THE RELATIONS OF BREEDING YELLOW-BELLIED SAPSUCKERS TO WOUNDED BIRCHES AND OTHER TREES

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WHILE I was studying Yellow-bellied Sapsuckers (*Sphyrapicus varius*) on their breeding grounds in central New Hampshire (Kilham, 1953, 1956, 1962), it became apparent to me that birch trees (*Betula*) were often used as sources of sap when young were in the nest or had emerged to become part of a family group. The species involved were the white (*B. papyrifera*), yellow (*B. lutea*, var. *alleghaniensis*), and gray (*B. populifolia*) birches.

Sapsuckers also feed on a variety of other trees (McAtee, 1911). Regardless of the trees utilized, however, it is not always obvious why they concentrate on a single tree here and there, leaving many others untouched.

In the summers of 1962 and 1963, I found three areas well suited to study of this problem. One, Area A, centered on groups of white birches growing along a dirt road (Figure 1), where snow plows and undercutting of banks had produced both injuries and weakening. This area was the territory of Pair A. Areas B and C were occupied by seven other pairs of sapsuckers and consisted of woodlands where hundreds of unwanted or weed trees had been girdled as part of a forestry management program.

AREA A

Conditions in 1962.—Practically all of the birches used to any extent by the pair in Area A, in the initial year of its territory (1962), had old scars below the feeding areas. While 10 birches with snow plow injuries all had drill holes (Figure 2), 50 others of similar size and adjacent to them, but unwounded, had no holes. The main feeding places of 1962, however, were on white birches which stood back from the roadway, beyond reach of the snow plow. Two of these trees were located in the midst of 80 healthy birches in a patch of woodland between two fields (Figure 1). Both had extensive scars of unknown origin below the drill holes. Two additional birches, the largest of those used by Pair A, had black, fungating infections of *Poria obliqua* below the bands of holes. Each of these latter trees appeared to be weakened, one by having its roots exposed in the undercutting of a roadside bank and the other from exposure following lumbering operations. The second had over 900 drill holes.

Drilling of "satellite" trees.—*S. varius* frequently makes small bands of drill holes, some of which may be expanded into main feeding bands in a succeeding year. These initial holes were always on birches within 1 to about 15 feet of a main feeding tree, at the same height (Figure 3), and were usually facing it. There was no obvious sap flow from such bands, which

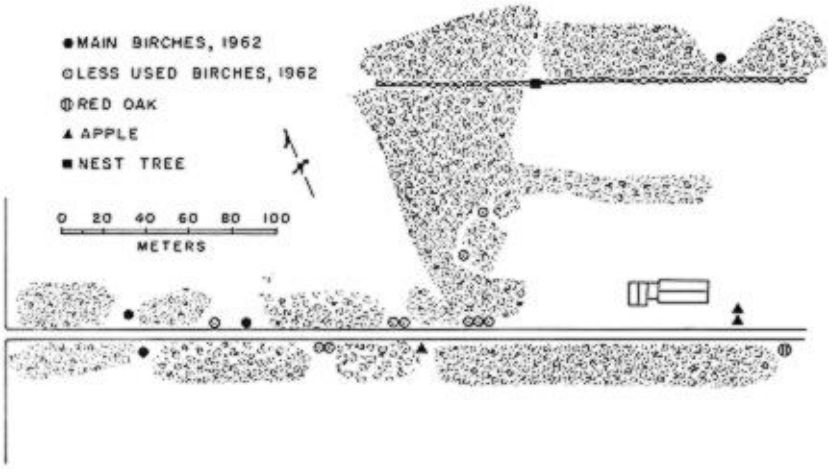

Figure 1. Diagrammatic map of the breeding territory of Pair A in 1962, showing locations of main feeding trees (*B. papyrifera*), all of which had been wounded or weakened initially by agencies other than *S. varius*.

Figure 2 (Left). Drill holes made by *S. varius* above areas of snow plow injury on a white birch.

