Mathematical Modeling
Last Class / HW Assignment

Select one of the following and write a wiki. The following questions should be addressed.

1. Identify the biological problem. Why is a model being used?
2. Explain the model.
3. Discuss the mathematical techniques used in the paper.
4. What is the main result? How is the model validated? Are additional experiments run to test the model?

Andy P. Dobson, A. D. Bradshaw, A. J. M. Baker
Hopes for the Future: Restoration Ecology and Conservation Biology
Conversion of natural habitats into agricultural and industrial landscapes, and ultimately into degraded land, is the major impact of humans on the natural environment, posing a great threat to biodiversity. The emerging discipline of restoration ecology provides a powerful suite of tools for speeding the recovery of degraded lands. In doing so, restoration ecology provides a crucial complement to the establishment of nature reserves as a way of increasing land for the preservation of biodiversity. An integrated understanding of how human population growth and changes in agricultural practice interact with natural recovery processes and restoration ecology provides some hope for the future of the environment.

Ilkka Hanski and Mats Gyllenberg
Uniting Two General Patterns in the Distribution of Species
Two patterns in the distribution of species have become firmly but independently established in ecology: the species-area curve, which describes how rapidly the number of species increases with area, and the positive relation between species' geographical distribution and average local abundance. There is no generally agreed explanation of either pattern, but for both the two main hypotheses are essentially the same: divergence of species along the ecological specialist-generalist continuum and colonization-extinction dynamics. A model is described that merges the two mechanisms, predicts both patterns, and thereby shows how the two general, but formerly disconnected, patterns are interrelated.

Marten Scheffer and Stephen R. Carpenter

Catastrophic regime shifts in ecosystems: linking theory to observation Occasionally, surprisingly large shifts occur in ecosystems. Theory suggests that such shifts can be attributed to alternative stable states. Verifying this diagnosis is important because it implies a radically different view on management options, and on the potential effects of global change on such ecosystems. For instance, it implies that gradual changes in temperature or other factors might have little effect until a threshold is reached at which a large shift occurs that might be difficult to reverse. Strategies to assess whether alternative stable states are present are now converging in fields as disparate as desertification, limnology, oceanography and climatology. Here, we review emerging ways to link theory to observation, and conclude that although, field observations can provide hints of alternative stable states, experiments and models are essential for a good diagnosis.

J. Timothy Wootton, Michael S. Parker, Mary E. Power

Effects of Disturbance on River Food Webs A multitrophic model integrating the effects of flooding disturbance and food web interactions in rivers predicted that removing floods would cause increases of predator-resistant grazing insects, which would divert energy away from the food chain leading to predatory fish. Experimental manipulations of predator-resistant grazers and top predators, and large-scale comparisons of regulated and unregulated rivers, verified the model predictions. Thus, multitrophic models can successfully synthesize a variety of ecological processes, and conservation programs may benefit by taking a food web perspective instead of concentrating on a single species.

Malcolm K. W. Ko, Nien-Dak Sze, and Michael J. Prather

Better protection of the ozone layer

How can we extend the Montreal Protocol to other ozone-depleting chemicals, such as fuel from the Space Shuttle and pharmaceuticals, when the life cycles of these compounds and the scales of the industries are different?