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BLACKBIRDS AND STARLINGS KILLED AT WINTER ROOSTS FROM PA-14 APPLICATIONS, 1974-1992: IMPLICATIONS FOR REGIONAL POPULATION MANAGEMENT

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ABSTRACT: The surfactant PA-14, registered with the U.S. Environmental Protection Agency (EPA) in 1973 by the federal Animal Damage Control (ADC) program, was used for 19 years (1974-1992) for lethal control of roosting blackbirds (Icterinae) and European starlings (Sturnus vulgaris) in the United States. In 1992, the ADC program withdrew the registration of PA-14 because of costs required to provide additional EPA-requested data. There were 83 roosts encompassing 178 ha treated with 33,300 L of PA-14 from 1974-1992. An estimated 38.2 million birds (48% common grackles [Quiscalus quiscula], 30% European starlings, 13% red-winged blackbirds [Agelaius phoeniceus], and 9% brown-headed cowbirds [Molothrus ater]) were killed, an average of 2.0 million/year. The annual kill represented ≤1.3% of the national winter population of blackbirds and starlings. We found no evidence using North American Breeding Bird Survey (BBS) data that PA-14 applications caused declines in regional breeding populations. Furthermore, there was no evidence of secondary poisoning or other adverse environmental effects from PA-14 applications. If regional population management of blackbirds and starlings is to be implemented to reduce agricultural damage or conflicts with native songbirds, new approaches, such as reproductive control, are needed because PA-14 alone will not be adequate. However, PA-14 could have a role in such regional programs in addition to solving localized roost problems. PA-14 was a useful management tool safely applied in human-populated areas (where most roost problems occur); its reregistration should be considered as part of an integrated management program for blackbirds and starlings.

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Red-winged blackbirds, brown-headed cowbirds, and common grackles, (hereafter collectively referred to as blackbirds), and European starlings (hereafter starlings) nest throughout much of the United States and southern Canada (Dolbeer and Stehn 1979). Most of these birds migrate during autumn to the southern United States (Dolbeer 1982) where they congregate in roosts during winter (White et al. 1985). A minimum of 537 million blackbirds and starlings were reported in roosts in the United States during winter 1974-1975 (Meanley 1975).

Blackbirds and starlings can cause substantial economic loss to various agricultural crops (Heisterberg 1983, Hothem et al. 1988, Decker et al. 1990, Dolbeer 1990). In a recent survey, 82% of North Dakota and South Dakota sunflower producers stated that a blackbird toxicant should be used to reduce the number of female red-winged blackbirds (U.S. Department of Agriculture 1995) to decrease crop depredation. Perhaps of greater concern is the noise, fecal accumulation, general nuisance and disease threat caused by large winter-roosting populations (Garner 1978, White et al. 1985). There are also concerns regarding conflicts between blackbirds or starlings and other avian species. For example, introduced starlings have been documented as a competitor of nest sites with indigenous species (Feare 1984:40). Additionally, parasitism by brown-headed cowbirds has been implicated recently as a major factor in population declines of neotropical migratory birds (Askins 1995, Robinson et al. 1995) with population reduction of cowbirds being considered as a potential means of control (Rothstein et al. 1987).

The only EPA-registered chemical for lethal control of roosting blackbirds and starlings was Compound PA-14 Avian Stressing Agent, a surfactant with excellent wetting properties. PA-14, applied with water to roosting blackbirds and starlings at night, was registered by the ADC program of the U.S. Fish and Wildlife Service in 1973 (U.S. Department of Interior 1976) and used on roosts for 19 years, 1974-1992. In 1992, a decision was made within the ADC program (which was transferred to the U.S. Department of Agriculture [USDA] in 1986) not to renew the registration of PA-14 because of costs required to provide additional EPA-requested data.

Garner (1978) and Heisterberg et al. (1987) summarized the results of PA-14 applications to blackbird and starling roosts from 1974-1978 and 1979-1986, respectively. Their reports provided detailed information on methods, logistics and costs of applications as well as estimates of total birds killed (but generally not by species). Our objective was to provide a complete summary of the number and characteristics of PA-14 applications and the number of birds killed (by species when possible) from 1974-1992. In addition, the number of birds killed annually was examined in relation to the estimated total winter population of blackbirds and starlings in the United States as well as to estimated breeding-season population trends of these species, 1974-1992. This document should aid in evaluating the utility of PA-14 during its 19 years of registered use and in future decisions regarding reregistration of this compound or in the development of other techniques for managing blackbird and starling populations.

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METHODS

Summary of PA-14 Applications

Relevant data for all PA-14 applications were organized into a database (available from authors). Initial data for 1974-1986 were obtained from Garner (1978) and Heisterberg et al. (1987). These authors were then asked to review the data and to provide additional, unpublished data regarding roost treatments from 1974-1992. A. R. Stickley, Jr. (USDA/ADC) and F. Boyd (USDA/ADC) similarly reviewed and supplemented the data. These data were then summarized to provide an overview of PA-14 use from 1974-1992 regarding the number of roosts treated by state and month, estimated total kill of birds by species, methods of application, and amount of material applied.

Impact on Breeding Populations

Using migration data (Dolbeer 1982), we determined that breeding distributions of blackbirds and starlings killed by PA-14 applications occurred primarily in Indiana, Michigan, and Ohio. We obtained BBS data (Robbins et. al 1986) for each species in these states from 1974-1992. We then calculated the mean number of birds observed/route/year and the mean percent annual change in relative abundance for each species for all 3 states combined. For each species, we used simple correlation analysis (SAS Inst., Inc. 1988) to determine associations between numbers of birds killed by PA-14 treatments each winter and the mean percent annual change in relative abundance during subsequent breeding seasons.

RESULTS

Summary of PA-14 Applications

There were 83 roosts treated with PA-14 from 1974-1992, an average of 4.4 roosts/year. Roosts averaged 1.4 million blackbirds and starlings present at the time of treatment and 0.5 million birds killed (Table 1). The mean $\pm$ SD reduction in bird numbers for 81 roosts was 42 $\pm$ 35%. In all, an

estimated 38.2 million birds were killed, an average of 2.0 million/year.

Estimated species composition of the kill was 48% common grackles (18.2 million birds), 30% starlings (11.4 million), 13% red-winged blackbirds (5.1 million), 9% brown-headed cowbirds (3.4 million), and 0.3% rusty blackbirds (Euphagus carolinus) (0.1 million). With the exception of 1 PA-14-treated roost where an estimated 2,700 American robins (Turdus migratorius) died, few nontarget birds were killed (Table 2).

PA-14 treatments were in Kentucky (51%), Tennessee (45%) and Alabama (4%). Most applications were in January and February (84%) with the remainder in March (11%), December (4%) and November (1%) (Table 3).

Methods of PA-14 application evolved over the years. From 1974-1980, PA-14 was applied by helicopter followed by rainfall or by supplemental water provided by fire truck or irrigation system. From 1981-1986, a ground-based sprinkler system that applied both PA-14 and water was used primarily. From 1987-1992, a ground-based water cannon was used primarily (Table 4).

The area treated/roost averaged 3.1 ha for aerial applications and 1.1-1.6 ha for ground-based systems (Table 4). In all, an estimated 178 ha were treated with 33,300 L of PA-14 (application rate was 187 L/ha) from 1974-1992. During or following on-site evaluations of the 83 roost treatments, there was no evidence of secondary poisoning of any wildlife or domestic animals. No fish kills or other adverse aquatic effects were noted in watersheds surrounding treated roosts.

Impact on Breeding Populations

There was no association between the number of starlings (r = 0.26, 19 df, P = 0.28), common grackles (r = -0.19, 19 df, P = 0.44), red-winged blackbirds (r = 0.17, 19 df, P = 0.48), or brown-headed cowbirds (r = -0.38, 19 df, P = 0.11) killed annually by PA-14 treatments and the respective mean percent annual changes in relative abundance during subsequent breeding seasons (Figs. 1, 2).

DISCUSSION

Of the 537 million blackbirds and starlings reported in roosts in the United States during winter 1974-1975, 398 million (30% red-winged blackbirds, 29% common grackles, 23% starlings and 18% brown-headed cowbirds) were in the eastern United States (states east of and including the tier from Minnesota to Louisiana) (Meanley and Royall 1976). Thus, the removal of 0-7 million birds/winter (x = 2.0 million) from 1974-1992 represented $\leq$1.3% of the national population and $\leq$1.8% of the eastern population of blackbirds and starlings. The maximum annual kill of a given species (4.2 million grackles in 1978 [Fig. 2]) represented about 3.6% of the eastern population of grackles. Thus, the lack of relationships between the number of birds killed/winter by PA-14 and subsequent changes in breeding populations was not surprising.

Various groups have discussed the feasibility of managing regional populations of blackbirds and starlings (e.g., Feare 1984:276-279, Rothstein et al. 1987, U.S. Department of Agriculture 1995). PA-14 could have an important role in such regional programs in addition to continuing to solve localized roost problems. However, PA-14 alone will not be adequate. If regional population management of blackbirds and starlings is to be implemented to reduce agricultural damage or conflicts with native songbirds, additional techniques, such as reproductive control through immunocontraception, will be needed.

PA-14, through 83 roost treatments over 19 years, proved to be a useful management tool that could be applied safely in human-populated areas (where most roost problems occur). Reregistration of PA-14 should be considered as part of an integrated management program for blackbirds and starlings. Updated national winter roost surveys (Meanley 1975), analyses of breeding population trends (Dolbeer and Stehn 1983), and population modeling (Dolbeer et. al 1976) also should be undertaken so

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that the current status of blackbird and starling populations and the feasibility and desirability of control can be better defined.

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Table 1. Number of PA-14 treatments to winter roosts of blackbirds and starlings and estimated kill of birds, 1974-1992.

Year[a]	No. of roost treatments	Mean no. of birds/treatment In roost	Killed	Total kill
1974	1	1,000,000	1,000	1,000
1975	6	1,483,000	677,600	4,065,500
1976	6	3,317,000	626,300	3,758,000
1977	6	2,138,000	1,172,000	7,031,100
1978	6	2,738,000	1,080,000	6,478,250
1979	4	1,850,000	115,000	460,000
1980	4	1,805,000	370,000[b]	1,110,000[b]
1981	2	474,500	43,050	86,100
1982	5	2,080,000	587,400	2,937,000
1983	7	861,100	198,100	1,387,000
1984	5	462,000	338,600	1,693,000
1985	3	989,700	178,300	535,000
1986	6	564,800	247,700	1,486,000
1987	8	647,800	233,400	1,867,000
1988	8	1,125,000[b]	265,600	2,124,500
1989	3	671,800	397,300	1,191,875
1990	0	0	0	0
1991	2	802,500	635,000	1,270,000

Table 1 (continued). Number of PA-14 treatments to winter roosts of blackbirds and starlings and estimated kill of birds, 1974-1992.

Year[a]	No. of roost treatments	Mean no. of birds/treatment In roost	Killed	Total kill
1992	1	1,150,000	700,000	700,000
Total	83	1,433,000	465,600	38,181,325

[a] Includes roosts treated during November-December of previous year and January-March of stated year.

[b] No estimates were made of number of birds killed for 1 roost in 1980 and of pretreatment population for 1 roost in 1988.

Table 2. Estimated species composition of blackbirds and starlings killed by PA-14 treatments to winter roosts, 1974-1992.

Species	Roosts (n = 47) where species composition of kill was estimated %	Total kill	Projected kill for all 83 roosts treated with PA-14[a]
Common grackle	48	5,991,675	18,156,400
European starling	30	3,764,850	11,408,500
Red-winged blackbird	13	1,698,990	5,148,400
Brown-headed cowbird	9	1,105,660	3,350,400
Rusty blackbird	<1	38,800	117,625
Total[b]	100	12,599,975	38,181,325

[a] Assuming species composition of the 36 roosts without species-specific estimates of kill was similar to total composition of roosts where species-specific estimates of kill were made.

[b] In addition, 2,700 American robins were killed during 1 PA-14 treatment in 1986. Only 10 other dead nontarget birds (4 northern bobwhites [Colinus virginianus], 3 northern cardinals [Cardinalis cardinalis], 2 American robins and 1 white-throated sparrow [Zonotricia albicollis]) were noted in 5 of 24 PA-14 applications where specific searches for nontargets were made.

Table 3. Number of PA-14 treatments to blackbird and starling roosts and estimated number of birds killed by state and by month, 1974-1992.

State	No. of treat-ments	Total kill	Month	No. of treat-ments	Total kill
Alabama	3	1,288,000	Jan	35	19,207,430
Kentucky	43	17,802,600	Feb	35	14,215,475
Tennessee	37	19,090,725	Mar	9	3,889,000
			Nov	1	27,170
			Dec	3	842,250
Total	83	38,181,325		83	38,181,325

Table 4. Estimated number of blackbirds and starlings killed and hectares of winter roosts treated by method of PA-14 application, 1974-1992.

Application method[a]	No. of birds killed			No. of ha treated		
	n	x[b]	Total	n	x	Total[c]
Aerial/rain	30	695,600	20,867,350	14	3.1	119
Aerial/SW	7	755,200	5,286,500			
GBSS	24	221,500	5,317,100	23	1.1	26
GBWC	21	319,500	6,710,375	21	1.6	33
Total	82[c]	465,600	38,181,325			178

[a] Aerial/rain = Helicopter followed by rain; Aerial/SW = Helicopter followed by supplemental water applied from fire truck or sprinkler system; GBSS = Ground-based sprinkler system; GBWC = Ground-based water cannon.

[b] Because the mean hectares treated/aerial application was 2-3 times the mean hectares treated/ground-based application, the number of birds killed/treated ha was similar for aerial and ground-based applications (Heisterberg et al. 1987).

[c] Data on hectares treated were unavailable for 24 aerial and 1 GBSS application; thus, total hectares treated for all roosts is projected from mean values for roosts with available data.

[d] An estimate of the number of birds killed was not made for 1 aerial/rain-treated roost in 1980.

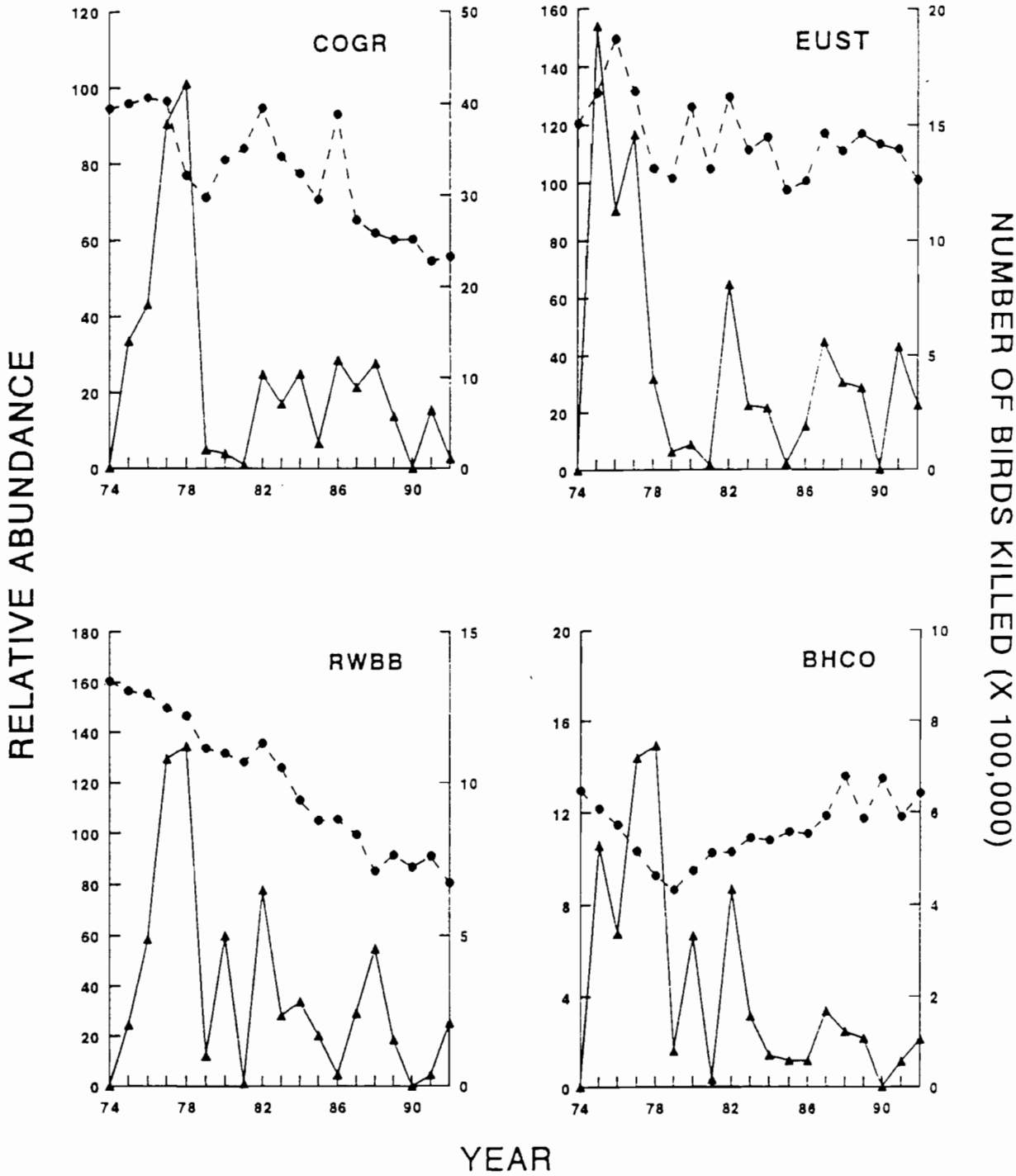

Fig. 1. Pooled mean annual percent change in relative abundance during breeding season (circles) (from North American Breeding Bird Survey data) of common grackles (COGR), European starlings (EUST), red-winged blackbirds (RWBB), and brown-headed cowbirds (BHCO) from Indiana, Michigan, and Ohio in relation to respective numbers of birds killed by PA-14 applications (triangles) at roosts in previous winter in Kentucky, Tennessee and Alabama, 1974-1992.

