PHEASANT NESTING AND CONCEALMENT IN HAYFIELDS

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My associates and I investigated the influence of the quality of nesting vegetation on the sites Ring-necked Pheasants (*Phasianus colchicus*) selected for their nests on a 36-square-mile tract near Sibley, Ford County, in east-central Illinois. Robertson (1958: 10–18) and Hanson and Labisky (1964) describe the pheasant's environment on the Sibley area.

During the years of this study (1957–59), farmers cultivated more than 90 per cent of the land; corn and soybeans were the major crops. Cattle grazed most of the forage (grass-legume) crops or farmers mowed them; the date of first mowing varied widely but was usually in June (especially the first half) for alfalfa and in late June and early July for red clover.

Methods

On the Sibley tract in the middle 1950s, workers selected at random one hundred 10-acre plots, and subsequently they or others searched them annually for pheasant nests. Among these plots the workers studied further those that contained at least 2 acres of hayfield (forage-crop) vegetation to determine the height, density, and composition of the plants, wherever they could make the studies before mowing began. In each of the selected fields, we located randomly and marked by a thin wire rod two points per acre. At each point where the rod stood, we counted and identified all plants touching any part of the rod and measured the maximum height of each plant with a yardstick. For each plot studied, these measurements yielded data on (a) the percentage frequency of occurrence of each species of plant, (b) the mean height of the plants, and (c) the average number of plants per point. Table 1 gives the number of acres and points sampled and other pertinent data.

We measured the intensity of light twice at each sampling point with an inexpensive light meter for photography (brand name "Sekonic"). The observer stood with his back to the sun's direction, held the meter at breast height, pointed it parallel to the ground's surface, and took the first reading of the reflected light; he then immediately repeated the procedure about 3½ inches above the ground. Later, by comparing each pair of light readings, we could calculate the percentage of the reflected light that penetrated to near ground level. (Incident light near ground level might be low or absent while reflected light was substantial.) Finally, we calculated the simple linear correlation between the number of pheasant nests established per 10 acres and the measurements described above.

The field measurements on plants were completed essentially within the following periods: 1957, last half of May; 1958, first half of June; and 1958, 8–10 June. We used data from only the pheasant nests that we judged were established prior to the following dates: 1957, 5 June; 1958, 17 June; 1959, 10 June. Pheasants of course start nests over a long period (beginning here in April). For best results one should measure the plant characteristics near each nest at the time the hen selected that nest site. As that was impossible, we tried to measure the plants at random points when the hens had established approximately 50 per cent of the total nests, which in this region occurs by 31 May (Hanson and Labisky, 1964). As is customary, field

TABLE 1
CHARACTERISTICS OF PHEASANTS' NESTING HABITAT IN ILLINOIS HAYFIELDS

	Year		
	1957	1958	1959
Number of plots studied	16	17	11
Number of sampling points:			
Total	265	247	164
Average per plot	16.6	14.5	14.9
Plant height (inches):			
Range in plot means	3.6–16.0	7.2–17.9	10.9–38.4
Mean of plot means	9.8	13.7	26.8
Plant density (per sampling point):			
Range in plot means	1.00–4.50	1.60–4.06	2.00–5.20
Mean of plot means	2.24	2.99	3.04
Light penetration (per cent):			
Range in plot means	5–77	2–19	2–66
Mean of plot mean	30	9	15
Number of pheasant nests per 10 acres:			
Range for plots	0.0–14.29	0.0–42.65	0.0–21.32
Mean number per plot	4.13	8.80	11.41

workers discovered most of the nests after the farmers mowed the fields; the founding dates of the nests were then estimated by standard methods (Baskett, 1947; Stokes, 1954: 18).

In addition to the randomized light readings, I made two light measurements within 6 inches of actual nests of pheasants and compared them with two light readings made 3 feet away, both distances measured horizontally, at 36 nests examined during the period 4–21 June 1957 in several hayfields.

RESULTS

Composition of vegetation.—The species present on the study area were essentially the same during each year (1957–59), but the percentage composition varied greatly from field to field. The most abundant species were usually, in order, red clover (*Trifolium pratense*), timothy grass (*Phleum pratense*), alfalfa (*Medicago sativa*), sweet clover (*Melilotus officinalis*), white clover (*Trifolium repens*), and smooth brome grass (*Bromus inermis*). The relative frequencies of the plants did not obviously affect the abundance of the pheasant nests, except as the frequencies related to the height and density of specific stands.

