

DOSSIERTÈCNIC

TRAINING AND GUIDANCE FOR THE AGRI-FOOD SECTOR

N97 SEABIRDS AND FISHERIES INTERACTIONS

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Generalitat de Catalunya
Departament d'Agricultura,
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INTRODUCTION



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The professional fishing sector in Catalonia is the starting point for a significant number of economic activities linked to the country's maritime and fishing tradition. Professional fishing is currently at a crossroads: it is necessary to meet the growing demand for quality fish products, it is important to maintain the dependent family economies and their tradition, and also working to preserve the marine ecosystems and the resources they provide us with, in a changing context where the European Union is determined to modify the rules of the game to protect the marine environment and the services provided by its ecosystems.

To face the challenges of the sector and meet the requirements of the new context at European level, the Catalan Government has provided itself with a tool to enable it to structure a true integrated maritime policy adapted to the reality of the country: The Maritime Strategy of Catalonia (EMC).

This strategy, with a 2030 horizon, is based on four basic areas of action. The first one is a sustainable, integrated and harmonious development of the blue economy that respects the human uses of the sea. The second area is dedicated to ensuring the conservation of resilient and fully functional marine ecosystems. The third area aims to improve the quality of life of citizens. Finally, the fourth area promotes a new and innovative governance framework that gives impetus to the strategy, ensures its operability and supports the other three areas.

In this *Dossier Tècnic* we want to focus on the initiatives jointly promoted by scientists and professional fishers to minimise the incidental catch of seabirds. These actions are part of the first objective of the second

area of the EMC Multiannual Plan 2018-2021, dedicated to the conservation of marine ecosystems and, more specifically, in strategic line 51: *Reduction of bycatch of protected species (birds and turtles) during fishing through training of the sector and the implementation of technical measures.*

Seabirds are one of the most endangered groups of animals in the world. Of the factors affecting them, the loss of coastal habitats and the proliferation of invasive species in their breeding and nursery grounds are notable. However, certain fishing practices also lead to bycatch, especially negative for some highly endangered species native to the Mediterranean, such as the Balearic shearwater, *Puffinus mauretanicus*.

The fisheries sector has been involved for years in the reduction of the bycatch of protected species through the application of new procedures and technical improvements, as well as in the appropriate management of the individuals caught, implementing the most appropriate action protocols in collaboration with scientists and public administrations.

This is the case of the collaboration of the fishing sector with research groups such as the Department of Evolutionary Biology and Environmental Sciences of the University of Barcelona, the Biodiversity Research Institute and the non-governmental conservation organisation SEO/BirdLife, with successful examples such as the *Manual of best practices in bottom longline fishing*, participated in by the Government of Catalonia and financed by European funds through the Biodiversity Foundation.

Minimising the negative impact of fishing activity on seabirds is a fundamental element of the ecosystem approach to fisheries, a principle established by the FAO and the current body of international doctrine regarding the attributes that a modern fisheries governance model based on high conservation standards should pursue.

Include this topic in the EMC is but a reflection of the determination of the Government and all the agents involved to give continuity to and reinforce this line of work. For this reason, we wanted the dossier to cover the problem of seabird bycatch, from the point of view of the various stakeholders, emphasising both the actions already taken and the challenges that remain to be tackled jointly.

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Cover photo:
Bottom longline fishing among seabirds.
Photo: Vero Cortés.

Presentation photo:
Seabirds following a trawler, attracted by the rejected fish.
Photo: Pep Arcos.



FISHERIES BYCATCH, A PROBLEM NO ONE WANTS



Figure 1. Scopoli's shearwater (*Calonectris diomedea*) and a longliner. Photo: Pep Arcos.

All human activities interact directly or indirectly with the environment in which they take place, and fishing is no exception. Thus, one of the existing problems in fishing is the accidental capture of fauna. These interactions, in addition to the problems for the conservation of marine biodiversity, entail economic costs for fishers in damage from to fishing gear and loss of time.

This undesirable problem is particularly relevant when the bycatch is of protected, threatened or endangered species such as sea turtles, sharks, cetaceans or seabirds. Beyond consideration of these species as a natural heritage to be preserved, the most obvious explanation for the interest of fishing activity to reduce bycatch is that it is an activity carried out for commercial purposes, and the bycatch is not of species of commercial interest. Moreover, these interactions generate cost overruns and efficiency losses for the activity. Minimising them will therefore be beneficial in economic terms.

As for seabirds, largely unknown to the general public, they have traditionally been the fishers's companions. Moreover, long before the widespread use of sonar in fishing, their presence indicated where the fish were and where the gear had to be set. That is why fishers are precisely one of the groups that are most familiar with a lot of these species and are the first to detect many of the problems that affect them. For this reason, the lack of birds in marine ecosystems is a scenario that no fisherman would want, as they could be an indicator of the poor state of the ecosystems on which their professional activity depends.

The decline of seabird populations on a global scale has been described and documented by the scientific community since the second half of the 20th century. The factors that threaten this group vary greatly depending on the species. However, in general the main threats are related to the degradation or destruction of their breeding and nursery grounds as a result



The fishing industry is keen to reduce bycatch as they are not commercially valuable species and can also lead to cost overruns and efficiency losses for the industry.

of the concentration of people and human activities along the coastal strip, as well as the introduction into these areas of non-native species that prey on their eggs and young. At sea, there are other threat factors such as the loss of marine water quality, interaction with marine litter or interaction with human activities at sea, such as professional and recreational fishing.



Figure 2. Trawler fisherman fishing among gulls.
Photo: Pep Arcos.

Within the large group of birds, marine seabirds are the most endangered on the planet and, for this reason, most of the species present on the Catalan coasts are protected by regulations. Directive 2009/147/EC, on wild birds, includes many of them in Annex 1, and establishes that “they must be subject to special conservation measures in relation to their habitat with the aim of ensuring their survival and reproduction in their range”. This European directive has been decisive in declaring special protection areas for birds (SPAs) in the marine environment, and in promoting management instruments for the protection and recovery of their populations.

The new fishing management models that are being implemented in Catalonia, based on co-management, favour the fishing sector, together with scientists and experts and with the support of the competent authorities, obtaining better economic results, exerting much less pressure on ecosystems and ensuring the future viability of the sector and of the marine species on which it depends. In this sense, with an ecosystem vision, work is being done from all areas to leave behind management models based on maximising catches and to adapt fishing effort to the state of stocks and consumer demand.

In addition to improving knowledge for the sustainable management of fishery resources, collaboration between fishers and specialised scientists makes it possible to launch research and innovation projects that reduce the bycatch of animals in the wild without affecting fishing efficiency. Fishers, conservation organisations and scientists have worked, and continue to work, together on projects aimed at mitigating these unwanted interactions.

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Figure 3. Longliners fishing at night.
Photo: Pep Arcos.



Figure 4. Purse seiner arriving at port.
Photo: Pep Arcos.

ENDANGERED SEABIRDS



Figure 1. Flock of seabirds eating discarded fish. Photo: Pep Arcos.

01 Seabirds in Catalonia

When we talk about seabirds, the first thing that comes to everyone's mind is the image of a Yellow-legged Gull, the kind that can be found in every fishing port or even on rooftops in many towns, calling and looking at you in a somewhat threatening way. This species, which is usually called a seagull by many people, is actually a Yellow-legged Gull. In fact, it is a non-threatened species and an opportunistic predator that in some places causes conservation problems.

Actually, there are dozens of species of seabird in Catalonia, many of which are protected and threatened. They need to be known in order to ensure they are assessed properly, because not all Catalan Seabirds are Gulls. Eight of the 74 bird families found in Catalonia are typically marine (see Table 1): the Diver Family (Gaviidae), Rare Winterers; the Storm-petrel Family (Hydrobatidae) and the Shearwater and Petrel Family (Procellariidae), Strictly Marine Birds; the Gannet and Booby Family (Sulidae); the Cormorant and Shag

Family (Phalacrocoracidae); the Gull, Tern and Skimmer Family (Laridae), with a Wide diversity of species; the Skua Family (Stercorariidae); and the Family of Auks, Puffins and Similar Species (Alcidae), Strictly Marine Wintering Birds. Of these families, a total of 56 species have been observed, 24 of which are rare or scarce. In addition to these, other species can be found at sea at certain times of the year, such as the Great Crested Grebe and mergansers.

The diversity of coastal environments in Catalonia, with sandy beaches, deltas, rocky coasts and islets, explains part of the diversity of birdlife. In this sense, the rocky coastline of the Costa Brava hosts nesting populations of species such as the Mediterranean Shag and the regular presence of the European Storm-petrel, while open bays such as those of Roses and Pals, or closed bays such as Els Alfacs or El Fangar, host wintering species such as divers. On the other hand, terns and gulls prefer the islands and beaches of the Ebro delta for nesting, while birds that nest in areas as far away as the Balearic Islands come to feed at the mouths of Catalonia's rivers, making the Roman

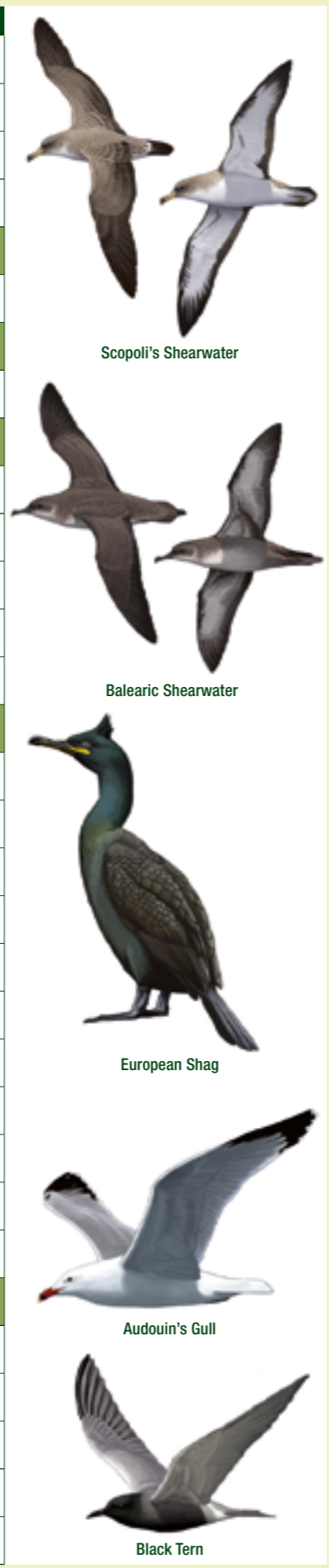
concept of the shared “mare nostrum” a reality.

