

# A standardised framework for processing abundance data of albatrosses and petrels and modelling their multi-decadal trends

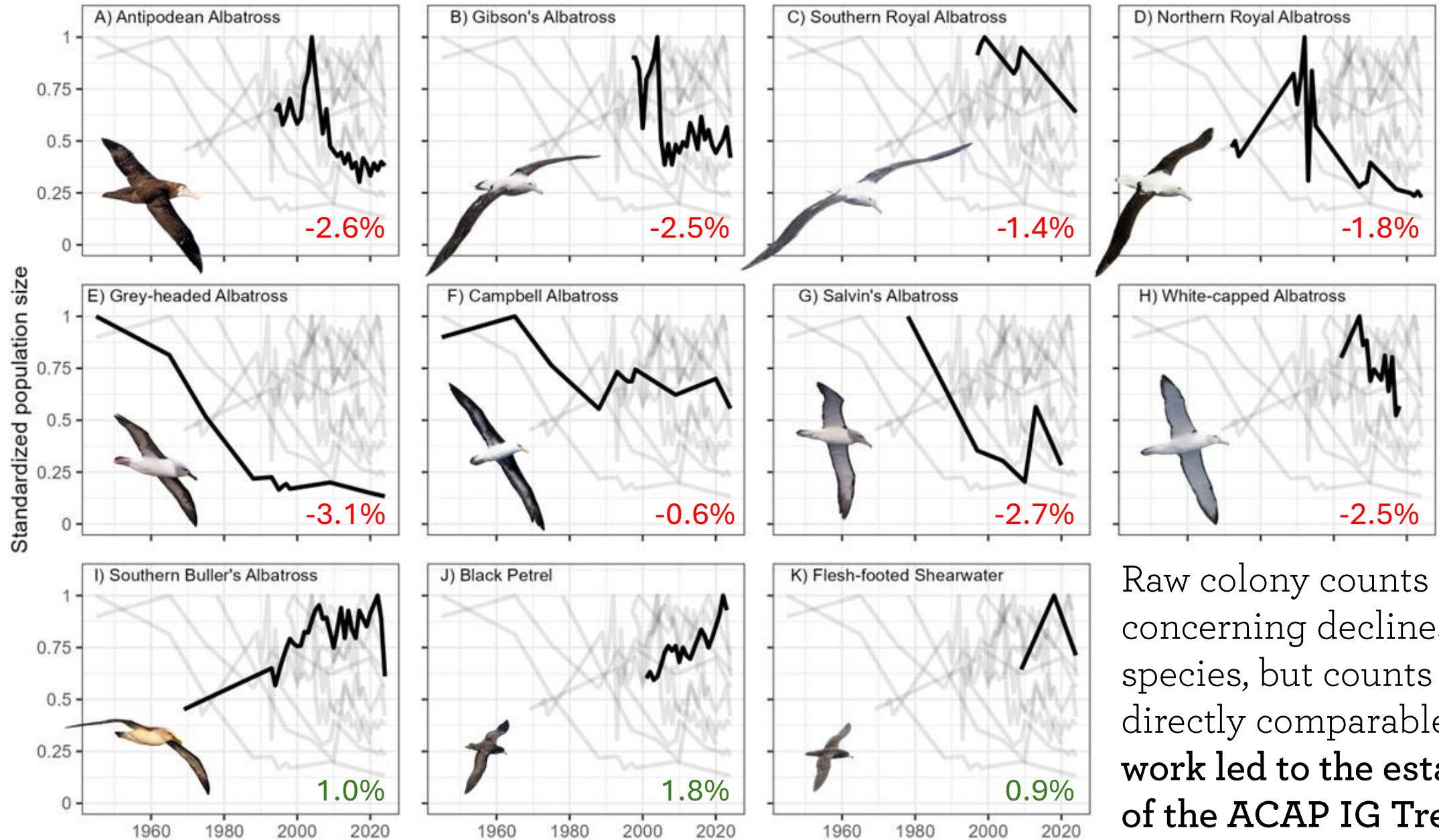


PaCSWG9 Doc3 Rev2



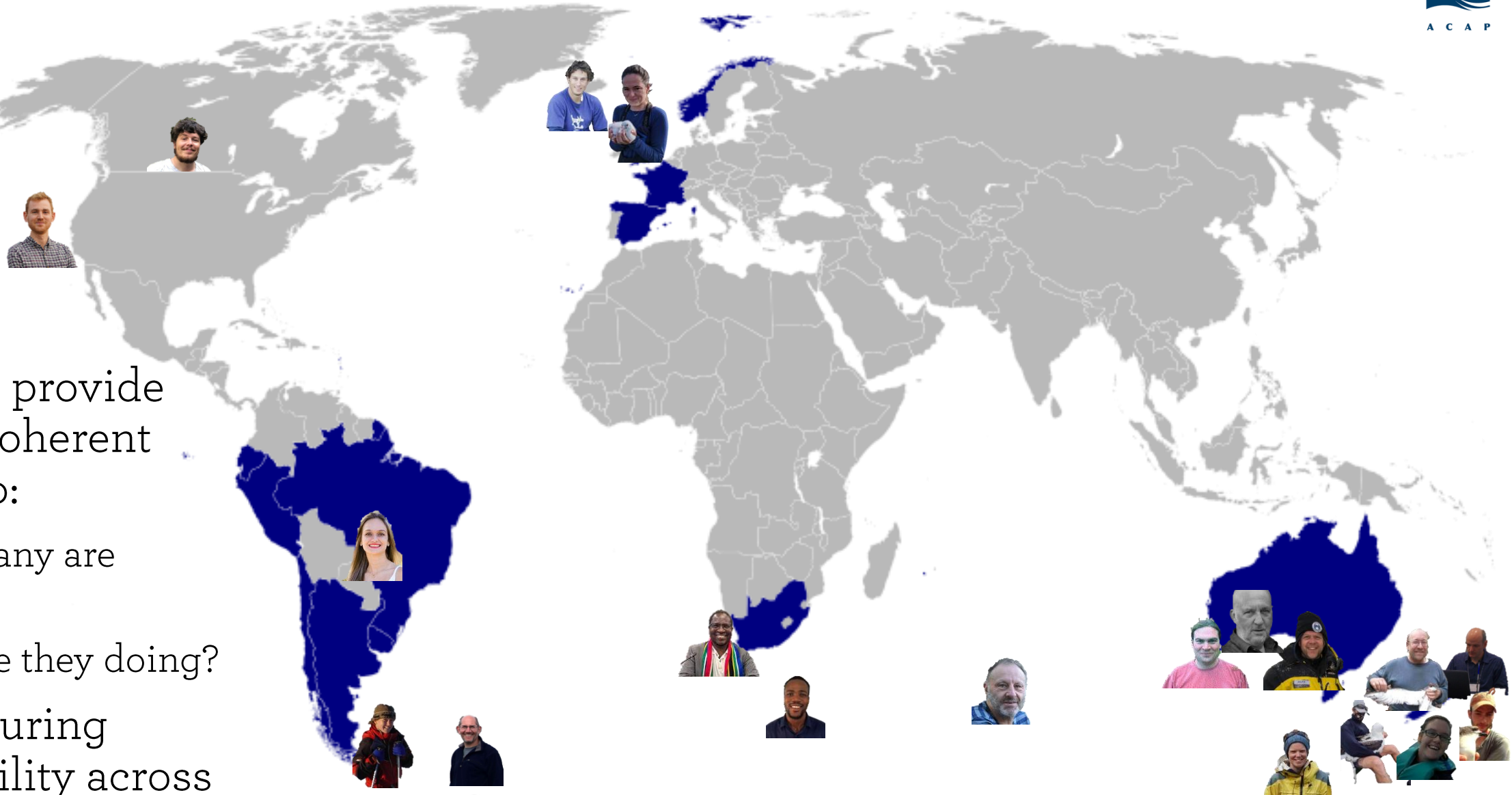
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# Previous work presented at PaCSWG8



Raw colony counts indicated concerning declines of NZ species, but counts were not directly comparable. **This work led to the establishment of the ACAP IG Trends**

# ACAP IG Trends



Formed to provide robust & coherent answers to:

1. How many are there?
2. How are they doing?

While ensuring comparability across space/time/species

# ACAP IG Trends goal statement (Adapted from AC14 ToR)



## ACAP IG Trends overarching goal:

*To robustly estimate and communicate the trends of all ACAP species for which sufficient data exists.*

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### ACAP IG Trends Aims

### Progress

|  |                                  |
|--|----------------------------------|
| 1. Review the methodology in <a href="#">PaCSWG8 Doc 03</a> .  | Complete                         |
| 2. Review and update the relevant definitions, terms, and metrics currently used in the ACAP database.   | Complete                         |
| 3. Develop outputs for reporting population counts and trends.   | Underway                         |
| 4. Improve the methodology in <a href="#">PaCSWG8 Doc 03</a> and apply it to all ACAP species for which sufficient data are available.   | Complete for 42% of ACAP species |
| 5. Explore methodologies that incorporate unmonitored colonies into species-level trend estimates.   | TBC                              |
| 6. Illustrate population trends spatially by integrating trend estimates with tracking data.   | TBC                              |
| 7. Document the final methodology to facilitate easy updates to the analyses.  | Complete (almost)                |
| 8. Provide input into IUCN Red List Assessments by BirdLife International.   | Complete for 42% of ACAP species |
| 9. Provide recommendations for improving the ACAP population database.   | Complete                         |
| 10. Provide recommendations for establishing suitable and robust ACAP population status indicators.  | TBC                              |
| 11. Provide recommendations for robust identification of ACAP priority populations.  | Tracking                         |
| 12. Report back to PaCSWG9 (May/June 2026; papers due in Mar 2026) on the process, results, and provide recommendations for the integration of results into different ACAP products. | Complete (almost)                |

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# ACAP IG Trends process & workshop

To meet its Aims, the ACAP IG Trends:

- Met six times online during 2024-2026
- Completed online questionnaires & held targeted engagement
- Worked iteratively on methodology & outcomes throughout 2024-2026

ACAP IG Trends workshop (24 May):

- Review progress of the IG
- Enable in-depth technical discussions on PaCSWG9 Doc3 Rev1
- Provide guidance on key methodological considerations for PaCSWG9 and AC15 endorsement

Workshop outcomes are captured in boxes in PaCSWG9 Doc3 Rev2 as well as in this presentation



# Overview of standardised abundance processing and trend modelling framework

1. Review & update definitions
2. Restructure data

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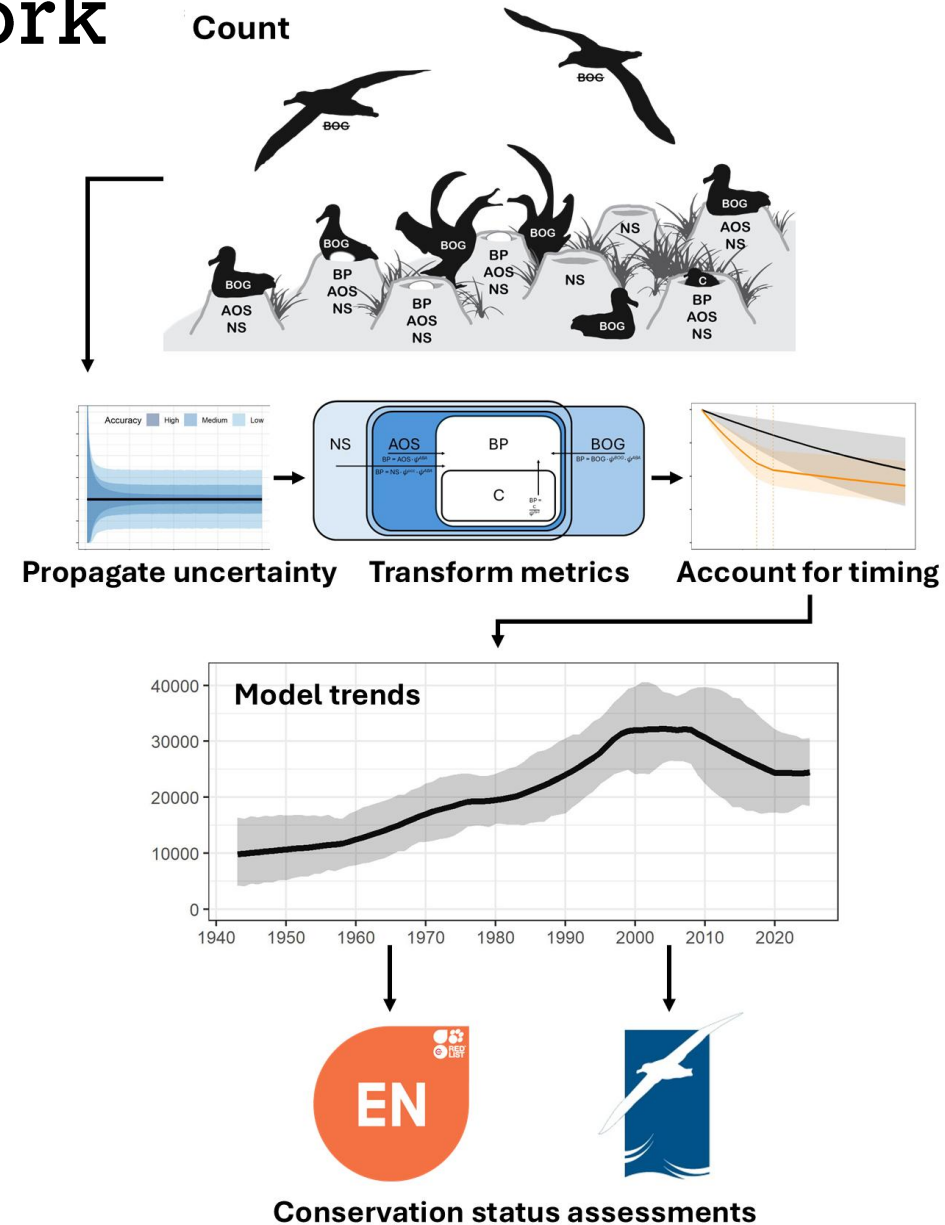
3. Account for sampling error, extrapolate & specify baseline uncertainty
4. Account for imperfect detection where possible
5. Transform abundance metrics to annual breeding pairs (as required)
6. Account for count timing (e.g., to account for nest failure)
7. Transform annual breeding pairs into mature individuals

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8. Model trends using the state-space model *ACAPT*

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9. Provide IUCN Red List guidance (Criterion A only)
10. Provide ACAP High Priority Population listing guidance



# Definitions

To achieve comparability, common language is crucial.

As data custodian, ACAP has some definitions and standardisation mechanisms:

- Main metric: annual breeding pairs
- Time indexing: year of fledging
- Some method definitions (but with method, metric, and error correction conflated)
- Some error definitions
- Accuracy and reliability scores

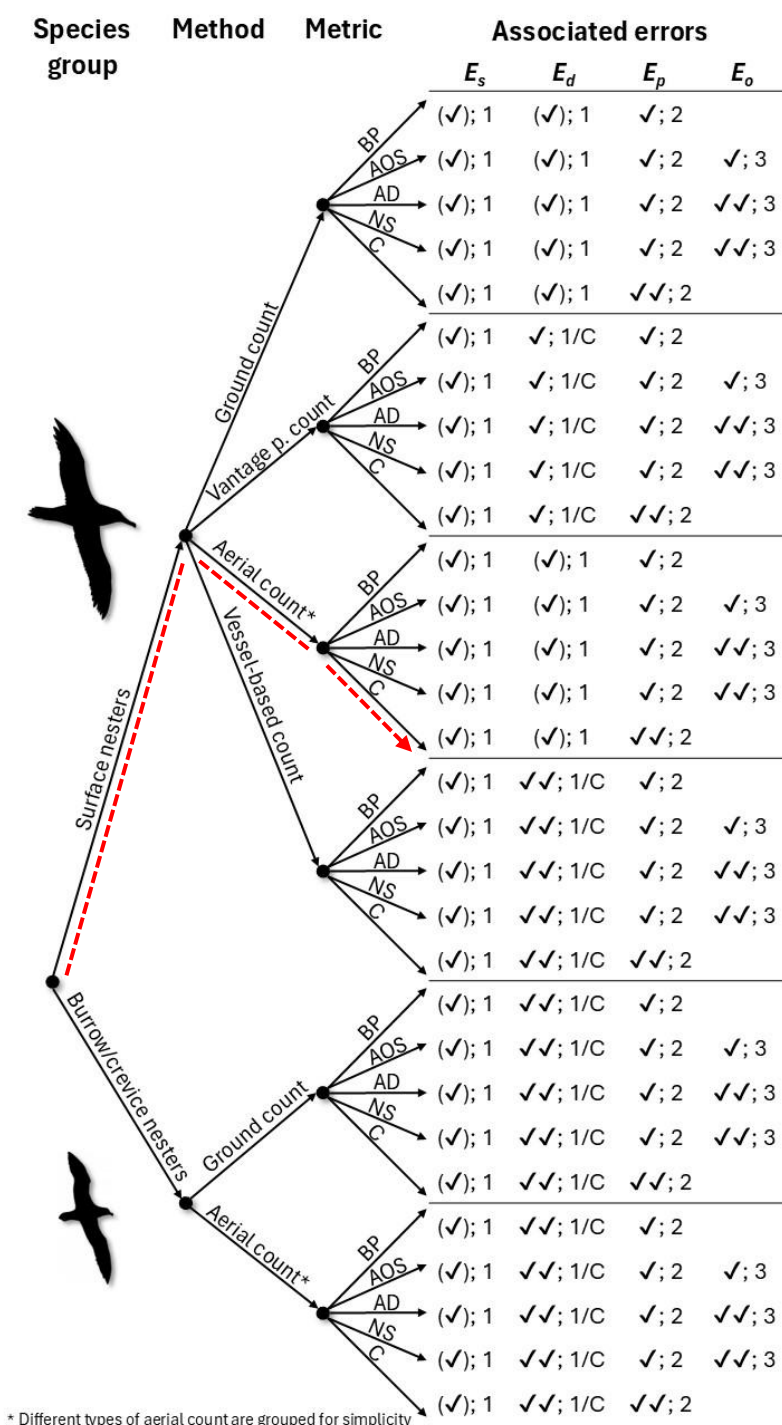
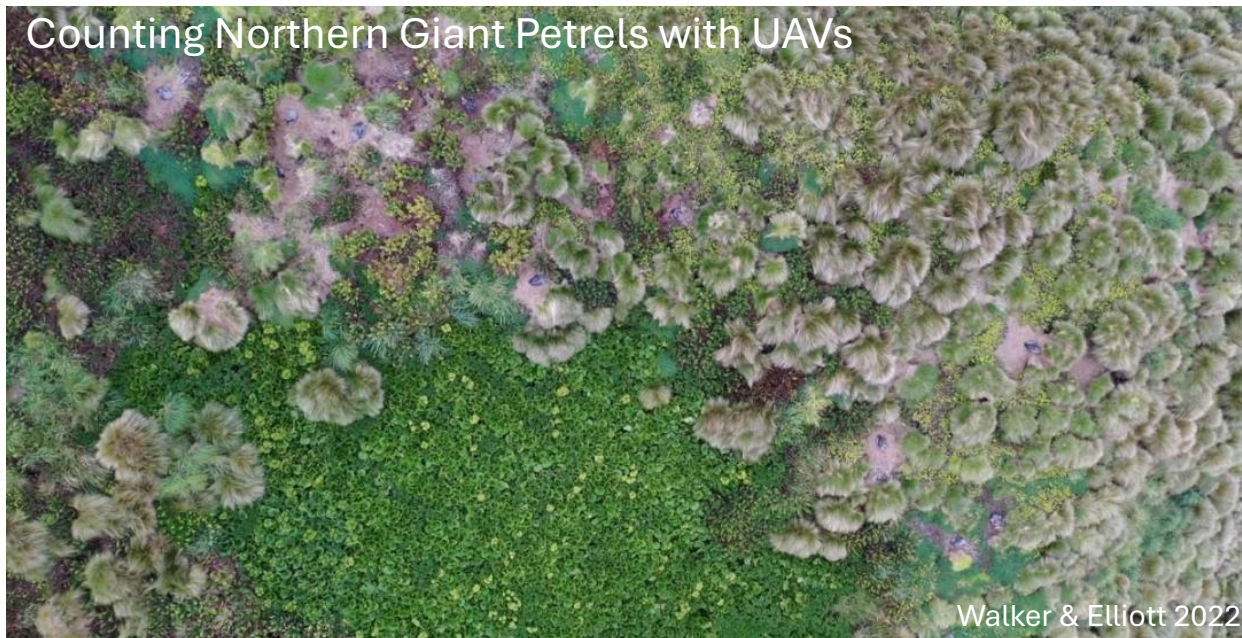
These were reviewed iteratively to formulate the updated definitions, separating method from metric from error corrections.

Following minor adjustments, the workshop participants agreed on definitions



# Standardised adjustment decision-making

Following standardised definitions, logic determines which combination of method and metric determines what errors should be accounted for, enabling standardised decision-making for error corrections



\* Different types of aerial count are grouped for simplicity

# Updated abundance data structure



Clear separation of method, metric, errors accounted and not accounted for then enabled the development of an updated data structure, suitable for standardised data processing

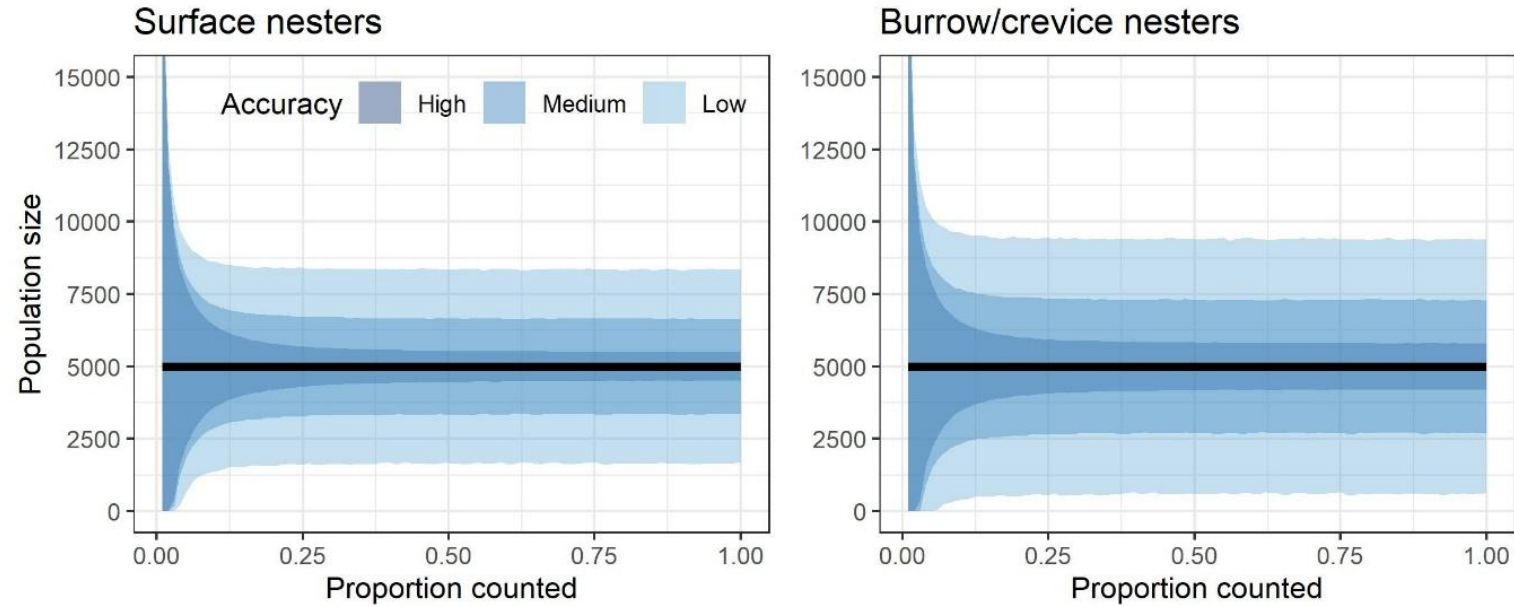
| Year  | Method   | Counted metric | Part site     | Reported raw count | Count date    | Weeks post $\mu$ lay <sup>A</sup> | $f$   | $p^b$ | $\psi^s$ | $\psi^d$              | $\psi^p$ | $\psi^o$           | $\pi^B$            | Acc. category | Reported adjusted count  | Reported adjusted metric | Standardised abundance ( $y_{it}$ ) | References                                |
|-------|----------|----------------|---------------|--------------------|---------------|-----------------------------------|-------|-------|----------|-----------------------|----------|--------------------|--------------------|---------------|--------------------------|--------------------------|-------------------------------------|---|
| 1969* | VPC & GC | BOG & BP       | Antipodes I.  | 1,867              | 7 Feb – 1 Mar | 2-5                               | NA    | NA    | NA       | 0.688 <sup>C</sup>    | ✓; ?     | 0.333 <sup>C</sup> | 1.000              | Unknown (low) | 5,000-8,000 <sup>C</sup> | BP                       | 6,500<br>(2,170-10,840)             | Warham & Bell 1979; Walker & Elliott 2005 |
| 1978* | GC       | C              | Antipodes I.  | 1,096              | Nov-Dec       | 40-49                             | NA    | NA    | -        | -                     | -        | NA                 | 0.333 <sup>C</sup> | Unknown (low) | 3,800 <sup>C</sup>       | BP                       | 5,384<br>(1,776-9,604)              | Bell 1978; Walker & Elliott 2005          |
| 1994  | GC       | BP             | Antipodes I.  | 4,635              | Feb           | 1-5                               | 0.748 | NA    | NA       | -                     | -        | NA                 | 1.000              | Medium        | -                        | -                        | 4,727<br>(3,175-6,283)              | Walker & Elliott 2005                     |
| 1995  | GC       | BP             | Antipodes I.  | 5,757              | Feb           | 1-5                               | 0.748 | NA    | NA       | -                     | -        | NA                 | 1.000              | Medium        | -                        | -                        | 5,858<br>(3,921-7,795)              | Walker & Elliott 2005                     |
| 1996  | GC       | BP             | Antipodes I.  | 5,148              | Feb           | 1-5                               | 0.791 | 0.538 | NA       | -                     | -        | NA                 | 1.000              | Medium        | -                        | -                        | 5,234<br>(3,496-6,967)              | Walker & Elliott 2005                     |
| 1997  | GC       | BP             | Antipodes I.  | 3,167              | Feb           | 1-5                               | 0.797 | 0.497 | -        | -                     | -        | NA                 | 0.612              | Medium        | -                        | -                        | 5,258<br>(3,511-7,004)              | Walker & Elliott 2005                     |
| 1998  | GC       | BP             | SA, MCBA      | 694                | 5-19 Feb      | 2-4                               | 0.748 | 0.535 | -        | (0.985 <sup>D</sup> ) | -        | NA                 | 0.121              | High          | 5,736                    | BP                       | 5,845<br>(4,535-7,146)              | Walker & Elliott 2005                     |
| 1999  | GC       | BP             | SA, MCBA      | 621                | 5-19 Feb      | 2-4                               | 0.626 | 0.472 | -        | (0.985 <sup>D</sup> ) | -        | NA                 | 0.121              | High          | 5,132                    | BP                       | 5,271<br>(4,037-6,514)              | Walker & Elliott 2005                     |
| 2000  | GC       | BP             | SA, B32, MCBA | 711                | 5-19 Feb      | 2-4                               | 0.774 | 0.472 | -        | (0.985 <sup>D</sup> ) | -        | NA                 | 0.148              | High          | 4,740                    | BP                       | 4,890<br>(3,891-5,876)              | Walker & Elliott 2005                     |
| 2001  | GC       | BP             | SA, B32, MCBA | 744                | 5-19 Feb      | 2-4                               | 0.784 | 0.571 | -        | (0.985 <sup>D</sup> ) | -        | NA                 | 0.147              | High          | 4,960                    | BP                       | 5,147<br>(4,120-6,177)              | Walker & Elliott 2005                     |
| 2002  | GC       | BP             | SA, B32, MCBA | 931                | 5-19 Feb      | 2-4                               | 0.678 | 0.448 | -        | (0.985 <sup>D</sup> ) | -        | NA                 | 0.147              | High          | 6,207                    | BP                       | 6,487<br>(5,286-7,679)              | Walker & Elliott 2005                     |
| 2003  | GC       | BP             | SA, B32, MCBA | 1,009              | 5-19 Feb      | 2-4                               | 0.731 | 0.518 | -        | (0.985 <sup>D</sup> ) | -        | NA                 | 0.147              | High          | 6,727                    | BP                       | 7,004<br>(5,758-8,251)              | Walker & Elliott 2005                     |
| 2004  | GC       | BP             | SA, B32, MCBA | 1,220              | 5-19 Feb      | 2-4                               | 0.719 | 0.474 | -        | (0.985 <sup>D</sup> ) | -        | NA                 | 0.146              | High          | 8,133                    | BP                       | 8,535<br>(7,089-9,979)              | Walker & Elliott 2005                     |
| 2005  | GC       | BP             | SA, B32, MCBA | 1,010              | 5-19 Feb      | 2-4                               | NA    | 0.483 | -        | (0.985 <sup>D</sup> ) | -        | NA                 | 0.146              | High          | 6,733                    | BP                       | 7,086<br>(5,811-8,371)              | Walker & Elliott 2005                     |
| 2007  | GC       | BP             | SA, B32       | 246                | Feb           | 1-5                               | 0.575 | -     | -        | -                     | -        | NA                 | 0.056              | High          | 4,393                    | BP                       | 4,530<br>(2,147-6,909)              | Elliott & Walker 2017                     |

# Data processing Step 1



Accounting for sampling error  $\Psi^s$ , by leveraging:

- Known proportion of population counted
- Prior beliefs on count accuracy through ACAP Accuracy score
- Asymptotic relationship between on count accuracy propagating baseline uncertainty. *The higher proportion counted, the more accurate up until a certain point.*



$$P_{t,i} = \left( \frac{\rho_{t,i}}{\xi_{t,i}} \right)$$

$$n_{t,i} \sim N(P_{t,i}, \tau_{t,i}^n)$$

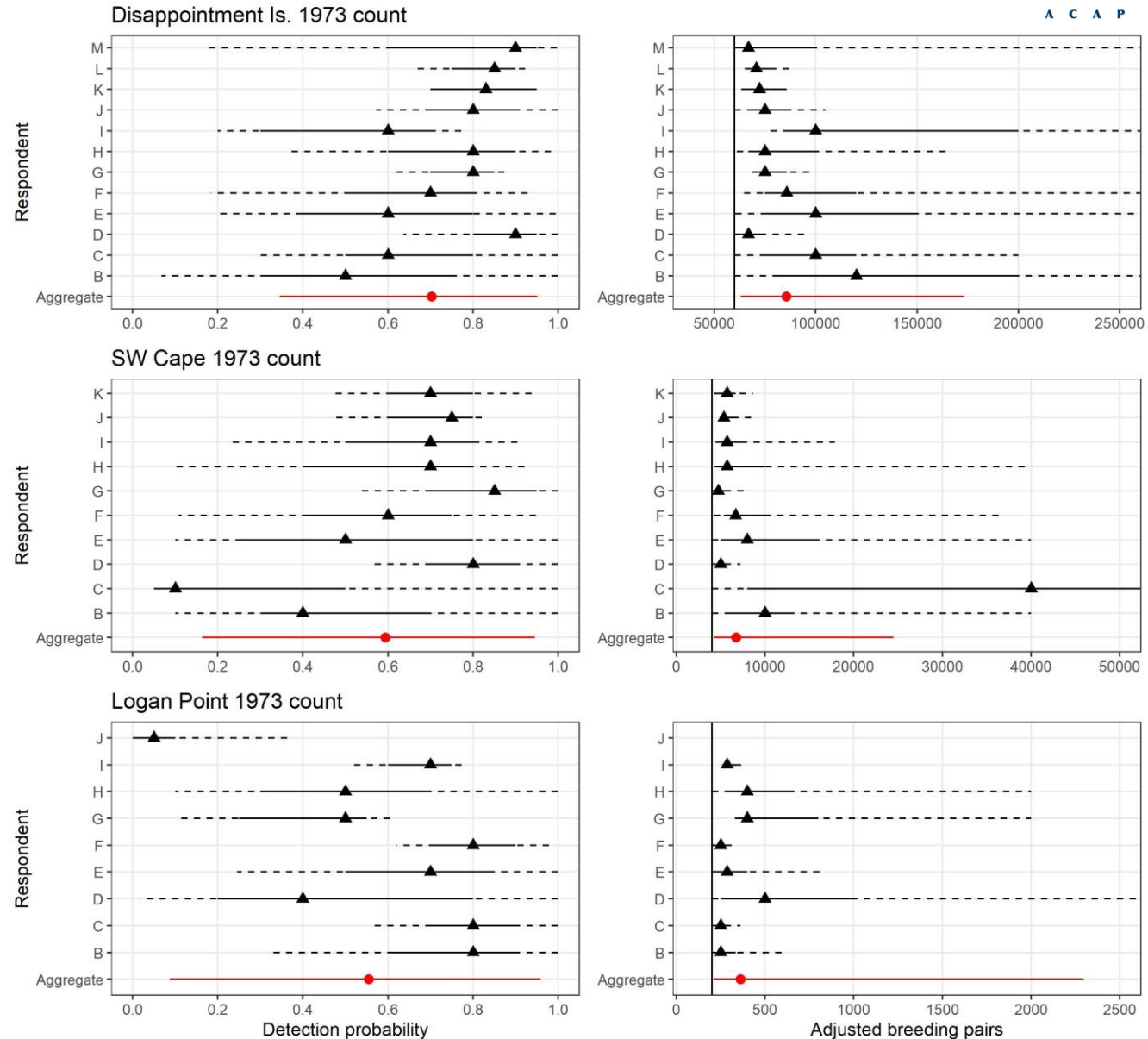
$$\tau_{t,i}^n = \frac{1}{S(a_{t,i}) \cdot P_{t,i}^2 + \frac{(1 - \xi_{t,i})}{\xi_{t,i}^2} \cdot P_{t,i}}$$

|                | Surface nesters |        | Burrow/crevice nesters |        |
|----------------|-----------------|--------|------------------------|--------|
|                | % within        | S(a)   | % within               | S(a)   |
| Accuracy score | stated value    |        | stated value           |        |
| High           | 10%             | 0.0026 | 16%                    | 0.0067 |
| Medium         | 33%             | 0.0283 | 46%                    | 0.0551 |
| Low            | 67%             | 0.1169 | 88%                    | 0.2016 |

# Data processing Step 2

Accounting for imperfect detection  $\psi^d$  retrospectively in a standardised proved challenging and as such custom approaches were applied:

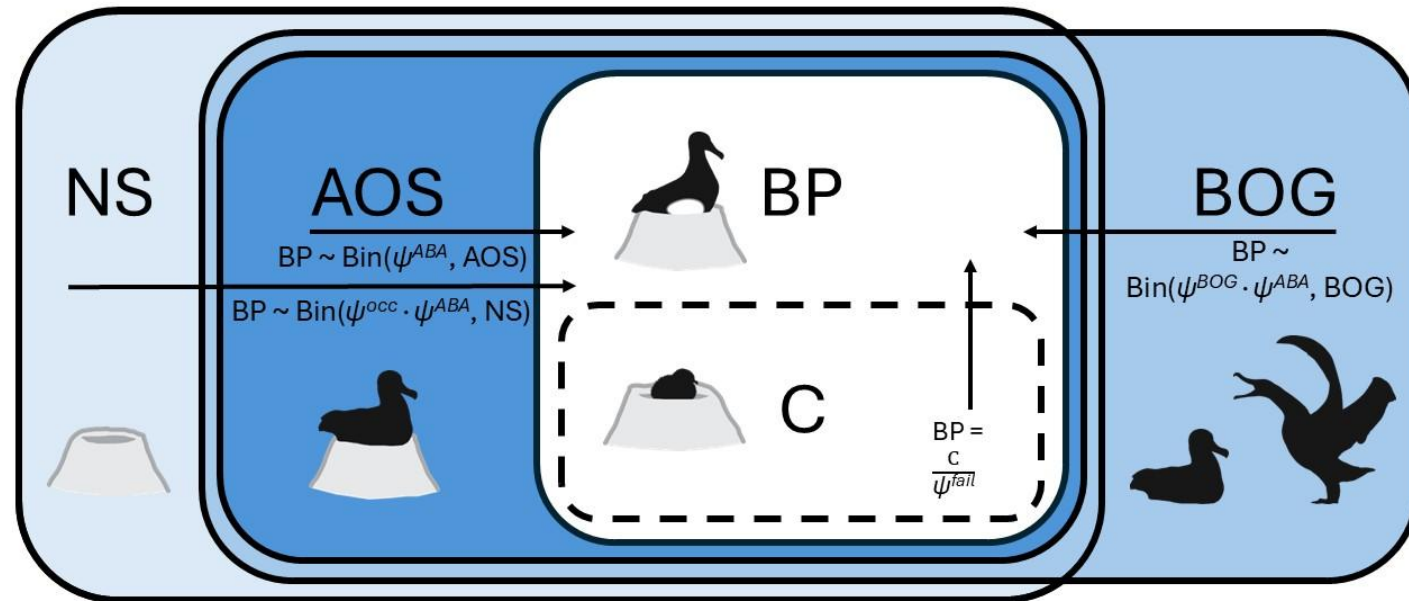
- If  $\psi^d$  was perceived negligible (e.g., GCs of great albatrosses) uncertainty propagated through Step 1 was considered sufficient.
- If existing  $\psi^d$  estimates existed, informative priors were formulated
- For problematic counts, formal expert elicitations following the Delphi protocol were conducted to estimate  $\psi^d$  retrospectively (VBCs for White-capped and Chatham Albatross only).



# Data processing Step 3

Accounting for occupancy error  $\psi^o$ , by leveraging:

- Inherent hierarchy associated with count metrics
- Data contained in auxiliary sub-counts (transects/close up photographs)
- Series of GLMMs with stochastic nodes mirroring metric hierarchy



$$bp_{t,i} \sim \text{Bin}(aos_{t,i}, \psi_{t,i}^{ABA})$$

$$\text{logit}(\psi_{t,i}^{ABA}) = \alpha_i^{ABA} + \varepsilon_{t,i}^{ABA} \quad \longleftrightarrow$$

$$\varepsilon_{t,i}^{ABA} \sim N(0, \sigma_{t,i}^{ABA^{-2}})$$

$$aos_{t,i} \sim \text{Bin}(bog_{t,i} - m_{t,i}, \psi_{t,i}^{BOG})$$

$$\text{logit}(\psi_{t,i}^{BOG}) = \alpha_i^{BOG} + \varepsilon_{t,i}^{BOG} \quad \longleftrightarrow$$

$$\varepsilon_{t,i}^{BOG} \sim N(0, \sigma_{t,i}^{BOG^{-2}})$$

$$aos_{t,i} \sim \text{Bin}(ns_{t,i}, \psi_{t,i}^{occ})$$

$$\text{logit}(\psi_{t,i}^{occ}) = \alpha_i^{occ} + \varepsilon_{t,i}^{occ}$$

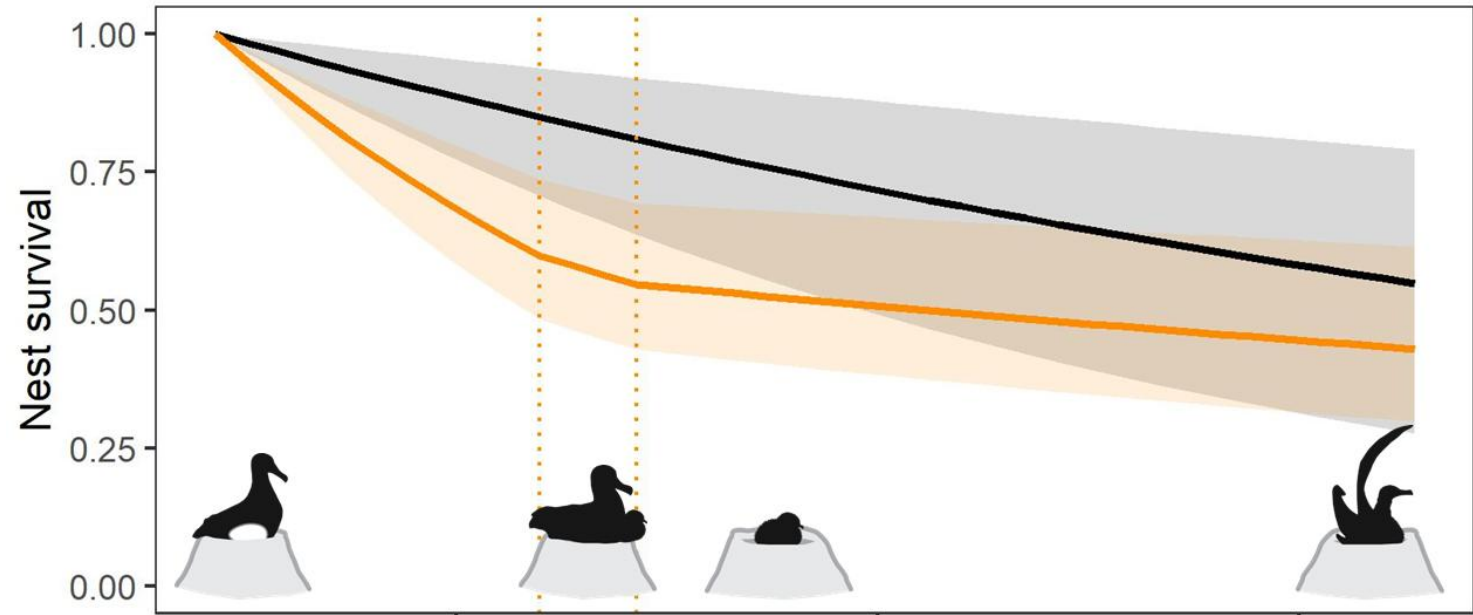
$$\varepsilon_{t,i}^{occ} \sim N(0, \sigma_{t,i}^{occ^{-2}})$$

# Data processing Step 4



Accounting for phenology-related error  $\Psi^p$ , by leveraging:

