MADE: PRELIMINARY INFORMATION ON A NEW EC PROJECT TO PROPOSE MEASURES TO MITIGATE ADVERSE IMPACTS OF OPEN OCEAN FISHERIES TARGETING LARGE PELAGIC FISH.

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SUMMARY

A particular attention has been paid worldwide on longline fisheries as they catch considerable amount of by-catch (seabirds, turtles, sharks, etc.). Seabird and turtles by-catch mitigation methods have now been established in many fisheries worldwide, but similar efforts must be put to reduce by-catch of sharks. In the same ecosystems, another issue attracts the attention of international tuna commissions: the use of drifting fish aggregating devices (FADs). These FADs are responsible for major catches of juvenile tuna and non target pelagic species (sharks). Finally, the effects of thousands of FADs released regularly in the tropical oceans are unknown, and must be studied to estimate if they impact the biology of pelagic species. The European open ocean tropical and Mediterranean pelagic fishery (Spain, France, Portugal, Italy, Greece) is one of the main sources of catch, income and employment for the European fishery, with interactions with many developing countries.

The MADE project was set up to develop measures to mitigate adverse impacts of fisheries targeting large pelagic fish in the open ocean: purse seiners using FADs and longliners. This 4-year project, started in mid-2008 within the 7th EC Framework Programme, and is a cooperative research carried out under the coordination of IRD, including 13 scientific institutions belonging to 6 European Countries and 2 ICPC countries in three different areas (Mediterranean Sea, Atlantic Ocean and Indian Ocean). Two main categories of mitigation measures will be studied: spatial management issues (e.g. closure areas) and technical solutions to reduce by-catch in these fisheries. The main concept of MADE is to follow a multi-disciplinary and comparative approach, combining biological and technological studies with economical analyses in different sites (Indian and Atlantic oceans, Mediterranean Sea), with a particular effort to closely associate fishers.

KEYWORDS : Mitigation, Longline, purse seine, FAD, by-catch, tropical tuna, swordfish, pelagic sharks, marine turtles, fishery technology, Mediterranean Sea, Atlantic Ocean, Indian Ocean.

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1. Introduction

This last decade, as an increasing number of scientists, politicians, fishers and conservationists clamoured for action to be carried out to resolve the problem of by-catch and discard in fisheries, numerous workshops, symposia and international agreements have been held to explore solutions (Inter-American Convention for the Protection and Conservation of Sea Turtles, IAC, *http://www.seaturtle.org/iac/*; Code of Conduct for Responsible Fisheries, *http://www.fao.org/fi/agreem/codecond/codbobp1.asp*; the International Plan to Reduce Seabird Bycatch and the International Plan to Reduce Shark Bycatch of the FAO, *http://www.fao.org/fi/site.asp*). However, the reality is that, for fisheries catching large pelagic fish such as purse seiners using FADs and pelagic longliners, more investigations must be done to reduce by-catch and more generally, adverse impacts of these fisheries.

A particular attention has been paid worldwide on pelagic longline fisheries, as they catch considerable amount of by-catch (seabirds, turtles, sharks, etc.). Seabird by-catch mitigation methods have now been established in many fisheries worldwide (Hall and Mainprize 2005), and several projects have been conducted to reduce the by-catch and mortality of turtles (Swimmer et al 2006), all protected species by international conventions. Synthesis of these past and current studies and their application must be done in order to integrate these outcomes, but similar research efforts must also be developed on the two other major longline by-catch groups that remain largely unaddressed by research and technological development: pelagic sharks and juvenile (undersized) swordfish. Sharks are long-lived, low fecundity, top predators. These characteristics reduce resilience of shark populations and make them highly susceptible to overexploitation, and concerns regarding this possibility have been increasing due to their progressive importance in the catches and to signs of population collapse worldwide. Catch of juvenile swordfish is considered a major problem in the Mediterranean and Atlantic longline fisheries, and the recent imposition of a size limit (approx. 25 Kg) has not had satisfactory effects.

In the same ecosystems, another issue attracts the attention of international tuna commissions: the use of drifting fish aggregating devices (FADs) which are floating objects used by fishers to attract pelagic fish. These FADs are responsible for major catches of juvenile bigeye and yellowfin tuna (Fonteneau et al. 2000) in all tropical oceans (Indian, Atlantic, Pacific). They are also responsible for by-catch of several pelagic species (sharks, dolphinfish, wahoo, rainbow runners, oceanic triggerfish, etc.), although the amount of these by-catch is not crucial (3-5% of tuna catches, Romanov 2002). However, particular attention is put on turtles which can be entangled in FADs equipped with nets and silky sharks, which are captured by purse seiners around FADs, and could represent a threat on this species considering its main biological characteristics. Finally, the impacts of thousands of FADs released regularly in the tropical oceans are unknown. Marsac et al. (2000) proposed the ecological trap hypothesis applied to fish and FADs. This theory indicates that tropical tuna and other associated species could be trapped within networks of drifting FADs due to their strong associative behaviour. Drifting floating objects could bring associated fish with them. The areas crossed by fish trapped in a network of FADs could be different from the areas fish would have visited if they were not aggregated. The ecological trap hypothesis assumes that this associative behaviour could thus modify migratory paths and have effects on certain biological functions, such as growth and reproduction. Recently, Hallier and Gaertner (2008) found some evidence that FADs could act as ecological traps. However, more and new data are needed to fully validate or invalidate this theory. An over view considers that this associative behaviour certainly emerged through evolutionary processes, providing advantages to associated species, and that the release of more FADs could benefit to some species. The only scientific consensus is that estimating the effects of floating objects on the behaviour and biology of fish (negative and positive effects), in an arbitrary and scientific way, becomes a research priority.

