

An update of the EU MADE project

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Summary

Numerous and various data have been collected by the project in the Indian Ocean: biological samples of sharks, PAT and miniPAT tagging of pelagic sharks, acoustic tagging of tuna, sharks and other bycatch species at FADs, observers data, knowledge from fishers. These data are currently being analyzed in order to investigate the potential of spatial (using results on the spatial dynamics of sharks for instance) and technical measures (e.g. ecological FADs, best practices onboard vessels, use of artificial bait, best vertical distribution of hooks, etc.) for both purse seine and longline vessels. The project will organize an international symposium in late 2012 to review progress in the world on this topic.

An overview of the project

The MADE (Mitigating adverse ecological impacts of open ocean fisheries) project, funded by the European Commission (DG Research), gathers 13 institutions from 8 different countries (France, Spain, Portugal, Italy, Greece, Belgium, Brazil, Seychelles). It is coordinated by IRD (France) from the Seychelles office. The primary objective of the project is to propose measures to mitigate adverse impacts of fisheries targeting large pelagic fish in the open ocean: purse seiners (using FADs) and longliners. The project specifically aims at:

- investigating spatial and technical management measures to reduce the by-catch of pelagic sharks and juvenile swordfish by pelagic longliners
- investigating spatial and technical management measures to reduce the by-catch of pelagic sharks and other species using FADs
- assessing the effects of FADs on the behavior and ecology of pelagic fish

If the project is conducting researches on three different oceans (Atlantic, Indian, Mediterranean Sea), this document will mainly present an update of data and results that are of interests for the Indian Ocean. The project has almost completed all field activities and has already started data analyses. The project ends in December 2012.

Spatial measures

Sharks represent one of the major targets of the project: silky, oceanic white tip and blue sharks. For all these species, there is a general need to improve the fundamental knowledge on their biology and behavior, a pre-requisite to develop science-based

measures for conservation and management. Most of investigations concerning potential spatial management measures in the Indian Ocean focus on sharks. The full investigation of such measures will combine results from biological analysis, tagging and observers data.

Biology of pelagic sharks

Biological samples of blue sharks and silky sharks were collected in the western Indian Ocean and in the Atlantic Ocean. Biological samples are analyzed to estimate the growth curves of both species, to investigate the diet of silky sharks caught by purse seiners under FADs, and to analyze the isotopic niches of both species from signatures in $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ of muscle tissues.

Behavior of pelagic sharks

Eight small juvenile silky sharks (88-109 cm TL) were tagged after being caught around FADs, eight larger sharks (154-285 cm TL) were tagged after being caught by commercial longliners (2 malfunctioning tags), and 20 sharks (86-235 cm TL) were tagged onboard purse seiners to study their post-release survival (2 non reporting tags) (see Poisson et al. 2011). Those tagging provided a total of 1168 days at liberty. Nine blue sharks were tagged after being caught by commercial longliners, with a total of 349 days at liberty (1 non reporting tag, 1 still at sea). Two oceanic white tip sharks were tagged after being caught by commercial longliners (1 non reporting tag), and one after being caught around a FAD, for a total of 119 days at liberty.

Areas with high rates of catch of silky sharks

Observers data (from French and Spanish fleets) have been analyzed to investigate the areas with high bycatch of silky sharks in the tuna purse seine fishery. Details are provided in Amandè et al. (2011) - IOTC-2011-WPEB07-29.

Technical measures for longliners

Ecological Based Artificial Bait (EBAB).

The objective of the EBAB is to make use of scrap and offal of capture and provide new utilisation of fish transformation, reducing the impacts of longliners on the ecosystem by reducing the catch of bait. A secondary objective is to reduce by-catch through size selectivity, and potentially, through deterrent systems inserted in the bait.

A prototype has been developed and patented by the INPI (Institut National de la Propriété Intellectuelle, France). While no catch was observed during the first tests performed in La Réunion (10-day fishing trip), several attacks on the EBAB were observed, confirming attraction of fish to the bait. More field tests are planned in the coming months.

Experimental longline fishing

A total of 62 instrumented longline sets (with hook timers and time depth recorders) were done around La Réunion (along with 74 sets done in the Atlantic Ocean and Mediterranean Sea) to obtain data on the depths of capture of various species. These

data, combined with information on the vertical behavior of sharks from electronic tagging, will be analyzed to investigate optimal vertical distribution of hooks so to minimize bycatch of some vulnerable species (e.g. some pelagic shark species).

