SWA: Elk Migration in Yellowstone

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Research Question

This model buries the lede on its research questions: they exist, but are not prominently advertised. Once the model is built, the authors use it to test the following hypotheses:

- Model variance is relatively low over multiple runs
- Model variance is highest in low-trafficked geographic areas
- Elk spatial memory degrades with distance from summer range and well-traveled paths
- Cognitive maps become more highly structured as strength of stimuli increases

It seems that the authors intended these more as sanity checks on the behavior of the model than as true research topics of interest, but I still give them credit for making clear hypotheses and testing them in a systematic way.

Model Effectiveness

I judge this to be a very effective model—one of the best we have read this semester.

Many things are good about this model—theoretical backing, implementation, documentation, etc.—but I want to devote most of my discussion to the inclusion of learning. Many of the models we have examined this semester encode some kind of agent cognition but do so in an ad-hoc and static fashion. Agent cognition patterns are chosen because they seem to make sense, and once coded and initialized, remain static throughout the simulation time-span. In real life, of course, human agents (and even some animal agents, such as elk) have the capacity to update their cognition so as to improve fitness against environmental stimuli. This model uses genetic algorithms and reinforcement learning to update elk cognition over the model timespan.

Also, the authors conduct validation that leaves the reader confident their model is a good map to reality. In section 5.1, they compare the output of their model to available data on elk kill rates and locations (which were not used for the initial training of the model), and find that they line up quite well. I actually think that the authors did not learn forward enough in their research questions to exploit the potential empirical implications of their model. Most of their research questions concern *internal behavior* of the model with no claim of its correspondence to reality, but since they have a basis for asserting findings in the model are predictive of reality, they could have explored more substantive hypotheses.

Course Themes

Empirical methods for building agent decision models: this model has the most empirically-driven agent decision models of any in this course. Agent cognition is altered as a function of environmental stimuli and rewards (based on real-world data such as biomass (food) density), rather than remaining static over the course of the model run.

Modeling cross-scale feedbacks and interactions: this model allows for individual knowledge to be transmitted to the group. For example, an elk's knowledge of a particularly good route will be mimicked by other elk in the group. This contributes to the impressive amount of adaptive learning in the model.