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A semi-spatial integrated population model to assess population dynamics of recovering species

Recolonizing species exhibit unique population dynamics, namely dispersal to and colonization of new areas, that are important to understand from a conservation and management perspective. Integrated population models (IPMs) have proven useful for making inference about population dynamics by integrating multiple data streams, including data relevant to population state and demographic rates. More recently, spatially explicit integrated population models (SIPMs) have leveraged the power of spatial capture recapture, resulting in a spatially explicit model of population dynamics. SIPMs, however, require information on the spatial observation process to correctly model spatially explicit data. In a recolonizing population of wolves in Washington, USA, we were lacking data on the spatial observation process but wanted to leverage the power of SIPMs to describe the recolonization process, which is critical to recovery. We present a semi-spatial integrated population model, which uses GPS collar and pack count data to estimate survival, reproduction, abundance, and movement rates. There are two components: [1] a matrix population model that governs the population state process and vital rates, and [2] an individual based component that allows movement of individuals and colonization of new areas. Following the identification of potential dispersers, their fate is determined by [1] drawing of a dispersal distance, [2] assignment to the territory of least cost based on an underlying connectivity model, [3] number of wolves at the potential new territory, and [4] a Bernoulli process by which those wolves will stay or go based on an underlying occupancy model. Our semi-spatial IPM can be used to assess population dynamics with a spatial component and determine how management strategies can affect population dynamics and recovery.