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THE WINTER FLOCKING BEHAVIOR OF THE COMMON CROW (*CORVUS BRACHYRYNCHOS* BREHM)[1]

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Gregariousness is one of the striking postnesting behavioral patterns for various species of game birds (Order, Galliformes) and passerines, such as many species of swallows (Family, Hirundinidae), crows (Family, Corvidae), the starling (*Sturnus vulgaris*), and some species of blackbirds (Family, Icteridae). This paper describes observations on the common crow made in Lucas County, Ohio, during the winter of 1961–62. The objectives for the project were to investigate roosting patterns and the relationships of light intensity, temperature, type of cloud cover, and wind velocity to the daily evening flocking behavior of the crow. The hypothesis that light intensity is a determining factor, initiating the return of the crows to the roost area and also initiating the settling down into the final roost, was the main concern of this study.

Winter roosts are scattered throughout Ohio with a heavy concentration in the west-central and the south-western parts (Good, 1952). Of the several roosts reported in Northwestern Ohio by Good (1952), the one in Lucas County was used as the study area for this project. This Lucas County roost, which was present in 1948–9 but not in 1950–1, seemed to have moved into the southern part of Wood County where there was another roost close by during both winters of the survey (Good, 1952). Emlen (1938), however, concluded that the same crows come back to the same general roost areas year after year. Why the Lucas County crows left the area but later returned is not known, but the heavy shooting pressure in this area may have been a factor.

The seasonal flocking behavior of the crow is not a sudden event. Beginning in late summer or early fall the birds congregate in small groups. As late fall and early winter set in, the roosts get larger, reaching their peak during midwinter. Various small groups come together to form the large roosts. These small groups, however, tend to maintain their identity and continue to feed in the same general area. The fluctuations in the size of the roosts during the winter are attributed to various smaller groups moving in and out as the season progresses (Good, 1952).

In their diurnal flocking the crows of a roost disperse in several directions to feed. Toward evening they return first to a secondary roost and later to a final roost. The factors which influence this behavior are far from being understood. Davis (1956) studied the similar starling flocking behavior in relation to light intensity, the relative amount and the direction of the wind, and the degree of cloud cover but found no clear relationships. Jumber (1956) in a similar study found that direct light intensity determinations are more revealing than are com-

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parisons with the times of the sunsets. He also analyzed the starling behavior in view of several weather conditions such as wind velocity, temperature, and precipitation (rain and snow) and found that adverse conditions caused earlier flocking patterns.

The area of the Lucas County roost and the surrounding areas are generally good flat farm land interspersed with small woodlots. The fields of corn and other grains are fed upon by the crows as they move across the countryside while the woodlots along the way are frequently used as temporary roosts. The airport and the Oak Openings Park areas are not as extensively farmed as some of the peripheral areas so that the woodlots in these areas are more frequent and somewhat larger (fig. 1).

