Received: 21 August 2015
IOTC–2015–WPEB11–36

ESTIMATION OF SEABIRD BYCATCH RATES AND NUMBERS

Anton Wolfaardt[1], Igor Debski[2]

SUMMARY

There is a range of methods that have been used to estimate and monitor levels of seabird bycatch in fisheries. Inevitably, the assessment methods are dependent on the quantity and quality of data available, as well as the specific objectives of the review. Where there is 100% observer coverage, bycatch should be completely observed, and there is no need for extrapolation. However, in most situations, observer coverage is substantially lower, and extrapolation of bycatch from observed fishing effort to total fishing effort is required. Within IOTC and the other tuna RFMOs, analysis and monitoring of seabird bycatch levels over time will most likely include a) bycatch rates per unit fishing effort (e.g. birds per 1000 hooks) and the total number of birds killed. The Seabird Bycatch Working Group of the Agreement on the Conservation of Albatrosses and Petrels (ACAP) is currently undertaking work to identify guidelines on methodologies for estimating bycatch in both data-rich and data-poor scenarios. A brief outline of the intersessional work being progressed by ACAP is provided so as to encourage linkages between the ACAP process and work being undertaken or planned within IOTC and other RFMOs.

KEYWORDS by-catch estimation, seabirds

1. Introduction

The review by IOTC of the efficacy of seabird bycatch mitigation measures prescribed in Resolution 12/06 will need to include some estimate and assessment of seabird bycatch. There is a range of methods that may be used to estimate and monitor levels of seabird bycatch in fisheries. Inevitably, the assessment methods are dependent on the quantity and quality of data available, as well as the specific objectives of the review. In most situations, including for IOTC, only a portion of the total fishing effort is formally observed for bycatch events. Consequently, extrapolation of bycatch figures from observed fishing effort to total fishing effort is required. Within IOTC and the other tuna RFMOs, assessment and monitoring of seabird bycatch levels over time will most likely include estimates of a) bycatch rates per unit fishing effort (e.g. birds per 1000 hooks) and the total number of birds killed per fleet. There are a number of issues to consider when estimating these parameters. The Seabird Bycatch Working Group of ACAP is currently undertaking work to develop guidelines on methodologies to estimate seabird bycatch that would be suited to the likely range of raw data available across different jurisdictions and fisheries, encompassing varying resolution, precision and data collection methods. The purpose of this paper is to provide a brief outline of the intersessional work being progressed by ACAP to encourage linkages between the ACAP process and work being undertaken or planned within IOTC and other RFMOs.

2. Bycatch rates per unit fishing effort

One of the commonest ways to measure and report levels of seabird bycatch is to express the number of birds caught per 1000 hooks set/hauled. Although this is a simple and well-understood parameter, there are challenges

1 Convenor, Seabird Bycatch Working Group, Agreement on the Conservation of Albatrosses and Petrels (ACAP), c/o ACAP Secretariat, 27 Salamanca Square, Battery Point, 7004, Tasmania, Australia. acwolfaardt@gmail.com

2 Vice-convenor, Seabird Bycatch Working Group, Agreement on the Conservation of Albatrosses and Petrels (ACAP), c/o ACAP Secretariat, 27 Salamanca Square, Battery Point, 7004, Tasmania, Australia idebski@doc.govt.nz

regarding representativeness and bias associated with low levels of observer coverage (see also below). Furthermore, even if bycatch rates decline, impacts on seabirds could increase if fishing effort increases. In some cases, changes in bycatch rates could also reflect declining or increasing seabird populations. Consequently, bycatch rates should be used in combination with, and as part of, other indicators for monitoring trends over time.

3. Estimating the total number of birds killed

3.1 Simple ratio estimate

The simplest method of extrapolating bycatch from observed to total fishing effort is to multiply the rate estimator (observed bycatch rates) by the total fishing effort (in the case of longline fishing, this would be number of hooks set). This can be applied to data across a fleet. The number of birds observed caught is divided by the number of hooks observed to derive the ratio estimator (Birds Per Unit Effort, or BPUE), which is normally expressed as the number of birds caught per 1000 hooks set. BPUE is then multiplied by the total fishing effort within the fleet or fishery to estimate the total number of birds killed. Ratio estimation relies on the assumption that the observed fishing effort is similar to the unobserved effort. Seabird bycatch rates and numbers are influenced by a range of environmental, ecological and operational factors (Klaer and Polacheck 1998), and it is inappropriate to assume that bycatch and associated data collected for a small sample of the overall fishing effort is necessarily representative of the whole fleet. Applying a bycatch rate from a particular area/time across a whole fleet, much/some of which may not be interacting with the seabirds will result in biases.

3.2 Stratified ratio estimate

In order to improve the accuracy of bycatch estimation in cases where bycatch rates vary spatially and temporally within the fleet it is useful to stratify the data. However it is important to ensure that sufficient data are contained within each stratum to allow estimation of total bycatch for each stratum.

The amount of data required to enable total bycatch to be estimated within each stratum is influenced by the level of observer coverage and the frequency of bycatch events observed. Stratifying the ratio estimation helps address the issue of representativeness because the observed and unobserved fishing effort are likely to be more similar within the strata than for the entire fleet.

