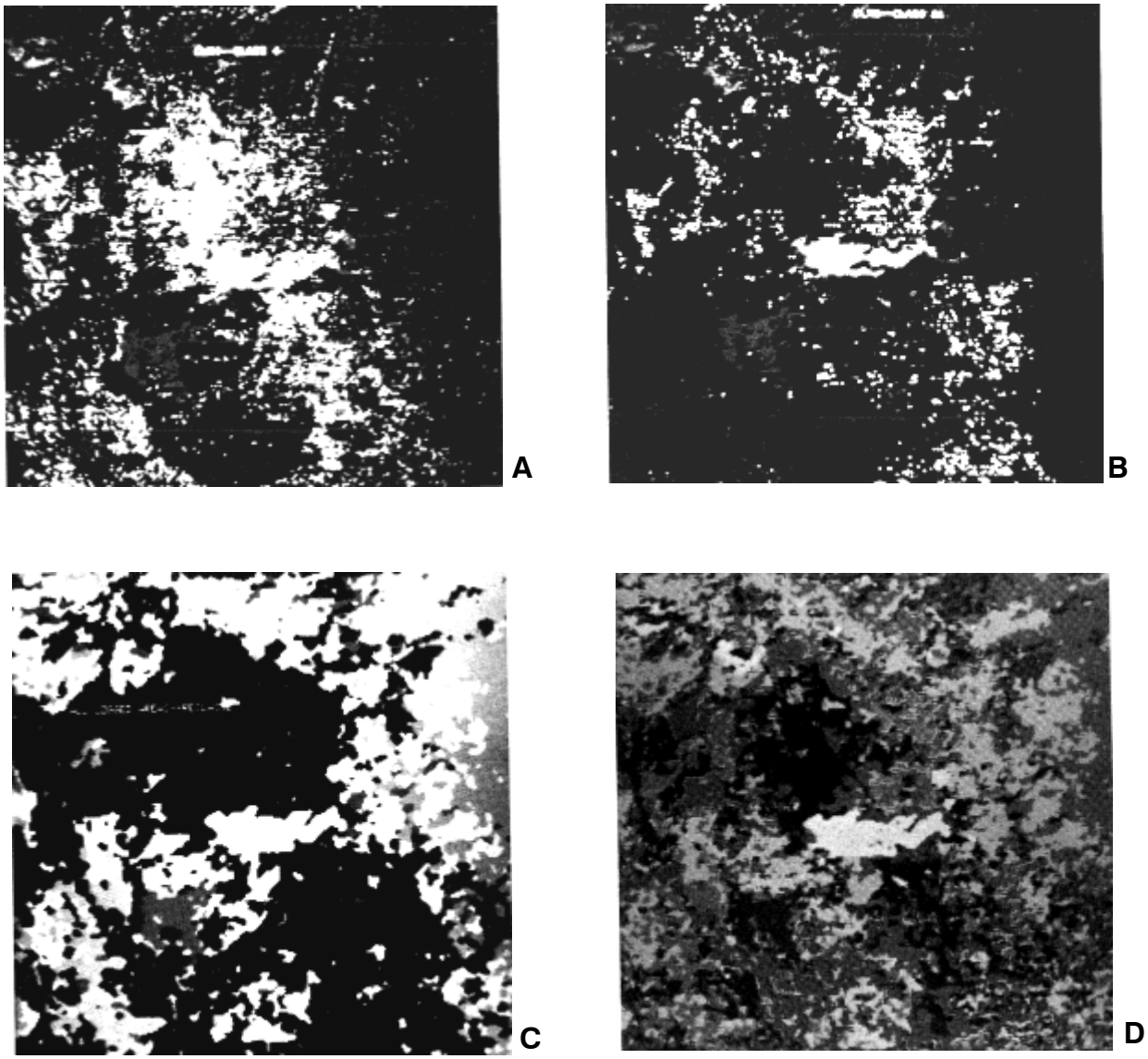


FIgure 9—Landsat images of mule deer range. All images are of the same 29- by 29-kilometer unit of land: A and B. Lightest areas are contrasted mule deer habitats. C. Darkest areas are unlogged, lightest is snow, and other shades are various logged plant communities. D. Final product showing all plant communities, logged and unlogged condition classes, and deer habitats.

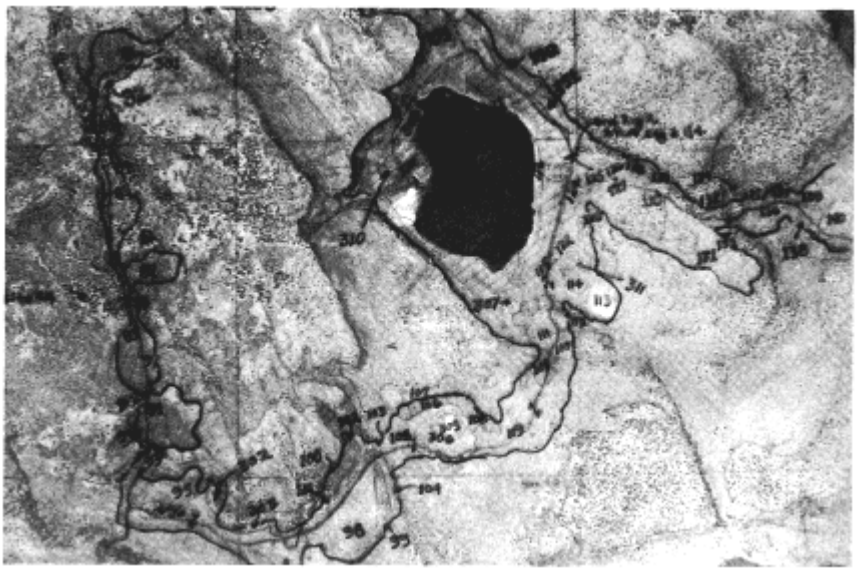


FIgure 1 —Plant community boundaries have been drawn on aerial photographs (2.7- by 4.0-kilometer view shown) around sample habitat stands where field plots were measured. Trainees were shown how ground information was correlated with satellite digital data to produce deer and elk habitat maps for herd ranges in these areas.

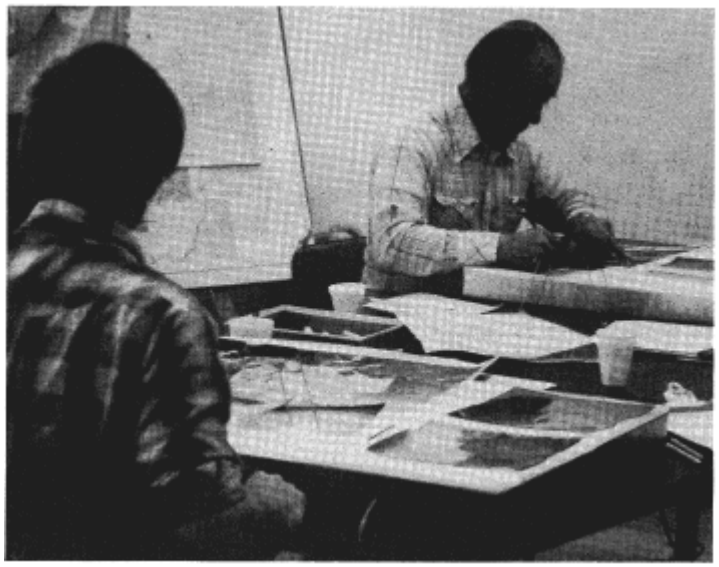


Figure 11—Trainees interpreting double-sample points on aerial photographs; a step in learning to use Landsat-derived deer habitat maps.

The level of sophistication needed to manage wildlife habitat currently (and probably in the future) was easily attained by the computer system. For example, managers normally only map units larger than 4 hectares (timber inventory down to 16 hectares), but the satellite-computer system resolves a minimum of 0.4 hectares and has been used by managers to accurately map at a resolution of 0.9 hectares. Quantitative errors encountered with this system were much less than with older methods of inventory and mapping. Likely risks of error (at various minimal sample sizes) for estimating accuracy were tabulated for managers. With the systems, the manager can check and refine the mapping accuracy (restricted to the maximum correlation of the Landsat Multispectral Scanner data with the habitat elements of interest). To date, over 7.3 million hectares have been mapped.

The cost of using the remote sensing and computer processing system for inventory and monitoring of cover and forage habitat components is less than the use of traditional methods of habitat assessment. For example, 500,000 hectares of deer and elk winter and summer ranges in Oregon were mapped and tabulated with a mainframe computer for about $0.05 per hectare with an overall accuracy of about 90 percent. Programs are now available for running the remote sensing and processing procedures on microcomputers. The amount of and quality of multiple resource work that can be done with the 71- by 71-kilometer parallelogram covered by each data set from Landsat shows the costs of data acquisition and analysis are insignificant when compared with the usual methods of habitat mapping and inventory.

Refinement and Testing—To confirm interpretations made from Landsat, managers were provided with ground-based methods and tools to readily obtain quantitative data on wildlife habitat structure, distribution, and area. Disagreements as to whether specific stands comprised or did not comprise some habitat component usually arose when no data existed. Researchers provided alternate (quick and less accurate) methods by which structural conditions could be estimated from related data (Dealy 1985) (for example, equations predicting crown closure from basal area) for cautionary use when relevant data could not be collected in time for a decision. Researchers also developed techniques and tools for collecting relevant data objectively (for example, collapsible sight-tube for determining sight distance of cover stands). Relative cost of using such techniques and tools was minor if managers were already required to take samples in stands. Each technique and tool was more consistently applied by individuals than the subjective methods being replaced. The management sophistication required was easily attained.

The above tools are being compared with existing methods and criteria for agreement, ease of application, cost to implement, and interpretability. Wildlife biologists are evaluating them on selected areas of Ranger Districts on several National Forests within the Northwestern United States. They are also being tested as part of geographical information systems in several Forest Service regions.

Questions Arising From the Case Study—The main question arising from this case study is whether the majority of managers concerned will adopt the methods, will apply them per se, or will supply their own adaptions, thereby adding to the confusion of foresters and increasing the number of loopholes. Eventually, the necessary expertise with computers, the required machines and software, and the essential data all will exist. Application of these tools for quantifying habitat will depend on the development of specific goals and the desire of resource managers to model future conditions of habitats and populations.

Summary

Deer and timber managers in the interior of Western North America are faced with the major challenge of reconciling the goals of timber production with the maintenance of deer habitat. In the past, the perspectives of managers have tended to emphasize one goal or the other. To successfully meet the challenge, however, forest managers must accept wildlife habitat as a valid and socially justified end to be achieved by the intelligent management of forests and not as a "constraint" on the production of wood-fiber products. Conversely, wildlife managers must recognize the legitimate need by the wood processing industry for a timber supply.

Many forest and wildlife managers in the United States and Canada have made the important and progressive step of conceptualizing an integrated approach for solving the demands for timber and deer resources. Although an integrated approach may not optimize either resource, such an approach offers the possibility of simultaneously producing sustainable yields of both from the land. To make the integrated approach work, researchers must study how the forest ecosystem, including deer and trees, responds to integrated management, and managers must be willing to accept the risks of experimental management (Bunnell 1985) to learn what happens when we play out our best hunches.

How will mule deer respond to integrated timber harvest plans? We have just begun to evaluate their responses. Large-scale, long-term experimental studies should be established. Wildlife researchers must work with managers to carefully decide how such studies proceed and what level of resolution must be reached to adequately assess whether responses of mule deer to forest management are favorable, unfavorable, or neutral.

The two examples of timber-habitat management tools that are described in this paper use somewhat different approaches and are at different stages of development. The timber and mule deer management handbook uses intensive field research and operational harvesting trials to develop site-specific guidelines. The implementation to operations is just beginning. The Wildlife Habitats in Managed Forests and Rangelands Program is now being adopted and evaluated by applications of physiological modeling and satellite imagery to define and map functional habitat units.

The common goal of both tools is to link biological conditions and principles with managerial operations and administration. The measure of success in achieving this goal hinges upon both the applicability of the tools in solving problems and the willingness of resource managers to use the tools.

English Equivalents

1 hectare = 2.47 acres

1 kilometer = 0.62 miles

1 centimeter = 0.3937 inch

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Timber and deer managers have struggled through years of increasing demands and growing conflicts in the interior of Western North America. Integrated management, supported by a sound research data base and effectively communicated to all users, is presented as the only viable approach to an increasingly complex resource future. Two examples of tools recently designed for managers in dealing with timber-deer habitat are discussed.

Keywords: Integrated management, timber management, wildlife habitat management, deer, mule deer.

The **Forest Service** of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives—as directed by Congress—to provide increasingly greater service to a growing Nation.

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Handbook for Timber and Mule Deer Management Co-ordination on Winter Ranges in the Cariboo Forest Region

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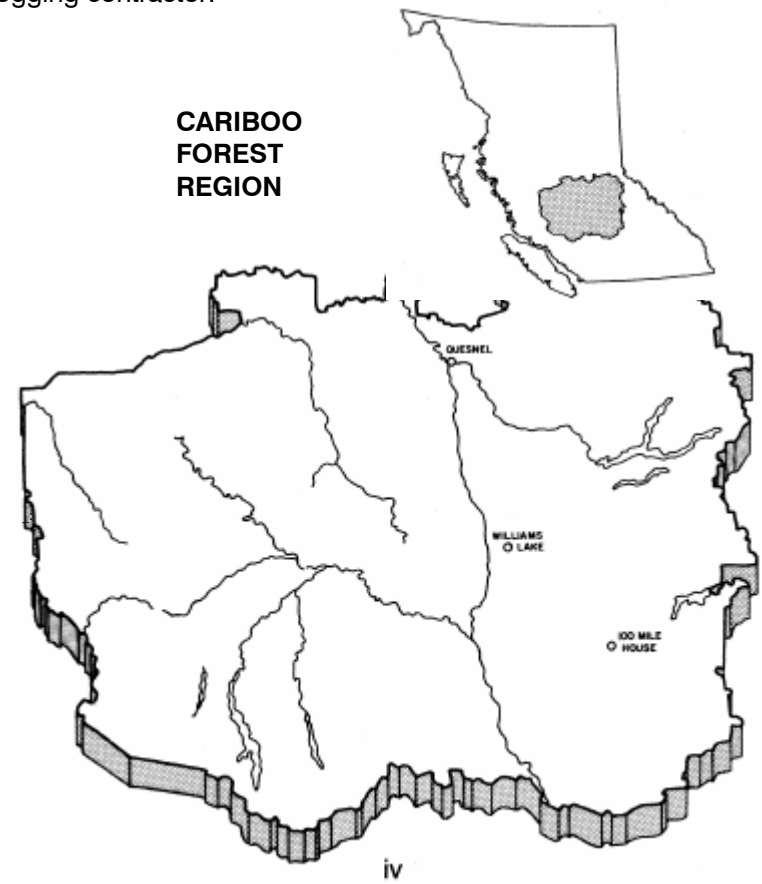
PURPOSE OF THE HANDBOOK

This handbook is a field guide. It provides forest and wildlife managers with the information necessary to co-ordinate mule deer and timber management on deer winter range in the Cariboo Forest Region.

It is not meant to be used as the sole determinant of whether logging should take place on a particular winter range: resource managers must make those decisions considering also regional objectives and priorities. It is, however, intended to aid managers in weighing the options for winter range management. If a decision has been made to harvest, the handbook describes how it should be done and includes detailed instructions for the logging contractor.

CARIBOO FOREST REGION

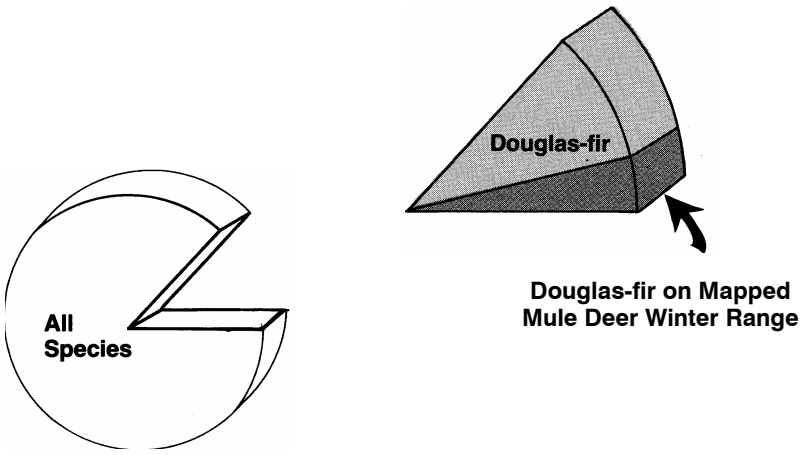


BACKGROUND

Douglas-fir is an important component of the timber supply in the Cariboo Forest Region. A significant amount of the Douglas-fir is also an important component of mule deer winter range. This situation has led to resource allocation problems: Should trees growing on winter range be reserved for mule deer and the benefits that stem from wildlife management? Or, should the Douglas-fir be harvested for timber values? Are compromises possible?

The B.C. Ministry of Forests and Ministry of Environment are working co-operatively to find ways to meet both timber and wildlife management objectives in the Cariboo Region. One part of this co-operative effort is a study of mule deer habitat relationships, funded by the Ministry of Forests and supported by the Ministry of Environment. This handbook is one important output from the study.

BREAKDOWN OF THE GROSS MERCHANTABLE TIMBER VOLUME IN THE CARIBOO FOREST REGION



USER'S GUIDE

The targeted users for this handbook range from managers to technicians and contractors. It will aid managers to develop co-ordinated resource plans for winter ranges in consultation with other resource professionals. Technicians will find it useful for field assessmer;1ts and inspections of logging operations. Contractors will get a clear picture of how to log and space on winter ranges.

The handbook was designed and written with the users in mind. Printed on durable water-proof paper, it is intended for both field and office use. The text is cross-referenced so the reader can locate related information quickly. An index is provided to help find specifics (see p. 97).

Structure

The handbook is divided into two parts. Part I provides the background: the ecological and forest management principles applicable to winter range. Part II describes a "how to" procedure for applying the principles covered in Part I in management and operations.

PART I: ECOLOGICAL AND MANAGEMENT PRINCIPLES FOR WINTER RANGE

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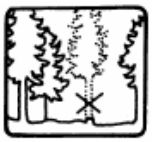

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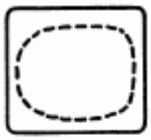

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FOR	EXAMPLE USES
BACKGROUND	**Background knowledge for:** • senior managers • foresters • forest and wildlife technicians • contractors
PLANNING	**Input to:** • co-ordinated resource management plans • local resource use plans • management and working plans • development plans • cutting plans
OPERATIONS	**Operating instructions for:** • logging contractors • fallers, skidder operators • spacing contractors • woodlot licensees

PART I

ECOLOGICAL AND MANAGEMENT PRINCIPALS FOR WINTER RANGE

PART I

This part of the handbook describes the ecological and forestry principles applicable to mule deer and winter range. It provides the basis for understanding how to manage winter range— the subject of Part II. With the principles of Part I in mind the manager can tailor his use of the handbook to meet the needs of specific situations.

Part I answers key questions: What is winter range? Why is winter range required? How does winter range function? Additionally, it reviews the forest management principles applicable to winter range.

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ECOLOGICAL PRINCIPLES FOR WINTER RANGE

WHAT IS WINTER RANGE?

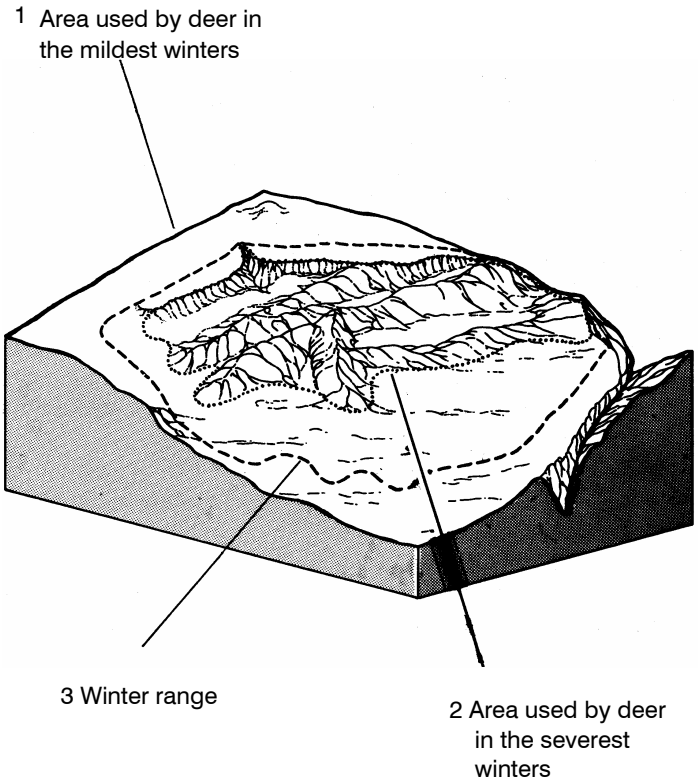
Winter range as described in this handbook is not simply an area occupied by mule deer under any winter condition. In the mildest winters, with little snow accumulation, mule deer will occupy a variety of habitats over a large area (1). Conversely, in the severest of winters, with deep snow accumulation, deer will concentrate on small areas that provide the best protection from these conditions (2).

