

**RAPPORT DE MISSION
CROATIE**

26 novembre - 29 novembre 1996

de

Maurice HERAL et Jean PROU

2/5

AFREMER



**OBJECTIF DE LA MISSION : POURSUITE DU PROGRAMME
BILATERAL DE COOPERATION FRANCE-CROATIE
SUR L'AQUACULTURE**

1) Calendrier de la mission

- 26 novembre : Trajet aller La Rochelle-Paris-Zagheb-Dubrovnik
- 27 novembre matin : Réunion au laboratoire de biologie marine de Dubrovnik avec Ivan KATAVIC sous-directeur de l'Institut Océanographique de Split et Adam BENOVIC, Directeur du laboratoire de Dubrovnik.
Bilan de la coopération bilatérale
Demande du laboratoire de Split
Réseau EAM - publications
- 27 novembre après-midi : Réunion au bureau maritime avec N. SRABOTNAK, directeur des affaires maritimes sur l'aménagement de la baie de Mali Ston et A. BENOVIK
- 28 novembre matin : Réunion au laboratoire de Dubrovnik avec A. BENOVIK et son équipe. Bilan du travail sur la baie de Mali Ston. Projet de rédaction d'articles.
- 28 novembre après-midi : Réunion au laboratoire de Dubrovnik avec A. BENOVIK et son équipe. Projet de coopération pour 1997 sur la baie de Mali Ston.
- 29 novembre : Trajet retour Dubrovnik, Zagheb, Paris, La Rochelle

2) *Faits marquants*

1) **Demande de coopération bilatérale de la part de l'Institut Océanographique de Split (Ivan KATAVIC)**

Programme concerné :

. Recherche génétique en aquaculture. Pour les poissons, le programme croate est détaillé en annexe dans le document 1. Le programme ne concerne pas le bar et la daurade mais 10 espèces de sparidés qui présentent des caractéristiques d'élevage potentiel intéressantes. Il est demandé qu'une étudiante, Melle Skakega Neda puisse être accueillie en France pour apprendre les techniques et pour déterminer les caryotypes et les isoenzymes pour les appliquer ensuite sur les sparidae. Ce stage pourrait s'effectuer à l'Université de Montpellier (F. Bonhomme, B. Delay) qui a déjà accueillie en 1994 une étudiante croate.

Le travail sur la génétique des mollusques se poursuit suite au stage de formation de 1994, par la détermination des différents sous espèces de moules et d'huîtres plates qui sont présentes sur la côte adriatique Melle Marsié-Lucié Jasma souhaite compléter sa formation sur les isoenzymes et apprendre la technique des microsatellites de l'ADN des huîtres plates. Ce stage d'une durée de 3 mois pourrait s'effectuer au laboratoire IFREMER de La Tremblade (A. Gérard).

. Ageâge des poissons : il est demandé par la laboratoire de Split qu'un étudiant post-doctoral : Jakov Dulcic puisse apprendre à maîtriser les techniques de marquage, préparation et lecture d'otholites particulièrement chez les jeunes stades de poissons. Ce travail pourrait être effectué au CREMA-L'HOUMEAU sous l'encadrement de F. Lagardère mais nécessite pour l'intéressé l'obtention d'une bourse post-doctorale de 6 mois.

2) **Demande de l'EAM (Environmental Aquaculture Monitoring Network in mediterranean)**. Le réseau est géré sous la responsabilité croate et sous la responsabilité de I. KATAVIK.

Il souhaiterait être moins isolé et pouvoir participer au groupe de travail IOC-CIEM sur les algues toxiques dont P. Gentien (IFREMER/DEL) est le Président. Une demande d'assistance technique est réalisée pour organiser un atelier pour écrire un guide avec les méthodes précises pour mettre en place une

surveillance du phytoplancton toxique et les procédures à suivre pour tester la toxicité des coquillages (test-souris). Il est souhaité que ce soit quelqu'un de l'IFREMER qui rédige ce manuel. Le travail serait rémunéré et publié comme le précédent que nous avons rédigé sur la place de l'aquaculture dans l'aménagement intégré de la bande côtière (document 2).

L'EAM serait prêt à supporter une étude sur les procédures de sélection de site favorable pour l'aquaculture et avec une application à la baie de Mali-Ston. Dans ce cadre, il est demandé à l'IFREMER (J. PROU) de voir quels sont les documents de Spot image disponibles sur cette zone et d'examiner les modalités d'achat. Cette recherche a été effectuée (voir document 3) et sera transmise à I. KATAVIC pour action.

Il est demandé un échange de littérature sur le traitement des eaux de ballast. M. HERAL se chargera de diffuser la littérature du CIEM abondante sur ce sujet au responsable du réseau EAM.

3) Coopération avec le laboratoire de Dubrovnik. Une poursuite du travail sur la capacité trophique de la baie de mali Ston sera réalisée avec des mesures de caractéristiques hydrobiologiques de la baie en fin de période hivernale (mai 1997). Ces nouvelles données permettront de rédiger une publication commune sur la conchyliculture en baie de mali Ston (Hydrologie, élevages, capacités trophiques, gestion de la baie). Il est intéressant de noter que la Croatie vient de mettre en place un système de concessions identiques au système français avec des modalités de contrôle et de gestion qui restent encore à définir.

Il est demandé dans le cadre de ce travail sur la baie de Mali Ston d'accueillir au CREMA (J. PROU) Vladimir Onofri pour une formation (3 mois) sur les Systèmes d'Informations Géographiques avec une application sur la conchyliculture en baie de Mali Ston.

Parallèlement à la campagne d'acquisitions de données, il est demandé de participer le 19 mars 1997 à la manifestation annuelle pour la promotion de l'huître plate. Le laboratoire de Dubrovnik désire, à cette occasion, promouvoir la coopération scientifique franco-croate sur l'aquaculture avec le soutien des médias (télé, radio, journaux).

A cette occasion, il est proposé que des professionnels conchyliculteurs français intéressés par des échanges commerciaux avec la Croatie puissent être invités.

Il nous paraît souhaitable de privilégier les contacts avec les ostréiculteurs méditerranéens (étang de Thau) ainsi les contacts ont été pris avec D. BUESTEL (IFREMER Palavas) qui a obtenu du CEPRALMAR qu'un voyage d'étude soit organisé par des ostréiculteurs de l'étang de Thau fortement intéressés par cette proposition. Malheureusement, les crédits CEPRALMAR ne pourront pas être mis en place en mars 1997 mais ce voyage pourra être réalisé à l'automne 1997.

4) Questions diverses

Il est demandé par des ostréiculteurs croates des renseignements sur du matériel pour laver les huîtres afin d'acheter ce matériel en France, une documentation et les prix seront fournis en mars par M. Héral.

Une rencontre avec M. PERKOVIC, directeur du parc marin de MLJET, francophone, a été fort instructive. Il souhaite avoir des adresses pour établir une coopération avec des structures similaires en France (parc marin) et souhaite développer une coopération sur la coquille St Jacques fort abondante dans cette réserve. D. Buestel se chargera de poursuivre ces premiers contacts.

- Il est en cours de réaction à Dubrovnik un International College of the Sea (document 4). Les organismes suivants : Plymouth University, Rochester Institute of Technology, York University sont des organismes qui ont déjà annoncé leur intention de participer à ce collège. Il est demandé à la France (Universités, IFREMER, CNRS...) de participer notamment aux enseignements sur l'aquaculture, sur la pêche, sur l'environnement et sur l'économie des ressources renouvelables. Il serait souhaitable de donner une réponse favorable à cette requête pour que les relations Franco-Croates établies depuis 1993 dans le domaine de l'aquaculture se renforcent et se pérennisent.



