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STATUS OF THE BALSAM WOOLLY APHID IN NORTH CAROLINA AND TENNESSEE - 1964

By

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ABSTRACT

Aerial and ground surveys were made of the native spruce-fir forests in western North Carolina and eastern Tennessee to detect infestations of the balsam woolly aphid. Five areas of infestation were found; three in new locations and two in areas near where infestations had occurred previously. New locations include Haw Orchard Ridge on Roan Mountain, a new center on Grandfather Mountain and an area near Cataloochee Knob in the Great Smoky Mountains National Park. Infestations detected adjacent to known infestations included several groups of infested trees on Feeding Ridge on Roan Mountain and an area north of Mt. Sterling in the Great Smoky Mountains National Park. In addition, an infestation was detected in a two acre Fraser fir plantation near Blowing Rock, North Carolina.

INTRODUCTION

The balsam woolly aphid, Chermes piceae Ratz. (Homoptera: Phylloxeridae) is a tiny sucking insect which infests the stem and branches of species of true fir, Abies spp. This insect is a native of Europe and was first discovered in North America in 1908 near Brunswick, Maine. The aphid spread rapidly through the coniferous forests of the New England States and the maritime provinces of Canada and was discovered in the western United States during the 1920's.

Balsam woolly aphid infestations were discovered in North Carolina in 1957, following reports of extensive fir mortality in the vicinity of Mt. Mitchell (McCambridge, 1958). A survey made the following year (Nagel, 1959) indicated that this infestation extended over the entire spruce-fir forest in the Black Mountains, but that the insect did not occur in other areas of native spruce-fir type in North Carolina and Tennessee. A localized infestation was detected on Roan Mountain in 1962 (Ciesla and Buchanan, 1962). Surveys made during 1963 revealed infestations on Grandfather Mountain, Mt. Sterling in the Great Smoky Mountains National Park and Roan Mountain (Ciesla et al., 1963).

The purpose of this report is to present the results of surveys made to discover additional infestations of the balsam woolly aphid in North Carolina and Tennessee during 1964. These surveys were conducted by personnel of the U. S. Forest Service, Forest Insect and Disease Control Branch, in cooperation with the North Carolina Division of Forestry, the U. S. National Park Service and the National Forest in North Carolina.

LIFE HISTORY, HOSTS AND DAMAGE

The balsam woolly aphid passes through two, and occasionally three generations in North Carolina (Amman, 1962). Eggs hatch within 10 to 12 days after they are laid. The first instar nymph (crawler) is a motile form and wanders about on the bark for a period of about 8 days. This stage is the only time in the aphid's entire life cycle that it is free to move about and spread from tree to tree or area to area. When the crawler finds a suitable spot on the tree, it inserts its mouth-parts and goes into a

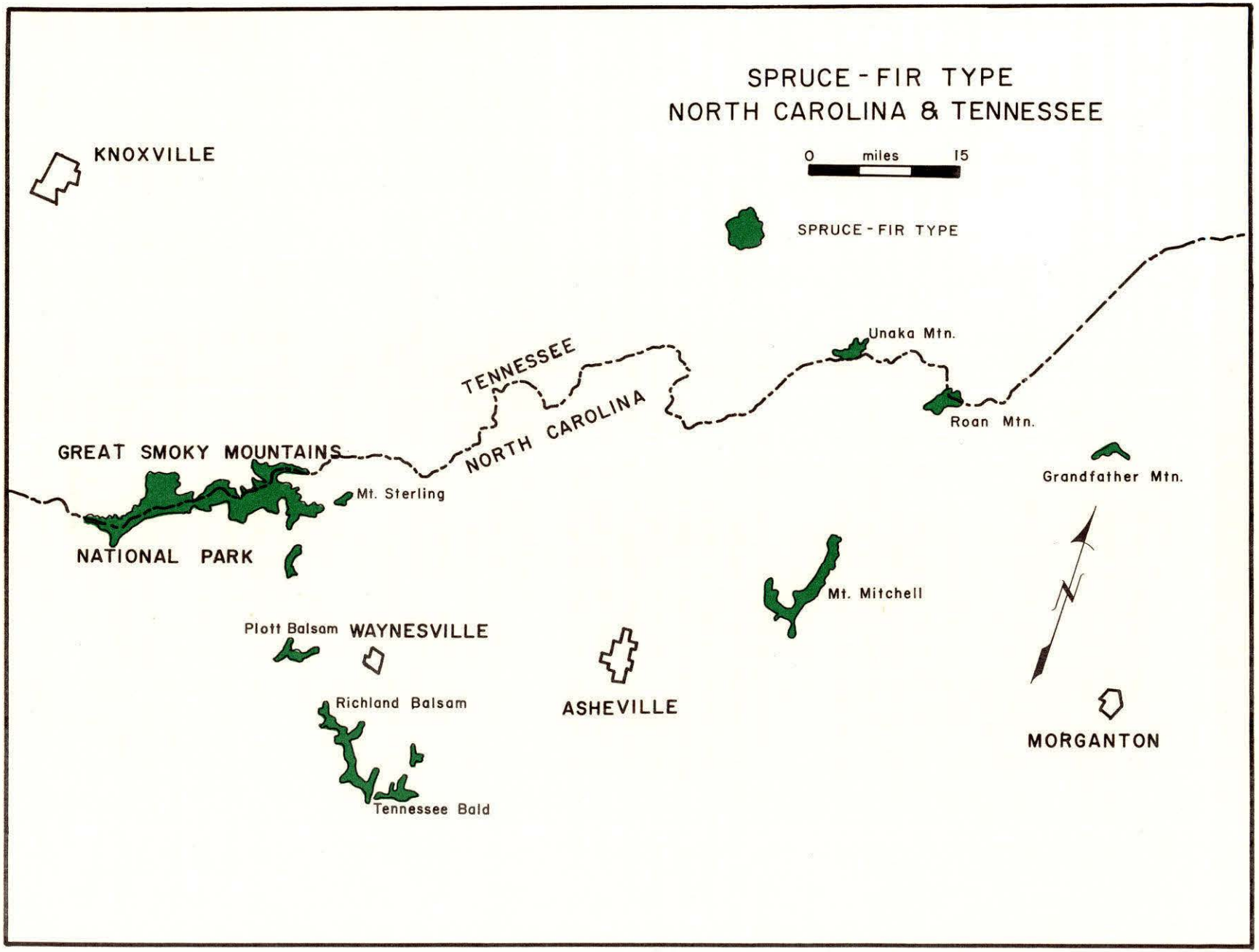

Figure 1 - Location of spruce-fir type in North Carolina and Tennessee.

resting stage or diapause. This sessile form is the overwintering stage of the aphid but in the summer months diapause lasts for about 2 to 8 weeks. The aphid passes through two more nymphal instars and then becomes a wingless adult. All adults are females. They begin laying eggs within a few days.

Figure 2 - Stem infestation of the balsam woolly aphid on Fraser fir.

The host tree in North Carolina and Tennessee is the Fraser or southern balsam fir, Abies fraseri (Pursh) Poir., a species whose range is restricted to the high peaks of the Southern Appalachian Mountains. This species occurs naturally in five, rather widely separated areas, comprising some 50,000 acres in the mountains of western North Carolina and east Tennessee (Figure 1). Fraser fir grows at elevations of roughly 4,000 feet and above in association with red spruce, Picea rubens, Sarg., yellow birch, Betula alleghaniensis Britton, mountain ash, Pyrus americana and other plants typical of the Canadian Life Zone of eastern North America.

Damage by the balsam woolly aphid may occur in one of two ways, depending on where feeding occurs. Stem attack, (Figure 2), which is the predominant form of infestation in North Carolina, results in the production of abnormal growth commonly referred to as "rotholz" or redwood. According to Balch, (1952) this is caused by a substance contained in the saliva or produced in the cortical tissue by the action of the salivary fluids. This substance stimulates cell division in the cambium layer and results in the production of a dark, hard, brittle wood. Fraser fir is highly susceptible to stem attack and infestations ultimately cause tree mortality. Death may occur from one to seven years following initial infestations depending on tree vigor and intensity of aphid attack.

