

## Chapter 65

# Managing Fisheries in Light of Complexity and Chaos Theories

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### ABSTRACT

*Chaos theory - and models related to non-linear dynamic systems - has increased in importance in recent decades. In fact, chaos is one of the concepts that has most rapidly expanded in research topics. Chaos is ordinarily disorder or confusion; scientifically, it represents a disarray connection, but basically, it involves much more than that. Change and time are closely linked, and they are essential when considered together as chaos theory foundations are intended to be understood. Given the large number of applications in several areas, the goal of this work is to present chaos theory - and dynamical systems such as the theories of complexity - in terms of the interpretation of ecological phenomena. The theory of chaos applied in the context of ecological systems, especially in the context of fisheries, has allowed the recognition of the relevance of this kind of theories to explain fishing events. It raised new advances in the study of marine systems, contributing to the preservation of fish stocks.*

### INTRODUCTION

Mankind's oldest concern inhabits necessarily on its survival. For thousands of years the Humanity always lived with an almost steady level in the way of living. Production followed the growth of the population. To the generality of the times and to the generality of the people, the historical

rule was a life with the strictly necessary for the populations' day-to-day.

The development is an exception in the history of the Humanity that exists just for a period not longer than 250 years. The Humanity had never had a so significant, consistent and intense transformation in its History. In this period, a complete revolution in the life style of the world-wide

population happened to the countries currently appointed as developed countries. However, its effects were not bordered to these zones. Its presence has been extensive to the whole world. In particular, with what it is assigned as external aid, the rich countries changed the stages of development of a great part of the globe, shortening the development stages of many countries and provoking several kinds of unbalances and disturbs - see, for example, what happened with vaccines on the field of health, with the pollution, with all the problems emerged on the feeding area and with other many forms of intrusion, with visible effects and heavy direct impacts.

This development represents a large step for the Humanity. The comfort, the best levels of health and the best standards of life correspond to a set of advantages which medal reverse represents so big costs that their effects we are not able to study yet.

It is not the progress and the development that may be contested but the way the societies do not find ways to get a supported and balanced development, respecting the principles of equity that must exist among our specie and the others.

Throughout the 20th century the extreme exploitation of resources brought out very big concerns about their preservation. Along the time the immoderation has shown the necessity of measures to avoid the depletion of many resources. That is why common resources become studied worldwide. Nowadays, they are an important subject to analyze resources problems. In the last few decades, international organizations have successively looked for balances to the problem of fragile resources preservation and environmental questions, searching for solutions. The international agents and the private interests are numerous and the convergences seem to be traditionally very difficult. National and international organizations and States have seen the balances of life and resources on Earth to be frequently broken.

It is on the basis of the existence of this type of position divergences that we intend to analyze

the framings and this idea relative to the Earth resources. Our study intends to conjugate the need of resources preservation - specially the common resources - with the perception of the way the involved agents face the subjects studied.

We intend to answer to the necessity of finding solutions that aim the preservation and the improvement of the conditions of life in society compatible with the environment.

The existing risks to the Humanity and to all the live resources require that some theoretical contexts are posed in a way that allow investigators to develop possible solutions and to find out the best ways to achieve them.

Since its beginning, chaos has become rapidly a developing field and many of the progresses in this area were revealed just since the 1970s. This means that many facets of chaos are distant from being understood or determined yet, making of it a field with great potential. It is important to note that nowadays chaos is extremely difficult to be identified in real world information in order to be workable. It is possible to find it in mathematical computer problems to be solved and laboratory research. As soon as the idea of nonlinearity<sup>1</sup> is introduced into theoretical models, chaos gets obvious. A very complex structure is observed in the field data. Simple patterns can be found and approximated; complex patterns are another matter. In any event, we can't just grab a nice little set of data, apply a simple test or two, and declare "chaos" or "no chaos." (Williams, 1997).

The chaos theory involves multiple interactions and supposes the existence of an enormous number of interrelations, with direct developments in vast fields of study. It got an important role in the context of recent theoretical developments of the non-equilibrium theories. The word chaos assumes the idea of the existence of turbulence and disorder; an unwanted chance or even the idea of an "abyss." The predisposition to a profound change in the direction of a phenomenon generates an own force, understood as a depth change

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