POPULATION ECOLOGY OF ROCK DOVES IN A SMALL CITY

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Abstract:

We studied population dynamics of rock doves *(Columba livia)* in Stevens Point, Wisconsin from June 1976 through September 1977. A relatively stationary population of about 900 rock doves used 112 roosting sites within the city. Eight communal roosts contained 70% of the population. Rock doves nesting in communal roosts may be more productive than pairs nesting on houses. Annual increment was estimated at 43%, but mortality and dispersal rates were balancing. Rock doves were relatively healthy; the only zoonosis was *Chlamydia,* found in 21% of 103 blood samples. Rock doves were considered a nuisance by 37% of 1,299 households interviewed. The rock dove population should be managed by reducing the number of large roosts and adopting procedures to reduce food sources.

INTRODUCTION

Rock doves (feral pigeons) can be found in almost every urban area in North America, and are controversial in most. Large concentrations can cause health hazards (Scott 1964), noise, aircraft threats (Solman 1974, and economic loss (Murton et al. 1972*a*). By contrast, they are beneficial scavengers, and the only large wild bird readily viewed in downtown areas (Scott 1961). Most efforts to reduce the population size of rock doves have temporary effect until the population recovers through recruitment (Scott 1961, Murton et al. 1972*a*). This study was initiated in response to complaints of nuisance rock doves. It examines recruitment, nesting locations, movement patterns to food and water, and nuisance status of rock doves in a typical midwestern city to identify weak ecological links which might be exploited for population control.

STUDY AREA

The city of Stevens Point in Portage County, central Wisconsin, contains 24,000 people in an area of 29 km^2. Most houses and business establishments within the inner core of the city were built between 1870 and 1930. Architectural designs include Italianate, Victorian, Neoclassical Revival, Prairie, and Southwest Bungalow. Churches are of the Gothic style with domes showing Polish influence. Suitable rock dove roosting and nesting habitat results from the intricate ornamentation, complex roof structure, gables, and long over-hanging eaves of buildings. Such architecture is typical of urban areas in Wisconsin. Railroad cars transporting grain are subject to spillage, and are emptied and washed in Stevens Point, providing rock doves with food. Winters are severe, averaging 74 days/year when the maximum temperature is 0°C or below. Stevens Point averages 122 cm of snowfall/year.

METHODS

From June 1976 through September 1977 daily movements were observed with spotting scope and binoculars from high vantage points. Nesting and roosting-site suitability

was identified by the number of rock doves using the site, amount of overhead cover, and nesting success after a season of observation. Productivity of 15 house nest sites and 2 church communal nest sites was compared during summer 1977.

Rock doves were live-trapped with a wood frame drop net triggered by a pull-string, a wood frame top-slotted drop-in trap, and with a fish landing net used in the roosts at night. Doves were banded, and marked with color-coded patagial tags and spray paint on wings to identify individuals and flocks. Population density was identified by 2 types of monthly observations: doves were counted in their roosting areas by night, and at feeding and loafing sites by day. Flock counts were most effective during winter, when rock doves concentrated daily at loafing areas, and few were on nests. Photographs were used to facilitate counts of large flocks. At intervals each month, daily observations of movement patterns to food and water were made from roofs of various buildings within the city, and on ground near roosting, nesting, staging, feeding, watering, and loafing areas. During winter months, local rural pigeon roosts were surveyed with binoculars for marked dispersed urban rock doves. Doves loaf on roofs of silos, barns, and other buildings, especially on clear, cold winter days. Requests were made through the local newspaper for sightings of marked rock doves outside of Stevens Point.

Blood samples and cloacal swabs were collected monthly and analyzed at cooperating laboratories for the following zoonoses and blood parasites: influenza, parainfluenza, Newcastle disease, western equine encephalitis, eastern equine encephalitis, St. Louis equine encephalitis, California encephalitis, chlamydiosis, histoplasmosis, blastomycosis, cryptococcosis, salmonella, *Haemoproteus, Leucocytozoan, Plasmodium.* Blood was obtained through heart puncture with a 22 guage, 3.8-cm needle used with a 5 cc vacutainer. All rock doves were returned alive to the population.

Results

Nesting and Roosting Sites.—Most of the 112 nesting locations found were in the central part of the city where the older houses and buildings are located. Eight large (<30 birds) nest sites accounted for 70% of Stevens Point's rock doves. These large nest sites were higher than 6 m, protected from the weather, and inaccessible to humans and other animals.

