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Guidelines for reducing by catch of seabirds in the Mediterranean region

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EXECUTIVE SUMMARY

Scientific evidence points to by-catch as the main cause for population decline in many seabird species around the world. Seabirds have become increasingly dependent on their association with fisheries for individual survival and breeding success. In so doing, they are augmenting the risk that they become injured and/or die and that their populations decrease as a result.

Mediterranean fisheries, where they have been investigated, have been found to cause seabird by-catch in relevant numbers.

A risk assessment of seabird-fishery interactions for the Mediterranean region is undertaken (Table II) and shows that shearwaters (*Calonectris diomedea*, *Puffinus mauretanicus* and *P. yelkouan*) are the species most at risk, and that longline fisheries represent the most immediate threat, although mortality probably occurs in trawling fisheries as well. Shearwaters are also the species of highest (global and regional) conservation concern.
Other species and other fisheries are also of concern and should be addressed. Longlining and trawling pose a threat for *Larus audouinii* and other Mediterranean endemics, as well as for species which occur as winter visitors. Of these, *Alca torda* is known to suffer mortality in gillnets (trammel).

Phalacrocorax aristotelis desmarestii, the Mediterranean Shag, suffers significant mortality in various fisheries, including gillnets/trammel nets and recreational fisheries form the coast. Ringing recoveries reveal that >40 % of its recorded mortality is related to fishing activities.
Several mitigation measures have been developed in various fisheries around the world and have proven to be effective in reducing by-catch to negligible levels. Best practice recommends a combination of measures, because considerable testing has shown that a suite of measures is the best way in most cases.

In longline fisheries, bird-scaring lines, night-setting and line-weighting have shown the best results, often in combination between them or with other measures such as area/seasonal closures, management of discards and underwater-setting devices. Some such measures are species-/ or fishery-specific, and a combination of ‘column A’ & ‘column B’ measures is proposed for the Mediterranean region.

In trawl fisheries, management of offal/discards and bird-scaring lines are widely recognized as effective means of reducing bird strikes on trawl warp cables. Other measures, such as net-binding and net-weighting are also analysed and proposed.

There are currently no best practice measures for reducing by-catch of seabirds in gillnet/trammel net fisheries, but visual and acoustic signals have been proposed in other seas. They, or other measures, should be trialled in the Mediterranean, where interactions with gillnet fisheries account for significant mortality of some species.

Mediterranean States are called to assess their fisheries and to identify whether they have a seabird by-catch problem. This process has been undertaken by other Nations in other seas, who have moved from initial denial to complete participation and sharing of the problem in

international forums. The precautionary principle needs to be applied whenever there is even slight evidence of mortality, and implementation of mitigation measures should be started without delay.

Observer programmes are fundamental to obtain data on species composition and temporal-spatial occurrence of by-catch. Scientific observers on board should receive proper training on species identification and use of mitigation measures. Their data collection protocols should follow the standards of appropriate RFMOs, such as ICCAT or GFCM, so that they can be shared and interpreted in international forums.

Innovation and research to improve current design of mitigation measures remains an important task. Specific adaptations may be required in areas where particular fishing techniques and seabird species overlap, so trials should be favoured wherever they are practicable. This inevitably requires the involvement of the fishing industry, researchers and resource managers, in a context of collaboration and sharing of experiences.

Monitoring of seabird numbers in their breeding grounds on land should be done regularly. Demographical data on seabird populations and their performance (survival, reproduction) can provide the best indication of success towards the goal of making fisheries sustainable and compatible with the conservation of biological diversity.

Several international conventions are relevant to the conservation of seabird populations, as part of the marine environment, in the Mediterranean region. The Barcelona Convention and the UNEP-Mediterranean Action Plan, the Agreement on the Conservation of Albatrosses and Petrels and the African-Eurasian Waterbird Agreement provide guidance and tools, and promote the collaboration of States at different levels. Participation at RFMOs such as ICCAT and GFCM facilitates the collection and exchange of data, and prompts appropriate management. The GFCM Scientific Advisory Committee, through its Subcommittee on Marine Environment and Ecosystems (SCMEE) maintain close collaboration with RAC/SPA on issues such as discards and by-catch of species of conservation concern.

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INTRODUCTION

The incidental mortality of seabirds as a result of their interaction with fisheries has received much attention by scientists, conservationists, policy-makers and government officials, worldwide, in the last two decades. Today, it is recognised as a major issue in the sustainability of fisheries and the UN Food and Agriculture Organization, FAO, has adopted an International Plan of Action to address seabird by-catch in longline fisheries (FAO, 1999). More recently, the FAO Committee on Fisheries has endorsed the conclusions of the expert consultation on Best Practice Technical Guidelines (FAO, 2008), which recommend that mitigation measures be incorporated to trawling and gillnet, as well as to longline fisheries, in order to make commercial fishing sustainable and compatible with the long-term conservation of seabird populations.

Since the first scientific evidence of by-catch was provided by Brothers in 1991(Brothers, 1991), mortality of seabirds at sea has been shown to be a serious environmental problem that is responsible for many declines in seabird populations, putting some of them literally on the verge of extinction (BirdLife International, 2008). In parallel, many researchers and seabird experts have devoted significant amounts of their time to the design of ways, devices and innovations with a view to correcting the negative consequences of the interaction between seabirds and fishing activities. The situation is most unwanted because it does not benefit anyone: killing birds is only the shameful result of an otherwise desirable human activity that provides healthy protein for human nourishment. Commercial and artisanal fishing are both impaired by the incidental capture of birds, instead of the target species, in their gear: there are important losses in terms of bait, fishermen's time and the overall image of their activity.

The last few years have seen the development of joint initiatives, by the authorities, the fishing industry and the scientific community, geared at improving our understanding of how the interaction occurs and at securing the continuity of fishing without a serious impact on the marine ecosystem. Almost certainly, the fishing of future decades will be done in a way that is totally, or mostly, 'seabird friendly'. The question is how to achieve those quality standards in the shortest time possible, so that seabird populations –subject to various other types of threat: destruction of habitat, pollution, disturbance– do in fact survive into the new times in sufficient numbers (and with enough genetic variability) to guarantee their continuity in the long term.

Somehow, this process is going more slowly in the Mediterranean region. In this highly humanised sea, where many fishing methods (including longlining, trawling and gillnetting) were invented, only limited attention has been paid so far to the interactions between seabirds and fishing vessels, and to the risks that they involve. The time is right, though, to address the issue at the beginning of the XXI century. Enough information is already available on how to avoid/prevent the interaction and its negative effects. What is known from bird populations, and their evolution, points at by-catch posing a serious threat to the preservation of this visible component of Mediterranean biodiversity, our common heritage.

PART ONE – THE PROBLEM

Seabird interactions with fisheries

Seabirds interact with fisheries in a number of ways. Some of those interactions inevitably result in the birds getting caught in fishing gear. Many of the birds caught then die or become seriously injured, and are lost to the population. Scientific evidence points to by-catch as the main cause for decline in many seabird species around the world (BirdLife International, 2004; FAO, 2008; Mínguez *et al.*, 2003; Reid & Sullivan, 2004; Ryan & Watkins, 2008).

Considerable research has centred on trying to avoid the negative consequences of seabird interactions with fisheries. Work on by-catch is being conducted at several levels:

a) prevention – keeping seabirds away from vessels and/or dangerous gear
b) mitigation – reducing the risk of death/injury when seabirds enter in contact with dangerous gear
c) rescue – freeing individual seabirds caught alive (see Appendix I)

Along with this, any serious attempt to reduce seabird by-catch must be embedded in the framework of a wider seabird conservation policy. Other essential elements of this are: the involvement of the fishing industry, an outreach programme for the wider public and the collection of long-term series of scientific-based data.

Still, the essence of the problem remains very simple: birds are attracted to fishing vessels, which –they have learnt– may be a reliable source of a free meal. This extra food may make the difference, and often seabirds have no choice. Fishing methods –on the other hand– were not designed to avoid catching birds, so the inevitable occurs sooner or later, at varying degrees depending on the area, time of year and the species involved. The ecological consequences also differ.

It is not realistic to expect that seabirds will learn, by themselves, that associating with fishing vessels may be detrimental for their populations. Some species are actually benefitting from their association with humans and, although they too lose some individuals, their overall numbers have increased. The problem lies with the rarer species.

Have seabirds stopped to feed 'naturally'? Not, as long as we know. But their chances of locating sources of abundant food have diminished as ecosystems have become simpler and the populations of tuna and dolphins have become smaller. These predators were 'natural' gatherers of fish schools, which they drove to the surface for seabirds to exploit in large flocks (causing havoc and thus making it easier for tuna and dolphins to catch). Such multiple-species temporal aggregations still occur, but are a rarer event in the gradually impoverished seas of the XXI century.

So, seabirds have become increasingly dependent on their association with fisheries for their individual survival and breeding success. But, in so doing, they are augmenting the risk that they will become injured and/or die and that their populations will decrease as a result. It is proving difficult, and a good deal of effort and commitment are needed, to break that circle.

Seabird by-catch in the Mediterranean region – the facts

Mediterranean fisheries are no exception and, where they have been investigated, have been found to cause seabird by-catch in relevant numbers. Evidence has been shown mainly for longline fisheries: Cooper *et al.* (2003) compiled data pointing at unsustainable catch rates for Cory's shearwater *Calonectris diomedea*, in all probability the most affected species, particularly in Spain. Subsequently, important by-catch rates have been found also for the other shearwater species in longline fisheries operating in Malta, France and Italy, as well as in Spain (Bourgeois & Vidal, 2008; Carboneras *et al., in press*; Dimech *et al.*, 2008; Dunn, 2007). Table I (Appendix II) summarises the status of seabirds in the Mediterranean region and their occurrence by country. In Table II (Appendix II), the first risk assessment of seabird-fishery interactions for the Mediterranean region can be found.

Byctach in longline fisheries is known to affect other species, apart from shearwaters. These include species of global/regional conservation concern, such as the Mediterranean endemics Audouin's *Larus audouinii* and Mediterranean gulls *Larus melanocephalus*, and species most commonly found in other regions that also use the Mediterranean in winter: Northern gannet *Morus bassanus*, Great skua *Catharacta skua* (Belda & Sánchez, 2001; Cooper *et al.*, 2003; Dunn, 2007; Guallart, 2004). Species of least concern, such as Yellow-legged gull *Larus michahellis*, also get caught in significant numbers.

Data on seabirds taken to recovery centres in Mediterranean countries also reveal that recreational fishing (angling from harbours or from boats, including trolling such as in 'curricán') is not a minimal source of further by-catch. It has been recorded in *Calonectris diomedea*, *Larus audouinii* and, most importantly, in Mediterranean Shag *Phalacrocorax aristotelis desmarestii*.

Band recoveries of ringed birds are a general source of objective data. The information they provide is not unbiased, as birds that are found in circumstances related to human activities have a higher probability of being reported. Four species, however, stand out as having unusually high (above 40 %, as opposed to 0-10 % in other seabirds) rates of recoveries reported as caught in a trap set for other species (Euring code 34: a*ccidentally trapped where the intention was to trap other species of birds or vertebrates, eg in fish nets or on a fist hook while the nets or hook were being used to catch fish*). Those species are:

- Cory's Shearwater *Calonectris d. diomedea*: mostly caught in longlines (pelagic & demersal)
- Balearic Shearwater *Puffinus mauretanicus*: mostly caught in longlines (demersal)
- Mediterranean Shag *Phalacrocorax aristotelis desmarestii*: mostly caught in gillnets and traps
- Razorbill *Alca torda*: mostly caught in gillnets

Current knowledge in the Mediterranean does not extend to trawl fisheries as a proven source of by-catch. Trawling, however, is the main method used in commercial fishing in the region, where it is also the main producer of fish offal and discards (Arcos, 2001; Bozzano & Sarda, 2002; Martinez-Abrain *et al.*, 2002; Oro & Ruiz, 1997). No studies have compared the relative numbers of seabirds attracted to the different types of fishing vessels, although it is common knowledge that trawlers produce large assemblages. Trawling is known to cause significant by-catch of albatrosses and other seabirds off southern Africa and in the

Patagonian shelf (Barnes *et al.*, 1997; BirdLife International, 2004; Croxall, 2008; Gonzalez-Zevallos & Yorio, 2006; Ryan & Watkins, 2008; Sullivan *et al.*, 2006; Watkins & Ryan, 2008). Research is being conducted, in the Mediterranean region, on the causes of certain types of injuries found in seabirds, as they may most probably relate to fishing gear used for trawling.

The precautionary principle

Where potentially dangerous effects of a process affecting the environment have been identified but scientific evaluation does not allow the risk to be evaluated with sufficient certainty, the precautionary principle applies (Commission of the European Communities, 2000). We know that enough seabird species in the Mediterranean region are of conservation concern and that interaction with fisheries has been identified as a potential threat for most of those species (UNEP - MAP - RAC/SPA, 2003) to merit immediate action.

In order to preserve the current diversity in the seabird communities in the Mediterranean region, it is probably wise to put in practice a suite of the mitigation measures developed elsewhere and which are known to reduce levels of by-catch to those that can be tolerated by the species concerned. Some of those methods have also been tested in the Mediterranean with good results.

In parallel with the immediate implementation of mitigation measures, the precautionary principle should lead to the development of comprehensive, scientific-based action plans, following the recommendations of the FAO Code of Conduct for Responsible Fisheries which promoted, among others, the International Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries (IPOA-Seabirds). At the national level, it is recommended that countries develop their own national plans of action (NPOA-Seabirds) and adopt a more proactive attitude, participating in international treaties (such as the Agreement on the Conservation of Albatrosses and Petrels ACAP, of interest for the three Mediterranean shearwater species, *Calonectris* and *Puffinus*) and Regional Fisheries Management Organizations, or RFMOs, contribute their statistics on seabird by-catch to these fora and put into practice on-board observer programmes for the collection of scientific data.

Mediterranean seabirds in context – the importance of endemic taxa

The Mediterranean region is a well-known source area for endemism at several biological levels, from plants to mammals (Margalef, 1985; Zotier *et al.*, 1999). Seabirds are a particularly good example of the region’s richness and diversity in biota – eight of the nine breeding taxa of exclusively marine birds are either endemic species or subspecies (Zotier *et al.*, 1999). This datum alone summarises the importance of the Mediterranean Sea: a relatively poor environment with comparatively harsh conditions and that has been in isolation long enough to force the development of new forms of life.

Mediterranean seabirds have a long history of coexistence with man and its consumption of natural resources (Oro, 2003). This is reflected in the current distribution of species and their numbers. However, the levels of threat that they are facing at present as a result of their interaction with fisheries may be overtly unsustainable. If no remedy is put, they would lead to the definitive extinction of these highly specialised, unique forms that are part of the Mediterranean heritage.

PART TWO – HOW TO AVOID/REDUCE SEABIRD BY-CATCH IN THE MEDITERRANEAN REGION

Avoid, reduce, minimise

The ultimate goal of these Guidelines is to contribute to make fishing, as we know it, be compatible with the long-term conservation of seabird populations. To reach that goal, it is necessary that seabird by-catch in the Mediterranean region remains as close to zero as possible. Or, in other words, by:

- avoiding seabird by-catch, *i.e.* *catch rates = 0*
- minimising seabird by-catch *i.e.* *catch rates ≈ 0*
- reducing seabird by-catch *i.e.* *catch rates* t_1 > *catch rates* $t_2 \geq 0$

Experience has shown that it is not always possible to reach the desirable '*by-catch = 0*' goal. When this happens, best practice should be directed towards minimising the impact, or at least, reducing it to levels that the seabird populations can sustain.

This can only be achieved through the use of mitigation measures. However, although we know that mitigation measures serve the purpose of avoiding/minimising/reducing by-catch, there is evidence that no single mitigation method is in fact fully effective. Best practice recommends that a combination of methods is used simultaneously (Agreement on the Conservation of Albatrosses and Petrels, 2008; FAO, 2008; Løkkeborg, 2008). The specific combination will depend on such factors as the target fishery, gear used, location and suite of seabird species encountered, and sea conditions. Furthermore, this may need to be fine-tuned on an individual vessel basis to optimise performance (Bull, 2007a).

Mitigation measures for longline fisheries – column A & column B

At the individual level, skippers of fishing vessels must choose a suite of the mitigation measures that they will put in operation to avoid/reduce seabird by-catch during every fishing trip. They should have in place *at least 2* mitigation measures in any of the following combinations:

- at least *one* measure from column A *plus* at least *one* measure from column B
- at least *two* measures from column A

Column A	Column B
[Longlining]	**[Longlining]**
▪ **night setting**	▪ offal and discard management
▪ **bird-scaring lines**	▪ area/seasonal closures
▪ **line weighting**	▪ bait condition (incl. blue-dyed)
▪ **under-water setting**	▪ line shooter

Below follows a more detailed review of the mitigation measures developed in the last decades by the scientific, managerial and fisheries communities and which have been proven to be effective in reducing seabird by-catch in concrete longline fisheries:

Night-setting (column A)

How it works

Birds are mostly visual predators, so fewer actually feed actively at night. Observations in virtually all oceans (except in the poles) confirm that fewer seabirds attend fishing vessels in total darkness. The number of attempts at stealing fish bait in longline fisheries is also significantly lower at night, possibly because they also find it more difficult to locate potential prey. Overall, the risk is reduced for most species and fishing areas.

Night-setting is easier to adopt, as a mitigation measure, in commercial fisheries that operate far from their port of reference. For fisheries where trips are 1-3 days long, it may require important changes in key habits (*e.g.* timing of fish auctions, fishermen's activities on land). These may be worth the while, though, because the reduction in seabird by-catch may be substantial.

How it can reduce seabird by-catch in the Mediterranean region

Night-setting has been shown to be an effective method to reduce seabird by-catch in longline fisheries, both pelagic and demersal, in Mediterranean waters in Spain (Belda & Sánchez, 2001) where Cory's shearwater *Calonectris diomedea* was the most affected seabird species. Fewer shearwaters associated with the fishing vessels when the line was set at night; the largest aggregations occurred around sunrise. By-catch rates were also highest around sunrise and sunset, so these are the periods to be avoided according to the authors. The lowest risk occurs in total darkness, as it has been shown also for other seas (Belda & Sánchez, 2001; Bull, 2007a; Guallart, 2004; Løkkeborg, 2008).

It is the light that affects seabird presence and by-catch rates, so there is a relatively higher risk in nights with full-moon phase (Bull, 2007a).

Recommendations

In order to maximise efficiency, it is important to ensure that decklights have been turned off and that illumination (especially, on deck) is limited to those lights necessary for navigation and for health & safety standards (Løkkeborg, 2008).

Also, when setting the longline at night with reduced lighting, fishermen must make sure that they do not face greater risks and, when appropriate, should incorporate additional protection so as not to injure themselves.

Night-setting may need to be used in combination with other mitigation measures (additional weighting, bird-scaring lines, etc.) to achieve 100% efficiency in reducing seabird bycacth.

The fact

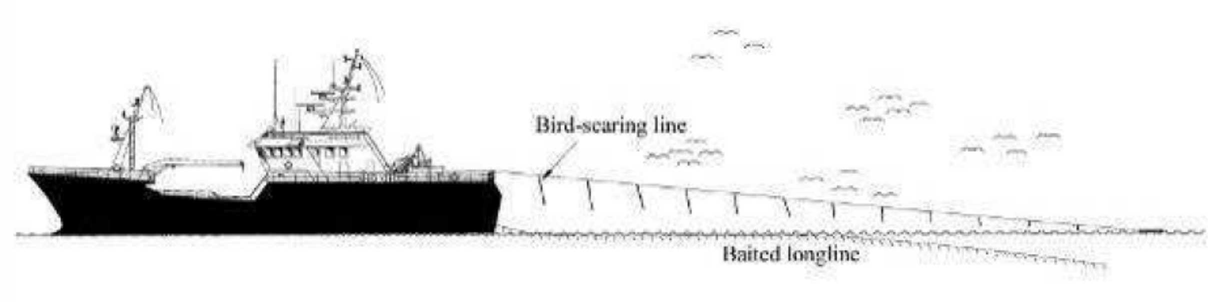
From Dunn, E. (2007():

"On the basis of this collaboration [between the Regional Government of Galicia, Puerto de Celeiro, S.A. and SEO/BirdLife], in October 2006 an observer (Álvaro Barros) undertook the first of a series of seven trips to the Gran Sol (SW Ireland) to assess the impact of the Galicia longline fishery on seabirds. The purpose of this project is to study the spatial and temporal interaction between the fishery and seabirds (i.e. in all seasons, inshore and offshore).

The first observations, reported in December 2006, were conducted aboard the vessel 'Breogán Uno' *between 14 and 26 October 2006, a 16-day trip including 10 fishing days to the*

Gran Sol (about 160 kms offshore: between 53°55’ N-12°30’ W and 53°055’ N-12°56’ W), targeting mainly hake Merluccius merluccius *and black bream* Brama ramii*. Each day, the vessel set 10,200 hooks along 15-20 kms. Of the total of 98,545 hooks set during the whole fishing period, 8496 (9%) were monitored.*
The main seabird species accompanying the fishing activities were northern fulmar Fulmarus glacialis *and great shearwater* Puffinus gravis*. In total, 121 birds were caught on the longlines, comprising 116 (96%) great shearwaters, 4 fulmars, and 1 sooty shearwater* Puffinus griseus*, a by-catch rate of 14.2 birds per 1000 hooks. An additional 20 birds (19 great shearwaters, 1 sooty shearwater) were caught during line-hauling (while attacking hooked fish) but were released alive.*
Setting was at night and at dawn, and by-catch was strongly associated with the use of deck lighting during the first six days. After the sixth day, the observer requested that – as a control – no deck lighting be used and in the four fishing days that followed, only 2 birds were caught. When the lights were on, 119 birds (98% of the total) were killed, an average of 20 birds a day. If this by-catch rate applies to all the hooks set, and not just those observed, then 240 birds would have been caught per day. By-catch rates were highest at dawn when the birds were most active.”

Bird-scaring lines (column A)



The bird-scaring line (from Løkkeborg 1998 and 2008)

How it works

Bird-scaring lines (also known as *streamer lines* or *tori lines*) have been designed to keep seabirds a distance away from moving vessels. They try to prevent hungry seabirds from entering the aerial space astern of the vessel and extending to at least 90-100 m. It is in this area where seabirds are most at risk and may interact with dangerous gear that is within their capacity to reach by diving, plunging or swimming; further away, fishing gear is generally below water and remains out of reach of most seabirds.

Research has shown that birds get scared by the combined effect of the aerial line, the streamers and the buoy being towed on the water. Most flee and keep at a distance that becomes crucial. Researchers have agreed to a ‘best practice’ design that has been achieved by trial-and-error by many people over nearly two decades in several oceans and in many sea conditions (Melvin et al., 2001). Appendixes III & IV contain two examples of this design: that annexed to Recommendation [07-07] by ICCAT on reducing incidental by-catch of seabirds in longline fisheries and Conservation measure 25/02 of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR).

The deterrent effect of bird-scaring lines is increased by using two (‘paired’) lines, one on each side of the stern and the fishing gear being operated in-between. This practice is recommended to large fishing vessels operating in waters where large seabirds are common. It is *e.g.* compulsory for longline vessels >24 m-long in CCAMLR waters (Melvin, 2004).

How it can reduce seabird by-catch in the Mediterranean region

Bird-scaring lines have proven to be successful mitigation measures in fishing grounds where large seabirds (particularly albatrosses, petrels, shearwaters and gannets) congregate astern of the vessels in large numbers (FAO, 2008; Løkkeborg, 2008). They are most effective when used in combination with another mitigation measure (e.g. night setting, increased line weighting). In the Mediterranean region, where shearwaters are of highest conservation concern, bird-scaring lines can contribute to effectively reducing seabird by-catch in the areas where they overlap.

Of the Mediterranean seabird species that suffer by-catch in longline fisheries, some species like *Calonectris diomedea* and *Larus audouinii* are mostly aerial and do not dive to great depths. In the fisheries where these species are predominant, the use of bird-scaring lines, preferably in combination with other mitigation measures, may significantly reduce the rates of by-catch. The situation could be different in waters where *Puffinus* shearwaters occur in relevant numbers. In those fisheries, bird-scaring lines may not be such a successful bird deterrent, because both *P. mauretanicus* and *P. yelkouan* are excellent divers and may easily reach considerable depths, thus being able to access baited hooks even some time after they have started to sink.

There is some geographical and technical separation between the two types of fishery mentioned in the above paragraph. The first type, where *Calonectris diomedea* and *Larus audouinii* abound, corresponds mostly to pelagic longlines set for tuna and swordfish far from the coastline. Bird-scaring lines may prove very effective in these (Belda & Sánchez, 2001; Guallart, 2004). The second type, demersal longlining for hake and other white fish, occurs mostly in waters close to the coastline, where *Puffinus* shearwaters are most common in the appropriate regions. There are no studies on the performance of bird-scaring lines in relation to these species, but it seems *a priori* that it may not function as well as for other species. For this case, it is highly recommended to use bird-scaring lines in combination with line-weighting (see below), which is designed to make the line sink faster (and, thus, closer to the vessel and to the area where the bird-scaring line works successfully)(Løkkeborg, 2008).

Recommendations

All fishing vessels operating in the Mediterranean should carry at least one (preferably, two) bird-scaring line(s) on board ready for operation and inspection. Crews should train to use them properly and without risks, in different fishing circumstances and sea states.

In the Mediterranean region, the use of bird-scaring lines may be required only in certain areas/seasons that are rich seabird ‘hotspots’ (e.g. near breeding colonies at the time of nesting). For the rest of the region, they may be required only irregularly, when birds are plentiful around the vessel and, therefore, at risk. Or when the same vessel has already caught some seabirds previously, for example. In those conditions, the crew must be able to set up the bird-scaring line(s) promptly and without hesitation, so some previous practice will favour its rapid use and will probably save the lives of some birds.

Bird-scaring lines, particularly when used in pairs, may increase the risk of entanglement with the longline gear (Løkkeborg, 2008). This situation is to be avoided, as in other seas it has been shown to have the opposite of the desired effect: when the vessel stops in order to solve the entanglement, the whole gear may be resting on the water for several minutes, an unwanted situation that may augment the risk of by-catch. It is therefore advisable that crews train themselves or receive some training on the technical aspects of setting the gear and manoeuvring the vessel with the bird-scaring line(s) fully deployed, so that they know which situations to expect and what to do in order to avoid them.

In practice, bird-scaring lines may benefit from some adaptation to the peculiarities of the fishing methods of the Mediterranean and to the suite of seabird species present. Experience gained by local fishermen, and considerable testing, should result in further improvement of the current design in relation to fishing practices in the Mediterranean region and the species present.

The fact

From Løkkeborg (2008):

*"A two-year research programme (1999–2000) comparing seabird by-catch mitigation strategies have been carried out in the two major Alaska demersal longline fisheries; the sablefish (*Anoplopoma fimbria*) fishery and the cod (*Gadus marcocephalus*) fishery (Melvin et al., 2001). This research programme tested single and paired streamer lines, weighted lines, setting funnel and line shooter. A total of 1.2 and 6.5 million hooks were set in the sablefish and cod fisheries, respectively, and 113 and 430 seabirds were caught. The primary seabird caught in both fisheries was northern fulmars [*Fulmarus glacialis*], but short-tailed shearwaters (*Puffinus tenuirostris*) and Laysan albatross (*Phoebastria immutabilis*) were also caught.*

Among the mitigation measures tested, paired streamer lines proved to be the most efficient solution. This device reduced seabird by-catch by 88–100 percent relative to controls with no deterrent. Thus paired streamer lines virtually eliminated the catch of surface foraging seabirds, and they were efficient in all years, regions and fleets despite the fact that seabird by-catches varied by orders of magnitude across years and among regions. Single streamer lines were slightly, but not significantly less effective than paired streamer lines, and reduced seabird by-catch by 71 percent and 96 percent in the cod and sablefish fisheries, respectively."

Integrated and external line weights (column A)

How it works

Adding some extra weight to the longline makes it sink faster. This reduces the time that the baited hooks are on or close to the surface, and are thus available for seabirds to prey upon. There are two main ways of adding weight to the line: tying stones, metal pieces or other external weights to the mainline, or by incorporating strands of heavy-weight materials (*e.g.* lead) when manufacturing the mainline. The second option is cleaner and easier to use but may be more expensive.

By sinking faster, weighted lines also increase the amount of time that the line is "in place" (*i.e.* at the right depth for catching the target species), so fishing is also more effective. Experiments have shown that fishing normally occurs within the first 2 hrs of immersion (Løkkeborg, 2001), probably the period when bait is still fresh and attractive for fish. A reduction in sinking time will make more bait available to fish in optimal condition.

Weighted lines do not solve *per se* the problem of seabird by-catch, but they can make a significant contribution when they are used in combination with other methods (night-setting, bird-scaring lines, management of offal, etc.) (FAO, 2008; Løkkeborg, 2008).

How it can reduce seabird by-catch in the Mediterranean region

Fast-sinking longline gear is safer for seabirds in all oceans, situations and combinations of species. Although little tested in the Mediterranean, there is no scientific reason to hypothesise this mitigation measure would perform differently in this region. Especially when used in combination with other measures, such as night-setting, management of offal and bird-scaring lines.

In parallel with other regions of the world, adding extra weight to the main line is likely to be more effective in demersal longlining set at slow speed. For pelagic longlining, which is usually set at greater speed, some standards require that the extra weight be added to the branch line (*e.g.* Hawaii, Australia). This is probably most effective for areas abounding with albatrosses, which mostly grab their food whilst sitting on the water. For the Mediterranean, where shearwaters are of greatest conservation concern, it is probably advisable to add the weight to the main line, either by attaching it externally or by integrating it in the line itself.

Recommendations

The combined use of weighted lines with effective mitigation measures like night-setting and bird-scaring lines will significantly reduce (or possibly even eliminate) the incidence of by-catch in most Mediterranean fisheries and situations. Weighted lines alone may not be so effective in some circumstances and should not be promoted as a stand-alone mitigation measure.

Technology now allows for the use of cheap, simple devices to obtain data on the sinking rate of longline gear set underwater. When this has been tried in other areas (*e.g.* Brazil) the results obtained were surprising even for the fishermen, and provided a new insight into the evolution of the longline gear from the moment it starts to sink until it reaches the seabed(Bugoni *et al.*, 2008). Information provided by this new source should induce some innovation of current fishing methods used in the Mediterranean and should encourage fishermen to increase line weighting in order to fish more efficiently.

The fact

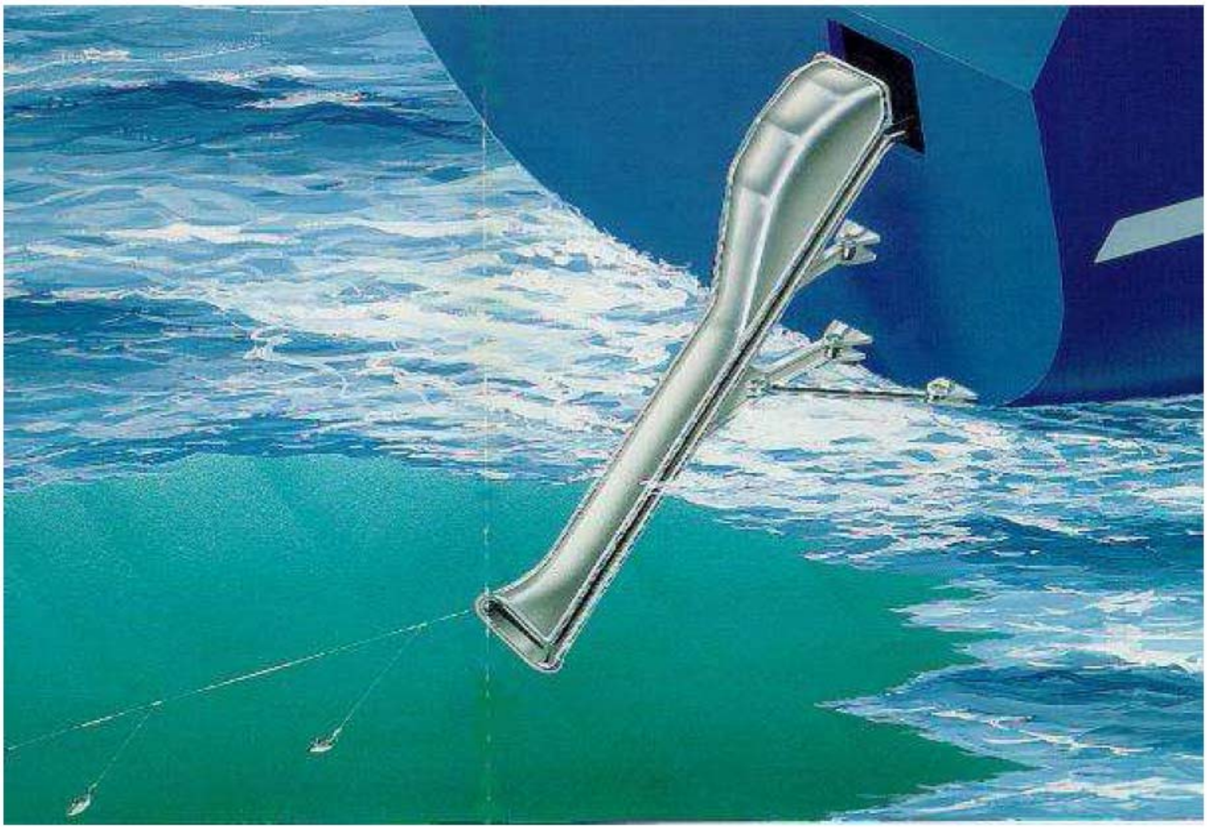
From Løkkeborg (2008):

*"The potential of longlines with integrated weight to reduce incidental catch of white-chinned petrel and sooty shearwater (*Puffinus griseus*) were investigated in 2002 and 2003 in the New Zealand ling (*Genypterus blacodes*) autoline fishery (Robertson et al., 2006). These seabird species are among the most difficult to deter from baited hooks. White-chinned petrels forage day and night (Weimerskirch, Capdeville and Duhamel, 2000) and are capable of diving to at least 13 m (Huin, 1994). Sooty shearwaters are agile flyers and have deep diving abilities (67 m depth; Weimerskirch and Sagar, 1996). Lines with integrated weight (50 g/m beaded lead core, sink rate: 0.24 m s-1) yielded a 94–99 percent reduction in capture of white-chinned petrels and a reduction of 61 percent for sooty shearwaters in comparison to unweighted conventional lines (sink rate: 0.11 m s-1). No albatrosses were caught in these experiments except a single Salvin's albatross [*Thalassarche salvini*].*

(...)

In addition to reducing the incidental capture of seabirds, weighted longlines may also give increased target catch rates as they reach the seabed more rapidly. The release rate of attractants from baits declines rapidly during the first 2 hours of immersion in seawater (Løkkeborg, 1990), and longlines with sink rate of 0.16 m s-1 (conventional lines) would take 1 h 44 min to reach fishing depth at 1000 m compared to 55 min for a line weighted to sink at 0.3 m s-1 (Robertson et al., 2003). Thus, to maximize bait attractiveness it is advantage to use longlines that sink fast. In addition, lines with integrated weight have superior handling attributes making gear easier to deploy and retrieve relative to traditional unweighted longlines (Robertson et al., 2006)."

Underwater setting devices (column A)



Underwater setting chute (from Løkkeborg 1998 & 2008)

How it works

In recent years, several devices have been developed that guide the gear (main line, branch line, hooks) through some mechanism (capsule, chute, funnel, the hull) and release it under the water, away from the reach of [most] seabirds. Some are more sophisticated than others, but they are all based on similar principles and they all seek to eliminate the aerial phase of the setting operation (i.e. the transition from the stern or side of the vessel into the water and as deep as possible). Seabirds being mostly aerial, the result of the use of these devices is that they reduce the attractiveness of the fishing vessel (the bait is more difficult to detect) and the risk of the birds becoming hooked (the gear is more difficult to access to)(Gilman *et al.*, 2003; Gilman *et al.*, 2007; Løkkeborg, 2003; Melvin, 2001).

Underwater setting devices have been tested in several seas, with varying success. Many only exist in prototype form, but some commercial types are available as well, like the *Autoline Setting Tube*™ manufactured by Mustad Longline A.S. from Norway (http://www.mustad-autoline.com). This and other underwater setting devices have shown some malfunctioning and did not perform as expected when tried on large vessels in rough seas (Gilman et al., 2007; Løkkeborg, 2008). BirdLife International (*in* Melvin & Baker, 2006) recommends further research into trying to overcome the design problems identified before these devices are considered suitable for widespread application.

How it can reduce seabird by-catch in the Mediterranean region

In the Mediterranean, underwater setting devices have been subject to little testing. Even though, they are recommended by some researchers (*e.g.* Guallart, 2004) and might in fact be quite effective, particularly if combined with well-known mitigation measures, such as night-setting, bird-scaring lines and line weighting.

Recommendations

It seems appropriate to undertake some testing of these devices, in controlled conditions and under the scrutiny of scientific observers, in the Mediterranean. Initial tests should be carried out in areas where only the more aerial species (*Calonectris diomedea, Larus audouinii*) occur. Waters that abound with the diving *Puffinus* shearwaters should be left for a second phase of testing, only for the case that the initial trials are successful.

The fact

From Ryan & Watkins (2002):

*"A demersal longline fishery for Patagonian toothfish (*Dissostichus eleginoides*) that commenced off the Prince Edward Islands during 1996 has killed significant proportions of locally breeding albatrosses and petrels. As one of a suite of mitigation measures, we tested the efficacy of a Mustad underwater setting funnel to reduce incidental mortality of seabirds. The funnel, which deploys the longline 1–2 m beneath the sea surface, was used on 52% of 1714 sets (total effort 5.12 million hooks) over a 2-year period. Used in conjunction with a bird-scaring line, overall seabird by-catch rate was low (0.022 birds per 1000 hooks), and was dominated by white-chinned petrels (*Procellaria aequinoctialis*) (88% of the 114 birds killed). By-catch rate was three times lower when the funnel was used both by day and at night. Daytime catch rates with the funnel were less than those attained during night sets without the funnel. In conjunction with other mitigation measures, underwater setting offers a significant reduction in seabird mortality in this fishery and could increase fishing efficiency by allowing daytime setting. However, small numbers of albatrosses were caught during daytime sets with the funnel, and its use for daytime sets should be closely monitored."*

Offal and discard management (column B)

How it works

The number of seabirds attending a fishing vessel is highly and positively correlated with the amount of food (offal, discards) that is made available to them (Furness *et al.*, 2007; Oro *et al.*, 2004; Weimerskirch *et al.*, 2000). Mitigation consists in decreasing the incentive for birds to follow vessels via a reduction in the amount of food that they can access. This can be achieved, for example, by:

- throwing no offal/discards overboard while at sea when seabirds are present *e.g.* through retention onboard for later disposal
- freezing offal into blocks which can be kept for later disposal or dumped overboard
- blending offal to form a homogenised fluid mass which can be kept or returned to sea, preferably through a pipe or mixed with water

Offal/discard management is an effective method when it results in a net reduction in the amount of food available to the birds. In its simplest form, the skipper can choose to separate the setting and hauling operations (particularly in longline fishing) so that they do not coincide in time or place.

How it can reduce seabird by-catch in the Mediterranean region

Living in a highly humanised environment, seabirds in the Mediterranean region are probably more inclined to become associated with fishing activities than they do in other parts of the world. Therefore, if this direct relationship can be avoided, seabirds will be able to live more independently of man.

It is generally incorrect to assume that seabirds benefit from the extra food that they may obtain by attending fishing vessels: while it is true that they obtain food at low cost at the individual level, it is also true that this causes disruptions at the species and ecosystem levels. The long-term outcome, in ecological terms, is probably negative.

Recommendations

The smaller the number of birds attending a vessel the better. It is mostly the skipper's decision to choose how to make his vessel less attractive for hungry seabirds. Fishing that is more selective on the target species and that extracts less unwanted catches will be both more profitable and better for the environment (Hall & Mainprize, 2005).

The desirable reduction in the amount of discards thrown overboard may involve changing habits and, possibly, increasing the storage capacity in the vessel, so the logistical implications are not minimal (Abraham *et al.*, 2009). However, research is being conducted at various levels to find practical uses for the offal and other biological material now being 'returned' to sea with many negative consequences. In the future, it may be possible to obtain revenue from what is currently being discarded that can compensate for the additional costs of processing, storage and/or transport.

The fact

From Petersen et al. (2007):
"Albatrosses and petrels are opportunistic scavengers and fishing vessels processing at sea and discarding offal provide a feeding opportunity for these birds (Ryan and Moloney 1988). Therefore by minimising or eliminating discards seabirds will not be attracted to fishing vessels. Seabirds are most at risk of being caught during setting (Brothers et al. 1999a) therefore discarding should not take place during this time. If discarding is necessary during hauling, crew should be instructed to do so on the opposite side thereby reducing the risk of capture to the birds. Current fisheries regulations for South African longline fisheries require vessels to dump offal on the opposite side of the vessel from that on which lines are hauled and no dumping of offal may take place during setting. Namibian fisheries regulations prohibit dumping of offal."

Area/seasonal closures (column B)

How it works

The co-occurrence of seabirds and fishing vessels can equally be prevented artificially, through the delimitation of areas where fishing is not allowed:

- in specific seasons of the year
- in specific times of day
- using specific methods

Modern fishing is an intensively regulated activity. Restrictions are mostly aimed at preventing over-exploitation (and damage to the ecosystem) and providing equal access to the resource. Few restrictions have been established and targeted to protect seabirds to this day, but they are becoming an increasingly useful conservation tool in various parts of the world (Bull, 2007a; Løkkeborg, 2008).

Experience has shown that area/seasonal closures are not necessarily followed by economical losses in surrounding commercial fisheries, and that they can be a source of diversity and biological richness that result in long-term profit if managed with the adequate vision and resources.

How it can reduce seabird by-catch in the Mediterranean region

Many seabird species in the Mediterranean region are highly mobile and can travel large distances (up to hundreds of kilometres) in search of food. However, a few small areas in specific times of the year concentrate very large portions of their global populations, and birds may be more vulnerable in those areas. This is particularly true in the vicinity of breeding colonies and in migration 'hotspots' (*e.g.* where land topography forces seabird passage to funnel into narrow corridors).

It is difficult to calculate the efficiency of area/seasonal closures as a mitigation measure because it will depend on the species, the distance to the key area and the fishing effort involved. In general, though, one can say that the average fishing will have a higher risk of having a significant impact on seabird populations when it takes place in the areas of highest seabird presence during the season of peak activity, particularly if no other mitigation is used. For the sake of conservation, fishing in those conditions is to be avoided.

Area/seasonal closures must not be regarded as the ultimate resource when everything else has failed, but it is unquestionable that they need to be imposed in those circumstances.

Recommendations

Accurate knowledge of species' requirements and abundance patterns is required before allocating area/seasonal closures efficiently (Melvin & Parrish, 2001). BirdLife International is currently developing guidelines and can assist in the delimitation of protection areas around seabird nesting colonies, depending on the species and the physical conditions of the place (BirdLife International, 2008). For areas in the open sea, enough data are required that there is a direct link between certain oceanographic/biological features (used to delimit the area) and the presence of seabirds in it; and that a significant reduction of the fishing effort within its perimeter will undoubtedly result in fewer birds being at risk and subsequently caught. Also, any attempt to close specific areas for certain fisheries in the open sea must ensure that it is not coupled with an increase in the fishing effort in their vicinity; otherwise there is a strong probability that birds will simply be transferred to those new areas, where they may suffer similar degrees of risk.

The fact

From Bull (2007a):

"The restriction of fisheries operating in CCAMLR waters to fish only during the winter months has resulted in a decline in the incidental mortality of seabirds from approximately 0.2 birds per 1000 hooks in 1995 to <0.025 birds per 1000 hooks in 1997 (SC-CAMLR 1995, 1998). However, the requirements by CCAMLR for vessels to employ other seabird avoidance methods act as confounding factors, thus making it difficult to determine if any single factor is responsible for the observed reduction in by-catch.

*While investigating methods to reduce seabird by-catch in the coastal salmon (*Oncorhynchus keta*, Salmonidae) drift gillnet fishery in Puget Sound (Washington, USA), Melvin et al. (1999) recorded temporal variation in seabird by-catch and abundance over different temporal scales (interannually, within fishing seasons, and over the day). Due to a reduction in effort (i.e. total sets) to meet the quota, it was estimated that a 43% reduction in seabird by-catch could be achieved by limiting fishery openings to periods of high salmon abundance. Knowledge regarding seasonal/annual variability in patterns of species abundance is required to accurately allocate seasonal/area closures (Melvin et al. 1999)."*

Bait condition: thawed, blue-dyed & other (column B)

How it works

Bait is the main attractor of seabirds to longline hooks and is, therefore, the main driver of risk. By dyeing squid bait blue, it has been proven to be less visible to seabirds, particularly at night. Also, bait (squid or fish) that is thawed sinks faster and more easily than if it is thrown while still frozen. Both these methods have been tested successfully, and may be acceptable to fishermen, because they result in neutral or increased catch rates of the target fish. The same is not always true of artificial lure used as bait, which is less attractive for birds, but maybe also for fish as well.

The idea of thawed bait is simple, but it may be demanding on space (e.g. on the deck, for the bait to thaw in contact with air) that is not easily available on a vessel. It has been suggested that the practical difficulties are greatest when the gear is set in the early morning (Melvin & Baker, 2006).

Dyeing the bait blue has been effective when tried on squid in experimental trials in Hawaii and Brazil. The concrete specifications of the dye used in successful tests are as follows: use 'Brilliant Blue' food dye (Colour Index 42090, also known as Food Additive number E133) mixed at 0.5% for a minimum of 20 minutes (Melvin & Baker, 2006). The same source recommends, however, that this method is used in combination with other mitigation measures, particularly bird-scaring lines or night-setting.

How it can reduce seabird by-catch in the Mediterranean region

Blue-dyed bait has been most successful with pelagic longlines in Hawaii and Brazil, which are both situated at relatively low latitude and where there is plenty of light. It is therefore possible that it might work equally well in pelagic fisheries in the Mediterranean, especially those that use squid as bait like the tuna & swordfish fisheries.

Using thawed bait in the Mediterranean poses no particular problems other than some availability of space. Its advantages extend to the blue-dyed bait, because the bait generally thaws during the process of dyeing, something that is usually done on board, in a bucket or some other recipient.

Recommendations

Using thawed bait should be the common rule in the Mediterranean, and this is recommended as a complementary measure in its pelagic fisheries. The same can be said about blue-dyed bait, which is recommended for testing in Mediterranean waters. Both need to be used with some additional (primary) mitigation measures, such as night-setting and bird-scaring lines.

The fact

From Cocking et al. (2008):

“The application of blue-dye to fishing baits is a seabird by-catch mitigation technique used in some pelagic longline fisheries that is thought to make the baits less visible and hence less attractive to seabirds. We tested this assumption in two ways. First, by measuring the spectral profiles of blue-dyed baits (fish and squid) and modelling the spectral profiles of the ocean under set conditions, we assessed how well wedge-tailed shearwaters (Puffinus pacificus) can distinguish dyed baits based on the known visual characteristics of this species. Results showed that no baits were perfectly cryptic against the background ocean, and only blue-dyed squid were relatively cryptic both in terms of chromatic and achromatic contrasts. Second, during at-sea trials blue-dyed and non-dyed baits that were simultaneously presented submerged on a longline or as surface presentations. During 26 longline sets which presented squid only, a 68% reduction in interactions with blue-dyed squid was observed compared to non-dyed squid. During surface presentations only 3–8% of blue-dyed squid baits were struck over the duration of the study compared with 75–98% of non-dyed squid bait. When using fish baits, however, approximately 48% of all blue-dyed baits presented in the first two days of trials received strikes from seabirds but this increased to 90% over the last three days. These

results suggest the use of blue-dyed squid bait could decrease seabird by-catch in pelagic longline fisheries whereas blue-dyed fish baits are less likely to have a mitigatory effect.
(...)
A successful by-catch mitigation technique needs to be effective regardless of environmental conditions, seabird abundance or composition, or the extent of exposure to the mitigation technique; these factors that are highly variable within areas where longline fishing occurs ([Brothers et al., 1999] and [Gilman et al., 2003]). Our results suggest that blue-dyed fish are unlikely to be effective as a long-term seabird by-catch mitigation technique because, in this study, the strike rate on blue-dyed fish baits increased over time. In contrast, over this three month study, blue-dyed squid baits caused a strong and consistent reduction in seabird interactions relative to non-dyed squid baits. However, it is not known whether blue-dyed squid will be equally effective in all conditions and remain effective with increased exposure, therefore its application within commercial longline fisheries would require monitoring.
(...)
No mitigation technique has been shown to completely eliminate seabird by-catch, but blue-dyed bait may increase the effectiveness of other proven seabird by-catch mitigation techniques such as bird scaring lines or weighted lines. The use of multiple approaches has been championed in CCAMLR fisheries which, through the mandatory use of bird scaring lines together with line weighting, achieved a 99% reduction in seabird by-catch (Small, 2005). Blue-dyed bait has yet to be comprehensively tested with other techniques but recently Minami and Kiyota (2006) showed that using blue-dyed bait together with bird scaring lines was more effective at reducing seabird by-catch in a pelagic longline fishery than employing either technique alone."

Line shooter (column B)

How it works

What is known as a line shooter is a device designed to reduce line tension of the longline at the moment of setting. It consists of a pair of hydraulically operated wheels that pull the line through an autoliner (*e.g.* as manufactured by Mustad™) at a speed that is slightly greater than vessel speed. The gear is thus delivered directly into the water, without tension, and is free to sink closer to the vessel and generally at a greater speed. The overall effect is to reduce the time that the hooks are close to the surface and within the reach of scavenging seabirds.

In trials carried out so far, the line shooter caused a reduction in seabird by-catch in some waters (*e.g.* of Northern fulmars in the North Sea, (Løkkeborg & Robertson, 2002)) but performed poorly in other situations (*e.g.* in Alaska, Melvin *et al.*, 2001). Experiments show that it may indeed increase sink rate but it does not eliminate the area behind the vessel where the birds are at greatest risk from being caught (Melvin & Baker, 2006), so the use of additional mitigation measures (*e.g.* night-setting and bird-scaring lines) is strongly encouraged.

How it can reduce seabird by-catch in the Mediterranean region

No trials are known on the use of line shooters in Mediterranean waters, so direct data are not available. It may be inferred that this method could work, as a complementary mitigation measure, in the pelagic longline fishery (where the use of autoliners is more widespread and the vessel speed during setting is greater), but the results are uncertain. Any further experimentation must be done with caution.

Recommendations

A line shooter manufactured by Mustad™ is available for purchase in combination with its autoliner system. However, this cannot be used as the only mitigation measure on board, and should always be used in combination with other methods.

The fact

From Løkkeborg (2003):
"The line shooter is designed to set lines at a speed slightly faster than the vessel's speed through the water during setting. It was placed after the baiting machine, and ensured that the line was set slack (i.e. without tension) in the water in order to increase the speed of sinking.
(...)
In all experiments there were significant differences in the numbers of seabirds caught using the various setting methods. The by-catch of seabirds was reduced by all the mitigation measures tested, although the reduction was not statistically significant for the line shooter. Seabird catch rates (number of birds per 1000 hooks) ranged from 0.55 to 1.75 for the control lines and from 0 to 0.49 for the lines set when one of the measures was employed. The clearest reductions in seabird by-catches were found with the bird-scaring line. In the course of the three experiments, a total of 185 000 hooks were set using the bird-scaring line and only two birds were caught compared with 205 for the control lines with a similar number of hooks. The great majority of the birds caught were northern fulmars.
(...)
Seabird by-catch was reduced by 59% for lines set with the line shooter, but this difference was not statistically significant. This device does not seem to be as efficient as the bird-scaring line or the setting funnel in reducing seabird by-catch. Longlines set with the line shooter have been shown to reach 3 m depth 15% faster than lines set without it, indicating that lines set with slack may reduce the availability of baited hooks to seabirds (Løkkeborg and Robertson, 2002). However, the results showed that birds were still able to take baits. Using weighted lines simultaneously is one possible way of improving the efficiency of the line shooter, and it is likely that less weight would be needed when the lines are set slack."

Mitigation measures for trawler fisheries

Evidence of seabird collisions and entanglements leading to injuries and mortality in trawler fisheries only came after scientific observers started to survey the operations of trawlers in the 2000s (Ryan & Watkins, 2008; Sullivan *et al.*, 2006). The known causes of mortality recorded in trawl fisheries are varied and depend on the nature of the fishery (pelagic or demersal) and the species targeted; however, they may be categorised into two broad types: cable-related mortality, including collisions with netsonde cables, warp cables and paravanes; and net-related mortality, which includes all deaths caused by net entanglement(Sullivan, 2006).

No concrete data on this type of mortality exists from the Mediterranean, but it is reasonable to infer that it is most likely to occur, and hence apply the precautionary principle and act consequently. Trawling is very widespread in the Mediterranean and the discards generated by this fishing method are indeed the main source of food for those seabirds that depend on scavenging for feeding. Among the species that regularly attend trawlers and feed on their offal, the most numerous ones include the three Mediterranean shearwaters (*Calonectris diomedea, Puffinus mauretanicus, Puffinus yelkouan*) and some of the endemic gulls, including those that are of some conservation concern (*Larus audouinii, Larus* *melanocephalus*)(Arcos & Oro, 2002; Dunn, 2007; Martinez-Abrain *et al.*, 2002; Mañosa *et al.*, 2004; Oro & Ruiz, 1997; Pedrocchi *et al.*, 2002). Equally, some other species also resort to scavenging from trawlers on an irregular basis or in some areas only. These include the Mediterranean Shag (*Phalacrocorax aristotelis desmarestii*), the Slender-billed Gull (*Larus genei*), the Sandwich Tern (*Sterna sandvicensis*) and the Razorbill (*Alca torda*). The group of Atlantic seabirds that obtain much of their food attending trawlers in the Mediterranean in winter include common species like the Northern Gannet (*Morus bassanus*), the Great Skua (*Chataracta skua*), the Lesser Black-backed Gull (*Larus fuscus*) and the Kittiwake (*Rissa tridactyla*). This list is completed with the common Mediterranean near-endemics Yellow-legged Gull (*Larus michahellis*) and Caspian Gull (*Larus cachinnans*). All of these species are at risk from interactions with trawling fishing vessels.

Objective data from scientific observers on board are urgently needed in order to quantify and situate (geographically and temporally) this kind of interaction with seabirds in Mediterranean fisheries. Sporadic observations (C. Carboneras, pers. obs.) have found, in various species of gull, injuries that point to trawl fisheries as a source of interaction with seabirds.

Offal and discard management

Its relevance as a mitigation measure in Mediterranean trawl fisheries

The strategic management of offal and fish discards is not exclusive to trawl fisheries as a mitigation measure but, in them, it can also effectively help reduce the number of birds present astern of the vessel and, therefore, diminish the risk of possible interactions. According to the group of experts consulted by FAO, this is the most likely long-term solution to reducing seabird incidental catch in trawl fisheries (FAO, 2008). Effective fish waste management combined with operational measures such as cleaning the net prior to shooting and reducing the time that the net is on the surface at shooting and hauling are the best practice measures available for reducing seabird net entanglements.

Area/seasonal closures

Its relevance as a mitigation measure in Mediterranean trawl fisheries

This mitigation measure intends to reduce the area of overlap between trawl fishing and the areas of maximum seabird density. By so doing, the risk of interaction would be reduced. However, in order to be effective, area/seasonal closures need to be established at the right scale (that is, far enough from the centres of seabird activity so that seabirds do not become attracted to the displaced fishing grounds), and this seems hardly practicable in the Mediterranean trawl fisheries of today.

Some Mediterranean countries, particularly those that belong to the European Union, have established regular temporal moratoria, during which they subsidise their fleet and crews to stop extractive fisheries for a few weeks and allow for the recovery of stocks. This is a fishery management measure that is renewed annually but, unfortunately, the exact timing is established without taking into account its impact on the rest of the ecosystem. The consequences on the seabirds that have started to breed, or about to do so, may be disastrous (Arcos, 2001; Oro *et al.*, 2004).

A more desirable functioning of this measure should aim to integrate seabird conservation needs in the design of its regime. Seasonal/area closures can be a powerful seabird conservation tool if managed correctly (Bull, 2007a; Louzao *et al.*, 2006).

Bird-scaring line

Its relevance as a mitigation measure in Mediterranean trawl fisheries

With a design similar to the bird-scaring (or streamer or *tori*) lines in use for longline fisheries, a single or double line is recommended to keep birds away from the dangerous area astern of trawler vessels. The principle of operation is the same as described for longlining, although in practice it requires some modification of habits and more caution on the side of the skipper, because there are more cables and more objects being towed and therefore there is an increased risk of entanglement. To deter birds from collision with the warp cables, paired streamer lines should be suspended on each side of the warps (Løkkeborg, 2008).

As with longlining, bird-scaring lines do effectively reduce the number of seabirds that enter the 'danger zone' astern of the vessel. Their use in trawl fisheries in the Mediterranean is highly commended as a management measure for those areas/seasons known to be of high conservation value for seabirds, *e.g.* in Special Protection Areas (SPAs) forming part of the Natura 2000 network according to the European Commission Birds Directive 79/409/EEC.

Warp scarer

Its relevance as a mitigation measure in Mediterranean trawl fisheries

A warp scarer consists of a series rings joined by a length of netting forming a hose around the aerial part of the warp. Streamers hang from each ring and scare birds, making warps visible and deterring them from colliding with the cable. Several designs have been developed and trialled for their effectiveness in reducing contacts and mortalities associated with the warp cable; they have shown good results in the Falkland Islands/Islas Malvinas demersal trawl fishery and in the squid trawl fishery in New Zealand, although in their current development and in rough seas, there are some instances when they may leave the warp unprotected and thus susceptible to collision by seabirds (Bull, 2007b).

Net-binding and net-weighting

Its relevance as a mitigation measure in Mediterranean trawl fisheries

Net-binding and net-weighting have been proposed as two appropriate mitigation measures for trawl fisheries in the Southern Ocean (Hooper *et al.*, 2003; Sullivan *et al.*, 2004). The former consists in tying some sort of binding (*e.g.* plastic strings) to nets in order to keep them closed as they are set. The net enters the water as a compact mass, instead of a floating mesh, and sinks more quickly; the bindings break as the moving vessel increases the tension, but by then the net is out of reach of prospecting seabirds. In experimental trials, net-binding successfully avoided the catching of birds off the Falklands/Malvinas in comparison with control tests (8 birds).

By adding extra weight to the trawling gear (net-weighting), the sinking rate is increased, and so the time that the net remains less time close to the water surface.

This has been trialled in one fishery only (Hooper *et al.*, 2003), and the non-conclusive results have been attributed to nets with several different designs being mixed in the tests.

The main conclusion is that net design, and the management of the setting and hauling operations (*e.g.* by cleaning the net and therefore reducing the amount of offal available to seabirds), can effectively contribute to reducing seabird by-catch in trawl fisheries as well as in longlining(FAO, 2008). The Mediterranean can be a good example case, and further testing of these, and possibly some other measures developed by fishers or researchers, should be encouraged.

Mitigation measures for gillnets/trammel nets & pot/trap fisheries

The impact of gillnets on some seabird species is well known from many parts of the world, including the Mediterranean, where the problem was detected initially in the 1970s (Carboneras, 1988; Guyot, 1990; Mead, 1974). Seabirds and fishing gear often co-occur in some favourable areas, and the birds may entangle and drown when diving in pursuit of fish. It is suspected that birds may sometimes be attracted to gillnets (and trammel nets) and the opportunity they offer to ‘steal' some fish. But the result is that some mortality occurs in nearly all cases. The species mainly affected are those that feed by diving, which in the region include the threatened endemic Mediterranean Shag *Phalacrocorax aristotelis desmarestii* (Culioli, 2006)and the scarce Razorbill *Alca torda*, a winter visitor. Recoveries of ringed birds reveal that mortality from interactions with fisheries is very high (>50 % of the Shags found dead in some countries) and this presumably has a huge impact on the species' demography.

However, despite the problem being known for a long time, little effort has been devoted to research into designing ways to avoid this negative interaction. The North Pacific, where alcids such as the Common Guillemot *Uria aalge* and other close relatives of the Razorbill abound) is the only region where some relevant research has been undertaken. The following mitigation measures have been forward as proposals:

Visual alerts

It has been proposed to add visual markers to gillnets (*e.g.* by dyeing the nets with an opaque colour or by adding highly visible netting in the upper net) to increase their visibility underwater and make them more conspicuous to approaching seabirds (Melvin *et al.*, 1999). The eyesight of these is sensibly more acute than that of fish, but in the published experiments it was not possible to find the best adjustment, and in some cases it was proven that there was also a significant reduction in fish catches that was associated with the important reductions in seabird by-catch. However, this is an area that is open to much experimentation by fishers and researchers. Knowing the different sensorial capabilities of seabirds and fish, it should be possible to find a visual/magnetic/chemical deterrent that acts successfully by keeping seabirds away from the standing net but which does not interfere with the activities of the approaching (target) fish.

Acoustic alerts (pingers)

Acoustic pingers, clipped to the nets, emit a sound signal that falls within the hearing frequency of seabirds (whilst that of fish is very limited or non-existent) and act as a deterrent with no obvious reduction in the amount of fish being caught. Successful tests were carried out by Melvin *et al.* (1999) in the North Pacific using pingers initially designed to avoid by-catch of cetaceans. Acoustic alerts, however, have not been adopted by this or any other gillnet fishery, so few concrete data are available for other areas or combinations of species. Again, this is an area most suitable for further research and experimentation, possibly with the aid of public funds.

Pots and traps, as those used to capture molluscs and arthropods in the Mediterranean, as well as some fixed nets set for small tuna, are also known to cause some mortality of diving seabirds, *e.g.* of Mediterranean Shags (C. Carboneras, pers. obs.). Unfortunately, no specific mitigation measures have been developed or tested to avoid or reduce the by-catch rates in these fisheries, so one can only conjecture on the possible ways to combat this by-catch and on their hypothetical success. In order to move from this situation, fishers and researchers should be encouraged to try to understand how the interaction occurs and to design and test mitigation measures that can successfully prevent it.

PART THREE – IDENTIFYING & MANAGING A SEABIRD BY-CATCH PROBLEM

Defining a by-catch problem

The FAO *International Plan of Action for reducing the incidental catch of seabirds in longline fisheries* (FAO, 1999), or IPOA-Seabirds, does not define what constitutes a seabird by-catch 'problem', generically, but it recommends that each State undertakes an assessment of its fisheries based on a list of components that include data on fishing effort, status of seabird populations, total annual catch of seabirds and mitigation measures in use. More recently, the experts consulted by FAO remark that reports of sporadic captures from fishermen or observers outside of formal observer programmes addressing seabird incidental mortality may be the first sign of a more generalized problem (FAO, 2008).

Experience has revealed that management authorities, in various countries, have gone through a slow progression, from denial through data collection to practical action (Croxall, 2008), and that this has taken at least a decade in the best of cases. However, as knowledge of fisheries and our understanding of how the interactions occur has tended to improve, the process may be compressed into only a few years.

Vital to the process is that each State assesses its fisheries and announces whether it has a seabird by-catch problem. If it does, it should start to take action immediately, namely by implementing the range of mitigation measures that is deemed most appropriate, coupled with sufficient monitoring by scientific observers. If, on the contrary, it does not have a seabird by-catch problem, the rest of the world would also be interested to know. Perhaps there is something in the techniques or methodologies they use that is relevant and effectively avoids the interaction from happening.

The essential role of scientific observers

The use of well trained observers is the most reliable means of monitoring fisheries performance with respect to seabird by-catch and use of mitigation measures (FAO, 2008). To this end, States are encouraged to establish on-board observer programmes that provide independent and representative data to be used later to confirm, revise or modify the adequacy of the fishery management regulations.

Observers should receive sufficient training on seabird identification, technically quite complex, and on the specific aspects of observation on different types of vessel and on the registration of data. It is important that data are comparable and, hence, are collected according to international standards. These can be provided by the scientific or technical committees of Regional Fisheries Management Organizations (RFMOs), such as ICCAT[1] and the GFCM[2], to which Member States are already committed to report.

Observer programmes require considerable technical and financial resources to be successful (FAO, 2008). In countries with well-developed commercial fisheries, the costs are often shared by the management agencies and the industry, who are also responsible for providing space to accommodate observers on the vessel. Collaboration between agencies,

[1] International Commission for the Conservation of Atlantic Tunas, http://www.iccat.int
[2] General Fisheries Commission for the Mediterranean, http://www.gfcm.org

and between States, can help to build capacity in those countries that are less prepared to implement comprehensive observer programmes but whose fisheries overlap with significant populations of seabirds that are equally worth of conservation measures.

Improving current mitigation tools through innovation and research

Innovation and research into the design of better and more efficient mitigation measures was an essential element of the FAO IPOA-Seabirds (FAO, 1999), originally prepared in 1997-98 and adopted in 1999. Unfortunately, one decade later, this is still true and the expert consultation convened by FAO (FAO, 2008) continues to recommend not only that research and innovation are maintained but also that mitigation measures are used in combination to maximise their effectiveness. The message, therefore, is that the ‘silver bullet’ or “magical solution that will solve the problem once and for all” has not been found yet. So, research must continue. And, in the meantime, a recipe of at least two mitigation measures used in combination at sea is recommended as the best practice.

Recent years have seen the opening and development of new lines of research into mitigation of seabird by-catch, ranging from olfactory deterrents (Pierre & Norden, 2006) to artificial lure, and including various types of curtains, bafflers and underwater-setting devices (Bull, 2007a). Several competitions of ideas have been run, and continue to run, with the aim of finding the best practical solution. Many scientists, all over the world, work to develop ways, carry out trials and experiment with tools, mechanisms and techniques.

Innovation and research require a great deal of involvement of the fishing industry, scientists and resource managers. This cannot be done without the collaboration and dialogue that have led to a lot of testing in the past, and without observation and sharing of experiences. Unfortunately, the Mediterranean region –where most modern fishing methods were originally developed– is lagging behind in this process. The future of fishing relies on its sustainability, and this should be seen in the Mediterranean mainly as an opportunity.

What seabird breeding numbers can tell us about the situation at sea

Seabirds live at sea, but must come to land in order to breed. There, they concentrate in colonies and are relatively easy to count and monitor. The evolution through time of seabird populations is the measure of our success. Their numbers need to be monitored regularly, and essential data on their demography (survival of adult birds, breeding productivity, recruitment of new breeders) needs to be gathered and analysed on a yearly basis. Seabirds live for very long (in the Mediterranean, the average lifespan of many species is >20 years) and the demographic effects on the population are not revealed immediately. Therefore, only the long-term monitoring of seabird numbers and their demography will tell what is happening at sea.

A key element of seabird demography is the survival of adult birds of breeding condition. And it is this, precisely, that is being threatened by interactions with fisheries. Breeding birds are more concentrated and need to gather more food (for their offspring as well as for themselves), so they have a higher risk of mortality in certain areas and at certain times of the year. By following them up closely (*e.g.* through mark-recapture methods) it is possible to have a precise idea of how well they survive and, so, how they contribute to the stability of their population.

Exercising responsibility in the international context: conventions & RFMOs

States have a shared responsibility to conserve biodiversity, particularly in the marine environment, where there are no borders, and even more particularly in the Mediterranean, an enclosed sea bordered by many Nations and subject to many pressures. One way to exercise responsibility in the international context is by signing conventions and treaties, and by taking part in their implementation. Foremost is the Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean, and its Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD). Both serve the purpose of protecting and preserving the seabird fauna and of providing the means for international cooperation in the conservation and sustainable use of biological diversity in the region. The Regional Activity Centre for Specially Protected Areas (UNEP-MAP-RAC/SPA) was commissioned by the Parties to the Barcelona Convention to implement the SPA/BD Protocol.

The Action Plan for the conservation of bird species listed in Annex II of the SPA/BD Protocol, adopted in 2003 (UNEP - MAP - RAC/SPA, 2003), identifies by-catch as an important threat for a number of species (*Calonectris diomedea*, *Puffinus mauretanicus*, *P. yelkouan*, *Phalacrocorax aristotelis* and *Larus audouinii*) and calls for the development of a specific Action Plan to reduce it. The 1st Symposium on the Mediterranean Action Plan for the conservation of marine and coastal birds (UNEP - MAP - RAC/SPA, 2006) continued to identify by-catch as a major threat for these species.

Additionally, the African-Eurasian Waterbird Agreement, signed by nearly all States bordering the Mediterranean among others, provides for the conservation of 255 species of birds ecologically dependent on wetlands for parts of their life cycle. Its article 4.3.7 reads*: "Parties are urged to take appropriate actions nationally or through the framework of Regional Fisheries Management Organisations (RFMOs) and relevant international organisations to minimise the impact of fisheries on migratory waterbirds, and where possible cooperate within these forums, in order to decrease the mortality in areas within and beyond national jurisdiction; appropriate measures shall especially address incidental killing and by-catch in fishing gear including the use of gill nets, longlines and trawling."*

Shearwaters are the most threatened seabird species in the Mediterranean region. The Agreement on the Conservation of Albatrosses and Petrels (ACAP), which came into force in 2004, provides a new and specific conservation tool in the international context. It was originally designed to protect the threatened species of albatrosses and petrels inhabiting the southern Hemisphere, but was later opened to provide for the conservation of a list of Procellariiform species that currently covers 19 albatrosses and 7 petrels but may soon extend to North Pacific albatrosses and possibly other species. It has been proposed that the three Mediterranean shearwaters (*Calonectris diomedea*, *Puffinus mauretanicus* and *P. Yelkouan*) be listed as well (J. Cooper & Baker, 2008). This would bring ACAP much closer to the Mediterranean, as France and Spain are member States of ACAP and, at the same, have breeding populations of those species. ACAP urges its Parties to *"take appropriate operational, management and other measures to reduce or eliminate the mortality of*

albatrosses and petrels resulting incidentally from fishing activities. Where possible, the measures applied should follow best current practice" (Agreement on the Conservation of Albatrosses and Petrels, 2008).
In parallel, two RFMOs are responsible for managing fisheries in the area and to do so in accordance to the FAO Code of Conduct for Responsible Fisheries: the General Fisheries Commission for the Mediterranean (GFCM) and the International Commission for the Conservation of Atlantic Tunas (ICCAT). The latter adopted its first Resolution on seabird by-catch in 2002. This has now been superseded by Recommendation 07-07 on seabird by-catch, reporting requirements and mitigation measures. The full text of this important Recommendation, applicable to tuna and swordfish fisheries in Mediterranean waters, is reproduced in Appendix III.

The GFCM Scientific Advisory Committee, through its Subcommittee on Marine Environment and Ecosystems (SCMEE), has remarked the need to maintain close collaboration with partner organisations on issues such as discards and by-catch of species of conservation concern (FAO, 2009). It collaborates with RAC/SPA on by-catch reduction issues along the last years, developing also a draft common protocol for data collection on by-catch; It set as well a workshop on by-catch reduction (September 2009).

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APPENDIX I – RESCUE INSTRUCTIONS: HOW TO HELP A HOOKED SEABIRD

1. Very few seabirds can survive with a hook and a line. So **NEVER cut the line** and release an injured bird. At least hold the bird and examine it.

2. Gently, **RETRIEVE THE BIRD ONBOARD** and get control over the animal. **Do not pull it**, if possible, as this can cause more harm.

3. **Beware of the beak.** Just try to hold it between your thumb and finger. If it is a big bird, then grab it and hold the top beak or both and calmly control it. Be careful and don’t cover its nose or it could die of suffocation.

4. It can be useful to place a towel or shirt over the bird’s head and eyes. Watch your eyes and use work gloves!

5. Ask somebody to help you, so one can hold the animal while the other tries to remove the hook or line.

6. If the **HOOK is VISIBLE** you can try to remove it carefully. The best practice is to cut one end of the hook with pliers or a cutter and then take out the two parts separately.

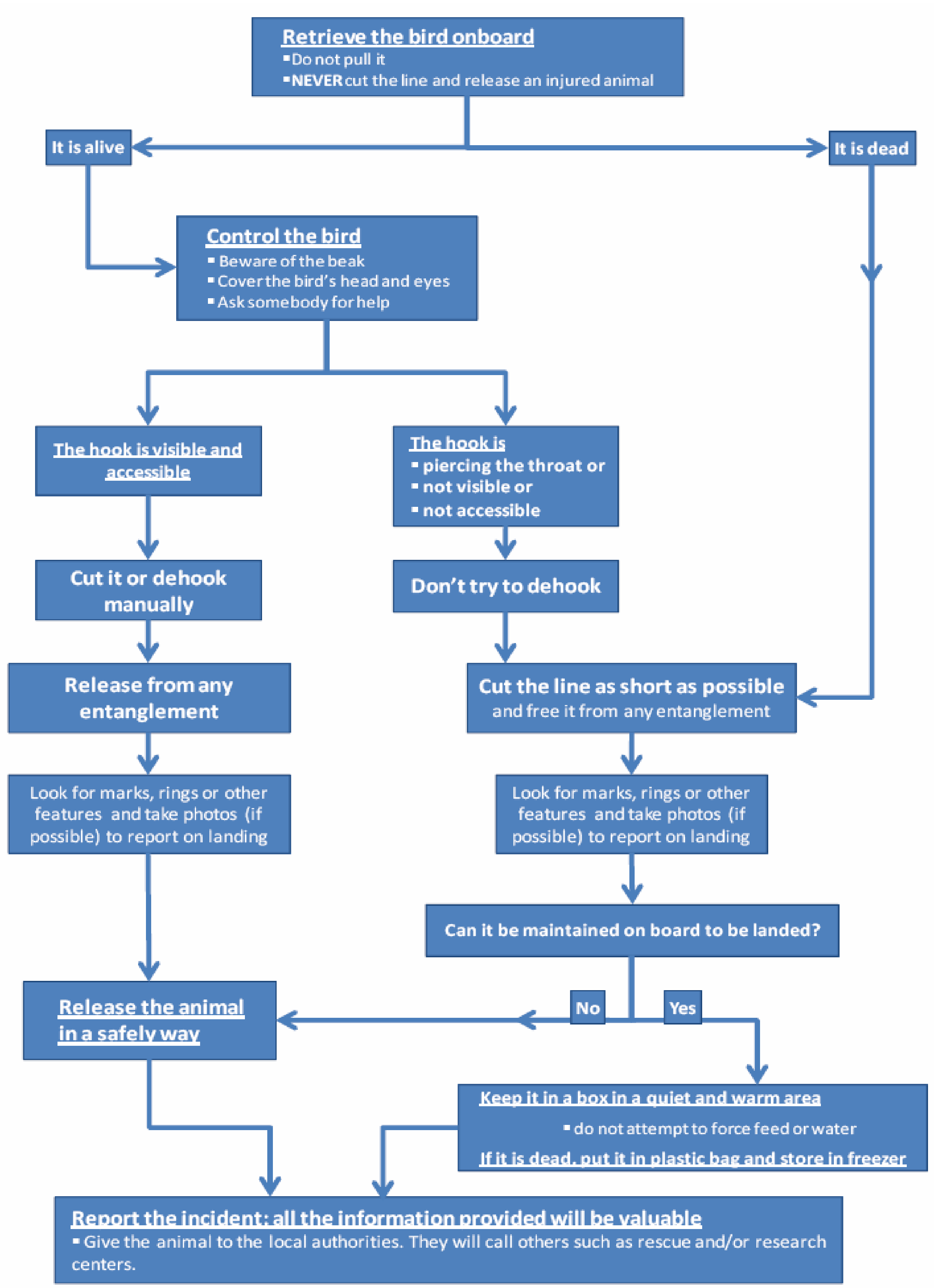
7. Once the hook is released and there is no line entangling the animal, you can release it gently overboard. Make sure there is no fishing gear in the water and the vessel is in neutral while you free the bird.

8. If the **HOOK pierces the throat** or if the bird has swallowed it **DON’T TRY** to remove it.

9. In that case, **CUT THE LINE AS SHORT** as you can and put the bird inside a box, in a warm, dark and a quiet environment and leave it there. Put water out for it and let it drink, but do not attempt to force feed it or make it drink.

10. Once you are back on land, **call the local authorities** and ask them to collect the bird. Give them the animal alive or dead, as it can provide valuable information (on the species, its origin and age) to researchers in any case. Also try to take a photograph and report any details such as marks, rings, numbers or any other remarkable feature.

11. If you can’t keep the animal onboard (even if it dies), you may decide to release the injured bird after cutting the line and freeing it from any entanglement. Remember that too long a line can also threaten the lives of other animals.


Retrieve the bird onboard
▪Do not pull it
▪NEVER cut the line and release an injured animal
It is alive
It is dead
Control the bird
▪ Beware of the beak
▪ Cover the bird's head and eyes
▪ Ask somebody for help
The hook is visible and accessible
The hook is
▪ piercing the throat or
▪ not visible or
▪ not accessible
Cut it or dehook manually
Don't try to dehook
Release from any entanglement
Cut the line as short as possible
and free it from any entanglement
Look for marks, rings or other features and take photos (if possible) to report on landing
Look for marks, rings or other features and take photos (if possible) to report on landing
Can it be maintained on board to be landed?
No
Yes
Release the animal in a safely way
Keep it in a box in a quiet and warm area
▪ do not attempt to force feed or water
If it is dead, put it in plastic bag and store in freezer
Report the incident: all the information provided will be valuable
▪ Give the animal to the local authorities. They will call others such as rescue and/or research centers.

APPENDIX II - International protection status for Mediterranean seabirds potentially subject to interaction with fisheries and their occurrence in coastal states & Risk assessment for seabird-fishery interactions in the Mediterranean

Table I – International protection status for Mediterranean seabirds potentially subject to interaction with fisheries and their occurrence in coastal States as breeders (◆) and non-breeders (◇).

Species	IUCN	BirdLife (Europe)	Barcelona Convention	AEWA	EC Birds Directive	Albania	Algeria	Bosnia and Herzegovina	Croatia	Cyprus	Egypt	France
MAP species												
Calonectris diomedea	LC	(VU)	●		●	◆	◆◇		◆	◇		◆◇
Puffinus mauretanicus	CR	CR	●		●		◇					◇
Puffinus yelkouan	NT	S	●		●	◆	◆◇		◆◇			◆◇
Hydrobates pelagicus	LC	(S)	●		●		◆◇					◆◇
Phalacrocorax aristotelis (desmarestii)	LC	(S)	●		●	◆	◆		◆	◆		◆
Larus audouinii	NT	L	●	●	●	◇	◆◇		◆	◆◇	◇	◆◇
Non MAP												
Morus bassanus	LC	S		●			◇				◇	◇
Phalacrocorax carbo	LC	S		●		◆◇		◆◇	◆◇	◇	◇	◆◇
Catharacta skua	LC	S		●			◇					◇
Larus melanocephalus	LC	S		●	●	◆◇	◇	◆	◆		◇	◆◇
Larus ridibundus	LC	(S)		●		◇		◆◇	◆◇	◇	◇	◆◇
Larus fuscus	LC	S		●		◇	◇	◇	◇	◇	◇	◇
Larus michahellis	LC	S		●		◆◇	◆◇	◆	◆◇	◆◇	◇	◆◇
Alca torda	LC	(S)		●			◇					◇
Fratercula arctica	LC	(H)		●			◇					◇

Species	Greece	Israel	Italy	Lebanon	Libya	Malta	Monaco	Montenegro	Morocco	Slovenia	Spain	Syria	Tunisia	Turkey
MAP species														
Calonectris diomedea	◆◇	◇	◆◇	◇	◇	◆◇	◇	◇	◇		◆◇		◆◇	◆◇
Puffinus mauretanicus			?						◇		◆		◇	
Puffinus yelkouan	◆◇	◇	◆◇	◇	◇	◆◇	◇	◇	◇	◇	◆◇		◇	◆◇
Hydrobates pelagicus	◆◇		◆◇			◆◇			◆◇		◆◇		◇	◇
Phalacrocorax aristotelis (desmarestii)	◆		◆	◇	◇			◇	◇	◇	◆	◇	◇	◆
Larus audouinii	◆◇		◆◇	◆	◇	◇			◆◇		◆◇	◇	◆◇	◆◇
Non MAP														
Morus bassanus			◇			◇	◇		◇		◇		◇	
Phalacrocorax carbo	◆◇	◇	◆◇			◇		◆◇		◇	◆◇		◇	◆◇
Catharacta skua			◇			◇	◇		◇		◇		◇	
Larus melanocephalus	◆◇	◇	◆◇	◇	◇	◇		◆	◇	◇	◇		◇	◆◇
Larus ridibundus	◆◇	◇	◆◇	◇		◇		◆◇		◆◇	◆◇	◇		◆◇
Larus fuscus	◇	◇	◇		◇	◇		◇	◇	◇	◆◇	◇	◇	◇
Larus michahellis	◆◇	◇	◆◇	◆◇		◆◇		◆◇	◆	◆◇	◆◇	◆◇	◆◇	◆◇
Alca torda			◇			◇	◇		◇		◇		◇	
Fratercula arctica			◇			◇	◇		◇		◇		◇	

IUCN categories from *IUCN Red List of Threatened Species. IUCN (2008)*: CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; LC – Least Concern
BirdLife (Europe) categories from *Birds in Europe: population estimates, trends and conservation status*. BirdLife International (2004): CR – Critically Endangered; VU – Vulnerable; H – Depleted; L – Localised; S – Secure
Barcelona Convention. Seabird species listed in the *Protocol concerning specially protected areas and biological diversity in the Mediterranean.* Annex II: List of Endangered or Threatened Species.
AEWA. Seabird species listed in the *Agreement on the Conservation of African-Eurasian Migratory Waterbirds.* Annex 2: Waterbird species to which the Agreement applies.
EC Birds Directive. Seabird species listed in the *Council Directive 79/409/EEC on the conservation of wild birds.* Annex I. Species subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution.

