MICROENVIRONMENT AND NEST SITE SELECTION BY RING-NECKED PHEASANTS IN UTAH

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Abstract.— Vegetative and atmospheric parameters were evaluated at 16 different nest sites of ring-necked pheasants in Utah County, Utah, to determine which parameters are influential in the nest site selection process. These data indicate that total vegetative ground cover, high amounts of cover immediately surrounding the nest cavity, and drying power of the air are the parameters most influential in nest site selection.

Several aspects of the environment have been reported to influence nest site selection by ring-necked pheasant hens. Hammerstrom (1936) proposed that pheasant nests occur more often around the periphery of fields. Nelson et al. (1960) evaluated several previously published studies, however, and found that nest densities near the edge of the field were equivalent to densities in the interior of the fields.

The importance of vegetative structure on pheasant nest placement has been the subject of several investigations. Hanson (1970) implicated the importance of vegetative cover and height on pheasant nest site selection within cultivated hay fields. The influence of vegetative canopy over the nest site was evaluated by Wagner et al. (1965). Salinger (1952), Bartmann (1969), and Baxter and Wolfe (1973), have shown that pheasants prefer to nest in residual cover from the previous season's growth or among early-growing plant species. One early-growing plant species abundant in most pheasant ranges is alfalfa. Olsen (1977) summarized 14 studies and found an average of 44 percent of all nests located in alfalfa, though this habitat provided only 21 percent of the total successful nests and 10 percent of the overall chick production. In contrast, wetlands contained 14 percent of the nests but produced 33 percent of the successful nests and 28 percent of the total chick production.

Other researchers have concentrated their efforts on the influences of temperature, humidity, and solar radiation on nest site selection and nesting success. Graham and Hesterberg (1948) were the first to implicate the effect of climate on ring-necked pheasant distribution. Yeatter (1950) documented the influence of temperature on pheasant populations. Studies on the ability of hen pheasants to select nest sites with optimum temperature and saturation deficit have been conducted by Francis (1968) and by Schulte and Porter (1974).

This study will collectively reevaluate the influence of solar radiation, temperature, saturation deficit, and vegetative structure on the selection of a nest site by ring-necked pheasant hens in central Utah.

Methods

Nests were located in Utah County, Utah, using a procedure similar to that outlined by Stokes (1954). The procedure consisted of visually searching a portion of each habitat type along 1 m wide transects. This procedure has been tested by Labisky (1968) and Baxter and Wolfe (1973), using dummy nests secretly placed in various cover types, and was found to be approximately 90 percent accurate.

Once nests were located, percent vegetative cover within a ¼ m^2 area surrounding the nest cavity, vegetation height, percent canopy cover immediately above the nest cavity, and percent side cover immediately surrounding nest cavity were recorded. Light intensity, humidity, and temperature within the nest cavity and above the vegetation

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were also recorded. Readings on these atmospheric parameters were repeated at random on subsequent days at several nest sites. All data were collected between 0800 and 1830 hours under varying weather conditions during the month of June 1979.

For each nest site found, an adjacent nonnest site was randomly selected in the same vegetation type. Position of the nonnest site was determined by turning away from the largest area of the habitat that was similar to the nest site and throwing the quadrat used for cover estimation over the shoulder. Identical measurements were then taken on those sites. This allowed paired comparisons of parameters affecting nest and nonnest sites. All data were analyzed for normality of distribution using a mean-to-variance ratio equal to one as the standard for the test. Vegetation height, percent canopy cover, percent side cover, and light intensity were not normally distributed ($p < 0.05$). Data collected on these parameters were evaluated using appropriate nonparametric techniques (Gibbons 1976).

Percent vegetative cover was determined by ocular estimation, using a ¼ m^2 quadrat centered on the nest. Determination of percent canopy cover directly above the nest cavity and percent side cover immediately surrounding the nest cavity was also by ocular estimation. Height of vegetation was measured directly with a meter stick. Light intensity within the nest cavity and in the air above the vegetation was measured with a Gossin Luna-Pro light meter. Relative humidity (greater than 25 percent) and temperature were measured within the nest cavity and in the air above the vegetation with a Lufft hygrometer. Saturation deficit was calculated as an index of the drying power of the air as suggested by Francis (1968). Saturation deficit was calculated by finding the appropriate saturation vapor pressure at the measured air temperature (in tables of the Handbook of Physics and Chemistry) and subtracting from that value the actual vapor pressure. Actual vapor pressure was calculated by multiplying saturation vapor pressure by percent relative humidity divided by one hundred.

TABLE 1. Summary of habitat types in which nest sites were located. The table also includes the predominant plant species and the number of observations recorded at each nest site.