In the past, terms such as "critical", "important", and "not so important", have been used to describe ranges that deer occupy during various types of winters. These terms are not used in this handbook because, for example, having suitable habitat for average winters is as important as having suitable habitat for the severest winters. Nevertheless, the designations can be useful for ranking winter ranges comparatively to one another.

Winter range, as discussed in this handbook, is defined as an area that provides the resources deer would use during all but the mildest of winter conditions (3). The physical criteria generally used to identify winter range include:

- general SE, S, SW, or W aspect (the exceptions include large river valleys)
- gentle to moderate slope (10-45%)
- elevation below 1500 metres in shallow and moderate snowpack zones and below 1000 metres in the deep snowpack zone (see p. 28)
- Douglas-fir as the predominant tree species (mature and over-mature trees present)

The principles used to define winter range boundaries are explained on pages 50-53.


1 Area used by deer in the mildest winters
3 Winter range
2 Area used by deer in the severest winters

WHY IS WINTER RANGE REQUIRED?

A deer's physical condition helps determine whether or not it survives and reproduces. Condition is usually described in terms of fat reserves, with adequate reserves equated with good condition. Condition changes throughout the year, influenced largely by the quality and quantity of seasonal ranges and weather conditions. During the annual cycle:

1. Deer reach their best condition during the summer and fall with abundant, high quality feed.

2. If the summer and fall range conditions are good, deer enter winter in good shape with adequate fat reserves.

3. If summer and/or fall range conditions are inadequate, deer enter winter with reduced fat reserves.

4. All deer lose some body weight during winter, even if winter range conditions provide adequate food and shelter.

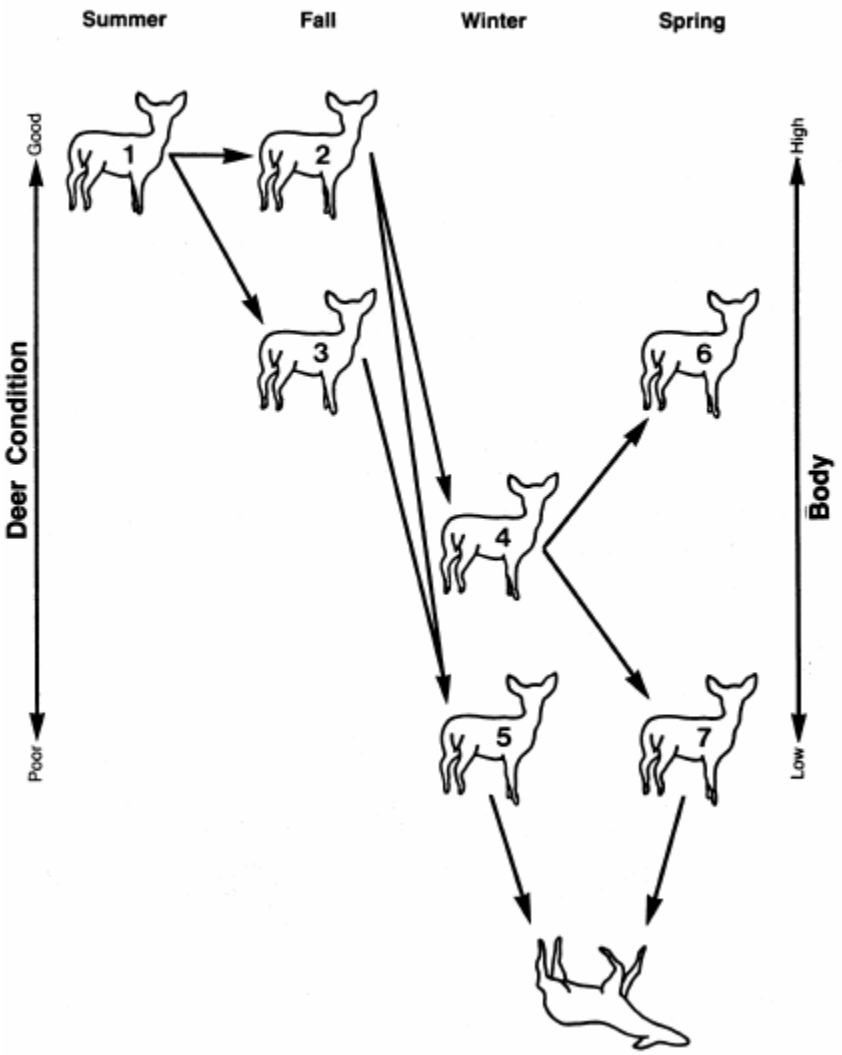
5. Deer can quickly lose weight and die if winter range is scarce or of poor quality. Even if winter range conditions are good, deer will die in moderate or severe winters if their condition at the start of winter is inadequate.

6. Available, good quality spring range can quickly boost animal condition.

7. Deer weakened throughout winter often die in March or April if spring range is unavailable or of poor quality.

Winter, therefore, is the most critical season for deer. During winter deer must cope with the worst environmental conditions while consuming the poorest quality food. This makes good quality winter range essential for their survival and productivity.

SEASONAL CHANGES IN CONDITION



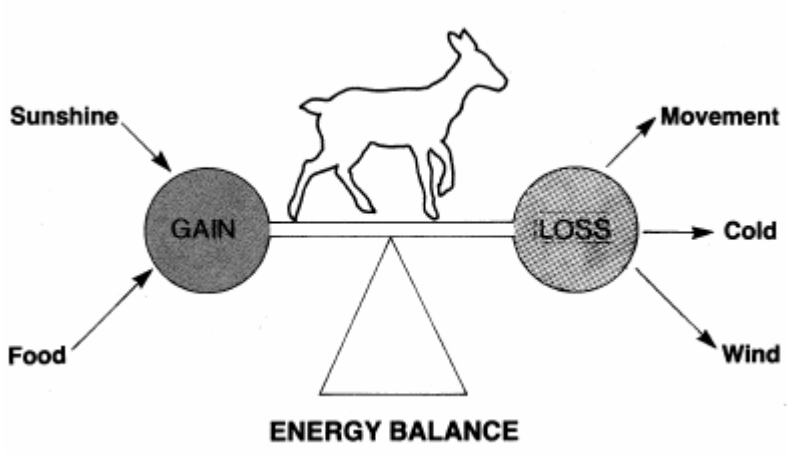
HOW DOES WINTER RANGE FUNCTION?

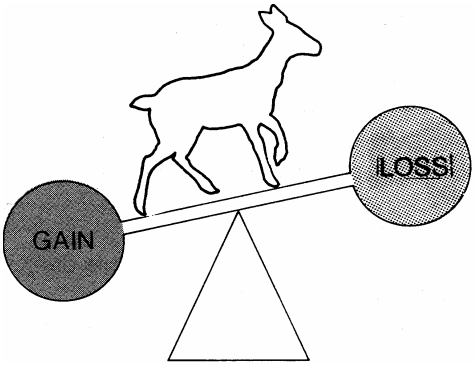
Condition is largely a reflection of an animal's ability to maintain its energy balance. If energy losses exceed gains over an extended period, then condition will suffer, deer will fail to successfully reproduce, and eventually will die. Food provides deer with energy (calories), and the warmth provided by sunshine means fewer calories are used up to maintain a constant body temperature. Increased movement by an animal and exposure to colder temperatures and greater wind result in more calories bei ng used up to keep warm.

Suitable winter range helps deer maintain their energy balance by slowing their rate of weight loss during winter, and improving their chances for survival until spring and summer when food and the environment are better. During winter, deer try to maintain their energy balance by using areas with:

A. Shallow Snow
B. Adequate Food
C. Sufficient Shelter

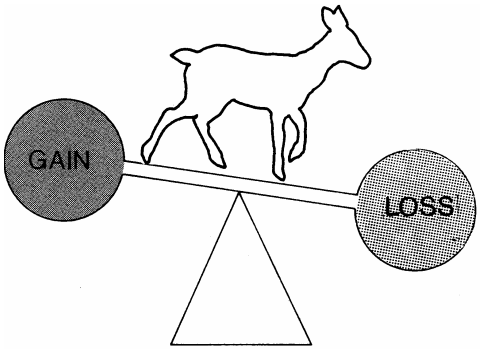
Winter range must provide these areas. They will be discussed over the following pages.





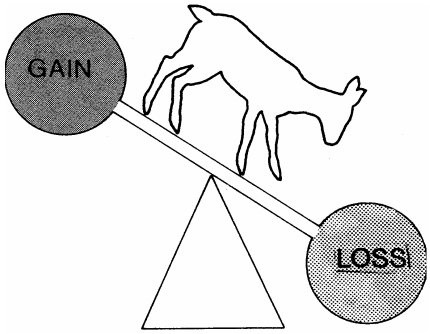
SUMMER RANGE

- energy gains exceed losses



GOOD WINTER RANGE

- energy losses slightly exceed gains



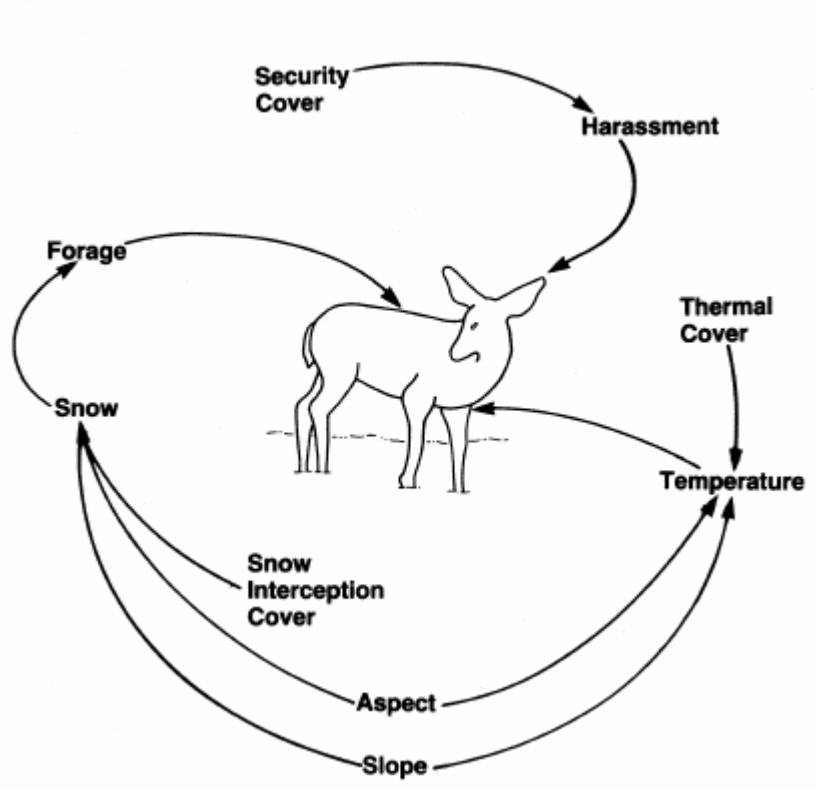
POOR WINTER RANGE

- energy losses greatly exceed gains

DEER CONDITION IN WINTER

The condition of mule deer on winter range (largely reflected by the state of their energy balance) is influenced by numerous factors. For example, the depth of snow with which deer must contend is influenced by the slope of the land, the aspect, and the type and degree of crown closure afforded by the trees. The deeper the snow, the more energy deer must expend to move, and consequently the greater the impact on their condition.

The relationship among the various factors influencing mule deer on winter range is illustrated below and will be discussed individually on the following pages. Arrows represent influences.

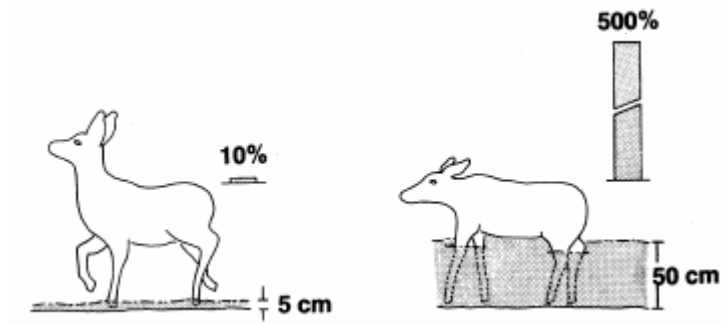


Snow

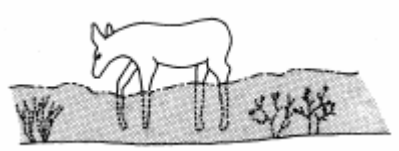
Snow depth affects ease of movement and forage availability. As snow depth increases, so does the energy required to move through it. More fat reserves are used up when deer are travelling through deep snow, than through shallow snow. These reserves cannot be replaced during winter. Movement through dense snow requires more energy expenditure than travel through light fluffy snow.

Moderate to deep snow also buries much food, making it unavailable. Condition of deer deteriorates if alternative food in low snow habitats is not available.

RELATIVE INCREASE IN ENERGY EXPENDITURE FOR MOVEMENT THROUGH SNOW AS COMPARED TO MOVEMENT WITH NO SNOW



GROUND FORAGE BECOMES INCREASINGLY UNAVAILABLE AS SNOW DEPTH INCREASES



Topographic Factors

Slope and aspect are important topographic factors on mule deer winter range because they affect snow characteristics, site temperature, and stand development.

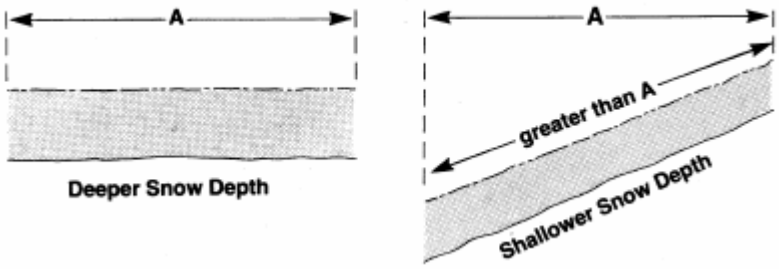
Slope and aspect must be viewed at two levels: 1) the winter range as a whole; and 2) topography within the winter range. Winter ranges as a whole are typically on west to southeast aspects and have gentle to moderate slopes (10-45 %). In some large valleys such as the Fraser and Chilcotin river valleys, other aspects are used because of the moderating effect the valley has on the local climate.

Within a winter range all aspects and slopes are valuable. For example, while northeast aspects often produce stands with the highest crown closure, which intercepts the most snow, on south aspects snow depths are quickly reduced. Slopes within a winter range may vary from near vertical cliffs to flat areas.

Slope

Snow depths are shallower on slopes than on flat areas because the same amount of snow is distributed over a greater area. For example, a 50% slope produces an 11 % shallower snow depth. Because slopes and ridges are often more exposed to wind and sunlight, snow depths are further reduced, making movement easier for deer.

INFLUENCE OF SLOPE ON SNOW DEPTH



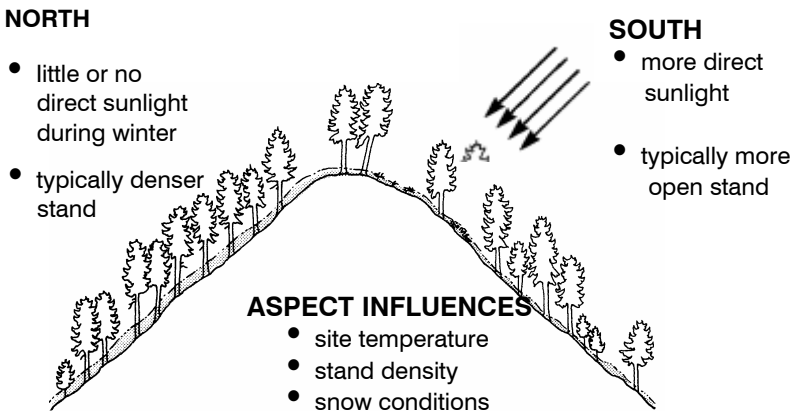
Aspect

Aspect influences snow depth as well as the daytime temperatures experienced by deer. During the day, south slopes are warmer than north slopes because they receive more direct sunlight. Besides helping animals to stay warmer on sunny days, direct sunlight often causes snow to melt on south slopes, making travel easier for deer.

As the snowpack deepens, optimal slopes and aspects become more important. Therefore, in high snowpack zones moderately steep slopes (35 -55 %) on southeast to west aspects are espec_ally important on winter ranges.

Conversely, site conditions on steep south slopes often produce stands that are more open than those produced on cooler aspects (NW, N, NE). This makes these latter aspects valuable within winter ranges, especially when higher snow interception ability is required (e.g., immediately after major snowfalls and before the sun can reduce snow depths on south aspects).

INFLUENCE OF ASPECT



Vegetative Factors

Vegetative factors influencing mule deer condition on winter range can be organized into two broad categories: 1) those that provide some form of shelter, and 2) those that provide forage.

Shelter

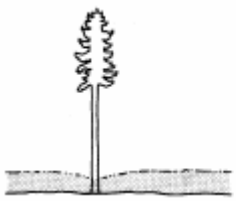
Three types of shelter are required by mule deer on any winter range: 1) Snow Interception Cover, 2) Thermal Cover, and 3) Security Cover. Topographic and vegetative factors in combination often provide necessary forms of shelter.

Snow Interception Cover

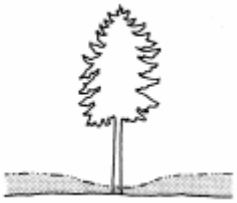
Tree crowns can intercept considerable amounts of snow, making it easier for deer to move about and find food. The size, shape, crown closure, and species of tree crowns influence their ability to intercept snow. Wide, deep tree crowns intercept more snow than do thin, narrow crowns. Interlocking canopies have high crown closure that intercepts the most snow. Douglas-fir is more effective than lodgepole pine at intercepting snow.

SNOW INTERCEPTION ABILITY

Individual Trees

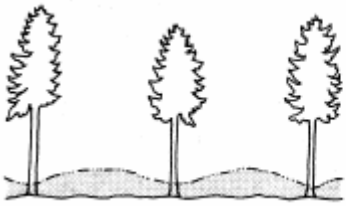


Short, narrow crowns intercept little snow

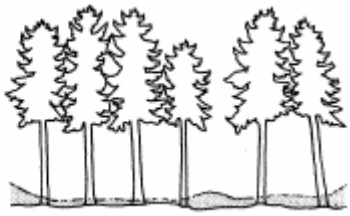


Deep, wide crowns intercept more snow

Stands



Widely spaced crowns intercept little snow

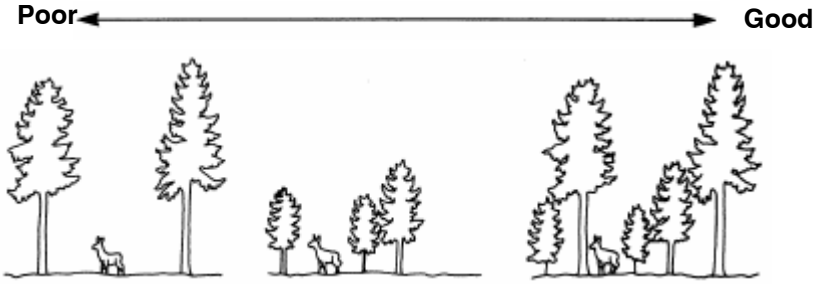


Interlocking crowns intercept the most snow

Thermal Cover

Cover used by deer to assist them in maintaining a constant body temperature is called thermal cover. Thermal cover is provided by trees and, to a lesser degree, topography. The forest canopy acts as a shield by reducing the animals' radiational heat loss to the open sky, especially at night.

STAND STRUCTURE INFLUENCES THERMAL COVER



Single-layered stands provide poor thermal cover

Multi-layered stands provide the best thermal cover

Trees, shrubs, and topography reduce air movement, thereby protecting deer from the chill factor associated with low temperature and increasing winds peed. This slows the deterioration of animal condition.

TOPOGRAPHY AND VEGETATION PROTECT DEER FROM WIND

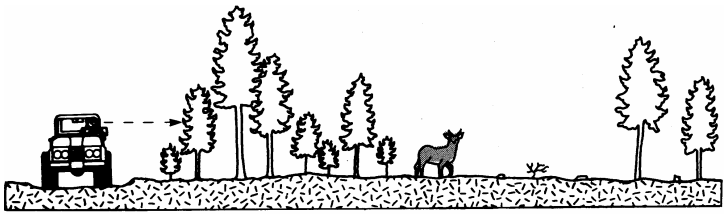
Security Cover

Cover used by deer to conceal themselves is called security cover. Harassment from humans, their machines, and other animals causes deer to run and hide, thus expending energy already in short supply. Security cover cuts this energy expenditure by reducing the need and the distance to flee.

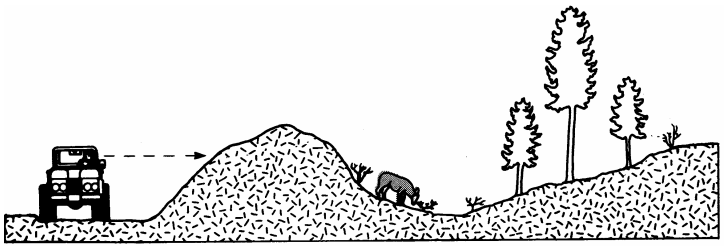
As with thermal cover, vegetation and topography combine to produce security cover. Good thermal cover will provide adequate security cover.

Security cover is especially important along roads to reduce harassment.

SCREENING VEGETATION



SCREENING TOPOGRAPHY



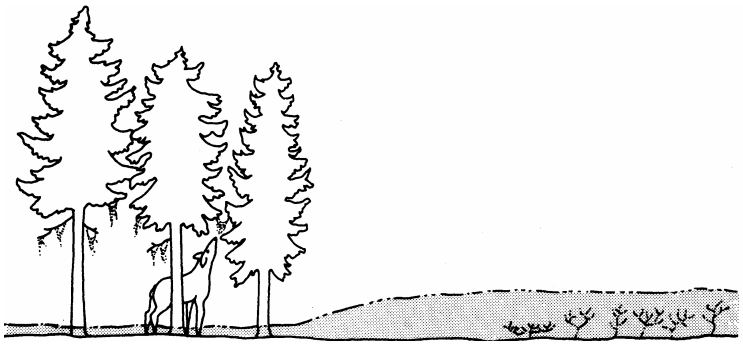
Forage

While the vegetative factors just described deal primarily with ways of minimizing energy losses, forage provides an energy gain. Mule deer use two broad categories of forage: 1) ground forage and 2) litterfall. Ground forage consists of rooted material that is available unless it is buried or inaccessible because of snow. Litterfall is food from the canopy, made available primarily by wind or snow action.

Ground Forage

Ground forage for mule deer on winter range consists of shrubs (predominantly saskatoon, mahonia, sagebrush, Douglas maple, red osier dogwood, wild rose, willow), grasses, and forbs. Shrubs are the preferred and most nutritious winter forage. Shrubs are more abundant in open areas, yet are often unavailable because of deep snow.

SHRUBS ARE OFTEN UNAVAILABLE BECAUSE OF SNOW BURIAL

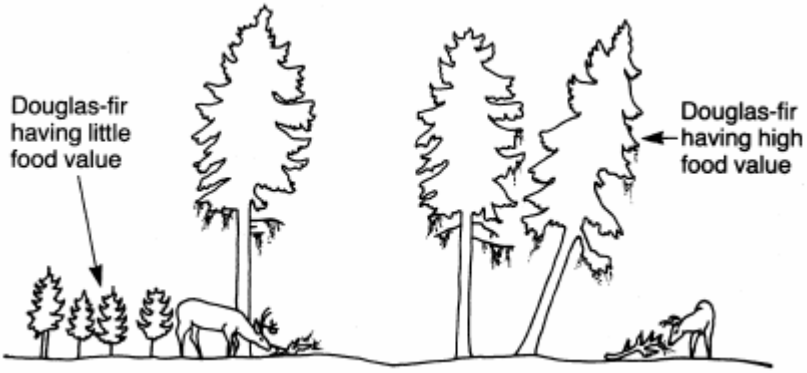


Litterfall

Litterfall consists of twigs and branches of Douglas-fir and arboreal lichens (Le., lichens living on trees). Although lichens are a significant food item where they occur, Douglas-fir is the most common food item in the winter diet of mule deer.

Not all Douglas-fir foliage is equally valuable deer forage. Foliage from the crowns of old trees is better quality forage than the foliage of young trees. Also, old trees are important because their brittle branches frequently break off during winter storms, providing food for deer.

QUALITY OF DOUGLAS-FIR FORAGE IS NOT UNIFORM



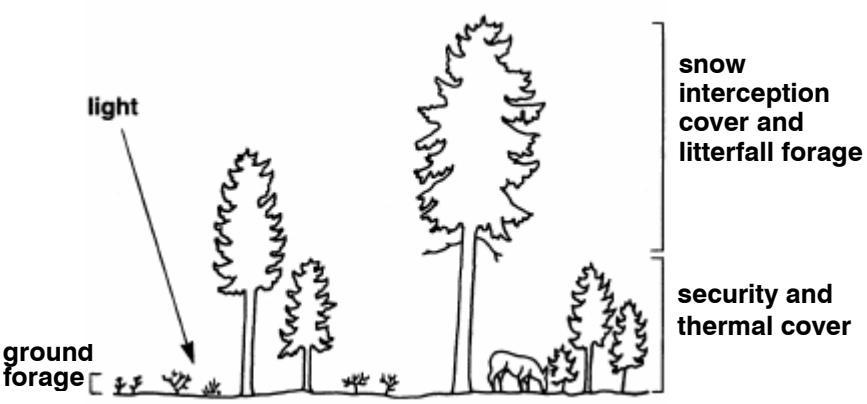
Diversity and Edge

All the components discussed to this point must be present on a winter range. However, how they are distributed across a winter range is important too. Suitable diversity can provide both cover and forage requirements -while edge makes them available in close proximity.

Vertical Diversity

Vertical diversity, created by a multi-layered stand, is important on winter range. For example, although a stand with closed interlocking crowns intercepts snow very efficiently, it allows little light to reach the forest floor and thus makes ground forage scarce. Managers should promote a multi-layered, uneven-aged stand structure with sufficient crown closure for snow interception and litterfall during moderate and severe winters.

VERTICAL DIVERSITY PROVIDES BOTH COVER AND FORAGE VALUES

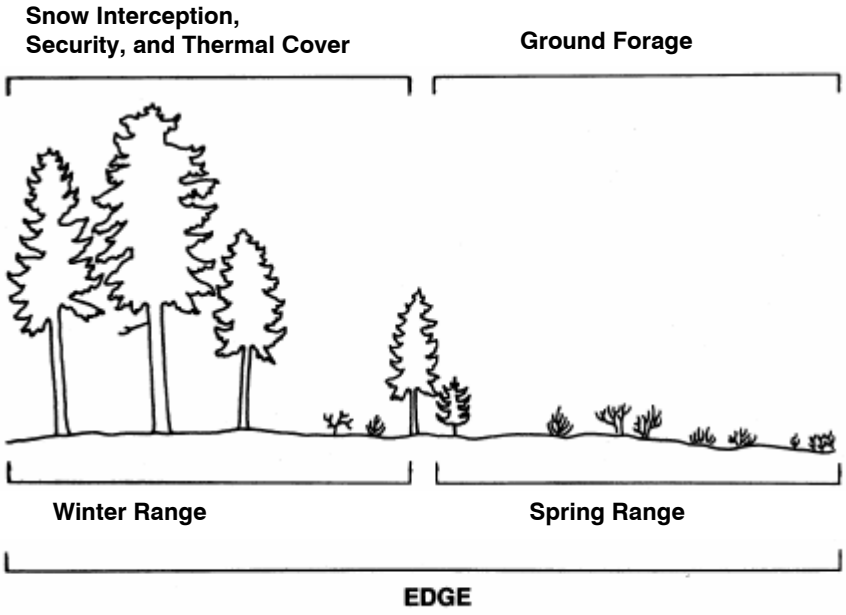


Edge and Horizontal Diversity

A mix of habitat types produces horizontal diversity. It is important for deer to have the resources offered by different habitats in close proximity. For example, as snow melts, deer make the most use of spring range that is adjacent to a habitat offering good security cover.

As well, deer use the edge between such habitats because it contains many resources found in both. Edge can provide cover and ground forage in close proximity—a valuable survival factor.

EDGE PROVIDES MANY RESOURCES IN CLOSE PROXIMITY



Micro-Habitat

Much of the foregoing material is now assembled and portrayed in three dimensions to illustrate how the factors come together on a micro-habitat basis. Any stand or broad habitat type is composed of numerous micro-habitats, each of different value to deer. Some of these are illustrated on the facing page and are explained below.

1. Mule deer make extensive use of ridges and knolls that have mature and over-mature Douglas-fir. These micro-habitats provide both cover and litterfall forage. Even when the surrounding area provides poor quality winter habitat, ridges and knolls are often used by deer.

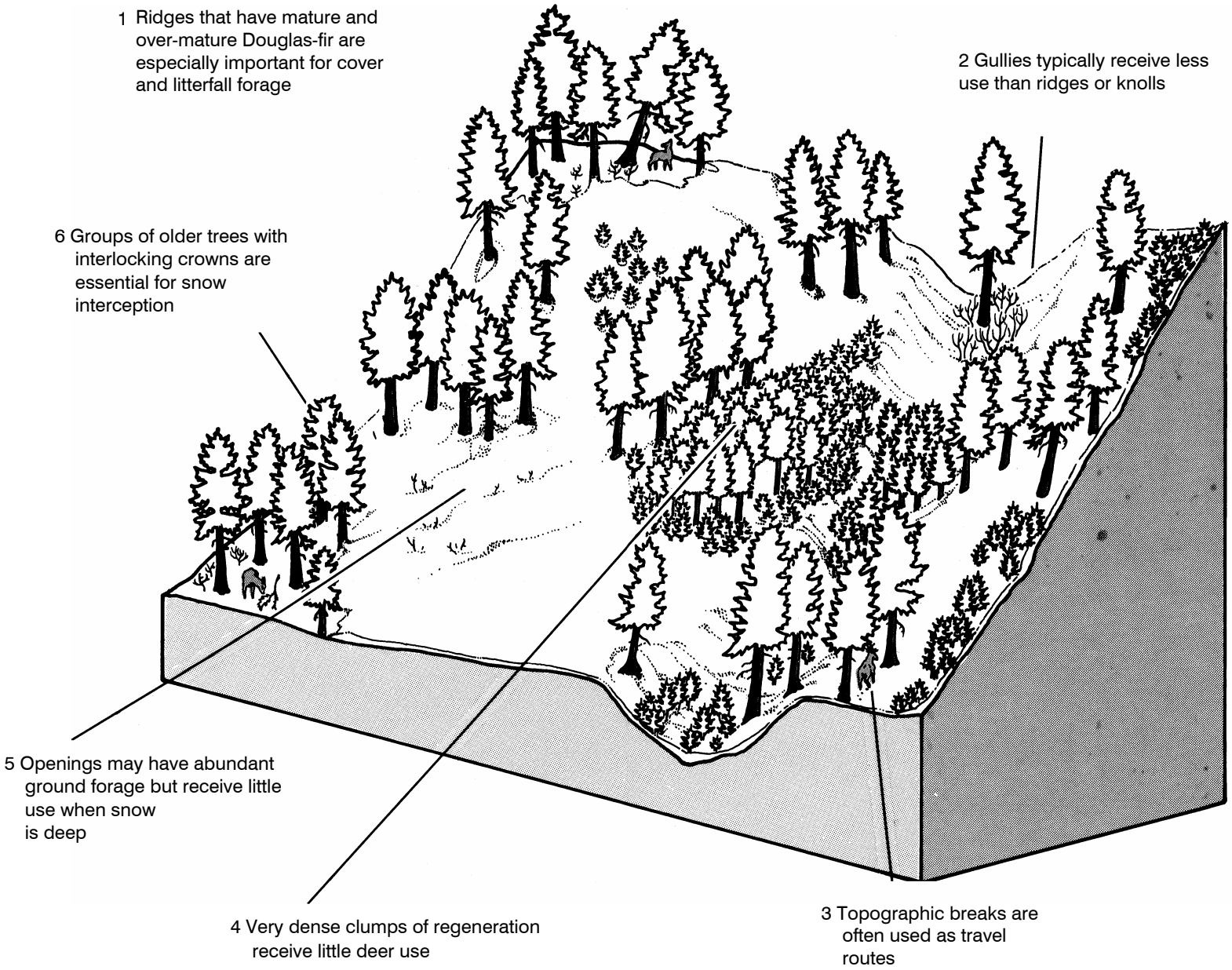
2. Gully bottoms and other moisture-receiving sites typically receive less use in the moderate and high snowpack zones (p. 28). In the low snowpack zone these micro-habitats are valuable to deer because they often provide corridors of high crown closure through otherwise open habitat and provide a source of more abundant ground forage, especially if crown closure is reduced.

3. Topographic breaks or edges are extensively used as travel routes, especially if they have suitable crown closure and security cover.

4. Dense clumps of regeneration within a stand typically receive little use. Ground forage is almost nonexistent under the shade of these clumps and their density often makes travel difficult. Deer use these micro-habitats if they offer the only cover within an area that has been heavily logged.

5. Openings within a stand may have abundant ground forage but receive less use as snow depths increase. Deer make little use of openings when they sink into 50 centimetres or more of snow.

6. Patches of mature Douglas-fir with interlocking crowns are very efficient at intercepting snow. Deer use these patches far more than micro-habitats that contain solitary trees.

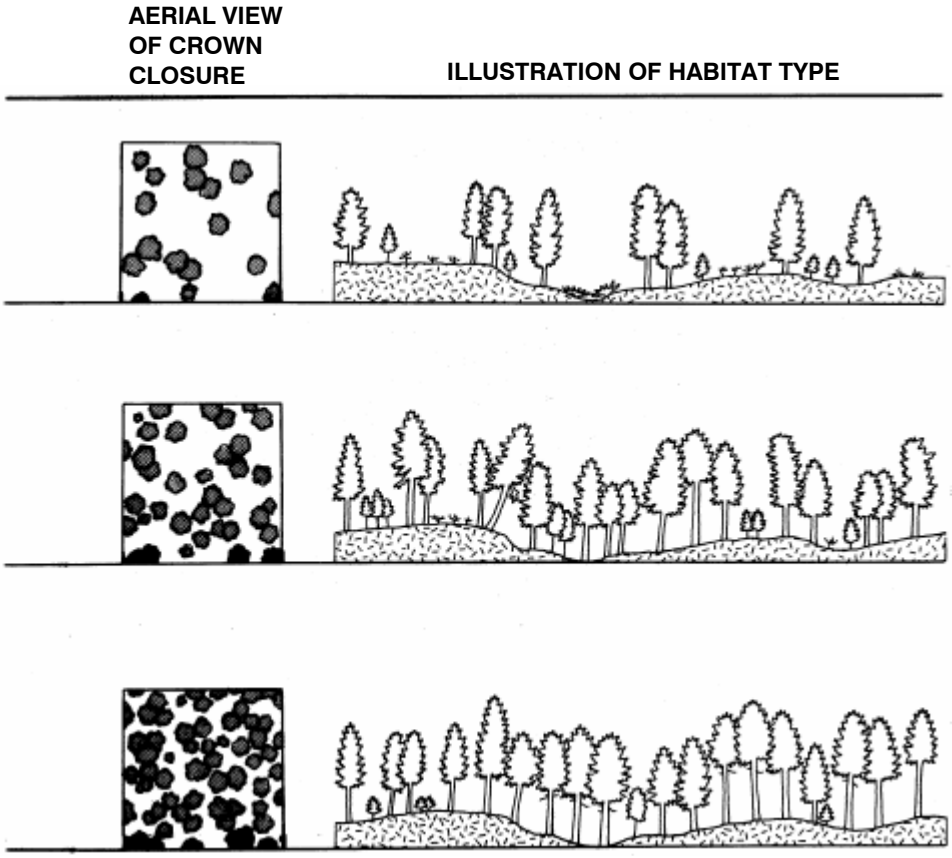

1 Ridges that have mature and over-mature Douglas-fir are especially important for cover and litterfall forage
2 Gullies typically receive less use than ridges or knolls
6 Groups of older trees with interlocking crowns are essential for snow interception
5 Openings may have abundant ground forage but receive little use when snow is deep
4 Very dense clumps of regeneration receive little deer use
3 Topographic breaks are often used as travel routes

Habitat Types

Besides having suitable micro-habitats, on a larger scale each mule deer winter range must have basic types of winter habitat, regardless of the snowpack zone (p. 28) in which it occurs. The differences among these basic habitat types can most easily be described by the amount of crown closure they offer and hence the amount they reduce snow depth. Therefore, the basic habitat types are labelled: Low Crown Closure Habitat, Moderate Crown Closure Habitat, and High Crown Closure Habitat.

HABITAT TYPES	PERCENT CROWN CLOSURE	CROWN CLOSURE CLASS CODES (from new series forest cover maps)
LOW CROWN CLOSURE HABITAT • some dominants • some intermediates • some regeneration	16-35	2,3
MODERATE CROWN CLOSURE HABITAT • all size and age classes well represented	36-65	4,5,6
HIGH CROWN CLOSURE HABITAT • dense canopy of co-dominants • some intermediates • some regeneration	> 65	> 6

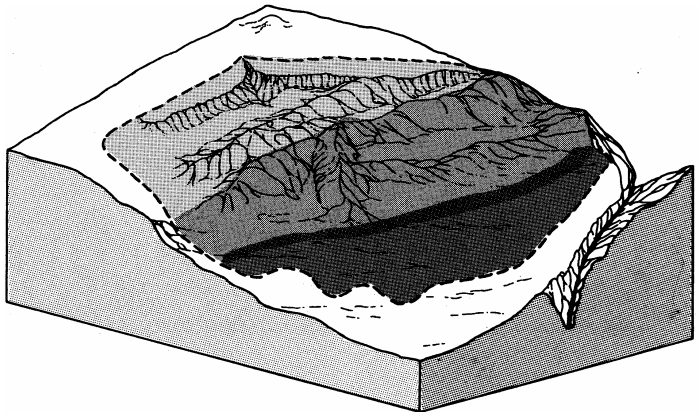
Crown closure is not the sole determinant of winter range habitat value. For example, a stand with high crown closure, made up of 25-year-old trees, 6 metres in height, can not provide the litterfall forage or snow interception as can a stand of the same crown closure, made up of200-year-old trees, 35 metres in height. Therefore, it is important to note that when reference is made to crown closure in this handbook, only trees greater than 10.4 metres in height are included (HEIGHT CLASS CODE > 1 on Forest Cover Maps produced by the Ministry, of Forests). Also, habitat types on mule deer winter range are most valuable if older age classes predominate (AGE CLASS CODES > 6).



Spatial Arrangement of Habitat Types

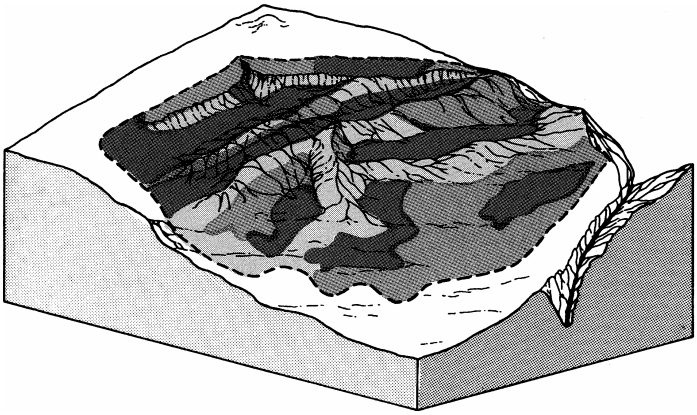
A diversity of habitat types is essential on any winter range because each habitat offers different combinations of food and shelter. For example, during winters or winter periods when snow depths are shallow most deer use areas with little crown closure in which ground forage is abundant. When snow is deep the energy costs of moving through this habitat are too great, so deer seek areas with high crown closure that have shallower snowpacks but less ground forage. Therefore, deer must have access to various habitats to respond to changing winter conditions. The condition of deer will suffer if they must travel over a large area to find these habitats or if travel through low crown closure habitat is required during periods of deep snow.

POOR SPATIAL ARRANGEMENT OF HABITAT TYPES



- all habitat types not easily accessible from any location
- small amount of edge

GOOD SPATIAL ARRANGEMENT OF HABITAT TYPES



- all habitat types readily accessible from any other type
- large amount of edge

Snowpack Zones

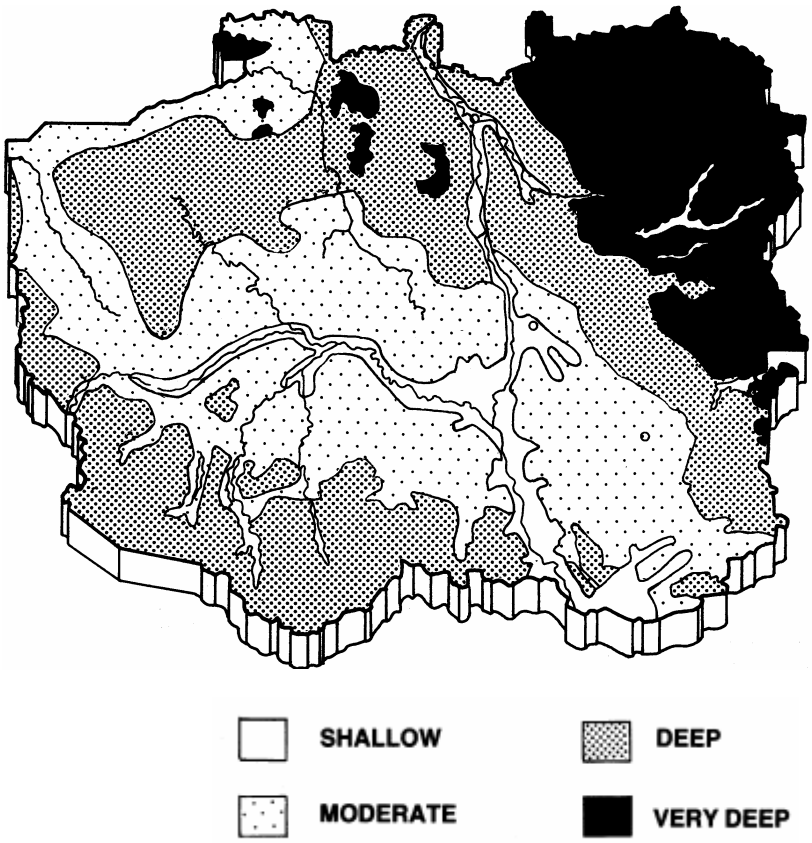
Depth of snowpack is a major factor affecting mule deer habitat requirements during winter. Therefore, as a basis for tailoring habitat management to various snowpack conditions, the winter ranges in the Cariboo Forest Region can be categorized into one of four snowpack zones. These zones are delineated on the basis of biogeoclimatic subzones. To identify the snowpack zone in which a particular winter range is located, the biogeoclimatic subzone in which it is located must first be determined (see draft map of the Biogeoclimatic Units of the Cariboo Forest Region, 1986 edition). The table below shows the corresponding snowpack zone.

CHARACTERISTICS OF SNOWPACK ZONES

SNOWPACK ZONE	MEAN ANNUAL SNOWFALL (cm)	BIOGEOCLIMATIC SUBZONES
SHALLOW	100	PPBGe, PPBGg, IDFa
MODERATE	1 00 - 150	IDFb, SBSa, SBSI
DEEP	150 - 200	SBSb, SBSk, SBSc, SBSm, IDFj, MS, MSe MSd, ESSFg, ESSF
VERY DEEP*	>200	ICHe, ICHh, ICHm, SBSe, SBSj, ESSFe, ESSFh

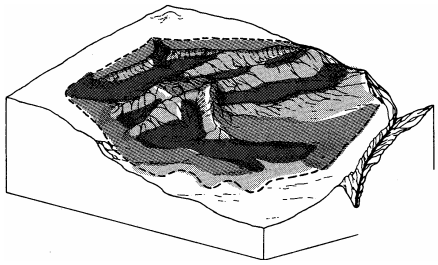
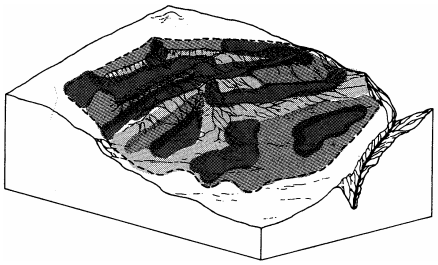
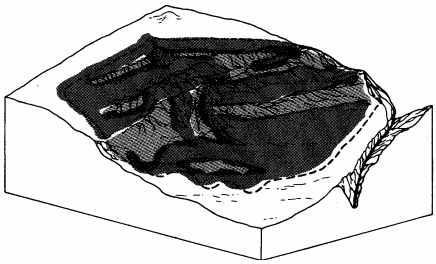
* This handbook does not address the few winter ranges in this snowpack zone.

SNOWPACK ZONES IN THE CARIBOO FOREST REGION



Snowpack Alters Habitat Proportions

Winter ranges occurring in each snowpack zone differ in the amount of each type of winter range habitat that is required to provide the winter needs of deer. For example, if a winter range is located in the high snowpack zone it must have more high crown closure habitat than a winter range located in the low snowpack zone.

WINTER RANGE LOCATION	ILLUSTRATIONS OF WINTER RANGES SHOWING HABITAT PROPORTIONS
SHALLOW SNOWP ACK ZONE	
MODERATE SNOWP ACK ZONE	
DEEP SNOWPACK ZONE	

Just as the snowpack zones do not have absolutely discrete boundaries, so the proportions of each habitat type required on winter ranges in the three snowpack zones are also only approximate. However, they are valuable for management and therefore will be referred to in Part II.

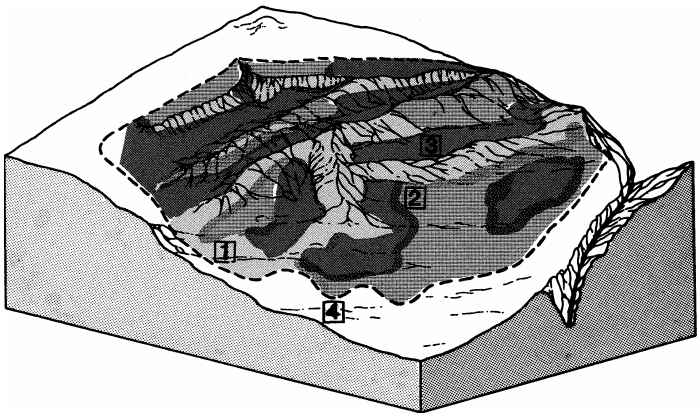
PROPORTION OF EACH HABITAT TYPE REQUIRED ON WINTER RANGES OCCURRING IN THE THREE SNOWPACK ZONES

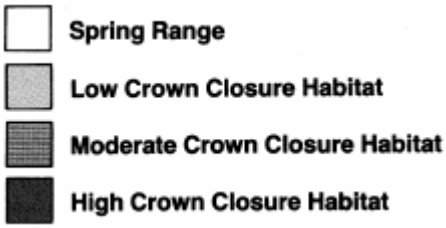
Low Crown Closure Habitat	Moderate Crown Closure Habitat	High Crown Closure Habitat
~40%	~40%	~20%
~33%	~33%	~33%
~33%		~66%

Features of a Prime Mule Deer Winter Range

The habitat principles and winter range components already discussed are now combined and spatially organized to illustrate an entire winter range. Of course, prime winter ranges vary with the snowpack zone in which they occur, especially in the proportion of the habitat types comprising the winter range. The following figures illustrate a prime mule deer winter range in the moderate snowpack zone.

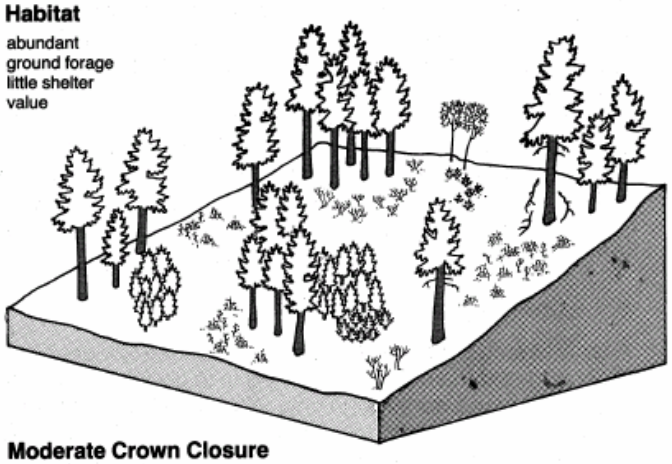
The value of a winter range is enhanced by the presence of adjacent spring range, as illustrated below.





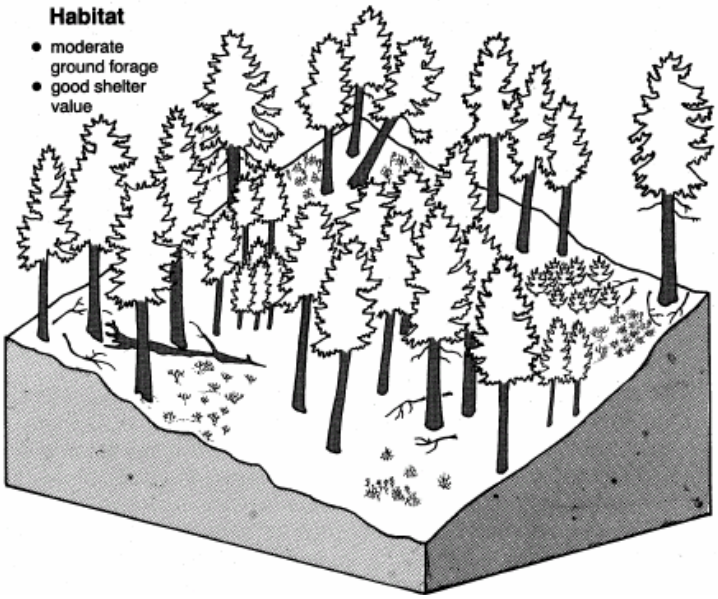
1 Low Crown Closure Habitat

- abundant ground forage
- little shelter value



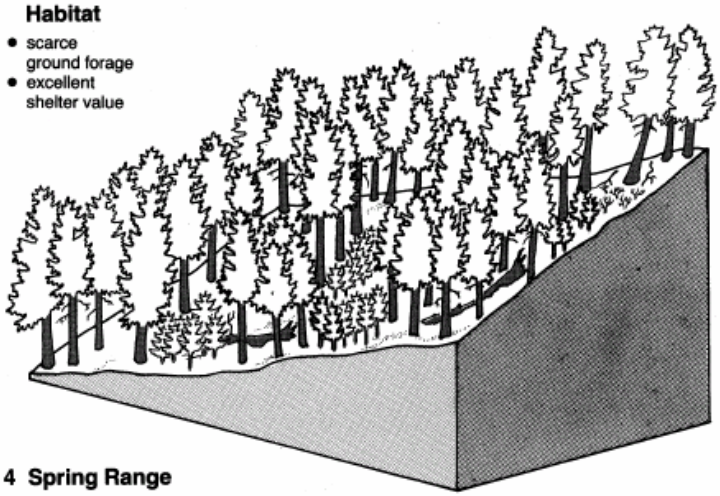
2 Moderate Crown Closure Habitat

- moderate ground forage
- good shelter value



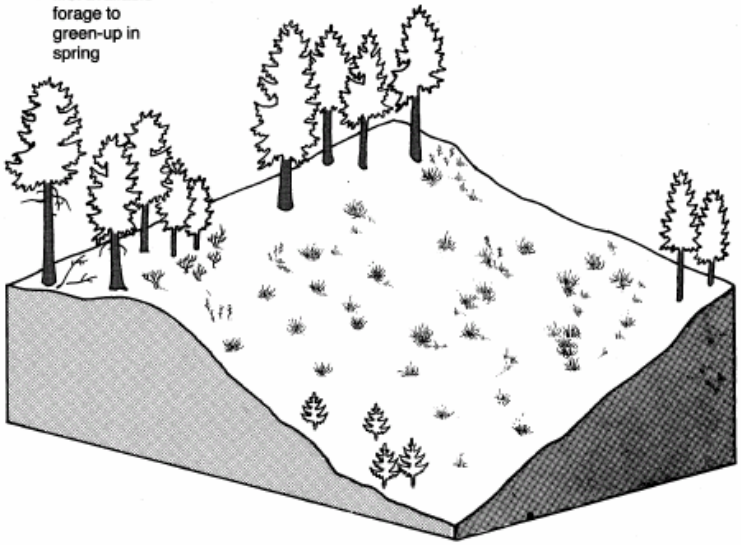
3 High Crown Closure Habitat

- scarce ground forage
- excellent shelter value



4 Spring Range

- first available forage to green-up in spring



FOREST MANAGEMENT PRINCIPLES FOR WINTER RANGE

While some timber management practices are compatible with the maintenance of mule deer winter range, others are not. For example, clearcut logging destroys winter range habitat, but low volume selective logging may have little impact. Juvenile spacing, properly applied, may in time enhance winter range values. This section describes forest management principles applicable to winter range once a decision has been made to harvest: that is, by adopting these principles, forest managers will be able to minimize the negative impact of timber extraction, maintain habitat values, or, in a few instances, enhance winter range values.

Selective Harvesting

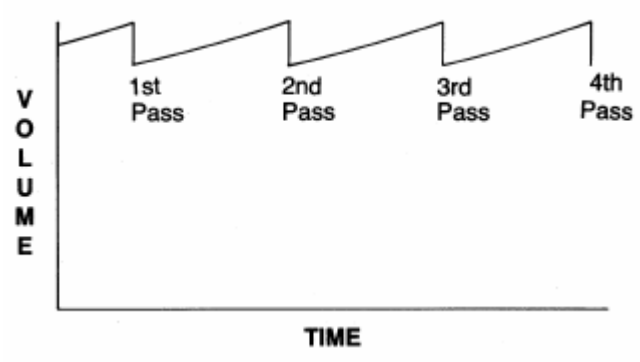
A multi-layered, uneven-aged stand structure should be promoted and maintained if an area is to provide continuous winter range values through time. Therefore, each harvest must be selective, removing only a small volume (typically 10-20% of the gross merchantable volume). A small percentage volume removal is recommended rather than a fixed amount because the "bottom line". objective on winter range should be to minimize the negative impact of timber extraction in every stand regardless of present volume. When growth has replaced the harvested volume and the stand has recovered any winter range values which may have been lost, the second pass may be taken. The re-entry period will vary with sites, depending upon the growing conditions, the structure of the harvested stand, the type of winter range habitat desired, and the status of the surrounding area. This harvesting pattern will produce a series of small impacts on the winter range. In contrast, a single heavy cut, especially in the older age classes, would create a large negative impact that could last for a very long time.

As multiple re-entries take place over time, the trees on micro-habitats least important to deer, and those on micro-habitats valuable for ground forage production, may be harvested at silvicultural or economic maturity. However, the trees on micro-habitats (e.g., ridges) offering valuable litterfall forage and snow interception should be managed on an extended rotation basis (e.g., 200 years +) or not harvested at all, to maintain habitat quality. A significant component of over-mature trees must always be present.

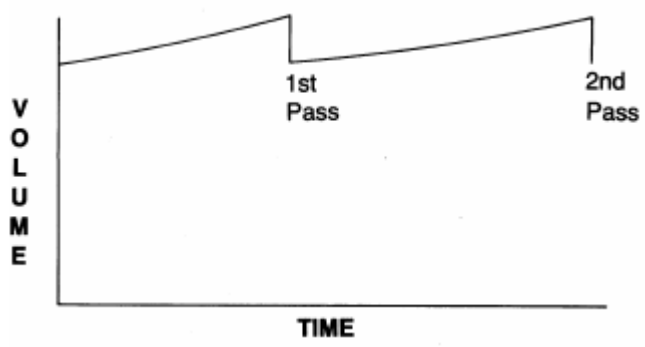
RE-ENTRY PERIOD DEPENDS UPON

- Growing conditions
- Structure of the harvested stand
- Habitat type objectives
- Status of the surrounding area

Low Volume Selective Logging
Short Re-Entry Period



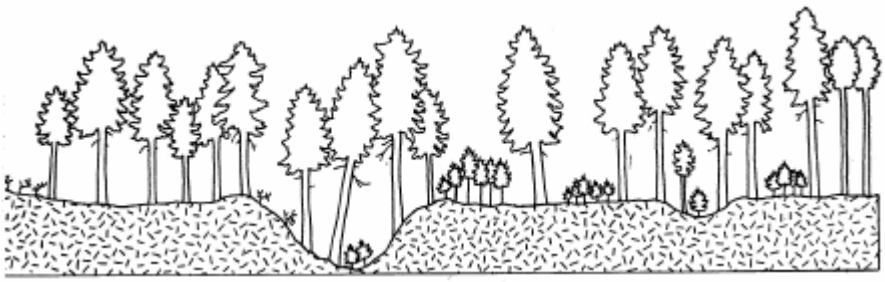
Low Volume Selective Logging
Long Re-Entry Period



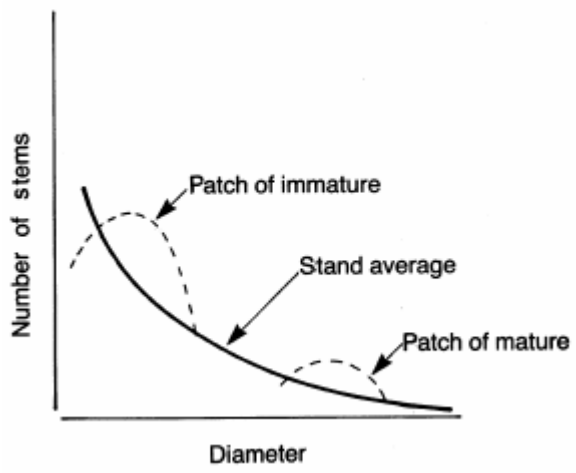
Selectively Harvesting "Dry-Belt" Douglas-fir
(Biogeoclimatic Subzones PPBGe, IDFa, IDFb)

The age and size structure of "dry-belt" Douglas-fir stands is complex. Patches of timber with wide ranges of size merge into dense clumps of regeneration, which in turn are often found adjacent to small stands of mature timber with a closed canopy and no regeneration.

GENERALIZED STRUCTURE OF A DRY-BELT DOUGLAS-FIR STAND

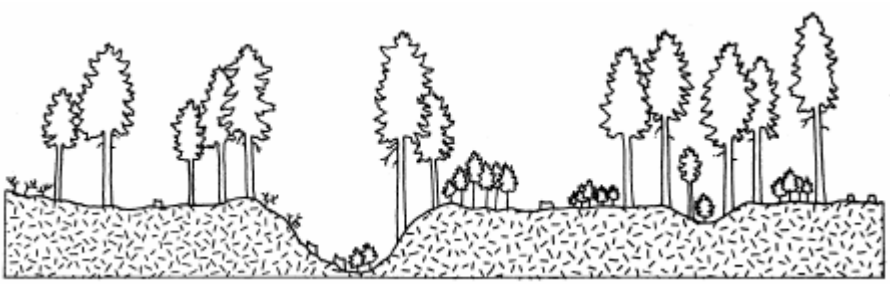


DIAMETER DISTRIBUTION



Many dry-belt Douglas-fir stands have an uneven-aged stand structure that is compatible with mule deer winter habitat requirements. It offers good vertical diversity: mature crown closure for snow interception, old trees for litterfall forage, saplings for thermal and security cover, and small openings that promote shrubs for ground forage. Selective logging can perpetuate an uneven-aged stand if minimal damage occurs to the numerous trees left after harvesting.

