Preliminary estimates of total seabird bycatch by ICCAT fisheries in recent years

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Abstract

Results of recent seabird bycatch studies in the ICCAT Convention area were combined to compare bycatch rates of demersal and pelagic longline, and to estimate pelagic longline bycatch per species. Preliminary results suggest that pelagic longline caught about 7% of the total longline seabird catch, and that about 57% of the pelagic longline seabird catch was albatrosses. Available studies do not apply to the full spatial and temporal extent of the fishing effort, so assumptions were made to fill missing information. Advice is requested from ICCAT to improve these assumptions, and to locate additional information.

Introduction

The aim of this paper is to provide estimates of recent total seabird bycatch in the ICCAT Convention Area. There are a large number of studies that have produced estimates of bycatch over smaller areas and for various fisheries, and this paper aims to integrate those results. These smaller fishery studies are listed in Table 1.

Various methods have been applied previously to estimate total seabird bycatch from fishing activity (e.g. Pennington 1983, Klaer and Polacheck 1997, Baird 2001, see review by Lewison and Crowder 2003). These studies use data collected by observers on individual fishing operations, and then scale the observed catch to the total catch. They provide estimates of seabird bycatch or bycatch rate for individual area/time/fishery strata. A second step is then required to aggregate the bycatch

estimates to all strata of interest. The study presented here is more concerned with the second stage, i.e. aggregation of results, and is really a meta-analysis of existing results rather than a bycatch estimation exercise using raw observations.

This paper has two specific objectives:

(1) to estimate the total bycatch of seabirds in ICCAT Convention Area from existing bycatch studies and examine the proportion caught by pelagic longline and
(2) to aggregate results from existing bycatch studies for ICCAT pelagic longline in order to estimate seabird bycatch for selected species.

Methods

ICCAT Convention Area total seabird bycatch

Existing seabird bycatch studies for fisheries within the ICCAT Convention Area have been compiled in Table 1. Effort has been made to ensure that these are independent in terms of fishery or spatial/temporal extent. Some rows in the table are incomplete and in the process of being updated. However, summing total seabird bycatch according to whether the fishing method is ICCAT pelagic longline or not should give a coarse indication of the relative scale of seabird bycatch produced by ICCAT and other fisheries within the ICCAT Convention Area.

Values that were able to be calculated using simple combinations of available information have been made so that the table is as complete as possible. A column has been added that indicates whether the study applies to ICCAT pelagic longline. Estimates of total seabird bycatch were then summed to an overall total and a total for ICCAT pelagic longline alone.

ICCAT pelagic longline seabird bycatch per species

Bycatch studies that provided estimates of seabird bycatch per species in recent years were examined in more detail. Species chosen for examination were: Cory's Shearwater *Calonectris diomedea*, Tristan Albatross *Diomedea dabbenena*,

Wandering Albatross *D. exulans*, Atlantic yellow-nosed Albatross *Thalassarche chlororhynchos* and Black-browed Albatross *T. melanophrys*. Observer data used in bycatch studies did not always split these species individually, so two additional groupings were created and identified as Albatross species (*Diomedea* and *Thalassarche*) and *Diomedea* species (Tristan, Wandering or Royal Albatross) (Table 2).

Studies were selected if they were recent pelagic longline seabird bycatch studies that included estimates of bycatch per species. If two or more studies related to the same fishery/area, then the most recent one was selected.

For each available bycatch study the overall seabird bycatch rate was extracted, and also the percentage contribution of each species or species group (Table 3). The region that the study applied to was related to ICCAT 5 degree squares as used to compile total fishing effort data. Each study was given a unique reference number, and those numbers were mapped over the distribution of total ICCAT pelagic fishing effort during the years 2003 to 2005 (Figure 1 – ID numbers shown in black). Five degree areas that did not have a corresponding bycatch estimate were allocated estimates based on nearby squares (Figure 1 – ID numbers shown in green). This allowed the application of existing bycatch estimates to all areas of ICCAT pelagic longline fishing effort.

