

Methodological Framework and simulation tools for assessment of sustainable development of small-scale benthic fisheries in Chile.

Jean Le Fur

In the case of benthic fisheries in Chile as well as in numerous others, exploitation is characterized by its heterogeneity, its complexity. To understand and master conditions of its viability and sustainability, three important constraints have to be considered :

- The first one is related to the structure of the studied system: within an exploitation, of an ecosystem, each element has its room within an intricate network of interdependencies. For example, modification of the fishing ground distribution is going to modify the exploitation diagram, will pass on to the production disembarked, will have consequences on the trading system, repercussions on the market which, through prices modifications, can reshape the consumers demand for fish and act to its tour on the fishing effort distribution. Giving account of the exploitation dynamics implies to consider the whole set of components concerned by this interdependence and to take account of the interdependencies.
- The second constraint relates to the dynamics of the constituent that one tries to study. The development of researches on diversity (bio - diversity, socio - diversity) and, more generally, researches on complex systems put forward the role of local and individual specificity in the global, populational or regional variable dynamics. For example, divergence of the behavior of a sub-population (biological or social) in a given place can produce a driving effect and meaningful consequences on the evolution of the whole system studied. To benefit of or at least to anticipate these "local surprises", spatial and individual heterogeneity must be taken in account in representation of the fishing system.
- Lastly, the specific problem of benthic fisheries sustainable development implies to hold in account multiple aspects bound to the fishery : preservation and development of marine resources, economic competitiveness, welfare, healthy relations between exploitations and government. To approach these aspects it is necessary to take in account standpoints of various professional sectors such as fishing, trade, management. It is also necessary to use the knowledge descended from different disciplines such as bio-ecology, socio-anthropology, management, jurisdiction. From here, a definition framework of the problem must be constructed to combine these multiple points of view in a coherent perspective. This

preliminary is essential to assert the place, role and potential of management areas in the current context of benthic fisheries in Chile.

Considering the object of survey thus like a complex entity, it is necessary to search for formalisms adapted to the representation of these three constraints.

Numerous researches in modeling bend on the problem of complexity and solutions have been proposed that tempt to solve one or the other aspect of the question. Among these approaches some call on the use of scale models. This method is founded on the simplified representation of every constituting element of a given problem: the constituent, the exchanged matters, the interactions, the environments, the driving forces. The integration of these elements within a simulation scale model permits to reconstitute, without formalizing it, the complexity of the system or phenomenon under study. This approach permits to study the behavior of the system, notably its reactions to changes (e.g., various scripts of management area introduction), without risk of damage for the real system. The integration is achieved by the simulation.

Simulation tools descended of artificial intelligence techniques permit to transpose this approach to fishery system studies and to elaborate scale models simulating these organizations (e.g., marine populations, fleets, markets, societies, management systems, economic sector, oceanic basin, etc.). Among these techniques the multi-agent approach permits to describe different entities of a problem or a domain and to put them in relation. The simulation of different diagrams of interaction between these entities permits to value what are the best configurations to reach a given goal; in this case the lasting development of benthic fishery by means of management area implantation.

The specific problem of Chilean small-scale benthic fisheries and the insertion of management areas are presented in this perspective.

Jean Le Fur, Montpellier, 27/01/99.