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REVIEW ON MARINE MAMMALS' BY-CATCH ISSUE IN MEDITERRANEAN and BLACK SEA

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1. Introduction

By-catch is one of the main sources of anthropogenic mortality in marine species of conservation concern worldwide. Interactions with fisheries are potentially harmful to marine mammals (e.g. depletion of fish stocks, direct kills in fisheries, and by-catch in fishing gear) and to man (e.g. gear damage and depletion of commercially valuable fish stocks (Beddington et al., 1985).

Several reviews have already been produced over the last fifteen years on the interaction of marine mammals with fishing activities in Mediterranean sea (Northridge, 1996; Notabartolo di Sciara et al, 2002; Bearzi, 2002; Notabartolo di Sciara and Reeves, 2006; etc.).

This document presents an overview of published results related to the various issues concerning this problem such as the direct or indirect impact on species and fisheries concerned, marine mammals behaviour and fishing characteristics responsible of the interactions, possible mitigations, etc.

2. Type of impacts

Interactions between marine mammals and fisheries result obviously into 2 types of consequences: Impact of marine mammals on fisheries and impacts of fisheries on marine

- ***Impact of cetaceans on fisheries*** including damage to fishing gear (e.g; holes torn in the nets), reduction in the amount or value of the catch (depredation), cost of loss of material and time (by-catch removing, gear repairing, time and cost loss for steaming out “hot spot”, etc.) money, or gear loss by fishermen due to cetaceans interacting with fishing operations, or getting caught in nets; fishermen perception that depredation reduces fish availability to fisheries (Reeves et al. 2001).
- ***Impact of fisheries on cetaceans*** including by-catch, injury or mortality incidental or deliberated; unintentional disturbance, reduction of food prey availability or changes in feeding behaviour, habitat loss and/or degradation, dispersion or reduced reproductive rates (Bearzi, 2002; Bearzi et al., 2008; Abella, 2004).

Conflicts between fisheries and cetaceans can take either on the accidental capture of cetaceans in fishing operations (bycatch) or on the depredation 1of fishing gear by cetaceans, leading to loss of catch and damage to fishing gear. In many cases these two problems occur in the same fisheries and resolving the latter problem may help to resolve the former (Northridge et al., 2006).

Since the end of 90’s, the use of dolphin meat as a bait for fishing gears (e.g. shrimp traps), for example in the Andalusia ports of Garrucha and Algeciras, in the Alboran Sea (Aguilar et al., 1991; University of Barcelona, 1995) seems to be stopped or at least is never more reported.

The reduction of food prey resources has been considered by several authors as a threat that may have contributed to the decline of some cetacean populations in the Mediterranean. According

[1] predation refers to predators preying on free-ranging prey, whereas depredation refers to predators taking, or attempting to take, prey that are confined in pens or that have been caught in fishing gear.

Bearzi, 2002, there is no clear evidence currently available to address this issue. With Reeves et al., 2001, Bearzi noted that conflict occurs in certain areas where target fish stocks are relatively abundant (e.g., in the Asinara Island, Italy) whilst in some other areas where target fish stocks are depleted there is little or no conflict between dolphins and fisheries (e.g., in the Kvarneric, Croatia).

3. Status of the main marine mammals and species concerned

Among the 12 assessed species in the Mediterranean sea, one was proposed to qualify for Critically Endangered (Orcinus orca), 5 for Endangered (Physeter macrocephalus, Delphinus delphis, Phocoena phocoena Relicta, Delphinus delphis ponticus) and two for Vulnerable (Tursiops truncatus, Stenella coeruleoalba). The other four were considered Data Deficient, meaning that there was inadequate information to assess their extinction risk.

Interactions between marine mammals and fisheries in the Mediterranean Sea involve mainly coastal fisheries and common bottlenose dolphins (Tursiops truncatus), that in the basin is typically found on the continental shelf, short-beaked common dolphins (Delphinus delphis), Mediterranean monk seals (Monachus monachus) and killer whale (Orcinus orca) with Spanish and Moroccan fisheries in the Strait of Gibraltar (Bearzi et al., 2008a; Guinet et al., 2007).

The striped dolphin - by far the most abundant cetacean in the Mediterranean - has a pelagic distribution and largely feeds on non-commercial prey species (Notarbartolo di Sciara and Demma cited in Bearzi, 2002). Therefore, it rarely represents a problem to coastal fisheries, apart from gear damage or time loss for fishermen when the animals get entrapped in fishing gear (Bearzi, 2002).

4. Main fishing techniques concerned

Fisheries involve mainly pelagic trawling, purse seining, drift gillnetting, bottom set netting and longlining.

- Pelagic trawling

Apart from some very occasional catches of fin whales or orcas, striped, common and bottlenose dolphins are the main species affected by trawling (Duguy et al., 1983; Sacchi, 2008). These animals come in the vicinity of trawls, attracted by the fish that escape or discards and can be caught incidentally.

Monitoring programs of cetacean by-catch have been carried out in UE countries beneath the European Regulation 812/2004. In this framework as in previous years, France has deployed in 2010 a program based on the observation on board for vessels longer than 15 m and also for vessels less than 15 m long. 4 Stenella coeruleoalba were notably caught by French trawls working in the gulf of Lions (Morizur et al., 2011).

In Adriatic sea, by-catch rate of Tursiops truncatus in Italian pelagic trawling was estimated at 0.0006 individuals per haul for a total of 3141 hauls. A total of 609 groups of bottlenose dolphins were sighted close to the net in over 30% of fishing operations, often interacting with the fishing operation

(e.g. persistently following trawlers during tows, entering the net and swimming around the cod-end during the final part of hauling operations, or feeding on discarded fish). Two bottlenose dolphins were recorded as dead by-catch. Given the low number of observed deaths, and the low range of effort covered by observation (0.9 and 6.3%) according the wide extend of the pelagic trawling, reliable estimates of total mortality for these two species were not obtained (Fortuna, 2010).

- Purse seining

The information available for the Mediterranean seems to confirm that dolphins are not being massively caught in purse seine operations at least for tuna. The activity of the purse seine fleets targeting small pelagic fish is widespread all around the Mediterranean sea and accidental bycatches of common and stripped dolphins are described for purse seining off the coasts of southern Spain, southern Italy and northern Africa (Aguilar et al. 1991; Zahri et al., 2007) As for example the Spanish purse-seine fleet may catch as many as 5 700 individuals annually, which the majority is however released alive (Tudela, 2004).

- Driftnetting

Despite international and national ban driftnets continue to be used illegally in the Mediterranean Sea and to be a major source of fatal entanglement of dolphins as well for large cetaceans, as shown the incidental catch of sperm whales (Physeter macrocephalus) found trapped in a driftnet 40 miles southwest off Capo Palinuro in Italy (Pace et al., 2008) and the transect surveys conducted in the southern Tyrrhenian Sea around the Aeolian archipelago (Fortuna et al., 2007).For these last ones. a rough estimate of striped dolphin by-catch, based on floating carcasses, was calculated as 36 by-caught animals over a period of 12 days.

The Italian driftnet fleets although important, are not the only ones operating in the Mediterranean. Cetacean species regularly caught by the large-scale Moroccan driftnet fleet in Mediterranean waters. Common dolphin and striped dolphin are by far the most impacted ones (Tudela et al., 2005). Annual by-catch estimation by this fleet was of to 3 647 dolphins (50% of D. delphis and 50% of S. coeruleoalba) in the Alboran Sea and further 13 358 in the Straits of Gibraltar and adjacent Atlantic waters.

Furthermore, although the national ban of the drift net for bluefin (thonaille) several indices of incidental mortality of Stenella coeruleoalba seem to show the persistence of this illegal activity along the French coast (David, 2010).

- Bottom static nets

The massive use of static nets in many small-scale Mediterranean fisheries is one of the reasons of the main interaction between marine mammals and fisheries.

Incidental catches of cetaceans in bottom static nets concern as well dolphins as monk seals, when the nets are set too close to reproduction areas (Panou et al., 1993; Cebrian, 1998a). When these nets are not strong enough to withstand the adults, juveniles are mainly go there drowned. As with turtles, dolphins and seals can become entangled in ground nets attempting to take the catch. When an animal is caught in a net, the lesions varying severity may appear on his skin in contact with mesh

panel and ropes. If there tangled, it can die by drowning. On the other hand the fishing gear can be seriously damaged or even destroyed (Sacchi, 2008).

Besides incidental catches of marine mammals the main issue is the depredation of gillnets and trammels catches by dolphin and pinnipeds. As evidenced by several observations realized in Balearic Islands (Brotons, 2008), Sardinia (Diaz-Lopez, 2005, 2006), in Corsica (Rocklin, 2008) the gillnet and trammel fisheries know problem of depredation by Tursiops truncatus, resulting in catch loss and dolphin mortality.

Reports of bottlenose dolphins either removing or damaging the catch, damaging fishing gear and disturbing fishing activities come from several Mediterranean areas, but the available information is largely unpublished and sometimes difficult to evaluate. Impacts have been reported on catch per unit effort of species such as striped red mullet, red mullet, common sole Solea solea, blotched picarel Spicara maena, European anchovy Engraulis encrasicolus, European pilchard, greater amberjack Seriola dumerili, common cuttlefish and the small octopus Eledone sp. (Gazo, 2008).

Damages by monk seals issue to static nets of the artisanal fishery are also pointed out notably in East Mediterranean waters (Güclüsoy, 2008).

- Ghost netting

In recent decades, the development of the use of gill nets and trammel nets in all coastal fisheries and extension of the continental slopes has led to increased risk of loss of these gears and, therefore, to unaccounted catches ("Ghost fishing").

All fishing gear or a fragment of net, may be abandoned by the impossibility of recover or simply through negligence of the fisherman. Although the risk of loss of net is much reduced with greater use of the system Global Positioning System (GPS), the problem of "ghost fishing" continues to affect probably many Mediterranean fisheries. If reports on marine mammals entangled in net fragments or other discarded fishing gear have been described in Atlantic waters (O'Hara et al. 1986, Fertl and Leatherwood 1997) The important of this threat has not been yet evaluated for the Mediterranean although several observations denounce the occurrence practice of discarding nets at sea (Galgani et al., 1996; Katsanevakis 2008).

The fragments of fishing equipment can be found especially with all litter the accumulate into the coastal canyons (Galgani 2000) and present consequently an additional risk of incidental mortality for cetaceans for which canyons provide natural refuges and important source of food.

- Longlining

Longlines are commonly used in the Mediterranean for catching tuna, albacore, swordfish and a number of other fish (Di Natale 1990). Excepted for some cases of bait and prey depredation or entanglement by lines, interactions between marine mammals and longlining in Mediterranean sea are poorly reported (Di Natale 1990, Mussi et al. 1998) because perhaps they are often released alive at sea by fishermen. Although bottom longlining can be affected, surface longlining targeting swordfish or bluefin tuna is mainly concerned. Indeed, striped dolphin, false killer whale (Pseudorca crassidens), Risso's dolphin, and fin and sperm whale were reported from time to time entangled and

killed by surface longlines in Italian and Spanish waters (Di Natale, 1989; Tudela, 2004; Cañadas et al., 2006).

The primary factor driving these interactions appears to be "depredation". The bait on the hooked longlines as well as the capture attract target species; seabirds, sea turtles, sharks and marine mammals which can take subsequently the habit of coming eat this easy meal. As example, in the Strait of Gibraltar, killer whales (Orcinus orca) take advantage of the fishing activities of Spanish and Moroccan longliners during the the summer in this zone for eating tunas directly on the hooks. If during the late 80s, killer whales which are qualified as Critically Endangered species in the IUCN Red List were known to be deliberately killed by Spanish fishermen, to date, there are no official information on occurrence of this illegal practice (Guinet et al., 2007).

For more strong cetaceans the consequences may be worse, if the animals are not only entangled in the gear but also caught on the hook. In such like cases the branchline is often cut and they are released with both a hook in the mouth and significant amounts of trailing monofilament line that can be a serious threat for their survival (Garrison, 2007).

- Squid handlines

Striped dolphins, Risso's dolphins, long-finned pilot whales and sperm whales were observed taking advantage of the squid fishery using illuminated handlines, by preying on the squids attracted by the lights (Mussi et al., 1998).

- Aquaculture

Interactions occur also, between marine mammals (dolphins, seals) and aquaculture facilities in the Mediterranean. Marine aquaculture and, in particular intensive fish farming, have shown a large expansion in most Mediterranean countries over these two decades. The main cause is due to the depredation attempts by bootlenose dolphins or monk seals attracted by farmed fish. Unfortunately some of these animals may be trapped into the net barrier used generally to protect the fish cages from attacks by airborne and underwater predators. Observations of incidental catch of bootlenose dolphin on marine farm on the north-eastern coast of Sardinia (Lopez, 2007) and of monk seal in Greece (Karamanlidis et al., 2008) and in Turkey (Güçlüsoy et al., 2003; Güçlüsoy, 2008) point out as main causes of incidental catches the inexperience of calves and the looseness of the physical structure of some predator barriers.

5. Assessment of the impact

The management of fisheries interaction needs to assess the importance of by-catch problem for a given fishery and its consequences in term of economical loss and in term of harm for the species affected. There are few studies aimed at defining the extent of the conflict, and estimating the actual costs to fisheries.

The objective is in fact to reply to 2 questions:

- are marine mammals posing significant threats to fishery activities?

- are fisheries leaving sufficient resources for the long term survival of these mammals?

Impact on fisheries

Gear damage, reduced catch, and loss of fishing time have an overall economic impact that it should be carefully assessed. Interviews with fishermen are the first step in studies aiming to evaluate the actual nature and extent of damage (Reeves et al., 2001). They need necessarily to be associated with boats surveys to reduce bias introduced by the fisher subjectivities. Indeed, while interviews can provide useful insight into perceived damage, fishermen may wrongly ascribe to dolphins the gear depredation and other damage caused by fish, sharks or invertebrates or even gear damage deriving from entanglement with bottom debris and natural substrate (Gazo et al., 2008). A new approach was used for analyzing the interactions between bottlenose dolphins and gillnets along the northeastern coast of Sardinia (Italy), combining interviews with fishers with boat-based direct observations and behavioural and group size analysis (Diaz Lopez, 2006). Whatever, such studies need to be completed by evaluation of relative abundance of the species concerned in the area or obtained in other portions of the Mediterranean Sea.

To calculate the biomass removed by fisheries and the degree of resource overlap with dolphins (short-beaked common dolphins common bottlenose dolphins) in a coastal area of Greece, estimates of dolphin abundance based on photographic capture-recapture were combined with an assessment of fishing effort and catch. The estimated total biomass removed by the local fishing fleet was estimated about 33 times greater than that removed by dolphins suggesting that ecological interactions between dolphins and fisheries in this coastal area have minor effects on fisheries. Conversely, prey depletion resulting from overfishing can negatively affect dolphins (Bearzi et al., 2010).

In a same way, two studies, carried out independently, investigated the seal-fisheries interactions for the Mediterranean monk seal Monachus monachus in Greece and the grey seal Halichoerus grypus in Cornwall, England provide evidence that seals depredation constitute a loss of profit for the fishermen but is not for them their most important problem (Glain, 2001). Same observations were made in Turkey where the overall annual economic impact on the artisanal fishery was found to be modest although, the damage inflicted by seals per occasion was found to be substantial (maximum 462.5 USD per occasion), (Guclusoy, 2008).

Estimation of the impact of interactions between artisanal fisheries and bottlenose dolphins around the Balearic Islands shows that the combined cost of catch loss and net damage is relatively low equal to 6.5% of the total catch value. The annual weight loss (3,4 % of the total catch) from fishery equates to the dietary needs of 12 dolphins thereby suggesting that the fishery catch would not be a vital food source for the dolphin population. In contrast, according on observation of dolphins died by entanglement during the observed fishing operations the authors suspect an important annual mortality with serious conservation implications for the dolphin population. In this study, to assess in particular the impact of depredation on the gear, the number of hole encountered in the nets was were registered by sizes because small holes can be caused by depredation from octopus, moray eels (Muraena helena), and other small fish and according their vertical location because the bottom of the net suffers damage from contact with the sea floor, especially with rocks, and the upper third can also be damaged by contact with the floats when the net is recovered (Brotons et al., 2008).