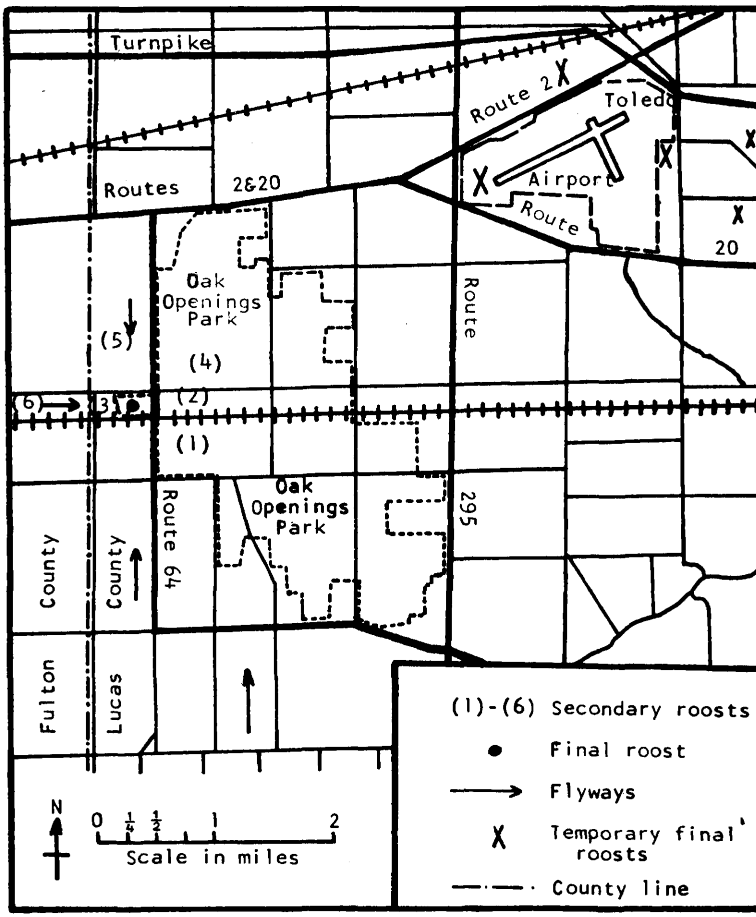

FIGURE 1. Location of Oak Openings Park and Toledo Airport roost areas.

METHODS

In October and November, 1961, with the initiation of winter flocking, weekly observations were made in the Oak Openings area to become familar with the behavior of the crow, but the most pertinent data were obtained from December through March. The daily field procedure involved, initially, the determination of the roost site for that night, since changes in the location were frequent. Then estimates of the number of arriving birds and measurements of environmental factors were made until darkness obscured vision.

The observation point for each day was established to give a clear view of the heaviest concentration of crows coming into the roost. Some landmark was chosen, and the birds were counted individually (when in sparse flocks) or in groups of fives and tens (when in dense flocks) as they passed the landmark during five minute intervals six times an hour. It was felt that the amount of counting error involved in this method was about 20 per cent, but no actual determination was possible. The estimate of the total population was made by doubling the number of crows counted, since the counts were made during only half of the observation period, and by adding 50 per cent of this total to account for the other less used flyways.

Between counts, environmental measurements were obtained using three types of instruments. A photographic exposure meter (Weston II, Model 735, equipped with an invercone) was used to measure incident light initially. Due to its lack of precision at low intensities, a more sensitive photometer (Science and Mechanics Light Meter Kit 1–A) was used during the bulk of the study. The light readings were taken pointing the probe of the kit meter toward the zenith at about 6 ft from the ground. Conversion of the readings to foot candle units was accomplished by direct comparisons with a Brockway Exposure Meter (Model S).

Wind velocities were determined with a vane anemometer; air temperatures, with a mercury-in-glass thermometer shaded from radiation error. Observations on milling, shifting, and various other behavior patterns were noted while the counts were being conducted. The total observation period each day lasted about two and one-half hours from 1600 to 1830 hours, but varied somewhat depending on the weather and on the time of the year. The light intensity at the beginning of the observation period was about 1000 ft-c, or one-tenth of full sunlight, and ended at about 5 to 10 ft-c when it became too difficult to make dependable observations.

RESULTS AND DISCUSSION

By late October groups of 50 to 100 birds were sighted, and during the first part of November the observed population increased into the thousands. By January and early February the estimated number was between 15,000 and 20,000 birds. In late February and early March the population declined so that by the end of March groups of only 50 to 100 were seen.

The Lucas County roost was not stationary. Up to January the major roost at the airport area (fig. 1) was not in the same place for more than a week at a time, and during November a different woodlot was used each evening. Prior to early January most of the airport flock shifted to the Oak Openings Park area (fig. 1), although several hundred birds remained around the airport. The cause of the shift is not known, but the hunting pressure around the airport had caused some disturbance. Since the Oak Openings area is a park and a state forest with less human activity during the winter months, and has more tree cover than around the airport, it is thus a more suitable roost area.

