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Review of project proposals submitted by the European Parliament Fisheries Committee to STOA

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1 Introduction

EASAC was invited to review proposals for three projects arising from the Fisheries Committee of the European Parliament. The proposals were sent to five experts identified by EASAC members; their responses are presented thematically below (with minor editing). There is, inevitably, some overlap and repetition; I have allowed this in order to preserve some of the flavour of the responses. A summary is given at the end of each review. No attempt has been made to seek consistency between the various responses, since differences where they exist can highlight important areas of uncertainty. However, where there is consensus this has been identified.

The identity of the five reviewers is confidential, in accordance with agreed practice. However, it may be reported that they come from Greece, Italy, Spain, Sweden and the UK; and their collective expertise includes adaptation in marine organisms; assessment and management of marine fish stocks; benthic community structure and function; biological oceanography; dispersion of particles in the ocean; marine ecosystems; population biology of fish and shellfish; population genetics. All reviewers have confirmed that they have no vested interests that could render them inappropriate for undertaking this task.

Three reviewers commented on the first proposal, and five on the second and third.

2 General

Most reviewers highlighted the absence of detail in the proposals. Each proposal had a brief abstract and a comment on relevance to current legislative work, but none identified the '4-6 topics to be covered' (#4 of the proposal form) or provided a timetable (#7) that could give an idea of the scale of project envisaged. In the absence of this level of information about the exact intentions of the Fisheries Committee, reviewers found it at times difficult to provide a focused response.

On the question of scale, one reviewer advised that 'the most cost-effective thing for the Parliament to do is to commission a (short ?) state-of-the-art report (by commissioned expert consultants), and use the results to motivate the Commission to fund an extended research project lasting for several years, and costing (in each case) several millions of Euros. Under successive Framework programmes the high level political imperatives have forced a broader and broader approach by the Commission (eg the "City of the Future"), to the detriment of targeted research on topics of genuine interest to the Parliament (and others), and this could help to reverse this process.'

3 Contribution of algal blooms to shellfish poisoning and their impact upon aquaculture

i Scientific assessment

There is an extensive literature on this world-wide problem (a quick internet search with Google yielded 2470 hits on "toxic algae blooms shellfish poisoning", of which 685 referred to Europe). Considerable research in this area has already been funded by the EU (see RTD News, at http://europa.eu.int/comm/research/rtdinfo/en/28/environnement2.html). However the factors that cause toxicity of blooms remain uncertain, and further research is likely to be funded under Framework 6 programmes., although this is not yet apparent from the current list of expressions of interest (see http://www.epsoweb.org/catalog/EU/fp6/P6_EoI_web%2027%20Aug.PDF)

UNESCO and ICES (International Council for the Exploration of the Sea) have also coordinated international research programmes on this topic (see eg http://ioc.unesco.org/gpsbulletin/Vol2article.htm and http://www.ices.dk/reports/OCC/2002/WGHABD02.pdf) and this most recent report of the ICES working group on this precise subject may be the best entry point into the literature.

The title of the proposal is very general and there is an extensive literature on the issue in respect of specific species and cultivations and specific European locations. The cycles of contamination of bivalves and the persistence of toxins in them have been described.

There is an extensive bibliography on the family *Mithyllidae* (mussels), where it is known that the toxins remain from five to nine days in the bowel of the animal, until they disappear in the purification phase with clean waters. However in the family *Pectinidae* (scallop) the toxin is never purified and it remains inside the animal.

There is no doubt that algal blooms cause shellfish poisoning and that this can and does have serious impacts on fisheries on both wild stocks and on aquaculture. But it is not certain that algal blooms have increased overall since the evidence to date focuses on specific species and locations.

ii Economic and social assessment

The issue is of considerable economic and amenity importance (in some places at some times, especially around the coasts of Spain, Portugal, France and the UK) and the question posed is therefore reasonable and pertinent.

The problem with harmful algae is of great immediate concern and has great economical, social and ecological impact on the mariculture industry in many parts of the world. I recommend that this project is given high priority in the further evaluation.

The project is very interesting since the problem of shellfish poisoning is much studied because of its significance for European aquaculture (http://www.nioz.nl/loicz).

