Preliminary assessment of the risk of albatrosses by longline fisheries

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Introduction

- Many albatross species currently have threatened by fisheries bycatch
- WCPFC tried to estimate total bycatch of seabirds caused by longline fisheries
- But estimate total mortality is very challenging
  - Lack of information
  - Rare catch rate
  - Spatially and temporally limited observer coverage

Development of total bycatch estimation

- Two characteristics
  1. **Abundance and distribution data is independently available** outside of fishery
  2. Bycatch rate is influenced by the type of mitigation measures

- SEFRA approach
  - Developed in New Zealand[1-4]
  - Integrating seabird distribution and abundance
  - Seabird catchability is composed of seabird vulnerability and fishery catchability
  - Overlap between seabirds and fisheries are used to assess interactions[5-9]
  - Through full-Bayes inference, uncertainty of calculated mortality can be considered.

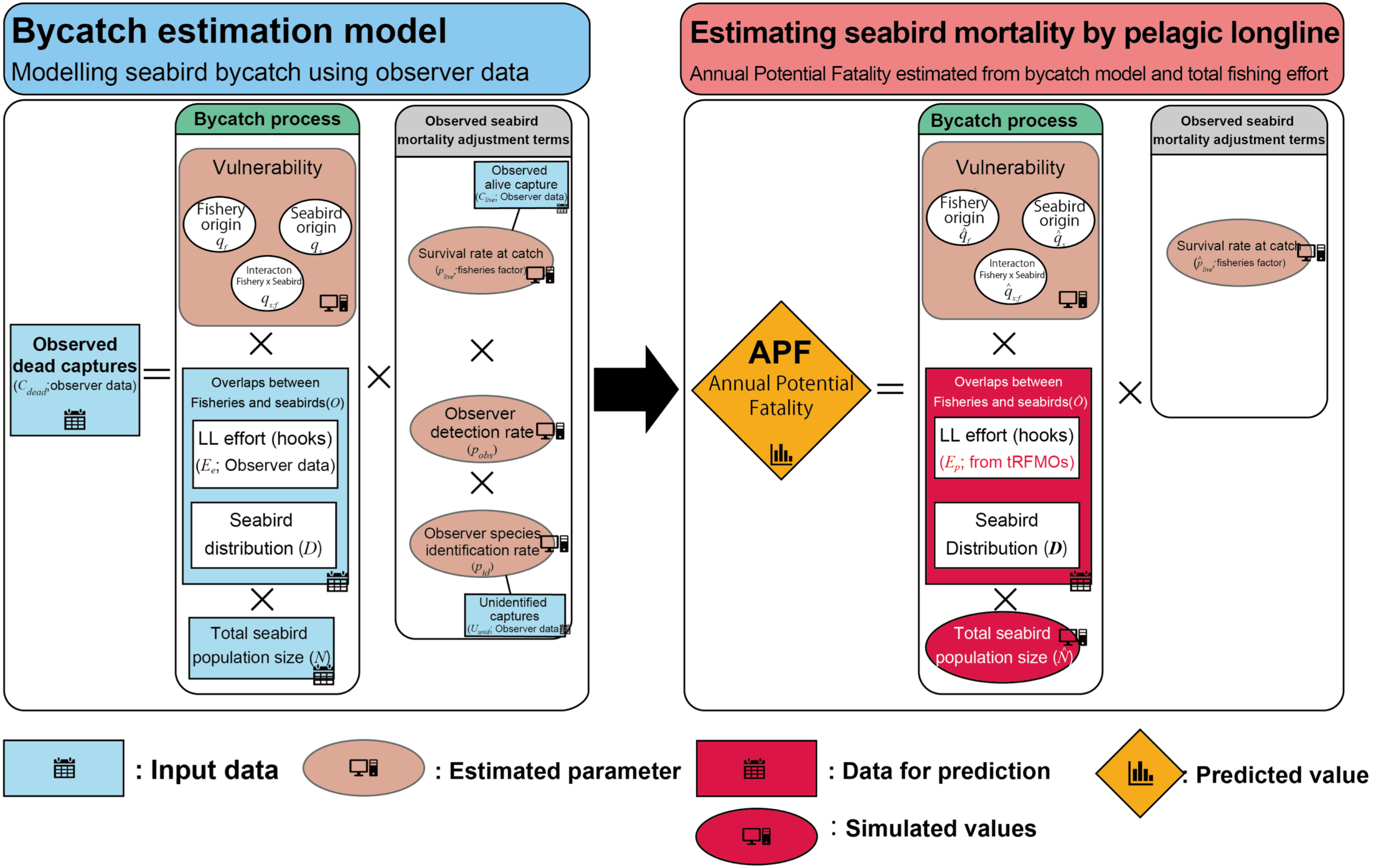
NZ-JP collaboration

- NZ – JP collaboration had started at 2017
  - Sharing model implementation protocol
  - Sharing observed albatross bycatch data
  - Discuss to develop effective estimation method of seabird mortality