Technical measures for purse seiners

Ecological FADs

After providing guidelines for ecological FADs (Franco et al. 2009), first in situ tests were done in collaboration with other projects in order to test the efficacy of different designs of ecological FADs to attract tuna while avoiding incidental capture of turtles and sharks. Two different approaches were adopted:

- 43 ecoFADs (biodegradable materials) deployed in the Atlantic Ocean (joint project 'EcoFAD' funded by ANABAC), with SATLINK echosounder buoys to assess the efficacy of such FADs (estimates of tuna biomass) every day.
- 600 ecoFADs (non biodegradable materials) deployed in the Indian Ocean (joint project 'Contrat Avenir' funded by the French organization ORTHONGEL): data from 51 ecoFADs that were fished on.

Using echosounder buoys to provide information on the presence or abundance of bycatch around FADs

Fishers' Echo-sounder buoys were identified as a potential tool for remote discrimination of bycatch. First results are described in Lopez et al. (2011) IOTC-2011-WPEB07-54.

Reducing mortality of sharks induced by purse seine fishing on FADs

Scientists participated to two regular fishing trips onboard French purse seiners in the Indian Ocean and one fishing trip in the Atlantic Ocean onboard a Spanish purse seiner. Data on conditions and mortality rates of captured sharks were collected during each cruise. Fishing strategy, procedures, and conditions faced by sharks and rays documented from the above cruises and from interviews with fishers. During cruises in the Indian Ocean, first tagging of released sharks have started, in collaboration with another project funded by the French fleet organization ORTHONGEL (Contrat Avenir). Tags were contributed both by MADE and the ORTHONGEL project. Results are presented in Poisson et al. (2011) - IOTC-2011-WPEB07-28.

Experiments were conducted around the Seychelles (during a scientific cruise co-funded by the ISSF By-catch project) to test if sharks can be attracted away from FADs before setting. Shark attraction experiments were conducted on 5 different FADs. The scientific protocol consisted of (i) assessing the numbers of sharks around the FAD at the start of the experiment (snorkeling), (ii) using a small tender to drift slowly away from the FAD with a bag full of fish chum (bait), (iii) assessing the number of sharks attracted and maximum distance of attraction using underwater GoPro cameras and a handheld GPS. Each experiment was terminated when either the tender reached a distance of 500 m from the FAD or when no more sharks were observed for several minutes.

FAD	Number of sharks at start	Number of sharks attracted	Maximum distance
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1	9	3	500 m
2	2	1	120
3	3	2	80
4	2	1	80
5	2	2	250

Table X: Results of the shark attraction experiment around the Seychelles

This pilot study provided key information:

- sharks can be attracted hundreds of meters away from FADs by simply towing a bag of bait away from the FAD
- reactions of sharks varied greatly between the experiments ranging from almost no reaction to attraction up to 500 m. It appears that many factors could be responsible for the success of the attraction: if the FAD was fished a few days before (probably affecting the natural behavior of sharks), the size of the multispecies fish aggregation, feeding motivation, etc. The small dataset does not allow conclusions to be drawn on the respective effects of each parameter.

The shark attraction experiment showed that sharks can be attracted using a bag of bait, but that the FAD always remains a very strong attraction stimulus. From this new knowledge, we recommend that future experiments be conducted on sharks that have already been encircled by the purse seine net. This protocol will involve placing a bag full of chum on top of the FAD, then towing the FAD out of the net and assessing the number of sharks that could be released.

Draft list of potential measures to mitigate impacts of open ocean fisheries

On the basis of the results obtained so far, and through a participatory approach to trigger a group discussion, a list of potential mitigation measures was drafted by the group. It is important to note that these potential measures were only listed, and not evaluated yet.

Proposed measures concerned the monitoring of fishing activities (e.g. FADs for purse seiners), the control of fishing efforts (e.g. numbers of hooks per sets, numbers of sets, numbers of FADs or FAD sets, etc.), the development of economic incentives or market-driven measures (e.g. use of non sensitive bycatch species, regulate price of undersized target fish, promote eco-labelling, etc.), the improvement of fishing practices such as methods to release bycatch or use of particular gears (e.g. promote the use of ecological FADs, ban lightsticks or wire leaders for longliners, promote the use of artificial baits, etc.). These measures will be investigated until the end of the project. The project will organize an international symposium in late 2012 to review progress in the world on this topic.