These species are very important for the aquaculture industry and the problem is very little studied in the Mediterranean sea. On the other hand there are not deep studies on the fisheries of bivalves and the regulations needed to address consumer safety issues.

Toxic algal blooms of genera such as *Alexandrium* and *Dinophysis* have been spreading in both time and space with great impact on the mariculture industry in many parts of the world.

iii Other issues

The question as posed is very general, and if a better understanding of the overall problem is required, this would imply that the Commission should be mandated to fund a further long-term targeted research programme. If, on the other hand, a short synthesis briefing report is required, it would be helpful to make the questions more specific, eg

a) When and where is shellfish poisoning due to harmful algal blooms a significant problem in European waters, for both aquaculture and fisheries on wild stocks?
b) Is the problem getting worse (and if so why)?
c) Can anything be done to reduce the problem (and if so, what)?

There would be no difficulty identifying and commissioning a consultant or a research institution in Europe to prepare a synthesis report, if those reports cited above are not adequate (or are too voluminous for the purpose).

One of the central objectives of EU environmental policy is to ensure the preservation of ecosystems as well as their functioning, biodiversity and service to society. For example, FP VI includes an expression of interest in this area. The proposed Network of excellence named ECCO is being established with the aim to making Europe a world scientific leader in understanding and predicting: (1) the interactions and feedbacks between marine ecosystems and climate, and (2) the changing cycles of biogenic elements due to anthropogenic effects. The mid-tem objective is the creation of a *European Institute for Marine Ecosystems and Biogeochemistry*. For more information on this see http://www.univ-brest.fr/IUEM/Projects/ECCO/ECCO.htm.

The proposed project should be carried out by a multinational and multidisciplinary team. The results should focus on the information needs of fisheries managers and of legislators, including the goal of accurately forecasting the arrivals of the algal blooms (red tides).

iv Summary

There is considerable support for the project proposal. A good deal of work has already been done on algal blooms nationally and internationally, though more remains to be done and funding may be available under FP VI. Algal blooms are of considerable economic and social importance. It is not clear whether they are increasing overall, but increases have been reported in certain circumstances. Some suggestions are put forward for making the proposal more precise.

4 L'impact des évolutions climatiques sur la population des espèces halieutiques dans les eaux communautaires

i Scientific assessment

There is no doubt that the major commercially exploited fish stocks have declined, since the mechanisation of fishing, and especially since the mid-1970's. The prime source of internationally agreed and authoritative advice on the subject is the International Council for the Exploration of the Sea (ICES; see http://www.ices.dk) which was founded in 1902 to study this sort of problem. The most reliable estimates come from internationally coordinated and standardised fishing surveys using research vessels. There is also no doubt that the dominant cause of the decline has been fishing pressure. A link to the current scientific advice on the stocks in European waters can be found at http://www.ices.dk/aboutus/pressrelease/codstatement.asp.

However, it is also very likely that changes of climatic conditions have had a significant effect, although it has proven very difficult to demonstrate this unequivocally, mainly because of the large (order of magnitude) year-to-year natural fluctuations in breeding success exhibited by most marine fish stocks. ICES is hosting a symposium on the subject in 2004 ["The Influence of Climate Change on North Atlantic Fish Stocks" 11-14 May 2004, Bergen, Norway; see http://www.imr.no/2004symposium/]. This subject is also the subject of major international collaborative research programmes, for example the "Cod & Climate Change" component of GLOBEC (the Global Ecosystem Dynamics programme, see www.pml.ac.uk/globec and www.ices.dk/committe/occ/wgccc.htm).

The problem is however difficult, has proved extremely intractable, and has not yet been solved to anyone's satisfaction, although some progress has been made [see e.g. O'Brien, C., C. J. Fox, et al. (2000). "Climate variability and North Sea cod." Nature **404** (March 2000): 142]. It would be possible to commission an up-to-date review of the state of the art from any one of several internationally recognised and independent (non-governmental) scientists, at a cost in the region of €10 000. However, the question as posed is again very general, and if a better understanding of the overall problem is required, would best be addressed by requiring the Commission to fund further long-term targeted research in the area.

