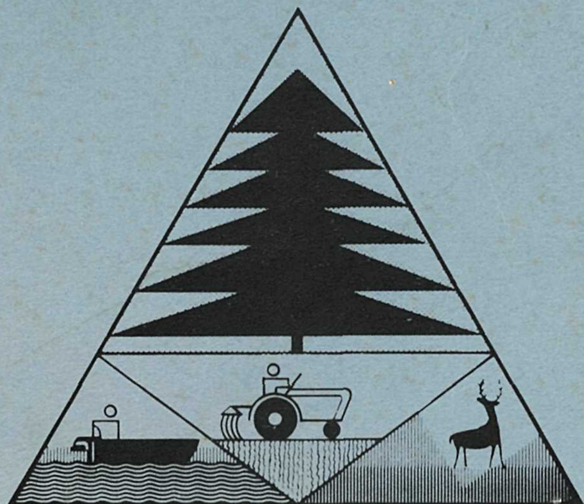
DEPARTMENT OF FORESTRY AND RURAL DEVELOPMENT

NOTES ON THE VEGETATION IN RIDING MOUNTAIN NATIONAL PARK MANITOBA



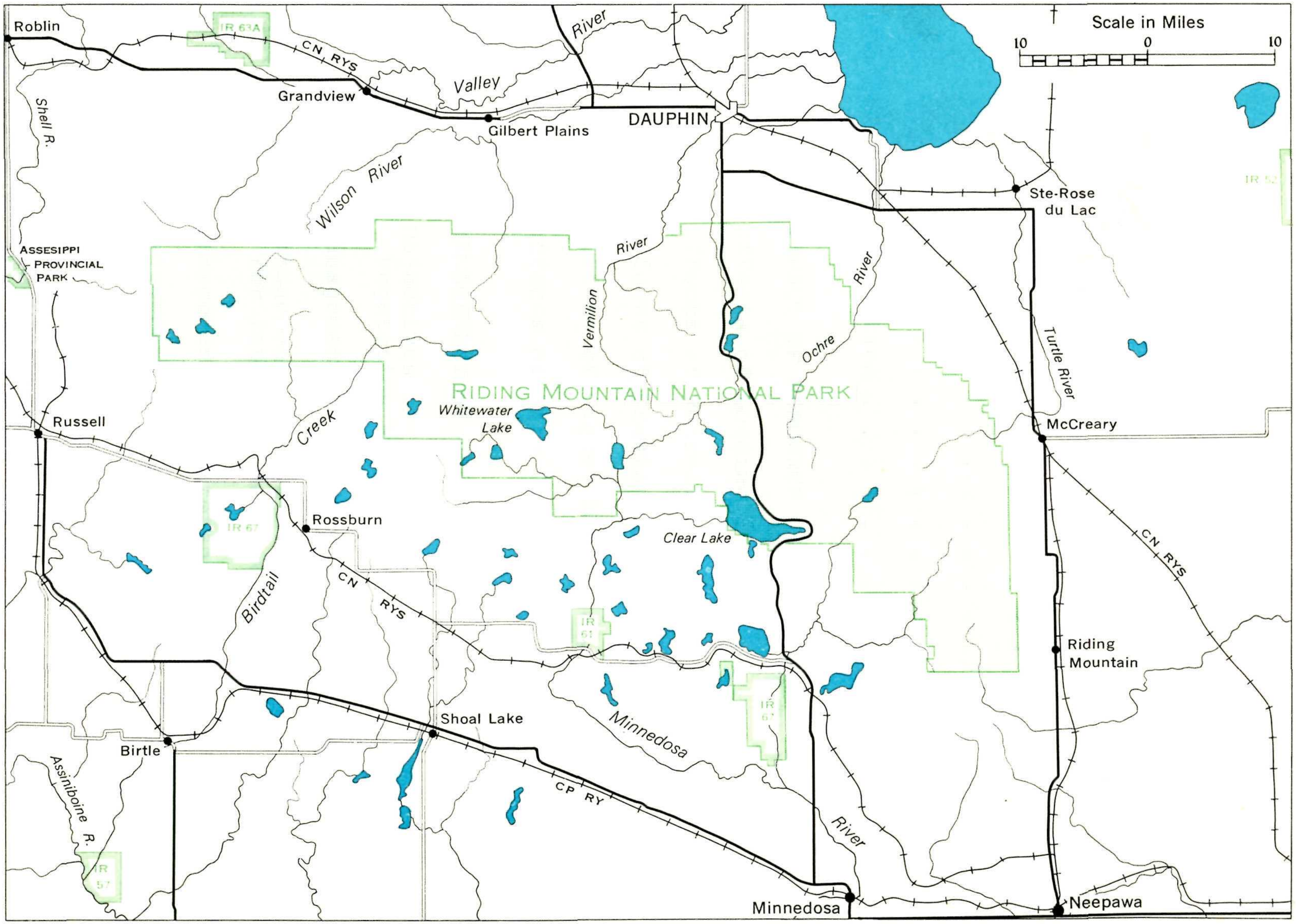
FOREST MANAGEMENT INSTITUTE

Services Section
Ottawa, May, 1968

R. H. Bailey
Forestry Officer

National Park Forest Survey
Report No. 2

RIDING MOUNTAIN NATIONAL PARK, MANITOBA



CONTENTS

NOTES ON THE VEGETATION OF RIDING MOUNTAIN NATIONAL PARK

Introduction

The purpose of this pre-planning report is threefold: (i) to present, under one cover, a summary of the data available on the structure and composition of the vegetation -- primarily forest -- in Riding Mountain National Park; (ii) to outline the effects of various resource uses on the plant communities; and, (iii) to discuss possible management techniques for conserving the inherent character of the vegetative mosaic.

The first section deals with the structure and composition of the major plant communities. This information should be useful to the park naturalist in his interpretation program. However, the data are preliminary, and should be supplemented or revised as additional data become available.

The second section describes the impact of logging, recreation, grazing and haying, gravel mining, and fire protection on the structure and composition of the vegetative resource. All of these activities have had an important role in shaping the present character of forest and grassland in the park.

In the final section, a number of pertinent vegetation management techniques are discussed.

SECTION I

PHYSICAL DESCRIPTION

Geology and Topography

The most prominent topographic feature of Riding Mountain National Park is the Manitoba escarpment which rises approximately 1,300 feet over a distance of 4 miles from the Manitoba Lowland (first prairie level) to the Saskatchewan Plains (second prairie level) (Putnam, 1952). The escarpment is composed of flat lying, dark-grey, cretaceous shales dipping gently to the southwest. The surface deposits on the face of the escarpment and on the lowlands are glacial tills. Sandy and gravelly beaches deposited by Lake Agassiz circumscribe the base of the escarpment at right angles to the direction of landfall. The escarpment face has been deeply incised by fast flowing streams which erode the bedrock and transports the resultant detritus to the lowlands, where it is deposited in alluvial fans and terraces.

Most of the park lies on the rolling plateau of the Western Uplands. Surface deposits are mostly glacial tills, although lacustrine materials, kames and terraces frequently occur near the borders of existing small lakes and in former water channels. Shallow peat deposits cover the glacial till in enclosed depressions and runways.

Climate

The park lies within Koppen's Dfc or humid microthermal, cool summer climatic zone, where the summers are short and the winters are long and cold (Koeppe and De Long, 1958). The average annual precipitation in this area is 18 inches, and the mean annual temperature is about 35°F. Eighty % of the rainfall, or 14 inches, falls during the April to October period; the remaining 4 inches is deposited as snow during the winter months.

Marked differences in climatic conditions may occur within the park. A comparison of meteorological data among weather stations located on the escarpment (Forestry Branch Station), the escarpment edge (Wilson Creek Watershed Station) and the Lowland Plain (Dauphin Station) shows that the plateau, probably because of its higher altitude, receives more precipitation and has lower temperatures than the surrounding Lowland (Table 1). The pronounced difference in the rainfall data from the two mountain stations indicates greater precipitation at the edge of the escarpment than on other areas of the plateau.

Table 1. Comparison of rainfall and temperature data from Riding Mountain Forest Experimental Area (elev. 2,200 feet A.S.L. approx.), Wilson Creek Watershed Station No. 13 (elev. 2,300 feet A.S.L. approx.), and Dauphin (elev. 961 feet A.S.L.) 1961 to 1965 inclusive.

Period	Mean Temperature			Average Precipitation		
	Dauphin	W.C.W. No. 13	F.E.S.	Dauphin	W.C.W. No. 13	F.E.A.
May	50	47	47	2.28	3.04	2.39
June	62	58	58	1.88	2.94	1.98
July	65	62	62	3.35	2.88	2.94
August	64	61	60	2.48	3.04	2.96
September	50	47	47	2.10	2.51	3.09
Avg Mean Temp ---	58	55	55			
Total Precipitation ---				12.09	15.41	13.36

Soils

Detailed soil surveys have been conducted only on limited areas in Riding Mountain National Park, viz., along the mmajor road systems (Ehrlich, Pratt, and Poyser, 1956; Ehrlich *et al.* 1958), in the Wilson Creek Watershed (Pratt and Poyser -- unpublished report) and in the Forest Experimental Area (Rowe, 1954 -- unpublished report). These localized surveys indicate that most of the soils belong to the Grey Wooded Soils Group which characteristically develops clay-impoverished and -enriched horizons on fine textured materials with a low to high lime content.

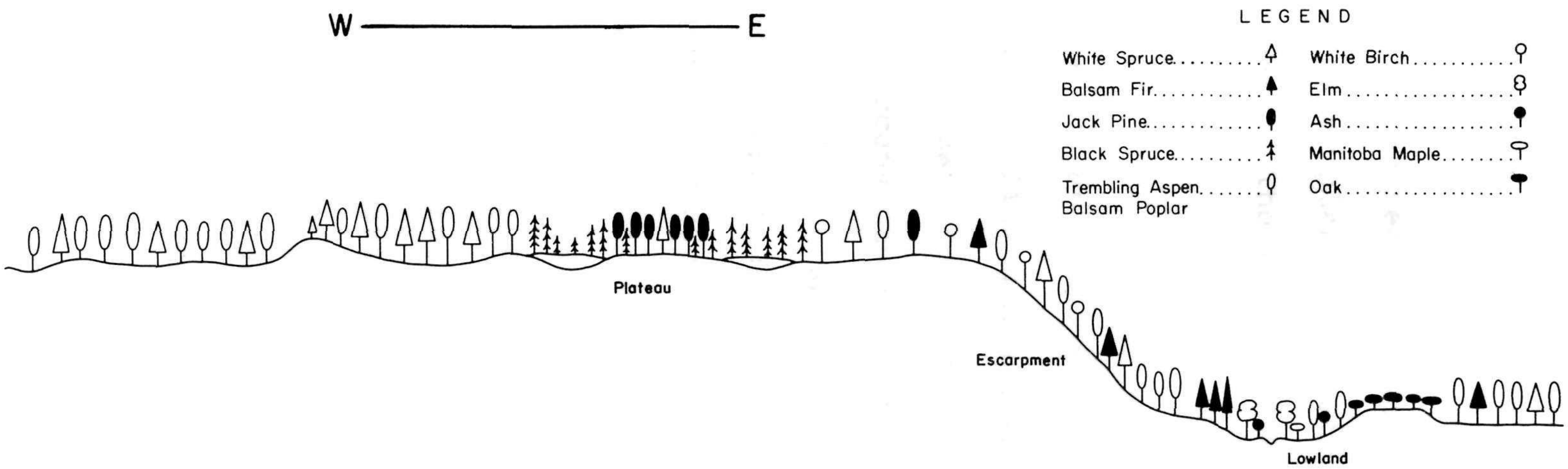
Black soils have formed on coarse textured, glacio-fluvial deposits exhibiting droughty conditions. These soils are found primarily on the old beach lines of Lake Agassiz and on some of the elevated bench lands in the western part of the park. A number of soil intergrades belonging primarily to the Dark Grey Wooded Soils Group are also present in many areas.

Below the escarpment numerous areas with Regosolic soils occur on recently deposited, level to gently sloping alluvial fans and terraces (Ehrlich, *et al.* 1958). When creek levels are low, these porous soils drain freely but when flooding occurs, they are subject to waterlogging. On some higher terraces where inundation is infrequent, weakly developed soil profiles have formed under the stabilizing influence of permanent vegetation.

Vegetation

Riding Mountain National Park lies in the Mixedwood Section (B.18a) of the Boreal Forest Region (Rowe, 1959). This section is characterized by aspen (*Populus tremuloides* Michx.), balsam poplar (*P. balsamifera* L.), white birch (*Betula papyrifera* Marsh.), white spruce (*Picea glauca* (Moench) Voss), and balsam fir (*Abies balsamea* (L.) Mill.) on the well-drained uplands; jack pine (*Pinus banksiana* Lamb.), and black spruce (*Picea mariana* (Mill.) BSP.) on the drier sites; and black spruce and larch (*Larix laricina* (Du Roi) K. Koch) on low, water catchment areas. Also present are minor occurrences of white elm (*Ulmus americana* L.), green ash (*Fraxinus pennsylvanica* Marsh. var. *subintegerrima* (Vahl.) Fern.), Manitoba maple (*Acer negundo* L. var *interius* (Britt) Sarg.), and bur oak (*Quercus macrocarpa* Michx.). The park contains a good representation of all of these tree species. Their relationship to physiographic and edaphic conditions is shown in Figure 1.

Although trees form the dominant vegetation throughout most of the park, there are a number of notable areas, especially in the western sector, where grasses and forbs dominate because of site factors or a combination of site and historical factors.



Parent Material	Glacial Till	Coarse Outwash	Glacial Till	Peat	Glacial Till	Peat	Glacial Till	Recent Alluvium	Gravel Beach	Glacial Till
Soil	Grey Wooded	Dark Grey Wooded	Grey Wooded	Organic	Grey Wooded	Organic	Grey Wooded	Regosol	Black	Grey Wooded
Soil Texture	Loam to Clay Loam	Coarse Sand to Sandy Loam	Loam to Clay Loam	Fibrous	Very Fine Sandy Loam to Clay Loam	Fibrous	Very Fine Sandy Loam to Clay	Silty Clay Loam	Loamy Sand	Fine Sandy Loam to Clay Loam
Soil Moisture	Fresh to Very Moist	Dry	Fresh to Very Moist	Wet	Dry to Fresh	Wet	Fresh to Very Moist	Very Moist	Dry	Fresh to Very Moist

FIGURE I. Relationship of tree species to edaphic and physiographic factors in Riding Mountain National Park.

