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John C. W. Bliese

Nebraska State Teachers College

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Cover Density of a City Summer and Fall Bronzed Grackle Roost

By JOHN C. W. BLIESE

INTRODUCTION

Ames, Iowa, is one of the many midwestern cities that have the dubious distinction of having a "blackbird" roost. During the summer and fall months thousands of birds each evening come to roost in the shade trees in residential areas. Records kept in 1951 (Bliese, 1953a) indicated that roughly 74 per cent of the birds were bronzed grackles, *Quiscalus quiscula*. Regularly associated with them were about 22 per cent starlings, *Sturnus vulgaris*, 3 per cent cowbirds, *Molothrus ater*, and 1 per cent robins, *Turdus migratorius*. Observations from 1949 to 1952 also revealed that at times purple martins, *Progne subis*, red-wings, *Agelaius phoeniceus*, and English sparrows, *Passer domesticus*, were present also.

One of the objectives of the investigation was to learn whether or not certain readily measurable features of the roost sites were correlated with the extent to which the birds used them. To that end records were kept of the degree of use accorded each tree in the roost area, as described in Bliese (1953 a & b). Degrees of use were: none, light, moderate, and heavy. Several physical measurements were made of the various trees, but only those dealing with cover density are discussed in this paper.

METHODS

Light Measurements Beneath the Trees

The density of cover provided by the foliage of the trees very early was suspected as a factor in the birds' use of roost sites. To gather data concerning this cover, the foresters' method of measuring forest canopy (Morris, 1936; Bacon, 1939; Wright, 1943; and others) was used, though in somewhat modified form. In essence, the method involved measuring the light beneath the trees and then expressing it as a percentage of the light in the open. All measurements were made with a Weston Sunlight Illumination Meter, Model 756.

Only zenith light, which come vertically through the crowns of the trees, was wanted to get indices of cover density. To eliminate sidelight, a modification of the method employed by

Morris (1936) was used. Morris used a metal cone-like shield which eliminated all light beyond 30 degrees from the vertical. For the present investigation a stovepipe-like arrangements was prepared from two orange juice cans, of number three size, cemented together end for end. The upper can had both ends removed, the lower can only one end. A slot, just large enough to permit the entry of the paddle with its sensitive element, was cut on the side of the lower can immediately next to the bottom. To keep the sensitive element centered, a wood block was glued to the inside bottom, and the completed unit was painted a flat black inside and out. In use the "stovepipe" with sensitive element in position was supported on a base equipped with two bubble levels at right angles to each other. Thus, essentially only a cylinder of light could reach the sensitive disk, and it always could be pointed definitely to zenith. The entire assembly, which consisted of meter, base, and the "stovepipe" with the sensitive element, was carried by the writer in front of him whenever light measurements were made.

To have as little change in the angular altitude of the sun as possible, all cover-density measurements were taken between 11:00 A.M. and 1:00 P.M. They were taken on days when sky conditions were quite uniform, for experience showed that a broadly broken cloud cover gave rapidly changing readings, sometimes even in a matter of seconds. Similar conclusions were reached by Bacon (1939), Sather (1950), and others. Since work by Bacon (1939) indicated that the same per cent of light got through a forest canopy on dark days as on clear days, uniformly overcast skies were used as well as clear skies. Very windy days were avoided, for strong winds opened and closed the tree crowns rapidly and caused wide fluctuations in the light readings beneath all but the densest hard maples.

Twenty readings were taken beneath each tree, the first 10 at arm's length from the trunk, and the other 10 at two arm's length. The meter was read at the end of every step when near the trunk, and at the end of every two or three steps farther out, as determined by the size of the trunk. The average of the 20 readings was expressed as a percentage of the average light in the open, which was measured approximately every 10 minutes, and was used as an index of the amount of cover provided by the foliage. A large percentage indicated little cover, and a small percentage much cover. A total of 23 noons, from July 3 to October 24, 1952, were occupied in getting such readings. The majority

were obtained during July when sky conditions were unusually favorable. Readings were taken on 16 city blocks, and some of the blocks were checked several times during the course of the season.

Light Measurements Within the Trees

To get a direct indication of cover conditions that the birds experienced, an attempt was also made in 1952 to measure the evening light intensities at the positions where the birds later roosted. The readings were taken on evenings when sky conditions were fairly uniform, from 15 to 30 minutes before the first birds arrived, until readings within the trees approached zero foot-candles.

A strong wood pole, which was made in sections, was used to get readings within the tree crowns. On the uppermost piece a frame was mounted to hold the sensitive element of the light meter firmly in place. Included in the frame was a thin glass plate to give protection against injury from twigs and branches. No "stovepipe" was used in these measurements, and the sensitive disk received light from nearly 180 degrees. A long extension cord connected the sensitive element to the meter which was kept on the ground.

Either 10 feet of pole or 20 feet, the latter composed of two 10-foot sections, usually was maneuvered upward toward the spot to be measured, and then smaller extensions, about two and a half feet long, were added as needed. When the entire pole was raised as high as the writer could reach, the sensitive element was about 35 feet above the ground, well within the range of the roosting birds in trees of moderate size. From any one place where the pole was pushed into the tree several readings were usually possible, either at different altitudes, different places at the same altitude, or both. Then the pole was dismantled and the process repeated at another place in the tree. The sensitive disk was kept pointed to zenith as nearly as possible when a reading was taken.

The usual method was to set up the pole and to read zenith light in the open, either 10 or 20 feet above the ground as determined by the size of the trees to be measured immediately thereafter. Then the pole was assembled and disassembled as needed to get 10 readings in each of two trees, and once more a reading was taken in the open. The process was repeated for two other trees, and sometimes for an additional one or two. After 10 readings had been secured in each of the four to six trees, the entire procedure was repeated, either once or twice. Thus, either

20 or 30 readings were made in each tree during an evening, and outside readings were taken as often as every 10 to 12 minutes. Since the light was changing constantly, the average of the 10 readings in a tree was expressed as a percentage of the average light in the open during the same time, and an overall average was computed for the evening.

Several factors limited the quantity of data that were secured for this phase of the investigation. To get the most data per evening, several trees which were receiving contrasting degrees of use by the birds were desired at the roosting site. Sky conditions had to be reasonably uniform to avoid wide fluctuations in light intensity readings that had nothing to do with cover conditions, and the dimensions of the trees checked had to be such that the writer could reach the roosting levels with the sectioned pole. In all, 25 trees were thus measured between July 23 and September 16, 1952.

RESULTS AND DISCUSSION

Light Conditions Beneath the Trees

The Two Methods of Tabulating the Data

Table 1, discussed in the next section, was based on the assumption that cover conditions did not change materially from late June to early September. Under this assumption all light readings taken during the summer were tabulated against the degree of use of the trees as determined on each of the four days that complete checks were made of the roost area. This made it possible to deal with a greater quantity of data, because the number of trees that could be measured for cover density on any one noon was somewhat limited. The results are also shown in Figure 1.

Table 2, which also is discussed in the next section, was based on the alternate assumption that cover conditions may have changed materially during the summer. Consequently, with the exception of the October data, the cover density measurements were tabulated only against those degrees of use of the trees as determined within two weeks or less of the light readings. In October, when cover changes were obvious and rapid, the light readings and degree of use determinations were made on the same days. Figure 2 shows the results graphically.

Relation Between Degree of Use and Light Measurements

On the assumption that there were no material changes in cover between June 24 and September 10, 1952, Table 1 shows that the birds used the American elms, *Ulmus americana*, according to the amount of cover present. In going up the scale of degrees

of use, there were progressive decreases in per cent of light getting through the crowns on each of the four days on which the roosting degrees were checked.

The birds' use of black maples, *Acer nigrum*, in general showed similar trends (Table 1), but, in line with their obviously heavier foliage, the percentages were much lower than for American elms. The data for August 6, however, did not fall into this general pattern. Likewise the percentage, 1.46, which was noted for lightly used trees on July 11, was not a good fit, for it was slightly higher than the percentage for trees not used, 1.40. Norway maples, *Acer platanoides*, tended to follow the overall trends shown by the black maples, but the data were more limited. "All other species" did not show any special pattern.

