

New Title is: "Estimating animal mortality from anthropogenic hazards"

Hidden Markov models for estimating animal mortality from anthropogenic hazards

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Abstract. Carcass searches are a common method for studying the risk of anthropogenic hazards to wildlife, including non-target poisoning and collisions with anthropogenic structures.

Typically, numbers of carcasses found must be corrected for scavenging rates and imperfect detection. Parameters for these processes (scavenging and detection) are often estimated using carcass-distribution trials in which researchers place carcasses in the field at known times and locations. In this manuscript I develop a variety of estimators based on multievent or hidden Markov models for use under different experimental conditions. I apply the estimators to two case studies of avian mortality, one from pesticide exposure and another at wind turbines. The proposed framework for mortality estimation points to a unified framework for estimation of scavenging rates and searcher efficiency in a single trial and also allows estimation based only on accidental kills, obviating the need for carcass distribution trials. Results of the case studies show wide variation in the performance of different estimators, but even wider confidence intervals around estimates of the numbers of animals killed, which are the direct result of small sample size in the carcass distribution trials employed. These results also highlight the importance of a well formed hypothesis about the temporal nature of mortality at the focal hazard under study.