REPUBLIKA HRVATSKA
JAVNA USTANOVA NACIONALNI PARK "MLJET"
20 226 GOVEDARI, Pristanište 2

Mr. **MARIN PERKOVIĆ**, prof.
Ravnatelj

URED:
Pristanište 2
Tel. (020) 744-041, 744-058
Fax: (020) 744-043

PRIVAT:
20 226 GOVEDARI
Pristanište 1
Tel. (020) 744-054

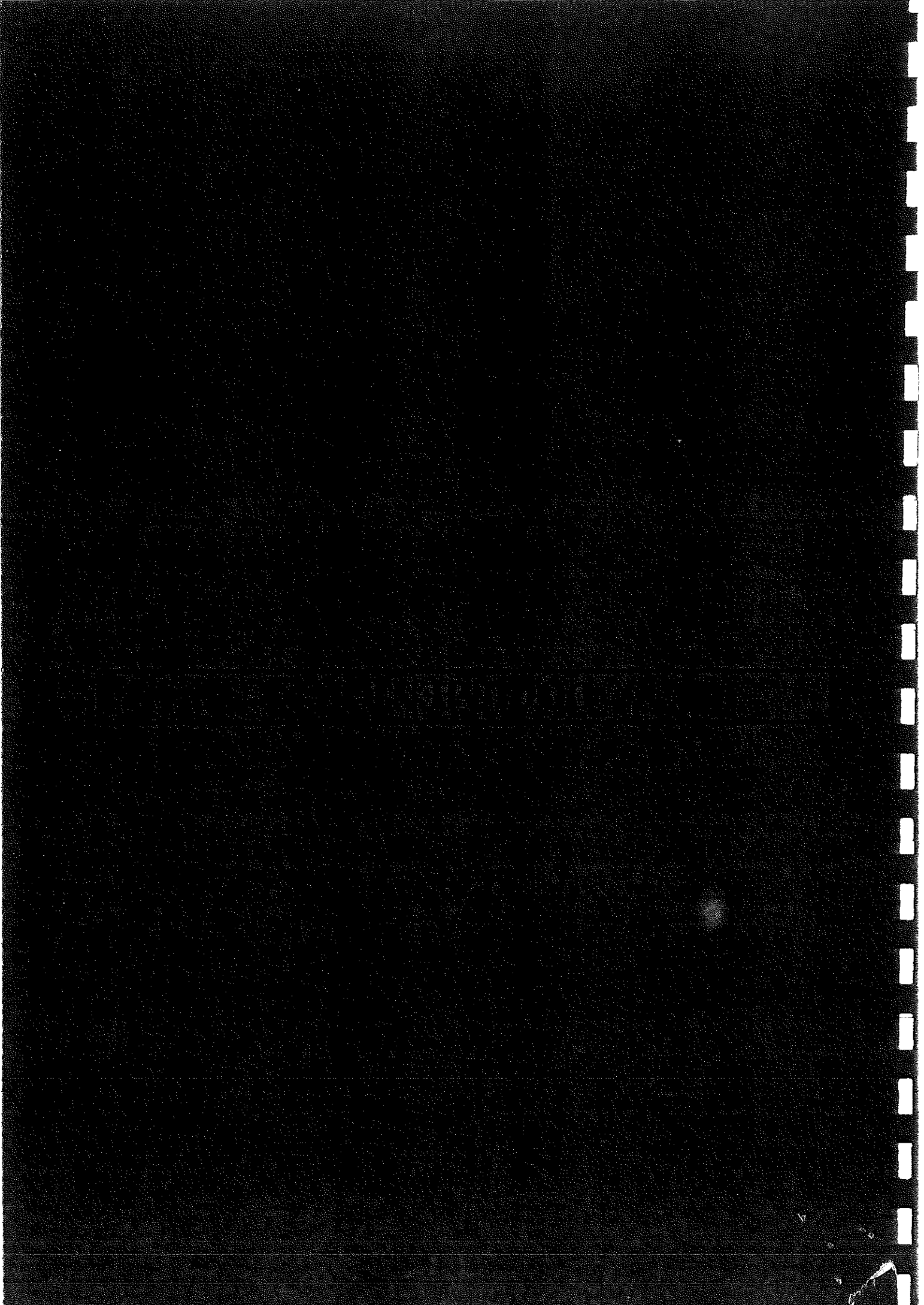


Republika Hrvatska
Županija Dubrovačko-Neretvanska

NIKOLA SRABOTNAK, kap.
Pročelnik ureda za pomorstvo
Head of maritime office

Ured - Office:
DUBROVNIK, Petilovrijenci 2
tel. 385 20/413-409
fax 385 20/20-740

Stan - Home:
DUBROVNIK
Iva Rožića 6
tel. 385 20/412-841



Institut za oceanografiju i ribarstvo
Setalište Ivana Meštrovića 63
21000 Split
aquaculture laboratory

Split, Nov. 1996.

Subject: Proposal for bilateral coop. France and Croatia
as submitted to Croatian Ministry for Science & Technology

GENETICAL RESEARCH OF FIN FISH

Background information:

Following the successful cooperation with IFREMER-Paris, plans for further continuing of the research started are being made. Two specializations for our colleagues Dr. Jasna Maršić-Lučić and Jakša Bolotin, lasting from April till June 1994, were realized during the previous cooperation, out of which two Ph.D. thesis were prepared.

Having in mind all current needs of aquaculture, as well as current programs in the field, we suggest widening of our research in ways to include genetic studies of fin fish.

It has been seen that the lack of relevant biological, especially genetical, information is an important limiting factor for introduction of new species in aquaculture. The aim of these researches is to widen the basic knowledge, primarily in the fields of reproductive biology (fecundity, ovulation in controlled conditions, egg and larva size, incubation), growth biology (growth rate, survival, conversion of food), genetics (caryological features, genetical structure) and ecology (low standards of water quality, changes in surrounding populations of organisms).

Special meaning to these researches is given by the fact that the number of references in ASFA data base for two most common aquaculture species in the Mediterranean is 670 for sea bass and 630 for sea bream, whilst the other 10 potentially interesting species are covered with only 60 references, all ten species belonging to sparids. The study of their reproductive cycle is some sort of scientific challenge, especially if we consider the possibilities of intergeneric hybridization of sparids, and also the related taxonomic problems. Special efforts are being put into genetical improvement of currently reared species.

Basic goals and aims of the program:

The first phase of this program would include the determination of genetic (caryotypic) features of fin fish, especially sparids. This basic research is needed for the realization of the second phase of the program, which would include intergeneric hybridization and the study of biological and ecological characteristics of the hybrids, especially stressing their growth potential and survival rate.

Other than just the direct application of the cytogenetic research in the program of hybridization, this research could also have its applicability in eventual revising of the taxonomy of the sparid species. Up till now, the taxonomy of sparids has been based exclusively on morphological and morphometric features, which could be highly questionable from the genetic point of view. This comes more into doubt when it is considered that the preliminary results from the studies of the sparid reproduction cycles show that the complete reproductivity isolation between these species has not happened yet.

Further research of population genetic will be conducted parallel to this research, applying the method of gel electrophoresis (isoenzymatic study), which is very useful in genetical identification. The study of population genetics would include research of genetical structure (heterozygosity, degree of genetic polymorphism, mean number of alleles per gene locus) of natural (wild) population, as opposed and compared to the populations reared.

