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Mark-recapture estimators for dual frame population size of prominent nesting structures: the effect of uncertain detection probability

Abstract

The combined mark-recapture and line transect sampling methodology proposed by Alpizar-Jara and Pollock [Journal of Environmental and Ecological Statistics, 3(4), 311–327, 1996; In Marine Mammal Survey and Assessment Methods Symposium. G.W. Garner, S.C. Amstrup, J.L. Laake, B.F.J. Manly, L.L. McDonald, and D.C. Robertson (Eds.), A.A. Balkema, Rotterdam, Netherlands, pp. 99–114, 1999] is used to illustrate the estimation of population size for populations with prominent nesting structures (i.e., bald eagle nests). In the context of a bald eagle population, the number of nests in a list frame corresponds to a "pre-marked" sample of nests, and an area frame corresponds to a set of transect strips that could be regularly monitored. Unlike previous methods based on dual frame methodology using the screening estimator [Haines and Pollock (Journal of Environmental and Ecological Statistics, 5, 245–256, 1998a; Survey Methodology, 24(1), 79–88, 1998b)], we no longer need to assume that the area frame is complete (i.e., all the nests in the sampled sites do not need to be seen). One may use line transect sampling to estimate the probability of detection in a sampled area. Combining information from list and area frames provides more efficient estimators than those obtained by using data from only one frame. We derive an estimator for detection probability and generalize the screening estimator. A simulation study is carried out to compare the performance of the Chapman modification of the Lincoln–Petersen estimator to the screening estimator. Simulation results show that although the Chapman estimator is generally less precise than the screening estimator, the latter can be severely biased in presence of uncertain detection. The screening estimator outperforms the Chapman estimator in terms of mean squared error when detection probability is near 1 wheareas the Chapman estimator outperforms the screening estimator when detection probability is lower than a certain threshold value depending on particular scenarios.

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