Damage Caused by *Eucosma gloriola* Heinrich in Three Different Forest Sites in the Sandilands Forest Reserve, Manitoba.—Damage by *Eucosma gloriola* to regeneration jack pine in the Sandilands Forest Reserve was reported in 1963 (Wong, H. R. and J. J. Lawrence. Bi-Mon. Prog. Rept. 19(2):2). Studies on the intensity of attack and the incidence of leader and lateral damage in relation to tree height were carried out in 1962, 1964 and 1965 in two twentieth-acre strip plots selected at random each year in three different site classes. These site classes have been described by Cayford (Dept. Forestry Publ. 1016. 1963) as dry, moderately-fresh and moist, and supported approximately 800, 4,000 and 12,000 stems per acre respectively.

Observations indicate that the pine shoot moth attacks the current year's growth of the leaders and laterals, but seems to prefer the former. More laterals were attacked only when populations of *E. gloriola* increased in numbers. In the moderately-fresh and moist sites, where lateral damage was most evident, up to six larvae were present in some of the leaders instead of the usual one larva. This may have resulted from a reduction of leaders that were suitable and uninfested.

The data recorded in Table I indicate that *E. gloriola* prefers to attack trees of the intermediate height class; and

Table I

Damage by *Eucosma gloriola* in three site classes in the Sandilands Forest Reserve, Manitoba

Site	Year	No. of trees in two 1/20-acre plots	% of trees infested	Height (ft.)			
				All trees		Infested trees	
				Range	Mean	Range	Mean
Dry	1964	134	7.4	1–5	3	3–5	4
	1965	44	34.0	2–12	6	2–8	5
Moderately fresh	1962	373	10.9	2–9	6	3–8	6
	1964	412	13.0	2–11	6	3–8	6
	1965	222	19.3	2–12	5	2–6	5
Moist	1962	483	6.8	2–10	5	3–8	6
	1964	1048	16.2	4–12	7	4–11	7
	1965	356	29.4	3–16	8	5–14	8

the percentage of trees attacked does not increase with stand density. This apparent height preference by the shoot moth could benefit the taller trees, and aid in the natural thinning of heavily stocked regeneration stands.—H. R. Wong, A. E. Campbell, and J. J. Lawrence, Forest Research Laboratory, Winnipeg, Man.

An Unusual Species of Ant, *Formica fossaceps* Buren, in Quebec.—During the course of recent investigations on ants as potential control agents of insect pests in plantations, *Formica fossaceps* Buren (material identified by R. Beique, Quebec Museum) a species previously unrecorded in Quebec, was found in considerable numbers near Megantic, P.Q. in 1965. Since it is a large aggressive ant often found foraging in trees, and its nests are built on open, sunny sites (similar to those found in young plantations), it was felt that the life history and habits of the ant should be observed in some detail to determine its value for biological control purposes.

F. fossaceps belongs to the group *rufa,* generally known as red ants. It was first described in 1942 by Buren (Iowa State Coll. Jour. Sci. 16, 399-408), who reported it in the State of Iowa. It has since been found in North Dakota by Wheeler and Wheeler (Univ. North Dakota Press. 238-239, 1963), but to the author's knowledge has not been recorded elsewhere in North America. The workers of this large ant measure 4-8 mm in length, and the males and females about 8-9 mm. The nests are monogynous (with only one queen) and apparently without slaves. Males and females are produced at the same time of the year in the same nests, and they emerge in late August and early September for their nuptial flight.

The nests are constructed in and around old dry stumps and fallen tree trunks (usually cedar), in thinly forested areas, overgrown, abandoned pasture-land, or at the edge of dense stands. A few nests were found completely in the ground, under rocks or in sandy loam, to a depth of 8-9 in. There is usually considerable thatching over nests in stumps or logs, and to a lesser extent over the main entrance of earth nests. Individual nests are not large, usually containing fewer than 3000 ants. However, colonies of a dozen nests or so were found, where the distance between nests was no greater than 25 ft. Consequently, there can be a fairly high population per acre, even when compared to other ant species with larger individual nests. It was found that ants originating as far apart as 10 miles were readily accepted in each other's nests, without any sign of hostility. This very desirable habit makes it possible to build up large nests in the laboratory for propagation purposes. Tests conducted in the laboratory, to determine the aggressiveness of this ant, revealed that the species was capable of attacking with vigour, and killing, a wide variety of insects.

In the field, nests of *F. fossaceps* have been found in close proximity to nests of *F. fusca* L., *F. whymperi* Forel, *Camponotus herculeanus* L., and *C. noveboracensis* (Fitch), without evidence of hostility.

