Risk of commercial fisheries to seabird populations within the New Zealand EEZ

Yvan Richard*, Edward Abraham*, and Dominique Filippi†

*Dragonfly Science
†Sextant Technology Ltd

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New Zealand: “seabird capital of the world”

- 85 species, many of them endemic
- Many species are listed as threatened, and their interaction with fisheries may be one of the major causes
- Level-2 risk assessment, contracted by the Ministry of Fisheries (now MPI)
Introduction

Level-2 risk assessment

- Built up on Sharp (2011) and Waugh (2009)
- Explicit parameter uncertainty
- Compared estimated fisheries mortality with estimated population productivity
- Only commercial trawl, bottom and surface longline fishing
- Species and fishery type level (64 species, 16 fishery groups)
- Semi-quantitative (lack of data to build population models)
• A lot of work on estimating annual captures
• So far on a few species with enough observations
• http://data.dragonfly.co.nz/psc publicly available soon

• Demographic impact?
• Poorly observed fisheries?
Estimating fatalities

Data

- From bird captures recorded by government observers
- In trawl, surface & bottom longline fisheries
- Data between 2003/04 and 2008/09

Vulnerability

-Captures assumed to be proportional to the density of birds at each fishing event.
- Species vulnerability to capture, varying among fisheries.

\[ C_{fgs} \sim \text{Poisson}(\mu_{fgs}) \]
\[ \mu_{fgs} = v_{gs} d_{fs} N_{s} E_{f} \]

- \( \mu_{fgs} \): mean captures for fishing event \( f \) in fishery group \( g \) and for species \( s \)
- \( v_{gs} \): vulnerability of species \( s \) to captures in fishery group \( g \)
- \( d_{fs} N_{s} \): number of birds of species \( s \) present at fishing event \( f \)
- \( E_{f} \): fishing effort during event \( f \)
- Used NABIS, Birdlife Tracking database, data on colonies.
- Two distributions: with and without colonies.

Example: White-capped albatross (*Thalassarche steadi*).
Potential annual fatalities

Estimating observable captures
- Fitted model to predict captures on unobserved fishing events

Estimating potential fatalities
- Included cryptic mortality
- Multipliers based on Watkins et al. (2008) & Brothers et al. (2010)
- Depends on type of seabirds
Potential Biological Removal (PBR)

- based only on population size and maximum growth rate
- designed to maintain populations above their Maximum Net Productivity Level (MNPL)
- developed and tested for marine mammals

\[ PBR = \frac{1}{2} r_{max} N_{min} f \]

- \( N_{min} \): conservative estimate of population size
- \( r_{max} \): maximum population growth rate
- \( f \): recovery factor
Maximum growth rate - $r_{\text{max}}$

- Estimated from survival rate ($S$) and age at first reproduction ($A$)

\[
\lambda_{\text{max}} = \exp \left[ \left( A + \frac{S}{\lambda_{\text{max}} - S} \right)^{-1} \right]
\]

\[
r_{\text{max}} = \lambda_{\text{max}} - 1
\]
Population size - $N_{\text{min}}$

- Estimated from survival rate ($S$) and age at first reproduction ($A$)
- $N_{\text{min}}$ by taking the lower quartile of the distribution of $N_{\text{BP}}$

\[
\rho = S^{1-A}
\]

\[
N_{\text{tot}} = \frac{2N_{\text{BP}}}{P_B} \rho
\]
Potential Biological Removal (PBR)

- PBR calculated only from $S$, $A$, $P_B$, and $f$
- Estimates of $S$, $A$, and $P_B$ from literature, groomed to keep best and most recent ones
- 205 final estimates, 65 using proxy species
- $f$ defined according to IUCN red list status, from 0.1 (Critically Endangered) to 0.5 (Least Concern)
- Uncertainties from literature or created to match typical values
Species at risk

Black petrel
Salvin's albatross
Flesh-footed shearwater
Stewart Island shag
NZ king shag
Campbell albatross
Southern Buller's albatross
Gibson's albatross
White-capped albatross
Northern royal albatross
Antipodean albatross
White-chinned petrel
Northern Buller's albatross
Chatham albatross
Cape petrel
Southern royal albatross
Westland petrel
Northern giant petrel
Light-mantled albatross
Grey-headed albatross
Side analyses

Sensitivity to uncertainties
- Inshore fisheries poorly observed
- Adult survival rate and number of annual breeding pairs

Time variation
- Captures in trawl fisheries has decreased, following fishing effort and the use of mitigation devices
- Possible increase in surface longline fisheries
Limitations

Some intrinsic problems...

- Wrong species identification
- Movement in/out the NZEEZ
- A few fisheries not included
  - e.g. recreational, setnet fisheries
- Other sources of mortality not taken into account underestimate risk
  - e.g. harvest at colonies, pollution, indirect trophic effects
- PBR might often be overestimated
  - $r_{\text{max}}$, adult ratio
Conclusions

- The species the most at risk are not the most caught
- Black petrel clearly at risk, urgent action needed
- Some fisheries with obvious lack of observations
  - Inshore fisheries: especially flatfish trawl, small bottom longline
- Some flaws potentially important
- Need international cooperation
- Risk assessments can guide management of research and fisheries
Thank you

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The report can be downloaded from: