

Gape-color polymorphisms have been noted in some parasitic species of birds (e.g. Fraga 1979, Nicolai 1964, Rothstein 1978), but we know of none in nonparasitic species, and we do not know of any cases of bill color polymorphism similar to the one in Darwin's finches. We do not know the significance of the color variation. From studies of domestic fowl, it is known that all skin colors are based on melanin, which is manufactured in dermal cells, and xanthophyll, which is ingested and stored in body tissues including all layers of the skin; pink skin lacks both. The genetic control of melanin production and xanthophyll deposition can be complicated, although the appearance of yellow color in bill and legs due to xanthophyll may be controlled by recessive alleles at a single autosomal locus (Hutt 1949).

The color variation we have observed may simply be an associated effect of variation in other morphological and physiological traits and therefore of no particular significance. On the other hand, bill color may have an individual recognition signal value in communication between parents and offspring, in which case variation in color reflects variation in signals (e.g. see Rothstein 1978). Either way, we offer the hypothesis that the color variation is a visible expression of underlying genetic variation for two reasons: Both morphs are present in some clutches and are recognizable at hatching, i.e. before the nestlings have been fed; and species living in the same environment and known to feed on similar foods in the breeding season have different morph frequencies (e.g. *magirostris* and *difficilis*), while others, which differ in diet (e.g. *Certhidea* and *G. conirostris*), have the polymorphism (Grant and Grant MS). Likewise, gape-color variation may be genetically determined in Darwin's finches, as in other species (e.g. Hutt 1949, Nicolai 1964). Breeding data are now needed to investigate the hypothesis of genetic control.

The research was supported by NRC (Canada), NSF (USA), and the Frank M. Chapman Fund. We thank G. A. C. Bell, R. I. Bowman, B. R. Grant, E. Greene, D. Nakashima, L. M. Ratcliffe, K. Sittman, and J. N. M. Smith for assistance with fieldwork and the manuscript. C. MacFarland and H. Hoek, directors of the Charles Darwin Research Station, provided logistical support.

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Received 9 February 1979, accepted 5 July 1979.

### Effects of Vegetation on Nesting Success of Vesper Sparrows

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Avian reproductive success is influenced by many factors, some of which have been quantified (e.g. Best 1978, Miller and Burger 1978). One factor, the structural characteristics of the vegetation directly surrounding the nest, has not been quantitatively linked with nesting success. Do subtle vegetational differences exist that may affect the success of nesting attempts? Here we ask if the success of a Vesper Sparrow (*Poocetes gramineus*) nest is affected by the surrounding vegetation. We studied Vesper Sparrows breeding in West Virginia on reclaimed surface mine habitat, where the vegetation is structurally heterogeneous and variable.

Four reclaimed surface mines, located within a 3.3-km radius of Valley Point, Preston County, West Virginia (39°37'N, 79°35'W), were used. The sites ranged in size from 16.4 to 41.5 ha, varied in age from 3 to 6 yr, and averaged 579 m in elevation. Mining and reclamation procedures were similar on all

TABLE 1. Mean and standard deviation (in parentheses) of the structural characters measured around the nests. Asterisks denote a significant difference (\* =  $P < 0.075$ , \*\* =  $P < 0.05$ ) between successful and unsuccessful nests and show which variables had discriminating power in stepwise discriminant function analysis.

Variable	Successful nests ( $n = 15$ )	Unsuccessful nests ( $n = 24$ )
Percent grass cover	23.68 (7.55)	23.05 (9.20)
Percent shrub cover	0.00 (0.00)	0.51 (1.96)
Percent forb cover	26.89 (18.58)	20.46 (15.59)
Percent litter cover	63.17 (22.34)	53.67 (18.29)*
Percent bare ground	32.93 (20.67)	44.84 (20.13)*
Litter depth (cm)	2.89 (1.50)	3.50 (2.00)
Forb height (cm)	9.31 (9.34)	8.51 (10.05)
Mean height (cm)	46.36 (13.61)	46.07 (17.21)
Effective height (cm)	64.00 (14.54)	67.08 (20.95)
Vertical density	15.33 (5.63)	11.64 (4.95)**
Vertical diversity	0.87 (0.37)	0.84 (0.33)
Horizontal density	124.60 (91.21)	126.92 (94.64)
Horizontal diversity	1.25 (0.33)	1.24 (0.38)

the sites. Reclamation involved application of lime and fertilizer, with subsequent hydroseeding of various grass, forb, and woody species. Since reclamation, some planted species have disappeared, while various other plant species have invaded the sites (Staples 1977). As a result, the structural character of the vegetation varies considerably between and within sites.

