February 1982

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ABSTRACT: The major results of recent research on the problem of red-winged blackbird (Agelaius phoeniceus) damage to field corn (Zea mays) in eastern Canada are reviewed. In the area of damage assessment, an indirect approach relying on energetic considerations appears to provide a rapid and inexpensive means for generating reliable damage estimates. The identification of pronounced compositional changes in roost populations has provided a more accurate means for predicting the impact of any management technique relying on population reduction at roosts. Investigation of the interaction of blackbirds and insects revealed that prey species conform to general patterns of coloration, mobility and the type of substrate from which they are taken. Also, a detailed examination of European corn borer (Ostrinia nubilalis) populations near a blackbird roost indicated that there was a tangible benefit to agriculture derived from blackbird predation of corn borers. An evaluation of blackbird population reduction through both surfactant spraying of spring roosts and through the use of decoy traps indicated that neither represented a viable solution to the crop damage problem.

INTRODUCTION

Once the existence of a pest problem has been recognized, three general steps are involved in attempting to solve it. In order to determine the severity of the problem, one must first develop methods for assessing the problem. Next one must develop a comprehensive understanding of the pest species, particularly with respect to those features of its behavior and ecology that bring it into conflict with man. Finally, combining the information from the two preceding steps one attempts to devise cost-effective management schemes, the efficacy of which can be tested in the field. To anyone familiar with pest management, it is obviously unrealistic to consider the three steps as either ordered or discrete since each contributes to the others, as for example, when the failure of a management scheme provides insight on some important behavioral or ecological parameter of the pest species. However, the three steps do provide a useful framework for discussing pest management problems.

My aim in this paper is to present an overview of the results of a research program which focused on the problem of damage to corn (Zea mays) by red-winged blackbirds (Agelaius phoeniceus) in eastern Ontario and southern Quebec (Weatherhead and Bider 1979). As a framework for this overview, I will use the three facets of pest management research discussed above, indicating what contributions I feel were made to each. Since most of these findings have either already been published or are in various stages of preparation for publication, details of methodology, etc., will be kept to a minimum with the discussion restricted to the general results and conclusions of the various studies.

ASSESSING THE PROBLEM

The problem of red-winged blackbird damage to corn crops has been the subject of pest management research for many years in areas such as the midwestern United States (Dolbeer 1980) and southern Ontario (Dyer 1968) where the problem has been long standing. In eastern Ontario and southern Quebec, however, both the problem and concern for it are more recent, probably in large part due to the dramatic increase in red-winged blackbird populations in this region through the late sixties and seventies (Erskine 1978, Dolbeer and Stehn 1979). The increased severity of the problem in this region provided impetus to the search for management programs. Since the evaluation of any such program necessarily involved a cost-benefit appraisal, there was an obvious need to accurately estimate the annual losses attributable to the birds.

The traditional method for assessing bird damage to corn involves extensive field sampling throughout the region of concern (Dolbeer 1980, Tyler and Kannenberg 1980). Since sampling must be conducted between the end of the damage period and the onset of harvesting, it becomes a costly enterprise over a large region. We therefore developed a more economical indirect method of assessment (Weatherhead et al. 1982).

Our method is based on that of Wiens and Dyer (1975) whereby one can calculate the total corn consumed per bird during the damage period from the energy budget of the bird (Kendeigh et al. 1977) and from a knowledge of the proportion of corn in the bird's diet during that time (McNicol et al. 1979). By estimating the total blackbird population from breeding bird surveys, one can then convert the per-bird-damage estimate to a population-damage estimate. The strength of this technique is that once the baseline data have been collected, the only new input required for any subsequent use is the population estimate. In North America, the Breeding Bird Survey (Robbins and Van Velzen 1967) provides us a free annual index of population size by regions. By determining how to convert this index to a population estimate (Clark, Weatherhead and Titman, in preparation), one can ultimately have an extremely rapid and inexpensive means for estimating damage.

Speed and economy are all very well, but how accurate is the technique? Our damage estimate for southern Quebec based on 1979 prices and production was approximately $300,000 or 0.4% of total production. This value contrasted radically with a subjective government estimate of $16.5 million. Two methods were used to assess the accuracy of our indirect estimate. Extrapolating per-bird-damage estimates obtained from birds housed in flight cages constructed over a corn field (Tinker and Weatherhead, in preparation) also yielded a damage estimate of approximately $300,000. Comparing our regional damage estimate of 0.4% with similar estimates determined through extensive field sampling in other regions with serious corn losses to blackbirds also produced close agreement. Mean estimates over a 10-year period in Ohio place damage at 0.4% of total production (Dolbeer 1980) while a one-year study in Ontario produced an estimate of 0.7% (Tyler and Kannenberg 1980). At least by these comparisons, therefore, the indirect method appears very reliable.

UNDERSTANDING THE PROBLEM

Roosting behavior and ecology

In spite of the relatively low proportion of total corn production lost to blackbirds, the problem is locally severe due to the gregarious nature of the birds during the damage period (Wiens and Johnston 1977). Since most damage occurs within 10 to 15 kilometers of roosts (Dyer 1967, Dolbeer 1980, Bendell et al. 1981), it is important to know something of the size, abundance and location of roosts as well as which birds use the roosts at what times. This is particularly true if one is investigating the possibility of population management conducted at roosts, as was the case in this study.

In the St. Lawrence River Valley of eastern Ontario and southern Quebec, there are two roosting periods annually. The first occurs in March and April after the birds have migrated north but have not yet dispersed to breed while the second occurs following breeding and prior to migration south. A survey of the 45,500 sq km study area from mid-July through August 1978 located 68 roosts. A similar survey the previous summer of a more restricted area indicated that there was approximately a 25% turnover of roosts between years (Weatherhead and Bider 1979; Weatherhead et al. 1980a). Roost sizes varied from a few hundred birds to several hundred thousand and roost sites were evenly distributed amongst marsh and upland habitat.

Continued monitoring of several of these roosts through the fall indicated that there were three general types of roosts (Weatherhead and Bider 1979). Many of the smaller roosts realized peak populations in September followed soon after by the departure of the birds. Those roosts remaining active appeared to act as sinks for the birds leaving the smaller roosts and achieved peak populations in late September and early October. A single roost near Beauharnois, Quebec, continued to increase throughout this time and did not reach its population peak until late October.

Most fall roosts appear to be of mixed species composition, including common grackles (Quiscalus quiscula), brown-headed cowbirds (Molothous ater) and starlings (Sturnus vulgaris) in addition to red-winged blackbirds. An investigation of the dynamics of both the total populations and red-winged blackbirds specifically, at four roosts during the formation period (mid-July - mid-September), produced two consistent trends (Weatherhead 1981). Within roosts, total population increase appeared to be linear with the rate of increase being reflected by how early the roost began to form. More surprisingly, in spite of the four roosts varying substantially in size, in each the increase of red-winged blackbirds as a proportion of the total population was very similar, overall being about 1% per day. The latter result is interpreted as suggesting that, at least for these four roosts, the ecological factors determining the size of the red-winged blackbird population in a roost are related to the factors determining the roosting populations of the other three species. Finally, mist net samples at one of these roosts revealed that amongst the red-winged blackbirds, all the age and sex cohorts are not equally well represented. Specifically, adult females appear never to use fall roosts in any great numbers and hatching-year females, while having initial representation equal to hatching-year males, become quite scarce by early September.

A survey of a sample of 1977 fall roost sites conducted during the spring of 1978 revealed that spring roosts were present at or near 61% of those sites (Weatherhead et al. 1980a). No fall roosts located in Typha were active in the spring, probably due to snow accumulation and amongst upland sites there was a shift toward coniferous or mixed coniferous-deciduous vegetation. An analysis of the composition of the population occupying the Beauharnois spring roost indicated that while red-winged blackbirds made up a relatively constant proportion of the total roost population, the age and sex composition of the red-winged blackbirds was very dynamic (Greenwood and Weatherhead 1982). Adult males arrived first and departed sooner and more rapidly than other cohorts. Second-year males arrived soon after but exhibited a slower rate of departure. Females arrived about the time of second-year males but, as a group, exhibited the slowest rate of departure. These results indicated that any measure aimed at reducing red-winged blackbird populations at a spring roost could have quite different outcomes depending on when it was conducted.

Bird-insect interactions

While the potential benefit to agriculture from the consumption of noxious insects by red-winged blackbirds has often been mentioned as a necessary part of any cost-benefit analysis (e.g., Robertson et al. 1978), no quantitative data were available. Therefore, two studies were undertaken. The first investigation measured European corn borer (Ostrinia nubilalis Lepidoptera: Pyralidae) abundance at varying distances from a major roost and thus under conditions of varying intensity of blackbird predation pressure. The results indicated that corn borer populations increased significantly with distance apparently due to intense incidental predation pressure by blackbirds near the roost (Bendell et al. 1981). An assessment of corn losses due to blackbirds relative to corn gains due to blackbird predation of corn borers suggested that, overall, predation of corn borers compensates for approximately 20% of the damage done by the birds.

The second study was aimed not at quantifying the economics of any specific bird-insect interaction but rather at identifying any characteristics that the insect prey of upland-breeding red-winged blackbirds had in common. The rationale for this study was that by knowing the general prey characteristics, which should remain much more constant geographically than would the specific prey items, in any area one could quickly identify which important insect pests might be subject to blackbird predation simply from their general characteristics. It was discovered that female red-winged blackbirds preferentially preyed on slow-moving, cryptically colored insects that spent the day on vegetation rather than on or below the soil surface (Bendell and Weatherhead 1982). These patterns were consistent whether the prey were lepidopterans or orthopterans.

