The Effect of Logging and Intensive Camping on Vegetation in Riding Mountain National Park

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"Silvicultural techniques such as fire, scarification, planting and seeding must be applied to maintain the spectrum of naturally occurring communities in all stages of their development."

Abstract

The effects of logging and intensive camping on the composition and structure of vegetation in disturbed forest communities in the eastern portion of Riding Mountain National Park were investigated by quantitative and qualitative methods.

The results indicated that logging favours the growth of shrubs, and tall coarse grasses and forbs, and hinders the development of small herbs. With few exceptions, logging did not appear to be responsible for the elimination of any species. The effects of logging on plant succession are discussed.

Camping was found to be detrimental to indigenous vegetation on intensively used areas.

Effets des exploitations forestières et du camping intensif sur la végétation du parc national de Riding Mountain.

Résumé

A la suite d'exploitation forestières et d'un camping intensif dans la partie est du parc national de Riding Mountain, on a fait des relevés tant quantitatifs que qualitatifs, sur la composition et la structure des communautés végétales présentes. L'analyse des données démontre que la coupe, d'une part, favorise la croissance de certains arbrisseaux, de certaines grandes herbes et de fougères, et qu'elle fait tort à certaines herbes plus courtes. L'auteur analyse les effets de ces coupes sur la succession des végétaux. Dans son optique la coupe, n'a pas éliminé d'espèces.

D'autre part, le camping, tout spécialement dans les replis hautement fréquentés cause de grands dommages à la végétation naturelle indigène.

Knowledge of the impact of resource use on plant communities is an important prerequisite for land-use planning in National Parks. A survey was conducted during the summer of 1965 to determine the effects of logging and intensive camping on the structure and composition of the major forest communities in the eastern part of Riding Mountain National Park[3].

Disturbed and undisturbed stands of aspen (**Populus tremuloides** Michx.), aspen/white spruce (**Picea glauca** (Moench) Voss), jack pine (**Pinus banksiana** Lamb.), and bur oak (**Quercus macrocarpa** Michx.) were investigated, both quantitatively and qualitatively, and the results compared to determine apparent differences which might be attributed to logging activities. The analysis of the recreational activities is based on information gathered from two widely separated campgrounds.

Description of Study Area

The most prominent topographic feature in the eastern half of the park is the Cretaceous Manitoba escarpment rising just inside the northern and eastern boundaries from the floor of ancient Lake Agassiz to a plateau 1200 feet above. Glacial till primarily in the form of ground and terminal moraines, is the principal Pleistocene deposit. Alluvial fans, formed of shaly detritus that has been eroded from the Cretaceous bedrock, occur at the base of the escarpment where the gradient of streams flowing from the plateau is sharply reduced. Sandy and gravelly beaches formed by Lake Agassiz, circumscribe the foot of the plateau (Johnston, 1934).

The study area lies in the Mixedwood Section of the Boreal Forest Region (B18a) (Rowe, 1959). Aspen communities dominate the eastern portion of the park, primarily because of their ability to regenerate rapidly following major disturbances such as fire and logging. Communities characterized by white spruce, black spruce (**Picea mariana** (Mill.) BSP.), jack pine, balsam fir (**Abies balsamea** (L.) Mill.) and white birch (**Betula papyrifera** Marsh.) are also prominent on the plateau. American elm (**Ulmus americana** L.), green ash (**Fraxinus pennsylvanica** Marsh. var. **subintegerrima** (Vahl) Fern.) Manitoba maple (**Acer negundo** L. var. **interius** (Britt.) Sarg.) and balsam fir dominate communities on the alluvium below the escarpment. Bur oak communities are prominent on droughty portions of the old gravel beaches of Lake Agassiz and on the upper slopes of stream valleys that have become deeply incised in the face of the escarpment.