During the breeding season of 1978, we found 39 Vesper Sparrow nests by systematically traversing the four sites and flushing incubating or brooding adults. Nests were visited every other day; we feel that investigator effect on nesting success was minimal (see Gottfried and Thompson 1978). A nest fledging at least one young was considered successful.

As each nest was vacated, four 1-m line transects were taken around the nest. The direction of the first transect was determined using a random numbers table and a compass, and the remaining transects were then taken at 90° increments, with the nest as the focus. We measured the following variables on each transect:

(1) Cover of grass, shrub, forb, litter, and bare ground.

(2) Litter depth at a single point next to the nest.

(3) Forb height at three intervals.

(4) Vertical density and diversity, determined by dropping a thin metal rod through the vegetation at a point next to the nest and counting the number of hits in each 10-cm height class. Density was calculated by summing the total number of hits, while diversity was computed by inserting the totals for each of the height classes into the Shannon-Weaver (1963) formula.

(5) Horizontal density and diversity, calculated by attaching a thin 1-m rod to a metal rod perpendicular to the ground. The horizontal rod was lifted up the vertical rod, recording the number of hits at each 10-cm height interval. Density and diversity were derived as in (4).

(6) Effective height, the height of the tallest plant on the four transects.

(7) Mean height, the average of the four highest hits on each transect.

For statistical analysis we employed the  $Z$  statistic, the Student's  $t$ -test, and stepwise discriminant function analysis (DFA).

Of the 39 Vesper Sparrow nests, 24 (62%) were unsuccessful. Predation accounted for the majority of the losses. The  $Z$  statistic (Johnson 1976) showed no significant difference ( $P < 0.05$ ) in the monthly predation rate of nests throughout the breeding season.

The data for each nest site (Table 1) were subjected to a stepwise linear DFA to determine which variables were important in separating successful nests from unsuccessful nests. The multivariate approach was employed because it takes into account not only the variate but also the covariate relationships of the variables (Green 1971, Whitmore 1977). Only 3 of the 13 variables proved to be important in discriminating between the 2 groups (Table 1). The first linear discriminant axis (Fig. 1) accounted for 100% of the total variation, which is to be expected when discriminating between only two groups. The axis showed strong product moment correlations with vertical density ( $r = 0.54$ ), bare ground ( $r = -0.45$ ) and litter cover ( $r = 0.37$ ). Successful nest sites were characterized by larger values for vertical density

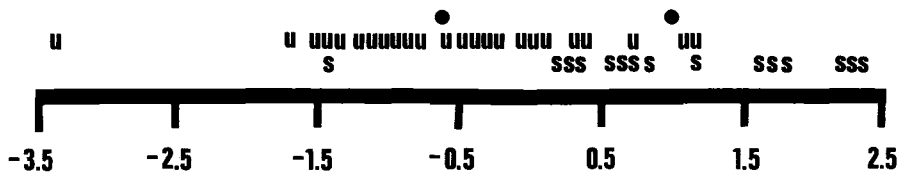


Fig. 1. First discriminant axis for Vesper Sparrow nests. The axis is positively correlated with vertical density of vegetation ( $r = 0.54$ ) and litter cover ( $r = 0.37$ ) and negatively correlated with bare ground ( $r = -0.45$ ). S = successful nests, U = unsuccessful nests, ● = group means.

and litter cover and smaller values for bare ground than were unsuccessful nests. A Student's  $t$ -test revealed a significant difference between the two groups for each of the three most important variables (Table 1). The overall distribution of the two groups on the discriminant axis was significantly different (Student's  $t$ ,  $P < 0.01$ ).

The predictive ability of this discriminant model is best exemplified by looking at its classification accuracy. The stepwise DFA misclassified only 6 (15%) nests after the 5 most important variables had been entered, with 1 successful nest classified as unsuccessful and 5 unsuccessful nests classified as successful.

Because all of the unsuccessful Vesper Sparrow nests were lost to predation, the degree to which a nest was concealed by the existing vegetation is an important consideration. We divided nests lost to predators into two groups: undisturbed nests, considered to be preyed upon by birds or snakes, and disturbed nests, considered to be preyed upon by mammals (Best 1978). Of the lost nests, 75% were attributable to bird or snake predators. We saw Common Crows (*Corvus brachyrhynchos*) on the study sites daily. Hines and Mitchell (pers. comm.) found crows to be major predators on Gadwall (*Anas strepera*) eggs and nestlings in Saskatchewan and determined that there was an inverse relationship between the degree of vertical concealment of the nest and the severity of losses to crows. As bird predators visually search for prey, their success should be influenced by the structural character of the vegetation. Vesper Sparrow nests with high values of litter cover and vertical density and low values of bare ground may be more concealed and thus more resistant to avian predation. In contrast, snakes that seemingly search for nests randomly (Best 1978) should not be influenced by nest concealment. As potential mammalian predators will most likely find bird nests by scent, their success should not be significantly affected by vegetation structure. Although we have no data to support this, the six nests misclassified by the model may represent differences in the effects of bird, snake, and mammalian hunting techniques.

If there is a significant difference in the vegetation surrounding successful and unsuccessful nests, why do some Vesper Sparrows select the poorer sites? As the unsuccessful sparrows produced no offspring, it seems likely that, if nest site selection were genetically controlled, the trait to select those sites should be promptly eliminated. What mechanism maintains this apparently nonadaptive character? Perhaps what is successful one year may not be the next. Because conditions vary from year to year (e.g. climate, predator populations, human disturbance), a wide range of nest sites may be favored over time.

We thank G. E. Hall, G. E. Lang, R. L. Smith, and D. E. Samuel for reviewing an earlier draft of this manuscript. Appreciation is extended to E. J. Harner and T. Carney for help with the statistical analyses. We are grateful to P. Wackenhut, J. Noullet, J. Manon, and S. Harmon for their invaluable assistance in the field. Special thanks are extended to S. Marcus for her assistance and encouragement. This study was undertaken in partial fulfillment of requirements for the M.S. degree at West Virginia University for the senior author. Financial support was received from the West Virginia University Agriculture and Forestry Experiment Station. This is paper 1606 of that station.

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Received 8 February 1979, accepted 27 July 1979.

### Varied Thrushes Feeding on Talitrid Amphipods

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At about 0700 on 28 June 1977, while camped near Norwegian Memorial along the Olympic National Park ocean-beach wilderness strip in Clallam County, Washington, I observed two Varied Thrushes (*Ixoreus naevius*) feeding actively above high tide line on an open sandy beach. At this location a dense old-growth coastal coniferous forest halts abruptly at the margins of the beach, and the thrushes ventured only as far as about 15 m seaward of the forest edge. The two birds were observed pursuing, capturing, and consuming a large number of "sand-hoppers," amphipods of the family Talitridae (Class: Crustacea), which were abundant on the beach at the time. After feeding for about 10 min on the amphipods, the thrushes flew back into the woods and did not reappear on the beach.

The great majority of the amphipods present on the beach during the observation period were *Orchestoidea californiana*, a numerous and widely distributed form on the Pacific Coast of North America (Kozloff 1973). Several other amphipods, though they are as yet imperfectly catalogued (Kozloff 1973, 1974), are known to occur on Washington coastal beaches, however, and some other species such as *Orchestia traskiana*, may also have been taken by the thrushes.

The Varied Thrush, a bird primarily of the dense, humid forests of western North America from California to Alaska (Bent 1949, Jewett et al. 1953), has not previously been recorded to forage on open beaches and is not mentioned in the literature as being a predator on amphipods. However, these behaviors are not out of keeping with the species' more common feeding activities. Varied Thrushes are widely mentioned as ground foragers in forests (Jewett et al. 1953), on suburban lawns (Dawson 1923), and in agricultural fields (Beal 1915). A variety of food sources has been documented for Varied Thrushes: insects of the orders Homoptera (McAtee 1906), Hymenoptera, Hemiptera, Diptera, Lepidoptera, Orthoptera, and Coleoptera; Arachnids; Diplopods; terrestrial isopod Crustaceans; oligochaete Annelids; gastropod Molluscans (Beal 1915); and a sizeable number of fruits, seeds, and other plant materials (Grinnell 1898, 1900; Beal 1915; Hoffman 1927; Adams 1947). Moreover, Varied Thrushes are known to breed to the outer edges of the coastal forests (Bent 1949), and pairs of birds nesting close to the beach, given their catholic taste in prey organisms, would be expected to exploit readily so abundant a food source as amphipods provide in some coastal locations.

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