On the assumption that the cover did change during the season, the light measurements, summarized in Table 2, showed the same general pattern for American elms as in Table 1. Only two percentages were out of line, but they were based on only one tree in each case. On the other hand, the percentages for black maples through the October 4 to 10 period, presented a very confusing picture and did not indicate any definite trends. If anything, they tended to accentuate the exceptions to the basic trends shown in Table 1. Data for Norway maples and "all other species" also showed no consistent trends, but the data were quite limited.

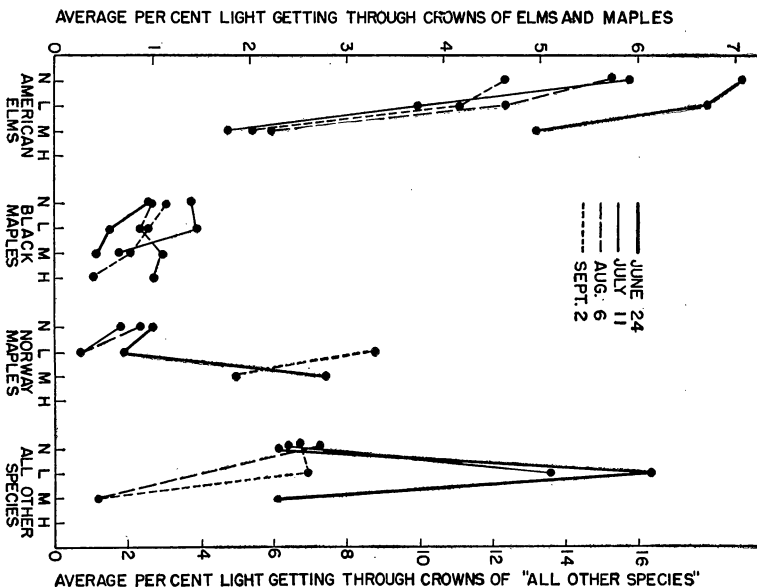


Figure 1. Cover density and degree of roosting on the assumption that cover did not change materially during the summer of 1952.

Table 1.
Relation of cover density readings to degree of roosting, assuming the cover did not change materially from June 24 to September 10, 1952.

Species of trees	Date of roost check	No. of blocks light was measured	Degree of roosting									
			None		Light		Moderate		Heavy		L&M&H ¹	
			No. of trees	% of light	No. of trees	% of light	No. of trees	% of light	No. of trees	% of light	No. of trees	% of light
Elms, American	June 24	9	61	7.06	17	6.71	8	4.96	0	—	25	6.15
	July 11	8	58	5.92	10	3.74	4	1.79	0	—	14	3.18
	Aug. 6	10	67	5.75	14	4.66	6	2.23	0	—	20	3.93
	Sept. 2	8	48	4.65	10	4.18	7	2.02	0	—	17	3.29
Maple, Black	June 24	9	20	0.96	6	0.58	2	0.44	0	—	8	0.55
	July 11	8	24	1.40	18	1.46	18	0.66	0	—	36	1.06
	Aug. 6	10	26	0.97	18	0.87	20	1.10	4	1.01	42	0.99
	Sept. 2	8	34	1.14	13	0.97	11	0.76	4	0.38	28	0.80
Maple, Norway	June 24	9	11	1.00	7	0.70	2	2.78	0	—	9	1.16
	July 11	8	5	0.66	2	0.28	0	—	0	—	2	0.28
	Aug. 6	10	6	0.86	2	0.28	0	—	0	—	2	0.28
	Sept. 2	8	0	—	3	3.26	1	1.86	0	—	4	2.91
All other species	June 24	9	31	6.19	1	16.50	2	6.09	0	—	3	9.56
	July 11	8	12	6.36	2	13.56	0	—	0	—	2	13.56
	Aug. 6	10	16	7.20	0	—	1	1.22	0	—	1	1.22
	Sept. 2	8	12	6.59	1	6.87	1	1.22	0	—	2	4.05

¹The sum of the Light plus Moderate plus Heavy figures. In other words, the data for trees used by the birds regardless of degree of use.

