

DETERMINATION OF RESOURCE / ENVIRONMENT DYNAMICS AT AN OCEANIC SCALE, AN INTEGRATED APPROACH NECESSARY FOR A NEW MANAGEMENT

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Unlike the other regions of the world, the South-west Indian Ocean has been able to support a rapid fisheries development since the beginning of the 90s. This particular local context needs to be seen in the perspective of a global background characterised by a precautionary approach and a fisheries crisis. This points to the development in La Réunion of an interdisciplinary, integrated approach.

In Reunion, IFREMER and ORSTOM have collaborated, in the framework of the Regional Tuna Program of the Commission de l'océan Indien, with the countries of the region, Comoros, Madagascar, Mauritius and Seychelles, to collect information on the activities of the fishing fleets. IFREMER focused on longliner fleets in the French EEZ, defined a compilation format to allow the integration of the data into a regional standard, and collected biological parameters about swordfish (*Xiphias gladius*), the main target of the local fishermen.

During this period, the SEAS station of ORSTOM La Réunion downloaded NOAA AVHRR imagery to construct sea surface temperature (SST) maps, set up a system of real time transmission of those maps to fishermen, collected other remotely sensed parameters (Ekman pumping, dynamic topography, winds, primary production, as well as bathymetry), and contributed to the maintenance of tuna catch statistics in the countries concerned (mainly purse seine).

The two institutes have complementary capabilities, data sets and interests and jointly set up a three year co-operative project built around the relationship between resources and environment in a dynamic perspective.

The integration in a dynamic GIS of environmental data including bathymetry and SST (Mourmant, 1997), Ekman pumping (Ramos *et al*, 1998), dynamic topography, sea water colour obtained on a daily to weekly basis, with a spatial resolution of 1 to 10 miles, will define a seascape closer to that perceived by the pelagic species than any previous approach, within a multi-use computer platform (Soulié *et al*, 1998).

In a second phase, individual-based and multiple-agent models, established in co-operation with the University of La Réunion (Applied Computer Sciences, Laboratory IREMIA), will provide information about decision making of the fish in this environment (Calderoni et Marcenac, 1998) and refine our knowledge about the ethology of the target species without heavy physical oceanography modelling. The results will be validated by fish catch statistics (Poisson and Mace, 1997) as well as archival tags (Carey and Robison, 1981).

Relationships between oceanic resources and the environment have not yet been fully investigated. Several studies have been conducted to better understand how

environmental parameters influence the presence and dynamics of populations of tuna and other pelagic species (Marsac, 1992). Nevertheless, at a fine scale, the influence of local environment and individual strategies on population distribution and movements, is under study (Le Page and Cury, 1997). It is specially important to determine more detailed population patterns, in particular the way in which individuals react to quick changes in the surrounding waters due to weather, evolution of water masses and other physical causes such as thermal fronts, vortices or horizontal currents linked with bathymetry, or other anomalies in the oceanic landscape, (Petit and Stretta, 1990; Dagorn, 1994).

The new paradigm of this research project is the evaluation of environment parameters as a major factor for the dynamics of exploited populations. Thus, new questions will arise: how will this permit the management of the fisheries system to be re-considered? How can we apply this approach to other high seas species such as mammals, turtles and birds? We can now understand how fisheries sciences can benefit from the development of new research fields, taking into account emerging requests on the patrimonial value of marine resources.

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IREMIA team Multi-Agent System Modeling And Simulation (MAS²) on the web: <http://www.univ-reunion.fr/~mas2I>

SEAS ORSTOM environmental data

Parameters	Spatial resolution	Periodicity	Satellite	Comments
SST	1 nautical mile	1 day	NOAA	data available
Vorticity (vertical dynamics)	4 nautical miles	9 days	ERS 1-2	data available
Horizontal currents	?	?	TOPEX/ERS	depends on data source
Bathymetry	2 nautical miles	constant		data available
Water plankton colour	1 nautical mile	1 day	SEAWIFS	(data available from 15 th September 1998)