AFTER SELECTIVE LOGGING TO PERPETUATE AN UNEVEN-AGED STAND IN DRY-BELT DOUGLAS-FIR



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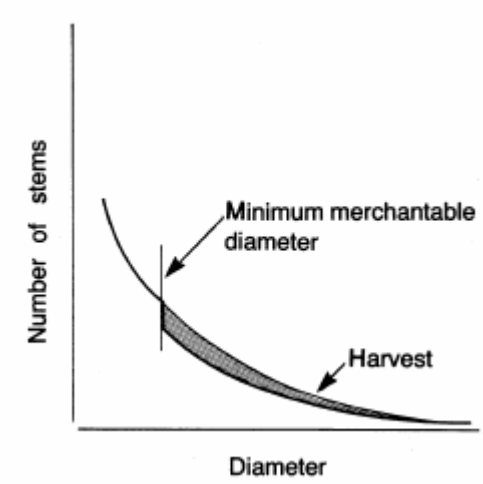
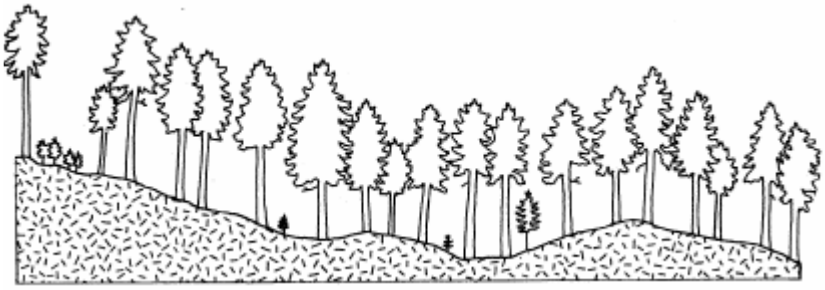


Selectivity Harvesting "Transition-Belt" Douglas-fir (Biogeoclimatic Subzones IDFj, SBSI, SBSk)

Typically, "transition-belt" Douglas-fir stands are simpler in structure than dry-belt fir stands. The canopy is more uniform with few dominant trees projecting beyond the main canopy of co-dominants. The regeneration and pole layers are scattered and often not well represented.

GENERALIZED STRUCTURE OF A TRANSITION-BELT DOUGLAS-FIR STAND



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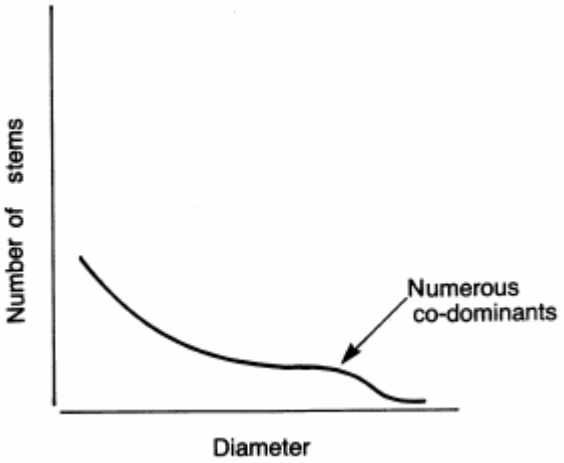
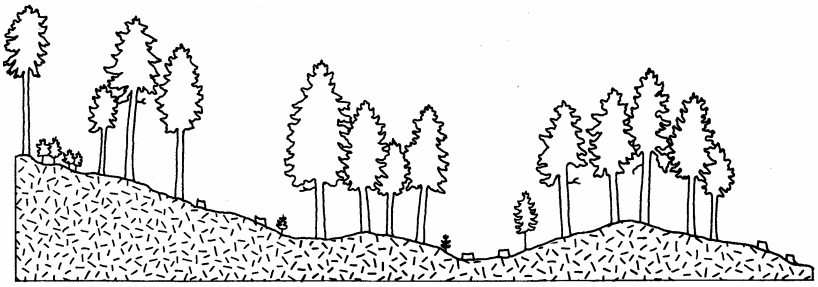


Some transition-belt Douglas-fir stands can be selectively logged to promote a more uneven-aged stand structure. Winter ranges in these biogeoclimatic subzones typically occur on the drier, warmer sites where uneven-aged management of Douglas-fir is silviculturally sound, through the application of light selective harvesting (10-15% of the gross merchantable volume). As with dry-belt Douglas-fir, the objective is to improve vertical diversity.

SELECTIVE LOGGING TO PROMOTE AN UNEVEN-AGED STAND \IN TRANSITION-BELT DOUGLAS-FIR



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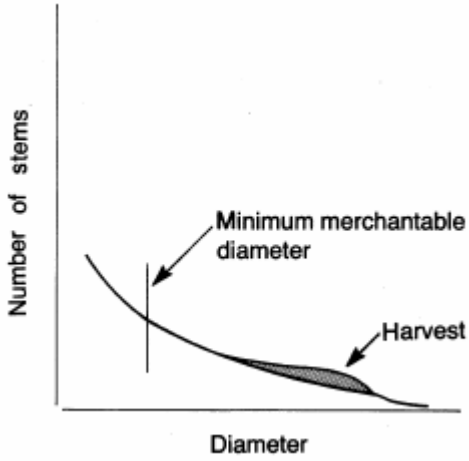


Silvicultural Treatments

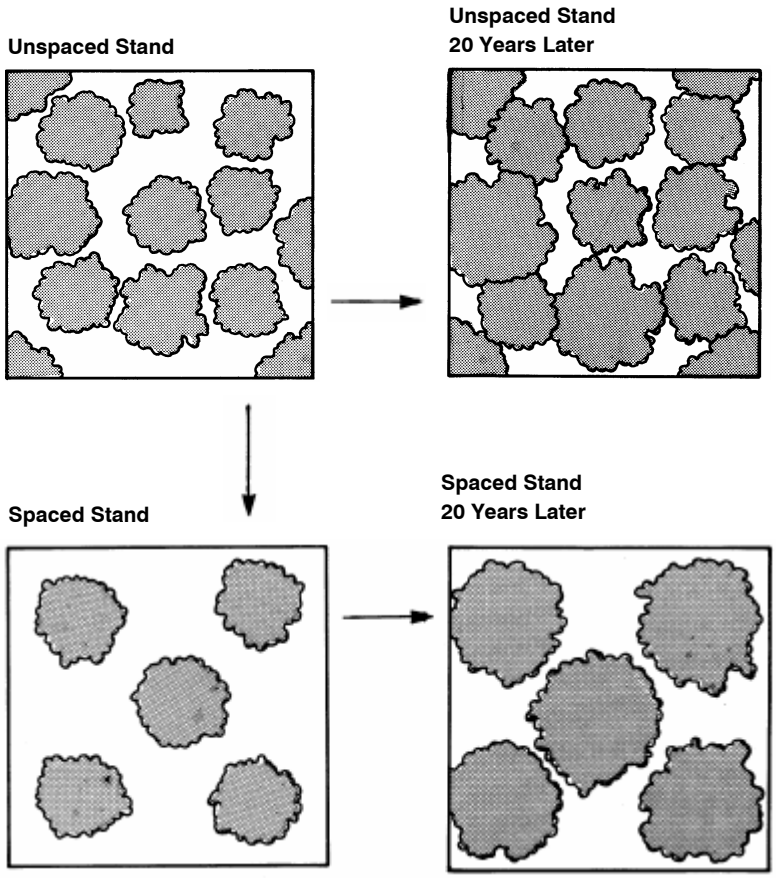
Stand tending should be considered for mule deer winter ranges for two main reasons. First, it is often necessary to promote replacements for trees removed through harvesting. This can speed restoration of any lost winter range values and provide trees for future harvests. Second, properly applied silvicultural treatments can improve the long-term value of habitats that are currently of little use to deer.

Planting is usually not necessary in dry-belt Douglas-fir stands if the advanced regeneration is protected during the logging operation. However, dense clumps of regeneration are common in these stands. This clumping causes slow growth because the large numbers of trees must compete for water, light, and nutrients. Juvenile spacing can remedy the problem by removing undesirable trees within a young stand, allowing more moisture to reach the forest floor and giving sufficient space for the remaining trees to grow relatively free of competition.

Juvenile spacing is generally beneficial on mule deer winter range. Deer do not use dense clumps of regeneration extensively. Spacing concentrates growth on fewer stems, producing trees with wider and deeper crowns—the type most useful to deer. However, if slash from spacing is deep it physically restricts deer mobility. Extensive juvenile spacing can also increase air movement through the stand, reducing the thermal cover value. Both of these situations require specialized practices, which are described in Part II (pp. 94-95).

BENEFITS OF JUVENILE SPACING ON WINTER RANGE

- Increased growth rate for future harvests and mule deer habitat values.
- Growth concentrated on fewer stems, producing trees more valuable for deer and timber.
- Dense clumps of regeneration converted into more useful habitat, improving long-term habitat value for mule deer.



SUMMARY OF PART I

- Suitable winter range is essential to survival and reproduction because winter is the most critical season for mule deer.
- Winter range provides deer with food and shelter through a combination of topographic and vegetative factors.
- Each mule deer winter range must have basic types of habitat which are spatially arranged to provide ready access to food and shelter.
- The desirable proportion of these habitat types varies with the snowpack zone in which the winter range is located.
- Juvenile spacing and low volume selective harvesting to promote uneven-aged stands are key forestry practices applicable to winter range management.

PART II

MANAGING AND OPERATING ON WINTER RANGE

PART II

This is the "how to" part of the handbook. It brings together the principles detailed in Part I to show how winter range can be managed for deer and timber. It guides forest managers through a process for locating, evaluating, and determining management prescriptions for winter range. It also shows how those prescriptions can be applied on the ground by contractors. This process is a guideline only. It is designed to allow flexibility in dealing with specific management situations on winter range. Examples are provided to illustrate how the process can be used.

This part of the handbook is not intended to be used as the sole determinant of whether logging should proceed on any winter range. Managers should use the handbook within the broad context of interdisciplinary resource management.

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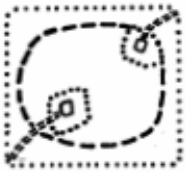
LOCATING WINTER RANGE



LOCATING WINTER RANGE

The first question to answer when considering any harvesting in Douglas-fir is whether the area is on a winter range and, consequently, whether this handbook applies. Consultation with the regional Ministry of Environment, Fish and Wildlife, is important at this stage because staff there are best able to identify and locate mule deer winter range. This contact also provides the opportunity to discuss the priority given to the particular winter range in question. This has clear implications as to what might be done on the winter range. For example, a particular winter range may be so critical that any logging would significantly reduce winter range values.

As with many biological units, winter ranges are not completely distinct areas around which precise boundaries can be drawn by applying simple criteria. Yet, for management purposes the limits of individual winter ranges must be delineated. Because the limits of many winter ranges are not accurately shown on maps, this section presents the principles used to draw boundaries.

Actions

- Consult with regional Ministry of Environment, Fish and Wildlife, concerning their maps of mule deer winter ranges in the Cariboo.

- If the proposed harvesting area occurs on an identified winter range, check with regional Ministry of Environment, Fish and Wildlife, to see if any specific management plans, priorities, or agreements apply to the proposed area.

- If uncertainty exists over the boundaries of the winter range, regional Ministry of Environment, Fish and Wildlife, may use forest cover maps, topographic maps, aerial photographs, and ground checking to identify the boundaries. Principles are presented on the following pages to help forest managers understand how this is done.

Principles for Winter Range Boundary Location

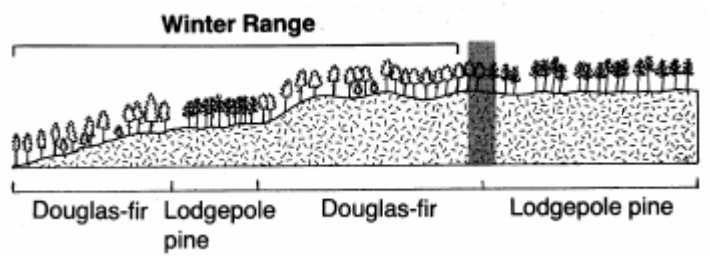
The boundaries of individual winter ranges must be delineated to facilitate management. However, because winter ranges are complex biological units, a simple set of rules or criteria can not be applied.

Presence or absence of deer or winter deer sign (Le., tracks, pellet groups, browsing) must be used with caution when locating boundaries since the severity of winter conditions influences the selection of habitats used by mule deer. For example, during a severe winter the presence of deer or deer sign would suggest a smaller area than what the defined winter range actually covers (see p. 4). During a very mild winter, deer occupy an area larger than that of the defined winter range. Additionally, if the local deer population is at a very low density (e.g., through over-hunting, poaching, predation, etc.), inaccurate winter range boundaries would be drawn if winter deer sign were the only criterion used.

The following information will illustrate the habitat principles used to determine winter range boundaries. Each principle is presented individually, but as the example will illustrate, all should be considered collectively.

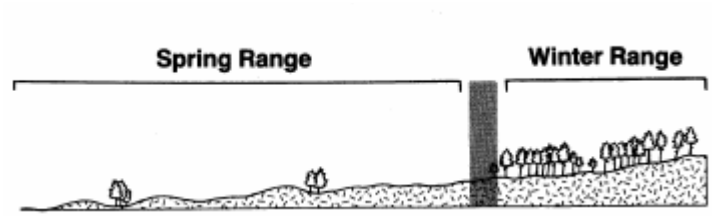
1. Douglas-fir is the dominant tree species on winter range in the Cariboo Forest Region. When the species changes (e.g., to lodgepole pine or spruce) it may indicate a winter range boundary. However, a species change must cover a substantial area and not just be a small, local change *of* stand type.

DOMINANT TREE SPECIES



2. Good quality winter range should be associated with spring range. This boundary is often easy to define. In the shallow and moderate snowpack zones spring range often occurs on lower slopes or valley bottoms, where the forest gives way to grassland and scattered thickets *of* trees in the moisture-receiving sites. These grasslands may occur naturally or be the result *of* agricultural activity.

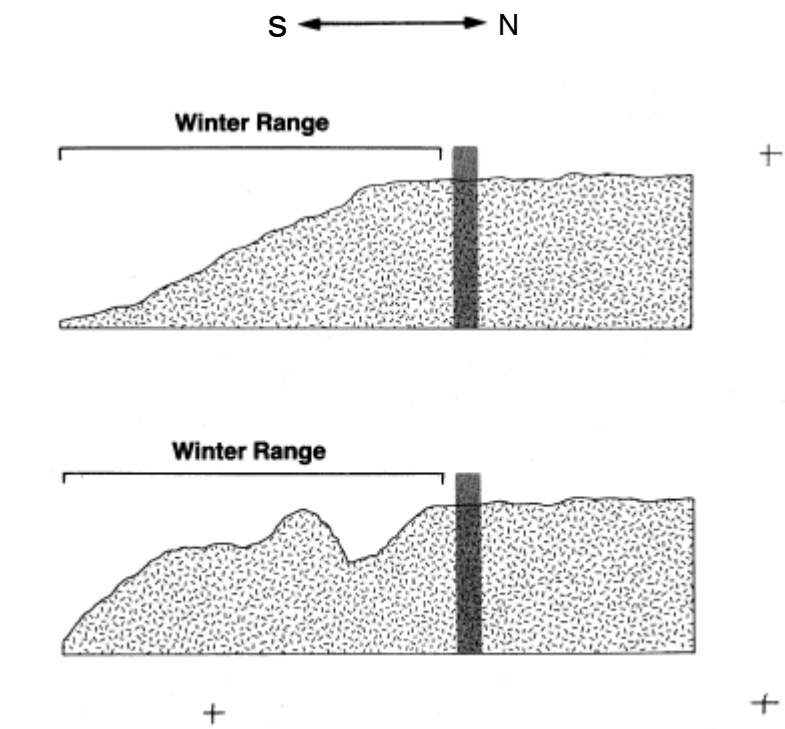
BOUNDARY WITH SPRING RANGE



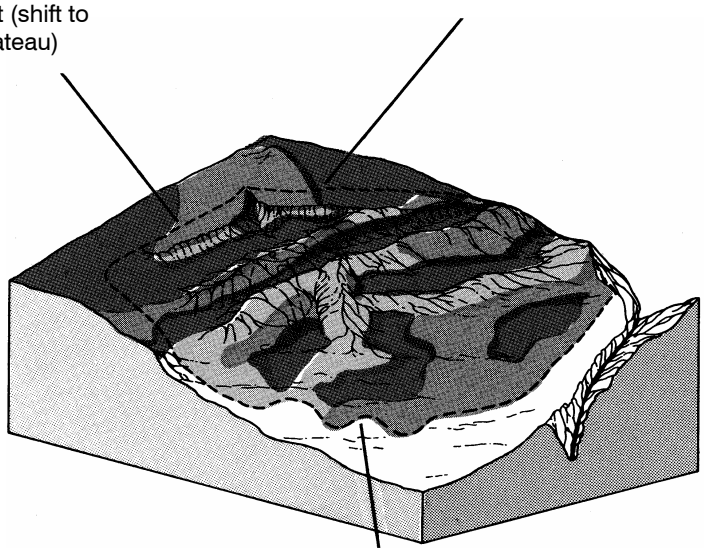
3. Winter ranges are typically located on general SE, S, SW, or W aspects. When the slope and aspect changes it may indicate a shift from winter range. For example, winter ranges are often associated with valleys and typically do not extend great distances onto the surrounding plateau.

   However, it is important to remember that areas within a winter range can include all slopes and aspects. On some winter ranges the cooler aspects (NW, N, NE) provide the only areas *of* high crown closure habitat and therefore are very important.

TOPOGRAPHY



EXAMPLE

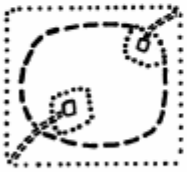

1 Dominant tree species shifts from Douglas-fir over an extensive area
3 Topography becomes flat (shift to plateau)
2 Boundary with spring range

Results

Having worked through this section the forest manager should know whether the proposed harvesting would occur on a winter range and whether this handbook applies. If a winter range is involved, discussions with Fish and Wildlife will help the forest manager decide whether or not to proceed beyond this step. To facilitate greater understanding, principles described show how winter range boundaries can be established. Once boundaries are identified, the manager should proceed to the evaluation stage.

LOCATING
WINTER RANGE

EVALUATING WINTER RANGE



EVALUATING WINTER RANGE

Often much time and expense are incurred in formulating winter range harvesting plans that later require extensive revision or are not approved at all. A prior evaluation of winter range can reduce this problem by providing the forest manager with a basis for deciding if it is worth pursuing any ,harvesting activity, and thus if a formal plan should be developed. For example, evaluating stand treatment options will indicate the volume and size distribution of the harvest that are most likely to be approved in the various stand types occurring on winter range. As with the other stages, input in addition to that provided in this handbook is needed before the forest manager can decide whether to proceed with preparing a specific plan.

Actions

- Determine in which snowpack zone the winter range is located by checking pages 28 and 29.

- Evaluate the current status of the habitat types on the winter range as described on pages 24 and 25, using forest cover maps. Measure the proportion of each type, and compare them to the proportions shown on pages 30 and 31 (see the following pages for details).

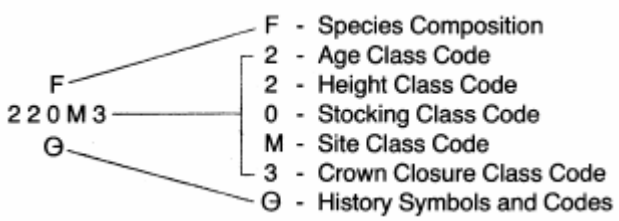
- If the decision is to proceed, evaluate stand treatment options as presented on pages 62-73 to determine how much volume, and the size distribution of the volume, that may be approved for harvesting on the winter range.

Current Status

After the snowpack zone in which the winter range is located has been determined (by referring to p. 28), the current status of the habitat types on the winter range, particularly the proportions of each type, should be evaluated. Forest cover maps provide the primary source of this information. Forest cover polygons can be categorized into winter range habitat types by noting the crown closure class codes and meeting the height class code requirement (see pp. 24-25). Measure the proportions of each habitat type using a dot grid or some other method of calculating area. A comparison of the observed proportions to those on page 31 will help managers decide whether or not the evaluation should proceed. Three examples are presented to illustrate the process.