- Information on annual breeding success and breeding period
- Knowledge on count timing, while propagating phenological uncertainty of exact start times through priors
- Hazard functions, which can be adapted to incorporate stage-specific survival to overcome assumptions of constant failure (provided such information exists)



$$n_{t,i}^{bs} \sim \text{Bin}(o_{t,i}^{bs}, f_{t,i})$$

$$\text{logit}(f_{t,i}) = \alpha_i^f + \varepsilon_{t,i}^f$$

$$\varepsilon_{t,i}^f \sim N(0, \sigma_{t,i}^{f-2})$$

$$\Psi_{t,i}^{fail} = f_{t,i}^{\frac{\theta_{t,i}}{\theta_i}}$$

$$\theta_{t,i} \sim U(|v_{t,i} - 1|, \omega_{t,i} + 1)$$

or

$$n_{t,i,k}^{bs} \sim \text{Bin}(o_{t,i,k}^{bs}, f_{t,i,k})$$

$$\text{logit}(f_{t,i,k}) = \alpha_{i,k}^f + \varepsilon_{t,i,k}^f$$

$$\varepsilon_{t,i,k}^f \sim N(0, \sigma_{t,i,k}^{f-2})$$

$$\Psi_{t,i,k}^{fail} = f_{t,i,k}^{\frac{\theta_{t,i,k}}{\theta_{i,k}}}$$

$$\theta_{t,i,k} \sim U(|v_{t,i,k} - 1|, \omega_{t,i,k} + 1)$$

$$\Psi_{t,i}^{fail} = \prod_k \Psi_{t,i,k}^{fail}$$

# Data processing Step 5

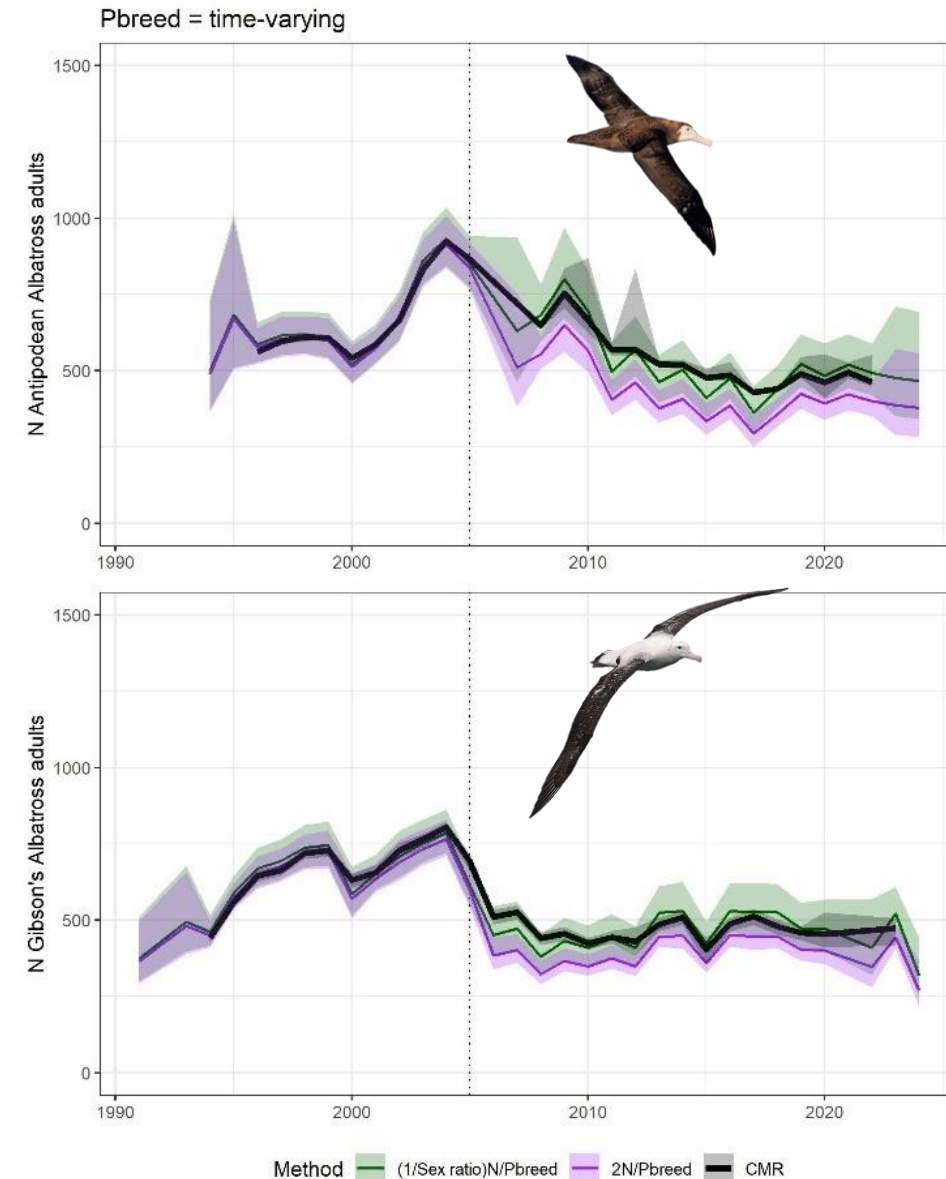
Transforming to mature individuals ( $M_{t,i}$ ) by leveraging insights into:

- Breeding probability
- Sex ratio, where relevant

This approach provided defensible estimates of mature individuals mirroring results obtained through CMR modelling

$$u_{t,i} \sim \text{NegativeBinomial} \left( p_i^b, \frac{1}{s_i} \cdot y_{t,i} \right)$$

$$M_{t,i} = u_{t,i} + \frac{1}{s_i} \cdot y_{t,i}$$



# Trend model

The custom Bayesian state-space model *ACAPT* built on *JARA* (Winker et al. 2020) and allowed for the incorporation of count-specific uncertainty.

*ACAPT* treats the trend underlying the observed abundance as a lognormal random-walk, with a shared mean log growth rate  $q$  that is constant and common to all breeding sites.

Despite this common  $q$ , *ACAPT* is highly flexible and successfully estimates divergent trends from multiple sites simultaneously

*ACAPT* varies from *JARA* through the more defensible forecasting approach (& some other technical differences).

$$N_{(t+1),i} = \lambda_{t,i} \cdot N_{t,i}$$

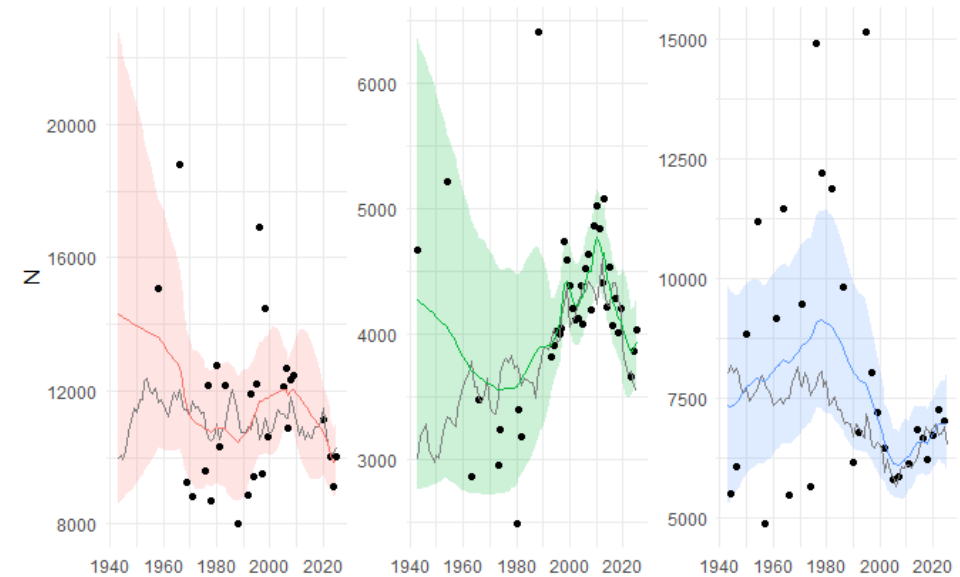
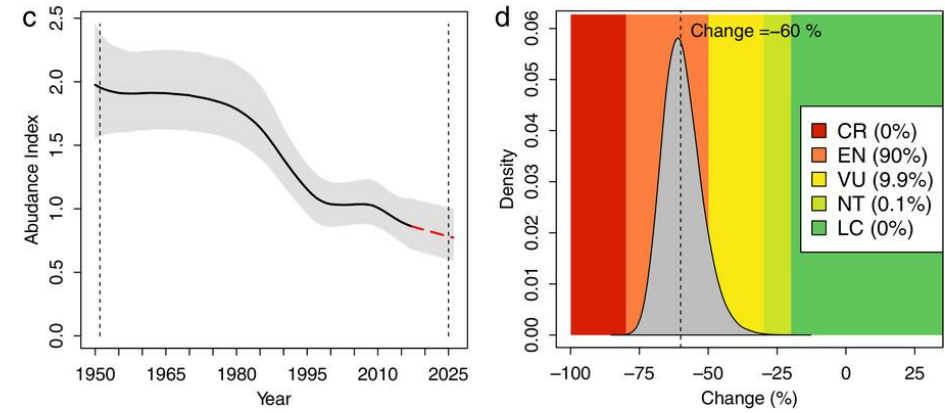
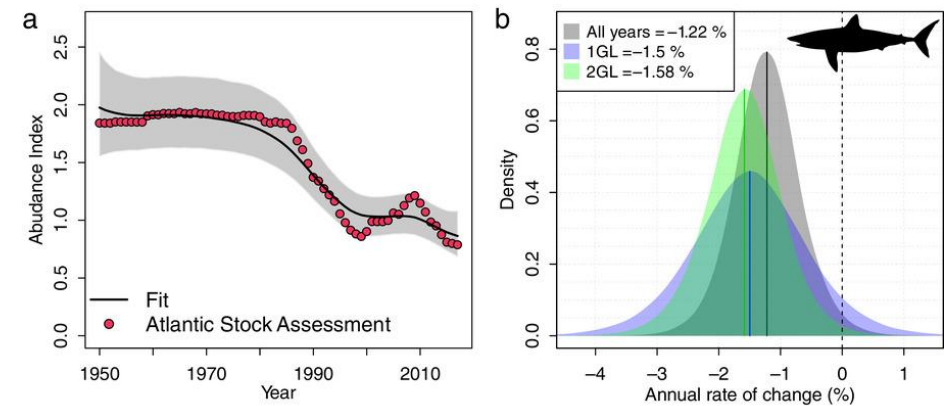
$$x_{(t+1),i} = x_{t,i} + r_{t,i}$$

$$\lambda_{t,i} \sim \text{LogN}(q_t, \sigma_q^2)$$

$$r_{t,i} \sim N(q_t, \sigma_q^2)$$

$$N_t = \sum_i N_{t,i}$$

$$y_{t,i} \sim \text{LogN}(x_{t,i}, \sigma_y^2 + \zeta_{t,i}^2)$$



# Conservation status assessments: IUCN Red List

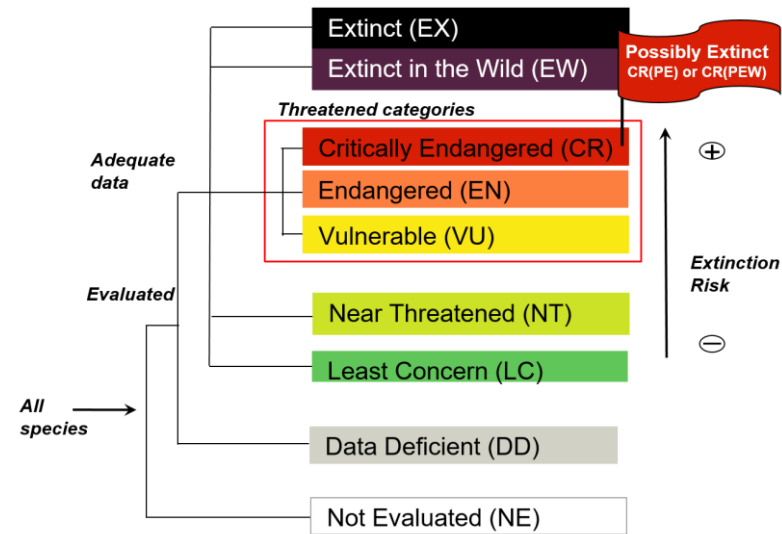


IUCN Red List re-assessment advice from ACAP to BLI is due **1 Oct 2026**

Assessment Criteria consist of:

- A. Population trend over three generation lengths
- B. Geographic range (extent of occurrence & area of occupancy)
- C. Small population size in decline
- D. Very small population size
- E. Direct extinction estimates

ACAPT facilitates IUCN Red List **Criterion A** evaluations by estimating overall population change (in  $M_{t,i}$ ) over customisable time periods (e.g., using generation length).



| Sub-criteria | Brief description   | CR   | EN   | VU   | NT   |
|--------------|---|------|------|------|------|
| A1           | Population reduction estimated over 3 GL in the past, for which causes are clearly reversible and understood and have ceased.   | ≥90% | ≥70% | ≥50% | ≥25% |
| A2           | Population reduction estimated over 3 GL in the past, for which causes may not have ceased or may not be understood or may not be reversible.   | ≥80% | ≥50% | ≥30% | ≥20% |
| A3           | Population reduction projected over 3 GL in the future.   | ≥80% | ≥50% | ≥30% | ≥20% |
| A4           | Estimated and/or projected population reduction over 3 GL, where the time period must include both the past and the future, and for which causes may not have ceased or may not be understood or may not be reversible. | ≥80% | ≥50% | ≥30% | ≥20% |

# Conservation status assessments: IUCN Red List



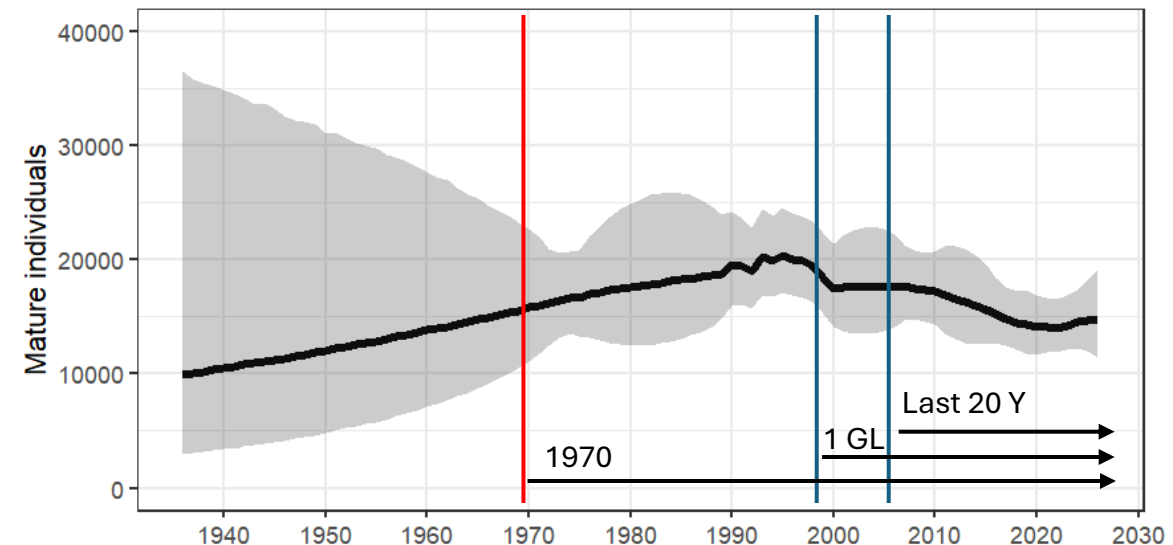
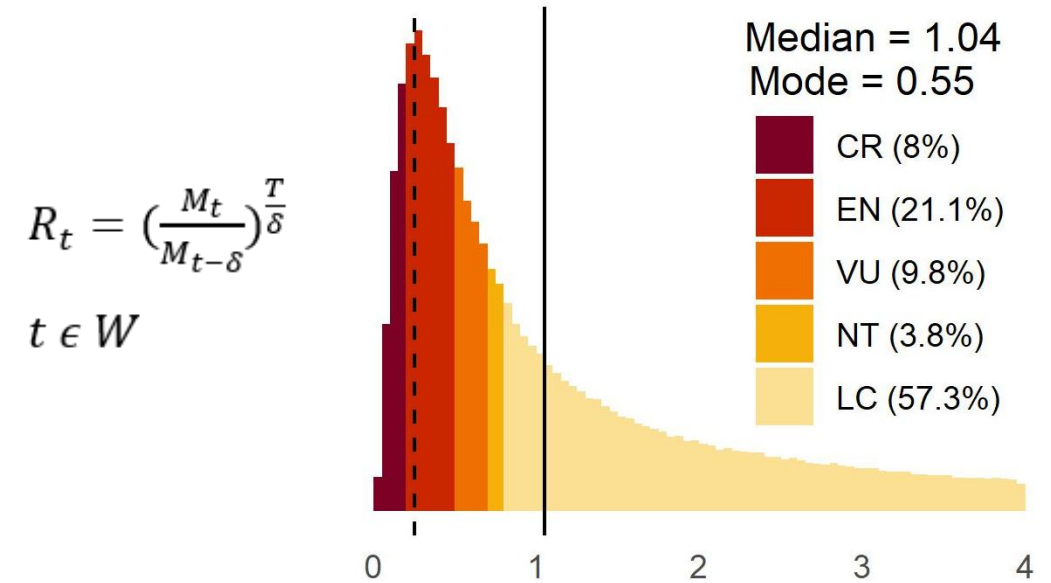
Following consultation with the BLI RL team, we used three observation periods for Criterion A2 / A4 evaluations:

1. Full time series available, forecast to 3GL
2. Last GL, forecast to 3GL (Crit. A4)
3. Last 20 years (based on ACAP reporting), forecast to 3GL. (Crit. A4)

We calculated median, mode, and density-based allocations to IUCN Red List categories to provide insights into uncertainty

1970 should be considered the first year in IUCN Red List assessment as counts pre-1970 are of poor quality.

Modes and densities are poor approaches of assigning Red List categories and instead 40%, 45%, or 50% (medians) percentiles should be considered



# Conservation status assessments: ACAP High Priority Populations

ACAP High Priority Populations meet three standard criteria:

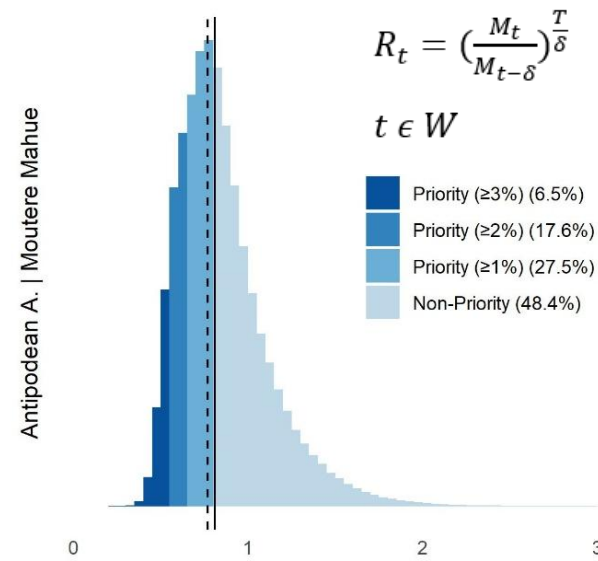
1. A population (breeding site) holds  $\geq 10\%$  of the species' global population
2. The population is at risk from fisheries bycatch
3. The population has declined for  $\geq 3\%$  per annum for the last 20 years

These criteria do not appear to have been applied in a standardised manner.

For ACAP High Priority Populations, we estimated  $R_{20}$  for each breeding site that held  $\geq 10\%$  of the global population (all were threatened by bycatch)

We calculated median, mode, and density-based allocations of  $R_{20}$  to provide insights into uncertainty

| Species                       | Breeding site                                       | Listing year |
|-------------------------------|---|--------------|
| Wandering Albatross           | South Georgia (Islas Georgias del Sur) <sup>1</sup> | 2011         |
| Black-browed Albatross        | South Georgia (Islas Georgias del Sur) <sup>1</sup> | 2011         |
| Tristan Albatross             | Gough Island  | 2011         |
| Sooty Albatross               | Crozet Island                                       | 2011         |
| Grey-headed Albatross         | South Georgia (Islas Georgias del Sur) <sup>1</sup> | 2016         |
| Indian Yellow-nosed Albatross | Amsterdam Island                                    | 2016         |
| Balearic Shearwater           | Balearic Islands                                    | 2016         |
| Waved Albatross               | Espanola Island                                     | 2016         |
| Antipodean Albatross          | Antipodes Island                                    | 2017         |



Further analyses and discussions on standardised criteria for identifying ACAP High Priority Populations are required, including on statistical thresholds.

