

Consequences of some Ecologic Phenomena on the Dynamics of Prediction Models

Saturday, Sunday – 13:00-14:20

Spanish

Abstract:

On this tutorial will be present the main properties of the continuous time predator-prey models considering ecological phenomena such as:

- The Allee effect on prey or on predators;
- The prey refuge use;
- The formation of group of defense;
- Migrations on one or both populations;
- The collaboration or interference of predators, and so on.

The basic models where this phenomena are incorporated are the Gause or Leslie-Gower type, which are described by a autonomous differential equations system of the form

$$G : \begin{cases} \frac{dx}{dt} = F(x) - y h(x) \\ \frac{dy}{dt} = (p h(x) - e)y \end{cases} \quad \text{or} \quad L : \begin{cases} \frac{dx}{dt} = F(x) - y h(x) \\ \frac{dy}{dt} = s \left(1 - \frac{y}{nx}\right) y \end{cases}$$

where $F(x)$ and $h(x)$ are the prey growth function, usually the logistic growth function and the functional response of predators or consumption rate, respectively.

The migration and the Allee effect on prey are formalized modifying the growth function rate $F(x)$. In particular, the Allee effect is described of different mathematical forms, being the more usual function $F(x) = r \left(1 - \frac{x}{K}\right) (x - m)x$.

Also, it can assume this effect on the predator population modifying the conversion rate p or the intrinsic growth rate or biotic potential s by a function of the form $b(y) = \frac{y}{y + b}$.

The functional response of predators are classified on four types represented by the functions:

- $h(x) = qx$, linear consumption rate or Holling type I functional response.
- $h(x) = \frac{qx}{x + a}$, hyperbolic or monotonic consumption rate or Holling type II functional response.
- $h(x) = \frac{qx^n}{x^n + a}$, sigmoid consumption rate or Holling type III functional response
- $h(x) = \frac{qx^m}{x^n + a}$, with $1 \leq m < n$, nonmonotonic consumption rate or Holling type IV functional response.

When it is assumed that a part of prey x_r is in cover, the functional response is modified and the disposable food for predator is $x - x_r$.

This different combined aspects originate the differential equations systems to analyze, for which it must to establish: a invariance region, the parameter conditions for existence of positive equilibrium points, the nature of each one, the existence of limit cycles, the quantity of them, and so on.