

State-space models for incorporating multiple data sources in capture-recapture models

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Abstract: Capture-mark-recapture (CMR) techniques are used in a wide variety of sampling scenarios, but remain vulnerable to sources of bias such as temporary migration and individual heterogeneity. We show how a state-space framework can be used to jointly analyze traditional CMR in combination with multiple data sources aimed at clarifying such sources of bias. We demonstrate the general modeling framework on a dataset for native fish in the Murray river, Australia. Using a combination of CMR data, roaming telemetry, stationary telemetry and resighting data, we account for individual movement, temporary migration and growth in estimates of mortality rates. We find that using the traditional CMR dataset alone, we have little power to estimate factors relating to individual movement, and that estimates of mortality rates are confounded by low detectability. Augmenting the CMR data with telemetry allowed us to estimate mortality rates more precisely, albeit at the cost of increased model complexity. Conversely, the volunteer resighting data provided little additional benefit, likely due to low recapture rates and variable effort. Overall, the joint analysis of telemetry and CMR data led to an increase in statistical power, suggesting excellent potential for integration of similarly complementary datasets.