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**Assessment of the impact of ICCAT fisheries on seabirds:
proposed methodology and framework for discussion**

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Abstract

This document sets out a draft framework for an assessment of the impact of ICCAT fisheries on seabirds to facilitate discussion by the ICCAT Ecosystems Sub-committee. The assessment could involve two phases, the first relating to data gathering, mapping and summation, and the second to the incorporation of these empirical data and analyses in the development and application of more complex models. This would be a tiered process with several objectives: (i) identify seabird species most at risk from fishing in the ICCAT Convention Area, (ii) collate available data on at-sea distribution of these species, (iii) analyze the spatial and temporal overlap between species distribution and ICCAT longline fishing effort, (iv) review existing bycatch rate estimates for ICCAT longline fisheries, (v) estimate total annual seabird bycatch (number of birds) in the ICCAT Convention Area, (vi) assess the likely impact of this bycatch on seabird populations. This is a working document that is open for input and guidance from the Ecosystems Sub-committee and other stakeholders.

INTRODUCTION

In accordance with the resolution by the International Commission for the Conservation of Atlantic Tunas (ICCAT) on Incidental Mortality of Seabirds (Res. 02-14), the ICCAT Sub-committee on Ecosystems is holding an inter-sessional meeting with a number of objectives, including (4.3) “Assessment of the mortality of sea birds in the ICCAT fisheries (in accordance with the *Resolution on Incidental Mortality of Seabirds [Res. 02-14]*). In preparation for this meeting, a draft assessment framework and a description of available sea bird information could be prepared by a sea bird expert. Similarly, a description of available fisheries information (from ICCAT) would be helpful.” (Circular # 2370/06). This document aims to fulfill the first part of this objective by providing the draft assessment framework.

The framework has been developed by the authors with input from a number of individuals and indicates the series of steps which they hope should lead to a robust and statistically defensible assessment of the impact of ICCAT fisheries on seabird populations. It is a working document with the intention that it be open for discussion at the meeting and inter-sessionally. The authors seek the input and guidance of the ICCAT Ecosystems Sub-committee and other stakeholders, including suggestions for any refinement of methodology or substitution of alternative approaches, the provision of additional unpublished data (particularly on fishing effort and rates of seabird bycatch collected by fisheries observers), and priorities for inclusion or exclusion of seabird species in any assessment (based, for example on an Ecological Risk Assessment – see under Objective 6). To this end, the text indicates a step-by-step approach to the assessment that highlights various data considerations and caveats in order to stimulate discussion on a number of key issues. The hope is that following this meeting, the revised methodology will be endorsed by members of the Ecosystem Sub-Committee such that much of the

data collation and model-building can take place inter-sessionally, during which time the Sub-Committee would be kept fully informed of progress.

METHODOLOGY

The assessment could proceed along the following lines, involving two phases. The first phase relates to data gathering, mapping and summation (objectives 1-4). The second phase would involve the incorporation of these empirical data and analyses in the development and application of models for assessing impacts on seabird populations (objectives 5-6).

OBJECTIVES

- 1. Identify seabird species most at risk from fishing in the ICCAT Convention Area.**
- 2. Collate available data on at-sea distribution of these species.**
- 3. Analyze the spatial and temporal overlap between species distribution and ICCAT longline fishing effort.**
- 4. Review existing bycatch rate estimates for ICCAT longline fisheries.**
- 5. Estimate total annual seabird bycatch (number of birds) in the ICCAT Convention Area.**
- 6. Assess the likely impact of this bycatch on seabird populations.**

DETAILED OBJECTIVES

1) Identify seabird species most at risk from fishing in the ICCAT Convention Area.

This could be achieved by reviewing available studies of seabird bycatch in ICCAT or adjacent fisheries and identifying the species and provenance (breeding colonies) of birds that are killed or captured. Further species/populations could be added to this list if they have similar foraging and life-history characteristics and are known to be vulnerable to bycatch in other fisheries (the number of these is likely to be small). A call would be made for unpublished seabird bycatch data to ensure the final list was as comprehensive as possible. Although no substantive problems are envisaged in the compilation of the list, defining the criteria for identifying priority species to be included in more in-depth impact assessment would require further discussion (see below).

2) Collate available data on at-sea distribution of these species.

BirdLife International is the repository of the Global Procellariiform Tracking Database, results from which were included in the *Tracking Ocean Wanderers* report published in 2004 (BirdLife International, 2004). Further tracking data have been incorporated in the Database since this publication. These data were collected predominantly using satellite-transmitters (Platform Terminal Transmitters or PTTs) and to a lesser extent using geolocators (GLS loggers). Although less accurate, GLS loggers are ideal for tracking wintering ranges of pelagic species (Phillips *et al.*, 2004). The Global Procellariiform Tracking Database is an exceptional resource that BirdLife International have kindly agreed could be made available for the proposed ICCAT seabird bycatch assessment study. However, it should be noted that access to these data is entirely at the discretion of the many dataholders who have collected tracking data at considerable effort and expense, and requires their explicit permission.

Tracking data would be processed using standard methods (BirdLife International, 2004), involving the elimination of locations that required unrealistically high flight speeds. Data can be interpolated assuming straight line flight between successive locations, with resampling at whatever interval is deemed appropriate (typically hourly for satellite-transmitter data, and twice-daily for geolocation data). Further analysis would account for duty-cycling (timed on-off periods of transmission by pre-programmed PTTs), missing data (e.g. during equinox periods for geolocator datasets) and erroneous locations on land (geolocator datasets). If data are available, appropriately weighted density distribution maps or utilization distributions (kernels) could be produced for relevant combinations of species, colony, breeding status (breeder/nonbreeder), age (juvenile/immature/adult) and sex, split temporally according to breeding/nonbreeding season and breeding stage (pre-laying/incubation/brooding/post-brood), accounting for annual changes in distribution if appropriate. This would indicate the proportion of the at-sea distribution of birds of each species, colony and breeding status etc. that is likely to occur within a particular area (e.g. 5° x 5° grid square) at a particular time of year.

Assuming permission is granted by the dataholders, this type of analysis is relatively straightforward, although time-consuming. However, data availability is a major issue. Although many (but not all) of the seabird species likely to be of interest have been tracked, there are usually data gaps. (1) A major limitation is the lack of non-breeding distribution data for most species (this is usually winter, as most seabirds breed during the summer). Although there may be a small number of PTT tracks from dispersing (usually failed) breeders at the end of the breeding season in the BirdLife Database, these usually cover only a few weeks in the early migration period and are not adequate for mapping the full extent of the wintering range or highlighting the key areas. There are several studies in progress

(mainly of nonbreeding birds fitted with geolocators), data from which would be invaluable for this assessment. However, analysis of geolocation data is time-consuming and it may be some months before these can be made available (although processing of data for key species could be carried out as a priority). (2) There are very few data on the distribution of juveniles or immatures, yet these may be particularly vulnerable to incidental mortality - either they feed in different areas from adults, spend the entire year (rather than just the winter) in the same areas as nonbreeding adults and/or have higher capture rates behind vessels. At South Georgia, large-scale population declines of three different albatrosses are to a considerable extent the result of substantial declines in immature survival in the last two decades (Croxall *et al.*, 1998). (3) Studies often cover only part of the breeding season, and distributions can vary more between breeding stages (incubation/brooding/post-brooding) within species, than between species at the same stage. (4) Even amongst nominally annually-breeding species, often a very high proportion of established breeders do not breed in a given year (sometimes termed 'sabbatical birds'), and even amongst birds that lay, many fail early in the season. There can be as many birds in these categories as there are active breeders, yet there has been very little tracking of either group during the summer – they may remain in, or travel to, wintering areas, or use an extended version of the typical foraging range of active breeders. (5) There have been few tracking studies of the same species and life-history group in multiple years, so it will be difficult to account for potential inter-annual variation in distribution. (6) Sample sizes can be small because only a few individuals were tracked (although fortunately this does not apply to most of the datasets likely to be used in this assessment).

Various approaches could be taken to fill data gaps. (1) For species where data are available for birds of known status, make assumptions about the likely distribution of other groups based on differences

observed in other studies e.g. introduce a buffer zone around the range of active breeders and assume that corresponds to the distribution of failed/sabbatical birds; assume the distribution of immatures is broadly the same as that of wintering adults etc. (2) For species/populations that have never been tracked, develop models of habitat preference, utilization and availability based on the same or ecologically similar species at other sites. This could be more or less time-consuming depending on the relative degree of sophistication of the models and would require access to bathymetric and remote-sensed environmental data. (3) Incorporate at-sea observations. Although these do not provide information on colony of origin and status (active breeder/failed breeder/nonbreeder etc.), such records are potentially extremely useful for confirming year-to-year consistency in distribution, for inferring the distribution of species that have not been tracked and, where immatures can be differentiated, for determining whether their distribution matches that of adults. Their inclusion would, however, require some obstacles to be overcome: variation in survey coverage and intensity (there are few studies on the high seas, often only a small proportion of the total potential foraging area will have been included in transects, and critical areas could be missed given the patchiness of seabird distributions); analytical complexities (these need to account for differences in methodology during data collection, and to extrapolate from often limited spatial and temporal coverage to predict overall distributions), and; permission would need to be sought from data holders. (4) Use data on foraging trip durations measured at colonies to estimate feeding ranges based on typical flight speeds. This is crude but might be the only approach available for some species. (5) Incorporate general range maps from published species accounts (e.g. Handbook of Australian, New Zealand and Antarctic Birds, Birds of the Western Palearctic, BirdLife International Threatened Birds of the World). (6) Initiate dedicated tracking programs for the key species, breeding populations and life-history stages identified as potentially the

