A comparison of the multinomial likelihood and chi-square approaches to statistical population reconstruction

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Statistical population reconstruction using annual age-at-harvest, catch-effort, and radio-telemetry data has recently emerged as a robust and versatile approach to estimating the population dynamics of harvested species of wildlife such as American black bears (*Ursus americanus*), elk (*Cervus canadensis*), and greater sage-grouse (*Centrocercus urophasianus*). This method simultaneously provides point estimates and uncertainties for several demographic parameters such as annual abundance, juvenile recruitment, and natural survival, as well as a flexible framework for incorporating auxiliary information from mark-recapture or food abundance surveys. Although current reconstruction techniques use either a multinomial likelihood or a chi-square approach to describe the expected harvest numbers for each combination of age-class and year, a comprehensive comparison of these two approaches has yet to be undertaken. We simulate populations using a stochastic version of a Leslie matrix model under a range of demographic conditions and harvest rates to investigate the relative performance of these two approaches in terms of accuracy and precision. We then use a harvested population of North American river otter (*Lontra canadensis*) in southern Kentucky, USA as a case study to demonstrate how these two approaches can result in conflicting estimates of population growth, recruitment, and other demographic parameters.

References

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