Mean height.—Average plant height, without regard to species, in each field studied was shortest in 1957, somewhat taller in 1958, and much taller in 1959 (Table 1). Plant densities were much larger in 1958 and 1959. Both kinds of data indicate that the measurements were made later than desirable in the last 2 years. Only in 1957 were the plants measured

TABLE 2

COEFFICIENT OF SIMPLE LINEAR CORRELATION BETWEEN VARIOUS FACTORS AFFECTING PHEASANT NESTING IN FORAGE CROPS

	Year			Weighted average of all years
	1957	1958	1959	
Number of nests per 10 acres compared to:				
Mean plant height:	0.874[1]	0.471[2]	0.736[1]	0.718[1]
Mean sum of heights of all plants per point:	0.939[1]	0.437	0.374	0.537[1]
Percentage light:	–0.667[1]	–0.056	–0.387	–0.391[1]
Percentage light compared to mean plant height:	–0.868[1]	–0.346	–0.613[2]	–0.488[1]

[1] Significant ($P < 0.01$).
[2] Significant ($P < 0.05$).

by the time hens started 50 per cent of the nests. Differential growth of plant species and edaphic differences among fields decrease correlation between nest densities and vegetative conditions when the plants are measured during the last half of the nesting season when probably all or most hayfields, except those mowed or grazed heavily, contain tall cover.

Ideally, one should measure the plant characteristics at frequent intervals throughout the nesting season and compare the findings for a given interval of time to the number of nests established in that interval. As we did not have enough manpower to make such frequent measurements, we gathered data during one interval, often long after a given hen selected her nest site, and thus our measurements and calculations (Tables 1 and 2) served only as a rough index to the cover in which the bird selected her nesting spot.

Nevertheless the average height of the plants in each field and the number of pheasant nests found there (Table 2) were considerably related, especially in the first year. The "coefficient of determination," r^2, which gives the explained fraction of the total sum of squares (Steel and Torrie, 1960: 187), showed that one could explain approximately one-half of the variation in the density of pheasant nests, for all years combined (i.e. 0.718^2), by variations in the plant heights. The plant heights were less correlated with nest density in 1958 than in the other years. Not only were the plants tall (and measured late), but the field crew had more trouble determining the correct number of pheasant nests (more standing hay had to be searched) than in any other year, and variability in the number of nests that they found was also high in 1958 (Table 1).

Mean height and mean density combined.—As both height and density should contribute to concealment for the ground-nesting bird, I calculated the joint effect of the tallness and density of the plants by multiplying average plant height in a given field times the average number of plants at each sampling point. This yielded a high degree of correlation in 1957 (Table 2); one could explain about 88 per cent (i.e. 0.939^2) of the variation in the density of nests by these measurements. The weighted average for all years also significantly affected the number of nests. Lower correlation in 1958 and 1959 may have resulted from less intensive sampling then (Table 1) and the before-mentioned later sampling of plants in 1958 and 1959 and difficulty in finding nests in 1958.

Percentage of light penetration.—The average amount of light that penetrated to near ground level, for all years combined, also significantly related to nest density, as the amount of light indicated cover conditions (Table 2). In the first year, r was highest, making the coefficient of determination (-0.667^2) about 0.44. In 1958 the data correlated least, probably for reasons I mentioned above. As the weighted average of r for all years was, of course, based on a much larger sample size than was r for any individual year, the rs for combined years were sometimes more significant when their numerical value was smaller.

Next, I considered the light readings adjacent to pheasant nests. The average amounts of available light reaching near ground level for the 36 nests were: 5.3 per cent at a distance 6 inches from the nests and 14.5 per cent at a distance of 3 feet. For each nest I also compared the average of the two close readings with the average of the two farther readings and calculated the significance of these differences by the t-test (Steel and Torrie, 1960: 78–79). The computed value of t for the resulting sample of differences was 3.38 ($P < 0.01$), additional evidence that the hen pheasants chose their nesting sites where cover was tallest, or densest, or both.

Because investigators can measure the light much more quickly than they can the plants themselves, they should use light readings more in future research of this type. Especially should workers make the light readings periodically throughout the nesting season and correlate results with nests established during comparable periods. Wiens (1967) reviews literature on measuring light in vegetation and describes an improved instrument for doing the work.

Discussion

The life form of the cover seems critical to the early-nesting pheasant hen, for the greater the plants' height, or density, or both, the more the hens tended to use them for nests. I am not aware of previous studies on pheasants nor other ground-nesting birds that give comparable data on the quantitative aspects of nesting shelter.

A possible benefit of heavy cover is to reduce losses to predators. Another possible value is increased shading of the ground surface, producing cooler temperatures and higher humidities. Too high temperatures on the ground may reduce the hatchability of pheasant eggs (Yeatter, 1950). Francis (1968) reports that extremes of temperature and humidity sufficient to lower the hatchability of pheasant eggs occur throughout the nesting season in east-central Illinois and concludes "the cover types in which pheasant nests are most often found are those in which temperatures and saturation deficits are lowest." On the other hand, early-nesting birds may sometimes experience excessively cold and damp weather, and again heavy vegetation might increase the hatching of eggs. Taller and denser cover should also tend to reduce visibility between pheasant cocks, lessen potential strife, and decrease territory size, as Watson (1964) found among Red Grouse (*Lagopus lagopus scoticus*).

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