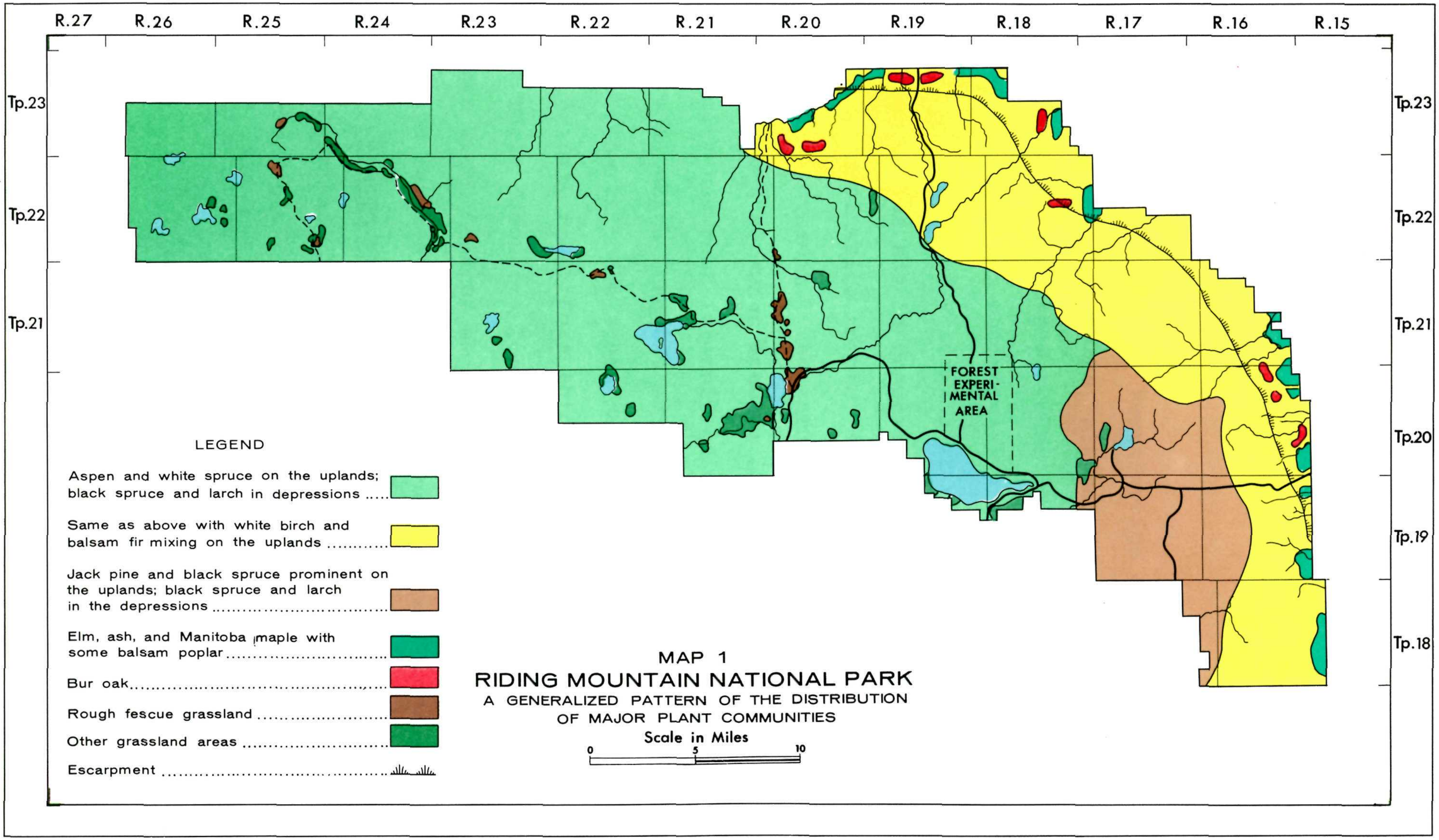
The following section describes the composition and structure of the major plant communities occuring within the confines of the park. Their approximate distribution is depicted in Map 1.

Aspen Communities: Aspen communities dominate the vegetation on the upland sites in Riding Mountain National Park. Dense, young and mature stands cover many areas and open, decadent, overmature stands occupy numerous others. Their prevalence may be attributed to a long and complex history of fire and logging; these phenomena favour aspen growth because of its inherent ability to reproduce vegetatively and prolifically. The same fires that kill aspen and associated shrubs and herbs stimulate prodigious aspen suckering; clearcutting dense young aspen stands generally has the same effect.

In young and mature aspen stands, there is a continuous shrub layer composed primarily of hazel (*Corylus cornuta*)[1] (Appendix, Table 1) beneath the closed crown canopy. The herb stratum, dominated by wild sarsaparilla (*Aralia nudicaulis*), also forms a continuous layer (Appendix, Table 2). Ground cover is confined to the occasional log and consists of a few scattered

---

[1] Nomenclature authorities for herb and shrub species are given in Tables 1 to 22 of the Appendix.



MAP 1
RIDING MOUNTAIN NATIONAL PARK
A GENERALIZED PATTERN OF THE DISTRIBUTION OF MAJOR PLANT COMMUNITIES

mosses, lichens and liverworts. Reproduction of any tree species in these stands is sparse, although the occasional white spruce seedling and aspen sucker do occur.

Overmature aspen communities are somewhat different in structure but essentially similar in composition. The tree cover is discontinuous and is composed of scattered overmature aspen; the occasional white spruce, white birch or balsam poplar may also be present. The shrub cover is dense and continuous, although somewhat patchy; in a number of places the cover density has been intensified by browsing ungulates, particularly elk, which frequent shrubby, treeless, areas. Elk concentrations in these areas may be attributed to the abundance of prickly rose (Rosa acicularis) and peavine (Lathyrus spp.) two of their favourite foods (Blood, 1966b). The herb layer is often discontinuous as the low light intensity beneath some dense shrub patches limits plant growth. Tall herbs such as blue-joint (Calamagrostis canadensis), late goldenrod (Solidago gigantea var. leiophylla) and tall lungwort (Mertensia paniculata) frequently fill openings in the shrub canopy. Ground cover is similar to that of the younger aspen communities.

White Spruce Communities: White spruce is probably the most ubiquitous tree in the park. It can be found advancing into small, dry 'prairie' areas but is equally often found bordering wet swamps. The most vigorous specimens grow under conditions similar to those outlined for aspen, its principal associate. Although widely distributed, white spruce forms few pure stands.

Rowe (1955) has noted three white spruce types characterizing the Mixedwood Section of the Boreal Forest, viz., swamp spruce, prairie spruce, and upland fire-type spruce. The swamp spruce stands in the park are often dense and occur on the swamp borders in a transition zone from upland mineral soils to lowland peat deposits; stands of this type are also found along small, flowing streams (Rowe, 1954 -- unpublished report). The structure and composition of the herb and shrub strata, as described by Rowe, are variable. Speckled alder (Alnus rugosa var. americana) and willow (Salix spp.) may or may not form a shrub stratum. Small plants such as Carex disperma, purple-stemmed aster (Aster puniceus), small enchanter's-nightshade (Circaea alpina), and common horsetail (Equisetum arvense) characterize the herb stratum. The continuous ground cover usually contains one or more of the following mosses: Mnium spp., Climacium americanum, Hylocomium proliferum, Aulacomnium palustre, and Hypnum uncinatum.

Prairie spruce stands of limited areal extent occur on some excessively drained sites such as those found on coarse outwash materials. The minor vegetation here is usually composed of small herbs giving the community a parklike appearance. Shrub cover is generally absent although the occasional rose and snowberry (*Symphoricarpos albus*) may be present. The herbaceous vegetation is dominated by two upland grasses, hairy wild rye (*Elymus innovatus*) and white-grained mountain rice grass (*Oryzopsis asperifolia*); these are accompanied by smooth wild strawberry (*Fragaria virginiana*), northern bedstraw (*Galium septentrionale*), Canada hawkweed (*Hieracium canadense*), veiny meadow-rue (*Thalictrum venulosum*), two-leaved Solomon's-seal (*Maianthemum canadense*), and yarrow (*Achillea millefolium*). In areas where this forest community has displaced a prairie community, relicts of the former flora, such as sheep fescue (*Festuca ovina*), puccoon (*Lithospermum canescens*), early blue violet (*Viola adunca*), everlasting (*Antennaria* spp.), and heart-leaved Alexander (*Zizia aptera*) are often found (Rowe, 1954 -- unpublished report).

Fire-type white spruce stands occupy only a small portion of the upland sites. Crown cover is continuous except for the occasional small opening generally identifiable on the ground by a dense growth of hazel and other tall shrubs. The shrub stratum is discontinuous; total coverage is about 40% and consists, for the most part, part of small shrubs or poorly developed specimens of large shrubs (Appendix, Table 3). Species such as Saskatoonberry (Amelanchier alnifolia) and red-fruited chokecherry (Prunus virginiana) normally growing to heights of 6 feet to 10 feet under open conditions are represented here by small straggling specimens less than 2 feet in height. Hazel and other tall shrubs, as noted above, are prominent under canopy openings where they attain heights of 5 feet or more.

The herbaceous stratum in these white spruce stands is continuous and is dominated by strawberries (Fragaria spp.) and palmate-leaved colt's foot (Petasites palmatus) (Appendix, Table 4. The ground cover usually forms a discontinuous patchwork pattern covering approximately 25% of the forest floor. It is composed primarily of bryophytic species, although various lichen forms grow on old logs and protruding rocks. One striking aspect of this community is the absence of spruce reproduction. Reproduction is composed principally of trembling aspen suckers which die after attaining a height of 3 to 5 feet, apparently because of poor light conditions.

Aspen/White Spruce Communities: The aspen/spruce community may be grouped into two classes: those growing on fresh to moist sites and those growing on very moist sites.

In aspen/spruce stands on fresh to moist sites, the shrub cover is dominated by hazel (Appendix, Table 5). It is essentially continuous except immediately beneath individual white spruce where its development is hindered by subdued light conditions. Herbaceous cover is approximately 50%; wild sarsaparilla, tall lungwort, and white-grained mountain rice grass prevail in this stratum (Appendix, Table 6). Ground cover is for the most part negligible. Tree reproduction is light and is dominated by aspen suckers although few survive past heights of 6 to 8 feet, perhaps because of elk browsing. Scattered spruce reproduction is confined principally to old rotting spruce logs and stumps.

The aspen/spruce community on very moist sites is not as common as the above community. In addition to white spruce and trembling aspen, balsam poplar is usually well-represented in the tree stratum. The shrub cover is discontinuous and sometimes absent. Wild red raspberry (Rubus idaeus) is usually the most frequently occuring shrub (Appendix, Table 7). The continuous herbaceous layer is dominated by the tall grass blue joint (Appendix, Table 8). The ground cover, composed primarily of mosses, is concentrated on old rotting logs although moss accumulates around the base of shrubby plants, particularly speckled alder. Aspen and balsam poplar reproduction is moderate but few individuals develop beyond 6 to 8 feet in height. Spruce reproduces periodically in the organic layer of the soil horizon, especially around the perimeter of very moist sites, as well as on old rotten logs; where the latter medium is available, spruce seedlings are more common.

Black Spruce Community: Black spruce communities are confined mainly to the many poorly drained, peat-filled basins frequenting the plateau portion of the park; however, in some regions, particularly the Whirlpool Lake area, they are often found in association with jack pine on dry sites adjacent to bogs. Larch is a common associated species.

A floral check-list is unavailable for presentation in this report. Tables 9, 10 and 11, of the Appendix were constructed from data gathered in a stand in the Wilson Creek Watershed area by J.C. Ritchie, (1958 -- unpublished report).

Jack Pine Community: The jack pine community is almost exclusively confined to the region outlined in Map 1. No satisfactory explanation has been advanced for this limited distribution. However, the slightly higher content of calcium carbonate in the soil parent material of most other areas in the park, which has been indicated by the incomplete soil surveys, may be an important limiting factor. Also, frequent fires on the southeast part of the escarpment have encourage the jack pine communities in this region. Overmature jack pine remnants to the north and west of this region indicate that jack pine communities would have had a greater distribution if recent fires had extended into adjacent areas (Waldron, 1967 -- personal communication).

Jack pine is a shade intolerant, pyrophytic species forming dense stands following fires on relatively dry sites. White spruce and aspen are often associated with it, especially in older stands; black spruce forms an integral part of the forest canopy around the periphery of bogs.

Primarily because of logging and plant succession, very few mature undisturbed stands remain. The following is a description of jack pine stands located near Whirlpool Lake.

The tree stratum consists of two distinct horizontal zones. The upper zone (75 to 90 feet) is composed principally of 120 year old jack pine; the occasional white spruce and aspen have also penetrated this layer. The second zone, varying from 15 to 40 feet in height, is composed exclusively of white spruce. The total coverage of the entire tree stratum approximates 75%.

Shrub coverage ranges from 50 to 60%. Green alder (Alnus crispa), growing to heights in excess of 10 feet, dominates growth in this stratum (Appendix, Table 12). Prickly rose and wild red raspberry are also frequent but their physical development is poor. Purple oat grass (Schizachne purpurascens) and smooth wild strawberry dominate the continuous herbaceous layer (Appendix, Table 13). The ground cover totals about 20% and is composed of heterogeneous moss patches. Some crustose and foliose lichens, along with various moss species, are also present, on old rotting logs. Reproductive growth is primarily white spruce; scattered individual trembling aspen and balsam poplar suckers are also present, but development beyond heights of 3 feet is rarely observed.

Young even-aged polewood jack pine stands were also examined near Whirlpool Lake. The dense tree canopy intercepts much of the sunlight and as a result, the shrub stratum consists mainly of a few scattered low or poorly developed shrubs dominated by rose (Appendix, Table 14). The discontinuous herbaceous layer is composed primarily of low herbs such as bunchberry (Cornus canadensis), palmate-leaved colt's foot and dewberry (Rubus pubescens) (Appendix, Table 15). The occurrence in this stratum of three club moss species (Lycopodium annotonium, L. complanatum and Lycopodium obscurum is of interest since, with the exception of stiff club-moss (*L. annotonium*), these plants were not observed in other areas (stiff club-moss was observed at infrequent intervals in the eastern part of the park). Low light intensities at the forest floor level facilitate the development of a continuous dense moss cover.

Balsam Fir Community: Balsam fir communities are confined to the eastern portion of the park. The limited distribution is an interesting phytogeographic phenomenon. It is possible that this zone receives more moisture than the surrounding areas since it is associated with the rim of the escarpment where orographic precipitation is likely to be greatest.

As in the case of the black spruce community, detailed check lists of the flora are not available. The following data were gathered by J.C. Ritchie (1958 -- unpublished report) in a number of stands located on the alluvial deposits below the escarpment. These stands averaged 55 feet in height. Scattered old, decadent white birch, jack pine, and white spruce were associated with the balsam fir. There was essentially no shrub layer in this community; prickly rose was the only woody perennial present. The important herb and ground cover constituents are listed in Tables 16 and 17 of the Appendix. Abundant fir regeneration was observed.

Bur Oak Community: The bur oak communities in Riding Mountain National Park occur primarily under droughty conditions on portions of the old Lake Agassiz gravel beaches and on the upper slopes of stream valleys deeply incised in the escarpment. Oak has been heavily exploited by the local populace for firewood and fence posts and no major undisturbed stands now remain. The following data were collected in partially disturbed stands located on an old beach line below the escarpment.