Figure 3 (Right). Main feeding band of *S. varius* above girdle on dying white birch. A satellite band of drill holes is located on adjacent healthy birch.

I have designated as satellite bands. The drilling was done casually, at times as if it were no more than a displacement activity of a sapsucker frightened from its main feeding band or simply waiting to return after others of the famly group had left the favorable places.

The drilling of these satellites, however, may be significant, because by laying down a series of small wounds, the sapsuckers were weakening a healthy birch and creating a favorable locus for sap feeding in a succeeding year.

Succession of feeding trees.—Four of the six main feeding bands in Area A in 1963 arose from satellites made in the previous summer. The spring of 1963, however, saw little change in the situation described for 1962. The male sapsucker arrived on 7 April and took sap during the next few weeks from hemlocks (*Tsuga canadensis*) and by drilling holes on the outermost branches of aspens (*Populus tremuloides*) where buds and catkins were unfolding. I saw no sapsuckers in birches in May. On 3 June, however, fresh drill holes appeared on all of the bands above the snow plow injuries. I marked them with a pencil to see when others might be made. Almost none were added later. On 25 June, however, both male and female returned to their main birches where both now drilled holes and collected sap for their nestlings. A possible explanation for the delay in feeding on birches until the beginning of summer is suggested by Zimmermann (1964: 290) who states that a period of no phloem transport may occur when new leaves are maturing. "Transport begins again when the new leaves are fully developed and ready to export photosynthetic products. . . . This stage is reached in the last days of June." It seems likely that some flow of sap does occur in June, since in 1964 both sapsuckers came to the birches during much of the month when feeding their young in the nest. The drill holes, however, appeared somewhat dry, with none of the streaming which was conspicuous in summer months.

Three young sapsuckers emerged from their nest in a butternut tree (*Juglans cinerea*) on 6 and 7 July and were able to take sap immediately, on their own. The ability to drill holes, however, was slower in development. Although they did do some drilling within a few weeks, it was always in unusual situations such as a dead birch, the dead limbs of aspens, or on trees in which the adults took little interest, such as sumacs (*Rhus typhina*). It was six weeks before the young birds drilled holes in the main birches in the manner of adults.

The visits of the sapsuckers to their white birches fell off rapidly during the second week of September. Beginning on September 18, the birds were working on red oaks (*Quercus rubra*) and apple trees (*Pyrus malus*), both of which continued to have green leaves after those of *B. papyrifera* had

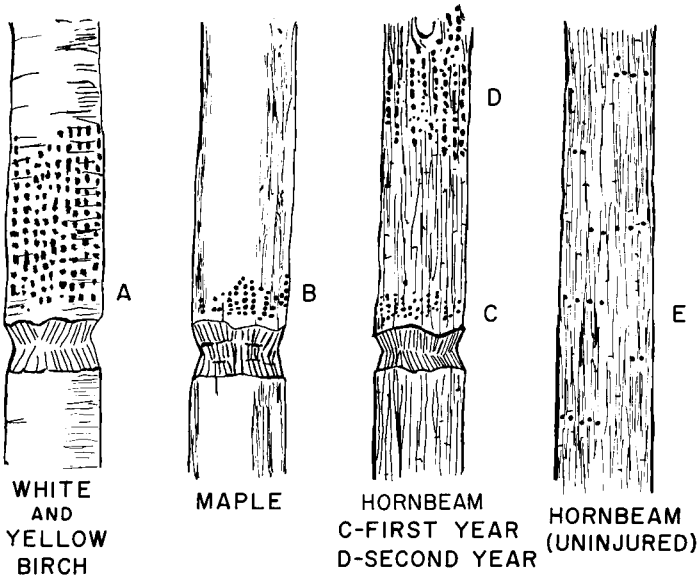

Figure 4. Patterns of drill holes made by *S. varius* above girdles cut on different species of trees.

turned color. All sapsuckers appeared to have left on migration by the end of the month.