Extensive logging of the park's forest resources began in the latter part of the nineteenth century and continued until 1938 when the first forest management plan was put into effect. This and subsequent plans, were designed to maintain a sustained yield of forest products and at the same time increase the softwood growing stock.

Intensive recreational activities such as camping and picknicking are concentrated around the major accessible lakes. Extensive recreational use of the park has been limited mainly to the gathering of flowers and various edible berries and nuts.

Methods of Study

Quantitative methods, supplemented by field observations, were used to record the effect of logging and recreation on the structure and composition of the various forest communities.

Cut and uncut stands on similar sites were selected with the aid of aerial photographs and forest type maps to study the effects of logging. The vegetation in these stands was sampled by running lines across their greatest extent and spacing the sampling units at regular intervals along these lines (Cain and Castro, 1959). Rectangular plots of 100 sq m (5.0 m × 20.0 m), 16 sq m (2.0 m × 8.0 m), and 1 sq m (0.5 × 2.0) in size were used to determine the presence and abundance of the various component species in the tree, shrub, and herb strata respectively. A total of 24 stands were sampled in this manner and, in addition, many others were investigated without the aid of quantitative methods.

Data for the purpose of analyzing the effect of recreational activity on the forest community were only collected from the shrub and herb layers. Transects were placed across campgrounds in such a fashion as to provide a continuum of use from low to high intensities. A total of 150 herb plots and 75 shrub plots were established in campgrounds located at Clear Lake and Whirlpool Lake.

Results

Effects of Logging

Results of the survey indicated that logging brought about a marked change in the structure of the forest community but, in most cases, influenced composition only slightly. In general, logging eliminated or severely reduced the tree stratum (in the sense that this stratum did not reproduce itself) which in turn promoted the growth of tall shrubs and herbs at the expense of small, shade-tolerant, woodland plants. These changes were least where logging was conducted in young, vigorous hardwood stands and increased proportionately with the amount of softwood cover; repercussions were greatest in softwood communities with dense tree canopies.

The white spruce/aspen community has been the major source of softwood sawtimber in the park. Logging in the mature stands removed most of the white spruce and left only the aspen component which was generally overmature, decadent, and subject to blowdown from increased exposure to wind. The resultant community was dominated by a dense, heavily browsed shrub stratum composed, with few exceptions, of species common to the original stands. Trees regenerated poorly; moderate aspen reproduction was recorded, but this failed to exceed 2.0 m, probably because of browsing by elk, moose, and/or deer which frequented these open brushy areas. White spruce reproduction was sparse and limited primarily to rotting spruce stumps and logs.

Logging effects on the major shrub and herb species in the upland spruce/aspen community on fresh to moist sites are depicted in Figures 1 and 2.

Hazel (**Corylus cornuta**) remained dominant in the shrub stratum after logging but ungulate browsing limited its height growth to approximately 1.5 m as opposed to undisturbed stands where it often reached heights of 3.0 m. Willow (**Salix** spp.) and hawthorn (**Crataegus chrysocarpa**), two light tolerant species, frequently invaded the cut over stands.

In the herb stratum, **Aralia nudicaulis** continued to be the dominant plant after logging. Tall, coarse herbs such as **Calamagrostis canadensis** and **Solidago gigantea**, replaced, to a large extent, the low herb stratum where **Mitella nuda** and **Pyrola secunda**, were apparently often deleted.