Corn parameters and vulnerability to damage

Dolbeer (1980) has suggested that a potentially effective method for reducing blackbird damage to corn would be to plant varieties of corn that are less susceptible to bird damage in areas where blackbird problems are anticipated. He bases this suggestion on the work of Linehan (1977) who demonstrated that caged red-winged blackbirds differentially damaged different varieties of corn. The corn ear parameter determined to be most important was the extent of tip coverage. To determine whether similar trends would obtain within a single variety and under more natural conditions, the extent of damage relative to five corn ear parameters was assessed for 865 ears sampled within the flight cages mentioned previously (Weatherhead and Tinker, in preparation). The parameters used were the length, diameter, angle from vertical, height above ground and weight of the ears. Ear length and diameter were both important correlates of damage, with the vulnerability of longer ears apparently due to poorer tip coverage. Data collected on ripening synchrony also indicated a greater vulnerability of ears ripening earlier or later than the majority. These results support Dolbeer's (1980) suggestion that careful selection of varieties in damage-prone regions could lead to significant reductions of losses to birds.

MANAGEMENT OF THE PROBLEM

The potential merits of two proposed management techniques were assessed as part of this investigation. The use of surfactants to reduce blackbird populations at winter roosts in the southeastern United States had been demonstrated to be a nonviable approach of reducing fall damage problems further north (Dolbeer et al. 1978). However, there was reason to believe that reducing blackbird populations at spring roosts in eastern Ontario and southern Quebec could be effective at reducing crop damage in that region. First, the birds occupying spring roosts were primarily birds that bred locally (Weatherhead et al. 1980b) and second, the population would be at its lowest level immediately prior to the breeding season and reduction at that time should be most effective at reducing productivity. In spite of these positive factors, however, the approach was judged to have limited merit at best (Weatherhead et al. 1980a). The limited period of roost occupancy coupled with the specific meterological conditions required for surfactants to be effective suggested that very few opportunities for a successful spray would be available each spring. Adding to this the logistic costs (e.g., helicopter, manpower, etc.), the limited availability of large roosts in suitable habitat and the disproportionate representation of males at the time roosts would be sprayed (Greenwood and Weatherhead 1982) forced the conclusion that this approach to reducing crop damage had little likelihood of general applicability.

The second proposed management technique evaluated was the decoy trap. Although not part of the original investigation, this study was initiated in response to the entrepreneurial efforts of an individual convinced that decoy traps could solve the "blackbird problem." The rationale used to convince farmers of the merits of this approach was as follows: If one decoy trap can capture X birds per year, then N decoy traps can capture NX birds per year. One simply has to increase N (i.e., sell more decoy traps) until NX equals the total blackbird population size and the pest could be completely eradicated. Rational arguments couched in biological logic refuting the above reasoning proved inadequate and the need for an empirical evaluation was recognized.

Two approaches were followed. The first involved a comparison of birds caught in decoy traps positioned near a roost with birds mist-netted in the roost. These results indicated an extreme bias in which young birds in poor condition were overrepresented (Weatherhead et al. 1980c; Weatherhead and Greenwood 1981). Since the birds caught in decoy traps are in poor condition through the crop-damage period, they represent the least important cohort contributing to that damage. Secondly, if one's intention is to reduce population productivity by removing potential breeders from the population, the birds caught in decoy traps are again of little interest since their age and condition make them the least likely candidates to return to breed. Finally, it would appear that increasing the number of traps in the area would only improve the effectiveness of capturing younger, weaker birds, with no reason to suspect that other cohorts should become more vulnerable.

A second assessment of decoy traps involved testing the hypothesis that decoy traps would attract many more birds than they would capture and thereby function to increase crop damage in their immediate vicinity. A comparison of corn damage along transects radiating out from three decoy traps confirmed the hypothesis that damage was higher closer to the traps (Weatherhead et al. 1980c). Thus, it appeared that in addition to failing to accomplish their role in population management, decoy traps could actually aggravate local damage problems.

CONCLUSION

The research program discussed herein has hopefully achieved two things. The first is that by determining that neither of the proposed management techniques is the panacea that their proponents believed they were, no additional funding needs be spent on them. Secondly, armed with a more realistic measure of the magnitude of the problem and with additional insights into the nature of the problem, research funds can be channeled into the development and examination of new solutions. I prefaced my initial comment with "hopefully," as research directed at solving the blackbird-corn damage problem, at least in Canada, has occasionally suffered from a provincialism prone to promoting the reinvention of the wheel. Only if this kind of pitfall is avoided in the future are we likely to achieve any progress in developing viable management programs.

ACKNOWLEDGEMENTS

The research reported on in this paper is a product of the efforts of a great many people, principal among whom are the authors of the various papers resulting from this project that are cited herein. Financial support was provided by Agriculture Canada and le Ministere de l'Agriculture du Quebec.

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