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The knowledge on the state of Mediterranean resources in relation to their sustainable management within the PA2F
Recent initiatives an proposals to fill the gaps

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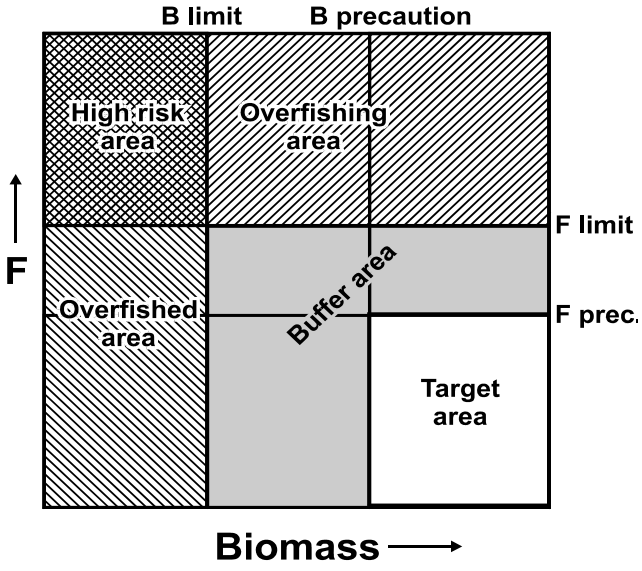
The Code of Conduct For Responsible Fisheries (http://www.fao.org/fi/agreem/codecond/codecon.asp) was adopted by the Twenty-eighth Session of the FAO Conference in October 1995 and can be considered as a consequence of the concern related to the sustainability of natural renewable resources expressed at the Earth Summit in Rio de Janeiro in 1992 (UNCED Rio). The Agenda 21 of the UNCED Rio calls for: "a harmonised development of sustainable development indicators ..." and the UNCED Rio Declaration states that: "In order to protect the environment the Precautionary Approach shall be widely applied ...". In this context the Code, that incorporates the Precautionary Approach to Fisheries (PA2F), sets out principles and international standards of behaviour for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity. The evolution of the implementation of the two concepts (PA2F and sustainable indicators) in fisheries has been recently, extensively reviewed (Garcia et al. 1999; Garcia, 2000, 2000a, in press; Garcia and de Leiva Moreno et al., 2000).



To support the implementation of various aspects covered by the Code, FAO has produced technical guidelines. Fishery-specific sustainability indicators are necessary to assess and monitor the state of the sector and the performance of its governance, and to assess the degree of implementation of the Code. FAO has therefore developed guidelines for the implementation of the precautionary approach (FAO, 1996) as well as for the development and use of sustainability indicators (FAO, 1999). These indicators which present use tend to be limited to biological components of the fishery system - i.e. stock biomass (B) and fishing mortality (F) - provide an operational tool for providing advice for fisheries management. Changes in indicators over time, however, cannot be meaningfully interpreted in relation to sustainable development without considering them in relation to a reference value corresponding to the sectoral or societal objectives (or target) and ecosystem constraints (or limits). In fisheries, these reference values are conventionally called target reference points (TRPs) limit reference points (LRPs) or threshold reference points (ThRPs) and, presently, mainly concern the target stock. PA2F requires also the adoption and use of indicators and reference values to determine the areas and degrees of risk created by the various sources of uncertainty (FAO, 1996). The need of both approaches to determine indicators and reference values and to take uncertainty into account has lead, during the last 5 years, to the merging of both concepts (Garcia, 2000 and in Press).

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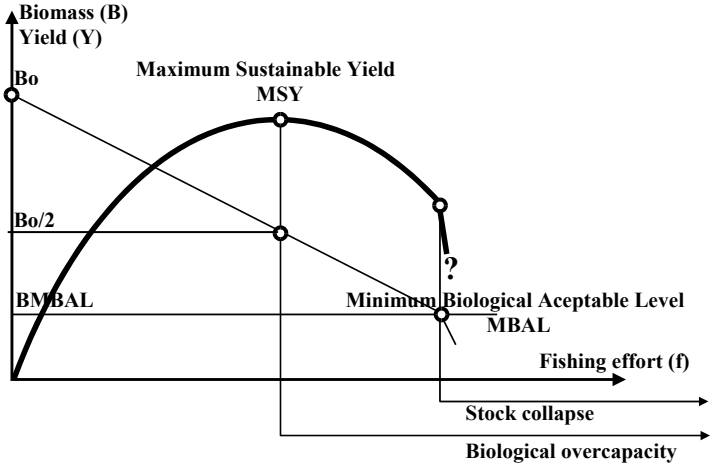
The Mediterranean is an area where the implementation of the PA2F should be considered as a basis for sustainable development of fisheries (Lleonart, 1999). The Scientific Advisory Committee (SAC) of the General Fisheries Commission for the Mediterranean (GFCM) at the last meeting held in May 2000 in Madrid (Spain), recognised "the opportunity to establish biological reference points in order to improve fisheries management within a precautionary approach", pointing that "biological reference points can help decision makers in defining the action to be taken in order to reach management objectives" (GFCM, in press).