Within each 5 degree square/year/quarter, the total seabird bycatch was estimated by multiplying total hooks set by the per hook estimate. One existing study (Neves et al., 2007) provided bycatch estimates for summer and winter separately, so these rates were applied differentially to quarters 1/4, and 2/3. All other studies provided annual estimates only, so there were no quarterly differences. Total seabird bycatch in a 5 degree square/year/quarter was assigned per species according to the corresponding per species contribution in Table 3. Total seabird and per species annual estimates were then made by adding the per 5 degree square/quarter values within each year.

Results

ICCAT Convention Area total seabird bycatch

The estimated total seabird bycatch from all fisheries within the ICCAT Convention Area was 145,494 birds annually (Table 1). Pelagic longline accounted for 9,536 birds, or about 7% of the total. Although we have not examined the species composition of the demersal longline bycatch, it should be noted that a great proportion of that catch is likely to be species other than albatrosses.

ICCAT pelagic longline seabird bycatch per species

The annual estimates of total seabird bycatch from ICCAT pelagic longline fisheries were 12,894 in 2003, 8,837 in 2004 and 5,860 in 2005 (Table 4). Over the three years from 2003-2005 the total seabird bycatch estimate is 27,591.

Based on the available data, estimates of per species proportions of the total seabird bycatch over the three years were 42% other species, 38% Black-browed Albatross, 8% Atlantic Yellow-nosed Albatross, 5% *Diomedea* species, 3% Albatross species, 2% Wandering Albatross, 1% Cory's Shearwater and less than 1% Tristan Albatross. Remember that these species groupings overlap to some extent, so Tristan Albatross, for example, probably forms part of the *Diomedea* species and Albatross species groupings. Results indicate that about 57% of the ICCAT pelagic longline seabird bycatch is albatrosses.

Discussion

ICCAT Convention Area total seabird bycatch

Studies listed in Table 1 document reasonably independent estimates of seabird bycatch for various fisheries in the ICCAT convention area. We recognise that time periods for each study are different, and that a simple addition of the estimates does not therefore relate to a specific set of years, or even the total bycatch in the region.

We primarily use these figures in an attempt to estimate the relative impact of pelagic longline to demersal longline fisheries. Results suggest that demersal longline has a much greater seabird bycatch in the region than pelagic longline. The majority of the bycatch, in terms of numbers of birds, was from Namibia, Spain (Gran Sol), Norway, Iceland and Faroes demersal fisheries. However, when evaluating the impact of these fisheries on seabird populations we need to consider the species involved. Gran Sol fishery data show bycatch predominantly of Great Shearwaters and Fulmars, which are not threatened.

The species composition of bycatch from demersal longline has not been examined here as the purpose of the current study was to examine bycatch from ICCAT fisheries. Such an examination is possible, but we also recognise that the available studies for these other methods are not as numerous, recent, or as detailed in species composition as those for pelagic longline. The majority of data on demersal fisheries are based on small sample sizes or older data sets. If this study was extended to include the species composition of demersal fisheries it would also be useful to investigate whether species can be classified and summarised according to whether they are threatened or not. However, unless substantial additional sources of information become available, it would be very difficult to justify such a detailed partitioning of the seabird bycatch within the Convention Area.

ICCAT pelagic longline seabird bycatch per species

The current approach is presented as providing preliminary estimates only. There is considerable scope to include further existing relevant studies and to use the results to direct future bycatch research in order to improve the estimates.

The method used here to estimate total seabird bycatch per species for ICCAT pelagic longline would work very well if each 5 degree square in each quarter in recent years had a well estimated bycatch rate and species composition. Available information is far from that ideal. There are large areas where significant amounts of fishing effort is placed where there are no bycatch estimates at all – in particular, the Gulf of Mexico, Eastern US, NW Africa, Eastern Mediterranean and Mid N Atlantic. This study can

be used to help define regions for which existing studies need to be found, or new ones proposed (see Phillips et al., 2007).

