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Report of the Workshop to Review and Advise on Seabird Bycatch (WKBYCS)

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Executive summary

An ICES-convened Workshop to Review and Advise on Seabird Bycatch (WKBYCS) met from 14 to 18 October 2013 at ICES HQ, Copenhagen. Chaired by Jim Reid (UK). Ten participants, invited either by ICES Secretariat or the Chair, attended the meeting. The objective of the meeting was to consider three Terms of Reference relating to seabird bycatch in European waters, including the Baltic, Mediterranean, and Black Seas. This report includes three chapters that address each Term of Reference.

In support of a proposed EC Plan of Action to reduce the incidental catch of seabirds in fisheries, the ICES Working Group on Seabird Ecology (WGSE) has considered and reported on seabird bycatch in commercial fisheries on four previous occasions from 2008 to 2011. Following publication of the Action Plan in 2012, an updated, regionalised review and summary of research on seabird bycatch undertaken since the earlier reviews is now presented here, although reference to older material is made where appropriate. This shows that the incidental bycatch of seabirds in most fishing gears persists throughout European waters, including the Baltic Sea, the North Atlantic, the North Sea, the Mediterranean Sea, and the Black Sea. There is some geographical variation in patterns of bycatch that result from fishing effort in the various métiers as well as the distributions of seabird species. Most new information comes from the Baltic and Mediterranean Seas, with little information available from the Black Sea. Set gillnets catch possibly unsustainably large numbers of diving birds in the Baltic, whereas longlines pose a particular problem for predominantly surface-feeding shearwaters in the Mediterranean.

The issue of what actually constitutes a bycatch “problem” is discussed. The first step in defining a problem needs to be an assessment of the size of the bycatch in the fisheries of interest, and the necessary and desirable metrics that contribute to this assessment are identified and reiterated from previous initiatives. Defining a seabird bycatch “problem” is less straightforward. The very large bycatch (tens of thousands of birds) of great shearwater in one fishery might well be sustainable in a population context as the species’ global population numbers many millions of individuals. However, this level of bycatch might not be acceptable from a cultural or societal point of view. The mortality of Balearic shearwater in longline, purse-seine and other fisheries off Iberia and in the Mediterranean, however, is probably not sustainable for the population; this is shown to be so by application of the Potential Biological Removal (PBR) tool. PBR would appear to be an appropriate method, although there are others, to assess the conservation consequences of bird bycatch.

In assessing bird bycatch levels in fisheries, reporting and database formats are considered. The recommendation is that reporting should be at EU fishery métiers level 5 (or 6 where feasible), and that fishing effort should be described at least in terms of days at sea, but where feasible using more gear-specific metrics. The workshop saw no need to design a new database to host bird bycatch data; the existing bycatch database for protected species compiled by the ICES Working Group on Bycatch of Protected Species (WGBYC) should be adequate and be maintained by the ICES DataCentre.

1 Introduction

1.1 Participation

The following individuals comprised the Workshop to Review and Advise on Seabird Bycatch (WKBYCS) and participated in the meeting (see Annex 1 for full details):

Orea Anderson	UK
Pep Arcos	Spain
Jochen Bellebaum	Germany
Euan Dunn	UK
Jakob Fric	Greece
Simon Northridge	UK
Daniel Oesterwind	Germany
Jim Reid (Chair)	UK
John Weinberg	UK
Ramunas Zydelis	Denmark

Six persons were invited members of the group and four persons were invited by the WK Chair to attend the meeting.

1.2 Terms of Reference

The Workshop to Review and Advise on Seabird Bycatch (WKBYCS) was given the following Terms of Reference by ICES Secretariat in response to a special request from the European Commission:

- a) To review and update current seabird bycatch data and identify fisheries where appropriate follow up monitoring to establish bycatch levels would be desirable.
- b) To explore the criteria and/or metrics that could be used to define a seabird bycatch problem. (This request is partially addressed in earlier request by the Commission to ICES on cetacean bycatch) but ICES should tailor this advice to specifically cover seabird bycatch.
- c) Establish a standard data reporting format for recording seabird bycatch and to develop a database of seabird bycatch data in EU fisheries, similar to the database developed by WGBYC for marine mammal bycatch.

1.3 Note on bird names

Throughout the text official English names for bird species are used; scientific and English names are listed in Annex 2. However, the Mediterranean race of the European shag (*Phalacrocorax aristotelis desmarestii*) is occasionally referred to as the Mediterranean shag, and the subspecies of Cory's shearwater that breeds in the Mediterranean (*Calonectris diomedea diomedea*) is referred to as Scopoli's shearwater.

1.4 Acknowledgements

The Workshop to Review and Advise on Seabird Bycatch (WKBYCS) wishes to thank ICES Secretariat for excellent facilities in ICES HQ in Copenhagen. In particular, Helle Gjeding Jørgensen provided excellent assistance before and during the meeting, and also in the production of this report. Claus Hagebro proved an attentive Professional Secretary to the Group and Mark Tasker was most helpful and supportive during the meeting.

Information, data and support were received from various sources. We thank: the Hellenic Society for the Study and Protection of the Monk Seal (MOM), the Hellenic Centre for Marine Research (HCMR), the Technological Institution (TEI) of the Ionian Islands; Albert Cama (coordination of SEO/BirdLife's fishermen questionnaires), as well as all the observers onboard plus the people that carried out the questionnaires; Juan Bécares provided updated information on fishing effort in the Mediterranean; Amélie Boué provided information for France on behalf of the Ligue pour la Protection des Oiseaux (LPO); Alison Duncan also supplied data on French fisheries; Joana Andrade and Nuno Barros supplied information for Portugal on behalf of Sociedade Portuguesa para o Estudo das Aves (SPEA), as did Ana Henriques on behalf of University of Minho; Nuno Oliveira of SPEA supplied bird tracking data from the FAME project in Portugal; Verónica Cortés and Jacob González-Solís provided information from observers in the Spanish Mediterranean on behalf of the University of Barcelona, and Salvador García-Barcelona on behalf of the Spanish Institute of Oceanography (IEO).

2 Background

In support of the development of a European Union Plan of Action (EU PoA) to minimise the incidental catch of seabirds in commercial fishery operations in EU waters, the topic of seabird and seaduck bycatch in all fishing gears has recently been extensively addressed by ICES, principally through the Working Group on Seabird Ecology (WGSE 2008, 2009, 2010, 2011).

In November 2012, the EU Commission adopted the Action Plan for reducing bycatch of seabirds in all fishing gears (COM(2012)665). The Action Plan seeks to provide a management framework to minimise seabird bycatch to as low levels as are practically possible in line with the objectives of the reformed Common Fisheries Policy (CFP) of moving towards ecosystem management covering all components of the ecosystem including seabirds. It is a voluntary instrument within the framework of EU fisheries and environmental legislation and international fishery legislation, Conventions and Agreements. It includes both binding and non-binding measures; there are 30 separate actions addressing five specific objectives:

- 1) identifying and addressing weaknesses and incoherencies in current management measures (seven actions);
- 2) data collection to establish the extent of seabird bycatch (six actions);
- 3) implementation of mitigation measures (eight actions);
- 4) providing education and training to fishermen in the use and benefit of mitigation measures and identification of seabirds for reporting purposes (five actions); and
- 5) instigating research into effective mitigation measures (four actions).

Over time, legally binding measures will be incorporated under the new framework for technical conservation measures being developed as part of the reform of the CFP. The monitoring requirements will be incorporated into the ICES Data Collection Framework (DCF) pending further assessment.

One of the biggest challenges in implementing the EU-PoA is to define the existence of a seabird bycatch problem in the first place. Current information such as IUCN listings and reporting under the Birds Directive (EU 2009) are perhaps the most reliable sources to identify fisheries where mitigation measures are needed urgently but these are limited. They do not allow accurate and realistic assessments of seabird populations and the impact of bycatch on them. Therefore, defining clear management targets is problematic in most fisheries. The United Nations Food and Agriculture Organisation international plan of action aimed at reducing this bycatch (FAO IPOA Seabirds) does not define what constitutes a seabird bycatch "problem" generically, but recommends undertaking an assessment based on the following components: the magnitude of seabird bycatch (rate or number); species that are incidentally caught, and their conservation status; spatial and temporal overlap of fishing effort with seabirds; and population trends of seabirds likely to be impacted by bycatch (FAO, 1999).

This assessment should be based on all available data including *inter alia*, bycatch data collected by at-sea observers, seabird data, and other anecdotal information that may signify a more generalised problem. Observer programmes are the best source of data but it is not realistic to establish specific seabird bycatch programmes for EU

fisheries, except perhaps in those fisheries in external waters where it is already a mandatory requirement. Therefore other approaches as well the criteria used to define what constitutes a 'problem' need to be developed. As actions under the EU-PoA, firstly the existing information on seabird bycatch needs to be reviewed and updated from the previous ICES assessments (ICES 2008, 2009, 2010, 2011). Secondly biological indicators or reference points that could be developed for defining a problem and setting management targets under a reformed CFP should be explored.

Under the EU-PoA, the intention is that Member States should report biennially to the Commission on the level of seabird bycatch observed by fishery and gear type, the implementation of any mitigation measures, and the effectiveness of these mitigation measures. To facilitate this, the Commission undertook in the Action Plan to develop a standard reporting format and database for Member States to submit information to the Commission and which could also be used to facilitate data access to the wider public. ICES have already developed a similar template to facilitate the reporting of cetacean bycatch under Regulation (EC) 812/2004.

This report addresses three issues that DG MARE as requested ICES to consider:

- to review and update current seabird bycatch data and identify fisheries where appropriate follow up monitoring to establish bycatch levels would be desirable;
- to explore the criteria and/or metrics that could be used to define a seabird bycatch problem; and
- to establish a standard data reporting format for recording seabird bycatch and develop a database of seabird bycatch data in EU fisheries, similar to the database developed by ICES WGBYC for marine mammal bycatch.

3 Review and update of current seabird bycatch data, identifying fisheries where appropriate follow-up monitoring to establish bycatch levels would be desirable

3.1 Introduction

There is relatively little new information available on seabird and seaduck bycatch in fisheries since previous WGSE reviews (ICES 2008, 2009, 2010, 2011), despite repeated calls for further data collection and monitoring, particularly in the more high risk fisheries (e.g. longline and gillnets). What new information is thought to be available largely concerns Portuguese and Spanish fisheries in the North Atlantic and Mediterranean. This information brings to light particular problems facing the Balearic shearwater in particular, and across a range of fishing métiers. What remains apparent is the need for increased monitoring in other European fisheries where threatened species are known to co-occur in large numbers.

The workshop was aware that some national discard monitoring schemes under the DCF/DCMAP have recorded seabird bycatch on discard monitoring trips. These data are not easily available (and in some fisheries are insufficient), but WKBYCS recognised that this may represent an important resource for understanding the vulnerability of seabirds to particular gear types in some instances. In line with parallel initiatives by WGBYC, ICES should endeavour to collate records of bycatch and bycatch rates of protected species and seabirds from national Discard Databases.

3.2 Review of new information by region

As far as possible the following review of recent information on seabird bycatch in European waters aims to identify those fisheries and gears used in four regions of European waters (in accordance with the DCF/DCMAP regionalisation), where bird bycatch is likely or known. Both seabirds and seaduck are included in this treatment. Following tabulated overviews (Tables 3.1, 3.2, 3.4, and 3.7), new information, if available, is summarised in the text that follows the Tables. Reference to earlier information on bycatch (reviewed by ICES 2008, 2009, 2010, 2011) is made where it was particularly detailed or important.

3.3 North Atlantic

Table 3.1 indicates the fisheries and fishing gears deployed in the North Atlantic and the known or likely interactions with birds that result in bycatch.

Table 3.1. Fisheries/gears used in the North Atlantic and likely/known interactions with seabird bycatch. Orange - major fishery, Green - minor fishery, No fill - minimal fishery.

Gear groups	Gear type	Bird By-catch ¹	Fishery	Target Species	Bycatch Species Affected	References	Monitoring needed
Dredges	Boat dredge [DRB]	No					No
	Mechanised / Suction dredge [HMD]	No					No
Bottom trawls	Bottom otter trawl [OTB]	Yes	Spain multispecies fishery (all coast) Portugal multispecies fishery (all coast)	Hake	Northern gannet, cormorants/shags, shearwaters, gulls	Bugot (2012); Henriques <i>et al.</i> (2013); SEO/BirdLife (2013).	Yes
	Multi-rig otter trawl [OTT]	No					No
	Bottom pair trawl [PTB]	No					No
	Beam trawl [TBB]	No					No
Pelagic trawls	Midwater otter trawl [OTM]	Yes	UK, France, Netherlands, Portugal	Sea bass, Pelagic fish	Northern gannet	Northridge (unpubl. data); Pierce <i>et al.</i> (2002); McCarthy <i>et al.</i> (2011); Henriques <i>et al.</i> (2013), SEO/BirdLife (2013);	Yes
	Midwater pair trawl [PTM]	No data	France	Anchovy			Yes

¹ 'No' indicates no bycatch thought to occur. Information on the fishery, target species, etc. in these instances are not compiled.

Gear groups	Gear type	Bird By-catch ¹	Fishery	Target Species	Bycatch Species Affected	References	Monitoring needed
Rods and Lines	Hand and Pole lines [LHP] [LHM]	No					No
	Trolling lines [LTL]	No data	France, Spain, Ireland	Albacore			Yes
Longlines	Drifting longlines [LLD]	Yes	Spain, Portugal	Tunas, swordfish, sharks, conger		Garcia-Barcelona <i>et al.</i> (2013); Henriques <i>et al.</i> (2013); SEO/BirdLife (2013)	Yes
	Set longlines [LLS]	Yes	Norway, Iceland, Faroes, France, UK, Portugal, Spain	Hake, bream spp, cod, haddock, ling, tusk	Northern fulmar, Balearic shearwater, northern gannet, gulls, Cory's shearwater, great cormorant, auks, terns, European shag, great skua	Dunn and Steel (2001); Løkkeborg (2003); Anderson <i>et al.</i> (2011); Bugot (2012); Henriques <i>et al.</i> (2013); SEO/BirdLife (2013)	Yes
Traps	Pots and Traps [FPO]	Yes	Spain		European shag	SEO/BirdLife (2013)	Yes, but not a priority
	Fykenets [FYK]	No					No
	Stationary uncovered poundnets [FPN]	No data					No
Nets	Trammelnet [GTR]	Yes	UK, Ireland, Spain, Portugal, France		Auks, shearwaters, northern gannet, cormorants, European shag, common scoter and other diving ducks, divers	Arcos <i>et al.</i> (1996); Bugot (2012); Henriques <i>et al.</i> (2013), SEO/BirdLife (2013); SEO/BirdLife (2013); LPO (FAME unpublished data)	Yes
	Set gillnet [GNS]						
	Driftnet [GND]	No data	UK, France				Yes
Surrounding nets	Purse-seine [PS]	Yes	Portugal, Spain	Sardine, anchovy	Balearic shearwater, Cory's shearwater, Northern gannet,	Henriques <i>et al.</i> (2013), SEO/BirdLife (2013);	Yes

Gear groups	Gear type	Bird By-catch ¹	Fishery	Target Species	Bycatch Species Affected	References	Monitoring needed
					gulls, auks		
Seines	Fly shooting seine [SSC]	No					No
	Anchored seine [SDN]	No					No
	Pair seine [SPR]	No					No
	Beach and boat seine [SB] [SV]	Yes	Portugal		Common scoter, black-headed gull	Henriques <i>et al.</i> (2013)	Yes
Recreational fisheries		No data	All Atlantic-facing countries				Yes

3.3.1 Comparative overview of major new sources of bycatch information from Western Europe

Recent work on seabird bycatch has been conducted covering several métiers, and overall comparisons can be made. The following is a description of the (new) work available and a brief overview of the seabird bycatch issue, on a country by country basis.

Spain: Bycatch information comes from a few sources, often initiatives restricted in time and spatial coverage. The most extensive initiative was conducted in 2011–2012 by SEO/BirdLife under Interreg FAME and LIFE+ INDEMARES Projects (SEO/BirdLife 2013), when 450 questionnaires to fishermen were distributed across the whole of Spain (250 in the Atlantic side, 43 ports), covering the most relevant métiers. Figures 3.1 and 3.2 summarise respectively the frequency of bycatch events in the various fisheries and maximum numbers of birds caught as indicated by the completed questionnaires. Previous questionnaires in the 1980s and 1990s had been conducted at a more limited scale in Asturias (Diego-García *et al.* 1988) and Galicia (Arcos *et al.*, 1996). There is no on-board observer information, except for Mediterranean drift longliners fishing in the Atlantic (Gulf of Cadiz to Canary Islands; García-Barcelona *et al.*, 2013). Beached bird surveys conducted during the FAME project also provided information on bycatch (Cama and Arcos, 2011; SEO/BirdLife 2013).

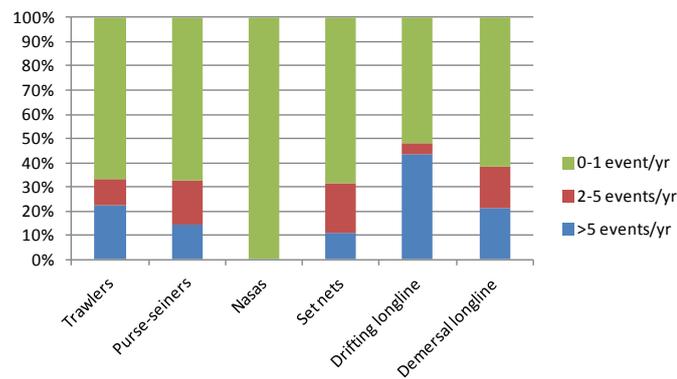


Figure 3.1. Overview of the métiers causing major bycatch according to questionnaires completed by fishermen and conducted by SEO/BirdLife under the frame of Interreg FAME and LIFE+ INDEMARES projects, 2011–2012 (Atlantic sector).

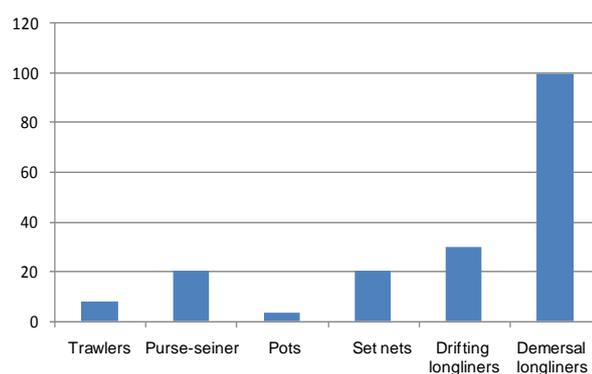


Figure 3.2. Maximum number of birds captured per fishing operation according to questionnaires completed by fishermen and conducted by SEO/BirdLife under the frame of Interreg FAME and LIFE+ INDEMARES projects, 2011–2012 (Atlantic sector).

Portugal: Substantial work has been carried out in recent years by SPEA (BirdLife Portugal) and the University of Minho Wildlife Portuguese Society, under the Species Guardian project for the Balearic shearwater (2008–2009), SafeSea and MedPro projects, and particularly the Interreg FAME Project 2010–2012 (Henriques *et al.*, 2013). This includes questionnaires to fishermen and observers on-board trawlers, purse-seiners, demersal longliners and small polyvalent vessels, and beached bird surveys (University of Minho/Wildlife and SPEA, unpublished). In total, 354 questionnaires in 15% of these covered about 7% of the Portuguese fleet (trawlers and purse-seiners being the best represented). One-day trips with observers on board totalled 557.

France: La Ligue pour la Protection des Oiseaux (LPO, French BirdLife Partner) conducted 41 questionnaires to fishermen during the FAME Project (2010–2012), highlighting the first evidence of bycatch in the French Atlantic (Bugot, 2012). Longline fishermen reported bycatch in 90% of the questionnaires ($n = 10$), for set-nets it was 33% ($n = 3$) and for trawlers 30% ($n = 10$). Also, 50% of recreational fishermen reported bycatch. The first anecdotal report of very large bycatch in set-nets was from spring 2012, when ca. 100 seabirds were found stranded in Ile d’Oleron.

3.3.2 Bottom trawls

Spain: According to SEO/BirdLife fishermen questionnaires, bottom trawlers in Atlantic waters do cause some bycatch, particularly in the Cantabrian coasts. The numbers of birds involved are relatively low (up to ten), but it appears to occur with certain frequency, contrary to the observations reported for the Mediterranean. Shearwaters, cormorants and shags, and gulls are among the seabirds reported. Despite these data, this métier does not appear to be of major concern compared with longlines or set-nets.

Portugal: Both small (<10 m) and large bottom trawlers operate in Portuguese waters. No bycatch was reported by observers on the 42 trips and 180 hauls monitored. However, more than 40% of the fishermen interviewed for questionnaires reported bycatch, although the only species involved appeared to be the northern gannet.

France: Information for France is limited to the LPO questionnaires conducted during the FAME Project, which included six demersal trawlers. Bycatch was reported only by one of these fishermen, as occasional (and sometimes intentional killing, “to keep seabirds away” from the vessel). Birds reported were gulls.

3.3.3 Pelagic trawls

Very little information is available on seabird bycatch in pelagic trawl fisheries within EU waters; this is due to lack of study, and also lack of bycatch. It is worth noting that bycatch in trawl fisheries can be cryptic; it is only recently that the scale of interaction between trawl warps and seabirds in the southern oceans has been fully documented (Sullivan *et al.*, 2006; Watkins *et al.*, 2008; Parker *et al.*, 2013).

Western channel: A winter midwater pair trawl fishery for bass, conducted by French and UK vessels, in ICES Region VII, has been much studied because of significant cetacean bycatch. Bycatch of seabirds is regularly (but not often) recorded. From c. 1200 observed tows (between 2000 and 2011, 24 guillemots, three razorbills and one great cormorant were reported caught (S. Northridge, personal observation). On the UK side, the fishery usually only involves one or two pair teams, while some tens of pair teams operate from French ports (S. Northridge, personal observation).

UK: One small study reported northern gannets present as bycatch in the Argentine *Argentina silus* trawl fishery operating off the northwest coast of Scotland (ICES Sub-region VIa; Pierce *et al.*, 2002). Gannets were observed caught in nets as they were hauled, with 20 in two hauls. Pierce *et al.* (2002) estimated that about 160 gannets may have been caught in the Argentine fishery that year. Herring, mackerel and horse mackerel are the most important species taken by pelagic trawlers (pair teams and otter trawls) in the European Atlantic, but there have been no dedicated studies to quantify seabird bycatch. Several studies have examined mammal bycatch, and in one such study McCarthy *et al.* (2011) reported ten gannets, four dead and six released alive, caught among 91 observed hauls while fishing for herring, mackerel and horse mackerel to the west of Scotland. There is a risk that marine mammal observer schemes may miss seabirds taken in these fisheries because fish are generally pumped on board directly into refrigerated seawater tanks.

France: Information for France is limited to the LPO questionnaires conducted during the FAME Project, which included four demersal trawlers. Bycatch of gulls was reported by two of them, birds being both injured by the funes and captured in the trawl; shearwaters and gannets may also be involved. With such little information, further monitoring is therefore required.

3.3.4 Drifting longlines (LLD)

Spain: There are about 60 longliners on the Atlantic side of Spain, mostly concentrated in Galicia. Their major fishing effort takes place south to the Canary Islands, although according to questionnaires they also operate to some extent in Galician waters (NW Spain) and the Gulf of Cádiz (SW). The latter area is also visited by vessels from the Mediterranean. Bycatch is described as frequent according to the questionnaires, although apparently it involves fewer birds per event than demersal longline (up to 30 birds reported in drifting longlines). On the other hand, information from observers on board suggests little impact. Indeed, García-Barcelona *et al.* (2013) reported a very low incidence in the Mediterranean vessels that operate on Atlantic waters, with only one Cory's shearwater captured in 152 setting operations (140 999 hooks). It is relevant to note, however, that these data combine fishing operations from the Gulf of Cádiz (where the bycatch event took place) to the Canary Islands.

Portugal: This métier was not monitored during the FAME project work, except for two questionnaires to fishermen that did not report bycatch.

Azores: There is no recent information from the Azores since the WGSE 2008 report (WGSE 2008). Some data were collected on the demersal longline fishery between 2005–2007, albeit not targeted on seabirds (no birds reported captured), while in the pelagic longline experiments (2000–2004) only one yellow-legged gull was caught. This indicates that while bycatch may occur, it is unlikely to be a major threat to seabirds in the domestic fleet. More data are required for other foreign vessels present in the Azorean EEZ (see below).

France: Only one of the ten questionnaires conducted by LPO for longliners pertained to drifting longlines. However, in this case the fishermen reported that on average a few gannets and two or three shearwaters were captured per set, which indicates a potentially serious problem.

3.3.5 North Atlantic albacore fishery

There is some overlap between this International Commission for the Conservation of Atlantic Tunas (ICCAT) fishery for which bycatch is recorded voluntarily and others reported here.

From 2010 to 2013 approximately 77% of the annual total allowable catch set by IC-CAT for albacore tuna (*Thunnus alalunga*) has been allocated to the European Union. The EU fleet, France, Ireland, Portugal and Spain, operates mainly in the Bay of Biscay, in the adjacent waters of the Northeast Atlantic and in the vicinity of the Canary and Azores Islands in summer and autumn.

The European fleet fishes variously with trawls, longlines, trolls, and bait boats with for example Ireland using mainly midwater pair trawls with a relatively small amount of trolling, and Spain deploys mainly bait boats and longlines. The declining Chinese Taipei operation is the biggest of the non-EU fleet and uses longlines.

3.3.6 Set longlines (LLS)

UK: There is no recent information on LLS from the UK but effort is relatively low (43 boats) and there are no recent data on bycatch. Apart from a few UK vessels in the Channel and Irish Sea targeting (e.g.) pollack, whiting, conger eels, sea bass, mullet, skate, dogfish, and rays, the main activity is by ca. ten (out of 43) Spanish-owned vessels registered to the UK fishing in areas VI and VII (including west of Ireland), targeting mainly hake in addition to those species listed above. The only records of bycatch are from April 1992 by an independent observer aboard a vessel fishing off the south coast of Wales for (mainly) dogfish and rays with 12 x 1 mile lines of 1200 hooks. The observer recorded bycatch of one northern fulmar, one northern gannet, one lesser black-backed gull, five great black-backed gulls, and two unidentified gulls (Royal Society for the Protection of Birds, unpublished).

Ireland: WGSE (2008) reported on the 2006–2007 independent on-board survey of the spatial and temporal interaction between the Gran Sol (W Ireland, ICES VII) longline fishery for hake and seabirds (Barros 2007; SEO/BirdLife, unpublished data); the fleet also operates to some extent in southern ICES VI area during summer. Three two-week cruises were surveyed, at different times of the year (late winter, summer, and autumn), in all cases reporting substantial numbers of seabird bycatch (48 to 130 birds per survey), with an average bycatch rate of 1.008 birds per 1000 hooks estimated. The fleet then consisted of about 35 Galician vessels operating on average ca. 165 days per year. At any one time, 16 vessels were estimated to be fishing, although actual fishing effort needs further quantification revision. Based on this estimate of

fishing effort, a total of 56 307 seabirds of six species might be captured per year. Great shearwater was the most affected species, followed by northern fulmar and black-legged kittiwake. Lines were set mostly at night and at dawn. At the time of the study, this bycatch rate represented the highest estimated average annual mortality of seabirds in any single global longline fishery (Anderson *et al.*, 2011).

In 2010 the Grupo Regal vessels in the Gran Sol fleet applied for Marine Stewardship Council (MSC) certification. According to the MSC Public Comment Draft Report, “the vessels under assessment have implemented detailed and comprehensive on-board reporting protocols for unintended bycatch, which lists all potential bird species and is supported by a species identification fact sheet”. So the need for monitoring is recognised. However, little is known about the implementation and effectiveness of the Grupo Regal approach, which is part of a voluntary Code of Conduct, relying on the rigour of skippers. The potential scale of seabird bycatch on the Gran Sol fishery warrants more than a Code of Conduct; it requires deployment of national on board observers as a preferred monitoring option or, failing that, fit-for-purpose remote monitoring technology. The duration of such a programme could be dependent on meeting objectives for seabird bycatch reduction and sustaining low bycatch rates.

Spain: Demersal longliners in the Spanish Atlantic region are artisanal vessels, mostly smaller than 12 m, for which effort information is difficult to collect. They target hake, bream, conger and other demersal fish. Only 79 vessels are officially registered as demersal longliners at present (Bécares and Cama, 2013), but this figure is misleadingly low; hundreds of small artisanal vessels alternate different métiers across the year, including demersal longlines, and there is no official register of their activity. Most of the activity is concentrated along the Cantabrian coast and Galicia. According to the questionnaires to fishermen, this is the métier that causes major bycatch, with up to 100 birds reported in a single event, although bycatch events appear to be less frequent than in the case of drifting longlines. Based on questionnaires to fishermen, Arcos *et al.* (1996) estimated that more than 4000 shearwaters and 3000 northern gannets would be caught annually in Galicia, plus some tens to hundreds of gulls and terns.

Portugal: Observers on board demersal longliners during the FAME and MarPro (Vingada *et al.* 2012) projects detected the bycatch of only five northern gannets in 35 trips and 283 154 hooks set (0.018 birds/1000 hooks). Questionnaires confirmed that gannets were captured on a regular basis, and to a lesser extent Balearic and Cory’s shearwaters, European shags and auks. A preliminary extrapolation of the data from questionnaires suggest that about 10 000 birds could die annually in demersal longliners in Portugal, including more than 1000 Balearic shearwaters. These estimates should be viewed very carefully as they come from subjective responses of fishermen and there is some conflicting information from FAME and the MarPro projects. In particular, it has not been possible until recently to accurately measure the effort of most fleets, especially the polyvalent fleet. There is now sufficient information to indicate that earlier extrapolated values may not be correct, but they do give an idea of the potential problem posed by this fishery.

France: Longlining appears to be the métier causing most bycatch in France according to fishermen questionnaires, although no clear differentiation between drifting and demersal longlining was made. Almost 90% of the fishermen reported bycatch (n = 9), including shearwaters, gannets and gulls.

The LPO questionnaires to fishermen included seven demersal longliners and two vessels that used longlines as a secondary métier. The former reported regular by-catch, many reporting gannets every day, often gulls, and rarely shearwaters.

Norway: There are no new data on bycatch in the Norwegian demersal autoline fishery for haddock and tusk, since the information presented in previous WGSE reports (WGSE 2008, 2009, 2010, 2011), which was taken respectively from Dunn and Steel (2001) and Løkkeborg (2003). These earlier studies identified considerable uncertainty surrounding the scale of the problem, but with numbers recently revised down (ca. 6514 birds per year, with range 3393–110 245) to reflect reductions in fishing effort and potential use of some limited mitigation in the fleet (Løkkeborg, personal communication; Anderson *et al.*, 2011). This fleet requires further (potentially targeted) monitoring to accurately assess the true scale of bycatch occurring since studies were conducted in the late 1990s.

More recent data were presented at WGSE in 2011 (WGSE, 2011) on seabird bycatch in the Greenland halibut longline fleet, for which fisher interviews suggested an estimated bycatch rate of 0.279 birds/1000 hooks or 0.759 seabirds/ton halibut. These figures were somewhat higher than those provided by the Norwegian reference fleet but are certainly of concern. Northern fulmar was the species most often reported as bycatch in the Norwegian Greenland halibut longline fishery, and if all bycatch represented adults from the Norwegian mainland population, the bycatch associated with this fishery alone would equal the level of predicted natural adult mortality rate for northern fulmar (Fangel *et al.*, 2011; WGSE, 2011). While mortality occurring in summer is likely to affect Norwegian colonies, there is the potential for winter-associated mortality to impact colonies outside Norway.

Faroes and Iceland: There are no observer data available for seabird bycatch in the Icelandic and Faroese demersal longline fleets. However, tens of thousands of birds, mostly northern fulmars but also great skuas, are notionally indicated as bycaught in these fisheries (A. Petersen, cited by Dunn and Steel, 2001). The only direct data source on bycatch comes from ringing recoveries in Iceland (15 great skuas and five northern fulmars (A. Petersen, cited by Dunn and Steel, 2001), providing a limited indication of proportions caught. However, these fisheries should be noted as a large (and potentially significant) data gap. Also unknown is the degree to which birds caught in these fisheries may originate in Western European colonies in the breeding season, to forage in Icelandic, Faroese, and Norwegian waters in the non-breeding season.

3.3.7 Set gillnets [GNS]

Ireland: In March 2010, a locally significant number of dead razorbills were found beached on Lacken Strand (near Killala Bay, between Co. Clare and Co. Sligo). The birds had rope 'burn' marks on their necks/upper breasts, indicating that they had been caught and drowned in gillnets (or illegal driftnets) and discarded, to later be washed up on beaches (BirdWatch Ireland, personal communication). The spatial scale and incidence of such interaction with fishing gears is unknown.

UK: Significant bycatch events are sporadic both spatially and temporally; the only quantified event was bycatch of 163 seabirds, mostly common guillemots, in gillnets (set for sea bass) in St Ives Bay, Cornwall, southwest England in January 2012. This triggered a local bye-law that closed the fishery for 21 days, subsequent to which, however, a large number of birds were caught in a neighbouring area outside the bye-law area (E. Dunn, personal observation).

Although no dedicated studies of seabird bycatch have been carried out, extensive monitoring of UK gillnet fisheries in the Celtic Sea have been undertaken since the 1990s aimed at quantifying mammal bycatch. More than 60 000 fishing operations involving gill and tanglenets fishing for bass, cod, sole, pollack, monkfish and rays have been monitored, with records of 24 cormorants bycaught, one northern fulmar and more than 120 auks, most of which were guillemots. Gill and tanglenet fisheries are ubiquitous in inshore waters of the Celtic Sea. It is likely that the same species are taken in similar fisheries in Ireland, France, Portugal and Spain (S. Northridge, personal observation).

France: In April 2012, in Charente-Maritime (ICES VIIIb), LPO reported a mass stranding of around 100 birds (mostly common guillemots, but also northern gannets, razorbills and common scoters) over a short period in several sites near fishing ports. Strong circumstantial evidence and necropsy pointed to gillnets as the cause of death. According to fishermen questionnaires, one third of the fishermen reported bycatch ($n = 3$) (LPO, unpublished data).

Spain: According to information from questionnaires (Diego-García, 1988; Arcos *et al.*, 1996; SEO/BirdLife, unpublished data), set-nets (trammelnets and gillnets) cause bycatch with certain regularity, which is also supported by evidence from beached bird surveys and opportunistic information. The main areas of concern appear to be Galicia and to a lesser extent Asturias, as well as the Basque country. European shags (particularly in the Galician breeding strongholds) and auks (including the almost extinct 'Iberian guillemot'; a putative subspecies of common guillemot) seem to be the main species affected, although recent questionnaires to fishermen also suggest that shearwaters could be affected. The introduction of nylon in the 1960s appears to have produced an increase of seabird bycatch due to the 'invisibility' of the nets, to the extent that it is considered the main reason of the near-extinction of the Iberian race of common guillemot (Munilla *et al.*, 2007), which has decreased from a few thousands in the mid-20th century to a handful of pairs at present (Alcalde and Do-campo, 2009). This is the southernmost population of common guillemot, but there have been no confirmed records of breeding in the region since 2007, although it is presumed there is still potential for immigration and population restoration if the threats are addressed. Mitigation of bycatch in gillnets is considered a priority. Arcos *et al.* (1996) estimated more than 5731 seabirds caught in Galicia annually, most of them in trammelnets (5269) and the remainder in gillnets (462). The main group affected were European shags and great cormorants (more than 3000 birds), followed by auks (ca. 2000 birds). From 2010 until 2012 more than 1000 razorbills and about 15 guillemots were collected entangled in nets in this region by the MarPro project (Vingada *et al.* 2012). The major cause of this mortality is probably an illegal seasonal driftnet fishery operating very close to the coast. It is considered illegal because the driftnets are set within 0.25 nm of the shore and target high value species, such as sea bass. The illegal fishery may be catching more seabirds than the legal set-net fishery.

Portugal: Previous information suggested significant mortality of European shags and auks from set-nets in Portugal. Along with the Spanish population, this coast represents the most southern extremity of the breeding range of the common guillemot ('Iberian guillemot', see above), making it especially significant. According to Catry *et al.* (2010) local fishermen at the Berlengas Islands have always linked the continuous decline of this species with a steady increase of the local gillnet fisheries (introduced in the 1960s). Munilla *et al.* (2007) also highlighted the gillnet fishery as a cause of the large-scale decline in Iberian guillemot populations. Observers on board vessels during the FAME and MarPro projects reported 15 birds of seven species

caught out of 300 setting operations, including eight northern gannets. Questionnaires also suggested regular bycatch of a diversity of species, mostly gannet and auks, but also European shag, common scoter, Balearic shearwater and others. More than 500 Balearic shearwaters could be caught yearly on these artisanal nets, although these fisheries are difficult to accurately monitor as they employ polyvalent gear types and are generally poorly characterized. Data collected by MarPro project (Vingada *et al.* 2012) indicates that the high levels of seabird bycatch are primarily associated with an illegal set-net fishery operating in some inshore waters off of Portugal.

Norway: Estimates suggest that there are 10–20 000 seabirds killed in study fisheries each year from 2009 and 2010 (WGSE, 2011; Fangel *et al.*, 2011). Northern fulmars, cormorants, black guillemots, Atlantic puffins and razorbills are the most common species affected. There is also episodic mass mortality of common guillemot in the lumpsucker gillnet fishery. Data from the reference fleet indicate that a similar number of northern fulmar are drowned in the cod gillnet fishery. Black guillemot, potentially the most numerous species caught in the lumpsucker fleet, experienced increased mortality of 22% in fished areas; given the rather sedentary nature of this species, this is unlikely to be affecting European birds (WGSE, 2011; Fangel *et al.*, 2011).

3.3.8 Driftnets [GND]

Driftnet fishing in Ireland has been banned since 2006, but in the UK and France at least, there are several small-scale driftnet fisheries targeting a diverse range of species including bass, mullet, herring and sardines. Observations of 96 such fishing operations in the UK Atlantic region did not result in any bird bycatch observations (S. Northridge, personal observation). Further monitoring of such fisheries would be useful given the observed high rates in some other driftnet fisheries (see Zydalis *et al.*, 2009; 2013).

3.3.9 Purse-seine

Spain: Questionnaires to fishermen reported occasional mortality of seabirds by purse-seiners targeting small pelagic fish during the hauling operation, particularly of shearwaters (SEO/BirdLife, unpublished). This seems particularly so in the Basque country and especially off Galicia, although the numbers of seabirds reported are relatively low (up to 20 birds). However, this should be considered a fleet of risk, as Balearic shearwaters appear to be particularly prone to be caught (see account for Portugal), along with auks.

Portugal: The purse-seine fishery targeting small pelagic fish does not seem to cause major bycatch, with fewer than 15% of the fishermen reporting it according to the questionnaires. However, the fishery seems of particular risk to one of the seabird species of top concern, the Critically Endangered Balearic shearwater. Moreover, this bycatch seems to occur on an irregular basis, but can affect large numbers of birds at a time, thus raising maximum concern. On-board observers reported three bycatch events out of 190 trips and 389 hauls, but these involved 37 birds, including 30 Balearic shearwaters. Events reported voluntarily by fishermen (A. Henriques, personal communication) include 100 and 200 birds in summer 2009 and 1000 birds in summer 2011 (70% dead), which clearly highlights the threat. The highly gregarious behaviour of this shearwater and its diving abilities, along with the overlap of target prey with the fishery, render interactions with the purse-seiners very likely. The birds get

caught when they are diving for the concentrated shoals of fish while the net is closing, and end drawn.

France: There is no information available regarding seabird bycatch in French purse-seines, although potentially it could be an issue given the data observed in other similar fisheries from other countries. Some monitoring is therefore required.

3.3.10 Beach and boat-seine [SB]

Portugal: 292 beach-seine operations monitored by observers reported two events of bycatch of common scoters, totalling five birds (plus one event for black-headed gull). Given the relevance of the Portuguese coasts as a wintering ground for common scoters, further effort should be devoted to assess the relevance of this threat for the species.

3.4 Baltic

Table 3.2 indicates the fisheries and fishing gears deployed in the Baltic Sea and the known or likely interactions with birds that result in bycatch.

Table 3.2. Fisheries/gears used in the Baltic and likely/known interactions with seabird bycatch. Orange - major fishery, Green - minor fishery, No fill - minimal fishery.

GEAR GROUPS	GEAR TYPE	BIRD BYCATCH ²	FISHERY	TARGET SPECIES	BYCATCH SPECIES AFFECTED	REFERENCES	MONITORING NEEDED
Bottom trawls	Bottom otter trawl [OTB]	No					No
	Multi-rig otter trawl [OTT]	No					No
	Bottom pair trawl [PTB]	No					No
Pelagic trawls	Midwater otter trawl [OTM]	No					No
	Midwater pair trawl [PTM]	No					No
Rods and Lines	Hand and Pole lines [LHP] [LHM]	No					No
Longlines	Drifting longlines [LLD]	No data	Germany, Poland, Denmark				Yes
	Set longlines [LLS]	Yes	Germany	Flatfish, cod, flounder, eel	Great cormorant, common scoter, auks, red-breasted merganser	Bellebaum <i>et al.</i> (2013), Bellebaum (unpubl. data); Oesterwind (unpubl. data); Mentjes and Gabriel (1999)	Yes
		No data	Poland, Sweden, Denmark, Lithuania, Estonia				Yes
Traps	Pots and Traps [FPO]	No data					Yes

² 'No' indicates no bycatch thought to occur. Information on the fishery, target species, etc. in these instances are not compiled.

GEAR GROUPS	GEAR TYPE	BIRD BYCATCH ²	FISHERY	TARGET SPECIES	BYCATCH SPECIES AFFECTED	REFERENCES	MONITORING NEEDED
	Fykenets [FYK]	Yes	Denmark, Germany, Sweden		Great cormorant	Bregnballe and Frederiksen (2006)	Yes, for certain gears
	Stationary uncovered poundnets [FPN]	Yes	Germany, Lithuania, Latvia, Estonia, Sweden	Herring, various other species	Red-breasted merganser, great cormorant, common eider	Bregnballe and Frederiksen (2006); Dagys <i>et al.</i> (2009); Bellebaum (pers. obs.)	Yes
Nets	Trammelnet [GTR] Set gillnet [GNS]	Yes	Germany, Lithuania, Latvia, Estonia, Denmark, Poland, Sweden		Seaducks, diving ducks, all diving species	Zydelis <i>et al.</i> (2009), (2013) and references therein	Yes
Surrounding nets	Purse-seine [PS]	No data					No
Seines	Fly shooting seine [SSC]	No					No
	Anchored seine [SDN]	No					No
	Pair seine [SPR]	No					No
	Beach and boat seine [SB] [SV]	No					No
Recreational fisheries		No	Non-commercial gillnetters are summarised under gillnets above				No

3.4.1 Gear types and fisheries known or suspected to have potentially high bird bycatch

3.4.1.1 Set longlines (LLS)

Existing data show that bycatch occurring on longlines set in the Baltic, but the information is too limited to estimate the magnitude of this bycatch. No data are available on the use of drifting longlines and bird bycatch in this type of gear.

3.4.1.2 Pots and traps (FPO) and fykenets (FYK)

Insufficient data are available on bycatch in pots and traps and in fykenets deployed in the Baltic, though great cormorants are known to drown in fykenets in Danish and surrounding waters (Bregnballe and Frederiksen, 2006). Bird bycatch is probably low in most small-size pots, traps or fykenets. Some types of pots and traps are currently considered as bird-friendly gear and are viewed as recommended alternatives to gillnets. Certain types of pots/traps cause bycatch of threatened pursuit-diving species in other areas (e.g. Bell, 2012). These gear types should undergo an assessment of bycatch risk wherever they are introduced. Large traps and fykenets may bycatch birds other than great cormorant, and monitoring may be necessary for specific trap/fykenet designs.

3.4.1.3 Stationary uncovered poundnets (FPN)

Stationary uncovered poundnets are used in various designs along the Baltic coast. Scattered information e.g. from questionnaires and ring recoveries proves the existence of bycatch of various bird species. Although bycatch levels appear to be low, monitoring data will be needed to assess the potential impacts of this gear.

3.4.1.4 Set gillnet (GNS) and trammelnet (GTR)

Bycatch in gillnets and trammelnets has been studied in various countries around the Baltic and found to be high and possibly unsustainable (reviewed by Zydalis *et al.*, 2009; 2013). Gillnet fisheries in Finland and the northernmost part of the Swedish coast may be an exception to this because the overlap with bird concentrations is lower there. Most studies of seabird bycatch do not distinguish between set gillnets and trammelnets. Gillnets form the majority of the set-net fisheries in the Baltic. Existing studies partly include the extensive, non-commercial use of gillnets, where similar bycatch occurs as in commercially deployed gillnets. Set gillnets and trammelnets, including non-commercial netting, are the gears most urgently in need of systematic monitoring of bycatch in all countries of the Baltic region.

Sweden: Gillnets are used widely in the Baltic and earlier studies indicate that several thousands of common guillemots become entangled every year (Österblom *et al.*, 2002); other frequently caught species are great cormorant, common eider (Lunneryd *et al.*, 2004) and long-tailed duck (Larsson and Tyden, 2005). Based on fishermen questionnaires Lunneryd *et al.* (2004) estimated the total bycatch to being ca. 18 000 birds. More recently, Bardtrum *et al.* (2009) investigated bird mortality in several gillnet fisheries and confirmed that bycatch continues to take place; however, small sample sizes did not allow for total numbers to be estimated.

Finland: No information is available on bird bycatch levels in commercial or recreational gillnets in Finland except for ringed bird recoveries from fishermen (Hario, 1998). There is probably little, if any, bycatch in winter when Finnish waters are large-

ly covered by ice, but some bycatch should be anticipated during the ice-free period of the year as Finnish waters support large numbers of breeding and staging waterbirds.

Estonia: Only a single study on bird bycatch is available from Estonia, which suggests that about 5000 birds, mostly long-tailed ducks, could be dying in fishing nets annually (Dagys *et al.*, 2009; Žydelis *et al.*, 2009). Most waterbirds wintering in the Baltic Sea stage in Estonian waters before crossing the land mass on their northward migration in spring and likewise their return in autumn. It is important, therefore, to determine whether migrating birds are threatened by fishing activities there.

Latvia: Bird mortality in fishing nets has been studied intermittently since the mid-1990s in Latvia, and indicates that several thousands of waterbirds die in fishing nets annually; the main species being long-tailed duck and divers (Urtans and Priednieks, 2000; Dagys *et al.*, 2009; Žydelis *et al.*, 2009). As in other parts of the Baltic, bycatch studies in Latvia are project-based, and bird mortality in fishing nets is not continuously monitored despite large proportions of several bird populations wintering in Latvian waters.

Lithuania: Bird bycatch in gillnet fisheries has been studied in several projects since mid-1990s in Lithuania, and all studies indicate that thousands of diving birds die in fishing nets annually, mostly long-tailed ducks, velvet scoter and divers (Dagys and Žydelis, 2002; Dagys *et al.*, 2009; Žydelis *et al.*, 2009). Globally threatened Steller's eiders were also regular victims in fishing nets until the recent disappearance of this species from the Lithuanian coast. Dagys and Žydelis (2002) suggested that about 10% of locally wintering diving birds probably die in fishing nets annually. The numbers of wintering seaduck has declined substantially in recent years and overall bycatch numbers are also probably lower now than compared to those a decade ago (M. Dagys, personal communication). However, bird–fishery interactions are not regularly monitored and this presents a clear information gap.

Russia: No information is available about bird mortality in fishing nets in the Baltic waters of Russia in the Gulf of Finland and off Kaliningrad Region.

Poland: High mortality of diving birds has been reported in Polish set-nets since the 1970–1980s, the total bycatch being estimated at ca. 17 500 birds in Gdańsk Bay (Stempniewicz, 1994). The most common victims were long-tailed ducks and velvet scoters. At the same time, bycatch was reported from various locations along the entire Polish coast. Birds continued to be caught in fishing nets in the later years, indicated by carcass recoveries during beached bird surveys (Meissner *et al.*, 2001) and one local study by Pokorski and Kulwas (2002). Bird–fishery interactions continue in Polish waters but information on more recent bycatch is not available.

Germany: There have been numerous studies and report documenting bird mortality in fishing nets in German Baltic waters. In the latest study, Bellebaum *et al.* (2013) estimated an annual bycatch of 17 550 birds along the eastern part of the German Baltic coast, and suggested that annual bycatch had at least halved since the early 1990s, most likely due to population declines. It is also possible that gillnet fishing effort declined during this period but there are insufficient data to support this (Sonntag *et al.*, 2012; Bellebaum *et al.*, 2013). No regular monitoring of bird bycatch is undertaken, although there are initiatives to test and implement electronic monitoring on some fishing boats.

Denmark: Bird bycatch in fishing nets in Denmark was first reported by Degel *et al.* (2010), who estimated 841 birds, mostly common eiders, to be caught in gillnets

around the island of Ærø from 2001–2003. This study covered only a small part of the Danish waters, which host thousands of diving birds and where commercial and recreational net fisheries take place. Currently, there are initiatives to assess bird mortality in recreational fisheries, and also on commercial fishing vessels using electronic monitoring systems deployed to monitor marine mammal bycatch (I. K. Petersen, personal communication).

Estimates of waterbird bycatch and the Baltic Sea countries with the most frequent bycatch are presented in Table 3.3, which has been updated from Zydalis *et al.* (2009).

Table 3.3. The order of magnitude of reported bycatch estimates and countries with the most frequent bycatch of waterbird species in the Baltic Sea (modified and updated from Zydalis *et al.*, 2009). DE-Germany, DK-Denmark, EE-Estonia, LV-Latvia, LT-Lithuania, PL-Poland, SE-Sweden.

SPECIES	ORDER OF MAGNITUDE OF REPORTED BYCATCH NUMBERS	COUNTRIES WITH THE MOST FREQUENT BYCATCH
Red-throated diver and black-throated diver	hundreds	SE, LV, LT, PL, DE, DK
Red-necked grebe	tens to hundreds	PL, DE
Great-crested grebe	hundreds	EE, LV, LT, PL, DE
Slavonian grebe	tens	PL, DE
Great cormorant	thousands	SE, DE, DK
Tufted duck	tens to hundreds	EE, PL, DE
Greater scaup	hundreds to thousands	PL, DE
Common eider	thousands	SE, PL, DE, DK
Steller's eider	tens	EE, LT
Long-tailed duck	thousands	SE, EE, LV, LT, PL, DE, DK
Common scoter	thousands	PL, DE, DK
Velvet scoter	thousands	LV, LT, PL, DE, DK
Common goldeneye	tens to hundreds	SE, PL, DE
Smew	single birds to tens (?)	PL, DE
Red-breasted merganser	hundreds	SE, PL, DE
Goosander	tens to hundreds	SE, EE, LT, DE
Razorbill	hundreds	SE, PL, DE
Common guillemot	thousands	SE, PL, DE
Black guillemot	tens to hundreds	EE, LT, PL, DE

3.5 Mediterranean and Black Sea

Table 3.4 indicates the fisheries and fishing gears deployed in the Mediterranean and Black Seas, and the known or likely interactions with birds that result in bycatch. Very little information is available from the Black Sea so this account refers principally to the Mediterranean Sea.

Table 3.4. Fisheries/gears used in the Mediterranean and Black Sea and likely/known interactions with seabird bycatch. Orange - major fishery, Green - minor fishery, No fill - minimal fishery.

GEAR GROUPS	GEAR TYPE	BIRD BYCATCH ³	FISHERY	TARGET SPECIES	BYCATCH SPECIES AFFECTED	REFERENCES	MONITORING NEEDED
Dredges	Boat dredge [DRB]	No					No
Bottom trawls	Bottom otter trawl [OTB]	Yes	Spain	Multispecific	Balearic shearwater, northern gannet, gulls	Abello and Esteban (2013); (occasional direct observation); SEO/BirdLife (2013)	No, not a priority
	Multi-rig otter trawl [OTT]	No data					No
	Bottom pair trawl [PTB]	No data					No
	Beam trawl [TBB]	No data					No
Pelagic trawls	Midwater otter trawl [OTM]	No data					No
	Pelagic pair trawl [PTM]	No data					No
Rods and Lines	Hand and Pole lines [LHP] [LHM]	No					No
	Trolling lines [LTL]	Yes	Malta, Greece		Scopoli's shearwater, Yelkouan shearwater, Mediterranean shag	Cooper <i>et al.</i> (2003); LIFE07 NAT/GR/000285 2013	Yes

³ 'No' indicates no bycatch thought to occur. Information on the fishery, target species, etc. in these instances are not compiled.

GEAR GROUPS	GEAR TYPE	BIRD BYCATCH ³	FISHERY	TARGET SPECIES	BYCATCH SPECIES AFFECTED	REFERENCES	MONITORING NEEDED
Longlines	Drifting longlines [LLD]	Yes	Spain, Italy, Malta	Large pelagic	Shearwaters, mostly Scopoli's, northern gannet, yellow-legged gull, Audouin's gull	Cooper <i>et al.</i> (2003), Garcia Barcelona <i>et al.</i> (2010a, b); SEO/BirdLife (2013) (questionnaires and direct observations), University of Barcelona (unpubl. data) (observers onboard, collection of corpses at fishing ports), Dimech <i>et al.</i> (2008)	Yes
		No	Greece	Large pelagic		LIFE07 NAT/GR/000285 2013 (questionnaires, direct observations); Peristeraki <i>et al.</i> (2008)	No
	Set longlines [LLS]	Yes	Spain, Malta, Greece	Hake, sparidae,	Shearwaters (Balearic, Yelkouan, Scopoli's), Audouin's gull, Mediterranean gull, yellow-legged gull, Mediterranean shag, kittiwake, occasionally skuas	Cooper <i>et al.</i> (2003); Garcia Barcelona <i>et al.</i> (2010a, b); SEO/BirdLife (2013) (questionnaires and direct observations), University of Barcelona (unpubl. data) (observers onboard, collection of corpses at fishing ports); Belda and Sanchez (2001); Laneri <i>et al.</i> (2010); Louzao <i>et al.</i> (2011b); Dimech <i>et al.</i> (2008); Karris <i>et al.</i> (2013); LIFE07 NAT/GR/000285 2013 (questionnaires, direct observations)	Yes
Traps	Pots and Traps [FPO]	Yes	Spain	Lobster	Mediterranean shag	SEO/BirdLife (2013) (questionnaires)	Yes, locally

GEAR GROUPS	GEAR TYPE	BIRD BYCATCH ³	FISHERY	TARGET SPECIES	BYCATCH SPECIES AFFECTED	REFERENCES	MONITORING NEEDED
	Fykenets [FYK]	No data					No
	Stationary uncovered poundnets [FPN]	No					No
Nets	Trammelnet [GTR] Set gillnet [GNS]	Yes	Spain, Greece	Multispecies	Mediterranean shag and great cormorant, seaduck, razorbill, Yelkouan (and potentially Balearic) shearwaters, Scopoli's sheawater	Louzao and Oro 2004, LIFE07 NAT/GR/000285 2013 (questionnaires, direct observations), SEO/BirdLife (2013) (questionnaires)	Yes
	Driftnet [GND]	No data					Yes
Surrounding nets	Purse-seine [PS]	Yes	Spain	Sardine, anchovy and other small pelagics	Balearic (and potentially Yelkouan) shearwaters	SEO/BirdLife (2013) (questionnaires)	Yes
	Lampara nets [LA]	No data					Yes
Seines	Fly shooting seine [SSC]	No data					No
	Anchored seine [SDN]	No data					No
	Pair seine [SPR]	No data					No

GEAR GROUPS	GEAR TYPE	BIRD BYCATCH ³	FISHERY	TARGET SPECIES	BYCATCH SPECIES AFFECTED	REFERENCES	MONITORING NEEDED
	Beach and boat seine [SB] [SV]	No data					Yes
Recreational fisheries		Yes	Spain, Greece (particularly hand and pole, trolling lines)	Multispecies	Mediterranean shag, shearwaters, Audouin's gull	SEO/BirdLife (2013), LIFE07 NAT/GR/000285 2013 (occasional direct observations, questionnaires)	Yes

3.5.1 Comparative overview of major new sources of bycatch information from Western Europe

For some countries/regions recent work on seabird bycatch has addressed several métiers, allowing overall comparisons among them. This summary and overview of new work on the seabird bycatch issue follows the FAO regionalization of the Mediterranean.

