European Fisheries
and Aquaculture
Research Organisations

EFARO

Trends in European Fisheries and Aquaculture Research

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Realised under the Concerted Action MUTFISHARE (Mutualisation of Fisheries and Aquaculture Research in Europe), according to the contract Q5CA-2002-1353 by the EC

Abstract

Trends in European Fisheries and Aquaculture Research

This report presents EFARO views about how science can contribute to the sustainable development of fisheries and aquaculture. It intends to diffuse the ideas of the 25 research Institutes, representing 2500 permanent researchers in the field of fisheries and aquaculture studies, and the 310 international experts which attended to the thematic workshops organised by EFARO from 2002 to 2005.

Part 1 illustrates the major challenges for the European seafood production has to face in order to meet the consumers demands for healthy and convenient seafood, with respect to environment and welfare concerns. The challenges require good understanding of the biological, ecological, (bio) technological and socio-economical aspects of sustainable fish production in the context of marine living resource management and coastal zone management. The **priorities in fisheries and aquaculture research** related to these challenges are presented in **Part 2.** The National Institutes in charge of fisheries and aquaculture research play a crucial role for knowledge-based innovations in seafood production. In order to meet the challenging objectives to fastening sustainable fisheries and aquaculture development in an efficient way, the scientific community has to operate in close cooperation at the European level.

The MUTFISHARE Concerted Action under FP5 has contributed to a more intensive collaboration, structured by the **EFARO-organization,** the aims of which are presented in **Part 3.**

From the perspective of integrated fisheries management and the capacity to produce healthy seafood, the stakeholders from both the public domain (national and EU governmental organizations, NGO's) and the private sector (fisheries, aquaculture and seafood industries) require from the scientists a more effective multi-disciplinary approach.

EFARO has been used as an **European platform** to link various disciplines to the fisheries and aquaculture sciences. In the **Annex** the outcomes of networking activity which included fundamental marine scientists, agricultural and food scientists, and socio-economic experts is provided.

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In addition to this synthesis, the extended reports of the meetings under MUTFISHARE , as well as position papers, posters and recommendations issued are available on the EFARO website at http://www.efaro.org

We thank all the participants to the EFARO general meeting and workshops performed during the Concerted Action MUTFISHARE.

Directors of the EFARO' member organisms during XVth General Meeting in Zeeland in 2005

List of the General Meetings:

Date	Location	Subject
June 2003	Rhodes (Greece)	XIIIth meeting of the Directors of Fisheries and Aquaculture Research Organisations of the EU
May 2004	Galway (Ireland)	XIVth meeting of the Directors of Fisheries and Aquaculture Research Organisations of the EU
May 2005	Renese (The Netherlands); Oostend (Belgium)	XVth meeting of the Directors of Fisheries and Aquaculture Research Organisations of the EU

List of the thematic workshops:

Date	Location	Subject
November 2002	Brussels (Belgium)	Building the ERA in the field of fisheries and aquaculture
January 2003	Barcelona (Spain)	Data bases for fisheries management
October 2003	Berlin (Germany)	Environmental interactions of aquaculture and fisheries
January 2004	Tunis (Tunisia)	Exchange of boats and equipment, evolution of the E. U. research fleet
October 2004	Lisbon (Portugal)	Genetics tools for fisheries and aquaculture. Identification of fish and shellfish populations
December 2004	Brest (France)	Age reading techniques: a E.U. strategy
February 2005	Budapest (Hungary)	Research for diversification in aquaculture
March 2005	Thessaloniki (Greece)	Fisheries management and Fisheries economics perspectives
October 2005	Gdynia (Poland)	Technological and methodological innovation for stock assessment

Contents

Foreword :
EFARO and the ERA for fisheries and aquaculture

The exploitation of marine biological resources in the seas bordering Europe is of vital importance for people living there, and particularly for small coastal communities. Fishing and aquaculture are often the backbone of the social architecture in those areas, some of them being particularly remote and far from being able to support alternative industries. Some of the richest grounds for fishing, and some of the highest primary production zones occurred in the north-east Atlantic, and may support high employment in the fishing activities. The production extracted from those environments are under pressure from a number of factors, such as over-fishing, eutrophication and contaminants coming from the catchment area or shipping, urbanisation, all of them resulting from the human activities. Europe extracts less fish in 2004 from its seas than 10 years ago while the fishing effort appears to increase. Aquaculture increased by 80% in the same period, mainly due to the salmon production and while using opportunities for growth it also raises new environmental concerns. Clearly there is a need for substantial scientific effort to develop and manage both activities within the framework of sustainable methods of exploitation.

With its present membership of 25 marine research organisations involved both in the research and the advisory processes, from 22 European and associated countries, the European Fisheries and Aquaculture Organisations – EFARO – provides a unique forum to express the vision about how research can support policies at national and European level. This paper represents an initiative to establish an overview of the research needs, and the future scientific challenges in the fields of expertise of the EFARO members. It also addresses some views about innovative ways to structure more efficiently the fisheries and aquaculture research in the ERA. This includes the necessary involvement of stakeholders, particularly the primary producers, in the management frameworks.

The domain of fisheries and aquaculture research addresses implementation issues that cut across the science themes, including modelling, socio-economy, molecular biology, sustained observations and provision for scientific advice. It also covers a variety of peripheral consideration involving scientist contribution, such as the use of research infrastructures, or the implementation of management plan. To achieve a holistic accounting of these internal and external drivers, EFARO proposes to act as a catalyser for more integration. This paper is an attempt by EFARO to synthesize the status of the European fisheries sector and to give and outline of the research needs. EFARO considers this to be a subject for discussion and dialogue.

EFARO hopes this attempt to be the initiation of a long lasting process, which would continue with the help of the European Commission, e.g. under the ERA-NET framework.

Maurice Héral
Director for Programmes and Strategy of Ifremer
EFARO President
MUTFISHARE Coordinator

Current status

Status of biological resources: seafood production and demand

Externalities and need for integration concern

Major challenges for the future of fisheries

Challenges for the future of aquaculture

Seafood quality

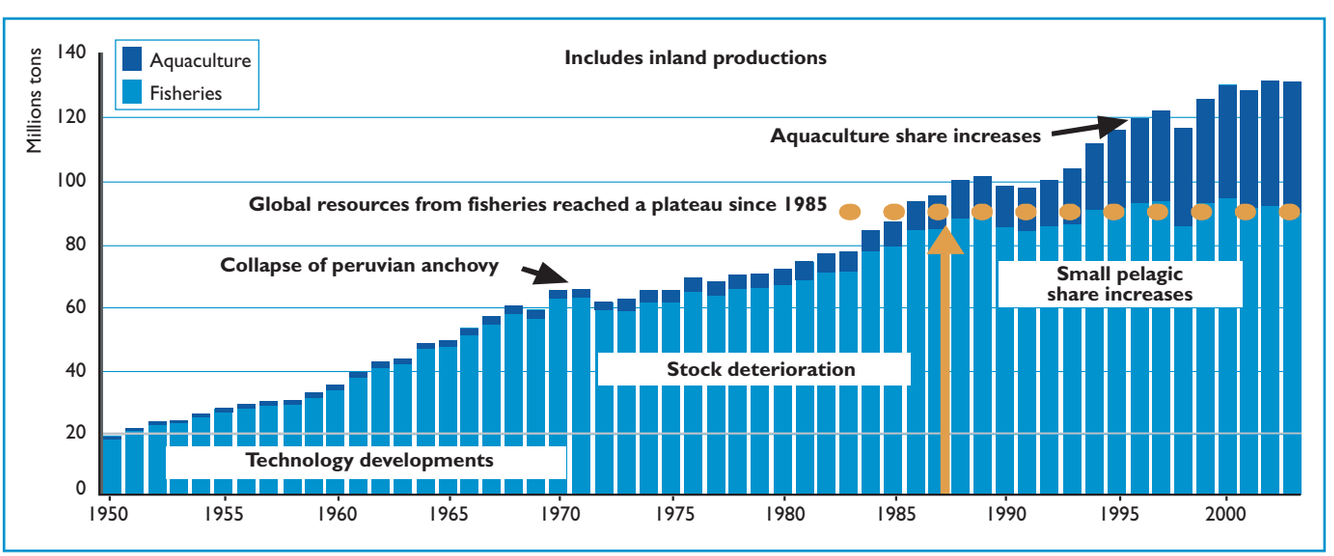
Status of biological resources: seafood production and demand

Production and Trade in the World : key figures

76 % of the world fisheries and aquaculture production are used for direct human consumption (100.2 millions tonnes) which represents 16 kg per capita in 2002 (NB - 28 kg in China, 14 kg in the world excluding China).

This amount is at least 20% of the animal protein contribution for more than 2.6 billions of persons in the world.

During the last ten years, the discard of the fisheries decreased from 27 to around 10 millions tons[1]. Aquaculture provides one quarter of the world total seafood supply. Most aquaculture is freshwater aquaculture, which production is done by small scale enterprises. China alone produce 80% of the



A changing world : the growing role of aquaculture in human food secutity. From FAO: The State of World Fisheries and Aquaculture, 2004.

1. Alverson, D.L., 1998. Discarding practices and unobserved fishing mortality in marine fisheries: an update. Report prepared for the NMFS. Washington Sea Grant Publication WSG 98-06. Seattle, USA, Washington Sea Grant.

total world aquaculture production.

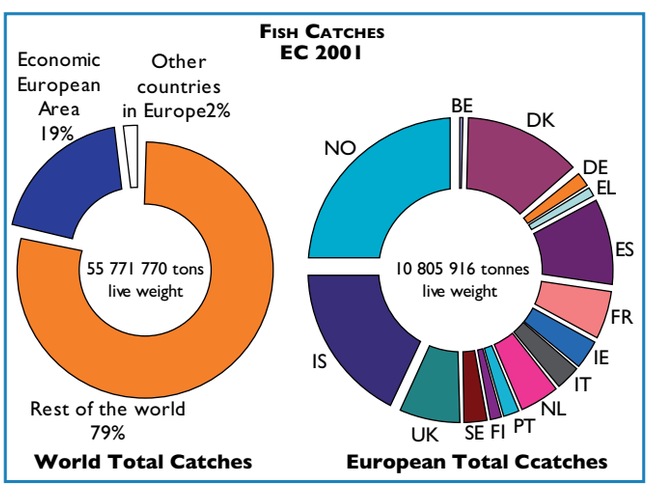
The total world exports in 2002 were 50 millions tonnes, for a value of US $58 billions.

Fisheries and aquaculture represent an income for 38 millions people, more than one third working full-time, 85% of which are in Asia.

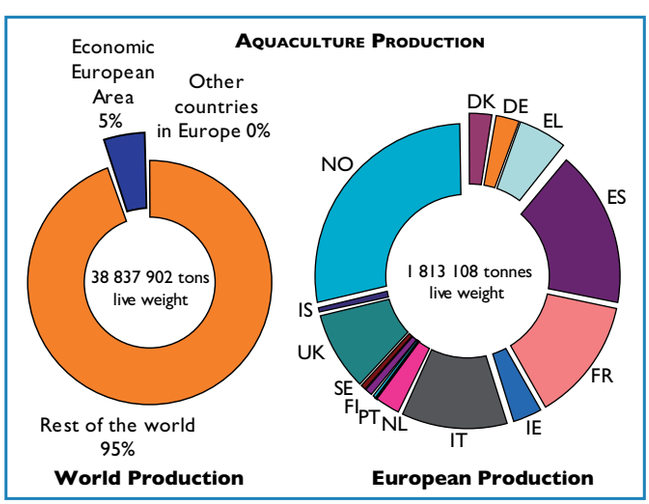
Status in the European Community

Production

The last available statistical data published by Eurostat in 2005 indicated that the EU (25 members) fishery production was in 2003, 7.3 millions tonnes. This includes fisheries and aquaculture in all the world areas, and represents about 5% of the world seafood production. Within the EEA[1] i.e. including Norway and Iceland, the European production reached 12.4 millions tonnes. During the last 10 years (1993 to 2003 the total production in EU-25 declined by 7.6%. In 1995, a maximum yield of 9.2 millions tonnes was achieved which means a global decline of 17% compared to 2003 production. Actually this corresponds to a decrease of 27% of the landings by the fisheries. During the same period Norway increased its global production by 17% and Iceland by 32%.

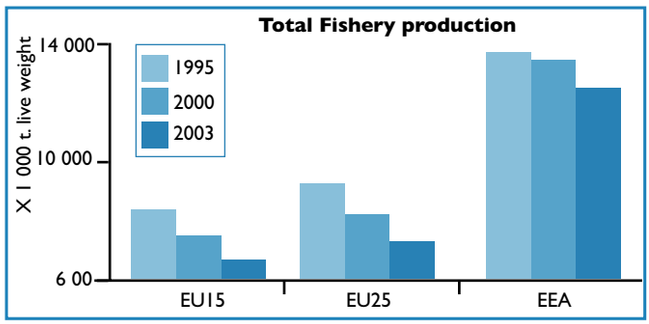


World and European fish catches by countries (excluding algae and shellfish). From FAO.

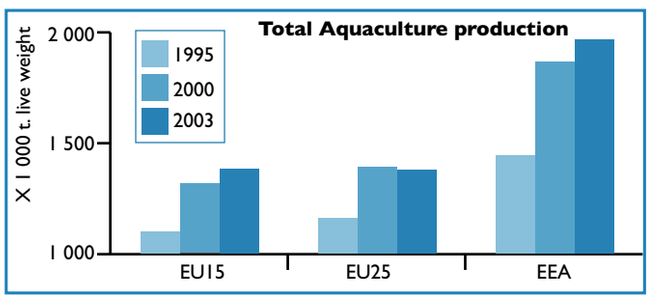


World and European aquaculture production by countries. From FAO.

1. EEA: European Economic Area



European Fishery production. From Eurostat.



European Aquaculture production. From Eurostat.

During the same period, aquaculture production in EU-25 moved from 0.97 to 1.37 millions tonnes representing an increase of 30%. It represented 10% of the total landings in 2003. In Norway that evolution has been tremendous with an increase of 70% mainly due to salmon products.

Values

The value of the fisheries annual landings (first hand value) have been estimated by the EAFE (2004 annual report) to 7,3 billions € for EU-25 and as 9,6 billions € within the EEA.

In the same context (EU 25), the share by aquaculture production was about 3,2 billions €.

Fish processing in the EU is an important activity as the value of this sector is higher than the primary production (fishery landings and aquaculture) averaging about 18 billions € for EU 25.

Exchanges

From Eurostat, in the EU 15, the value of imported seafood increased from 9 billions euros in 1994 to 15 billions euros in 2004. In the same time, the deficit of the seafood trade increased from 3.7 to 5.6 billions euros, representing 3.2 millions tonnes of raw product. The major product which explains this deficit is the category "fish fillet", while the major countries in deficit are Italy, France and Germany. Meanwhile, the average price of the imported seafood increased from 2.2 to 3.2 euros by kg.

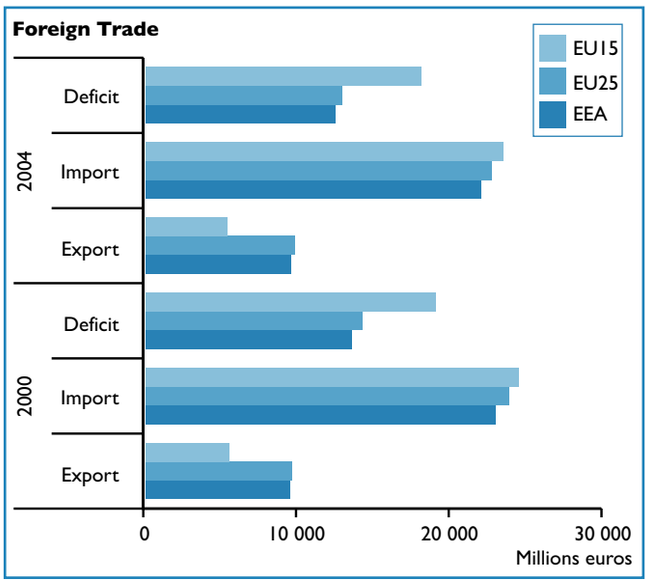
Employments

The fisheries sector employed (in 2003) about 251 700 persons (EAFE, 2004 Report). EAFE estimated 192 000 full time jobs for the EU-25 on 81 300 vessels.

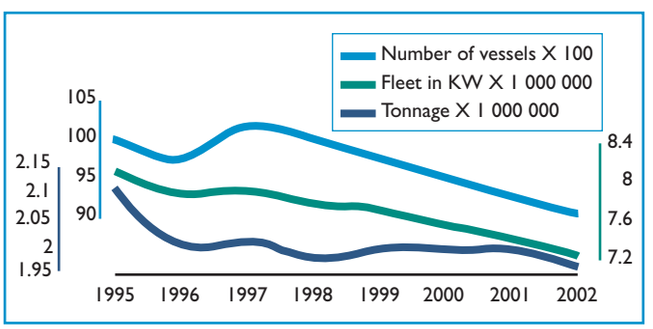
The aquaculture sector employment was 56 400 (Eurostat, 2000) for the EU-15 and is still increasing.

In 2002 the seafood processing sector employed was 135 000 persons (EU-25).

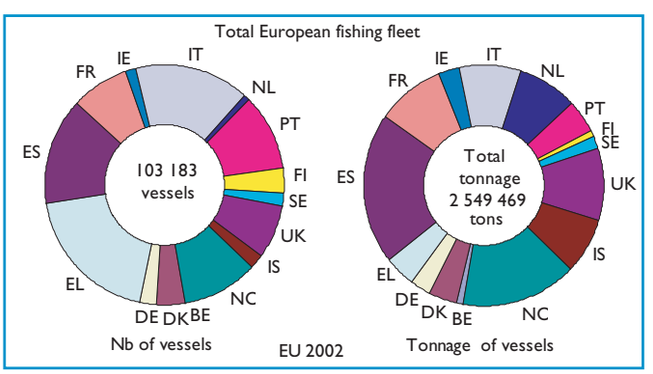
Ancillary industries such as marketing, distribution, shipbuilding, aquaculture food and equipment are a source of employment in coastal regions, but comprehensive studies have not



Deficit of the European trade balance ~ 10 billion €
(import ~ 23 billion €, export ~ 13 billion €). From Eurostat.



Trend for the fishing vessels in Europe. In facts and figures on the FCP, Basic data on the Common Fisheries Policy - European Communities 2004.

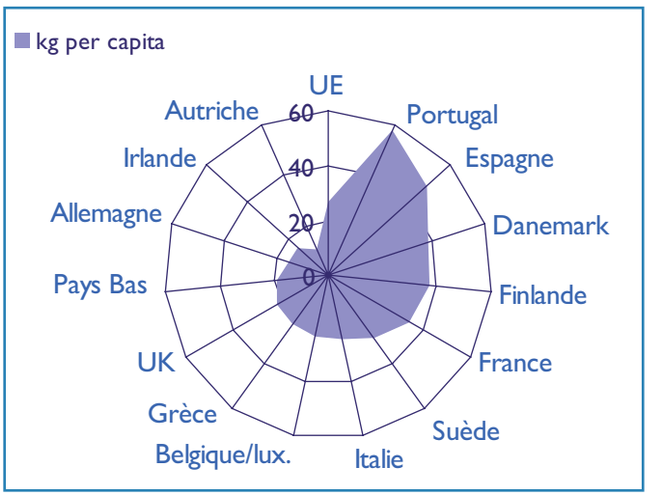


Fishing vessels: tonnage and fleet composition in european countries. In facts and figures on the FCP, Basic data on the Common Fisheries Policy — European Communities, 2004. On statistics provided by Eurostat.

been conducted to estimate their importance in all the EU countries.

Main Facts

Landings in EU-25 continue to decrease, mainly due to the overexpoitation of some important fish stocks. The EU has adopted policies to reduce fleet capacity (10% between 1995



European seafood consumption (kg per capita) in 2002. From OFIMER/P. Paquotte (After Eurostat).

and 2003) by decreasing the number of vessels, their size and their power. In parallel the average price of the fishery products is continuously increasing and the aquaculture (which represents 43% of the value of the landings) is going on this expansion for high value species such as salmon, oysters, seabass and seabream. As consumption and demand are still high (24.5 kg by habitant by year in EU-25), in relation with the high quality of the products and their human health effects, the processing industry remains active and innovative in Europe.

Statements and policy objectives

The **Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem** in October 2001 endorsed the following statement, relevant to the "Planet" :

"Capture fisheries, and particularly their management, bear heavily on food security. The livelihoods of hundreds of millions of people around the world are dependent on fisheries, and for many countries, fish constitutes the main source of animal protein. After decades of successful fisheries developments in most coastal and ocean areas of the world, the rate of increase in fish supplies has far surpassed that of the world population increases. This is a remarkable achievement, as it means that the nominal per caput consumption of fish has never been as high as it is now."