A previous exercise to estimate seabird mortality in the ICCAT Convention Area stratified the estimates spatially on the basis of the 5 x 5° degree grid squares used by ICCAT to compile total fishing effort data, and per year or quarter, depending on the temporal resolution of the available data (Klaer 2012). There were many squares for which bycatch rates were not available, and these were allocated rates based on estimates from adjacent or nearby squares.

3.3 Model based extrapolation

If additional data are recorded by observers for variables that might influence the capture rate of seabirds (such as specific fishing activities and environmental conditions), it may be possible to construct statistical models that analyse the effect of these variables on seabird bycatch. One can then estimate the expected level of bycatch based on these variables and resulting coefficients.

This method is better able to account for a lack of representativeness of observer coverage. Models can be of varying complexity depending on the data available (i.e. observer coverage level). For example, the inclusion of random year effects and random vessel effects are possible when sufficient data are available and will improve the model fit.

3.4 Quantitative risk assessment approaches

More complicated modelling approaches have been used to estimate total seabird bycatch. One example of this is the quantitative risk assessment for seabirds undertaken by New Zealand (Richard and Abraham 2013). This method uses seabird distribution maps and migration timing to estimate overlap with fishing effort. The overlap is compared to observed captures to estimate the vulnerability of species to capture. The vulnerability is applied to the fishing effort to predict annual potential fatalities (note the different terminology, annual potential fatalities are an assessment of risk rather than a true estimate of what would be observed with 100% observer coverage). This approach includes estimates for multipliers for cryptic mortalities but does not account for lack of observer representativeness.

4. General considerations

An important consideration for bycatch estimation is whether it is possible to estimate bycatch by species or some species groupings. The ability to provide estimates for each species is dependent on the accurate identification of bycaught seabirds by the observers. In order to understand the conservation implications of bycatch, it is clearly preferable that estimates are derived for each species, which can also then be aggregated to groupings of birds, and for all birds combined. Consequently, efforts should be directed towards encouraging the identification of all bycaught birds to the lowest level of taxonomic resolution (i.e. species level identification), by for example retaining carcasses, biological samples, and taking photographs for later identification. However, it may not always be possible to identify a bycaught bird to species level. In these cases, the identification of a bycaught bird at a coarser level (e.g. large/great albatross), or even unidentified birds, still contribute to the estimate of the total number of birds caught.

Given the low levels of observer coverage in most observer programmes, data gaps and unobserved strata (for both bycatch rates and fishing effort, but especially the former) represent one of the most significant challenges in raising/scaling up bycatch estimates from observed to total fishing effort. Consequently, several assumptions are required to fill observations in space and time, which inevitably leads to high but unquantified uncertainty in bycatch estimates (Tuck et al. 2011). It is important that the potential bias and uncertainty associated with unobserved effort is accounted for, or at least acknowledged in any assessment process.

5. ACAP process to develop advice for methods to estimate seabird bycatch

The Seabird Bycatch Working Group of ACAP is currently undertaking work to develop guidelines for estimating bycatch in both data-rich and data-poor scenarios. This work forms part of a process to develop further and improve the bycatch data reporting and assessment framework for ACAP Parties (member countries). The first step in this process is to define clearly the bycatch indicators that would be used by ACAP to measure and track bycatch of ACAP species. Once these indicators are defined, the data, methodological approaches to estimating bycatch, and reporting requirements will be determined.

The primary indicator for bycatch has been defined, for ACAP purposes, as the total number of birds killed per year of ACAP species (by species where possible), and their bycatch rate, across each of the fisheries of member Parties. A range of methodological approaches could be used by Parties to estimate these figures, and appropriate methodologies would vary according to data availability. The frequency of estimates, the accuracy of estimates, the ability to back cast estimates to the establishment of ACAP, and the ability to distinguish between species in bycatch are all recognised as key considerations.

The aim of the ACAP intersessional process is to review the range of methodologies currently used by Parties, in order to establish guidelines and advice on suitable methodologies. The proposed work programme includes the following components:

- Refine the proposed indicator relating to the bycatch rates and total number of birds killed. This will include identifying and considering key issues influencing interpretation of bycatch estimates (e.g. how to deal with uncertainty in species identification and estimation).

- Identify a range of methodological approaches that could be used to report against the bycatch indicator. These approaches should be suited to the likely range of raw data available across different jurisdictions and fisheries, encompassing varying resolution, precision and data collection methods. The range of input data (e.g. varying levels of observer coverage, electronic monitoring, industry reported) for which analytical methods are required will be identified. Bycatch estimation methods currently in use will be described to identify suitability, strengths and weaknesses of each method.

- Develop a reporting framework that allows input of bycatch estimates across the range of recommended methods such that each jurisdiction/fishery estimate can be provided in the most robust form. The framework will encompass the range of recommended bycatch estimation methods developed.

The outputs of this intersessional work will be presented in a paper to the next meeting of ACAP's Seabird Bycatch Working Group, which will likely take place in April-May 2016.

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