In addition, numerous rare marine species (43% of all the marine species described in Catalonia) arrive on the Catalan coast from as far away as the American coasts (Franklin's Gull), African (Royal Tern or Lesser Crested Tern), northern Europe (Great Black-backed Gull and Iceland Gull), tropical areas (Red-footed Booby) or even the Pacific (Elegant Tern). The Mediterranean, therefore, is not as isolated as it seems and the Catalan coasts are very important for the survival of some species of seabirds.



Marine species, which are great fliers, look for three factors: suitable habitat for nesting, peace and quiet for nesting and sufficient food to survive.

| FAMILY | SCIENTIFIC NAME | ENGLISH NAME | PROTECTION | THREAT |
|-------------------|--|--------------------------|------------|--------|
| Gaviidae | <i>Gavia stellata</i> | Red-throated Diver | x | |
| | <i>Gavia arctica</i> | Arctic Diver | x | |
| | <i>Gavia immer</i> | Common Diver | x | |
| Hydrobatidae | <i>Hydrobates (pelagicus) melitensis</i> | European Storm-petrel | x | |
| Procellariidae | <i>Calonectris diomedea</i> | Scopoli's Shearwater | x | VU |
| | <i>Puffinus yelkouan</i> | Yelkouan Shearwater | x | |
| | <i>Puffinus mauretanicus</i> | Balearic Shearwater | x | EN |
| Sulidae | <i>Morus bassanus</i> | Northern Gannet | x | |
| Phalacrocoracidae | <i>Phalacrocorax aristotelis desmarestii</i> | Mediterranean Shag | x | VU |
| | <i>Phalacrocorax carbo</i> | Great Cormorant | | |
| Laridae | <i>Rissa tridactyla</i> | Black-legged Kittiwake | x | |
| | <i>Larus genei</i> | Slender-billed Gull | x | |
| | <i>Larus ridibundus</i> | Black-headed Gull | | |
| | <i>Hydrocoloeus minutus</i> | Little Gull | x | |
| | <i>Larus audouinii</i> | Audouin's Gull | x | VU |
| | <i>Larus melanocephalus</i> | Mediterranean Gull | x | |
| | <i>Larus canus</i> | Common Gull | x | |
| | <i>Larus michahellis</i> | Yellow-legged Gull | | |
| | <i>Larus fuscus</i> | Lesser black-backed Gull | | |
| | <i>Gelochelidon nilotica</i> | Gull-billed Tern | x | |
| | <i>Hydroprogne caspia</i> | Caspian Tern | x | |
| | <i>Thalasseus sandvicensis</i> | Sandwich Tern | x | |
| | <i>Sternula albifrons</i> | Little Tern | x | |
| | <i>Sterna hirundo</i> | Common Tern | x | |
| | <i>Chlidonias hybrida</i> | Whiskered Tern | x | |
| | <i>Chlidonias leucopterus</i> | White-winged Tern | x | |
| | <i>Chlidonias niger</i> | Black Tern | x | EN |
| Stercorariidae | <i>Catharacta skua</i> | Great Skua | x | |
| | <i>Stercorarius pomarinus</i> | Pomarine Skua | x | |
| | <i>Stercorarius parasiticus</i> | Arctic Skua | x | |
| Alcidae | <i>Alca torda</i> | Razorbill | x | |
| | <i>Fratercula arctica</i> | Atlantic Puffin | x | |



02 Protected birds

Not all species are threatened to the same level and, among other measures, in some cases legal regulations must be established to ensure their conservation. Thus, until we have the Catalan catalogue of species threatened with extinction (currently being processed), Royal Decree 139/2011 of 4 February, for the development of the List of Wild Species under Special Protection and the Spanish Catalogue of Threatened Species. (Spanish Official Gazette 46 of 23 February 2011) and subsequent modifications, establishes the list of species that are protected and threatened with extinction at state level. According to the Catalogue, currently two thirds of the seabird species listed in Catalonia are protected (36 species), and five of them are listed as species threatened with extinction to varying degrees.

Of these five endangered species, the two shearwaters are strictly marine species present a good part of the year on our coast, while the Mediterranean shag nests on the coast between La Selva and L'Alt Empordà and Audouin's gull nests on the central and southern coasts. The Black Tern is a regular migrant.

02.01 Shearwaters

Scopoli's shearwater and the Balearic Shearwater are nesting species in the Balearic Islands, which come to the Catalan coasts to feed regularly. In reality, they are not from here or there, but use a place that has better characteristics in terms of the presence of islets or caves for breeding (Balearic Islands) and a place richer in nutrients and fish for feeding (Catalonia). As they are dependent on oily fish and discards from fishing activities, they present a marked problem due to interaction with longline fishing gear, which has led to high mortality in these species. Technical mitigation measures are being developed that should improve the conservation status of these endangered species when they are widely implemented. We must bear in mind that the entire world population of Balearic shearwater feeds on the Catalan coast and, therefore, it is also our responsibility to conserve these birds for the future.

02.02 The Mediterranean Shag

Another bird that is also exclusive to the Mediterranean is the subspecies *desmarestii*, which is found on the Catalan coast. This is a black bird typical of the rocky coastline of

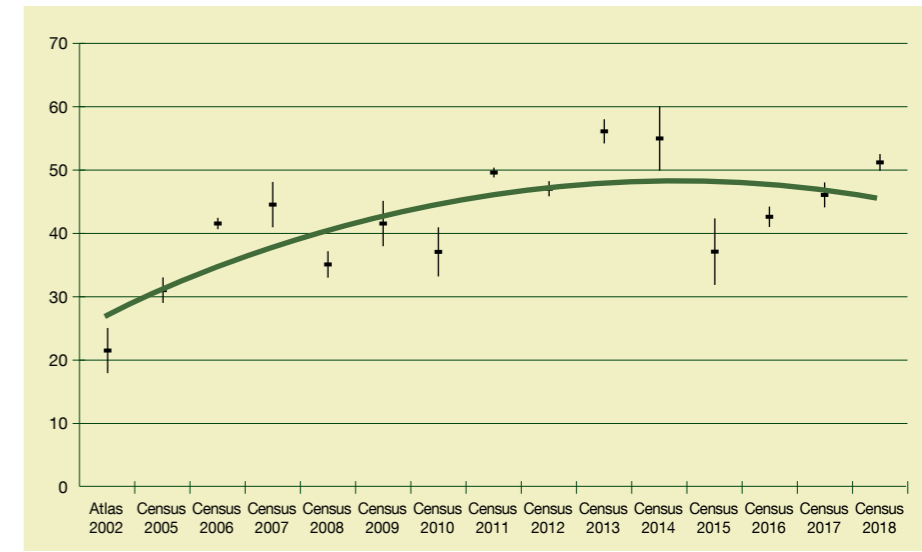


Figure 2. Evolution in the number of nesting pairs of European shag in Catalonia. Source: SFF/Government of Catalonia.

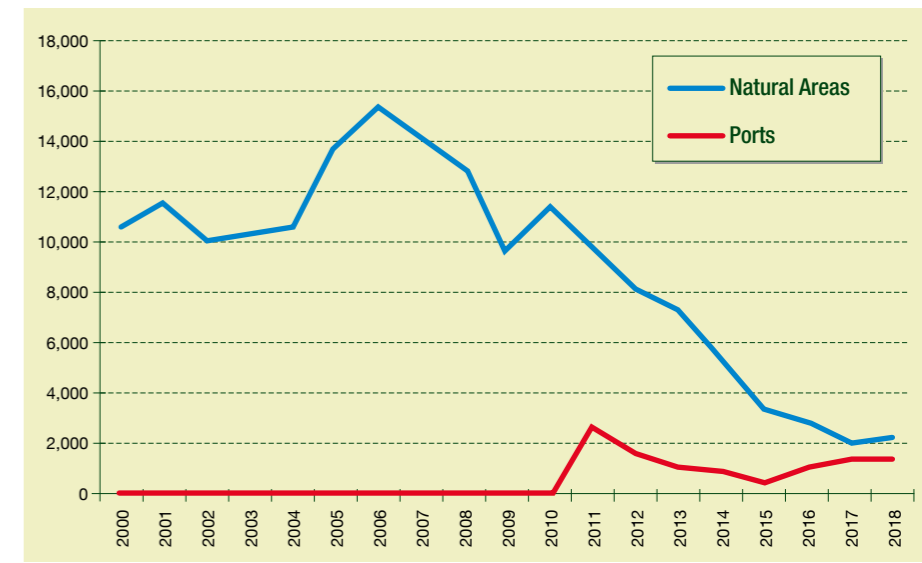


Figure 3. Number of Audouin's Gull nesting pairs in protected natural environments and port areas in Catalonia. Source: SFF/Government of Catalonia.

the Costa Brava and some privileged spots on the central and southern coasts during the summer. Unlike most birds, this species starts nesting in winter and, therefore, may already be incubating in December and January, resisting the winter Tramuntana storms. In March, the white chicks hatch. They stay near the nests during the spring, and in the summer they gather in specific areas of the coast to moult and feed, such as Palomera (Blanes), Roca Grossa (Calella) or Sant Pol de Mar.

Although most of the European population nests on islands such as the Balearics, from where we also receive specimens that come to spend the summer, the Catalan population numbers around 50 pairs (Figure 1) and is the most important in continental Western Europe. Concentrated on the Costa Brava, all the areas where they nest are classified as Special Protection Areas for Birds (SPAs) under European legislation. This guarantees

the protection of their habitat from potentially landscape-altering initiatives such as offshore wind infrastructures along the coastline.

In addition to human disturbance of their breeding grounds or interaction with recreational fishing, the species can also fall victim to natural phenomena such as the proliferation of toxic algae. In this respect, the population of the Medes Islands is currently recovering from a mass mortality event linked to the presence of toxic algae that made it disappear completely between 2014 and 2015.

02.03 Audouin's Gull

Audouin's gull is the only gull catalogued as endangered in our country. The name of this specie comes from a Mediterranean island where they nest, it colonized Catalonia during 80's, establishing the largest colony

Table 1. Most common seabird species recorded in Catalonia indicating the protection and degree of threat in accordance with Royal Decree 139/2011 of 4 February, for the development of the List of Wild Species under Special Protection and the Spanish Catalogue of Threatened Species. Illustrations: Martí Franch.