The composition and structure of the disturbed

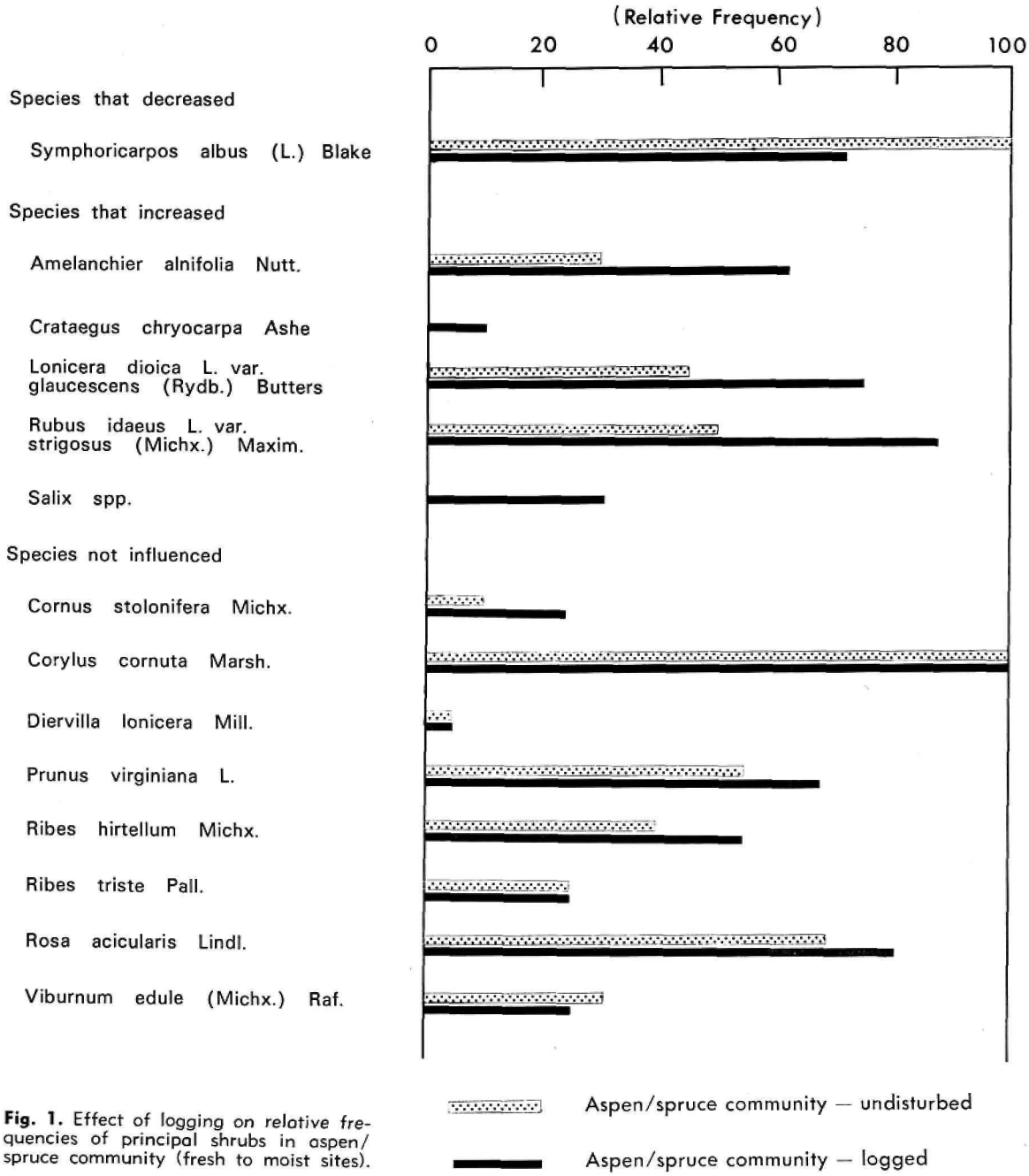

Fig. 1. Effect of logging on relative frequencies of principal shrubs in aspen/spruce community (fresh to moist sites).

white spruce/aspen community were remarkably similar to those of the decadent over-mature aspen community.