Available equipment and materials:

- photo-equipped microscope,
- binocular microscope;
- thermostat;
- sterilizers;
- analytical equipment;
- smaller lab equipment;
- wet lab with experimental pools;
- bio-material (live)

Materials needed:

Chemicals:

- colchicine (for caryotype analysis);
- set of chemicals for gel-electrophoresis

PRICE: 9500 DEM

Traveling expenses:

- two plane tickets Split-Pariz-Split

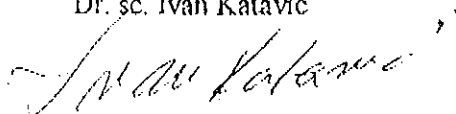
(living and internal traveling expenses while in France will, as arranged previously, be covered by the French Institution)

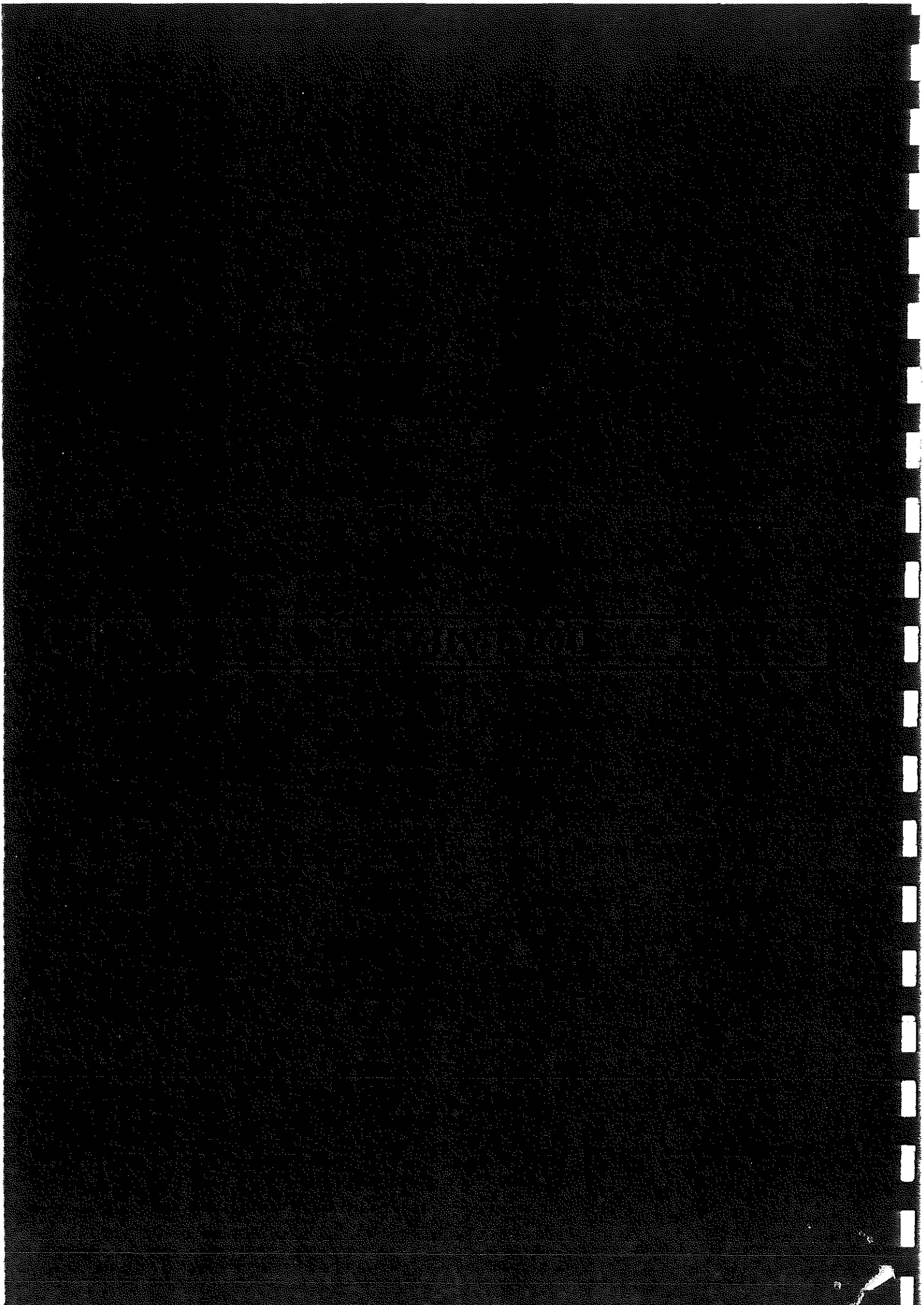
PRICE: 1500 DEM

Total expenses estimated: 11000 DEM

Chief scientist:

Dr. sc. Ivan Katavić







MEDITERRANEAN
ACTION PLAN



In cooperation with:



INSTITUTE OF MARINE BIOLOGY OF CRETE
.....
ΕΠΙΤΡΟΠΗ ΘΑΛΑΣΣΙΑΣ ΒΙΟΛΟΓΙΑΣ ΚΡΗΤΗΣ

APPROACHES

FOR ZONING OF COASTAL
AREAS WITH REFERENCE TO
MEDITERRANEAN AQUACULTURE

PAP-10/EAM/GL.1

Priority Actions Programme
Regional Activity Centre
Split, Croatia

PREFACE

This document was prepared in the framework of the network on "Environmental Aspects of Aquaculture Management in the Mediterranean" (EAM network). It is implemented by the Regional Activity Centre for the Priority Actions Programme (PAP/RAC) of UNEP's Mediterranean Action Plan (MAP), Split (CROATIA), while overall coordination is provided through General Fisheries Council for the Mediterranean (GFCM) and its Committee on Aquaculture.

On the occasion of a number of seminars organized by UNDP-sponsored Mediterranean Regional Aquaculture Project (MEDRAP II) and PAP/RAC, participants expressed the need for the preparation of document for selection of sites suitable for aquaculture. Discussions centered on the problems of identification of zones suitable for aquaculture, definition of the criteria and methodology for the zoning, as well as the proposal of appropriate protection measures for existing and future aquaculture operations, all as part of the process of integrated coastal area management (ICAM).

In accordance with the recognized need, the purpose of the present document is to provide an efficient and standardized tool for coastal zone planning to ensure a sustainable development of the aquaculture industry whilst minimizing conflicts between different users of coastal resources.

The structure and the content of the document were defined at the expert meeting held in Split, in October 1994. The first draft of the document was reviewed during the meeting held in Toulon, February 1995, and finalized by the individual work of the authors. The second draft was presented and discussed at the workshop on the Selection and Protection of the Sites Suitable for Aquaculture held in Iraklio (Crete), in November 1995.

The preparation of the document benefited from suggestions by PAP/RAC staff, in particular by A. Pavasovic and I. Trumbic. Professional suggestions on the draft text provided by U. Barg (FAO) are greatly appreciated.

CONTENTS

PREFACE	i
EXECUTIVE SUMMARY	1
1. BACKGROUND	3
2. THE ROLE OF AQUACULTURE IN INTEGRATED COASTAL AREA MANAGEMENT	4
3. AQUACULTURE IN RELATION TO COASTAL AREA USES	5
3.1. Relationships between aquaculture and other coastal area users	5
3.2. Relationships between aquacultural practices	6
4. CRITERIA AND PROCEDURE FOR COASTAL ZONING	8
4.1. Organization of the planning process	8
4.2. Description of the procedure	8
5. REGULATORY ASPECTS	14
5.1. Introduction	14
5.2. Protecting environment and living resources	14
5.3. Land use, regional and sectorial development and management	15
5.4. Aquaculture development and protection	17
5.5. Recommendations	18
ANNEX A: Working definition of fundamental notions related to document	22
ANNEX B: Species and technology in Mediterranean countries	24
ANNEX C: Suggested information base for zoning of aquaculture in ICAM	29
ANNEX D: Guidelines for an environmental impact assessment (EIA) in intensive aquaculture	33
6. LITERATURE	35

EXECUTIVE SUMMARY

Marine aquaculture as a relatively new sector capable of economic growth and benefits is now moving beyond its traditional stages to the point where it needs to have a recognizable and effective position - both in developmental and regulatory terms. In that context selection of the site is of vital importance since the quality and characteristics of the site are essential for both farming performance and reducing the negative impact on the environment.

Site selection procedures are closely related to the coastal zone planning and management policy, especially in a climate of competition for coastal space and resources use. Aquaculture must be considered as a coastal activity having the right to exist and necessary conditions should be preserved for its development. Environmental management should consider aquaculture as a part of the whole resources system upon which it relies. Relations between aquaculture development and coastal resources and the relations between aquaculture and other users of these resources need to be harmonized.