The European open ocean pelagic fishery is one of the main sources of catch, income and employment for the European fishery. Fishing vessels belonging to Spain, France, Portugal, Italy and Greece operate in all tropical oceans (Atlantic, Indian, Pacific) and in the Mediterranean Sea, with interactions with many developing countries.

A new European 7th FP scientific project just started to propose mitigation measures to reduce the impacts of those fisheries on the pelagic ecosystems: MADE (Mitigating Adverse Ecological Impacts of Open Ocean Fisheries). While recognizing that solutions to by-catch often need to be tailored to specific fisheries, and may differ between regions of the world (Alverson 1999; Bache 2002), we consider important to gather in a single project mitigation issues of pelagic longliners and purse seiners using FADs. These different fisheries-specific issues concern the same groups of species living in the same ecosystems, managed by the same fisheries commissions (international tuna commissions). Some of the management objectives concern interactions issues between fisheries, such as the high catch rates of juvenile tuna by purse seiners using FADs, which are of low value at that size but which support high-value longline fisheries when adult. Therefore, we consider that a project aiming at developing measures to mitigate adverse impacts of fisheries on the pelagic ecosystems should consider both fishing fleets: **tuna purse seiners** and **pelagic longliners**.
Adverse impacts of these fisheries can be summarized in the following table, constituting the **specific targets** of the project:

Adverse impacts/Fisheries	Tuna purse seiners using FADs	Pelagic longliners
By-catch of non-target species	Sharks and turtles	Sharks, turtles, seabirds
Catch of undersized target species	Juvenile tuna (bigeye and yellowfin tuna)	Juvenile swordfish (< 25 kg)
Habitat modification/spatial issues	Habitat modifications with thousands of FADs deployed in the oceans	Fishing activities on hotspots of biodiversity and essential fish habitat

The S&T objectives of the project will target each fishery-dependent issue listed in the table above.
Two main categories of mitigation measures will be examined:

- **Spatial management measures**
- **Technical measures**

2. Methods

Scientific approach

The challenge in mitigation science is to find the optimal balance between technical measures (deterrent systems) and spatial management measures (avoidance). Spatial management solutions comprise closure areas/seasons in habitats of particular ecological relevance for by-catch species (for example, for spawning, nursing or growth), but also control of fishing effort according to knowledge on the dynamics of animals, and control of impacts on habitat if possible.

Mitigation issues typically involve different and often conflictive stake-holder interests, and are too often contaminated with *a priori* assumptions, especially in fisheries involving oceanic, little-known species as the ones targeted by this proposal. Many by-catch problems can be resolved via technological solutions, but it is apparent that the successful adoption and use of these technological solutions will only occur when fishing industries are involved in all stages of the process. To address this issue, **fishers** will be closely associated to the project from the beginning, and specific research actions will be dedicated to examine **the economic efficiency of mitigation measures**, so that

proposed measures will support a viable commercial exploitation of fish resources with minimum effects on the marine environment.

MADE is based on a multi-disciplinary approach:

- Behavioural studies (pop-up tags, acoustic tags)
- Biological studies (growth, reproduction, trophodynamism)
- Analyses of fisheries activities (observers data)
- Technical/technological developments (fishing gears, fishing practices)
- Socio-economical studies

Specific objectives are planned for each fishery.

Pelagic longliners:

1) Ecology of sharks (Blue shark, *Prionace glauca*, and Oceanic whitetip shark, *Carcharhinus longimanus*) and juvenile swordfish (*Xiphias gladius*).
2) Identification of essential habitats for some species, and hotspots of biodiversity.
3) Ecologically based artificial bait (EBAB)
4) Fishing strategy and practices (Control of fishing depth, fishing period and soak time)

Purse seine fisheries using FADs:

a) Biology and ecology of the Silky shark (*Carcharhinus falciformis*)
b) Improved fishing practices:
   - Reduce passive catches by FADs.
   - Improve remote information on the composition of fish aggregations around FADs.
   - Use the behaviour of fish to avoid their capture.
c) Identification of essential habitats for some species (sharks) and zones with high rates of by-catch, developing indices of biodiversity.
d) Effects of artificial FADs on the biology of tunas (are FADs ecological traps?).