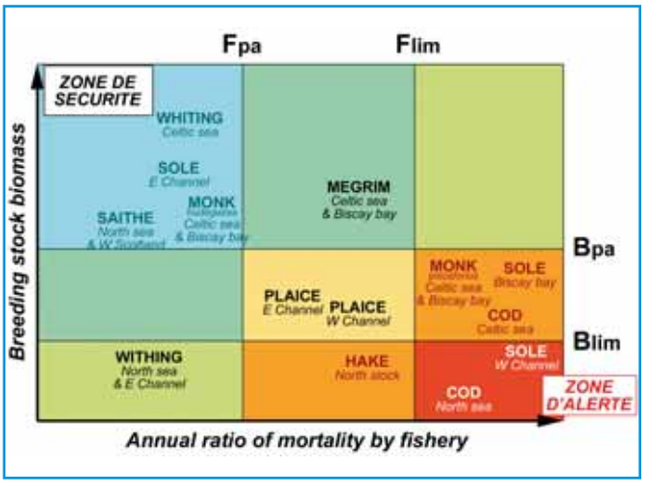
"Despite the fact that the majority of all ocean resources are now fully exploited, access to these resources remains open, or practically open, in far too many fisheries around the world. Consequently today there are too many vessels chasing too few fish."

"Utilizing ever improving technology that, due to its low cost, is becoming available to even small fishing operators, man is really not giving the fish in the sea much chance of escaping from the fishing gear and allowing them time to grow and reproduce."

In September 2002, during the **Johannesburg World Summit on Sustainable Development,** the head of fisheries Ministries approved further a resolution addressing four major issues in a tight agenda :

2005 - Develop and implement national and, where appropriate, regional plans of action, to put into effect the international plan of action for the management of fishing capacity and the international plan of action to prevent, deter and eliminate illegal, unreported and unregulated fishing.

One of the Mediterranean fishing specificity is the species diversity of landings. Sicily market. (Mediaqua/J.-M. Deslous-Paoli).



Levels of marine fish stock exploitation. (from ICES, 2002). (http://www.ices.dte/iceswork/acfm.asp).

2010 - Encourage the application of the ecosystem approach.

2012 - Develop and facilitate the use of marine protected areas consistent with international law and based on scientific information, and time/area closures for the protection of nursery grounds and periods.

2015 - Restore stocks to levels that can produce the maximum sustainable yield with the aim of achieving these goals for depleted stocks.

The Common Fisheries Policy of the EU in its late reform (2003) and the proposal for a Marine Strategy (2005) incorporated these concerns to comply with global policy objectives, which would probably be intensified after the implementation of the Marine Policy under the Green Book in preparation by the EC.

How to face an increased demand in a sustainable way

With declared current catches of about 100 millions tonnes per year, including discards, fisheries have most probably reached a plateau since a decade. It is expected that the wild fish stocks in the ocean will not be able to produce more. On the contrary, aquaculture is one of the most expanding activity in the world, but its continued development is not guarantied, particularly in cases where aquaculture is relying on wild stock production (e.g. for feed). It is expected that in 2030 world aquaculture would produce 80 millions tons per year (FAO, 2004[1]). To get more food from the oceans, a better use of natural resources is required, which must include i.a. allowing over-fished stocks to recover, avoiding wastage, making renewed efforts in better management of fisheries and accompanying aquaculture growth. After a century of geographical expansion followed by technical intensification, the effective management of fisheries need to enter a new era. In this respect, aquaculture activities follow the same trends and are already facing the same obligations, e.g. the focus on sustainability, environmental impact and food safety in a global market.

This means for fisheries and aquaculture sectors to develop capacity for supporting research and management, allocating specific exploitation rights (particularly in the context of coastal zone management for aquaculture and small scale fisheries), improving monitoring control and surveillance, and improving reporting of production data.

The role of science

One of the major challenges the research institutions have to face is to provide explanation and innovative solutions. This is of particular relevance when stakeholder confidence in existing assessment and management models is declining. There is a need to focus on methods and models. These include fleet interactions, geographical differences, as well as the impact of the environment on fish stocks and the impact by fisheries on the ecosystem.

New approaches and models are also required to communicate complex insights effectively to the increasing number of stakeholders involved in the decision-making process (e.g. by the development of efficient partnerships between public research and research by the industry). This addresses particularly the two following fields :

- social and economy sciences which enter in a new paradigm where they have to deal together with the same object rather than looking at it separately;

- ecosystem based management, which considers all human activities affecting the ecosystem, in a particular geographical area.

Externalities and need for integration concern

Fisheries and aquaculture contribute significantly to the European food sector economy and provide important parts of the diet and quality of life for the people in the European Union. Not only this is achieved through the direct consumption of fish and shellfish, but also by the use of fish meal for other animal protein production in agriculture (actually 75%

1. FAO, The state of the world fisheries and aquaculture 2004

of the fish meals are used for poultry and pig productions). Both fisheries and aquaculture rely upon renewable and natural resources. In this respect, sustainable environmental interaction is a prerequisite for future growth. As well, fisheries and aquaculture are clearly important economic activities with a strong impact on both nutrition and health issues and environmental aspects of quality of life.

Management of competing claims for the use marine resources and space

This is an on-going process, with new and constant ad-up, but the main concerns are still confined to the role of the environments. In the recent proposal by the EC for a Marine Strategy, fisheries are considered as one of the major threat on the marine environment. In this regard, the key points are:

- Fishery starts with the exploitation of fish stocks and living aquatic resources. The main strategic component from a biological and natural perspective is to comply with the impact of climate (including long term evolution) and environmental drivers on the living resources, and the ecosystem response to fishing. The aim for the fishing industry is to anticipate changes and to incorporate new practices for achieving sustainable exploitation levels that provide sufficient production yields. The aquaculture sector is similarly confronted with the same constraints, aiming at balancing high yields and healthy aquatic products, with the lowest possible environmental impact.

Fisheries are concerned with both macro-economic and micro-economic aspects of fishing. This includes investments in vessels and other facilities, their profitability, limited flexibility, and – on the micro economic scale - fishermen responses to management measures such as closed areas. In recent years, social aspects impacted the sector of fisheries, with the necessity to encompass decision rules other than economic. This includes subjects such as:

- acceptance of new governance and management rules;
- higher involvement of stakeholders in the management process.

- Both fisheries and the aquaculture industry use the marine areas and are in this respect competing with other uses of the marine resources and space. Competition with recreational uses involves many of the same concerns requiring low environmental impact, such as limiting catch of marine mammals and securing food for marine birds in certain areas. For the aquaculture industry similar questions are at play, but additionally the design and visual aspects of the marine constructions and its interference with tourism and recreational use can cause problems. A systemic approach is more and more relevant to address these issues.

- Competition with other commercial activity will in general involve the same questions as environmental impacts on the living resources. Energy productions and ship traffic reduce the habitat for fishing and aquaculture. Noise and potential harmful substances from these productions can interfere negatively with fish recruitment. Similarly eutrophication from agriculture production on land and pollutions from urbanisation will modify the marine ecosystem, and consequently will impact the fisheries and aquaculture sectors.

Coastal zone management

Concerns, actions and advices addressing activities in the marine area – e.g. fisheries and aquaculture, tourism, energy production, sand and gravel extraction – are currently focused on their own "one dimensional" sector.

It is widely accepted that to stimulate and enforce the current move towards cross-sector and cross-institutional initiatives, to provide a holistic platform for a rationalised exploitation of the marine resources, a step further for the management of coastal areas is required.

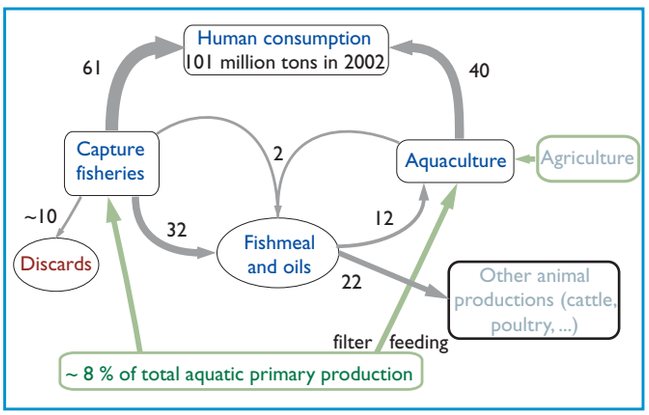
The linkage between the natural system evolution (generally degradation) and economical/social unbalancing to political pressures is a key issue to sustainability, particularly in the coastal areas. These are the most important areas of human habitat exposed to social and economical threats. Progress are still to be made in order to understand and predict the response of natural systems and human development to management decisions, i.e. the knowledge based approach. Fisheries is one of the most interesting case study in this respect, and EFARO is committed to supporting the necessary scientific developments.

Onshore uses, such agriculture, industry and urban development could interact with fisheries and aquaculture (Mediaqua/J.M. Deslous-Paoli).

Other uses, such as sporting hunting, fishing, sailing or protected areas can enter in concurrence with traditional fishing (Mediaqua/J.M. Deslous-Paoli)

Major challenges
for the future of fisheries

Fisheries are still important sources of food security, employment and other economic benefits. Their preservation is a world wide stake.



Share of food and non-food fish products by capture and aquaculture world biomass fluxes. 2002 estimate (million tons live weight per year). Ifremer/P. Gros adapted from R.L. Naylor et al., Nature (2000) and FAO (SOFIA 2004).

Sorting of fish for data collection during a program of stock evaluation. (DFU/J. Astrup).

Balancing the capacity of fisheries with stock natural renewal

Declining yields, shrinking stock biomass and uncertain profitability are characteristics common to many commercial fisheries. In those that are unmanaged or managed as *de facto* open-access fisheries, the race for fish tends to create a fishing capacity that is larger than that needed to catch the "sustainable yield". Over-capacity develops in the form of over-expanded harvesting (and processing) capacity. This capacity generally leads to over-fishing. Over-capacity and management capacity have become key issues for fisheries management in the new millennium. Over-capacity and over fishing are really symptoms of the same underlying management problem – the absence of well-defined property or user rights. Other than that, important issues are the effort to improve monitoring control and surveillance as well as fisheries data collection and reporting.

Improve management and governance

European fisheries management is under pressure. Stakeholder confidence in existing assessment and management models is shaken, including fleet interactions, impact of the environment by fisheries and vice versa. The challenge is to provide the best possible synthesized knowledge and made it available to decision-makers. New models are also required to communicate complex insights effectively to the increasing number of stakeholders involved in the decision-making process. Article 10 of the UN Fish Stocks Agreement includes the obligation for states to "agree on decision-making procedures which facilitate the adoption of conservation and management measures in a timely and effective manner". In this context, decision-making procedures are not confined to a voting formula but could involve a variety of inputs such as research and development with broad participation of stakeholders in specialized instruments (e.g. Regional Advisory Councils).

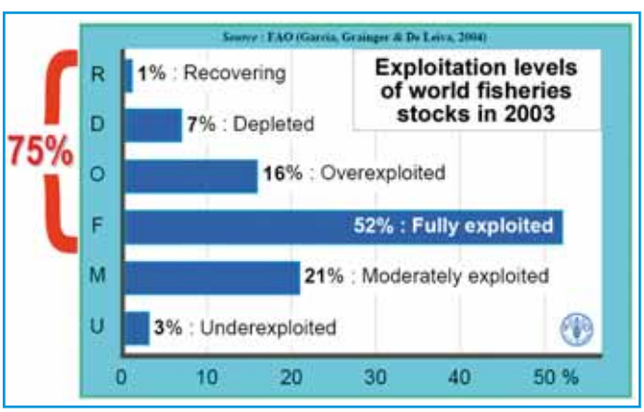
Fishery management is largely based on annual fish stock assessments. Owing to the uncertainty inherent in annual estimates of the stock size, fish quotas set on such a basis will be variable. This makes planning for the future difficult. Multi-annual assessments, that incorporate biological and socio-economical considerations, will help improve the decision making process for medium to long-term planning. Within the context of marine fisheries management, challenges that have been highlighted by the MUTFISHARE project include:

- the more effective translation of social, economic and biological information into concrete fishery management policy in which objective policy frameworks and performance criteria are given priority;
- the more explicit recognition of access rights in both artisan/small-scale and industrial fisheries so as to reinforce management input and output controls;
- the management of fleet capacity and the clarification of the role of industry subsidies which may distort production arrangements;
- the strengthening of monitoring, control and surveillance as a means of ensuring that agreed fishery conservation and management measures are implemented effectively, speedily, and as intended;
- pro-active support, possibly though the provision of objective and competent advice, research and training, to facilitate efficiency and competitiveness within the industry privatization initiatives.

However, it is important to note that, in the absence of agreed performance indicators for self-evaluation, it is difficult to establish a correlation between strengthening governance in terms of decision-making and effective fisheries management. One of the indicator could conceivably include the evaluation of decision-making authority and process. In some way this is also the case for the integrated coastal zone management.

Better use of biological resources

Reducing fishing effort has been the main measure for recovery when the stock has been depressed by over-fishing. The progressive reduction of fishing, for example through a reduction in total allowable catches (TAC), has generally been the first choice. However, because of the cost and difficulty of reducing fishing capacity to the level of harvest compatible with stock recovery, these actions have often been insufficient and slow while catching efficiency and the real fishing effort of the sector increased. To this end, measures such as season closures, mutual moratoria, TACs and QUOTAs have been the main tools for fisheries management and stock rebuilding but the effects vary based on the stocks and geographic areas in question. Recently closed or protected marine areas have been used as tools for recovery plans. It is obvious that recovery plans will have significant costs both in the form of recovery expenses as well as socio-economic repercussions to the stakeholders involved with the particular stocks.



Over 75% of the natural fish stocks in number are fully or over exploited. (FAO, 2004).

Artificial Reefs (marine habitats) kheops (9 months after immersion)(www.kheops-m.com) deployed by Hydro-M in the Côte Bleue marine park (South of France) in September 2005. Artificial reefs are spots of deep-sea diving and can also be used like passive protection against trawling. (Hydro-M/C. Barthélémy).

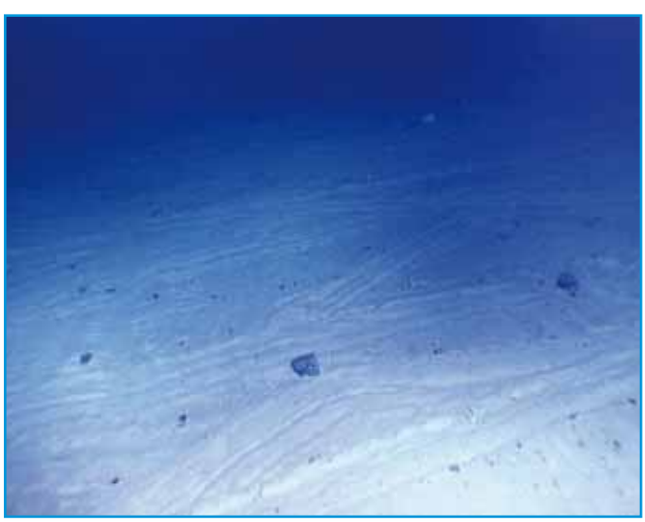
The problem of over fishing was recognized by the first FAO Fisheries Technical Committee in 1946 and confirmed during many other events. Most of the stocks considered depleted are found among the demersal stocks in the Northeast Atlantic, the Mediterranean and Black Seas. They are in the greatest need for recovery. The measures needed for stock rebuilding are not different from depleted stocks:

- the reduction of mortality through reduction of effort, including moratoria when they are unavoidable, and by catch reduction;
- the reduction or elimination of environmental degradation, including the use of marine protected areas;
- the enhancement of increase factors, for example through stock enhancement and habitat rehabilitation.

Environmental degradation

EU fish stocks have been declining for years. Fishery policies have not managed to halt the drop and have not provided enough environment protection from the associated damage to marine ecosystems. The reformed CFP now provides tools for the progressive implementation of an ecosystem approach to fisheries. The later have to encompass the consideration of anthropogenic impacts other than fisheries. Two examples illustrate these issues :

- in the estuaries water quality impairment and dredging have modified extensively the quality of nurseries and the recruitment capacity of the habitat. In the same context, anadromous species are under threat.
- global warming should impact on fish behavior and migration patterns, displace nursery grounds, and change the food web features.



Trawling marks on a soft bottom. (Ifremer/P. Gros)

Challenges for the future of aquaculture

Aquaculture is a very dynamic activity in Europe and associated countries. Its growth rate has been around 4% during the last decade. It represents around 70 000 direct jobs in EU 25. The major stakes that European aquaculture has to face are embedded in the concept of sustainable development. In practice, this addresses the achievement of process and methods

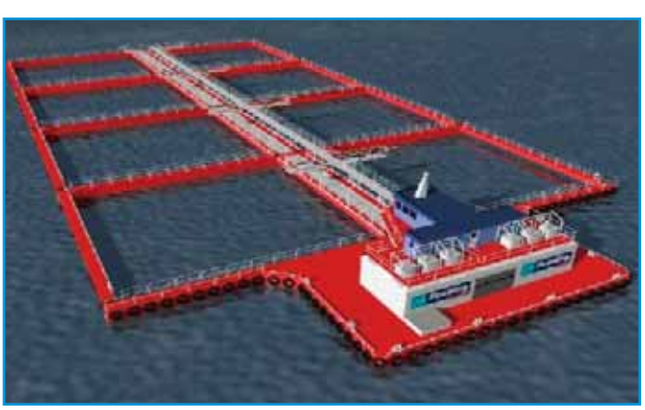
directed to a better use of natural resources, including fishing for fish meal, a better protection of consumer health while preserving the competitiveness of the sector in a global and open economy.

Aquaculture characteristics

Being concerned with both marine and freshwater environments, European (EU 25 plus Norway and Iceland) aquaculture is characterised by:

- the focus on a limited number of species being raised at industrial level (oyster, mussel, salmonids, sea bass and sea bream) when the market demand is for a more diversified offer;
- the environmental constraints due to the global pressure on the coastal zones, and to the shortage in available biological resources (e.g. fish oils) which call for improvements in technology (e.g. extensive polyculture systems, offshore facilities and recirculating technology) and in production factors (e.g. fry, food, vaccines, …);
- the increasing demand by the internal market for high quality and/or labelled products;
- an image of healthy products, close to the nature that needs further objectivity and transparency;
- an increasing competition for market share, particularly confronted by importation from low revenue countries, which should lead to a greater consideration to cost composition (e.g. the cost of fossil energy, impact of mechanisation) and macro-indicators (life cycle of products, employment).

The increase of price due to overexploited natural stock has induced the development of the cod aquaculture. (Ifremer/S. Lesbats)



New Open sea fish farming technology is one of the futures for aquaculture. (SINTEF/Fredhiem)

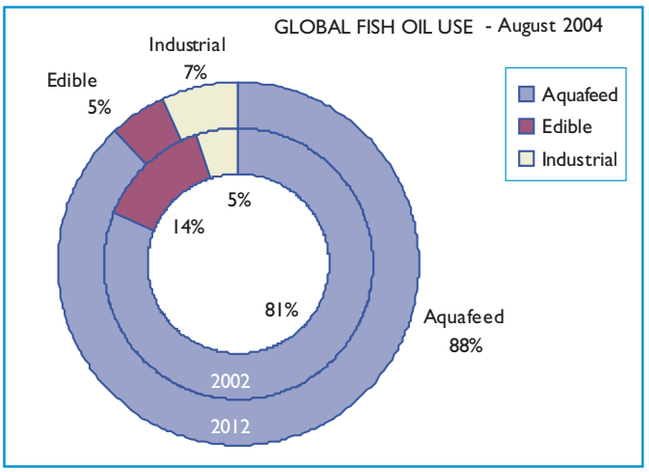
Mussel aquaculture colonized new off-shore spaces with the development of long-line techniques. (Ifremer/J. Barret).

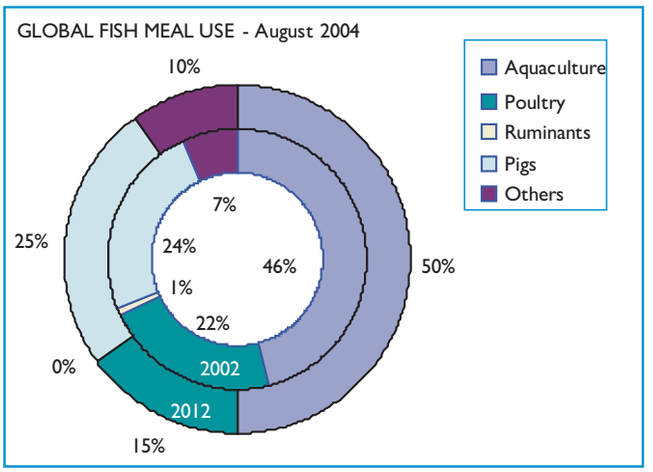
Some specifics can be added with consideration to the farmed species:

- shellfish farming, relying directly upon natural resources, is facing original problems. Shellfish rearing are subject to various risks (toxic algae, microbiology, pollutants), and is directly related to the expectations of society in terms of safety and food quality. Traditional activities should accommodate even more restrictive European standards, which lead to greater domestication (hatcheries, purification basins, genetic selection, etc) and higher requirements in terms of the microbiological quality of inshore waters;
- other marine aquacultures (fish farming, shrimp farming) are growing steadily through the world and, in particular in the tropics. Quality and traceability requirements (including when addressing imported goods), the risks of epizooty (including those from trade of live animals), the environmental constraints on genetic issues deriving from selective breeding programmes are increasing everywhere. The question of the food supply to carnivorous species may slow down the development of this industry.