A normal flocking sequence was as follows: By mid-afternoon (1400 to 1500 hours) small groups gathered and were feeding around the roosting area. Between 1500 and 1600 hours additional groups came in from the south and the west and a few from the north. Those from the west flew over the eventual final roost area, cawed several times, and then went to secondary roosts in woodlots to the north, the northeast, and the east. At about 1600 hours the counting started. The crows came in a heavier flight as the light decreased. Toward 1800 hours as many as 4000 crows arrived within a 5-min period from the west approach alone. Within about 10 min after the peak, the flight of crows into the final roosting area stopped except for a few stragglers. For an hour afterwards the crows shifted between areas and within the final roost itself. Chatter and periodic commotions always went with the shifting and settling.

Good(1952) stated that in areas of heavy hunting pressure the crows congregated from the flyway into a secondary roost and moved a mile or so to the final roost in a flight lane at a lower light intensity. This was the situation in the roost areas used in this study. Due to the almost continuous shifting among the airport roosts, distinction between the secondary roosts and a final roost was usually not possible; but at the Oak Openings Park area one or more secondary roosts and a final roost were frequently discernible (fig. 1). The secondary roosts varied in their relative use each day. Several of these were used each day, probably to accommodate the different flyways.

The six secondary roosts surrounding the final roost in the Oak Openings Park area are shown in figure 1. The quantitative data, however, were collected as the crows came from the westerly flyway and from secondary roost 6.

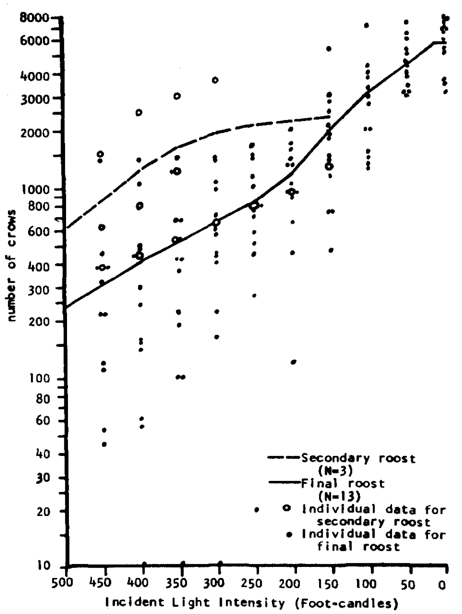

FIGURE 2. Cumulative rates of filling of the secondary and final roosts in relation to light intensity.

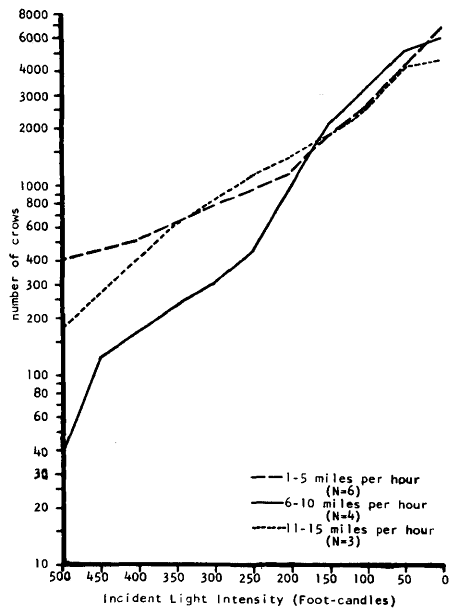

FIGURE 3. Cumulative rates of filling of the final roost in relation to light intensity and wind velocity.

Counts of the birds coming into the roost were compared graphically with light intensity, and variations in the curves were related to differences in the wind velocity, the temperature, and the cloud cover. The secondary roost data from area 4 (fig. 1) for three days (January 15, 29, and 31) were combined in figure 2. A filling of the roost at a logarithmic rate was indicated. Between 300 and 100 ft-c of light, great confusion was evident, and most of the birds moved into the final roost.

The graphical presentation of incoming birds to the final roost is quite different (fig. 2). The arrival of the birds into the final roost was similarly logarithmic during the observation period, but at about 15 ft-c of light, the flight was suddenly terminated. Considerable variation as indicated in figure 2 in both the secondary and the final roost data is evident and suggests the interaction of a number of factors.