Of 970 rock doves, 30% nested on 92 houses. These were older houses with eaves, dormers, roof support brackets, or other structures of a characteristic height, shape, depth, and overhead coverage lacking on newer houses in the city. A count of 502 houses with apparently suitable nesting habitat in the community indicated that 12-15% of available nesting structures were being used. Rock doves roosted mostly under the dormer eaves and on the brackets. Single pairs of rock doves occupied the roost/nest niches of houses. Additional rock doves roosting at the same site usually were the pair's most recent progeny. The mean height from the ground of a house roost was

Table 1. Results of a survey of all Stevens Point households with rock doves where the question, "Do you believe pigeons are a nuisance?" was asked.

Households interviewed ($N = 1299$)	N	%
Nuisance	475	36.6
Not nuisance	750	57.7
Undecided	74	5.7
Total	1299	
Answers from people who had encounters with rock doves on their property.		
Nuisance	59	50.0
Not nuisance	44	37.3
Undecided	15	12.7
Total	118	
Answers from people who did not have encounters.		
Nuisance	416	35.2
Not nuisance	706	59.8
Undecided	59	5.0
Total	1181	

6.5 m. Selection by rock doves of aspect ($N=107$) showed no distinct pattern, although they seemed to avoid west, north, and south sides of houses.

A complete house-to-house survey of the central (older) section of Stevens Point, where rock doves occurred, was conducted for locations of pigeon activity and to determine if people considered rock doves a nuisance. Of 1,299 people sampled, 58% thought rock doves were not a nuisance (Table 1).

Production.—We banded, marked, and released 284 rock doves, including 56 juveniles, with patagial markers. We monitored 281 nests (246 nests at 2 churches, 30 nests on 15 houses, 3 nests in trees, 2 nests at a school).

During April-August 1977, 86% ($N=70$) of the house-nesting rock doves nested on the 15 houses studied intensively. House-nesting rock doves usually did not renest (Table 2) or nest at all during a 5-month period from late fall to early spring. Hatching success of 281 nests observed throughout the city was 71%. From 544 eggs laid, 288 rock doves (53%) fledged. During April-August 1977, 70 house-nesting rock doves fledged 37 young, or 53% of their population, compared to 104% for the 2 churches studied (Table 2). The number of young produced was different ($P<0.01$, $x^2=9.47$,

TABLE 2. Productivity of communal nest sites versus house sites in Stevens Point, WI, 1977.

		Communal		
Total	*Houses (N=15)*	*St. Stansilaus Church*	*St. Joseph Church*	*Combined*
N rock doves	70	65	46	111
N Nests[a]	30	54	31	85
N fledged	37	67	48	115
Fledglings/nest	1.23	1.24	1.55	1.35

[a] Includes renests.

TABLE 3. Estimated productivity and annual increment for the Stevens Point, WI, pigeon population, 1977.

Roost site	N *Roosting*[a]	N *nesting*	N *nests*	*Total*[d] *young/year*
St. Stanislaus[b]	100	66	33	134
St. Joseph[b]	75	46	23	93
Shippy Store[b]	100	24	12	49
St. Stephen[b]	50	20	10	41
Fox Theater[b]	100	10	5	20
Dam	50	—	—	—
Old Main[c]	75	30	15	37
Black Bridge[c]	50	30	15	37
Houses[c]	291	210	105	258
Total	891	436	218	669

[a] Average *N* pigeons at roost site.
[b] Communal roost productivity value of 1.35 fledglings/nest and 3 nests/year.
[c] House roost productivity value of 1.23 fledglings/nest and 2 nests/year.
[d] Total young = nests x productivity value (b or c).

$$\text{Annual Increment} = \frac{N_T - N_O}{N_T} = \frac{(891+669)-891}{1560} = 43\%$$

df = 2) between the 15 house sites studied and the communal nest sites in the 2 churches, but the number of fledglings/nest was similar between 1 of the churches and the houses (Table 2). On the 15 houses studied intensively, at least 57% of the rock doves were non-breeders (Table 2); on the 92 houses with rock doves, at least 28% of the rock doves were non-breeders (Table 3). In the 2 communal nest sites studied intensively, at least 28% of the rock doves were non-breeders (Table 2); in the 5 communal nest sites, at least 61% of the rock doves were non-breeders (Table 3). Overall, 51% of the rock doves in Stevens Point were non-breeders in 1977 (Table 3).

Although more nests were produced in the 1st nest attempt, nest success reached 71% with the 3rd nest attempt (Table 4), of which 68% were started in June and July. First nest attempts of the year were 81% successful during April through July 1977. No eggs were laid in December and January and no young fledged in February.