The method used to allocate regions to individual studies requires refinement. For example, the Jimenez et al. (2005) study has been assigned to regions as far east as 20°West (ID = 10, Figure 1), but the majority of the data in that study applies to about 45°West. We hope that discussion of this analysis and results among experts with close involvement in the original studies will lead to recommendations for better placement of these bycatch rate boundaries. Examination of species seasonal and spatial distributions will also inform these decisions.

Results from single studies have been used to generate bycatch rates over very large areas. In particular, Chang et al. (2007) has been used for much of the Atlantic high seas, both north and south of the equator. Only an overall estimate of the species composition was available from this study, even though total seabird bycatch rates were separated north and south of 25°S. It would be very useful if species composition was available from this study at least differentiated north and south of 25°S.

Available information on pelagic longline seabird bycatch rates per species in recent years, although used in this study, are severely limiting in many ways. For example, we have assumed that demersal longline seabird bycatch per species in a 5 degree square/quarter is the same regardless of the origin of the fishing fleet. We know that fishing practices such as the implementation of seabird bycatch mitigation measures probably varies across fleets. Most studies have been applied equally across a large number of 5 degree squares, and the time period and level of observer coverage varies considerably across studies.

In some cases, studies overlapped in their spatial extent. A decision was then made as to which study would apply to each 5 degree square block. Studies with ID 1 and 10 in Figure 1 overlapped, and were assigned to each side of the 30°S line because this latitude line roughly separates Brazil and Uruguay on the map. Studies with ID 8 and 9 were assigned last where no previous study applied.

The years that the ICCAT pelagic longline studies applied to ranged from 1998 to 2006, and some did not overlap in study time range at all. We recognise that seabird bycatch rates change from year to year because of changes in fishing practices and distribution of fishing effort, and it would therefore be preferable to use studies that apply to the same time periods.

The decline in the estimated annual seabird bycatch from 2003 to 2005 is simply due to reduction in fishing effort and changes in effort distribution. Actual bycatch rates used for each year were the same.

Error values have not been estimated. Coefficient of variation (CV) values of 0.5 are given in Table 3 simply to indicate that the values would necessarily be large. A CV of 0.5 implies a 95% confidence interval of the mean of nearly +/- 100%. Even if the individual study provided a CV value, if that study was applied to a wider region, then it would not be appropriate to apply that CV to the additional area. At this stage we simply recognise that the estimate errors would be large. If individual studies are independent, then a combined CV can be calculated by adding the individual study variances (variance = $(CV * mean)^2$). However, we recognise that the individual studies are not independent as they often measure the same species populations, are subject to the same variations in oceanographic conditions or changes in fishing effort distributions. When studies are not independent, the covariance amongst studies should be considered. Calculation of the covariance, per species in particular, is likely to be impossible given the available data.

Improvements to this study will be discussed within ICCAT and implemented in an updated analysis later this year. The authors would like specific guidance on the following aspects:

- Are there further known studies that should be included in this analysis?

    - What additional data are available to generate refined overall seabird bycatch rates and rates per species, particularly for pelagic longline?
    - Who might do those analyses to produce refined per species catch rates for particular areas/seasons?

- Are there specific recommendations on geographic lines to use to separate catch rates from the various studies?

- What modifications should be made to the effort data – e.g. how should effort that is currently assigned on land be dealt with?

- Which recent years should be considered for ICCAT pelagic longline bycatch estimation per species? How should this choice be related to the time-frame of relevant studies?

- Should the per species analysis be extended to demersal longline in the ICCAT Convention Area? Should the selected species list be changed? Should threatened status be included?

- Should we examine annual and seasonal changes in ICCAT fisheries effort distribution as part of this study?

The last two items above are beyond the scope of the study we had originally planned, and would be considered as project extensions.

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Table 1. Preliminary summary of seabird bycatch studies applicable to the ICCAT Convention Area for pelagic and demersal longline fishing.