3.5.1.1 Western Mediterranean

Spain: Bycatch information for Spain comes from several sources, often initiatives restricted in time and spatial coverage. The most extensive initiative was conducted in 2011–2012 by SEO/BirdLife under Interreg FAME and LIFE+ INDEMARES Projects, when 450 questionnaires were distributed to fishermen across the whole of Spain (excepting the Canary Islands; 200 in the Mediterranean), covering the most relevant métiers. Figures 3.3 and 3.4 summarise respectively the frequency of bycatch events in the various fisheries and maximum numbers of birds caught as indicated by the completed questionnaires. The Spanish Institute of Oceanography (IEO) has run an observer programme on pelagic longliners in the Mediterranean collecting data on seabird bycatch since 2008 (more irregularly before this since 2000; García-Barcelona *et al.*, 2010a). Observers on board demersal (and pelagic) longliners have also been placed by SEO/BirdLife (grant by the SGP from 1998–2001 and LIFE+ INDEMARES from 2009–2013), the IMEDEA (2003 and 2005), and the University of Barcelona (2007–2013) in the E and NE Mediterranean coast and the Balearics (Belda and Sánchez, 2001; Laneri *et al.*, 2010; Cortés *et al.*, 2013), but observer effort is low relative to the total effort of the fishery. Questionnaire studies were also conducted locally in the Balearic Islands (Louzao and Oro, 2004). Opportunistic information also comes from trawling oceanographic surveys (Abelló and Esteban, 2013), seabird stranding events (Arcos *et al.*, 2008; Louzao *et al.*, 2011b), and “mass mortality” events in which fishermen collected the corpses (Cortés *et al.*, 2013).

Overall, information from the questionnaires to fishermen (SEO/BirdLife, unpublished) confirm that the métiers causing more seabird bycatch are longlines (both pelagic and demersal), followed by set-nets. Trawlers and purse-seiners also cause bycatch occasionally, although the number of birds involved in these events seems low, particularly in trawlers.

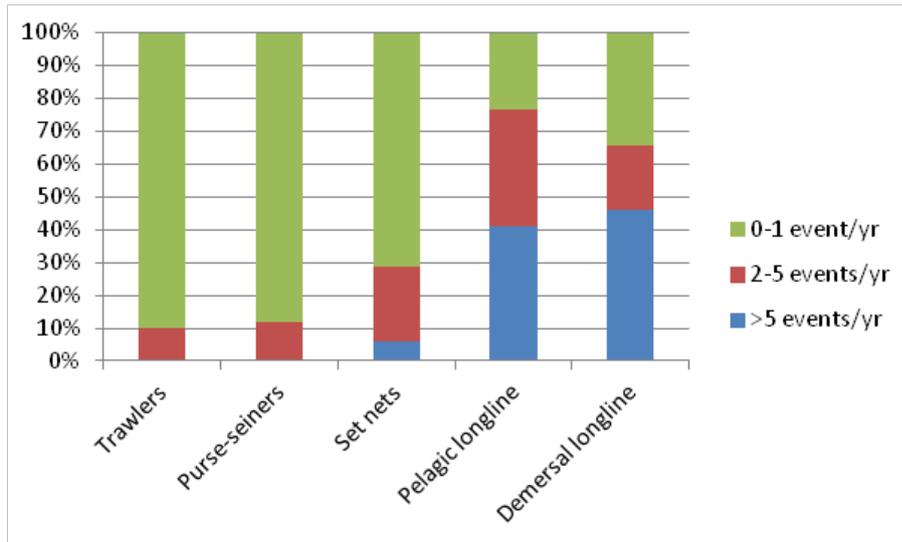


Figure 3.3. Overview of the métiers causing major bycatch according to questionnaires to fishermen conducted by SEO/BirdLife under the Interreg FAME and LIFE+ INDEMARES projects, 2011–2012 (Mediterranean sector).

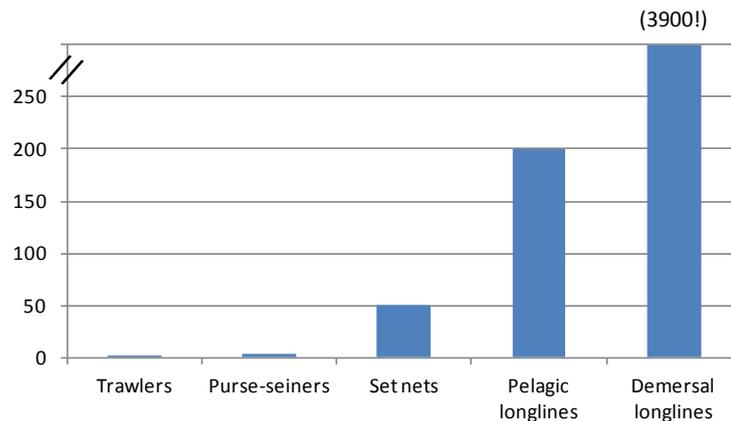


Figure 3.4. Maximum number of birds captured per fishing operation according to questionnaires delivered to fishermen by SEO/BirdLife under the Interreg FAME and LIFE+ INDEMARES projects, 2011–2012 (Mediterranean sector).

3.5.2 New sources of information on bycatch in Central and Eastern Mediterranean

The main sources of information on seabird bycatch for the Eastern and Central Mediterranean are the EC supported LIFE project LIFE06 NAT/MT/000097 in Maltese waters and LIFE10 NAT/GR/000285 in Greek waters, as well as data collected during monitoring of the Hellenic Centre for Marine Research on board pelagic fisheries. The datasets include questionnaire data (241 in Greece, 146 in Malta), observations on board fishing vessels, and first hand records of seabird bycatch victims at sea or at seabird colonies.

3.5.2.1 Trolling lines (LTL)

3.5.2.1.1 Central Mediterranean

Malta: Scopoli's and Yelkouan Shearwaters have been reported caught in trolling lines operated by Maltese fisheries (Cooper *et al.*, 2003). Similarly, Scopoli's Shearwaters have been reported being caught in trolling lines in the Southern Ionian Sea (Greece; LIFE10 NAT/GR/000285 2013).

3.5.2.1.2 Eastern Mediterranean

Greece: Scopoli's Shearwaters, Yelkouan Shearwaters and the Mediterranean race of the European shags have been reported caught in Greek trolling lines in the Aegean Sea (LIFE10 NAT/GR/000285 2013). Further monitoring is required to assess the extent and impact of seabird bycatch by this métier in Mediterranean EU waters.

3.5.2.2 Drifting longlines (LLD)

3.5.2.2.1 Western Mediterranean

Spain: Spanish pelagic longline vessels fishing in the Mediterranean are semi-industrial vessels that leave port for a single or several days. About 88 vessels are based in the region, targeting swordfish and various tuna species (Bécares and Cama, 2013), although some operate in Atlantic waters. A comprehensive observer programme is run by the IEO, as described above. As previously reported (WGSE, 2011), overall cpue from the semi-industrial Spanish fleet from 2000–2009 was 0.0483 birds/1000 hooks (Garcia-Barcelona *et al.*, 2010a), and ca. 506 birds were estimated to be killed annually by that fleet (Garcia-Barcelona *et al.*, 2010b), of which 239 would be Cory's shearwaters. The same study reported only two Balearic shearwaters caught out of 400 000 hooks set for the albacore, the tuna species where the smaller hooks are used, and which are more likely to catch this medium-sized shearwater. Previously, Belda and Sánchez (2001) had reported higher bycatch rates in the Gulf of Valencia area, 0.25 birds/1000 hooks (n=24 setting operations, 40 088 hooks set). Also recently, Cortés *et al.* (2012, 2013) reported 0.34 birds/1000 hooks out of 41 505 hooks set off Catalonia (NE Spain), with two Balearic shearwaters among the caught birds. All these studies indicate that the most affected species are those large enough to be regularly attracted to the large bait offered, particularly Scopoli's shearwater and yellow-legged gull. The fact that pelagic longliners often set their lines far away from the coast, over the continental slope and the open sea, also reduces the risk to the smaller shearwaters (which tend to forage over the continental shelf) and other coastal species.

Results from SEO/BirdLife questionnaires confirm pelagic longlining as a fishery of concern regarding bycatch. Compared with demersal longlining, bycatch appears to occur on a more regular basis but tends to involve fewer birds per bycatch event. Combining frequency (three categories: rare ≤ 1 bird/year; moderate 2–5 birds/year; high > 5 birds/year) and number of birds involved per event (few; moderate; high), a map showing the bycatch risk to seabirds from the various gear types was compiled (Figure 3.5).

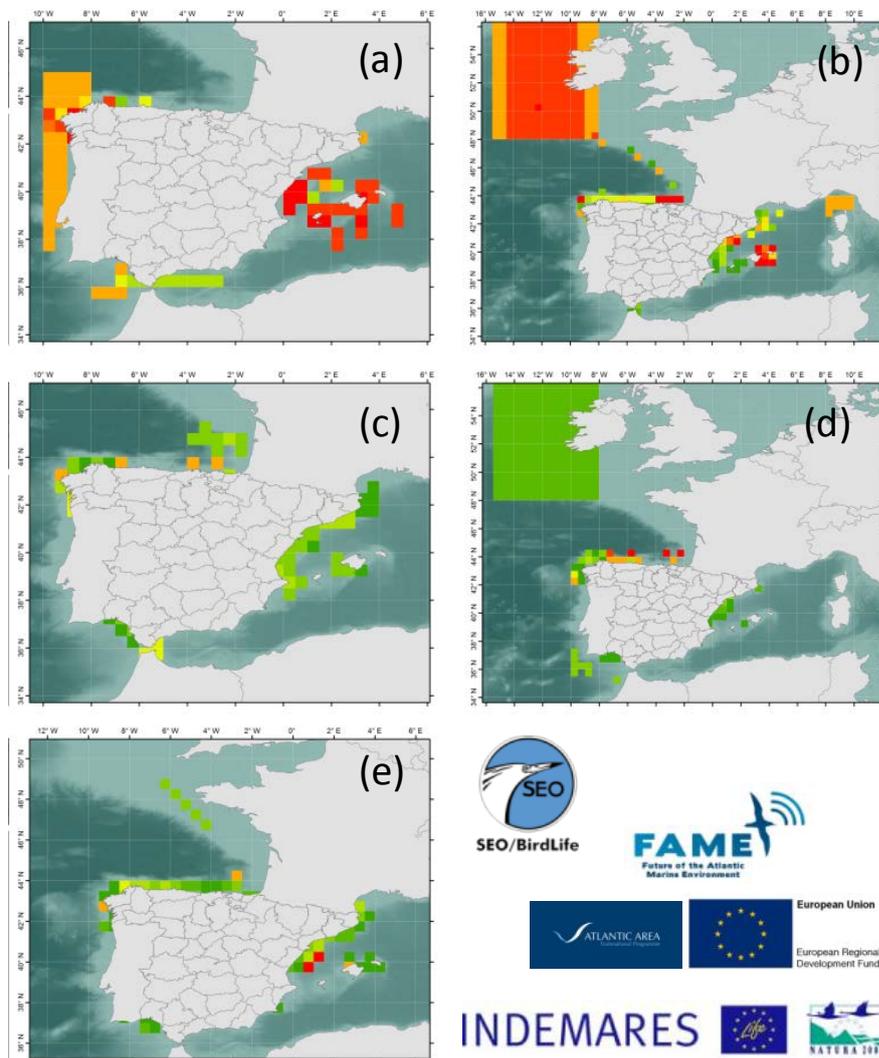


Figure 3.5. Maps of bycatch risk (from dark-green, low, to red, high) in Spanish waters for the five fishing gears causing most bycatch: (a) pelagic longlines; (b) demersal longlines; (c) purse-seines; (d) bottom trawlers; (e) set-nets. Information comes from questionnaires to fishermen conducted by SEO/BirdLife under the Interreg FAME and LIFE+ INDEMARES projects, 2011–2012. Fishermen were asked to report on their fishing areas at a 30'x30' resolution.

3.5.2.2.2 Central Mediterranean

Greece: In Greece (Ionian Sea), no seabird bycatch has been recorded during on-board observations of large pelagic fishing boats using drifting longlines (Peristeraki *et al.*, 2008). Additional sampling on board drifting longline fisheries is currently considered not to be a high priority compared with other types of fishing gear affecting seabirds.

Malta: Scopoli's shearwaters have been reported in fishermen questionnaires to get caught in drifting longlines in the Maltese fisheries. However, drifting longlines are probably not the main fishing gear responsible for Scopoli's shearwater bycatch in Maltese waters. Additional studies need to be undertaken in order to assess the overall impact of the Maltese fishing fleet on Scopoli's shearwater populations (Dimech *et al.*, 2008).

Italy: In Italy, Scopoli's shearwaters have been reported to get caught in drifting longlines (Copper *et al.*, 2003).

Slovenia/Croatia: No information is available for drifting longlines and related seabird mortality for Slovenia and Croatia (Cooper *et al.*, 2003).

3.5.2.2.3 Eastern Mediterranean

Greece: In Greece (Aegean Sea), no bycatch was recorded in the drifting longline fishery, which targets large pelagic species, during the sampling periods 2009–2012 (LIFE10 NAT/GR/000285 2013, HCMR 2013) and 2004–2006 (Peristeraki *et al.*, 2008). Additional sampling on board drifting longline fisheries is currently considered not to be high priority.

Cyprus: Drifting longlines are being deployed by fisheries by Cyprus but there are no data on seabird mortality (Cooper *et al.*, 2003).

So the available information indicates substantial seabird bycatch by drifting longlines in Mediterranean waters. Further monitoring effort is required to properly assess the extent and impact of this, and might also be extended to countries where no information is available.

3.5.2.3 Set longlines (LLS)

3.5.2.3.1 Western Mediterranean

Spain: Demersal longliners in the Spanish Mediterranean region are artisanal vessels, most often well under 12 m, for which effort information is difficult to collect. Only 78 vessels are officially registered as demersal longliners at present (Bécares and Cama, 2013), but this number is an underestimate; hundreds of small artisanal vessels alternate different métiers throughout the year, including demersal longlines, and there is no official register of their activity. Both observers on board and opportunistic information indicate that this type of fishery causes particularly high rates of bycatch, especially of smaller species such as the Balearic shearwater, due to the use of smaller hooks and more suitable bait (often sardines, targeting hake, Sparids and other demersal fish). Combining observer work undertaken in the area (Belda and Sánchez, 2001; Laneri *et al.*, 2010; Cortés *et al.*, 2013), an average bycatch rate of 0.29 birds/1000 hooks would result (89 birds out of 311 527 hooks set), with values ranging from 0.16 birds/1000 hooks (Catalonia area) to 0.69 birds/1000 hooks (Balearics). The most frequently bycaught species according to these on-board observations are Cory's (Scopoli's) shearwater (63%), Audouin's gull (12%), yellow-legged gull (10%), Balearic shearwater (9%), and Yelkouan shearwater (2%).

Considering only Catalonia, Cortés *et al.* (2013) estimated that ca. 1912 birds would be caught per year, 384 of which would be Balearic shearwaters. These estimates are very high, notably so for the Critically Endangered Balearic shearwater, but they might also be very conservative. The fishing effort data used in the estimates were restricted to the official data on demersal longliners, while the small artisanal vessels that can use this métier are far more numerous and also cause bycatch. Mass mortality events do occur in the region on an irregular basis, but were not detected by the observers due to very limited effort. Evidence of mass mortality events comes from different sources, including questionnaires, stranding events, and corpses brought to port by some fishermen (Louzao *et al.*, 2011b; Cortés *et al.*, 2013). The questionnaires reported cases of tens to a few hundreds of birds as being "not rare", particularly in demersal longlines, with one specific report of up to 3900 birds. On the other hand,

from the collection of corpses from these events it seems that the shearwaters would be the most affected (84% of all birds, $n = 577$, Cortés *et al.*, 2013), including the Critically Endangered Balearic shearwater (27%) and the Vulnerable Yelkouan shearwater (21%).

A few tests on mitigation measures have been conducted or evaluated (SEO/BirdLife 2001; Sánchez and Belda, 2003; Laneri *et al.*, 2010). Nocturnal setting appears to be quite effective (Sánchez and Belda, 2003), as well as use of tori lines, but adding weight to the line was not welcomed by the fishermen, who claimed lower catches (SEO/BirdLife, 2001). An issue of particular interest was the interaction of longliners (both demersal and pelagic) with other fisheries; bycatch rates increased when there was no trawling activity (and therefore no discards available from them; Laneri *et al.*, 2010; García-Barcelona *et al.*, 2010).

3.5.2.3.2 Central Mediterranean

Greece: From limited sampling on board demersal fisheries in the Southern Ionian Sea (Greece) using set longlines, no bycatch incidents have been recorded. However, the sampling revealed significant attendance of seabirds, primarily Scopoli's Shearwaters and, to a lesser extent, yellow-legged gulls, during longline setting and hauling, frequently resulting in bait losses. On the other hand, significant bycatch, primarily of Scopoli's Shearwaters, as well as yellow-legged gulls, has been reported through questionnaires for fishermen using set longlines. Set longlines are probably the main type of fishing gear responsible for Scopoli's Shearwater bycatch and the related mortality but reliable estimates of bycatch rate would require more data from on-board sampling (LIFE10 NAT/GR/000285, 2013; Karris *et al.*, 2013).

Malta: In Malta, questionnaire data suggest that set longlines are the primary type of fishing activity causing seabird bycatch. The most numerous victims are Scopoli's Shearwaters, followed by Yelkouan shearwaters. The questionnaire data suggest that bycatch in set longlines may be a significant cause of mortality for the Scopoli's Shearwater, whereas the estimated bycatch rates for the Yelkouan shearwater are very low. However, due to the difficulty in distinguishing between Scopoli's and Yelkouan shearwater, it is possible that actual numbers of Yelkouan shearwaters caught could be higher (Dimech *et al.*, 2008).

Italy: In Italy, Audouin's gulls and Yelkouan shearwaters have been reported to get caught in set longlines (Copper *et al.*, 2003).