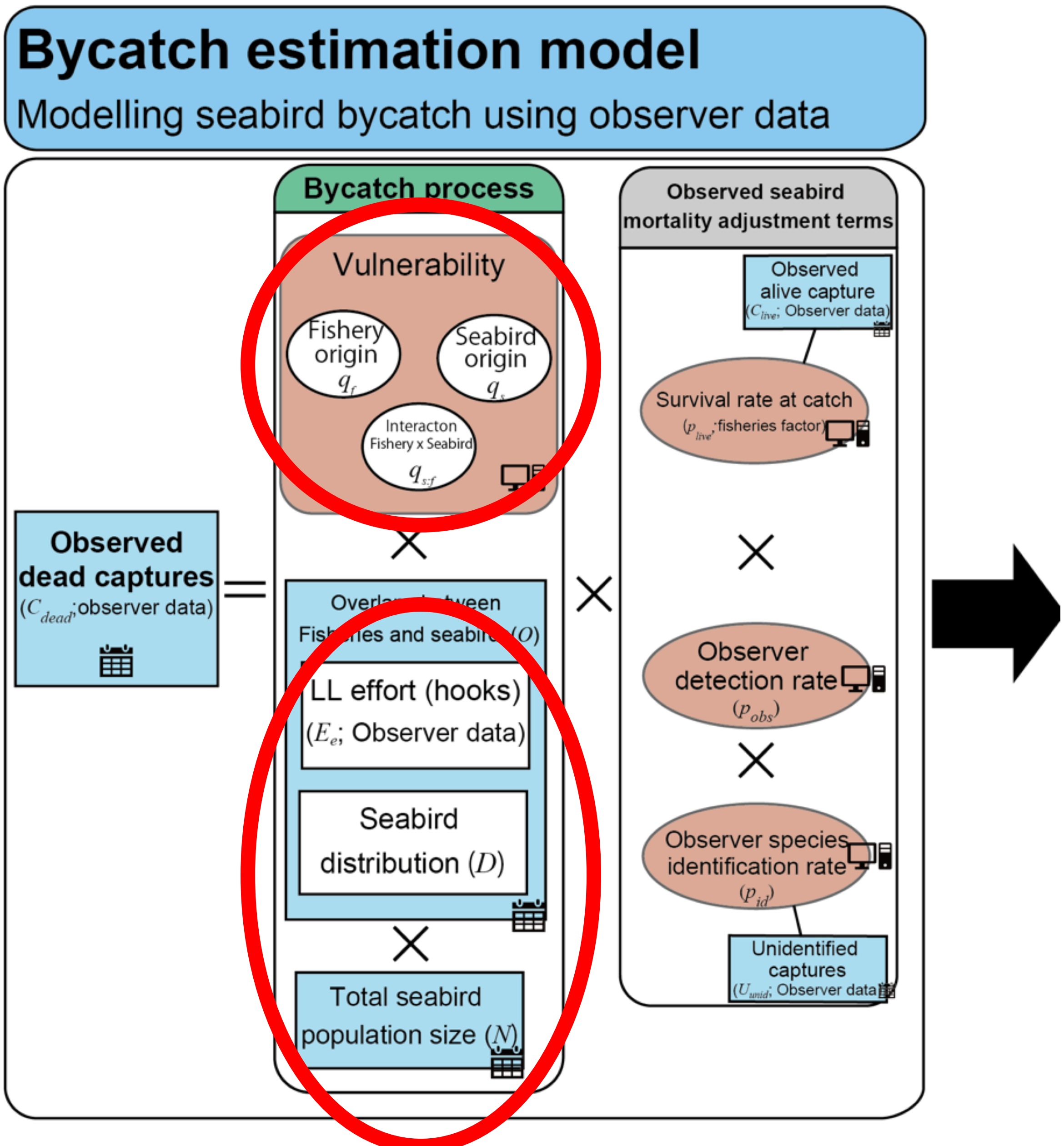
Objective

- Introducing methodology of estimation of total seabird mortality
- We explores the applicability of SEFRA to assessing Annual Bycatch Mortality (ABM) of great albatrosses
- **The results presented is just preliminary**.

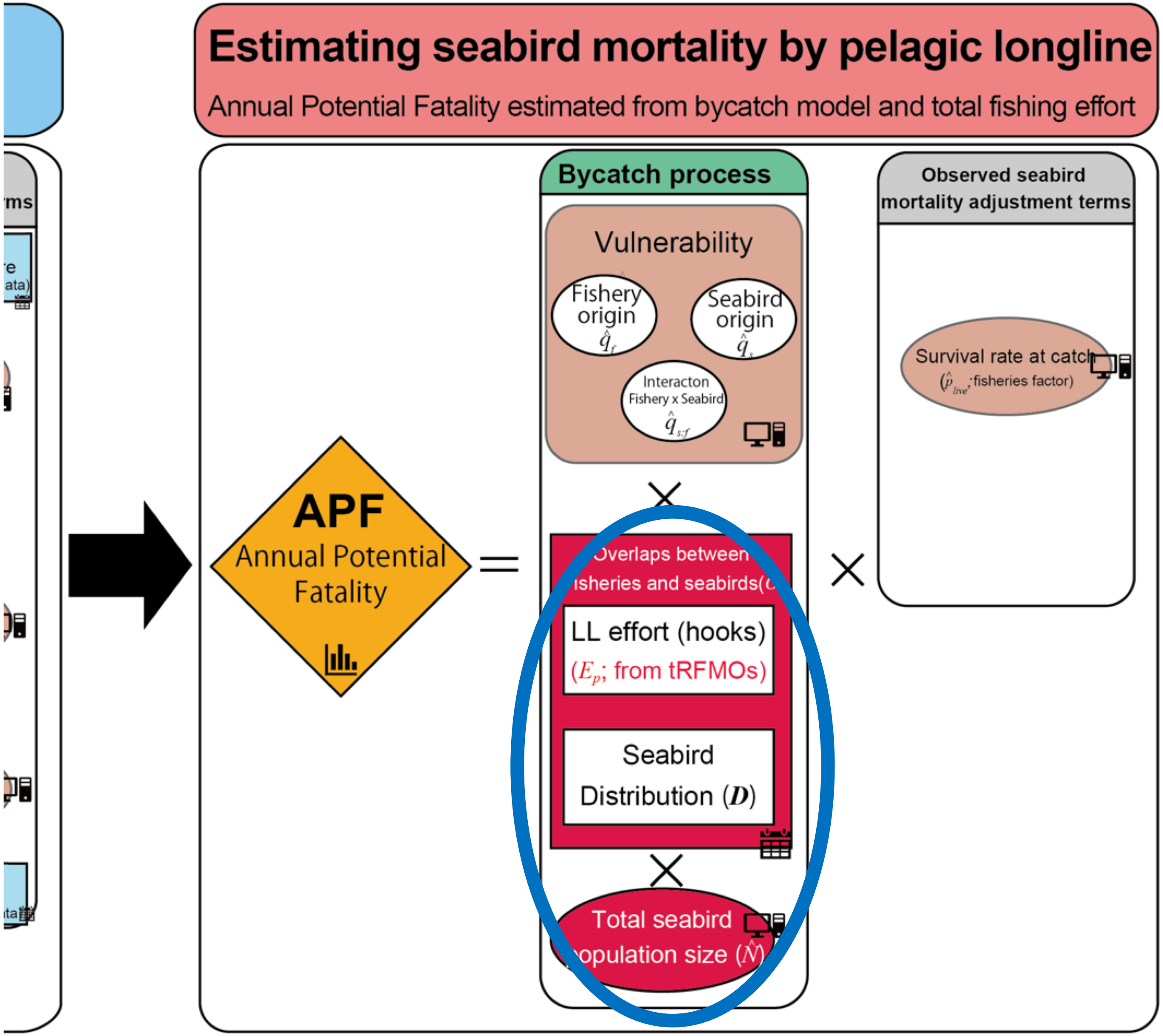
Model structure for APF/ABM



Model structure – bycatch estimation



Model structure – Calculating APF/ABM



Data for parameter estimation

Albatross species - Wanderings & Royals

➢ Wandering group

- Wandering albatross
- Tristan albatross
- Antipodean albatross
- Gibson's albatross
- Amsterdam albatross

➢ Royal group

- Northern royal albatross
- Southern royal albatross

Data content:

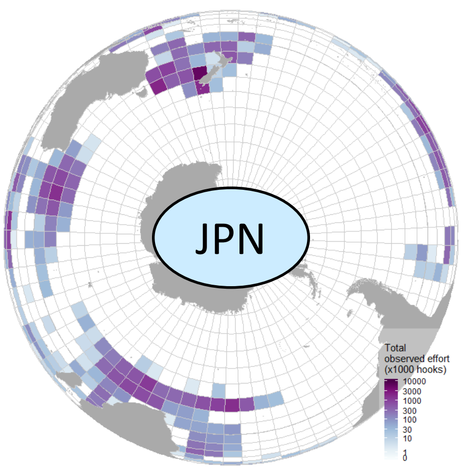
- Population parameters
  (from Literatures & extrapolation)
- Spatio-Temporal distribution
  (Generic data; replace by tracking data in future)

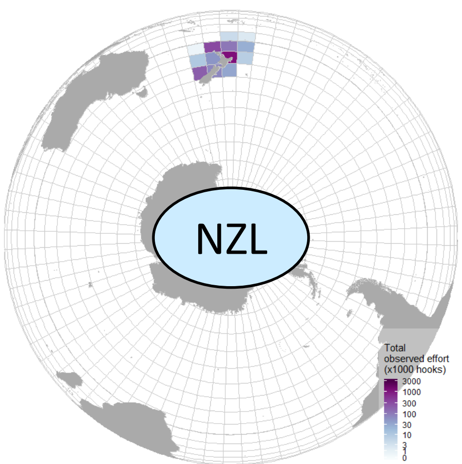
Data for parameter estimation

Bycatch data by pelagic LL operations

➢ NZ and JP observer program

- Data collected during 2003-2016
- Southern Hemisphere
- Quarterly, 5x5 LAT-LONG grid
- **NZ fishery:** divided into **NZ-domestic** and **JP fleet**
- **JP fishery:** High seas JP fleet





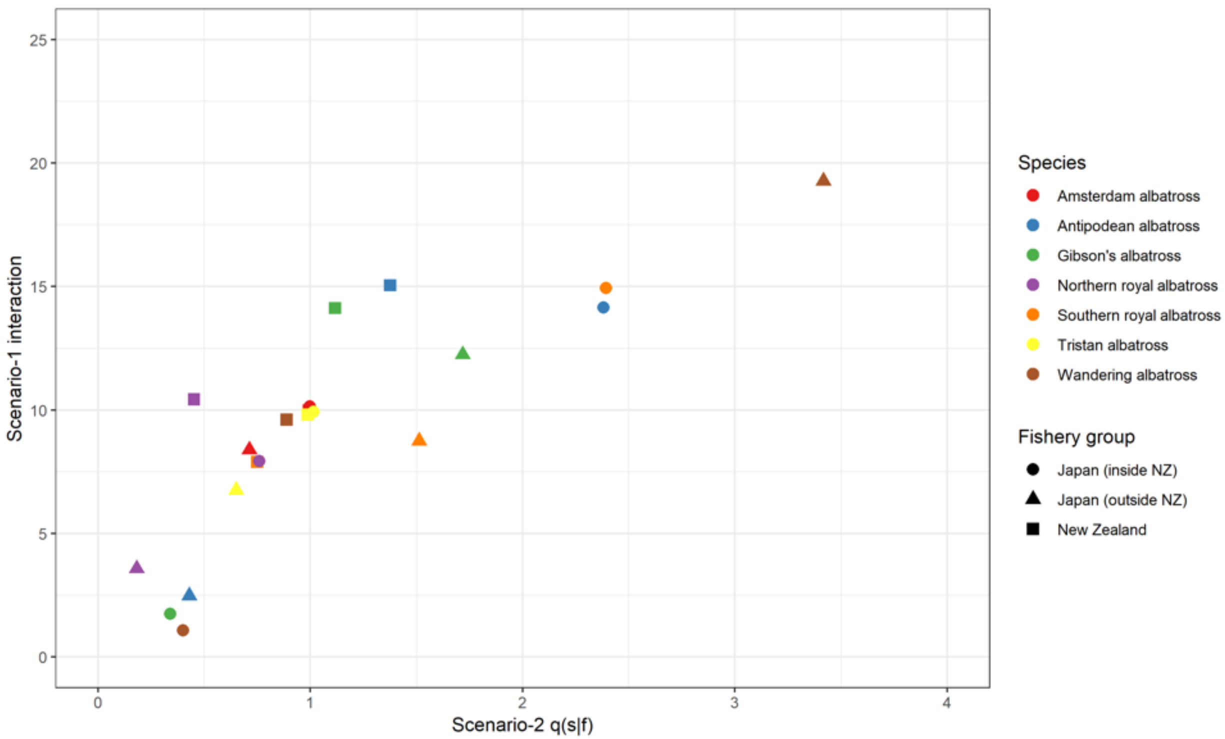
Data content:

