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ENVIRONMENTAL AND HEALTH STUDIES OF KENTUCKY BLACKBIRD ROOSTS

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At the present time we are under contract from the Kentucky Environmental Quality Commission to study three aspects of Kentucky starling-blackbird roost problems: (1) a study of birds killed this coming winter through PA-14 treatments, to obtain more accurate data on species composition, sex ratios, kill success and food items; (2) a compilation of breeding and wintering data on Kentucky populations through analysis of U.S. Fish and Wildlife Service summer bird counts and banding returns; and (3) a study of spore dispersal of various fungal species, most notably *Histoplasma capsulatum*, from roost sites. The winter sampling is yet to be done, as sprayings most likely will not be undertaken until December. The analysis of population figures is complete and will be partially reported herein, as some data may be of significance for application to future management efforts. The histoplasmosis study began in June 1976 and will continue throughout the winter and spring; some preliminary results are deemed of significance to management efforts and are also reported herein.

It was first necessary to obtain the best available data on Kentucky winter roost populations. There are basically three sources of such data: (1) Christmas Bird Counts of the National Audubon Society; (2) Department of the Interior surveys, conducted generally on a five-year cycle, most recently completed in the winter of 1974-75; and (3) analysis of kill data from previous PA-14 treatments, with the best data also available from the winter of 1974-75.

So far as Kentucky is concerned, the Christmas Count data are not very useful. Most roosts are not within count circles and thus go unreported. The Fish and Wildlife survey of 1975 is clearly the best available data, reporting most of the existing roosts of any size; although a few major roosts were omitted and the species composition of several were apparently in error, it is felt that the reported figures of about 31 million birds in 21 roosts were reasonably close to correct. Breakdown by species in the 21 state roosts was as follows: 48% European Starling (*sturnus vulgaris*), 32% Common Grackle (*Quiscalus guiscula*), 12% Red-winged Blackbird (*Agelaius phoeniceus*), 6% Brown-headed Cowbird (*Molothrus ater*), and 2% undetermined blackbirds, known to include small numbers of Rusty Blackbird (*Euphagus carolinus*) and Brewer's Blackbird (*E. cyanocephalus*). We personally feel that the Starling figure is somewhat high and Grackles correspondingly low, since several roosts reported as mostly or entirely "Starlings" actually contained moderate numbers of Grackles. There is also considerable variability among roosts as to species composition, with several consisting of nearly all Starlings (mostly urban roosts) and thus contributing to the high overall percentage of same, whereas the majority of roosts contain fewer then 40% Starlings. In southwestern Kentucky, at least one major roost is predominantly Red-winged Blackbirds, with this species constituting but a small percentage in most other state roosts.

Kill data from the February-March 1975 sprayings generally support the above analysis. Results of the six treatments (five in Kentucky, one in Tennessee) indicate that the 4,063,000 birds killed comprised the following percentages as to species: 42% European Starlings, 40% Common Grackle, 11% Brown-headed Cowbird, 7% Red-winged Blackbird, and a trace of Rusty and Brewer's Blackbirds.

We have analyzed all banding data through 1975 Involving any of the roost species and pertaining to the state of Kentucky. We further restricted the data to obtain a better idea of source of our winter birds, so far as breeding areas are concerned. Birds were considered to be on their breeding grounds if recorded between April and August (either banded or recovered); birds were considered to be on their wintering grounds if recorded between October and March. On that basis, banding data are available for 218 individual birds (64 starlings, 143 grackles, 7 cowbirds and 7 redwings). While the data for the Cowbird and Redwing are too scanty to be meaningful, analysis of the Starling and Grackle reports is enlightening. Of the 131 winter roost records for the Grackle in Kentucky, but 12 (9%) were of birds that also bred within the state; the majority of the individuals originated from breeding populations to the northwest, north, or northeast of Kentucky. On the other hand, 47% (29 of 62) Starlings represented local breeding birds, the remainder of the wintering individuals originating from areas to the northeast of the state. In contrast to the icterid species, therefore, the Starling should show greater effect on the Kentucky breeding populations as a result of the 1975 sprayings than would be expected for the various blackbirds.

To determine if this were the case, we analyzed summer breeding populations of the species involved on the basis of data from the breeding bird surveys of the Fish and Wildlife Service ("roadside counts"). Population changes are reflected in the graph in Figure 1, with data based on breeding seasons from summer 1966 through summer 1975. Most notable is the drop in Starling populations from summer 1974 to summer 1975. While the data in Figure 1 indicate but a comparison of relative population levels per count in succeeding years, rather than being expressed in actual numbers of individuals, we feel that a reasonable projection of breeding population levels may be made from such data for the more conspicuous species. Based on our studies of Redwings, correlating individual summer count runs (roadside counts) with actual breeding bird censuses (conducted annually through the National Audubon Society), it was found that the roadside counts were low, in the case of Redwings by a factor of five (i.e., the three-minute stop resulted in recording of about 20% of the actual number of Redwings within a quarter-mile radius of the stop [125 acres]). Projecting the average number of Starlings recorded per count in Kentucky in 1974 and in 1975 to the area of the entire state, a figure of 166,000 is generated as the decrease from 1974 to 1975. If the Starling, as another conspicuous species recorded primarily by visual means and in open habitats, is comparable to the Redwing, then the 166,000 birds is low by a factor of five, generating an actual decrease of 830,000 individuals. The recorded kill of Starlings in Kentucky roosts in 1975 was 680,450; if 47% of these birds were Kentucky breeders, then the summer 1975 breeding population for the state was reduced by 320,000 individuals, a figure between the uncorrected and corrected numbers produced by the summer counts. Regardless of the validity of any of these figures, the drop from 1974 to 1975 was certainly real and correlated with the sprayings the previous winter. On the basis of these data, we feel that while PA-14 sprayings killing less than ten million birds has little effect on overall national population levels of any of the species, it certainly can have effect on local populations of at least one species, the European Starling.

