ON TERRITORIAL BEHAVIOR AND OTHER FACTORS
INFLUENCING HABITAT DISTRIBUTION IN BIRDS

II. SEX RATIO VARIATION IN THE DICKCISSEL
(Spiza americana Gmel)

by

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I. INTRODUCTION

Although the main intent of the series of which this paper is the second one is to provide clearer definitions of the territorial hypotheses that have been debated, it is possible that non-theorists might have difficulty in relating these definitions to the sort of observations commonly made. Therefore, this and the following paper present two examples of the way in which the theory is intended to be used. The format of each example is the same. We wish to compare density and suitability in a territorial species. In order to do so, we must assume that suitability (which is not well defined) is related to some measurable feature of the bird-habitat interaction. In each case, we

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make this assumption carefully as the interpretation of the following data depends on it. Having made the assumption, we proceed to measure our supposedly suitability-related feature for comparison with the habitat variation in density. If the suitability index does not vary appreciably, we conclude that the distribution may be nearly ideal free. If, at the same time, there is annual and habitat variation in densities, some density cue, perhaps territorial behavior, is implicated. If there is appreciable variation in the suitability index, which is positively correlated with density, then, since this correlation is a characteristic of the ideal dominance distribution defined in Equation (9), we conclude that the actual distribution may be nearly ideal dominance. In the absence of evidence of some other density limiting factor, we conclude that the function of territorial behavior may be to limit density. If there is appreciable variation in the suitability index, which is not positively correlated with density, then there is no evidence to support either the density cueing or density limiting hypotheses, and the spacing hypothesis becomes the most likely of the three.

It is worth repeating that this method of evaluating the role of territorial behavior rests on a number of assumptions. The birds must be ideally adapted in their habitat selection behavior. The suitability index must be truly related to the potential genetic contribution of the individuals. Suitability within a habitat must decrease as density increases, at least over normal ranges of density variation. The presence of these assumptions emphasizes the complexity of the problem, which will not be solved easily for a given species. The studies presented in this section are a first step, from which one may find direction, but not final conclusions.

Consider a species where all females have a choice of males (either because there are more males than females or because males are polygynous). Suppose further that only the males are territorial, that the females are free, and that all individuals are ideally adapted. Then it follows that the suitability for males is validly indexed by the sex ratio (females/males). This is so because the genetic contribution of males is achieved through the females. If all females have identical suitabilities, then males with equal numbers of mates will have equal suitabilities. Males with more mates will have higher suitabilities; males with fewer mates will have reduced suitability. Therefore, male suitability can be measured by the sex ratio, and we can study the role of male territoriality by comparing sex ratios in habitats occupied by the males at different densities.

One may look at the correlation between sex ratio and density in situations where only males are territorial and females have choice of males. These conditions are satisfied by the Dickcissel which breeds throughout the Mid-