- Bycatch number of each species
- Bycatch number of unidentified birds
- Fate of captured birds (dead/alive)
- Observed number of hooks

Estimated parameters

- Catchability in each fishery group
  - High seas JP > NZ-domestic >> JP (inside NZ)
- Susceptibility of albatross species
  - Antipodean > S. royal > Wandering >
  - Gibson's > Tristan > N. royal > Amsterdam

Interactions species x fishery

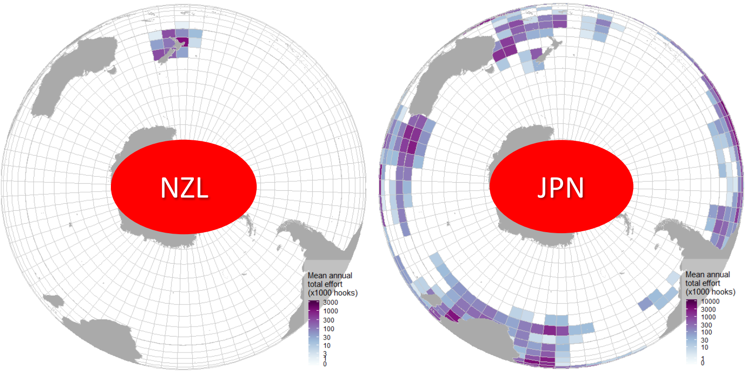


Parameter	Mean	95% c.i.
Intercept		
	0.0001	(0.00004 – 0.0004)
Fishery group		
Japan (outside NZ)	1.230	(0.288 – 3.436)
New Zealand	1.000	(1.000 – 1.000)
Japan (inside NZ)	0.216	(0.034 – 0.753)
Species		
Antipodean albatross	12.134	(2.963 – 30.328)
Southern royal albatross	11.516	(2.870 – 28.673)
Wandering albatross	10.981	(2.758 – 27.110)
Gibson's albatross	8.960	(2.131 – 23.310)
Tristan albatross	6.787	(0.705 – 22.621)
Northern royal albatross	2.047	(0.126 – 8.833)
Amsterdam albatross	1.000	(1.000 – 1.000)
Species x fishery group		
Wandering albatross in Japan (outside NZ)	19.281	(5.113 – 50.257)
Antipodean albatross in New Zealand	15.047	(3.722 – 37.238)
Southern royal albatross in Japan (inside NZ)	14.944	(2.918 – 41.977)
Antipodean albatross in Japan (inside NZ)	14.148	(2.833 – 38.294)
Gibson's albatross in New Zealand	14.124	(3.661 – 36.383)
Gibson's albatross in Japan (outside NZ)	12.242	(2.809 – 30.839)
Northern royal albatross in New Zealand	10.430	(1.088 – 32.191)
Amsterdam albatross in Japan (inside NZ)	10.138	(0.309 – 36.265)
Amsterdam albatross in New Zealand	9.980	(0.338 – 33.871)
Tristan albatross in Japan (inside NZ)	9.929	(0.392 – 34.445)
Tristan albatross in New Zealand	9.810	(0.287 – 34.700)
Wandering albatross in New Zealand	9.611	(1.832 – 25.623)
Southern royal albatross in Japan (outside NZ)	8.746	(1.779 – 23.105)
Amsterdam albatross in Japan (outside NZ)	8.392	(0.276 – 28.173)
Northern royal albatross in Japan (inside NZ)	7.936	(0.224 – 28.441)
Southern royal albatross in New Zealand	7.898	(1.428 – 21.793)
Tristan albatross in Japan (outside NZ)	6.750	(0.738 – 22.688)
Northern royal albatross in Japan (outside NZ)	3.575	(0.153 – 14.568)
Antipodean albatross in Japan (outside NZ)	2.479	(0.303 – 8.500)
Gibson's albatross in Japan (inside NZ)	1.738	(0.182 – 6.208)
Wandering albatross in Japan (inside NZ)	1.074	(0.013 – 5.411)