AREAS B AND C

The trees which attracted sapsuckers as a result of girdling took two or more years to die. In the summer of 1963 most of the trees in Area C had a fairly complete canopy following girdling in February and March of the same year, while trees in Area B, which were in the second summer after girdling in October 1961, were either dead or dying by August and September. The sapsuckers worked almost exclusively on the latter type of tree. My observations in these summer months in Area B were on four family groups of parents and young which were taking sap from dying birches within or adjacent to their regular territories. A considerable amount of phloem exudate appeared to be flowing from these trees. I judged this by the amount of staining on the bark below the bands of drill holes, which were located just above the girdles (Figure 3 and Figure 4, A), as well as by the steady succession of visits, not only by the sapsuckers but also by commensals which included paper wasps (*Dolichovespula maculata*), Ruby-throated Hummingbirds (*Archilochus colubris*), Black-throated Blue Warblers (*Dendroica caerulescens*) (Kilham, 1953), Downy Wood-

TABLE 1

HOLES DRILLED BY SAPSUCKERS IN GIRDLED TREES

Species	*Average number of holes above girdles (approximate)*		*Number of trees examined*
	First summer	*Second summer*	
B. papyrifera	None	500	22
B. lutea, var. *alleghaniensis*	None	500	5
A. rubrum	50[1]	50	5
O. virginiana (first site)	150	—	17
O. virginiana (second site)	—	500	38

[1] All trees dying.

peckers (*Dendrocopos pubescens*), and a chipmunk (*Tamias striatus*). The last visitor had to climb only a few feet to reach the holes above the girdles.

The main feeding trees in Area B were one yellow and three white birches. All of these had satellite birches with small bands of drill holes. About 70 feet from the main white birch shown in Figure 3 there was a dead yellow birch with five to six thousand holes made by sapsuckers in previous years. Such trees indicated that sapsuckers had long been in the area, although not generally distributed. Several hundred girdled birches and other trees in intervening stretches of woodland were untouched. Table 1 shows that more than 80 trees dying as a result of girdling were attacked by sapsuckers. All of these trees belonged to the Betulaceae except the five maples. It appears that wounding does not render maples especially attractive to sapsuckers, not only because of the relatively few holes made above the girdles in Area B, but also because, of five red maples (*Acer rubrum*) which stood along the road in Area A and had been injured by the snow plow, none had drill holes.

Area C, with its girdled trees in a more viable condition, offered a considerable contrast to Area B described above. I could, for example, find only three among hundreds of trees in their first summer after girdling which had a significant number of drill holes. Two of the three were in red maples, one having 20 and the other 70 holes above the girdle (Figure 4, B). Both of these maples differed from undrilled but girdled neighbors of the same species in that they had lost their foliage and were obviously dying. A hop-hornbeam (*Ostrya virginiana*) was the third tree with holes. *S. varius* makes three different patterns of drills in this species, as I had noted in Area B where it was more common. In the summer after girdling, as shown for a hornbeam in Figure 4, C, sapsuckers make a compact band of drill holes a few inches above the wounds, whereas in a second summer when the hornbeams are dying and more attractive to them, they make

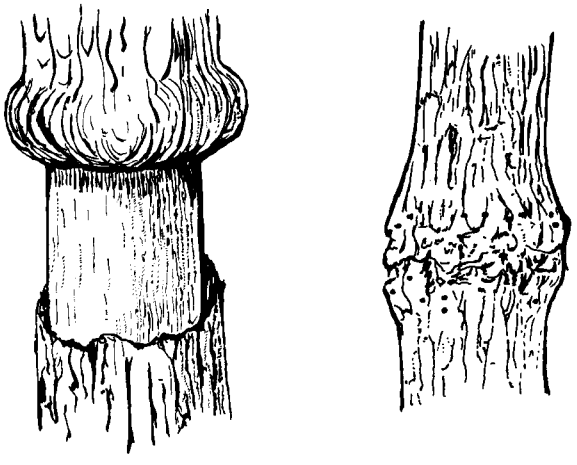

Figure 5. Excessive growth of wood, representing increased flow of nutrients to area above a wound: (A) above girdle (after Hales, 1727); (B) at site of former sapsucker holes on *Q. rubra*.

