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**NATURAL REGENERATION
UNDER MATURE AND
OVERMATURE STANDS OF
BALSAM FIR ON THE
CAPE BRETON HIGHLANDS**

by
B. C. WILE



CANADIAN FORESTRY SERVICE

MARITIMES FOREST RESEARCH CENTRE

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STANDS OF BALSAM FIR ON THE CAPE BRETON HIGHLANDS.

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ABSTRACT

A survey of natural regeneration under 15 mature and overmature balsam fir, *Abies balsamea* (L.) Mill., stands heavily defoliated by spruce budworm, *Choristoneura fumiferana* (Clem.), on the Cape Breton Highlands indicates that 80% of the stands are at least 80% stocked with fir seedlings of which over 90% are less than 15 cm (6 inches) in height and in good condition. It is uncertain how these small fir seedlings will survive a persistent budworm epidemic, eventual removal of the overstory, and the subsequent rapid growth of herbs, shrubs, and deciduous trees. Probably the fir will have to be released from competing vegetation and supplemented by planting.

RESUME

Un relevé de la régénération naturelle dans le sous-étage de 15 peuplements exploitables ou sur-rannés de Sapin baumier, *Abies balsamea* (L.) Mill., gravement défoliés par la Tordeuse des bourgeons de l'Épinette, *Choristoneura fumiferana* (Clem.), sur les hautes terres du Cap Breton indique que 80% des peuplements sont peuplés au moins à 80% de semis de Sapin, dont plus de 90% ont moins de 15 cm (6 pouces) de hauteur et sont en bon état. Advenant l'enlèvement de l'étage dominant et la rapide croissance subséquente des herbes, arbrisseaux et arbres à feuillage caduc, on ne sait pas comment ces petits semis de Sapin pourront survivre à une invasion persistante de la Tordeuse. Il faudra probablement débarrasser le Sapin de la végétation concurrente et le renforcer par plantation.

INTRODUCTION

In 1974, a spruce budworm, *Choristoneura fumiferana* (Clem.), epidemic began on Cape Breton Island, Nova Scotia, causing wide-spread defoliation. A survey of a limited number of sample plots estimated that by 1977 about 16% of the balsam fir, *Abies balsamea* (L.) Mill., on the Highlands were dead and over one-half of the trees were heavily defoliated (Sterner et al. 1977). Another 10% were expected to die in the following year.

Concern about the quantity, species, and condition of natural tree regeneration under these heavily damaged mature stands of balsam fir caused the Technical Services Sections of the Maritimes Forest Research Centre to undertake a small-scale survey of regeneration in October 1978. The results of that survey are presented here.

Review

The spruce budworm is a native insect: periodic outbreaks at epidemic levels have occurred for hundreds of years in eastern Canada (Prebble and Morris 1951). During an outbreak many balsam fir trees die as a result of heavy defoliation over several years, but enough small seedlings survive and mature so that the cycle is repeated. These new stands may have more or less fir than the old ones (Ghent et al. 1957), and shade intolerant, broad-leaved tree species often increase.

Data collected in 1964 by the Maritimes Forest Research Centre at the Kedgwick Control Area in northern New Brunswick, an area reserved from insecticide spraying to control spruce budworm, showed

that after mature balsam fir stands were largely destroyed by budworm, fir was the most numerous species of regeneration on about 40% of the area. On another 40%, fir seedlings were mixed with white birch, *Betula papyrifera* Marsh, and "weed" trees, (pin cherry, *Prunus pensylvanica* L.f., mountain maple, *Acer spicatum* Lam., mountain ash, *Sorbus americanus* Marsh., and service-berry, *Amelanchier* sp.), while on the remainder, weed trees, white birch, and shrubs predominated.

Balsam fir regeneration under heavily defoliated stands is "advance" growth, i.e., it comes from seed formed before the budworm infestation becomes severe (Prebble 1949, Ghent 1958). Heavy defoliation quickly stops female flower production, and consequently, the production of seed.

MATERIALS AND METHODS

Description of the Highlands Forest

The forest on the Cape Breton Highlands is mostly balsam fir with scattered spruce *Picea* sp. and white birch (Hawboldt and Bulmer 1958). It has been described as boreal (Hawboldt and Bulmer 1958, Rowe 1972), and certainly it has the appearance of a northern forest with few species and slow growth. Loucks (1962) notes that the Highlands are mostly between 305 and 457 m (1000-1500 ft) in elevation and, except in the valleys, trees are exposed to continuous winds from the surrounding ocean.

The climate is poorly documented, but is cool and moist. The growing season is short and frosts may be expected in all months of

the year (Putnam 1940). The vegetation has been described in detail by Nichols (1918).