# Model implementation

The entire analysis process consists of Bayesian processes which were completed in two separate steps:

1. Data processing completed in OpenBUGS or JAGS (two MCMC chains, 100,000 iterations)
2. Trend model & conservation assessments completed in JAGS called via *ACAPT* in R (four MCMC chains of 20,000 iterations)

No convergence issues and posterior predictive checks supported fits

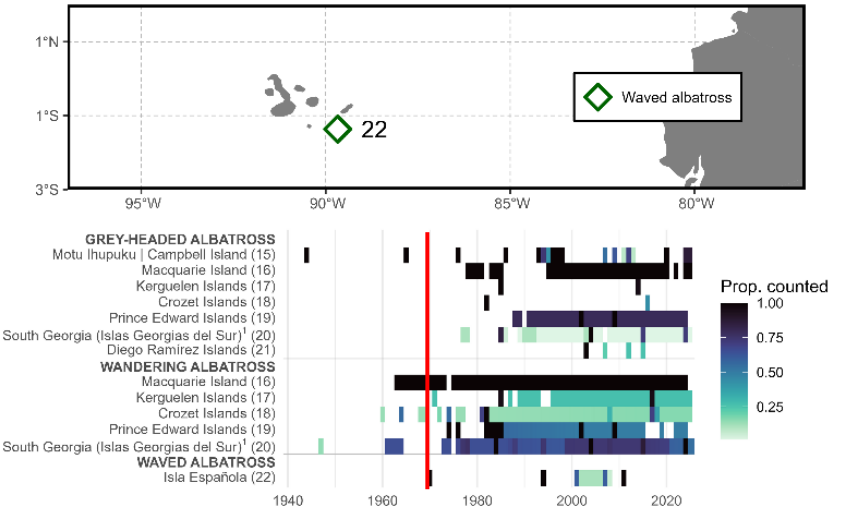
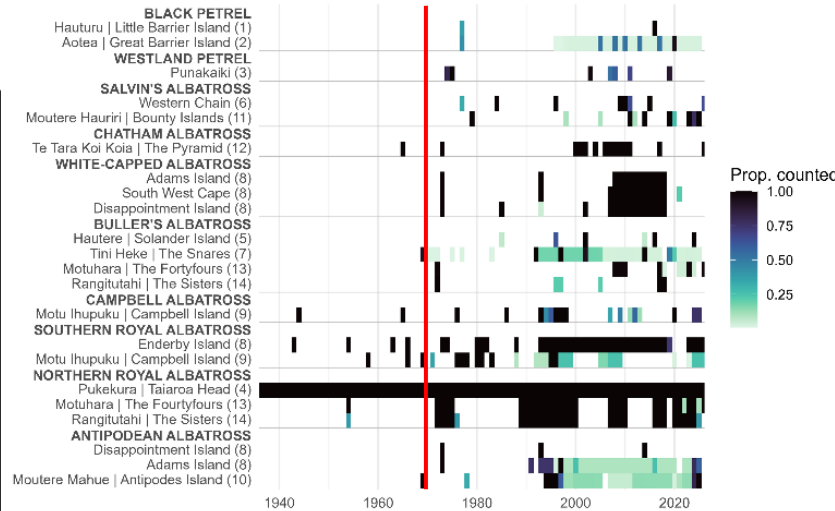
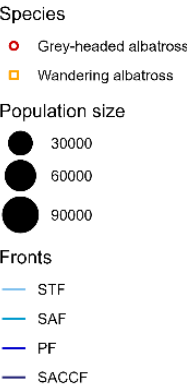
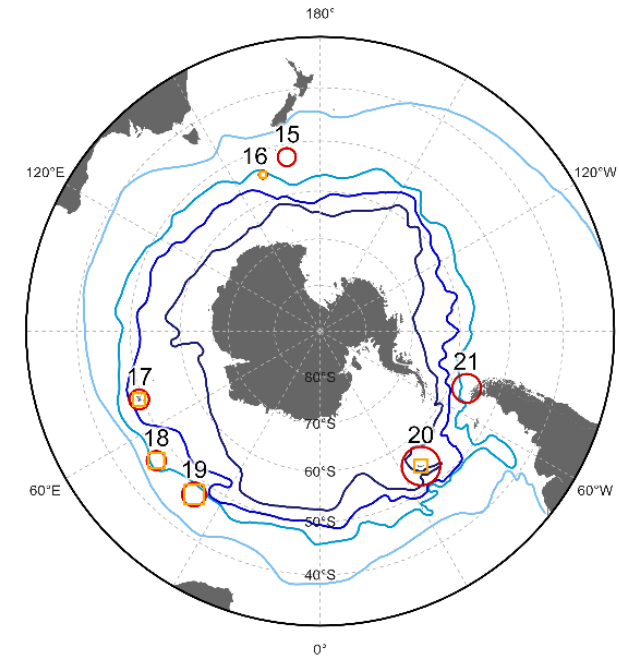
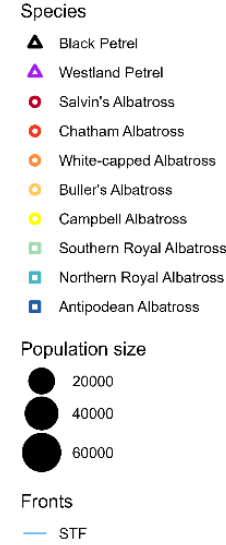
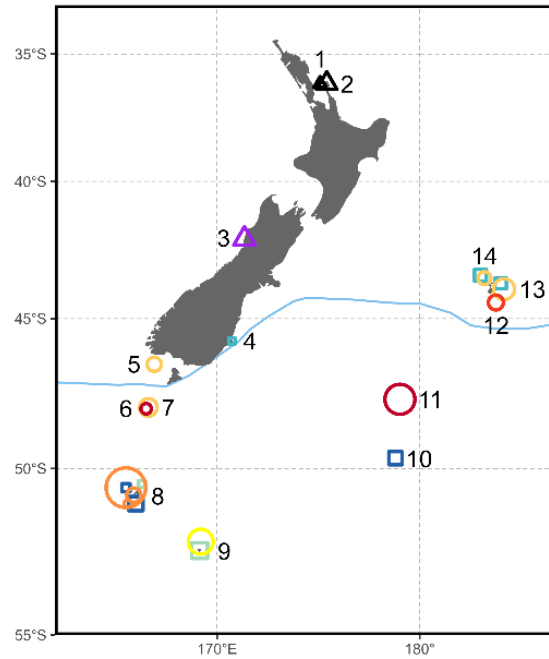


# Case studies



- 13 ACAP species from 36 breeding sites were subjected to the data processing framework.
- Differing time series quality, length (53; 40-91 years), and varying characteristics and context.
- Total of 893 individual counts were processed by four separate analysts (thank you Jo, Pat & Theo)

Counts pre-1970 should be excluded. Further ID of poor counts required together with data custodians. Archipelagos require some further review to ensure combined modelling is appropriate



# Antipodean Albatross

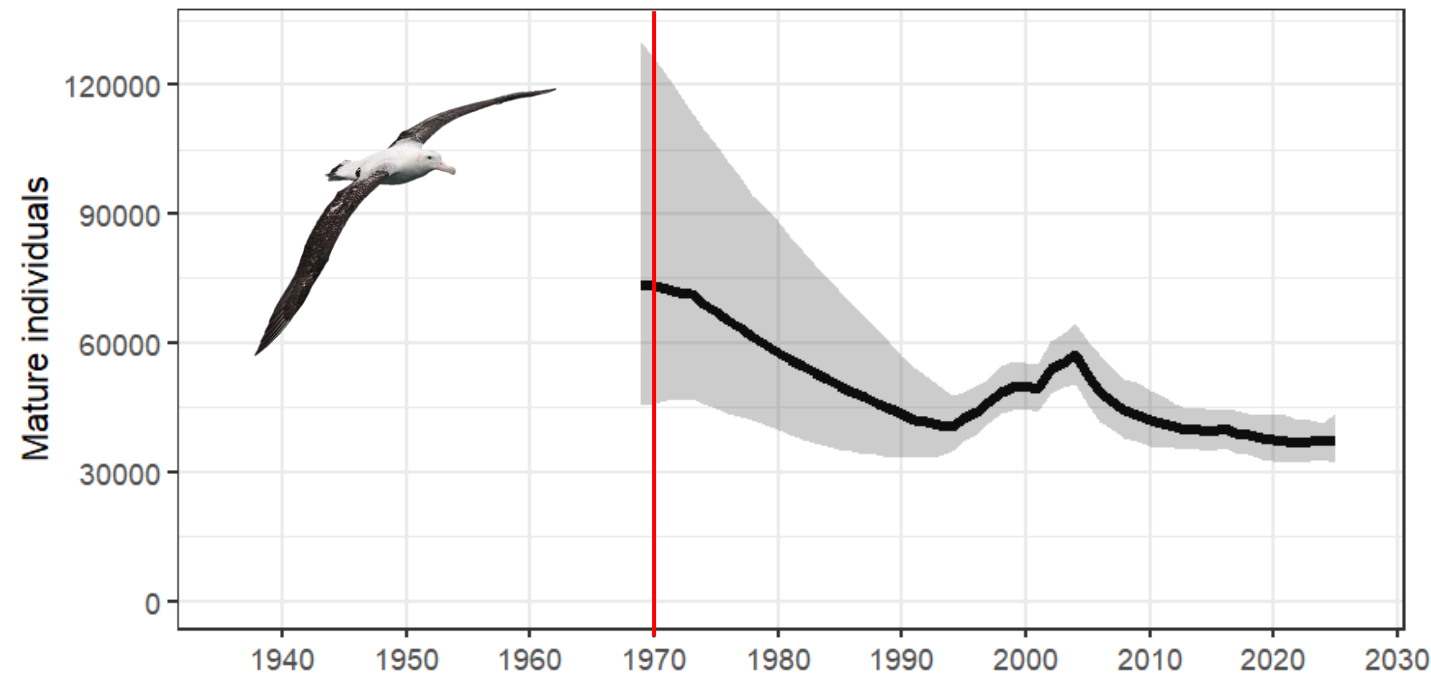
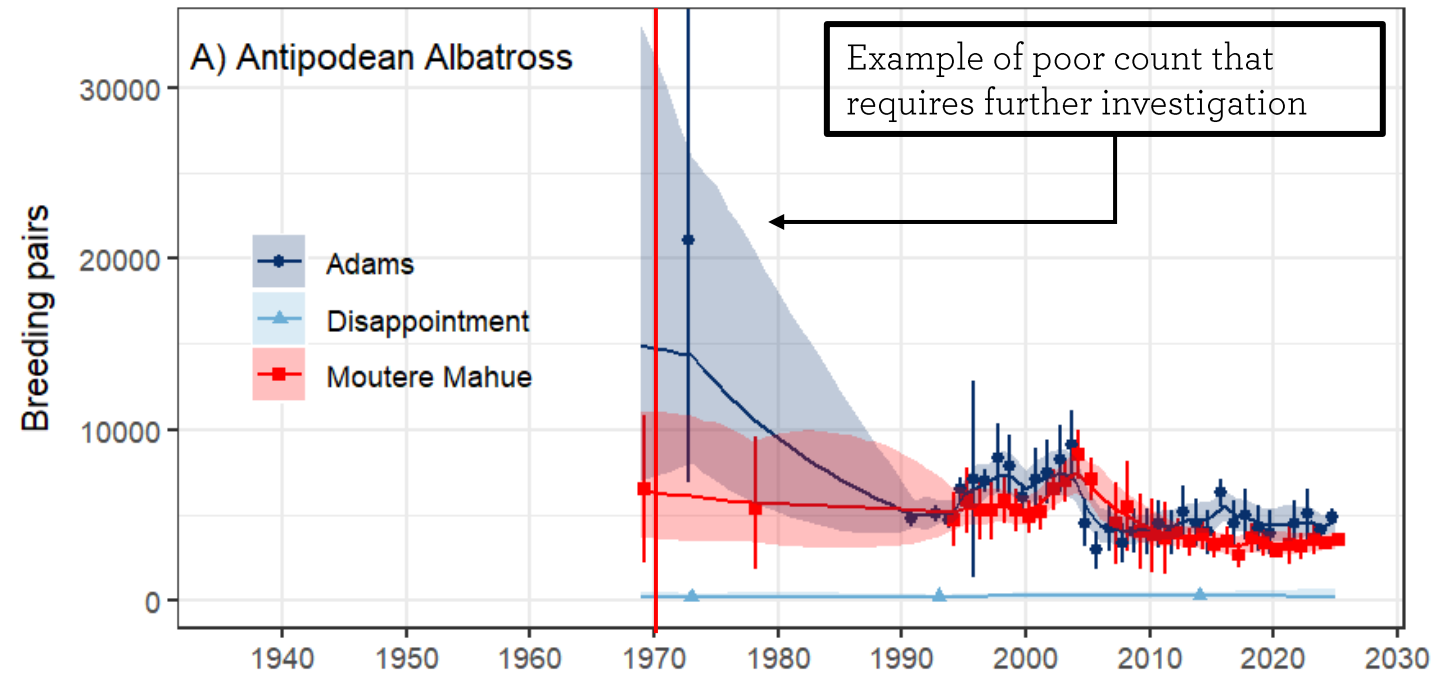
Data included 69 individual counts (GC, VPC, AC<sup>UAV</sup> & AC<sup>heli</sup>) across 1969-2025 and three sites, expressed BP, AOS & BOG.

## Data processing adjustments included:

- Uncertainty propagation, which was assumed sufficient for  $\psi^d$
- Original  $\psi^o$  adjustments for two main sites, but Adams model intercept used for Disappointment
- Time-varying  $\psi^p$  model for Moutere Mahue where required, Adams model intercept used for Disappointment
- Time-varying  $p^b$  and  $s$  pre/post 2005 used to convert to  $M_{t,i}$ .

## Results highlight:

- Ongoing catastrophic declines, which were particularly pronounced on Adams in the past
- However situation appears to be stabilising in recent years



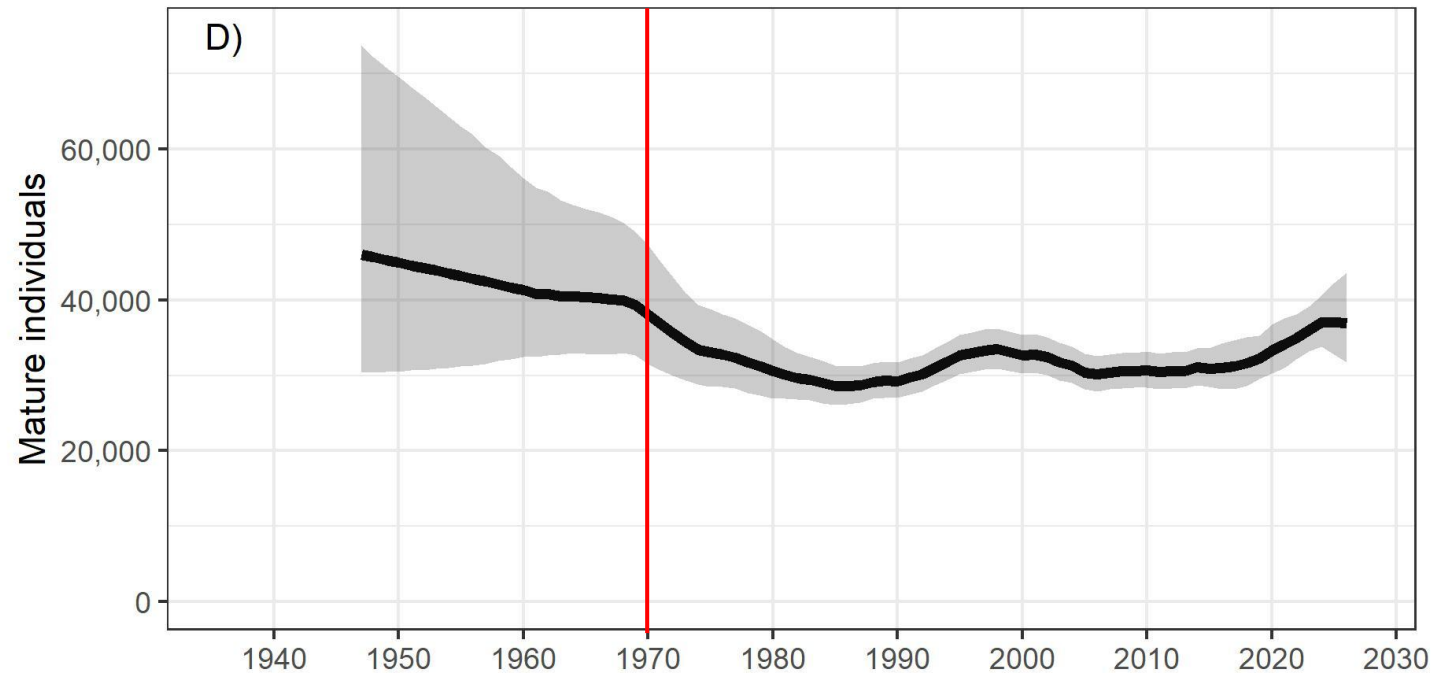
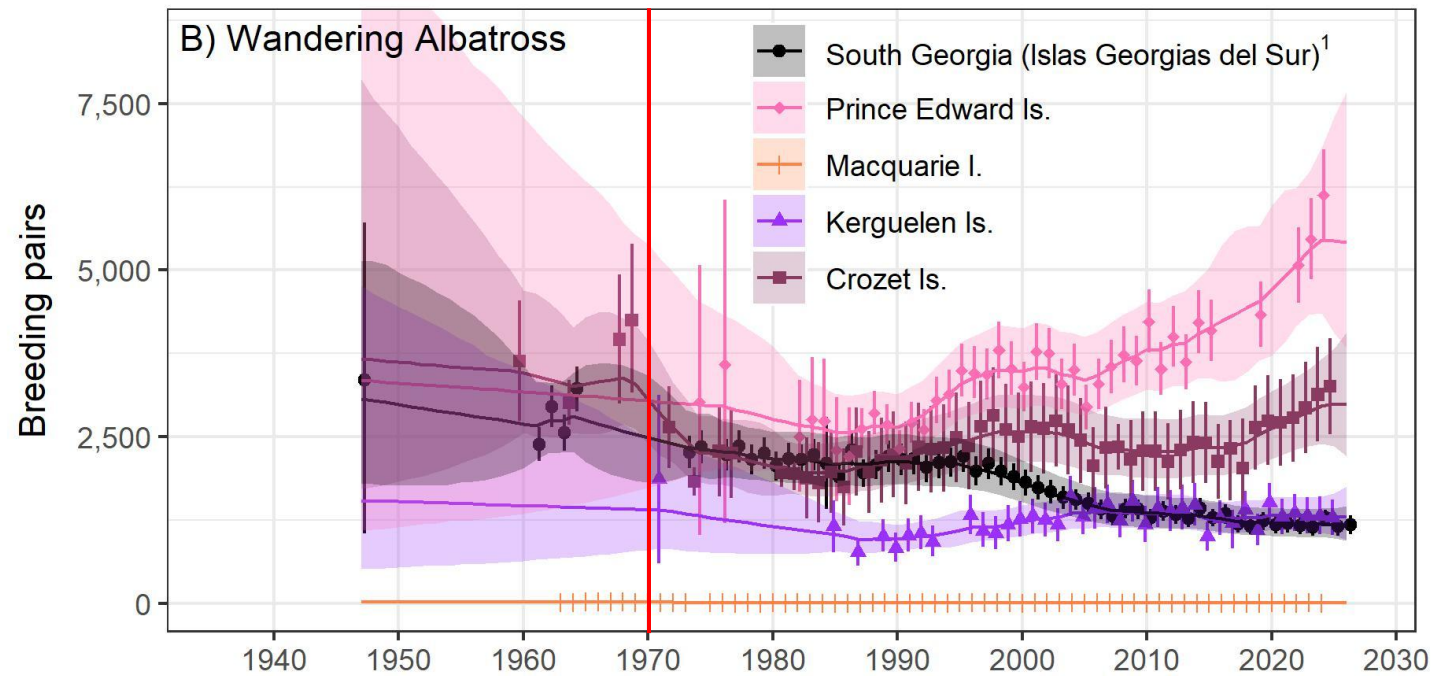
# Wandering Albatross

## Data processing adjustments included:

- Uncertainty propagation, which was assumed sufficient for  $\psi^d$
- Original or fixed  $\psi^o$  adjustments depending on the site and year
- Time-varying  $\psi^p$  model was used for all breeding sites but Prince Edward Islands (model intercept only for this site)
- Fixed  $p^b$  using a beta prior. For Prince Edwards, Kerguelen, and Macquarie the Crozet intercept was used.