Habitat	Major plant spp. at nest site*	Number of nests	Number of observations at each nest
Hayfield	alfalfa	4	1,2,2,6
	smooth brome	1	2
Irrigated pasture	tall wheatgrass	3	2,5,6
Wet meadow	sedges	1	3
	wiregrass	1	2
Herbaceous weeds	whitetop	2	1,3
	pepperweed	1	3
Woody shrubs	saltcedar	1	1
	greasewood	1	4
	big sagebrush	1	1

*Scientific names of plants listed above:

alfalfa	*Medicago sativa*
smooth brome	*Bromus inermis*
tall wheatgrass	*Agropyron elongatum*
sedges	*Carex* spp.
wiregrass	*Juncus* spp.
whitetop	*Cardaria draba*
pepperweed	*Lepidium perfoliatum*
saltcedar	*Tamarix ramosissima*
greasewood	*Sarcobatus vermiculatus*
big sagebrush	*Artemisia tridentata*

RESULTS AND DISCUSSION

Data were collected on 16 nests located in five distinct habitat types (Table 1). Data are summarized in Table 2. Percent vegetative cover at the nest site was significantly higher ($p < 0.05$) than that found at the adjacent nonnest sites. Furthermore, comparison of the variance between the two samples showed that nest sites deviated significantly less ($p < 0.05$) from the average percent vegetative cover than did the nonnest sites (Table 3). The percent side cover immediately surrounding the nest cavity also indicated that the hens were sensitive to vegetative structure. Although the median for the nest site did not differ significantly from that of the nonnest site for this parameter, comparison of the distributions of the two sets of data shows a significantly smaller range of values around the median of the nest site ($p < 0.01$).

Vegetative height above the nest cavity showed no significant difference in the medians or in the distributions of data about the medians when comparing the nest and nonnest sites. Vegetative height at the nest site varied from a low of 40 cm to a high of 271 cm (1.3 to 8.9 feet). Hansen's (1970) data suggest that pheasants may be selecting nest sites with specific vegetative height. Nevertheless, the strongest correlation his data indicated was between an index of average vegetative cover (plant height times plant density) in a given field and nest density in that field.

Data collected on canopy cover indicated that this factor does not influence nest site selection. No differences were noted between the median canopy cover or in the distribution of the recorded values when comparing the nest and nonnest sites. Studies by Wagner et al. (1965) tend to confirm this observation. They reported that, of a total of 502 nests, 30 percent were completely exposed from above, and the exposed nests had equivalent hatching success to unexposed nests.

All atmospheric parameters showed significant differences between values recorded within the nest cavity and values recorded in the air above the vegetation; no differences were found between the nest and nonnest sites when comparing means, medians, or distributions of data sets. Comparison of median light intensities above the vegetation with those recorded within the nest cavity showed that light intensity was greatly reduced. By comparing light intensity within the nest cavity to the intensity in the vegetation of the nonnest sites, however, it was apparent that the hens were not selecting nest sites for some optimum light intensity.

Temperature within the nest cavity was significantly higher than that recorded in the air above the vegetation ($p < 0.005$) by an average of 1.7 C. This is consistent with the results of Francis (1968), who found temperatures significantly higher at 10 cm than at 100 cm above the ground. Comparison of the nest to the nonnest site indicated no ability on the part of the hen pheasants to minimize this increase in temperature. Solar radiation and atmospheric temperature within the nest cavity are the major factors influencing internal egg temperature prior to incubation (Schulte and Porter 1974). Egg temperature in turn influences viability and hatching success (Yeatter 1950). Even so, our data indicate that hen pheasants do not select nest sites that minimize incident solar radiation and temperature effects.

Saturation deficit was found to be significantly lower within the nest cavity than in the air above ($p < 0.05$). The difference in saturation deficit between the nest and nonnest sites was not significant, although a comparison of data between habitats indicated that hen pheasants may be selecting for a minimum saturation deficit. An analysis of variance using deviations from values recorded above the vegetation at the nest and nonnest sites, grouped according to habitat, was conducted on temperature and saturation deficit data. There were no significant differences indicated between habitats for temperature data, or saturation deficit data at the nest site. Saturation deficit data at the nonnest sites, however, indicated a significant difference between habitats ($F_{4,17} = 3.04$ $p < 0.05$). Francis (1968) also reported differences in saturation deficits between habitats. If these differences truly exist between habitats and are not evident at the nest sites, then hens must be selecting environmentally similar areas within different habitats.

By collectively reevaluating several factors that have been previously reported, we have been able to develop a composite picture of factors influencing nest site selection by ring-necked pheasant hens. Ground cover surrounding the nest and drying power of the air

Table 2. Mean or median values and sample size for parameters evaluated at the nest site, adjacent site, and in the atmosphere.

Parameter	Sample size	Mean or median value: Nest site	Nonnest site
Cover (%)[1]	16	85.6	74.4
Vegetation height[2] (centimeters)	16	65	60
Canopy cover (%)[2]	16	40	25
Side cover (%)[2]	16	85	75
Light intensity[2] (foot candles)	44		
Above vegetation		6982	6982
Nest level		623	669
Temperature[1] (C)	44		
Above vegetation		27.9	28.0
Nest level		29.6	29.4
Saturation deficit[1] (millibars)	22		
Above vegetation		16.2	16.0
Nest level		15.0	14.3

[1]Values recorded are means
[2]Values recorded are medians