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phenomenon?

W. Paul Gorenzel* Terrell P. Salmon† Gary D. Simmons‡
Bob Barkhouse** Mark P. Quisenberry††

*University of California, Davis

†University of California, Davis

‡USDA Wildlife Services, Sacramento, CA

**City Hall, Yuba City, CA

††Sutter County Agricultural Commissioner, Yuba City, CA

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Urban crow roosts - a nationwide phenomenon?

W. Paul Gorenzel, Department of Wildlife, Fish, and Conservation Biology, One Shields Ave., University of California, Davis, CA 95616, USA

Terrell P. Salmon, Department of Wildlife, Fish, and Conservation Biology, One Shields Ave., University of California, Davis, CA 95616, USA

Gary D. Simmons, United States Department of Agriculture, Wildlife Services, P. O. Box 255348, Sacramento, CA 95865-5348, USA

Bob Barkhouse, City Hall, 1201 Civic Center Blvd., Yuba City, CA 95993, USA

Mark P. Quisenberry, Sutter County Agricultural Commissioner, 142 Garden Highway, Yuba City, CA 95991, USA

Abstract: We conducted surveys of federal officials nationwide and of local officials in California to determine historical and temporal aspects, location, size, and control of American crow (*Corvus brachyrhynchos*) urban roosts. The national survey consisted of a 2-page questionnaire sent via email to United States Department of Agriculture Wildlife Services state directors representing the lower 48 states. The California survey consisted of a 3-page questionnaire mailed by the League of California Cities to 473 towns and cities and an email inquiry sent to Agriculture Commissioners in 29 counties. In the national survey respondents in 27 of 39 states identified 86 urban and 15 rural roosts. Most urban roosts ($n = 69$) were used in the fall, winter, or spring and had been occupied for ≤ 30 yr ($n = 59$). Most respondents ($n = 26$) didn't know if a shift from rural to urban roosts had occurred, but 12 said it began in the 1970s and continued into the 1990s, with most roosts now in urban locations in 11 states. Based mainly on personal observations and the number of complaints received, respondents indicated crow populations had increased in 27 states. In the California survey 17 Agriculture Commissioners and 206 cities responded, identifying 57 cities with crow problems including 24 with night roosts. Cities responded to citizens' complaints most often by giving advice on control methods ($n = 20$). Most control efforts consisted of individual efforts by residents or businesses; only 3 cities attempted large-scale organized efforts led by local officials. Respondents listed 14 techniques used for crow control. Only poisoning, firearms, pyrotechnic devices, and sticky contact repellents received good ratings. Most respondents indicated roosts had been in their city for ≤ 30 yr ($n = 14$) and about 50% said crow populations had increased. Results suggest crow populations are increasing, a shift to urban roosts has occurred and is still in progress in some regions, and problems with urban crow roosts are likely to increase. New strategies and techniques are needed to disperse roosts on a large scale.

Key words: American crow, California, *Corvus brachyrhynchos*, questionnaire, roosts, urban, Wildlife Services

In recent years the popular media have reported that American crows (*Corvus brachyrhynchos*) roost in urban areas in many regions of the United States (e.g., Lindelof 1989, Walker 1995). However, the scientific literature prior to the 1960s mentions only roosts in rural locations and none in urban areas (Barrows and Schwarz 1895, Emlen Jr. 1938, 1940, Kalmbach 1915). In the later half of the 1900s crows apparently began to establish urban roosts (Gilbert 1988, 1992, Grant 1973, Houston 1980). We suspect that not only did crows begin using urban roosts, but that there was a shift in the location of winter roosts away from rural to urban sites. The timing and geographical extent of this "urbanization" is not documented.

Communities with crow roosts typically face ongoing damage as crows return annually to their traditional roosts. Yuba City, in Sutter County, California, is located in a traditional roost area, with crows roosting in the vicinity of the city since the mid-1930s (Gorenzel and Salmon 1992). In 1988 the primary crow roost in a walnut orchard on the outskirts of the city was destroyed. Crows established new roosts in nearby residential and commercial areas of the city. The crow roosts prompted complaints from residents and business owners concerning potential health hazards from droppings and regurgitated pellets, costs to cleanup droppings on vehicles, sidewalks, and buildings, and excessive noise, particularly from crows departing roosts in the morning. In 1999, with an estimated crow population of 1 million birds, city officials organized planning meetings involving county, state, federal, and university representatives. Plans were drawn to survey other cities and towns in California to determine the extent of the problem and to identify successful control

techniques.

The planned survey of California cities provided an opportune time to not only obtain information on crow roosts in California, but also to examine the status of roosts nationwide. Our objectives were to: 1) to survey United States Department of Agriculture (USDA) Wildlife Services personnel nationwide regarding the status of crow populations and roosts (urban vs. rural) and the concept of a shift to urban roosts, and 2) to conduct an intensive survey of officials in California cities and towns regarding the presence of crow roosts and control responses.

Methods

National survey

We designed a 2-page questionnaire with 14 questions. We asked respondents if they knew of any crow night roosts. If yes, we asked respondents to name the roost location(s), characterize each roost location as either rural or urban-suburban (hereafter referred to as urban), list the seasons when crows used the roost(s) (spring, summer, fall, winter), and indicate the number of years that crows have been roosting at each location (1-10, 11-20, 21-30, >30 years). We asked if there had been a shift with the last 40 years from crows roosting predominately at rural roosts to more roosting in urban/suburban locations. If yes, when did the shift begin (before 1960, in the 1960s, 1970s, 1980s, or 1990s), and where are most roosts in their state now located (rural or urban locations). We asked respondents if crow populations had changed (increased, decreased, stayed the same) and to indicate the basis for that answer (personal observations, data sources such as Breeding Bird Surveys or Christmas Bird Counts, newspaper or other media reports,

number of complaints). We asked respondents to name the location(s) where large-scale control efforts to disperse roosts were undertaken by local officials, to indicate whether the effort was successful (yes, no, partially), and to list the control techniques used (e.g., pyrotechnics, shooting, distress calls).

We emailed the questionnaire to 38 USDA Wildlife Services state directors, representing the lower 48 states, in May 2000. We requested that the questionnaire be routed to District Supervisors or the State Biologist. We sent follow-up emails in July and August 2000 and in some cases telephoned nonrespondents. We completed data collection in September 2000.

California survey

The California survey included a mailed questionnaire and an email inquiry. We designed a 3-page questionnaire with 20 questions. We asked respondents if they had received complaints about crows, the type of problem(s) reported (night roost, noise in the morning or evening, droppings, damage to trees, structural damage, spreading trash from containers), and the location of the problem(s) (residential, business, park, other). We asked respondents which season crows were most abundant in their city (spring, summer, fall, winter), how many years had crows been roosting in their city, and whether crow populations had changed (increased, decreased, stayed the same). We asked respondents to list their city's response to citizens with crow problems (give advice on control methods, refer to a private pest control company, provide a list of pest control companies, refer to another government agency, send city personnel to deal with the

problem, other), and if referred to another government agency, to name it. We asked respondents to indicate the magnitude and organization of crow control efforts (individual efforts by residents or businesses, group efforts such as an entire neighborhood, large-scale efforts organized by local officials, or no control efforts), and to indicate whether the efforts were successful (yes, no, partially). We provided a list of 22 potential control techniques (e.g., shouting, pyrotechnics, tree removal, trapping, distress calls) and asked respondents to indicate which ones were used for crows and to rate effectiveness (0 = useless, 1 = poor, 2 = good, 3 = excellent). We calculated an average value for each technique from the effectiveness ratings. We asked for an estimate of the annual expense by citizens and businesses to deal with crow problems.

With the assistance of the League of California Cities (LOCC), we mailed the questionnaire to 473 California towns and cities in October 1999. The cover letter, written by LOCC, was addressed to the City Clerk and did not request that the questionnaire be routed to the appropriate person. We did not send a follow-up letter to nonrespondents. We completed data collection in December 1999.

In January 2000 we conducted an email survey of California Agriculture Commissioners in 29 counties. The 29 counties (out of 57 counties in California) were selected based on cities reporting crow problems in the mailed questionnaire. We asked the Commissioners to name cities or towns in their county with crow problems. We did not ask that the type of problem be specified.

Results

National survey

We received 46 responses from 39 states (81% of states). We received 5 responses from Texas, and 2 responses each from Montana, Oregon, and Wisconsin. We combined responses within each of the 4 above states.

Respondents in 30 states knew of the location of crow night roosts. Respondents from 27 states identified 86 urban and 15 rural roosts (Table 1). Seventy-four of the urban roosts (86%) were used by crows during the fall, winter, or spring. Eight urban roosts (10%) were occupied year round. Five urban roosts (6%) were used only in the summer or fall. Nine rural roosts (60%) were used in the fall or winter and 1 rural roost was used only in the summer and fall. Respondents did not know the time span of occupancy at 27 roosts, but indicated the remaining 59 urban roosts had been used for ≤ 30 yr as follows: 1 - 10 yr ($n = 34$), 11-20 yr ($n = 22$), 21 - 30 yr ($n = 3$). Respondents indicated use of rural roosts from 1 -10 yr ($n = 4$), 11 - 20 yr ($n = 2$), and >30 yr

Regarding a shift in roosts from rural to urban locations in the last 40 yr, respondents didn't know ($n = 26$), indicated there was a shift ($n = 12$, Colorado, Iowa, Kentucky, Maryland, Michigan, Missouri, New Hampshire, New York, North Dakota, Pennsylvania, Tennessee, Wisconsin) or that none had occurred ($n = 6$, Arkansas, Maine, Mississippi, Montana, Oklahoma, South Carolina). Respondents answering affirmatively indicated the shift began in the 1970s ($n = 3$, Kentucky, Maryland, Tennessee), the 1980s ($n = 5$, Iowa, Michigan, Missouri, New York, Virginia), or the 1990s

($n = 3$, New Hampshire, North Dakota, Wisconsin). When asked where most roosts are now located in their state, respondents didn't know or didn't answer ($n = 26$), indicated urban locations ($n = 11$, Colorado, Connecticut, Iowa, Kentucky, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, Rhode Island, Tennessee) or rural locations ($n = 8$, Arkansas, Indiana, Mississippi, North Dakota, Oklahoma, Pennsylvania, Wisconsin, Wyoming).

Respondents said they didn't know if crow populations had changed in 5 states (Kansas, North Dakota, Nebraska, New Jersey, New Mexico), had increased in 27 states (Arkansas, Colorado, Connecticut, Idaho, Illinois, Indiana, Iowa, Louisiana, Maine, Maryland, Massachusetts, Michigan, Missouri, Montana, Nevada, New Hampshire, New York, Ohio, Oklahoma, Pennsylvania, Rhode Island, Texas, Utah, Virginia, West Virginia, Wisconsin, Wyoming), and had stayed the same in 6 states (Kentucky, Mississippi, North Carolina, Oregon, South Carolina, Tennessee). The reasons for the respondents' statements regarding populations changes were personal observations ($n = 29$), number of complaints received ($n = 21$), data sources such as Breeding Bird Surveys or Christmas Bird Counts ($n = 3$), or newspaper or other media reports ($n = 2$).

Respondents named 16 locations where large-scale control efforts were undertaken to disperse crow roosts (Table 2). The degree of control varied with success at 6 sites, partial success at 9 sites, and failure at 1 site. Hazing, primarily with pyrotechnics was the most common technique used. Shooting and distress calls were used at 7 and 6 sites, respectively.

Table 1. Characteristics of crow night roosts by state including location (urban-suburban, rural), seasons used (Sp = spring, Su = summer, F = fall, W = winter), and range of years used by crows (1 - 10, 11-20, 21-30, >30), as reported by USDA Wildlife Services personnel. For all characteristics, don't know or no answer = NA.

State	Roost name	Location	Seasons used	Years used
Arkansas	Ashdown	rural	W	11-20
Connecticut	Napaug	rural	W	NA
	Orange	urban	SpFW	NA
	West Hartford	urban	W	1-10
	Hartford, Norwich, Uncas, Waterbury	urban	W	11-20
	Groton	urban	F	NA
Florida"	Alafia Bank	rural	W	NA
	Terra Ceia Bird Key	rural	W	NA
	Clearwater Habor, Tarpon Key	rural	W	NA
	National Wildlife Refuge			
Illinois	Springfield, Danville, De Kalb, Dwight	urban	FW	1-10
Indiana	Anderson, Lafayette, Mt. Vernon, Muncie, Terre Haute	urban	FW	1-10
	Newburg	urban	W	NA
Iowa	Ames, Des Moines, Mason City	urban	SpSuFW	11-20
Kansas	Wichita	urban	FW	NA
Kentucky	Lexinton, Louisville	urban	W	11-20
Maine	Lewiston-Auburn	urban	W	NA
Maryland	Baltimore, Baltimore County, Frederick, Hagerstown, Rockville- Montgomery County	urban	W	11-20
	Laurel #1	urban	W	NA
	Laurel #2	rural	W	NA
Massachusetts	Springfield	urban	SpFW	11-20
	Methuen-Lawrence	urban	W	11-20
	Framingham, Worcester	urban	SpW	11-20
	Pittsfield	urban	Su	NA
	Arlington, Canton, Newton	NA	Su	NA
	Brookline, Northbridge, Quincy, Reading	urban	FW	NA

(Continued next page)

	Boston, Chicopee, Framingham, Hull, Northampton, West Roxbury, West Springfield	urban	W	NA
Michigan	Hillsdale	urban	SpSuFW	1-10
	South Lansing	urban	SpFW	NA
	Ann Arbor	urban	NA	NA
Missouri	St. Louis	urban	SpSuFW	1-10
	Kansas City	urban	SpSuFW	11-20
Nebraska	Kearney	urban	FW	NA
New Hampshire	Manchester	urban	W	NA
	Rochester	urban	W	1-10
	Portsmouth	urban	FW	1-10
	Kingston, Tilton-Franklin	urban	F	1-10
	Orford	rural	F	1-10
	Hollis	rural	NA	1-10
New Jersey	Bridgetown, Newark, Trenton	urban	W	21-30
New York	Albany, Utica	urban	FW	1-10
	Poughkeepsie	urban	NA	NA
North Dakota	Bismarck	urban	SuF	1-10
	Williston	rural	SuF	NA
Ohio	Bucyrus, Mansfield	urban	W	NA
Oklahoma	Welch	rural	NA	NA
Oregon	McKinzie River	rural	FW	>30
Pennsylvania	Bethlehem, Harrisburg, Lancaster, Philadelphia, Scranton	urban	W	1-10
	Columbia, Halifax	rural	W	1-10
Rhode Island	Providence, Warwick	urban	FW	1-10
	Westerly	urban	W	11-20
	Cranston, Greenville	urban	W	NA
Tennessee	Jackson, Nashville	urban	W	1-10
	Coffee County	rural	W	11-20
Texas	Brownfield	urban	FW	1-10
Virginia	Annandale, Tyson's Center	urban	FW	11-20
	Norfolk Airport, Richmond	urban	FW	11-20
	Norfolk Naval Base	urban	SpFW	1-10
Wisconsin	Madison, Milwaukee	urban	SpSuFW	1-10

^aRoosts identified in Florida are probably fish crow (*Corvus ossifragus*) roosts.

Table 2. Locations where large-scale control efforts have been undertaken to disperse crow roosts, the degree of success of the control efforts, and the control techniques used as reported by USDA Wildlife Services personnel.

State	Location	Control successful?	Control techniques used
Indiana	Mt. Vernon	partially	hazing, pyrotechnics, sanitation, shooting
	Newburg	yes	DRC-1339"
Iowa	Des Moines	partially	pyrotechnics, propane cannons
Kansas	Wichita	no	pyrotechnics, shooting, distress calls
Kentucky	Lexington	partially	DRC-1229, hazing, trapping, shooting
	Louisville	yes	DRC-1339, habitat modification
Maryland	Frederick	partially	pyrotechnics, distress calls
	Hagerstown	partially	pyrotechnics, distress calls
Michigan	Hillsdale	yes	pyrotechnics
Pennsylvania	Bethlehem	yes	pyrotechnics, shooting, distress calls
	Harrisburg	yes	pyrotechnics, shooting, distress calls
Rhode Island	Westerly	partially	pyrotechnics, propane cannons
Tennessee	Jackson	partially	habitat modification
	Nashville	partially	DRC-1339, pyrotechnics, distress calls
Texas	Brownfield	partially	pyrotechnics, shooting
Wyoming	Riverton	yes	pyrotechnics, shooting, handing birds

^aDRC-1339 is a restricted use pesticide for use only by USDA personnel trained in bird control. The active ingredient is 3-chloro-4-methylbenzenamine hydrochloride.

California survey

We mailed 473 questionnaires; 206 (44%) were returned. Of 29 Agriculture Commissioners queried by email, 17 (59%) responded. The responses represented 53 (93%) of California's counties.

Respondents identified 57 cities in 21 counties with crow problems (Figure 1). Respondents indicated crow problems as night roosts ($n = 24$), noise in the morning or evening ($n = 25$), droppings ($n = 22$), damage to trees ($n = 3$), structural damage ($n = 2$), and spreading trash from containers ($n = 9$). Most

cities with crow problems were located in the Central Valley ($n = 26$) and the south coast region ($n = 25$), however nearly twice as many roosts (Table 3) occurred in the Central Valley ($n = 15$) than in the south coast region ($n = 8$). (The Central Valley extends approximately from Redding in Shasta County south to Bakersfield in Kern County.) No cities in counties north of Yuba City in Sutter County or to the east in the Sierra Nevada mountains reported any crow problems. Within cities crow problems were located at residential sites ($n = 44$), businesses ($n = 32$), parks ($n = 8$), or other locations including a school, hospital and a golf course.

Figure 1. Number of cities or towns in California counties (in white) reporting crow problems (night roosts, noise in the morning or evening, droppings, damage to trees, structural damage, spreading trash from containers) in a 1999 survey of city officials.

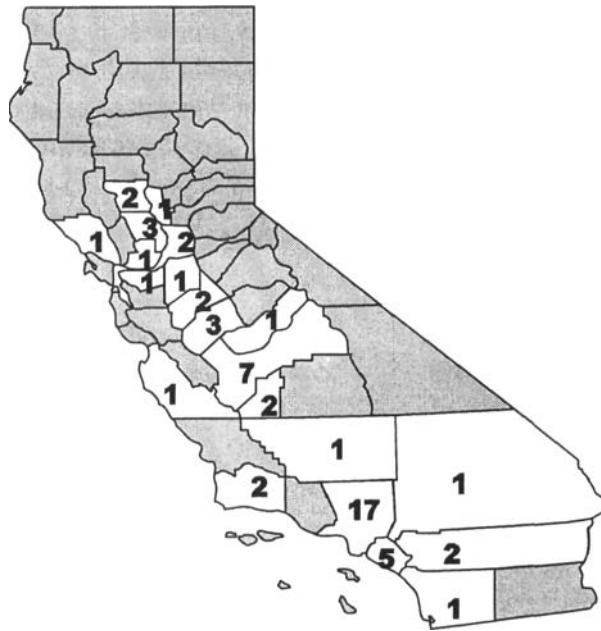


Table 3. The location of crow night roosts listed by county, city, and region in California as reported by city officials and Agriculture Commissioners, winter 1999-2000.

County	City	Region
Colusa	Colusa, Williams	Central Valley
Fresno	Kerman, Selma	Central Valley
Kings	Hanford, Lemoore	Central Valley
Los Angeles	Palos Verdes Estates, Pico Rivera, Rancho Palo Verdes, South El Monte, West Hollywood	South Coast
Madera	Madera	Central Valley
Merced	Los Banos, Merced	Central Valley
Orange	Cypress, Santa Ana	South Coast
Riverside	La Quinta	South Desert
Sacramento	Sacramento	Central Valley
Santa Barbara	Santa Barbara	South Coast
Stanislaus	Oakdale	Central Valley
Sutter	Yuba City	Central Valley
Yolo	Davis, Winters, Woodland	Central Valley

Cities' responses to citizens' complaints were to give advice on control methods ($n = 20$), refer them to a private pest control company ($n = 12$), provide a list of pest control companies ($n = 1$), refer them to another government agency ($n = 10$), send city personnel to deal with the problem ($n = 8$), or refer them to the local Humane Society or an animal care group ($n = 3$). Referrals to other government agencies were to the County Agriculture Commissioner ($n = 5$), County Animal Control ($n = 4$), County Health Department ($n = 2$), California Department of Fish and Game ($n = 1$), USDA Wildlife Services ($n = 1$), and the University of California ($n = 1$).

With regard to the magnitude and organization of crow control efforts, 36 cities indicated no control had been attempted, 19 cities reported individual efforts by residents or businesses, 3 cities reported group efforts such as by an entire neighborhood or a business association, and 3 cities had large-scale efforts organized by local officials. The success of control efforts was variable, with 20% of individual efforts successful, 66% of group efforts successful, and 33% of large scale efforts successful (Table 4). Partial success ranged from 33% to 40%.

Respondents listed 14 techniques used for crow control (Table 5). Only 4 techniques received an average rating of good or better (>2.0), poisoning, firearms, pyrotechnic devices, and sticky contact repellents. Most respondents didn't know ($n = 21$) or indicated nothing was spent on crow control ($n = 14$). Five respondents estimated annual expenses for crow control at $\leq \$ 100$ ($n = 1$), $\$ 101 - \500 ($n = 2$), $\$501 - 1,000$ ($n = 1$), and $\$100,000$ ($n = 1$).

Respondents indicated crow roosts were present in their city for 1 - 10 years ($n = 7$), 11 - 20 years ($n = 4$), 21 - 30 years ($n = 3$), and >30 years ($n = 7$). Responses regarding the period(s) of greatest crow abundance varied, from spring - summer ($n = 14$), fall - winter ($n = 8$), fall - spring ($n = 1$), spring - fall ($n = 2$), and year-round ($n = 6$). When asked if crow populations had changed, 31 respondents didn't know. For those that gave an answer regarding population change, 13 respondents (52%) indicated an increase, 2 a decrease, and 10 that it had stayed the same.

Table 4. Number of cities or towns in California reporting on the success of crow control efforts with different levels of magnitude with organization.

Level of crow control efforts	<u>Were control efforts successful</u>		
	Yes	No	Partially
Individual efforts by neighborhoods or business associations	3	6	6
Group efforts by neighborhoods or business associations	2	0	1
Large-scale effort organized by local officials	1	1	1

Table 5. Number of cities or towns in California in 1999 reporting the use of specific control techniques for crows and the average rating of effectiveness (0 - useless, 1 = poor, 2 = good, 3 = excellent).

Control technique	Used on crows (<i>n</i>)	Effectiveness	
		\bar{x}	SE
Shouting, clapping hands	6	0.6	0.4
Pyrotechnic devices (e.g., bird bombs, whistlers)	5	2.0	0.4
Distress calls	5	1.2	0.6
Water spray	2	1.5	0.5
Pellet or BB gun	1	0	--
Firearms (e.g., shotgun)	3	2.7	0.3
Tree pruning	6	1.3	0.2
Tree removal	3	1.7	0.3
Mylar tape	2	1.0	- ^a
Sticky contact repellents	1	2.0	-
Poisoning	1	3.0	-
Food and water source removal	1	- ^a	-
Scarecrows or decoys (e.g., plastic owls or snakes)	4	0.5	0.3
Wire grid	1	1.0	-

Discussion

Urban roosts as a nationwide occurrence

Although urban roosts were reported from Maine to California, there were gaps in occurrence. Urban roosts, reported from 24 of the 39 states, were mostly concentrated in the eastern half of the United States in New England, the mid-West, and the mid-Atlantic regions. Urban roosts were not reported from the western states, with the exception of California. Urban roosts were also not reported from most of the southern states. At most locations roosts were used during the winter period, although 8 roosts in 3 states were used year-round. Year-round crow

roosts have been observed in northern California (Gorenzel and Salmon 1995). In northern locations where crows are migratory, roosts were used only in the summer and fall (e.g., North Dakota).

Shift from rural to urban roosts

Several factors support the concept of a shift from rural to urban roosts in the last 40 years. In the national survey, 56 of 59 urban roosts (95%) were used for ≤ 20 yr, indicating urban roosts are a relatively recent event. In the California survey, 11 of 21 urban roosts (52%) were used for ≤ 20 yr. Emlen (1940) did not report any urban roosts in his statewide survey of California whereas our

survey identified 24 cities with roosts. USDA Wildlife Services personnel in 12 states indicated there had been a shift and in 11 states indicated that most roosts were now located in urban rather than rural locations. The timing of the shift is variable beginning as early as the 1970s in some locations, but only recently, in the 1990s, at other locations. The range in answers regarding the timing of a shift suggest it is an ongoing process.

The above factors, however, do not conclusively demonstrate an abandonment of rural roosts in favor of urban roosts. It is suggested that rural roosts continue to be used and that urban roosts represent an expansion into a formerly unused habitat driven by increasing crow populations. A survey of historic, rural roosts used in the 1950s and 1960s for present-day occupancy would provide the necessary information. In California rural roosts in winter are uncommon; the authors know of only 1 such roost.

Crow population status

Most respondents in the national and the California surveys thought that crow populations were increasing. We compared responses with results from United States Geological Service breeding bird surveys (BBS) from 1966-1999 (Sauer et al. 2000). Wildlife Services personnel responses agreed with BBS in 24 (73%) of 33 instances. BBS indicated growing crow populations (defined as $>+0.25\%/yr$ from 1966-1999) in 28 of 33 states. BBS also confirmed increasing crow numbers in California, with a 2.4% annual increase statewide. In the Central Valley of California BBS indicated an annual increase of 4.7%, a rate that more than quadruples populations over the 1966-1999 period.

Urban roost control efforts

Large-scale control efforts to disperse roosts have not been common with only 3 attempts reported from California and 16 attempts elsewhere in the nation. Most control efforts employed hazing in some form, usually pyrotechnics, and were individual efforts by residents or businesses. Lethal control, either shooting or poisoning with DRC-1339, was proportionately more often used in the large-scale control efforts (62%) reported by Wildlife Services personnel than in reports (10%) from local officials in California. Large-scale efforts, even with lethal control, are not guaranteed success. Most of such efforts have been only partially successful.

Respondents knowledge and ability to answer questionnaire

The analysis of responses from any questionnaire should be tempered by an understanding that the respondents may have limited knowledge about the subject in question. Some questions require long-term knowledge (e.g., how long have roosts been occupied or when did a shift occur). It is likely that at both the local and federal level some if not many respondents simply have not been on-site long enough to acquire the historical perspective to answer particular questions. For such questions, respondents often answered "don't know" or gave no answer. On the other hand, some respondents exhibited a detailed knowledge (e.g., the identification of 32 roosts in Connecticut, Massachusetts, and Rhode Island by 1 Wildlife Services director), perhaps aided by long-term experience, personal interest, or current events (e.g., concern about West Nile Virus and dead crows).

Knowledge of roosts in some cases may depend on whether the respondent has received complaints. This situation may especially apply to Wildlife Services personnel, who indicated most often that the basis for their answer regarding crow population changes was based on the number of complaints received. In California some cities ($n = 10$) did refer complaints to other government agencies, but only 1 city referred to Wildlife Services. Wildlife Services personnel in states with urban roosts reported on average fewer than 4 roosts/state. The California survey identified a large number of cities ($n = 24$) with roosts, many of which were previously unknown to the authors. Based on the discrepancy in the number of roosts reported, we suggest that the number of urban roosts identified by Wildlife Services personnel is less than actually exists and thus underestimates the extent of urban roost problems.

Management implications

The responses from the surveys, backed by data from BBS, indicate crow populations are increasing in many regions of the country. There is support for the concept that a shift from rural to urban roosts has occurred in many regions of the country. This shift has already occurred in many locations, but is probably still in progress elsewhere and could occur in urban areas currently without any urban roosts. These trends suggest increasing problems at established roosts as crow numbers grow and new problems as crows establish new urban roosts. Probable underreporting of urban roosts suggests crow roost problems are more common than generally known.

There is a need to develop new techniques and strategies to relocate or

disperse roosts on large scale. New hazing techniques such as lasers or remotely-activated distress calls hold promise. Hazing, however, often only moves the problem to another location. Research on roost characteristics may someday permit the identification or even the creation of roosts in acceptable locations to which crows may be naturally drawn or herded by hazing. With increasing crow numbers, population management by lethal or reproductive control should be examined. Computer modeling should be employed to determine the feasibility of population management.

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