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DISAPPEARANCE AND RECOVERABILITY OF SONGBIRD CARCASSES IN FRUIT ORCHARDS

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Abstract.—Songbird mortality due to agricultural pesticides is often assessed by searching treated areas for carcasses. However, carcass removal by scavengers and the failure of searchers to find carcasses that are present may bias mortality estimates. We conducted two studies in 1987 and 1988 in New York to evaluate such biases at the time of fruit maturation in cherry and apple orchards. In the first study, mean survival times for carcasses were 8.2 d in cherry and 10.4 d in apple orchards. In the second study, searchers located an average of 75% of carcasses placed in orchards. Our results suggest that careful searches conducted within 2 d of application of pesticides in orchards should suffice for detecting significant songbird mortality. However, variable survival times among orchards demonstrate that studies to assess songbird mortality by searching for carcasses should also measure disappearance rates of carcasses.

DESAPARICIÓN Y RECOBRO DE AVES CANORAS MUERTAS EN SEMBRADOS DE FRUTAS

Sinopsis.—La mortalidad en aves debido a la uso de pesticidas en sembrados de frutas, se puede determinar buscando el cuerpo de aves muertas luego de la aplicación. Sin embargo, la remoción de los remanentes por parte de carroñeros y fallas en la localización de las aves muertas por parte de los investigadores, puede ocasionar un sesgo en los estimados de mortalidad causados por pesticidas. Durante 1987 y 1988 llevamos a cabo dos estudios en New York, para evaluar dichos sesgos en sembrados de cereza y manzana al tiempo de maduración de la fruta. En el primer estudio el tiempo promedio de permanencia en el ambiente de los remanentes de aves lo fue de 8.2 d y 10.4 d en huertos de cereza y manzana, respectivamente. En el segundo estudio, los investigadores pudieron localizar el 75% de los remanentes de aves colocadas en los sembrados. Nuestros resultados sugieren que busquedas cuidadosas dentro de los proximos dos dias luego de la applicación de un pesticida es suficiente para determinar adecuadamente la mortalidad causada por la sustancia a aves conoras. Sin embargo, se evidenció una gran variabilidad en el tiempo de supervivencia de las aves en diferentes huertos, por lo que los estudios para determinar la mortalidad de aves canoras a base de la recuperación de cuerpos debe incluir la tasa de desaparición de las aves muertas.

There is continuing concern about the effects of pesticides on birds (Blus et al. 1985, Custer et al. 1985, DeWeese et al. 1983, Stone 1979), and registration requirements for agricultural pesticides frequently include avian mortality studies (EPA 1987). The most common method for

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assessing songbird mortality in orchards and agricultural fields is to search pesticide-treated areas for carcasses (Besser et al. 1984, Holler et al. 1982, Somers et al. 1981). However, the removal of carcasses by scavengers and the failure of searchers to find carcasses that are present result in biased mortality estimates (Avery 1987, Balcomb 1986, Rosene and Lay 1963).

Orchards commonly receive multiple applications of pesticides (Castaldi and Forshey 1988, Prokopy 1985), which has prompted interest about possible hazards to birds (Dolbeer et al. 1988, Hooper et al. 1989, Hegdal and Colvin 1988, Merson et al. 1984). While working in cherry and apple orchards (Tobin and Dolbeer 1987, Tobin et al. 1989a,b, Tobin and Richmond 1987), we became concerned about possible nontarget effects of pesticides applied during the period of fruit maturation. To our knowledge no studies of bird carcass removal rates or of the efficiency of searches for dead birds have been made in orchards. We describe a study that (1) monitored the rate of songbird carcass removal in cherry orchards in early summer and in apple orchards in autumn in the mid-Hudson Valley of New York, and (2) evaluated the efficiency of searches for such carcasses.