Description of Stands

The stands used in this study are described by Sterner et al, 1977. They are mainly mature and overmature balsam fir, with wood volumes averaging 233 m³/ha (26 cords/acre) and ranging from 107 to 358 m³/ha (12 to 40 cord/acre). Defoliation by spruce budworm began in 1974 and is continuing unabated. All fir trees have some defoliation. Approximately two-thirds of the trees have lost 50% or more of their foliage but were still alive in 1977; 16% were already dead. By 1978, 32% of the fir was dead (Magasi 1978).

Design of Survey

The 15 stands are scattered over the Highlands (Fig. 1). Five temporary, contiguous 4-m² (0.001-acre) quadrats were established in each stand in an untrampled area. Notes were made on the condition of the site, the overstory, and the reproduction, abundance, and species of shrubs. Only the largest tree seedling of each species was recorded by species and height

class. (A seedling is defined as any tree 13 mm or less in diameter, breast high.) They were grouped in three size classes: (1) up to 15 cm, (2) 15 to 90 cm, and (3) over 90 cm in height and up to 13 mm dbh.

RESULTS

Stocking

All 15 stands have natural regeneration of balsam fir (Table 1). Two-thirds (67%) of the stands are 100% stocked with balsam fir regeneration (i.e., there is at least one fir seedling on each 4-m² quadrat). Eighty percent of the stands are at least 80% stocked with fir.

Species

Balsam fir is the most common species of regeneration being present on over 90% of the quadrats (Table 2). White birch, the second most common species, is present on 28% of the quadrats. Spruce is scattered (on about 5% of the quadrats), and mountain ash, mountain maple, and pin cherry are very scattered. These last three species, however, usually increase rapidly in numbers after the overstory is removed.

Table 1. Stocking of 15 stands on the Highlands by species

| Percent Stocking | Balsam fir | | White birch | | Spruce | |
|------------------|------------|---------|-------------|---------|--------|---------|
| | Number | Percent | Number | Percent | Number | Percent |
| 100 | 10 | 67 | 1 | 7 | 0 | 0 |
| 80 | 2 | 13 | 2 | 13 | 0 | 0 |
| 60 | 2 | 13 | 2 | 13 | 0 | 0 |
| 40 | 1 | 7 | 2 | 13 | 1 | 7 |
| 20 | 0 | 0 | 2 | 13 | 2 | 13 |
| 0 | 0 | 0 | 6 | 40 | 12 | 80 |