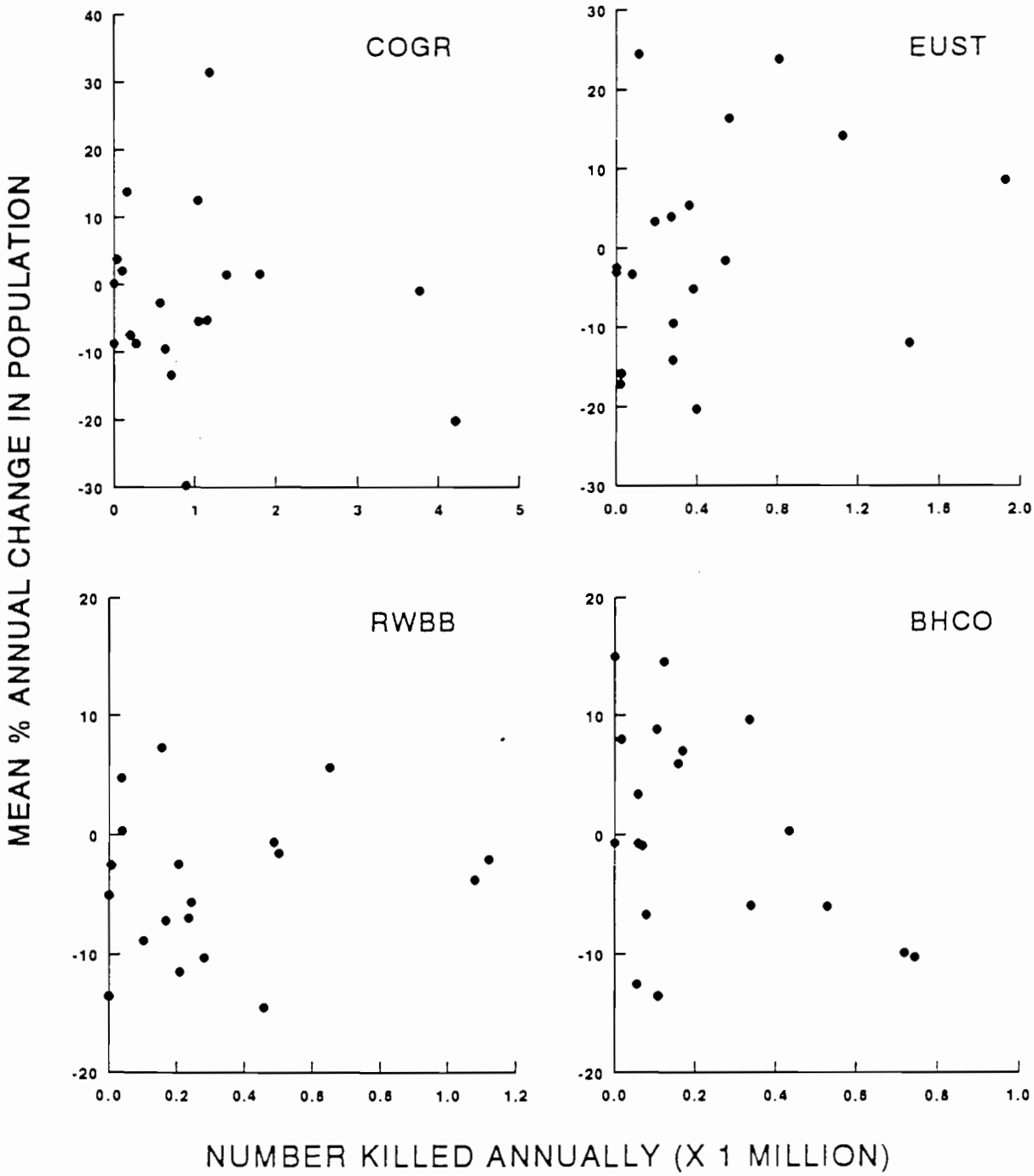

Fig. 2. Pooled mean relative abundance during breeding season (circles) (from North American Breeding Bird Survey data) of common grackles (COGR), European starlings (EUST), red-winged blackbirds (RWBB), and brown-headed cowbirds (BHCO) from Indiana, Michigan, and Ohio in relation to respective numbers of birds killed by PA-14 applications (triangles) at roosts in previous winter in Kentucky, Tennessee and Alabama, 1974-1992