3.5.2.3.3 Eastern Mediterranean

Greece: In Greece (Aegean Sea), based on questionnaire data, four seabird species of conservation concern have been reported to get caught in set longlines, namely Scopoli's Shearwater, Yelkouan shearwater, Audouin's gull and the European shag (Mediterranean race). The data from questionnaires also indicate that the set longlines are the main type of fishing gear responsible for the bycatch of the two shearwater species and Audouin's gull in the Aegean Sea. The largest numbers of individuals of these four species trapped in set longlines have been reported during spring and summer, coinciding with breeding or migrating periods when these species are most abundant in the area. The numbers of seabirds caught vary spatially within the Aegean Sea, but the largest bycatch rates have been reported mainly from the birds' main foraging areas, migratory stop-over sites, or sea areas near large breeding colonies (LIFE10 NAT/GR/000285, 2013). More on-board sampling in the set longline fishery is of high priority.

Cyprus: Set longlines are being used by fisheries of Cyprus but seabird mortality is unknown (Cooper *et al.*, 2003).

The available information already highlights notable seabird bycatch by set longlines in Mediterranean waters. Further monitoring is required to robustly assess the extent and impact of any problem, however defined (see Chapter 4), and should be extended to countries where no information is available.

Table 3.5 summarises estimated annual seabird bycatch by longline vessels in each region of the Mediterranean.

Table 3.5. Estimated annual seabird bycatch by longline vessels in the (W)estern, (C)entral and (E)astern Mediterranean (ICES, 2008; Louzao *et al.*, 2011b; Cortes *et al.*, 2013; SEO/BirdLife - LIFE+ INDEMARES). Blank entries indicate no data.

SPECIES	W MEDITERRANEAN	C MEDITERRANEAN	E MEDITERRANEAN
Balearic shearwater	100s +		
Scopoli's shearwater	1000s	1000s	1000s
Yelkouan shearwater	100s +	100s +	100s +
European shag	10s		
Mediterranean shag		10s	10s
Great cormorant		10s	
Northern gannet	10s - 100s	10s	
Great skua	<10s		
Audouin's gull	10s - 100s	10s	10s
Mediterranean gull	10s +	10s +	
Black-headed gull	10s		
Yellow-legged gull	100s +	100s +	100s +
Black-legged kittiwake	10s +		
Sandwich tern		10s	
Black tern		10s	

3.5.2.4 Purse-seiners (PS)

3.5.2.4.1 Western Mediterranean

Spain: Questionnaires to fishermen reveal occasional mortality of seabirds by purse-seiners targeting small pelagic fish during the hauling operation, particularly of shearwaters (SEO/BirdLife, unpublished). Also, some recent stranding events of Balearic shearwaters suggest that they could have died in purse-seiners (or perhaps in trawlers), with up to 25 birds at a time (Juan Jiménez and Blanca Sarzo/Comunitat Valenciana, personal communication). No direct evidence has been collected, although seabird work on board purse-seiners has been limited to a few tens of trips in the Ebro Delta and the Balearics area (Oro and Ruiz, 1997; Arcos and Oro, 2002). The fishermen questionnaires suggest that bycatch by purse-seiners occurs more often in the Atlantic area of Iberia (see above). However, the potential exists for rare events to cause mortality of large numbers of birds, particularly of Balearic and Yelkouan shearwaters due to their diving abilities and highly gregarious behaviour.

Recent evidence suggests that purse-seiners could cause relevant seabird bycatch, albeit irregularly, particularly for the smaller shearwaters (Balearic and Yelkouan).

Further monitoring is required to assess the extent and impact of this métier on seabird populations.

3.5.2.5 Bottom otter trawl (OTB)

3.5.2.5.1 Western Mediterranean

Spain: Bottom trawlers in the Spanish Mediterranean region represent a very important fleet in economic terms, consisting of semi-industrial vessels up to 30+ m long that operate over the continental shelf and slope. They attract large numbers of seabirds due to high discarding (Arcos, 2001). However, bycatch by trawlers appears to be rare in the region. According to fishermen questionnaires some birds get occasionally trapped in the net during hauling operations (shearwaters?) and others occasionally collide with the cables (northern gannets and gulls), but this is rather infrequent and involves few birds. Recently, Abelló and Esteban (2013) reported two cases of Balearic shearwater bycatch on a research trawler, in both occasions one bird caught in the net. This occurred in late spring during the breeding period in the species' favoured foraging area species, and represents the first seabird bycatch evidence in trawling since 1994 (Arcos and Oro, 2002b; Abelló *et al.*, 2003; Louzao *et al.*, 2006). In more than 150 trips where on-board seabird observers were present on commercial trawlers off Catalonia and Valencia, no evidence of bycatch was reported (Arcos, 2001).

Seabird bycatch by bottom otter trawlers does not seem to be a significant source of seabird bycatch in the Mediterranean.

3.5.2.6 Set gillnet (GNS) and trammelnet (GTR)

3.5.2.6.1 Western Mediterranean

Spain: Set-nets (trammelnets and gillnets) are used along the whole Mediterranean coast by small artisanal vessels, but there is little information on fishing effort available. Bycatch by these vessels does occur according to fishermen questionnaires (Louzao and Oro, 2004; SEO/BirdLife, unpublished) and opportunistic information, with reported events of up to 50 birds in a single net. These affect pursuit diving species such as Mediterranean shags and great cormorants, seaduck and razorbills. However, bycatch in set-nets appears to be mostly localised to particular areas, such as waters adjacent to shag colonies and shallow bays. However, bycatch of shearwaters has been reported by fishermen (SEO/BirdLife questionnaires), probably of Balearic and Yelkouan shearwaters. Besson (1973) reported such bycatch off the French Mediterranean coast in the 1970s, although no further records have been published.

France: A series of incidents involving tens of stranded Balearic/Yelkouan shearwaters off the French Mediterranean coast in March 1972 was related to bycatch in set-nets, as revealed by interviews with fishermen (Besson, 1973). This author suggested that, considering the fishing effort at the time, ca. 800 shearwaters could die annually in the French Mediterranean in this fishery. The author also noted that the introduction of nylon had rendered nets far more dangerous to seabirds, which has also been reiterated more recently for Iberia (e.g. Munilla and Velando, 2007). However, no further information has been published for France.

3.5.2.6.2 Central Mediterranean

Greece: Seabird species that have been reported to be caught in gillnets and trammelnets in the Southern Ionian Sea (Greece) include the two main species breeding in

the area, Scopoli's shearwater and the Mediterranean shag. Data on bycatch are available only from questionnaires from the Southern Ionian Sea. Additional sampling, particularly on board fishing vessels is required to estimate bycatch rates and their impacts on the local populations of seabird species of high conservation importance (LIFE10 NAT/GR/000285 2013; Karris *et al.*, 2013).

Malta: No incidental catches in gillnets and trammelnets have been reported in questionnaires from Maltese fishermen (Darmanin *et al.*, 2010).

3.5.2.6.3 Eastern Mediterranean

Greece: The main seabird species entrapped in gillnets and trammelnets in Greek fisheries in the Aegean Sea include the Mediterranean shag and the Yelkouan shearwater. Bycatch of Mediterranean shags as reported in questionnaires usually refer to individual events, which generally involve small numbers of individuals. However, the reported or recorded incidents of the Yelkouan shearwaters caught in trammelnets or gillnets are less frequent, but they usually involve larger numbers of birds, ranging from a few tens up to a few hundred individuals. The species seems to be particularly vulnerable during spring when a large proportion of the global population, having spent the non-breeding period in the Black Sea and the Northern Aegean Sea, disperses through the Aegean Sea *en route* to breeding colonies throughout the Mediterranean basin. Due to large distributional ranges and lack of direct on-board observations further on board monitoring of potential bycatch of the Yelkouan shearwater and the Mediterranean shag is required (LIFE10 NAT/GR/000285, 2013).

Set-nets pose a risk to some seabird populations at a local level. Further monitoring is required, concentrating efforts in the most sensitive areas, such as areas of sea near shag colonies and shallow areas where large numbers of waterfowl and/or shearwaters congregate.

Table 3.6 summarises estimated annual seabird bycatch in set-nets in each region of the Mediterranean.

Table 3.6. Estimated annual seabird bycatch by vessels using set-nets in the (W)estern, (C)entral and (E)astern Mediterranean (LIFE10 NAT/GR/000285, 2013; SEO/Birdlife – LIFE+ INDEMARES; Louzao and Oro, 2004). Blank entries indicate no data.

SPECIES	W MEDITERRANEAN	C MEDITERRANEAN	E MEDITERRANEAN
Red-breasted merganser	10s		
Other sea duck	inds		
Grebes	10s+		inds
Balearic shearwater	10s +		
Scopoli's shearwater	inds	inds	
Yelkouan shearwater	10s +		10s
Mediterranean Shag	100s	inds	inds-10s
Great cormorant	10s-100s		
Northern gannet	inds		
Audouin's gull	inds		
Mediterranean gull	inds		
Yellow-legged gull	inds		
Razorbill	10s+		

3.5.2.7 Recreational fisheries

3.5.2.7.1 Central Mediterranean

No data are available on seabird bycatch in recreational fisheries in the Southern Ionian Sea. Monitoring is required here because of the large number of recreational fisheries.

3.5.2.7.2 Eastern Mediterranean

Apart from sporadic records of seabirds caught in recreational fisheries in the Aegean Sea (Greece) e.g. trolling lines and pole lines, no data are available on seabird bycatch. Due to the large number of recreational fisheries some monitoring might be required.

3.5.2.7.3 Western Mediterranean

Opportunistic information (birds found dead in beaches and colonies, reports by fishermen) suggests that recreational fisheries cause bycatch with a certain regularity, particularly trolley lines in Spain, and also pole lines. Further monitoring would be required to assess the extent and impact of seabird bycatch here. These are the less monitored fisheries in the region, and would merit further investigation.

3.6 North Sea

Table 3.7 indicates the fisheries and fishing gears deployed in the North Sea and the known or likely interactions with birds that result in bycatch.

Table 3.7. Fisheries/gears used in the North Sea and likely/known interactions with seabird bycatch. Orange - major fishery, Green - minor fishery, No fill - minimal fishery.

GEAR GROUPS	GEAR TYPE	BIRD BYCATCH ⁴	FISHERY	TARGET SPECIES	BYCATCH SPECIES AFFECTED	REFERENCES	MONITORING NEEDED
Dredges	Boat dredge [DRB]	No					No
	Mechanised / Suction dredge [HMD]	No					No
Bottom trawls	Bottom otter trawl [OTB]	Yes	Denmark (c. 10 wks, active April–July)	Sandeel	Common guillemot	Tasker <i>et al.</i> (2000);	No, not a priority
		Yes	Germany			Oesterwind (pers. obs.)	
	Multi-rig otter trawl [OTT]	No					No
	Bottom pair trawl [PTB]	No					No
	Beam trawl [TBB]	No					No
Pelagic trawls	Midwater otter trawl [OTM]	Yes	UK	Herring	Northern gannet	Pierce <i>et al.</i> (2002)	Yes
		Yes	Germany			Oesterwind (pers. obs.)	
	Midwater pair trawl [PTM]	No data					No

⁴ 'No' indicates no bycatch thought to occur. Information on the fishery, target species, etc. in these instances are not compiled.

GEAR GROUPS	GEAR TYPE	BIRD BYCATCH ⁴	FISHERY	TARGET SPECIES	BYCATCH SPECIES AFFECTED	REFERENCES	MONITORING NEEDED
Rods and Lines	Hand and Pole lines [LHP] [LHM]	No					No
Longlines	Set longlines [LLS]	No	UK	Skate, dogfish, Pollack, flatfish			No
Traps (c)	Pots and Traps [FPO]	No					No
	Fykenets [FYK]	No					No
	Stationary uncovered poundnets [FPN]	Yes	UK (Filey Bay) J/T-nets	Salmon, sea trout	Common guillemot, razorbill	Environment Agency	Yes
Nets	Trammelnet [GTR] Set gillnet [GNS]	Yes	Sweden, Netherlands (Ijsselmeer), Germany, Denmark	Multispecies	Great cormorant, common eider, common guillemot, diving ducks, grebes, common scoter	Zydelis <i>et al.</i> (2009; 2013); Kinet-Larsen <i>et al.</i> (2012); Oesterwind (pers. obs.)	Yes
	Driftnet [GND]	Yes	UK (Northumberland)	Salmon, sea trout	Common guillemot	Northridge (unpubl. data)	No
Surrounding nets	Purse-seine [PS]	No					No
Seines	Fly shooting seine [SSC]	No					No
	Anchored seine [SDN]	No					No

GEAR GROUPS	GEAR TYPE	BIRD BYCATCH ⁴	FISHERY	TARGET SPECIES	BYCATCH SPECIES AFFECTED	REFERENCES	MONITORING NEEDED
	Pair seine [SPR]	No					No
	Beach and boat seine [SB] [SV]	No					No
Recreational fisheries		No	(As non-commercial gillnetters are summarised under gillnet options)				No

3.6.1 Pelagic trawls

Very little information is available on seabird bycatch in trawl fisheries within EU waters; this will be due to both lack of study and lack of occurrence of bycatch. It is worth noting that bycatch in trawl fisheries can be cryptic; it is only recently that the scale of interaction between trawl warps and seabirds in the southern oceans was fully documented (Sullivan *et al.*, 2006; Watkins *et al.*, 2008; Parker *et al.*, 2013). One small study reported northern gannets to be caught in the herring trawl fisheries operating off the north and northeast coasts of Scotland (Pierce *et al.*, 2002). Gannets were observed caught in nets as they were hauled, with 21 observed in two hauls in the herring fishery near Shetland. Pierce *et al.* (2002) estimated that ca. 620 gannets may have been caught in the herring fishery that year (2001).

Common guillemots have been recorded in sandeel trawls in the North Sea deployed in the feeding area of a colony (Tasker *et al.*, 2000). At least 22 birds were caught in five hauls (others may have been missed due to bulk processing of the catch). A single great cormorant was observed caught from 239 observed midwater pair trawl tows in the UK Bycatch Monitoring Programme (S. Northridge, unpublished data).

3.6.2 Set longlines (LLS)

UK: there has been no recent information on seabird bycatch in set longlines but effort has been low with no data on bycatch. UK vessels target skate, dogfish and pollack in southern North Sea and eastern Channel.

3.6.3 Set gillnets (GNS)

Netherlands: Information on gillnet bycatch in the North Sea is very limited and restricted mainly to knowledge of the Dutch coastal lakes IJsselmeer and Markermeer. Very high bycatch was estimated for these lakes in the 1980s, totalling up to 50 000 birds annually (van Eerden *et al.*, 1999). The most common species caught were tufted duck, greater scaup, red-breasted merganser and great crested grebe. Following this, in 2001 an agreement was signed between BirdLife Netherlands and Dutch Fishermen Cooperative Organisation aimed at reducing waterfowl bycatch to 1% of the national population or approximately 2000 birds by 1 June 2004 (Witteveen and Bos, 2002). A study conducted in 2002 estimated lower bycatch of 10–15 000 and attributed the reduction to declining bird numbers and lower fishing effort (Witteveen and Bos, 2003). It is not known whether the target to reduce bycatch to 2000 individuals has been achieved. There have been no systematic bycatch studies since then, but it is known that fishing effort has reduced compared with the 1990s, with several waterbird populations having also declined. However, bycatch is still an issue at IJsselmeer/Markermeer and its impact still requires assessment against the recent change in fishing pressure and in the face of lower bird populations (van Eerden, personal communication).

Denmark, west coast: There have been no systematic studies of bird bycatch reported for the east coast of the North Sea. Occasional bycatch incidents have been reported (e.g. 340 common and velvet scoters drowned in fishing nets at one location of the Danish sector of the North Sea during one night in March 1987; Durinck *et al.*, 1993) and ringed bird recoveries also indicate bycatch occurrence. This could indicate an important data gap.

Sweden: In the 1980s it was estimated that about 4000 diving birds, mostly common guillemots, were caught annually in Swedish gillnets in southern Kattegat (Olden *et al.*, 1986). With no information since, this could indicate an important data gap.

UK: More than 20 000 set gillnet hauls have been observed in English North Sea waters since the 1990s under the Protected Species Bycatch Monitoring Scheme. Six cormorants, three gannets, nine unidentified gulls and 54 guillemots were recorded caught, as well as three common guillemots in 83 observed driftnet hauls (S. Northridge, unpublished data).

3.6.4 Traps

3.6.4.1 Stationary uncovered poundnets (FPN)

UK: Over four years (2010–2013) T- and J-nets set for salmon and sea trout in Filey Bay, North Yorkshire caught variable numbers of razorbills (11–120) and common guillemots (2–42), and very small numbers of Atlantic puffins. A seasonal bye-law to mitigate this bycatch entered into force in 2010, requiring high visibility panels on the lead part of the net, which must be attended at all times and removed from the water at night. Coastal poundnets remain in Scotland fishing for salmon and some substantial seabird bycatch has been noted but no dedicated observations have been made (S. Northridge, personal observation).

3.7 Monitoring techniques to assess bycatch

3.7.1 Targeted use of existing observer schemes

Any expansion of the many and varied seabird-specific bycatch observer schemes needs to be considered in the context of financial constraints. However, the potential exists to use current Protected Species Observer Schemes to collect improved, higher-resolution data on seabird bycatch. Many such schemes have traditionally focused on cetaceans and other marine mammals, with seabird bycatch information collected opportunistically. Positioning of observers to record incidents of cetacean bycatch on board a vessel might differ from that needed to accurately observe seabird bycatch, for example. There is a need for more targeted observer monitoring in high risk areas, including stratified sampling of effort directed towards seabird vulnerable regions/fisheries. Seabird sensitivity mapping applied at an appropriate regional scale (e.g. North Sea or Mediterranean) would aid the selection of existing observer schemes that could be improved from the point of view of seabird bycatch data collection. Where vessels are too small to carry observers, the feasibility of observers using separate boats might be further explored.

3.7.2 Remote Electronic Monitoring (REM)

For fisheries with many and/or small vessels (i.e. <15 m length), placement of observers can be difficult. In the Baltic, there are a large number of vessels <15 m including <8 m length (74% <7.5 m and 26% 7.5–15 m in the German fleet (Sonntag *et al.*, 2012), which do not record logbook data. For such fisheries, remote electronic monitoring systems (REM) can be used to record bycatch incidents and fishing activity with no on-board observer. REM has been tested in pilot studies (Tilander and Lunneryd, 2010; Kindt-Larsen *et al.*, 2012a; Oesterwind *et al.*, 2012). These studies demonstrate that REM systems can ensure a reliable documentation of marine mammal bycatch. Data on seabird bycatch, fishing effort, and catch composition may also be collected but the reliability of seabird bycatch detection needs to be further tested and im-

proved. Bycatch detection depends on the position and number of installed cameras and their resolution. Consequently, it is important to choose the best camera position for on-board observations and at least one camera for observations outside the vessel if there is a possibility of bycaught birds falling out of the net before they are brought on board and into the view of the REM system. This may require changes to the vessel to achieve the desired camera position. Further work is required to demonstrate the technique's potential to perform consistently with regard to species-identification (which can be solved if the fisherman land caught birds) and that all bycatch incidents are being detected. In addition, there remain fleets of very small vessels without sufficient power supply to run REM. However, REM could cover large segments of fleets that are otherwise too difficult or expensive for the establishment of on board observer schemes. A comprehensive monitoring programme, across a range of fishing métiers and scenarios, might require a combination of all available methods (i.e. observers, logbooks and REM) in order to obtain reliable seabird bycatch statistics.

