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Bird damage to commercial fruits has long been a problem in many countries, but the true magnitude of the damage incurred is difficult to determine objectively. Often the opinions of fruit growers provide the only measure of importance. In 1972, the U.S. Fish and Wildlife Service, the Michigan Department of Agriculture, and the Statistical Reporting Service of the U.S. Department of Agriculture obtained quantitative information on bird damage to tart cherries (*Prunus mahalob)* in Michigan. The results of the survey are presented in this paper.

Methods

The methods used in the survey were described in detail by the Michigan Crop Reporting Service (1972), whose personnel were responsible for field and laboratory aspects of the study. Briefly, a list of all Michigan growers who marketed cherries in 1971 was used to locate 100 survey orchards in the state's three major fruit-growing districts (Northwest, West Central, and Southwest, Fig. 1). In each orchard, one tree was selected by a weighted randomized scheme, a terminal branch (one growing from a primary limb and having a cross-sectional area of 0.5-1.0 inch) was marked off, and its location on the tree (top or bottom half) was recorded. All green cherries on each terminal branch were counted in mid-June, before the bird-damage season; these counts were estimated to be accurate to ± 10 percent (C.A. Hines, Statistical Reporting Serv., USDA, personal communication).

In July, 3-5 days before harvest, all cherries were stripped from the same branches and taken to one of three Michigan Crop Reporting Service laboratories for counting and examination. Laboratory workers were given handouts and shown photographs and examples of damaged cherries so that they could distinguish bird-damaged fruit (pecked cherries with some or all of the pulp missing) from "splits" and deformed and insect-damaged fruit. Laboratory counts of total cherries and pecked cherries were then compared with the mid-June counts of green cherries on the same branches. It was assumed that all missing cherries had been taken by birds.

All data were analyzed at the Fish and Wildlife Service's Denver Wildlife Research Center. Thirty-six branches on which cherries were known through quality control checks to have been miscounted in mid-June, were eliminated from the analysis, leaving 64 branches (25,223 green cherries). Percentages of cherries lost to birds were transformed to arcsin values and subjected to a two-way analysis of variance by the method of unweighted means (Bancroft, 1968:35).

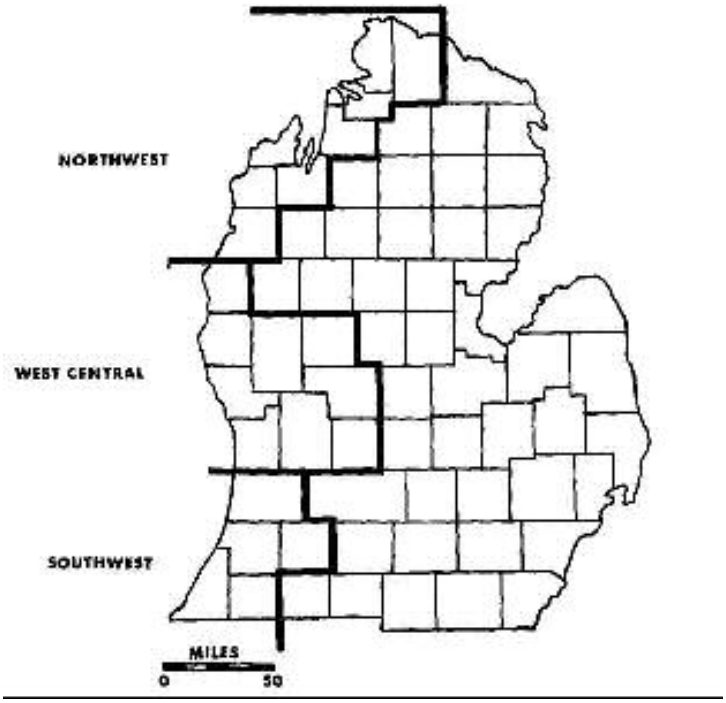

Figure 1. Michigan fruit districts.

Results and Discussion

The survey results indicated that maximum bird damage was 17.4 percent of the potential Michigan tart cherry crop in 1972. Since 98.1 percent of this loss was the result of missing cherries, the problem of separating those taken by birds from those lost to other causes is evident. Cherry droppage curves (Small, 1967:32-33) indicated that a maximum of 10 percent of potential production is lost between the green cherry stage and harvest; therefore, if droppage was maximum, 7.4 percent of the potential production was taken by birds. Potential production in 1972 in Michigan was 162,906 tons (including 11.7 percent loss to economic abandonment and machine wastage), so a minimum 12,054 tons worth $1,808,000 and a maximum 28,345 tons worth $4,252,000 (based on an average $0.75/pound paid to growers) were lost to birds.

