Outline of the results of the COPEMED International Workshop on Environmental Variability and Small-Pelagic Fisheries in the Mediterranean Sea

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1. Background

During the First Session of the Scientific Advisory Committee (SAC) of the GFCM (Rome, 23–26 March 1999), the need for studies dealing with the coupling between the distribution of small-pelagic-fish species and oceanographic features was stressed (document GFCM/SAC/99/inf 5).

The COPEMED Project, one of whose major aims is to support the work of GFCM, has contributed during the last six years by organizing a series of workshops with the purpose of assisting the SAC in the fields of research of major concern.

In June 2001, a workshop focused on the study of relationships between fluctuations in the abundance of small-pelagic-fish species and oceanographic features was organized in Palma de Mallorca with the support of the Instituto Español de Oceanografía's Balearic Centre which hosted the event.

2. Goals of the Workshop

- To encourage the exchange of knowledge/dialogue between experts in the field.
- To agree on an approach to the study of coupling mechanisms between fish population dynamics and environmental factors which could be applied in a possible future project.
- To begin to identify the useful data sources and owners.
- To begin to assess the availability of these data.
- To assess the feasibility of a future cooperative project.

3. Report[1]

Participants from eight Mediterranean countries (Morocco, Algeria, Tunisia, Malta, Libya, Italy, France and Spain) and three experts from outside the region (A. Bakun and P. Cury, of IRD, France, and W. Wooster, of the University of Washington, Seattle) attended the workshop. Scientists with different areas of expertise (fishery biology, oceanography, GIS) presented their work in the region.

The workshop was organized in four sessions: one for presentation of the theme, and three other sessions for discussions, in which a conceptual model and a set of indicators were

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[1] Full text report of the workshop is available at http://www.faocopemed.org/vldocs/0000744/index.htm

agreed upon. The research of several participants was presented and, finally, recommendations were made for future possible scenarios.

In Session I, a *conceptual diagram* was introduced, discussed and agreed upon. This diagram is intended to be a framework for discussion of the proper approach and to provide a list of items that needs to be addressed in the study of fishery and environmental variability. The final design is given in Figure 1.

A diagram, as any model that is intended to produce an abstract representation of reality, has always some limitations. In this particular case, the limitations of the model were identified:

- Loss of information due to simplification
- False view of the ecosystem due to compression into one or two boxes
- Loss of generality (applicability to different geographic areas) due to excessive elaboration.

Likewise, some misrepresented components were identified:

- The biomass box should be detailed.
- Factors driving horizontal flow in the Mediterranean.
- Horizontal flow in the Mediterranean is driven by buoyancy loss (heat flux) in well identified areas; the resulting density-driven surface circulation is only slightly modified by wind stress.
- Mixing of processes and variables in the conceptual diagram.
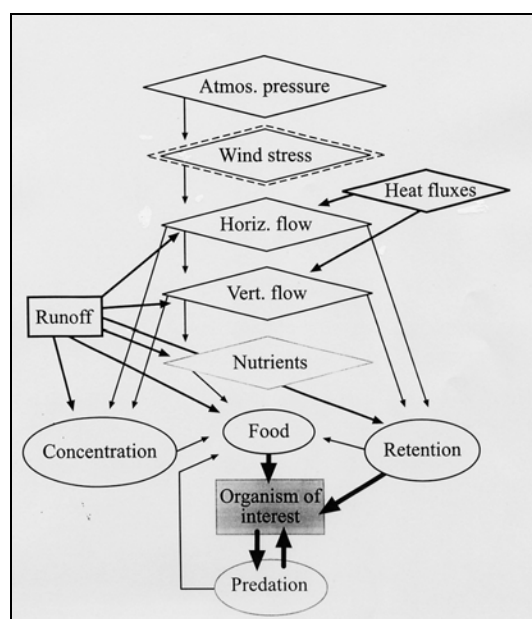- Ecosystem.

Figure 1. Conceptual diagram for the study of the relationships between the distribution of small-pelagic-fish species and environmental conditions.

Going one step forward, A. Bakun introduced a *potential method to be employed in the analysis of marine ecosystems.*

STEP 1. Perform climatological analysis of the ecological system to identify potential controls on environmental processes.

STEP 2. Construct time-series indicators of variabilty in environmental control processes.

STEP 3. Assume responses to values of anomalies (negative–positive or absolute).

STEP 4. Construct multiple seasonal-anomaly time-series of independent variables (different response time-scales).

STEP 5. Perform multiple empirical tests to identify: (1) a favoured form of response; (2) best-fit adaptive time-scale; (3) etc.

STEP 6. Repeat steps 1 to 5 for different regional fish-environment systems.

STEP 7. Identify informative patterns in 1, 2, 3 of step 6 that may yield generalized insights.

In Session II, the participants identified a series of *indicators* to represent diagram components outlined during Session I. Indicators were identified for each component. A preliminary list is presented in Table 1. This list needs to be expanded and further refined taking into account the needs of particular geographic areas, and the experience of other groups of experts, etc.