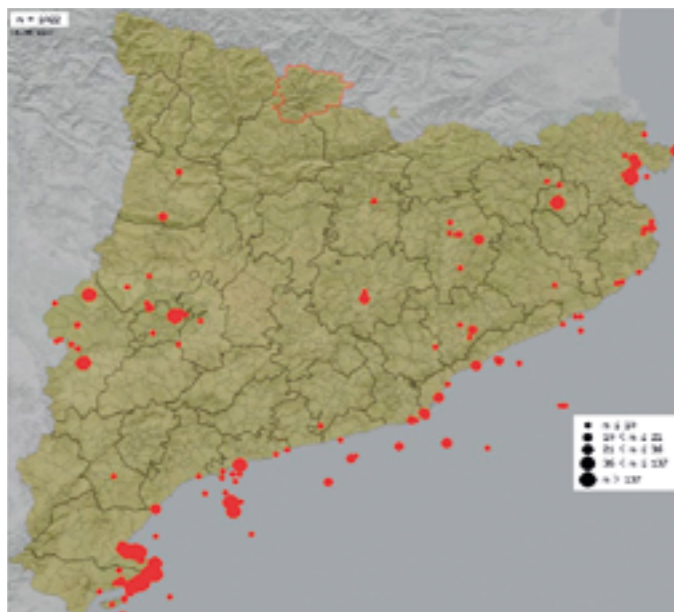


Figure 4. Distribution of observations of the black tern in Catalonia. Source: www.ornitho.cat

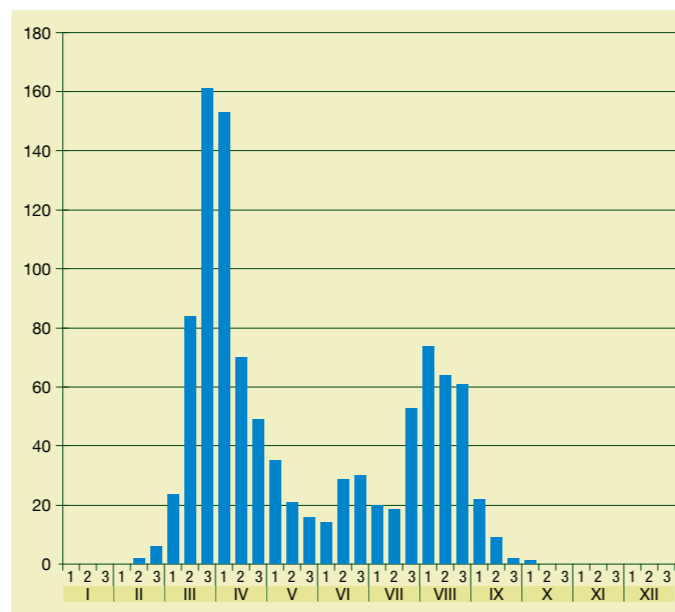


Figure 5. Migratory phenology of the black tern in Catalonia in ten-day periods. Source: Graph compiled with data from www.ornitho.cat

of the world in the Ebro Delta. As many as three out of every four Audouin's gulls in the world nested there.

This may seem positive, but it was a conservation problem, as a chance local catastrophe could suddenly drive the species to extinction. To avoid this problem, a European LIFE project was developed to ensure that the gull could also nest in other wetlands in Catalonia, such as the mouth of the River Llobregat. The combination of several negative factors in the Ebro in 2009 and 2010 led to the colonisation of other areas such as the Llobregat delta, but also the discovery of the port environment as a safe place for nesting with little human disturbance.

Of the 15,396 pairs that nested in Catalonia in 2006 in the Ebro delta colony, 3,754 did so in 2018 in four different colonies: Punta de la Banya and the Tancada salt marshes in the Ebro delta area and the ports of Tarragona and Barcelona. The species has even abandoned the Llobregat delta due to the presence of predators. Currently, the number of pairs nesting in port environments is approaching those nesting in natural areas (see Figure 3). The remaining pairs in Catalonia have not disappeared, but have been redistributed to other areas of the Mediterranean, particularly in the Valencian Community and mostly related to port environments.

02.04 The Black Tern

The Black Tern is a migratory species, particularly present in spring in Catalonia, when it is distributed in marine, coastal and inland areas (see Figure 4). Migration begins

tentatively in February and increases in March, reaching a maximum in April. The number of records drops to minimums in June, with individuals that can be considered non-breeding summer specimens (see Figure 5). The autumn passage is more diffuse, but peaks in July and August, when concentrations of over a thousand specimens can occur in the Ebro delta. Outside this area, the species is scarce and can be seen migrating out at sea, over 50 nautical miles from the coast.

03 Conservation challenges

The example of Audouin's gull is the paradigm of the required adaptive management. Like all birds, marine species, which are great fliers, seek three things: a suitable nesting habitat, peace and quiet for nesting (and therefore few predators) and sufficient food to survive. What seems like an easy equation to solve is not so easy at times like the present, when opportunistic species are on the rise and are increasingly cornering threatened species, be they nesting species such as Audouin's gull or the European Shag or migratory species such as Shearwaters or the Black Tern. Many of the other marine protected species have identical problems and some elements in the equation are failing or could be improved. They are merely indicators of global, climate, ecological or land and resource management changes. They must be considered in order to avoid both the loss of these species and the loss of their habitats.

Suitable habitat does not seem to be a limiting factor for the European shag, which uses the coastal cliffs of the Costa Brava. It is, however, a limiting factor for the post-

breeding concentrations along the Catalan coast, not only in the counties of Girona, but especially on the central and, to a lesser extent, the southern coast. Guaranteeing quiet conditions day and night, the absence of recreational fishing activities around these sites, due to the danger posed by lost hooks and lines, and guaranteeing planning that does not affect these areas are current management challenges. The existence of resting areas for migratory species such as terns is also important and it is not surprising that the highest concentrations occur in protected deltas such as the Ebro, particularly in areas with restricted access such as Buda Island or Punta de la Banya, and secondarily in other preserved areas such as the Llobregat delta. This is a migratory area with high coastal productivity and guaranteeing resting, moulting and feeding areas is a necessity and obligation derived from animal protection legislation.

The existence of sufficient food stocks conditions and partly explains fluctuations in the populations of these marine species. A better knowledge of their requirements and their interaction with professional fishing will allow us to better model their management and foresee possible impacts derived both from changes in fish stocks and from the management of discards of some species.

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SEABIRDS AND FISHERIES INTERACTIONS: HOW TO SOLVE THE BYCATCH PROBLEM



Figure 1. Seabirds following a trawler, attracted by discards. Photo: Pep Arcos.

01 Seabirds and fisheries

Seabirds are marine top predators, and as such share habitat and prey with fishers. The lives of seabirds and fishers are therefore closely intertwined, and this means that they interact in many different ways.

On the positive side, it should be remembered that, since time immemorial, fishers have used birds to find shoals of fish. Even today, birds complement the information on the location of catches that new technologies bring to fishing. Moreover, by studying the diet and movements of birds, we can obtain data on the abundance and distribution of their prey and help improve the management of fish stocks. Birds have also been able to benefit from fishing, especially from the discarded fish, as it can represent an extra food source that is easier to obtain. This resource has become very important for some species, to the extent that their ecology and behaviour is strongly influenced by fishing activity and the availability of discards, and their populations can fluctuate accordingly.

But it is not all plain sailing. When sharing prey, birds and fishers can also become competitors, and birds, with less extractive capacity, will always be more sensitive to change. The great flying ability of many seabird species means that they can compensate for local food shortages by moving to areas far from their breeding colonies. However, there might be severer effects if prey declines are widespread, either by environmental and/or overexploitation reasons. On the other hand, changes in the birds' diet can also alleviate these food shortages. In this respect, birds become good indicators for fisheries management, as they often warn of changes in prey abundance before we detect them more directly.

For example, the decline of the lesser sandeel, a member of the family Ammodytidae, in the North Sea has wreaked havoc on the many seabird colonies in Scotland and nearby areas, affecting iconic species such as the Atlantic Puffin and the Black-legged Kittiwake. In this situation, the Atlantic Puffin has partly compensated for the loss of the lesser sandeel by catching more herring, although in this case the



By sharing prey, birds and fishers may become competitors and birds, with less extractive capacity, will always be more sensitive to change.

change in diet could not halt the decline in their populations.

Another negative interaction between seabirds and fisheries, and probably the most serious one, is bycatch. Bycatch is unintentional, and often occasional, but can still pose a very high risk to some bird populations. It should be borne in mind that seabirds are usually long-lived animals with low reproductive rates. Some species may live for over fifty years, take years to breed for the first time and, when they do, lay only one egg per season, and may even take "sabbatical" years during which they do not breed. Thus, any factor that shortens life

expectancy can cause significant population declines, as the low reproductive rate cannot make up for the additional deaths.

But bycatch is also a problem for fishers, who want to catch fish. If birds are caught instead of fish, this causes problems, damage to gear and loss of fishing opportunities, and thus leads to economic losses.

02 Bycatch, who is affected, how and where?

Bycatch can occur in different fishing gear and affect various seabird species around the world. To understand how it occurs, it is important to analyse it on a gear-by-gear basis, and also to know the characteristics of the species affected. The gears most often involved are longlines, nets (both static and drift nets), trawls and purse seines.

02.01 Longlines

Longline (both surface and demersal) is the type of gear that has received most attention in relation to seabird bycatch. The crucial moment is when the lines are set, when the birds try to catch the baits and can either swallow them with the hook or get stuck superficially with the hook or tangled up with the line. They then sink with the gear and drown. This especially affects species that feed relatively close to the surface and often in groups, such as albatrosses and shearwaters.

The Southern Oceans were the first place where the link between catches with this gear and the sharp decline in many albatross populations could be demonstrated almost 30 years ago. It was also the area where the first firm measures were taken to solve the problem. But the phenomenon is much more widespread and affects many regions of the world, with a global estimate of between 160,000 and 320,000 seabirds killed annually as a result. However, there are still areas where much work needs to be done to document the problem properly and implement solutions, as is the case of the Mediterranean.

We can observe significant differences depending on the type of longline used. In the case of surface longlining, large fish species such as tuna and swordfish are often set in more pelagic waters and using larger hooks and baits, so large seabird species such as albatrosses, large petrels and gannets are those with higher risk of bycatch. Demersal



Figure 2. Atlantic Puffin (*Fratercula arctica*) have learned to exploit alternative prey, such as herring (pictured), in the face of the decline of their main prey, the Lesser Sandeel. Isle of May, Scotland. Photo: Pep Arcos.



Figure 3. Scopoli's shearwater (*Calonectris diomedea*) in its nest. Balearic Islands. Photo: Pep Arcos.

longlining (in its many variants) tends to be set in more coastal and more productive areas and uses smaller baits and hooks, and therefore may also affect smaller seabirds, especially shearwaters and some petrels, but also gulls and others.

02.02 Nets

Diving birds, such as cormorants, sea ducks and even shearwaters, can become entangled when attracted by the fish

caught or when swimming past the gear, as the birds are unable to detect it. In the case of bottom-set nets such as gillnets, these catches can be significant in coastal and/or shallow areas, especially seabird breeding colonies, or in areas where birds congregate to feed. This is a problem typical of temperate and cold areas, where diving species are usually more abundant. But it can also be observed in lower latitudes such as the Mediterranean, where locally it can affect the European shag and other



Figure 4. Great grebe (*Podiceps major*). Note the net around its body. Punta del Este, Uruguay. Photo: Pep Arcos.

species. Globally, an estimated 400,000 birds are killed each year as a result.

Driftnets pose a danger to many seabirds, and for many other marine species, and can affect more surface-bound species such as shearwaters and petrels. However, in 1992, the United Nations established an international moratorium on this type of gear in oceanic waters, so that today its legal use is limited to a few coastal areas.

02.03 Trawling

Accidental seabird deaths caused by trawlers went unnoticed for a long time. However, in some areas it appears that these deaths may be significant, particularly in the Southern Hemisphere where there is a high density of seabirds.

The main problem is collision with the wraocables, especially when large numbers of birds are associated with the boat, attracted by the discarding of fish. It mainly affects large species with long wings and poor manoeuvrability, such as albatrosses and some large shearwaters and petrels. Most collisions go unnoticed, as the bird is injured (usually with a broken wing) or sinks with the cable and drowns, but rarely comes aboard. On the other hand, some birds such as deep diving penguins or shearwaters can get caught in the net during fishing operation.

On a global scale, no estimate has been made of the number of seabirds affected by trawling, but the problem is known to be significant in areas such as southern Africa and the Patagonian Continental Shelf. In the Mediterranean, the available information suggests that this is an occasional phenomenon.

02.04 Purse seines

This practice can also cause bycatch, mainly when the target species are small pelagic fish such as sardines and anchovies, which are consumed by many seabirds. The moment of maximum danger is when the net is closing over a mass of fish and the birds are attracted by this abundance of prey near the surface. They are then in danger of getting caught in the net with the fish and suffering fractures or drowning. The problem mainly affects species that have some diving ability, especially shearwaters, as they may be underwater when the net has just closed, thus becoming unable to react and leave in time.

This is the least studied type to date, but it is known that the problem can be significant in areas such as the coasts of Chile and Peru. In the Mediterranean, documented cases are anecdotal.

03 How can the problem be solved?

Over the last three decades, great efforts have been made in some regions to minimise the bycatch problem, but much remains to be done. Existing experiences show that reducing bycatch is possible, often with small operational changes or simple technical measures that do not involve significant effort, and benefit both birds and fishers.

The Agreement on the Conservation of Albatrosses and Petrels (ACAP), with the support of the NGO *BirdLife International*, is constantly updating available information and developing recommendations on bycatch mitigation, promoting their implementation on a global scale. On its website (<https://acap.aq/>), we can find recommendations on how to act, and, in particular, it has factsheets with the most appropriate mitigation measures for each type of gear. According to their recommendations, for a seabird bycatch mitigation measure to be appropriate it must be simple and easy to implement, it must be proven to be effective in significantly reducing seabird bycatch and it must not increase the bycatch of other endangered species. Furthermore, it is also important to check that it does not adversely affect the capture of commercial species.

Beyond these recommendations, it should be remembered that minimising bycatch by fishing gear is a win-win objective and it is essential that all stakeholders work together to find solutions, and with fishers at the forefront. No one knows their gear and practice better than the fishers themselves, and they are therefore best placed to seek adjustments to improve the sustainability of their activity. On the other hand, scientists and conservationists know the behaviour and ecology of the birds well, and can help identify the factors that drive catches in order to find solutions. They can also bring experience from elsewhere. And public administrations are responsible for the resources and welfare of the marine environment, and for regulating any measures deemed appropriate to achieve these objectives.

When developing or adapting mitigation measures, the particularities of the area and the gear to be addressed must be well understood. As a starting point, however, it is useful to know what solutions have been found for similar gear in other regions. Let us look at some of them.



Figure 5. The decline of several species of albatross and petrel raised the alarm about bycatch in the early 1990s. In the photo, an Antipodean albatross (*Diomedea antipodensis*) and northern giant petrels (*Macronectes halli*) taking advantage of the discards from a fishing boat in New Zealand. Photo: Pep Arcos.

03.01 Longlines

Longline is the gear that has received most attention for developing and applying mitigation measures. There are two important factors to consider, and to work on: the vessel's likelihood of attracting seabirds and the sinking speed of the longline.

If we make sure that there are few birds associated, or that they cannot get very close, we significantly reduce the probability of catches. Thus, setting the gear at night (when most bird species are less active) can be a first approach, and often reduces the risk of capture significantly. Significant reductions can also be achieved by avoiding setting longlines during periods of peak interaction (usually

during the breeding season) and in areas close to breeding colonies. Another very effective method, as long as it does not affect fish catch, is to use bait that is unattractive to birds, such as crustaceans or octopus. Managing discards properly also helps: they should not be thrown out moments before or during the setting of the longline, so that birds do not follow the boat when the risk of catch is highest. On the other hand, mechanisms can be used to scare birds away or prevent them from approaching the area where the line is being set or retrieved, such as the so-called tori lines (a line stretched behind the boat from which brightly coloured strips are hung, which deters birds from approaching the area where the baited hooks are accessible to them). Finally, in the case of surface longlines, the use of encapsulated hooks, which do not open until they reach a certain depth, so that the bait remains inaccessible to the birds, is also very effective.

Achieving fast sinking rates also helps to minimise the risk of bird catches. When little (or no) weight is attached to the line, baited hooks take a long time to sink, and can be accessible to birds even hundreds of metres from the boat, at least for species that have a certain ability to dive (such as shearwaters). The more weights we add,

and the heavier they are, the faster the line will sink and the lower the risk of catching birds. An extreme case is the Chilean system, where vertical lines are used with a weight at the end that makes them sink quickly. In addition, with this system, as the gear is lowered vertically and with the boat stationary, the line stays close to the deck, which makes it more difficult for the birds to approach the bait.

03.02 Nets

The bycatch of birds in nets usually occurs when the gear is set, making it more difficult to find solutions. The aim is to prevent birds from approaching the net once it is set, and various deterrent or signalling systems have been tested for this purpose. The most widespread are acoustic deterrent systems, which emit high-frequency sounds. These devices often work well for preventing the capture of marine mammals, but for birds they are not always as efficient. Visual systems that signal the presence of the net, such as flashing lights or panels with colouring patterns that are particularly conspicuous to birds, are also being experimented with.

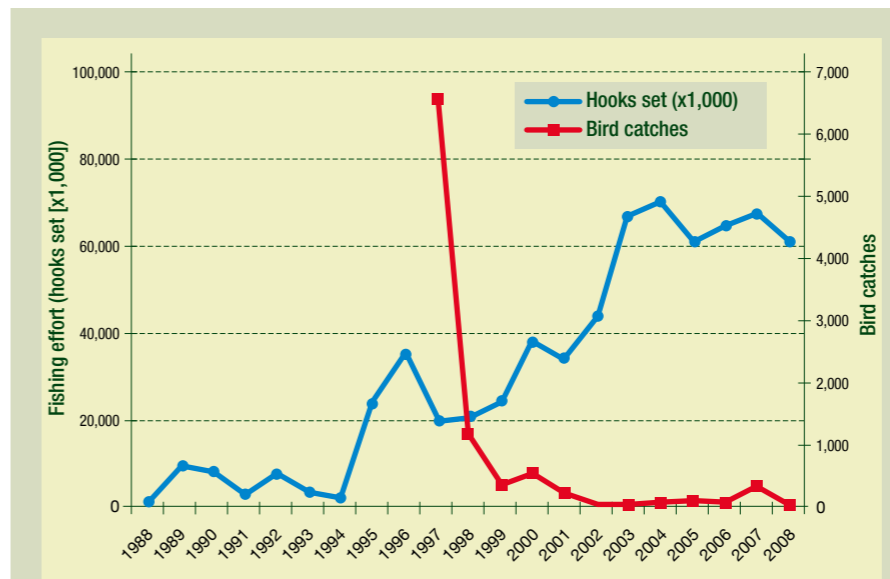


Figure 6. Comparative graph between fishing effort and bird catches, from data recorded by CCAMLR.

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) is an international convention established in 1982 to manage fisheries in Antarctic marine ecosystems. This convention has been a model to follow in the management of fishing activity, taking into account its impact on the marine ecosystem as a whole, and birds have not been left out. Thus, seabird bycatch mortality has gone from affecting thousands of birds annually to almost zero within the area managed by the convention, thanks

to the development and implementation of a combination of measures including seasonal closures, night setting, the use of bird-scaring lines and the use of weights to ensure the rapid sinking of longlines. This reduction in bycatch has been accompanied by an increase in fishing effort, and shows that minimising bycatch has nothing to do with to place obstacles in the way of fishing obstacles in the way of fishing.



Figure 7. Purse seine fishing and Balearic shearwaters. Photo: Pep Arcos.



The reduction in bycatch in the CCAMLR area has been accompanied by an increase in fishing effort, and shows that minimising bycatch has nothing to do with placing obstacles in the way of fishing.

03.03 Trawling

One of the most commonly used systems to minimise bird mortality on trawlers is bird-scaring lines, similar to those used on longliners, to prevent birds from getting too close to risk areas (stern and wrap cables). This, combined with good discards management, which in this case is very important (as this type of fishing generates large amounts and attracts many birds), can significantly reduce bycatch.

03.04 Purse seines

This type of fishing has received the least attention in developing mitigation measures for seabird bycatch. However, recent studies in Chile show how slight improvements in gear, which avoid making unnecessary "bags", significantly reduce shearwater catches. Another way of minimising catches is to fish at night and to avoid the net closing manoeuvre extending into the early hours of the morning, when the birds are most active.

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It is essential to work together to find solutions collaboratively and led by the fishers.

SEABIRD BYCATCH IN CATALONIA: DEMERSAL LONGLINING



Figure 1. Yelkouan shearwater bycaught during the setting of a demersal longline. Photo: Vero Cortés.

01 Joint actions to solve the problem

As has been mentioned above/before, bycatch in fishing gears, not only entails losses and inconveniences for fishing activity, but also represents one of the most important threats to many seabirds. Therefore, all efforts aimed at resolving this interaction lead to a win-win situation. However, in order to achieve a common and successful solution, it is essential the exchange of knowledge and joint work between the different actors involved.

An example of joint work can be found in Catalonia, and specifically in demersal longlining, the fishery that has the greatest impact on seabirds in our country. Over the last few years, research centres (led by the University of Barcelona) and conservation organisations (mainly SEO/BirdLife) have worked closely with fishers, with the support of the Administration, to assess the problem and seek effective solutions compatible with the activity of demersal longliners. The common goal is to make this activity more sustainable and respectful of the marine

environment.

02 Seabird bycatch in demersal longlining

In Catalonia, demersal longlining is used in two types of fishing: bottom longlining, where it is typical to use hanging or "pedra-bola" longlines, and small-scale polyvalent vessels, where a smaller longline called "palangró" is used. Although seabird bycatch occurs in both modalities, there are certain conditions there are certain conditions that prompt it, in particular those related to the fishing techniques and fishers's habits, as well as the behaviour of the seabirds. It is therefore important to study on a case-by-case basis what changes could be introduced to reduce seabird bycatch.

02.01 Identifying and understanding the issue

Understanding how, when and under what conditions seabird bycatch occurs and which species are most affected is the first step to solving this problem. This prior information is



In Catalonia, demersal longlining has a particular impact on the 3 species of shearwater endemic to the Mediterranean, all of which are in decline: Scopoli's shearwater, the Balearic shearwater and the yelkouan shearwater.

essential, and helps us to identify the most dangerous situations for the birds and the most appropriate mitigation strategy for the fishing fleet studied. To achieve this, reliable data must be collected on the interactions between seabirds and fishing gears, as well as the particularities of the fleet, the fishing methods, the gears used and the distribution of the effort.

This information can be obtained through different methods which complement each

other. The methods used in Catalonia and the conclusions reached with the information collected are described below.

02.01.01 Questionnaires to fishers

The best way to obtain a global vision of the problem and understand the diversity of fishing practices and their interaction with birds is to carry out questionnaires to fishers.

Thus, questionnaires carried out in the sector have shown that longlining is the fishery with the greatest risk of catching seabirds in Catalonia (Figure 4).

In addition, it has demonstrated a higher level of seabird bycatch in demersal longliners, with exceptional cases of hundreds of individuals caught in a single setting. This could be explained by the fact that demersal longliners usually use smaller baits and hooks than surface longliners, which makes it easier for the birds to swallow the bait and become hooked. In addition, demersal longliners tend to fish closer to shore, where seabird abundance and diversity are higher.

According to questionnaires, demersal longlining particularly affects the 3 species of shearwaters endemic to the Mediterranean, all of which are in decline: Scopoli's, Balearic and yelkouan shearwaters. These species are at high risk of bycatch, as they are good divers and can reach baits up to 30 metres deep. In addition, they are very gregarious birds so often hundreds of birds are gathering behind the boats, which increases the probability of multiple captures.

02.01.02 Direct on-board observations

On-board observations expert personnel allow to obtain more accurate information on seabird interactions. However, to achieve a broad coverage and obtain sufficient information of the different fishing grounds and methods throughout the year, it is necessary to put in place an observer programme with, with sufficient personnel to cover an acceptable percentage of the fishing effort of the target fleet. Furthermore, in some cases, it is not possible to go onboard fishing vessels because the maximum legal number of crew members is exceeded. This is particularly the case of the small-scale polyvalent vessels, which hampers the collection of data in this fishery.

In Catalonia, this method has shown that seabird catches on longliners occur



Figure 2. Seabird bycatch during demersal longline setting. The risk of capture is greater when fishers set the longline during the day, with low weights and using small pelagic fish as bait. Illustration: Martí Franch.



Figure 3. Bycatch of the 3 Mediterranean shearwater species. From left to right: yelkouan shearwater (1), Balearic shearwater (2-3) and Scopoli's shearwater (4-5). Photo: Vero Cortés.

irregularly. Although seabird bycatch seems to be infrequent, occasionally could occur massive catches of dozens to even hundreds or hundreds of individuals in a single setting; especially affecting the 3 species of shearwater.

From data collected between 2011 and 2014, a minimum annual mortality of 126 to 642 seabirds has been estimated for the demersal longline fleet of Catalonia (Cortés et al., 2017). These estimates should be considered very conservative for several reasons: (1) information is not available for some areas and gears, (2) the irregularity of seabird catches makes their detection more difficult without a regular monitoring and good coverage, and (3) not all birds caught are retrieved (they may become unhooked or eaten by scavenging marine species, such as benthic amphipods)

02.01.03 Self-reporting logbook

The distribution of logbooks in which fishers collect information about seabird bycatch themselves allows to extend the coverage especially, in those vessels where it is not possible to carry out onboard observations due to space limitations. However, for fishers this represents additional work to fishing, additional work to fishing, so they don't do it with the same dedication as an observer cannot do with the same dedication as an observer. However, the motivation of many fishers has allowed to collect interesting data.

During the spring of 2017, logbooks were distributed to demersal longline fishers in central-northern Catalonia for the first time. This experience was very positive, as the fishers were really involved in the study, which improved the information on the occurrence of bycatch and the factors that prompt it, at the same time this awareness

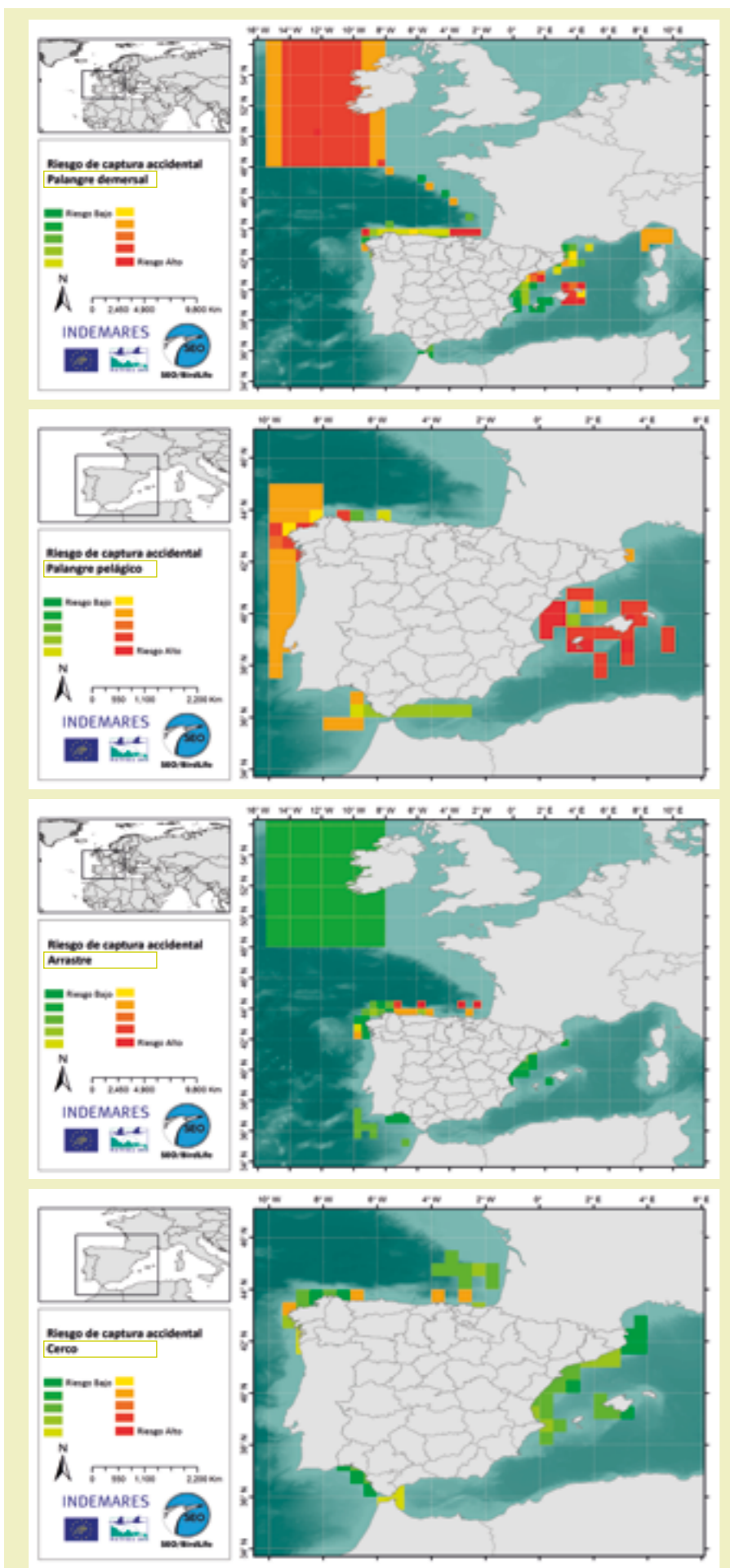


Figure 4. Maps of the level of bycatch risk (from green, low, to red, high) in the Spanish fishing fleet's different fishing modalities, according to surveys of fishers carried out by SEO/BirdLife during the Interreg FAME and LIFE INDEMARES projects. Source: SEO/BirdLife (2014).

of the problem. That is why this action was repeated in 2018, but increasing the coverage.

The logbooks distributed in 2017 allowed to register 685 birds bycaught (see Figure 5). Of these catches, 97% were shearwaters, especially Puffinus shearwater species (Balearic and yellow), as they were often caught in groups of up to a few dozen per setting. However, a large number of the shearwaters caught were released alive (59%), but is unknown how many of these survived following release. This release is only possible in the small-scale polyvalent vessels, as they tend to set the longlines more slowly, at shallower depths and with less weight, allowing to stop the setting and retrieve the line to release the bird caught, or even the birds hooked could reach the surface and survive until the hauling.

02.01.04 Study of seabird carcasses

The study of the seabird carcasses seabird due to bycatch allows to know the sex, age, reproductive status and, sometimes, the colonies of origin.

The results of these studies in Catalonia show that, although immature birds are captured at the end of the breeding season, adult males are the most affected by this interaction, especially at the beginning of the breeding season (when they are mating or incubating). In the case of Puffinus shearwaters, the females are captured more frequently during the period of chick-rearing. The mortality of breeding adults and the imbalances between sexes in bycatch aggravate the decline of these species.