"Gouting", or "gout disease" is a result of infestations on twigs and is characterized by a swelling and distortion of twigs and smaller branches. Branchlets are thickened and irregularly twisted, often turned downward at the ends. This form of attack is common in the northeastern United States and Canada but seems to be of minor importance on Fraser fir in North Carolina. Gouting occurs predominately on seedlings growing underneath an infested overstory (Fig. 3) and occasionally in open grown

Figure 3 - "Gouted" Fraser fir reproduction.

stands where it is accompanied by a heavy stem infestation (Fig. 4)

Fraser fir is not important for lumber or pulp production because of its restricted range and limited acreage. However, much of the native spruce-fir type in North Carolina and Tennessee occurs in areas of high scenic and recreational value. In addition, Fraser fir is a highly favored species for Christmas tree production and is being planted extensively for this purpose in western North Carolina.

Figure 4 - Open grown Fraser fir with gouted branches.

SURVEY METHODS

Aerial Surveys -- Aerial surveys were made of all areas of native spruce-fir type in North Carolina and Tennessee with the exception of the Black Mountains where the infestation is known to occur throughout the entire area of host type. Each area was flown twice; during May and again in late summer, August or September.

Cessna 172 and 182 aircraft were used in the aerial surveys. An airspeed between 90 - 100 MPH and a flying height of approximately 1,000 feet was maintained. Due to the rugged nature of the terrain where spruce-fir type occurs, no set pattern of flight lines was flown. Flight lines were flown parallel to contours and 100 per cent coverage of each area was obtained. All groups of dead or dying fir seen from the air were plotted as accurately as possible on topographic maps.

One characteristic which proves helpful is that the lower limbs of infested trees tend to fade and turn red before the upper limbs fade. This is readily discernable from the air and serves as a definite indicator of balsam woolly aphid infestation.

Ground Surveys -- Dead and dying fir seen from the air, were ground checked to determine the causal agent responsible. Trees in and surrounding each center were carefully examined for the characteristic symptoms and signs of aphid infestation including "gout", "rotholz" and stem attack. When an infested area was located, the number of trees or acres involved was estimated. Where typical symptoms and signs were not observed, microscopic examinations of the bark surface of trees in and surrounding each center were made. An attempt was made to determine the cause of fir mortality in each area ground-checked.

Centers of infestation detected during 1963 on Mt. Sterling and Roan Mountain and subsequently treated to reduce the rate of spread were revisited to determine the

Figure 5 - Checking crowns for balsam woolly aphid infestation.

need for further suppression. Survey personnel used tree climbers to examine crowns of trees adjacent to old centers for stem attack (Figure 5).

SURVEY RESULTS

Mt. Mitchell (Black Mountains) -- As in 1963, no formal surveys were made of the Black Mountains because infestations are known to occur over the entire 7,000 acre spruce-fir forest in this area. Fir mortality, due to aphid infestation, is progressing at an ever increasing rate and now appears to encompass the entire lower edge of the spruce-fir type.

Roan and Unaka Mountains -- A new aphid infestation was detected on Haw Orchard Ridge below the Balsam Road (Figure 6). Two red-topped trees were detected from the air and subsequent ground checks indicated that at least 80 trees had stem infestations.

Infested trees were found scattered over a 96 acre area on Feeding Ridge where several infestations were detected in 1963 (Figure 6). Groups containing as many as 250 trees with conspicuous stem infestations were found. These spots surround a seed production area which was established as a cooperative effort by the North Carolina Division of Forestry and the U. S. Forest Service to provide a source of Fraser fir seed. Trees within the seed production area itself were carefully examined and are apparently free from aphid infestation.

No dead or dying trees were found in a 800 acre tract of spruce-fir type on Unaka and Beauty Spot Mountains in Tennessee. This area lies immediately west of Roan Mountain.

Grandfather Mountain -- Ten spots containing sixteen dead and dying trees were detected during aerial surveys made of Grandfather Mountain. One of these spots was the result of balsam woolly aphid infestations and is near an area detected in 1963 between Calloway Peak and Pilot Knob (Figure 7). This infestation is located near Bearwallow Spring close to the head of Green Mountain Creek. Sixty-five trees with moderate to heavy stem infestations were found over an area approximately 10 acres in size. Other groups of dead and dying trees appeared to be the result of mechanical injury.