MADE will develop scientific actions in several geographical areas as shown on figure 1.

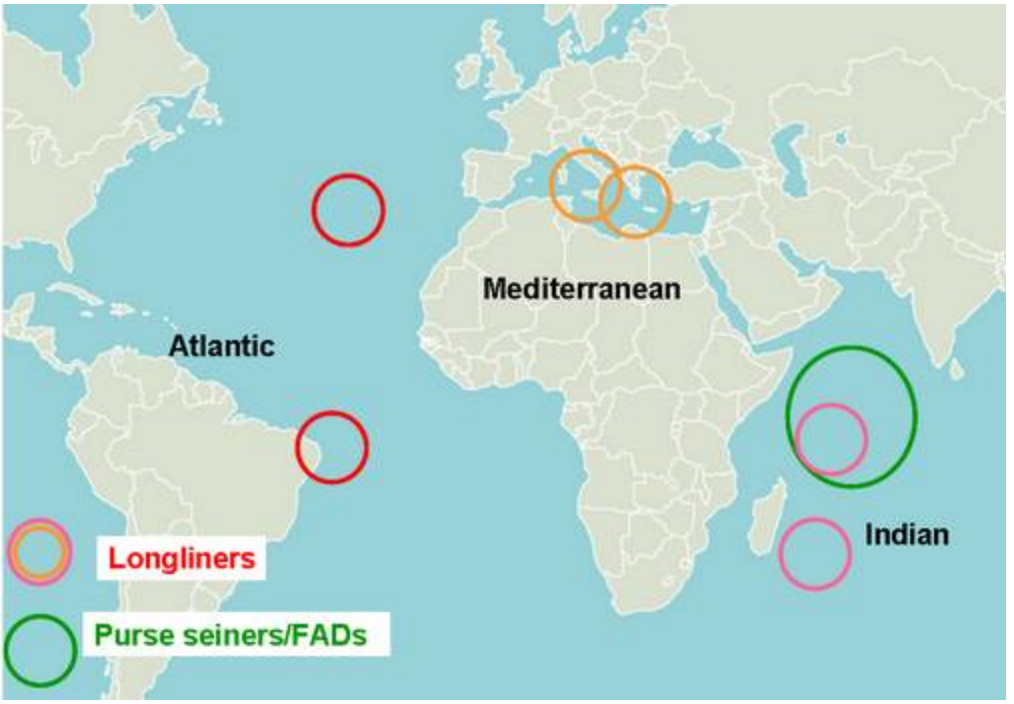

Figure 1 – Area where the studies of the MADE project will be carried out.

A communication and dissemination strategy is included in the MADE project and it will be addressed to Fishers Organisations (which will be directly involved within one of the Committees of the project), to the RFMOs concerned (ICCAT, IOTC and GFCM) and directly to the Fishers in the various areas, using various approaches (press releases, press conferences, media instruments, posters, a dedicated website and scientific papers).

Funding and members of the project

The MADE project is funded within the 7th EC Framework Programme and it is a small collaborative project. 13 scientific institutions are cooperating in MADE under the scientific coordination of the IRD - Institut de Recherche pour le Développement. Table 1 provides the list of institutions cooperating in MADE and their field of action in the two fisheries concerned.

Table 1 – Institutions and countries cooperating in MADE and gear concerned.

Institution	**Country**	**Pelagic longline**	**Purse seine on FADS**
IDR – Institut de Recherche pour le Développement	France	X	X
SFA – Seychelles Fishing Authority	Seychelles	X	X
ULB - Université Libre de Belgique	Belgium		X
AZTI – Fundacion AZTI	Spain		X
AQUA – Aquastudio Research Institute	Italy	X	
HCMR - Hellenic Centre of Marine Research	Greece	X	
UFRPE – Universidade Federal de Pernambuco	Brazil	X	
RUN – Université de la Réunion	France	X	
IFREMER – Institut Française de Recherche pur l'Exploitation de la Mer	France	X	X
UM2 – Université de Montpellier 2	France	X	
FADG – Fondazione Acquario di Genova Onlus	Italy	X	X
IMAR-DOP – Centre of the University of the Azores	Portugal	X	
UPAT – University of Patras	Greece	X	

The project had the kick-off meeting in Genova (Italy) on 12-14 May 2008 and the work is planned for a total of 48 months.

3. Discussion

The objective of the MADE project is to propose measures to mitigate impacts of fisheries on pelagic ecosystems. A fishery committee has been set up to ensure that MADE will work in close contact with fishermen, associating them to the different stages of the project. The three main associations gathering European tuna purse seiners provided their full support to the project (ANABAC, OPAGAC, ORTHONGEL), and local longline fishery located in each country of the project will also work with the project. Those fisheries have already shown their willingness to cooperate in order to reduce negative impacts of their fishing activities.

MADE will also maintain close relationships with the relevant RFMOs, in particular ICCAT, GFCM and IOTC. Those RFMOs are ideal places to discuss results of the project, and to disseminate them to a large audience.

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