ESTIMATING CARNIVORE DENSITY USING SPATIAL CAPTURE-RECAPTURE MODELS: SAMPLING DESIGNS AND POTENTIAL PITFALLS

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Spatial capture-recapture (SCR) models have improved the ability to estimate densities of rare and elusive animals. However, SCR models have seldom been validated even as model formulations diversify to incorporate new sampling methods and/or additional sources of information. The relationship between encounter probabilities, sources of additional information, and the reliability of density estimates, is poorly understood but crucial to assessing reliability of SCR-based estimates. We used a simulation-based approach that incorporated prior empirical work on mountain lions in western Montana to assess the accuracy and precision of density estimates from SCR models using direct search effort. Our simulations focused on understanding the consequences of: 1) variable probabilities of encounter generated from different levels of search effort, and 2) including additional spatial information from collars. Overall, we found that although low search effort resulted in sparse datasets and highly biased and imprecise estimates of density (relative bias, RB = 0.71, coefficient of variation, CV = 1.16), a combination of increased effort and/or additional information generated unbiased and precise density estimates (e.g., moderate effort and 4 collars, RB = -0.004, CV = 0.19). This work suggests that reliable density estimates can be generated by multiple sampling designs such that additional spatial information from collars can be used to supplement direct search effort when resources are limited, or by increasing search effort when collaring is impractical. Using the open-source code for our simulation-based approach, we further offer recommendations on sampling designs for SCR-based density estimation.