In the Northeast Atlantic, the impacts of climate change are probably less than (or perhaps comparable with) the effects of over-fishing. [NB The same may not be true elsewhere, eg off the coasts of Peru and California, where the effects of climate may be dominant.] However, it is also probable that the effects of over-fishing and of climate change are synergistic, and that the demise of (for example) the Canadian Northern cod, and the probable demise of North Sea cod, are due to the combined effects of climate change on a stock already severely stressed by over-fishing, and would have been much less severe on a less heavily exploited stock.

The effects of other environmental factors (such as pollution) are most probably much less, with the possible exception of those of (mechanical) damage to the ecosystem by fishing itself, and the possible (but largely undocumented) effects of introduced species (including possibly diseases).

ICES recently stated that global change may deplete fish stocks to a critical level in the North Atlantic Region. ICES cited conclusive reports from the past 100 years that prove changes in ocean currents do affect fish stocks number and distribution. The more recent change noted in this region occurred during

1920s, following a warming of currents that brought large cods off the coasts of Greenland. According to ICES, future changes in ocean currents and temperature could equally have an adverse effect. The long-term survival of fish in the region would be threatened.

In recent years evidence has been accumulating that many types of fish populations may change their locations within their ocean habitats, not only during seasonal cycles, but also over much longer multi-annual time scales. Research to date suggests that some recent stock collapses and species shifts in pelagic communities are the results of changes in ocean climate, caused by global environmental change, leading to periods of high and low ocean productivity.

In the Mediterranean, an increase in water temperature induced changes in fish distribution and abundance. New lessepsian migrants (from Red Sea) appeared, and warm-temperate species (eg *Sphyraena sp*.), distributed in the eastern Mediterranean, expanded their distribution toward north-west during the last decades.

In recent years many research projects on this topic have been developed by European countries (see GLOBEC programme) to advance our understanding of the structure and functioning of the global ocean ecosystem, its major subsystems, and its response to physical forcing so that a capability can be developed to forecast the responses of the marine ecosystem and fish stocks to global change.

The Mediterranean Sea is a semi-enclosed multibasin ecosystem with a large-scale decadal thermohaline circulation (THC) analogous to the deep ocean climate system. Its negative estuarine water balance and circulation makes it a trap for anthropogenic inputs. The food web of the open Mediterranean is hyperoligotrophic and limited by phosphorus rather than nitrogen. However, there is increasing incidence of coastal eutrophication along populated coasts and river delta systems particularly off the European and East Mediterranean coastal zones. There is evidence from fossil plankton and sapropel formation in the sedimentary records of widespread changes in the hydrology, circulation and productivity of the Mediterranean Sea coincident with precession cycles. Given the decadal response times and scope for rapid biogeochemical changes, it is clear that the Mediterranean Sea is a sensitive barometer for anthropogenic (fisheries) and climate change.

The Mediterranean THC system appears particularly sensitive to climate forcing. A dramatic example occurred in the 1980s and early 1990s. The source of the deep water layers for the entire Eastern Mediterranean changed from the normal Adriatic Sea to a new source in the South Cretan-Aegean Sea. This Eastern Mediterranean Transient (EMT) sea water with its inherent properties (temperature, salinity, nutrients, O_2) is presently displacing and uplifting overlying water masses. A decadal persistence of EMT flux could eventually affect regional climate, nutrient regimes and the productivity of Eastern Mediterranean and exchange fluxes in the Straits of Sicily.

The IPCC 2001[1] report indicates a general agreement in the predictions from most of the atmosphere ocean global circulation models (AOGCM)[2] tested. Assuming a 1% per year increase in CO_2, in the Mediterranean region the average temperature is predicted to increase by 3.5-5.5ºC and precipitation rates to decrease by 10-30%. These changes will have a pronounced impact on the functioning and modalities of the Mediterranean Sea.

[1] Intergovernmental Panel on Climate Change
[2] Atmosphere Ocean Global Circulation Models

Studies on this topic need a multi-disciplinary approach to correlate physical and biological processes. Research on fish stocks response to long-term environmental fluctuations should be based on the analysis of long term time-series of data on fish abundance and distribution. It also needs to be able to distinguish big natural cycles (in many cases today ignored for the scientists) from global warming effects.

There are some international work groups specialized in carrying out predictions, quotas, etc within the European Union (DG Fisheries) and globally (ICES, CECAF).

Key research recommendations (Mediterranean sea): Greenhouse scenario models should be set up to investigate the oceanographic and dynamic sensitivity of the Mediterranean to climate change, including thermohaline circulation, interbasin exchange, nutrient dynamics, deep ventilation and thermohaline export to Atlantic ocean. Novel high resolution downscaled climate models will be required to get regionally reliable predictions of climate forcing for different marginal seas and sub-basins that make up the Mediterranean Sea. The different impacts that can affect to the professional fisheries of the Mediterranean Sea and what these models explain is uncertain to short and half term. The cycles of natural abundances and densities of the target species of the fisheries are not still known and it should be continued carrying out a seasonal monitoring (annual surveys) for their knowledge.

One reviewer, however, was less convinced about a link between climate change and fish stocks. 'I was faced with a lot of hesitancy and skepticism from most people who ought to know. They feel that there is too much talk about it, but little in terms of real data. This is certainly the case with the Greek fisheries. If there has been a change in the fished product, it is not so much as a result of climatic change, but rather because of changes in the way of harvest, in the habits of consumers and movement of people from the periphery to urban centers. These factors may have an effect on the abundance and distribution of fish stocks, but are in the main socially induced rather than environmentally.'

ii Economic and social assessment

For most reviewers, the issue was self-evidently important: 'Understanding how the productivity of stocks is linked to ocean climate and predicting the productivity cycles of the ocean is essential to avoid overexploitation when the ocean shifts to a period of low productivity.' But there was one dissenting voice: 'The economical and social implications of the project seem to be of minor importance. This project is given low priority.'

iii Other issues

Reviewers commented particularly here on the lack of precision and detail in the proposal.

- 'I think, given the complexity of research in this field, that it is not possible to referee the proposal submitted. Authors do not furnish any significant detail on the outlines of the project. We don't know which data they want to analyse, in which manner they think to achieve the objectives (which objectives ??) and so on.'
- 'The proposal is too general and it seems from the Abstract of Proposal not possible to obtain general information in this field of research.'
- 'The title of the proposal is very ambitious and it has a concept error in its own content. We don't still know to certain science, which is the magnitude of the global climatic change. And less in the two differentiated oceanic parts of the European Union. The question is not easy and it seems difficult that serious recommendations can be elaborated.'

iv Summary

There is very probable that climate change can and does affect fish stocks, though the interactions are complex with different species and different habitats being affected differently. Moreover, though the decline of fish stocks has been established as fact for a variety of species and locations, the extent to which this caused by climate change, by over-fishing or by other factors or combinations of factors is far from clear, and it is likely that population levels are the result of interplay between competing or mutually reinforcing factors. Most reviewers are supportive of work in this area, but the proposal needs to be considerably more developed before it can be usefully taken forward.

5 Effects on the marine environment of trawling for deep-sea fish stocks in the Mediterranean

i Scientific assessment

The impact of fisheries on deep-water resources has been documented for many species in various marine areas (eg Orange roughy *Hoplostethus atlanticus* in New Zealand). Studies on the biology of deep-water species showed life history characteristics (long-life spawn, late reproduction, slow growth) which make them particularly vulnerable to fishing. Moreover, species assemblages (ie benthos) in deep waters are characterized by high biodiversity and recent studies showed the negative impact of towed gears (trawl) on species richness and diversity.

In European waters (ICES area) some deep-sea fisheries are long established, and they tend to be traditional and on a small scale, using mainly static gear such as longlines. Fisheries by factory trawlers and modern longliner fleets started in the late 1960s and early 1970s and gradually expanded the deep-sea fisheries. In the 1980s and 1990s, lost fishing opportunities in shelf waters provided further stimulus for several fleets to turn to deep-sea species to make a living. Many deep-sea fish stocks are in decline in this area and can only sustain very limited fishing pressure. ICES has suggested that there should be an immediate reduction of fishing pressure on fully exploited or overexploited deep-sea stocks.