The tree stratum, composed entirely of oak, was stratified into two relatively distinct layers: the first averaged 35 feet in height and the second averaged about 15 feet. Downy arrowwood (*Viburnum rafinesquianum*) and Saskatoonberry dominated the dense, continuous shrub cover (Appendix, Table 18). Herbaceous coverage, for the most part, was continuous, although not dense; *Carex paryana* and white-grained mountain rice grass were omnipresent (Appendix, Table 19). Ground cover was negligible. Reproduction, almost exclusively oak, was primarily by seed, although coppice growth was observed on old stumps left after cutting.

Elm/Ash Community: The elm/ash community is confined to riparian sites below the escarpment. The tree canopy of the mature stands is continuous and provides almost complete coverage. The upper story, composed of elm and the occasional balsam poplar, reaches a height of approximately 60 feet. Below this, and ranging in height from 30 to 40 feet, is a layer of green ash and Manitoba maple. The discontinuous shrub stratum is not prominent in this community. Except for the occasional tall shrub, almost all specimens are below 5 feet (Appendix, Table 20).

The tall herbaceous layer, (Appendix, Table 19) together with the forest stratum, dominates the structure of the elm/ash community. The dominant species is ostrich-fern (*Matteuccia struthiopteris* var. *pennsylvanica*), which forms a continuous shoulder-high layer throughout the stands. Spotted touch-me-not (*Impatiens capensis*) and tall meadow-rue (*Thalictrum dasycarpum*) also occur frequently in the tall herb stratum. The low herbs, dominated by sedges (*Carex assiniboinesis* and *C. dewyana*), form a very distinct but discontinuous layer (Appendix, Table 21). Ground cover is negligible.

Reproduction of all major tree species is apparently sufficient for the perpetuation of this community. Balsam poplar frequently produces suckers but only scattered individuals survive beyond heights of 6 feet. Elm reproduction is not particularly widespread, but those individuals that are present appear to be vigorous.

A second type of 'visually' different elm/ash community often occupies stream flood plains. Here, instead of the continuous tall herbaceous layer characterized by ostrich-fern, there is a continuous low layer dominated by hog-peanut (Amphicarpa bracteata). This latter species forms a dense twining mat over most herbaceous and shrubby vegetation in the community.

Grassland Communities: Most grassland communities are confined to the western half of the park. Field investigations to dermine the composition of these communities have been limited to the rough fescue (Festuca scabrella) association (Blood, 1966a).

At present, differentiation by site appears to be the most convenient method for classifying these types. To collect further botanical information, the various communities could be stratified as follows:

Upland Meadows

(a) Undisturbed

(b) Disturbed (grazed)

Lowland Meadows

(a) Undisturbed

(b) Disturbed (grazed and/or mowed)

Blood (1966a) conducted a study to determine the composition of the rough fescue association; he believes that the association represents climax conditions on undisturbed upland sites. Important constituents of this community are tabulated in Table 22 of the Appendix. Blood (1966 -- personal communication) also recognizes undisturbed upland communities dominated by species of wheat grass (Agropyron), goldenrod, and yarrow; these communities are probably seral and may have originated following fire.

Blue grass (Poa spp.), and dandelion (Taraxacum officinale) dominate many grazed areas; excessively grazed communities usually contain shrubby species such as shrubby cinquefoil (Potentilla fruticosa) and snowberry (Symphoricarpos albus).

The composition of lowland communities is variable (Blood, 1966 -- personal communication). Some are dominated almost entirely by sedges and others by grasses (primarily reed grass (Calamagrostis spp.), and timothy (Phleum pratense)) and forbs. The superimposition of grazing and haying activities on many areas further complicates community composition.

SECTION II

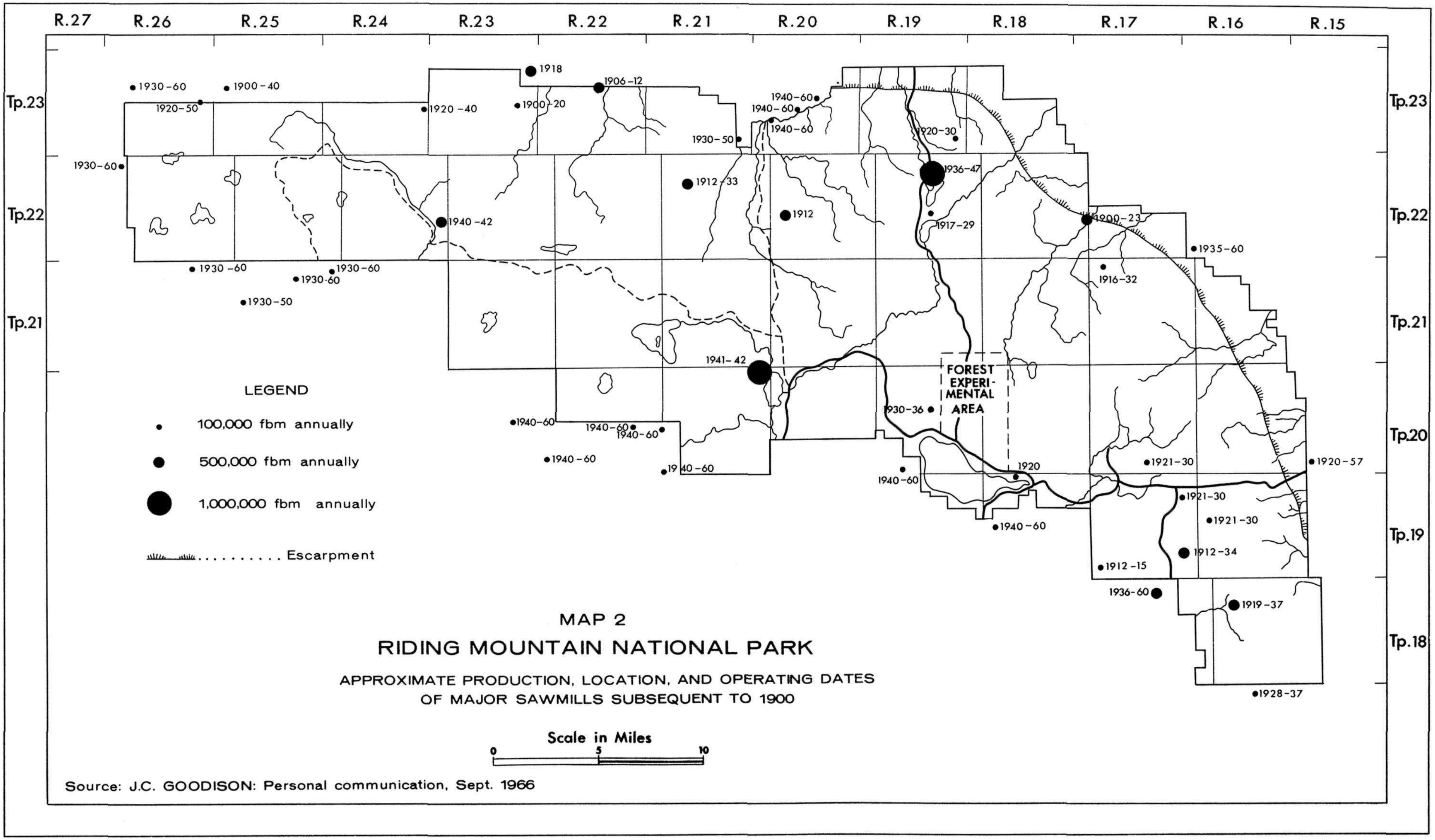
IMPACT OF RESOURCE USES ON VEGETATION

The following is a description of important resource uses and their effects on the structure and composition of plant communities.

Effects of Logging

Logging activities, under limited control, began with the settlement of the surrounding countryside in the latter part of the nineteenth century and continued until 1938 when the first working plan was put into effect. During this period, numerous sawmills were in operation throughout the park; important mill locations are shown in Map 2.

White spruce, because of its value for lumber, was the most heavily exploited species; jack pine, balsam fir and aspen were utilized to a lesser extent. Construction of the railway to Dauphin in the early 1890's precipitated a heavy demand for jack pine railway ties and many of these were obtained by intensively logging the southeastern part of Riding Mountain. Aspen, ash and oak have been continually removed from the periphery of the park for fuelwood; moreover, the latter two species along with black spruce have often been utilized for posts and poles.



MAP 2

RIDING MOUNTAIN NATIONAL PARK

APPROXIMATE PRODUCTION, LOCATION, AND OPERATING DATES OF MAJOR SAWMILLS SUBSEQUENT TO 1900

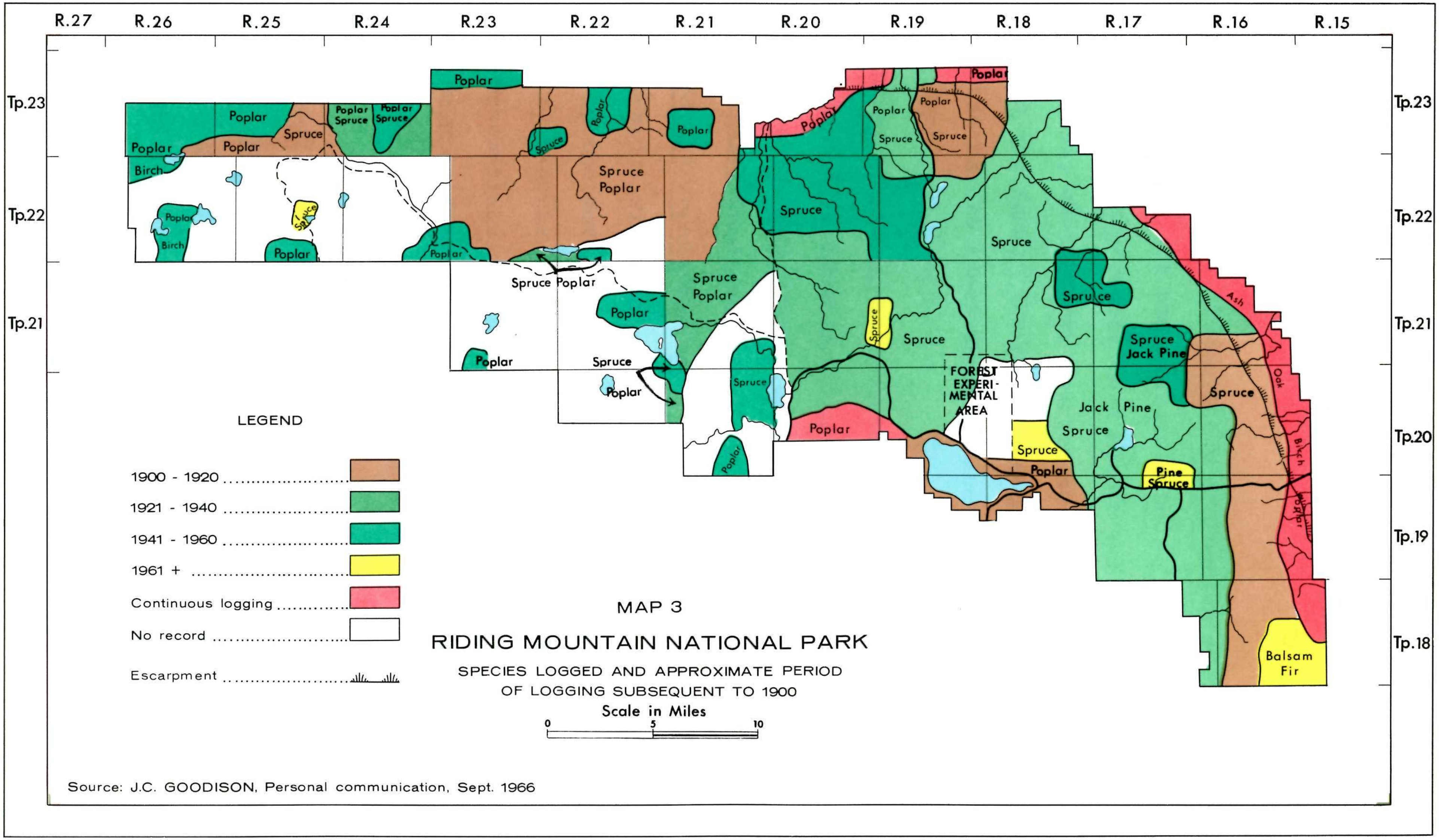
Source: J.C. GOODISON: Personal communication, Sept. 1966

Map 3 is a very generalized illustration of the approximate logging periods and of the principal species removed after 1900. Although most areas had been logged at least once for softwood prior to the initiation of the first working plan in 1938, there are no logging records for the area between Clear and Elk Lakes. Within this section, forest communities undisturbed by logging may be found.

The next sections outline some important effects of logging on the composition and structure of the major forest communities in Riding Mountain National Park, (Bailey, 1966 -- unpublished report).

Aspen: The effect of clearcutting in polewood aspen stands (usually for fuelwood) is not particularly severe. A dense cover of vigorous aspen suckers comes up rapidly from the underground root system of the extracted trees, and quickly forms the dominant stratum.

Immediately following logging, the shrub layer intensifies, primarily through the increased growth of red-osier dogwood (*Cornus stolonifera*), hazel and wild red raspberry. The herb stratum remains basically unchanged except on haul trails and skidways, where the flora are augmented by various tall grasses (e.g. blue joint and fringed brome (*Bromus ciliata*)) and exogenous forbs (e.g. lettuce (*Lactuca* spp.) and perennial sow-thistle (*Sonchus arvensis*)).



MAP 3

RIDING MOUNTAIN NATIONAL PARK

SPECIES LOGGED AND APPROXIMATE PERIOD OF LOGGING SUBSEQUENT TO 1900

Source: J.C. GOODISON, Personal communication, Sept. 1966

White Spruce Communities: The effects of logging in the white spruce community have not been investigated. After logging, swamp spruce stands may revert to a meadow stage if the water table should rise, or they may regenerate themselves if edaphic factors remain the same. The prairie spruce stands are rarely cut because the mature trees usually have poor form and limby trunks.

On upland sites, heavy cutting would result in the rapid development of a dense continuous shrub stratum on the fresh to moist sites and a heavy cover of herbs on the very moist sites. Small woodland herbs such as lesser rattlesnake-plantain (Goodyera repens var. ophioides) Bishop's-cap (Mitella nuda) and one-sided wintergreen (Pyrola secunda), would either be displaced by the more vigorous heliophytic forbs and grasses, or smothered by the heavy leaf fall from deciduous flora. The rudimentary discontinuous moss layer would also, no doubt, be eliminated because of exposure to excessive amounts of sunlight and because of the smothering action of the leaf fall. The resultant community would undoubtedly resemble those described below.

Aspen/White Spruce Communities: Mixedwood stands have generally been selectively logged for large, mature white spruce. This action opens the stand and increases the possibility of spruce blow-down and aspen breakage. The resultant community is often dominated by a heavy shrub stratum.

In disturbed communities on fresh to moist sites the shrub stratum, especially the hazel and prickly rose components, is heavily browsed and closely cropped by elk at a height of about 5 feet. Saskatoonberry, wild red raspberry, and twining honeysuckle (*Lonicera dioica* var. *glaucescens*) are more frequent here than in undisturbed stands. Round-leaved hawthorn (*Crataegus chrysocarpa*) and some willow species occasionally establish themselves in disturbed areas but none becomes an important part of the residual community. Small shrubs, such as snowberry, are often markedly reduced because of poor light conditions beneath the taller shrub element and excessive competition from tall or coarse herbs, or both, growing beneath openings in the shrub canopy.