The rock dove population was relatively stable, fluctuating between 850 and 1,030 birds from May 1976 to August 1977, or 76-89 rock doves/km² (Table 5). In August 1976, 66% of the population of rock doves ($N = 910$) lived in communal nest sites, 32% on houses, and 2% on other buildings. A population decline in March 1977 followed a very cold winter. A decline in May 1977 resulted from more rock doves (140) than usual being shot by the Stevens Point Police Department in response to complaints; the effect on nesting is unknown.

Mortality and Dispersal.—We estimated an annual increment of 43% for the rock dove population by expanding productivity values obtained from known church and house nest sites to the other nest sites in Stevens Point (Table 3). From January through August 1977, the mortality of 155 rock doves was accounted for. With an estimated production of 670 rock doves, 515 rock doves remained unaccounted for. Although the study period did not cover the last 4 months of 1977, data from the same period in 1976 indicated that little mortality occurred. We found only 8 dead rock doves from September to December 1976. Much of this mortality probably was caused by human-related activities (i.e., shooting, trapping, road-kills). Such mortality was difficult to monitor because some people shoot and trapped rock doves secretly, and road-kills often were picked up immediately by the city sanitation crew. Dispersal, perhaps to rural roosts, may have been high. No marked rock doves were observed during 3 visits to adjacent rural roosts in winter

TABLE 4. Nest attempts of 64 pairs of rock doves at 2 churches and the fate of their 160 nests, Stevens Point, WI, January-September 1977.

	N *nest attempts*					
	1	*2*	*3*	*4*	*5*	*6*
N nests	64	41	28	20	6	1
Nest mortality[a]	15	12	7	8	3	1
N successful[b]	36	28	20	10	2	0
N unsuccessful	28	13	8	10	4	1
% success	56.3	68.3	71.4	50.0	33.3	0

[a] Nest mortality = number of nests abandoned or destroyed before hatching and is part of the unsuccessful nests.

[b] Successful nest = fledged at least 1 young.

TABLE 5. Monthly census of rock doves in Stevens Point, WI.

Time	N
May 1976	850
June 1976	910
July 1976	900
August 1976	910
September 1976	950
October 1976	1000
November 1976	1010
December 1976	1020
January 1977	950
February 1977	950
March 1977	880
April 1977	1030
May 1977	890
June 1977	960
July 1977	975

1976, and no one responded to newspaper articles requesting sightings of marked rock doves outside Stevens Point. However, in 1986, a student reported shooting a banded rock dove in late 1977 at his rural farm about 10 km from Stevens Point.

We found 4 rock doves killed by hawks, 1 by an owl, 10 by car collision, and 4 by shooting. We found 4 adult and 88 juvenile rock doves dead in the 2 church nest sites, August 1976-August 1977, with a high of 14 dead juveniles in September 1976 and March 1977. Of 53 juveniles patagium-marked at the 2 churches from May through August 1977, 43% were recaptured there at the end of August 1977. Others were observed on ledges outside the churches, on nearby houses, and at communal nest sites downtown.

Tests for zoonoses produced positive results only for *Chlamydia,* which occurred in 21% of 103 blood samples examined for it. Of 224 blood smears examined for parasites, 3% contained 7 *Haemoproteus* and 1 suspected *Plasmodium.* These results reflect a low incidence of parasites compared to other studies (Table 6). No other zoonoses were found in the 451 blood samples, 384 cloacal swabs, and 15 fecal samples examined.

Movement to Food and Water.—The Soo Line railroad track area within Stevens Point's city limits was the main feeding area. Most rock doves spent at least part of each day there. After snow melt this source was augmented by seeds and litter picked up in an athletic field and throughout the city, but the tracks were the main food source. Water was obtained from pools on buildings after precipitation and from the Wisconsin River. The Wisconsin River was used more often during summer.

Observations revealed the following daily schedule for rock doves in Stevens Point during summer:

Sunrise to 1 hour after—about ⅓ of the city's rock doves were feeding, courting, and flying in the Soo Line track area. Others were occupied with young and/or eggs or loafed near the roost area.

Rest of morning—the rock doves were back around the roost site or in its general area. They loafed in the sun or picked up food and grit nearby. Noon through afternoon—the birds were back at the Soo Line tracks, but not all at the same time. During this period, small groups (4-25) were constantly leaving and flying into the area; only 150-300 birds could ever be counted at any one time at the railroad tracks. However, during this period most of the city's rock dove population visited the Soo Line track area as the primary food source in the city, as evidenced by color-coded patagial tags and spray-painted wings.