The logarithmic increase with a sharp break off was expected, since crows are gregarious. When the threshold for the roosting behavior is approached, probably at different times for different birds, they, in increasing numbers, start for the final roost. As some go to the final roost, others are drawn by their actions. Thus the filling of the roost develops very rapidly, so that a logarithmic rate of increase with a sudden break off, apparently controlled by light, results.

From the individual graphs comparing the numbers of crows that came into the final roost with the respective light intensity readings, groupings were made on the basis of varying wind velocities, temperatures, and relative cloud covers.

The roost accumulation patterns related to wind speeds indicated no consistent pattern (fig. 3). Similarly, no consistent pattern with temperature was evident (fig. 4).

A comparison of the roost accumulation with the amount of cloud cover indicated that that flight began at higher light intensities on heavily clouded days (overcast) than on partly clouded or cloudless days (fig. 5). However, regardless

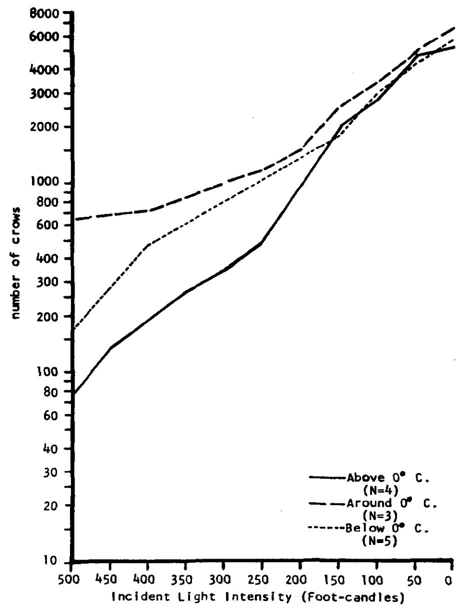

FIGURE 4. Cumulative rates of filling of the final roost in relation to light intensity and temperature.

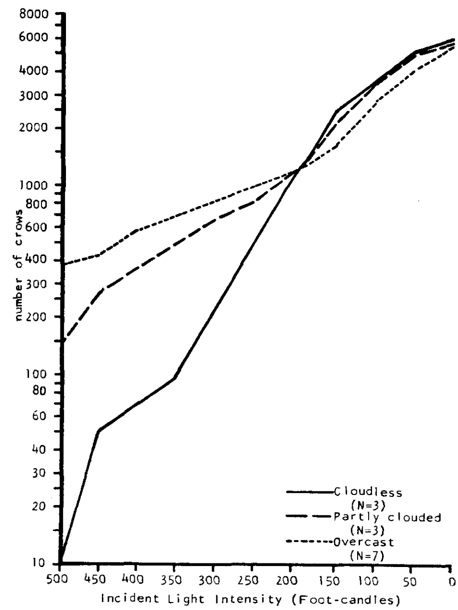

FIGURE 5. Cumulative rates of filling of the final roost in relation to light intensity and amount of cloud cover.

of the earlier pattern, the flights were essentially the same at the lower light intensities (below 200 ft-c).

On consecutive days varying widely in amount of cloud cover, however, little or no difference between photometer readings at the same clock times was found. Furthermore, Davis (1956) stated that clouds coming overhead greatly increased the light readings; and in the evening the low sun reflects off the clouds, so that a cloudy day records light readings much the same as a clear day at corresponding times. It is interesting to note that on February 23 which had a -3 C temperature, a 14 miles per hour wind velocity, and a blizzardly snow, making the weather the most adverse of all the observations, the earliest arrival times were recorded. Adverse conditions do seem to bring the crows in earlier, as Jumber (1956) also indicated in his work with starlings.

