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Statistical significance and density-dependent nest predation.—Bradley Gottfried (Wilson Bull. 90:643–646, 1978) recently published a note on an experimental study of the effect of nest density on nest predation. He tested the null hypothesis that there was no difference between the experimental and control, the high and low density plots. The study was well thought out and presented, and is in fact a model for the kind of information that alone will convince us that our hypotheses are or are not valid. Dr. Gottfried's excellent study produced results, however, that did not show a statistically significant difference between the rates of nest predation on artificially placed nests at high densities, and similar nests placed at low densities. This result led him to accept the hypothesis that there was no density-dependent predation in the field he was studying, in contrast to the results reported in other studies. In his discussion he then addressed the question of potential difference between the old field plots he studied and the plots that others have studied. To show that this difference exists, we need to show that his data were significantly different from the data presented by scientists who worked in either marshes or in forests, both of whom have found statistically significant differences in nest predation between habitats with high and low densities of nests.

For example, one of the studies which he supposed produced different results from those in his study is Fretwell's (Populations in a Seasonal Environment, Princeton Univ. Press, Princeton, New Jersey, 1972). Fetwell found that Field Sparrows (*Spizella pusilla*) nesting in two early succession pine forests at two different densities had nesting success rates of 0.21 (high nest density) and 0.33 (low nest density). Fretwell presented this difference as being statistically significant, but a critique by Dow (Wilson Bull. 90:291–295, 1978) on the technique used by Fretwell (1972) is valid and suggests that the difference should be re-evaluated by a more appropriate method. Fretwell, however, did note the same trend in all 3 years that he collected data, and also found a statistically significant trend in an intensive within-habitat study. The difference discovered by Gottfried (1978) for 1 week of nest exposure was 0.69 success in the high density plot and 0.76 success in the low density plot. Since the normal successful nest is exposed for at least 3 weeks, we can estimate the magnitude of this difference for nests that would be comparable to those in Fretwell's study by taking these survival rates to the third power. This assumes that these nests would be replaced as lost, which in fact is what would occur in a natural situation. This yields 0.33 success for the high density plot and 0.45 for the low density plot. Thus, at high densities, sucess was about 27% lower than the value in the low density plots. This compares to the difference of 37% in Fretwell's study.

We attempted to see if this difference in studies was statistically significant, by doing a z-test on the difference between the differences. We first corrected each survival rate for the average in the study in which it was measured, since we are interested in comparing relative and not absolute differences. For example, a difference in survival rates of 10% and 5% is more significant than a difference of 50% and 40%, and Fretwell's nests survived less well than Gottfried's nests. We tested the null hypothesis that the 37% density-dependent effect in Fretwell's study is the same as the 27% density-dependent effect in Gottfried's study using the following formula:

$$Z = \frac{\frac{P_{11}}{\bar{P}_1} - \frac{P_{12}}{\bar{P}_1} - \frac{P_{21}}{\bar{P}_2} + \frac{P_{22}}{\bar{P}_2}}{\sqrt{Pq}\left(\frac{1}{\bar{P}_1^2 n_{11}} + \frac{1}{\bar{P}_1^2 n_{12}} + \frac{1}{\bar{P}_2^2 n_{21}} + \frac{1}{\bar{P}_2^2 n_{22}}\right)}$$

where

P_{11} = proportion of successful nests in Fretwell's low density plot,
P_{12} = proportion of successful nests in Fretwell's high density plot,
P_{21} = proportion of successful nests in Gottfried's low density plot,
P_{22} = proportion of successful nests in Gottfried's high density plot,

$$\bar{P}_1 = \frac{P_{11} + P_{12}}{2}, \bar{P}_2 = \frac{P_{21} + P_{22}}{2}, P = \frac{\bar{P}_1 + \bar{P}_2}{2}, q = 1 - P,$$

n_{11} = sample size in Fretwell's low density plot,
n_{12} = sample size in Fretwell's high density plot,
n_{21} = sample size in Gottfried's low density plot,
n_{22} = sample size in Gottfried's high density plot.

The value obtained is 0.33. If all the ratios in the numerator are normally distributed with variances as calculated beneath the square root bracket in the denominator, then the probability of the value calculated follows a z-distribution, since the sum of normally distributed variates is also normally distributed. These ratios are all calculated from means and should therefore be normally distributed. A z value of 0.33 is not large enough to reject the null hypothesis ($P < 0.37$).

Statistical significance is a statement about sample size, not about a biological phenomenon. The presence of statistical significance in some data simply means that one's sample is sufficiently large to detect the biological differences that are present. Absence of statistical significance means that one's data are insufficient to detect any measurable biological differences that are present. The inability to detect a difference does not justify the conclusion that no differences are present, however. Gottfried's data, which are invaluable and beyond any doubt deserve our attention, are yet too few (one breeding season, 136 nests) for us to know whether or not there is any biologically significant density dependence of nest predation in old fields. They are also too few for us to know whether or not there are any differences between old fields and marshes and successional woodlands.

If Gottfried replicated his study 4.5 times, he would have an 80% chance of detecting the presence of a density effect (Sokal and Rohlf, Biometry, W. H. Freeman and Co., San Francisco, California, 1968:609). To show differences between habitats, we would need many more replications in both woods and old field. Replicating both Gottfried's experiments and Fretwell's studies the same number of times, assuming all samples are the size of Gottfried's and correcting to equalize mean predation rates between old field and woods, it would take over 30 sets of results identical to Fretwell's and Gottfried's (or results showing a greater difference) to demonstrate significance.—STEPHEN D. FRETWELL AND FRANK S. SHIPLEY, *Div. Biology, Kansas State Univ., Manhattan, Kansas 66506.* *Accepted 18 Nov. 1980.*

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A comparison of nest-site and perch-site vegetation structure for seven species of warblers.—One aspect of the study of avian niche structure has involved habitat relationships of breeding birds. In general, birds seek a characteristic vegetation-structure type, their niche-gestalt (James, Wilson Bull. 83:215–236, 1971), in which to establish a territory (Hilden, Ann. Zool. Fenn. 2:53–75, 1965). This territory provides many breeding passerines with suitable areas for singing, feeding and nesting. Some previous descriptions of avian habitat relationships (James 1971; Whitmore, Wilson Bull. 87:65–74, 1975; Smith, Ecology 58:810–819, 1977) have been based on information collected from within a 0.04-ha circular