In the Mediterranean, a well developed trawl fishery is targeted to some deep-water crustacean species of great economic importance (Red shrimps *Aristeus antennatus* and *Aristaeomorpha foliacea* and Norway lobster *Nephrops norvegicus*) on the continental slope (400-800 m depth). These resources have been intensively studied in the last years using experimental trawl surveys data (a Mediterranean trawl survey project MEDITS is financed by EC DG XIV since 1994). Stocks of these species appeared in an overexploitation status in various Mediterranean areas. Moreover, fishery on deep sea crustaceans cause the capture of large amount of non-commercial species that are discarded as bycatch.

However, the studies on the impact of trawl activities on deep-water fish assemblages, bycatch species and benthic communities are currently scarce, particularly in the Mediterranean. There is a lack of studies aimed to analyse critical biological interactions between and within target species and bycatch species and to assess the impact of fishing on these interactions.

In general, deep-sea trawling has developed in Greece only during the last years. The slow growth, low natural mortality and delayed maturity of deep-water species lead to a slower rate of stock renewal. This means that these species are sensitive to changes, either physical or anthropogenic, that may occur over a few generations. The increase of commercial fishing activities at deep waters without prior knowledge of the local abundance and fragility of the fish species could lead to the depletion of their resources. The shift of fishing effort to deep water could affect the status of stocks of demersal species as well. It is known that in several of these species fish move to deeper and offshore waters as they become older. An increased effort toward deep-sea fishing will include these fish and will have an effect on the recruitment and stock recovery of several demersal species.

Our understanding is improving of how natural climate variability, such as the NAO[3] shifts in the Gulf Stream and nutrient regimes, can modulate marine productivity and fish stocks. This will make future fish stock assessments much more reliable.

[3] North Atlantic Oscillation

The deep ocean had until recently been considered to be a very stable environment, undisturbed by climatic or human action. This view is now changing. For example, long-term observations in the Porcupine Abyssal Plain have indicated drastic shifts in the population of sea cucumbers in the deep sea. The reasons for these changes are not clear. Such changes could be natural long-term oscillations within the population, or they could be attributed to changes in the supply of phytogenic organics from the upper ocean. In the deep Pacific Ocean a decline in the sedimentation of organic matter was observed and attributed to climatic changes. These observations indicate that deep ocean ecosystems are more variable than hitherto assumed, and that the deep ocean ecosystems may also be affected by climate changes.

The proposed study is well conceived, and the problem is significant. Deep-water trawls are used extensively off the West of Scotland, the Iberian coast (including Madeira), and elsewhere in the world. However, it is rather unlikely that there is sufficient scientific information for the questions to be answered with great confidence as yet. There have always been major problems in the Mediterranean area in acquiring adequate data on fishing effort and fish catches (caused by the length and fragmentation of the coastline, the prevalence of small scale local fisheries, the inadequacy of administrative structures and scientific capacity, and in some cases socio-economic forces (up to and including the involvement of the Mafia)).

As a general rule, the rates of biological processes (metabolism, growth and mortality) decrease as water depth increases, simply because the flux of food (actually detritus) from surface waters is quite small as a fraction of total production, and also decreases with depth. Since harvestable production rates are broadly expected to be proportional to the biological production and mortality rates, these are also likely to be low. Deep sea stocks are therefore particularly vulnerable to over-exploitation by fishing, and major reductions of stocks have been observed in all areas where industrial-scale fishing has occurred and stocks have been monitored (the case of Orange Roughy off New Zealand is a classic example). Similar phenomena have been observed outside the Mediterranean: off Australia, New Zealand, Scotland and elsewhere.

The most probable explanation for the decline in deep-sea fish stocks is fishing, although climate change may also be a contributory factor. Other causes (such as pollution) are much less likely to be relevant, because the deep sea is still relatively uncontaminated by comparison with coastal and shelf waters.

The EU has funded some studies in the Mediterranean in recent years (see eg europa.eu.int/comm/fisheries/news_corner/press/inf02_13_en.htm), and may be expected to do so in the future. The generic problems of deep-sea fisheries have been considered by ICES (see http://www.ices.dk/reports/ACFM/2002/WGDEEP/directory.asp) and this includes a brief account of the Mediterranean per se. Further major long-term (and therefore expensive) research will be needed to provide a better understanding of the specific problems of the Mediterranean.

Our experiences in the Western Mediterranean shows traces of PCBs and other xenobiotics in deep abyssal sediments and fauna indicates that even the most remote parts of the deep oceans are affected by long range and diffuse sources of pollution. To understand how the flux of material from land, or the alteration of surface ocean processes, ultimately affects the deep sea ecosystems it is essential to improve long-term observation of key terrestrial biomarkers and xenobiotics at specific deep oceanic locations.

Key research recommendations: It is necessary to develop new technologies for observations, sampling and experimentation in the largely unknown ecosystems of the deep ocean as well as techniques for cultivation of organisms from extreme habitats. Deep ocean vehicles and observatories should be upgraded with smart sensors, *in situ* experimental capabilities and two-way telemetry for remote exploration, experimentation and monitoring of extreme ecosystems and their response to climatic (if exists) and episodic events, and to integrate these with historic data for decadal to centennial scale analysis. Of course, these observations are required to establish baseline studies that adopt an ecosystem approach, a priority in advance of exploitation of deep ocean resources. Research on the specific adaptations of organisms to a range of extreme conditions found in habitats of the deep sea is required. Research on the vertebrate populations supported by these habitats should also be initiated, and can largely be done in an interdisciplinary manner concurrent with geological and oceanographic surveys. The results of such baseline studies will contribute to effective management and governance of ocean resources.

ii Economic and social assessment

This issue is of paramount importance for fishery management, as demonstrated by the number of studies on the impact of fishing activities on deep-water stocks and habitats published during the last 20 years.

Deep-water fisheries activities began in the 1960s stimulated by the decline of shallow-water stocks caused by overfishing. Fishing effort and landings of deep species increased strongly in the last years and 40% of the world's trawling grounds are carried on now in water deeper than continental shelves.

The Common Fishery Policies (CFP) of European Union places a particular focus on research work for improving the scientific basis for fisheries management and for integration of environmental requirements into CFP. Recently, the 6th Framework Programme defined specific research objectives aimed to the enhancement of technical measures like the protection of non-target species and habitats.

Therefore, I can conclude that a wide-scale study on this topic in the Mediterranean could be of great importance to make deep-water fishery sustainable on a long-term basis. However, objectives and sampling design of such study should be carefully defined to achieve the expected results. I think that in the Mediterranean, where there is a lack of time series of catch and effort data, the assessment of impact of fisheries on the stocks should be analysed on a spatial scale. It is necessary to compare areas under different levels of fishing effort, where stocks are affected by different fishing mortality.

The impact of trawling on the seabed and on non-target species has been of great and increasing concern during the last decade. Many bottoms are trawled repeatedly each year with negative impact on benthic fauna including demersal fish. This proposal deals with trawl impact studies in the Mediterranean and the possible negative effects of "rock hoppers" on flora and fauna and on declining fish stocks.

This project has great economical, social and ecological significance and I recommend that a detailed proposal be presented.

The reduced catches of coastal species produced an increase in the fishing pressure on deep-water species. At the same time, the modernisation of fishing fleet made the fishing operations at deep waters and at long distances from the coast more effective. In general deep-water fish species are more vulnerable to fishing, because, with a few exceptions, they are more long-lived. In the Mediterranean there is also an increasing interest for exploitation and management of new deep-water resources, as most demersal stocks are either fully exploited or overexploited.

The deep-sea stocks were not intensely exploited by the Greek fishing fleet until recently. During the last five years a shift towards the deep-sea fishing grounds has been observed as a result of the modernization of the fleet. Because deep-sea fishing is a relatively new activity in Greece no detailed data exist on the degree of exploitation of the deep-sea stocks. Indeed, this is an intensifying activity as new fishing grounds, previously unknown to fishermen, are now becoming targets for fishing.

The main deep-sea species that are being exploited by the Greek fishing fleet are the wreckfish (*Polyprion americanus*), the bream *Pagellus bogaraveo* and red shrimps (*Aristeus antennatus* and *Aristaeomorpha foliacea*). The first two species are mainly exploited by the artisanal vessels (longliners), while the shrimp is the target of deep-water trawling. Other fished deep-water species are *Helicolenus dactylopterus*, *Galeus melastomus*, *Lophius piscatorius*, *Merluccius merluccius*, *Physis blenoides* and *Squalus spp*. The Institute of Marine Biology of Crete (IMBC) operates a network of stations throughout Greece through which it monitors the landings of commercial fish in the most important fishing harbors of the country. The records show an increase of landings of wreckfish (*P. americanus*) during the last four years. However, a research project that carried out by IMBC produced no concrete evidence that the stocks of this species have been over or heavy exploited.

The situation is more uncertain with red shrimps. Neither the size of the stocks nor their fishing grounds are well known. Two EU funded projects, MEDIS and INTERREG II (the last in collaboration between Italy and Greece), aimed at verifying the existence of exploitable stocks and the training of Greek trawlers in the fishing of red shrimp, particularly in the eastern Ionian Sea. The overall conclusion is that this fishery would viable if regulated in a proper way.

Over 130 commercially important fish stocks have been monitored in the North East Atlantic for over half a century by fisheries agencies, including ICES[4], to provide advice for National and European policy makers on quotas and other management and conservation measures. In the Mediterranean area other approaches are adopted to know and control the fishing effort evaluation and management measures.

While taking into account climate-driven fluctuations, it is apparent that most demersal and pelagic fish stocks are now in certainly decline (serious?), mainly because of: overfishing of commercial stocks, discards of unwanted bycatch and wholesale disturbance of seabed ecosystems. ICES (in 2000) estimated that by 1998, 34% of European fish stocks were beyond sustainable limits, 46% were overfished, with only 20% of stocks classified as sustainable. This situation is exacerbated by the overcapacity in European fishing fleets.

Within the deep sea, there has also been a rapid increase in deep-sea trawling for non-quota fish stocks (eg roundnose grenadier, blue and red shrimp) especially along European continental margins, which have only recently been regulated. Populations of deep-sea cold water fish are particularly very

[4] International Council for the Exploration of the Sea.

vulnerable to overfishing, as these species are slow growing and at risk from irreversible depletion of their population, as recently happened to the orange roughy (*Hoplostethus atlanticus*) fishery off New Zealand. In addition these deep pristine ecosystems are biodiverse and fragile, particularly those associated with the recently discovered cold waters corals (*Lophelia pertusa*). These coral or other ecosystems are at particularly risk from deep-sea trawling, hydrocarbon exploration and drilling wastes.

FAO and other international agencies recommended strongly that future fisheries management take action to ensure that fishing becomes a sustainable activity, compatible with the limits of marine resource renewal and with the need to reduce impacts on the marine environment.

iii Other issues

Our opinion about the proposed project in Mediterranean is that it should be coordinated by scientific institutes involved in data collection on demersal resources in Mediterranean through indirect methods trawl surveys (see MEDITS project) and should consider the large amount of experience existing on the item. A project restricted to small areas may give results useful on local scale and should be linked to some particular condition present.

The abstract of the project is too poor to be evaluated. Authors did not give any information about the species, the areas (depths and bottom features) where they want to conduct the study and the sampling design.

The project, on the basis of the little information given in the proposal, appeared to be focused on the impact of trawl activities on the eastern Mediterranean shelf where artisanal and industrial fishing fleets share the same resources. We do not think that this proposal is aimed to study deep-water stocks. Fishery biologists intend for "deep-water species" that species distributed deeper than the continental shelf, where defined environmental condition occurred. The authors, therefore, should furnish much more information about the structure and objectives of their proposal.

A state-of-the-art report could be commissioned from either a governmental organisation (eg IFREMER, the Institut Francais pour l'Exploitation de la Mer), from an NGO such as WWF, or from a non-governmental research organisation such as the Scottish Association for Marine Science at Dunstaffnage (where one of the leading experts in this field, Dr John Gordon, is located).

Other useful Web resources:
www.wwf.org.uk/filelibrary/pdf/darwin_mounds.pdf ; www.ifremer.fr/drvrhbr/publi/NAFO_scr01-093.pdf ; www.jncc.gov.uk/marine/fisheries/pdf/greenpaper.pdf ; www.eces.org/ec/ecosystems/overfishing.shtml ; www.esf.org/generic/626/marinebiodiversity.pdf

iv Summary

Strong support for work in this area. A detailed project proposal should be prepared.