Sustainable development of the aquaculture

The European Union policy for aquaculture is presented in a strategic document which calls for effort to be undertaken by both industry and research to address these challenges. The implementation of this strategy for the sustainable development of European aquaculture requires an increased effort from the research as an essential step to support the sector and to enable its integration in the coastal zone and its competitiveness in a global open market. There is a clear need for scientific support to aquaculture within the scientific areas of the Community Framework Programmes, like health and environmental issues – including cleaner technologies, new species, fish feed improvement, impact of genetic improvement on the sector, and product quality and safety (see also page 21). Europe may play a leading role in the world, (particularly when addressing shellfish production), which is driven by European directives (water framework, bird, habitat and shellfish water directives). But this will require further research (e.g. toxins from phytoplankton, bio-accumulation of environmentally linked pesticides and heavy metals, pathogens…).





The share which the aquaculture will take in the use of fish oil and meal will have to increase in the future. (Source IFFO, 2005).

Interaction between industry and consumers

The dynamism of the sector should enable a very profitable interaction between the research operators and the industry. This interaction calls for additional concern and effort to ease the transfer of knowledge and the development of shared research activities.

These actions should be built on a total value chain approach, including aspects of live fish traits and the impact this will have on harvesting operations, processing and the quality of the final consumer product. The today's consumer and public need better and clearer information, which calls also for a greater responsibility by the scientists when proposing new avenues for research.

Sea bass larvae feeding on micro particles. (Ifremer/C. Cahu)

Seafood quality

The breakdown of apparent consumption per capita between fish and shellfish in kg/year (MASMANAP calculations in equivalent landed weight from average data 1997/1998)

	Spain	Portugal	France	Italy	Greece*	UK	Germany*
Fish	35	40	19	18	20	15	15
Shellfish	16	6	10	8	4	2	1
Total	52	46	29	26	24	17	16

* Breakdown fish/shellfish only known for aquaculture production

The European citizen becomes more and more a consumer of seafood. Seafood is considered as healthy and nutritious. Moreover it contributes to the requirement for more variation in the diet.

The consumers trust in safety and quality of the seafood that is offered on the market is crucial. For that, new concepts of transparency are required and innovative consumer driven seafood production is necessary to satisfy the needs and expectations of the European consumers.

Parts of the consumers are also critical with regard to the environmental and animal welfare aspects of seafood production. Therefore the license to produce requires more and assured environmental and welfare care in sustainable fisheries management and aquaculture.

With respect to seafood, the consumer in the European Union is concerned with the following five important issues:

- Seafood safety;
- Impact of seafood on consumer health and well-being;
- Nutritional value and consumption quality of seafood;
- Convenience of acquisition, handling and consumption of seafood products;
- Sustainable, traceable and animal friendly seafood production.

Healthy

In the near future, seafood contribution to reducing the incidences of chronic disease will be of utmost importance for the two sectors (i.e. aquaculture and fisheries). The production of functional seafood with high levels of insaturated-fatty

Gustative comparison of oysters during a "slow food" manifestation in Montpellier. (Mediaqua/S. Maldonado)

Herring conservation in ice. (DFU/J. Astrup)

Sea food consumption is mainly the fact of processed products. (Ifremer/Y. Harache).

acids, fish proteins and other health-promoting nutrients is a challenge for the future. The exploration of the potentials of marine biodiversity in terms of metabolic products of high value (pharmaceuticals etc.) is still in a very early stage and needs more fundamental research.

It has became clear that seafood lipids are protective in the prevention of chronic nutrition related diseases, e.g. cardio vascular and inflammatory diseases, and a major challenge is now to validate the underlying benefits. The protective effect of seafood in relation to certain forms of cancer needs further focus on the importance of seafood lipids or proteins. Understanding the impact of other important nutrients from seafood (amino acids, peptides and trace elements) on the health of consumers will have huge impact on the consumption profile of European consumers.

Consumer protection (toxicity, disease)

Food safety concerns require a better understanding of pathogenic infectious diseases, biotoxins and toxicant contamination. The restricted availability of seafood resources require the maximal use in terms of valorization of by products, i.e. in fishmeals and oils, or even in non-food applications.

Most consumers consider fish healthy and nutritious. Even so, some European countries experience a trend towards declining consumption of fish. A further in-depth analysis of European consumer behaviour related to seafood should be initiated with focus on specific issues like sustainability and the image of aquaculture production systems. Product development based up consumer's perception, expectations and preferential behaviour should be developed and must be consumer driven. Special attention should be focused on two populations of seafood consumers 1) younger people and the effects on their long-term health, 2) immediate health effects of consumption of seafood in elderly people.

Development of marketing processes

Both "slow" and "fast" food movements can be provided with tailored healthy seafood, and can lead to a higher price for value. These concepts will lead to more diversification and economic profit in seafood production and marketing.

It is to the European policy to improve the European seafood production in a direction that is meets the requirements and interest in seafood, in order to become less dependent from import of seafood from elsewhere (China, S.E. Asia, Chile)

Some questions which remain under debate :

What competitiveness do we have in Europe, versus SE Asia and Africa? What would remain as an activity in the EU OO?

What type of product would the E.U. sector produce (impact of technology, new products to comply with the market demand) ?

How to ensure the provision of product from E.U. fishery and aquaculture?

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Priorities in fisheries and aquaculture research

Introduction

Historical perspective

There is a long tradition of international joint fisheries research in the North East Atlantic, under the auspices of ICES, based on interlinking national research activities. Not all EU members are associated with ICES (North Atlantic Region, including Canada, USA and Russia). Similar, but not widely supported, programmes have been in place for the Mediterranean.

In addition to the national programmes, the EC stimulated European joint research since FP4, in order to support the European Common Fisheries Policy. During FP4 and FP5, specific research programmes in fisheries and aquaculture (e.g. FAIR), accounted for respectively 130 and 150 m€. In FP6, the resources allocated to fisheries and aquaculture research has been reduced to 60 m€, mainly in a special priority for Scientific Support to Policies (SPP; Priority 8)) and some areas under the priorities 5 and 6 (Food Science and Environmental Science). The European Parliament decided in 2003 that additional resources were needed for the improvement of scientific support to fisheries policies at the European level.

A sharp decrease in resources allocated to fisheries and aquaculture research is visible from the FP4 to FP6 included. There is no doubt that this tendency is highly prejudicial to any ambitious development of an ERA on these issues. It would be discouraging to see no reversal in this trend in FP7 when fisheries and maritime policies are more and more under European responsibility.

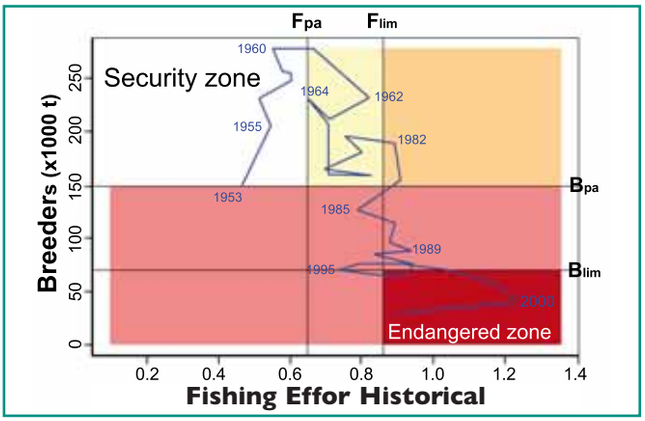
Long-term fishery management strategies

Since fishery management in Europe is historically based on stock assessments provided annually, given the uncertainty of estimates of the stock size, annual quotas are frequently variable from year to year and may have huge impact on the activity of the sector. In addition it makes management plans at risk. A multi-annual management strategy is needed and, to be effective, this requires the commitment of managers and the compliance of stakeholders with agreed strategy. Multi-annual assessments that incorporate biological and socio-economic considerations will help improve the decision-making process for medium- to long-term planning.

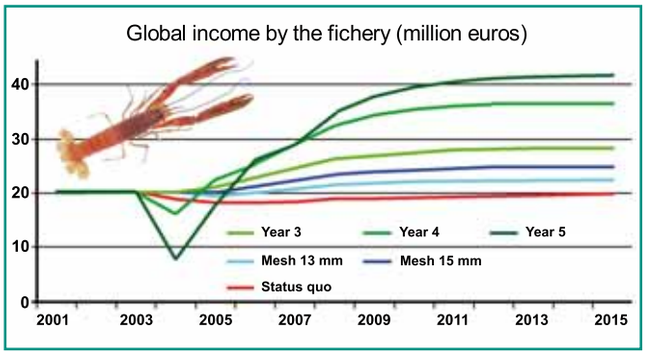
EU fish stocks have been declining for years. So far, fishery policy have not managed to halt the drop sufficiently and the preservation of the marine ecosystem is still questionable. The EU's Common Fisheries Policy (CFP) now provides for the progressive implementation of an ecosystem approach to fisheries management.

Environmental and socio-economic effects of aquaculture

Aquaculture continues to expand across Europe, often bringing benefits where traditional employment is in decline, but also posing threats to the natural environment. There is again potential for conflicts between the aquaculture sector and other coastal users. Although research has been conducted on these topics, relatively little of that information available has been drawn together to provide best-practice guidelines of general applicability across Europe. This remains a need to develop an understanding and predictive capability in the European ecosystems where aquaculture is practiced.



Cod stock collapse in the North sea is due to over fishing. (Ifremer/ P. Gros).



Bioeconomic simulation of the effect of fishery management on *Nephrops norvegicus:* final revenue increases after an increase of the mesh or year class. (Ifremer/C. Macher et al.)

Landing of fish at an auction plant (Ifremer).

Externalities and need for integration concern

Fisheries - Introducing socioeconomics in a more integrative way

Socio-economic issues must be integrated in the traditional scientific advice (Annex C-2. recommendations R5 from Gdynia workshop) based primarily on fisheries biology, technical questions, ecosystem functions and environmental interactions. This requires collaboration across many fields and must induce interaction with large stakeholder groups. An integration of the social and economic dimensions into the CFP should take place both in relation to governance and the impact. In relation to governance, there is a need to understand how the legitimacy and efficiency of the CFP can be improved through better linkages to coastal communities, regionalisation and how economic and market forces can enhance fisheries management (1). In this respect, the ways to optimise the fisheries production can not be independent from downstream production perspectives. There is a need to enhance the understanding of the social and economic impacts of fisheries management both in relation to the industry, the local communities and in relation to national economies and the community (Annex C-2. recommendation R3 from Gdynia workshop).

Promoting multidisciplinary research focused on merging ocean sciences, fisheries biology and social sciences will also require the integration of economic data in coherence with the data bases developed for stock management:

- Bio-economic modelling should be promoted to determine the economic consequences of proposed management measures and to assess the efficiency of economic incentives to promoting long-term sustainable fisheries (Annex D-2. recommendation R1 from Thessaloniki workshop). The likely geographical scale of these studies is regional, with substantial input from RAC's and stakeholder organisations;
- With respect to social science, the institutional and societal aspects of the scientific advisory process, management formulation and implementation as well as enforcement and control processes and their impact on the functioning of fisheries management need to be studied (Annex D-2. recommendation R2 from Thessaloniki workshop);
- Legal aspects related to the property rights when resources are common, along with the way to allocate the fishing efforts must be revisited, including the various level of management (European, national, regional). Comparative analysis of governance mode of various management plans, including various level of incentive (Annex B-1. recommendation R6 from Berlin workshop) could provide analysis to find the best methods to involve fishermen and other stakeholders in the most valuable dialogue;
- Social impact assessments need to be conducted before implementing major new fisheries management measures or change of entire management systems (Annex D-2. recommendation R1 from Thessaloniki workshop);
- The triple-P bottom line, Profit-Planet-People (see page 48), has to be made operational for fish production chains (Annex D-2. recommendations from Thessaloniki workshop).

Aquaculture – ICZM and Socioeconomic aspects

A systemic analysis will enable identify the major determining factors for the harmonious integration of aquaculture activities within the context of the integrated management of coastal areas. Such descriptive variables (biological, economic, social), in a generic ecosystem approach (Annex B-1. recommendation R13 from Berlin workshop) should establish durability criteria on robust indicators.

Socio economic aspects are not properly covered, and need increased effort to better understand and better integrate aquaculture in the decision process and management. These

1. OECD, Recommendation of the Council on: The use of Economic Instruments in Promoting the Conservation and Sustainable use of Natural Resources. Endorsed by Environment ministers on 20.04.2004, adopted by the OECD Council on 21.04.2004.

Monitoring of the environmental quality by automatic recording from MAREL buoy. (Ifremer/O. Dugornay).

GIS systems allow the display of complex relations between sea areas used for different purposes, or with different designations. An important aim of coastal zone planning is to minimise any potentially adverse interactions between established activities such as fishing and "new" activities such as aquaculture, renewable energy developments or ecotourism and thereby optimise the use of valuable coastal resources. (FRS Marine Laboratory/ I.M. Davies).

evaluations must rely on reliable sets of socio-economic data (Annex D-1. recommendation R1 from Budapest workshop). The analysis of risks according to the precautionary principle should combine with this evaluation, together with an assessment of "externalities".

Fisheries management

In the stakeholder consultation for the development of the FP7, EFARO has formulated the following priority actions. recommendations were made in 2004 to the EC – DG "Fisheries & Maritime Affairs", in 2005 to the European Parliament.

Organise Data collection, including databases

The assessment of the validity/quality of fisheries data reported coupled with operational Vessel Monitoring Systems (VMS) and other automatic recording system (e.g. electronic logbooks) would make data more useful for input in predictive models and to implement regional management. In this

Assessment of the validity and quality of fisheries data to be input in predictive models is of first importance to implement regional management. (DFU / J. Astrup).

regard, enforcement of regulations addressing data collection should include (Annex C-3 recommendation from Barcelona workshop):

- close cooperation with the fishing industry to ensure active participation and compliance;
- rapid processing and quality assurance of collected data at national level;
- transfer of data into operational international databases hosting the data at a sufficient temporally and spatially resolved level for close to real-time monitoring as well as ad-hoc and longer-term fisheries management purposes;
- increase the confidence in the data collected through better cooperation with the fishing industry.

A clue would be a better coordination of national fisheries data collection and environmental monitoring programmes to establish a foundation for an ecosystem approach to fisheries management (Annex C-3. recommendation R2 from Gdynia workshop) and ensure optimal utilisation of resources devoted to monitoring. Databases allowing linkage of fisheries and environmental data need to be designed and implemented in a sustainable way in accordance with the objective of the Strategy on the Marine Environment in which the data Collection Regulation under the CFP is embedded (Annex C-3. recommendations from Barcelona workshop) over long periods.

For both aquaculture and fishery products, in order to maintain the positive image of fisheries products, and to address the protection of the consumers, monitoring should also consider the quality and safety of fish products and enhance their traceability (Annex B-1. recommendation R15 from Berlin workshop).

Improve Scientific Basis

Current fish stock management systems need further development. The objective to developing a holistic fisheries management approach focused on conservation and sustainable fisheries management must be maintained across all the research initiatives. This requires methods to evaluate the function and efficiency of existing and alternative fisheries management systems taking into account the ecological, technical, socio-economical and political processes involved, i.e. from biological production to stakeholder acceptance of introduced management measures. This will also addresses recreational fisheries. Understanding the interplay between these processes is a prerequisite for:

Fisheries data base (Ifremer/Patrick Berthou).

- the formulation and evaluation of management targets at regional level and harvest control rules in a multi-annual management framework (Annex C-2 recommendation R4 from Gdynia workshop);
- the successful implementation of new technical management measures (Annex C-2 recommendation R6 from Gdynia workshop);
- changes of entire management systems, e.g. from an input control system to output.

Subsequent actions should be:

- Prepare the implementation of the ecosystem-based approach to fisheries management;
- Reinforce quality in data collection, control and monitoring
- Interactive communication with stakeholders and the public.

The actions address ecological, social, economical, control and communication aspects, and they should integrate their findings. To facilitate this concept, an improved understanding of the dynamics of marine living resources and their exploitation is needed. Multi-species, multi-fleet and regional management tools should be developed to predict the multi-annual dynamics of fish stock and fisheries by metier with sufficient precision and, at the same time, generate information needed for adaptive changes in management at short time scales and at regional scale. Increased coherence between geographical dimensions has to be taken into account to increase the relevance of management scenarios (Annex C-3. recommendation R1 to R8 from Barcelona workshop).

Methods should include:

- a variety of input and output based management mechanisms including TACs, effort control, technical measures, marine protected areas, longer-term capacity control and institutional adjustments;
- fishing technology, fishing practices, social impacts and economic drivers and a higher relevance of these inputs in relation to management measures and decision process.

Methods should furthermore:

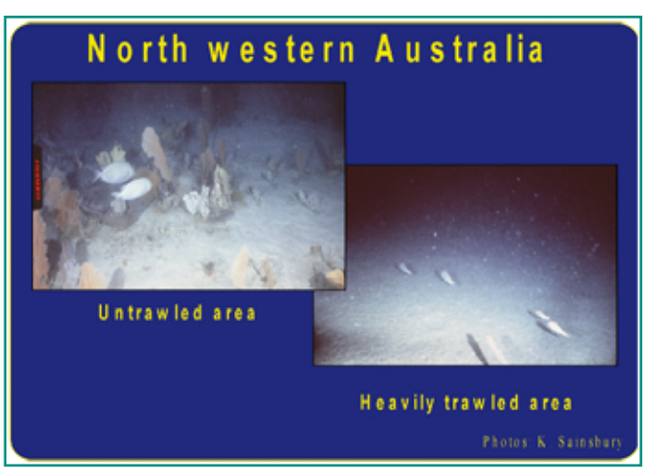
- generate quantitative estimates of uncertainty in stock and fisheries assessments (Annex B-1. recommendation R4 from Berlin workshop);
- facilitate the use of multiple and semi-quantitative data from the industry, (Annex B-1. recommendation R3 from Berlin workshop);
- allow for data poor situations, e.g. in deep-sea fisheries.

Implement Ecosystem Approach

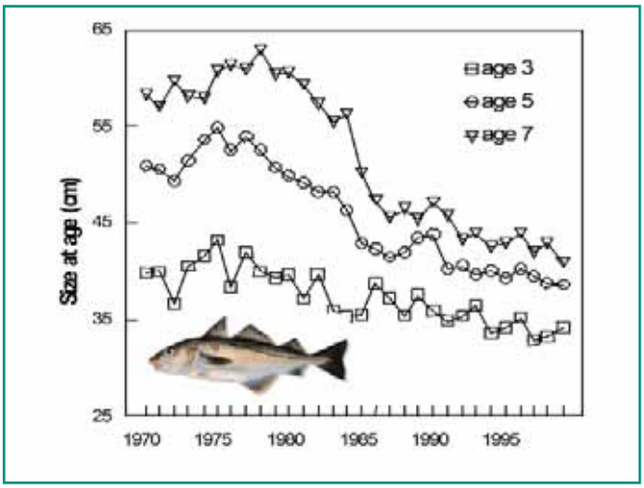
The next decade will see the full implementation of an ecosystem-based approach for fisheries management. This will require the implementation of a range of new management tools such as no take zone, marine protected areas, innovation in reduction of fishing effort, …, and supporting science, not previously employed in the quota based, TAC dominated, approach of the EC Common Fisheries Policy. This will initiate a move from traditional single species to ecosystem-based fisheries management where all components of the ecosystem (biological, chemical, and physical) are considered as well as their interactions with human activities (Annex B-1. recommendation R7 from Berlin workshop). Research activities will have to address the effect of changes (including global change) in ecosystems on marine living resources and their exploitation (Annex B-1. recommendation R1 from Berlin workshop) as well as the impact of exploitation on the structure and functioning of marine ecosystems (Annex B-1. recommendation R7 from Berlin workshop).

Fisheries ecosystems will be directly impacted by the removal of targeted and by-catch species and by physical habitat degradation. Improving size and species selectivity of fishing gears and fishing fleets is a prerequisite to reduce unwanted by-catch (Annex B-1. recommendation R6 from Berlin workshop), including marine mammals and sea birds. Mitigating habitat destruction by fishing operations requires impact assessment studies and technical innovation to reduce the damaging impact of fishing gear in use, and the development of protected areas.

By targeting specific stock components, e.g. size or age, fisheries alter the stock structure, life history traits and genetic structure of targeted and by-catch species, and will ultimately alter the biodiversity of all these exploited ecosystems. Specific alteration of the genetic composition may have irreversible effects on population dynamics of exploited species, this process needs further investigation (Annex B-3. recommendation R1 from Lisbon workshop). Therefore the key issue is to determine which is the optimal state of the resources to give exploitation levels. Indirect ecosystem effects of fishing are alterations of food web structure by removing large quantities of predator and prey. Enhanced knowledge on intermediate and upper food web processes is required to separate the top-down effect of fisheries from the bottom-up effect of changes in the productivity of marine systems (Annex B-1. recommendation R8 from Berlin workshop). In addition, chemical contaminations that occur through the food web have to be characterized and assessed.