Although *F. fossaceps* has many obvious desirable qualities, its value as a biological control agent may be weakened by two factors. The first is that nests are monogynous, thus making it difficult to propagate the species into new areas. The second is that its natural range seems to be quite limited in the province of Quebec. However, should current trials on propagating the species outside its natural range prove successful, and should the ant be capable of forming large, widespread colonies over a reasonably short period of time, then it could become of importance in biological control work.—R. J. Finnegan, Forest Research Laboratory, Quebec.

Occurrence of a Fir Adelgid (*Adelges nusslini* C.B.) in British Columbia.—Surveys in 1965 and 1966 for the balsam woolly aphid, *Adelges piceae* (Ratz.), on *Abies* spp. in commercial nurseries and ornamental plantings on southern Vancouver Island and in the lower Fraser River Valley revealed another introduced adelgid attacking true firs. An examination of two nurseries in Vancouver and one in Victoria revealed approximately thirty 3 to 7 foot Nordmann fir (*Abies nordmanniana* (Steven) Spach) infested with this insect and seven similarly infested young fir were observed at a private residence in Burnaby. Seedlings in the nursery were imported from either Holland or Belgium and those in Burnaby from Holland. The only previous record of *A. nusslini* in Canada was from a residential area in Vancouver in 1941 on an unknown host.

In Europe, *A. nusslini* is an important pest of young silver fir (*Abies alba* Miller). The trees examined here showed marked injury, particularly in the upper crown where needles were yellowed and cast, and some branches were killed.

Other *Abies* spp. in nurseries and gardens were not attacked and after extensive surveys of native stands only *A. piceae* and a native adelgid (*Pineus abietinus* Underwood and Balch) were observed. It is not known if any native *Abies* are susceptible to attack by *A. nusslini.*

Eight infested trees were drenched with 0.1% lindane water emulsion spray, once in late April 1965 and again 1 month later; periodic examinations until August 1966 showed that all aphids were killed. Two infested trees were planted in a large cage and 20 *Aphidecta obliterata* (Linnaeus), a predator recently imported from Europe, were released into the cage in April 1965. Three months later, 154 adult *Aphidecta* progeny were found and most of the aphids had been destroyed. Control was not complete, as the aphid population recovered the following spring.

The discovery in local commercial nurseries of this damaging European adelgid emphasizes the danger of transporting trees into and within the Province without proper quarantine regulations. The dormant stages of many insects, commonly present when trees are moved in spring and fall, escape discovery too easily. The propagation of introduced tree species from seed would reduce the chances of introducing forest pests to the Province.—J. W. E. Harris, Forest Research Laboratory, Victoria, B.C.

Recent Outbreak of the Bruce Spanworm in Quebec.—The Bruce spanworm, *Operophtera bruceata* (Hulst), a defoliator seldom reported in Quebec prior to 1960 severely damaged sugar maple (*Acer saccharum* Marsh.) in eastern Quebec recently and was a cause of alarm to sugar producers. Sudden increases in the population of this pest were first noted in Portneuf County in 1962. During the next 2 years the outbreak continued to expand over a 15,000 square mile area extending from the Eastern Townships in the west to Chaleur Bay in the east. Populations began to decline in 1965 and in 1966 the insect was rare. The western half of the outbreak area was characterized by solid blocks of light to severe infestation whereas in the east the outbreak was restricted to relatively small areas because of the scarcity of the two preferred hosts: sugar maple and beech, (*Fagus grandifolia* Ehrb.).

In Quebec the life cycle of the Bruce spanworm is similar to that reported by Brown in Alberta (Can. Entomol. 94:1103-1107, 1964), except that oviposition may continue later in the season sometimes lasting until the end of November, and that hatching occurs earlier generally coinciding with the swelling of maple buds in the spring. The larvae usually feed on the underside of the leaves, eating out small areas without touching the veins. Defoliation is generally not conspicuous until populations reach a high level when the foliage becomes thin and crowns take a distinct reddish-brown hue. When feeding is completed, severely defoliated maple trees put on new foliage and crowns are usually green by mid-July. In all of several points under observation, the infestation period lasted only a few years, populations increasing very rapidly and just as suddenly collapsing.

