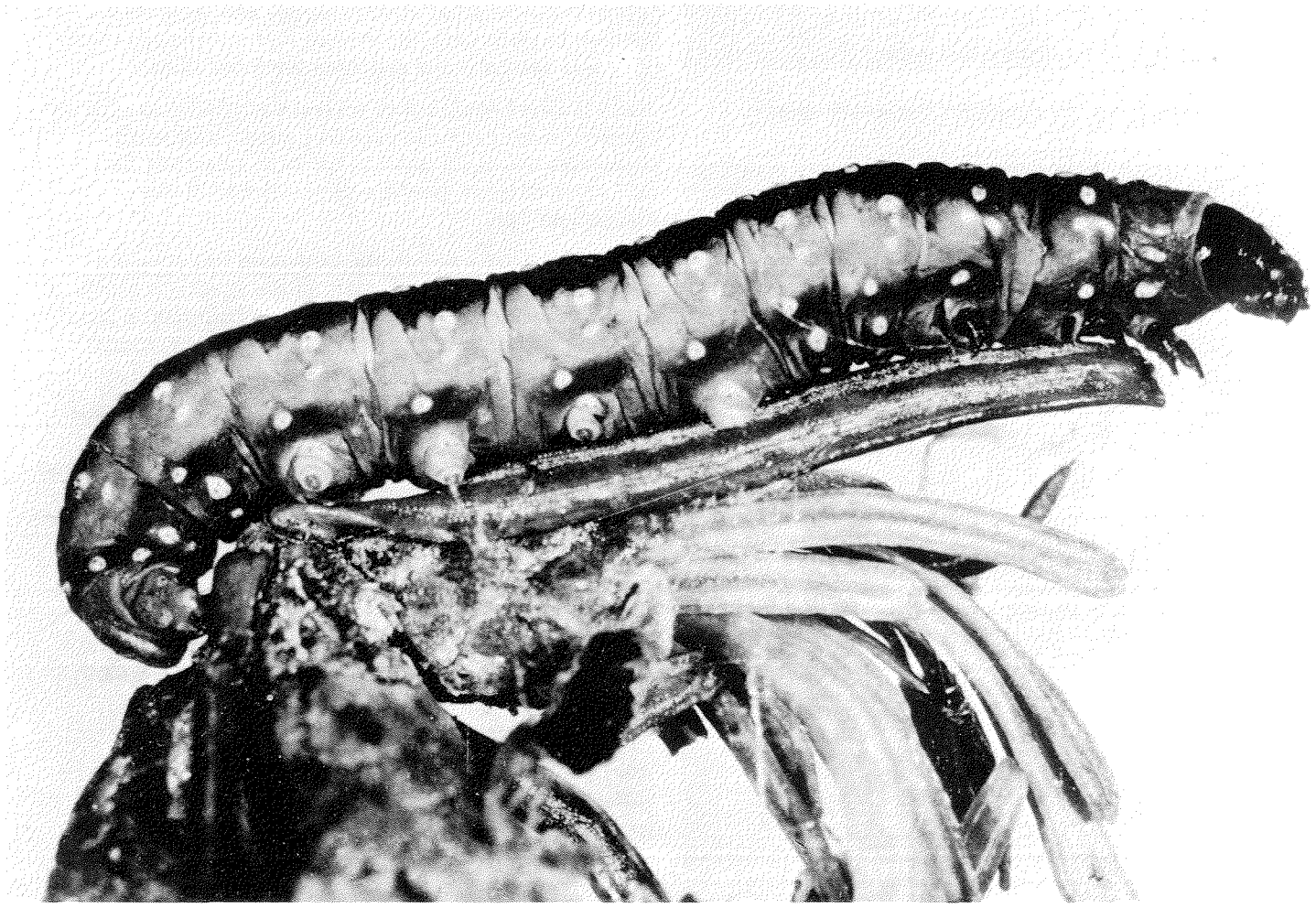
CANADIAN FORESTRY SERVICE

fact sheet

SPRUCE BUDWORM



Budworm larva in late stage of development.