Great Smoky Mountains National Park -- Two spots of dead and dying trees were detected in the Great Smoky Mountains National Park during aerial surveys made of this

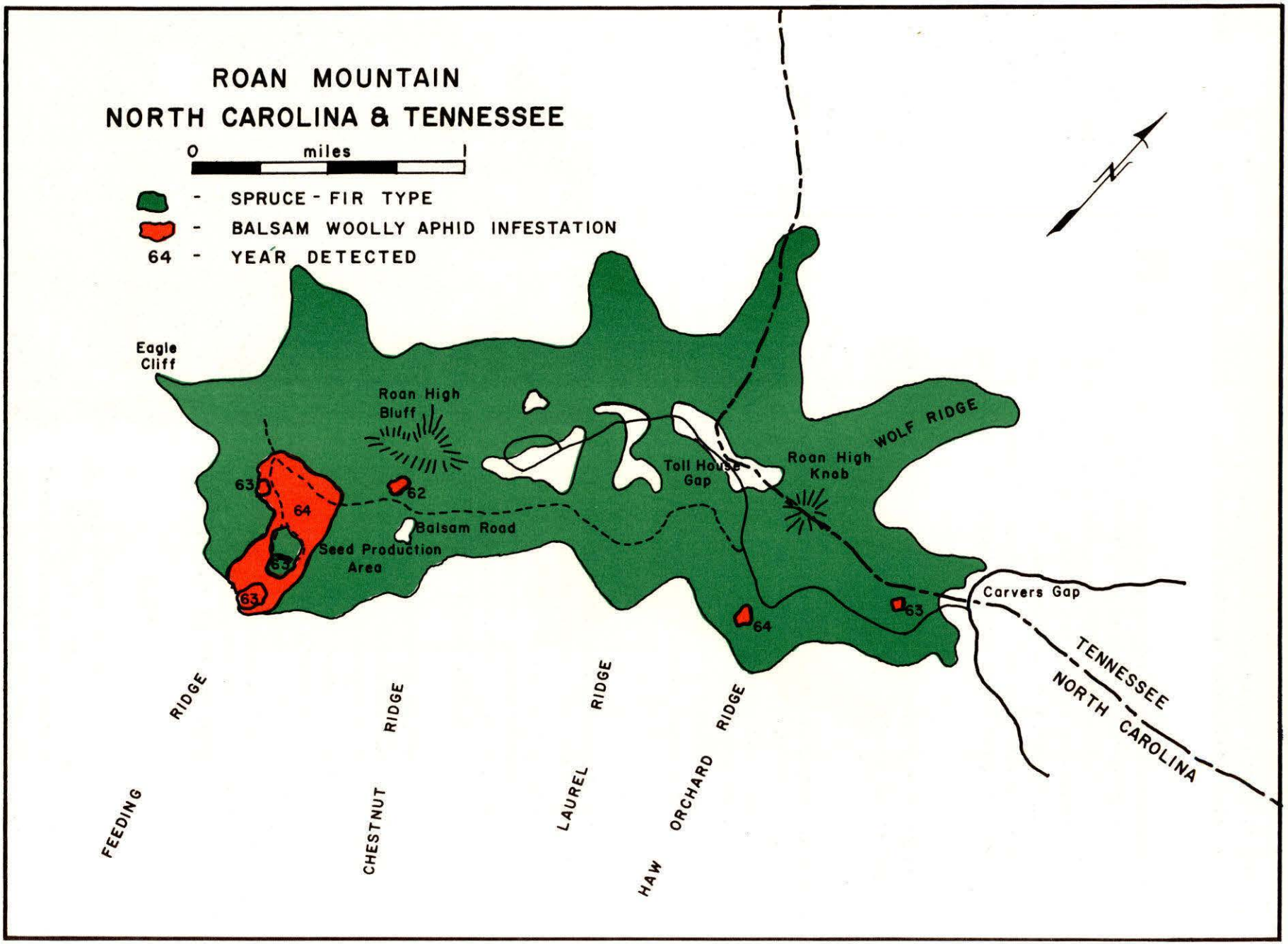

Figure 6 - Location of balsam woolly aphid infestations on Roan Mountain.