Trawling have a huge impact on soft bottom habitat. (K. Sainsbury).



Stakes of management are the changes observed in demographic features which influence the production, reversible (phenotypical plasticity) or irreversible (genetic selection). (E. Kenchington, 2001).

Existing time-series on ecosystem components should be analysed to generate and test the applicability of quantitative indicators of fisheries impacts, with emphasis on indicators and thresholds of the status of benthic communities, sensitive species and food web structure (Annex B-1. recommendation R2 from Berlin workshop).

This will require bringing together marine ecologists, geneticists, fishery scientists and social scientists into integrated projects, focused on developing an ecosystem approach to Management of Fisheries (Annex B-1. recommendation R3 from Berlin workshop). In this regard, *in situ* observations would need to be coupled with experimental ecology trials to assess the effects of some environmental factors and of selection by fishing devices on life traits of fish population.

Unfortunately even though the science community has been recommending effort reductions for decades, in an effort to preserve the stocks, this has proven a conspicuous lack of success. The protection of the ecosystem will provide more intensively the incentive politicians and managers will need to enact the necessary controls.

Aquaculture development

The European research capacity has been evaluated through a survey among the EFARO partners. The major strengths of the European Institutes appeared to be in the health, genomic and environmental impact issues, which is in line with the EC requirements. The major weaknesses are in the extensive and integrated aquaculture, the effect of the environment on fish and shellfish, and in the economic domains. Concerning the environmental interactions of aquaculture, the effect of nutrients loadings and their modelling is well covered, while the genetic impacts are lesser implemented in the national institutes, particularly in the marine environment. One particular weakness that is common with the fisheries sector is the quasi absence of economic prospective (and of sounded data bases) in the aquaculture sector. The actual needs for the enhancement of research activities can be synthetised under five topics which follow:

The environmental impact of marine fish farming is function of the hydrodynamic level under the cages. (SAMS / K. Black).

Environmental concern, including the context of ICZM

The growth in aquaculture production leads to increasing constraints on the use of inshore resources in Europe (spaces, ecosystems, eutrophication, harmful algal blooms) but also throughout the world (use of fish proteins and oils). The study of interactions with the environment should be defined according to different spatial scales: **local** for the interaction of food chains in the benthic ecosystem, **regional** for effects on eutrophication and toxic algae prevalence, on the capacity of the food chain or the dissemination of pathogens, **global** for the analysis to the cycle of life, effects on the control of genetic impact due to farmed animals escaping into the wild, invasive species and on the resources of industrial fisheries.

One of the emerging concerns considers the genetic drift that releases of reared animal in the wild should lead to. Genome duplication is one of the possible developments to avoid these possible detrimental effects (Annex B-3. recommendation R4 from Lisbon workshop).

Diversification of systems and species

Producing new species is perceived by a number of producers in every European country as a problem to solve the glutting of the markets by some few species, and the drop in prices. The major seizing in new species development is the provisioning for good quality juveniles. Rearing technologies are still in their infancy and a huge number of external (water quality, environmental parameters, food) as well internal (quality of egg and spawn, genetic issues) factors are still not completely understood and controlled (Annex D-1. recommendation R2 from Budapest workshop).

These new species should be of interest in developing integrated systems under extensive or semi-intensive processes (i.e. with low input of energy and nutrients). These systems are well developed in Asia, but are facing land tenure and capital costs in coastal Europe as well as in continental ponds and wetlands. New technologies could facilitate a better consideration of these systems in the context of the European policies for the management of coastal zones (Annex D-1. recommendation R3 from Budapest workshop, Annex B-1. recommendation R14 from Berlin workshop).

The most extensive system is defined as restocking or stock enhancement. Again, progress has been made, particularly by the development in genetic tools that enable to trace released populations in the wild (Annex D-1. recommendation R5 from Budapest workshop, Annex B-1. recommendation R16 from Berlin workshop). This modality is one of those that make aquaculture and fisheries working together for a common objective. The other one consist in the use of wild juveniles ultimately fattened in aquaculture facilities (e.g. bluefin tuna), which carries specific environmental and policy constraints (Annex B-1. recommendation R10 from Berlin workshop).

Domestication

Domestication corresponds to a loss of genes in the medium-long term, and consequently to the loss of the genetic diversity which could lead to detrimental impact on farmed populations of a given species. Domestication is mainly achieved through selective breeding. It is a very powerful tool to improve numerous criteria in animal rearing. It has been successfully utilised for all terrestrial animal. Its use for aquatic animal is more recent and requires major adaptation to cope with the very high prolific and the high environmental effect encountered in marine fish and shellfish. As such, it may avoid some undesirable effects that have been reported (e.g. meat quality, carcass conformation, susceptibility to diseases, disease resistance, …). The recent advance in modelling capacities and the use of genomic tools increased recently the powerfulness of this approach (Annex B-3. recommendation R8 from Lisbon workshop). A new frontier in research is opened in order to mix indicators to cope with the market requirements for quality, the variety of environment and farming systems, and the higher productivity required by the producers (Annex B-3. recommendation R5 from Lisbon workshop).

The bad image of these development might drive in the public, particularly when unduly assimilating them to GMO, make necessary to better inform the producers of the use of these new capacities (Annex B-3. recommendation R4 from Lisbon workshop).

Domestication also requires a better understanding of the behaviour of the reared animals to improved adaptation at the rearing facilities. This is linked to both farming system development and welfare studies.

Technology development

Contrary to the previous 50 years, technology improvements have not only addressed productivity increases, but also the limitation of uncertainty, and the better use of natural resources. Two main tendencies are to be supported:

- Going onshore - In this respect, recirculation technologies are very promising. They appear as an important breakthrough to ensure both securing the in-farm production issues gained by a greater control of the processes, but also to achieve a higher level of environmental protection and therefore to facilitate the incorporation of aquaculture production plant in the coastal zone (Annex D-1. recommendation R4 from Budapest workshop). Their new challenge will be to face the increase in energy costs;
- Going offshore – Even if the progress being made these years is less important than in recirculation technologies, there is a constant trend to move sea cages in offshore locations. Developments there are driven by the need to

A live bluefin tuna being brought onboard and sampled for blood from the heart. The reproductive hormone gonadotropin releasing hormone agonist (GnRHa) was used to induce final maturation and ovulation in captive bluefin tuna broodstock. (EU FP5 program REPRODOTT - Helenic Center for Marine Research / C. Mylonas).

New technology to control both external and internal factor for marine aquaculture in Eilat National Center for Mariculture. (INCM/M. Shpigel)

Domestication through selective breeding may avoid some undesirable effects on fish such squeletal malformations (here is sea bass). (Mediaqua / J.M. Deslous-Paoli).

Intensive recirculating rearing system for fresh water fish aquaculture. (DFU / J. Astrup).

secure the facilities and to reduce their operating costs. The huge mechanisation in the salmon industry is an important driver in this regards.

The need for continuous improvement of fish feed has been expressed for years. Again after being driven by cost issues, feed improvements have to taken into consideration the need for substitutes to fish meal and fish oils (in 2010 fish oils resources would be insufficient) and the adaptation of the final quality to the demands by the different markets while maintaining the nutritional/sensorial values and the contamination level of the final product. Alternative sources should be developed (plant products, zooplankton).

Health and welfare

The control of the health of farmed fish and shellfish is one of the key elements of the competitiveness and the sustainability of the industry. A high priority should be given to both:

- the health care within the farms, by using prophylactic methods (including the bio-security concepts), development of vaccines, or indirect methods such as probiotics or immuno-stimulation through the feed;
- the understanding of host-pathogen-environment interactions in different ecosystems and, in particular for molluscs reared in the wild.

The control of disease spreading is of major concern in an aquatic environment which facilitates disease transmission. Epidemiological models and prevention tools (e.g. vaccines) must be developed (Annex B-1. recommendation R15 from Berlin workshop). In the context of possible zoonosis, the protection of the consumer health is also at stake.

In shellfish culture, producing disease resistant strains is the only solution to decrease the mortality rates after several generations. Disease control and animal care are major issues in the definition of animal welfare, and consequently both aspects are highly linked. Welfare consideration leads to new research developments in behavioural (e.g. swimming behaviour in various production systems), environmental studies (e.g. effect of water quality on feeding behaviour), genetic (e.g. integration of welfare indicators in selective breeding process)(Annex B-3. recommendation from Lisbon workshop). Cost analysis should be undertaken in order to evaluate the impact for the European industry facing countries where legislation could be not so advanced.

The multidisciplinary approach which is needed and not well developed will require adequate infrastructures which are rare at the EU level. They need to be optimised to achieve such an ambitious goal, which requires:

- the networking of the operators within the infrastructures;
- pursuing activities designed to integrate their technological development;
- improved access for researchers who do not have such infrastructures.

These initiatives are needed to improve the cohesiveness of the scientific community which is particularly fragmented and improve communication with the industry. This need for defragmentation should be supported by the European capacity to provided cooperation tools with small and medium size businesses and industry (collective research, CRAFT, Technological Platform associating producers, processors and researchers) and the Scientific Support to European Policies which should be reinforced in this particular field. The special case of ultra-peripheral Regions, which also have a strong potential of development, should be considered.

Seafood quality

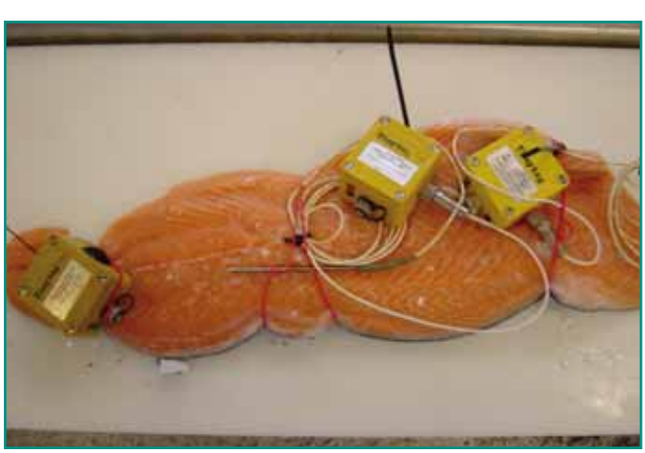
With respect to seafood the consumers and producers in Europe need a sound scientific basis on the following thematic issues:

Quality control and traceability

The safety risks connected to seafood consumption are diseases caused by bacterial and viral shellfish poisoning, shellfish biotoxins (diarrheic, paralytic, amnesic), pathogenic contamination (e.g. *Vibrio* spp, *Listeria*) and the presence of contaminants in products from wild resources or aquaculture (including additives).

It is expected that standard detection methods for viruses and *Vibrios* spp will become available in the near future. This will allow the identification of critical control points for viral contamination in harvesting areas. The development of a risk based management approach for enhanced control of the virus risk associated with bivalve shellfish could be the next step.

The use of molecular tools to increase and standardise the traceability (e.g. geographical origins) should be further enforced (Annex A-3. recommendation R6 from Lisbon meeting).



Temperature recording in salmon meat to be smoked. (DFU/H. Ladefoged).

Fatmeter : a non invasive method for fat determination in the fish flesh (Mediaqua/J.-M. Deslous-Paoli by courtesy of SYSAAF)

Fat localization in the fish meat. (Ifremer / Y. Harache).

Sensory test on fish meat. (DFU/ H. Ladefoged)

Process innovation biotechnology

In order to retain the intrinsic qualities of seafood it is necessary to consider the whole production chain. Special attention is needed for obtaining tailor-made products meeting and satisfying the needs and expectations of European consumers. In that respect taste and texture are important eating characteristics for seafood and the presence of 'new' functional components with health beneficial effects may enhance the consumption of seafood. It is expected that new emerging healthy components or new products for consumption, derived from by-products or discards will be available. Consumer oriented functional seafood product development and health claim research (intervention studies) will be needed (e.g. effects on cancer or cardio vascular diseases).

Impact on consumer health

Further development and implementation of hurdle strategies for prevention of contamination and growth of pathogens in mild preserved seafood products using innovative processing techniques is considered to be important. Involvement of seafood SMEs in this area is essential in order to guarantee the transfer of the generated scientific knowledge.

Still, very little is known on the effects of the combination of organic contaminants. For several contaminants maximum residue limits have been set at an EU level. However, effects may be rather different, lower as well as stronger, when contaminants are combined, which is the case generally. Studies on combination toxicology are therefore badly needed. For a few emerging contaminant groups (brominated flame retardants, perfluorinated compounds, pharmaceutical compounds and the so-called C60 compounds deriving from nanotechnologies) research is needed within the area of method development and quality assurance.

Product innovation, including marketing

Aquaculture as source for seafood products will become more and more important. Novel endocrine, proteomic and genomic technologies to identify quality traits in finfish aquaculture will become available in the next years. A further exploration of these tools is necessary to improve understanding of factors regulating growth and body composition and to increase the productivity and quality of the aquaculture production.

Fish composition reflects the composition of their feeds, using wild fish. These resources are limited. In addition, wild fish accumulate lipid soluble contaminants and are a source for safety risks. Overall, this situation creates a challenge to optimise the retention of health-promoting nutrients by selecting low risk novel feed sources and to reduce the previously mentioned organic contaminants. A further exploration of dietary modulation to develop functional farmed seafood products containing health promoting substances is recommended.

Seafood convenience in acquiring, handling, marketing, coaching and eating should be looked at. Enhanced acceptance and consumption of seafood products by different consumer categories must be dedicated to matching different consumer types to seafood product differentiation.

In order to improve consumer trust, acceptance, and subsequent preference, new concepts should be implemented cross sectors:

- production chains that integrate image and public perception;
- adjustment of production concepts to take account of citizen values.

These concepts will lead to more diversification and economic value, based on "non price" incentive, when imports are mainly driven by price considerations. Both, local craftsmanship-like production initiatives as well as big production plants can implement these strategies, thus enhancing involvement and trust of EU citizens and consumers, as well as worldwide acceptance.

Structuring effect of MUTFISHARE : EFARO

Introduction

Historical perspective

Since 1989, the Directors of the main fisheries and aquaculture Institutions used to meet together once a year DG"Fish" was invited as an observer. Annual reports of these meetings have been published since, including a document describing the forces and main research programs of these Institutes (Arcachon in 1995). This informal consortium produced strategic plan to develop a common approach in fisheries and aquaculture research among its partnership (in 2002, see document at www.efaro.org).

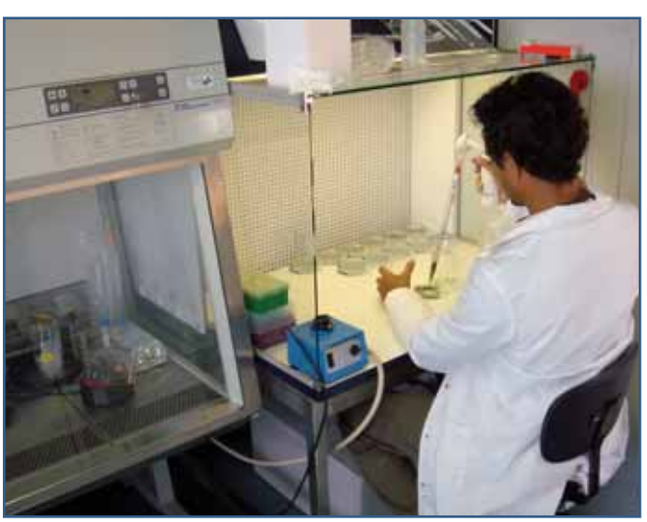
It has been proposed by this group of Directors to answer to an EC call under the FP5 as the first step to move towards an European Research Area on fisheries and aquaculture, in order to increase the cooperation in the research activities.

As a follow up, a Concerted Action named MUTFISHARE, has been accepted from 2002 to 2005 to, basically :

- avoid duplication in research;
- create synergy between the different Institutes;
- create critical masses of research for different topics.

The MUTFISHARE Concerted Action

The Common Fisheries Policy (CFP) proposes to reach the objectives of sustainability of the fish population and their ecosystems. To achieve these issues, better data collection and availability, appropriate applied research, adequate management and participation of stakeholders are the key factors. The research institutions have a major role to play to increase knowledge and to provide the tools that are necessary to its implementation.



Bacteriological analysis of shellfish. (Ifremer)

The principal outputs of MUTFISHARE have been:

- To create the EFARO (European Fisheries and Aquaculture Research Organisations) network as an efficient structure of coordination of the Directors of research Institutes in EU, Norway and Iceland. Through its web site (http://www.efaro.org), a leaflet and its different reports, it has been recognize as a plateform for discussion with the scientific community, DG "Fish", DG "Research", DG "Environment", others institutions (ESF, EAFE,…) as well as policy makers at the national and EU levels, including the EU parliament;
- To facilitate technical exchanges through thematic workshops which produced reports and recommendations on various issues;

- To increase efficiency of research in relation with the request from managers and stakeholders;
- To increase scientific cooperation with other disciplines through institution like the Marine Board from the European Science Foundation, and the economists of the European Aquaculture and Fisheries Economists, to face towards the challenge of multidisciplinarity which will be a key success to contribute to the CFP;
- To contribute to increase institutional cooperation:

- among EFARO Institutes : 21 research contracts under the Scientific Support to Policy of the 6th Framework Program (FP6) included EFARO Institutes, of which 13 are coordinated by an EFARO member;
- with other institutes through 4 Integrated Projects or Network of Excellence frrom the priority 5 and 6 in FP6;
- with the science managers through EFARO participation as an expert group in MarinERA to coordinate national research programmes, by taking the initiative of MARI-FISH, an ERA-net dedicated to coordinate fisheries research, and by playing a strong role in this project.
- through bilateral agreement among EFARO partners to implement new projects.

- To increase dialogue between research Institutes and EC DG "Fish" through 3 annual statuary meetings where:

- data collection programs for biology and economy have been discussed;
- recommendations on research priorities have been approved by the Directors and submitted to the EC as contribution to the preparation of the annual work programme of the EU calls;
- the nature of research issues to answer specific questions has been addressed for medium or long term tendancies. A prospective document for FP7 has been produced.

After the concerted Action MUTFISHARE

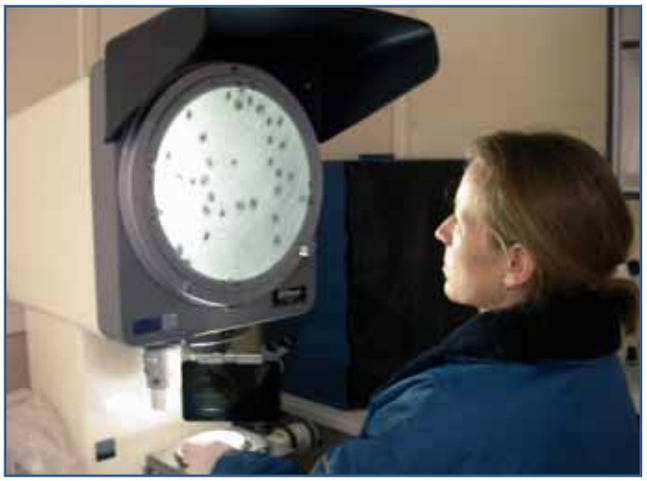
It has been decided by the Directors to maintain EFARO activities, to move towards a formal association, and to maintain the following objectives:

- Sharing best practices and knowledges;
- Prospectives, strategies, analysis and decisions;
- Represent Institutes in ERA-net;
- Interface (dialogue) between science suppliers and science consumers;
- Optimising of research resources at EU level;
- Answer specific E.U. calls.
- Links with other institutions (e.g. universities).

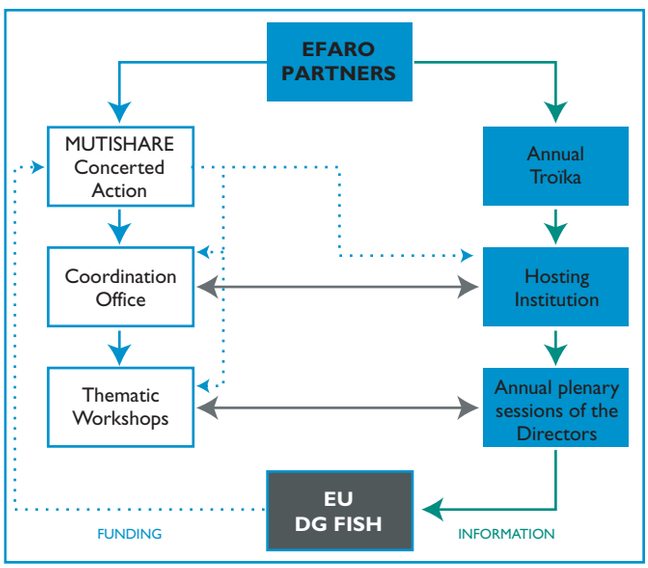
From the perspective of integrated fisheries management and the capacity to produce seafood, the stakeholders from both the public domain (national and EU governmental organizations, NGO's) and the private sector (fisheries, aquaculture and seafood industries) require a more multi-disciplinary approach from the scientific support. The main goal of EFARO as a European platform is to link the various disciplines to the fisheries and aquaculture sciences.

