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Patuxent Wildlife Research Center

Development of Methods Associated with Animal Population Dynamics

- ***The Challenge:*** Conservation and management of natural animal populations requires knowledge of their dynamics and associated environmental and management influences. Specifically, informed management requires periodic estimates of system state (e.g., population size) and models for projecting consequences of management actions for subsequent state dynamics. However, it is very difficult to draw strong inferences about system state and dynamics for natural animal populations and communities. The primary challenges are: (1) the tendency of animal densities to vary substantially over space and (2) the likelihood that any method of sampling animals (capture, direct observation, etc.) will produce counts that represent some unknown fraction of the true number of animals in the sampled locations.

- ***The Science:*** This research project focuses on development of scientific approaches for dealing with these 2 primary challenges. The issue of spatial variation requires that we sample space in a manner that permits inference about the locations that are not sampled, based on the counts or other data from locations that are sampled. This issue is dealt with via (1) design-based approaches that associate a probability of selection with all locations within the area about which inference is desired and (2) model-based approaches that associate the quantity of interest with covariate information available at all potential locations. The issue of non-detection requires that we draw inferences about detection probabilities (the probability that an animal within a group of interest at a location appears in the count for that location). A variety of methods (capture-recapture models, distance sampling, multiple observers, time at detection methods, etc.) has been developed to estimate detection probability and thus to develop inferences about the quantities of interest (e.g., population size, survival rate) based on count data.

- ***The Future:*** Substantial progress has been made during the course of this project, and methods and ssociated software developed here have been adopted by other USGS scientists, other DOI scientists and managers (e.g., FWS, NPS), state and local government managers, university researchers, and scientists and managers involved in conservation and management throughout the world. Nonetheless, there is substantial room for additional progress. For example, no two field designs or sampling programs are identical, leading to a need for adapting general approaches to a variety of specific biological and sampling situations. In addition, the future will include additional efforts to integrate data from multiple sources and sampling approaches in order to draw inferences about a single quantity or set of quantities. Such efforts will require the development of joint models that include not only the quantities of interest but also models for the sampling approaches used to collect each type of data. USGS has been a world leader in the development of these inference methods, and it is anticipated that this leadership will continue into the future.

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