The composition and structure of the even-aged white spruce community were investigated but a recent cut over counterpart could not be located. This park-like community is characterized by an inconspicuous shrub stratum composed primarily of small, poorly developed species of **Rosa acicularis** and **Symphoricarpos albus,** and by a continuous, low, herb layer dominated by **Fragaria virginiana** Duchesne and **Petasites palmatus.** Scattered patches of moss were often present. Logging here would severely alter the community structure and composition. Increased insolation would stimulate prodigous growth of hazel and other shrubs, and the tall, vigorous herbs such as **Calamagrostis canadensis, Solidago gigantea** and **Heracleum lanatum. Goodyera repens** (L.) R. Br. var. **ophiodes** Fern., a small orchid, was recorded only in these white spruce stands and would undoubtedly disappear with the removal of the over-story.

Logging in the jack pine community removed, almost completely, the continuous tree stratum. Reproduction of the jack pine component was observed only sporadically. Some white spruce reproduction, most of which had occurred prior to logging, was present in the clear-cut areas. Aspen suckers were frequently recorded but, as in the spruce/aspen community, few were observed in excess of 2.0 m in height.

In the 'natural' community, the tall shrub stratum was composed primarily of **Alnus crispa** (Ait.) Pursh, but in the disturbed community this stratum was usually replaced by a denser, waist-high stratum consisting chiefly of **Rosa acicularis** and **Rubus idaeus,** two species that were present but not prominent in the undisturbed stands.