LEGEND FOR EXAMPLES

EXAMPLE OF A SIMPLIFIED FOREST COVER LABEL
(for details see legend on any new series forest cover map)



FOREST COVER POLYGON BOUNDARY.....

WINTER RANGE BOUNDARY ----------

WINTER RANGE HABITAT TYPES

Low Crown Closure

Moderate Crown Closure

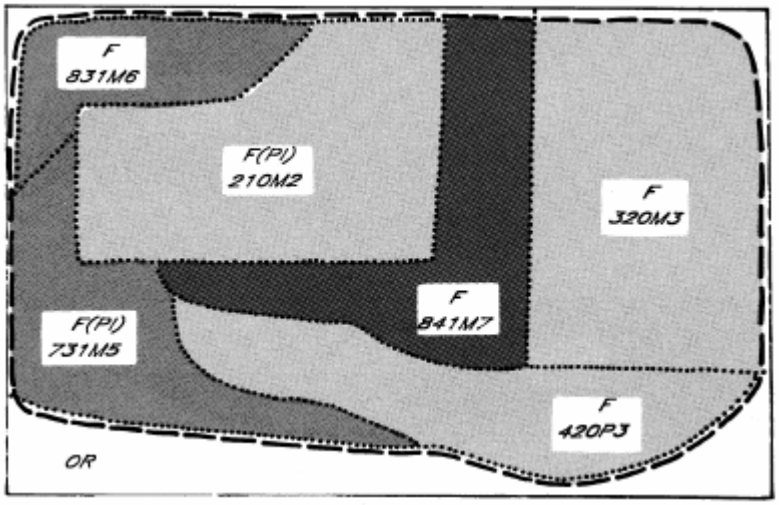
High Crown Closure

Continued

EXAMPLE: Winter Range "A"

CURRENT STATUS

- located in the moderate snowpack zone
- 65% Low Crown Closure Habitat
- 20% Moderate Crown Closure Habitat
- 15% High Crown Closure Habitat



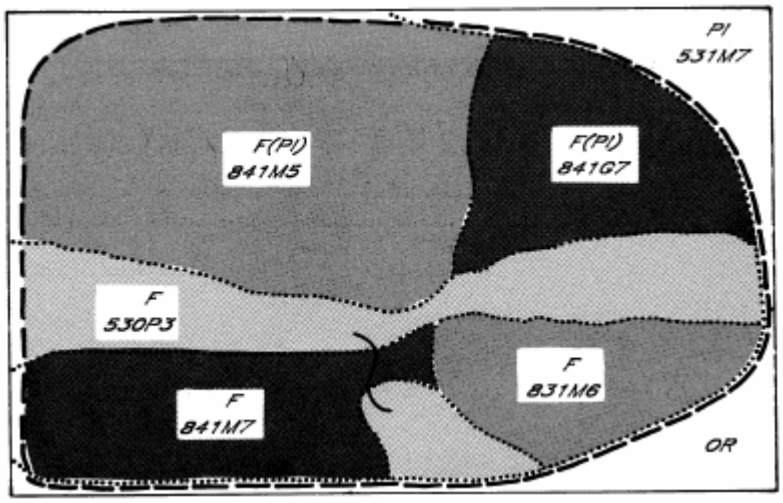
CONCLUSIONS

- Winter range lacks sufficient Moderate and High Crown Closure Habitat for the moderate snowpack zone (p. 31).
- Do not proceed with the evaluation since any harvesting will negatively impact winter range values.

EXAMPLE: Winter Range "B"

CURRENT STATUS

- located in the moderate snowpack zone
- 20% Low Crown Closure Habitat
- 50% Moderate Crown Closure Habitat
- 30% High Crown Closure Habitat



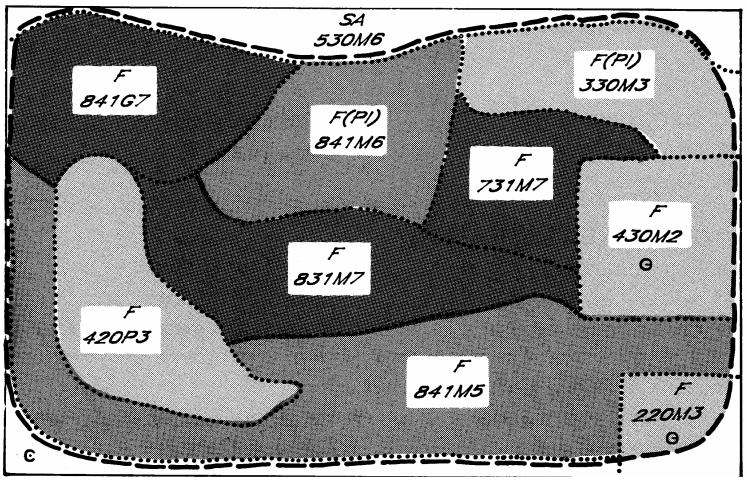
CONCLUSIONS

- Winter range has abundant Moderate Crown Closure Habitat but could have more Low Crown Closure Habitat (p. 31).
- Selective harvesting of some Moderate Crown Closure Habitat to create more Low Crown Closure Habitat may be considered.
- Proceed with the evaluation.

EXAMPLE: Winter Range "C"

CURRENT STATUS

- located in the moderate snowpack zone
- 33% Low Crown Closure Habitat
- 33 % Moderate Crown Closure Habitat
- 33% High Crown Closure Habitat



CONCLUSIONS

- All habitat types are present in the right proportions for a winter range within the moderate snowpack zone (p. 31).
- May consider light selective harvesting within, for example, Moderate Crown Closure Habitat, if enough trees are left after harvesting to still classify the habitat as moderate crown closure. (Note: taking all habitat types to their minimum crown closure values will negatively impact winter range values.)
- Proceed with the evaluation.

Treatment Options

If the evaluation of the current status of the winter range habitat types leads to the conclusion that the process should be continued, an evaluation of the treatment options should next be made. This evaluation. will give the forest manager an indication of how much volume, and the size distribution of the volume, that may be approved for harvest from the winter range. It also shows the manager what silvicultural options are available.

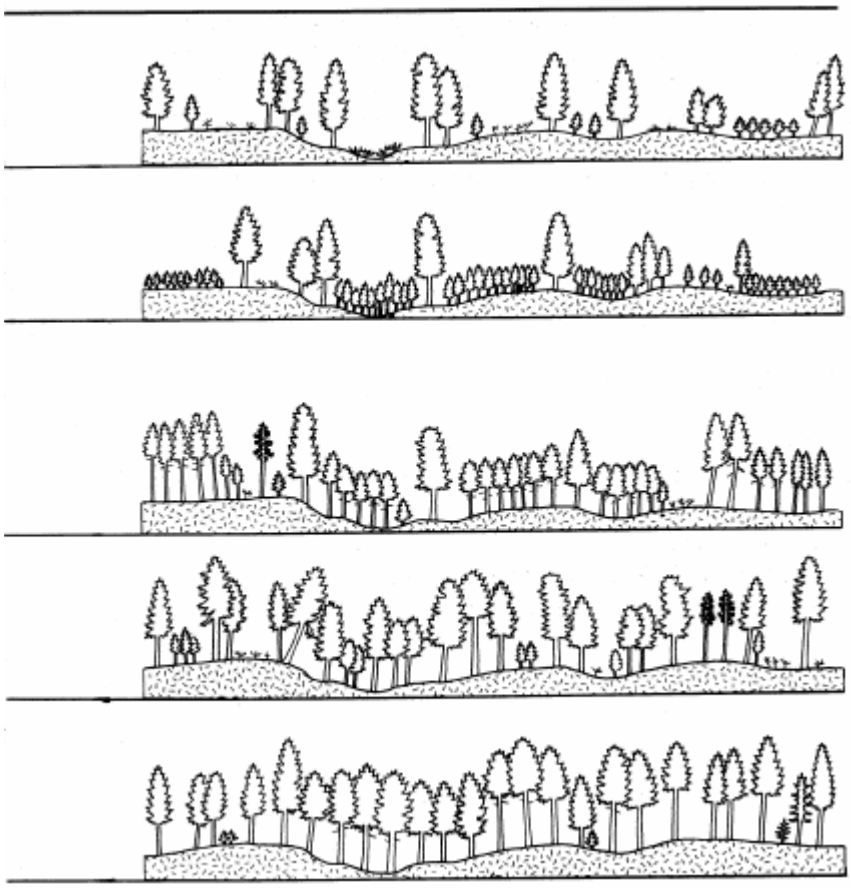
Forest managers recognize a number of common stand types in interior Douglas-fir. Some of these are suitable winter range

CHARACTERISTICS OF COMMON STAND TYPES	PRESENT VALUE AS WINTER RANGE HABITAT
1 OPEN • some dominants • some intermediates . • some regeneration	• ideal Low Crown Closure Habitat
2 DENSE REGENERATION • few dominants • some intermediates • dense regeneration	• poor Low Crown Closure Habitat • dense regeneration of little value
3 DENSE POLE LAYER • scattered dominants • dense pole layer • little regeneration	• mediocre Moderate Crown Closure Habitat • pole-sized trees lack forage and cover value of mature and over-mature trees
4 ALL-AGED • all size and age classes well represented	• ideal Moderate Crown Closure Habitat
5 DENSE CANOPY • many co-dominants • few intermediates • little regeneration	• good High Crown Closure Habitat

habitat, but others are not. Five common stand types are described below and their present value as winter range habitat is indicated.

These common stand types are discussed in detail in the next 10 pages. Stand characteristics are described, the present and potential value of each stand as winter range habitat are discussed, and the harvesting and silvicultural options, applicable to each stand type when it occurs on winter range, are outlined. A common harvesting and/or silvicultural treatment is presented as an example for each stand type.

ILLUSTRATIONS OF STAND TYPES



Open Stand

Stand Characteristics

- typical crown closu re 16-35 %
- Crown Closure Class Codes 2,3
- some dominants
- some intermediates
- some regeneration

Present Value and Potential as Winter Range Habitat

This stand type is ideal Low Crown Closure Habitat. The scattered clumps of older trees are valuable for security cover, while the open areas provide ground forage during periods with shallow or no snow accumulation. These stands often occur on warm, dry sites (often on steep south slopes) and therefore site conditions may not allow increased crown closure. Alternatively, they may be the result of past logging and, in time, could provide greater cover value.

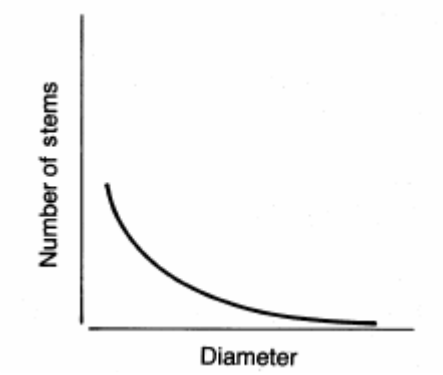
Harvesting and Silviculture Option(s)

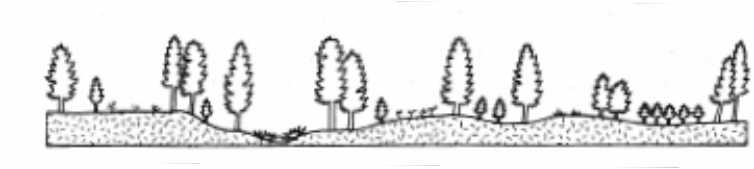
1) LIGHT SELECTIVE HARVESTING

- Low initial volume restricts options.
- Harvesting should only be considered if the crown closure is in the 30-35% area to avoid a decrease in habitat value (see example).
- If sufficient Moderate or High Crown Closure Habitats are lacking on the winter range, no logging should take place to allow the stand to increase crown closure (if site conditions make this possible).

EXAMPLE

BEFORE

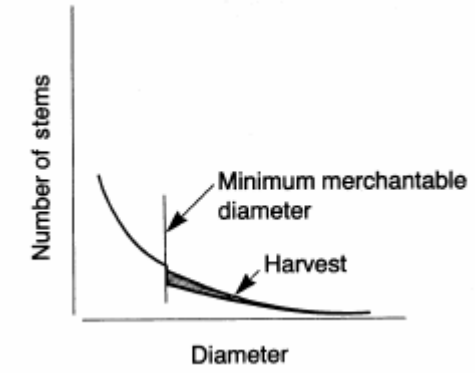


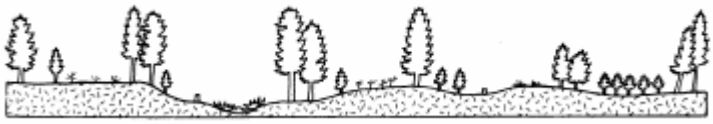


ACTIONS

- Light selective harvest.
- Leave some larger trees to provide clumps of cover.

AFTER





Dense Regeneration Stand

Stand Characteristics

- typical crown closure 16-45 %
- Crown Closure Class Codes 2, 3, 4
- few dominants
- some intermediates
- extensive dense regeneration

Present Value and Potential as Winter Range Habitat

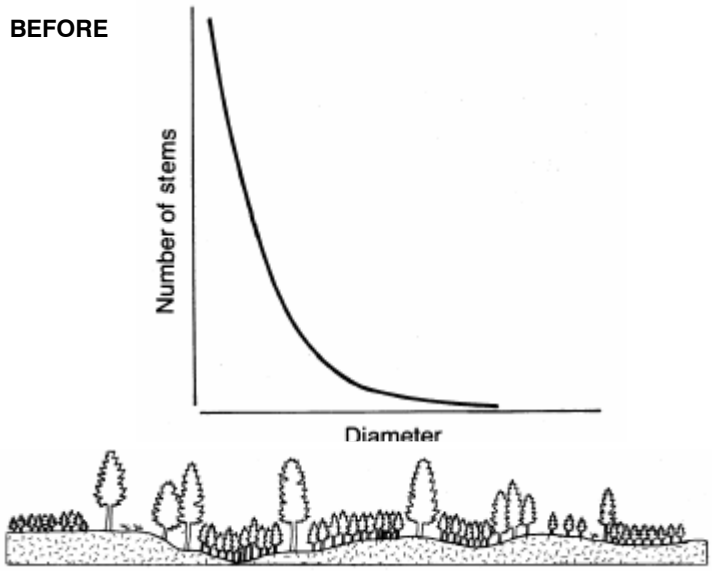
The dense regeneration is of very limited value to deer, making the stand poor Low Crown Closure Habitat. Juvenile spacing can increase the short-term value of the stand by encouraging ground forage development. Long-term benefits will occur as trees grow and provide better cover.

Harvesting and Silviculture Option(s)

1) JUVENILE SPACING
   - Space the dense regeneration to give remaining trees room to grow (see example).

EXAMPLE

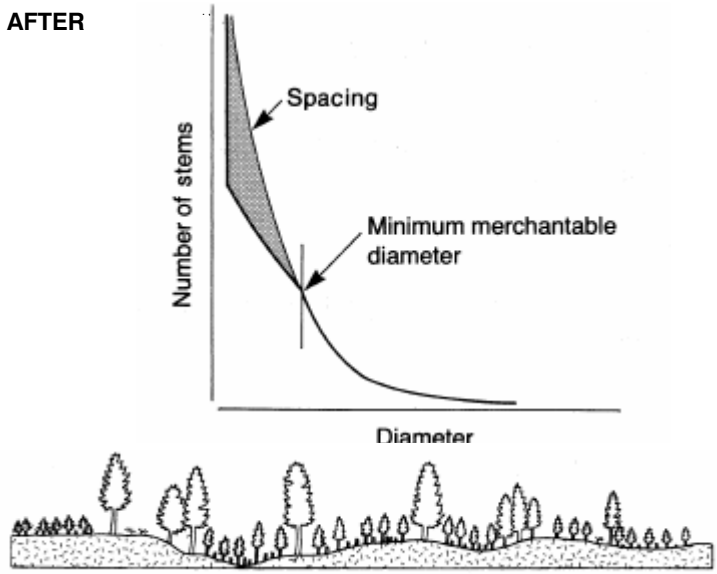
BEFORE



ACTIONS

- Juvenile spacing (see pp. 94-95 for details).
- Lop and scatter the spacing debris to promote decomposition and reduce obstacles to deer movement.

AFTER



Dense Pole Layer Stand

Stand Characteristics

- typical crown closure 46-75%
- Crown Closure Class Codes 5, 6, 7
- scattered dominants
- extensive dense pole layer
- little regeneration

Present Value and Potential as Winter Range Habitat

The extensive pole layer lacks the litterfall and cover value of mature and over-mature trees, making the stand mediocre Moderate Crown Closure Habitat. Long-term benefits to habitat value would result if the pole layer were thinned. This would occur at the expense of a short-term reduction of snow interception ability.

Harvesting and Silviculture Options

1) LIGHT SELECTIVE LOGGING (10-20% gross merchantable volume)

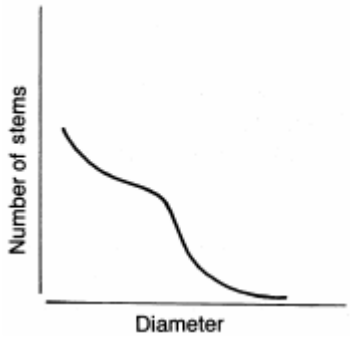
   - Thin the extensive pole layer by selective logging (see example).

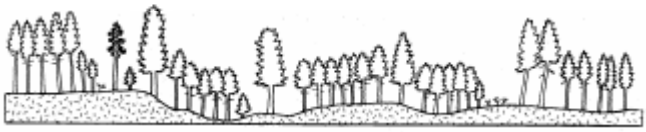
2) THINNING

   - This option is appropriate if the pole layer is not merchantable.

EXAMPLE

BEFORE



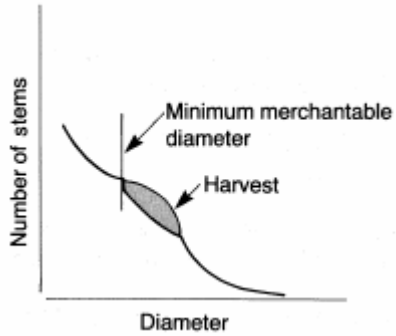


ACTIONS

Light selective harvest concentrating on the pole layer.

Harvest small groups of trees to promote an uneven-aged stand.

AFTER



All-Aged Stand

Stand Characteristics

- typical crown closure 46-75%
- Crown Closure Class Codes 5, 6, 7
- all size and age classes well represented

Present Value and Potential as Winter Range Habitat

The all-aged stand structure makes this type ideal Moderate or High Crown Closure Habitat, depending on the degree of crown closure. The younger age classes provide thermal and security cover; the older age classes offer excellent snow interception ability and a supply of litterfall forage. This ideal stand structure should be maintained.

Harvesting and Silviculture Options

1) LIGHT SELECTIVE LOGGING (10-20% gross merchantable volume)

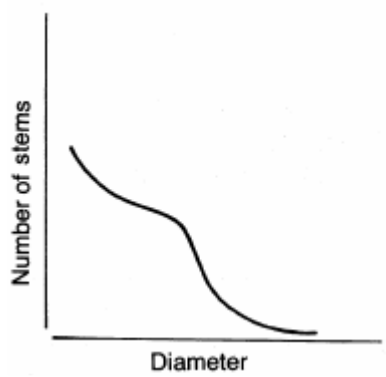
   - Perpetuate the all-aged stand structure by harvesting in all merchantable age classes (see example).

2) MODERATE SELECTIVE LOGGING (20-30% gross merchantable volume)

   - This option should only be considered if the winter range has an excess of High and Moderate Crown Closure Habitat.
   - This level of cut will reduce crown closure to the level of Low-Moderate Crown Closure Habitat.

EXAM PLE

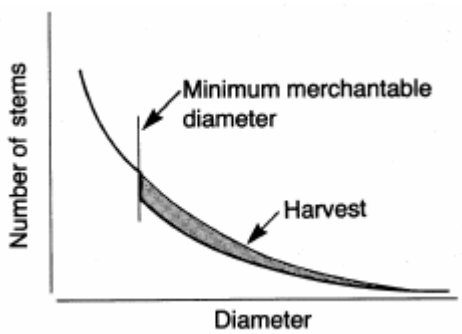
BEFORE



ACTIONS

- Light selective harvest in all merchantable size classes.
- Ensure that a good representation of the oldest age classes remains after logging.