The Code of Conduct for Responsible Fisheries establishes that conservation and management measures should be based on the best scientific evidence available. In order to provide advice, the SAC analysed all the scientific information available in the region, produced during the period 1985-1999, concerning the eight most important demersal and small pelagic species within those management units where shared resources existed (hake, red mullet, striped red mullet, blue whiting, red shrimp, anchovy, sardine and sardinella). More than 100 evaluations were identified and analysed. Three species of large pelagics (bluefin tuna, swordfish and albacore) were also taken into consideration (ICCAT, 1999). The result of this exercise is summarised in the following table:

Species	Number of assessments[1]	State of resources			
		Over-fished	Fully-fished	Under-fished	Comments
Merluccius merluccius	36	28	7	1	general growth overfishing
Aristeus antennatus	10	6	3	1	
Mullus barbatus	32	18	14		
Mullus surmuletus	8	2	4	2	
Micromesistius poutassou	4	3	1		
Engraulis encrasicolus	14	2	8		risk of recruitment overfishing
Sardina pilchardus	**7**	2		2	3 without results
Sardinella aurita	Never evaluated				Unknown
Thunnus thynnus	See ICCAT 1999				Over-fished
Thunnus alalunga	Never evaluated				Unknown
Xiphias gladius	See ICCAT 1999				Unknown

It should be noted that most of the evaluations correspond to stocks of the Northern and Western part of the region. In general the assessments are based on the aplication of Virtual Population Analysis (VPA) or Length Cohort Analysis (LCA) together with a Yield per Recruit Analyses (Y/R) and sometimes "surplus production methods", based in short series of data and on the results of scientific surveys. Furthermore, it seems that important non-published information, relevant to stock assessment and already existing in some countries were not available at the meeting.

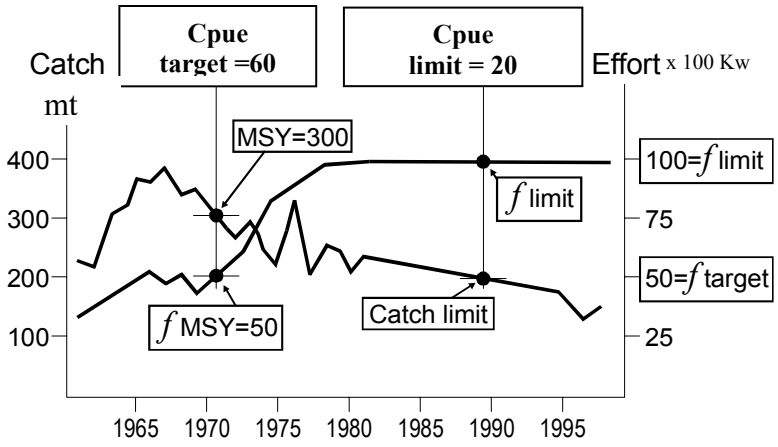
The analysis has evidenced a lack of fishery databases with enough coverage and reliability to allow for a correct assessment of resources. Some statistically valid series exist only in a few areas and time periods corresponding to projects in which research teams have concentrated on compiling databases for the assessment of specific stocks. Sadly, when these projects terminated, the database usually met with problems of continuity and the time series were interrupted. Nonetheless, SAC detected "a clear growth over-fishing in some selected demersal species and the risk of recruitment over-fishing of anchovy" and it recommended "to develop and apply management measures in order to correct these problems". The SAC proposed to "temporary adopt of a Harvest Control Rule (HCR), based on the Exploitation Rate (E=F/F+M) and current Spawning Stock Biomass (SSB_c) preferably, or Standing Stock Biomass (B_c), both expressed as percentage of the estimated unexploited condition (SSB_0, B_0)". SAC suggested also



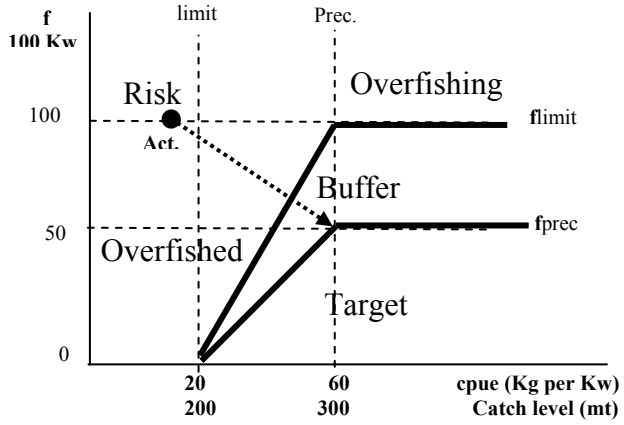
[1] The number refers to separate stocks or separate assessments of the same stocks.

that "recent literature reviews indicate plausible ranges for preliminary proxies of target reference points: 0.4 to 0.5 for the Exploitation Rate (E target), 20 to 30% of Virgin Spawning Stock Biomass (SSB target) and 30 to 40% of Virgin Standing Stock Biomass (B target). Both indirect (i.e. LCA and VPA) and direct methods (i.e. scientific surveys) can be used as source of information to estimate and improve the above described reference points as well as to analyse their performance". However the fact that the use of these methods implies a high level of uncertainty or even ignorance (in the sense that relevant factors and/or elements cannot be fully assessed) needs to be pointed out.