The principal cause of population decline in the recent Quebec outbreak was due to the action of a virus disease. Some parasitism of eggs by *Telenomus* sp. and of larvae by *Horogenes* sp. as well as predation by birds were also recorded. The disease was first observed in laboratory material and later in nature by the senior author and was studied and described by Smirnoff (J. Insect Pathol. 6:384-386. 1964). A gradual discoloration of the abdominal segments of the larvae and cessation of feeding are signs of virus infection. In laboratory rearings of field material collected in the opening buds on May 15, 1964, disease symptoms were first observed on May 28 and most of the larvae died within the next 2 weeks. In nature, the first diseased larvae were recorded on heavily defoliated trees in early June of the same year and 2 weeks later 95% of the larvae were infected.

Despite the high mortality in the Bruce spanworm populations reported above, most of the maple trees in the areas under observation were almost completely stripped of their foliage at the peak of the infestation. However tagged trees kept under observation in severely defoliated areas, have shown no serious after-affects.—R. Martineau and C. Monnier, Forest Research Laboratory, Quebec, P.Q.

FOREST MANAGEMENT

Predicting Stem Diameter Distributions and Yield.—Mensurational data collected from 206 sample plots in red pine (*Pinus resinosa Ait.*) plantations in Ontario were analysed to determine methods for accurately describing and predicting stem diameter distributions (Bonnor, G.M., M.Sc.F. thesis. Univ. Toronto, October 1966). To describe the stem diameter distribution, seven frequency functions were tested. The Charlier Type A function, which was used by Meyer (Yale Univ., School of Forestry, Bull. No. 28. 1930) to describe stem diameter distributions of several North American tree species, proved best and was selected for further study. This function is based on the normal distribution function and its derivatives; its characteristics are the mean diameter (M), the standard deviation (S) and the coefficients of skewness (B_3) and kurtosis (B_4). This function resulted in a better fit than the other six functions, indicating that the distribution of the stem diameters in these red pine plantation plots is approximately normal.

To estimate the future development of present stem diameter distributions, the function characteristics M, S, B_3 and B_4 were calculated for each plot and the resulting values were used as dependent variables in multiple regression analyses, in which the independent variables were age (A), site index (I) and number of trees per acre (N). Site index values were obtained from site index curves derived from the basic data, using a key age of 25 years. The regression equations and their multiple correlation coefficients (R) are shown in Table 1.

TABLE 1

Regression equations predicting standard deviation, mean and coefficients of skewness and kurtosis.

Equation	R
$S = 1.699 - 9.227 \times \frac{1}{A} - 10.69 \times \frac{1}{I} - .0000003479 \times N^2 + .0005500 \times N$	.482
$M = 2.174 + .002381 \times A \times I + 806.1 \times \frac{1}{N} - .0000006999N^2 + .00001764 \times I \times N$	.910
$B_3 = .2079 - .0000003449 \times A \times N - .000001371 \times I \times N - .002803 \times A - .00001510 \times I^2$	.486
$B_4 = .04693 - .0000005766 \times I \times N - .007859 \times A - .000002745 \times N - .000000004743 \times N^2$	.333

Tests were made to determine if the relationships in the equations in Table 1 were different for thinned and unthinned stands; no significant differences were found.

The regression equations in Table 1 were then used with the equation for the Charlier Type A function to obtain estimates of stem diameter distributions from age, site index and number of trees per acre. Substitution of different age values yielded estimates of stem diameter distributions at different points in the development of the stand.

A separate regression analysis produced an equation for the estimation of tree height (H) from age (A), site index (I) and stem diameter (D):

$H = -139.6 + 1.175 \times A + 35.10 \times \ln(I) + 10.19 \times \ln(D)$

where ln is the natural or Naperian logarithm. The equation has a multiple correlation coefficient $R = .975$ and a standard error of estimate s.e. $= \pm 2.7$ ft.

From the above equations tables were constructed showing the estimated stem diameter distributions and tree heights corresponding to various combinations of age, site index and number of trees per acre. Tables were also developed to estimate the merchantable yield from red pine plantations showing the alternative utilization of individual trees for poles, lumber and pulpwood.

Inherent in any study predicting stand and tree growth are several limitations due to lack of knowledge of growth patterns, the causes of mortality and various interactions which take place during the life of an individual tree or stand. The results of the present study, however, are sufficiently accurate to indicate the value of this method in predicting stand potential under various management alternatives.—G. M. Bonnor, Forest Management Research and Services Institute, Ottawa, Ont.

FOREST PRODUCTS

The Effect of Boron Trifluoride Solutions on Pinene.—The volatile terpene fraction of red pine extractives plays an important role in the mechanism of resin exudation occurring in red pine lumber. As a possible means of eliminating