METHODS

We monitored the removal of carcasses at the time of fruit maturation from four cherry orchards in Columbia and Ulster counties between 18 Jun. and 7 Jul. 1987, and from four apple orchards in Ulster County between 29 Sep. and 12 Oct. 1987. Two orchards of each crop type had a band of bare ground under the canopy of each row of trees, and mowed vegetation in the alleys between rows; the other two orchards were overgrown and weedy throughout. All orchards were mapped by trees within rows so that a random sample of trees could be selected. We placed one frozen carcass (either Brown-headed Cowbird [*Molothrus ater*] or House Sparrow [*Passer domesticus*] of either sex) under each of 25 randomly selected trees in each orchard, with approximately equal numbers of both species placed in each orchard. For each tree, we used a random number table to select a direction (north, south, east, or west side of tree) and position (next to the trunk, halfway between the trunk and the dripline, or at the dripline) for dropping a carcass from breast height. We stuck a 50-cm wire stake with a 16-cm^2 plastic flag in the ground 1 m from each carcass to facilitate relocation. Beginning the day after placement we checked carcasses every 1–3 d for 11–12 d, except that searches were discontinued in orchards where all carcasses disappeared or the flesh decomposed and only skeletons remained. Carcasses that had decomposed to skeletons were still considered to be present in the orchards at the time the searches were discontinued. We used an accelerated failure time model that fitted a Weibull distribution to the times that carcasses remained in the orchards (i.e., the times until they were removed by scavengers or were no longer discernable as dead birds). The model estimated "survival" times and performed log-likelihood ratio tests to compare orchard types

and the effects of ground cover management (Cox and Oakes 1984, SAS 1985).

We assessed the ability of searchers to find carcasses in eight cherry orchards in Columbia and Ulster counties from 16 to 25 Jun. 1988. All orchards were mapped to facilitate the random selection of trees, and one male Brown-headed Cowbird carcass was placed in a randomly selected location (next to the trunk, halfway between the trunk and the dripline, or at the dripline in the north, south, east, or west quadrant of the tree) under each of 10 trees in each orchard. Within 1 h after placement of the carcasses in each orchard, a person different from the one who selected the placement sites or put out the birds slowly walked through the orchard and searched under the trees for carcasses. At the end of each search, any unfound carcasses were recovered. Three searchers participated in the evaluation.

The Brown-headed Cowbirds used in this study were collected in decoy traps in Ohio in May 1987 under Federal Fish and Wildlife Permit PRT-680104 issued to the Denver Wildlife Research Center and under Scientific Collecting Permit 397 issued by Ohio to R. A. Dolbeer. The House Sparrows were collected in walk-in traps in Ohio in May 1987.

RESULTS AND DISCUSSION

The estimated mean time that the carcasses remained evident at their site of placement was 8.2 d (SE = 1.2 d) for the cherry orchards, significantly less than the 10.4 d (SE = 1.4 d) for the apple orchards (χ^2 = 74.89, df = 1, P = 0.0001, Fig. 1). Seasonal variations in scavenger activity, as well as seasonal differences in decomposition rates of the carcasses, probably accounted for the different survival times for carcasses in the two types of orchard. Orchard ground cover did not affect survival times (χ^2 = 0.60, df = 1, P = 0.44).

In studies investigating the effects of pesticides on birds, searches for carcasses usually are conducted within the first few days after application of the pesticide. The majority of carcasses at most of the sites remained intact and recognizable as dead birds for this duration. The exception was in one cherry orchard with bare ground under the canopy where all the carcasses were removed within the first 24 h. The average percentages of carcasses remaining in the cherry and apple orchards, respectively, were 60% and 95% after 24 h, 47% and 88% after 48 h, and 31% and 62% after 96 h.

Our results are comparable to those of other studies in upland sites. Rosene and Lay (1963) found 53% and 87%, respectively, of 30 Bobwhite Quail (*Colinus virginianus*) carcasses 4 d after placement in each of two upland fields in Alabama and Texas; and Woronecki et al. (1979) recovered 66% and 28%, respectively, of House Sparrow carcasses 2 and 8 d after placement in corn fields in Ohio. Balcomb (1986), however, found only 14% of songbird carcasses 2 d after placement in corn fields in Maryland, and only 8% remained 7 d after placement.

Most carcasses apparently were carried off by scavengers, because

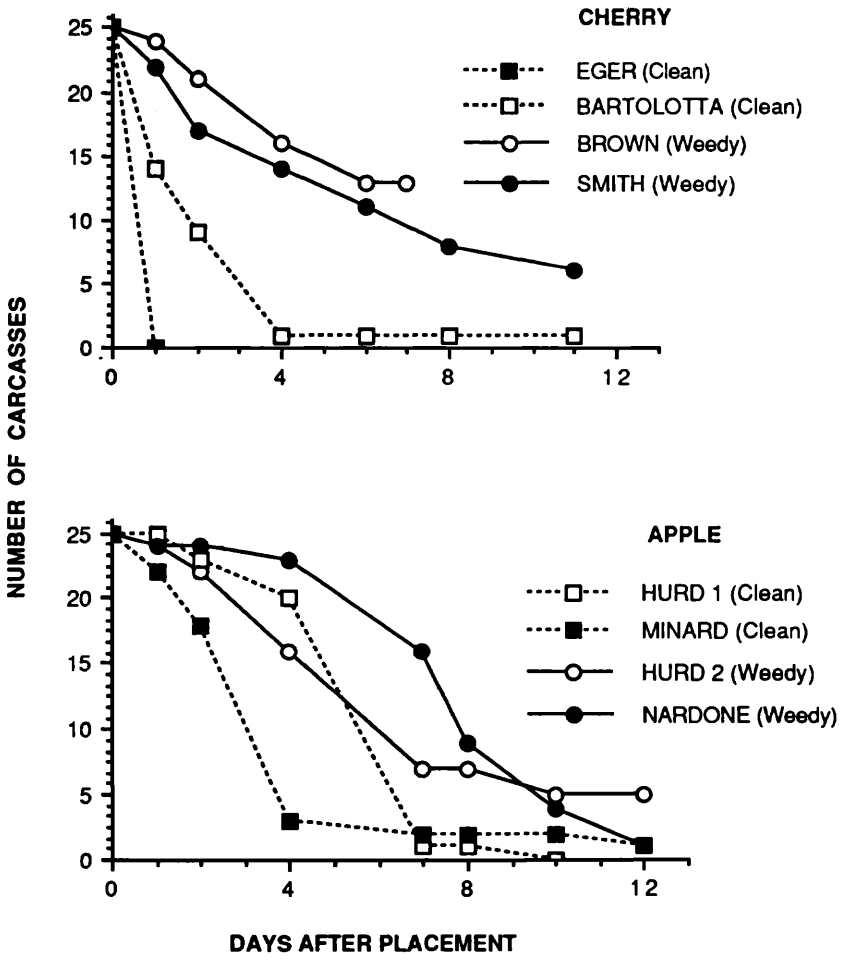

FIGURE. 1. Number of Brown-headed Cowbird and House Sparrow carcasses remaining in each of four cherry and four apple orchards at various times after placement.

75.0% (150 of 200) ultimately were completely removed from their original placement site, and an additional 12.0% (24 of 200) had only one or more feathers remaining. More carcasses were completely removed, with no evidence remaining, in the clean orchards (90 of 100) than in the weedy orchards (60 of 100) ($t = 4.27$, df = 6, $P < 0.01$). The presence of ground vegetation and compacted soil under the trees prevented us from identifying tracks of scavengers; however, we suspect that house cats (*Felis silvestris*), striped skunks (*Mephitis mephitis*), red foxes (*Vulpes fulva*), and dogs (*Canis familiaris*) were the most likely species. Insects and bacteria caused the decay of the 13.0% (26 of 200) of the carcasses

that had intact skeletons with no flesh; we observed maggots covering many of these carcasses.

In the search efficiency trials, searchers recovered an average of 75% of the carcasses placed in the eight cherry orchards. Searching rates varied slightly among the three searchers, but generally were slower in the weedy orchards (1.0–1.7 min/tree) than in the clean orchards (0.3–0.6 min/tree). Nonetheless, the percentages of carcasses recovered were similar and ranged form 70% to 90% for seven of the eight orchards. The lowest recovery success (50%) occurred in the orchard that had the heaviest growth of ground cover. We assume that the search efficiencies measured in the cherry orchards would be comparable to those in apple orchards, because tree spacing and ground cover were similar in both types of orchards.

The initially high survival rates in most orchards, together with the high recoverability of the carcasses, indicate that careful searches conducted within 2 d of pesticide application should usually suffice for detecting significant songbird mortality. However, this study demonstrates significant variation in carcass disappearance rates among orchards. Thus, if accurate estimates are to be made of bird mortality following pesticide application, the rates of carcass disappearance should be measured in the orchards being monitored.

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