AFTER



Dense Canopy Stand

Stand Characteristics

- typical crown closure 66-85%
- Crown Closure Class Codes 7, 8
- dense canopy of co-dominants
- few intermediates
- little regeneration

Present Value and Potential as Winter Range Habitat

The extensive canopy of older trees makes this stand type very effective at intercepting snow and therefore good High Crown Closure Habitat. A more uneven-aged stand structure would be beneficial to improve thermal and security cover if high crown closure is maintained for snow interception.

Harvesting and Silviculture Options

1) LIGHT SELECTIVE LOGGING (10-20% gross merchantable volume)

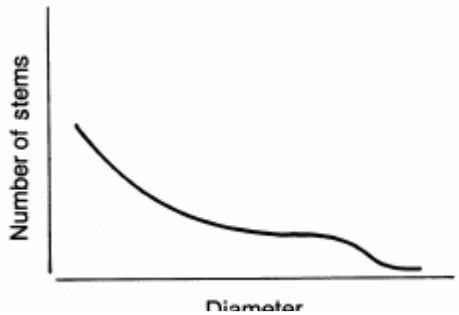
   - This option could promote an uneven-aged stand while maintaining a relatively high degree of crown closure (see example).

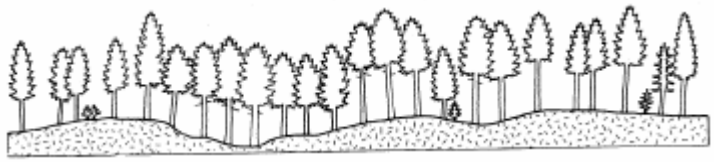
2) MODERATE SELECTIVE LOGGING (20-30% gross merchantable volume)

   - This option is possible only if the winter range has an excess of High Crown Closure Habitat (see p. 31).

EXAMPLE

BEFORE

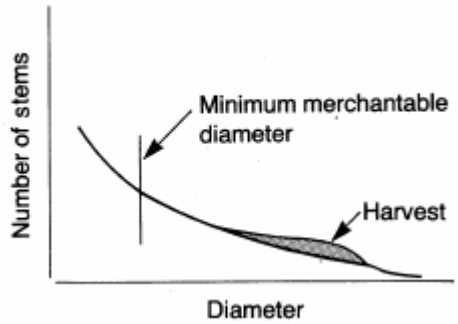


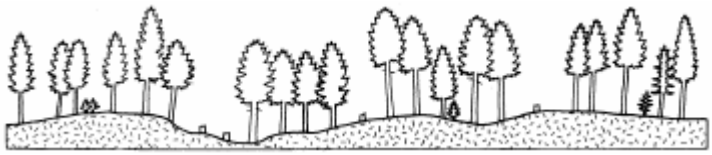


ACTIONS

- Light selective harvest (15% gross merchantable volume) concentrating on the co-dominants.
- Harvest groups of trees to create small openings that encourage regeneration and ground forage.

AFTER





EXAMPLE: Winter Range "B"

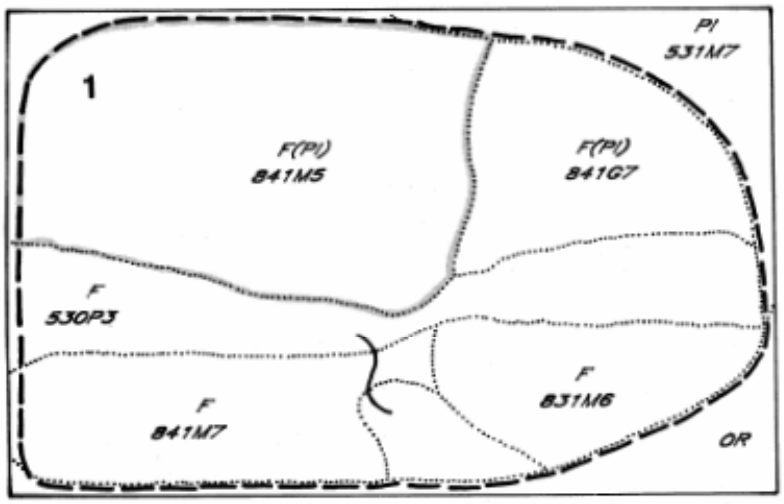
TREATMENT OPTION

HARVESTING

- Part of this large area (1) of Moderate Crown Closure Habitat might be harvested to create more Low Crown Closure Habitat (see conclusions of the current status evaluation on p. 60).

- This stand (1) has a significant lodgepole pine component which is of little value to deer and might be harvested.

- The stand also has a well-defined pole layer with scattered dominants and intermediates, and therefore much of the harvest should come from the pole layer to promote an uneven-aged stand (p. 68).



EXAMPLE: Winter Range "C"

TREATMENT OPTIONS

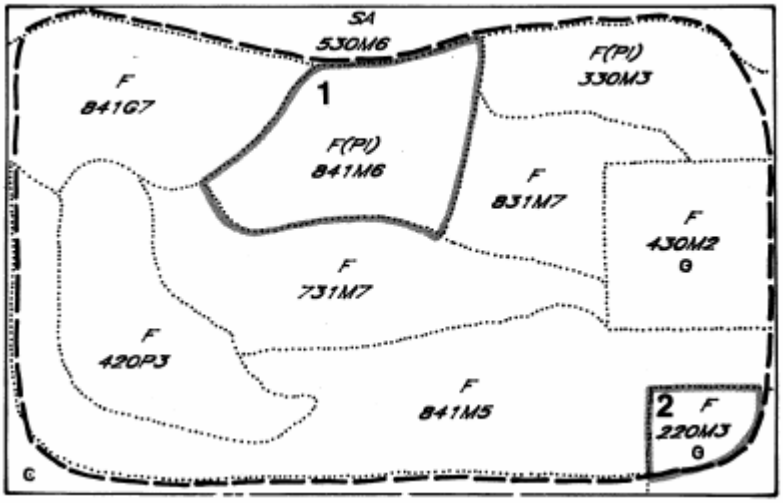
HARVESTING

- The crown closure of this habitat type (1) is at the highest level for moderate crown closure (Crown Closure Class Code 6 = 56-65% crown closure), and therefore a light selective cut, reducing the crown closure by only a small amount, would result in a habitat type still classified as moderate (see conclusions of the current status evaluation on p. 61).

- This stand (1) is basically an all-aged type, and therefore harvesting should remove some trees from all merchantable size classes.

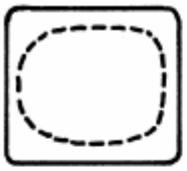
SPACING

- Aerial photos and ground checking showed this to be a dense regeneration stand (2) for which juvenile spacing should be considered.



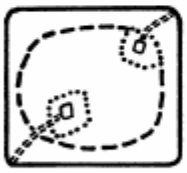
Results

This section has provided the forest manager with input necessary for making an informed decision about whether to proceed to make a specific plan for harvesting on a winter range. It includes procedures for: determining in which snowpack zone the winter range is located; delineating the habitat types present on the winter range and measuring their proportions; assessing the stand types present on the winter range; and deciding what harvest and silviculture options might be applied to them. This information is essential for both decision making and determining management prescriptions—the next step in the process to gain approval to harvest on winter range.



LOCATING
WINTER RANGE

EVALUATING
WINTER RANGE



DETERMINING MANAGEMENT PRESCRIPTIONS

DETERMINING MANAGEMENT PRESCRIPTIONS FOR WINTER RANGE

This section describes how a proposal for timber harvesting on mule deer winter range can be made. The principles described in Part I are assembled to illustrate how they apply to operational planning. If the principles are followed carefully, fewer revisions to harvesting plans should be required, and the efficiency of the referral process enhanced.

Actions

- Plan the proposed harvesting and/or silvicultural treatments using the results of the evaluation section and applying the principles presented in Part I. In particular, consider the proportions and spatial arrangement of habitat types found on pages 26 and 31 .

- For individual cutblocks specify the volume and size distribution of timber to be removed, using the stand treatment principles presented on pages 62 to 73.

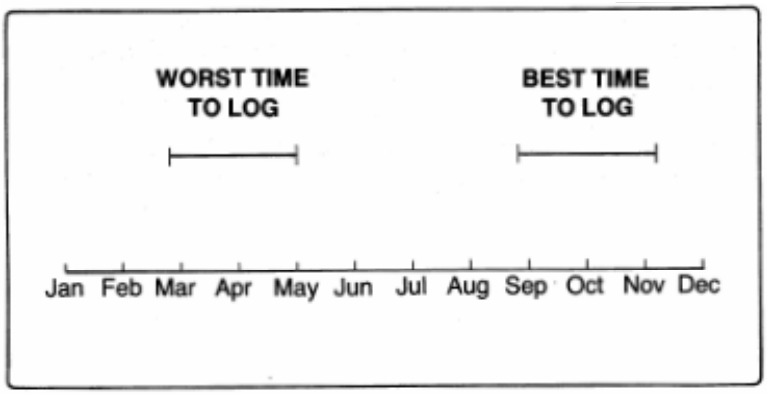
- Propose road locations and the scheduling of the harvest according to the principles presented on the following pages.

Timing of Treatments

The timing of harvesting and, to a lesser extent, stand tending treatments, is important on winter range for two reasons.

First, if logging occurs in late winter or early spring, the fresh slash will attract the Douglas-fir bark beetle when they fly in spring and summer. Although beetles tend not to survive in slash, the surrounding trees are often attacked, particularly if they have been damaged during logging. This can result in the loss of valuable trees. Postponing the harvest until after the beetles fly gives the slash longer to dry and makes it less attractive to the beetle.

Second, harvesting can provide Douglas-fir foliage (the main component of the winter diet of mule deer) as a short-term supply of forage. If operations take place in the late autumn the slash is valuable to deer as forage during the early winter and perhaps longer.



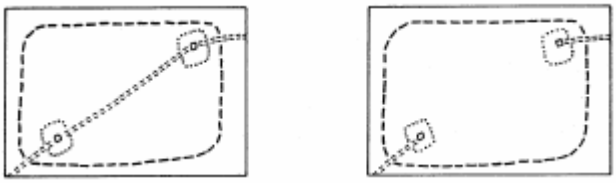
Road Locations and Design

As described in Part I (p. 17), security cover along roads is particularly important in preventing high levels of harassment to deer. The location of roads also influences the harassment level that deer experience during winter. By not building main roads through winter ranges and by avoiding circle routes, managers can ensure harassment pressure is reduced.

Roads can be designed to minimize harassment, built with intersections as shown below.

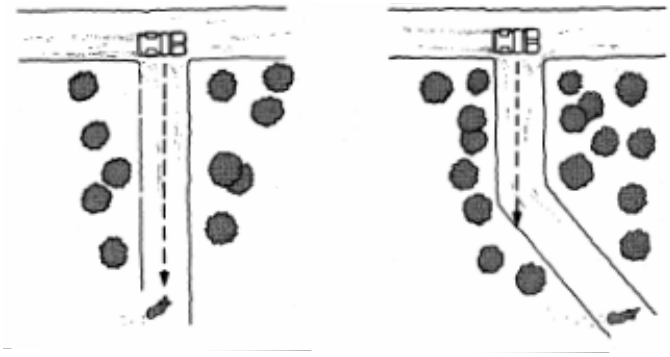
LOCATION OF ROADS

Poor **Good**



DESIGN OF INTERSECTIONS

Poor **Good**



EXAMPLE: Winter Range "B"

MANAGEMENT PRESCRIPTIONS TO SUBMIT FOR APPROVAL

HARVESTING (Blocks 1 and 2)

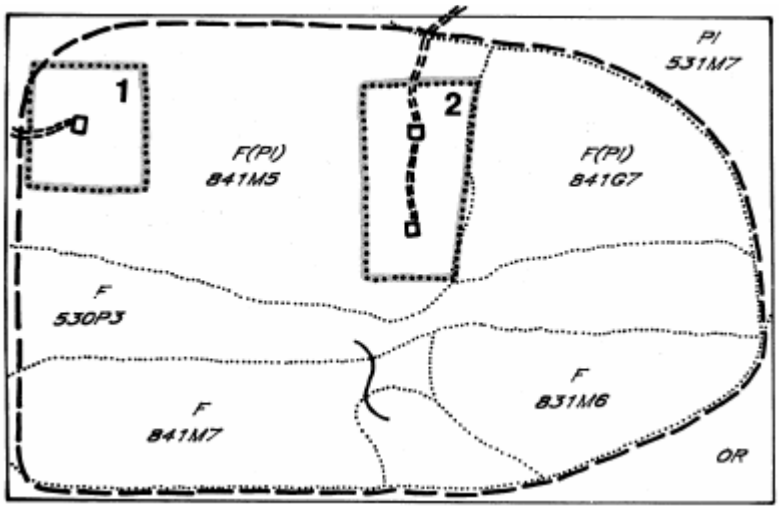
- A light selective cut of 20% of the gross merchantable volume is proposed in each cutblock. This would produce approximately 12% more Low Crown Closure Habitat on the winter range and reduce the abundant Moderate Crown Closure Habitat by the same amount.

- Two smaller cutblocks are proposed instead of one large block to increase horizontal diversity and edge (p. 21).

- Harvesting would remove all merchantable pine and then concentrate on the pole layer *of* fir.

- Harvest is proposed for September (p. 80).

- Road layout is designed to minimize the negative impact to the winter range (p. 81).



EXAMPLE: Winter Range "C"

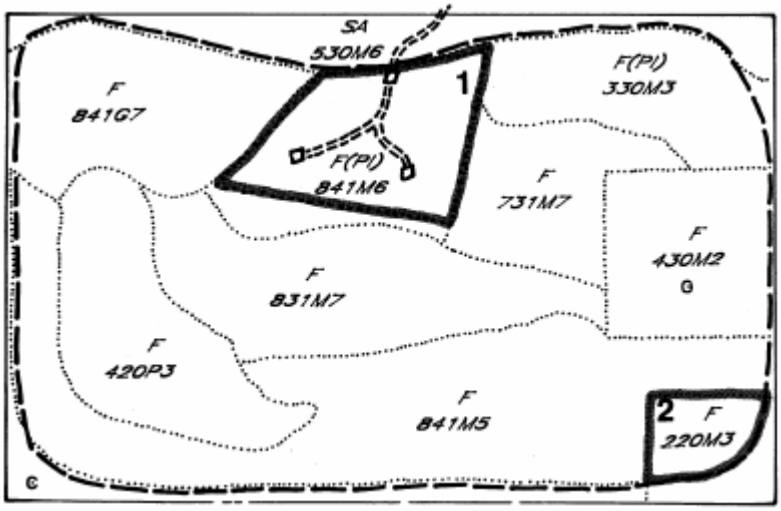
MANAGEMENT PRESCRIPTIONS TO SUBMIT FOR APPROVAL

HARVESTING (Block 1)

- A light selective cut of 15% of the gross merchantable volume is proposed in the cutblock.
- Harvesting would remove all merchantable pine and then remove some fir in all merchantable size classes.
- Harvesting is proposed for October or November (p. 80).
- Road layout is designed to minimize the negative impact to the winter range (p. 81).

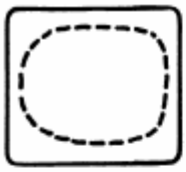
SPACING (Block 2)

- Juvenile spacing of the dense regeneration in this stand is proposed according to the standards for winter range found on page 94.



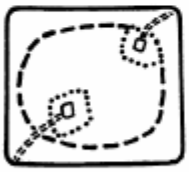
Results

After working through this section and meeting the requirements of the management agencies for the specific type of plan being developed, the forest manager should be ready to submit the plan for approval. The care with which the principles of this handbook are applied should be reflected in the efficiency of the approval process. Once a plan for harvesting on winter range has been approved, the forest manager should be ready to go to the final stage: selecting a contractor to carry out the plan.



LOCATING
WINTER RANGE

EVALUATING
WINTER RANGE



DETERMINING
MANAGEMENT
PRESCRIPTIONS

**HARVESTING AND
SPACING**

HARVESTING AND SPACING ON WINTER RANGE

At this stage the forest manager should have an approved cutting plan. This section describes the specific principles that the logger must follow to apply the system. Instruction is also included for juvenile spacing contractors. The principles apply to all harvesting and spacing that is done on mule deer winter range. However, any specifics as determined in the previous section and detailed on the cutting plan will have to be explained to the contractor.

Actions

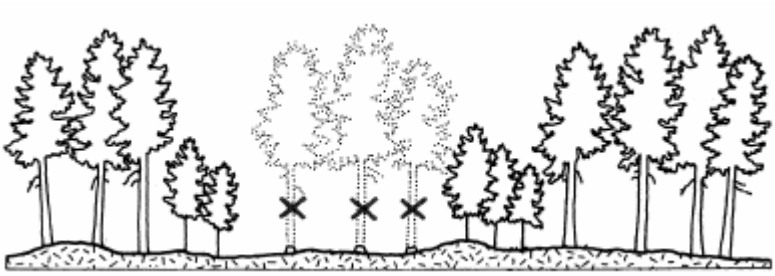
- Use only contractors who have been trained in applying the handbook principles for operating on winter ranges.
- Ensure that all crew members are familiar with the principles for operating on winter ranges (found on pp. 88-93).
- Ensure that fallers are thoroughly familiar with the principles for timber harvesting (found on pp. 88-91).
- Explain to fallers the specific objectives in each cutblock, including volume to be cut and the size distribution of that volume.
- Inspect the operations to ensure that the objectives are being met.

Principles of Harvesting

Recommendations for harvesting in various stand types were presented on pages 64-73; however, there are certain principles that apply to harvesting in any stand type on a winter range. For example, the "faller's selection" method should be used for harvesting (i.e., trained fallers decide which trees are cut) because it is more efficient than marking trees for harvest. Additional principles are presented individually, and then are. combined in an example.

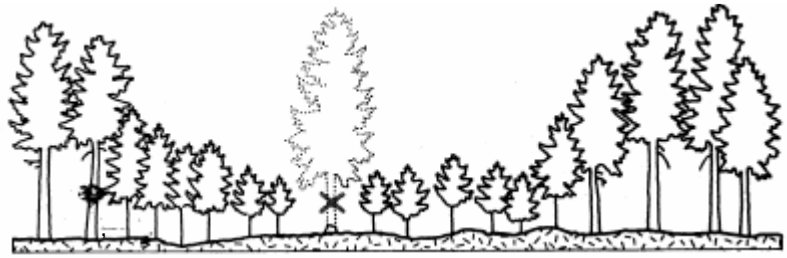
1. Low volume selective harvesting (typically 10-20% of the gross merchantable volume) should be used to minimize the impact on winter range habitat. Groups of trees should be harvested rather than uniformly thinned because the maintenance of clumps of cover trees is essential for effective snow interception. The faller's selection method should be used for harvesting because it is more efficient than marking trees for harvest.

HARVEST SMALL GROUPS OF TREES



2. Single trees should be harvested when they are isolated from other cover trees. These trees are less important to deer because they are poor snow interceptors and are often difficult for deer to reach during times of deep snow accumulation.

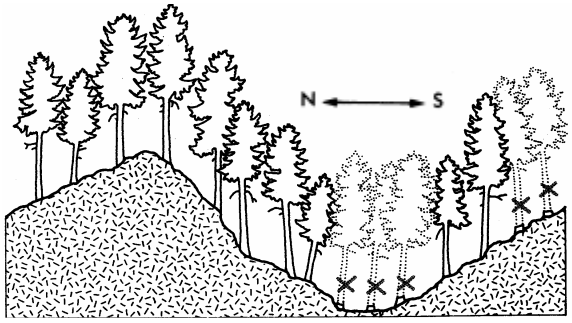
SINGLE TREES ISOLATED FROM OTHER COVER TREES CAN BE HARVESTED



3a. Micro-habitats most important to deer should receive minimal disturbance (see pp. 22-23). Specifically, ridge tops and knolls should not be logged and warm, southerly aspects should be logged lightly or not at all.