Impact on marine mammals

Most species of marine mammals are located near or at the top of marine food webs and may therefore be utilizing the same or similar food resources as those exploited by fisheries. If we consider fishermen as also top predators in a given ecosystem, this may result in direct or indirect competition between them and marine mammals (CIESM 2004.).

The knowledge of trophic overlap between marine mammals and fisheries is a useful tool to elucidate the importance of this competition for food which may occur in a given area between these 2 categories of top predators. This overlap in resource use was investigated by comparing species-specific marine mammal diet composition with catch composition of different fisheries (Blanco et al., 2004). Fractional Trophic levels (TL) of each species caught were estimated to take account of the selective effect of different fishing techniques interacting with marine mammals affected (Kaschner et al., 2004).

6. Potential mitigating measures

This paragraph is essentially dedicated to the mitigation of the direct effects of the interaction between marine mammals and fisheries. The issue of the impact of fisheries on the food availability for top predators cannot really be considered in a rational way only within an ecosystem approach to fisheries management. Among the panel of solutions worldwide proposed few of them are tested and applied in GFCM area.

Between the various mitigation measures the objectives can objectives can be of two kinds: to avoid the incidental capture or to reduce risk of mortality after capture. Their nature can be either technical or of managing.

Furthermore, the optional solutions based on the same steps irrespective of the fishing techniques; it can be:

1- to reduce of the attractiveness of the fishing gear including all warning or scaring solutions,

2- to modify the gear for reducing risk of entanglement or easier the release of the animals caught,

3- to reduce or to avoid the fishing effort in ““hot spot”; in MPA.

Reduction of the attractiveness

- Reduce noise

to stop hauling while cetaceans are in the area and wait to resume the haul until the animals have left (Donoghue et al., 2003).

- Lures deterrents

Some studies have also suggested that setting “dummy” surface buoys with no attached longlines may distract animals working in the vicinity of the fishing area or setting strings with no hooks on them in between regular sets, (Donoghue et al., 2003).

- Reduction of sets length

It may make net less detectable to marine mammals, and shorter hauling time would result in less risks of depredation, entanglement, or hooking (Garrison, 2007). In southern Corsica, the attacked nets were characterized by significantly higher catch per unit effort (Rocklin et al., 2009), suggesting that dolphins either only attack nets when catches are notable, or actively drive the fish into the nets, thereby increasing fish catches.

- Other sensory systems

- It was recommended that other sensory systems in addition to sound, such as taste and vision, be investigated for their potential in aversive conditioning of dolphins (Reeves et al., 2001).

- it was notably pointed out that light might also be considered, whether as a repellent or attractant.

- Acoustic detectors

The main objective is to increase the delectability of gillnet by addition of objects or modification of the constitution of the twine. If the first solution was unworkable in practice, nets impregnated with iron oxide (Larsen et al., 2002) or sulfate Barium (Trippel et al., 2003) allowed to capture fewer dolphins and birds; Nevertheless, it will be necessary to verify if this improvement of the net selectivity is due really to an increase of the detect ability and not to an increase of the stiffness of the net.

- Pingers

Two major categories of acoustic mitigation devices are commonly recognized: Acoustic Harassment Devices (AHDs) and Acoustic Deterrent Devices (ADD), including pingers. Pingers are relatively low-intensity (generally <150dB re 1µP at 1m) operating between about 10kHz to around 100 kHz. They are usually designed to prevent small cetaceans from becoming entangled in gillnets. At the other extreme, AHDs are designed to work by causing pain, discomfort or irritation to potential predators, and have been developed primarily with the aim of discouraging seals from approaching caged fish.

The possible adverse impacts of acoustic devices on cetaceans, at both individual and population level remain poorly known. Furthermore, their effectiveness in reducing depredation is still in the process of being assessed. There is scientific evidence that pingers may reduce the by-catch of harbour porpoises and other small cetaceans in some fisheries. It is still too early to say whether acoustic devices will be effective in reducing depredation over the long term (Northridge et al., 2006). The results of trials in artisanal fisheries of the Balearic Islands, suggest that pingers can reduce the rate of net interaction, but further study is required to know dolphins' potential for habituation (Brotons, 2008).