The document therefore suggests that coastal zonation relevant to aquaculture must be included in the national policy and with the goals it define at every level, mainly the control of developmental activities affecting the sustainability of coastal resources. When the decision of the planning process is taken, a specific procedure is to be set including the delimitation of the areas to be zoned, an extensive collection of data in order to complete the first database on natural and socio-economic environments, an application of the aquaculture specific requirements to the context of a given zone in order to determine its suitability and sustainability. The process is ended when a political decision is taken, indicating the ability for a zone to be utilized, exclusively or not for aquaculture purposes. A necessary updating of the database and of the regulatory measures is often required within the process of decision making.

Regulation is required for the promotion of sustainable aquaculture and its integration into coastal zone planning and management. This covers various fields, which may be complementary: environmental and living resource protection, land use, regional and

sectorial development and management, aquaculture itself, including resolution of conflicts.

Environmental and living resources protection applies to environmental quality objectives, living resources, as well as species, biotopes and other natural resources. Regulations exist at international and national levels and may have regional and local implications (quality criteria, conventions, endangered species, protected areas, restrictions on certain activities, ...).

Land use, regional and sectorial development and management calls for effective and realistic regulations and planning tools which are specific to each country and related to its political priorities and administrative organization. According to this, their application may be more or less decentralized (land use plans, master plans for specific territories or activities, planning schemes, ...).

Aquaculture development and protection is concerned by its own regulations, applying to it directly or indirectly: development policy and plans, siting, competition with other coastal zone users, environmental compliance.

Aquaculture, being highly dependent on a healthy environment, is also the best guarantee for its quality. Thus, environmental considerations must be integrated at an early stage in any project. But over-regulation has to be avoided, because it may advantage less environmentally friendly activities. Moreover, aquaculture can be of great value in terms of land use and occupation, population prosperity and stabilization, best use of renewable resources. Therefore, there is an urgent need to integrate it as an important and legitimate activity in coastal zone development, planning and management strategies.

1

BACKGROUND

Marine aquaculture has shown a large expansion in production in a number of Mediterranean countries over the past few decades. It provides an important source of high quality food and could be considered to be an important management tool to limit pressure on wild fish stocks which are heavily stressed due to overfishing and pollution in coastal areas.

Aquacultural activities require good quality water. Degradation of the surrounding environment may result in increased stress and incidence of disease of the culture species and a consequent decline in productivity.

As the aquaculture industry expands, it can create different kinds of environmental and socio-economic problems. Firstly, it comes into conflict with other users of coastal resources, and secondly, if not properly managed and regulated, it can cause environmental harm.

The degree of interaction between aquaculture and the environment depends on the sensitivity of the ecosystem where it is implemented, on the culture system, and on the species. As a result of these interactions and of the growing public concern of environmental problems, the choice of sites for the aquaculture operations is becoming more important.

The future expansion of aquaculture must be based on well balanced interventions through integrated coastal area management plans. This should consider aquaculture in relation to all other existing and planned activities and developments. The careful selection of the sites will minimize specific impacts on the ecosystem and reduce the effects of negative feedback which affect the production potential of the culturing operation.

The purpose of this document is to assist the Mediterranean countries in establishing control over planning the use of coastal and insular zones for aquaculture activities by combining scientifically based principles and a pragmatic approach in positioning the "right activity on the right place".

The specific objectives of the document are defined as follows:

- To ensure the continued development and growth of the aquaculture industry without causing large-scale conflicts with other users;

- To assist in the process of coastal area planning and to achieve effective regulation of the future aquaculture development.

The document is based on relevant published information and currently available experience. It is focusing on the countries bordering the Mediterranean basin. However, it is believed that, if adapted, it could be applicable in other parts such as Black Sea. The document is addressed to decision makers, planners and managers, and all those who are involved in the process of coastal area planning, aquaculture regulation and development. The document is not an exhaustive manual presenting a rigid set of prescribed steps and procedures. It is a flexible approach giving the most suitable options in zoning of coastal areas for aquaculture in the Mediterranean basin. However, the real application is to be adapted to the local relevant conditions, the size, nature and actual circumstances of the area considered.

2

THE ROLE OF AQUACULTURE IN INTEGRATED COASTAL AREA MANAGEMENT

In defining the role of aquaculture in ICAM there is a need to point out that this industry is relatively new and that its development has coincided with a large increase in environmental awareness. Unlike other industries located in the coastal zone, aquaculture relies heavily on natural aquatic resources, and it is characterized by the demand for a very high quality of environment. Because of its specific site requirements and competing interests for coastal space, aquaculture development tends to be forced into disadvantaged regions, sometimes with limited opportunities for success.

To be successful, the aquaculture industry requires many inputs - biophysical, social, economic etc. However, it also may have multiple impacts on the environment, some positive and some negative. For example, it has been blamed for navigational disturbance, pollution of the coastal environment (visual, organic, chemical and genetic pollution), as well as for disease and parasite transfer to natural fish populations. On the positive side it produces a valuable product for consumers. It can also be a promising activity in rural areas. An important positive physical impact is that the presence of a fish or shellfish farm will help discourage pollution and habitat degradation from less environmentally friendly industries. Aquaculture may generally be considered as a kind of guarantee for water quality and integrity of the environment as a whole. It should be noted that where aquaculture projects have resulted in pollution, the principal causes have been improper siting and poor management.

The impacts of aquaculture on social conditions have not been studied enough. In rural areas, in particular, its importance has also been neglected. In addition, most of the rural coastal communities rely heavily on one activity (e.g. agriculture, traditional fisheries or tourism) that may be vulnerable to external financial inputs.

Aquaculture in most cases represents a new activity in an area, and as such has to establish rights of access to coastal areas and resources in the context of the existing. Most legislative systems will act to protect the established activities. In general, legislation and regulation in most countries are often inadequate and non-specific to aquaculture. They are based upon the existing regulators framework for other related

sectors and may not be particularly beneficial for integration of aquaculture and other activities in coastal zone management plans.

Since aquaculture uses both terrestrial and aquatic environments, it has experienced much duplication, confusion and uncertainty. This results in conflicts with other coastal users and managers as, for example, the frequent problems with tourism. Each of these users have different requirements and aspirations. Of most relevance to integrating aquaculture into ICAM is the interaction between scientists, ICAM policy planners, economists, general public and neighboring coastal communities. Each of these groups require information in a format understandable to them. The lack of effective transfer of information between these groups is considered a major obstacle in integration of aquaculture into ICAM policies and resource allocation strategies.

The role of aquaculture in ICAM is to develop the industry with a full appreciation of environment/production interdependencies and allow it to become an integral part of the overall ecosystem. ICAM will take advantage of a full integration of aquaculture if techniques, planning and management is harmonized with the natural ecosystem and compatible with other coastal users so that any negative impact is minimized.

3

AQUACULTURE IN RELATION TO COASTAL AREA USES

Site selection for aquaculture is probably one of the main factors that determines the feasibility and sustainability of aquaculture projects. However, the coastal zone is under pressure from many different competing activities which may affect existing and future aquaculture operations.

3.1. Relationships between aquaculture and other coastal area users

Competition for space is one of the most critical factors of the relationships between aquaculture and other activities. Fishing zones, spawning areas, nurseries, artificial reefs, access to harbors, military zones, land reclaiming, protected or reserved zones, dredging, recreative activities such as bathing, sailing or fishing may be submitted to regulations which limit the possibilities for selecting suitable areas for sea-based aquaculture. Land-based aquaculture system interact naturally with all other developed activities on the seashore and especially with urbanization, industry, tourism and agriculture activities.