In the herbaceous stratum of logged stands, there is generally a decrease in small plants (e.g. two-leaved Solomon's seal, Bishop's cap, white-grained mountain rice grass, pink wintergreen (*Pyrola asarifolia*), and one-sided wintergreen) characterizing cool shady woodlands, because of excessive competition from larger and more heliophytic plants (e.g. blue joint, fireweed (*Epilobium angustifolium*), cow-parsnip (*Heracleum lanatum*), late goldenrod, and Canada goldenrod (*S. canadensis*)).

On very moist sites, increased light conditions in the minor strata after logging, stimulate the development of the aggressive blue joint and broad-leaved heliophytic forbs such as aster (*Aster* spp.), cow-parsnip, and late goldenrod.

The dense growth of these plants reduces the frequency of smaller herbs, such as wild mint (*Mentha arvensis* var. *villosa*) and marsh skullcap (*Scutellaria galericulata* var. *epilobifolia*), that characterize the patches of open ground in the undisturbed stands. Reproduction of white spruce is very poor and is confined chiefly to decaying spruce stumps. Moderate sucker growth comprises the aspen and balsam poplar reproduction; however, this growth rarely exceeds 8 feet, probably because of heavy browsing by ungulates.

The foregoing effects of logging may be considered as immediate or short term and, with the exception of the white spruce communities, indicate that logging activities do not seriously alter the composition of the aspen/spruce communities although they do change the relative relationship between various groups of species.

In addition to the contemporaneous effect of logging, it is also necessary to consider the temporal effect, or effect of plant succession.

Pre-logging descriptions of the Riding Mountain forest mosaic are not available. Dickson (1909), together with other early investigators (Evans 1923, and Tunstell *et al.*, 1922 -- unpublished reports) believed that the aspen, aspen/spruce, and spruce communities on upland sites formed a successional continuum of increasing stability with respect to environmental factors. Aspen was considered to be the pioneer phase following catastrophic events such as fire, flood, or windfall ploughing of the soil; spruce represented the self-perpetuating climax phase. However, more recently, Rowe (1961) has proposed that, in the absence of such catastropic events, the climax forest on many upland sites in the western boreal forest is " . . . open, unhealthy, ragged, and frequently brush-filled." It is probable, therefore, that the so-called climax vegetation would be dominated by shrub species, particularly hazel, prickly rose, and wild red raspberry and that the tree stratum would be represented only by the occasional white spruce, trembling aspen, and balsam poplar. Perhaps, the structure and composition of such communities may bear a close resemblance to many stands where logging operations have been conducted.

There is evidence that spruce was once more abundant than it is now. Dickson (1909) reported a number of white spruce stands " . . . of several square miles . . ." in areal extent and Evans (1923 -- unpublished report) noted that in the western part of the park " . . . the original forest type on the reserve was coniferous. It consisted principally of white spruce . . . ." Evans attributed the decrease in the number of white spruce to the two successive fires in the 1880's and 1890's that followed white spruce logging in this part of the park.

Clearly the perpetuation of white spruce and aspen/white spruce communities depends upon the ability of spruce to regenerate adequately; from a forestry viewpoint, this attribute has long been recognized as a major problem in the southern Boreal Forest. Poor seedbed conditions, competition from vigorous herbs and shrubs, heavy deciduous leaf fall, and inadequate moisture conditions are perhaps the major environmental factors limiting white spruce reproduction (Phelps, 1948; Rowe, 1955). Furthermore, the period of intensive logging from late in the nineteenth century until 1938 may have accentuated this problem. Rowe (1955) concludes that logging rarely assists spruce reproduction and that it sometimes makes conditions unfavourable by opening up the canopy and allowing competitive herbaceous and shrubby growth to increase. Rowe also notes that decaying wood, primarily white spruce, provides the most favourable seedbed in undisturbed forests; therefore, the removal of this species has in effect destroyed a part of the seedlings' environment and reduced the source of seed supply as well; both factors combined may limit any increase in the number of white spruce.

The current white spruce stands are even-aged and undoubtedly of fire origin. These provide a closed coniferous cover and refuge for the small plants which are light intolerant, or subject to smothering by deciduous leaf fall, or both.

Jack Pine Community: The immediate effects of logging on the jack pine community are severe and variable. The variability may possibly be attributed to changes in the water table caused by the removal of the tree cover. On some areas, logging precipitates an invasion of grasses and the site reverts to a meadow (Cayford, 1958). Jack pine stands studied in the vicinity of Whirlpool Lake indicate that after clear-cutting, the tall shrub stratum composed of green alder is replaced by a waist-high stratum consisting chiefly of prickly rose and wild red raspberry; low wild gooseberry (*Ribes hirtellum*) and snowberry which are not found in undisturbed stands, invade and establish themselves in the cutover stands.

In the herbaceous layer, small plants such as purple oat grass, smooth wild strawberry and two-leaved Solomon's seal are displaced by tall coarse herbs, namely, blue joint, fireweed, Lindley's aster (*Aster ciliolatus*) and tall lungwort. The variety of flora in this stratum is augmented after logging by several exogenous species, most notably, perennial sow-thistle, and also by species such as Canada anenome (*Anenome canadensis*), spurred-gentian (*Halenia deflexa*) and horsetails which migrate to the clear-cut areas from neighbouring moist depressions. Other additions include wood-rush (*Luzula acuminata*), star-flowered Solomon's seal (*Smilacena stellata*) and heart-leaved Alexander. Some species, such as one-sided wintergreen, violets, Bishop's cap, and twin flower (*Linnea borealis* var. *americana*), characteristic of cool woodland areas, are often scarce or non-existent in the subsequent community.

Jack pine, is a light tolerant, pyrophytic species, dominating many pioneer communities on burned-over areas in the southeastern part of the plateau (Map 1). Information about successional stages in the jack pine community in the absence of fire is very scant but field observations indicate that communities dominated by white or black spruce would gradually replace those dominated by jack pine.

Although there are only a few small stands of undisturbed mature jack pine left, there are many healthy young stands approximately 40 to 50 years of age. Some probably owe their origin, at least indirectly, to logging, since the heavy pine slash provided an excellent fuel source for nurturing extremely hot fires; Dickson (1909) noted that "The fire danger in this type is alarming; in fact, it is difficult to see how the mass of debris and young growth on these great brules has so far escaped." However, where there are no fires after logging or where logging has removed most of the trees providing the seed source, many jack pine communities may be replaced by dense stands of grass or other forms of lesser vegetation.

The effect of logging on the jack pine community, although severe, is probably negligible, in the long run; it removes only the dominant species of an intermediate successional stage which is incapable of reproducing itself under 'normal' circumstances. In fact, the resultant debris in partially logged stands provides a favourable host for fire -- the necessary environmental link to the survival of this community.

<u>Black Spruce and Balsam Fir Communities:</u> The effects of logging on the black spruce and balsam fir communities have not been studied in Riding Mountain National Park.

Small to medium sized patches of black spruce have been removed for posts. On dry upland sites, grass species dominate the subsequent community; on the wet organic sites, ericaceous shrubs form the most conspicuous component.

<u>Oak Community:</u> Since there are no large areas of undisturbed oak stands left in the park, defining the exact effect of logging is impossible. A comparison of moderately logged stands with clear-cut stands indicates that cutting has very little effect on the composition of the residual community.

The shrub stratum dominates both the lightly disturbed and clear-cut communities although it is somewhat denser in the latter type. Species composition is basically the same although round-leaved hawthorn occasionally invades the disturbed areas.

Differences in the composition and structure of the herb layer after logging are minor.

The oak community represents the climax phase of successional development on the draughty parts of the old beach lines of Lake Agassiz. Logging is apparently not detrimental either immediately or in the long run to the community composition. Removal of the oak initiates vigorous coppice growth and in a short time, this species again dominates the community.

Elm/Ash Community: Logging activities in this community are limited and generally selective in favour of green ash. All dominant species in the tree layer appear to reproduce satisfactorily, and these minor disturbances probably do not greatly affect the basic plant structure or composition.

Introduction of Exogenous Species: Timber removal within the various communities may have aided the introduction and establishment of the few exogenous species that now form an integral part of the flora, viz. yarrow, Canada thistle (*Cirsium arvense*), hemp nettle (*Galeopsis tetrahit*) and dandelion. Haul trails, in addition to access roads and trails, provide suitable environmental avenues for the establishment of many species belonging to this class. A complete check list of these is not available, but some of the more common species, in addition to the foregoing, are awnless brome (*Bromus inermis*), narrow-leaved hawks's-beard (*Crepis tectorum*), lettuce species, medick (*Medicago* spp.), timothy, common plantain (*Plantago major*), lady's-thumb (*Polygonum persicaria*), perennial sow-thistle, and clover (*Trifolium* spp.).

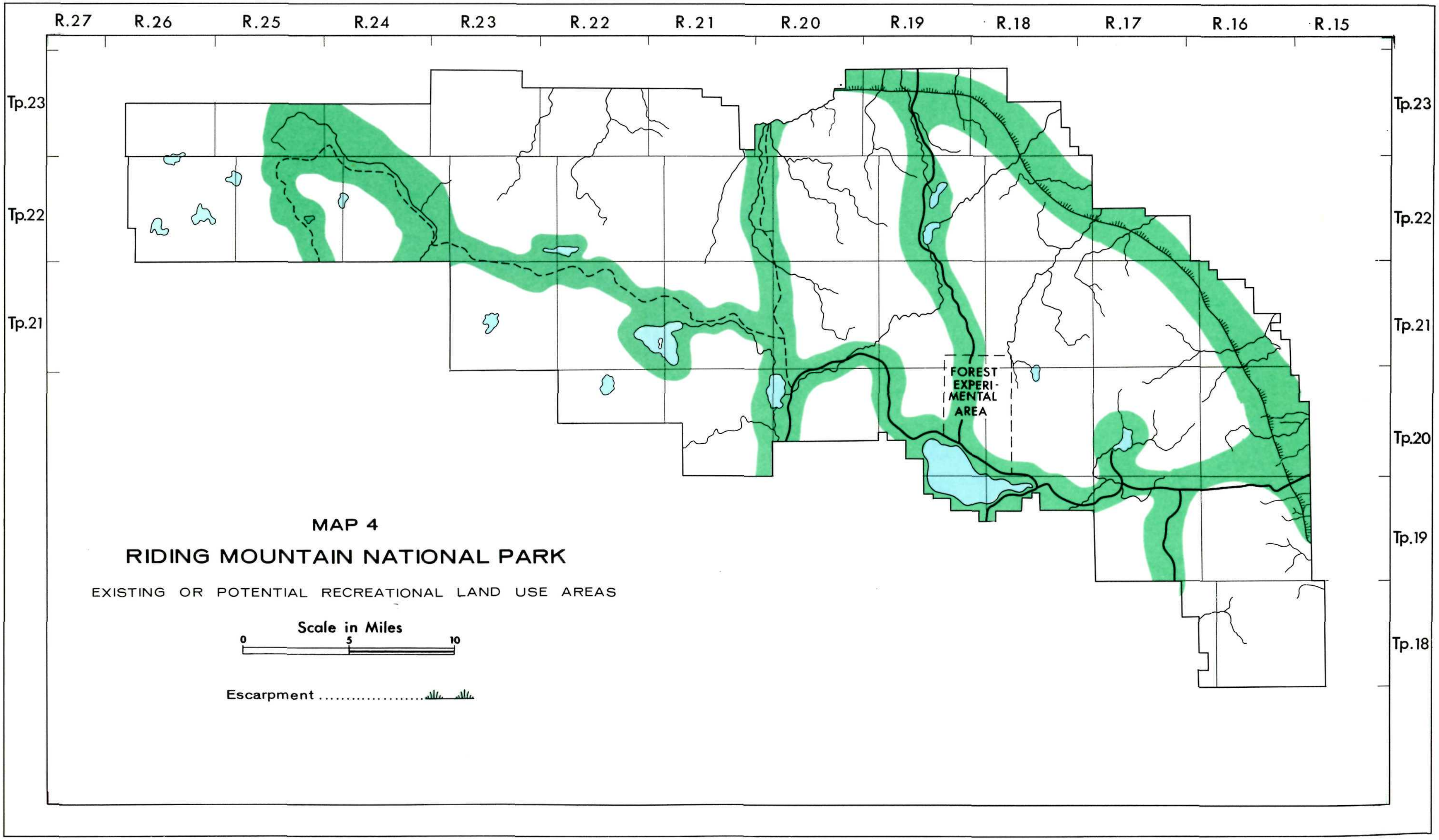
Although logging may be blamed for the introduction of a number of 'weeds', it cannot be blamed for their establishment. Establishment depends on the adaptability of the species to the new environment. In most cases, the exogenous plant will disappear after the disturbed areas has 'healed' (Polunin, 1960). Species that have become an integral part of some forest communities would probably have done so without the aid of logging. The surrounding farmland and waste places provide the required habitat for the production of abundant seed that may be readily transported to all parts of the park by wind or by the local fauna.

Effects of Recreation

The use of the landscape for recreational purposes (Map 4) may be divided into two categories: consumptive use, connoting direct physical impact on the resource; and non-consumptive, signifying an amenity use of the resource.

The direct physical impact of recreational activites on vegetation in the park is localized in camping and picknicking areas and around public buildings such as shelter huts and washrooms serving as focal points of human activity. Heavy use has removed much of the vegetation from these areas and has no doubt drastically changed soil and microclimatic conditions.

Soil compaction and reduction of organic matter are probably the most important edaphic changes related to trampling. (Hartesveldt, 1964 -- unpublished report). Soil compaction substantially reduces the penetrability of many plant roots. In addition, it reduces pore space and thereby limits soil moisture and increases run-off; the erosion of the most fertile layer of the solum is increased in turn. Microclimatic changes following clearing and trampling also contribute to the alteration in vegetative composition. Increased insolation, abrupt diurnal temperature changes, reduced relative humidity, and increased atmospheric turbulence near the surface of the bare ground may be important limiting factors to the survival of some plants (Geiger, 1965).



R.27
R.26
R.25
R.24
R.23
R.22
R.21
R.20
R.19
R.18
R.17
R.16
R.15
Tp.23
Tp.22
Tp.21
Tp.20
Tp.19
Tp.18
FOREST EXPERI- MENTAL AREA
MAP 4
RIDING MOUNTAIN NATIONAL PARK
EXISTING OR POTENTIAL RECREATIONAL LAND USE AREAS
Scale in Miles
0
5
10
Escarpment

However, despite the environmental changes, trampling is probably the major cause of plant destruction. In the center of intensively used zones, plant growth of any type is completely absent. Around the periphery scattered exogenous annuals (most of which are exotic) manage to survive and successfuly complete their life-cycle. Grasses (principally species of blue grass and wheat grass) are the most important of these, although some forbs such as shepherd's purse (Capsella bursa-pastoris), lamb's-quarters (Chenopodium album), pineappleweed (Matricaria matricariodes), common plantain, doorweed (Polygonum aviculare) and dandelion are also prominent. The presence of exogenous species in such areas is perhaps somewhat fortuitous as they are capable of surviving despite heavy use and thus help to prevent erosion; at the same time they contribute some organic matter to the soil.