The difficulties in measuring light prompted undertaking another type of analysis after consulting Seibert's (1951) work with the roosting of herons and Davis' (1956) work with starlings. The times in relation to civil sunset (determined from a standard almanac) at which 50, 75, and 100 per cent of the final roost population had arrived were determined and were recorded as the number of minutes before (+) or after (−) sunset (table 1). Also, the means with their standard deviations are given for the wind velocity, temperature, and cloud cover groupings. The bulk (75 per cent) of the crows came in within the half hour span of 20 minutes before sunset to 10 minutes after sunset.

The Mann-Whitney U Test (Siegel, 1956), a nonparametric statistic, was used to test the significance of the differences in arrival times due to the wind velocity, the temperature, and the cloud cover. The only statistically significant (P = 0.05) differences were between the high and low wind velocity ranges, suggesting that high winds hasten flocking. Trends relating light intensity and cloud cover to the flocking behavior are evident, but were not statistically significant.

TABLE I

Percentage accumulations of the total roost in minutes before (+) or after (−) civil sunset in relation to wind velocity, temperature, and cloud cover.

	No. Days	50 per cent		75 per cent		100 per cent	
		Mean	S.D.	Mean	S.D.	Mean	S.D.
Wind Velocity (mph)							
1- 5	6	+ 7.8*	4.1	+ 0.2*	4.1	−13.5*	5.2
6–10	4	+11.8	8.2	+6.2	6.8	−9.0	1.4
11–15	3	+17.3*	8.1	+10.7*	9.1	−6.7*	4.0
Temperature							
above 0 C	4	+13.8	7.5	+7.8	7.1	−11.0	2.4
around 0 C	3	+10.0	3.5	+1.7	0.6	−14.3	5.1
below 0 C	5	+11.8	8.2	+5.0	8.8	−7.0	2.6
Cloud Cover							
cloudless	3	+8.7	6.2	+1.0	7.5	−11.3	7.6
partly cloudy	3	+8.7	1.4	+2.3	2.4	−11.7	6.3
overcast	7	+13.4	8.6	+6.3	8.8	−8.8	4.0
All Data	13	+11.2	7.1	+4.2	7.4	−10.1	5.1

*Differences between means statistically significant (P=0.05).

The two methods of analysis have both merits and disadvantages. The photometer method seems to be more closely connected with the crow flocking mechanism, while the sunset analysis was easier to use and does not involve instrumentation variation. Jumber (1956) stated that he received more reliable results using photometer data than using the sunset data in working with starlings. Nice (1935), working with starlings and bronzed grackles, found that the leaving and the returning to the roost area was closely related to light intensities. But neither Jumber (1956) nor Nice (1935) analyzed their data for statistical significance, merely giving light intensity ranges at which the birds came in. Davis (1956), furthermore, did not find statistically significant correlations using photometer readings in his work with starlings. He suggested, however, that the lack of correlation was due to the difficulties in the techniques used and not with the lack of relationship. More observations and the refinement of the methods are necessary before the contradictions and the confusion can be cleared up.

CONCLUSIONS

The crows followed definite flyways from the west, the south, and the north into first a secondary roost and later a final roost. The birds filled the roost at a logarithmic rate as the light intensity decreased, with a sharp break off at about 15 ft-c.

For the purpose of comparing the effects of wind velocity, temperature, and cloud cover the use of sunset times was more helpful. Arrivals on windy days were significantly (P=0.05) earlier than on calm days, and there was a tendency for earlier roost filling on days with a heavy cloud cover. No relationship between the flocking pattern and temperature was found.

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SUMMARY

1. Winter flocking behavior of the crow (*Corvus brachyrhynchos* Brehm) in the Lucas County roost areas of northwestern Ohio was evaluated to determine the effect of various environmental factors. The population oscillated during the study from a few hundred in October and the end of March to about 20,000 birds at its peak in January and early February.

2. Upon arriving from distinct flyways, in the late afternoon the crows usually went first to a secondary roost area and later to a final roost.

3. A logarithmic filling of the roost by the crows was indicated, and light seemed to be a basic factor influencing this flocking behavior. A heavy cloud cover tended to be related to earlier flock formation, and on windy days arrival times were significantly (P=0.05) earlier than under calmer conditions. Temperature variations had no apparent influence.

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