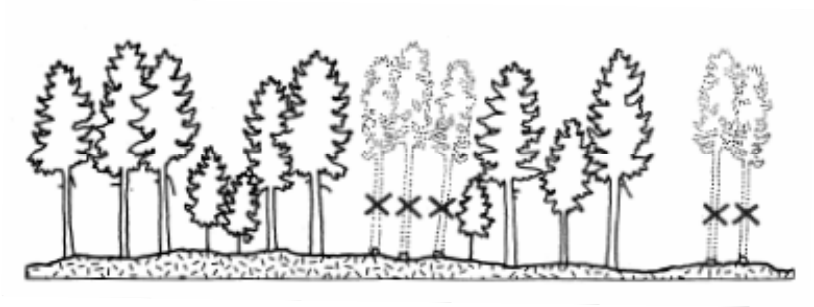
3b. Conversely, less important micro-habitats can be logged more heavily, though typically only 10-20% of the stand volume should be cut. These less important habitats include gullies and cool, northerly aspects.

CONCENTRATE HARVEST IN GULLIES AND NORTHERLY ASPECTS WHILE LEAVING RIDGES



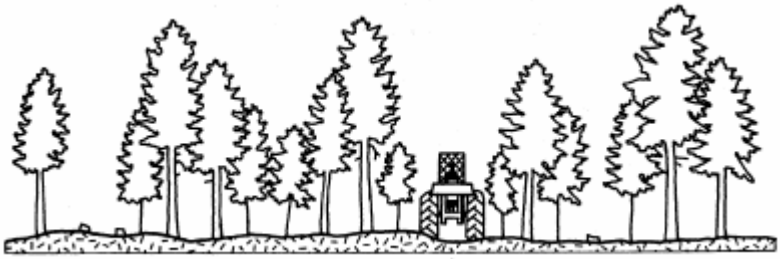
4. All lodgepole pine, spruce, balsam, and deciduous species may be harvested because they are of little value to deer on winter range.

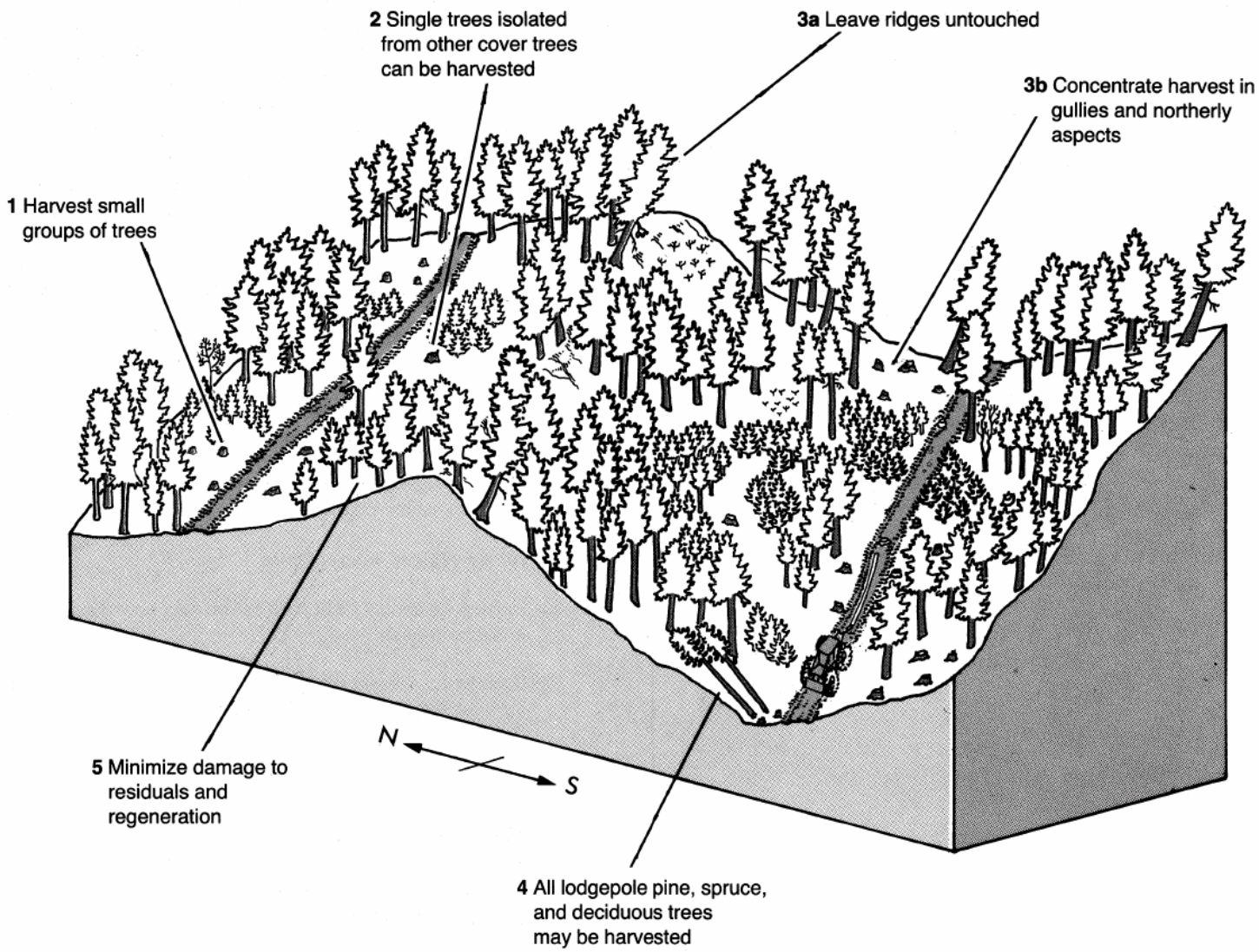
ALL LODGEPOLE PINE, SPRUCE, AND DECIDUOUS TREES MAY BE HARVESTED



5. Damage to residuals and regeneration must be minimized to protect winter range values and future harvests. This includes logging with care and keeping skid trails and landings as narrow and small as possible. The use of small equipment for building skid trails and skidding is recommended (see the following pages for details) .

MINIMIZE DAMAGE TO RESIDUALS AND REGENERATION




2 Single trees isolated from other cover trees can be harvested
3a Leave ridges untouched
3b Concentrate harvest in gullies and northerly aspects
1 Harvest small groups of trees
N
S
5 Minimize damage to residuals and regeneration
4 All lodgepole pine, spruce, and deciduous trees may be harvested

Principles for Stand Protection

Douglas-fir bark beetle is a major source of mortality in mature and over-mature fir stands. Each year a new brood of beetles fly and attack trees from mid-April to June, with a second smaller flight occurring in July and August. Trees weakened or damaged (including freshly felled trees) are most susceptible to attack, and poor logging practices can encourage the spread of the beetle. Because maintenance of mature and over-mature trees is of prime importance on a winter range, extra care must be taken to minimize mortality from the beetle. Ways of minimizing a beetle problem are explained below and illustrated in the facing diagram.

1. Slash must not be piled against trees. Douglas-fir beetles are attracted to slash, and will also attack standing trees next to it.

2. All slash over 20 centimetres in diameter should be removed because it attracts beetles.

3. Damage to residual trees should be minimized because beetles are attracted to damaged trees.

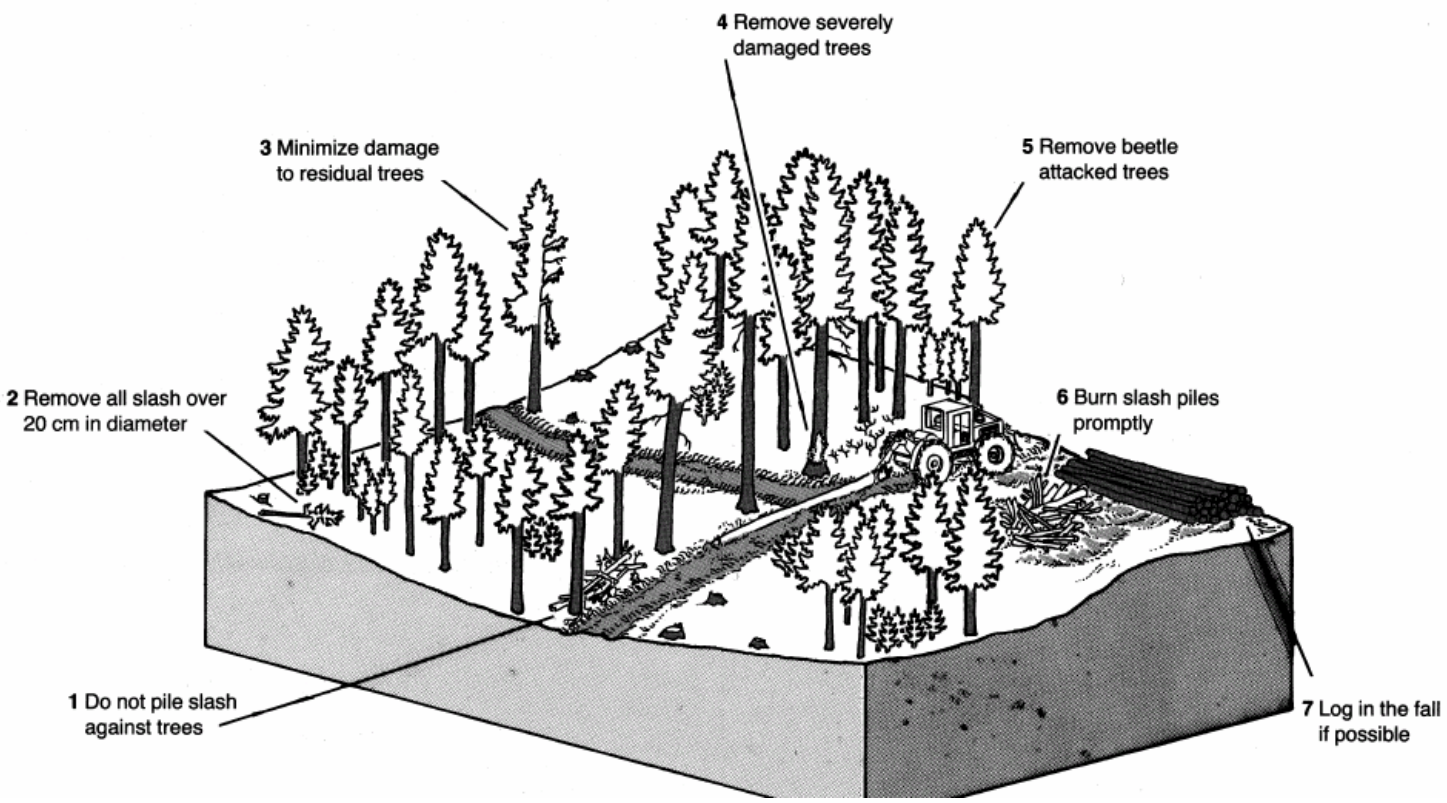
4. Severely scarred trees (Le., over half of the circumference of the bole) should be removed.

5. Remove beetle attacked trees.

6. Slash piles should be burned before they become breeding grounds for more beetles.

7. Logging operations should be scheduled as long before the beetle flight as possible to allow the logging debris to dry. Late summer and fall are ideal.

If an area has a major beetle problem, a trap tree program may be necessary. This involves falling a number of trees shortly before the beetle flight. The beetles are attracted to these trees, which are removed and milled before the next flight, reducing the local beetle population.

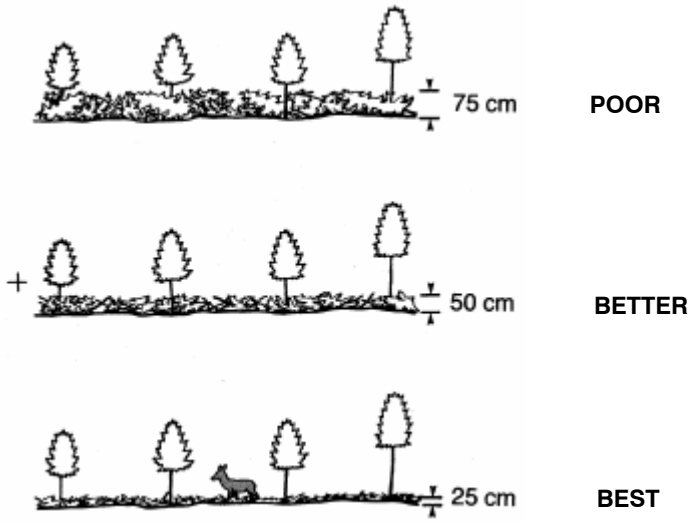

4 Remove severely damaged trees
3 Minimize damage to residual trees
5 Remove beetle attacked trees
2 Remove all slash over 20 cm in diameter
6 Burn slash piles promptly
1 Do not pile slash against trees
7 Log in the fall if possible

Principles for Juvenile Spacing

The benefits of juvenile spacing on winter range were described in Part I (pp.40_41). These are basically long-term benefits that occur as the spaced trees respond to the reduced competition. However, in the short term, measures must be taken to minimize any negative impact to deer caused by- juvenile spacing. These are discussed below and illustrated in an example.

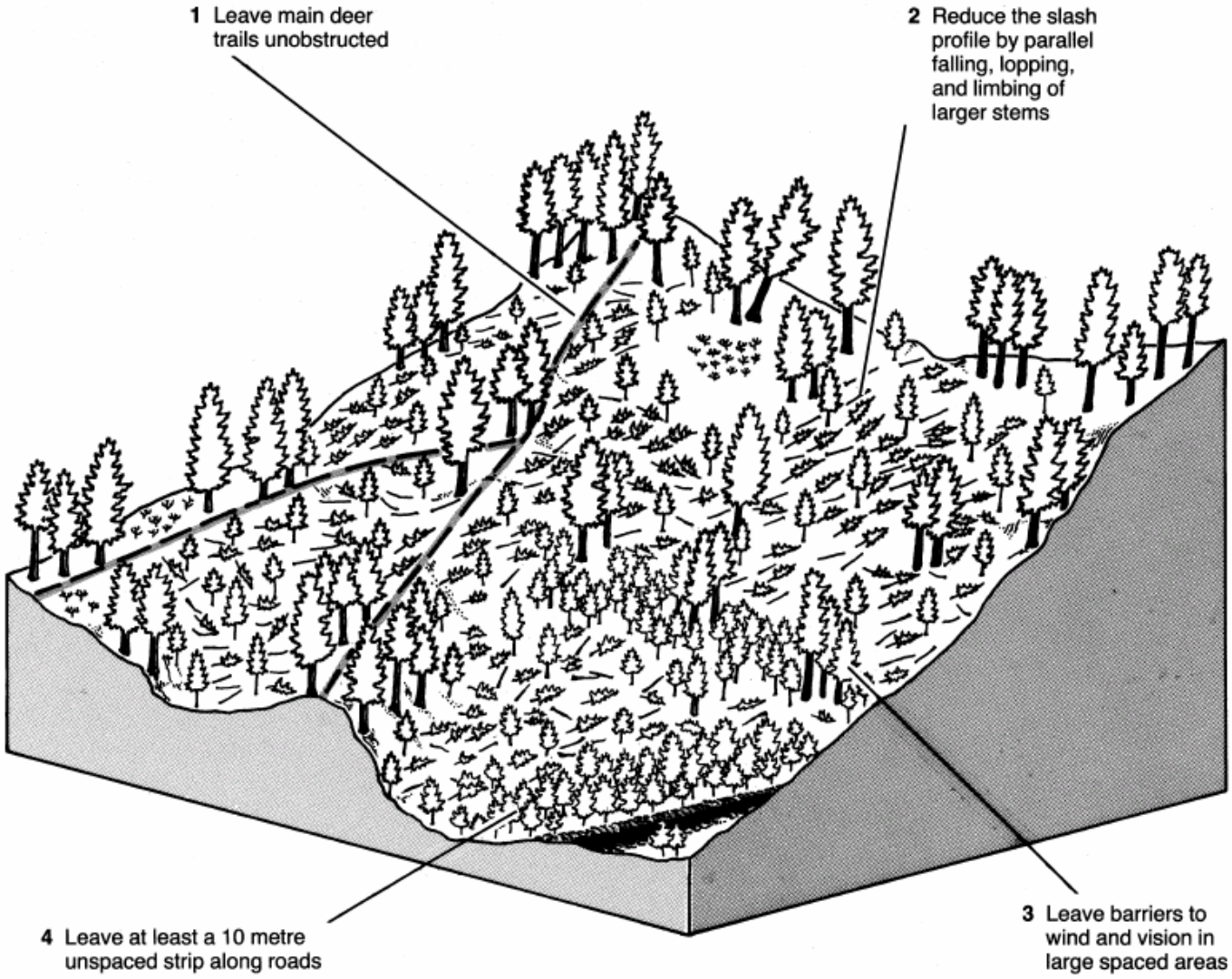
1. Main trails are important to deer as they move about to find suitable forage and shelter. These trails should not be obstructed by spacing slash.

2. The deeper the slash, the greater the obstacle to deer. When slash is 75-100 centimetres deep, the physical obstruction excludes deer from the area. Parallel falling, lopping, and limbing of the larger stems can reduce slash depth.



3. Spacing a large area that has little topographic relief will increase the air movement through the stand, thereby reducing the thermal cover value. Spacing also increases sight distances, causing a decline in security cover. Therefore, large spaced areas should be broken by barriers (Le., trees and/or topography) to wind and vision.

4. Security cover along roads is important (p. 17). Leave an unspaced strip at least 1 0 metres wide along roads.


1 Leave main deer trails unobstructed
2 Reduce the slash profile by parallel falling, lopping, and limbing of larger stems
3 Leave barriers to wind and vision in large spaced areas
4 Leave at least a 10 metre unspaced strip along roads

Results

By applying the handbook principles, obtaining the necessary inputs from the resource agencies, and using a properly instructed and conscientious contractor, the result should be a winter range on which mule deer habitat values have been maintained, or minimally affected, while valuable timber has been extracted.

The harvesting system described in this handbook is applicable to those winter ranges or parts *of* winter ranges where the approval has been given to harvest timber. If the system is properly applied and sufficient time is allowed between passes (e.g., 20-30 yr,), it should be possible to extract timber periodically without significantly harming mule deer habitat values.

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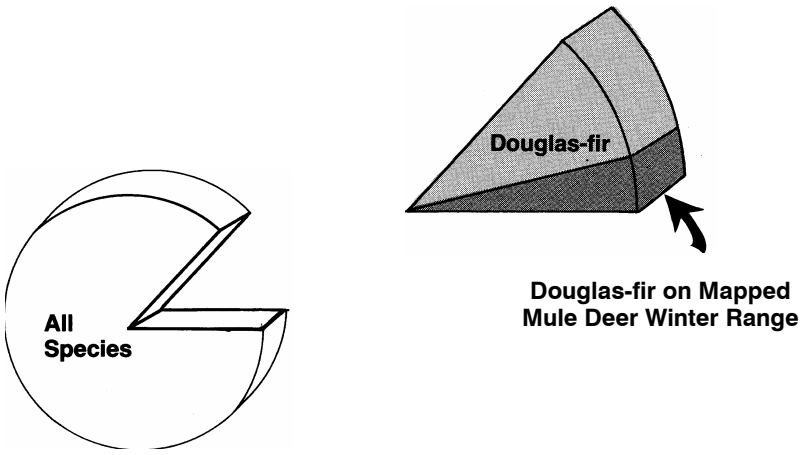
BACKGROUND

Douglas-fir is an important component of the timber supply in the Cariboo Forest Region. A significant amount of the Douglas-fir is also an important component of mule deer winter range. This situation has led to resource allocation problems: Should trees growing on winter range be reserved for mule deer and the benefits that stem from wildlife management? Or, should the Douglas-fir be harvested for timber values? Are compromises possible?

The B.C. Ministry of Forests and Ministry of Environment are working co-operatively to find ways to meet both timber and wildlife management objectives in the Cariboo Region. One part of this co-operative effort is a study of mule deer habitat relationships, funded by the Ministry of Forests and supported by the Ministry of Environment. This handbook is one important output from the study.

BREAKDOWN OF THE GROSS MERCHANTABLE TIMBER VOLUME IN THE CARIBOO FOREST REGION



WE WELCOME YOUR COMMENTS

The relationships and management recommendations presented in this handbook were derived from ongoing research and represent the best available and most current data. As research increases our level of understanding, parts of the handbook may have to be revised.

Extensive effort has gone into making the handbook practical to all user groups, but undoubtedly as it is used operationally its strengths and weaknesses will become apparent. Comments from you, the users, will provide valuable insight not only to future editions but also to related projects.

Please direct all comments to:

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