

**Literature review:
methods for estimating population size of burrowing petrels
based on extrapolations**

Department of Conservation, Conservation Services Programme Objective 7, Project POP2014-02

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CONSERVATION, TRANSLOCATIONS, RESTORATION, RESEARCH, MANAGEMENT

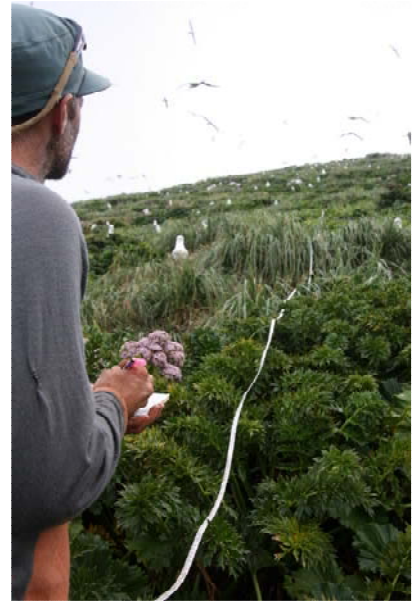
Problem

- Robust population estimates required



Scope

- Population estimates extrapolated from surveys

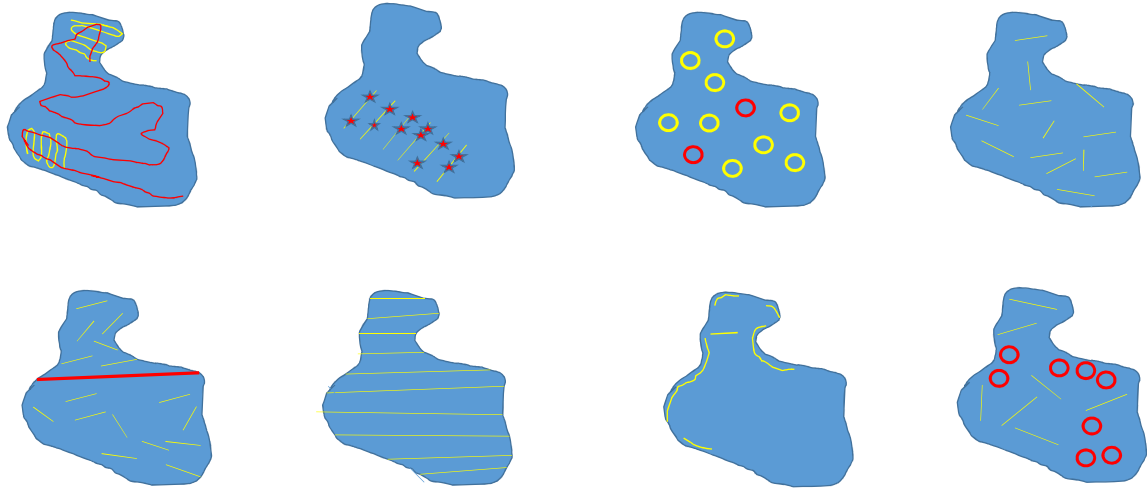


Surveys

- Extrapolation
- Large error bounds
- Less informed species risk
- Limited ability to detect trends in population size



Not just transect surveys



Objectives of literature review

- Identify, and where possible quantify, the sources of error
- Develop recommendations for future surveys



Burrow occupancy of *Procellaria* petrels

- High priority to DOC CSP



Procellaria petrels

- Slim literature

23 *Procellaria* pop estimates (21 papers)

11 with no precision reported



Included other petrels

- Pop estimates other species
- Clear overlap in methodologies



Counting burrows

Three general error sources:

- Temporal
- Spatial
- Detection probability



Counting burrows

- ACAP guidelines
- Literature
- Experience
- Workshop
- Expert comment



Error sources

- (1) uncertainty of burrow contents
- (2) timing
- (3) burrow detection probability
- (4) availability bias
- (5) observer bias



Results:

- 87 relevant studies
- 79 published 8 unpublished
- 45 quantitative surveys of burrowing petrels



Uncertainty of burrow contents



Uncertainty of burrow contents

- burrows occupied by breeders?