Country	Location	ICCAT?	Fishery Type	Annual Effort	CPUE/1000	Source	Period	Total Seabirds
Angola	S Angola, Benguela current, S Atlantic	no		3500000	0.07	Petersen et al., 2007, Petersen et al., unpublished (2007)		245
Argentina	Patagonian shelf	no	Demersal	7200000	0.04	Frere, personal communication	2006-2007	288
Argentina	San Matias Gulf	no	Demersal		0.0			0
Brazil		no	Demersal	17700000	0.238	Neves 2001; Olmos et al. 2000	1994-1997	4,214
Brazil		yes	Pelagic	4402000	0.151	Neves et al., 2007	2000-2006	665
Canada	Gulf of St. Lawrence	no	?	30,744,000	0.007	Canadian NPOA, 2007	2001	221
Canada	Scotian Shelf and Bay of Funday	no	Demersal		0.00	Canadian NPOA, 2007	1986-2001	0
Canada	Atlantic	no	Demersal	31,250,000	0.016	Cooper et al. data in Canadian NPOA, 2007	1986-1999	500
Canada	Scotian Shelf and Bay of Funday	yes	Pelagic		0.00	Canadian NPOA, 2007	1986-2001	0
Canada	Atlantic, Scotian Shelf and Grand Banks	yes	Pelagic	43,750,000	0.032	Cooper et al. data in Canadian NPOA, 2007	1986-1999	1,400
Namibia	Benguela current, S Atlantic	no	Demersal	104000000	0.3	Petersen et al., 2007, Petersen et al., unpublished (2007)	2000-2004	31,200
Namibia	Benguela current, S Atlantic	yes	Pelagic	2,900,000	0.07	Petersen et al., 2007, Petersen et al., unpublished (2007)	2002-2004	203
Norway	NE Atlantic	no	Demersal	312,000,000	0.043	Dunn and Steel, 2001, S. Lokkeborg (pers. comm.)		13,333
Iceland	N Atlantic	no	Demersal			Dunn and Steel, 2001	1998	18,000
Faroes	N Atlantic	no	Demersal			Dunn and Steel, 2001	1998	12,000
South Africa	Benguela current, S Atlantic	no	Demersal	9,500,000	0.04	Petersen et al., 2007, Petersen et al., unpublished (2007)	2000-2004	380
South Africa	Benguela current, S Atlantic	yes	Pelagic	932000	0.2	Petersen et al., 2007, Petersen et al., unpublished (2007)	2000-2005	186
Spain	Columbretes Islands, Mediterranean	no	Demersal	1800000	0.31	Belda and Sanchez 2001	1992-1998	558
Spain	Columbretes Islands, Mediterranean	yes	pelagic	2300000	0.25	Belda and Sanchez 2001	1992-1998	575
Spain	West Mediterranean	yes	Pelagic			Valeiras and Caminas 2003		925
Spain	Gran Sol, SW Ireland	no	Demersal	3,873,239	14.2	Gran Sol Report, 2006; Dunn unpublished EC CAP draft 2007	2006	55,000
UK	Falkland Islands	no	Demersal	9355201	0.002	Falklands Conservation, unpublished data	2005-2006	19
UK	Tristan da Cunha	yes	Pelagic			Cuthbert et al., 2005	1990-1998	164
Uruguay	S Atlantic	yes	Pelagic	987,719	0.570	Jiménez & Domingo in press, PNOFA & Proyecto Albatros y Petrels unpublished data	1998- 2006	563
Uruguay		no	Demersal					0
USA	NW Atlantic, Gulf of Mexico, Carribbean	yes	Pelagic	9793 sets		Hata, 2006	2004	128
Japan, Taiwan, Korea	Atlantic	yes				Based on ICCAT effort data and Japanese Kiyota and Takeuchi/RTMP bycatch rates and Taiwan bycatch rates Chang 2007 and ICCAT effort		4,727
IUU		no						0
							Total	**145,494**
							ICCAT	**9,536**

Note: values highlighted in yellow are calculated from associated catch, catch rate or effort information.

Table 2. Seabird species or groups examined in this study and the codes used.

