Analyzing Species Population Size and Habitat Relations (Newsletter)*

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There are many animal species whose population numbers bring them to the attention of resource agencies and others; e.g., Greater sage-grouse, Oregon spotted frog, Lahontan cutthroat trout. Some of these species are listed under the ESA, others are not; in both cases accurate estimates of population size and limiting factors are critical for informed policy and management decisions. Correctly measuring population size and the factors affecting it is not always obvious because of the data formats and mathematical formulation of the statistical models.

Biological data are counts of individuals, integers not fractions. While data summaries often present a fractional mean (2.4 children per family) it is more realistic and accurate to use the median value (a whole number) with the same number of values both less and greater than it.

Population size is determined in one of two ways: direct counts or presence/absence. In both cases, when a species is not found during a data collection event, we cannot be certain whether that species does not inhabit that location or was not observed at the time. This is especially important when we know that the species has been observed there in the past. To correctly analyze and interpret these data, so decisions are technically sound and legally defensible, the appropriate statistical model must fit the amount and type of available data rather than fitting the data to a pre-determined statistical model.

Regression models are the statistical tools used to determine cause and effect; correlation measures only degrees of association, not dependence. Population size is the response variable (the effect) while independent factors such as habitat type, habitat abundance, habitat distribution, landscape, and predation are potential explanatory variables (the causes). There are many regression models (linear and generalized) including Poisson regression for count data and logistic regression for presence/absence or proportional data.

Other factors requiring consideration include whether the population-habitat relationships vary with the population size. For example, larger populations (90th percentile) may respond more rapidly to an increase in habitat size than do smaller populations (10th percentile) for the same habitat size increase. This information can be valuable to policy and regulatory decision-makers.

A more subtle difference in regression analysis of species-habitat relationships can occur by taking the average response of several regression models, each using a different set of explanatory variables. Because explanatory variable scales can differ (e.g., time in years, elevation in meters, and slope in degrees) the output of the models cannot be averaged without producing incorrect results.

Non-technical decision-makers do not need to know the details of these statistical models, but they do need to understand that incorrect model results can lead them to ineffective policies or regulations. Lawsuits aside, decisions based on incorrectly analyzed data may have unwanted consequences. Anticipated increases in population size might not occur while the economic impact might be severe. Societal confidence and trust in the decision-makers could be decreased because expectations have not been met.

Natural events such as climate change, long-term drought, El Nino weather effects, and a focus on sustainability should encourage policy and regulatory decision-makers to require that analyzed and interpreted data presented to inform their decisions be shown to be statistically appropriate and correct.

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