most vulnerable to fisheries bycatch in an initial gap analysis. Resulting data could then be incorporated into models at a later stage of the assessment.

3) Analyze the spatial and temporal overlap between species distribution and ICCAT longline fishing effort.

A key aspect of this will be the provision of data by ICCAT member nations. Providing that the fishing effort data were of the appropriate spatial and temporal resolution and sufficient information was available on gear type and target species (for Discussion at the meeting), overlaying of maps of seabird distribution (produced under Objective 2 above) on spatial distribution of fishing effort would be relatively straightforward, although time-consuming. However, issues pertaining to missing data and known or inferred annual changes in fishing effort may introduce complications. Early identification of gaps in fishing effort data might allow improved data collection or collation by ICCAT members within the timescale of the assessment.

4) Review existing bycatch rate estimates for ICCAT longline fisheries.

Reviewing existing studies of seabird bycatch rates in ICCAT and adjacent fisheries (for comparative purposes) is uncomplicated providing there is sufficient detail in the methodology sections. However, lack of data from some fisheries and the limited observer coverage in others may be a problem in fulfilling Objective 5. It is hoped that data from other seabird bycatch studies will be made available by ICCAT members for the purposes of this assessment.

5) Estimate total annual seabird bycatch (number of birds) in the ICCAT Convention Area.

The methods for statistically estimating seabird bycatch are generally well established in the scientific literature (Klaer and Polacheck, 1997, Lewison *et al.*, 2004). However, because of the likely heterogeneous and sparse nature of the data, some method development may be required. For example, precautionary methods could be developed based on a risk assessment of the type adopted by the Commission for the Conservation of Antarctic Living Marine Resources (CCAMLR, 2005). The ability to estimate total annual bycatch of selected species will be dependent on the quantity, quality, and successful integration of the available data on seabird distribution, fishing effort and bycatch rates carried out as part of Objectives 1-4. Statistically robust methods will then be applied to estimate bycatch by species and total bycatch in the ICCAT area of jurisdiction, based on overall longline fishing effort and using best and worst case bycatch rate scenarios.

(6) Assess the likely impact of this bycatch on the affected seabird populations.

This requires information on population status and, preferably, detailed demographic data collected from long-term monitoring studies at breeding colonies. One approach that has been successfully applied in the assessment of fishery impacts on target and non-target species is the Ecological Risk Assessment (ERA) framework developed by Hobday *et al.* (2006). Given the potentially large number of seabird species involved, variation in the quantity and quality of the data available and the complexity of the modeling necessary for fully quantitative estimation, a staged or hierarchical approach should be considered for the ICCAT assessment, according to this ERA framework or that adopted by CCAMLR (CCAMLR, 2005).

The multi-level risk-framework adopted in an ERA moves from a comprehensive but largely qualitative analysis of risk at the lower levels (for species considered to be minimally affected), through a more focused and semi-quantitative approach, to a highly focused and fully quantitative “model-based” approach at the highest level (for high risk species for which good quality distribution and demographic data is available). This method is efficient because many minimally affected species are screened out at the lowest levels, so that the more intensive and quantitative analyses (ultimately at the highest level) are limited to a much smaller subset of high risk seabirds. This ERA framework also provides a basis for the rapid identification of high-risk species and potentially detrimental fishery activities, which in turn can lead to immediate remedial action (risk management response) without the need for full quantitative assessment. The approach is also precautionary, in the sense that risks may be scored high in the absence of information, evidence or logical argument to the contrary.

The guidelines for inclusion of particular species at different levels of the analysis (in effect whether they are considered under each of the objectives) would need to be developed through consultation with key scientists and stakeholders involved in the project. The decision rules at the lower levels will probably require literature-based assessments of the scale and intensity of interactions, and knowledge of breeding productivity and likely susceptibility to varying degrees of incidental mortality. The higher levels will require intensive modeling based assessments (Tuck *et al.*, 2001).

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