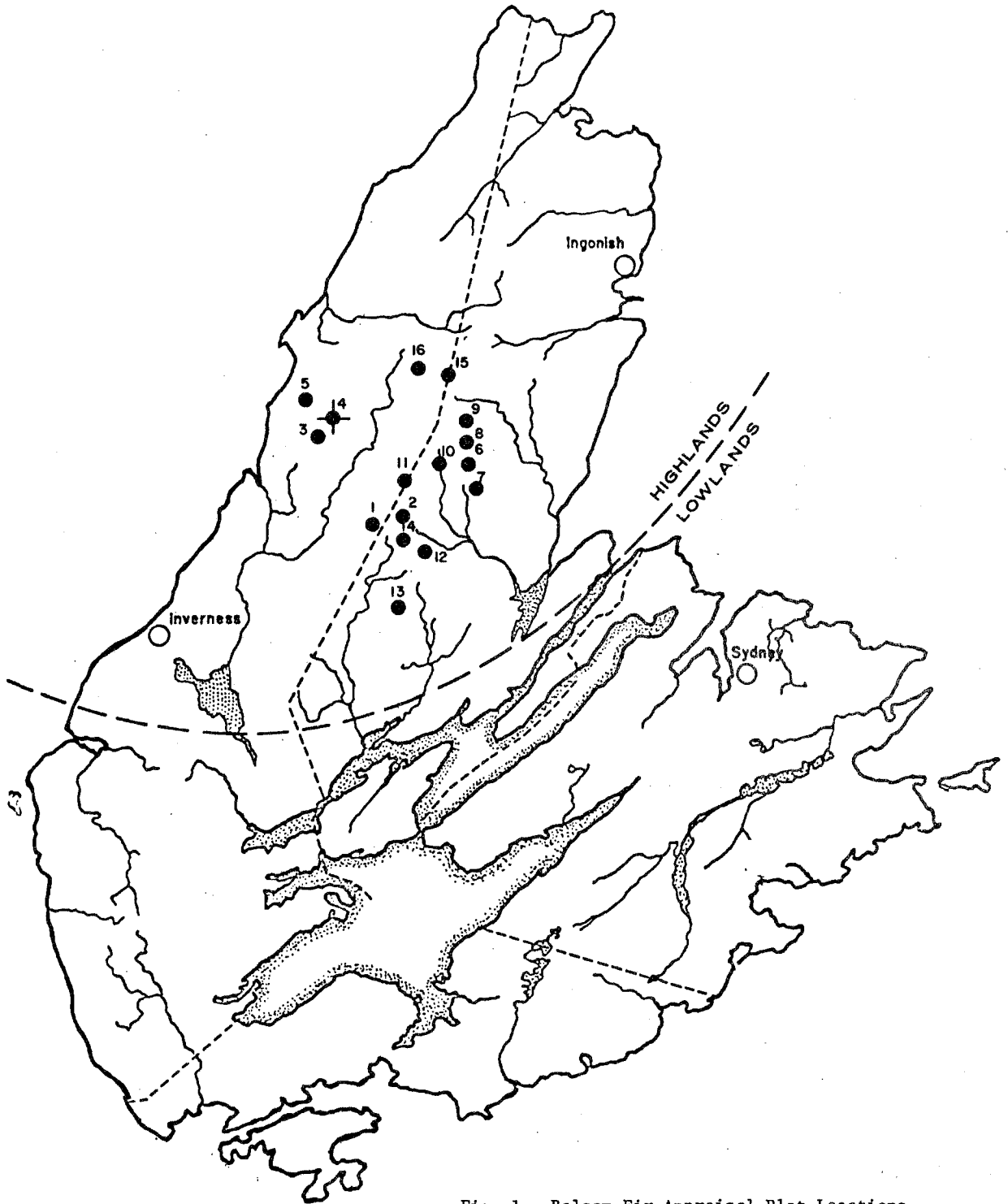


Fig. 1. Balsam Fir Appraisal Plot Locations
October 1976 and September 1977.

✦ cut before examination in 1977

Table 2. Stocking of 4 m²-quadrats by species.

| Species | Number | Percent |
|-------------|--------|---------|
| Balsam fir | 70 | 93 |
| White birch | 21 | 28 |
| Spruce | 4 | 5 |
| Other | 5 | 7 |

Size and Density

There are thousands of small balsam fir seedlings per hectare (range 7,400 - 74,000/ha, 3000 to over 30,000/acre). Over 90% of the fir regeneration, under mature and overmature fir, is less than 15 cm in height (Fig. 2) but is in good condition. Most seedlings taller than 15 cm are defoliated, often severely.

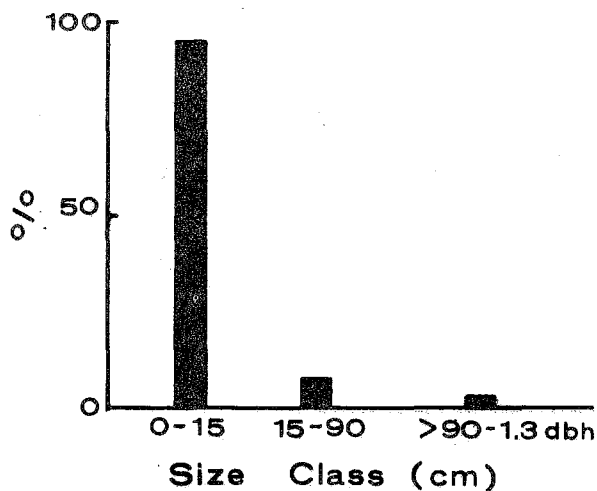


Fig. 2. The percentage of balsam fir regeneration in each of three size classes.

DISCUSSION AND CONCLUSIONS

At present, most of these stands are adequately stocked with acceptable natural regeneration (i.e., balsam fir), but it is uncertain how the seedlings will survive continued defoliation by spruce budworm and harvesting of the overstory which are occurring over much of the Highlands. Most previous studies were done in stands where no salvage was attempted (e.g., the Kedgwick Control Area in northern New Brunswick). In these stands many large trees died and fell, crushing some of the natural regeneration. Scattered overstory fir and spruce survived and remained standing but were almost useless as seed trees because of their poor condition and because the rapid growth of herbs, shrubs, and deciduous trees soon occupied most of the space suitable for fir regeneration.

Stands in the Highlands are expected to respond in similar fashion. Clear-cut areas will have to be watched carefully. Some deciduous trees and shrubs and some ferns may be beneficial to the natural regeneration of conifers by reducing exposure and recycling nutrients, but where competition is damaging, release will be necessary for best growth. Where conifer regeneration is insufficient it can be supplemented by planting; where regeneration is oversufficient, stands can be cleaned to concentrate growth on fewer trees.

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