Some recovered birds were ringed, which proved that most of the captures in Catalonia correspond to birds from the nearest breeding colonies (Balearic Islands), although other more distant colonies may also be affected, especially from France and Italy.

02.01.05 Tracking birds

Seabirds equipped with remote tracking devices such as GPS allows to learn about their behaviour, routes and foraging areas. Furthermore, if this information is combined with the distribution of fishing vessels, it is also possible to know when, where and in which fisheries the seabirds interact, which allows to identify bycatch risk areas.

The combined analysis of the Scopoli's shearwater's foraging trips and the daily

movements of fishing vessels, have shown that the birds attend longliners with lower intensity when there are more trawler around them (Figure 6), as the latter provide to them more feeding opportunities (discards).

02.02 Conditions that favour seabird bycatch

Seabird bycatch varies according to season and setting time, meteorological conditions and the particularities of the fishing techniques. Previous studies indicate that there is a higher risk of bycatch when fishing early morning and during the breeding season (spring and summer). There is also an increased risk of bycatch when fishers use baits attractive to seabirds (such as sardines and anchovies), or set longline configurations with low weight that are light in weight and slow sinking.

Seabird bycatch may also increase on windy days and non-working days of trawlers. In strong wind conditions, birds find it more difficult to get food by themselves, so therefore they follow the trawlers more intensively. Moreover, during the weekends or trawl closures, when the discards provided by these boats are not available, the birds search other sources of food, such as longline baits, thus increasing the risk of being bycaught, as seen above (see Figure 6).

02.03 Effects on bird populations

Because of seabird bycatch occur irregularly and unevenly, some fishers are not aware of the importance of this problem. However, if all the longliners in the region are taken into account, along with the possible bycatch in other gears and regions, the mortality caused becomes unsustainable for some species, especially if they have small populations such as the Balearic shearwater.

In this latter species, the decline observed in their populations due to a high mortality of adults is of particular concern. Almost 50% of this mortality is attributed to fishing. Each year, the population of this shearwater is estimated to be declining by 14% and, if this rate continues, it will become extinct in less than 60 years. It must be remembered that seabird populations are very sensitive to increased mortality.

This negative population trend has also been detected in Scopoli's and the yellow shearwater, and all scientific evidence points to fishing mortality as the

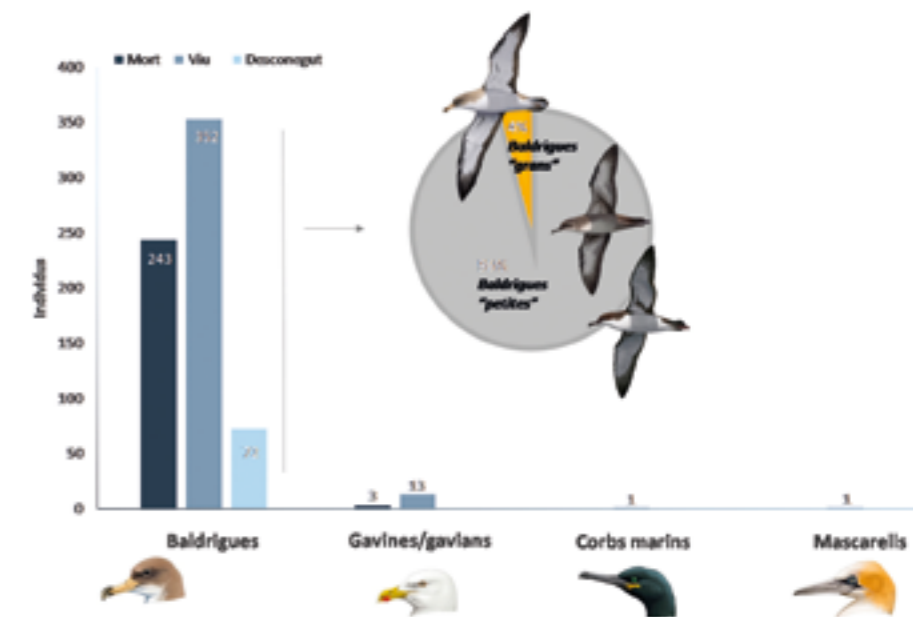


Figure 5. Number of captured individuals of the different bird groups recorded in the logbooks distributed in 2017 (685 birds in total). It is also specified whether they were recovered dead or alive. For shearwaters, the circle indicates the proportion of Scopoli's shearwaters (large) in comparison with the Balearic/yellow shearwaters (small). Drawings by Martí Franch. Source: Tarzia et al. (2017).

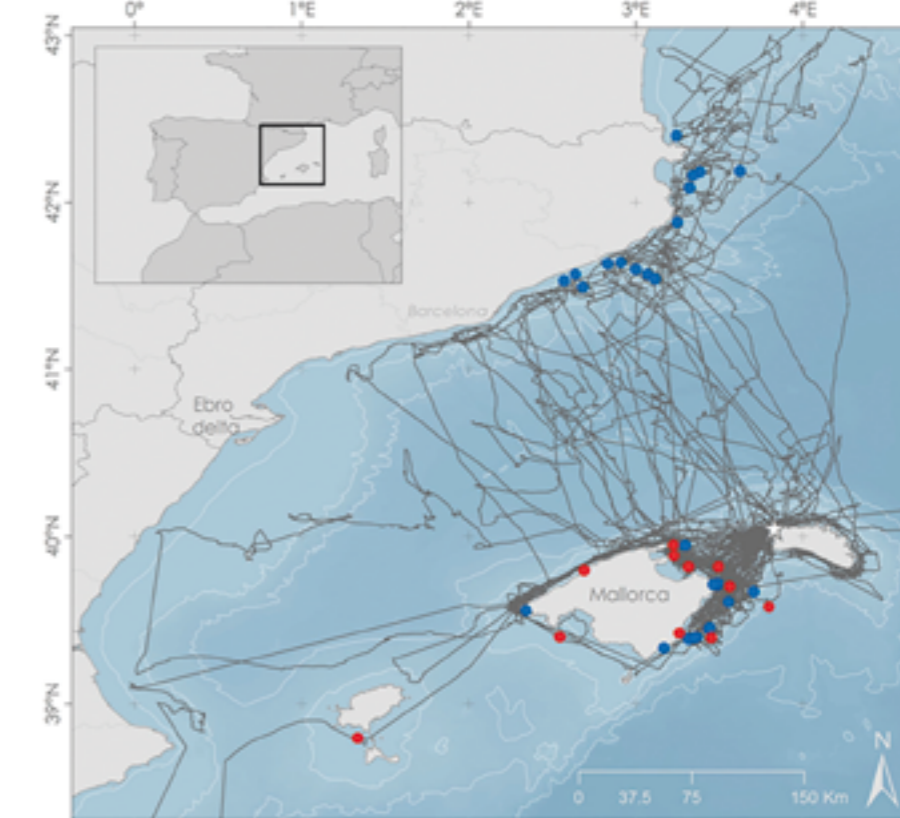


Figure 6. Foraging trips of Scopoli's shearwater from the Cala Morell colony (Menorca) and interactions with trawlers (blue dots) and longliners (red dots) for which VMS locations are available. Source: Taken from Soriano-Redondo et al. (2016).

main cause of this situation. In the case of Scopoli's shearwater, moreover, it has been observed an uneven mortality between breeding colonies. These differences are caused by a variation in the distribution of the birds according to the colony of origin, and, linked to this, in the different degrees of overlapping with the fishing grounds.

02.04 Effects on fishers

It should not be forgotten that fishers also suffer direct effects when birds interact with

their activity. During the setting, seabirds steal the baits that are thrown to the sea, which reduces the amount of bait available for their catch. In addition, when the birds are caught, the baits are rendered useless and, at the same time, they increase the buoyancy of the longline, which modifies the way of the line is settled on the bottom, ultimately affecting its efficiency. This reduces fishing opportunities and, as a consequence, has an effect on performance. Finally, catching birds can also lead to line entanglement and gear losses.

03 Mitigation measures for demersal longlining in Catalonia

03.01 Studied mitigation methods

Seabird bycatch can be minimised if there is a good knowledge of the factors that cause it and if appropriate measures avoid it are implemented. According to the recommendations of the "Agreement on the Conservation of Albatrosses and Petrels" (ACAP), the most effective mitigation measures to reduce seabird bycatch in demersal longline fisheries are (1) the use of bird-scaring lines, (2) the addition of weight to longlines, and (3) night setting.

Both the University of Barcelona and SEO/BirdLife have developed and tested these potential mitigation measures, adapted to the characteristics and ways of working of the Catalan fleet. The results obtained in the tests carried out are presented below.

03.01.01 Bird-scaring lines

These lines consist of a rope with streamers that is dragged from a high part of the stern of the boat (see Figure 7). It is designed to keep birds away from the setting area, especially in the area where the baited hooks are more accessible.

During the trials, birds tried to steal the baits more frequently outside the area covered by the streamer line (about 50 m behind the stern). However, some seabird catches occurred, possibly because in calm conditions the streamers did not move and therefore did not deter the birds away.

On the other hand, it is found that on days with strong crosswinds there was a risk of entanglements between the bird-scaring line with the longline.

03.01.02 Additional weight

Increasing the sink rate of the longline by adding more weight to the line weight is one of the most recommended practices to reduce seabird bycatch (see Figure 8).

During the trials performed in Catalonia, 10 and 20 g weights were added above the hooks to accelerate the sink rate. However, the sinking speed obtained was not high enough to avoid the bycatch of shearwaters, and also the weights could increase the risk of entanglement.

Therefore, alternative methods to increase the sink rate, such as adding heavier weights to the mainline and reducing the distance between them, should be sought.

