

Advances in Statistics

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Abstract

The papers included in the Advances in Statistics section of the Partners in Flight (PIF) 2002 Proceedings represent a small sample of statistical topics of current importance to Partners In Flight research scientists: hierarchical modeling, estimation of detection probabilities, and Bayesian applications.

Sauer et al. (this volume) examines a hierarchical model describing attributes and change of aggregates of bird populations using a Bayesian statistical inference approach with WinBUGS. They point out that WinBUGS provides a user-friendly software environment for hierarchical modeling that more realistically describes many biological contexts.

The authors of two papers focus on the issue of detection. Farnsworth et al. (this volume) presents a summary of detection probability estimation procedures, including distance sampling, double observer methods, time-depletion (removal) methods, and hybrid methods that combine these approaches. They conclude by presenting a method that combines distance and removal sampling methods, along with results. Earnst and Heltzel (this volume) describe estimates of detection ratios based upon songbird surveys as a function of species, forest type, and season. They report that detection ratios reflecting detectability differed with species (not surprising), but also with timing of surveys (even a couple of weeks makes a difference) and habitat.

Stauffer et al. (this volume) describes a Bayesian interpretation of Akaike weights, useful for assessing the competitiveness of a collection of models with a series of datasets. They illustrate these ideas with habitat selection models for Northern Spotted Owl in California.

Statistical Guidelines

We conclude this summary by recommending that the following statistical components be included in future PIF proposals for sample surveys and experiments:

- 1) Any project proposing an “experiment” with a comparison of “treatments” should include results of a power analysis in the methodology section of the proposal, indicating
 - a) the effect sizes of interest (i.e., what differences of biological significance are being examined in the experiment?),
 - b) the confidence level, and
 - c) the number of replicates required to attain a specified level of power in the experiment. We emphasize that the level of power may differ, depending on the nature of the “experiment.” 80 percent power is a generally accepted standard, but there are circumstances where desired power might be higher or lower.
- 2) Any project proposing to estimate a trend (e.g., in abundance, productivity, nesting success, survival, fitness, occupancy) should indicate
 - a) the amount of decline or increase that is of biological interest, and
 - b) the number of replicates required with a specified confidence level and power to detect this trend in the project, based upon a power analysis.
- 3) Projects proposing to estimate parameters (e.g. abundance, occupancy, productivity, nesting success, survival, fitness) should indicate the amount of precision anticipated for the specified confidence level and sample size.
- 4) Projects examining demographic parameters such as survival and breeding propensity, should use up-to-date software available for these estimates, such as MARK or an equivalent alternative (e.g., SURGE).
- 5) Confidence levels lower than 95, such as 90 percent, may sometimes be more appropriate for sample surveys and experiments, given the statistical difficulties inherent in the analysis of

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these datasets that are sometimes sparse and often noisy. A 90 percent two-sided confidence interval can be useful, for example, because it can be split into an upper one-sided 95 percent confidence interval and a lower one-sided 95 percent confidence interval, if one is interested in the minimum value that a parameter may take (use the upper one-sided 95 percent CI) or the maximum value that a parameter may take (use the lower one-sided 95 percent CI). Standards lower than 95 percent may also be useful when other sources of error in the decision-making process are appreciably larger than the significance level of 5 percent.

Readers are referred to Nur et al. (1999) for further discussion and recommendations for those designing monitoring programs and analyzing these data.

Literature Cited

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- Earnst, S. L. and J. Heltzel. This volume. **Detection ratios of riparian songbirds.**
- Stauffer, H. B., C. J. Zabel, and J. R. Dunk. This volume. **Application of Bayesian methods to habitat selection modeling of the Northern Spotted Owl in California: new statistical methods for wildlife research.**