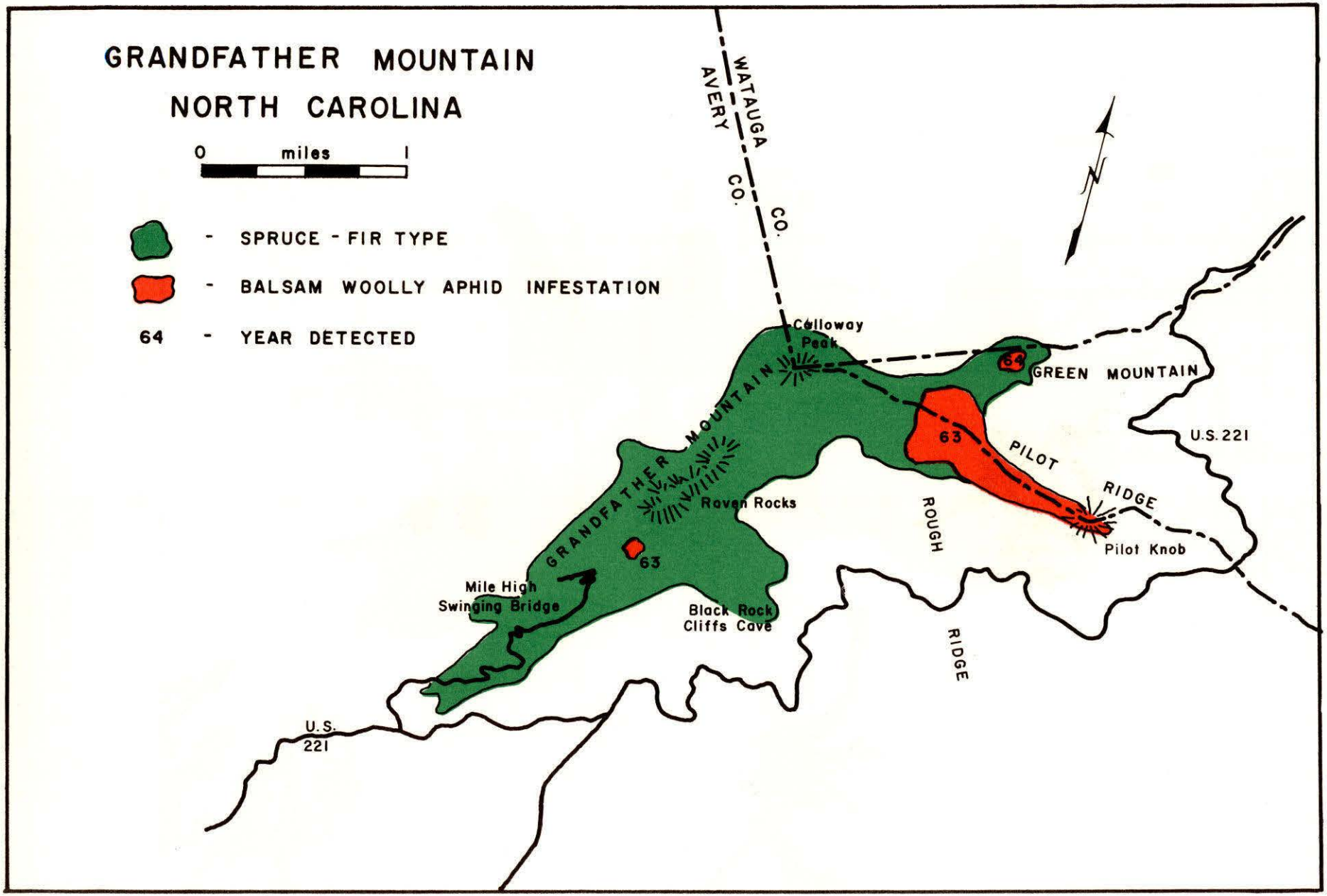

Figure 7 - Location of balsam woolly aphid infestations on Grandfather Mountain.