Of the many insect pests that plague Canada's forests, the most widespread, persistent and voracious is the spruce budworm *(Choristoneura fumiferana),* which destroys hundreds of thousands of acres of valuable fir and spruce timber every year.

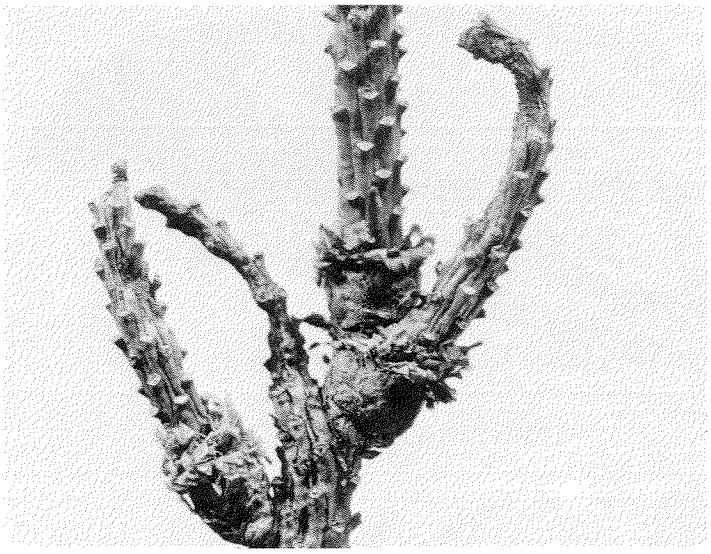
Active in all provinces and the Territories, the insect causes greatest damage in the extensive spruce and fir stands of New Brunswick, Quebec, Ontario and British Columbia.

The spruce budworm is the larval or caterpillar stage of a small brown moth. Hatched from eggs laid by the moths on the undersides of fir and spruce needles, the larvae feed on the needles of mature and overmature trees until they enter the pupal stage.

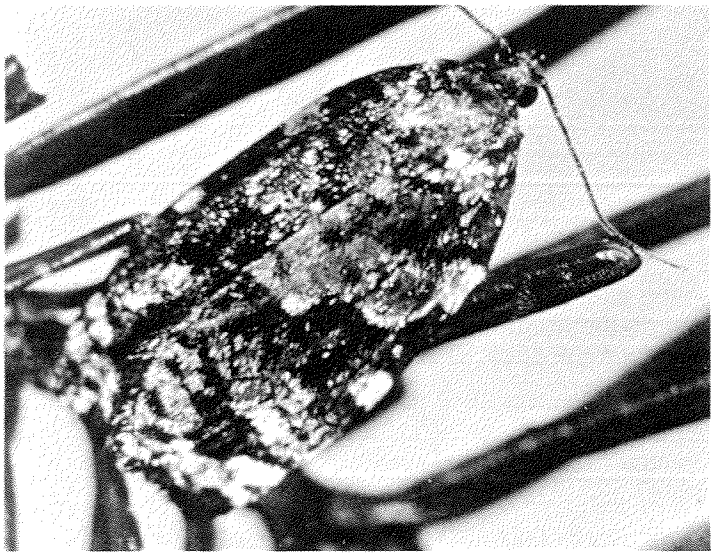
In eastern Canada, their preferred food is balsam fir and red and white spruce, while in the west they favour Douglas-fir, alpine fir, Engelmann spruce and white spruce.

It will usually take from three to five years of severe budworm infestation to kill a tree completely, so that excessive forest damage can be expected if an outbreak lasts that long and extends over large areas.

Balsam fir stand killed by repeated budworm attack.



Spruce leader stripped of needles by budworm.



Adult stage of the spruce budworm — a small brown moth.

habitat and history

The spruce budworm has inhabited the softwood forests of eastern Canada for thousands of years. Its range stretches across the whole Boreal forest region, north to the 67th parallel and in the Subalpine and Montane forests of the west.