3.7.3 Standardisation of fishing effort, observer effort and bycatch statistics

To understand cumulative impacts across multiple countries and regions, it is important for scientists to have access to standardised reporting of effort and bycatch statistics. For example, Birds per Unit of Effort (bpue) figures for longline fisheries are typically reported as Birds per 1000 Hooks. However, there is considerable variability in methods of reporting (particularly for fishing and observer effort) in gillnet and trawl fisheries. In addition, fishing effort statistics are frequently difficult to obtain, particularly for small-scale or non-commercial fisheries (e.g. gillnet fisheries in the Baltic). Often it is exactly these fisheries where there are predicted to be bycatch problems.

3.7.4 Fisher questionnaires

The difficulties and biases associated with fisher questionnaires or interviews have been widely covered in a number of studies. In particular they suffer from a variable degree of (partly unintentional) underreporting (Lewison *et al.*, 2004; Moore *et al.*, 2010). However, for those difficult-to-monitor fisheries mentioned above, questionnaires might be the only viable monitoring option. Indeed, such surveys have been useful in identifying potentially significant bycatch problems across a number of fisheries, for example the Norwegian Greenland halibut fishery (northern fulmar), and the Portuguese purse-seine fishery (Balearic Shearwater), or in fisheries difficult to estimate effort for a particular métier due to their polyvalent nature (Portuguese polyvalent fleet). It is important to recognise the value of using questionnaires to identify those fisheries where there might be a significant bycatch problem, as opposed to being the (sole) source of quantitative information on bycatch rates and overall bird numbers caught.

Table 3.8 summarises those elements of monitoring methods that should be considered when selecting among them.

Table 3.8. Considerations when selecting from available methods to monitor seabird bycatch.

METHOD	COST/EFFORT	POSSIBLE COVERAGE	QUALITY OF RESULTS/LEVEL OF DETAIL	RELIABILITY
Observers	High	Low only on larger boats ¹	high	high
Electronic monitoring	medium-high	Medium only on boats with sufficient power supply	medium-high depending on number and resolution of cameras	medium? detection probability for birds requires testing
Interviews/self-reporting	low	high	Low may be improved by tracking boats with autonomous GPS loggers	Low underreporting is a known issue

¹ observing nearshore fisheries with small boats from the coastline, or from own boats may be locally feasible.

4 Criteria or metrics that could be used to define a seabird bycatch problem

The issue of what constitutes a bycatch “problem” is outwith the scope of this report. In the conservation context a problem might be relatively straightforwardly defined as a mortality rate that results or would result in population decline. However, societal or cultural definitions might not be so conservative. Certainly, bycatch of tens of thousands of great shearwaters, whose global population numbers many millions of individuals would seem difficult to ignore and would clearly need to be addressed in the context of the EU PoA (see Box 1).

BOX 1. THE GRAN SOL FISHERY: A CASE OF SOCIETAL CONCERN

The disproportionately high bycatch mortality of great shearwater in the Gran Sol demersal longline fishery for hake (see North Atlantic section, Chapter 3), demonstrated by a study in 2006–2007, suggests this to be a priority for further assessment and monitoring, and for strengthening of statutory mitigation measures.

The overall estimated bycatch rate (all seabird species) of 1.008 birds/1000 hooks was highlighted by Anderson *et al.* (2011) as the “highest estimated average annual mortality of seabirds in any [global longline] fishery”. The great shearwater is a seasonal migrant into EU waters from its highly restricted breeding grounds on Tristan da Cunha in the South Atlantic, where it is a relatively numerous species with a population estimate at more than 15 million individuals (Brook, 2004). However, bycatch of great shearwaters has also been recorded in demersal and pelagic longlines and trawls elsewhere in the species’ range (Tristan, South Africa, Uruguay, Argentina, Canada) and there are also unconfirmed reports of hundreds killed on tuna pole and line fisheries in southern Africa. As such, cumulative impacts on this species should not be overlooked.

Notwithstanding that the great shearwater is a relatively abundant species, the high estimated mortality on the Gran Sol transcends consideration that the threat to the conservation status of this species may not be acute. This invokes a wider frame of reference of societal choice to give priority to minimising this particular fisheries interaction. The fact that major reduction in bycatch of great shearwater (and the other species impacted in this fishery) is a readily solvable technical problem (see WGSE 2010, p. 30) adds to the argument for prioritisation on societal grounds.

In order to identify what might be a bycatch problem the first step must be to assess the magnitude of the incidental catch. The FAO IPOA-Seabirds does not define what constitutes a seabird bycatch problem generically, and recommends undertaking an assessment based on the following (i) the magnitude of seabird bycatch (rate or number); (ii) species that are incidentally caught and their conservation status; (iii) spatial and temporal overlap of fishing effort with seabirds; and (iv) population trends of seabirds likely to be impacted by bycatch.

Given the number of both seabird species or populations and fishing métiers in EU waters, it is not feasible to carry out a detailed assessment for each seabird population/métier combination. A stepwise approach is recommended here, beginning with a simple initial step. Further, more detailed steps may be considered when earlier stages indicate a potential problem, however that may be defined.

Step 1. identify the spatial and temporal overlap of fishing effort with the distributions of all seabird species. Populations that are considered to be threatened, declining, or otherwise in an unfavourable conservation status will be of particular interest here. Various well-established mapping and numerical tools, e.g. indices of spatial overlap, are available to aid in this exercise. Considering the migratory nature of many seabird species, any index of overlap should be calculated seasonally in order to account for spatial and temporal variation in the distribution of seabirds. Tem-

poral stratification would allow focus on seasons when bycatch is most likely; an example is presented in Sonntag *et al.* (2012). If an overlap is identified, the assessment should proceed to step 2.

Step 2. review or collect evidence of regular bycatch in the areas with identified overlap of seabird distribution and relevant fisheries. (see Chapter 5). If seabird species are killed regularly or there are records of bycatch of threatened species, the assessment should proceed to step 3.

Step 3. assess whether bycatch is likely to be unsustainable, using bycatch evidence and bird information. In order to determine bycatch severity, three pieces of information will be required:

- 1) at what rate (bpue) the species is being taken;
- 2) what is the total effort in the fishery; and
- 3) what is the level of annual fishing-related mortality, having accounted for other sources of anthropogenic mortality that the population could withstand without compromising conservation objectives?

The metric to be assessed here is ‘numbers of individuals being bycaught in relation to the population estimate set for each population range or Management Unit (MU)’. The numbers of individuals being bycaught should be estimated where appropriate from attempts per unit of effort (apue) and total effort at the same spatial and temporal scales; however, further work is required to explore the appropriate spatial scales at which seabird bycatch might be assessed.

Potential Biological Removal (PBR) is one tool that could be used for this initial assessment of bycatch sustainability. If this assessment indicates possible unsustainable mortality levels, the assessment should proceed to step 4. An example where PBR has been applied to the bycatch of a Critically Endangered seabird is presented in Box 2.

Step 4. conduct a more detailed, process-related assessment of bycatch impacts on the population, using more sophisticated methods such as the various methods of population viability analysis (PVA), possibly considering spatial variability in distribution of birds and fishing effort. After taking these four steps management measures to mitigate bycatch might then be developed.

Currently a major issue across all four stages is a lack of coherent effort data in many fisheries known or expected to have high bycatch levels. WKBYCS recommends that fishing effort be recorded for all vessels in fisheries that potentially have a bycatch issue, rather than restricting reporting vessels of a certain size class. Bycatch monitoring and general reporting will also have to use identical or comparable effort metrics (see Chapter 5). Throughout this process, the inherent uncertainty surrounding most parameter values needs to be acknowledged. FAO advises a precautionary approach where information is lacking or uncertain.

Steps 1 to 3 enable a focused approach to step 4, and facilitate determination of further management efforts on the likely species and gears of most concern. PBR may be applied to the seabird bycatch issue as a rapid assessment tool. It must be recognised that other methods could also be considered. However, among the methods already developed and being used for cetaceans, the PBR approach has proved a useful tool. It has also been applied to seabirds and seaduck to assess potentially unsustainable levels of bycatch (e.g. Zydalis *et al.*, 2009). The technique is an option to identify po-

tentially excessive losses at step 3 defined above. It nevertheless still requires tests of basic assumptions and external validation (e.g. Richard and Abraham, 2013). Estimation of maximum growth rates from limited information as well as the choice of appropriate values for the recovery factor f need particular attention.

Overall, while PBR can be useful for assessment purposes to identify possible threats to seabirds from bycatch, uncertainties mitigate against its application in a management context to set levels of allowable bycatch in a population. Moreover, the option of regulating fishing to meet, for example, some 'maximum allowable catch' of seabirds would appear not to be consistent with the EU PoA's overall objective to "minimise and where possible eliminate" bycatch. This objective derives directly from Article 5 of the Birds Directive (EU 2009), which requires Member States to take measures prohibiting the "deliberate killing or capture [of birds] by any method".

BOX 2. POTENTIAL BIOLOGICAL REMOVAL (PBR) AS AN INDICATIVE TOOL TO ASSESS POSSIBLE FISHERY IMPACT; THE BALEARIC SHEARWATER AS A CASE STUDY

A simple method of assessing what would be “acceptable” added mortality due to human activities is Potential Biological Removal (PBR), which was originally developed for marine mammals (Wade, 1998) and has become widely used as a conservation guidance tool for cetacean and pinniped populations. The PBR approach was proposed as a practical guidance tool for seabirds by Niel and Lebreton (2005) and Dillingham and Fletcher (2008, 2011), aimed at species for which demographic information is often limited. The method consists of the following simple formula:

$$PBR = \frac{1}{2} R_{MAX} * N_{min} * f$$

where R_{max} is the maximum annual recruitment rate (which can be estimated from the “optimal” adult survival rate and the average age at first breeding), N_{min} is a conservative estimate of population size defined as the 20th percentile of the population estimate, and f is a recovery factor between 0.1 and 1. Appropriate recovery factors have not been developed for most seabirds, although sufficient population information exists for many species; if PBR were to be applied to seabirds then recovery factors might be determined for broad taxonomic groups of birds, as has been done for marine mammals to account for differences in their life histories.

Although application of PBR has not been made in a binding or regulatory way, the method has been applied descriptively to assess the significance of seabird bycatch in regions such as the Baltic Sea (Zydulis *et al.*, 2009) and Australia (Tuck, 2011). Here, the method is applied to the Critically Endangered Balearic shearwater, for which bycatch is regarded as one of the main threats to the species (Arcos, 2011). The PBR assumed the following:

N_{min} = 16 426 birds. This is a revised population estimate (previously a much larger estimate of 25 000 individuals based on breeding estimates, Arcos *et al.*, 2012);

Age at first breeding (average) = 3.5, after Oro *et al.* (2004)

Adult survival (optimal) = 0.90, a conservative estimate for a Procellariiform (Weimerskirch, 2002; Dillingham and Fletcher, 2011)

R_{MAX} = 0.15, estimated from the above parameters.

f = 0.1, following the criterion proposed by Dillingham and Fletcher (2011) for threatened species.

Using these parameters, the PBR would set a limit of 125 Balearic shearwaters caught per year. In this case, the limit is clearly exceeded, although no robust bycatch estimates for the species are available. By considering only single events of multiple bycatch, this limit would have been exceeded on several occasions. Of particular concern are bycatch events by Spanish Mediterranean longlines (up to more than 100 birds) and by purse-seines in Portugal (reported cases of 100, 200 and 1000 birds; Louzao *et al.*, 2011; Cortés *et al.*, 2013; Henriques *et al.*, 2013). For Spain, considering the area of Catalonia (NE Spain) alone, a very conservative estimate suggests a minimum bycatch of almost 400 Balearic shearwaters per year (Cortés *et al.*, 2013), again well in excess of the indicative PBR. The estimate for the whole Spanish Mediterranean could likely be far more than 1000 birds per year. For mainland Portugal, bycatch occurs in purse-seines, but also in demersal longlines and to a lesser extent in other métiers, and a figure of up to 3000 birds per year has been suggested, although more robust data are required to confirm this (Henriques *et al.*, 2013).

The Balearic shearwater is considered the most threatened seabird in Europe, with a current decline that would lead to its extinction in less than 50–100 years (Oro *et al.*, 2004). This trend is largely due to an unusually low adult survival rate, and bycatch has been suggested as the main source of mortality for the species (Arcos, 2011).

This PBR exercise reinforces the perception that observed levels of bycatch of the Balearic shearwater, while still requiring refinement to assess total numbers, are well beyond any sustainable level.

5 A standard data reporting format for recording seabird bycatch and database of seabird bycatch data in EU fisheries

5.1 Existing bycatch database at ICES

ICES has been collating fishery bycatch records for all protected taxa for several years under the auspices of the Working Group on Bycatch of Protected Species (WGBYC). The aim of this work is to provide an EU-level overview of the scale of bycatch of individual protected species and to identify fisheries and areas in need of more directed monitoring. A Bycatch Risk Assessment approach has also been promulgated in order to identify which protected species/fishery combinations are most likely to constitute a conservation problem (ICES, 2013).

One of the primary problems with this approach has been the difficulty in defining fishing intensity for specific fisheries because fishing effort data are poorly resolved and often unavailable in an appropriate format for analyses of this nature.

Under Council Regulation 812/2004, EU Member States have provided annual fleet effort data for midwater trawl and static net métiers in order to estimate cetacean bycatch in these fisheries. These effort data have been made available to ICES annually, and a database has been established under WGBYC where these data have been stored, along with associated observer effort data and records of observed bycatch. Most records relate to cetaceans, but records of other taxa (e.g. sea turtles and seabirds) have been included by some Member States when these have been recorded in dedicated 'Regulation 812' national observer schemes.

Some limited data on protected species (including seabirds) bycatch from several Member States are available within the Discard Sampling Programmes, established under the Data Collection Framework (DCF). However, effective observer effort is poorly described (and in many cases is likely to be insufficient) as not all Member States record or report non-commercial species catch all of the time.

Nevertheless, a prototype database, including some fleet effort data (for pelagic trawls and gillnets) as well as observer effort and bycatch records has been established and is being managed by the ICES DataCentre. It would seem sensible to consider collating any further seabird bycatch observations, alongside existing data, within this database. In order to do this, the existing database needs to be adapted and expanded to include seabird bycatch observations in a comprehensive and appropriate format.

5.2 Standard reporting format

The Workshop interpreted this part of the request to provide advice on a standard reporting format by Member States to the commission or to ICES in order to facilitate a European level overview of seabird bycatch and to enable bycatch risk assessment to identify fishery seabird interactions of most concern. The Workshop did not think it feasible to develop a standard observer reporting format or data sheet, which should necessarily be applied individually at a national observer programme level.

The specification of a detailed reporting format for seabird bycatch observations is difficult in the absence of a framework for the establishment of observer schemes or for reporting, and in the absence of any clearly stated objectives for such monitoring.

Several Regional Fisheries Management Organisations (RFMOs) have specified objectives for their bycatch monitoring schemes. Under the International Commission for the Conservation of Atlantic Tunas (ICCAT), the monitoring of seabird bycatch in longline fisheries is mandated (Rec. 11-09⁵). Key objectives for recording bycatch within the ICCAT observer programme are (Birdlife International, 2011):

- 1) to document and quantify bycatch within a fishery;
- 2) to understand what factors (e.g. spatial, temporal, gear and operational) contribute to observed bycatch rates recorded;
- 3) to scale up reliably observed information to that of the fishery; and
- 4) to assess the effectiveness of mitigation measures aimed at reducing incidental mortality.

Each of these objectives carries with it implied obligations as to which data items need to be collected, and these will vary depending on the fishery type.

At the most basic level, any observer scheme should address Objectives 1 and 3 above, namely to document and quantify bycatch in such a way that it is possible to provide a reliable estimate of the total bycatch in the whole fleet based on the sample that has been observed. To this end, an observer scheme needs at least to address:

- the gear type and target species;
- the amount of overall fishing effort in the sample of trips (by métier);
- the amount of fishing effort effectively monitored for bycatch (by métier);
- the location of fishing (at a species-specific appropriate scale);
- the time of day, month or season of observation;
- the number of individuals and number of bycatch events for each bycatch species;
- the numbers dead and released alive at each event;
- any mitigation measures deployed; and
- any other ambient conditions relevant to the fishing gear in use.

An appropriate effort metric for the fishery concerned needs to be identified so that the observations from the sampled trips can be raised to the fleet level, though it may make sense to record several such metrics (e.g. net hauls, gillnet length, number of hooks, tows and tow duration, soak time, days at sea, trips, etc.). 'Days at sea' is considered the most flexible and widely available unit of effort so that observed days at sea should always be collected along with other measures.

More specific details on the reporting format will depend on both the fishery concerned and the stated observer programme objectives. Estimates of total bycatch could be achieved with the above list of data items alone, but clearly if resources are being deployed to monitor bycatch, it would make sense to try to address other objectives such as items 2 and 4 above where feasible.

In longline fisheries, for example, it has been suggested that ten minimum data items should always be collected (Birdlife International, 2011) as follows:

⁵ <http://www.iccat.int/Documents/Recs/compendiopdf-e/2011-09-e.pdf>

- 1) Total fishing effort (number of 1000 hooks);
- 2) Total hauled hooks observed (number of 1000 hooks);
- 3) Weight of added weight, if used (grammes);
- 4) Branchline length (m);
- 5) Distance between weight and hook (m);
- 6) Mitigation measure used;
- 7) Species level identification;
- 8) Number of birds caught of each species;
- 9) Disposition (dead/alive); and
- 10) Description of condition/viability of animal upon release (if released alive).

Other lists can be drawn up for other fisheries (see for example CCAMLR 2007, IOTC, 2010; BirdLife, 2011), including such things as soak time, tow duration, mesh sizes, twine type and colour and other gear specific metrics, though it is probably unwise to be too prescriptive at this level of detail.

Assuming some reporting mechanism were to be implemented for reporting seabird bycatch, then as with the reporting under Regulation 812/2004 on cetaceans, it will be important for Member States to provide fleet effort data in a useable format so that raising of bycatch observations can be achieved at the fleet level. To this end, the Workshop recommends that reporting should follow the métiers (to level 5 or even 6 where feasible) described under the DCMAP, and that effort should be described at least in terms of days at sea, but where feasible in more gear-specific terms (e.g. number of tows, hours towed, km net set, average soak time, number of hooks set per day). In order to identify whether a seabird bycatch problem exists, bycatch needs to be estimated at the fleet and at the annual levels. Bycatch reporting in this way should follow the reporting format laid out under DCMAP to ensure convergence and harmonisation of datasets.