Self organisation under a non profit organisation

EFARO has been created as a body to coordinate research between the major EU and Associated member Institutes. The MUTFISHARE Concerted Action gave the opportunity to support Workshops and General Annual Meetings in which the Directors of the Institutes meet and exchange with the representatives of the European Commission.



Control of the quality of eggs before artificial fecundation in sea bass. (Mediaqua / J.M. Deslous-Paoli).



The linkage between EFARO and MUTFISHARE during the period 2002-2005.

In that respect, they initiate and increase formal cooperation on targeted subjects in tight connection with the CFP requirements (Annex A).

EFARO is an association composed by the heads of the main European Research Institutes involved in the Fisheries and Aquaculture research. ICES is an associated member DG "Fish" is an observer. It was founded under a consensus agreement. The criteria for participation are:

- to be a public national Institution from the EU, the Associated Countries and the Candidate Countries,
- to be, at national level, a major actor in the field of fisheries and aquaculture research,
- to participate in the advice process, at national and/or European level, for the implementation of the CFP and related issues.

Each new member is adopted by previous partners. In that sense, Institutions from Associate or Candidate Countries will be involved in EFARO on their request. More than one Institution by country may be represented in EFARO. Each Institution is represented by its Director, or by a Director's representative.

Otolith observation. (Ifremer / O. Barbaroux).

Meeting in Brest, France. (Ifremer/P. Gros).

There is an adhesion fee and EFARO runs a current budget coming from the partner Institutions. It acts as an independent body, which is not linked to any Institution. The deliverables produced are only reflecting the partners' viewpoint.

The general meeting is organised annually. It is organised by the secretariat and hosted in one of the country member in EFARO. Experts can be invited. Regularly, thematic workshops about specific topics may be organised.

Contribution to the ERA

EFARO has the clear global objective to enable its member Institutes to collaborate to the provision of better understandings of the marine production systems. Since the sustainable management of these systems and more en more complex, no single institute is able to support the necessary pluri-disciplinarity that is often required to address these issues.

Contribution to the content of the FP6

In this regard, EFARO intends to contribute to the European Sciences(http://europa.eu.int/comm/research/era/index_en.html) under two aspects:

1 – The FP6 deliberately decided to move toward the European Research Area. In consequence, the Institutes had promoted updated common research objectives that are directed:

- to avoid fragmentation and duplication in fisheries and aquaculture research by organizing research activities;
- to promote high synergy between the members Institutions;
- to create critical masses for research in various topics;
- to initiate foresight studies.

2 – The reform of the CFP, that occurred in 2002, which particularly drives the objectives of fisheries and aquaculture science towards:

- the environmental management of fisheries and aquaculture, including multi-annual framework;
- the economic and social issues in the management of fisheries and aquaculture;
- the improvement of scientific advice and the increase of stakeholder involvement.

Contribution of EFARO members to ongoing project under FP6 (see appendix 3)

One of the task EFARO undertakes under its own initiative is to provide a forum for its members to adapt collectively to the projects which have an European dimension, e.g. those who are proposed by the EC under the FP6 or the future FP7. This mutual agreement leads to:

- a better focus on the actual innovation to be implemented;
- the provision of the better available collective expertise;
- the avoidance of undue competition and artificial fragmentation among research operators.

In that sense, the activities generated by EFARO benefited greatly to both the European scientific community in the field and the EC (DG "Fish"). From the implementation of MUTFISHARE, the partners increased the level of confidence both in EFARO and in the other partners. The incoming of new candidate country Institutes did not unbalanced this statement. Nevertheless the willingness to cooperate between Institutes is a medium-long term process that requires constant attention and diplomacy. It is a major outcome of the MUTFISHARE initiative.

In the same way, EFARO helps enhance the mutual acceptation and comprehension between the decision makers (e.g. the EC) and the Research Institute. Part of the recommendations produced through MUTFISHARE was considered for the SSP Priority under FP6. Both ways the requirements for advices and recommendations led to an increased transparency and a better understanding of the decision making processes.

Opening collaboration to non member

A particular attention has been devoted during this year to open the contribution to MUTFISHARE out of the scope covered by the MUTFISHARE consortium, particularly when answering to the SSP calls for proposals. Of particular significance is the fact that leadership in many projects in which Institutes participated through an EFARO initiative was given to non-EFARO institutions. This is also relevant to the experts, which were invited to technical workshop, mainly from the Universities.

Joint answer to calls to avoid fragmentation and overlaps

The two proposals below illustrate this opening when EFARO decided to launch two significant projects, aiming at structu-

ring the research activities on both aquaculture and fisheries at European level.

- From the Berlin workshop, it was decided that Ifremer with the HCMR and the IMR will propose an Integrated Infrastructure Initiative to the next call to be open in late 2004. Ifremer was designated to coordinate the initiative. The first drafting meeting concluded rapidly to the enlarging of the consortium, which include two non-EFARO institutions: the CSIC in Spain and the University of Stirling in UK. This led to the proposal for a Network of Research Infrastructure for Aquaculture (NERIA). Unfortunately, shortage of EC resources did not allow funding it under the FP6. It will be resubmitted during FP7;
- From the Galway meeting (Annex 1-A-2), it was decided to answer the next Marie Curie call for tenders (to be open in 2005) by submitting a project under the RTN instrument. With respect of the scope of the call, the project was fitted to cover both the trans-discplinarity (fisheries and ecosystem, biology and economy) and the trans-sectoriality (academic science, finalised research and expert advices). The University of Hamburg was proposed to coordinate the bid.

Contribution to ERANET (MarinERA), initiator of Marifish

Under a joint initiative by Ifremer and the Marine Board of ESF, an overarching ERANET project, addressing the marine science as a whole has been launched in 2002. EFARO was proposed to contribute and become an expert group in MarinERA to provide expertise, particularly in the option of linking ecosystem and fisheries.

Consequently, EFARO initiated in 2003 during its General Assembly (Annex 1-A-2) the process of submitting an ERA-NET project about fisheries. EFARO advised the DEFRA in Brussels (March 2004) to set the objectives, the partnership and the content of such an application (named Marifish). The position of EFARO in the bid was investigated and it was decided to incorporate EFARO as an advisory body providing expertise under the form of technical WS. This project begins in January 2006, and will lead to shared Regional Programmes.

EFARO has also been selected by the consortium of the MarinEra Eranet project to be an advisory member with ICES. This recognition proved the quality of the EFARO representation and advices.

Common proposal for FP7 to structure the research in the fields to the EC and the EP

One powerful tool to increase the coherence and the cohesiveness of the European scientific capacities is the Framework Programme. This is particularly the case for fisheries and aquaculture which are driven by common policies.

To strengthen the position of aquaculture and fisheries science in the FP7, EFARO implemented on its own two major initiatives:

- a common contribution to the thematic content of the "Cooperation" axis , addressing particularly Themes 2 (agriculture and food) and 6 (environment) in December 2004.
- a presentation (in association with the Marine Board of the European Science Foundation) to the Fisheries Committee of the European Parliament of the services provided by marine science and technology with a focus on fisheries.

Power point presentation about social needs in fishery research at the E.U. Parliament. (Ifremer / A. Dosdat).

Considering the important role of science in support to policies, EFARO in association with other bodies, contribute to the Green Book on Maritime Policy by:

- addressing to the European Parliament the research needs in the field of management and exploitation of marine biological resources (in association with the German Consortium for Marine Researchs the National Oceanographic Centre in UK and Ifremer);
- presenting the research activities implemented in Europe and their future scope to the Task Force in charge of drafting the Green Book (in association with the Marine Board of the European Science Foundation).

Establish links with external research institutions

The MUTFISHARE project has been an efficient tool to establish contacts and flow of information between EFARO and other organisations working in the field of international research coordination (e.g. the universities).

As noted, EFARO is well aware that successful and efficient recommendations concerning fisheries management and development and aquaculture sector need a broad scientific international basis. EFARO meetings and workshops have therefore frequently, and as a common rule, had input and attendees from other organisations. These include:

ICES - The International Council for Exploration of the Sea promotes and coordinates marine science primarily in the North Atlantic. Representatives of ICES have been attending the annual Directors meeting and given several presentations and contributions to the meeting. EFARO and ICES work programmes and activities have been ensured to supplement each other rather than overlap.

GFCM/FAO promotes the development, conservation and management of the living marine resources in the Mediterranean. EFARO institutes take an active part in the work of GFCM/FAO and the work of EFARO will support and not duplicate the work of GFCM. Contacts have been established.

EAFE – European Association of Fisheries Economists. Strong links between EFARO and EAFE have been established as some institutes are members of both associations. EAFE has also had representation at EFARO meetings, and a specific workshop has been jointly organized in March 2005. Collaboration and coordination between fishery research institutes, which generally has its focus on marine biology and natural sciences, and the fisheries economy research institutes, focussed on economy and social sciences, need to be enhanced and supported. A strong relationship between EFARO and EAFE will add to this effect.

ESF-MB. – The Marine Board of the European Science Foundations –. Several contacts and collaborative initiatives have been taken between EFARO and ESF-MB. The two organisations are involved in EU ERA-NET's relevant to the marine research, and they will coordinate and complement their contributions to these structuring measures. The collaboration and coordination have been increased in the recent year as consultations on partnerships in EU research projects have been initiated. Similarly it has proven useful to coordinate the two organisations dialogue with policy authorities such as European Parliament.

EAS – European Aquaculture Society. EFARO and EAS have taken the opportunity to exchange views on common objectives and have established contact. About one third of EFARO members undertake research in aquaculture and EFARO initiatives in this area need to be coordinated with other international bodies.

EFARO has demonstrated that it can work with relevant other international bodies. The structure of EFARO, being a network of the directors of European fisheries and aquaculture institutes, ensures that it will be well informed about international collaborative scientific initiatives of relevance for fisheries and aquaculture. There is a clear view in EFARO not to take initiatives which duplicate and overlap with such activities. EFARO will focus on institute efficiency and coordination to enable high, quality cost efficient research in support of the European fisheries sector. (Ref article 3 "Objectives" in EFARO statutes). EFARO is in a strong position to establish links with other organisations to ensure that the EFARO institutes play a strong and coordinated role. The issueof the links with universities will be addvesesed in the near future.

Establish links with non research institutions

The accomplishment of EFARO goals is achieved through the organization of common research programs and workshops in which a wide range of research bodies and international organizations involved in various aspects of the management of European fishery resources participate.

Advertising of the EP (Fisheries Commission) to rise the awareness of MPs

EFARO conveyed to the EU Parliament the main outcomes of the Commissions proposal. In the FP7 (2007 to 2013), the European Community stresses that "in order to strengthen the diffusion and use of the output of EU research, the dissemination of knowledge and transfer of results, including to policy makers, will be supported in all thematic areas, including through the funding of networking initiatives, seminars and events, assistance by external experts and information and electronic services. (..) Support will also be provided to initiatives aiming at engaging the dialogue on scientific issues and research results with a broad public beyond the research community, and in the field of scientific communication and education". In this regards, EFARO insisted on the necessity to make the EC recommendations a reality in order to bring science and society closer together for the harmonious integration of science and technology in European society, and to improve communication between the scientific world and the wider audience of policymakers, the media and the general public.

On board a trawler in operation. (Ifremer).

Reinforce the dialogue with the DGs in the EC (DG Fish and CFP) about EU policies

In the last three years, the EFARO group formed one of the advisory parties to DG "Fisheries", providing ideas for research actions aiming to provide the required scientific information that finally contributes to the sustainable management of European resources. Some of them were incorporated in calls for proposals and particularly in the FP6 package.

Open sea aquaculture. (Ardaq Red Sea Fish).

In November 2005, EFARO together with the ESF-MB made proposals for a more integrated marine science in Europe to the Task Force in charge of the implementation of the Green Book about the future European Maritime Policy.

Information flows to demonstrate the role of science to answer societal concerns

Science is a collective endeavour, an activity in which the work of one set of specialists serves as input for other. The production of scientific knowledge is increasingly vast and specialized. But even if much is published anyway, little is read, analyzed and synthesized.

If the communication with the public through knowledge diffusion is encouraged, scientists do not have enough time and experience to do it.

Scientific terminology provides the detail essential to the integrity of science, yet may be unintelligible or unnecessarily complex for communicating with the general public. Scientists are encouraged to use language and tools appropriate to their audience, even though this may result in some loss of detail.

Create more effective systems to improve dialogue with stakeholders and society at large regarding fisheries management, to incorporate the views of the industry, the citizens and the consumers of the harvested marine resources as basis for policy decisions is a challenge that EFARO should undertake. This can include new mechanisms for developing and delivering scientific advice, expertise, and results of performance evaluations to both the stakeholders and the public.

Organise the information to decision makers at EU and national level(1) (2)

The decision-makers and users of the environment and its resources miss information on the mediums which they have to manage or to use, or lose themselves in too full and too detailed information.

The same is true for companies which more or less directly use information in relation to the marine environment (impact, image etc).

Moreover, these communications help to disseminate knowledge to the general community and can promote an appreciation of research.

Image acquisition for a movie on the sea bass sperm cryopreservation methods in an Ifremer research center by Mediaqua and IAM Montpellier. (Mediaqua/J.-M. Deslous-Paoli).

Communicating European Research 2005 International Conference - Brussels Exhibition Center (Heysel) 14-15 November 2005

These communications must be made responsibly, staying within the boundaries set by the level of understanding of the audience and the need for accuracy and responsibility.

While being based on the three guiding principles, Listening, Communicate and be in Contact, it becomes essential to encourage the integration of an accompaniment to the research projects, on the level of their national and/or European coordination, to ensure the dissemination of acquired knowledge.

Project participants are encouraged to make use of all methods of communication to make their products and services known to potential customers. Publicity brought about by dissemination can also open doors to commercial exploitation of results.

For that, new technologies (web sites, electronic newsletters, cdrom, DVD, etc.) must supplement the more traditional tools (press releases, conferences, exhibitions, workshops, events, leaflets, and other publications, video, etc.) to provide society the information relevant to their needs.

Several projects have also used external observers as part of the publicity process. Where appropriate, end users, financiers, venture capitalists, trade unions and other organisations

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1. Position of the Universities

On October, 2003, the Berlin Declaration (http://www.zim.mpg.de/openaccess-berlin/berlindeclaration.html) which is an engagement to develop the free access to the results of research was signed by a certain number of persons in charge for universities and European institutes of research. A call is made (http://www.zim.mpg.de/openaccess-berlin/signatories.html) so that other institutions join the list of the signatories.

2. Government position

A request for awakening of the governments on a world level, on the need for the free access to the results of research, was made within the framework of the World summit on the information society (WSIS - http://www.wsisgeneva2003.org) by the organization of a conference "Open Access :Towards a Free Science" on december 2003 in Geneva.

A drafting of a Declaration of Principles was written at the end of this conference (http://www.itu.int/wsis/documents/doc_multi-en-1161|1160.asp).

are invited to take part in dissemination and exploitation workshops and meetings. New ways, possibly in connection with NGOs, for delivering this information can be developed.

The Commission wants the partners to make the results of the project as well known as possible. Specific promotion measures exist for this reason. Apart from the restrictions agreed on to protect intellectual property rights, all projects are encouraged to publish their results.

Scientific workshop (Ifremer/A.G. Martin).

EFARO action plan

- Improve our communication of scientific information to specialist audiences (scientists), decision-makers (government, managers, and others), and the public.
- Explore the nature of scientific communication, identifying its unique challenges, and provide solutions to those challenges.
- Understand the importance of science to society, and communicate that importance to various audiences in the appropriate context.
- Share tips and tricks for resolving typical communications problems that arise in the sciences.
- Use more typical communicators (people who most commonly document computer or software applications) and teach the benefits of what we've learned as "best practices" in the sciences.
- Improve our own communication skills by learning from the "best practices" of other communicators (e.g., those used in computer documentation).

Conclusion

Thanks to the EC, the MUTFISHARE project funded under the FP5 "Quality of Life" has enhanced the level of communication and coordination between fisheries research institutes in the EU. MUTFISHARE has added value to the previously established contacts among the EFARO partners, made a step forward toward integration possible, and recently it has been a very important instrument to establish contact to all maritime EU-25, plus Norway and Iceland, member states.

The annual meetings, but also the workshops, have strongly facilitated the dialogue between the national institutes and the Commission services. It has served as a contact point between the fisheries science users and fisheries science producers.

The EFARO consortium has at the end of the project period, prepared this document which intends to give an overview of the challenges of the fishing and aquaculture sector. The role of research must be enforced to ensure the quality of life of the European population through adequate supply of healthy marine products produced by a profitable and sustainable fishing sector.

The document provides an overview of the challenges for science to meet the needs of the fishing sector. These encompass an improved basis for management of marine fisheries and improved basis for prediction and control of environmental drivers, continued development of sustainable and diversified aquaculture production, knowledge and tools to manage competing interests and activities in the marine and coastal areas, and finally better understanding of health aspects of marine products.

Research priorities

The activities in MUTFISHARE have focused on discussions of the research needs to meet the demands and this document provides an overview of the research priorities. These priorities are mainly derived from the thematic workshops and the level of detail differs between the various "themes". The research priorities could therefore be more well-balanced and require more work. However the project consortium finds it useful to prepare this "first draft" of research priorities to stimulate the process to identify joint targets and objectives.

Structuring the European fisheries research area.

In order to achieve the objectives more research and better coordinated research are needed.

The MUTFISHARE project concludes that the European fisheries research needs:

- Stronger collaboration with industry and stakeholders to enhance innovation processes in the fishing sector, and to strengthen dialogue and acceptability among stakeholders;
- Stronger links with science disciplines outside the traditional fisheries science (for example: environment drivers, socio economics and health aspects);
- Improved coordination of manpower, infrastructure and information sharing.

To structure and facilitate the achievement of these objectives, the partners have therefore decided to continue and enhance their collaboration. They have transformed EFARO into an association of European Fisheries and Aquaculture Organisations. The main objective of the organisation is to share best practice and knowledge, develop prospective strategic analyses and take the appropriate decisions, build critical mass of dedicated research in Europe, interface (dialogue) between science suppliers and science consumers and represent institutes in european research instruments such as ERANET and article 169 measures. EFARO will seek to coordinate its work with other international marine science aquaculture and seafood institutions and associations.

EFARO will take the initiative to ensure cooperation between national fisheries and aquaculture institutes in Europe. It will act to linking national networks in marine and food science in this network. EFARO is committed to provide a sound scientific basis for stakeholder discussion and decisions with regard to fisheries management, sustainable aquaculture, and consumer needs for seafood products.

The main research priorities detected by EFARO are globally addressing "Environment drivers and marine fisheries" and "Sustainable growth in aquaculture"

More in detail these are :

Fisheries research

Fish stock assessment and prediction, stock recovery, multi-annual evaluation
Fleet and effort management, including monitoring tools
Fisheries economy, fishery governance
Socio-economic aspects of fisheries communities

Aquaculture research

Development of sustainable techniques (inshore, offshore, hatchery)
Fish management: health and welfare, selective breeding
Feed improvement
Diversification of products, species and systems

Seafood research

Food quality and safety
Analysing consumers demands
Seafood processing
Food-chain optimising

Environmental research

Marine living resources management (trophic chains, contamination process, climate change effects, alien species)
Environmental impacts of/to fisheries
Environmental impacts of/to aquaculture
Coastal Zone Management

Annex I
Mutfishare outcomes and major recommendations

All the synopsis of the General Meetings, Workshops and Working Groups and their recommendations realized during the MUTFISHARE Concerted Action by the EFARO group are available on the EFARO web site (http://www.efaro.org). This annex intends to present the major outcomes from these events.

Three thematic General Meeting and Workshops addressing hot scientific issues have been organised during the period 2002-2005.

Bacteriology laboratory. (Ifremer).

A- Recommendations from EFARO Meetings

During the period 2002-2005, EFARO organized 3 annual meetings to consider policy issues with the participation of the European Commission.

A-1 – Recommendations from Rhodes General Meeting (2003)

The meeting, hosted by the Hellenic Centre for Marine Research (HCMR) of Greece, concluded that:

- Implementing a Coordination Action under the ERANET scheme would be the best way to consolidate the operational implementation of EFARO and to contribute to the building of the ERA in fisheries science.
- Developing multi-species modeling, including bio-economic, is necessary to optimize the management of the ecosystems submitted to fisheries activities. This is of particular relevance in case of recovery plans.

Therefore, the EFARO Directors stressed the necessity to correlate oceanographic data with biological and fishery data and gave their recommendations on the major topics discussed during the sessions:

- Review of the fisheries research under the FP6
  - ❍ EFARO favoured the constitution of consortium for each Topic to be submitted to EC with the participation of the Universities.
  - ❍ EFARO sees merit in a broad, inclusive approach to participation in Priority 8 projects which supports learning and transfer of technology among partners.
  - ❍ EFARO should continue to add value by providing advice and feedback to the EC, by making information available to members and by addressing strategic at a high level.
  - ❍ EFARO agreed that it is important to suggest coordinators with expertise in management of research projects, and that they must be given sufficient time and resources to carry out the job effectively. In order to facilitate the planning of proposals, small groups of scientific experts will be asked to assist coordinators.
- The new Common Fisheries Policy in Europe
  - ❍ Following the process of consultation, EFARO will propose recommendations to the DG "fisheries", focused on translating their requirements into relevant research priorities.
  - ❍ EFARO is supporting the EC initiatives in order to achieve the implementation of the CFP. As a consequence, EFARO national Institutes need support from the DG "fisheries" to convey appropriate initiatives to the DG "Research".
  - ❍ Long-term research is also necessary for fisheries and aquaculture science. There are few places for more generic question to be tackled in the FP6 thematic priorities. There is a need to include this type of research program in the forthcoming calls and FP7.
  - ❍ Social and economic sciences are very scarcely available in the present FP6. Both the research communities and research issues in this fields need to be promoted in order to properly address and achieve the CFP goals. EFARO will tentatively take the step by contacting the EAFE to evaluate the possibility of common approaches.

- Mediterranean Fisheries

The conflicts between the different types of fishing gears, as well as the competition between fisheries and other economic activities (e.g fish farming) were highlighted. Furthermore, the following recommendations in the area of fishery research and management were outlined:

  - ❍ The need to expand CFP by including the Mediterranean and the harmonization of fisheries management measures in the whole region.
  - ❍ The need to better collect, manage and use scientific fisheries data in the management system of the fishery resources in the Mediterranean.
  - ❍ The need to establish a management structure for the whole Mediterranean, which will be composed of the relevant National and International Fisheries Agencies, representatives of the scientific community and the stakeholders of the sector.
  - ❍ The need to support aquaculture industry in order to diversify the production (new species and new products) and to increase its competitiveness (e.g. genetic and husbandry improvement).
  - ❍ Direct market issues are to be addressed by the industry. But the implementation of "sustainability" labels needs further research at the sector level to enable relevant indicators to be introduced.

- Environmental interaction of fisheries and aquaculture
  - ❍ Research about the complex interactions in the intermediate food chain should be encouraged.
  - ❍ The dissemination of secured results explaining the interactions between the fish stocks and the moving environment should be increased and implemented using resources from the professionals (i.e. not only from scientists).
  - ❍ The impact of climate changes on wild populations must be investigated, using available data and models. This applies for example to the recruitment issues and changes in species location.
  - ❍ Indicators of additional drivers must be developed to evaluate the respective impact of fisheries activities and other anthropogenic impacts on the marine environment.

A-2 – Recommendations from Galway General meeting (2004)

The meeting, hosted by the Irish Marine Institute of Ireland, concluded on the following themes:

- Developing networks with other organisations – including the European, Science Foundation's Marine Board.
  - ❍ MarinERA and Marifish (two ERAnet projects) overlaps should be avoided through coordination and good communications. There should be few overlap as Marifish is more restricted to fisheries and fisheries managers, to deal with practical and operational research and, as such, is distinct from MarinERA.
  - ❍ Marifish should be open to integrated advice of all kinds.

Mediterranean fishery boat for coastal fisheries. (UM2-COM/C. Boudouresque).

Fish aquaculture in sea cages in Scotland. (FRS Marine laboratory/ D. Crown).

  - ❍ There is an important role for EFARO in seeking a good, balanced approach regarding the application of the ecosystem approach to fisheries and aquaculture.
  - ❍ EFARO gives to MUTFISHARE coordinator a mandate to act as representatives of EFARO at MarinERA and Marifish. EFARO will not be an active member of MarinERA or Marifish, but will act as an advisory body. If the co-ordinating body of either of these networks ask for additional expertise, they EFARO can provide it. This could be through a specific workshop, which could be funded by MarinERA or Marifish.
  - ❍ EFARO recommends that ICES be included more closely in MarinERA. MarinERA should be used as the formal communications channel for EFARO and ICES.

- Co-operation on research vessel usage.
  - ❍ EFARO needs to intensify collaborative arrangements concerning ship resources in Europe. To do this, Collaboration Working Groups should be set up.
  - ❍ The object of the Working Groups would be to find partners who are willing to look at specific ship resources that may be shared in the future. The groups

will also discuss the common building of new facilities, including vessels and heavy equipment. The first task will be to compile an inventory of who owns vessels and who manages them.

❍ The main co-ordinators of research vessels are the chairs of ICES working groups, which makes it important that they be involved in any EFARO group. They will know which vessels, or which size, are included in ICES joint projects (such as IBTS).

- Data collection regulation

❍ Data should be validated by cross-checking wherever possible. (e.g. fuel consumption, log book data etc...).

❍ Knowledge as to where data already paid for by the Commission as part of the Data Collection Regulation is held in some countries is lacking. It is important to ascertain this, since the Commission plans to check availability of such data in the near future.

❍ There are concerns about the availability of commercial vessels to observers.

❍ EFARO cannot express an opinion about the new observing scheme under the new regulation addressing the catches of marine cetaceans.

❍ There is an urgent need to get information from fish processing industry. However, governments do not have as much influence over the processing industry as they do over the fishing industry through the issuing of fishing licences.

❍ Regional Advisory Groups constitute the proper forum for the resolution of data issues, and the input from the Commission is welcome.

- Working with the European Commission on the advisory process and funding programmes.

❍ EFARO welcomes the development in the production of concrete proposals, but practical recommendations are needed on how to make this work. The number of ICES working groups is increasing all the time and institutes cannot cover all the expenses of researchers as much time is spent in analysing data and collecting it.

A mechanism is needed for funding peer review of data between national laboratories (i.e. covering of travel and expenses to ICES meetings).

Dissatisfaction with the future call for advice was expressed in terms of the logic of biding to do a job that has already been done successfully for the last twenty years. The risk is that the Commission may settle for the cheapest advice it can get.

- Mediterranean fisheries.

From the EFARO point of view, research priorities in the Mediterranean should include:

❍ Standardisation of stock assessment methodologies between countries.

❍ Reference points for the main stocks.

❍ Improved knowledge of the ecosystem.

❍ Development of more selective fishing methods.

❍ Develop simulation models to study the impact of management strategies and policy changes.

Celtic Explorer scientific vessel from Ireland. (Marine Institute, Ocean Science Service).

Data base Coriolis. (Ifremer/ Maudire).

Tuna fishing vessels in Sete harbour. (Mediaqua/J.M. Deslous-Paoli).

❍ Development of a co-ordinated method of assessment based on fisheries independent data.

❍ Increase effort on the monitoring and management of small scale coastal fisheries.

A-3 – Recommendations from Zeeland General meeting (2005)

The meeting, hosted by the Netherlands Institute for Fisheries Research (RIVO) concluded mainly on:

- The role of EFARO in support of DG Fish and Common Fisheries Policy.

  ❍ The EFARO network has a broad view of the research needs. For DG "FISH" the advice of EFARO is important in several areas of interest. EFARO services are important in the field of dissemination of results, management of a (scarce) research budget, investigation of new areas of interest There is certainly a role for the promotion of regional research projects.

  ❍ An independent EFARO structure with its own profile will be an important partner to DG "Fish". The agenda of EFARO should be broadened to include other disciplines, environment, economics, etc., and could, in fact, be much broader than the concern of the EU. The continuous need for communication between the research institutes and the EC needs to be organised.

- Aquaculture.

  ❍ There is not always a clear border between fisheries and aquaculture. Recent developments show that aquaculture is not an isolated activity. There are conflicts over resource use, and introduction of species. Aquaculture practices may have negative impacts on the environment. National and EU policies on these issues are still underdeveloped. In the years to come there will be an increased need for strategies and developing policies in order to develop aquaculture in a sustainable way. A forum is required to reach consensus on how to tackle these issues. EFARO can fulfil this role.

  ❍ To insure a relevant strategic positioning, EFARO has to organize contacts with other representative bodies such as EAS, FEAP, to set priorities and objectives to research activities that are not redundant nor conflicting.

- Data Collection Regulation.

  ❍ Member States devoted a lot of time and effort to establish their National Programs and these have started to mature and deliver appropriate results.

  ❍ Demands are changing and in 2005 there is an opportunity to review the DCR. The new areas such as environmental data will have to be included. Better coordination and cost-efficiency improvements should be promoted. DG Fish aims at having a simpler and better system implemented in 2008.

- Future of EU Fisheries and Aquaculture Research.

  ❍ Now that the 7th Framework Program has been proposed, EFARO can and should be an active participant (network) and give feedback on the FP7.

Cods (Netherlands Institute for Fisheries Research/ M. Pastoors)

  ❍ EFARO should also be a structure for coordination and horizontal integration of marine science across themes and coordinate the exchange of information on different initiatives taken by the Commission and the Member States.

- Partners views and demands on cooperation with EFARO.

  ❍ Does EFARO need an umbrella organization? Fisheries and aquaculture encompasses much more than biological and ecological research. For strategy and common policy development it is necessary to deal with other disciplines as well. It is possible to work under the umbrella of a larger organization, collaborate with other organizations, or become an umbrella organization itself.

  ❍ Whatever solution is adopted it will be necessary for EFARO to remain an interesting organization for the EU to deal with all aspect of fisheries and aquaculture (including environmental and economic aspects).

Oyster and mussel culture in Mediterranean lagoons conflicts with other users and introduces exotic species. (Ifremer/D. Buestel).

Scientists work close to the fish producers. (Helenic Center for Marine Research/ C. Mylonas).

- Certified fish production, eco-labeling.

Since presently the main interest of the EFARO-members in certified fish-production and eco-labeling is the sharing of experiences, institutes should keep each other informed about their developments in this area. An email-correspondence will be initiated to keep the discussion alive.

- Exchange of Human Resources.

  ❍ The EFARO members believe that Human Resource Exchange is of great value to the further quality of work and skills of all institute staff, particularly for young scientists. Several subject areas are identified as being of special value in this context. These include fish stock assessments, ecosystem modelling, fishing gear technology, solving conflicts between fisheries and other uses, expert opinions and reviews of research activities, fish monitoring surveys, learning new methods, cruise participation, standardization/calibration of methods, and fishery economics.

  ❍ The rate of success under the Marie Curie Fellowship instruments is usually very low (around 10%). In this context of competition, fisheries and aquaculture research is under-represented with only 29 projects funded among 4700 during the FP5 (respectively 7 among 750 in FP6). Another mechanism is prominently required to enhance this level which represent less that one exchange by Institute every 4 years. Therefore EFARO Institutes feel that a particular effort should be made to manage these weaknesses.

  ❍ The same statement is worth concerning the mutual opening of the infrastructures. Only six projects dedicated to aquaculture research have been funded under the FP5, and none during FP6. This is also an issue that EFARO should consider in its perspectives.

  ❍ The methods and forms of such exchanges are discussed and included duration of stay: short term less than 6 months, medium term 6-12 month and long term more than one year. Financial barriers as well as other obstacles need to be resolved, and agreements on exchanges at an institutional level (bilateral and multilateral) need to be established. In case of vacancies at an institute, the desire was expressed to give priority to occupy the position with staff from other EFARO-institutes (permanent or former doc or post-doc).

  ❍ A 'market' for offers of vacant research positions at Institutes, researchers with interest to stay in another institution, and available space onboard research vessels and land based facilities should be put on the EFARO website.

B- Workshops on Biological aspects

B-1 – Environmental interactions (Berlin workshop, October 2003)

General comments

In the field of Fisheries

Even if one may consider that the weaknesses of the data collection system are under - declared and under -estimated, critical information is provided by these data. But the majority of the resources from the National Institutes in Europe is dedicated to stock assessment issues. The consequence of this is the draining of skills from the research areas to the advice and recommendation activities for policy implementation, mainly for the EC needs and requirements, either under the national or the ICES frameworks. The correlated consequence appears in the lack of human and financial resources that remain available to run scientific programmes particularly in the field of ecosystem research. This is enhanced by the increasing weakness of nationally funded research, the ageing of the researchers in the field, and the very small attraction to the new generation of scientists.

Apart from this major consideration, the major weaknesses in the European organisation of fisheries research relies in (i) the absence of integration of the socio-economic and ecosystem aspects in all the compartments of the research in fisheries, i.e. at the modelling level as well as in the management tools, (ii) the lack of communication of the results, particularly those addressed to end users, and (iii) to a lesser extent in the absence of concrete protocols to implement the ecosystem approach of fisheries activities (ecosystem indicators, genetic approaches).

The major strengths are in the fields of (i) the technical measures for improved selectivity and efficiency of fishing, (ii) the various modelling issues mainly devoted to population dynamics and less frequently to ecosystem and fisheries couplings, and (iii) on the biology and the status of fish stocks under fishing pressure.

In the field of Aquaculture

The major strengths of the EU research appeared to be in the health, genomic and environmental impact issues, which is in line with the EC requirements. The major weaknesses are in the extensive and integrated aquaculture, the effect of the environment on fish and shellfish, and in the economic domains. Concerning the environmental interactions of aquaculture, the effect of nutrients loadings and their modelling is well covered, while the genetic impacts are lesser implemented in the national institutes, particularly in the marine environment. One particular weakness, that is common with the fisheries sector, is the quasi absence of economic prospective for the aquaculture sector.

In both cases, the information about the size of research teams (researchers and technicians) would be very helpful to

Aquaculture development could impact on environment. (SAMS/K. Black)

gain a better quantification.

EFARO's recommendations

R1 – Effects of hydroclimatic and temperature changes on operational indicators for recruitment prediction.

Objectives: The primary goal is to assemble and provide a synthesis of existing knowledge from regional, national, EU and international sources on the effects of climatic forcing on recruitment of marine fish populations.

R2 - Testing and application of candidate indicators of fishing impact to support ecosystem- based fishery management.

Objectives: To identify, further develop and test candidate indicators to support the application of an ecosystem-based approach to fisheries management.

R3 - Integration of fisheries, environmental, and socio-economic data for management scenario analysis.

Objectives: Based on pilot studies, demonstrate the potential of integrated approaches for improving management advice, and the requirements of such approaches in terms of fisheries, environmental and socio-economic data management and exchange at the European level.

R4 - Sources of uncertainty in fisheries advice, variance estimation and degree of confidence.

Objectives:

- To give a quantitative estimate of uncertainty (confidence intervals) for individual sources as well as an overall estimate.
- To reduce the various sources of uncertainty in fisheries advice.

- To improve the reliability and to assess the degree of confidence of advice.

R5 - Determining the spatial and temporal genetic population structure of exploited fish populations.

Objectives:

- Improvement of current assessments of stocks and the advice emanating from such assessments (on which EU management actions are largely predicated) may at best be overly simplistic and or worse seriously defective where the advice formulated and presented may do more harm than good.

- Be able to model or predict the effects of natural variability in the environment or directional climate change on the productivity, recruitment, mortality or sensitivity to fishing by understanding the importance of spatial and genetic population structure in maintaining those exploited fish populations.

R6 - Evaluation of the efficiency of technical (e. g. selectivity) measures and establishing criteria for successful performance.

Objectives: To establish criteria for success and failure regarding the above mentioned performance areas, with the outcome of providing guidelines for technical measures which can be applied meaningfully in various management situations, and recommended implementation.

R7 - Evaluating the impacts of human activities on sensitive fisheries resources.

Objectives: To develop practical, broad-scale methods of spatial and temporal analysis for assessing the impacts of human activities on sensitive fish and shellfish resources.

R8 - Intermediate food chain: Complex interactions.

Objectives: Resolve and model intermediate food chain processes affecting the population dynamics of fish and how this dynamics affect invertebrates (top-down control) and predatory fish (bottom-up control). Describe environmental processes driving these complex intra- and interspecific interactions.

R9 - Analysis of the potential effects of market incentives for fisheries management into the CFP.

Objectives: Development of market based management instruments and development of indicators to assess the efficiency of economic incentives to promote sustainable fisheries.

R10 - Biological and economical relations between fisheries and aquaculture: the case of the Blue fin Tuna.

Objectives: Programs of observers on board and on cages, pilot biological studies on caging fish, cooperation between flag and farming countries and regulations of farming activities, economical incentives.

R11 - Controlled experiments on exploited fish populations.

Objectives: Determine which factors determine the changes in life history of exploited fish and shellfish. Separate environmental from genetic influences.

R12 - Biological experiments on harvested species (hake, cod, sole, anchovy).

Objectives: To determine the effect of capture shock on fitness, including survival, maturation (if applicable) and growth, and its impact on population structure and health.

R13 - A generic ecosystem approach for assessing sustainable levels of aquaculture development in diverse environments.

Objectives: Provide a European-wide working collaboration in which (i) current scientific and regulatory developments can be compared and synergies identified, taking particular note of the needs of industrial, regulatory and end-user stakeholders; and (ii) a generic set of steps developed and validated as tools and concepts for application within different sites and scenarios.

R14 – Extensive aquaculture systems in the context of integrated coastal zone management.

Objectives: to assess the past, present and future role of extensive aquaculture in Europe, in the context of ICZM (in contrast to intensive Aquaculture).

R15 - Development of epidemiological models as management tools to promote a sustainable aquaculture industry.

Objectives:

To provide a modelling framework for understanding the transmission of pathogens between farmed and wild individuals.

To develop models of the contact structure and patterns of trading in aquaculture products and to advise on the likely spread and consequences of exotic pathogen introduction and the implications for risk assessment procedures.

To develop models to predict and manage the impact of changes in production patterns (e.g. trends in stocking density and farm size), culture of new species, multi-species farming and the extension of aquaculture into new areas on disease emergence.

R16 - Restocking programs (turbot, salmonids) with genetic

GIS systems allow the display of complex relations between sea areas used for different purposes, or with different designations. An important aim of coastal zone planning is to minimise any potentially adverse interactions between established activities such as fishing and "new" activities such as aquaculture, renewable energy developments or ecotourism and thereby optimise the use of valuable coastal resources. (FRS Marine laboratory/I.M. Davies)

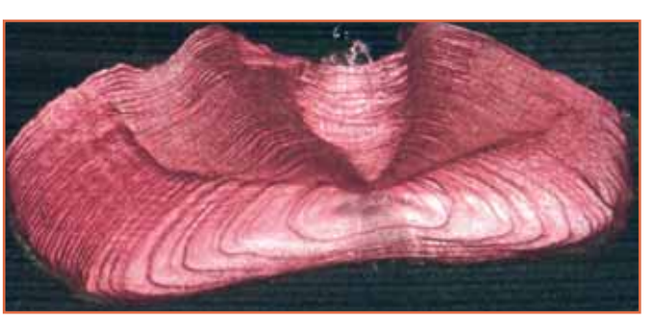
and socio-economic aspects.

B-2 – Age reading techniques (Brest workshop, December 2004)

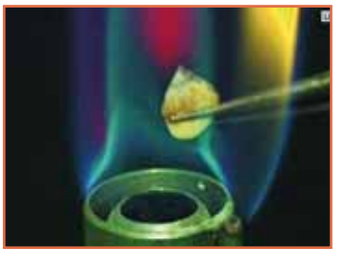
General comments

The EFARO group considers that the ageing community in Europe needs a stronger commitment to make progress one step further toward a higher integration. It appears that a lot of discrepancies are regularly appearing in fish ageing, which are due either to various reading techniques by different Institutes or to insufficient standardisation and normalisation. Nevertheless, a good evaluation of age is currently achieved in some species in various conditions. These species could be considered as a core group to support the European organisation, e.g. by specialising organisation/institutes on reading the age of dedicated species on a permanent and up-dated basis. Some reluctance appears from some Institutes to a more centralised organisation, not completely supported by strong technical arguments. Political issues would also be of relevance in the decision making process which could lead to a real European organisation in this field. This political aspect is not addressed in the scientific recommendations that follow.

In the same way the geneticist community asked EFARO to enlightening the paramount interest in opening land based facilities generally dedicated to marine biology to fisheries



Otolith (CEFAS / R. Millner).



Preparation of the fish otolith for age reading. (Ifremer / Panfili)

sciences, this community is asking experiments to connect age, somatic growth and otolith growth not only from field originating assumptions, but also from reliable controlled experiments.

EFARO's recommendations

R1 – Developing objective model-based and computer-assisted age determination technology for fish stock assessment.

Objectives: To develop a framework that combines information on stock specific otolith accretion patterns and models of age and growth interpretation with computer-assisted age estimation tools. The purpose is to routinely acquire age and growth data from fish otoliths to improve both precision and accuracy of age interpretation and at the same time reduce the acquisition cost.

R2 – Reference collections of calcified structures.

Objectives: Establish validated ("known age") reference collections, collate and disseminate "known age" and "agreed age" reference collections through Internet.

R3 - Network on training and tool development for age determination.

Objectives: Develop training protocols and international networks focused on communication information on standardizing, and on new development within the field of age determination of aquatic living resources.

R4 – Key information on hake biology for assessment: growth, mortality and stock structure through tagging.