With respect to health-related matters, we have been concerned with the ecology of fungi associated with blackbird roosts, most notably *Histoplasma capsulatum*. We began obtaining aerial samples at a local blackbird roost near Louisville last June and will continue this coming season. It is our contention that a knowledge of the amount of spores released in the environment and the ecological conditions under which spore dispersal occurs are critical to a determination of the actual health hazard and thus would be of great importance from a roost management standpoint.

Surprisingly, not a great deal of information concerning the ecology of *Histoplasma* appears in the literature. In the environment the fungus has been frequently isolated from soils containing fecal matter of bats and various birds, from chickens to pigeons, blackbirds and Starlings. It is somewhat of a mystery why it should grow in these situations at all, since attempts to grow the mycelial form in fresh bird droppings has met with failure. There is very little in the literature that would explain this phenomenon, although at least one study (Howell, 1941) shows that *Histoplasma* grows poorly under acidic conditions; in addition, histo is customarily cultured in clinical laboratories in media with the pH near 7.

In environmental situations, *Histoplasma* is detectable in soil of roosts generally only after they have been established at least three years. There can be little doubt that blackbird roosts are a source of the spores. In areas of low endemicity of histoplasmosis, there is an inverse relationship between percentage of positive skin reactants and distance from a positive roost. In areas of either low or high endemicity, roost sites of sufficient age have frequently yielded histo from soil samples (Ajello, 1964; Dodge et al., 1965; Chin et al., 1970; Tosh et al., 1970.)

In problems dealing with management, it is necessary not only to know if the fungus is present in the soil but also under what conditions a possible epidemic of symptomatic cases might be produced. Degree of severity of infection seems to be in direct proportion to amount of spore inhalation (Tosh et al., 1966; Powell et al., 1973), thus the most common result of infection by a low spore count is an asymptomatic case (detectable by skin reactivity tests, x-rays to reveal possible healed lung lesions, and complement-fixation tests to indicate chronicity of infection); more than 30,000,000 people in this country are now estimated to be skin-positive, with parts of central Kentucky up to 95% positive. To determine the circumstances and conditions for the occurrence of an epidemic of symptomatic cases originating from blackbird roosts, we have analyzed all such epidemics recorded in the literature. A total of seven epidemics may be found involving 538 individual symptomatic cases, plus an additional 195 cases that were probably also associated with the roost sources in question. The analysis follows:

(1) June 1948, Madison, Winconsin- -Ten persons infected from digging fishing worms in a shaded, marshy area at a roost site of thousands of blackbirds and Starlings; no details of clinical types, presumed acute benign respiratory with normal recovery (Furcolow et al., 1961).

(2) June 1956, Walworth, Wisconsin- -19 persons infected, resulted from excavation of a shaded lot that had been a roosting site of blackbirds and starlings ten years previously, with neither birds nor droppings evident at time of epidemic; several cases severe, three requiring between six and eleven months for complete recovery, no disseminative cases reported; oral administration of amphotericin B in three cases, apparently no significant effect; most infections occurred under "dry and dusty conditions" (wilcox et al., 1958).

(3) April 1959, Mexico, Missouri--Ten clinical cases summarized out of "more than 20 infected," epidemic originating through clearing of a park that had been a starling roost for about ten years; all acute benign pulmonary cases, the most severe recovering in six weeks; no chronic or disseminative cases reported (Furcolow et al, 1961).

(4) August-September 1962, Mason City, Iowa--16 confirmed cases connected with site, 12 others probably associated, from bulldozing and clearing area in town that had been a Starling roost, the clearing done under very dry and dusty conditions; several severe cases, two deaths (one postmortem showed disseminative histo in bone marrow), others recovered without chronicity, except for reinfections in case #5 following (d'Alessio et al., 1965).

(5) February-March 1964, Mason City, Iowa--87 associated cases (plus another 183 cases possibly associated), resulting from attempted clearing of same Starling roost site as in 1962; although weather cold, surface disturbance was created and airborne dissemination of spores in community occurred, evidenced by isolation of spores on rooftops; no deaths or chronicity reported, although three cases were determined to be reinfections of persons skin-positive (Powell et al., 1973); five persons received amphotericin B treatment for severe cavitary histo; all recovered, no disseminative cases reported (Tosh et al., 1966).

