

*Three Decades of Five-Year Cycles of the Spruce Aphid,
Neomyzaphis abietina (Wlkr.)*

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THE spruce aphid, *Neomyzaphis abietina* (Wlkr.), has a life history that is apparently almost unknown. With a view to aiding in understanding this insect, which may often cause serious losses in sitka spruce stands on the Pacific coast of North America, this paper offers a series of observations extending over 30 years, beginning in 1916 at Prince Rupert, B.C., Canada.

Available accounts give no hint of any regularity in the appearance of outbreaks of this aphid. For instance, Keen (1952) gives, after description of the insect, only a statement that it appears in the spring and disappears toward early summer. He gives the range as Alaska to California, mentioning some severe outbreaks. Essig (1946) says that the species "moves in early summer to some unknown alternate host." The present account will describe a regular series of outbreaks in one region near 54° N. latitude, forming an apparent five-year cycle and including altogether seven separate occasions of outbreak at exactly five years apart.

The district affected is about 10 miles (16 km.) across, centering around Prince Rupert harbor. Insects were identified in 1926 at Ottawa by Miss Irene Mounce of the Canadian entomological service, and have since been reidentified at the University of British Columbia.

In 1916 the sitka spruces on Dodge Island at the west end of the harbor were attacked and almost completely defoliated by green aphids. This destroyed the beauty of the site of the Canadian marine quarantine station. Total area of the island is about five acres. It is an old Indian midden, and the trees were luxuriant, in a nearly pure stand averaging about four feet (12 dm.) dbh. This infestation was new to the local residents, who deplored the loss of beauty.

In 1921 the same "green plant lice" attacked the dense stands of sitka spruce at the western end of Kaien Island, two miles (3.5 km.) from Dodge Island across the entrance to the harbor. Kaien Island is the site of Prince Rupert city, and the spruce forest extended for miles along the foot of a 1,500-foot cliff parallel to the entrance of the harbor. Thus it was a conspicuous sight when the huge trees, many 200 feet (60 m.) tall, lost nearly all foliage and began to look grey and dead. This defoliation was not

immediately complete, but all trees looked sickly and some were dead by the end of 1921. Quite likely there had been some infestation here in 1916, but it was inconspicuous and went unnoticed.

In 1926 at the end of April, there was a tremendous infestation extending for seven miles (11-12 km.) along the base of Mount Hays, a 700-meter ridge, which runs east to west from end to end of Kaien Island. Also, most of the spruce saplings over the townsite were attacked. There was a definite difference in susceptibility to attack among the saplings. In several cases noticed, in pairs of thrifty trees three to five meters tall, with interwoven branches, one was found to have a bad infestation and the other few or no aphids.

Incidentally, the dense crowds of aphids had attendant robber flies (Asilidae) hovering over them. These asilids were not identified, but the writer at no time saw any other insects showing any interest in the aphids.

This was the first outbreak studied in any detail as to duration, etc. By the end of May, literally every sign of aphids had disappeared from the sitka spruce trees, excepting the damage done. This is normal, as agreed by Keen and Essig (l.c.), and the disappearance was so complete and sudden that in mid-June of 1926 Dr. E. M. Walker, the entomologist from Toronto University, and the writer were unable to find a single specimen. In fact, Dr. Walker, who was present for quite other reasons, demanded to know what had caused the damage to the magnificent spruces and the spindly growth of the saplings. On being told of the aphid outbreak (identification had not then been completed), he, as an entomologist, expressed amazement and at once began to look for some alternate host. Dr. Walker was actually collecting Odonata, and in the limited time he had we were unable to find anything as alternate host. Nor has anything been found since.

On being told by the writer of the two previous outbreaks in 1916 and 1921, Dr. Walker, who later became Head of Zoology at the University of Toronto, suggested that it began to look like a possible regular cycle. He also suggested that this author try to continue observations. Being then in my last year at the University of British Columbia, I interested several local citizens who were much concerned with the aphid damage to trees in their gardens. They agreed to keep me informed should I be absent at the next outbreak. This was done, with results to be explained.

While at the University of Illinois in May, 1931, I received word of a new outbreak, although I had found none in the years between. Continued watch was urged upon the volunteers, and outbreaks were reported in 1936, 1941, and 1946. It ought to be understood that these were perfectly reliable

reports, because the people involved were much concerned about the malformation of their prized trees, and all were well educated. Also, the writer had returned often in intervening years, including 1945, and had each time reminded the watchers. Furthermore, in this region sitka spruce grows normally straight, tall, and clean with no disease or deformity whatever. There are no budworms, as in regions with Douglas fir far to the south. In 1941 my most constant and faithful observer, Major A. G. Rix, R.C.A., was officer commanding forts around the city. He said in letters and later that year in conversation, "The blankety-blank lice were as bad as ever, and seemed to have spread, this spring."

It will help also to understand the layman's interest (and reliability) to know that in the past one of the few outdoor recreations at Prince Rupert was picnicking on nearby islands and beaches. There were no roads at all, and the land is one dense virgin forest. The climate being notoriously unreliable, it had always been a matter of course for picnic parties to take shelter from summer rains under the ubiquitous spruces, which spread wide, dense shade over every beach and cove. With the death of the large trees, summertime beach parties were much less successful, for the gaunt, dead trees gave no shelter but stood over the festive sites like skeletons.

On the basis of this series of outbreaks, it was anticipated that there would be another in 1951. The writer was in the area doing ecological work from May 18 to June 15, 1951, and found no sign of any outbreak. A few active *Aphis abietina* were found on two or three trees 30 to 40 years old, on Dodge Island where the first-noticed outbreak occurred 35 years before. Some elongation of older internodes was noticed and some other indications of aphid damage in the past, but this was almost certainly from the 1946 outbreak, reported as having been only a mild one.

The reason for the cessation of heavy outbreaks is not known. It seems unlikely that it is due to predation by the asilid flies noted previously, else surely they would have interrupted the dense occurrences long before. Certainly, they did not control the aphids in 1926, and in any case are not known to be enemies of aphids.

Damage to Trees

Damage to infested trees is easily described, and can be detected for years afterward. On susceptible trees, there are literally masses of tiny, green aphids, so small that they can almost walk two abreast on the needles. Needles, if older than growth of the year, turn yellow and then brown, and fall off. Buds are forced into hypertrophic growth, elongating the internodes.

This makes the young leaders and branches look like normal ones of Douglas fir (*Pseudotsuga menziesii*).

Older or fully reproductive trees usually die at the second attack, while saplings withstand the effects fairly well. It seems probable that this differential survival, which is not to be confused with differential susceptibility, is due to the greater elongation of the shoots on younger trees. Relying for photosynthesis in the usual case upon needles only one or two years old, and with green tissues in much of their relatively immature branch structure, saplings are left with proportionately a much higher ratio of photosynthetic tissue to nongreen, heavily corticated tissue, than are the mature trees. Older trees losing all their mature needles have relatively little photosynthetic tissue left. Hence they are weakened and probably die of sheer starvation. The hypertrophied shoots of the year, producing abnormally large areas of green tissue, are seldom or never defoliated because the aphids are gone before shoots have elongated to any great extent. These shoots may reach a length of two feet (6-7 dm.), while those of a mature tree seldom grow more than six inches (15 cm.), even after aphid attack. It is not suggested that there is any increase of the number of needles.

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Literature Cited

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