One hour before sunset to sunset—the rock doves were in or near the roosting area, loafing or feeding.

Sunset—all rock doves were roosting.

During winter the schedule changed in that the rock doves arrived at the tracks 3 hours after sunrise and left 3 hours before sunset. They spent proportionally more of

TABLE 6. A comparison of various geographical locations for the incidence of *Haemoproteus columbae* in rock doves.

% infection	N *rock doves Sampled*	*Location*	*Authority*
3.0	224	Stevens Point, WI	This study
58.3	60	Henrico Co., VA	Jochen 1962
82.2	—	Honolulu, HA	Kartman 1949
57.7	—	Parana, Brazil	Giovanni 1946

their time in the track area during winter because it was their only food source and no nesting occurred. Therefore, we saw larger concentrations (500-800) at the tracks during winter. Spring and fall were transitional periods between the 2 schedules.

Discussion

Nesting and Roosting Sites.—Rock dove roosting/nesting sites in Stevens Point were characteristic of those in other urban areas (Potts and Wolmendorf 1960, Scott 1961, Woldow 1972). Feral rock doves are colonial nesters like their ancestors which nest in coastal caves (Gompertz 1957) and roost in groups (Goodwin 1960). Rock doves in Stevens Point used only 12-15% of available house roosts and all available communal sites. Communal sites were crowded. House sites may be marginal habitat for rock doves, perhaps occupied by surplus or subordinate birds from overcrowded communal sites, as Murton et al. (1974) suggested.

We observed no seasonal preference of nesting sites. Rock doves leave sites exposed to cold weather winds (Woldow 1972), and move to locations not facing prevailing winds (Murton et al. 1972*b*). The rock doves of Stevens Point were observed to avoid cold winter winds, seek shade during hot summer days, seek sunlight during cold winter days, and avoid the north and west sides of houses which receive the harsh cold winds of Wisconsin's winters, and the south side which was hot during nesting in summer. Overhanging eaves of dormers and the proximity of other houses apparently provided enough protection from the weather all year on some houses. Rock doves used certain houses as loafing areas during winter days; these houses had poorly insulated, gently sloping roofs. Roofs too steep were difficult to walk on. Poorly insulated roofs radiated heat which reduced snow and perhaps warmed the rock doves.

Population Characteristics.—The relative monthly stability of the rock dove population probably was due to a combination of year-round availability of food and water, relatively few breeders (49%), distributing reproduction over a long time (9 mo.), and probably high dispersal rates. The size of the rock dove population (850-1030) in Stevens Point may be related to the number of communal nest sites within the city, food availability, and low incidence of parasites and disease. Four large sites not intensively studied in the downtown area were used by 300 rock doves, but only an estimated 18% nested in what may have been generally unsuitable nesting habitat with few nest sites. These sites also may have contained many young-of-the-year from other sites; young rock doves marked from the 2 churches were seen at these sites.

Human-related activities probably were the major mortality factors for adult rock doves. Most of the increment of young birds could not be accounted for later, and may have dispersed outside the city or the population pressure may have forced subordinate non-breeding adults to disperse. Because many fledged young-of-the-year were forced from their natural area by established adults, they probably sustained higher mortality than adults from shooting and trapping. Fledging success in Stevens Point compared favorably with that in Maryland (Schein 1954), England (Murton et al. 1972*a*), and New Zealand (Dilks 1975) even though weather extremes are greatest in Stevens Point. Mortality of squabs may result from exposure, disease, and sibling rivalry. Murton and Clarke (1968) stated that the weakened condition of adults in late summer due to moulting, rearing several clutches, and a lack of food supplies caused higher nestling deaths. The cold winters of Stevens Point may eliminate rock doves that are weak or subordinate. Weak birds which are often chronic or subclinical disease carriers may succumb with the added stress of weather. Subordinate rock doves also may be culled from the population by exposure to winter weather.

The 2 church communal nest sites pro-

duced more young than the house sites partly because rock doves prefer communal nest sites; more rock doves are available to produce more young there. The apparent difference in the number of birds fledged probably is due to most birds in the churches nesting and many renesting. House nesting birds laid only 1 clutch or did not nest during a 5-month period. Murton et al. (1974) stated that rock doves which could not establish themselves at their natal area were subordinate. Murton et al. (1974) also stated that reproduction was best at the natal area. Displaced rock doves from the Stevens Point communal roosts therefore might not be as successful.