Common name	Species or group	Code
Albatross spp	*Diomedea* or *Thalassarche* spp	ALBSPP
Cory's Shearwater	*Calonectris diomedea*	CALDIO
Tristan Albatross	*Diomedea dabbenena*	DIODAB
Wandering Albatross	*Diomedea exulans*	DIOEXU
Wandering, Tristan or Royal Albatross	*Diomedea* spp	DIOSPP
Atlantic Yellow-nosed Albatross	*Thalassarche chlororhynchos*	THACHL
Black-browed Albatross	*Thalassarche melanophrys*	THAMEL

Table 3. Studies of pelagic longine in the ICCAT region that contain seabird bycatch estimates per species, total seabird bycatch rate per '000 hooks, and percentage contribution per species.

ID	Source	Start yr	End yr	Season	Country	Method	ICCAT Region	Rate	CV	CALDIO	DIODAB	DIOEXU	DIOSPP	ALBSPP	THACHL	THAMEL	OTHER
1	Neves, T., Mancini, P.L. and Nascimento, L. 2007.	2000	2006	2-3	Brazil	Pelagic longline	55-25W 15-40S	0.15	0.5	0.46	0.00	0.61	2.73	0.00	16.97	10.44	68.79
2				1-4				0.07	0.5	0.46	0.00	0.61	2.73	0.00	16.97	10.44	68.79
3	Fisheries and Oceans Canada. 2007.	2001	2001	0	Canada Gulf of St Lawrence	Pelagic longline	55-70W 45-55N	0.0072	0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
4		1986	2001	0	Scotian Shelf, Bay of Fundy	Canadian pelagic longline, assume 2000 hooks per set	55-75W 40-45N	0.02290576	0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
5		1989	2001	0	Newfoundland	Faroes pelagic longline, assume 2000 hooks per set	50-55W 45-50N	0.00044893	0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
6	Petersen, S., Nel, D. and Omardien, A. 2007.	2000	2005	0	South Africa, Namibia	Pelagic longline	5W-20E 35S-20S	0.2	0.5	0.00	0.00	0.00	0.00	9.14	10.15	19.80	60.91
7	Valeiras, J. and Caminas, J.A. 2003.	1999	2000	0	Spain	Pelagic longline	5W-5E 35N-40N	0.0133	0.5	42.86	0.00	0.00	0.00	0.00	0.00	0.00	57.14
8	Chang, S., Tai, J. and Shiao, C. 2007.	2002	2005	0	Chinese Taipei	Pelagic longline	Atlantic N of 25S	0.00063714	0.5	0.00	0.00	10.50	0.00	14.50	20.00	19.50	35.50
9							Atlantic S of 25S	0.03078745	0.5	0.00	0.00	10.50	0.00	14.50	20.00	19.50	35.50
10	Jimenez, S., Brazeiro, A. and Domingo, A. 2005.	1998	2006	0	Uruguay	Pelagic longline	55-20W 40S-25S	0.26	0.5	0.00	0.76	3.05	10.69	0.00	3.05	65.65	16.79

Notes: Blank values in the table take existing values from preceding rows (e.g. ID 1 and 2 have the same source). Season 0 means that seasonal estimates were unavailable.

Table 4. Estimated total seabird catch by pelagic longline from the ICCAT Convention Area using rates from Table 3 and distribution from Figure 1.

Year	000 Hooks	Birds	CALDIO	DIODAB	DIOEXU	DIOSPP	ALBSPP	THACHL	THAMEL	Other
2003	385,654	12,894	105	51	282	756	399	960	5,324	5,017
2004	363,970	8,837	127	31	163	458	307	656	3,371	3,724
2005	315,982	5,860	149	13	140	228	234	586	1,727	2,783
Total	1,065,605	27,591	381	95	585	1,442	939	2,202	10,423	11,525

Figure 1. Total ICCAT fisheries pelagic longline fishing effort 2003-2005 overlayed with existing seabird bycatch estimate ID numbers from Table 3.