Aquaculture development is under controlled of quality of the environment, mainly the water quality as well as the bottom conditions. Chemical pollutions are generated by industrial activities, by intensive agriculture with large uses of pesticides (weedkillers) and also by recreative activities with the general use of antifouling and preservative paints (TBT, heavy metals, pesticides..). Bacteriological pollution is more related to permanent urbanization and to tourism which often cause an overpass of the sewage treatment capacities. Biological pollution is connected with the discharge of ballast waters causing invasion of non indigenous species as cholera vibrios, toxic algae and several other pests. Genetic escapes of cultivated strains can present a high risk for the sustainability of wild strains of fish and shellfish. Disease transmission from aquaculture to fisheries can provoke deleterious effects on the wild stock. Industrial and agricultural practices lead often to modify freshwater inputs in the coastal waters. Power plants with warmed water discharges, large settlements with sewage, agriculture with drainage and irrigation, dams with both uses: control of run-off and of dryness can have positive or negative effects (nutrients, salinity,

organic matter) function of their intensities and of the dispersion capacity of the coastal areas. Water quality entering an aquaculture system shows a large time-scale variability and should, therefore, be viewed as a dynamic process. For example, pollution reaching the aquaculture system, could have a distant origin, but be transported into the area by local currents. Concentrations of a pollutant could be at very reduced levels, but on a large time scale could contaminate the reared species to a harmful level. Water quality standards are, therefore, often difficult to establish and the source of pollution is difficult to locate because of dispersion processes. Over-urbanized or industrialized areas are often responsible for organic matter discharges leading to eutrophication or oxygen depletion. Although sewage can be depurated, viruses could pass through the depuration plant and be responsible for viral pollution.

Economical facilities for aquaculture development are positively influenced by attraction of investment and of infrastructure (roads, electricity supply) connected with industry, urbanization and tourism. Tourism provides often the development of local markets for aquaculture products. Fishery activity in the vicinity of aquaculture could also have a positive effect by providing aquafeeds and enhancing demand for aquaculture products.

Aquaculture development refers also to social constraints. Urbanization may involve new ways of living where fresh fish and shellfish consumption could be replaced by new standards of human nutrition (frozen and cooked products, high quality). Existing fishery education system could have a positive effect for education for new aquaculturists. However, competition between aquaculturists and fishermen could arise especially in low settlement areas where transfers of employment from fishery to aquaculture occur and lead to social disturbance. Development of wildlife preservation and seascape preservation may lead to major constraints on aquaculture development and social conflicts with local inhabitants and tourists. On the opposite, ecotourism provides mutual benefits between tourism activity, discovery of wildlife and aquaculture practices.

In the coastal zone, the pre-existing activities are protected by large sets of regulations from multi-national level, through national plans to

municipality level. All these regulations are presenting main constraints for the development of new activities such as aquaculture.

Table 1: Relationships between aquaculture and other uses of coastal area

ACTIVITY	INDUSTRY AND HARBOR	URBANIZATION	TOURISM AND RECREATION	AGRICULTURE		FISHERIES
				INTENSIVE	EXTENSIVE	
SPATIAL RESOURCES	- land reclaiming (-) - shipping traffic (-) - military zones (-) - dredging (-)	- land use (-) - land reclaiming (-)	- land reclaiming (-) - harbors (-) - sailing, bathing (-) - fishing (-) - historical sites (-)	- coastal land (-)	- coastal land (-)	- spawning areas (-) - nurseries (-) - artificial reefs (-) - fishing zones (-)
QUALITY OF ENVIRONMENT	- pollutants (-) - ballast water (-) - warmed water (+)	- sewage (-) - organic matter (-) - bacteria and viruses (-) - nutrients (-)	- sewage (-) - antifouling paints (-)	- fertilizers (-) - pesticides (-) - organic matter (-) - suspended solids (-) - freshwater management (-)	- nutrients (+) - organic matter (+) - freshwater management (+/-)	- disease transmission (-) - genetic escape (-)
ECONOMY	- infrastructure (+) - attraction of investment (+/-)	- market (+) - infrastructure (+)	- attraction of investment (+/-) - seasonal employment (+/-) - local market (+) - infrastructure (+)	- infrastructure (+)	- infrastructure (+)	- attraction of investment (+) - market (+) - infrastructure (+) - fish meal for aquafeeds (+)
SOCIAL RESOURCES		- living habitats (-)	- eco tourism (+) - seascape (-) - wildlife (-)			- internal competition (-) - education (+)
REGULATIONS	- areas around (-) - harbors reserved (-) - military zones (-)	- municipality (-) - policy (+/-)	- protected area (-) - wild fauna and flora (-) - environmental standards (+)			- sanctuaries for fisheries (+/-)

(+) in favor of aquaculture development

(-) negative effect relationship to aquaculture development

3.2. Relationships between aquacultural practices

Spatial conflicts could occur between traditional aquaculture system, mainly shellfish cultivation (oysters and mussels) but also finfish as mullets and new aquaculture practices such as fish farm cages and long lines for shellfish. However, the water column could be managed at different levels such as surface, water mass, bottom. Both shellfish cultivation and finfish aquaculture could be damaged by disease due to pathogens. In some cases, pathogens from finfish can be accumulated by the shellfishes cultivated in the vicinity. Furthermore, treatments by drugs as antibiotics and antifouling substances used for

finfish cultivation can have deleterious effect on the shellfishes cultivated in association.

Both activities are producing a large amount of biodeposits which can have an adverse effect on the bottom quality causing anoxic conditions when current velocities are too low to avoid stratification.

Carrying capacity for the extensive shellfish culture is a relation between the fluxes of food and the biomass of wild and cultivated animals present in an area. Over a certain biomass, carrying capacity may be over passed and may cause, by trophic limitation, reduced growth rates and increased mortality.

For land-based aquaculture systems, seawater availability can be a serious limiting factor when

the farms are using underground seawater or when they are located in wetlands.

The ability of the ecosystem to accept the wastes of the finfish farms is defined as the holding capacity. In some cases, when current are too low or when residence time of water masses are too long, dispersion of wastes may affect the water quality. In land-based farms, with recirculating system, water volumes must be sufficient to allow depuration. In integrated aquaculture systems, shellfish or finfishes could be used for recycling wastes.

Consumption of marine products is very often limited to some restricted areas and species. Development of aquaculture (finfish or shellfish) could enhanced the consumption of new products and correlatively could contribute to the implementation of new ways of marketing and creation of networks for commercialization of marine products.

New aquaculture technique needs qualified skills, provided by special training courses. This education system could benefit to the marine workers (fishermen, traditional aquaculturists). However, in places where manpower is scarce, competition between different activities could occur by transfer of employment from one to the other.

Implementation of license system could promote creation of administrative arrangements, which could be favorable to the management of aquaculture and development of water quality monitoring (bacteriological standards, toxic algae, heavy metals, pesticides...).

Table 2: Relationships between aquacultural practices

ACTIVITY	INTERNAL RELATIONSHIPS		FINFISH/SHELLFISH RELATIONSHIPS
	SHELLFISH	FINFISH	
SPATIAL	- already established activity (-)	- already established activity (-)	- already established activity (-)
QUALITY OF THE ENVIRONMENT	- pathogens (-) - biodiversity (-) - biodeposition (-) - anoxia (-) - genetic (-)	- pathogens (-) - waste (-) - food faeces (-) - treatments (-) - genetic (-)	- pathogens (-) - biodeposition (-) - anoxia (-)
WATER QUANTITY AND DYNAMICS	- carrying capacity under (+) above(-)	- (land-based) wetlands - (land-based) underground seawater (-) - holding capacity under (+) above (-)	- Integrated aquaculture systems (+)
ECONOMY	market (+)		
SOCIAL	internal competition (-) education (+)		
REGULATIONS ADMINISTRATION	licensing or leasing system (+) monitoring (+)		

(+) In favor of aquaculture development

(-) Negative effect relationships to aquaculture development

4

CRITERIA AND PROCEDURE FOR COASTAL ZONING

4.1. Organization of the planning process

In the context of the coastal zone, planning refers to the development of goals and policies in order to optimize the production of goods and services from predefined areas over time.

