Demography and dispersal: sensitivity analysis for multiregional matrix population models

Christine M. Hunter[1] , Hal Caswell[2] and Michael G. Neubert[3].

Demographic models link the vital rates of individuals (e.g. survival, reproduction, development) to the dynamics of populations. Sensitivity analysis shows how changes in the vital rates affect such measures of population performance as the population growth rate. Sensitivity analysis is essential for studying the effects of environmental changes, evaluating management strategies, and improving monitoring schemes. Spatial distribution adds an extra complication to sensitivity calculations. Spatially distributed populations (i.e., metapopulations) are composed of subpopulations, each with its own vital rates, dependent on local habitat conditions. The subpopulations are linked by dispersal, which may depend on distance and/or dispersal barriers or corridors. Thus, metapopulation sensitivity analysis must include changes in both demography and dispersal. Here, we show a new way to use periodic models to incorporate dispersal into multiregional matrix population models. We will show how to calculate the sensitivity and elasticity of population growth rate to changes in the vital rates of each subpopulation and to dispersal between each pair of subpopulations. As examples we will compare the sensitivity analysis of three published metapopulation models: the Peregrine Falcon (*Falco peregrinus*; 2 subpopulations with symmetrical dispersal), the Iberian lynx (*Lynx pardinus*; 6 subpopulations with dispersal dependent on patch arrangement and inter-patch habitat), and the Wandering Albatross (*Diomedea exulans*; 10 subpopulations with dispersal dependent on distance).

[1]Biology Department MS-34, Woods Hole Oceanographic Institution, Woods Hole MA 02543, USA (e-mail: cmhunter@whoi.edu).

[2]Biology Department MS-34, Woods Hole Oceanographic Institution, Woods Hole MA 02543, USA (e-mail: hcaswell@whoi.edu).

[3]Biology Department MS-34, Woods Hole Oceanographic Institution, Woods Hole MA 02543, USA (e-mail: mneubert@whoi.edu).