# Incidental capture of seabirds in fishing for southern bluefin tuna in the New Zealand waters in 2003 and 2004.

Susan Waugh and Darryl MacKenzie
Ministry of Fisheries and Proteus Wildlife Research Consulting

## Abstract

Incidental catch rates and estimated total captures of seabirds in New Zealand, Japanese charter and Philippine charter vessels are reported for fishing in New Zealand waters for southern bluefin tuna *Thunnus maccoyi.*

## Introduction

This paper reports on the incidental capture of seabirds on vessels fishing for southern bluefin tuna in New Zealand waters during 2003 and 2004. The catch rates and total estimated captures of seabirds are estimated by fleet, with New Zealand, chartered Japanese and Philippines vessels treated separately. This work updates material presented to previous meetings of the CCSBT-ERSWG (CCSBT-ERS/0111/05, 31, 32, CCSBT-ERS/0402/11).

New Zealand annually estimates seabird and marine mammal incidental take in fisheries in New Zealand waters. Results presented here are a subset of the dataset used for these analyses.

## Methods

*Seabird bycatch estimation*

The capture of seabirds during surface long-lining is a relatively rare event. As such, bycatch data (the number of birds captured per set) from observer programmes is very sparse with a large number of zero observations. To account for this when estimating seabird bycatch, here we followed MacKenzie and Fletcher (MacKenzie and Fletcher, unpublished report) and used a model-based estimation approach where the number of seabirds captured per set is assumed to follow a two-component *mixture distribution*; in this case a mixture of zeros and random values from a Poisson distribution. The main advantage of using a model-based approach in this setting is the ability to borrow information from data-rich strata to improve estimates of seabird bycatch in strata that had little observer coverage.

The first component of the mixture distribution is a binary (0-1) random variable ($Z$), which is used to model the excess number of zeros. If $Z = 0$ then no seabirds will be caught, but if $Z = 1$, then the number of seabirds caught will be a random value from a Poisson distribution: the second model component. We therefore need to estimate two parameters; the probability $Z = 1$ ($p$) and the Poisson rate parameter ($\lambda$; lamda). These parameters can be modelled to allow them to vary for fishing events conducted in different years, regions, seasons and so forth. Here four factors were included in the $p$ and $\lambda$; fishing fleet (Japanese/NZ Charter, Domestic or Philippine/NZ Charter), year, fishing area and number of hooks set. Four fishing areas were defined based upon fishery management areas (FMAs); 1) FMAs 1,2, 4, 8-10; 2) FMAs 3 and 6; 3) FMA 5; and 4) FMA 7.

The probability that $Z = 1$ for a set by a vessel in fleet F, year Y, fishing area A with H 1000 hooks was modelled as

$$\text{logit}\left(p_{\text{FYAH}}\right) = \alpha + \beta_{\text{F}} + \delta_{\text{Y}} + \gamma_{\text{A}} + \upsilon\text{H}$$

where $\beta$, $\delta$, $\gamma$ and $\upsilon$ denote the fleet, year, fishing area and number of hooks set effects respectively.

The Poisson rate parameter was modelled using a log-link function (to maintain values of $\lambda$ in the range 0 - infinity) with the same factors as above. Hence, given seabirds were at risk of being caught incidentally, the bycatch rate (per 1000 hooks) for a set by a vessel in fleet F, year Y, fishing area A with H 1000 hook was modelled as,

$$\log\left(\lambda_{\mathrm{FYAH}}\right) = \alpha' + \beta'_{\mathrm{F}} + \delta'_{\mathrm{Y}} + \gamma'_{\mathrm{A}} + \upsilon'\mathrm{H}\ .$$

As $\lambda$ is the bycatch rate parameter per 1000 hooks, given $Z$ =1 the number of seabirds caught is a random value from a Poisson distribution with mean H $\lambda$.

The model was fit to the data using Bayesian statistical methods (Markov chain Monte Carlo; MCMC) in the software WinBUGS. Vague or uninformative prior distributions were used for all model parameters (normal distributions with mean = 0.0 and variance = 100.0). For the MCMC analysis, 3 chains with different initial values were used for each model. The chains were initially run for 10,000 iterations to achieve appropriate convergence and mixing of the chains. The chains where then run for an additional 10,000 iterations to predict seabird bycatch on unobserved sets using the same approach as MacKenzie and Fletcher (*unpublished report*). This results in 30,000 samples from the approximate posterior distribution of predicted seabird bycatch. Reported in Table 1 is the median value of the posterior distribution, and the $2.5^{\mathrm{th}}$ and $97.5^{\mathrm{th}}$ percentiles to represent a 95% credible interval (analogous to a 95% confidence interval).