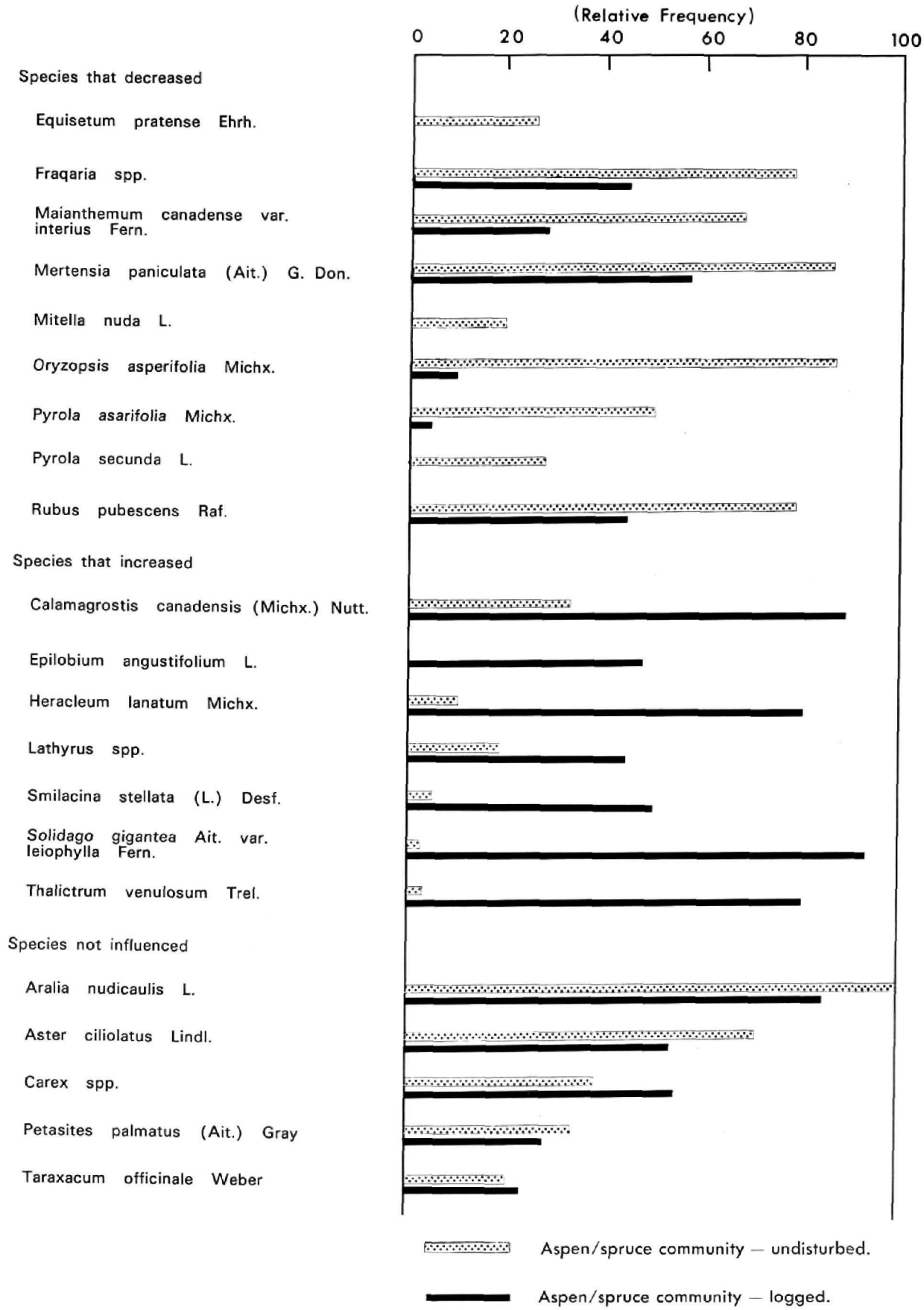

Fig. 2. Effect of logging on relative frequencies of principal herbs in aspen/spruce community (fresh to moist sites).

In the herb stratum, four small plants, **Linnea borealis** L. var. **americana** (Forbes) Rehd., **Mitella nuda, Pyrola secunda,** and **Viola** spp. which were frequently recorded under undisturbed conditions, were not recorded in the clear-cut community. The tall, coarse herbs that characterized the disturbed spruce/aspen stands were also prominent in the jack pine counterpart. In addition, the herbaceous flora of the disturbed stands was augmented by several hygric species that were characteristic of neighbouring moist depressions e.g. **Anenome canadensis, Halenia deflexa** (Sm) Griseb. and **Equisetum** spp. Other additions included **Luzula acuminata** Raf., **Smilacena stellata** (L.) Desf., and **Zizia aptera** (Gray) Fern.

Clear-cutting in young aspen stands did not noticeably alter the composition or affect the structure of this community. A dense tree cover of vigorous aspen suckers sprang up almost immediately from the underground root system of the trees that had been removed, and quickly regained its dominant position. The effect of clear-cutting in communities dominated by bur oak, which sprouts vigorously from residual stumps, was similar. Changes in the structure and composition of the minor strata in both the aspen and oak stands were negligible.

Effects of Intensive Camping

Studies of the impact of intensive camping on the composition of vegetation were limited to two campground areas: the Wasagaming campground, south of Clear Lake, and the Whirlpool Lake campground. Although the former was situated in a 40 year old aspen stand, and the latter in a mature white spruce/jack pine area, the results of the study with respect to species composition were remarkably similar.

Intensively used sites such as those that existed around tenting and trailer sites, were dominated by a grass/forb association (Table 1) wherever the complete destruction of vegetation had not taken place. **Agropyron** spp. and **Poa** spp. were the dominant grass species and **Taraxacum officinale** was the most prominent forb on the heavily used campsite regions, although broad patches of **Trifolium** spp.

Table 1. Plants characteristic of intensively used areas

[1]*Achillea millefolium* L.
[1]*Agropyron cristatum* (L.) Gaertn.
[1]*A. repens* (L.) Beauv.
A. trachycaulum var. *novae-angliae* (Schribn.) Fern.
A. trachycaulum var. *unilaterale* (Cassidy) Malte
Agrostis scabra Willd.
Aster ciliolatus Lindl.
A. laevis L.
Bromus ciliatus L.
[1]*Capsella bursa-pastoris* Medic.
Carex spp.
[1]*Chenopodium album* L.
Festuca ovina vaf. *saximontana* (Rydb.) G1.
Fragaria virginiana Duchesne
Galium septentrionale R. & S.
Heracleum lanatum Michx.
Lathyrus spp.
Matricaria matricarioides (Less.) Porter
[1]*Phleum pratense* L.
[1]*Plantago major* L.
[1]*Poa annua* L.
P. arida Vasey
P. palustris
P. pratensis L.
[1]*Polygonum aviculare* L.
Populus tremuloides Michx.
Rosa acicularis Lindl.
Sanicula marilandica L.
Solidago canadensis L.
[1]*Sonchus arvensis* L.
Symphoricarpos albus (L.) Blake
[1]*Taraxacum officinale* Weber
[1]*Trifolium* spp. (L.) Blake
Vicia americana Muhl.