Ready sources of food and water in Stevens Point were available throughout the year only a short distance from the nest sites. Especially important is the availability of food and water at the railroad tracks during winter, when the ground is covered with snow. The food that is eaten at the tracks is supplemented by weed seeds found within the city during spring and summer. Murton et al. (1972*a*) stated that food directly affected the breeding success and size of a population of rock doves in Manchester, England. Ricklefs (1972) stated that the number of clutches is an integral part of the annual fecundity and depends in large part on the length of the season that is suitable for reproduction. Ricklefs (1972) also noted that the long breeding season in rock doves is attributed to their varied and flexible diet.

The results of the rock dove nuisance survey and the complaints which led the city of Stevens Point to invite and support our study suggest that rock doves are a valued wildlife resource, but that the density of 76 rock doves/km^2 is too high. Public opinion must be considered in management objectives. Efforts should be aimed at maintaining an acceptable population size by monitoring and managing on an annual basis. Temporary rock dove control, such as shooting, trapping, drugging, poisoning, repellents, or destruction of nests and eggs, have been tried in other cities with relatively little success (Scott 1961) because they are short term in effect. The public often is offended by many of the temporary control measures (Penn 1965). Some of these are of value when used in conjunction with more permanent measures.

Control efforts should concentrate on nest site elimination and prevention. These methods offer permanent control and have been part of successful rock dove control programs (Potts and Wolmendorf 1960, Scott 1961). In the case of Stevens Point, the dependable source of food at the railroad station was probably the key factor, especially in winter, in maintaining the population of rock doves at 76-89/km^2. The daily practice of washing out grain cars with hot water provided a regular source of food, grit, and water during these critical months. Reduction of the rock dove population probably would occur if the station could reduce the spillage of grain atop grain cars and on the tracks, and if it could wash the cars less often, inside a building, or on top of a single catch basin to which the birds were prevented access.

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Literature Cited

Dilks, P. J. 1975. The breeding of the feral pigeon in Hawke's Bay, New Zealand. Notornis 22:295-301.

Gompertz, T. 1957. Some observations on the feral pigeon in London. Bird Study 4:2-13.

Goodwin, D. 1960. Comparative ecology of pigeons in inner London. British Birds 53:201-212.

Giovanni, M. 1946. Fauna parasitologica parenese. I. *Haemoproteus columbae,* Celli and Sanfelici, 1891 em *Columba livia* nos Pombias de Curitiba. Arg. Biol. e. Tecnol. 1:19-21.

Jochen, R. F. 1962. A survey of parasites in a population of pigeons (*Columba livia,* Gmelin) in Henrico County, Virginia. M.S. thesis, Univ. Richmond, Richmond, VA. 63 pp.

Kartman, L. 1949. Observations on the *Haemoproteus* of pigeons in Honolulu, Hawaii. Pacific Sci. 3:127-132.

Murton, R. K., and S. P. Clarke. 1968. Breeding biology of rock doves. British Birds 61: 429-448.

_____, C. F. B. Coombs, and R. J. P. Thearle. 1972*a*. Ecological studies of the feral pigeon *(Columba livia)* Var. I: population, breeding biology and methods of control. J. Appl. Ecol. 9:835-874.

_____. 1972*b*. Ecological studies of the feral pigeon *(Columba livia)* Var. II: flock behaviour and social organization. J. Appl. Ecol. 9:875-889.

_____. 1974. Ecological studies of the feral pigeon *(Columba livia)* Var. III: reproduction and plumage polymorphism. J. Appl. Ecol. 11:841-854.

Penn, L. A. 1965. Pigeon control in Milwaukee. Pest Control 33:16-18.

Potts, R. M. and D. J. Wolmendorf. 1960. Pigeon control in Fresno, California. Vector Views 7:59-62.

Ricklefs, R. E. 1972. Fecundity, mortality and avian demography. Page 366-434 *in* D. S. Farner, ed. Breeding biology of birds. Nat. Acad. Sci., Washington, D.C.

Schein, M. W. 1954. Survival records of young feral pigeons. Auk 71:318-320.

Scott, H. G. 1961. Pigeons—public health importance and control. Pest Control 29:9-20.

_____. 1964. Pigeon-borne disease control through sanitation and pigeon stoppage. Pest Control 32:14-15.

Solman, V. E. 1974. Aircraft and wildlife. Pages 137-141 *in* Symposium on wildlife in an urbanizing environment. Coop. Ext. Serv., Univ. Massachusetts, Amherst.

Woldow, N. L. 1972. Studies on the reproductive capacities of birds with a field study of the feral rock dove, *Columba livia,* L., in the urban environment. Ph.D. thesis, Rice Univ., Houston, TX. 169 pp.