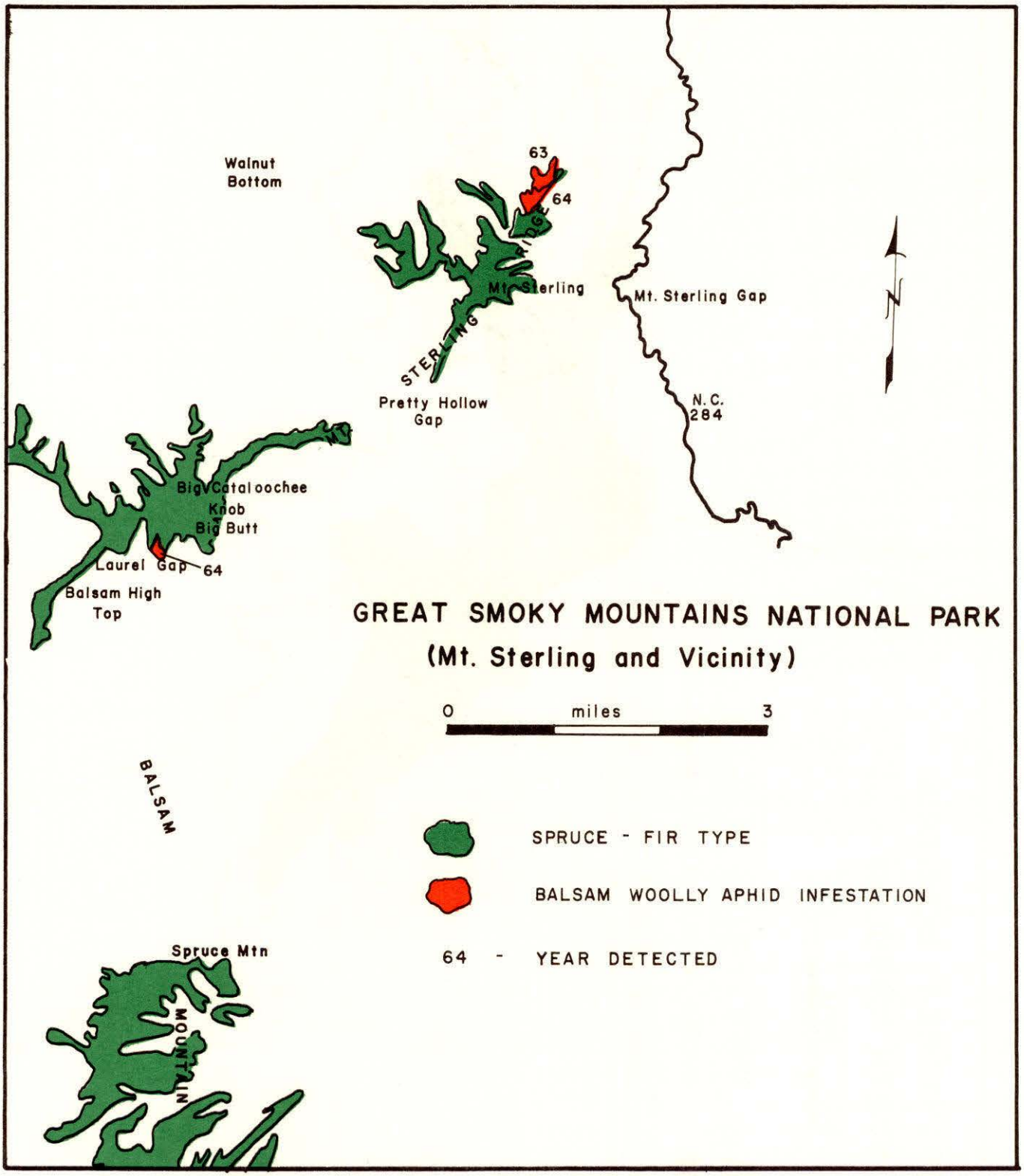

Figure 8 - Location of balsam woolly aphid infestations in the Great Smoky Mountains National Park.

area in May and September. One of these areas, located on the south slope of Cataloochee Mountain was the result of aphid infestation (Figure 8). This infestation occurs near the lower elevational limits of spruce-fir type where host trees occur in scattered groups, separated by extensive areas of hardwoods and rhododendron thickets. A total of 50 trees in seven separate areas were found having stem infestations. A second spot of fir mortality, located near the head of McGinty Fork on the north slope of Cataloochee Knob was the result of a lightening strike.

All Fraser fir which occurred within the boundary of an infestation detected north of Mt. Sterling during 1963 were cut to reduce the spread of this insect. This area was revisited during October to evaluate the effectiveness of this procedure and to determine the need for further cutting. Additional trees with stem attacks were found over roughly 40 acres adjacent to the infestation detected last year (Figure 8). Infestations were inconspicuous or non-existant on the lower bole and observers had to climb into the crowns of the trees to confirm the presence of balsam woolly aphid stem infestations.

Moses H. Cone Memorial Park -- A two acre Fraser fir plantation, located on the Moses H. Cone Memorial Park near Blowing Rock, North Carolina and administered by the Blue Ridge Parkway, was examined for aphid infestations in addition to the native spruce-fir type. Fir mortality was detected from the air in August and subsequent ground checks indicated that the balsam woolly aphid occurred throughout the plantation with 80 per cent of the trees exhibiting moderate to heavy stem infestations. Individual trees were also observed infected by annosus root rot, Fomes annosus (Fr.) Cke., and fir mortality, which is currently present in this stand, was attributed to this organism rather than the aphid infestations.

Balsam Mountains -- Several groups of dead and dying trees were detected during the course of aerial surveys made of the Balsam Mountains during May and August. Ground checks of all of the multiple tree spots failed to reveal the presence of the balsam woolly aphid and this area remains as the one major section of spruce-fir type in North Carolina apparently free from aphid infestation.

DISCUSSION

A total of five balsam woolly aphid infestations were detected in the native spruce-fir forests in western North Carolina during 1964. New infestations were detected on Haw Orchard Ridge on Roan Mountain, Grandfather Mountain, and the lower slopes of Cataloochee Knob in the Great Smoky Mountains National Park. Infestations were detected close to areas of known infestations on Feeding Ridge on Roan Mountain and Mt. Sterling in the Great Smoky Mountains National Park.

Thus far, all infestations detected outside of the Black Mountains have one thing in common; they have occurred at or near the lower elevational limits of the host tree; usually in areas where there is a high proportion of red spruce or hardwoods in the stand. None of the infestations, to date, have occurred on high peaks where the proportion of fir approaches 90 - 100 per cent of the stand. Consequently, attempts to reduce aphid spread by cutting host trees has resulted in the removal of a small pro-

portion of stems comprising the stand and has had little adverse impact on any scenic values involved (Figure 9).

Figure 9 - Suppression of aphid infestations by cutting infested trees.

Only casual observations of the native predator complex were made in the areas where infestations were detected. A large red mite, Allothrombium mitchelli Davis (Trombidiidae), which is reportedly a predator, was frequently encountered on infested trees in the Great Smoky Mountains National Park and on Roan Mountain.

RECOMMENDATIONS

The balsam woolly aphid is spreading rapidly through the spruce-fir type in the mountains of North Carolina. No practical overall control method exists. The following recommendations are made to help reduce the rate of spread and gain time to develop a practical control measure. They apply principally to recreation and other high value areas.

1. Land managing agencies who possess tracts of native spruce-fir type should maintain intensive surveillance over their respective areas. Fraser fir mortality should be reported immediately to the State Forester or the Zone 1, Forest Insect and Disease Control Office, so affected areas may be examined for aphid infestation.

2. Infested trees and a buffer zone of fir surrounding the infested trees should be cut. The balsam woolly aphid cannot survive and complete its life cycle on dead material; therefore, cutting of infested trees will reduce aphid populations and consequently the rate of spread into uninfested areas.

3. Forested areas of high aesthetic and recreational values may be treated with a 1/8 per cent BHC emulsion where cost and impact on other resources can be justified in light of benefits desired. For adequate control, the entire bole of the tree must be completely covered with insecticide. Spraying near streams and watershed areas should be avoided, however.

4. Consideration should be given to reducing the number of stems per acre on high value sites such as recreational and scenic areas. This

would reduce chemical control costs, but more important reduce the amount of insecticide necessary.

5. Continue cooperative surveys to detect new infestations.

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