## Results and Discussion

### *Seabirds*

A summary of seabird bycatch data collected via the scientific observer programme during 2003 and 2004 is given in Table 1. Observer coverage is high in the non-domestic fleets, but very low in the domestic fleets resulting in very wide credible intervals for the estimated total bycatch (Table 1). Figure 1 indicates the start positions of all sets that targeted or captured southern bluefin tuna during 2003 and 2004, combined for all fishing fleets. Note that there was very little coverage of sets made off the east coast of the North Island, which represents most of the domestic fishing effort.

**Table 1.Summary of data from scientific observers and estimated total seabird bycatch. -, no data.**

| | *Fishing Fleet* | | |
|---|---|---|---|
| | Japanese Charter | Domestic | Philippine Charter |
| Observed sets | | | |
| 2003 | 264 | 84 | 21 |
| 2004 | 334 | 135 | - |
| Observed hooks (1000s) | | | |
| 2003 | 809.9 | 241.7 | 74.8 |
| 2004 | 1029.7 | 318.2 | - |
| Observed seabird captures | | | |
| 2003 | 42 | 1 | 19 |
| 2004 | 47 | 24 | - |
| Overall Strike Rate per 1000 hooks | | | |
| 2003 | 0.052 | 0.004 | 0.254 |
| 2004 | 0.046 | 0.075 | - |
| Estimated Total Bycatch | | | |
| 2003 | 45 (42, 49) | 439 (110, 1293) | 22 (19, 26) |
| 2004 | 53 (49, 60) | 322 (124, 799) | - |
| Unobserved hooks (1000s) | | | |
| 2003 | 61.1 | 2713.6 | 13.4 |
| 2004 | 103.5 | 1954.9 | - |
| Unobserved sets | | | |
| 2003 | - | 2244 | - |
| 2004 | 8 | 1640 | - |

Seabirds caught during 2003 and 2004 were identified to 11 different taxa (Table 2). Of these, one is listed as Endangered species by the IUCN, five as Vulnerable, and two as Near Threatened (IUCN 2004). For the remaining species, the IUCN threat classification has not been assessed.

**Table 2. Seabirds species identified by experts, caught during fishing for southern bluefin tuna in New Zealand waters in 2003 and 2004.**

| *Species* | *Scientific name* | *IUCN threat classification* | *Number caught in 2003* | *Number caught in 2004* | *Total* |
|---|---|---|---|---|---|
| Buller's albatross | *Thalassarche bulleri* | VU D2 | 17 | 22 | 39 |
| Black-browed albatross | *Thalassarche melanophris* | EN A4bd | | 1 | 1 |
| Campbell albatross | *Thalassarche impavida* | VU D2 | 4 | 1 | 5 |
| Grey petrel | *Procellaria cinerea* | NT | 2 | 3 | 5 |
| Grey-faced petrel | *Pterodroma macroptera gouldi* | Not assessed | 1 | | 1 |
| Light-mantled albatross | *Phoebetria palpebrata* | NT | - | 1 | 1 |
| Southern Royal albatross | *Diomedea epomorphora* | VU D2 | 3 | - | 3 |
| Gibson’s wandering albatross | *Diomedea exulans gibsoni* | Not assessed | 4 | - | 4 |
| White-chinned petrel | *Procellaria aequinoctialis steadi* | VUA2bcde+3bcde | 3 | 2 | 5 |
| White-capped albatross | *Thalassarche steadi* | Not assessed | 1 | 16 | 17 |
| Westland petrel | *Procellaria westlandica* | VU D2 | 1 | 1 | 2 |
| Unidentified species | | | 26 | 24 | 50 |
| **Total** | | | 62 | 71 | 133 |

Fifty other birds did not have their species identifications verified by an expert. For these birds, observers recorded species identifications, in 2003 and 2004 respectively, as Buller's Albatross (20, 17), Sooty shearwaters *Puffinus griseus* (0, 4), Campbell Albatross (2, 0), White-capped Albatross (1,1) Westland Petrel (0,1), and Grey-headed Albatross *Thalassarche chrysostoma* (1,0). The remainder were not identified to species level.

Twenty-four percent of seabirds caught were landed alive, indicating that they were probably caught on the haul.

## Conclusions

The study showed that a wide range of seabird species are vulnerable to capture in fisheries targeting southern bluefin tuna. These species range in conservation status from rare to abundant, with eight species having vulnerable to endangered threat classifications. The birds were landed both dead and alive, with an important proportion (24%) landed alive. This indicates that birds were caught both at the set and during the haul, and mitigation techniques need to be applied during both parts of the fishing operation to avoid seabird captures.

## Acknowledgements

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## References

MacKenzie, D. I., and D.J. Fletcher. Characterisation of seabird captures in NZ fisheries: final report. Unpublished Ministry of Fisheries report

IUCN 2004. *2004 IUCN Red List of Threatened Species.* <www.iucnredlist.org>. Downloaded on 12 January 2006

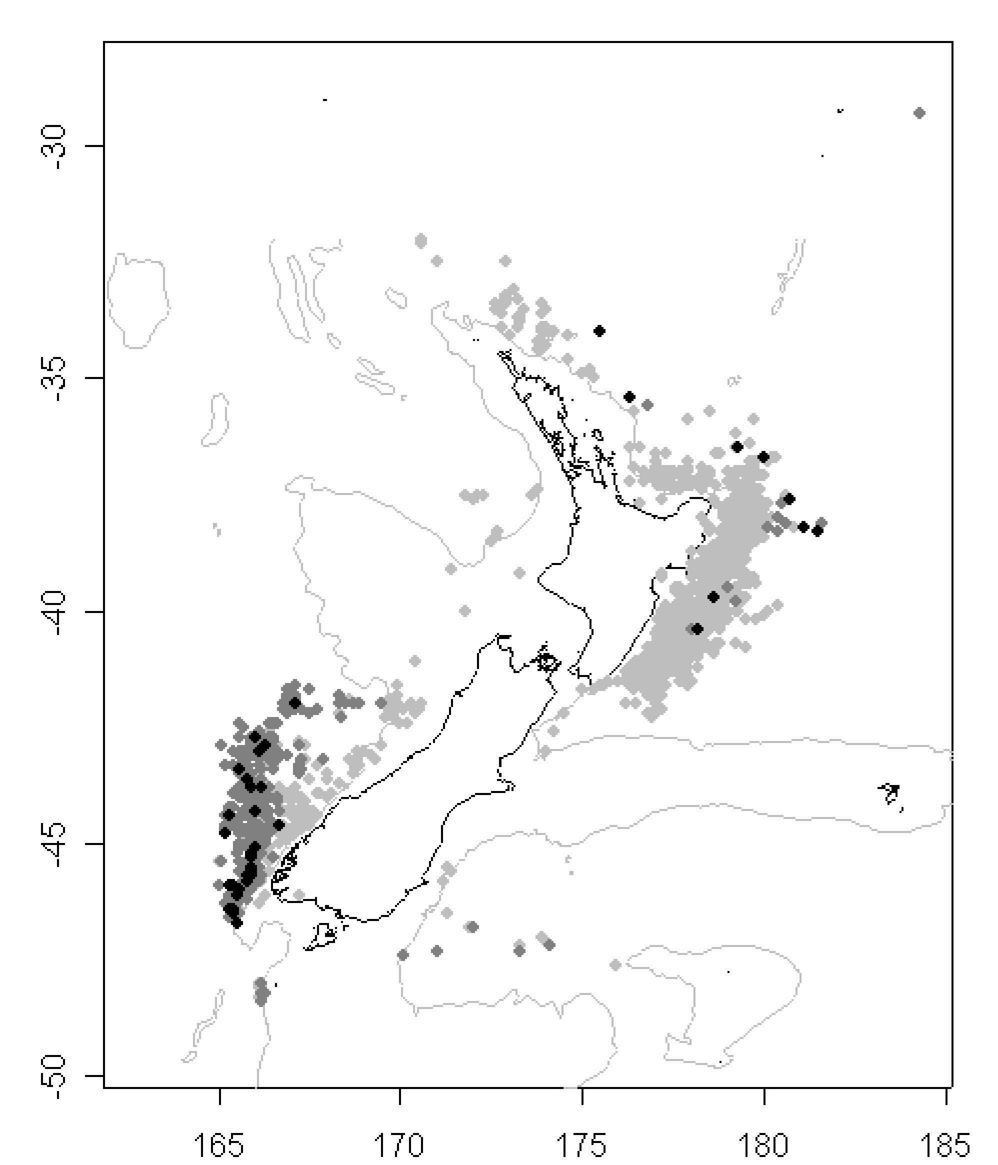


**Figure 1: Start position of sets that targeted or caught STN in 2003. Indicated are 1) unobserved sets (●); 2) observed sets with no seabird bycatch (●); and 3) observed sets with seabird bycatch (●)**