Uncertainty of burrow contents

- Burrowscope 54%
- Grubbing 24%
- Call playback 24%
- Sign
- Excavation
- Hatches
- Cameras



Uncertainty of burrow contents

- multiple species at the survey site



Uncertainty of burrow contents

- Detection probability



Detection probability

- Affected by burrow complexity
 - moats
 - multiple chambers
 - collapsed chambers or entrances
 - deviating burrows



Detection probability

- Burrow occupancy may vary
- False-negatives
- Occupant detection probability tested
 - two observers checking the same sub-sample
 - repeated checks of the same burrows over time

Timing

- collecting data at the ideal breeding stage
 - Main lay
 - Prior knowledge
 - Laying asynchrony
 - Disturbance?



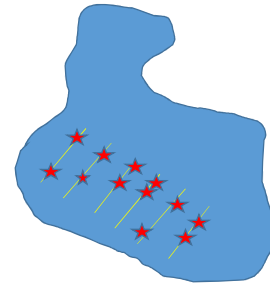
Timing

- collecting data at the ideal breeding stage
- survey consistency between years



Availability bias

- Ability to sample all petrel habitat: cliffs



Availability bias

- Fragile environments

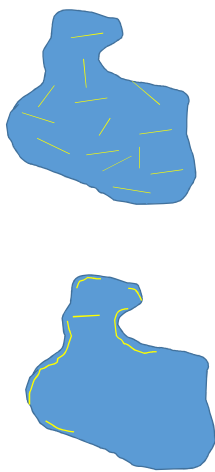


Representativeness

- Area sampled may not be representative of area extrapolated to

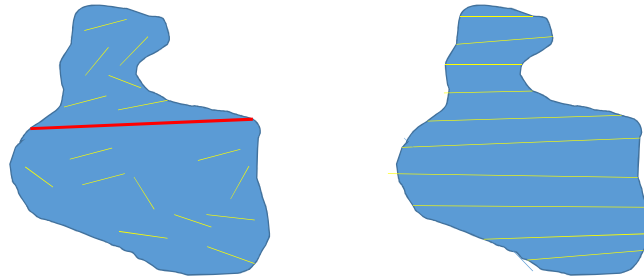


Representativeness



Representativeness

- Stratification
- Systematic



Burrow detection probability

- False-negative rate



Burrow detection probability

- Correcting missed burrows may increase variance
but more likely to contain true population size



Burrow detection probability

- Repeat surveys
- Double observer
- Exhaustive with validation transects
- Distance sampling



Observer bias

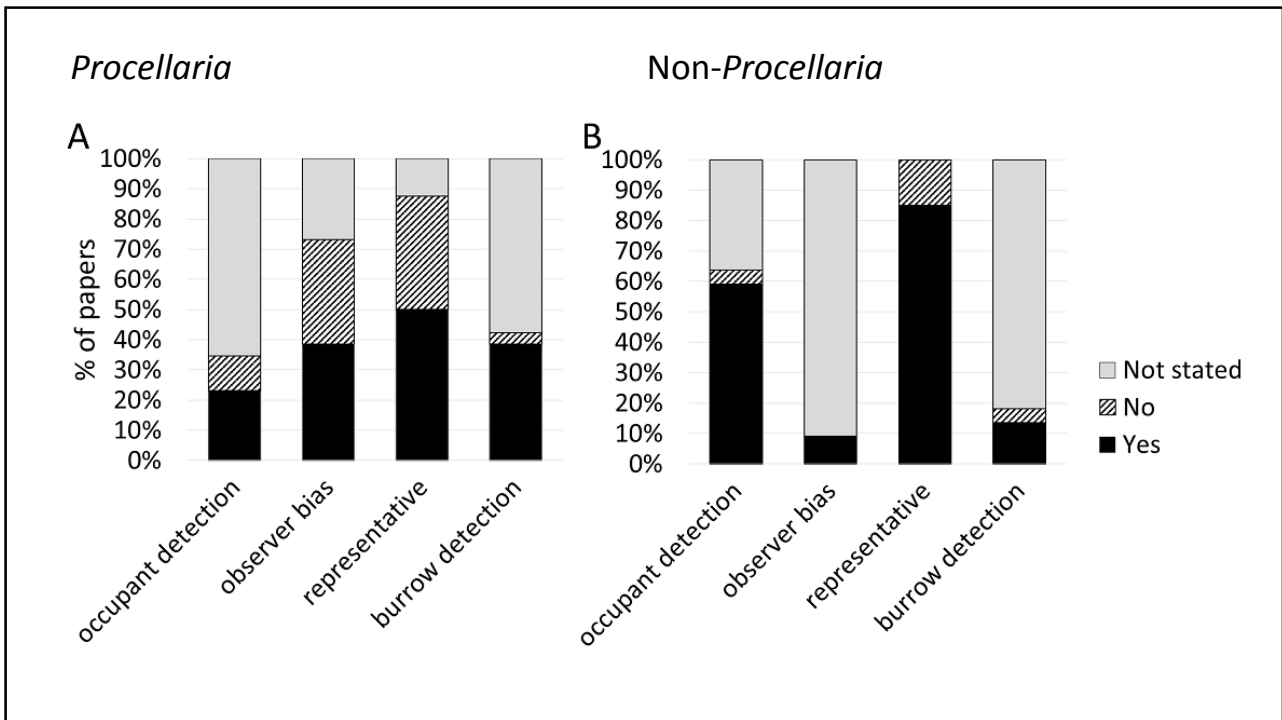
- Observer differences
 - Detecting burrows
 - Detecting burrow contents



Observer bias

- Observer differences
- Inter-annual observer difference





Factor	Problem	Implications if not addressed	Section discussed
Burrow contents			
<i>Accessibility</i>	Occupancy of burrows with unconfirmed contents may not be the same as burrows where the contents can be confirmed	Under or overestimate of burrow occupants in breeding population estimate	4.1.1
<i>Occupant detection</i>	Incorrectly assign occupied burrow as empty	Underestimate burrows occupied by breeding birds	4.1.2
	Non-breeding birds included in breeding bird totals	Include non-breeding burrow occupants in breeding population estimate	
	Mistaken identity	Include other burrowing seabird species in breeding population estimate	
<i>Timing</i>	Burrows not occupied by the majority of the season's breeding pairs	Under or over-estimate population size depending on breeding phenology	4.2
	Detection probability varies with time	Detection probability for some survey methods affected (response to taped playbacks, sign)	
	Some spp. may be more disturbance prone during incubation	Detrimental disturbance to study species	
	Inter-annual surveys conducted at different times of breeding season	Between year estimates not comparable	
Availability bias			
<i>Habitat availability</i>	Incorrectly assume birds are present or absent in the non-surveyed habitat	Decreased accuracy of population estimate	4.3.1
	Assume burrow density or occupancy consistent across habitat	Decreased accuracy and precision of estimate	
	Sampled area not representative of the area samples are extrapolated to	Extrapolation error resulting in poor accuracy and precision	4.3.2
<i>Representativeness</i>	Incorrect or no stratification of sampled areas when required	Estimate less precise	
Burrow detection probability			
	Burrows that are present are not detected	Underestimate burrow numbers	4.4
		Increased variance due to correction factor applied for missed burrows	
Observer bias			
	Burrows not detected	Decreased precision due to difference in observers data	4.5
	Burrows of different species not accurately discerned	Decreased precision due to difference in observers data	
	Burrow occupants not accurately identified	Decreased precision due to difference in observers data	
	Distances (e.g. 1 m either side of a transect) estimated differently	Decreased precision due to difference in observers data	



Conclusions

- Burrow occupancy critical
- Pilot study
- Ideal timing
- Representative sampling
- Test burrow detection probability
- Test for observer differences



Thank you