Gear Modifications

- BRDs for pelagic trawls

Prototypes of by-catch reducing devices have been tested in USA and Europe to solve the problem of mortality of cetaceans in pelagic fisheries (de Haan et al., 1998). Considering both difficulties of developing reliable and commercial devices and low catch of dolphins in pelagic trawling such systems are not today applied. However this technique is an effective solution used in particular

since 2001, in trawl nets in the squid fishery around the Auckland Islands to mitigate the incidental capture of pinnipeds during trawling (Mattlin, 2005 in Rowes, 2007).

- Circle hooks

There have been no analyses of the effects of circle hooks on catches of marine mammals or sea birds due to their very low capture rates in fisheries examined to date. In 2004, regulations were implemented in U.S. waters for the Hawaiian pelagic longline fishery to mandate the use of larger circle hooks to reduce turtle bycatch of turtles. Preliminary analyses suggested a reduction in the overall rate of marine mammal interactions with longline gear associated with this change. However, a thorough analysis of the available observer data did not suggest any correlation between hook size or type and marine mammal bycatch (Garrison, 2007).

Thus, while the limited data available do not indicate that the recent regulations have significantly increased marine mammal by-catch, there is also no indication that they have significantly decreased by-catch.

- Reducing entanglement risks

The main causes of capture of large animals as cetaceans in a gillnet or in a longline is the entanglement. The increase of the stiffness of the twine (e.g. in longline and in gillnet), of the hanging ratio in gillnet and the reduction of slackness should reduce significantly incidental catches of cetaceans. The reduction of the height of the hanging staples of the floatline line should reduce the risk of entanglement of the animals into this part of nets.

Finally, the limitation of fishing effort by the number and length of nets deployed and duration of the haul, is often an effective preventive solution to reduce bycatch vulnerable species in general. Finally the use of ropes shorter and less resistant to marine mammals would constrained to escape more easily.

- Switch to other gears

When it is possible, it is advisable to encourage fishers to switch their techniques which are affected by a problem of by-catch for harmless ones (e.g. traps and pots). A study comparing seal damage by gear type suggests that substituting longlines for nets and reducing soak time could reduce the incidence of seal damage as well as the risk of entanglement (Güçlüsoy, H. 2008).
The classification of fishing techniques in degree of aggressiveness to the environment helps to guide managers and professionals to the less aggressive techniques for ecosystems. The difficulty is that most of the proposed changes may result in immediate losses profitability, the lack of knowledge, a lower intrinsic efficacy of the device selected, a need for reorientation of markets, at least in early years. This means accordingly prior assessment of the socio-economic and when necessary, by an accompanying financial measures and a educational support.

- Time or area closures for fisheries

It can sometimes be useful to close certain areas to fishing or certain fishing methods at risk for a season or a period when the levels of bycatch of marine mammals are considered too high by fisheries managers. For example the Pelagos Sanctuary is a Specially Protected Areas of Mediterranean Importance (SPAMI), established by the Action Plan (MAP) within the protocol

"Biodiversity" of the Barcelona Convention, under the United Nations for Environment Programme (UNEP) and beneath an agreement between Italy, Monaco and France for the protection of marine mammals that frequent the area include between the golfe of Genova and the North of Sardinia.[2]

Furthermore, the creation of permanent or temporary fishing zones to prevent the entanglement of suckling pups of monk seal breeding sites is proposed as an appropriate management practice (Güclüsoy, 2008.

The correlation between cetacean distribution patterns and oceanographic features can help to multidimensional pelagic habitats (Wurtz et al., 2007). Such areas can be found with the association of optimal hydrological conditions as frontal thermal structure (Abella, 2004) and physical structures as shelf-break and sea mountains which seasonally result in high densities of preys, of both large pelagic fish and marine mammals (Garrison, 2007). These types of area can constitute in some periods “hot spots” of risks by-catch. Reducing set length and soak-time, modifying the gear or avoiding these hot spot when there nothing else to do during the most critical period are the most reliable solutions (Garrison, 2007).

