

From: [Grizzle, Betty](#)
To: [John Guinotte](#)
Subject: Fwd: PVA models
Date: Wednesday, November 1, 2017 4:07:17 PM
Attachments: [Notes of PVA models.docx](#)

FYI - see attachment (sent in July to Jodi and Justin, only).

----- Forwarded message -----

From: **Grizzle, Betty** <betty_grizzle@fws.gov>
Date: Mon, Jul 10, 2017 at 8:17 AM
Subject: PVA models
To: "Shoemaker, Justin" <justin_shoemaker@fws.gov>, "Bush, Jodi" <jodi_bush@fws.gov>

Justin and Jodi - Please see attached for a few summary notes I prepared on the use of PVA models and my concern with the approach by USGS for wolverine. Let me know what you think. If needed, I can provide additional material from other references, but my goal was to keep this brief.

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A few notes on PVA models:

Background: Population Viability Analysis (PVA) uses quantitative methods to analyze data and link results to models representing population growth and decline to calculate the risk of extinction/quasi-extinction or a similar measure of population viability. Demographic PVA models can be divided into four main approaches (in order of complexity): deterministic single-population, stochastic single-population, metapopulation, and spatially-explicit. Genetic models (i.e., effective population size) represent a non-demographic approach to PVA. Demographic PVA models are not recommended when the distribution and/or abundance of a species is poorly known.

Population simulation models (deterministic and stochastic) are constructed using an estimated number of abundance for a species, and its future abundance is calculated over time by applying demographic rates (survival and reproductive). They are structured around individuals grouped into stages (life-cycle diagrams). USGS has presented a preliminary deterministic single-population matrix model approach for the North American wolverine.

Limitations of Population Simulation Models: Although it's always best to start first with the simplest model, a deterministic (or stochastic) single-population models do not incorporate spatial structure ("patches" and connectivity) or dispersal data (e.g., age class and timing of dispersal), both of which are important in the life history of the wolverine and can affect population viability. Deterministic single-population type models also assume nearly constant demographic rates, which may not be the case in habitats with considerable environmental variation or with a polygamous species like the wolverine. A *stochastic* single-population model can use variations in demographic rates to mimic environmental stochastic effects, but these rates may be variable within the different habitats occupied by wolverines or between subpopulations.

More importantly, we have very little data on the current abundance of wolverines in the contiguous United States, though the multi-state occupancy study should provide some insights. Using a projected population number of wolverines that was *estimated* using a resource selection function habitat model (from Inman *et al.* 2013) may not be appropriate for constructing a single-population PVA model.

Recommendation: Rather than develop a deterministic or stochastic single-population simulation model, a metapopulation or spatially explicit approach to developing a PVA may be more appropriate for the wolverine, which exists as a classic metapopulation across a large area of the contiguous United States, with emigration/immigration with Canada. Unfortunately, it's unlikely that we will be able to construct either of these more complex PVA models given the lack of current population estimates and the limited time remaining for completion of the status review.

Sources:

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