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SUMMARIZING REMARKS: ESTIMATING BIRDS PER UNIT AREA

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Techniques to enumerate populations fall into two categories: (1) relative estimators that provide some measure of abundance or activity to assess change or make comparisons, and (2) absolute estimators that provide direct measures of densities or population numbers. Density, the subject of this session, requires both an accurate count of objects and a defined area associated with the count. Two of the presentations partially addressed both parameters. The remaining presentations were indirectly related to the subject or addressed only one of the parameters. Rather than depart from the subject to review the presentations, I'd prefer to motivate your thought processes on the "how many?" and the "why?" questions associated with estimating densities.

The dynamics of avian communities (i.e., demographic variables), the difficulty of detecting all individuals (i.e., physical and behavioral barriers) and the problems of defining the spatial and temporal sampling frame (i.e., relating observations to objectives and geographical boundaries) all confound the estimation of bird densities. All of the density estimators attempt to remove these variables by somehow freezing birds or objects for a count within a defined space-time frame. Techniques to achieve this range from quantitatively removing or accounting for the variables via sampling and experimental design to developing estimators that are robust to or are unaffected by the variables. When this fails, we impose restrictions on the conclusions by constricting objectives and defining assumptions. Even after all of this a gnawing concern persists because we have never validated the estimator on known populations that match ours; an effort that is grossly deficient in the field.

Ideally, the instantaneous location of all objects of concern in three dimensional space would: (1) provide a precise estimate of density within any selected plane or strata, and (2) permit a quantitative description of the spatial pattern of the objects. The former answers the obvious question of "how many per unit area?" and the latter provides insight into the "why?" that inevitably follows. Spatial patterns are mentioned to encourage all of you involved with defining objectives and developing estimators to go beyond the tunnel visioned approach of answering only "how many?" The possibility of understanding the underlying distributions and regulatory mechanisms behind the objects with the same data set used to estimate density should be sufficient incentive.

Objectives, assumptions and effort associated with the applied density estimators can also be compared in terms of the spatial and temporal resolution of objects within the sampling frame. For example, the quadrat type methods (strip and circular plot) utilize only the number of objects observed within a fixed search area. The variable search area methods (line transect, circular variable plot) require spatial resolution of the objects in one dimension; perpendicular distance from transect line to object or distance from observer to object respectively. Mapping methods, an extension of the quadrat methods, increase spatial resolution to two dimensions by plotting objects on a horizontal plane. The increase in spatial resolution is generally interrelated with: (1) a greater knowledge about the population (interspecific relationships, packing, etc.), (2) an extension of the temporal sampling frame, (3) a change in objective from the density of all individuals to territorial individuals, (4) an increase in effort, and (5) altered assumptions. It is apparent that many budgets are wasted because these interrelationships are poorly understood. A prime example is the failure to recognize and utilize the differences in the detection related assumptions between the variable search area and quadrat-type methods.

Similarly, modern technology has more to offer than binoculars, tape measures, pencils, paper and adding machines to collect and analyze the data. Excellent "state of the art" publications and computer programs already exist and with a little creativity, technological breakthroughs in data collection are just around the corner.

To summarize, the ultimate method for estimating density is yet to be developed. In the meantime, you users have the responsibility of selecting the method that answers well-defined objectives within acceptable limits of accuracy, precision, effort and funding. If no method fits, stay in bed.

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