(6) May 1970, Delaware, Ohio--383 symptomatic cases reported (11 in detail), known as the "Willis flu" epidemic, resulting from Earth Day cleanup in a school yard frequented by "blackbirds and pigeons;" dust stirred up apparently entered ventilation system of school, resulting in symptomatic cases of acute benign pulmonary histoplasmosis in about one-third of the school children (294 ill enough to stay home from school); one adult was ill six to eight weeks, all others recovered in less time, no chronic or disseminative cases reported (Pass and Saslaw, 1971).

(7) July 1970, Springfield, Missouri--three bulldozer operators ill (six other supervisors on site not affected), one hospitalized, from clearing operations of roost site that had been in existence at least five years, under very dry and dusty conditions; all recovered without complications and without amphotericin B treatment, and two were cases of reinfections of skin-positive persons (Powell et al., 1973).

On the basis of the foregoing analysis, we have formulated the following working hypotheses:

(A) Active roosts in which the soil remains undisturbed are responsible at most for a low spore level producing asymptomatic cases (conversions from negative to positive skin reactants), perhaps as a result of growth retardation from continued fresh, acidic bird droppings; what few spores are apparently produced may come from areas within the roost site that do not get fresh droppings, as a result of the summer absence of the birds, or possibly from bird carcasses; and

(B) Epidemics of clinical or symptomatic cases are the result solely of conditions of surface disturbance, with greatest severity in areas of low endemicity, under dry and dusty conditions, and in older roost sites, even those unused by birds for years.

Thus management should include evaluation of these matters in relation to the health hazard potential and consequences of moving or clearing a site. We hope at the University of Louisville to evaluate these hypotheses through our continuing research.

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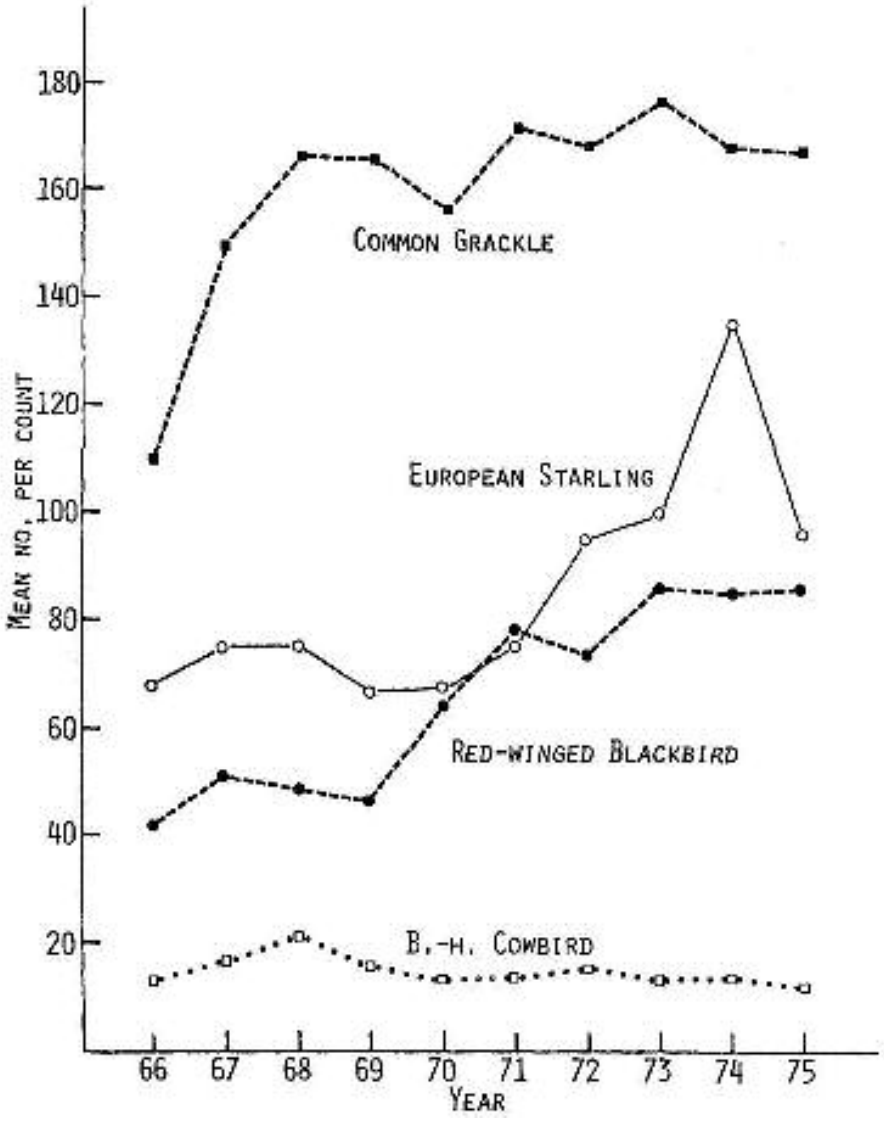

FIGURE 1. Mean number of individuals recorded on Kentucky summer bird counts, 1968-1975. (From data of U.S. Fish and Wildlife Service.)