The factors leading to budworm outbreaks appear to be the combination of large, continuous areas of susceptible forests and several consecutive years of warm, dry spring weather — which favours the budworm's survival.

Three spruce budworm outbreaks were recorded in New Brunswick between 1800 and the early 1900's; each lasted about 10 years and ended when the budworm population exhausted its food supply and went into decline. In each case, the mature and overmature stands of fir and spruce in the province were devastated.

There is direct evidence of several such outbreaks having occurred even earlier in eastern Canada, and in all probability the same process has been operating for thousands of years, perhaps since the end of the Pleistocene age.

Thus at irregular intervals the budworm has played a critical role in the development of the fir-spruce forests of eastern Canada, killing off mature and overmature stands and releasing young growth to establish a new forest.

Today in the Maritimes, Quebec and Ontario, the budworm is a major problem affecting some 30 million acres of forest, with the threat of severe losses to the region's pulp and paper industry. In the Prairie region and British Columbia the incidence is less severe, but increasing in some districts.

life cycle

The adult moth of the spruce budworm makes its first appearance in the forests in July or August. Each moth lays from 15 to 50 apple-green eggs in clusters on the undersides of needles.

After about 10 days the eggs hatch into larvae that spin silken hibernation shelters in the crevices of twigs and bark, where they remain until the following spring.

The warm days of late April and early May that bring out the new foliage on the trees also bring out the budworm larvae. Emerging as tiny caterpillars, they immediately begin to form tunnels or "mines" in the old needles. After a few days they emerge to begin their damaging work — feeding on the tree's tender new foliage.

After three to five weeks of feeding, during which time they undergo six stages of development, the caterpillars have reached a length of three-quarters of an inch or more. They now enter the pupal stage; 10 days later the new generation of moths emerges, and the life cycle continues.

There are several budworm species in western Canada closely related to *Choristoneura fumiferana*. One of these — *Choristoneura biennis* — requires two years instead of one to complete its life cycle.

Aerial spraying for budworm control.

control

Despite some promising new developments in biological methods of control, chemical spraying is still the only effective way to keep down the numbers of spruce budworm. Because of the vast areas to be covered aircraft must be used, making the operation an expensive one. In New Brunswick the program against spruce budworm, which commenced in 1952, includes one of the world's largest aerial spraying operations.

In Quebec, too, an extensive spraying program has been mounted in recent years, and both Ontario and British Columbia have similar but smaller operations.

Since 1967, when the use of DDT was discontinued, a less persistent class of insecticides has been used against forest pests like spruce budworm. However, the search for yet safer and more effective chemical pesticides continues, as well as research into alternative methods of control.

research

During the past quarter-century, a wealth of valuable information has been gathered on the life cycle and habits of the spruce budworm. Scientists of the Canadian Forestry Service, as well as others in provincial departments and in industry, are continually working to improve chemical control techniques, as well as testing new weapons against the menace, a number of which show promise.

These include the use of naturally occurring viruses, bacteria and fungi as potential substitutes for chemical pesticides; introduction of parasitic insects from other parts of the world; use of sex attractants, sterilants and other means of disrupting the budworm's reproductive cycle; and introduction of juvenile hormones into the budworm's system to cause abnormal or incomplete development.

Such methods, if successful, would have the great advantage of controlling the budworm while having little or no adverse effect on other forms of life. And, in some areas of research, results are highly encouraging.

The Canadian Forestry Service currently is testing several viruses to determine their effect on the budworm. One of

Collecting budworm moths for laboratory study.

the potential advantages of using viruses is the possibility of permanently infecting a budworm population, so that the virus remains in the population from generation to generation, acting as a control agent. One of the Service's most promising developments in biological control involves the use of a bacterium in combination with an enzyme. After extensive testing the formulation has been patented for commercial production.