A substantial effort is urgently needed in the Mediterranean to improve the scientific advice provided to managers. The current level of stock assessment and, more generally, of fishery research for assessment purposes is not enough or not appropriate for the elaboration of proper and efficient advice to fishery managers and industry. In order to encourage the efforts to produce the needed scientific advice, the SAC, at its last meeting (Madrid, May 2000), recommended *inter alia*, to up date and improve the quality and coverage of fishery data and statistics, to increase the number of assessments in the southern and eastern areas and to ensure that all the assessments will be carried out on a regular basis. SAC also drew the attention on the importance of the role of the relationship between the environment and resources. Additionally the SAC indicated that the definition of geographical management units to report the indicators is essential and that homogenous socio-economic indicators in each of these management units had to be developed.

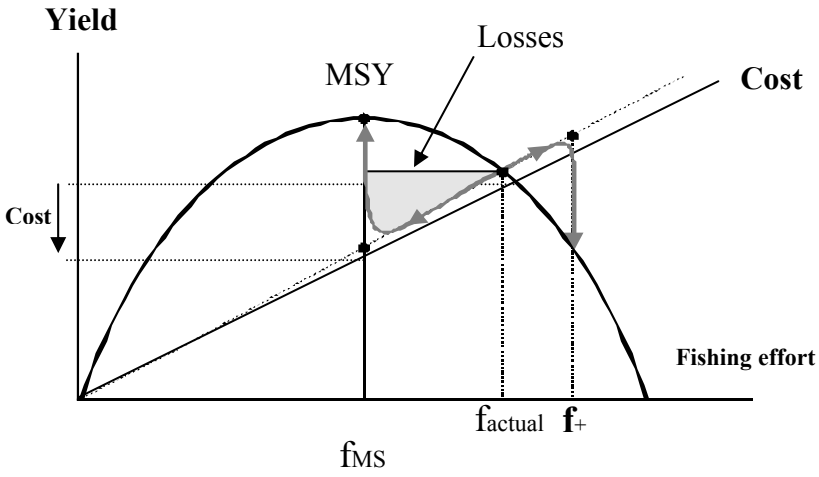


While solutions are sought to correct deficiencies in the scientific advice, and in line with the PA2F, a provisional **Recovery Control Rule** (RCR), based on the data available and specifying the objective, planned recovery trajectories and time frame could be adopted for stocks which are obviously overfished. For that purpose, a simple set of indicators reflecting abundance and fishing capacity (such as cpue or even yields and fishing effort) could be used. The Maximum Sustainable Yield (MSY), together with the corresponding effort level could be taken as Target RP for resource recovery (in line with 1982 UNCLOS and 1995 UN Fish Stock Agreement). In the upper figure, the evolution of the deep shrimp trawl fishery of Balearic Islands in the last 40 years, which can be considered as a typical example of one of the most common current situations in the Mediterranean fisheries, is presented to illustrate how the suggested RCR could be elaborated and used. The stock has been evaluated several times by means of surplus production models (Oliver, 1983; Carbonell, 2000). The results are estimations of MSY (close to 300 mt) which correspond to an optimal fishing effort of 5000 Kw, since the current effort is over 10,000 Kw and the current annual catch level is under 200 mt. The MSY parameters on the equilibrium curve (5,000 Kw and a cpue of 60 Kg per Kw) can be used to establish: 1) the TRPs at which the fishery should be placed, 2) the current values for the same parameters (10,000 Kw and 20 Kg per Kw) as LRPs that should not be exceeded (Figure at the right)



Certainly, it is necessary to acknowledge the high risk inherent of this proposal, due not only to the weakness of the basic data used,

but also to the uncertainty of the degree of reversibility of the present (overfishing) situation. The economic impact (i.e. the costs of the proces) also has to be taken into account. The figure below provides a theoric view of the trajectory to be followed to reduce the fishing effort loking for a most convinient situation in the curve of equilibrium (from f_{actual} to f_{MSY}), the losses to be expected and the evolution of costs. The theoric evolution of yields in case the effort were increased is also indicated.



In any case considering the scientific data available in the region and the low probability to improve its quality in the medium term, the suggested RCR can represent an option to the application of the PA2F in one of the regions where it seems to be particularly urgent to do so. Naturally, the approach would have to be fishery-specific, based on a careful analysis of the current situations. Furthermore aditional elements like the fact that technological progress increases F without changing nominal effort should be considered as well as the possibility of combining a direct reduction of F trough fishing capacity – reduction measures combined with other technical measures such as No Take Zones (NTZ) to accellerate, where appropriate, the recovery of the fishery.

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