ABSTRACT & SUPERVISORS

Nankinga Loy
BSc Educ. (MAK.), Msc (MAK.)
2016/HD13/18976U
Student No. 216023289

Title: Mathematical Modelling of Harvesting of a Stage and Size - Structured Fish Population: the Case of African Catfish and Nile Tilapia

ABSTRACT

We develop a model for interaction of a consumer-resource system with harvesting, in which African catfish (*Glarias~gariepinus*) consume a food resource. The cannibalistic behavior of African catfish is captured by using a four stage-structured system. The dynamics of food resource and African catfish result in a system of ordinary differential equations referred to as stage-structured fish population model. We have investigated eight different harvesting scenarios which account for yield of the fish stock. Results from the simulations showed that harvesting large juveniles and small adults under equal harvesting rates gives the highest maximum sustainable yield compared to other harvesting scenarios.

We also formulate a stage - structured model for African catfish (*Glarias~gariepinus*) and Nile tilapia (*Oreochromis~niloticus*) together with two food resources. This model is used to compare financial profit and biomass outtake in a two species system versus single species systems. The model dynamics include cannibalism, predator-prey, feeding, reproduction, maturation development, mortality, and harvesting. We prove consistency of the model in the sense that the solutions will stay bounded and non-negative over time. Conditions for local stability of fish-free equilibrium point are established.

The simulation results revealed:

(i) Asymptotically stable solutions, with co-existence of African catfish, Nile tilapia, and the two food resources.

(ii) Harvesting in a system with both species yields more biomass and financial profits than harvesting in a system with only one species.

(iii) Impact of harvesting on population size structure is negative and decreases with increasing harvesting pressure. This means the proportion of adult African catfish in the population is increasing because of cannibalism and predation.

Supervisors:

1. Dr. Linus Carlsson,
   Division of Mathematics and Physics,
   Malardalen University , Sweden.

2. Prof. Livingstone S. Luboobi,
   Institute of Mathematical Sciences,
   Strathmore University , Kenya.

3. Prof. J.Y.T Mugisha,
   Department of Mathematics,
   Makerere University , Uganda.

4. Dr. Betty Nannyonga,
   Department of Mathematics,
   Makerere University , Uganda.