Diagnosis of Chaos in a pelagic Ecosystem

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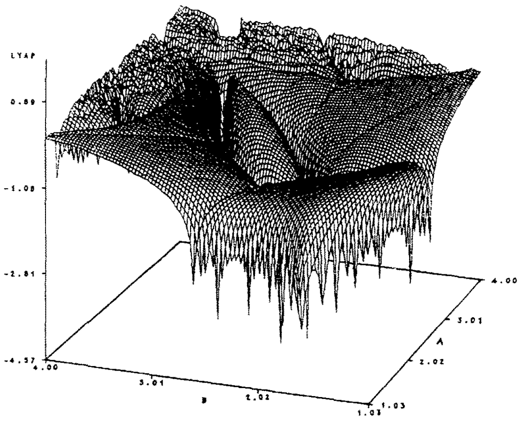
In order to achieve a "substainable development" is very important to manage natural resources. For an efficient management of the marine environmental, it's necessary to know the state of resources, their biology and how they interact with the environment. There is some experimental evidence that the abundance of the small pelagics, in a given marine area, shows strong time fluctuations and is, year by year, unpredictable. Several theoretical studies (MAY, 1976; MAY *et al*., 1979) demonstrated that the growth of some biological populations can exhibit a wide range of dynamical behaviours, from stable equilibrium points, to stable cycles with several points, through to a chaotic regime.

The dynamical behaviour of a population in chaotic regime makes unpredictable the amount of the biomass in a certain time. This problem makes the population dynamics models, useless for resources management purposes, particularly for the small pelagics. The diagnosis of the dynamical behaviour of pelagic ecosystem can be very useful to reduce management errors.

The aim of this paper is to describe a method for characterizing the turbulence in a biological population.

The figure shows a mapping of turbulence in a biological system obtained computing the Lyapunov exponent for a couple of values -a and -b representing the population fecundity parameter in the logistic equation. In this example it's possible to observe, to the top side of the plot (right and left), the typical structure of turbulence. The analisys of this maps allows to get usefull informations for practical applications.
The classical method utilized to diagnose the turbulence have some limitation, because, 1) needs a high number of input points for the mathematical convergency and 2) shows only the presence or absence of the chaos but not the intermediate levels (OLSEN *et al*., 1985). The first problem affects the possibility to apply in the future this method to the natural populations, in which the amount of the measures is often low, specially in the marine environment, where the data sampling is very expensive. The second problem limits the amount of the information and it doesn't allow a thicher characterization.

Our method is based on the classical turbulence theory of KOLMOGOROV (KOLMOGOROV, 1941). For testing our method we have simulated the dynamic behaviour of a biological population by means a simple model namely the simplest of all non linear population models - the discrete generation logistic growth equation. Given a particular iterate it's possible to obtain its position in the "Kolmogorov spectrum". **Our results demonstrate how** is possible to overcome the limits of classical methods.



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