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A Dynamic Programming Approach to Ecosystem Management

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Abstract: We propose a way of dealing with invasive species or pest control in agriculture. Ecosystems can be modeled via dynamical systems. For their study, it is necessary to establish their possible equilibria. Even a moderately complex system exhibits, in general, multiple steady states. Usually, they are related to each other through transcritical bifurcations, i.e., the system settles to a different equilibrium when some bifurcation parameter crosses a critical threshold. From a situation in which the pest is endemic, it is desirable to move to a pest-free point. The map of the system's equilibria and their connections via transcritical bifurcations may indicate a path to attain the desired state. However, to force the parameters to cross the critical threshold, some human action is required, and this effort has a cost. The tools of dynamic programming allow the detection of the cheapest path to reach the desired goal. In this paper, an algorithm for the solution to this problem is illustrated.

Keywords: optimization in graphs; optimal paths; directed graphs; population models; ecoepidemic models; dynamical systems equilibria

MSC: 92D45; 94B60; 90B10; 90C39; 92D25; 92D30; 92D40

Term 1: Dynamic Systems

- Definition: Systems that change over time, influenced by internal and external factors
- Ecological Relevance: Interconnected components of ecosystems (e.g. populations, resources, climate, etc...)
- Key components: