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INTRODUCTORY REMARKS: ESTIMATING BIRDS PER UNIT AREA

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Many ornithological investigations require estimates of density in order to make inferences about hypotheses being tested. The most common method used to estimate density is line transect sampling and I will make a few comments on this general technique because of its importance in this symposium.

At least 26 papers have appeared on line transect sampling since 1970. I suggest the term *line transect* be reserved for the data gathering, sampling, and field measurement activities. These are becoming somewhat standardized, e.g., grouped or ungrouped perpendicular distance data, with or without a fixed width or boundary. Alternatively, sighting distances and angles can be recorded and then the perpendicular distances can be calculated.

The analysis of these distance data is far from standardized and about three dozen analysis methods can now be found in the literature. It is no longer sufficient to remark "density was calculated by the line transect method." The majority of the methods are ad hoc; they lack a firm foundation, little is known about their small sample properties, sampling variance estimators are not available, and so on. Unfortunately, several of these methods are still seeing heavy use by ornithologists.

Well based methods did not appear until 1968 (see Eberhardt 1968 and Gates et al. 1968) and approximately a dozen have appeared since then. A few of these dozen form a class that represent very good analysis methods, but are just beginning to see widespread use (see Burnham et al. 1980). These methods have estimators of sampling variance, the small sample properties are known, they are very efficient, they allow broad assumptions about the unknown detection function, and goodness of fit tests are available. Finally, it is important to note that strip transects and circular variable plot surveys are special cases of line transect theory and methodology.

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