Objectives:

- To improve our knowledge on several aspects of the biology of European hake (growth, mortality and movement).

- To improve current stock assessments and management through the realisation of a large-scale tagging programme,

- To develop of innovative methodological tools.

R5 - Experimental approaches to the study of otolith growth and fish age estimation.

Objectives:

- Establish a database of large experimental studies with calcified tissue material that would be suitable for analysis.

- Identify the locations/institutions capable of supporting experimental studies on otolith (or other calcified tissue) growth in relation to environmental variables.

- Identify the locations/institutions capable of performing advanced analyses of otolith material for identification of physical and chemical signals linked to growth under different conditions.

- Develop and realize protocols, through the use of pilot studies, for enhancing the output of experimental studies (aquaculture research) by the addition of fish age estimation goals or deliverables (e.g. in the field of relationships between

somatic growth, gonadic growth, spawning and calcification processes).

R6 - Fish otoliths as Environmental indicator.

Objectives: Develop the analysis and interpretation of otoliths from appropriate species (for example, a widely distributed goby species such as the sand goby *Pomatoschitus minutes),* as an environmental indicator in coastal areas, with special reference to the Water Framework Directive.

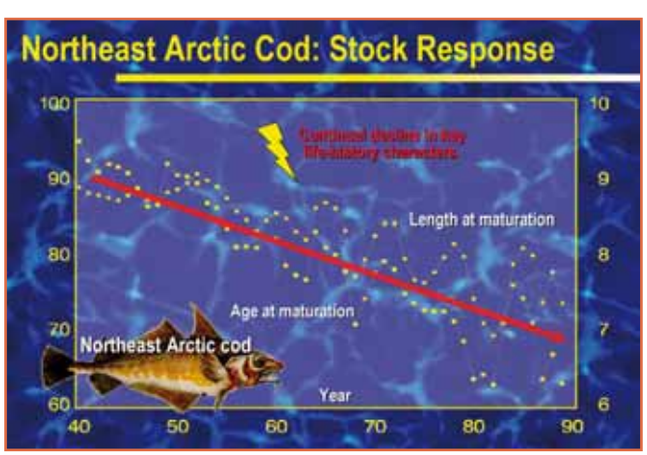
B-3 – Genetic tools and population identification (Lisbon workshop, October 2004)

General comments

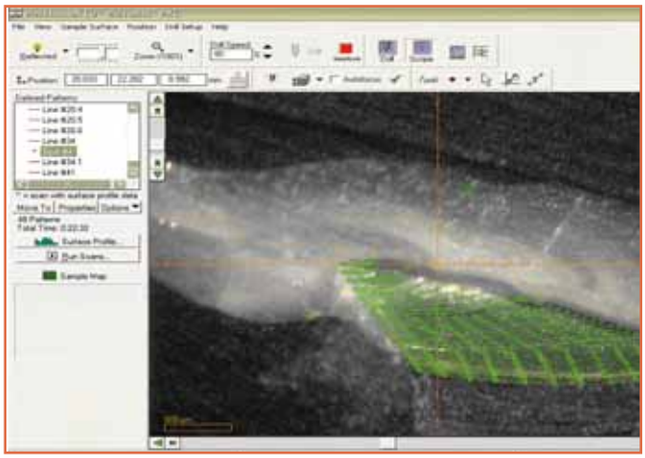
The reflection was oriented towards objects of public interest that could not be handled at the enterprise and/or national level. The level of complexity and the long term schedule of the research in this fields impose an European wide conception of the research process, which makes it a good candidate to promote the European Reseach Area.

This multidisciplinary scientific community, i.e. geneticists, biologists and fisheries scientists, considers that the scientific content of the recommendations they issued during the workshop are readily feasible and realistic.

Sperm sampling for cryopreservation during Freezbass European program in Ifremer Palavas. (Mediaqua / J.M. Deslous-Paoli).



Continual decline in key life-history characters for length and age at maturation for the Notheast Artoc cod. (Bergen Univ. / M. Heino)



Merchantek drill control software running a New Wave Research micromill. Screen shot of the control in the process of milling cod otolith samples for measurement of isotope ratios. The green lines are the pre-programmed drill paths. The camera window shows the drill progress, and the remainder of the windows indicate the control options available through the software. (Dpt of Biology, University of Bergen / H. Høie, A. Geffen, A. Folkvord).

Fish escape due to storm effect could have an impact on genetic diversity of wild population. (FRS-Marine laboratory / Crown).

In addition this community asked to enlighten the paramount interest in opening land based facilities generally dedicated to marine biology to fisheries sciences, in the scope for experiments on Fisheries Induces Evolution, providing a useful bridge between aquaculture and fisheries sciences.

EFARO's recommendations

Differing by the format and the nature, the recommendations are presented into 4 major headings.

Linking genetic diversity and exploited fish stock management.

R1 – Linking the genetic structure of exploited fish stocks with concomitant life history local adaptation.

Objective: Assess the consequences on the population dynamics of exploited fish stocks.

Identify a model species having the required characteristics to perform a complete study before initiating a more general approach to assess potential local adaptation and redefine

species specific management areas

R2 - Addressing fisheries induced changes in the genetic composition of exploited fish stocks and their consequences on population dynamics.

Objective: Develop eco-genetic models as operational tools for the management of genetic changes induced by fisheries (changes in the effective population size, inbreeding depression).

R3 - Using genetic information to clarify biological characteristics of fish stocks related to the potential for recovery.

Objective: Characterize the spatial distribution and the temporal stability of spawning grounds, use genetic information to identify migration patterns and routes, relate patterns of gene activity due to the exposure to pollutants to specific physiological and ecological effects.

R4 - Standardizing data and methods across Europe with a common database.

Objective: The Data Collection Regulation should be opened to genetic data.

Increasing sustainability prospects in aquaculture by using genetics.

R5 - Towards sustainable competitiveness of SMEs in aquaculture thanks to selective breeding programs.

Objective: To fill this gap providing to SMEs this lacking information while creating and animating an European industrial and scientific network in the frame of a Concerted Action.

R6 - Joint optimisation of molecular and quantitative tools in selective breeding programs for aquatic organisms.

Objective:

- Optimization of breeding nucleus design using integration of quantitative and molecular tools.
- Optimization of testing designs for sustainability traits.
- Development of optimal multiplier designs.

R7 - Towards sustainable fish breeding.

Objective: Detail the characterization of sustanability traits and indicators, measurable on elite breeding stocks.

R8 - Domestication in fish and shellfish.

Objective: determine what are the genetic losses during the domestication process of wild strains; appropriate models to study the impact of domestication would be Atlantic salmon, Gilthead seabream, European seabass, Pacific oyster, Atlantic cod, zebrafish or medaka.

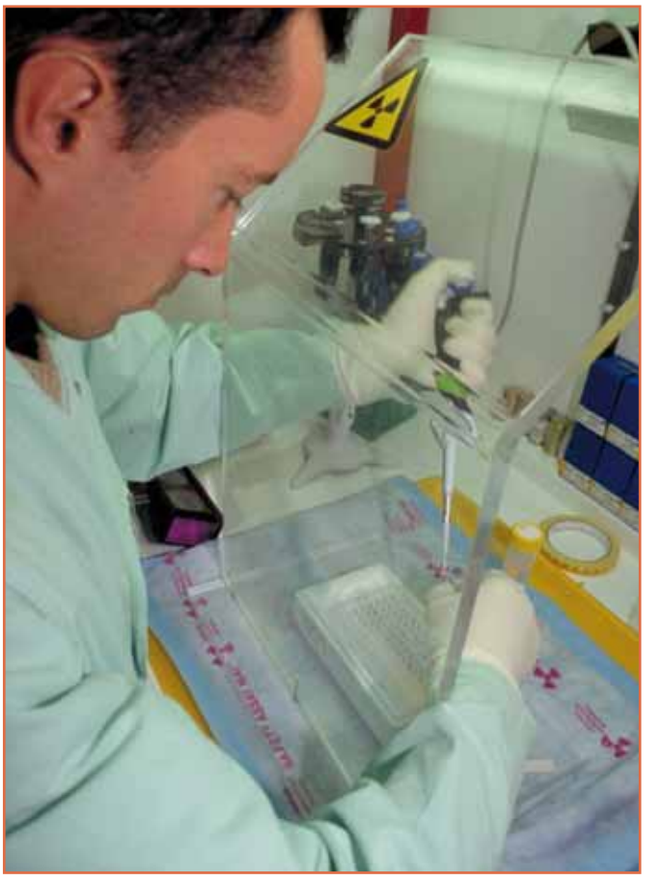
R9 - Optimisation and implementation of genome duplication methods in aquatic animals, including the use of sterility for the protection of wild populations.

Objective:

- Evaluate the consumers level of acceptance (and needs of information) towards triploid products.
- Improve triploid fish performances.
- Alternative strerilisation methods.
- Investigate genome mechanistic by understanding the effects of current techniques, developing new techniques to induce genome duplication, using theoretical simulations and investigate the potential use of genome duplication in breeding programs and "genetic user restriction technology" (GURT).

Food safety and traceability.

R10 - Standardization at the European level of methodologies to develop high throughput tools.



Electrophorese preparation for oyster genes at Ifremer La Tremblade. (Ifremer/O. Dugornay).

Objective: High-density multi-detection test systems specifically designed for the seafood and fish products should be developed using highly innovative molecular genetics procedures to provide extremely accurate results.

C- Workshops on Technological aspects

C-1 – Exchange of boats (Tunis workshop, January 2004)

General comments

Fleet management costs, including depreciation, represents some 50% of the cost in fisheries research. The survey organised by EFARO demonstrates that large parts of European fleet capacities remained unused, either by lack of funding or by lack of appropriate management, while over-subscription was described in other cases. In addition, some very specialised vessel could be better used for specialised cruise requiring their specificity. In these two cases, time could be made available to the fisheries research community, and appropriate technical and financial mechanisms could be invented.

Many institutes have national commitments to monitor remote regions, and loose time and money in non productive passages. Fleet operators could manage their vessels more efficiently and increase the usefulness of the vessels at sea by a regional organisation not necessarily restricted to States borders.

The investigation made by the EurOcean portal (http://www.eurocean.org) displays that the European research fleet is relatively old. In the same time, the European fleet managers indicates a need for building around 25 new vessels within the next 5 years. To the best utilisation of public funds would be the investigation of possible co-utilisation of new and more specialised vessels or equipments that could be shared within scientific communities instead of duplicating them. These observations are not limited to the fisheries research fleet.

Iceland vessel ARNI FRIDRIKSSON. (Marine Research Institut).

The survey organised by EFARO highlights the significant variety of processes and methods adopted by EU countries to implement their fleets. It is a bridle for a better shared use of vessels at the European level. Access to ship time by non-national researchers needs transparency in both technical and financial aspects.

Preliminary statistical analyses on the European fishing research fleet. The first statistical analyse conducted revealed that:

- Half of the 195 European RVs are used for fishing research.
- 46 out of the 94 fishing RVs are smaller than 30 meters.
- 25 fishing RVs are older than 30 years.
- 50 fishing RVs, of which 30 RVs smaller than 30 m are older than 20 years.
- 32 fishing RVs out of 87 European RVs have been built during the last 20 years.
- 16 fishing RVs longer than 50 m have been built during the last 20 years.

EFARO's recommendations

R0 – Both the European countries and the research community would benefit from a better organisation by addressing (i) medium size vessels on a regional basis, and (ii) bigger units on a European level.

R1 – Determine the ways and methods (i) to utilise unused time in fisheries fleet management and (ii) to utilise highly specialised vessel/equipments for an improved scientific return to fisheries research programmes.

R2 – Investigate the solutions to reduce the costs of operating fisheries fleets, particularly in avoiding undue transit time and useless steaming by improving utilisation and/or sharing of common resources.

Norway vessel G.O. Sars. (IMR).

R3 – Facilitate and develop the common specifications and the common building of new facilities, including vessels and heavy equipment.

R4 - Identify expertise, propose improvements and define standardisation issues of both technical and financial management of the national research fleets, including fisheries research fleets.

The EFARO group proposed to his members to organise, on a regional basis, groups in charge of defining strategies to implement fisheries fleets in common in a better way, where it is relevant and necessary, using the EU tools where required. This proposal was accepted by the DG "Fisheries".

These groups were:

- The Baltic Sea (Copenhagen, November 2005).

The main result of the WG was to make the two major partners (Sweden and Denmark) to agree on a process to share a new coastal vessel. Indeed a global agreement is not sufficient when other countries are willing to push the building of new vessel in a context of global overcapacity in RV all around Europe. The two partners agreed to push forward the topic in various places. A third partener (Norway) could be interested. EFARO will follow up the initiative.

- The North Sea and the Irish Sea (Brussels, April 2004).

The group discussed the Term of Reference edited during the Tunis WS. It concluded that there are likely to be advantages in closer co-operation between EFARO members in a number of areas. However, to take the process of collaboration further, there is a need for agreement at a high level (e.g. by institute Directors). The Group therefore recommends that a strategic planning group be formed to establish the basis for collaboration and identify the tasks that would be needed to implement the strategy. The group would be comprised of institute Directors or senior managers who could make policy and financial decisions about the assets concerned. He recommended that an experimental workshop be held to explore how ships programmes might be planned collaboratively.

The four main issues on which they should make progress towards common implementation are :

- How access to resources in the differing institutes would be 'paid for' ?

- How the planning for the replacement or decommissioning of old vessels might be co-ordinated on a regional scale ?

- How scientific standards and procedures may be harmonised among the participants ?

- The scope for marketing un-funded capacity.

There was a global agreement from UK, Scotland, Denmark and Norway to go further in these directions, while Germany considered that its requirements were well covered by their existing facilities at sea. Even if ICES Study Groups are working on standardization of international data collection programme cruises, these are done from a research/scientific point of view, rather than the efficiency of operation. For the management point of view there is urgent need for a multi-year cruise, manning and new-building strategy to co-ordinate the national plans as specified per country.

The group recommended meeting again to implement in a practical ways these recommendations using 2003 national implementation plan for the fisheries RVs. To take advantage of the ESF-MB activities on RVs, MUTFISHARE supported the presence of an EFARO observer to the annual ERVO-OFWG conference in Barcelona

• The Atlantic (essentially Biscaye Gulf) and the Mediterranean (Paris, May 2004).

The group addressed the four same questions than the Brussel's working group.

On the question of the utilisation of available time, it appears in this group of the Southern European countries which did not included Italy, Malta, Slovenia and Cyprus, that very few spare time could be available provided the large number of cruises required.

On the question of cost reduction, the major issue that has been raised concern a better utilisation of transit time, particularly for the steaming out of French and Spanish RVs from the Mediterranean to the Atlantic (and vice versa). Nevertheless the Group pleaded for a better cooperation in the Western and Eastern Mediterranean basins.

On the question about common investment, the idea of building a medium (30-40m) size polyvalent RV to be utilised from the Adriatic to the Aegean Sea was validated, but still need further discussions with interested parties.

On the question about standardisation, the main issue considered by the Group addressed the problem of the big discrepancies in the costs to running the vessels in the different countries, which is a barrier to overcome in the perspective of exchanging campaigns and scientific teams.

C-2 – New methods and tools for stock assessment (Gdynia workshop, October 2005)

General comments

The objective of the meeting was to share experience between three EU projects, EASE, PKFM and FEMS, all of them addressing management and strategy for advice under the CFP.

The principal objective of EASE is to develop the basis for data collection and analysis programmes more appropriate for existing and emerging fishery management issues. This includes to i) resolve the balance between resources devoted to data collection and value of these data in provision of advice,ii) quantify the quality of the scientific outputs derived from the data inputs, iii) identify alternative uses of data and analytical methods and iiii) outline ways of re-deploying existing resources in order to support a modern fishery management system.

Belgium vessel BELGICA. (Agricultural Research Center-Sea Fisheries Department).

Greek marine submersible THETIS.(HCMR).

The overall objectives of PKFM are to identify and understand specific shortcomings in the European fisheries policy and its implementation, which have contributed to the problems evident in several European fisheries, and to devise means for their rectification. The project focuses on the knowledge production and decision-making within the fisheries management system, the interrelationships between these processes and the role played by stakeholders.

FEMS has developed a generic computer based simulation framework to evaluate alternative assessment and management strategies through a variety of contrasting case studies. The framework is able to explicitly take into account a broad range of uncertainty both in the dynamics of stocks and fleets, and their response to management and is intended to be used to evaluate assessment and management.

EFARO's recommendations

R1 – Effort management system.

Objective: set-up an effort management system, including the data and monitoring requirements, assessment methods,

advisory and management procedures, enforcement and control requirements. This study should address the likelihood to minimise problem areas in the present fisheries management e.g. mixed fisheries issues, discards, multi-annual harvest control rules, ecosystem approach.

R2 - Ecosystem approach to fisheries management

Objective:

– Asses how human impact can change the productivity of the ecosystems, and how external drivers may alter the productivity of the systems and its forcing function.

– Additionnal resources will be required for process studies on the manner in which fisheries impact the environment. On of the most obvious external factors which may have affect productivity in the last few decades is climate change. Research would aim to provide a quantifying current knowledge of processes throught whichclimate change acts, implementing models to stimulate plausible climate change processes and hypotheses, and using them to provide better advice in the future.

Objectives:

– How human impact can change the productivity ?

R3 - Framework for the evaluation of monitoring, assessment and management strategies.

FEMS developed a generic software framework for the evaluation of management strategies against a broad range of objectives.

Objectives: This tool will allow major questions to be addressed with respect to sampling schemes, stock assessment methodologies, harvest rules and enforcement regimes and to identify what elements of the system require a better understanding (e.g. where to target research) and what elements can be controlled (i.e. how to apply management action).

R4 - The role of scientific surveys in future science and advisory programs.

Objectives: 45% of the whole resources devoted to fisheries research are utilised for conducting surveys and advice about fish stock status. Introducing ecosystem related data will increase the demand. Therefore it seems unrealistic that this increase would be executed without major revision of the present organisation. Further coordination at EU level is required, the framework of which is to be developed.

R5 - Sociological research in support of the CFP.

Objectives: The fishing industry and conservation interests are no longer prepared to accept the results of fisheries science without question and this can be seen overall as positive development because it forces these groups to engage directly with the production of knowledge. Management strategies must be built on a comprehensive, multidisciplinary understanding of the fisheries system that considers the linkages between the scientific, economic, behavioural/compliance and regulatory sub-systems. Sociological human ecology provides a conceptual framework for this kind of systems-reasoning.

R6 - The management of the small scale coastal fisheries (SSCF) in the Mediterranean.

Objectives: To date SSCF has not been identified as a special case and in policy terms has largely been ignored by both Europe and the member states. The vacuum in policy has left SSCF exposed to competition from within the sector (allocation of property right is not well defined) and from pressures from other sectors (offshore fisheries or large boat fisheries, tourism, aquaculture). This is particularly relevant to the Mediterranean. Research usually does not address socio-economic components, or particular areas (e.g. lagoons). At special concern should be the updating of a flexible management approach of SSCF.

Scientific estimation of fish stock. (DFU/N. Madsen).

Resurfacing of a bottom travel on Soard the R.V. Thalassa in the gulf of Biscay.(Ifremer/O. Dugornay).

C-3 – Data bases (Barcelona workshop, January, 2003)

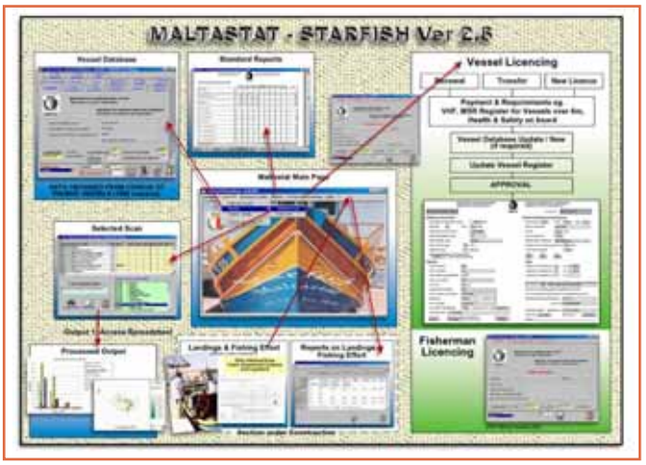
The workshop dealt with two typical cases: the Mediterranean and the economy.

General comments

Data base for the Mediterranean Fisheries

France, Spain, Italy, Greece and Malta all have their national system for collection and storage of fisheries data under the Council regulations. A rough comparative analysis displays that:

- in all four Mediterranean MS, scientific institutes are able to give additional and neutral data among those obtained through the official declarative process.
- in all four Mediterranean MS, the data will be centralised



FAO MedStat data base. (FAO).

prior to their exhaustive availability to the Public authority.