## Results highlight:

- Initial range wide declines now offset by increases on Prince Edward Islands and Crozet
- South Georgia (Islas Georgias del Sur)<sup>1</sup> continues to decline

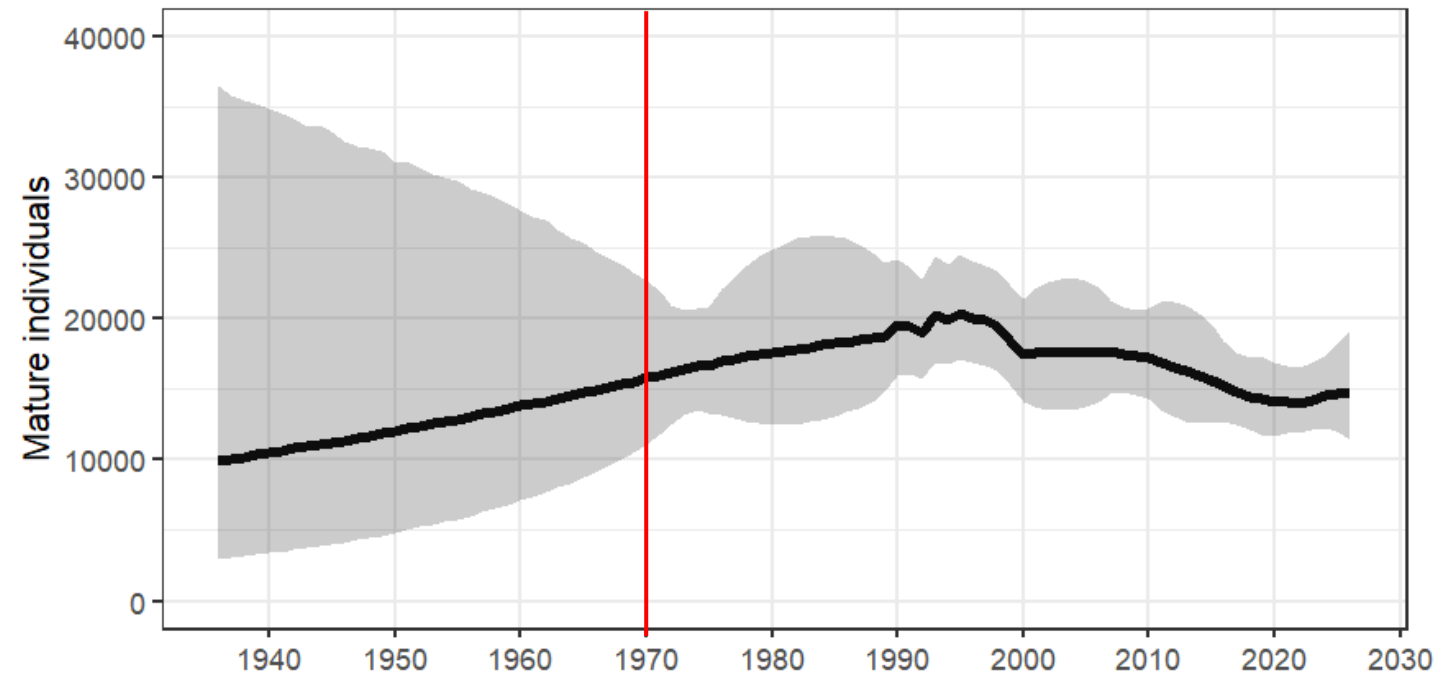
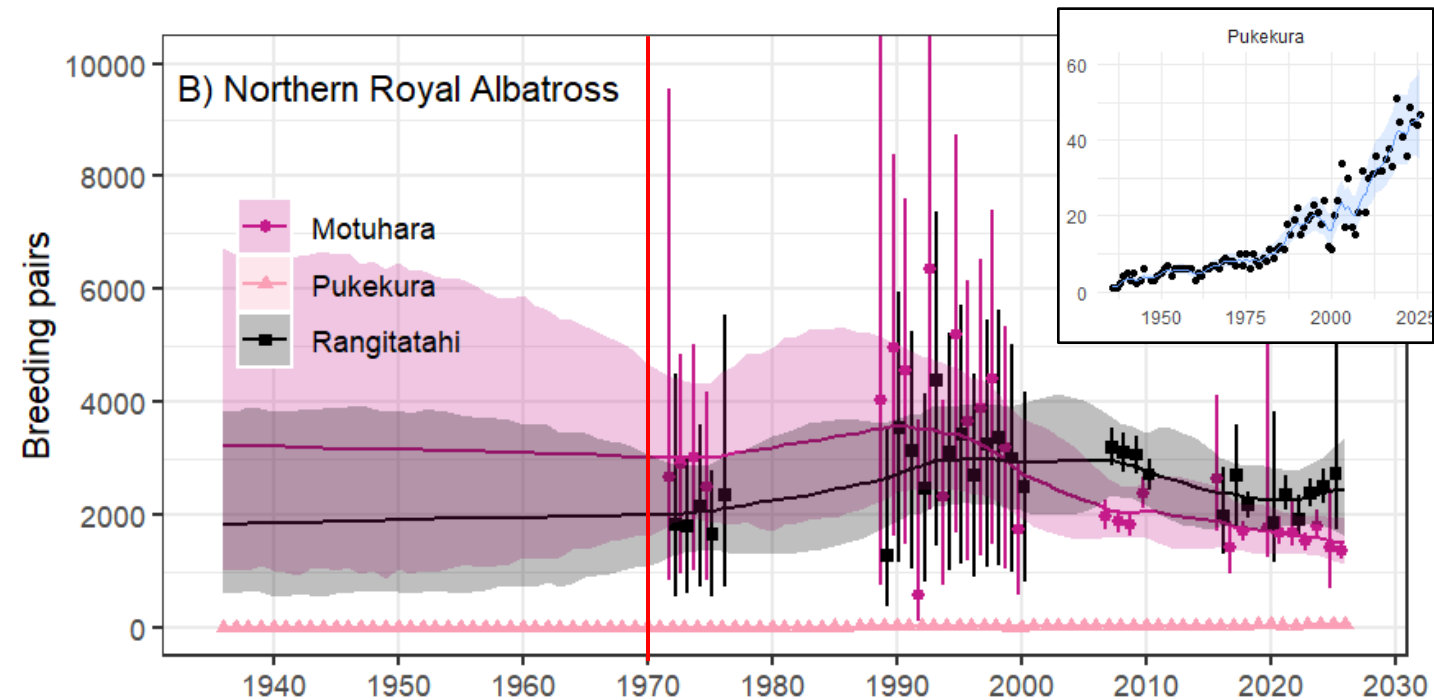


# Northern Royal Albatross

Data included 151 individual counts (GC, AC<sup>fw</sup> & AC<sup>sat</sup>) across 1936-2026 and three sites, expressed BP, AOS, BOG & C.

## Data processing adjustments included:

- Uncertainty propagation, which was assumed sufficient for  $\psi^d$
- $\psi^o$  adjustments for two Chatham sites through model intercepts and informative priors
- Time-varying  $\psi^p$  model for two Chatham sites, with additional fixed effects to account for storm impacts
- Constant  $p^b$  but with **specific storm impacts** incorporated to convert to M
- **Results highlight:**
- Large uncertainty until counts start in the Chathams in 1970 (included due to the long Pukekura timeseries)
- Continuing large uncertainty during storm impacts in 1980s-1990s
- Subsequent onset of declines on Chathams
- Now Motuhara population is smaller than Rangitutahi



# Southern Royal Albatross

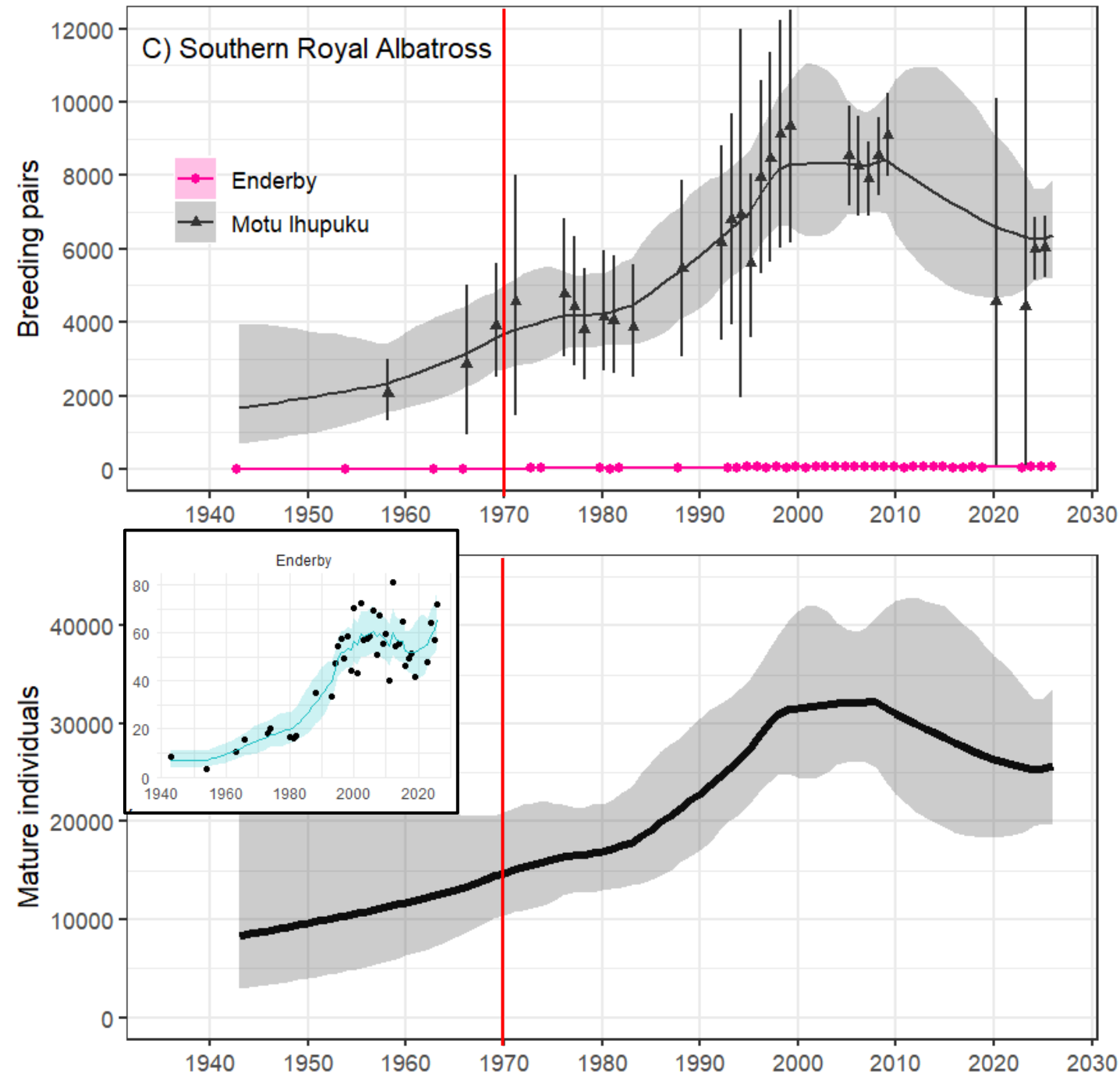
Data included 70 individual counts (GC, VPC & AC<sup>heli</sup>) across 1943-2026 and two sites, expressed BP & AOS.

## Data processing adjustments included:

- Uncertainty propagation, which was assumed sufficient for  $\psi^d$ , aside from VPCs for which informative priors were devised.
- $\psi^o$  adjustments for VPCs made through model intercepts.
- Time-varying  $\psi^p$  model used for Motu Ihupuku, model intercept used for Enderby.
- Conversion to  $M_{t,i}$  completed through informative priors.

## Results show:

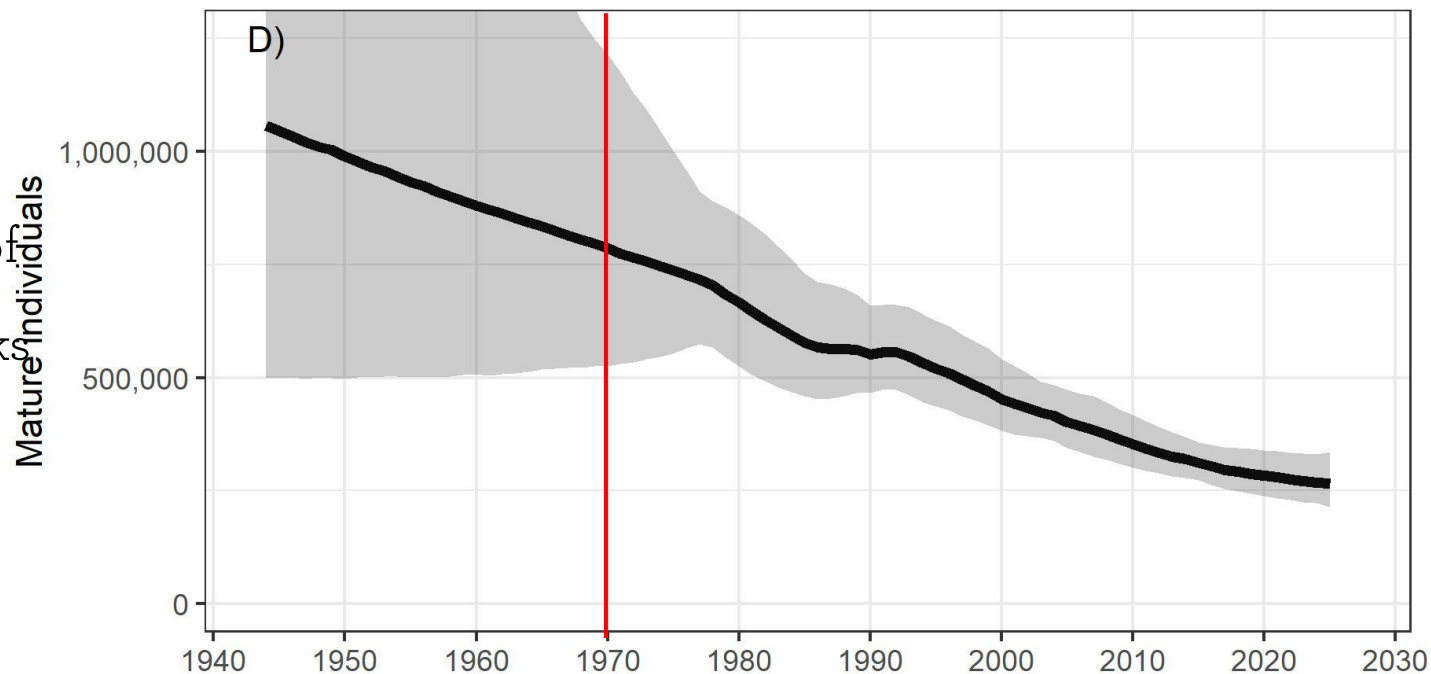
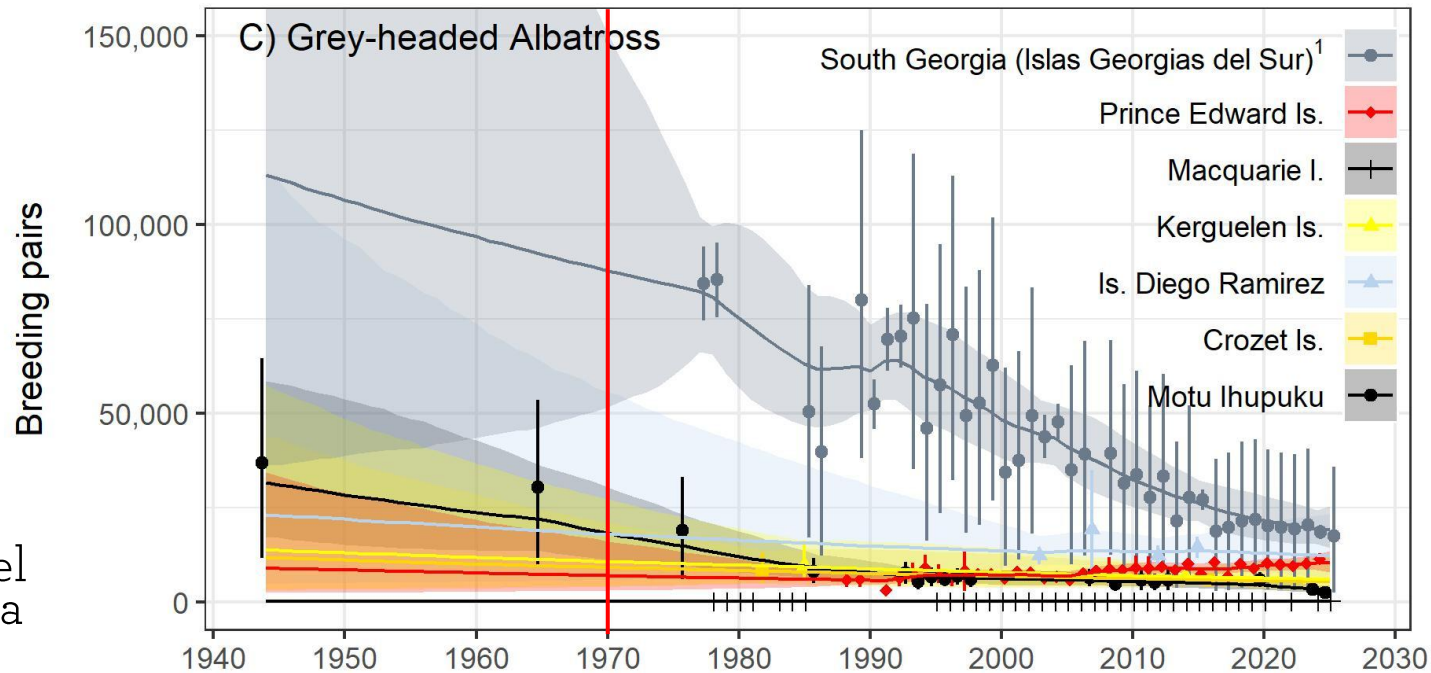
- Steady increase across most of the timeseries or Motu Ihupuku as a consequence of eradications and restorations
- Then in mid-2000s a plateau, followed by a concerning decline became evident
- This pattern is mirrored on Enderby, but after a plateau, Enderby continues to slowly increase



# Grey-headed Albatross

## Data processing adjustments included:

- Uncertainty propagation, which was assumed sufficient for  $\psi^d$  apart from Motu Ihupuku for which estimates exist
- $\psi^o$  adjustments either through time-varying models (Motu Ihupuku), model intercepts, or original approaches (South Georgia (Islas Georgias del Sur))<sup>1</sup>
- $\psi^p$  adjustments either through time-varying models (Macquarie and Prince Edward Is.), model intercepts, or original approaches (South Georgia (Islas Georgias del Sur))<sup>1</sup>
- Either fixed  $p^b$  or model intercepts (South Georgia (Islas Georgias del Sur))<sup>1</sup> and Prince Edward Is.) used for transformation to mature individuals.
- **Results highlight:**
- Large uncertainty 1940-1980 driven by sparsity of counts (basically only Motu Ihupuku)
- Lack of counts on Crozet & Kerguelen (but thanks to other sites model still fits successfully!)
- Large declines at most sites, with South Georgia (Islas Georgias del Sur)<sup>1</sup> and Motu Ihupuku suffering the biggest declines by far
- Declines not offset by smaller stable (e.g., Diego Ramirez), or increasing populations (e.g., Prince Edward Islands)



# Campbell Albatross

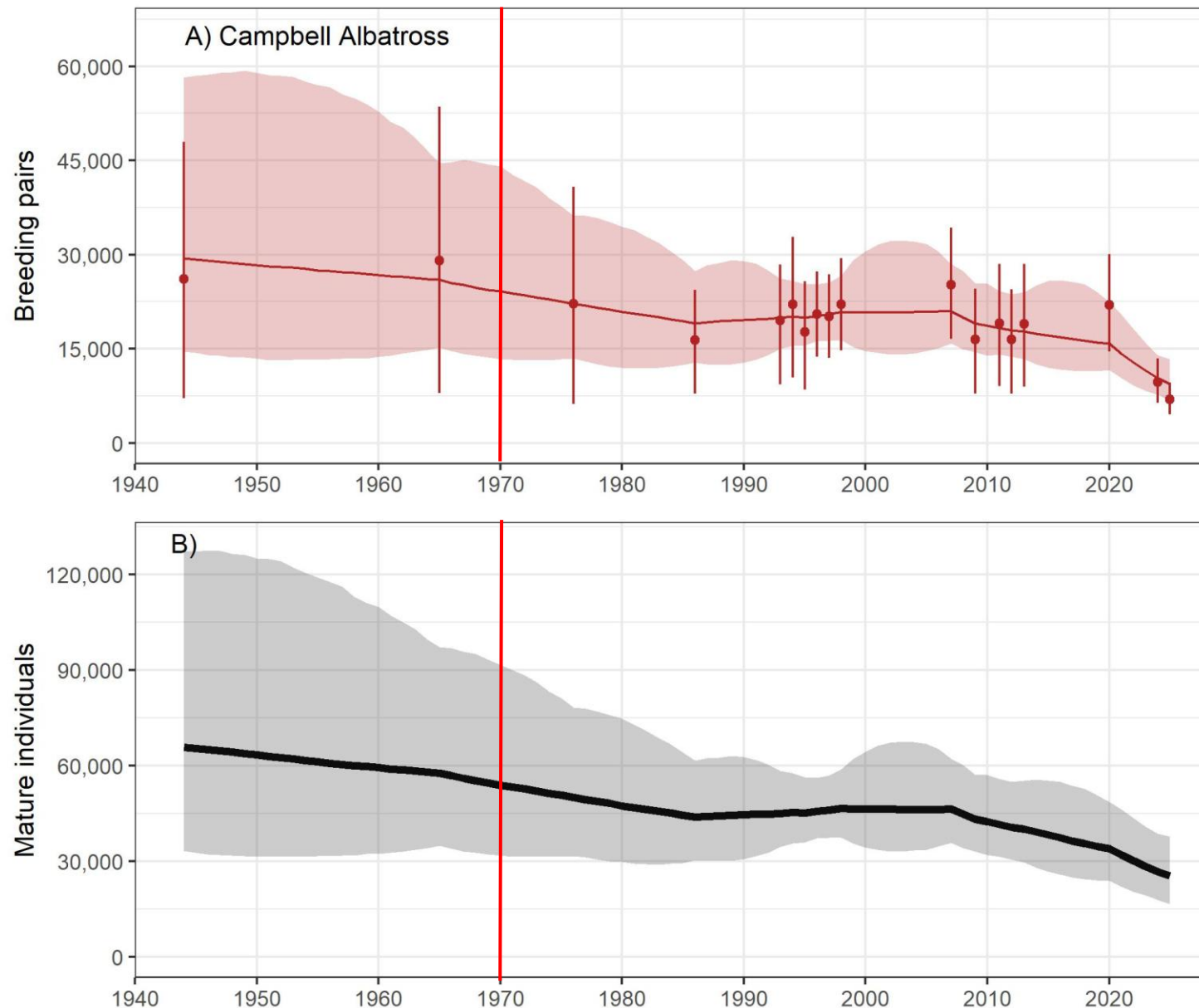
Data included 18 individual counts (GC, VPC,  $AC^{\text{heli}}$  &  $AC^{\text{fw}}$ , VBC) across 1944-2025, expressed AOS, BOG & C.