In addition to its long-standing studies on the budworm larva, the Canadian Forestry Service has also zeroed in on the adult moth stage of the insect. Researchers recently discovered that female moths, after mating, disperse in flights that may extend as far as 70 miles. This inclination to travel raises the possibility that large numbers of egg-bearing females may be concentrated in the airspace by wind patterns and deposited in one or more localities that might then become sites of infestation the following year.

Current studies are aimed at determining if in fact the female moths are concentrated in large numbers in the airspace and if so, whether or not their eventual resting places can be predicted, or at least located, on the basis of detailed meteorological information. An important new element in this research program is the use of radar to monitor moth flights. At the same time, the Service is conducting experimental aerial spraying operations aimed at the moth rather than the larva, and results to date are encouraging.

What of the future? There is sometimes a tendency to look on biological control as a panacea — to assume that eventually it will replace chemical control of insect pests entirely. There have been a few outstanding cases where biological control has been completely successful, but these are rare. In the case of the spruce budworm, scientists are in general agreement that effective control — when it is achieved — will consist of an integrated program involving both chemical and biological agents.

small-scale protection

We have seen that in large, commercial forest stands, control measures against spruce budworm are of such magnitude that they must be carried out by specialists, and with the use of aircraft.

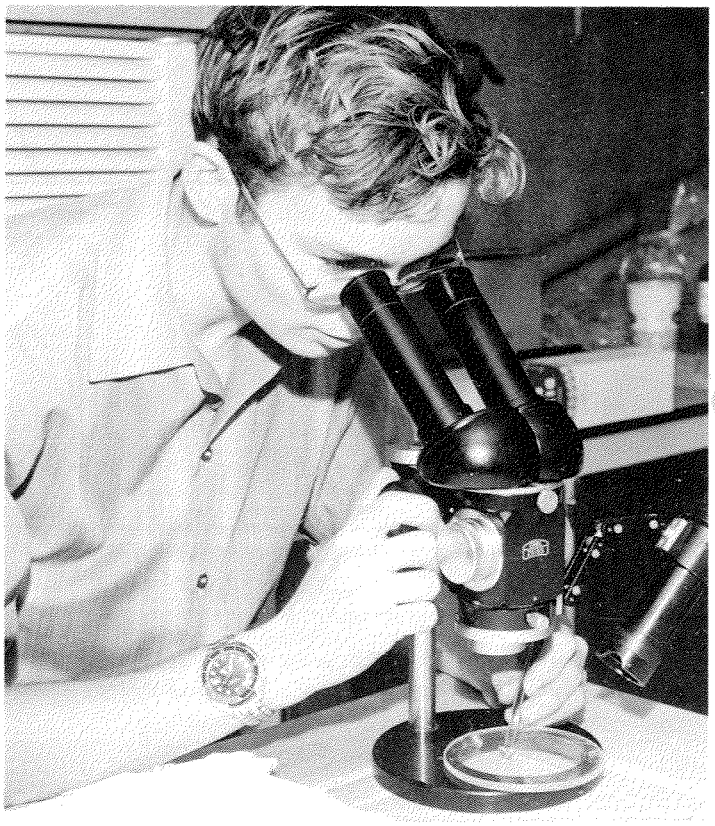
However, owners of small woodlots, homes and cottages in budworm areas may be equally anxious to protect their trees. In such cases, the following precautions are recommended:

In the spring, new buds of balsam fir, spruce and other susceptible species should be examined for any abnormalities.

If small budworm are found feeding, trees should be sprayed as quickly as possible with malathion, an insecticide registered in Canada for use against defoliating insects such as the budworm.

About a week after spraying, a further examination should be made. If any worms are found feeding, the treatment should be repeated.

It is important to remember that insecticides are toxic; care in handling is essential, and manufacturer's instructions should be followed to the letter.



Research technician examines female moth to determine stage of egg production.

Cette publication est disponible en français sous le titre *La tordeuse des bourgeons de l'épinette.*

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