Further towards the edge of the zone, where disturbance is constant but not extremely intense, grasses, sedges and indigenous perennials such as asters (Aster spp.), smooth wild strawberry, and cow-parsnip are predominant. Some exogenous species with extensively creeping rootstocks, such as couch grass (Agropyron repens) and perennial sow-thistle, are also present.

Plants recorded in the zone of disturbance are listed in Table 2.

Table 2. Plants characteristic of intensively used areas

*Achillea millefolium
*Agropyron cristatum
A. repens
A. trachycaulum var. novae-angliae
A. trachycaulum var. unilaterale
Agrostis scabra
Aster ciliolatus
A. laevis
Bromus ciliatus
*Capsella bursa-pastoris
Carex spp.
*Chenopodium album
Festuca ovina
Fragaria virginiana
Galium septentrionale
Heracleum lanatum
Lathyrus spp.
Matricaria matricarioides
*Phleum pratense
*Plantago major
*Poa annua
P. arida
P. palustris
P. pratensis
*Polygonum aviculare
Populus tremuloides
Rosa acicularis
Saniculata marilandica
Solidago canadensis
*Sonchus arvensis
Symphoricarpos albus
Taraxacum officinale
*Trifolium spp.
Vicia americana

*Species that are not indigenous to North America.

The transition from the intensively used zone to the 'extensively' used area is abrupt; the vegetation in the area resembles that found under undistrubed conditions.

Recreation in Riding Mountain National Park is largely intensive. However, some extensive use of the park has been made in the past, primarily for 'gathering' activities (flowers, berries and nuts). The effect of these activities cannot be readily ascertained but verbal reports from local inhabitants indicate that extensive populations of lady's slippers (Cypripidium) spp.) growing in the vicinity of Clear Lake have been virtually eliminated.

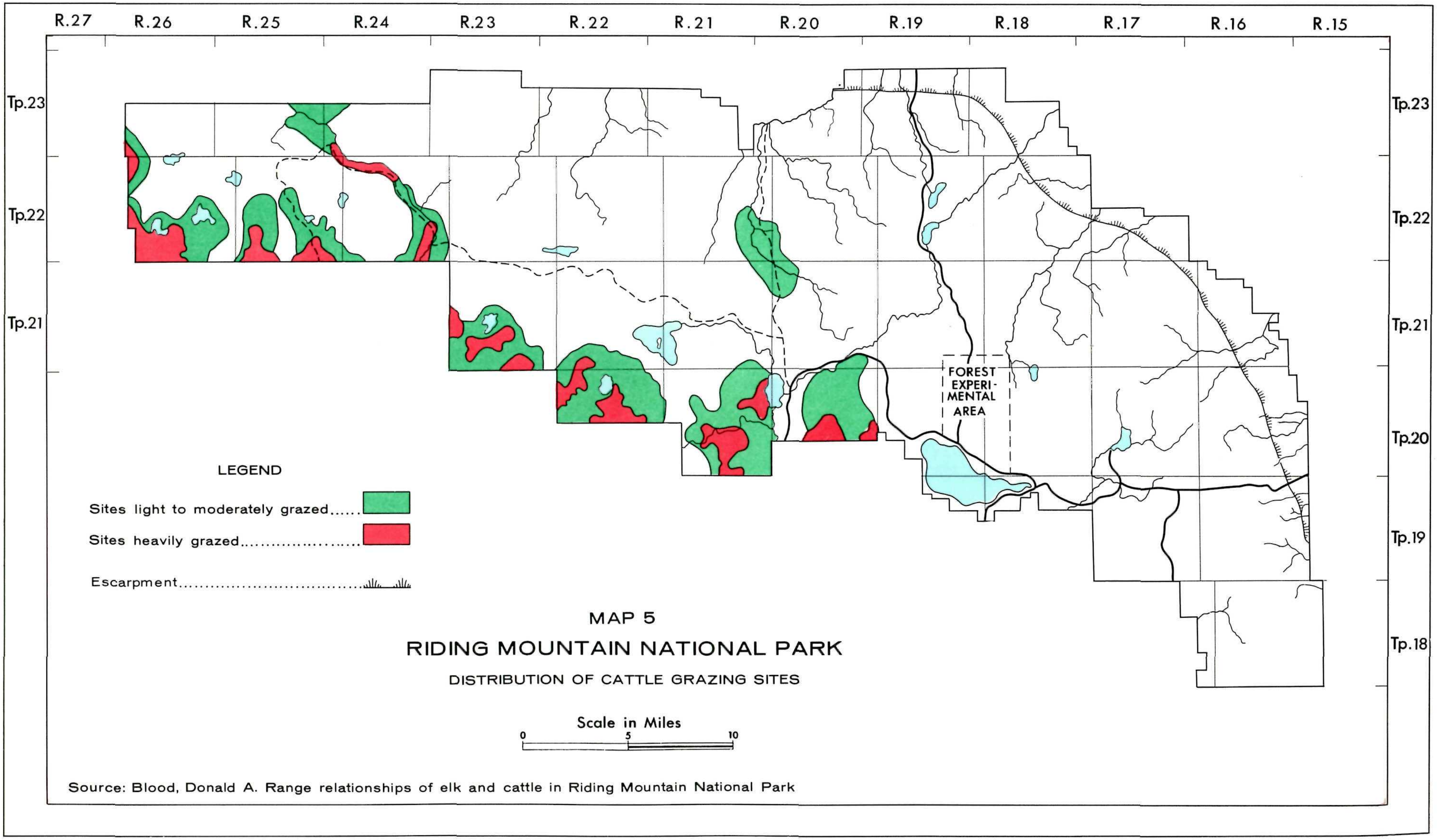
Non-consumptive use areas have not as yet been affected in any physical manner by recreational activities. These areas representing certain aesthetically desirable amenities, are located along public roads, trails, and lakes and on the face of the escarpment, which is visible from many points to the north and east of the park.

Effects of Grazing and Haying

The effects of grazing and haying on the plant communities in the park have been dealt with by Donald Blood (1966b). Of the two uses, grazing (Map 5) has probably had the greatest effect on plant communities. Observations indicate that, in the absence of fire, haying has protected many moist graminoid meadows from colonization by woody plants.

Effects of Gravel Mining

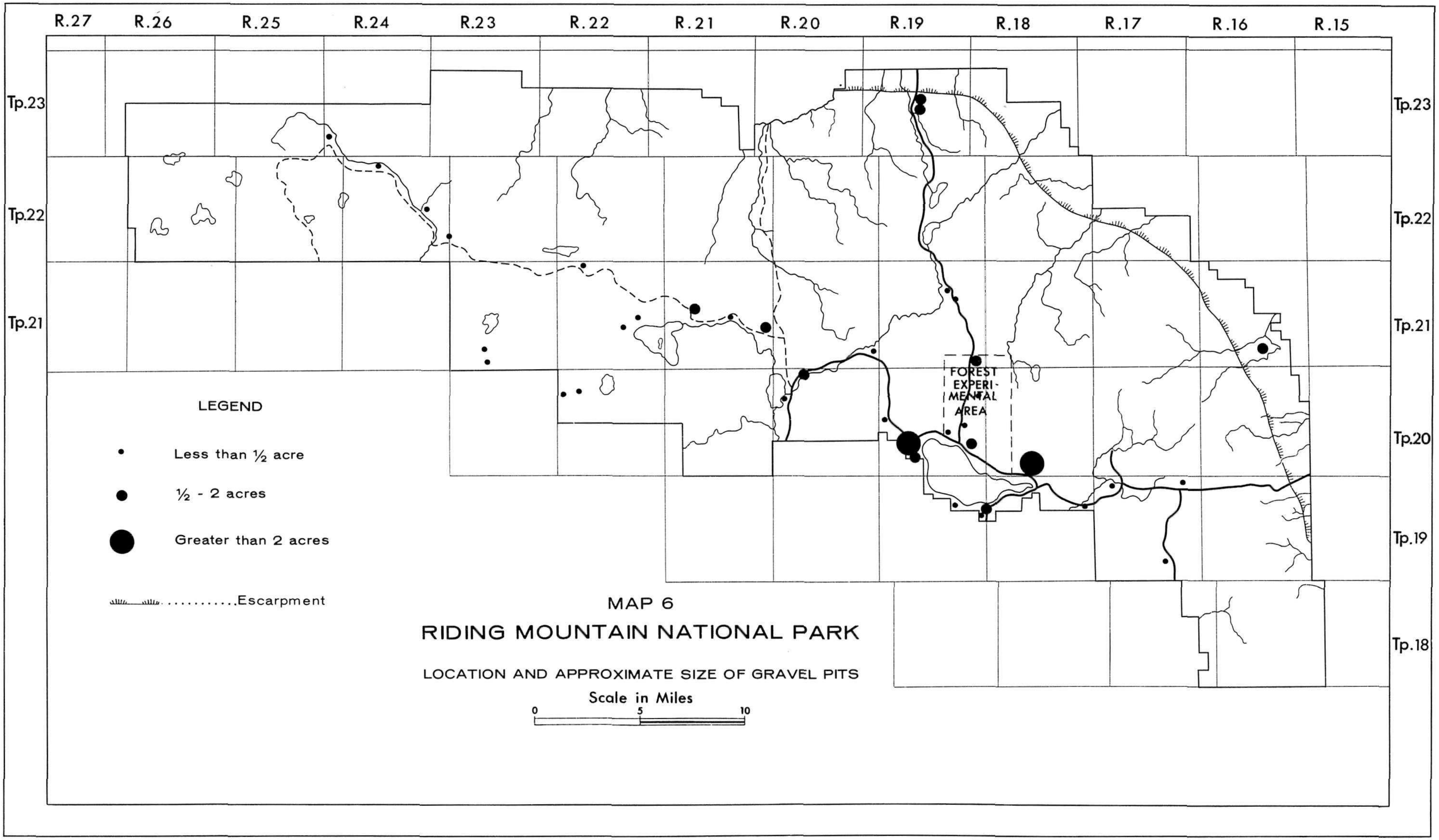
The effects of gravel mining on the vegetative community may appear to be trivial, but of all the activities in the park, this is the most permanently devastating. In addition to their permanent effect on plant communities, gravel pits (Map 6) detract considerably from scenic beauty. For example, the 'naturalness' of both the Gunn Creek and Pedens Prairie has been almost completely nullified by the presence of these unattractive pits.



MAP 5

RIDING MOUNTAIN NATIONAL PARK

DISTRIBUTION OF CATTLE GRAZING SITES



MAP 6

RIDING MOUNTAIN NATIONAL PARK

LOCATION AND APPROXIMATE SIZE OF GRAVEL PITS

Effects of Fire Protection

Fire control has been a major management problem in Riding Mountain National Park. In 1940, the present system of 11 fire towers was completed. Records kept since then indicate that the average annual burn is decreasing. In the period 1940-49, a total of 53,141 acres was burned; the average annual burn, amounting to 0.7% of the park, was 5,314 acres. Under these circumstances, and assuming that the same area was not burned twice, the 'rotation period' would be 134 years. In the subsequent 16 years, 27,964 acres were burned. During this period, the average annual burn amounted to 0.2% of the park area, i.e. 1,748 acres. The 'rotation period' in this instance would be 409 years.

These figures indicate a sharp reduction over the past few years in the average annual burn. Further reductions may be expected when grazing and logging practices are eliminated (or conducted under strict supervision for park management purposes), and when their elimination is accepted by the surrounding populace; it is believed that some farmers in the vicinity of the park are, for various reasons, responsible for many of the fires.

One can only speculate about the effects of fire protection on plant communities in the park. Present ecological information indicates that an increase in the efficiency of fire protection would bring about a decrease in the prevalence of communities dominated by intolerant species such as trembling aspen, balsam poplar, and jack pine. It would also eliminate, to a large extent, the even-aged white spruce community. Many moist lowland meadows would succumb to shrubby growth and dry upland prairies might be invaded by trees in the absence of fire. On the other hand, the confinement of fire damage may benefit the elm-ash, and balsam fir communities. A check of the area record in the Riding Mountain Forest Management Report (Bailey, 1967 -- unpublished report) illustrates some of the above trends. In particular it will be noted that the pine, spruce, and aspen areas are considerably less in cutting class 2 than in the higher classes.

SECTION III

MANAGEMENT OF VEGETATION

There are two aspects to the management of National Parks: the management of the natural resources, and the management of the people. The objective is to maintain on a 'sustained yield basis' the inherent natural characteristics of the Parks for the enjoyment of present and future generations. This section deals exclusively with the management of the vegetative aspect of the landscape.

Any decision to interfere with 'natural' processes in National Parks should be based on each particular situation; the necessity for intervention in one area does not necessarily mean intervention in all areas. However, where the impoverishment of the fauna, flora and other aspects of the environment is likely under a *laissez-faire* policy, continuous intervention on ecological grounds will be required (Anon., 1963; Anon., 1966; Gabrielson, 1957; Gibbens and Heady, 1964; Heinselman, 1965; Nicholson, 1957).

Riding Mountain National Park lies within a chronically unstable forest region described by Rowe (1961) as " . . . a disturbance forest usually maintained in youth and health by frequent fires to which all tree species, with the possible exception of fir are nicely adapted". The implication here is clear: management will be required to maintain many of the characteristic plant communities. In the absence of management and in the presence of continued fire protection, a monotonous mono-type of open, brush-filled forest may result.

Objectives of Vegetation Management

The National Park policy is explicit in stating that the utility of vegetative resources in National Parks lies in their aesthetic and educational values and not in their economic values. The objectives of vegetation management must therefore revolve around the enhancement of these values. Unfortunately, even though at this time there is probably sufficient ecological knowledge of the major plant communities, and of the techniques for their management, to create numerous vegetative landscapes, there is almost a complete lack of aesthetic guidelines for determining management objectives.

From a philosophical point of view, the aesthetic value of an object, in this case the Park vegetation, may be judged by the following three criteria: (i) unity, (ii) complexity, and (iii) intensity of quality (Beardsley, 1958).

Unity implies the existence of meaningful spatial and temporal patterns of indigenous plant communities with respect to environmental factors. Consequently, a major management objective would be to provide and maintain the naturally occuring spectrum of plant communities for each broad site group and to eliminate incongruous elements in the landscape. For example, on most moist to fresh upland sites, aspen, aspen/spruce, and spruce communities are the principal components. Management should assure an adequate representation[2] of these communities as well as the maintenance of all stages of successional development.

---

[2] Adequate representation should not be equated with equal representation, which might be detrimental to the ecology of the entire park. For example, the maintenance of moderate populations of ungulates will require sufficient disturbed forest conditions to meet their browsing requirements.

A list of the major communities for each broad site group is provided in Table 3. A number of site groups other than those listed in Table 3, both natural and artificial, could be delineated in the Park; the erosion slopes of the escarpment and the abandoned gravel pits are examples.