- from 2002, these systems are improving permanently, including the rationalisation of sampling methods and the spacialisation of the fleet activities.
- the quality control of the original data (i.e. during the collection phase) is not mastered in the same way in each countries. This calls for normalised and standardised protocols.
- the data from the independent surveys are not aggregated. Nevertheless, efforts have been made to have common survey methods at the Mediterranean level, particularly in the MEDITS initiative.
- the technical aspects of the data management (software) seem well mastered in all the MS.
- the evaluation of discards using onboard observers seems to be the less advanced activity.
- recreational fisheries are not evaluated, except for tunas and wordfish.
- biological sampling is always difficult, costly and time consuming.

Data bases for the economy aspects of European Fisheries

The recent communication of the Commission regarding "Improving Scientific and Technical Advice for Community Fisheries Management" recommends in its Basic Principles that "The scientific advises should cover all relevant factors, and notably (…) economical and social factors." and declares for the social and economic dimension that "the Commission's intentions are to evaluate the quantity, quality and scope of the [fisheries economic] data concerned.

The main consideration by the participants were :

- There are a huge quantitative and qualitative diversities among the data collected at national levels.
- Some countries (France, Italy) developed very detailed procedures, based on precise methodologies submitted to constant improvements.
- The procedures utilised seemed to lack a common conceptual frame.

Ifremer SISMER data base. (Ifremer).

EFARO's recommendations

Data base for the Mediterranean Fisheries

R1 - The MedStat system, seems convincing and well organised. It is based on a National data base network. It would be necessary to include biological data, scientific surveys, discards and socio-economical data and associated additional developments to this open system.

R2 - The system would utilise data processing protocol and data quality insurance process compatible with EU requirements.

R3 - The GFCM could be a very valuable partner in the context of the international management of fisheries data bases in the Mediterranean area (the EC strongly supports the Scientific Advisory Committee of GFCM and participates in the funding of MediFISIS projects in collaboration with FAO). As a regional organisation, GFCM should be eligible to participate in an EU project aiming at rationalising the fisheries data management in the Mediterranean area.

R4 - The GFCM is co-ordinating programmes to implement data collection. Nevertheless, the capacity by GFCM to manage large quantity of data with no permanent staff at the present, is questionable. A process should be formalised to make the data available to the ICCAT, FAO and GFCM advisory Committees, and to the Commission (STECF).

R5 - Consensus appears to organise distributed data bases instead of one centralised centralised data base. Raw data (but not personalized), and not only the aggregated data required by the EU commission, must be exchanged for scientific purposes.

R6 - Opportunities offered by Infrastructure and ERANET instruments in the FP6 were also investigated. Infrastructure instruments are well adapted to support the technical aspects of data bases through. ERANET could improve the exchange of data.

R7 - The question of the linkage with the SEADATANET initiative is also worth discussing, since it could facilitate the integration of oceanographic data in fisheries data.

Data bases for the economy aspects of European Fisheries

R8 - ICES confirmed that it is not interested in the management of a socio-economy data bases, but the question may be addressed again by DG Fish to the ICES general secretariat. In any case, it will not cover the Mediterranean area. The sharing of this data in an international network is relevant, as it is the case for the biological data. EAFE proposed being the management unit for these data base issues.

R9 - The central role of the EAFE has been acknowledged, and the quality of their advices has been recognised. Nevertheless, as is the case for the GFCM, EAFE does not run data bases on their own, and does not have the permanent staff to manage them. Committing EAFE to the management of this data seemed premature to number of participants.

R10 - In both cases (i.e. sharing of data and long term series), the access controls have to be strengthened, because they are applying to very sensitive data.

R11 - Contrary to data describing catches and landings (where European standards are perceivable) to date there is not a common European approach.

R13 - The determination of the future role and structure of the STECF will be a huge determinant for the development of these "economy centred" actions. The EAFE advice function after 2005 and its linkage with the STCEF are under debate and will be stated at the same time of STECF's re-organisation.[1]

R14 - For a first preliminary step, it is proposed that EAFE could coordinate a project to standardize the national economic and social data management.

R15 - EFARO proposed to suspend any final recommendation before a strong line will be adopted by the EU countries following the reinforcement of the STECF.

D- Workshop on Specific research issues

D-1 – Aquaculture diversification (Budapest workshop, February, 2005)

General comments

New pending EU legislation on the introduction of new species will limit the number and nature of species that can be farmed in Europe, except in the case of recirculation technology.

The objective of the European aquaculture is to provide healthy safe and nutritious seafood for the EU consumer and reduce the chronic imbalance between fisheries capture and consumer demand.

Statistics on fish farming in the EU-15 appears to show that there has not been any growth (in volume or value) since 2000/2001. The trout industry is recessing, the production of eel and turbot has been consolidated. The only growth is expected for seabass and seabream in the Mediterranean and for carp in inland Europe. Within 10 years, the European self-sufficiency will decrease from 60 to 45 %. Again the lack of relevant and secure data makes the appreciation difficult.

In **freshwater aquaculture,** a new species will provide a market opportunity if prices rise. The introduction of new species will involve expensive culture techniques and there is a high risk of loss when the market drops. Potential candidates are: perch, sturgeon, African catfish and tilapia.

In **Mediterranean aquaculture,** new species could

Overall, the general position is that of extreme caution because of the number of technical failures, lack of economic viability and incorrect market assessments/analysis.

The industry will recommend reviewing at the technical issues but also at marketing (what the consumer wants as well as what the retailer buys).

Among the 32 candidate new species currently looked at, 4 are fish species found for a worldwide market and 27 are for regional ones. Slow growers have to be forgotten, except for targeting small niche market. In this regard, the strategy is to produce low quantities (around 10 000 T/y) for a regional market at high price. But there is no example where an increase in production has not been followed by a decrease of the prices.

EFARO's recommendations

R1 - Evaluation of socio-economic value of European aquaculture (including processing and non-commercial value, eg. aquaculture compared to imports) together with the development of methods and database at the European level (including production, economical & social aspects, consumption and market issues, consumer acceptance).

Objectives:

- To design a framework that addresses the different types of value or total value that we can assign to aquaculture. A database on its content can be set up and also the way the information will be collected.
- To develop tools and methods to assess the total value of the European aquaculture.

R2.- Evaluation of production of high quality fish and shellfish juveniles, including new species.

Objectives:

- Identification of criteria to assess egg, larval and juvenile quality by integrating environmental, genetic and nutritional factors.
- To investigate the influence of environmental parameters on general reproductive processes and egg quality.
- To investigate the influence of broodstock nutrition and husbandry on egg quality.

Captive bluefin tuna after being administered the GnRHa implants, with a visual tag for individuall identifycation. EU FP5 program REPRODOTT.(Helenic Center for Marine Research / C. Mylonas).

1. STECF is the only regular provider of economic advice to the Commission. (…) A way must be found to continue and to develop this valuable economic tool". "The scope of activity of STECF could be reduced to two main areas : the provision of economic advice and information, and an monitoring and supervisory role for the activities of ICES. Advice on the Mediterranean issues may be retained within STECF". (UC communication "Improving Scientific and Technical Advice for Community Fisheries Management").

Abalone aquaculture in Israel. (National Center for Mariculture / A. Diamant).

- Development of to egg quality criteria based on parental condition, and biochemical and morphological features of the eggs, able to predict larval quality.

- To investigate the influence of environmental production system and larval nutrition on juveniles quality.

- Use of morphological, behavioral criteria to assess the quality of juveniles produced with different systems.

- Extension of biological and technical knowledge to the production of juveniles of new species.

- Identification of criteria able to identify juvenile characteristics for different future uses: intensive, extensive, restocking.

R3.- Modern approach for fresh and seawater extensive and semi-intensive pond aquaculture.

Objectives:

- Product diversification (new species, new product quality).

- Research of modern aquaculture strategies (fertilisers, engineering, new poly-cultural, and combined extensive-intensive systems).

- Development of modern extensive, semi-intensive, and integrated aquaculture systems in coastal and inland European waters.

- Semi-extensive pond production of "high quality" fingerlings for lagoon and pond re-stocking.

- Health management of the aquatic organisms.

- Bioeconomic evaluation of the aquaculture systems.

- Research of multifunctional sustainable systems (waste treatments, eco-tourism, water resources management, biodiversity).

- Food safety and consumer acceptance of final aquatic products.

- Improved methods to control undesirable species (invasive plant and fish species, competitors, predators).

R4.- Development of recirculation system focused on sustainable development of aquaculture in Europe.

Objectives:

- Identify the main bacterial communities, their activities and interactions. Model the bacterial populations functioning in relation with water quality. Effect of treatments and of potential introduction of pathogens.

- Identify and characterize the GIF produced by the fish and/or the system and define means to avoid their production or to remove them, possibly by removing POM for some fish species using modified feed or technical means.

- Temperature control, improving energy use efficiency for water circulation, gas treatments.

- Treatment and valorization of waste products.

- Any solution developed should take into consideration the animal welfare and consumer perception.

R5. Restocking towards stock enhancement.

Objectives:

To review the numerous stocking programs that have been carried out with highly varying success, to determine which criteria and conditions are necessary to meet the objective of stocking and develop procedures for responsible stocking. A multidisciplinary approach is required and workshops are an ideal tool for addressing the different topics.

Case studies using information from earlier or present day releases of fish, shellfish and other invertebrates in different areas and under different scenarios can be used to validate and test the hypotheses and models developed.

New concept for off shore fish farming. (SINTEF)

D-2 – Fisheries management (Thessaloniki workshop, March 2005)

General comments

The global EFARO philosophy behind this initiative was:

- To update the willingness of both scientific communities to cooperate formerly.
- To try to fill the gap detected in the advisory process within the CFP, between biological and economic advice.;
- To evaluate the possibility to change the paradigm from "working sequentially" to "working in parallel", precluding "working in an integrated way".
- To propose, if possible, some research projects, merging the two approaches more intensively, with the twined objective to support the CFP with new tools in the toolbox, and to demonstrate the potential benefit such an ambition could bring.

What is the Triple Bottom Line?

The triple bottom line (TBL) focuses corporations not just on the economic value they add, but also on the environmental and social value they add – and destroy.

The triple bottom line.

The three lines represent society, the economy and the environment. Society depends on the economy - and the economy depends on the global ecosystem, whose health represents the ultimate bottom line.

Instability.

The three bottom lines are not stable; they are in constant flux, due to social, political, economic and environmental pressures, cycles and conflicts.

Continental plates.
Think of each bottom line as a continental plate, often moving independently from the others.

Shear zones.
As the plates move under, over or against each other, 'shear zones' emerge where the social, economic or ecological equivalents of tremors and earthquakes occur.

- *Economic/environmental* - In the economic/environmental shear zone, some companies already promote eco-efficiency. But there are greater challenges ahead, e.g. environmental economics and accounting, shadow pricing and ecological tax reform.
- *Social/environmental* - In the social/environmental shear zone, business is working on environmental literacy and training issues, but new challenges will be sparked by e.g. environmental justice, environmental refugees, and the intergenerational equity agenda.
- *Economic/social* - In the economic/social shear zone, some companies are looking at the social impacts of proposed investment, but bubbling undermeath are issues like business ethics, fair trade, human and minority rights, and stakeholder capitalism.

EFARO recommends that a typical protocol to address these issues should include the definition in common of a management scenario applied to one specific case. This typical methodology needs to be predictive enough to enable comparative analysis based simultaneously upon a wider range of parameters relevant to both the resources and the socio-economy indicators. It could be applied on historical cases where sufficient data sets could be available.

Deep sea lobster, *Nephrops norvegicus* (Ifremer/O. Barbaroux).

Cod. (RIVO / M. Pastoors)

Trawling vessel (Ifremer).

EFARO's recommendations

R1 - Priorities for cooperative research on ecological, economical and social aspects of fisheries.

Objectives:

- Mixed fisheries: description and modeling, comparison of outcomes from the three perspectives, combined advices on management options.
- Spatially explicit management measures: information needed for design, monitoring methodologies, modeling and evaluation; first application could be on MPAs.
- Fisheries response to regulations: resource and market state, social considerations.
- Needs and possibilities for an adaptive fisheries management in a dynamic world, e.g. climate change, market development.
- Role of institutional structures in the functioning of the advisory process.

R2 - Priorities for structural considerations.

Objectives:

- Temporal and spatial scale of advice: the need for regionalization and multi-annual management scheme.
- Management objectives: authorities and stakeholders taking responsibility).
- Stakeholder involvement: transparent communication of advice, research results, consideration of feedback, involvement in short- to medium-term research planning.

Annex 2
Acronyms and abbreviations

AIR	Agriculture and Agro-Industry- Programme under FP4
ASFA:	Aquatic Sciences and Fisheries Abstracts
CFP:	Common Fisheries Policy
CIESM:	Mediterranean Science Commission (www.ciesm.org)
CFP:	Common Fisheries Policy
CMR:	Hellenic Centre for Marine Research (http://www.ncmr.gr)
CRAFT :	Cooperative Research
DCR:	Data Collection Regulation
DESIRE:	Development of a European Service for Information on Research and Education
DFU:	Danish Institute for Fisheries Research (=DIFRES, www.difres.dk))
DG:	Directorate General. For Fish see (europa.eu.int/comm/dgs/fisheries/index_en.htm)
EAFE:	European Association of Fisheries Economists (www.eafe-fish.org/)
EAS:	European Aquaculture Society
EASE:	European Advisory System Evaluation
EBM:	ecosystem-based management
EC:	European Economic Area
EEAA:	European Commission (europa.eu.int/comm/index_en.htm)
EFARO:	European Fisheries and Aquaculture Research Organisations (www.efaro.org)
EoI:	Expression of Interest
EP:	European Parliament (www.europarl.eu.int)
ERA:	European Research Area
ERANET:	European Research Area Network
ERVO:	European Research Vessel Operators
ESF-MB:	European Science Foundation – Marine Board (www.esf.org/esf_generi page.php?language=0&section=2&domain=3&genericpage=177)
EU:	European Union
EurOcean:	European Centre for Information on Marine Science and Technology (www.eurocean.org)
FAIR:	Agriculture & Fisheries Agro-industrial research
FAO:	Food and Agriculture Organization (www.fao.org)
FEMS:	Framework for the Evaluation of Management Strategies
FP4/5/6:	Framework Program 4, 5, 6
GFCM:	General Fisheries Commission for the Mediterranean (www.fao.org/fi/body/rfb/GFCM/gfcm_home.htm)
GIF:	Growth Inhibiting Factor
GMO:	Genetically Modified Organism
GPA:	Global Program Action for the Protection of the Marine Environment from Land-Based Activities (http://pops.gpa.unep.org)
IBTS:	International Bottom Trawl Survey
ICCAT :	International Commission for the Conservation of Atlantic Tunas (www.iccat.es)
ICES:	International Council for the Exploration of the Sea (www.ices.dk)
ICZM:	Integrated Coastal Zone Mangement
Ifremer :	Institut Français de Recherche pour l'Exploitation de la mer (www.ifremer.fr)
IMBR:	Institute of Marine Biological Ressources
INSU:	Institut des Sciences de l'Univers (www.insu.fr)
IP:	Integrated Project
KDM:	Konsortium for Deutsche Meeresforschung (www.deutsche-meeresforschung.de)
MASMANAP:	Methodology for Seafood Market studies in the aim of introducing new aquaculture products (UE Concerted Action)
Marifish:	Marine Fisheries ERANET
MarinERA:	Marine ERANET
MediFISIS:	Mediterranean fishery statistics and information system
MEDITS:	Mediterranean international trawl survey
MPAs:	Marine Protected Areas
MS:	Member State
MUTFISHARE :	MUTualization on FISHeries and Aquaculture european REsearch institutes
NERIA:	Network for European Research Infrastructure for Aquaculture
NGOs:	Non Governmental Organisation
NoE:	Network of Excellence
OECD:	Organisation for Economic Co-operation and Development (www.oecd.org)
OFWG:	Ocean Fleed Working group of the ESF.MB
POM:	Particulate Organic Mater
PKFM:	Policy and knowledge in Fisheries Management
R&D:	Research and Development
RAC:	Regional Advisory Committee
RTN:	Research Training Network
RUP:	"Ultraperipherical Regions" in French
RV:	Research Vessel
SEADATANET:	Pan-European infrastructure for Ocean & Marine Data management for on line integrated data access (www.seadatanet.org)
SMEs:	Small and Medium Enterprise
STECF:	Scientific, Technical and Economic Committee for Fisheries
STREP:	Specific Targeted Research Project
TACs:	Total Allowable Catches
TBL :	Triple Bottom Line
UN:	United Nation
VMS:	Vessel Monitoring Systems
WSIS:	World Summit on the Information Society (www.worldsummit2005.org)

Annex 3
List of the projects with EFARO members coordination or participation during the 6th FP

AQUAFIRST	Key genetic characteristics to improve selective fish breeding for disease resistance
BECAUSE	Improving multi-species fisheries assessment in five European regional seas
BLUESEED	Technology development for a reliable supply of high quality seed in blue mussel farming
CAFÉ	Capacity, fishing mortality and fishing effort
COMMIT	Committing to tailor-made long-term fishery management strategies
DEGREE	Development of fishing gears with reduced effects on the environment
DIPNET	Learning more about the transfer of pathogens in the sea
ECASA	Environmental and socio-economic effects of aquaculture
EFIMAS	Evaluating scientific advice and decision-making processes in fisheries management systems
EMPAFISH	Ecosystem conservation and fisheries management through Marine Protected Areas
EUROCEANS	European network of excellence for ocean ecosystem analysis
EVENT	Enteric virus emergence : new tools
FASTFISH	On Farm Assessment of. Stress in Fish
FISBOAT	Fishery Independent Survey Based Operational assessment Tools
GENIMPACT	Evaluation of genetic impact of aquaculture activities on native populations
GRRAS	Towards Elimination of Growth Retardation in Marine Recirculating Aquaculture Systems for Turbot
ICES-FishMap	Updating the ICES Atlas of North Sea Fishes
INDECO	Developing environment indicators for assessing fishery management
ISTAM	Improve scientific and technical advice for fisheries management
MARIFISH	ERANET project on fisheries
MARINERA	ERANET project on Marine Sciences
NECESSITY	Modified fishing gear and practices to reduce by-catch in trawl fisheries
PANDA	Permanent Advisory Network for Diseases in Aquaculture
POORFISH	Probabilistic assessment, management and advice model for fisheries management in the case of poor data availability
PROTECT	Ecosystem conservation and fisheries management through Marine Protected Areas
UNCOVER	Understanding the Mechanisms of Stock Recovery
WEALTH	Improving the health and welfare of farmed fish

EFARO Members

BFA	Federal Research Center for Fisheries – GERMANY www.bfa-fisch.de	
CEFAS	Centre for Environment, Fisheries and Aquaculture Science - UNITED KINGDOM www.cefas.co.uk	
DFMR	Department of Fisheries and Marine Research – CYPRUS	
DIFRES	Danish Institute for Fisheries Research – DENMARK www.difres.dk	
EMI	Estonian Marine Institute – ESTONIA www.sea.ee	
FGFRI	Finnish Game and Fisheries Research Institute – FINLAND www.rktl.fi	
Fisheries Research Laboratory	LITHUANIA www.zum.lt/min/OS/dsp_struktura.cfm? StambesnisID=81&langparam=EN	
FOI	Institute of Food and research Economics – DENMARK www.foi.dk	
FRS	Fisheries Research Services - UNITED KINGDOM www.frs-scotland.gov.uk	
HCMR	Hellenic Centre for Marine Research – GREECE www.ncmr.gr	
ICRAM	Instituto Centrale per la Ricerca scientifica e tecnologica Applicata al Mare – ITALY www.icram.org	
IEO	Instituto Espanol de Oceanografia – SPAIN www.ieo.es	
Ifremer	French Research Institute for the Exploitation of the Sea – FRANCE www.ifremer.fr	
ILVO	Instituut voor Landbouw and Visserijonderzoek, Eenheid DIER – Visserij (ex CLO – DVZ) –- BELGIUM www.dvz.be	
IMR	Institute of Marine Research – NORWAY www.imr.no	
IPIMAR-INIAP	Instituto de Investigação das Pescas e do Mar - Instituto de Investigação agraria e das Pescas - PORTUGAL ipimar-iniap.ipimar.pt	

LATFRA	Latvian Fish Resources Agency - LATVIA www.latzra.lv	
LEI	Dutch Agricultural Economics Institute, Wageningen UR – NETHERLANDS www.lei.dlo.nl	
MCFS	Fisheries Conservation and Control Division, Malta Centre for Fisheries Sciences – MALTA www.maltafisheries.gov.mt	
MIR	Sea Fisheries Institute – POLAND www.mir.gdynia.pl	
MRI	Marine Research Institute – ICELAND www.hafro.is	
NBF	Fiskeriverket / National Board of Fisheries – SWEDEN www.fiskeriverket.se	
RIVO	Netherlands Institute for Fisheries research, Wageningen UR - NETHERLANDS www.rivo.wageningen-ur.nl	
The Marine Institute	IRELAND www.marine.ie	
ZZRS	Fisheries Research Institute of Slovenia – SLOVENIA www.zzrs.si	

EFARO's partners

European Aquaculture Society	
European Union	
International Council for the Exploration of the Sea www.ices.dk	
EAFE www.eafe-fish.org	
ESF-MB	