

## **Competition in Harvesting Systems**

*Donald B. Olson*

RSMAS/MPO University of Miami  
4600 Rickenbacker Cswy., Miami, USA, dolson@rsmas.miami.edu

*Ashley McCrea Strub*

RSMAS/MBF University of Miami  
4600 Rickenbacker Cswy., Miami, USA, amccrea@rsmas.miami.edu

*Carlos Laciana*

Facultad de Ingeniería, Universidad de Buenos Aires  
Las Heras 2214, Buenos Aires, Argentina, clacian@fi.uba.ar

### **ABSTRACT**

Models of food chains and simple food webs are explored to consider the impact of harvesting on population dynamics [1]. The first system considered involves two predators feeding on a single population of prey. After treating the dynamics of this system its response to harvesting either of the predators or the prey are considered. The system is parameterized to match properties of striped bass and bluefish foraging on menhaden as occurs on the east Coast of North America. Conditions for coexistence of the two predators are examined. The changes in these situations when fishing pressure on either predator is added is then considered. Harvesting raises the order of the equilibrium conditions by two to four, and therefore adds a number of additional states. Adding fishing to the prey species destabilizes the system in most cases. The second system considered involves competition between different agricultural sectors on a landscape. The system involves logistic formulation of land use where area ( $A_i$ ) under production in a particular commodity is bound by a carrying capacity. The model then computes the area under use by the competing crops. The system involves a crop yield for these areas and capital gain from the crop at a market. This in turn acts as a catalyst for the change in area usage. The variables of interest then are the capital and land areas over time in the face of yield variations and market forcing. The system is parameterized for soybeans and wheat in the Pampas of Argentina. The system has a number of fixed points including multiple interior ones. Lower area states with low capitalization are apparently prone to Allee effects. The explicit inclusion of economics in the model through capital ( $C_i$ ) equations introduces an interesting set of states where  $A_i = 0$ . and  $C_i < 0$ . These stable equilibria are identified with bankruptcy in an agricultural sector. The attention of the ongoing analysis is to understand the trajectories in the system that take a commodity to these states and therefore end production. The role of competition for land area and capital play an important part in determining the dynamics of this system. A mutualistic state where capital is exchange between sectors to stabilize the over all economy and promote diversity in land use is also considered.

**Keywords:** fisheries, agriculture, economics.

### **REFERENCES**

- [1] Olson, D., C. Cosner, S. Cantrell, and A. Hastings. Persistence of fish populations in time and space as a key to sustainable fisheries. *Bulletin of Marine Science*, 76, Univ. Miami., pp. 213-231, 2005.