[1]Species not indigenous to North America

Fig. 3. Mutilated trembling aspen stem. Wasagaming campground.

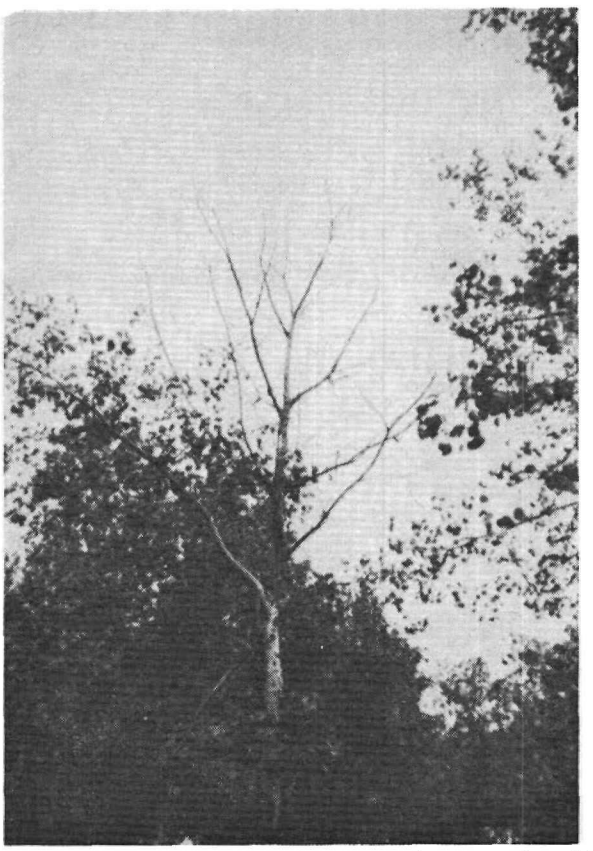

Fig. 4. Trembling aspen dying from stem damage inflicted by campers. Wasagaming campground.

occurred in the larger clearings. Over one-third of the species were exotics which normally inhabit waste places.

Fig. 5. Severely damaged white spruce stem. This species exhibits a greater ability to survive mechanical damage than trembling aspen.

Areas between campsites were dominated by shrubby species, the most notable being hazel. The floral composition here was the same as that found in adjacent undisturbed stands.

Tree mutilation by campers was an important aspect of intensive recreational use (Figures 3 and 4). These thoughtless acts appeared to be the principal cause of death for many aspen. Softwood species were apparently able to successfully withstand this pressure to a greater degree (Figure 5).

Discussion

Effects of Logging

The results of this study indicate that logging has not seriously altered the composition of the plant components in either the shrub or herb strata. The lesser vegetation in most disturbed stands was largely determined by the composition prior to the disturbance. Exceptions to this general conclusion occurred where dense stands of softwood were clear-cut. Here, increased insolation was apparently responsible for the disappearance of moss patches and some small shade tolerant herbs. The major effect of logging on composition was to change the relative importance of several species and, in some cases, to increase the variety of plants.

The perpetuation of the tree stratum and thus the basic character of the forest community, is dependent upon the ability of the tree species involved to regenerate following disturbances or deterioration. Oak and aspen regenerate vegetatively and vigorously after logging although in the case of aspen, this ability diminishes as the age of the trees increases (Rowe, 1955). White spruce, on the other hand, regenerate poorly — an aspect that has been intensively studied by a number of investigators (Jarvis et al. 1966) — and forest operations may accentuate this problem. Rowe (1955) has concluded that logging in the western boreal forest rarely assists spruce reproduction and that it sometimes makes conditions very unfavourable by opening up the canopy and allowing herbaceous and shrubby growth to increase. Poor reproduction after cutting may partially account for the apparent decline in white spruce abundance. Early forest and land survey reports (Dickson, 1909)[4, 5] compiled several years after logging had begun, indicate that it once occupied a more prominent position.

Past logging practices have probably helped to maintain the areal extent of the jack pine community. The large quantities of combustible debris associated with early operations (Dickson, 1909) provided a favourable medium for fire — the necessary environmental link to the survival of this type. Here, logging apparently had a marked effect on plant succession. The removal of large white spruce along with the jack pine and the destruction of much of the young white spruce understory have hindered an orderly transition to spruce and subsequent forest types. The shrub-dominated vegetation that replaced the jack pine stands appeared to be resisting successional changes.

The natural occurrence of open, shrubby, overmature aspen stands on upland sites would seem to verify the statement by Rowe (1961) that the overmature spruce/aspen forest is ". . . open, unhealthy, ragged and frequently brush-filled". The similarity between these communities and those that have been logged indicates that logging may hasten the development of a similar vegetation on upland sites in this region.

The past 3 or 4 decades of logging, fire and animal protection have undoubtedly combined to create large, uniform areas of sparsely treed brushland. Silvicultural techniques such as fire, scarification, planting and seeding must be applied to maintain the spectrum of naturally occurring communities in all stages of their development.

Effects of Intensive Camping

Aspen mortality is perhaps the most serious effect of intensive camping. Tree mutilation is definitely a major factor causing death, and site alteration may also be important. The replacement of indigenous plants by exogenous and pioneer species on intensively used sites may not be desirable, but it must be accepted. To some extent their presence is fortuitous as they partially protect the soil from erosion as well as contribute some organic matter which helps maintain soil structure.

Management methods for maintaining protective and aesthetically desirable vegetation would seem

to fall into three categories: 1) campsite rotation, 2) selection of durable sites, and 3) selection of vegetation capable of withstanding intensive recreational use. Campground rotation may be useful for reconstituting degraded sites, but in general the heavy investment and servicing costs, together with the current high demand for campground facilities, limits the utility of this technique. The latter two methods appear to provide a more pragmatic approach to this management problem.

Soils with good permeability, good drainage, low compaction potential, low erosion hazard, and high organic content are best adapted to intensive camping and picnicking activities (Stevens, 1966, and Dotzenko, Papamichos, and Romine, 1967). Sites containing soils with these characteristics would undoubtedly reduce maintenance costs and eliminate the necessity for campground rotation.

Information is lacking on the relative abilities of various native plants to survive intensive recreational use. Observations during the study indicated that white spruce and jack pine were able to withstand intensive use to a greater degree than the young aspen characterizing most campsites. Shade-tolerant species, such as white spruce, capable of producing and maintaining an all-aged stand structure, should be encouraged on intensively used sites. Aspen and other shade-intolerant species comprising even-aged stands, probably cannot be regenerated in sufficient quantities beneath the parent trees to maintain a continuous cover on a perpetual basis. Among the lesser vegetation, the results indicated that grasses and exogenous annual forbs were best adapted to heavy recreational use. Periodic sodding or seeding with exotic grasses, as suggested by Wagar (1964), may therefore be a useful technique for maintaining a protective cover of vegetation on intensively used sites.

Sites for future campgrounds or picnic areas should be selected well in advance of their intended development in order that a permanent, durable vegetative cover, capable of withstanding intensive recreational use, may be established.

Acknowledgement

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