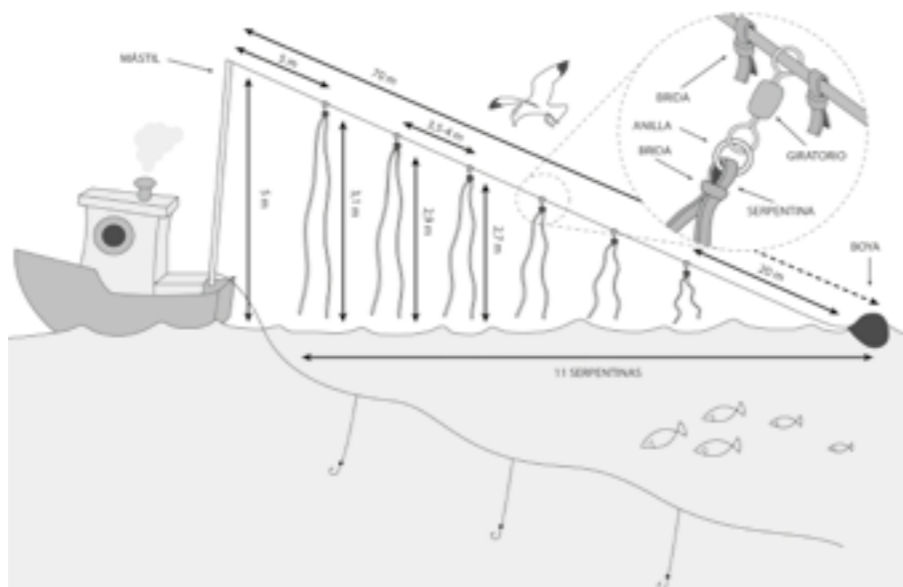


Figure 7. Bird-scaring line to prevent birds from approaching the area where baits are most accessible. Illustration: Toni Mulet. Source: Taken from Cortés and González-Solís (2018).

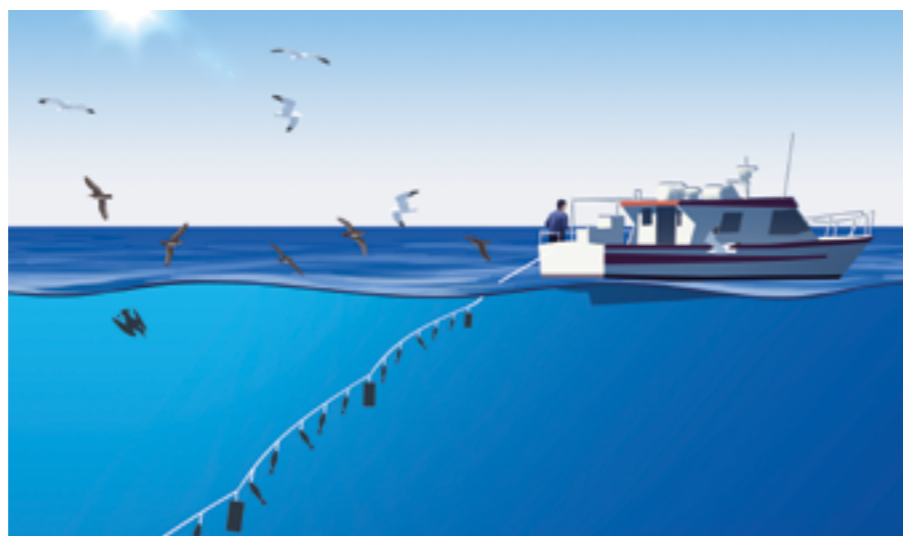


Figure 8. Adding weight to the longline to reduce the sink rate of baited hooks. Illustration: Martí Franch.

03.01.03 Night setting

Setting the longlines at night substantially reduces the risk of bycatch, as the birds present in the Mediterranean tend to be less active during the night (see Figure 9).

According to data from the logbooks distributed in 2017, the risk of catches was 10 times higher when line setting was performed during the day. However, some target fish species have different daily rhythms, so night setting could reduce the chances of catching them. In these cases, alternative methods should be used to reduce seabird bycatch.

03.01.04 Other methods

In addition to the above measures, we have tested other methods that could also reduce bycatch. These include the Chilean system, consisting in setting vertical lines consisting vertical lines

or "espielles" joined with a horizontal line. This system may be suitable in special cases, but it is not an ideal substitute for conventional longlining, as the effort required to set the same number of hooks must be higher. Another method, currently being tested, is the NISURI system, that is a longline setting system used by artisanal longliners in Ecuador to avoid seabird bycatch. It consists of a PVC tube with a slot along its length through which the baited hooks are passed, so that the baits are hidden inside. The use of this tube allows to set the longline faster and safer, while at the same time it reduces the seabird interaction and thus the bycatch risk.

Beyond the measures tested, the measures tested, some of the operational measures mentioned initially should also be taken into account, such as the use of baits less attractive to seabirds (as long as they are efficient for fishing) or avoid throwing any type of discard overboard while setting or hauling the gear.



Figure 9. Night setting to avoid the period when birds are more active. Illustration: Martí Franch.

Best practices to reduce bycatch

Primary measures:

- Night setting (see Figure 9).
- Using baits less attractive to birds (octopus, shrimp, hermit crab, etc.).
- Increasing the sinking speed of the longline (heavier weights distributed at a shorter distance)
- The use of vertical lines, similar to the "pioc". (See Figure 2).
- Avoiding the use of longlines during the pick season of bycatch use longlines in the months when there are more bird catches, i.e. from April to June (in the case of smaller types of gear).

Complementary measures:

- Performing short and fast settings short, quick sets.
- Do not throw fish to the sea and keep the bait covered before the setting.
- Do not set the longline when there is a high concentration of birds on the fishing ground (wait for them to leave) or following other boats around (e.g. trawling or seining).
- Using olfactory bird repellents.

Table 1. Set of primary and complementary measures for best practices to reduce bycatch. Source: own research.

03.02 Recommendations for minimising seabird bycatch

Due to the complexity and dynamics of the Catalan longline fleet, the strategy to mitigate seabird bycatch should include a set of methods to suit the full variety of fishing practices (see Table 1). In this way, fishers could choose and implement those methods that are most compatible with their activity.

We can differentiate between two types of measure: (1) primary, which can be used alone, although in some cases they need to be combined with other measures to be effective, and (2) complementary, which are practices that reduce bird interaction but should be combined with a primary measure.

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SEABIRDS: SOCIETY'S VIEW

The following is an outline of the views of different stakeholders representatives interviewed about the issue of seabird bycatch in Catalonia.

Thus, the vision of the professional fishing sector was expressed through the opinions of Fermín Masdeu Duch (FM) and Jaume Pagès Codina (JP), professional surface longline and demersal longline fishers respectively; the vision of recreational fishing was provided by Oriol Ribalta Aymami (OR), representative of the Catalan Association of Responsible Fishing; and, finally, the more conservationist view was provided by Joan Grajera Mela (JG), member of the European shag study group and of the Catalan Institute of Ornithology.



Fermín Masdeu Duch (FM), professional surface longline fisherman.



Jaume Pagès Codina (JP), professional demersal longline fisherman.



Oriol Ribalta Aymami (OR), representative of the Catalan Association of Responsible Fishing.



Joan Grajera Mela (JG), member of the European shag study group and of the Catalan Institute of Ornithology.

QUESTIONNAIRE

Do you think seabirds are important? If so, what aspects of them would you highlight or do you think make them important?

FM: Seabirds are important because they are part of my environment. In fact, I use them to see where the fish are, so I can locate them. Still, I don't know how they can be important.

JP: I think they are beneficial to the marine community and they also create a beautiful scene along with the landscape. Thinking about practical day-to-day fisheries issues, they have an important role to play in recycling fishing waste.

OR: I don't know if the word is "important", but they are part of the marine ecosystem, although

the loss of their food is making them terrestrial or dependent on human activities at sea such as fishing or aquaculture. Seabirds are part of the delicate ecological balance of the sea and coasts, forming part of the environment and landscape. They are theoretical indicators of the state of their habitat, but lack of food has made them visitors to human landfill sites to obtain food that was not previously part of their diet, so some species are not good indicators of anything.

Three groups can be distinguished among seabirds: those, such as gulls and the like, that have adapted to eating anything, cormorants that have had to supplement their marine diet with the food they find in rivers stocked with farmed trout and another group that are winter migrants like the Northern gannet, the Arctic puffin and the razorbill

that come to spend the colder season in the Mediterranean. Therefore, we export poverty to seas in a better condition and perhaps better managed; global responsibility must not be forgotten.

JG: In the past, before the advent of new technologies such as radar, fishers used seabirds to detect shoals of fish. Today, in science, they are used as bio-indicators of the state of the oceans: by studying their diet, we can determine changes in fish stocks and, by determining the pollutants accumulated in their tissues, we can get an idea of the presence of these harmful agents in our seas. Finally, in recent years, there has been an increase in demand for marine wildlife watching trips, which generates income and is another option in the range of offers in the sustainable and nature tourism sector.

Did you know that most seabirds are protected, and that some are seriously endangered? Which pressures do you think that have contributed to their poor conservation status?

FM: My trade is longlining and that's what I know. I am aware that it has done a lot of damage, and this has affected the birds and some are threatened. But it's all a wheel: there is no food source or there is less, the tackle, the fishing gear, the air and marine pollution, etc.

JP: From my perspective and from all the years I have been at sea, I do get the feeling that some species are seen less than they used to be. There are probably various pressures that have affected their conservation status. Longline seabird bycatch, which is the issue at stake, may affect them significantly depending on how you work.

OR: Protection is not enough, since the very administration that protects them authorises the overfishing of small pelagic fish that have been the birds' food for millions of years. The reduction is due to the lack of food for these

birds because of the overfishing of small pelagic fish. The Administration has created areas called SPAs, included in the Natura 2000 Network, which protect seabirds but does not foresee any action to recover the fish stocks that are their food and which, undoubtedly, are the source of the problems both for the birds and for the rest of the fish.

JG: We believe that the population trends of most seabirds are worrying. Bycatch in fishing gear, pressure from invasive predators such as cats and rats on breeding colonies, oil spills, the presence of plastics that can end up being ingested by seabirds and, finally, urban pressure and overtourism are the main causes of the decline of most species.

How does your activity interact with seabirds, both positively and negatively?

FM: On the negative side, it would be the risk of them getting caught on hooks. On the positive side, we provide them with easy food, but in the end it is also negative for the birds.

JP: The negative interactions are mainly due to attacks by birds during the setting of the

longline. For us fishers, when this happens, it is a difficult and problematic time. In the best case scenario, they steal your bait and it is a hook that will no longer catch fish. However, when the birds get stuck on the hooks, the longline floats and no longer works properly and the gear can even break. All in all, it adds to the complication of the day, manoeuvring to free the birds and wasting time waiting for them to leave.

Apart from these stressful moments, there are positive aspects. I like to watch the birds at sea, and sometimes when pulling in the longline and a fish you have caught becomes unhooked, the birds get excited and you can detect where it is. If you get there before they bite, you can take it.

OR: I don't see any negative interaction, recreational fishing uses seabirds as indicators of fish activity and they are very useful for locating where the marine predators are that chase small pelagic fish.

JG: Basically, our interaction with seabirds is focused on the study of the European shag. We try to assess what their diet is and how it varies throughout the year, where their feeding



Figure 1: Demersal longline fishers setting in the absence of birds. Photo: Pep Arcos.



Figure 2: Yellow-legged gull watching fishers. Photo: Pep Arcos.

areas are, what the main mortality factors are, how and when dispersal movements take place and how the population dynamics of the species evolve.

In your activity, do you think it is possible to reduce negative interactions with seabirds?

FM: Yes, I think it is possible to reduce these interactions.

JP: Yes, you have to take into account that these negative interactions do not occur all year round. In our area, the times when we tend to have problems with birds are limited to the period between the end of April and the beginning of June, a little bit also depending on the year. I think it is possible to reduce seabird bycatch, and in fact we have always tried different solutions, some with more success than others. But I also think that on days when there are a lot of birds it is difficult to do anything.

OR: For me there is nothing special to do, recreational fishing has no problem with seabirds, just the opposite.

JG: Our efforts are aimed at obtaining mitigation measures to reduce negative interactions with human activity. Therefore, our interest foresees the transfer of acquired knowledge to management proposals aimed at the Administration, land managers and the scientific community, as well as the dissemination to the general public and users who may interact with the species, with the aim of raising awareness.

In our particular case, we have been able to determine how recreational fishing from the coast has a direct impact on European shag individuals by collision with the lines and direct ingestion of bait and hooks. These birds make a very restrictive and specific use of the coast, grouping in nocturnal roosts and rocky diurnal resting places. Therefore, agreeing small exclusion or seasonal fishing zones with the recreational sector would quickly avoid this negative interaction for the birds and annoyance for recreational anglers.

Do you think that minimising these negative interactions could be beneficial in any way? If so, how?

FM: Reducing the interactions is of no benefit to me but, if it were possible for them not to get stuck on the hooks, they would take less of our bait.

JP: Undoubtedly, for fishers, minimising these negative interactions would mean being able to get on with the work without problems. In short, we would avoid economic damage, which may be high if we add up the loss of time, the theft of bait, the misplacement of the line and the damage of the gear.

OR: If measures were taken for the recovery of fishing, there would be benefits for society in general, everyone would win. It would recover a public good such as the fish in our sea, which form part of our wealth and our health and are a basic part of the Mediterranean diet.

JG: For us / From our side, reducing negative interactions would be a very important milestone and would allow us to devote more time to understanding more biological aspects of the European shag.

Bycatch in some fishing gear is one of the problems for these protected species, but also for the activity itself. How do you think these negative interactions should be tackled and resolved?

FM: By working closely with the biologists and looking for economic compensation that would come from Europe based on the days that a fisher decides not to set the hooks because of the risk of killing a lot of birds. Also to include any devices that encourage non-interactions.

JP: As I mentioned earlier, in the longline sector, for years each individual angler has been trying different methods to avoid bycatch, such as dragging a buoy, making noise.... For me, what has worked well is to make short sets and stop setting and cover the bait when the birds are approaching. Wait for them to leave or change fishing grounds and continue working. Night setting also works, but is not a good option depending on the type of fishing you want to do. It works for hake fishing but not for dentex fishing, which is a more inshore form of longlining, and during the spring when we coincide with the birds.

OR: In general, if there were food for the birds at sea, we would not have so many problems with accidentally caught birds, or it would be a lesser evil. This issue has been solved elsewhere; so, it is not the source of the problem.

JG: It is important to remind that bycatch is a problem that harms seabird populations but also negatively affects fishing. It is a problem that can be recurrent and that ranges from simply being a nuisance to causing significant economic losses.

We therefore believe that there is a need for cooperative work between the fisheries sector, the Administration, NGOs

and the scientific community. Bycatch should be approached as a problem with many different aspects and, therefore, with different solutions for each mode, in both the professional and recreational sectors. We must try to find the key to regulating coexistence and avoid outdated management based on direct prohibition, which only strains the position of the different agents involved. Therefore, the only option is to work together, understand the problem and manage it on a firm cooperative basis.

Throughout your life, do you consider that there have been changes in your environment in relation to seabirds? In what way?

FM: Yes, a lot. There are fewer shearwaters and there were not so many cormorants before. I think the main change is that they don't have any food.

JP: I think yes, some birds, such as cormorants or gannets, are seen less frequently than they used to be; for example, very few shearwaters have been seen this year. On the other hand, there have always been seagulls in the harbour and at sea, but now they are everywhere.

OR: Simply put, a slow but steady reduction in the number of birds.

JG: Undoubtedly, there has been a marked decline in most seabird populations in recent decades. Perhaps one of the most extreme cases is the Balearic shearwater, a species endemic to the Mediterranean, and one of the most endangered birds in Europe; If we do not manage to curb its main threat factors, it is doomed to extinction in a few decades. On the other hand, some species have acquired inverse trends, such as the yellow-legged gull, which has been able to take advantage of the indirect resources provided by human activity, mainly landfills and discards from fishing.

What do you think the Mediterranean Sea would be like without birds?

FM: A disaster, we have no right to annihilate a species and damage its habitat, a habitat that is also ours. Everyone is to blame.

JP: I don't see it, I can't conceive of the Mediterranean without its birds. They are important and must be conserved. That is why I think it is a good idea to work together with the fishing community, the Administration and biologists, and to share experiences and possible new technical solutions.

OR: This is the path we seem to have decided to take together. We are slowly reducing the fish stocks and, consequently, the populations of seabirds that feed on these fish. We all want to fool ourselves, both politicians and managers, and we will end up with a blue sea but without fish and without seabirds.

JG: Seabirds have contributed historically and evolutionarily to shaping the fish community of the Mediterranean Sea. Undoubtedly, a complex natural system that loses a part of its mechanism will never be able to function in the same way again, and therefore the consequences are difficult to foresee.

Apart from the more ecosystemic relationships, another reason of a more social nature could be highlighted. That is to say, without this fauna, or with this group reduced to a few specimens, we would lose natural heritage of great value. Therefore, we have a responsibility to let future generations enjoy an ecosystem at least in the same way as we found it.

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How did you get interested in the sea? Why birds? Why fisheries?

I was scared of the sea when I was young, and the fear made me want to learn about what lay beneath the dark waves. I learnt to snorkel and then dive and discovered the most incredible world. On one of the dives in my early years, off the coast of Scotland, I surfaced to find puffins flying low across the water very close to me. I was amazed how the birds were such an integral part of the marine system. I was so interested in what I was experiencing I went on to study marine biology.

What is the BirdLife International Albatross Task Force? How did you end up there?

The ATF is an international project to build a bridge between scientists, industry and decision makers in government - the idea behind it is to work with the fishers on board fishing vessels to better understand their reality and generate trust and collaborations to find the best methods to reduce impacts of fisheries on vulnerable marine animals - supporting industry be sustainable into the future.

What jobs did you perform during your stage at the ATF? Do you remember any period with special nostalgia?

It all has special nostalgia, as the team work so hard to find solutions under difficult circumstances. I found the most reward in developing relationships with the people, both the inspirational members of the team and the critical support and understanding from the governments and industry who made such

INTERVIEW

Oliver Yates

Member of BirdLife International's Albatross Task Force for 10 years (2007 to 2017)

"BYCATCH: IT IS ESSENTIAL TO WORK TOGETHER TO FIND THE SOLUTION THAT BEST SUITS EACH FISHERY".

important decisions that helped drive progress. I will never forget testing early versions of the Hook Pod at sea in Brazil and meeting the Fisheries Minister in Namibia, two moments in time that I think could have huge implications for seabird conservation in the future. I feel very proud of those moments.

What do you think about the interaction between seabirds and fisheries? Do you think that there is a solution for bycatch?

There isn't a solution for seabird mortality in fisheries, there are many! We have reached the point where fisheries really have no excuse to permit large numbers of seabirds to die accidentally. The solutions are available and they are incredibly effective when adopted. Anyone who is interested should consult the agreement on the conservation of albatross and petrels website where the latest best practice measures are listed www.acap.aq

Do you think that the experience gained during your time onboard fishing vessels has been beneficial to minimize seabird bycatch?

I think that anyone who wishes to make sensible suggestions about fisheries management should spend as much time at sea as possible to understand the practical challenges that fishers deal with everyday. For me it was essential.

What do you think are the key elements to success in solving bycatch? Can you give us some examples of success?

The critical factor is collaboration. It is essential to work together to find the solution that suits each fishery, as every area and season has different seabird assemblages with varying behaviour and each fleet has a variety of technical and operational factors to consider. It is very rare that one person can be knowledgeable about all those aspects, so working as a team with openness and trust is of immense importance. Examples of this include the development of measures and regulations in South Africa, Namibia, Argentina, Brazil, Chile, Uruguay, New Zealand, Australia.... the list goes on! In fact I can't think of an example where it has worked without collaboration.

In your opinion, what is the balance between regulation and promotion of good practices to minimize bycatch?

For me it is a stepwise process. Some operators will adopt measures with a little encouragement and the right guidance. Others will delay as long as is possible, so I think you need to find the right balance of giving all operators the chance to trial new measures and provide support while they test things out. Including a feedback mechanism to ensure they are listened to adequately and their concerns dealt with effectively is not simple. So sometimes that time needs to be a long process. However, for all vessels across a fleet to have the incentive to adopt best practice, regulations should be adopted with appropriate incentives.

From your experience in Catalonia, how do you see this problem? How do you think it would be the best way to deal with it?

I have very limited experience in Catalonia, but from what I have seen the fishery is operating in a situation where the normal practice has a low impact on birds but when conditions are right, there can be heavy and unexpected mortality, which at a population level could be catastrophic for the birds. So time is not a great luxury and I hope industry can be proactive and help find the right combination of measures to prevent the issue. I have great trust in the people working with the fishery and am confident the tests underway will provide good options that could be used widely across the fleet.

Based on your experience, what should be the role of fishers in minimizing the accidental capture of seabirds? And that of the administrations?

I have probably answered this already - the industry have to partners and collaborators in the entire process. The best situation is when industry has ownership of the solution because they have tested it and used it and seen the results. They can then help the administrators understand they are willing to adopt measures and the incorporation of the solution into legislation is much easier. Administrators are very respectful of industry, so it is hugely positive to work together to promote measures that really work and have some level of acceptance before seeking regulatory change. Not an easy path to follow, but one that has been demonstrated to work.