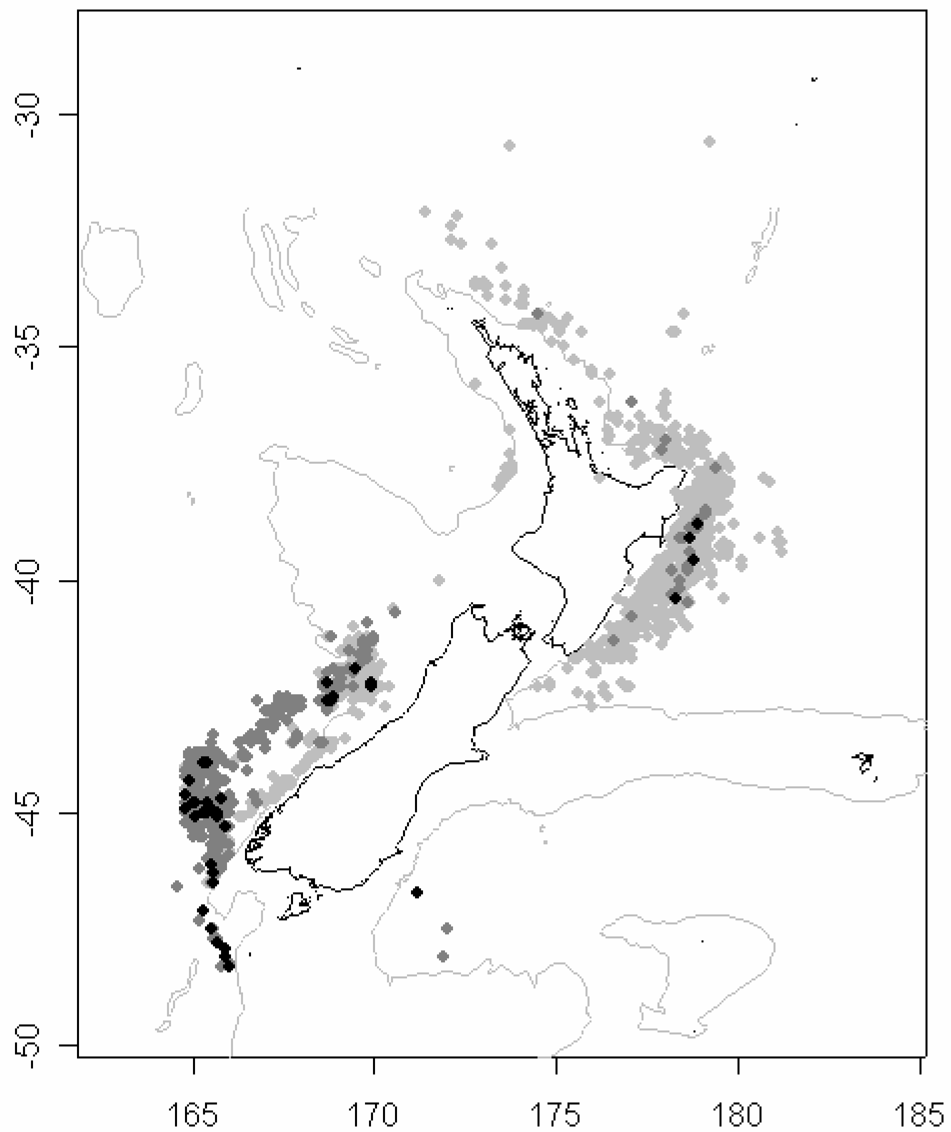


**Figure 2: Start position of sets that targeted or caught STN in 2004. Indicated are 1) unobserved sets (●); 2) observed sets with no seabird bycatch (●); and 3) observed sets with seabird bycatch (●)**