Table II –Risk assessment for seabird-fishery interactions in the Mediterranean. The table shows attractiveness and risk of capture of selected seabird species in different fisheries and types of gear commonly used in the Mediterranean region. Blue dots indicate very strong (●●), strong (●) or light (○) attraction of seabirds to operating vessels or set gear. Known or predicted risk of capture has been evaluated into five categories (very high, high, moderate, low or unknown), according to the birds' feeding habits and the characteristics of the fishing method. Fishing methods from Coppola (2003).

Species	**Longlining** (demersal)	**Longlining** (pelagic)	**Trawling**	**Gillnet / trammel net**	**Purse-seining**	**FAD** (fishing attractive device) dolphinfish	**Driftnets**	**Trolling** (line, lure)	**Recreational** (boat)	**Recreational** (shore)	**Pot** (artisanal)	**Trap** (artisanal)	**Fish farms**
Calonectris diomedea	●● very high	●● very high	● high	○ unknown	○ unknown	○ unknown	○ high	○ moderate					
Puffinus mauretanicus	●● very high	● high	● high	● high	○ unknown	○ unknown			○ moderate				
Puffinus yelkouan	●● very high	● high	● high	● high	○ unknown	○ unknown	○ high		○ moderate				
Hydrobates pelagicus					○ unknown	○ unknown	○ high						
Phalacrocorax aristotelis	○ low		○ low	● high					○ moderate	○ moderate	○ moderate	○ moderate	○ moderate
Phalacrocorax carbo	○ low		○ low							○ low		○ low	● high
Morus bassanus	● moderate	● moderate	● high	○ unknown				○ moderate					
Catharacta skua	● moderate	○ low	● low										
Larus audouinii	● high	● high	● high	○ unknown	● unknown	○ unknown	○ high	○ moderate		○ moderate			○ low
Larus melanocephalus	○ low	○ unknown	● high		○ unknown								
Larus ridibundus	○ low		● low										
Larus fuscus	○ low		● moderate										
Larus michahellis	● moderate	● moderate	● moderate	○ unknown	○ unknown			○ moderate	○ moderate	○ moderate			○ moderate
Alca torda	○ low		● low	● high	○ unknown				○ moderate				
Fratercula arctica				○ unknown			○ unknown						

APPENDIX III – RECOMMENDATION [07-07] BY ICCAT ON REDUCING INCIDENTAL BY-CATCH OF SEABIRDS IN LONGLINE FISHERIES

RECOGNISING the need to strengthen mechanisms to protect seabirds in the Atlantic Ocean;
TAKING INTO ACCOUNT the United Nations Food and Agriculture Organisation (FAO) International Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries (IPOA-Seabirds), and the IOTC Working Party on By-catch objectives;
ACKNOWLEDGING that to date some Contracting Parties and Cooperating non-Contracting Parties, Entities, or Fishing Entities (hereinafter referred to as “CPCs”) have identified the need for, and have either completed or are near finalised, their National Plan of Action on Seabirds;
RECOGNISING the concern that some species of seabirds, notably albatross and petrels, are threatened with extinction;
NOTING that the Agreement on the Conservation of Albatrosses and Petrels, has entered into force;
RECALLING the *Resolution by ICCAT on Incidental Mortality of Seabirds [Res. 02-14]*;
CONSCIOUS that there are on-going scientific studies which may result in the identification of more effective mitigation measures and therefore that these current measures should be considered provisional;
THE INTERNATIONAL COMMISSION FOR THE CONSERVATION OF ATLANTIC TUNAS (ICCAT) RECOMMENDS THAT:

1. The Commission shall develop mechanisms to enable CPCs to record data on seabird interactions, including regular reporting to the Commission, and seek agreement to implement such mechanisms as soon as possible thereafter.

2. CPCs shall collect and provide all available information to the Secretariat on interactions with seabirds, including incidental catches by their fishing vessels.

3. CPCs shall seek to achieve reductions in levels of seabird by-catch across all fishing areas, seasons and fisheries, through the use of effective mitigation measures.

4. All vessels fishing south of 20°S shall carry and use bird-scaring lines (tori poles):

   - Tori poles shall be used in consideration of the suggested tori pole design and deployment guidelines (provided for in Annex A);

   - Tori lines are to be deployed prior to longlines entering the water at all times south of 20°S;

   - Where practical, vessels are encouraged to use a second tori pole and bird-scaring line at times of high bird abundance or activity;

   - Back-up tori lines shall be carried by all vessels and be ready for immediate use.

5. Longline vessels targeting swordfish using monofilament longline gear may be exempted from the requirements of paragraph 4 of this Recommendation, on condition that these vessels set their longlines during the night, with night being defined as the period between nautical dusk/dawn as referenced in the nautical dusk/dawn almanac for the geographical position fished. In addition, these vessels are required to use a minimum swivel weight of 60g placed not more than 3m from the hook to achieve optimum sink rates. CPCs applying this derogation shall inform the SCRS of their scientific findings resulting from their observer coverage of these vessels.

6. The Commission shall, upon receipt of information from the SCRS, consider, and if necessary, refine, the area of application of the mitigation measures specified in paragraph 4.

7. This measure is a provisional measure which will be subject to review and adjustment in the light of future available scientific advice.

8. The Commission shall consider adopting additional measures for the mitigation of any incidental catch of seabirds at its annual meeting in 2008 based on the results of the ICCAT seabird assessment which is currently underway.

Annex A

Suggested Guidelines for Design and Deployment of Tori Lines

Preamble

These guidelines are designed to assist in preparation and implementation of tori line regulations for longline vessels. While these guidelines are relatively explicit, improvement in tori line effectiveness through experimentation is encouraged. The guidelines take into account environmental and operational variables such as weather conditions, setting speed and ship size, all of which influence tori line performance and design in protecting baits from birds. Tori line design and use may change to take account of these variables provided that line performance is not compromised. On-going improvement in tori line design is envisaged and consequently review of these guidelines should be undertaken in the future.

Tori line design

1. It is recommended that a tori line 150 m in length be used. The diameter of the section of the line in the water may be greater than that of the line above water. This increases drag and hence reduces the need for greater line length and takes account of setting speeds and length of time taken for baits to sink. The section above water should be a strong fine line (e.g. about 3 mm diameter) of a conspicuous colour such as red or orange.

2. The above water section of the line should be sufficiently light that its movement is unpredictable to avoid habituation by birds and sufficiently heavy to avoid deflection of the line by wind.

3. The line is best attached to the vessel with a robust barrel swivel to reduce tangling of the line.

4. The streamers should be made of material that is conspicuous and produces an unpredictable lively action (e.g. strong fine line sheathed in red polyurethane tubing) suspended from a robust three-way swivel (that again reduces tangles) attached to the tori line, and should hang just clear of the water.

5. There should be a maximum of 5-7 m between each streamer. Ideally each streamer should be paired.

6. Each streamer pair should be detachable by means of a clip so that line stowage is more efficient.

7. The number of streamers should be adjusted for the setting speed of the vessel, with more streamers necessary at slower setting speeds. Three pairs are appropriate for a setting speed of 10 knots.

Deployment of tori lines

1. The line should be suspended from a pole affixed to the vessel. The tori pole should be set as high as possible so that the line protects bait a good distance astern of the vessel and will not tangle with fishing gear. Greater pole height provides greater bait protection.

For example, a height of around 6 m above the water line can give about 100 m of bait protection.

2. The tori line should be set so that streamers pass over baited hooks in the water.

3. Deployment of multiple tori lines is encouraged to provide even greater protection of baits from birds.

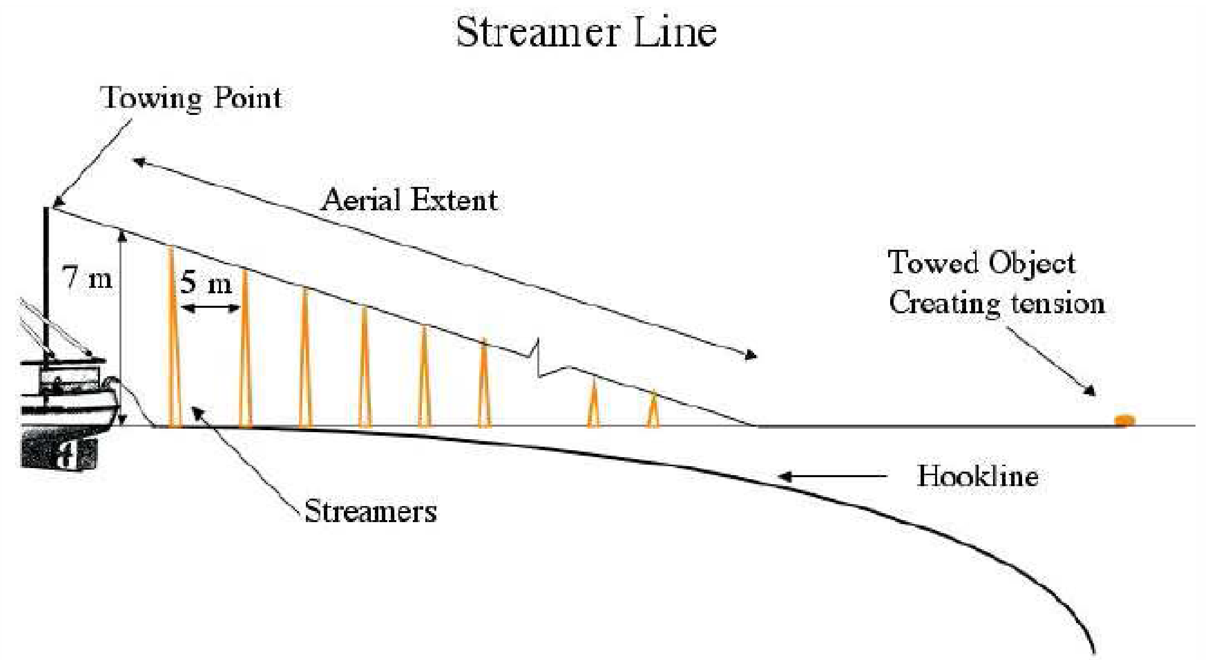
4. Because there is the potential for line breakage and tangling, spare tori lines should be carried onboard to replace damaged lines and to ensure fishing operations can continue uninterrupted.

5. When fishers use a bait casting machine (BCM), they must ensure coordination of tori line and machine by:

    (i) ensuring the BCM throws directly under the tori line protection, and
    (ii) when using a BCM that allows throwing to port and starboard, ensure that two tori lines are used.

6. Fishers are encouraged to install manual, electric or hydraulic winches to improve ease of deployment and retrieval of tori lines.

APPENDIX IV – BIRD-SCARING LINE DESIGN FOLLOWING CCAMLR CONSERVATION MEASURE 25/02



UNEP

MAP

RAC/SPA