Effort data for calculating ABM

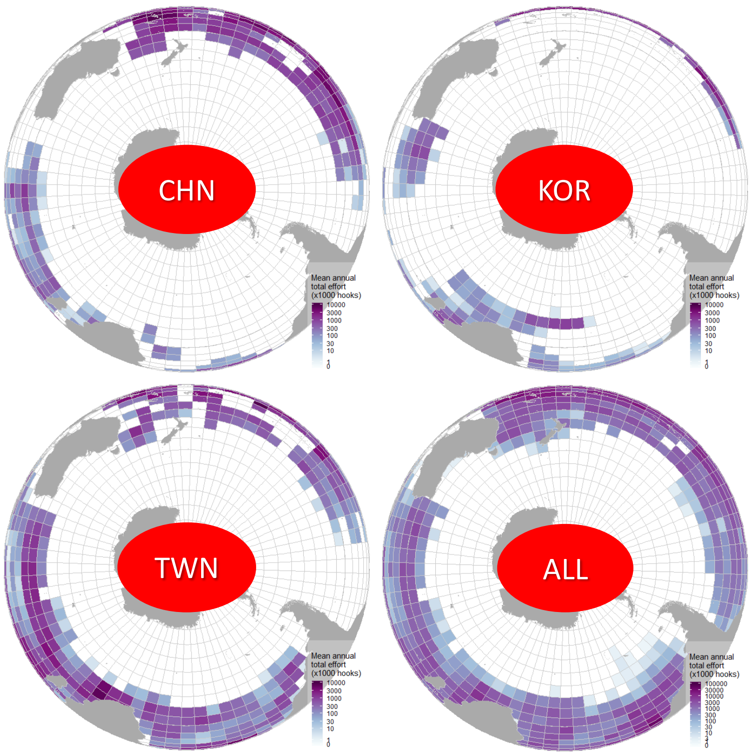
New Zealand and Japan

- Actual pelagic LL effort data
- Whole southern hemisphere
- Annually averaged during 2012-2016
- Aggregated by monthly, 5x5 grid



Other flags

- Obtained from tRFMOs
- Pacific, Indian and Atlantic
- Annually averaged during 2012-2016
- Quarterly, 5x5 grid
- Fishery catchability was mirrored by high seas JP



Total bycatch mortality

➢ Flag and species specific bycatch mortality

- Taiwan exhibited the highest, following Japan, China, NZ, South Korea,…
- Wandering albatross was the worst, followed by Gibson's, Tristan, S. royal, Antipodean…

Flag	All albatrosses	Amsterdam albatross	Antipodean albatross	Gibson's albatross	Tristan albatross	Northern royal albatross	Southern royal albatross	Wandering albatross
All flags	**1070 (834–1345)**	**1 (0–4)**	**49 (14–116)**	**162 (100–242)**	**86 (29–189)**	**7 (0–21)**	**81 (51–119)**	**684 (482–928)**
Australia	**23 (13–36)**	0 (0–0)	2 (0–7)	10 (3–18)		0 (0–1)	1 (0–4)	10 (4–18)
Belize	**39 (23–57)**				9 (2–22)	0 (0–0)	1 (0–3)	29 (16–44)
China	**80 (53–114)**	0 (0–0)	9 (1–26)	45 (24–71)	0 (0–2)	0 (0–1)	1 (0–4)	25 (13–38)
Fiji	**17 (8–30)**		3 (0–9)	14 (6–25)				0 (0–2)
Japan	**130 (96–170)**	0 (0–1)	5 (0–15)	20 (9–34)	9 (2–22)	0 (0–2)	14 (6–24)	82 (53–116)
New Zealand	**55 (32–88)**		19 (5–44)	17 (7–31)		5 (0–18)	10 (2–23)	4 (0–10)
Other flags	**28 (17–41)**	0 (0–0)	2 (0–6)	8 (2–16)	4 (0–12)	0 (0–1)	2 (0–5)	12 (5–20)
Seychelles	**12 (5–21)**	0 (0–0)			2 (0–6)	0 (0–0)	0 (0–0)	10 (4–18)
South Africa	**25 (14–38)**	0 (0–0)			4 (0–10)	0 (0–1)	2 (0–5)	19 (9–30)
South Korea	**43 (28–61)**	0 (0–1)	0 (0–0)	0 (0–1)	5 (0–13)	0 (0–2)	9 (3–16)	29 (16–44)
Spain	**34 (21–51)**	0 (0–0)	1 (0–3)	3 (0–8)	7 (1–17)	0 (0–1)	1 (0–4)	22 (12–34)
Taiwan	**553 (415–720)**	1 (0–3)	6 (0–19)	32 (16–52)	45 (14–101)	1 (0–5)	39 (22–59)	429 (301–585)
Vanuatu	**28 (17–42)**		2 (0–8)	12 (5–22)		0 (0–0)	0 (0–2)	13 (6–22)