Reasons for suspecting that birds were responsible for most of the 10

percent drop loss (and most of the 17.4 percent maximum cherry loss) include the fact that wind losses in 1972 were relatively minor; that cherries plucked or knocked off by birds comprise an unknown portion of the 10 percent drop loss; and that retention of fruit on trees is enough of a problem to warrant development of a chemical (2 chlorethyl phosphonic acid) to accelerate formation of dehiscent layers and decrease fruit retention. On the other hand, since trees were well-pollinated and produced well in 1972, and retention of fruit on trees is inversely related to production in some manner, birds may not have been responsible for all of the 17.4 percent loss.

An analysis of variance showed a significant difference ($P < 0.025$) in percentage of damage among the three major fruit-growing districts (Fig. 1). Losses were greatest in the Northwest District (18.6 percent), least in the West Central District (16.1 percent), and intermediate in the Southwest District (17.1 percent). According to Scheffé's test ($P = 0.10$) all differences among the three were significant. Differences in damage to tops and bottoms of trees seemed to exist in the Southwest District (21.3 percent vs. 8.2 percent) and West Central District (21.6 percent vs. 10.5 percent) but were not significant ($P > 0.05$), probably because sample sizes were small.

Table 1: Bird damage to tart cherries in three major Michigan fruit-growing districts, 1972.

District	Orchards in District[a]			Percent Cherries Lost		
	Mean Size (acres)	Mean No. per sq. mile	No. trees sampled	Pecked	Missing	Total
Northwest	26.7	0.20	31	2.0	16.6	18.6
West Central	21.9	0.09	11	0.7	15.4	16.1
Southwest	11.6	0.33	22	2.1	15.0	17.1
Total and Means	18.9	0.18	64	1.9	15.5	17.4

[a]1969 figures.

Reasons for differences in bird damage in the three regions are speculative, but may be related to the number of orchards in each region (Table 1). The few orchards in the West Central District may have been less readily found by birds than other more available sources of fruit. Chances that a sample tree would be attacked by birds should be less in larger than in smaller orchards (the average tree is farther from the edge of the orchard and more likely to be surrounded by other vulnerable *cherry* trees), but large orchards had both highest and lowest damage in this study. The low peck damage in the West Central District would seem indicative of less bird use, and possibly birds tested fewer green cherries for ripeness in that area.

Bird damage is also a function of bird density, and much fruit damage results from resident birds (Smith, 1963:132). Starlings *(sturnus vulgaris),* Robins (*Turdus migratorius),* and Baltimore Orioles *(Icterus galbula),* are the chief birds that consume commercial fruit in Michigan (Shake, 1972, personal communication) but Rose-breasted Grosbeaks *(Pheucticus ludovicianus)* and Catbirds (Du*metella carolinensis*) are also involved. Data from breeding bird censuses (supplied by the Migratory Bird Populations Station, U.S. Fish and Wildlife Service, Laurel, Maryland) indicate that breeding densities of Robins, Orioles, and Catbirds are lowest in the Northwest District where tart cherry damage was greatest. In contrast, although differences are not significant because sample routes are few, Starling breeding densities seem more directly related to tart cherry damage. Mean numbers of Starlings per 30-mile route were 241 in the Northwest, 146 in the Southwest, and 61 in the West Central Districts. This suggests that Starlings may be a major species involved in bird damage to tart cherries in Michigan.

Of the 64 branches sampled in this study, 22 (34 percent) had lost 21-100 percent of the green cherries present in mid-June, and 7 (11 percent) lost 51-100 percent by harvest time. If these samples are representative of all orchards, some tart cherry growers may suffer considerable economic losses. If total Michigan losses are representative of tart cherry losses in other states, birds may cost growers between $2.2 and $5.4 million per year. Sweet cherries are vulnerable to birds for a longer period than tarts, are possibly more desirable because of high sugar content, and are produced in about the same tonnages as tarts. At present, statewide and national data on bird damage to sweet cherries are not available.

Summary

Bird damage to tart cherries in Michigan in 1972 was estimated to be 17.4 percent of the total crop, based on early counts (25,223 green cherries) and later examination of the same 64 randomly chosen trees in the state's three major fruit-growing districts. Missing cherries accounted for 98.1 percent of the loss. Possible reasons for regional differences in damage are discussed.

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