Table 3. A listing of the major communities for four broad site groups in Riding Mountain National Park

Site Type	Vegetative Spectrum (Plant Communities)
Upland Sites	
Zone 1 (Central and Western areas)	Aspen, aspen/spruce, poplar, poplar/spruce, spruce (even- and uneven-aged), brushland (primarily hazel) and grassland.
Zone 2 (Southeastern plateau area)	Similar to above (with exception of grassland) plus jack pine, jack pine/white spruce, jack pine/black spruce.
Zone 3 (Escarpment area)	Similar to Zone 1 (with exception of grassland) plus balsam fir, balsam fir/white spruce, white birch, white birch/spruce.
Lowland Sites	Black spruce, black spruce/larch, muskeg, meadow.
Alluvial Fans and Terraces	Aspen, poplar, balsam fir, elm/ash.
Gravel Beaches of Lake Agassiz	Bur oak.

The criterion of complexity implies variety. Hills' (1961) principle of contrasting features provides a meaningful criterion upon which to base management objectives, and, applied to vegetation, would dictate the maintenance of such diverse features as open meadows and dense forests, and softwood and hardwood stands.

The third criterion -- intensity of quality -- does not lend itself readily to the formulation of objectives for management purposes, perhaps because it has a functional relationship with the first two criteria. For example, a landscape ravaged by fire, insects, or disease, would certainly have an intensity of quality but this would be gained at the expense of unity.

Intensity of quality, therefore, may be interpreted as impressiveness. The amenities associated with pristine conditions would undoubtedly have some relevance here. Currently, many erroneous concepts concerning the primeval landscape exist. Among the most important is the virgin forest sentiment depicting an unravaged, well-stocked, mature stand of trees existing in a state of suspended animation. In the park, there are few areas where such conditions may be found, if indeed they ever existed, and, as pointed out previously, attempts to preserve such areas would be futile. The amenities of the primeval landscape, as the term is popularly misconceived, lie in their intrinsic rather than their extrinsic values. This, therefore, suggests that the simulation of the 'virgin' forest and meadow is a valid management objective. Modified standard forestry techniques for regenerating tree cover and maintaining stand vigour could be employed to help reach this objective.

There is undoubtedly a second type of park visitor for whom the value of the undisturbed landscape is perhaps extrinsic. For this visitor, the 'undisturbed' or 'virgin' characteristics are more important than the intrinsic characteristics of the landscape. To provide the former, preservation would have to be considered as a management objective. However, preservation in the 'disturbance' forest region would sacrifice unity and complexity for intensity of quality -- in this case, virginity. Heinselman (1965) has proposed that virgin forests should be defined as those owing their genesis to some natural catastropic phenomena such as fire, wind, water, insects, or disease. These, then, would be the agents which the park manager would attempt to manipulate to 'create' virgin vegetation.

Management for the maintenance of a healthy vegetative cover on intensively used campground sites is an important objective of park administration. Unfortunately, this subject has not received attention commensurate with its importance.

Management of vegetation along the escarpment to help prevent flooding on the farmlands below, is also an important consideration.

The manipulation of vegetation for the control of animal populations is a final major objective. The park manager may wish to consult with wildlife management experts to determine desirable habitat conditions and population levels for various animal species.

Management for Aesthetics

The following is a brief outline of a number of techniques available for managing the vegetation to increase and maintain the aesthetic value of the landscape. Complete descriptions of each operation, its relative degree of success and its limitations are not discussed here in detail; this account is intended only to draw attention to tested techniques. Some of these have been mastered, others are imperfectly known. Before any are applied, it would be advisable to consult with forestry or wildlife specialists.

The park vegetation is dominated by hardwood cover types; softwoods and mixedwoods are definitely in the minority. In general, therefore, this section will discuss methods helpful in maintaining and increasing the present distribution of softwood and mixedwood types.

Fire: Historically, fire has been the principal agent of disturbance in the western Boreal Forest; the current level of fire protection effeiciency will undoubtedly endanger the 'natural' characteristics of the biotic communities.

The use of fire as a management technique for regenerating communities in this forest region has not been thoroughly investigated. Experiments indicate that prescribed burning could be used successfully to regenerate white spruce, jack pine, and black spruce (Phelps, 1948; Jarvis, 1966). The most promising results with white spruce have been obtained by burning the forest floor in wooded areas (Phelps, 1948). Reproduction of the shade intolerant jack pine, is best where the crown cover is absent; therefore, it may be necessary to clearcut these treated areas after burning. Burning followed by clearcutting may also prove to be the most desirable method of reproducing white spruce stands.

Fire may also be used to stimulate poplar regeneration in old decadent poplar and mixedwood stands filled with shrubby growth.

The heavy, lush, difficult-to-burn forest understory characterizing many forest communities in the park, may limit the large scale use of fire at the present time. Fire would probably be the most effective tool for preventing colonization of many upland prairie and lowland meadows by shrubby or arborescent growth.

Cutting Systems: Various cutting methods have been tried in an attempt to increase white spruce reproduction, but none of these by themselves have been appreciably successful (Jarvis *et al.*, 1966). These techniques have been designed primarily to increase the volumetric growth of white spruce and therefore have little utility in park management.

Mechanical Seedbed Preparation: Artificial seedbeds have been prepared in several areas of the park in an attempt to encourage white spruce and jack pine reproduction. Bulldozer blades, ploughs, tillers, and scarifiers have been used to expose the mineral soil, and in some cases, to remove the perennating parts of competing herbaceous and shrubby vegetation. Scalping large patches of the forest floor down to the mineral soil with the ordinary or toothed bulldozer blade, has proven to be the most successful method for obtaining white spruce reproduction on mesic sites (Jarvis et al., 1966). However, the resultant mosaic of bared mineral soil, piles of dumped humus, and patches of undisturbed forest floor may be detrimental to the aesthetics of certain areas.

Jack pine reproduction on scarified sites in the park has only been moderately successful (Cayford, 1958; Cayford and Waldron, 1963). Techniques for using scarification in aspen silviculture have not been developed for this region.

Planting: Planting to increase the coniferous forest area has been conducted since the first nursery at Lake Audy was established in 1925. White spruce plantations on unprepared sites have had little success; jack pine and larch plantations have had no success at all (Haig, 1959).

Drought was a major factor in the failure of many white spruce plantations (Haig, 1959). A large portion of these plantations were established on dry, sandy outwash materials occupied by prairie vegetation. The attempt to establish forests on these sites was unfortunate from both an economic and aesthetic viewpoint. The open prairie vegetation adds to the diversity of flora in the park and any attempt to destroy such areas should be avoided.

Many of the more recent and successful white spruce plantings have been done on seedbeds prepared by scalping and discing to reduce the prevalence of competing vegetation (Waldron, 1964). In areas where disturbance to the forest floor is undesirable for aesthetic reasons, planting 2-0 spruce nursery stock at the base of aspen may be a useful method for establishing softwood species in hardwood stands (Waldron, 1961). Planting with jack pine growing stock has not been a successful silvicultural technique (Cayford and Waldron, 1963).

Seeding: Several experiments involving the dispersal of white spruce seed on mechanically prepared sites have proven successful (Jarvis et al., 1966). Treating areas with fire prior to seeding may be particularly effective (Phelps, 1948; Jarvis, 1966). Scalping and seeding at the base of aspen provide an unobtrusive method of establishing white spruce (Waldron, 1961).

Seeding white spruce or jack pine on burned-over areas may be an effective method for increasing softwood regeneration.

Herbicides: Herbicides have been used primarily to release white spruce regeneration from aspen and shrub competition. Aspen suckering may be eliminated in areas where white spruce is to be regenerated by poisoning the parent trees (Waldron, 1966). Experiments involving aerial spraying with 2, 4-D indicate that herbicides may effectively eliminate aspen suckers and hazel underbrush (Waldron, 1959; Pratt, 1966).

The long term effect of chemicals on the environment has not been investigated.

Protection: Protection of certain areas from destructive environmental and human interference may be the most suitable management technique. For example, in many areas, balsam fir stands reproduce well under undisturbed conditions. However, ungulate browsing, particularly by moose, often prevents the young growth from developing into mature trees.

The basic characteristics of elm/ash and oak communities may also be preserved by protecting them from grazing and logging.

The application to park management of any or all of the above techniques may be considered as applied research; results should therefore be continually checked and recorded to assess their suitability for obtaining the desired objectives.

Even where a <u>laissez-faire</u> policy is followed, regular periodic recordings of changes in the biotic communities would prove invaluable for formulating future management plans. This is especially true in Riding Mountain National Park where the capacity for repair of vegetative communities in the absence of catastrophic events may be very low.

Research is necessary to develop more sophisticated techniques for bringing about, or arresting changes in the biotic landscape. Areas with secure tenure and freedom from infringement by recreationists, for ecological research projects, have been advocated by many, e.g. Ira N. Gabrielson (1957), President of the Wildlife Management Institute in the United States. Riding Mountain National Park is fortunate in having within its confines a Forest Experiment Area where research in forest ecology is actively pursued. However, a comprehensive, co-ordinated program for ecological studies of the grassland, minor plant communities and fauna has not yet been developed for the park, although some isolated studies have been made.

Management of Vegetation on Intensively Used Areas

The deterioration of aspen tree cover because of vandalism and site degradation on portions of the Wasagaming Campground is perhaps the most serious example of the destructiveness caused by intensive recreational activity in the park.

Quantitative data were not collected on aspen mortality in the campground area; observations of mutilated trees led to the conclusion that polewood and saplings suffer a higher rate of mortality than mature individuals. Young spruce seemed capable of withstanding heavy damage; this may justify the continuation of underplanting aspen with white spruce. Some modification in the planting technique may be required as many of the spruce transplants are dying (Waldron, 1966 -- personal communication).

Records should be kept of the number of dead and decadent trees removed from the campgrounds. Information concerning tree species, size, age, and cause of condition would be valuable for developing successful management techniques and for future research projects.

Sod may be utilized successfully to maintain or rehabilitate the vegetative cover on some intensively used sites. Wagar (1964) has indicated that grasses are capable of withstanding greater pressures than dicotyledonous herbs, especially on areas where much of the tree cover has been removed.

Rotation of intensively used sites has been advocated as a method for maintaining site quality. Although a heavy investment in campgrounds at Riding Mountain makes this technique undesirable from a utilitarian standpoint, such a procedure might be considered where accelerated site degradation is apparent.

Site considerations are paramount in the selection of future areas for campgrounds. Therefore, research might be undertaken to determine the carrying capacity of various site types. For example, it is doubtful if the Agassiz soil association, (Ehrlich, et al. 1958), which has developed on the old beach lines below the escarpment, would be suitable for intensive use. Droughty soils of this nature would readily 'powder' and erode under this type of use. On the other hand, heavy, imperfectly-drained clay soils such as those in the Proven Lake Association (Ehrlich, Pratt, and Poyser, 1956) would become very compact under intensive use; this compaction would make plant growth difficult as well as create engineering problems with drainage for sanitary facilities. Studies in the United States indicate that, in general, soils with good permeability, good drainage, low compaction potential, low erosion hazard and high organic matter content, are best adapted to camping and picnicking activities (Stevens, 1966; Dotzenko, Papamichos, and Romine, 1967). Locating intensively used areas on 'durable' sites would no doubt reduce initial investment and subsequent maintenance costs.

Management for Watershed Control

Flooding, silting, and erosion problems associated with the clearing, draining and settlement of the agriculturally productive belt of alluvial soils around the base of the escarpment, have posed serious problems for watershed management near the escarpment.

Most of this portion of the watershed is covered with forest. Open decadent woods dominated by a heavy shrub stratum, occupy much of the upper catchment basins and vigorous stands of aspen and white birch clothe large segments of the face of the escarpment, except in excessively steep stream valleys where slopes are either bare or dominated by herbaceous vegetation.

The contribution of vegetation manipulation to the alleviation of flooding on the lowlands is as yet imperfectly understood. Attempts have been made to replace the open, decadent, shrubby cover types with vigorous forest growth. Such ventures have included experiments in planting white spruce, scalping, suckering aspen, poplar and birch, and protecting areas from browsing by ungulates.

The establishment of white spruce on critical watershed areas, where practical, may be the most suitable biotic measure for controlling run-off. Shrub cover is capable of intercepting as much precipitation as hardwood cover types but is only one-third as efficient in this process as softwood cover types (Lull, 1964). Snowmelt in the spring is usually rapid below the leafless shrub cover but beneath coniferous cover, the rate of melting is considerably slower.

Complete flood control may doom many riparian plant communities requiring frequent or periodic flooding and siltation to ensure their survival. In particular, reduction of flooding may eliminate various phases and characteristics of the elm/ash community although further ecological research will be required to substantiate this supposition.

Management for Wildlife

Vegetation and wildlife interactions are important considerations in park management. An inventory of the fauna and their habitat requirements plus a subsequent determination of desirable population levels for each species, would be an important contribution to the development of a refined master plan for vegetation management. The co-operation of both foresters and wildlife biologists is necessary in this field of endeavour.

LITERATURE CITED

ANON. 1963. A report by the Advisory Committee to the National Park Service on Research. National Academy of Sciences, National Research Council, Washington.

----- 1964. National Parks Policy. Canada, Dept. of Northern Affairs and National Resources, National Parks Branch.

----- 1966. Proceedings of a symposium on management for park preservation . . . a case study at Bull Creek, Humboldt Redwoods State Park, California. Univ. of California, Berkeley, California.

BEARDSLEY, M. C. 1958. Aesthetics: problems in the philosophy of criticism. Harcourt, Brace, and Co. New York.

BLOOD, Donald A. 1966 a. The Festuca Scabrella Association in Riding Mountain National Park. Can. Field Natur. 80(1): 24-32.

----- 1966 b. Range relationships of elk and cattle in Riding Mountain National Park, Manitoba. Canada, Dept. of Northern Affairs and National Resources, Natural and Historic Resources, Natural and Historic Resources Branch, Canadian Wildlife Service, Wild. Manage. Bull., Ser. 1, No. 19.

CAYFORD, J.H. 1958. Scarifying for Jack Pine Regeneration in Manitoba. Canada, Dept. of Northern Affairs and National Resources, Forestry Branch. Forest Research Division, Tech. Note No. 66.

CAYFORD, and R.M. WALDRON. 1963. Regeneration trials with jack pine on clay soils in Western Manitoba. Forest. Chron. 39(4): 398-400.

DICKSON, J.R. 1909. The Riding Mountain Forest Reserve. Canada, Dept. of the Interior, Forestry Branch Bull. No. 6.

DOTZENKO, A.D., N.T. PAPAMICHOS, and D.S. ROMINE. 1967. Effect of recreational use on soil and moisture conditions in Rocky Mountain National Park. J. of Soil and Water Conserv. 22(5): 196-197.

EHRLICH, W.A., L.E. PRATT, and E.A. POYSER. 1956. Report on reconnaissance of Rossburn and Virden map sheet areas. Manitoba, Dept. Agr. and Immigr.

EHRLICH, et al. 1958. Report on reconnaissance soil survey of West-Lake map sheet area. Manitoba, Dept. Agr. and Immigr.

