Environmental Systems – Dynamic Systems, Simulation and Modelling

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1. Introduction

The goal of this work is to simulate a bioinvasion of a invasive species in an stable ecosystem. Ecosystems are complex, dynamical, non-linear and multilevel system with many feedbacks due to the co-operation of positive and negative loops (*Awrejcewicz et al* 2015, P.267)

An appropriate way to analyse and model the dynamics of Ecosystems is the method of Dynamic Systems which was developed by Jay W. Forrester in the late 1950's (*Awrejcewicz et al* 2015, P.267).

We will use the open access Software VENSIM (Venata Systems Inc 2015: VENSIM) to simulate a predator pray system with two predators in a food competition. .

2. Model Scenario „Invasiv Species“

Since the increasing transport and exchange caused by globalisation (Perrings et al. 2005, p.212) ecosystems are threatened by invasive species (Meyerson & Mooney 2007, p. 199). If a foreign species reaches a new ecosystem there is a chance that it can establish in the new habitat (e.g. a niche). A successful reproduction can lead to an invasion of the native ecosystem with a probable risk of displacement to the native species. (Nentwig 2010, p.16ff).

An actual example is *harmonia axyridis* (Asian ladybug) which was introduced in many country as an biological control agent (Majerus et al. 2006, p.210f., after Gordon 1985) but has negative influences on the native *Coccinellidae* (Ladybugs) populations. *h. Axyridis* has some superiorities over native species like a higher reproduction rate, a fast dispersion (Majerus et al. 2006, p.210) and improved overwintering abilities (Labrie 2008, p.860f). With our model we want to simulate the arrival of *h. Axyridis* in a stable system with native *Coccinellidae* (predators) feeding on Greenflies (prey).We assume that the superior *h. Axyridis* will outcompete the native species due to its higher reproduction rate.

3. Model capability

Our model is based on the Lotka-Volterra equation predator prey model (zitieren) with a second predator as the invasiv species. The model is capable of simulationt the food competion between both predators feeding on the same prey (Greenfly). The prey has a constant birthrate while the preadtors birthrate is dependet on the population of prey (amount of food supply) and a reproductionrate (individual). Both preadotrs have a constant death rate and the prey deathrate is depend of the population of both predators. With normalized initail values (1) and rates (0.1) the system is stable. The main adjustment to simulate the superiority of *h. Axyridis* is an increased reproductinrate and a decreased deathrate.

4. Discussion

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