The Design and Implementation of Eco-Evolutionary PVA Models: An Integrative Approach Using HexSim

Allen Brookes
Nathan H. Schumaker
Jennifer M.W. Day

To persist into the future, species of conservation concern must remain both demographically and genetically viable. Developing mitigation and recovery strategies to ensure species' viability necessitates the use of forecasting models that can incorporate ecological and/or evolutionary processes. Of the available models commonly used for forecasting population dynamics, few are both spatially-explicit and individual-based, and there are fewer still that merge ecological and evolutionary processes. But the speed and extent of species and habitat loss has pushed the long-standing need for eco-evolutionary models into the forefront of PVA research. We demonstrate how an eco-evolutionary modeling tool, HexSim, can improve PVA by linking demography and genetics. HexSim is a spatially explicit, individual-based life history simulator that uses a flexible trait-based approach to associate multiple dynamic attributes with simulated individuals. This modeling approach simplifies the simulation of multiple-stressor interactions as well as adaptive (or neutral) genetic traits. We illustrate how this flexible, eco-evolutionary scheme is implemented, demonstrate its application to PVAs with HexSim example simulations, and discuss how it could be adopted for use in other model development efforts.