The first phase of such a planning procedure that is to be managed for every coastal specific use, must be the definition of a national policy. This policy has to define:

- the coastal area involved in the planning decision. Concerning aquaculture, planning can be foreseen at different scales: national, regional, local or farm level. Generally, at this stage of planning, the area is relatively broad;
- the goals and objectives of development and environmental protection.

A legislative action is often necessary, that can give the authorization to launch the planning procedure.

The policy statement will lead to the structuring of actions within the planning procedure: definition of the executive authority, stating the participation of governmental agencies and experts, funding the work to be done and determining the time schedule. Only general directives and goals are required at this level, such as "sustainable development of living resources". There is some danger at this stage however, in becoming locked into specific activity that could restrict the credibility of the process.

The next stage of the planning process involves preliminary data collection that could enable the definition of more precise or smaller zones, and can be described as a management zone. A global data base is the necessary tool to collect information concerning activities, environmental conditions, and existing regulations. The needs of existing or potential future activities must be stated using the existing data.

Concerning specific requirements for aquaculture activities, the first and most important source of information is a bathymetry map, that can subsequently be used for different types of coastal water planning. For example,

when there is a need to know which coastal area is the most suitable for cage farming and when data on water turnover and predominant bottom type are lacking, the map can help for making a first rough assessment.

One principal hypothesis, is that morphology has a major impact on the ecological functioning of the water system, since it is both costly and time-consuming to determine the turnover of deep and surface water, and bottom dynamic conditions. It would be advantageous if these parameters could be predicted directly from chart information. If not sufficient, the capability to acquire new data must be foreseen.

The following phase deals only with aquaculture activities and their specific requirements. The objective is to determine the suitability of every type of aquaculture for defined zones. It must lead to definition of smaller areas within the zone (aquaculture site), in which aquaculture can be authorized or restricted on the basis of environmental suitability and availability of essential infrastructures. It requires the building of a specific database.

Lastly, planning must define the necessary measures in order to implement the work and to make available the recommendations from the actual Coastal Plan available. This also concerns the updating of the databases.

4.2. Description of the procedure

The procedure is shown in the flow chart presented in Figure 1. Four phases can be determined.

Phase 1: Definition of the policy

Planning decision

The policy statement should declare in the strongest terms possible that it is the intention of the nation to review and regulate over developmental activities affecting the sustainability of renewable coastal resources. The goal should be maintenance of the optimum sustainable use of coastal resources, in both the economic and social context. The policy should then list specific national coastal concerns and issues to be addressed and state the priorities of

the nation toward coastal resource utilization and conservation.

Policy statement: structuring the project

The strategic plan lays the foundation for the legislation or the executive order that is required to authorize the Programme Development phase that follows. The strategic plan should:

1. specifically assign responsibility for the programme to a particular agency, and identify interagency mechanism;
2. authorize the funding necessary for programme development;
3. state clearly the objectives of the programme;
4. recommend a method for collaboration amongst the various sectoral agencies and private interests involved;
5. state the time limits involved for various stages of programme development; and
6. require a specific step-by-step programme development and organizing process.

Delimitation of areas

To establish manageable units for the information base and mapping, the first phase involves the partitioning of coastal boundaries into coastal areas. They may be fixed units following administrative or geographical boundaries (i.e. region, country, prefecture). The registration of suitability for aquaculture involves a rough evaluation of communal and natural limitations of a certain coastal area. At this level, the major problems are identified and decisions are to be taken as regards the initiation of the planning process. Information bases contain existing sources of global data only, supplemented by expected future trends.

Phase 2: Database constitution

The database must be constructed in such a way that it allows analyses to be pursued along the lines of the predefined aims of the planning. Geographic Information System (GIS) are powerful tools in order to achieve this goal. A precise content of such a database is given in Annex B. Schematically, it should proceed from:

- an analysis of the natural environment: physical processes, protection, foreseen dispositions, impact of activities, etc.
- an analysis of the economic systems: existing economic activities, evaluation of the demands for coastal resources, etc.

This data base is not merely dedicated to aquaculture, but should include information on aquaculture activity (existing farms, main requirements..)

Criteria for zoning

Criteria refer to the original data of the database to which thresholds are attached (ex.: the data base gives an extensive bathymetry map, and zoning process states that the isobathes -25m and -50m will be criteria for demarcating the boundaries of the zones). To this level, in addition to the global infrastructural, social and economical considerations, ecological parameters are the most relevant (Annex C).

Zoning

Because of the great diversity of environmental conditions, even within relatively small coastal areas, these may be divided into smaller manageable units (-zones-) depending on topography, productivity and water regime. The principle of this division is that each major water volume is handled separately as either lagoon-like zones, bays, channels or estuaries, so called homogenous zones. Zonal limits should be identified without regard to administrative borders. The idea is that this may lead to co-operation rather than competition between neighboring municipalities on the use of the water bodies which should be seen as common resources. Incentives for such co-operation are often needed.

Phase 3: Identifying zones suitable for aquaculture

The objective of this phase is to determine the suitability for aquaculture within the zone. It is the first phase entirely dedicated to aquaculture operations, even if some aquaculture requirements had been taken into account in Phase 2.

Such an analysis is aimed at:

- protecting existing aquaculture sites;
- ensuring sustainable growth of the aquaculture industry in the future;
- providing responsible authorities with tools to locate optimal and sub-optimal areas suitable for aquaculture in agreement with holding/carrying capacities of the environment and environmental quality objectives;
- advising on opportunities and limitation for minimizing conflicts with other users.

A specific database is necessary to meet the aquaculture needs.

Initial elimination

To restrict the need for data collection, zones of no interest for any kind of aquaculture should be eliminated initially by applying "eliminating" criteria of high risk and incompatible uses (Table 3). A number of zones may be unfavorable either due to natural conditions and/or anthropogenic activities. In addition to unsuitable zones, there will be zones limited by other purposes where aquaculture may be forbidden (i.e. nature reserves, animal protection zones, existing aquaculture, security zones, navigation zones, military zones, etc.). Having eliminated all these zones from the larger area one is left with suitable zones which are to be subjected to further analysis.

Table 3: Eliminating criteria - environmental characteristics that make aquaculture impossible or risky

-
- Severe pollution (city, harbor, industry)
 - Insufficient hygienic conditions
 - Unfavorable hydrodynamics
 - Eutrophic areas with harmful plankton blooms
 - Shipping traffic
 - Specially protected areas
 - Restricted areas
 - Areas for intensive recreational activities
 - Areas of high economic interest
-

Further assessment of the suitability of remaining coastal zones is based on the most common fish farming technology and the species to be cultured.

Selecting technology and species according to site characteristics

In terms of land and water resources two fundamental systems (land based and water based) are used for aquaculture production, each involving different considerations for siting, construction, operation and management. The range of the types of system (i.e. lagoons, tanks, raceways, cages, enclosures, rafts and longlines for molluscs etc.) and species used is very large and for any given set of circumstances there is a range of options. However, a clear relationship exists between these main elements which

narrows down the possibilities to a quite small number, allowing the developer to match species, type of system and the main characteristics of the site (Table 4). In some cases, a certain site will suggest particular species. On the other hand, a particular system will support certain species and will require a particular environment.

In considering a particular set of circumstances in a given zone, there would be a need to assess the importance of individual factors and rank these factors according to their significance. Thus if water area is in scarce, a system requiring less water area is a major consideration. In the case of a shortage of skills, a less complex technical design may be a better choice. The analysis of the sites and resources available may indicate whether a polyculture would contribute to the maintenance of the sensitive ecological balance in the site (e.g. integration of molluscs in fish cage culture area).

An analysis of the potential consequences induced is necessary, not only on environmental aspects, but also on social and economic issues.

Concerning these, there are two major tendencies: the first is aquaculture with a higher level of social responsibility, generally by using extensive or semi-intensive rearing of species that can meet the high internal demand for affordable food; and the second tendency is the orientation towards intensive production of higher value organisms, a large part of which may be allocated to foreign markets or touristic involvement. While the first productive strategy is based on rearing species which are direct utilizers of the natural environment for their food supply, the second is using more advanced technology based on economic strategy and utilizes natural environment for fodder.