When all the evidence was summed, therefore, it was concluded that the birds tended to use the American elms selectively for cover, and used more intensively those that were denser. The tendency to use the trees with heavier cover reached its culmination in the hard maples in Ames, for Bliese (1953 a & b) showed that in general a larger percentage of hard maples than of American elms was used by the birds. Once within the range of cover provided by the hard maples, though, the variations in the densities of individual trees apparently had little if any effect on the birds. As will be shown elsewhere, other factors such as location with reference to other trees, and size of the tree, determined which hard maple was used lightly, moderately, or heavily.

In line with this reasoning, attention is called to the generally large percentages for "all other species" in Tables 1 and 2. Bliese (1953 a & b) found that roosting in Ames occurred chiefly in American elms and hard maples. The generally more open crowns of "all other species" may have been one reason why more of these trees did not serve as roost places.

Additional evidence of the tendency of the birds to use more intensively the trees with heavier cover was obtained from the light measurements taken from October 20 to 24 (Table 2). Although some of the percentages obtained were based on only a few trees, there was a definite trend for all trees to show smaller percentages with increasing degrees of use by the birds. The percentages, because of loss of leaves in October, averaged considerably higher than those obtained earlier in the season. The reason for the definite trends in latter October, in contrast to the relative absence of any consistent pattern for some of the tree species earlier in the year, probably lay in the loss of the cover by the trees and the consequent shift by the birds. The birds evidently stayed in their early fall roost trees until loss of cover drove them out. In seeking out new roost places, none of which had very dense cover after mid-October, they followed their tendency to use more intensively those trees with the heavier cover.

Light Conditions Within the Trees at Roosting Level

Table 3 shows the percentages of light at the roosting levels for the 25 trees that were measured. As can be seen in the "Summary" lines for the several species of trees, the American elms showed a definite tendency of lower percentages with increasing degree of roosting use, entirely in agreement with the results obtained with the more conventional measurements made during noon hours beneath the trees. The hard maples showed irregular trends with

Table 2.

Relation of cover density readings to degree of roosting, assuming the cover may have changed materially from July 2 to October 24, 1952.

Species of trees	Date of roost check	No. of blocks light was measured	Degree of roosting									
			None		Light		Moderate		Heavy		L&M&H	
			No. of trees	% of light	No. of trees	% of light	No. of trees	% of light	No. of trees	% of light	No. of trees	% of light
Elm, American	July 11	5	28	5.46	9	3.85	4	1.79	0	—	13	3.22
	Aug. 6	3	22	5.09	0	—	1	4.90	0	—	1	4.90
	Sept. 2	1	9	5.36	0	—	0	—	0	—	0	—
	Oct. 4-10	5	10	23.10	13	22.35	6	20.10	8	18.14	27	20.60
	Oct. 20-24	3	14	57.04	8	49.41	6	33.56	1	36.84	15	42.23
Maple Black	July 11	5	12	0.85	15	1.55	18	0.66	0	—	33	1.07
	Aug. 6	3	16	1.24	2	1.86	3	1.14	1	2.01	6	1.34
	Sept. 2	1	0	—	1	1.42	2	0.48	0	—	3	0.79
	Oct. 4-10	5	1	3.69	5	9.43	6	22.25	9	12.26	20	14.55
	Oct. 20-24	3	7	47.94	0	—	1	44.25	0	—	1	44.25
Maple, Norway	July 11	5	5	0.66	2	0.28	0	—	0	—	2	0.28
	Aug. 6	3	1	1.86	0	—	0	—	0	—	0	—
	Sept. 2	1	0	—	3	3.26	0	—	0	—	3	3.26
	Oct. 4-10	5	0	—	2	3.39	2	7.33	2	12.04	6	7.54
	Oct. 20-24	3	6	33.62	2	36.34	1	12.40	0	—	3	28.36
All other species	July 11	5	12	6.37	2	13.56	0	—	0	—	2	13.56
	Aug. 6	3	2	4.98	0	—	0	—	0	—	0	—
	Sept. 2	1	3	4.50	0	—	0	—	0	—	0	—
	Oct. 4-10	5	3	12.10	2	7.44	1	10.57	0	—	3	8.49
	Oct. 20-24	3	12	52.78	3	42.21	2	32.62	0	—	5	38.37

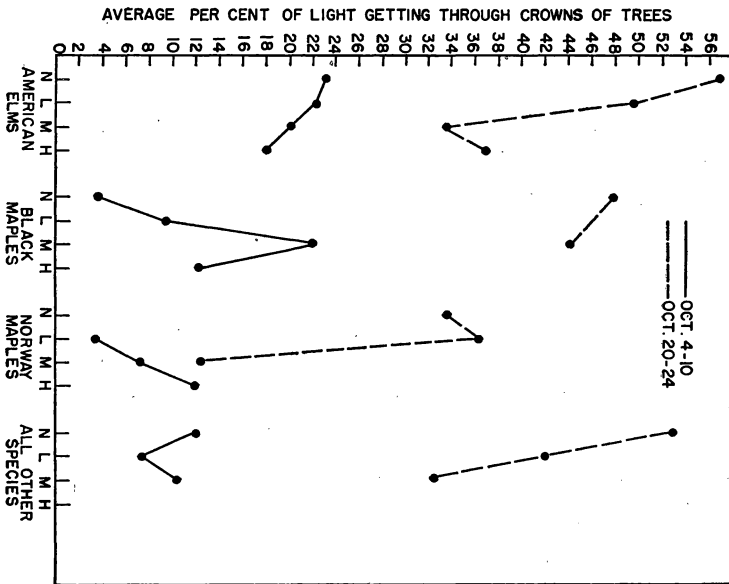


Figure 2. Cover density changes during October, 1952.

no particular interpretation, but, as was expected from their noticeably denser foliage, their percentages averaged lower than for American elms. Of the three Chinese elms, *Ulmus parvifolia*, the ones with the larger percentages of light getting through to the perching sites did not receive the attention of the birds. The one used lightly showed a percentage comparable to that for lightly used American elms.

Three of the Norway maples were measured again on October 24. One of these, not used by the birds but with a moderate amount of cover, gave a percentage of 37.33. Another one with very thin cover, but used lightly by the birds, permitted 42.19 per cent of the light to reach the perches; and a third tree, used moderately and with good cover, had an index of 28.16 per cent. Except for the expected low latter percentage, therefore, no trend that had any interpretation was shown for these three trees.

Light Conditions Within the Trees Versus Those Under the Trees

Table 4, which lists percentages of light obtained within the crowns and those obtained beneath the same trees, shows that without exception the percentages within the crowns were higher. This was as expected, for the light had to pass through only a

Table 3.
Evening light conditions at roosting level within the tree crowns at the time of arrival of the birds.

Species of trees	Date of light and roost check (1952)	Degree of roosting									
		None		Light		Moderate		Heavy		L&M&H	
		No. of trees	% of light	No. of trees	% of light	No. of trees	% of light	No. of trees	% of light	No. of trees	% of light
Elm, American	July 23					1	4.93				
	30			1	6.75	1	6.12				
	Sept. 9	1	13.41								
		1	10.17								
		1	10.56								
	Summary	3	11.38	2	9.60	2	5.52	0		4	7.56
Maple, Black	July 26			1	2.91	1	3.38				
						1	2.42				
	29					1	5.31	1	3.23		
						1	2.48				
						1	4.53				
	Summary	0		1	2.91	5	3.62	1	3.23	7	3.47
Maple, Norway	July 23	1	6.16	1	5.43	1	7.89				
	24			1	5.45	1	2.76				
	Sept. 10					1	4.35				
						1	9.10				
	16							1	6.67		
	Summary	1	6.16	2	5.44	4	6.03	1	6.67	7	5.96
Elm, Chinese	Sept. 9	1	18.76								
	16	1	14.81	1	12.60						
	Summary	2	16.78	1	12.60	0		0		1	12.60

portion of the crown on its way to the roosting positions, but had to pass through all of the crown to be measured beneath the trees. Also no "stovepipe" was used within the crowns to limit the light that struck the sensitive element of the light meter.