## Data processing adjustments included:

- Uncertainty propagation and adjustments for detection through informative priors
- Time-varying occupancy adjustments
- Original adjustments for breeding failure
- Conversion to  $M_{t,i}$  completed through informative priors that take recent nuance into account

## Results show:

- Long term decline that may be accelerating in recent years



# Buller's Albatross

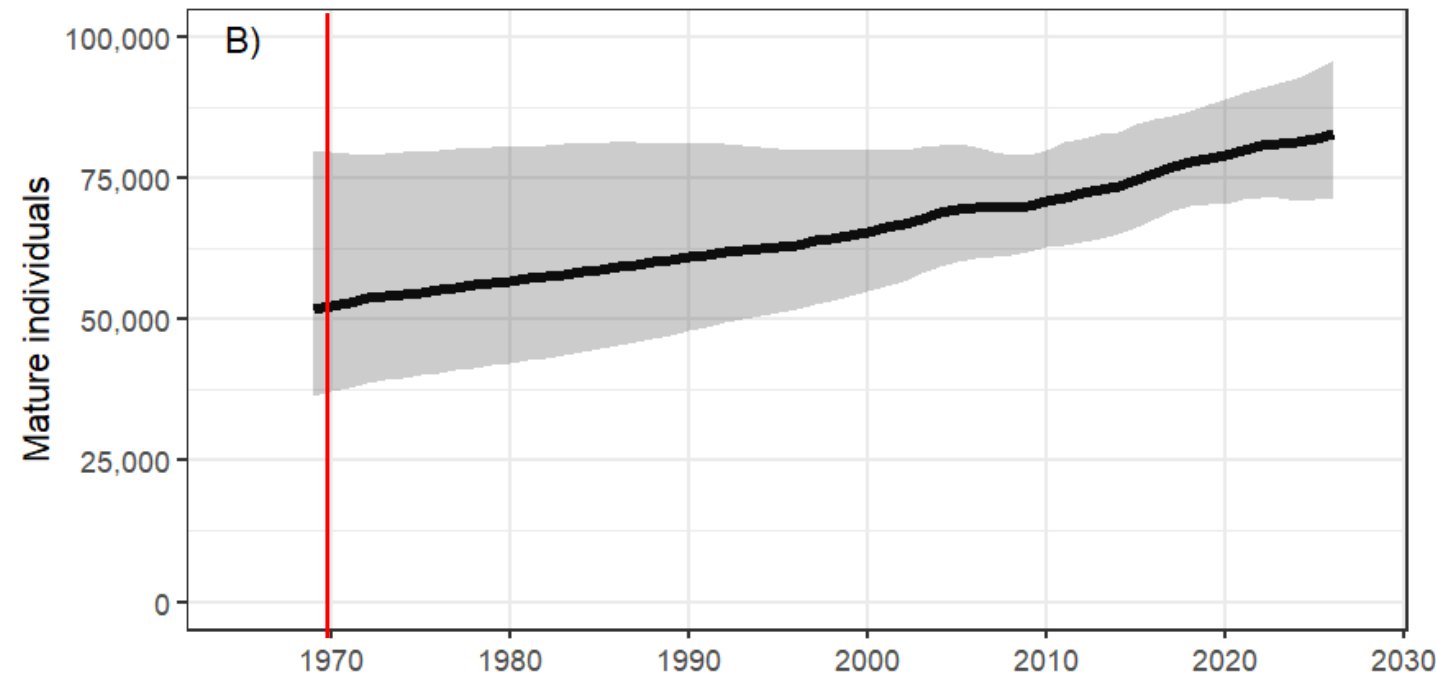
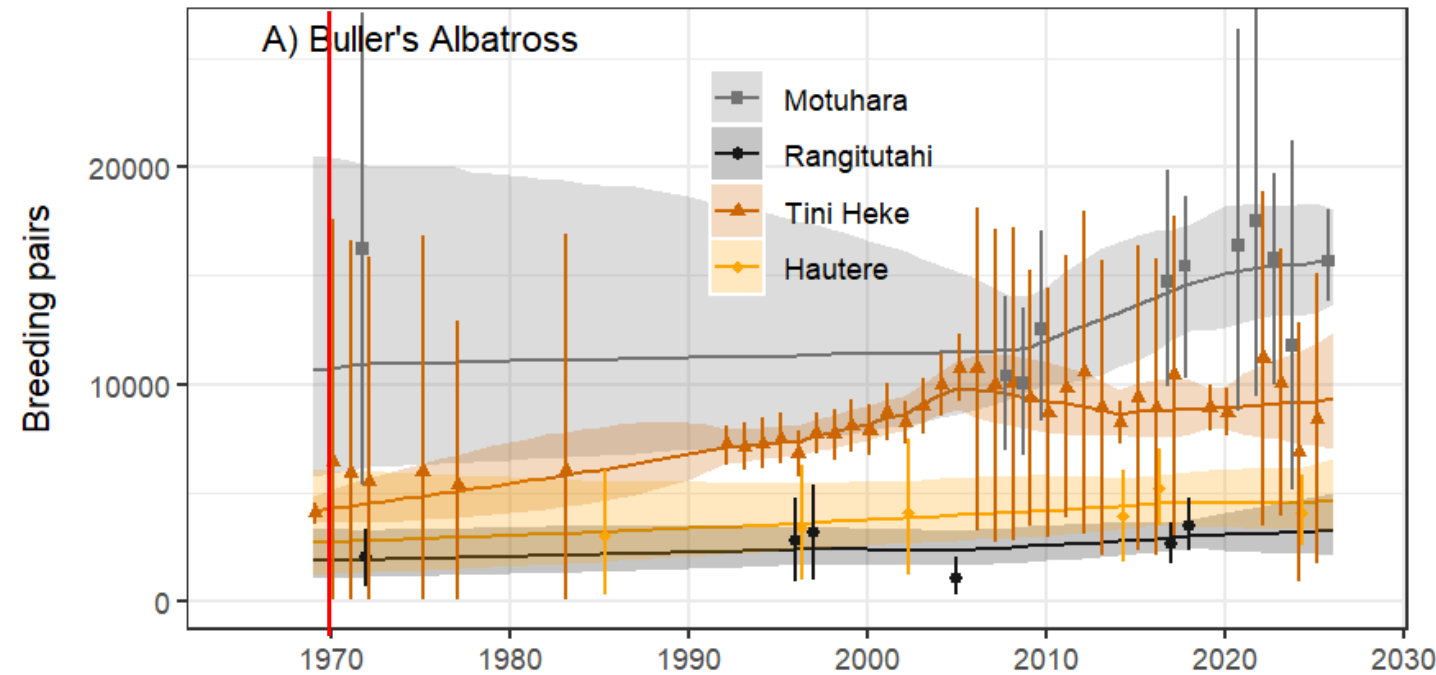
Data included 62 individual counts (GC, VPC,  $AC^{heli}$  &  $AC^{fw}$ ) across 1969-2026 and four sites, expressed BP, AOS, BOG & C.

## Data processing adjustments included:

- Uncertainty propagation, which was assumed sufficient for Chatham sites, but adjustments of  $\psi^d$  for forested sites through informative priors.
- $\psi^o$  adjustments made through a combination of time-varying models and model intercepts, depending on site and parameter.
- Time-varying  $\psi^p$  model used for Hautere and Tini Heke, but informative priors used for Chatham sites.
- Conversion to  $M_{t,i}$  completed through informative priors.

## Results show:

- Long term increase across most populations
- However, Tini Heke seized to increase around mid-2000s and has been declining since
- Large uncertainty surrounding study colony counts when only small proportion (~3% of overall population) is counted



# White-capped Albatross

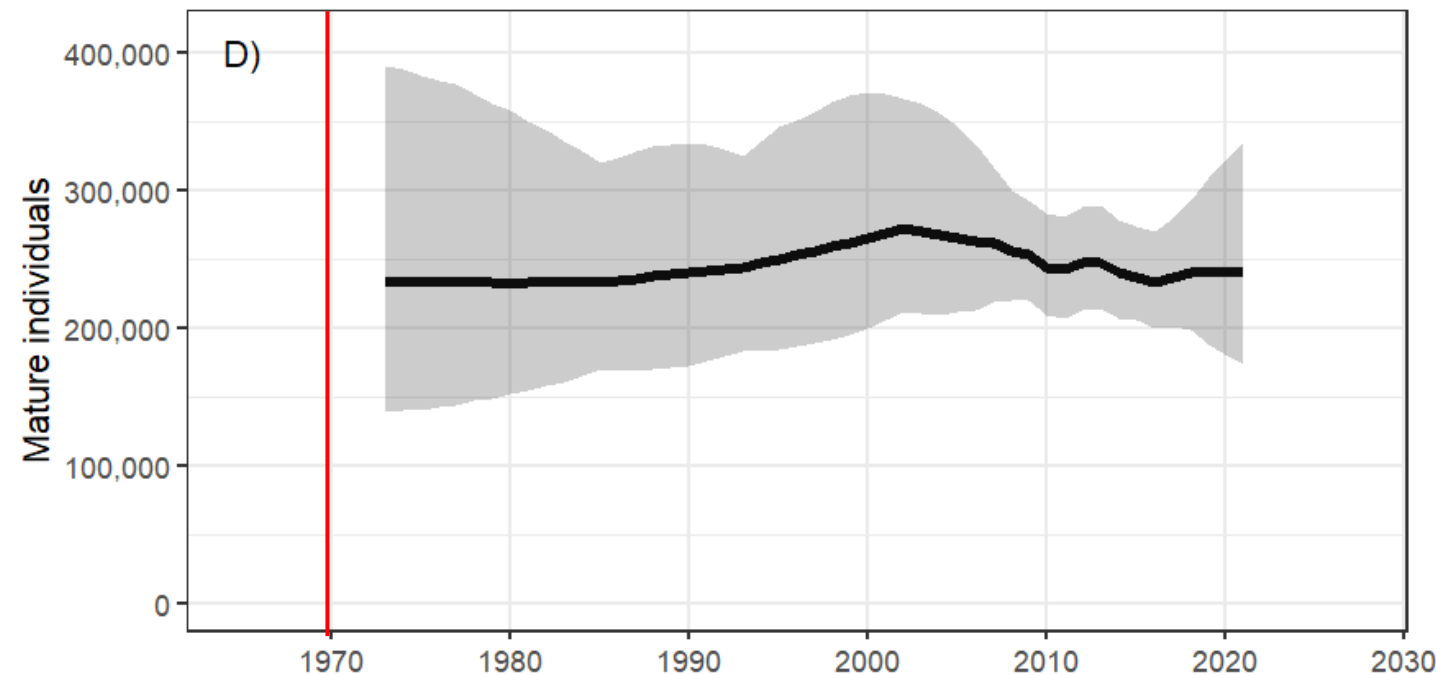
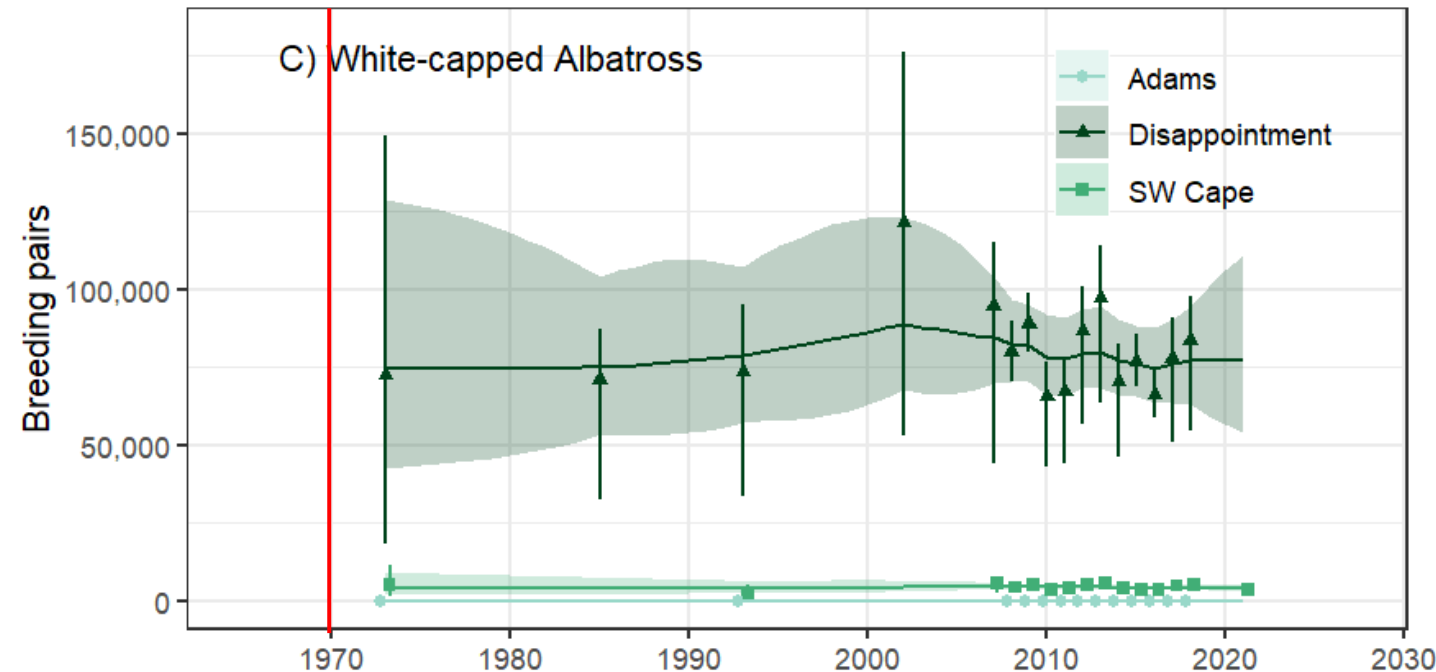
Data included 44 individual counts (GC, VPC, AC<sup>heli</sup> & VBC) across 1973-2021 and three sites, expressed BOG & AOS.

## Data processing adjustments included:

- Uncertainty propagation, which was assumed sufficient for  $\psi^d$ , apart from the VBC for which we used an expert elicitation.
- $\psi^o$  adjustments made through time-varying models, but using Disappointment only.
- $\psi^p$  adjustments made using model-intercepts only.
- Conversion to  $M_{t,i}$  completed through informative priors.

## Results show:

- Uncertain but potential stability until mid-2000s
- A shallow decline became evident after the mid-2000s, forming a middle-ground between two previous studies
- After 2018 (last full Disappointment count, uncertainty rapidly increases)
- Latest count on SW Cape suggests continuing decline



# Chatham Albatross

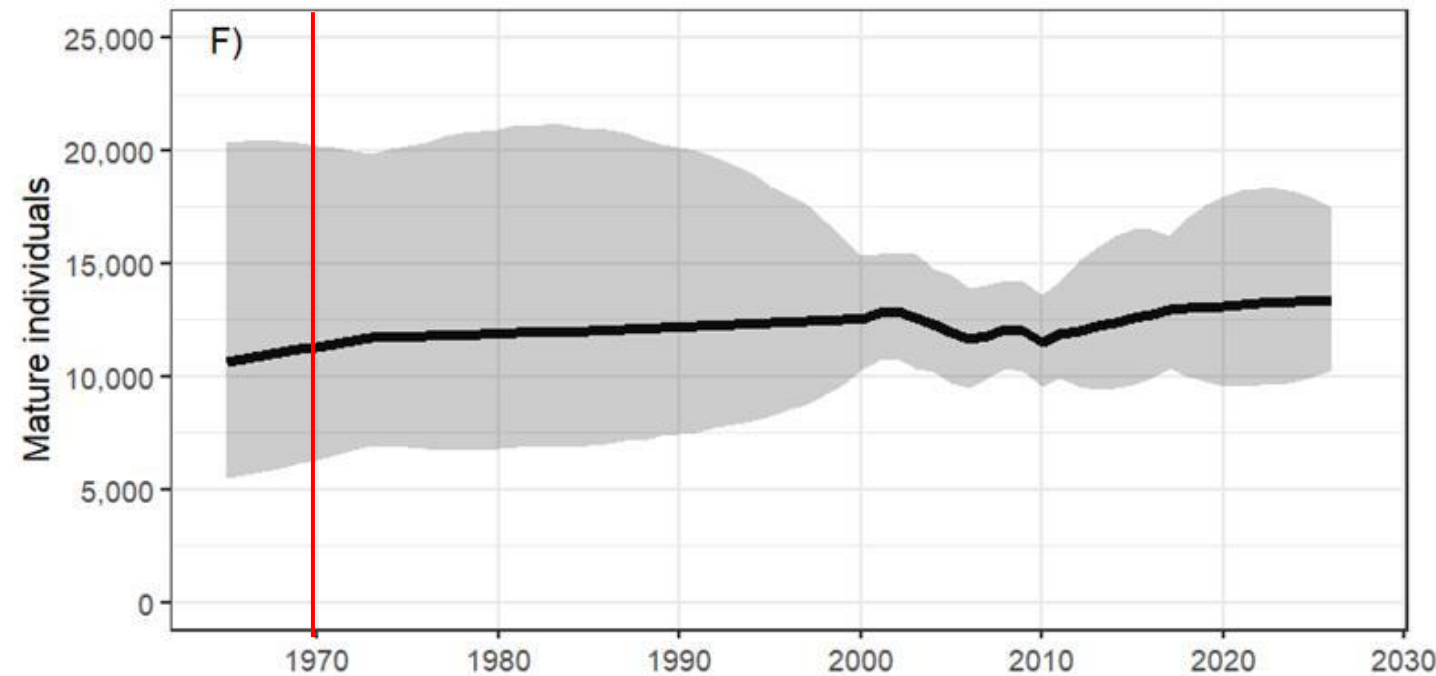
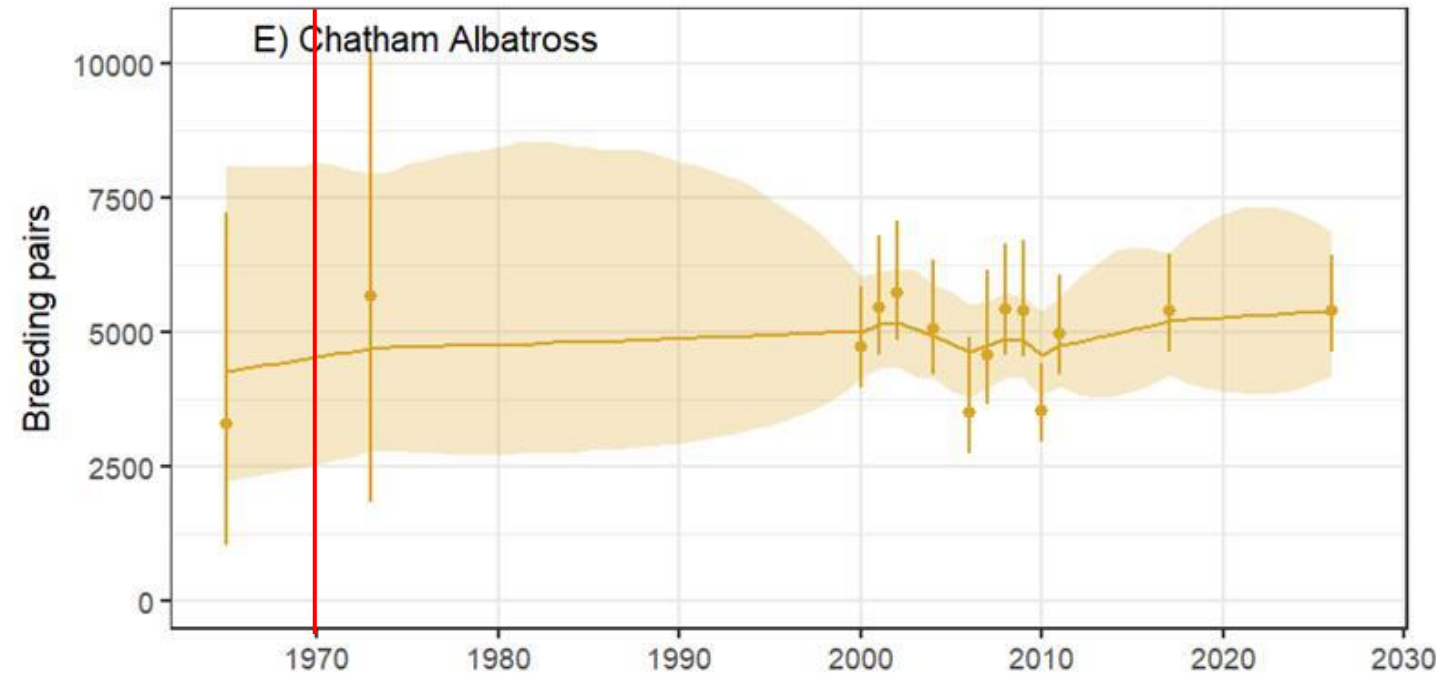
Data included 14 individual counts (GC, VPC,  $AC^{fw}$  & VBC) across 1965-2021, expressed AOS & NS (but recording of nest contents enabled inference of BP).

## Data processing adjustments included:

- Uncertainty propagation, which was assumed sufficient for  $\psi^d$ , apart from the VBC and  $AC^{fw}$  for which we used an expert elicitation.
- $\psi^o$  adjustments for made the VBC and  $AC^{fw}$  through intercept only model.
- $\psi^p$  adjustments made through informative priors.
- Conversion to  $M_{t,i}$  completed through informative priors.

## Results show:

- Remarkable stability throughout the entire time period



# Salvin's Albatross

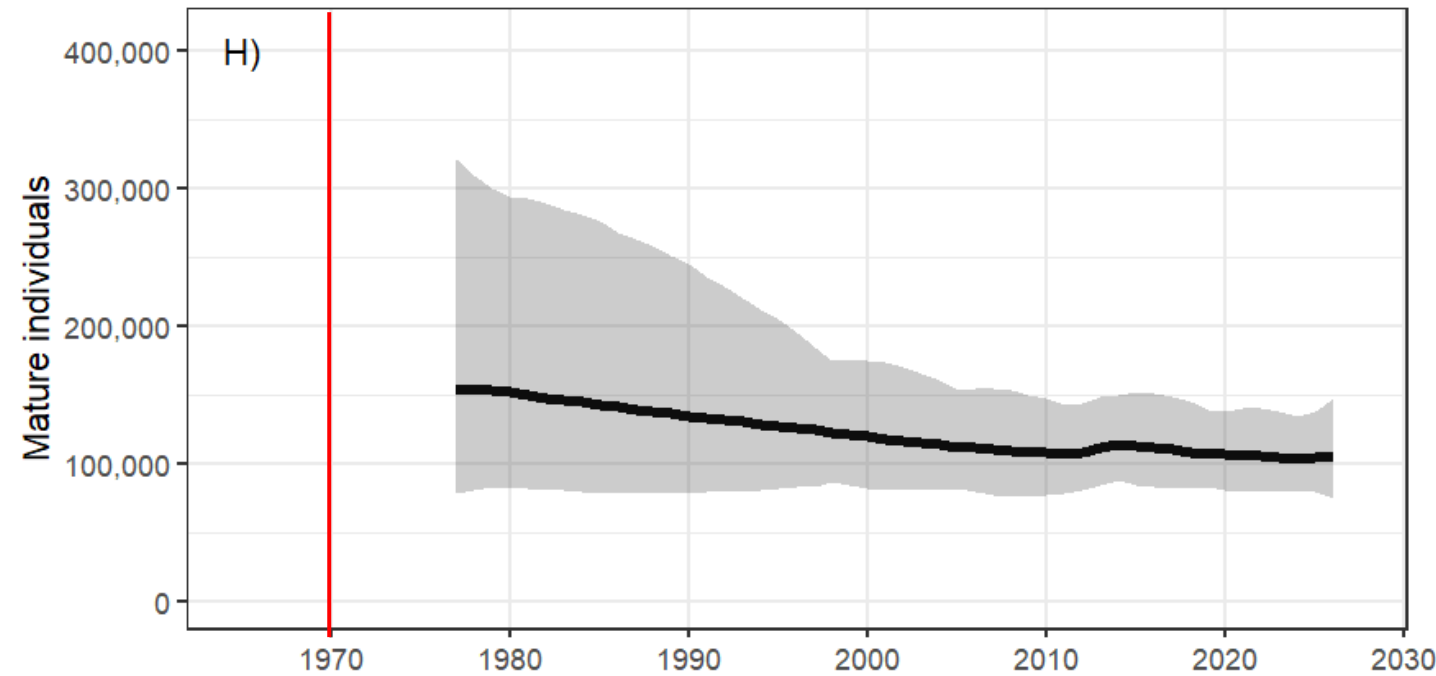
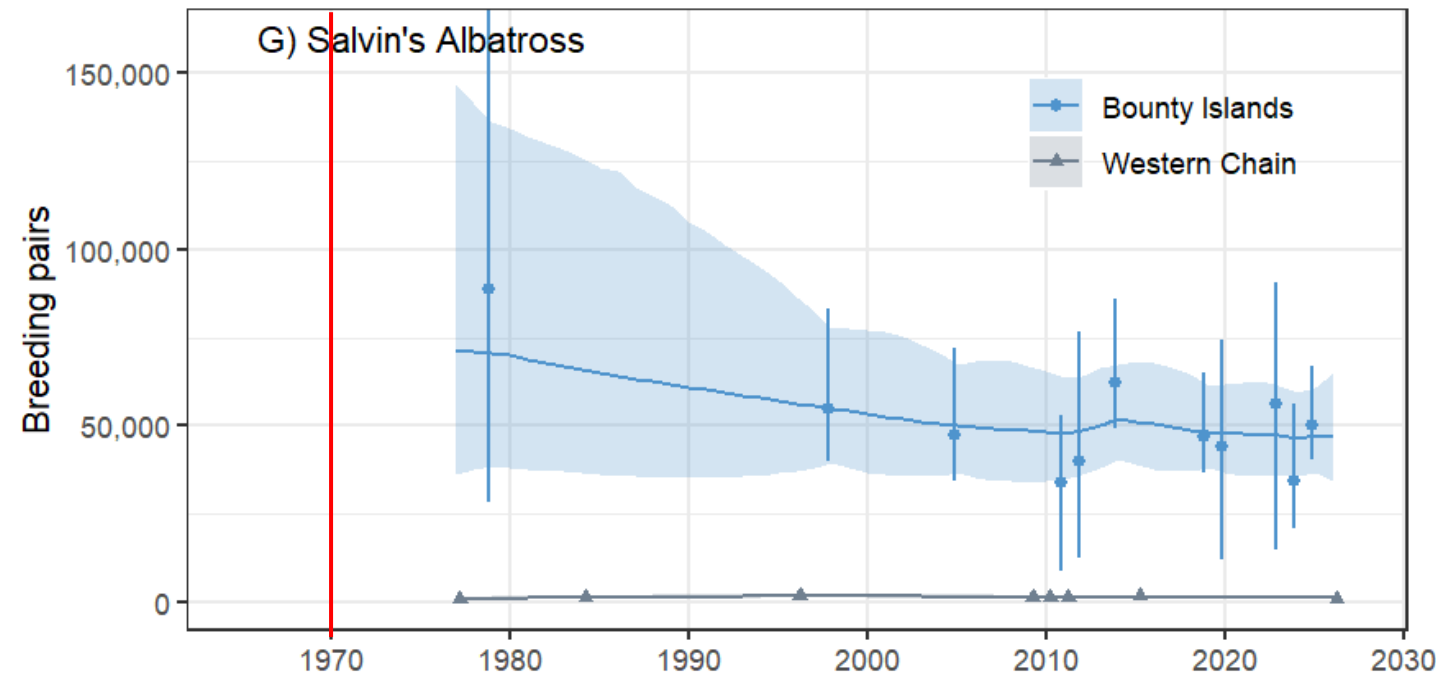
Data included 19 individual counts (GC,  $AC^{fw}$  &  $AC^{UAV}$ ) across 1977-2026, expressed BP, AOS & BOG.

## Data processing adjustments included:

- Additional GIS exercise to adjust first count
- Uncertainty propagation, which was assumed sufficient for  $\psi^d$ .
- $\psi^o$  adjustments for Moutere Hauriri for through time-varying models.
- $\psi^p$  adjustments made through informative priors as well as conversions to  $M_{t,i}$ .

## Results show:

- Concerning long-term declines since 1980s, but despite best efforts, large uncertainty remains
- Large interannual fluctuations in recent years
- Recent counts on small Western Chain population also indicate ongoing declines



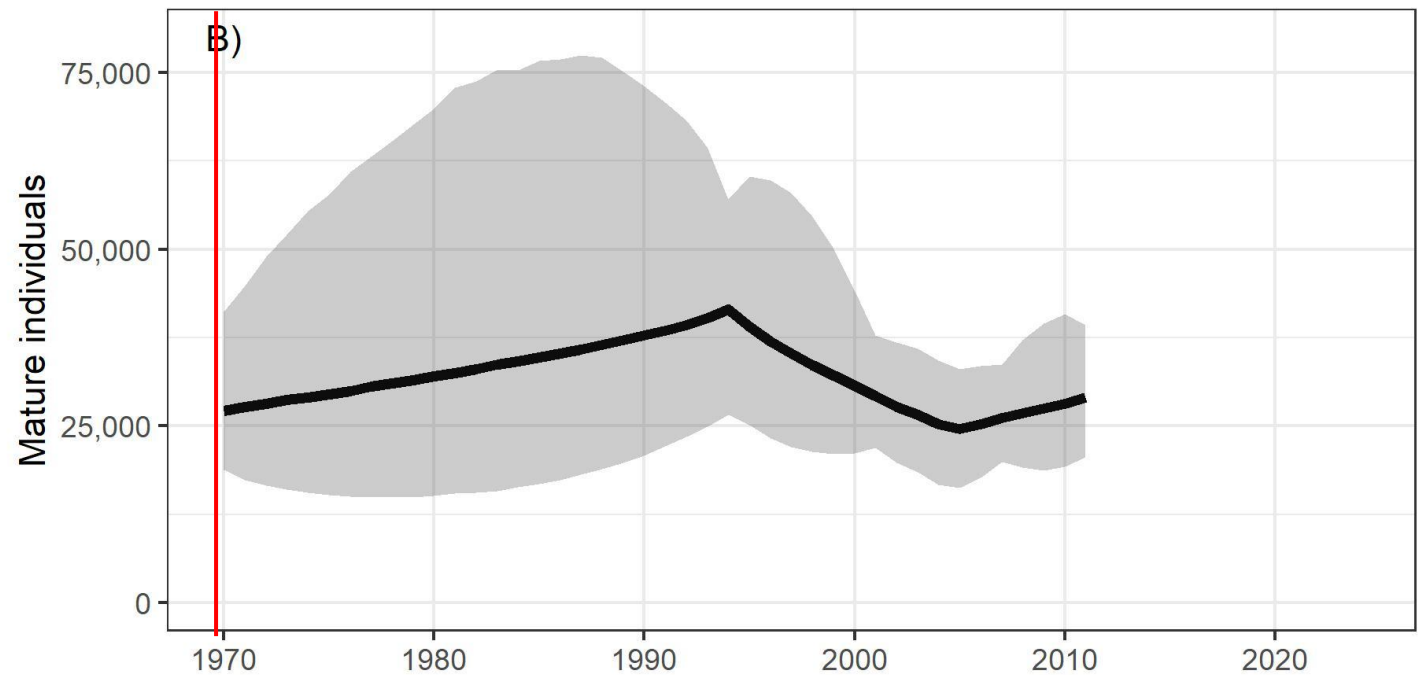
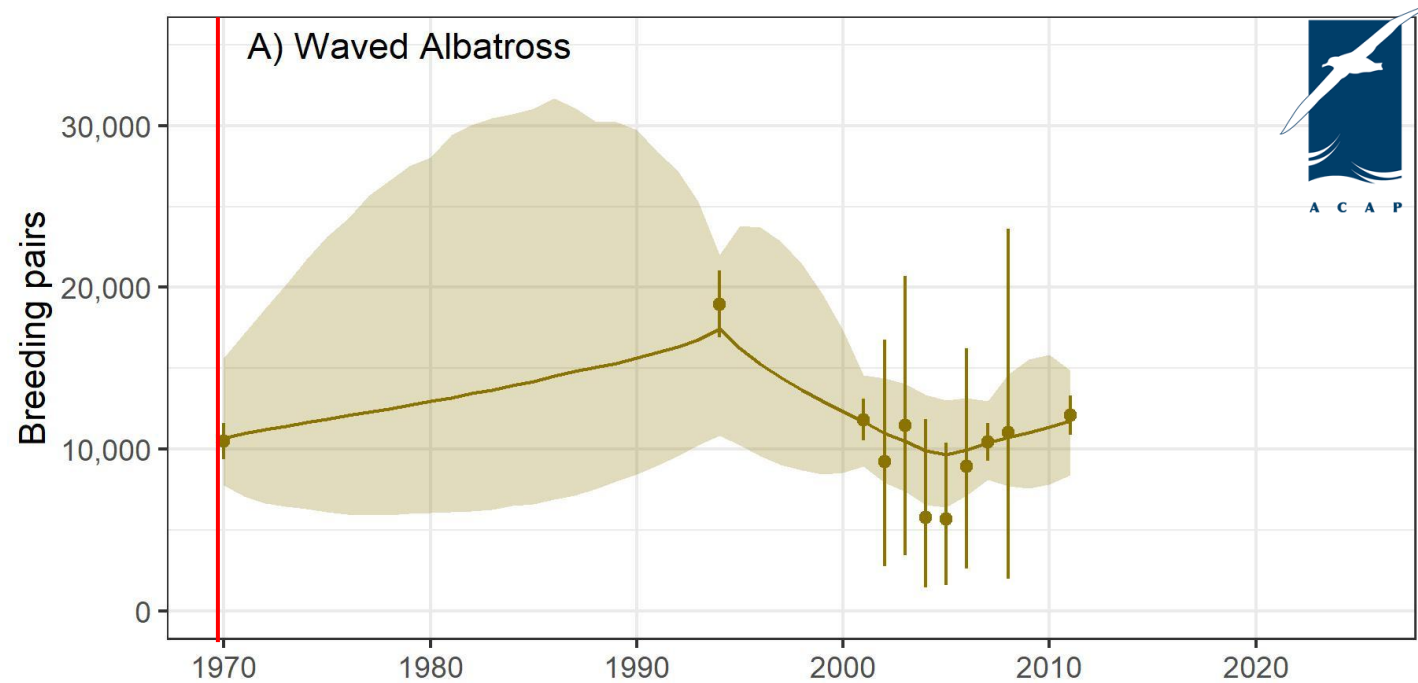
# Waved Albatross

## Data processing adjustments included:

- Baseline uncertainty propagation followed by uniform prior used for  $\psi^d$
- Original or fixed  $\psi^o$  adjustments depending on the site and year
- Original  $\psi^p$  adjustments retained for wider counts, but informative priors used for CMR data
- Fixed  $p^b$  specified using an informative prior, which prevents incorporation of skewed sex ratio. Further work required

## Results highlight:

- Initial increase, followed by decline in 1990s and 2000s
- Apparent stabilization post mid-2000s
- Large uncertainties



# Westland Petrel

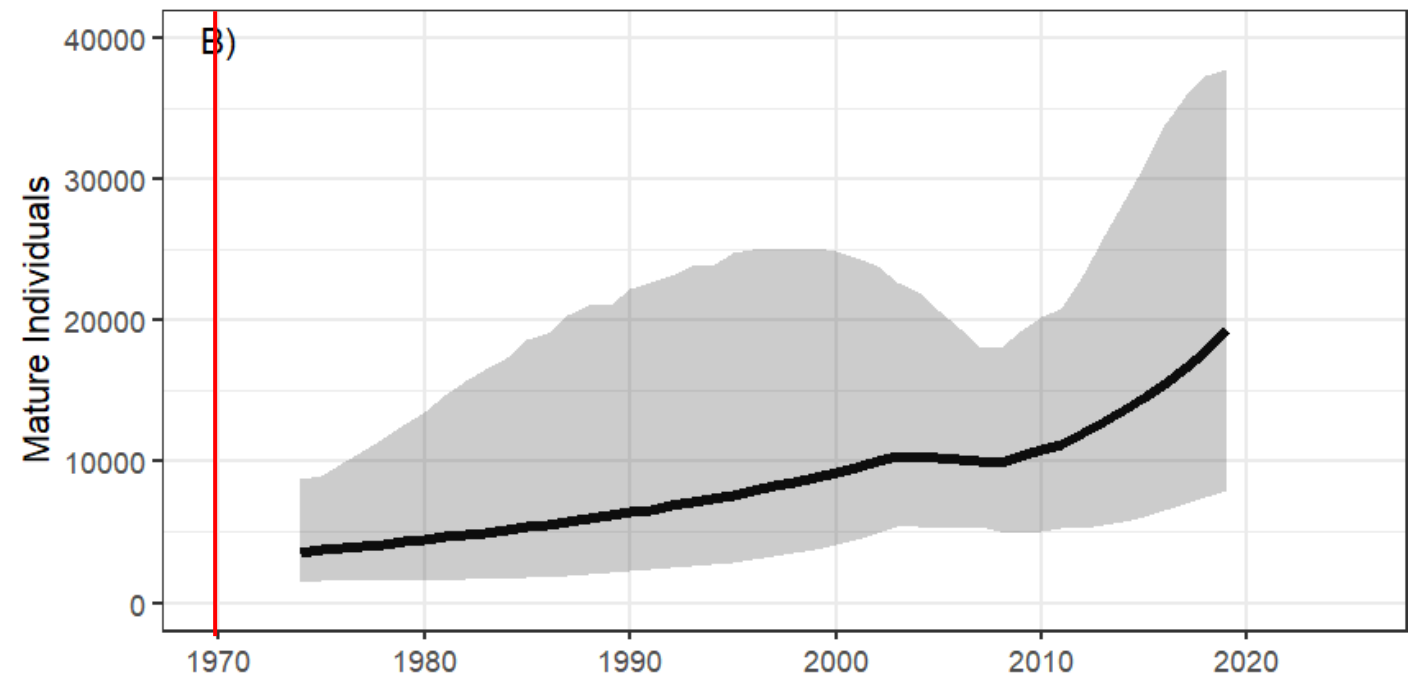
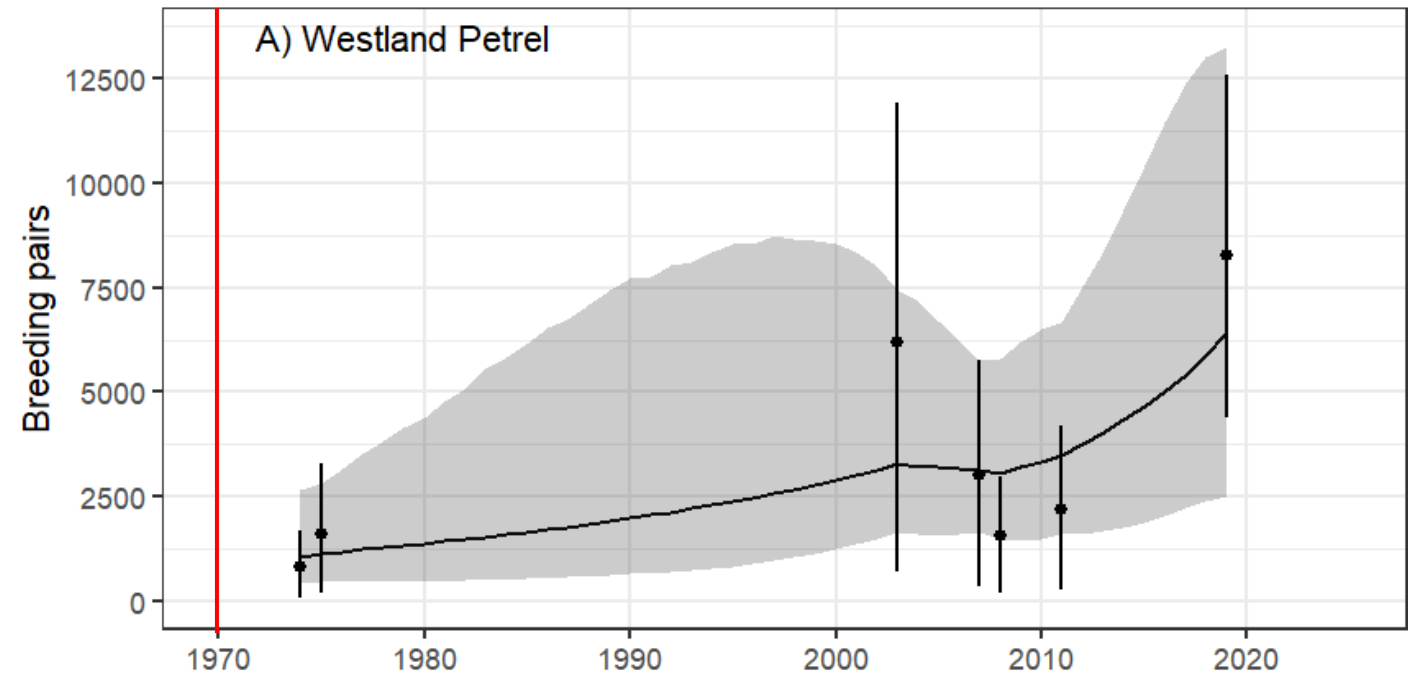
Data included 7 individual counts (GC) across 1974-2019, expressed BP, AOS & NS.

## Data processing adjustments included:

- Uncertainty propagation with adjustment of accuracy categories.
- $\psi^o$  adjustments using a combination of intercept only models and informative priors.
- $\psi^p$  adjustments made through separate informative priors to acknowledge change in breeding success over time.
- Conversion to  $M_{t,i}$  completed through informative priors, again for separate time periods.

## Results indicate:

- Tentative long-term increase
- Large amounts of uncertainty
- Limited number of data points



# Black Petrel

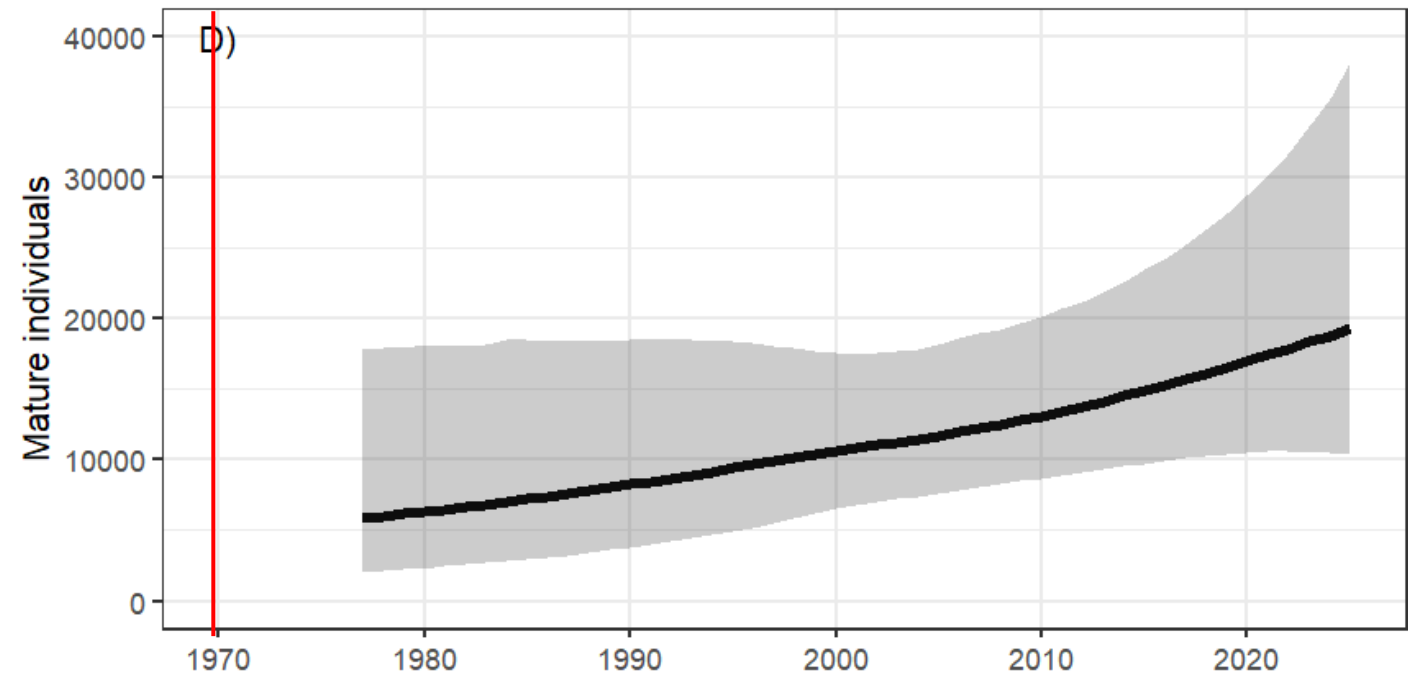
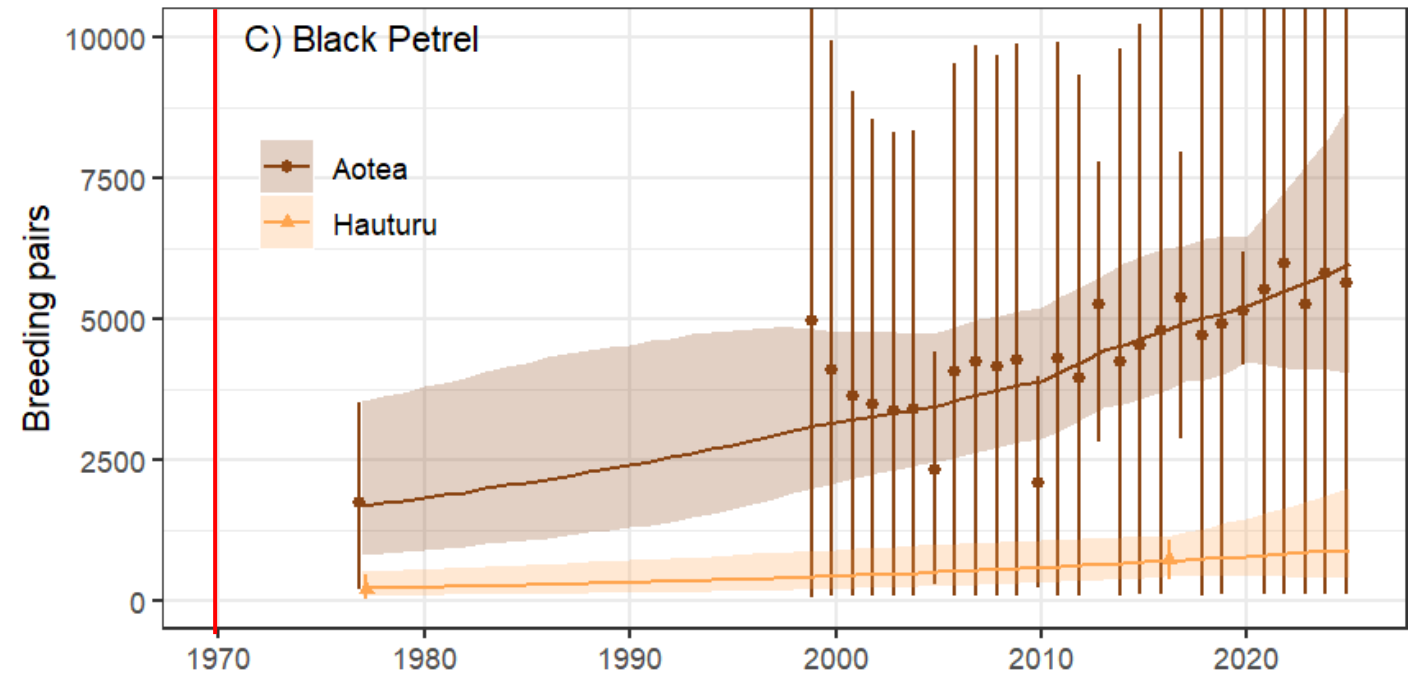
Data included 33 individual counts (GC) across 1977-2025, expressed BP & NS.

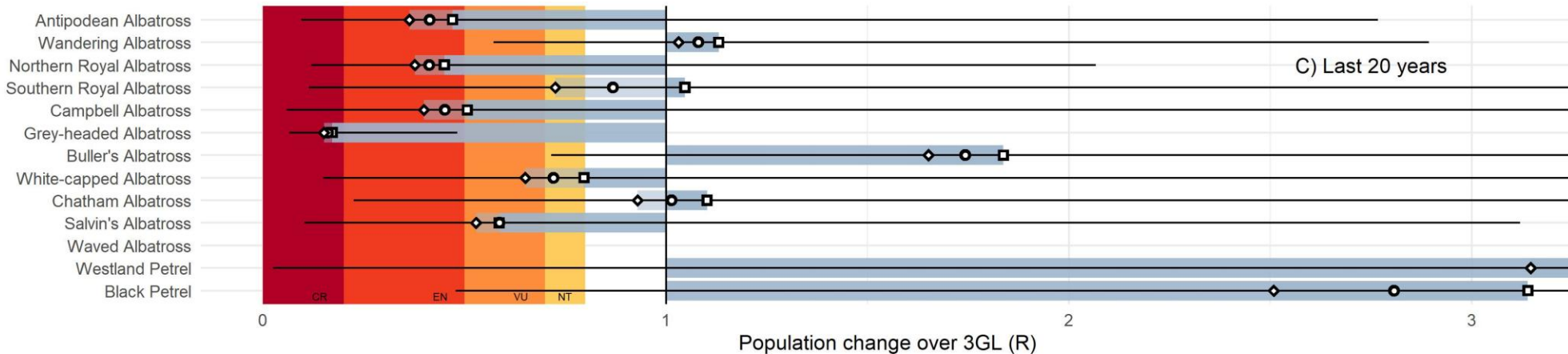
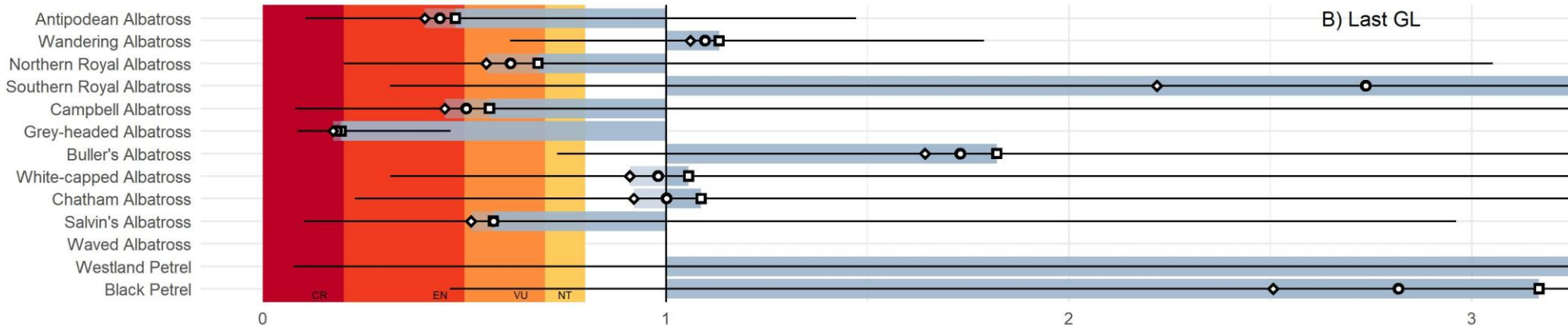
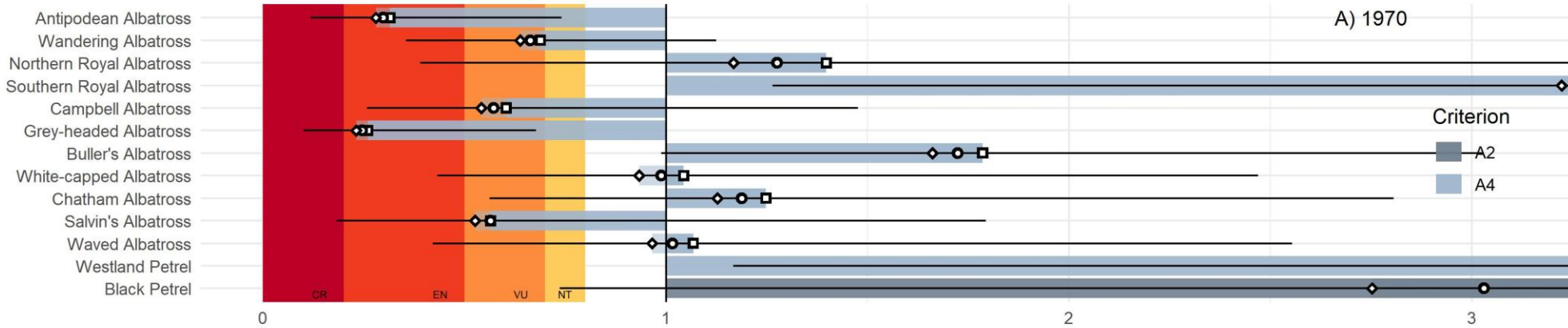
## Data processing adjustments included:

- Uncertainty propagation, which included explicit prop uncertainty for first counts.
- Carrying over of original  $\psi^o$  adjustments.
- $\psi^p$  adjustments made through time sensitive model (Aotea) or model intercept (Hauturu).
- Conversion to  $M_{t,i}$  completed through informative priors.

## Results show:

- Surprising long-term increases despite high risk status of this species
- Considerable uncertainties associated with census quadrat counts (only ~2% of overall Aotea population)





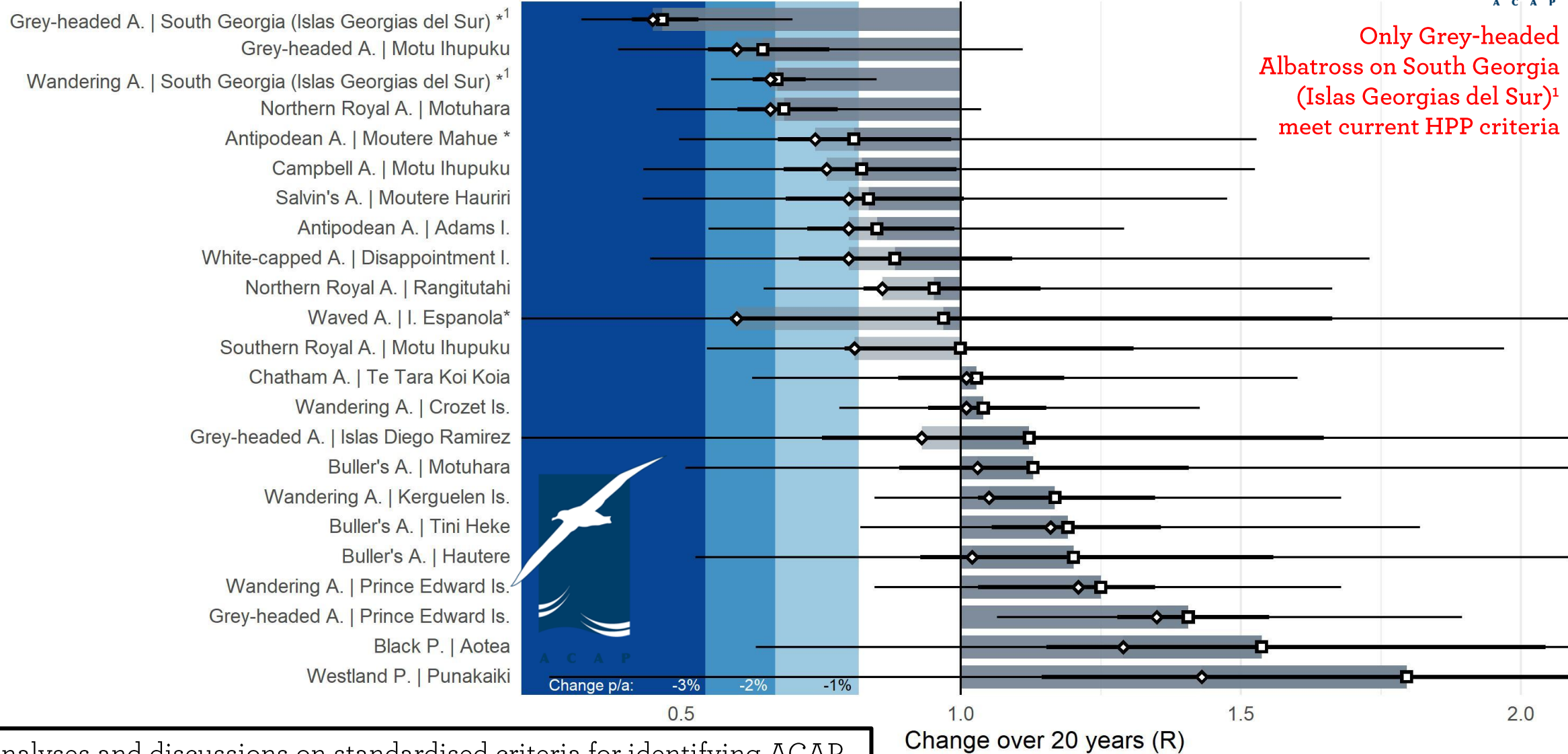
IUCN Red List category allocation is dependent on the statistical threshold considered

Further work is required to complete draft IUCN Red List re-assessments by 1 Oct 2026

# IUCN Red List category allocation is dependent on the statistical threshold considered

| Species                  | Current Status (critaria) | Highest cat. under A2 (median; 45%; 40%) | Highest cat. under A4 (median; 45%; 40%) |
|--------------------------|---------------------------|--|--|
| Antipodean Albatross     | <b>EN (A4)</b>            | -  | <b>EN; EN; EN</b>                        |
| Wandering Albatross      | <b>VU (A4)</b>            | -  | <b>VU; VU; VU</b>                        |
| Northern Royal Albatross | <b>EN (A4, B2)</b>        | -  | <b>EN; EN; EN</b>                        |
| Southern Royal Albatross | <b>VU (D2)</b>            | -  | <b>LC; LC; NT</b>                        |
| Campbell Albatross       | <b>VU (D2)</b>            | -  | <b>VU; EN; EN</b>                        |
| Grey-headed Albatross    | <b>EN (A4)</b>            | -  | <b>CR; CR; CR</b>                        |
| Buller's Albatross       | <b>NT (D2)</b>            | -  | <b>LC; LC; LC</b>                        |
| White-capped Albatross   | <b>NT (A4)</b>            | -  | <b>NT; NT; VU</b>                        |
| Chatham Albatross        | <b>VU (D2)</b>            | -  | <b>LC; LC; LC</b>                        |
| Salvin's Albatross       | <b>VU (D2)</b>            | -  | <b>VU; VU; VU</b>                        |
| Waved Albatross          | <b>CR (B2)</b>            | -  | <b>LC*; LC*; LC*</b>                     |
| Westland Petrel          | <b>EN (B2)</b>            | -  | <b>LC; LC; LC</b>                        |
| Black Petrel             | <b>VU (D2)</b>            | <b>LC; LC; LC</b>                        | <b>LC; LC; LC</b>                        |

# ACAP HPP evaluations (median and mode)



Further analyses and discussions on standardised criteria for identifying ACAP High Priority Populations are required, including on statistical thresholds.

# ACAP IG Trends draft Terms of Reference 2026-27

**To robustly estimate and communicate the trends of all ACAP species, the Intersessional Group will:**

1. Review trajectories truncated at 1970, poor quality counts as identified by data holders, and review percentile cut-offs for IUCN Red List category assignments.
2. Publish the methodology developed in PaCSWG9 Doc 3, including placing *ACAPT* on *GitHub*.
3. Complete standardised abundance data processing, trend modelling, and conservation assessments for all ACAP species.
4. Lead development of ACAP input into IUCN Red List re-assessment process led by BirdLife International.
5. Develop updated, standardised criteria for identifying ACAP High Priority Populations.
6. Investigate trends spatially by integrating trend estimates with tracking and fishing effort data.
7. Develop outputs for reporting population counts and trends, including the use of clear and easy to understand figures and graphics.
8. Evaluate changes in trends following RFMCO resolutions and relevant domestic legislation changes.
9. Work with the ACAP secretariat to improve the ACAP population database.
10. Provide recommendations to refine ACAP population status indicators.
11. Explore options to streamline updates to abundance and trend analyses.
12. Report back to PaCSWG10 (Aug 2027; papers due in May 2027) on the process, results, and provide recommendations for the integration of results into different ACAP products.

# PaCSWG9 Doc3 Rev 2 recommendations

1. *Endorse* the updated definitions of metrics, count methods, and errors for ACAP abundance data in Table 1-3.
2. *Endorse* the proposed abundance data processing, modelling framework, and decision rules, including of standardised approaches to 1) generate baseline uncertainty and account for sampling error, 2) account for detection error where possible, 3) account for occupancy error to ensure breeding pairs as the primary abundance metric, 4) account for phenology-related error using breeding success data, 5) convert breeding pairs to mature individuals using breeding probability estimates, and 6) modelling trends through the custom-built R package *ACAPT*.
3. *Endorse* the proposed IUCN Red List Criterion A<sub>2</sub>/A<sub>4</sub> assessment approach under different timelines and *recommend* the most suitable statistical threshold.
4. *Recommend* that AC assigns resource in the AC Work Programme to improve the ACAP database data structure, mirroring the examples in the Supplementary Tables, through clearer separation of metrics, methods, and error treatment, and count adjustment history and incorporation of additional auxiliary data.
5. *Recommend* that AC commits resource in the AC Work Programme to apply the agreed data processing and modelling framework to the remaining ACAP species as well as completing the complementary spatial analyses required for the IUCN Red List assessments.
6. *Request* ACAP Secretariat to advise BirdLife International on IUCN Red List Assessments of ACAP species by 1 October 2026.
7. *Update* the monitoring guidelines to include the insights obtained through the data processing framework (e.g.,  $\geq 10\%$  of breeding sites should be monitored).
8. *Recommend* that PaCSWG9 encourage ongoing research that will aid future abundance estimation processes, including breeding probability monitoring, retrospective assessments of errors, and (density-based) extrapolations.
9. *Request* AC approves the updated Terms of Reference of the Intersessional Group on ACAP Trends.

# Any questions?



O Thomas



## Acknowledgements

The data, insights, and work presented here would not exist without the commitments of dozens of people, too numerous to exhaustively name here and we thank all those on who's shoulders we stand.