The main difficulties encountered in this process of identification were: lack of definition of space- and time-scales and the variety of methods for data collection.

4. Monitoring and data analysis

The proper design of a monitoring programme and the possibilities for the establishment of a monitoring network in the Mediterranean were discussed during Session III.

A number of key steps were outlined as follows:

- The identification of existing programmes and the availability of data.
- The establishment of a system for quality-control of data.
- The identification of a system for sharing/pooling data.

Workshop participants emphasized the need for objective assembly and analysis of data on ecosystem forcing and response. Holistic analysis of changes in ecosystems will be useful for informing governments about changes that might affect resource use.

A formal scientific organization, such as PICES in the North Pacific and ICES in the Atlantic, was suggested as a body that could coordinate: (1) operational monitoring; (2) data exchange; (3) analysis; (4) promotion, development and execution of required research.

Table 1. Indicators

Component	Indicator
Atmospheric pressure	Sea-level pressure
Atlantic inflow	Sea-level height on both sides of the Strait of Gibraltar
Wind speed	Wind stress
Heat fluxes and evaporation	Air and sea-surface temperature; wind intensity
Horizontal flow	Front position and meso-scale activity (satellite SST); satellite altimetry (only valid at least 10 km offshore in the open sea and for relatively intense horizontal flows)
Vertical flow	Wind-stress curl (open sea), SST images (wind-driven upwelling near the shore)
Nutrients	P, Si, nitrates
Food	Primary production (chlorophyll-*a*, phytoplankton abundance) Zooplankton (abundance, species composition)
Biomass	Recruitment, spawning, egg and larval abundance, daily egg production, spawning area, catches
Retention	Indices provided by numerical simulation. Analysis of time-series of SST images
Parameters for biomass indicator	
DEPM parameters: Daily egg production, batch fecundity, mean female weight, spawning fraction	
Condition parameters: Gonado-somatic index, condition factor, lipid content, hepato-somatic index, macroscopic fat content, larval daily growth and annual growth, larval condition (RNA/DNA), genetic quality (maternal effects)	
Other parameters: Egg and larval abundance, length–weight relationship, size at first maturity, zooplankton biomass, phytoplankton biomass, food availability) microzooplankton biomass	

The present nature and the future of existing Mediterranean data bases and monitoring programmes (MEDITS, MEDATLAS, MedGOOS) were discussed. The short-term nature of these programmes may result in the termination of valid data collection. At present the main effort is on physical-data collection. The situation for biological data and for resource information (i.e. fisheries) is not as clear. The existence of a large number of data in the form of unpublished reports was also discussed. The importance of trying to retrieve this information was emphasized. The role of a central body to pool, quality-control and organize all these data was again discussed. Such a body was considered essential for the success of such an effort.

The danger of duplicating effort in the Mediterranean was stressed. The existence of Mediterranean organizations, such as MedGOOS and ICSEM (CIESM), which could provide an umbrella for this type of activity, was discussed. The need for a biological focus in the MedGOOS programme was discussed, since the initial emphasis of this observing system is on the physical components of the system. A biological focus might be ensured by adopting the living marine resources component of MedGOOS's parent programme, the IOC–WMO Global Ocean Observing System (GOOS).

Available data sets

A preliminary list of data sets available for each sub-area was generated, though it was not comprehensive; however, it may serve as a first approach. It can be found at http://www.faocopemed.org/vldocs/0000744/index.htm. The participants agreed on continuing its further elaboration.

6. Final discussion and recommendations

Long-term actions were viewed as necessary, although outside *the scope of COPEMED,* through:

- the establishment of a monitoring programme

- the establishment of a Mediterranean body analogous to ICES or PICES, which would coordinate: (a) operational monitoring; (b) data exchange, quality-control and analysis; (c) promotion, development and execution of required research

- the establishment of a cooperative regional project to try to elucidate mechanisms linking changes in population of small-pelagic fishes with environmental processes.

Two types of short term action, feasible *within the COPEMED context,* in order to have a more realistic prospect, were suggested:

- Organization of workshops:

  (a) to assess data availability in specific areas: Alboran Sea and the Strait of Sicily to be given priority
  (b) to provide training in data analysis, for standardization throughout the region
  (c) to begin conducting data analysis in areas of interest using the approaches/tools agreed at workshop (a).

- Preparation of a catalogue of existing Mediterranean data sets/data bases specifying:

  (a) type of data
  (b) data owner
  (c) contact information.

COPEMED expressed its interest in supporting the execution of some of the short-term actions proposed, provided they correspond to the priorities of COPEMED, which are to support GFCM/SAC and bridge the gap between the northern and southern sides of the Mediterranean.

The development of such activities in the COPEMED context was subject to the request of the interested countries and to the availability of the necessary held data by the national institutions involved. Unfortunately, COPEMED has not received any formal request in this sense, meaning that no action has been taken so far.