[2] http://www.sanctuaire-pelagos.org/accueil/index.php

Conclusion

All marine mammals can have a problem of interaction with a Mediterranean fishery but dolphins are the most impacted cetaceans by fishing activities concerning mainly coastal fisheries. Fishing gears of greatest risk of incidental catch of dolphins are longline, driftnet and bottom static nets.

Considering the international ban of drift-netting and the binding resolution of GFCM (97/1) (GFCM, 1997), the only one solution to solve problem of by-catch of this gear is to encourage the countries for which this technique is still being practiced to enforce definitively this resolution.

For the other fishing techniques, various mitigating solutions have been experienced in other seas with more or less success but that could be tested in Mediterranean conditions. They target either the improvement of the gears selectivity, their modification or the management of the fishing effort in sensitive areas.

The choice of most reliable solutions and best suited to a specific case of by-catch needs to analyze in a first step by surveys and interviews all incidental capture or mortality which may occur for any interaction in order to identify the major causes responsible for defining the most important parameters to correct. Negative effect of interaction with fisheries can be corrected by changes in fishing patterns with the help of fishers. Aware of risks of a total ban of their activities, they can end by giving from their own experiences relevant information on how to avoid obstacles related to the specific context of their fishery. As example, interviews surveys were carried out in USA in different fishing places to identify the most important by-catch issue per area and to find the consensual and practical solutions to apply (Glass, 2002).

The definition of new process or new technology involves research on the behavior of the species often expensive and difficult to implement. Financial assistance in the form of reward or assistance innovation are effective incentives for the creation of new types of gear or changes. For this purpose the World Wildlife Fund (WWF) has created in 2004, the International Competition for intelligent devices ("Smart Gear") to reward the search for methods fishing that could reduce non-target species taken while maintaining profitability fisheries.

More recently, Sextant Technology Ltd was contracted in 2010 by the Convention for Migratory Species to provide technical advice on the impacts of gillnet fisheries on non-target species. This program will characterize gillnet fisheries globally and assess the impacts of these fisheries on marine turtles, birds, mammals and selected shark species listed under the Convention for Migratory Species.

In a second step, solutions prototypes should be tested on a small scale as pilot studies with the partnership of fishermen examining closely the economic and social implications of changes relevant fisheries. Some gear modifications or tactics, effective experimentally may be too expensive, difficult to implement in the fisheries concerned. Their acceptance by the fishermen is possible only if the benefit can be clearly demonstrated. The implementation of best mitigation solutions should be done consequently again with the implication of the fishery industry in the regulation process.

In this context, the Cetacean Conservation in South Mediterranean Countries, adopted at the end of its Second Biennial Conference on (El Jadida, Morocco, 12-14 October) the following recommendations:

- "*Encourage the establishment of National Committees of the ACCOBAMS or similar structures to coordinate and strengthen the involvement of various parties involved in cetaceans ...*"

- *"…ensure the implementation of the actions recommended by the PAN in accordance with their schedule similar structures to coordinate and strengthen the involvement of various parties involved in cetaceans".*

- *"Encourage the integration of cross-border cooperation actions in the NAPs for the conservation of cetaceans.*

- *"Encourage the establishment of joint actions between the countries of the region on themes of common interest, such as the question of the elimination of interactions with fisheries."*

- *"Finalize the technical paper on the impact of fishing gear on cetaceans recently developed in the context of ACCOBAMS by supplementing all countries covered by the report. This document is to be finalized in close collaboration with GFCM through its next workshop SCMEE and Joint GFCM / ACCOBAMS".*

- *"Convert the fishing activities posing problems of interaction with cetaceans … to evaluate the feasibility and advantages of such conversions and their impact on cetaceans and fishermen".*

- *"…"*

- *…"strengthen the effort raising awareness among fishermen"…*

- *"… set up systems to collect the grey literature and make it available".*

- *"Strengthen the use of media via television spots to educate the public on the occasion of media reports of strandings".*

- *"Encourage the development of cetacean observer programs on ocean liners and implement training activities for these observers.*

In last, considering that fisheries can have often several by-catch problems with various other vulnerable species such as turtles, birds, elasmobranches, it would be advisable to adopt a multi-taxon strategy of mitigation taking into account all risks of by-catch that a same fishing technique.

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