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Risk Ratio

Risk ratio calculation

- Risk ratio is given as a annual bycatch mortality (ABM) to population sustainable threshold as below;

$$PST = 0.5 \times r_{max} \times Total\ population$$

$$RiskRatio = \frac{ABM}{PST}$$

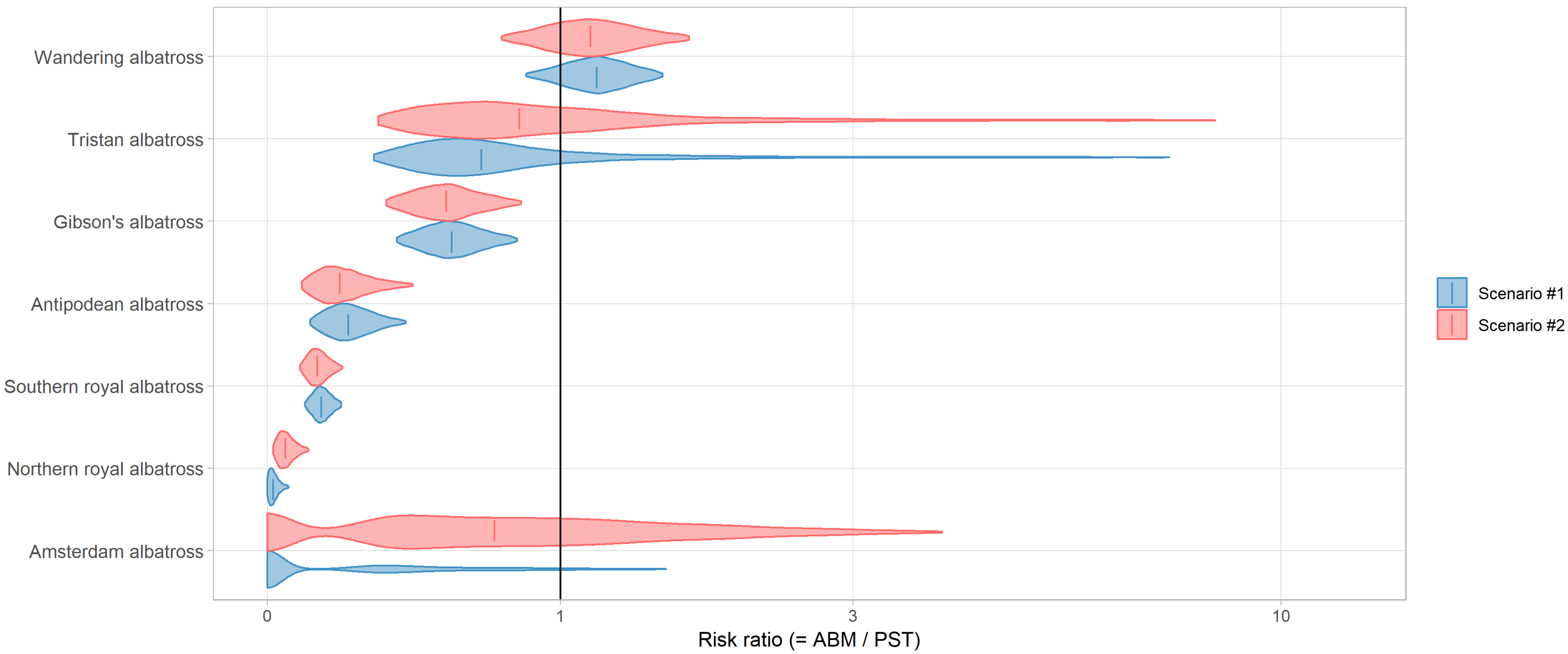
- Bycatch mortality of Wandering albatross exceeds its PST on average
- Risks of Gibson's and Antipodean were less than above