Conclusively, the process results in a classification of a culture site within a zone which is presented to local (municipal) authorities to protect existing aquaculture operations from pollution threats, to promote aquaculture development as well as in evaluation of aquaculture applications. Local authorities should not be necessarily tied to this classification and may make their decision based on other factors (for example: collection of taxes, political agreement...). Finally, the methodology employed will strongly depend on capital and operating availabilities, and hence the socio-economic impact of a project.

A number of different decisions can be made that will allow a zone to be selected for the development of aquaculture.

Table 4: Criteria to be considered in selecting sites for aquaculture in marine environment

BIOPHYSICAL CHARACTERISTICS	SUPPORTING INFRASTRUCTURE	SOCIAL & ECONOMIC CONSIDERATION
Exposure	Road and communications	Local demand and supply
Depth	Electricity	International market
Current (velocity, direction)	Fish-feed manufacture	Cost of basic supply for goods
Wind (fetch, speed and direction)	Slaughtering facilities	Capital cost
Waves	Waste disposal facilities	Risks & Insurance
Topography (slope, threshold)	Health service	Employment
Substrate	Advisory service	Regulations
Suspended matter	Expertise	
Available land	Education	
Water quality-min. max. and variations (T.C., %O ₂ , ppt Sal.)	Repair and maintenance	
Water quantity		
Space		
Trophic status		
Fouling		
Existing cultivated species		
Predators		

- a) The area is reserved exclusively for aquacultural activities. This will occur in very few examples. The area should be protected by legislation so that any other proposed activity that might in any way threaten aquacultural activities must be submitted to the appropriate governing authority and can be refused without appeal. Existing threats should be reduced and controlled.
- b) The area has been zoned for aquaculture, but not exclusively, and may also be opened to other activities. Two situations can occur: aquaculture is a priority in the zone or aquaculture is not necessarily a protected interest. In these cases, specific tools for conflict resolution must be foreseen and implemented with graded correction in function of the level of priority.

One of the potential problems is over-development of any particular area which may then have a negative feedback and may lead to conflict of interests. Once an area has been zoned for fish farming development, the carrying/holding capacity of the area should be established with respect to the extent and type of cultural activities proposed or suitable. The area should then be divided into farming units for specific application. Individual farm licenses

can then be granted to applicants on the basis of the quoted capacity of the area within the allowable framework. Individual applications would still require researching and environmental impact assessment, depending on perceived potential risks and pre-determined environmental quality objectives. Environmental impact assessment requirements and procedures should be cut to size of the project and of the acceptability of environmental risk. After limited development of the area, allowance should be reviewed again with respect to carrying capacity and the appropriate "licensed quota" to be reset if necessary.

- c) The area is not suitable for aquaculture activities through either non-compatible activities, unsuitable characteristics, or political decision not to support these activities in this area. Without suitable characteristics, for example, climatic conditions, the area will never be able to be used. Non-compatible activities may change in the future even in the long term so there could be a need to reassess the area if these activities and/or their effects cease. Political or socio-economic conditions can change remarkably quickly so there may be a possibility of reassessing the area in the short term.

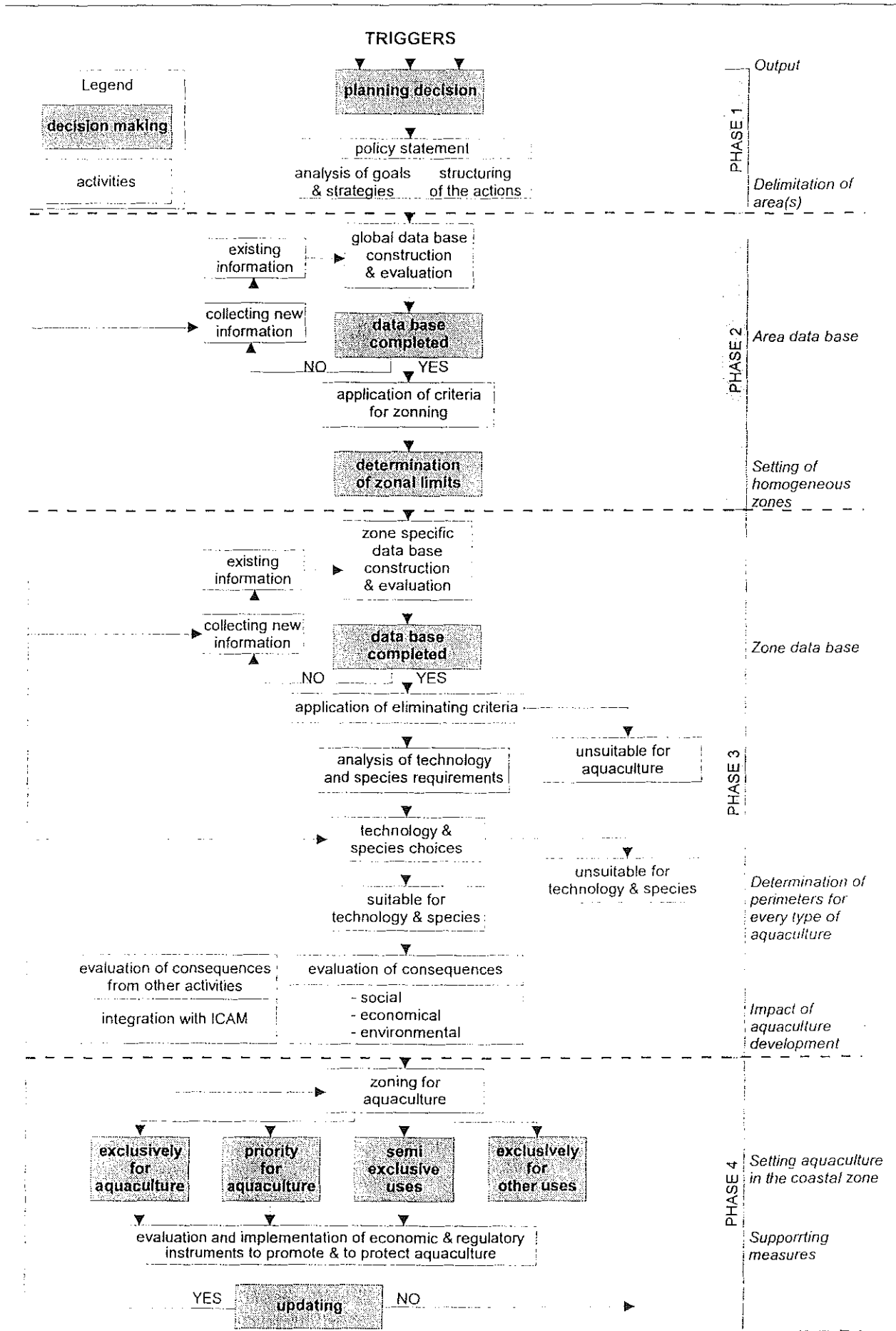
Phase 4: Enabling aquaculture development

In the case where an area has been zoned for aquacultural activities, it should be maintained as far as possible to ensure that its conditions are kept stable and that it does not deteriorate to a situation where those activities are no longer possible at the previously decided level.

In that context, a particular set of regulatory measures have to be undertaken, concerning:

- protection of the sites: e.g. prevention of pollution from other sources;
- up-dating, enforcement and implementation of the legislation;
- monitoring of the development;
- assessment of carrying and/or holding capacity;
- method for conflict resolution, e.g. round table conference, plurisectorial Commissions;
- management tools; e.g. licenses, payable rights.

Both promotion of aquaculture operations and protection of natural environment have to be encouraged through not only control instruments (regulations) but also economic incentives.



Flowchart for ICAM process with reference to aquaculture activities

5

REGULATORY ASPECTS

5.1. Introduction

Marine aquaculture utilizes space and natural resources, such as water, part of the existing food chain, seedlings, and requires as well a good quality environment. As it is confronted with competition from other coastal activities and subject to terrestrial runoff, its maintenance and development must receive the necessary guarantees. To this purpose, it should be included in coastal zone planning and management, with appropriate regulatory tools. This calls for regulations covering various fields, which may be complementary:

- environmental and living resource protection,
- land use, regional and sectorial development and management,
- aquaculture itself, including its environmental compliance.

Any aquaculture development policy will be bound by this context, and should define related opportunities and limitations.

5.2. Protecting environment and living resources

General laws concerning the protection of the environment and living resources aim at the

public welfare and are not specific to aquaculture. They often have an universal character and their preoccupations are common to a large number of countries. They may exist at different levels: firstly, national, but also international (conventions for major pollution risks, protection of endangered species and very important sites). They may also have regional or local implications (protected areas, restrictions on certain activities). The main fields covered concern water quality, living resources, species, biotopes and sites.

Water quality

This applies to water preservation in itself or to water use, generally related to marine life or human health. The corresponding regulations concern:

- polluting activities, whether using marine water to dilute or eliminate their outputs, or inducing environmental risk (industry, navigation, urban waste), through emission standards; and
- water use, through quality standards (such as oxygen level compatible with salmon and sea trout life in estuarine water, bathing water criteria, shellfish quality criteria). These may be national or international (e.g., EC water quality criteria for sanitary regulation of shellfish production zones, as shown on Table 5).

Table 5: Sanitary regulation of shellfish production zones - French regulation after EC directive n° 91/492 (15/07/91)

	Zones	Limits CF/100 ml	Exploitation	
			Farming	Natural grounds
A	HEALTHY	300	Authorized (direct consumption)	Authorized (direct consumption)
B	UNHEALTHY	6 000	Authorized after purification or restocking in a healthy zone	Authorized after purification or restocking in a healthy zone
C	EXPLOITABLE	60 000	PROHIBITED (unless special dispensation)	Authorized after purification and/or restocking in a healthy zone
D	UNHEALTHY PROHIBITED		PROHIBITED	PROHIBITED

A complete regulatory sequence normally includes:

1. administrative authorization, generally based on an environmental impact assessment (EIA) for large scale projects;
2. complementary requirements, specific to the activity concerned (e.g. effluent standards, treatment requirements); and
3. monitoring, also requested by the authorization, and including both project-run and administrative control.

Taxes may be collected by local and government authorities or by water boards in compensation for this "right to pollute" or to use the environment as a dispersion facility, in accordance with the so called "polluter pays principle". These taxes are generally based on water consumption by industries and citizens and, directly or indirectly, are reverted to effluent treatment (urban plants, funding applied to research and technology, monitoring). Classification criteria based on faecal coliform bacteria concentration per 100 ml mashed flesh, CF/100 ml.

Monitoring networks may exist for different purposes. Some are devoted to public health and refer directly to water quality (e.g. bathing) or indirectly, through shellfish quality for consumption, using the filtering bivalve as an indicator (shellfish quality as related to bacteria and toxic phytoplankton). These make up an integral part of the regulation, and their official quality criteria can lead to constraining measures when not met: closing of beaches or low ranking in quality classifications, calling for waste water treatment improvements, temporary prohibiting of shellfish trade or requirements for depuration. Another type of monitoring aims at providing information on coastal water quality trends and is not directly related to regulation. The parameters surveyed concern the water itself or, better, the sediment and living organisms, which are more suitable long term indicators, due to their ability to accumulate contaminants.

Living resources

Fisheries management involves a series of rules ultimately aimed at the best use of a natural renewable resource for the benefit of the community or determined human groups. This operates on all levels, from international to local.

Regulations principally apply to the following fields:

1. Fishing effort and access to the resource (fishing gear and techniques, power

limitations, seasons, quotas, permits, exclusive zones),

2. Recruitment (protection of nursery areas, minimum mesh size, minimum catch size of commercial species),
3. Biotopes and populations (totally or partially protected zones).

The tendency to full or over-exploitation of many species and fishing grounds results in a general concern about access to the resource and its protection, as well as an internationalization of the problem. Thus, individual licenses have appeared locally for some sedentary species (lobsters, abalones, scallops). Otherwise, international agreements and committees endeavor to manage stocks at a regional or even wider scale (International Code of Conduct for Responsible Fisheries, FAO; "Blue Europe"; GCFM or General Fisheries Council for the Mediterranean; NAFO or North Atlantic Fisheries Organization).

Species, biotopes and natural sites

Some rare or endangered species are protected by international and regional conventions (marine turtles, marine mammals). Others appear on red lists with strong recommendations for protection.

International agreements also apply to certain types of large scale valuable sites in the coastal zone, such as migrating water bird sanctuaries. These and other important areas, due to their landscape, terrestrial or marine flora and fauna, may be classified as parks or reserves, and partially or fully protected by local regulations (with reference to agriculture and forestry, fishery, environmental protection, urban and industrial development).

As regards biotopes, there is a general concern for sea grass beds, principally for *Posidonia* beds, considered to be a highly productive ecological climax community in the Mediterranean. Their presence should be a constraining factor for many activities in the coastal zone, including aquaculture.

5.3. Land use, regional and sectorial development and management

These regulations and planning tools are specific to each country. The guiding principles are set up on a national level: land use and development policy, town and country planning code, general planning and management tools, etc. According to the political and administrative

organization, their application may be more or less decentralized: land use at diverse levels, sectorial development (by activity), regional development.

Land use

Land use planning is determined on different levels, with corresponding objectives, time scales and regulatory tools.

A national plan defines a general strategy for the evolution of the country at medium to long-term range, major centres of activity, developing zones, links and fluxes between them, and necessary public incentives.

Regional plans translate these directives to a smaller scale with more details and make them fit regional and local needs.

Local plans exist on a municipal level, regulating land use within the township. Generally they do not apply directly to the sea, but may be important for aquaculture through the necessary land-based infrastructures, as well as through the public concern for this activity when a clear political willingness to promote it appears in the planning document.

Sectorial development

Master plans are set up on a national or regional scale to develop and manage certain activities or basic infrastructures: such as branches of industry, tourism, aquaculture, etc. Naturally, they concern the activity itself, as well as corresponding means and infrastructures, including land use anticipation and reservation, which can be detailed in regional plans and introduced in local documents. To meet this need, surveys may be necessary to identify and select the most suitable sites.

These plans are important for aquaculture, mainly for the purpose of its own development and management, in which case they should be strongly recommended, but also because of potential conflicts with other activities competing

for the same space and water usage (e.g., tourism). To prevent such problems, concerted actions are necessary, requiring a multidisciplinary territorial approach involving all interest parties. Opportunities for co-existence with benefits for various activities may also be identified.

Regional development and management

Master plans of this kind are mainly devoted to a specific territory, including a large number of important activities. National, regional and local powers and interests come into play, in accordance with prevailing political and administrative organization. The territory taken into account may coincide with administrative boundaries or correspond to natural homogeneous characteristics. With respect to the coastal zone, these may include catchment basins, estuaries or gulfs.

As different activities are simultaneously concerned, the approach is necessarily multidisciplinary and involves many parties, to allow for harmonization of the master plan. This is also a good opportunity to open the way for smaller scale concerted actions, setting up management schemes able to organize the coexistence of different users of the space and water in a given area. (An example of such a regional development and management scheme, specially designed for coastal zone planning, is provided by the French case exposed in the box enclosed). The natural characteristics and suitabilities of the sites, as well as their best usage, must be defined, if necessary by scientific studies, as a sound basis for discussion, decision making and planning. A wide range of people from different origins will also have to work together for the common interest: public services, professionals, elected bodies, science and technology. This sort of approach is certainly time- and energy-consuming, but can greatly benefit the solving or prevention of conflicts.