GABRIELSON, I.N. 1957. Management of nature reserves on the basis of scientific knowledge. Proc. and papers, Int. Union for the Conserv. of Nature and Natur. Res., 6th Tech. Meeting. London, England.

GEIGER, R. 1965. The climate near the ground. Rev. ed. Transl. by Scripta Technica Inc. Harvard Univ. Press, Cambridge, Mass.

GIBBENS, R.P. and H.F. HEADY. 1964. The influence of modern man on the vegetation of Yosemite Valley. Div. Agric. Sci., Univ. of California.

HAIG, R.A. 1959. Reforestation by Planting, 1918-1930, Riding Mountain and Duck Mountain, Manitoba and Saskatchewan. Canada, Dept. of Northern Affairs and National Resources, Forestry Branch, Forest Research Division Mimeo. 59-3.

HEINSELMAN, M.L. 1965. Vegetation Management in wilderness areas and primitive parks. J. Forest. 63(6): 441-445.

HILLS, G.A. 1961. The ecological basis for land-use planning. Ontario, Dept. of Lands and Forests, Res. Rep. No. 46.

JARVIS, J.M. 1966. Seeding white spruce, black spruce and jack pine on burned seedbeds in Manitoba. Canada, Dept. of Forestry and Rural Development, Forestry Branch, Dept. Public. No. 1166.

JARVIS, et al. 1966. Review of silvicultural research, white spruce and trembling aspen cover types, mixedwood forest section boreal forest region, Alberta-Saskatchewan-Manitoba. Canada, Dept. of Forestry and Rural Development, Forestry Branch, Dept. Public. No. 1156.

KOEPPE, C.E., and G.C. DE LONG. 1958. Weather and climate. McGraw-Hill Book Co. Inc., Toronto.

LULL, H.W. 1964. "Ecological and Silvicultural Aspects". Handbook of applied hydrology. ed. Ven Te Chow. McGraw-Hill Book Co., Toronto.

NICHOLSON, E.M. 1957. Nature conservation and the management of natural areas. Proc. and Papers, Int. Union for the Conserv. of Nature and Natur. Res. 6th Tech. Meeting. London, England.

PHELPS, V.H. 1948. White spruce reproduction in Manitoba and Saskatchewan. Canada, Dept. Mines and Resources, Lands, Parks, and Forests Branch, Dom. Forest Serv., Silv. Res. Note 86.

POLUNIN, N. 1960. Introduction to plant geography and some related sciences. Longmans, Green and Co. Inc. Toronto.

PRATT, R.H.M. 1966. Aerial spraying with 2, 4-D to eliminate trembling aspen. Pulp and Paper Mag. of Can., 67(9): 460-462.

PUTNAM, D.F. (ed.). 1952. Canadian regions -- a geography of Canada. J.M. Dent and Sons. Ltd., Toronto.

ROWE, J.S. 1955. Factors influencing white spruce reproduction in Manitoba, and Saskatchewan. Canada, Dept. of Northern Affairs and National Resources, Forestry Branch, Forest Research Division, Tech. Note No. 3.

----- 1956. Uses of undergrowth plant species in forestry. Ecol. 37: 461-473.

----- 1959. Forest Regions of Canada. Canada, Dept. of Northern Affairs and National Resources, Forestry Branch, Bull. No. 123.

----- 1961. Critique of some vegetational concepts as applied to forests of northwestern Alberta. Can. J. Bot. 39: 1007-1017.

SCOGGAN, H.J. 1957. Flora of Manitoba. Canada, Dept. of Northern Affairs and National Resources, Nat. Mus. Can. Bull. 74.

SPURR, S.H. 1966. Wilderness management. Univ. of California, School of Forestry, Berkeley, California.

STEVENS, M.E. 1966. Soil surveys as applied to recreational site planning. J. Forest. 64(5): 314-316.

WAGAR, J.A. 1964. The carrying capacity of wildlands for recreation. Forest Sci. Monogr. 7.

WALDRON, R.M. 1959. Hazel foliage treatments to reduce suppression of white spruce reproduction. Canada, Dept. of Northern Affairs and National Resources, Forestry Branch, Forest Res. Div., Tech. Note No. 75.

-------- 1961. Seeding white spruce at the base of aspen. Forest. Chron. 37(3): 224-227.

-------- 1964. The effects of pre-planting ground treatment on early survival and growth of planted white spruce. U.S.D.A. Forest Serv. Tree Planters' Notes, No. 65: 6-8.

-------- 1966. Factors affecting white spruce regeneration on prepared seedbeds at the Riding Mountain Forest Experimental Area, Manitoba. Canada, Dept. of Forestry and Rural Development, Forestry Branch, Dept. Public. No. 1169.

UNPUBLISHED MATERIAL

BAILEY, R.H. 1966. The effect of resource use on vegetation in Riding Mountain National Park. Unpubl. M.A. thesis, University of Waterlooo, Ontario.

------ 1967. Report on the Forest Survey of the Riding Mountain National Park, Province of Manitoba, 1960. Dept. of Forestry and Rural Development, National Park Forest Surv. Rep. No. 1.

EVANS, S.L. 1923. Land classification. Riding Mountain Forest Reserve. Canada, Dept. of the Interior, Topographical Surveys Branch.

HARTESVELDT, R.J. 1964. Sequia-Human impact analysis. Memorandum to the Regional Director, Western Region, U.S. National Park Service, San Francisco, California.

PRATT, L. and E.A. POYSER. Undated. Report of detailed reconnaissance soil survey of Wilson Creek.

RITCHIE, J.C. 1958. The vegetation of the Wilson Creek Watershed, Riding Mountain National Park, Manitoba. Canada, Dept. of Northern Affairs and National Resources, Forestry Branch, Res. Div.

ROWE, J.S. 1954. Forest sites -- Riding Mountain Experimental Area. Canada, Dept. of Northern Affairs and National Resources, Forest Res. Div., Progress rep.

TUNSTELL, G., C.B. GILL, and G.E. KUHRING. 1922. Silvical report on Riding and Duck Mountain Forest Reserves. Canada Forest Service.

APPENDIX

Tables 1 to 22 -- Species composition of herbaceous and shrubby strata for major plant communities.

Photographs -- Photographs with descriptive captions.

Index map -- Index map of available forest type maps.

Table 1. Relative frequency of shrubs in 40 year old aspen stand

Relative frequency -- 76% to 100%	
Corylus cornuta Marsh.	*Prunus virginiana* L.
Relative frequency -- 51% to 75%	
Lonicera dioica L. var. *glaucescens* (Rybd.) Butters	*Symphoricarpos albus* (L.) Blake
Rosa acicularis Lindl.	
Relative frequency -- 26% to 50%	
Acer spicatum Lam.	*Viburnum edule* (Michx.) Raf.
Cornus stolonifera Michx.	*Viburnum trilobum* Marsh.
Ribes triste Pall.	
Relative frequency -- 1% to 25%	
Amelanchier alnifolia Nutt.	*Ribes hirtellum* Michx.
Diervilla lonicera Mill.	*Rubus idaeus* L. var. *strigosus* (Michx.) Maxim.

Table 2. Relative frequency of herbs in 40 year old aspen stand

Relative frequency -- 76% to 100%	
Aralia nudicaulis L.	
Relative frequency -- 51% to 75%	
Aster ciliolatus Lindl.	*Mertensia paniculata* (Ait.) G. Don
Maianthemum canadense var. *interius* Fern.	*Rubus pubescens* Raf.
Relative frequency -- 26% to 50%	
Disporum trachycaulum (Wats.) B. & H.	*Galium triflorum* Michx.
Fragaria spp.	*Heracleum lanatum* Michx.
Relative frequency -- 1% to 25%	
Actaea rubra (Ait.) Willd.	*Petasites palmatus* (Ait.) Gray
Agropyrum trachycaulum (Link) Malte	*Poa palustris* L.
Apocynum androsaemifolium L.	*Pyrola asarifolia* Michx.
Arenaria lateriflora L.	*Pyrola elliptica* Nutt.
Carex deweyana Schwein.	*Sanicula marilandica* L.
Cornus canadensis L.	*Similacena stellata* L. Desf.
Epilobium angustifolium L.	*Solidago gigantea* Ait. var. *leiophylla* Fern.
Galium septentrionale R. & S.	*Taraxacum officinale* Weber
Lathyrus spp.	*Thalictrum venulosum* Trel.
Monotropa uniflora L.	*Trillium cernuum* L.
Oryzopsis asperifolia Michx.	*Viola rugulosa* Greene
Osmorhiza obtusa (C. & R.) Fern.	

Table 3. Relative frequency of shrubs in 80 to 100 year old white spruce community

Relative frequency -- 76% to 100%	
Rosa acicularis Lind.	*Symphoricarpos albus* (L.) Blake
Relative frequency -- 51% to 75%	
Corylus cornuta Marsh.	*Ribes triste* Pall.
Relative frequency -- 26% to 50%	
Amelanchier alnifolia Nutt.	*Prunus virginiana* L.
Relative frequency -- 1% to 25%	
Lonicera dioica L. var. *glaucescens* (Rydb.) Butters	*Rubus idaeus* L. var. *strigosus* (Michx.) Maxim.
Ribes hirtellum Michx.	*Shepherdia canadensis* (L.) Nutt.

Table 4. Relative frequency of herbs in 80 to 100 year old white spruce community

Relative frequency -- 76% to 100%

Aster ciliolatus Lindl.
Fragaria spp.
Maianthemum canadense var. interius Fern.
Mertensia paniculata (Ait.) G. Don
Petasites palmatus (Ait.) Gray
Rubus pubescens Raf.
Schizachne purpurascens (Torr.) Swallen

Relative frequency -- 51% to 75%

Aralia nudicaulis L.
Elymus innovatus Beal
Pyrola asarifolia Michx.

Relative frequency -- 26% to 50%

Carex spp.
Cornus canadensis L.
Galium septentrionale R. & S.
Galium triflorum Michx.
Lathyrus spp.
Oryzopsis asperifolia Michx.
Prenanthes alba L.
Smilacina stellata (L.) Desf.
Taraxacum officinale Weber
Thalictrum venulosum Trel.

Relative frequency -- 1% to 25%

Achillea millefolium L.
Actaea rubra (Ait.) Willd.
Agastache foeniculum (Pursh) Ktze.
Agropyron trachycaulum (Link)
Anenome sp.
Arenaria lateriflora L.
Aster umbellatus Mill. var. pubens Gray
Botrychium virginianum (L.) Sw.
Bromus ciliatus L.
Calamagrostis canadensis (Michx.) Nutt.
Campanula rotundifolia L.
Cinna latifolia (Trev.) Griseb.
Disporum trachycarpum (Wats.) B. & H.
Epilobium angustifolium L.
Equisetum pratense Ehrh.
Erigeron philadelphicus L.
Geum macrophyllum Willd. var. perincisum (Rydb.) Raup
Goodyera repens (L.) R. Br. var. ophioides Fern.
Halenia deflexa (Sm.) Griseb.
Heracleum lanatum Michx.
Lilium philadelphicum var. andinum (Nutt.) Ker
Mitella nuda L.
Osmorhiza obtusa (C. & R.) Fern.
Pyrola secunda L.
Sanicula marilandica L.
Senecio tridenticulatus Rydb.
Solidago gigantea Ait. var. leiophylla Fern.
Solidago hispida var. lanata (Hook.) Fern.
Stachys palustris L. var. pilosa (Nutt.) Fern.
Steironema ciliatum (L.) Raf.
Vicia americana Muhl.
Viola rugulosa Greene

Table 5. Relative frequency of shrubs in unevenaged aspen/spruce community on fresh to moist site

Relative frequency -- 76% to 100%	
Corylus cornuta Marsh.	*Symphoricarpos albus* (L.) Blake
Relative frequency -- 51% to 75%	
Prunus virginiana L.	*Rosa acicularis* Lindl.
Relative frequency -- 26% to 50%	
Amelanchier alnifolia Nutt.	*Rubus ideaus* L. var. *strigosus* (Michx.) Maxim.
Lonicera dioica L. var. *glaucescens* (Rydb.) Butters	*Viburnum edule* (Michx.) Raf.
Ribes hirtellum Michx.	
Relative frequency -- 1% to 25%	
Cornus stolonifera Michx.	*Ribes hudsonianum* Richards.
Diervilla lonicera Mill.	*Ribes triste* Pall.

Table 6. Relative frequency of herbs in unevenaged aspen/spruce community on fresh to moist sites

Relative frequency -- 76% to 100%

Aralia nudicaulis L.
Fragaria spp.
Mertensia paniculata (Ait.) G. Don
Oryzopsis asperifolia Michx.
Rubus pubescens Raf.

Relative frequency -- 51% to 75%

Aster ciliolatus Lindl.
Maianthemum canadense var. interius Fern.
Viola rugulosa Greene

Relative frequency -- 26% to 50%

Anenome canadensis L.
Calamagrostis canadensis (Michx.) Nutt.
Carex spp.
Cornus canadensis L.
Galium septentrionale R. & H.
Petasites palmatus (Ait.) Gray
Pyrola asarifolia Michx.
Pyrola secunda L.

Relative frequency -- 1% to 25%

Actaea rubra (Ait.) Willd.
Agastache foeniculum (Pursh) Ktze.
Agropyrum trachycaulum (Link) Malte
Apocynum androsaemifolium

Bromus ciliolatus L.
Disporum trachycaulum (Wats.) B. & H.
Elymus innovatus Beal
Equisetum pratense Ehrh.

Galium trifolium Michx.
Heracleum lanatum Michx.
Lathyrus spp.
Luzula multiflora (Retz.) Lejeune

Mitella nuda L.
Osmorhiza obtusa (C. & R.) Fern.
Sanicula marilandica L.

Schizachne purpurascens (Torr.) Swallen
Senecio tridenticulatus Rydb.
Similacena stellata (L.) Desf.
Solidago canadensis L.
Solidago gigantea (Ait.) var. leiophylla Fern.
Taraxacum officinale Weber
Thalictrum venulosum Trel.
Trillium cernuum L.
Vicia americana Muhl.

Table 7. Relative frequency of shrubs in unevenaged aspen/spruce community on very moist sites

Relative frequency -- 76% to 100%

Rubus ideaus L. var. strigosus (Michx.) Maxim.

Relative frequency -- 51% to 75%

Alnus rugosa (Du Roi) Spreng. var. americana (Regel) Fern.
Ribes hirtellum Michx.
Ribes triste Pall.
Rosa acicularis Lindl.

Relative frequency -- 26% to 50%

Amelanchier alnifolia Nutt.
Cornus stolonifera Michx.
Ribes hudsonianum Richards.
Prunus virginiana L.

Relative frequency -- 1% to 25%

Corylus cornuta Marsh.
Lonicera dioica L. var. glaucescens (Rydb.) Butters
Symphoricarpos albus (L.) Blake
Rhamnus alnifolia L'Hér.

Table 8. Relative frequency of herbs in unevenaged aspen/spruce community on moist to very moist sites

---

Relative frequency -- 76% to 100%

Calamagrostis canadensis (Michx.) Nutt.

Rubus pubescens Raf.

Relative frequency -- 51% to 100%

Anenome candensis L.

Carex spp.

Fragaria spp.

Galium triflorum Michx.

Relative frequency -- 26% to 50%

Aster ciliolatus Lindl.

Aster umbellatus Mill. var. *pubens* Gray

Equisetum arvense L.

Galium septentrionale R. & S.

Geum macrophyllum perincisum (Rydb.) Raup

Mentha arvensis L. var. *villosa* (Benth.) Stewart

Mertensia paniculata (Ait.) G. Don

Petasites palmatus (Ait.) Gray

Petasites vitifolius Greene

Smilacena stellata (L.) Desf.

Solidago gigantea Ait. var. *leiophylla* Fern.

Stachys palustris L. var. *pilosa* (Nutt.) Fern.

Thalictrum venulosum Trel.

Relative frequency -- 1% to 25%

Actaea rubra (Ait.) Willd.

Aralia nudicaulis L.

Arenaria lateriflora L.

Aster puniceus L.

Bromus ciliatus L.

Caltha palustris L.

Cinna latifolia (Trev.) Griseb.

Circeae alpina L.

Cirsium arvense Scop.

Cirsium muticum Michx.

Cornus canadensis L.

Dryopteris disjuncta (Lebed.) C. V. Mort

Elymus innovatus Beal

Epilobium angustifolium L.

Equisetum sylvaticum L.

Halenia deflexa (Sm.) Griseb.

Heracleum lanatum Michx.

Impatiens capensis Murb.

Lathyrus spp.

Luzula multiflora (Retz.) Lejeune

Maianthemum canadense var. *interius* Fern.

Mitella nuda L.

Oryzopsis asperifolia Michx.

Poa palustris L.

Potentilla norvegica L.

Pyrola asarifolia Michx.

Pyrola secunda L.

Sanicula marilandica L.

Schizachne purpurascens (Torr.) Swallen

Scutellaria galericulata L. var. *epilobiifolia* (Hamilt.) Jordal

Taraxacum officinale Weber

Urtica dioica L. var. *procera* Wedd.

Vicia americana Muhl.

Table 9. Important shrubs in the black spruce community -- in order of decreasing importance

Ledum groenlandicum Oeder	*Chamaedaphne calyculata* (L.) Moench.
Vaccinium vitis-idaea L. var. *minus* Lodd.	*Vaccinium myrtilloides* Michx.
	Andromeda glaucophylla Link

Table 10. Important herbs in the black spruce community -- in order of decreasing importance

Carex leptalea Wahl.	*Moneses uniflora* (L.) Gray
Gaultheria hispidula (L.) Bigel.	*Galium triflorum* Michx.
Carex tenuiflora Wahl.	*Eriophorum spissum* Fern.
C. disperma Dew.	*Luzula parviflora* (Ehrh.) Desv.
C. paupercula Michx.	*Listera cordata* (L.) R. Br.
Rubus chamaemorus L.	*Carex trisperma* Dew.

Table 11. Important mosses in the black spruce community -- in order of decreasing importance

Pleurozium schreberi	*Sphagnum fuscum*
Sphagnum recurum	*Ptillum crista-castrensis*

Table 12. Relative frequency of shrubs in mature jack pine community

Relative frequency -- 76% to 100%	
Alnus crispa (Ait.) Pursh	*Rubus idaeus* L. var. *strigosus* (Michx.) Maxim.
Rosa acicularis Lindl.	
Relative frequency -- 51% to 75%	
Relative frequency -- 26% to 50%	
Betula glandulosa Michx. *Symphoricarpos albus* (L.) Blake	*Viburnum edule* (Michx.) Raf.
Relative frequency -- 1% to 25%	
Alnus rugosa (Du Roi) Spreng. var. *americana* (Regel) Fern. *Amelanchier alnifolia* Nutt.	*Lonicera dioica* L. var. *glaucescens* (Rydb.) Butters

Table 13. Relative frequency of herbs in mature jack pine community

Relative frequency -- 76% to 100%	
Fragaria sp.	Schizachne purpurascens (Torr.) Swallen
Relative frequency -- 51% to 75%	
Aralia nudicaulis L.	Petasites palmatus (Ait.) Gray
Elymus innovatus Beal	Rubus pubescens Raf.
Maianthemum canadense var. interius Fern.	
Relative frequency -- 26% to 50%	
Carex spp.	Oryzopsis asperifolia Michx.
Cornus canadensis L.	Pyrola asarifolia Michx.
Epilobium angustifolium L.	Pyrola secunda L.
Galium septentrionale R. & S.	Thalictrum venulosum Trel.
Relative frequency -- 1% to 25%	
Achillea millefolium L.	Mertensia paniculata (Ait.) G. Don
Agastache foeniculum (Pursh) Ktze.	Mitella nuda L.
Aster ciliolatus Lindl.	Prenanthes alba L.
Arenaria lateriflora L.	Senecio sp.
Calamagrostis canadensis (Michx.) Nutt.	Taraxacum officinale Weber
Galium triflorum Michx.	Urtica dioica L. var. procera Wedd.
Heuchera richardsonii R. Br.	Vicia americana Muhl.
Hedysarum alpinum L. var. americanum Michx.	Viola rugulosa Greene
Lathyrus sp.	Viola sp.
Linnaea borealis L. var. americana (Forbes) Rehd.	Zegadenus elegans Pursh.

Table 14. Relative frequency of shrubs in polewood jack pine community on dry sites

Relative frequency -- 76% to 100%	
Rosa acicularis Lindl.	
Relative frequency -- 51% to 75%	
Vaccinium cespitosum Michx.	
Relative frequency -- 26% to 50%	
Alnus crispa (Ait.) Pursh	*Symphoricarpos albus* (L.) Blake
Rubus idaeus L. var. *strigosus*	*Virburnum edule* (Michx.) Raf.
Relative frequency -- 1% to 25%	
Amelanchier alnifolia Nutt.	*Salix* sp.
Corylus cornuta Marsh.	*Shepherdia canadensis* (L.) Nutt.
Lonicera dioica L. var. *glaucescens* (Rydb.) Butters	

Table 15. Relative frequency of herbs in polewood jack pine community on dry sites

---

Relative frequency -- 76% to 100%

Cornus canadensis L.
Petasites palmatus (Ait.) Gray
Rubus pubescens Raf.

Relative frequency -- 51% to 75%

Aralia nudicaulis L.
Elymus innovatus Beal
Linnaea borealis L. var. *americana* (Forbes) Rehd.
Maianthenum canadense var. *interius* Fern.
Pyrola secunda L.

Relative frequency -- 26% to 50%

Carex spp.
Epilobium angustifolium L.
Fragaria virginiana Duchesne
Galium boreale L.
Lycopodium annotinum L.
Oryzopsis asperifolia Michx.
Pyrola virens Schweigg
Schizachne purpurascens (Torr.) Swallen

Relative frequency -- 1% to 25%

Actaea rubra (Ait.) Willd.
Aster ciliolatus Lindl.
Calamagrostis canadensis (Michx.) Nutt.
Campanula rotundifolia L.
Dryopteris spinulosa (O. F. Muell) Watt.
Equisetum spp.
Goodyera repens (L.) R. Br. var. *ophioides* Fern.
Hedysarum alpinum L. var. *americanum* Michx.
Lathyrus sp.
Luzula sp.
Lycopodium complanatum L.
Lycopodium obscurum L.
Mertensia paniculata (Ait.) G. Don
Mitella nuda L.
Trientalis borealis Raf.
Viola adunca Sm.
Viola rugulosa Greene
Viola selkirkii Pursh

Table 16. Important herbs in the balsam fir community -- in order of decreasing importance

Aralia nudicaulis L.	*Fragaria virginiana* Duchesne
Rubus pubescens Raf.	*Pyrola asarifolia* Michx.
Cornus canadensis L.	*Maianthemum canadense* var. *interius* Fern.
Linaea borealis L. var. *americana* (Forbes) Rehd.	*Disporum Trathycarpum* (Wats.) B. & H.
Galium triflorum Michx.	*Oryzopsis asperifolia* Michx.
Galium septentrionale R. & S.	

Table 17. Important mosses in the balsam fir community -- in order of decreasing importance

Pleurozium schreberi	*Peltigera apthosa*
Ptilium crista-castrensis	*Mnium affine*
Dicranum rugosum	*Eurhynchium strigosum*
Rhytidiadelphus triquetrus	

Table 18. Relative frequency of shrubs in mature oak community

Relative frequency -- 76% to 100%	
Amelanchier alnifolia Nutt.	*Symphoricarpos* spp.
Rosa acicularis Lindl.	*Viburnum rafinesquianum* Schultes
Relative frequency -- 51% to 75%	
Lonicera dioica L. var. *glaucescens* (Rydb.) Butters	
Relative frequency -- 26% to 50%	
Corylus cornuta Marsh.	*Prunus virginiana* L.
Relative frequency -- 1% to 25%	

Table 19. Relative frequency of herbs in mature oak community

Relative frequency -- 76% to 100%	
Aralia nudicaulis L.	*Fragaria* spp.
Aster ciliolatus Lindl.	*Oryzopsis asperifolia* Michx.
Relative frequency -- 51% to 75%	
Galium septentrionale R. & S.	*Rhus radicans* L. var. *rydbergii* Rehd.
Lathyrus sp.	*Thalictrum venulosum* Trel.
Relative frequency -- 26% to 50%	
Agastache foeniculum (Pursh) Ktze.	*Maianthemum canadense* var. *interius* Fern.
Agropyron trachycaulum (Link) Malte	*Monarda fistulosa* L.
Apocynum androsaemifolium L.	*Sanicula marilandica* L.
Aster laevis L.	*Schizachne purpurascens* (Torr.) Swallen
Elymus innovatus Beal	*Solidago canadensis* L.
Relative frequency -- 1% to 25%	
Achillea millefolium L.	*Poa* sp.
Anenome cylindrica Gray	*Polygala senega* L.
Arenaria lateriflora L.	*Senecio* sp.
Bromus ciliatus L.	*Smilax herbacea* L. var. *lasioneura* (Hook.) A.DC.
Comandra pallida A.DC.	*Solidago nemoralis* Ait. var. *decemflora* (DC) Fern.
Elymus canadensis L.	*Sonchus arvensis* L.
Lilium philadephicum var. *andinum* (Nutt.) Ker	*Steironema ciliatum* (L.) Raf.
Muhlenbergia mexicana (L.) Trin.	*Vicia americana* Muhl.

Table 20. Relative frequency of shrubs in mature elm/ash community

Relative frequency -- 76% to 100%	
Relative frequency -- 51% to 75%	
Prunus virginiana L.	Rubus pubescens Raf.
Relative frequency -- 26% to 50%	
Ribes triste Pall.	Viburnum trilobum Marsh.
Relative frequency -- 1% to 25%	
Cornus stolonifera Michx.	Symphoricarpos occidentalis Hook.
Corylus cornuta Marsh.	Ulmus americana L.
Ribes hudsonianum Richards.	

Table 21. Relative frequency of herbs on elm/ash community (mature)

Relative frequency -- 76% to 100%	
Matteuccia struthiopteris (L.) Todaro var. *pensylvanica* (Willd.) Morton	*Carex* spp.
Relative frequency -- 51% to 75%	
Impatiens capensis Murb.	*Thalictrum dasycarpum* Fisch. & Lall.
Maianthemum canadense var. *interius* Fern.	
Relative frequency -- 26% to 50%	
Aralia nudicaulis L.	*Osmorhiza* sp.
Galium triflorum Michx.	*Rudbeckia laciniata* L.
Heracleum lanatum Michx.	
Relative frequency -- 1% to 25%	
Actaea rubra (Ait.) Willd.	*Sanicula marilandica* L.
Anenome canadensis L.	*Schizachne purpurascens* (Torr.) Swallen
Aster ciliolatus Lindl.	*Smilacina stellata* (L.) Desf.
Calamagrostis canadensis (Michx.) Nutt.	*Smilax herbacea* L. var. *lasioneura* (Hook.) A.DC.
Elymus canadensis L.	*Solidago gigantea* Ait. var. *leiophylla* Fern.
Equisetum arvense L.	*Stachys palustris* L. var. *pilosa* (Nutt.) Fern.
Mitella nuda L.	*Steironema ciliatum* (L.) Raf.
Milium effusum L.	*Taraxacum officinale* Weber
Phryma leptostachya L.	*Urtica dioica* L. var. *procera* Wedd.
Rubus pubescens Raf.	*Viola rugulosa* Greene

Table 22. Relative frequency of plants in the *Festuca Scabrella* Association

Relative frequency -- 76% to 100%

Achillea lanulosa Nutt.
Aster laevis L.
Aster spp.
Festuca altaica Trin. var. *major* (Vasey) Gleason
Galium septentrionale R. & S.

Koeleria cristata (L.) Pers.
Solidago missouriensis Nutt.
S. rigida L.
Thalictrum confine Fern.
Vicia americana Muhl.

Relative frequency -- 51% to 75%

Campanula rotundifolia L.
Fragaria virginiana var. *terrae-novae* (Rydb.) Fern. & Wieg.
Monarda fistulosa L.

Potentilla arguta Pursh
Stipa spartea var. *curtiseta* Hitchc.
S. richardsonii Link

Relative frequency -- 26% to 50%

Agoseris glauca (Nutt.) Greene
Agropyron trachycaulum var. *unilaterale* (Cassidy) Malte
A. smithii

Arctostaphylos uva-ursi (L.) Spreng.
Artemisisia ludoviciana Nutt. var. *grapholodes* (Nutt.) T. & G.
Carex spp.

Cerastium arvense L.
Erigeron spp.

Lithospermum canescens (Michx.) Lehm.
Polygala senega L.

Rosa acicularis Lindl.

Relative frequency -- 1% to 25%

Agastache foeniculum (Pursh) Ktze.
Agrostis scabra Willd.

Amelanchier alnifolia Nutt.
Anenome canadensis L.
Bromus inermis Leyss.
Comandra pallida A.DC.
Danthonia spicata (L.) Beauv.
Geum triflorum Pursh
Festuca ovina var. *saximontana* (Rydb.) Gl.
Heuchera richardsonii R. Br.
Zizia aptera (Gray) Fern.

Lathyrus venosus Muhl. var. *intonsus* Butt. & St. John
Liatris ligulistylis (Nels.) K. Schum.
Poa pratensis L.
Potentilla fruticosa L.
Prunus virginiana L.
Smilacina stellata (L.) Desf.
Stellaria longipes Goldie
Symphoricarpos albus (L.) Blake
Taraxacum officinale Weber

Viola spp.

1

Upland prairie surrounded by white spruce. Fire might be successfully employed to check encroachment by this species.

2

Heavy hazel cover beneath trembling aspen. Spot planting of white spruce at the base of aspen may be the most suitable method of increasing the softwood component in some of these stands.

Trembling aspen dying from stem damage inflicted by campers. Wasagaming campground.

3

Mutilated trembling aspen stem. Wasagaming campground.

4

5

Severely damaged white spruce stem. This species exhibits a greater ability to survive mechanical damage than trembling aspen.

Index Map
RIDING MOUNTAIN NATIONAL PARK
Forest Inventory Mapping
1961
Scale in Miles