Taxa	PST		ABM		Risk ratio		
	Mean	95% *c.i.*	Mean	95% *c.i.*	Median	95% *c.i.*	*p(ABM>PST)*
Wandering albatross	**588.0**	390.6–866.7	**684**	482–928	**1.18**	0.84–1.55	**85.2%**
Tristan albatross	**123.9**	10.2–294.1	**86**	29–189	**0.66**	0.29–7.44	**22.4%**
Gibson's albatross	**293.0**	221.4–377.4	**162**	100–242	**0.55**	0.36–0.81	**0.1%**
Antipodean albatross	**224.2**	88.9–471.9	**49**	14–116	**0.21**	0.11–0.39	**0.0%**
Southern royal albatross	**589.9**	437.5–776.8	**81**	51–119	**0.14**	0.09–0.19	**0.0%**
Northern royal albatross	**405.1**	287.2–547.5	**7**	0–21	**0.01**	0.00–0.05	**0.0%**
Amsterdam albatross	**3.0**	1.3–5.2	**1**	0–4	**0.00**	0.00–1.57	**6.8%**

Risk Ratio

➢ Uncertainty

- Risks of Tristan and Amsterdam had huge uncertainty
- That caused from lack of catch event observed
- It makes difficult to interpret those species risks



Conclusion

- SEFRA approach is very useful for:
  - Full utilization of limited observer data
  - Full utilization of independent seabirds biological, behavioral and population information
  - Obtain robust estimates of total seabird mortality by bycatch
  - Evaluate the impact of bycatch by fisheries to seabird population
  - Evaluate the effectiveness of mitigation measures

Future refinement plan

- ✓ Investigation of robustness related observer data
- ✓ Improvement of input datasets, especially of seabird distributions
- ✓ Inclusion of effort data from EEZs
- ✓ Improvement of model structure
- ✓ Expansion to other fisheries
- ✓ Expansion to other seabird species
- ✓ Inclusion of observed effort and captures from other fleets

Summary - Advantage of SEFRA approach

- Easy for data preparation
  - Only needs, 5 x 5, quarterly observer data
- Easy-to-understand structure
- Extensibility
- Model diagnosis available
  - Posterior predictive check
  - LOOIC & WAIC
  - Dispersion parameter

Summary - Advantage of SEFRA approach

- Easy for data preparation
  - Only needs, 5 x 5, quarterly observer data

This approach is recognized as a candidate of bycatch estimation model in the ABNJ workshop

(please check; EB-IP-05)

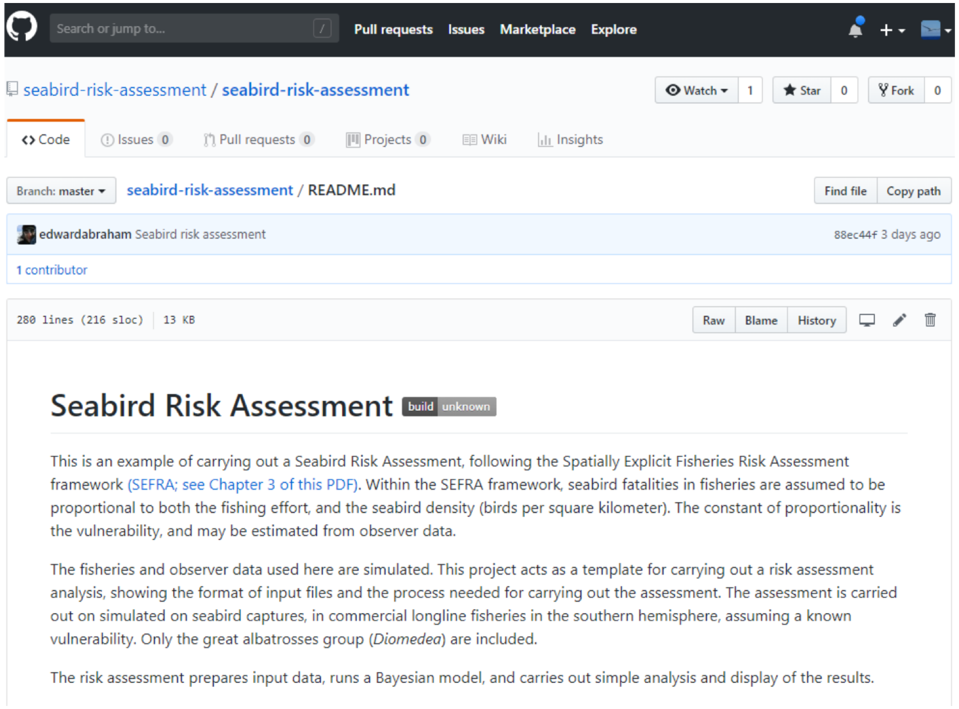
-
-
-
  - Posterior predictive check
  - LOOIC & WAIC
  - Dispersion parameter

Further Collaborations….!

- We welcome your participation to this collaboration!

- You can check detail of the analysis on;

  https://github.com/seabird-risk-assessment/seabird-risk-assessment



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