The possibility of using other sources of data to augment direct observations should not be overlooked. For example, (improved) interview data and logbook records could be used to provide ancillary information on bycatch for specific métiers and some thought should be given to how such data could be reported and stored in a common format, and how they might be used to augment bycatch estimates from more traditional data sources.

Observer programmes must report observer effort regardless of whether any bycatch has been recorded. From an analytical perspective, observed hauls with zero bycatch are as important as those where bycatch has been observed, but it must be clear that such observations were made with the intention of recording bycatch if any had been observed. Some observer schemes in the past may have had ambivalent attitudes towards recording bycatch of some non-commercial species.

5.3 Development of a database

A protected species bycatch database has been compiled by WGBYC (ICES, 2013) and maintained by the ICES DataCentre. This database currently consists of two related tables; one contains data by DCMAP métier, on fleet effort and the amounts of bycatch monitoring effort achieved annually, and the second consists of bycatch records that are related to specific DCMAP métiers and years, and associated observer effort.

The second table should be modified to include bird data, or alternatively a separate bird table could be devised. This should be limited to a few essential fields (species, number of individuals and number of events, numbers dead and alive, for example). Ambitions are best pitched at achieving effective and straightforward analyses at the European level rather than establishing over-elaborate datasets. The exact structure of the database will certainly evolve as the ICES DataCentre takes over the management of this database, and it may be better to keep *métier definition* separate from *annual fleet effort data* and from *annual observer monitoring data* (i.e. three tables to be derived from the existing one).

5.4 Discussion

Reporting on bird bycatch at the European level should be kept simple and straightforward in order to provide an overview of the scale of bycatch by species and region, and to enable bycatch risk assessments to be undertaken to identify fishery/bird combinations that are either in need of better monitoring or of bycatch mitigation measures.

However, this should not preclude individual Member States from developing more rigorous and detailed programmes that can be used to study aspects of bycatch (e.g. estimating total mortality, understanding processes leading to bycatch, developing mitigation measures) in greater depth than is likely to be possible or desirable at an aggregated EU level. Such scientific studies should be encouraged by or expected of Member States.

Looking forward, the proposed integration of the 812/2004 cetacean bycatch observations under the new DCMAP indicates the potential integration of Ecosystem Level Impact Assessments for non-commercial species under the DCMAP. In this context, on-board observer programmes and electronic monitoring could and should play an important role in impact assessment over a broad range of taxa, thus economising on sampling and maximising the amount of information to be derived from the relevant sampling programmes.

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Annex 1: List of participants in WKBYCS 14–18 October 2013

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Annex 2: English and scientific names of birds mentioned in this report

ENGLISH	SCIENTIFIC
Red-throated diver	<i>Gavia stellata</i>
Black-throated diver	<i>Gavia arctica</i>
Red-necked grebe	<i>Podiceps grisegena</i>
Great-crested grebe	<i>Podiceps cristatus</i>
Slavonian grebe	<i>Podiceps auritus</i>
Northern fulmar	<i>Fulmarus glacialis</i>
Cory's shearwater	<i>Calonectris diomedea</i>
Scopoli's shearwater	<i>Calonectris diomedea diomedea</i>
Great shearwater	<i>Puffinus gravis</i>
Yelkouan shearwater	<i>Puffinus yelkouan</i>
Balearic shearwater	<i>Puffinus mauretanicus</i>
Northern gannet	<i>Morus bassanus</i>
Great cormorant	<i>Phalacrocorax carbo</i>
European shag	<i>Phalacrocorax aristotelis</i>
Mediterranean shag	<i>Phalacrocorax aristotelis desmarestii</i>
Tufted duck	<i>Aythya fuligula</i>
Greater scaup	<i>Aythya marila</i>
Common eider	<i>Somateria mollissima</i>
Steller's eider	<i>Polysticta stelleri</i>
Long-tailed duck	<i>Clangula hyemalis</i>
Common scoter	<i>Melanitta nigra</i>
Velvet scoter	<i>Melanitta fusca</i>
Common goldeneye	<i>Bucephala clangula</i>
Smew	<i>Mergellus albellus</i>
Red-breasted merganser	<i>Mergus serrator</i>
Goosander	<i>Mergus merganser</i>
Audouin's gull	<i>Larus audouinii</i>
Great black-backed gull	<i>Larus marinus</i>
Lesser black-backed gull	<i>Larus fuscus</i>
Yellow-legged gull	<i>Larus michahellis</i>
Black-headed gull	<i>Chroicocephalus ridibundus</i>
Mediterranean gull	<i>Larus melanocephalus</i>
Black-legged kittiwake	<i>Rissa tridactyla</i>
Sandwich tern	<i>Sterna sandwicensis</i>
Great skua	<i>Stercorarius skua</i>
Common guillemot	<i>Uria aalge</i>
Razorbill	<i>Alca torda</i>
Black guillemot	<i>Cepphus grylle</i>
Atlantic puffin	<i>Fratercula arctica</i>

Annex 3: Technical minutes

- The Review and Advise on Seabird Bycatch Review Group-RGBYCS
- Review deadline: 12 November 2013
- Participants: Nicole LeBoeuf, USA (Chair); Sara Königson, Sweden; Ana Marcalo, Portugal; Bob Furness, UK
- Working Group: Workshop to Review and Advise on Seabird Bycatch-WKBYCS

Audience to write for: These comments are to be provided to the Seabird Bycatch Advice Drafting Group on at its meeting on 14–15 November.

Workshop to Review and Advise on Seabird Bycatch

An ICES-convened Workshop to Review and Advise on Seabird Bycatch (WKBYCS) met from 14 to 18 October 2013 at ICES HQ, Copenhagen. It was chaired by Jim Reid (UK). Ten participants, invited either by ICES Secretariat or the Chair, attended the meeting. The objective of the meeting was to consider three Terms of Reference relating to seabird bycatch in European waters, including the Baltic, Mediterranean, and Black Seas.

The WKBYCS was given the following Terms of Reference by ICES Secretariat in response to a special request from the European Commission:

- To review and update current seabird bycatch data and identify fisheries where appropriate follow up monitoring to establish bycatch levels would be desirable.
- To explore the criteria and/or metrics that could be used to define a seabird bycatch problem. (This request is partially addressed in earlier request by the Commission to ICES on cetacean bycatch) but ICES should tailor this advice to specifically cover seabird bycatch.
- Establish a standard data reporting format for recording seabird bycatch and to develop a database of seabird bycatch data in EU fisheries, similar to the database developed by WGBYC for marine mammal bycatch.

The Workshop participants reviewed available seabird bycatch data and provided some indication of where appropriate follow-up monitoring to establish bycatch levels was needed. They noted that there is relatively little new information available on seabird and seaduck bycatch in fisheries since previous WGSE reviews, despite repeated calls for further data collection and monitoring, particularly in more high risk fisheries (e.g. longline and gillnets). Workshop participants expressed concern that what remains apparent is the need for increased monitoring in other European fisheries where threatened species are known to co-occur in large numbers. They concluded that what new information that was available, shows that the incidental bycatch of seabirds in most fishing gears persists throughout European waters, including in the Baltic Sea, the North Atlantic, the North Sea, the Mediterranean Sea, and the Black Sea.

WKBYCS discussed the issue of what actually constitutes a bycatch “problem” and provided some treatment of how to approach the assessment of whether a seabird bycatch problem exists. The Workshop participants were challenged to define what a

seabird bycatch “problem” is, but explored various metrics by which such a definition might be chosen and discussed methods of monitoring that might be employed. With regard to the establishment of a standard reporting format, WKBYCS determined that it was not feasible to do so and that it was better for such a form to be developed at the national observer program level. Regarding a seabird bycatch database, WKBYCS recommended that the ICES protected species database compiled by WGBYC be modified to accommodate seabird bycatch, but provided no additional suggested actions.

General comments

The topic of seabird and seaduck bycatch in all fishing gears has been extensively addressed by ICES, principally through the Working Group on Seabird Ecology, but also by the Working Group on Bycatch of Protected Species (WGBYC), as well as by the FAO and others. As such, there is a substantial body of work from which to provide guidance to the EU in fulfilment of this request. The Reviewers note the substantial work that was undertaken at the Workshop. The addition of several new pieces of information (particularly with respect to Spanish and Portuguese fisheries) and demonstrates progress in the collection of data related to seabird and seaduck bycatch. This information revealed areas of concern with regard to bycatch of Balearic and other shearwaters across a range of fishing métiers, and is essential to attaining a better understanding of where bycatch may be of greatest concern in EU waters.

Nevertheless, and as indicated by the WKBYCS, there are substantial fisheries and areas for which there remains little to no bycatch information. As such, the Reviewers see a need for specific recommendations (e.g. with regard to setting bycatch monitoring priorities) than is contained within the report. There is sufficient information, as well as ways in which the information may be considered either within this report, in previous ICES reviews, and in other relevant documents that can be drawn upon to augment the current report and to provide to the EU. For example, where the WKBYCS observed geographical variation in patterns of bycatch that result from fishing effort in the various métiers, as well as in the distributions of seabird species, a scheme for considering of this information in combination might lead to more advanced advice.

Review and update current seabird bycatch data

The Reviewers noted several areas in the report that require clarification of scope and application of the information being reviewed, particularly as additional effort may be required to fulfil the part of the EU’s request with regard to the identification of fisheries for appropriate follow up monitoring to establish bycatch levels. Of note, the Reviewers suggest that the Workshop report be clarified to indicate that both seabirds and seaducks are being considered simultaneously unless otherwise indicated.

Scope of the reviewed information

Multiple reviewers noted throughout the document that there are inconsistencies with regard to the time frame for studies being reviewed. Some examples of this include within Sections 3.3.5, 3.4.4, 3.7.6.1, and elsewhere. The EU’s request was for a “review and update” of “current seabird bycatch data” but throughout the document, there are references to older information and/or information previously reported by the WGSE. For example, in Section 3.8.3, it was noted that while this is all important information, it is not new and doesn’t appear appropriate to this section as

presently described. In another example, there are references within Section 3.7 that are not new as the title of the section suggests.

The Reviewers recommend clarifying where recent information only is being reviewed, where information is being updated, and where previously reported data are being referenced for particular reasons. One Reviewer suggested that the overall problem be reviewed, rather than updating previous reviews, while noting the work that has already been achieved by ICES at assessing the problem. Perhaps clarification regarding what is being reviewed could be included in the Executive Summary and/or with regard to Chapter 3.

Absence of information

The Reviewers note that it was difficult to determine where potentially important information gaps exist because, in many cases, where there was an absence of bycatch data, no data were presented. For example, in Section 3.3.2, with respect to the paragraph describing pelagic trawls, two Reviewers noted that it is not possible (without additional explanation) to indicate that there is a lack of bycatch at the same time as there is very little information available for this fisheries. In reviewing the tables, the Reviewers had difficulty telling the difference between there being no observed seabird bycatch in fisheries that are observed, and there being no bycatch monitoring at all. In Table 3.2, for example, it was noted that there are several areas lacking seabird bycatch information in the Baltic fisheries and yet those fisheries are not included in the table. It is suggested that another table be included indicating where data were sufficient and insufficient to determine whether a bycatch problem exists, consistent with the criteria recommended by FAO below.

In other examples, in Tables 3.5 and 3.6, an indication of whether blank entries in the table indicate an absence of data or an absence of bycatch is lacking. By building the tables on likely/known bycatch (as has been done), one reviewer noted that it's difficult to identify where critical information is lacking. For example, the narrative describes which nations are providing little to no seabird bycatch data, but they are not listed in the table. This provides an incomplete picture of the status of the EU's data gathering needs. One Reviewer recommended that all nations and all gear types be included with indications of where data are not available for consideration. Alternatively, it is recommended that a separate table where data are lacking but where fishing activities overlap vulnerable seabirds be provided. For example, in Section 3.3.2, within the discussion of the UK pelagic trawl fishery, one reviewer noted that the suggestion of a seabird bycatch problem that has not been well studied or remains underestimated due to lack of observer dedicated effort indicates a need for future research.

Identify fisheries where appropriate follow-up monitoring to establish bycatch levels would be desirable

It is within this area of the EU's request, that the Reviewers recommend additional effort. While the idea of "desirability" in monitoring activities is indicated in the request, it is clear from previous ICES reviews and from the information newly compiled in this report that there are many locations and/or fisheries from which little to no bycatch data are being reported. Resources for carrying out seabird and seaduck bycatch monitoring are limited and, therefore, prioritization is necessary. The Reviewers believe that the development of a prioritization scheme would benefit from a fuller assessment of bycatch risk and consideration of the absence of data, along with the presence of it.

Clear and consistent criteria for priority setting

The Reviewers noted that the standard for which fisheries needed monitoring differed, wasn't clear, or in some cases, appeared inconsistent. Throughout Section 3, including within the tables, there are indications of where additional monitoring is indicated, but there is no overall explanation of how this determination is made; other than can be found within the narrative of the report and which varies widely from section to section. The Reviewers also noted several references within the narrative that do not appear to match the table entries. For example, in Table 3.1, the entry for set longlines notes no reported bycatch and no need for monitoring, but in the narrative, in the discussion of Ireland, the need for monitoring was indicated. In Section 3.9.1, it was noted that while this section is indicated to discuss targeted use of existing observer schemes, it lacks detailed rationale for prioritization of monitoring efforts.

Another example is the entry for driftnet fisheries in the UK, where seabird bycatch is reported, but no monitoring is recommended. The Reviewers recommend that all table entries be cross-checked with their corresponding narratives to ensure that they are consistent and that consistent criteria for where monitoring is needed. The Reviewers also recommend including more specific indications of where monitoring is a priority based upon what is known about seabird and seaduck interactions relative to specific gear types and/or fishing practices and what is known about the distribution and conservation status of the seabird or seaduck species likely to interact with fishing activities which they are vulnerable.

Assessment of risk

Where bycatch information is lacking, other factors may be considered in providing guidance regarding to the EU in assigning priority to specific fisheries for monitoring. For instance, it would be useful to conduct some level of assessment of bycatch risk of certain fishing operations to interact with seabird and seaduck species. In some cases, such risk is evident in a review of the information provided. In other cases, it is not. Given what information is available, it might be reasonably predicted where a type of fishery is observed to interact with a particular seabird species in one nation's waters, it might be similarly prone to interact with that same species in adjacent waters. Likewise, in several areas of the report, there is an absence of information regarding seabird or seabird bycatch in a particular fishery that seems to lead to a conclusion that there is not likely a problem and that monitoring is not needed. In both cases, there are reasonable conclusions that may be drawn about relative risk of bycatch when recommending which fisheries to monitor and/or setting priorities for that monitoring.

Moreover, additional data are needed to better understand the nature of the interactions between birds and fishing gear. Any such data could lead to more informed assertions about how similar species of birds might interact with similar gear from one country to the next. This notion is commonly understood and yet there is no indication within the Workshop report that monitoring efforts could be informed by some degree of lumping bird species into foraging styles. For example, it was noted that there may be similarities in foraging patterns among the shearwaters, which could indicate risk wherever shearwaters and the types of gear with which they are believed to interact in terms of the identification of a seabird bycatch problem. For example, in Section 3.7.3.1, there was similar approximate magnitude and geographic coverage of bycatch in the three shearwater species. Some combined approach to these species in terms of recognizing foraging style and similarities in the fisheries

they are likely to interact with might be useful. Doing so could contribute to an assessment of risk for bycatch in the identification of whether a seabird bycatch problem exists for predominantly surface-feeding shearwaters in the Mediterranean. Combining the three shearwaters into a general foraging strategy category could elucidate their risk as a group from certain types of fishing gear regardless of the location and could result in combined benefits if/when monitoring and/or mitigation measures are applied. This concept should be further explored.

It was noted that the use of maps, such as this one, are essential as they describe fisheries for which data are otherwise sparse. One reviewer inquired as to whether seabird distribution and/or utilization could be overlaid as an indicator of the risk of seabird bycatch in these fisheries. Taking the information above regarding similar foraging style and using it to inform monitoring priorities where bird distribution and specific gear types and fishing practices overlap, provides a more coherent understanding of the vulnerability of seabird species to bycatch in certain areas. Based upon the information contained within the report, it seemed that geographic location plays an important role in predicting at least some seabird co-occurrence with fisheries (see Section 3.7.3.3). This overlay of information could be used to identify risk of bycatch, contributing to the identification of a seabird bycatch problem. Additional mapping using these parameters for assessing relative risk would be particularly informative for the EU in assigning priorities to monitoring efforts and would build upon the work already contained in this report.

It is also recommended that a table be added depicting the fisheries and/or nations for which there is little to no monitoring and which utilize gear and/or fishing practices in areas of overlap with species known to be vulnerable to those gears and practices. Without an indication that the risk to birds is different in a similar fishery where no data exist, prioritization for monitoring could be difficult (particularly if the conservation status of the seabird or seaduck species is worrisome). For example, in Table 3.4, with regard to Greek drifting longlines, no monitoring is recommended. It is not clear from the report what makes this fishery and the risk to birds different from the Spanish, Italian, and Maltese fisheries, where monitoring is recommended. One study is cited as justification for this difference, but there is no description or explanation as to why the Greek fishing may pose a lower threat to birds.

Other considerations

There may be efficiencies to be gained by taking advantage of fisheries in which there are existing marine mammal observers or other monitoring schemes that might be modified for use in collecting seabird bycatch information. This may be particularly true given the likelihood that observers currently being utilized for marine mammal bycatch data collection would also be used for seabird bycatch data collection, rather than separate seabird-dedicated observers.

With regard to the use of information derived from questionnaires, the Reviewers were encouraged about such substantial efforts to collect bycatch data complementary to that obtained by onboard monitoring programs. However, it was noted that additional work is needed to improve the comparability of the information collected by questionnaires and fisher interviews. Further discussion of how questionnaire methodology could be improved and incorporated more fully into other approaches to quantifying seabird bycatch might be useful. One commenter noted that where interviews and/or self-reporting measures are in place, it helps to have good relationships between fishermen and researchers/observers. This provides additional confi-

dence that the data collected are reliable and interview data match in many cases estimates of bycatch coming from onboard observation for a particular year.

There was a reference in the WKBYCS report regarding a significant stranding event as an indicator of a potential uptick in fisheries interactions across seabird species, but later in the text there's no indication of how additional strandings data might be obtained and used to complement other data collection schemes. As strandings data can provide useful insights into how and where fisheries are interacting with seabirds, additional consideration of how and where seabird strandings data may be obtained could provide the EU with an additional option for monitoring.

Explore the criteria and/or metrics that could be used to define a seabird bycatch problem

The Reviewers note the first sentence of Section 4 "The issue of what constitutes a bycatch "problem" is outwith the scope of this report" and assert that the exploration of criteria and/or metrics for defining a seabird bycatch problem is essential to resolving what constitutes a seabird bycatch problem. Indeed, the WKBYCS report takes several important steps in this regard. Still, the report would benefit from additional consideration of examples of where nations have developed NPOAs-Seabird and from other examples of how a variety of information (including that examined in the report) can be used to identify and apply suggested metrics to determine whether a seabird bycatch problem exists in different fisheries and locations.

The Reviewers make two observations that may result in furthering the work begun at the Workshop with regard to exploring criteria and/or metrics for defining a seabird bycatch problem. First, while it is true that the FAO IPOA-Seabirds (FAO, 2013) does not specifically define what constitutes a seabird bycatch "problem", there are examples of how nations developed and are implementing their own NPOAs-Seabirds that might be illustrative of how a seabird bycatch problem might be identified. Where examples exist and provide useful insights into how seabird bycatch problems have been defined, they should be considered.

Second, FAO IPOA-Seabirds recommends considering the following components in defining a seabird bycatch problem: the magnitude of seabird bycatch (rate or number); species that are incidentally caught, and their conservation status; spatial and temporal overlap of fishing effort with seabirds; and population trends of seabirds likely to be impacted by bycatch (FAO, 2013). Similarly, the FAO Report of the Expert Consultation on Best Practice Technical Guidelines for IPOA/NPOA-Seabirds recommends very similar elements with regard to defining a seabird bycatch problem (FAO, 2008) –

"When defining a seabird incidental catch problem, States and RFMO/As should consider the following:

- i) Defining the rationale for determining if a problem does, or does not, exist. The rationale should be based on: (a) the magnitude of seabird bycatch (rate or number); (b) species that are incidentally caught, and their conservation status; and (c) spatial and temporal overlap of fishing effort with seabirds.
- ii) Reviewing available data relevant to the incidental mortality of seabirds.
- iii) Validating sources of information and where appropriate follow up with more detailed investigations.

- iv) Adopting a precautionary approach where information is lacking or uncertain.”

Instead of a national-scale POA, an EU-wide POA was developed (due, in large part, to ICES recommendation to do so) in 2010. This indicates that, at a general scale, the EU has already determined that it has a seabird bycatch problem. The EU has not, however, conducted similar assessments at regional levels so that appropriately scaled monitoring and mitigation measures may be recommended and implemented. With regard to implementation of the EC-POA, in 2008, ICES advised the EU on facilitating the development and use of appropriate regional seabird bycatch mitigation measures, a geographic substructure be adopted for the EC-POA (ICES, 2008). ICES noted that it is important that this substructure form the basis for an assessment of the total EU impact by seabird species. ICES advised that an eleven-part geographic substructure be adopted. While the WKBYCS report contains a detailed nation-by-nation description of interactions, it also includes broader geographic coverage within its main tables. This complementary presentation of information is helpful, but the Reviewers would suggest consideration of presenting the findings in a similar geographic break down similar to that ICES advised in 2008. This could assist the EU in the design and implementation of appropriate monitoring priorities.

With regard to identification of one or more seabird bycatch problems at a regional scale, information exists within this report to begin the effort, as well as to consider the use of a framework for analysing the information. At the beginning of Section 5.1, the WKBYCS notes that “A Bycatch Risk Assessment approach has also been promulgated in order to identify which protected species/fishery combinations are most likely to constitute a conservation problem (ICES, 2013).” Within that document, Section 4.1 details an approach for assessing impact of bycatch with regard to cetaceans and yet there is no further discussion of this approach within the WKBYCS’ report. Given that the EU’s request included a reference to an “earlier request by the Commission to ICES on cetacean bycatch”, the Reviewers suggest the inclusion of additional information regarding this earlier work and how it may or may not have bearing on the findings of WKBYCS would be useful.

Based on this and the available information, it would be helpful to the EU to provide a framework within which it can conduct such assessments. In addition, it is recommended that insights into what information is and is not available within each region be included as a way to prioritize seabird bycatch monitoring. Indeed, in many cases, the suggested rationale for determining if a problem does or does not exist may be useful for consideration in setting specific monitoring priorities. Following the FAO guidance noted above, below are general comments regarding the three elements to be considered when defining the rationale for determining if a problem does, or does not, exist.

Magnitude of seabird bycatch

Throughout the report, it is difficult to ascertain whether sufficient information exists or could be readily obtained through concerted monitoring to reliably estimate the magnitude of seabird bycatch, although in some cases, estimates of bycatch are provided. For example, in Section 3.6.1, it was noted the recent additions of a variety of information on Spanish fisheries, including the results of significant numbers of questionnaires, provide substantial information that could be further examined and/or strategically augmented to quantify seabird bycatch in some of these fisheries. In addition, the drifting longline information might be further considered in terms of

combining known information to quantify the magnitude of seabird bycatch as a way to identify if a problem exists. In other cases, where bycatch rates already exist, including for Balearic and Cory's Shearwater, they may be so high that they indicate a bycatch problem straight away.

Species incidentally caught and their conservation status

Awareness of species' conservation status can inform not monitoring (and mitigation) priorities and can help to determine whether a seabird bycatch problem exists in particular fisheries. For example, with respect to Table 3.6, the combination of magnitude and/or risk and/or species conservation status might lead to findings regarding whether a seabird bycatch problem exists in a particular region. It might also be useful if Tables 3.1, 3.2, 3.3, 3.4 and Annex 2 include a column indicating seabird and seaduck species' IUCN conservation status.

Also, as mentioned above, another consideration element of assessing risk of seabird bycatch is a broad understanding of species' foraging behaviours and how those behaviours might make them more vulnerable to interactions with fisheries. In Section 3.3.7, there is a note regarding Balearic shearwaters being "particularly prone to be caught" in purse-seine nets. Such an indication of risk could not only inform monitoring prioritization efforts, but could also suggest similarities among species' foraging styles and, therefore, their vulnerability to certain fisheries. In another example, in Section 3.7.2.3, in the description of Cyprus, it was noted that the relevance of the available information where no seabird bycatch is available and an indication "substantial seabird bycatch" was not well-explained. This kind of rationale might be important to help justify extending similar risk of seabirds and a particular gear type in one region to another, even where seabird bycatch is not being monitored and, therefore, reported. See also comments above regarding consideration of shearwater species together.

Spatial and temporal overlap of fishing effort with seabirds

As noted above, additional information can be included in mapping efforts by region to provide the EU with a more complete understanding of where risk for seabird bycatch lies and where problems exist.

Potential metrics

The WKBYCS discussed the use of PBR with seabird species as a primary metric for whether a seabird bycatch problem exists. There were references within the report about how PBR has been applied to seabirds. One reviewer inquired regarding whether PBR has ever actually been applied in a legally binding manner, or whether these references regard the calculation of PBR only. One reviewer notes that the calculation of PBR requires a substantial amount of information about a given species or population of seabird and can be difficult to quantify in the absence of sufficient stock assessment information. Another reviewer agrees that PBR may not be an appropriate tool in all cases for estimating sustainable levels of seabird bycatch, but suggested that further work could be done to verify its applicability for seabirds. One commenter added that PBR has proven difficult to attain for marine mammals in a regulatory context and can override other less quantifiable considerations if used as the primary management tool. One commenter asked whether appropriate recovery factors have been developed, noting that recovery factors could be designated by broad taxonomic groups as has been done for marine mammals to account for differences in their life histories.

Performance testing would be required to ensure compatibility with seabirds and the assignment of recovery factors, but that conducting such tests was possible.

One commenter appreciated the discussion of “societal choice”, implying that “societal grounds” could form some portion of a basis for the identification of a seabird bycatch problem. This concept could be further explored in terms of being a potential metric and in light of the FAO Code of Conduct suggesting that bycatch can be wasteful and should be minimized, even where there may not be an immediate conservation risk (FAO, 1995).

Considering mitigation

In addition to the prioritization of monitoring efforts, there may be some cases where not only monitoring but where proven mitigation measures may be warranted based on what is already known about the nature of the seabird bycatch problem and/or availability of effective mitigation measures (see examples above regarding Balearic and other shearwaters). In Section 3.7.3.1, in the discussion regarding Spain, one reviewer noted that this appears to be the only reference to mitigation measures known to work in a particular fishery within this report. In light of bycatch involving both Balearic and Yelkouan shearwaters, the reviewer inquired whether it would be appropriate to recommend, in cases such as this where species with conservation status of concern are involved and where there are proven bycatch mitigation measures available, not only monitoring but mitigation as well. In another example, within Section 3.3.6.1, the very large numbers of seabirds taken in Spanish and Portuguese gillnets and/or trammelnets was considered significant in terms of quantification of the magnitude of bycatch in the identification of whether there is a bycatch problem in these fisheries. This is particularly disconcerting given the interactions with Balearic shearwaters. This case provides an excellent example of how the EU might prioritize monitoring activities based both on magnitude and conservation concern of the seabird species involved and may also present a good case for recommending mitigation measures along with monitoring.

Establish a standard data reporting format for recording seabird bycatch

Two commenters noted that WKBYCS provides little detail about how it intends to fulfil the request to develop a standard reporting form, including the identification of key minimum data fields that should be included. WKBYCS recommends that Member States develop their own forms, but without clear direction for what the critical data fields would be. One reviewer agrees that Member States could develop additional reporting measures, but believes that this would be more likely to happen if clearer guidance was provided in this report.

Develop a database of seabird bycatch data in EU fisheries

The Reviewers suggest that additional detail regarding the compatibility and/or feasibility of modifying the database developed by WGBYC for marine mammal bycatch to accommodate seabirds be included. There is so little detail about how this might take shape at present that it is difficult for the Reviewers to comment further on whether this approach is sound.

Technical comments

The Reviewers made numerous more specific, technical comments throughout the report. In addition, several questions requiring clarification were raised. Both types of

input are listed below generally in the order in which they can be found within the report. Inline comments and suggested edits have been provided to the WKBYCS Chair.

With regard to Tables 3.1, 3.2, 3.4, and 3.7, further explanation/clarification for how “major”, “minor”, and “minimal” were determined for each fishery is needed.

Within Table 3.1, the bottom otter trawl fishery is listed both this and Table 3.7. The correct placement of this fishery is in Table 3.7.

In Section 3.3, in the discussion on Spain, clarification is needed as to whether the phrase “most relevant” is referring to the most commercially relevant fisheries or to fisheries that were most relevant as they pertain to bycatch.

Also in Section 3.3, some indication of coverage in % of the total coverage of questionnaires distributed would be helpful.

In Figure 3.2, any available information on the average number of birds caught per fishing operation and whether confidence intervals might be included.

First in Section 3.3 in the discussion of Portugal and throughout the Workshop report, there were references to polyvalent (multigear) vessels. Because polyvalent vessels are difficult to monitor or obtain correct effort estimates specifically for one type of gear, it is recommended including caveats to this effect within the document to acknowledge ongoing discussions within the WGBYC on fisheries operating with multiple gear types on individual vessels.

Also in Section 3.3 and with regard to polyvalent vessels, one reviewer pointed out that not all of the observed polyvalent boats were “small.” In fact, a large effort was done in polyvalent vessels above 15 meters. Another reviewer noted that the use of the word small here may be imprecise and may not conform to in-country standards and/or practice. A more specific size standard would be helpful for interpretation.

Within Sections 3.3 and 3.6.1, in the discussion of Spain, there is some missing information regarding the relative responsiveness of those in receipt of the questionnaires. For example, 450 questionnaires were distributed, but how many were completed? Is the number of those completed representative?

In Section 3.3.1, in the discussion of Spain, it is not clear whether “up to ten” birds taken pertains to a single fishing trip, or a single fishing set.

With regard to Section 3.3.4, the usefulness and/or relevance of including this information is not clear. There does not appear to be any direct or even implied linkage to these data collection efforts and the EU’s assessment of a seabird bycatch problem. Additional context for why this information was included and how the EU member nations’ reporting requirements under ICCAT might be used to supplement the EU’s ability to assess seabird bycatch would be helpful.

In Section 3.3.5, it is unclear whether 90% of nine is a sufficient sample size for making a conclusion. Another reviewer asked if these data came from the LPA FAME project.

In Section 3.6 and within the tables, there are some cases where different terminology for net and/or gear types is used. For example, in 3.6.1, the term set gillnet is used. Elsewhere the term set-net is used. In most cases, there is consistency in terminology, but a review of this is recommended. For example, in Section 3.6.1 in the discussion of Spain, it is not clear whether the drifting longline fishery is the same as the pelagic longline fishery.

In Section 3.3.7, in the discussion on Spain, there is a note regarding a "fleet of risk." It sounds like a term of art, but is not used elsewhere within the document. It is unclear whether this has any specific, measurable meaning that could potentially be applied to other fisheries.

In Section 3.3.7, in the discussion on France, it is not clear what the difference may be in the rationale for monitoring this fishery relative to that for Greek drifting longlines further down.

With regard to Section 3.4, one reviewer asked whether this section was meant to only contain information regarding the Baltic Sea and recommended that unless other regions are described herein the name of the section be amended.

Within Table 3.2, the reviewers asked for clarification regarding which fisheries are being referred to with the note of "Certain types of pot/traps" and then "These types should". Both references seem important to clarify. With regard to fykenets, one reviewer inquired as to the meaning of this note.

With regard to Table 3.3, one commenter inquired as to whether the term "waterbird" is being used to collectively describe both seabirds and seaducks. Also, it is recommended that an explanation of what constitutes "Countries with the Most Frequent Bycatch." Is most frequent derived only for fisheries from which reliable estimates of seabird bycatch can be quantified? If so, it would be helpful to provide another table indicating the magnitude of bycatch for each of these seabird species where data are available and indicating where there are insufficient data to perform such calculations of magnitude.

In Table 3.4, with regard to bottom otter trawl fisheries in Spain, it is unclear why this fishery is not considered a priority for monitoring despite reports that there are indications of bycatch of threatened species such as the Balearic shearwater.

Within Figure 3.4, one reviewer asked whether the report of 3900 birds is referring to birds caught during one fishing operation (i.e. one set) or whether it refers to the maximum number of birds per operating fishery (i.e. the maximum number of birds reported in one fishery, compiling all fishing operations together).

With regard to Figure 3.5, it would be helpful to further define and/or discuss "risk" as used in this map, given its importance to this review and the identification of a bycatch problem. Another commenter suggested that the title of the figure be amended to indicate whether these are Spanish vessels that might also operate in other EU waters.

Within Section 3.6.1, the meaning of "relevant" is not clear.

With regard to Section 3.8.1, this language is almost verbatim from Section 3.3.2 and inquired if this was deliberate. Is that purposeful?

In Section 3.9.2, it was noted that it is not yet clear how well remote electronic monitoring works with marine mammals, nor how well it could be transferred to monitor seabird bycatch. Several fundamental issues are still being worked through with regard to accurate electronic monitoring of marine mammal bycatch. Fundamental improvements in this technology are needed before they can be utilized for seabird bycatch, particularly as it relates to species identification and underreporting. This is particularly important given how cryptic seabird bycatch can be (e.g. thrown overboard before it reaches the vessel or difficult to identify to the species level, particularly once wet). At this time, the Reviewers suggest caution in recommending this technology for ready transfer to seabird bycatch.

Within Table 3.8, one reviewer inquired as to whether analytical costs were factored into the assessment of these methods, noting that with all methods someone will be required to analyse the results, raising the costs substantially in some cases. It was also suggested separating interviews from self-reporting in this table as these are two very different approaches to data collection with very different challenges. Also within Table 3.8, one reviewer inquired about what kinds of information (and for what use) would autonomous GPS loggers provide. Additional explanation of this would be helpful.

In Section 3.8.4.1, it was noted that information regarding to required attendance and removal is important to understand whether existing characteristics of a fishery may be contributing to or mitigating bycatch.

In the first point of Step 3 in Section 4, there is a reference to bpue, but it is a concept not otherwise explained or discussed. It was suggested that there be an explanation of this term first used here in the document. This is particularly important as it could be used as a metric.

It might be useful to provide a table with PBR calculated for seabirds species considered most at risk in European waters, based upon these species as priorities. One of these reviewers also indicated that it would be useful for the table to include an indication of where there is insufficient population information from which to calculate PBR as a way to denote data gaps.

One reviewer inquired as to whether PBR has actually be applied to seabirds pursuant to a nation's management and regulatory scheme or whether this reference describes the calculation but not application of PBR for seabirds.

One reviewer noted that the relevance of the reference to deliberate killing was unclear as bycatch is considered accidental or incidental to fishing operations in most cases. The reviewer asked if the WKBYCS considered bycatch deliberate because, in some cases, it is reasonably expected to occur.

In Section 5.3, it is unclear why the key objectives recommended by BirdLife International to ICCAT are placed here. Perhaps these points might be better placed earlier in the report in the discussion of metrics for identifying a bycatch problem.

One reviewer asked whether data reported pursuant to ICCAT reporting requirements could be used to further identify metrics for determining whether a seabird bycatch problem exists.

In Section 5.2, there is a bulleted list of data than an observer scheme needs at least to "document and quantify bycatch in such a way that it is possible to provide a reliable estimate of the total bycatch." While these data are useful for quantifying bycatch, they do not provide sufficient information for characterizing interactions between fisheries and seabirds. Particularly with respect to middle three bullets, data for each of these should be taken at the time of each interaction. Other key data to be collected should include: the disposition of the gear at the time of the interaction (i.e. hauling, setting, etc.). It is not enough to simply quantify the interactions.

With regard to Section 5.4, it was noted that it would be useful to include remarks regarding improvements over time (or lack thereof) of bycatch information reporting by nation as a means to chart progress.

With regard to Annex 2, it was noted that it would be helpful to include the IUCN's conservation status for each species within this annex.

Conclusion

The WKBYCS' report provides a good summary of existing seabird and seaduck bycatch and provides some new information with regard to the Baltic and Mediterranean Seas.

Nevertheless, there are substantial fisheries and areas for which there remains little to no bycatch information. There is, however, in some cases sufficient information, within this report, in previous ICES reviews, and in other relevant documents to provide sound advice to the EU. Although it is recommended that several areas in the report be clarified and/or amended, the summary of information regarding which fisheries are known to or are likely interacting with seabirds is a substantial step forward in assigning priorities for data collection and potentially mitigation.

In the exploration of criteria and/or metrics for defining a seabird bycatch WKBYCS report takes several important steps in this regard and provides a foundation for consideration of a more detailed framework in which to conduct such an assessment. WKBYCS further considered the issue of "societal choice" as a non-scientific metric another potential basis for the identification of a seabird bycatch problem. With regard to the establishment of a standard data reporting format and the development of a database of seabird bycatch in EU fisheries, there are compatible structures in place within which the work of WKBYCS can fit. WKBYCS is encouraged to continue to pursue the development of these areas as they are compatible with the EU's request and may make use of existing ICES resources.

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