hundreds of holes extending up the trunk for several feet (Figure 4, D). Both of these patterns differ from the short linear lines made on ungirdled hornbeams (Figure 4, E). The three patterns of holes encountered on a single species of tree indicate that the sap-feeding activities of *S. varius* may be intimately related to physiological conditions within the trees on which they are working.

DISCUSSION

Sap from trees in leaf is food for varied forms of life. While aphids obtain phloem exudate and excrete honey dew by inserting their stylets into individual sieve tubes (Zimmermann, 1961), sapsuckers obtain exudate by a process of repeated wounding of their main tree. The amounts of sugar-containing sap which may run from drill holes is described by Crafts (1961: 97). The reasons why *S. varius* makes tiers of holes in the same place on the same tree, however, remain to be explained in more complete terms. It is possible that repeated wounding leads to an increased flow of nutrients and a proliferation of tissue on the part of the tree. These would be efforts to repair the injury. It has been known since the time of Stephen Hales (1727) that nutrients will accumulate above a ring or girdle and that a layer of thickened wood will form just above the ring (Figure 5, A). Sapsucker activity prevents formation of such extra wood under usual

TABLE 2

REFRACTOMETER READINGS OBTAINED AT DRILL HOLES IN YELLOW BIRCH

Date	*Per cent sucrose*	*Hour*	*Weather*
16 July 1958	19.4	1030	After rain
	19.1	1315	Warm, sunny
	16.2	1600	
	17.0	1845	Sun setting
17 July 1958	19.3	0715	
	19.0	0900	Sun, wind
	19.6	1030	
	20.0	1700	

circumstances. When sapsuckers discontinue a series of holes, as happens on rare occasions, swellings may appear (Figure 5, B) which are not dissimilar to those described by Hales.

A common assumption is that *S. varius* is interested primarily in insects coming to the sap and that the sap itself is too dilute to have nutritive value. Simple observation, however, should lead to other conclusions. Not only is sap at drill holes sweet to human taste, but also sapsuckers feeding on it pay relatively little attention to insects. When seeking insect prey, as they often do when feeding young in the nest, they are proficient at catching the insect by other methods, such as flying against clusters of leaves, hitching along trunks of trees, or hovering in mid-air (Kilham, 1962).

That sap or phloem exudate contains sugars, primarily sucrose, in substantial amounts has been described by Zimmermann (1961) and Crafts (1961: 99–100) among others. Seeking confirmation of this, I tested sap as it flowed from sapsucker holes in a yellow birch in July, 1958. Results obtained with a hand refractometer are given in Table 2. One may assume that the readings represent almost direct percentages of sucrose, since they are in line with those obtained by others from various species of *Betula* (Huber, 1937; Löhr, 1953). Exposure to wind and sun may concentrate exposed sap still further.

Translocation, or the movement of materials within trees, differs from one species to another. Observations such as those described above for birches, for example, do not apply generally to oaks, maples, or hemlocks. In whatever situations sapsuckers may be active, however, they appear to have a knowledge, innate or acquired, of conditions of sap flow in the trees they attack, whether in winter (Kilham, 1956) or in summer.

SUMMARY

Birches of various species are main sources of sap for Yellow-bellied

Sapsuckers in summer in central New Hampshire. Wounded and weakened birches are singled out by the birds from among healthy trees. In two areas where birches had been injured by man, one along a dirt road by snow plows and the other where hundreds of trees had been girdled, sapsuckers drilled holes just above the areas of injury. Sap or phloem exudate, moving down from the leaves in summer, is a rich source of nutrients. Sapsuckers appear to induce a greater and more concentrated flow by repeated wounding of a single place with their drill holes.

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