That it was not safe to try to predict the percentage within the crown from the percentages obtained on the ground was suggested by the differences between the two sets of percentages (Table 4). Except for the black maples, the differences formed a rather irregular pattern (last column). Further evidence, given in Table 5, indicated a high coefficient of correlation only for the black maples; and only for the black maples did the regression coefficient give a significant t-test (probability of less than 5 per cent),

Table 4

Light percentages within the crown compared to those taken beneath the trees

Species of trees	% of light in trees		% of light under tree		% in tree minus % under tree			
	Date taken (1952)	%	Date taken (1952)	%				
Elm, American	July	23	4.93	July	23	0.91	4.02	
		30	6.75		9	1.48	5.27	
		30	12.45		9	5.17	7.28	
		30	6.12		9	0.96	5.16	
	Sept.	9	13.41	Sept.	9	2.85	10.56	
		9	10.17		9	1.67	8.50	
		9	10.56		9	4.99	5.57	
Maple, Black	July	26	2.91	July	3	0.38	2.53	
		26	2.38		3	0.62	2.76	
		26	2.42		3	0.33	2.09	
		26	2.48		3	0.22	2.26	
		26	5.31		3	1.48	3.83	
		29	4.53		3	0.52	4.01	
		29	3.23		3	0.25	2.98	
	Maple, Norway	July	23	6.16	July	23	0.42	5.74
23			5.45	23		0.46	4.99	
23			5.43	23		0.35	5.08	
23			2.76	23		0.91	1.85	
23			7.89	23		0.27	7.62	
Sept.		9	4.35	Sept.	9	1.55	2.80	
		9	9.10		9	5.29	3.81	
		16	6.67		July	30	1.86	4.81
Elm, Chinese	Sept.	9	18.76	Sept.	9	1.70	17.06	
		16	14.81		July	30	3.08	11.73
		16	12.60		30	6.87	5.73	

although the probability for American elms was about 6 per cent, not far from the 5 per cent mark. No reason for the wide discrepancy obtained between the two sets of light measurements for the Norway maples was apparent. Statistical tests for the Chinese elms were not included for only three were involved.

Table 5
Regression of light in trees on light beneath trees.

Species of trees	No. of trees	Coeff. of corr. (r)	Regression equation	Stand. error of regression coefficient	t ¹
Elm, American	7	.7422	Y=5.76+1.34X	.5385	2.4800
Maple, Black	7	.8481	Y=2.33+2.09X	.5841	3.5806*
Maple, Norway	8	.5366	Y=5.10+.63X	.4057	1.5577

¹Test of significance of the regression coefficient and/or correlation coefficient.

*Significant at P=<.05.

SUMMARY

To learn whether or not the density of tree crowns was correlated with the degree to which they were used as roost places by "blackbirds" at Ames, Iowa, cover density indices were determined. Average light conditions beneath the trees were expressed as percentages of light in the open. A large percentage indicated little cover, a small percentage much cover.

The birds used American elms selectively for cover, and gave progressively greater degrees of use to those elms that were denser.

The hard maples provided much denser cover than other trees, and the birds used a greater percentage of them as roost places than of American elms; but once within the range of cover provided by the hard maples, the variations in densities of individual trees had little effect in determining degree of use.

The few trees other than American elms and hard maples that were measured for cover density, had relatively high percentages of light getting through their crowns. The generally more open crowns of these trees may have been one reason why more of them did not serve as roost places.

Trees used by the birds in late October had less cover than trees used earlier, but the birds, forced to use such cover as remained, followed their tendency to use more intensively those trees with the heavier cover.

Light conditions at roosting level within the crowns, at the time of arrival of the birds, were also compared with light in

the open. For these measurements only the American elms showed a definite tendency of lower percentages with increasing degrees of roosting use. The hard maples showed irregular trends with no particular interpretation, and averaged considerably lower than American elms. One Chinese elm, used lightly by the birds, showed a percentage of light comparable to that found for lightly used American elms.

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