Bio 255 Handout | Dahl Winters
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When Large-Scale Disturbances Interact

We know that ecosystems are always recovering from the last disturbance, but how might recovery be affected after a flurry of intense disturbances? This is an important question, given the increasing frequency of large-scale infrequent disturbances (LIDs) due to both climate change and human land use. The consequences of interacting LIDs on recovering ecosystems will be explored through 2 articles, both suggesting that the ecological consequences will be more serious than might result from a single LID. The first article provides theory as well as examples of what happens after a series of rapidly compounded disturbances—the ecosystem can surprisingly and irreversibly change to a new stable state. This is rather different from the outcome of a single LID, in which the ecosystem rebounds to its previous condition. The second article is a case study investigating whether prior fire regimes have any effect on pine mortality after a subsequent hurricane. Not only was a strong effect noted, but two other findings arose, with important research and management consequences:

1) *The combined effects of disturbances are often unforeseeable from studying the individual disturbances alone*. This means if we want to predict the combined effects of multiple LIDs, we need new research, since what we know about the ecological effects of individual LIDs may not help.

2) *Slight variations in initial disturbances can influence the long-term direct and extended effects of subsequent disturbances*. Thus, even if we limit ourselves to making small alterations to ecosystem processes, those alterations can still produce very large ecological effects in the future, during and after subsequent LIDs. This poses an important question for ecosystem management. Since modern industry significantly alters ecosystem processes via the extraction and use of copious natural resources, can we realistically expect to maintain stable ecosystems in the long run?

Primary Articles:

Paine RT, Tegner MJ, and Johnson EA. 1998. Compounded Perturbations Yield Ecological Surprises. Ecosystems 1: 535-545.

Platt WJ, Beckage B, Doren RF, and Slater HH. 2002. Interactions of Large-Scale Disturbances: Prior Fire Regimes and Hurricane Mortality of Savanna Pines. Ecology 83(6): 1566-1572.

Additional Articles:

Foster DR, Knight DH, and Franklin JF. 1998. Landscape Patterns and Legacies Resulting from Large, Infrequent Forest Disturbances. Ecosystems: 497-510.

Kulakowski D and Veblen TT. 2002. Influences of fire history and topography on the pattern of a severe wind blowdown in a Colorado subalpine forest. Journal of Ecology 90: 806-819.

Kulakowski D, Veblen TT, and Bebi P. 2003. Effects of fire and spruce beetle outbreak legacies on the disturbance regime of a subalpine forest in Colorado. Journal of Biogeography 30: 1445-1456.

Turner MG, Baker WL, Peterson, CJ, and Peet RK. 1998. Factors Influencing Succession: Lessons from Large, Infrequent Natural Disturbances. Ecosystems 1: 511-523.