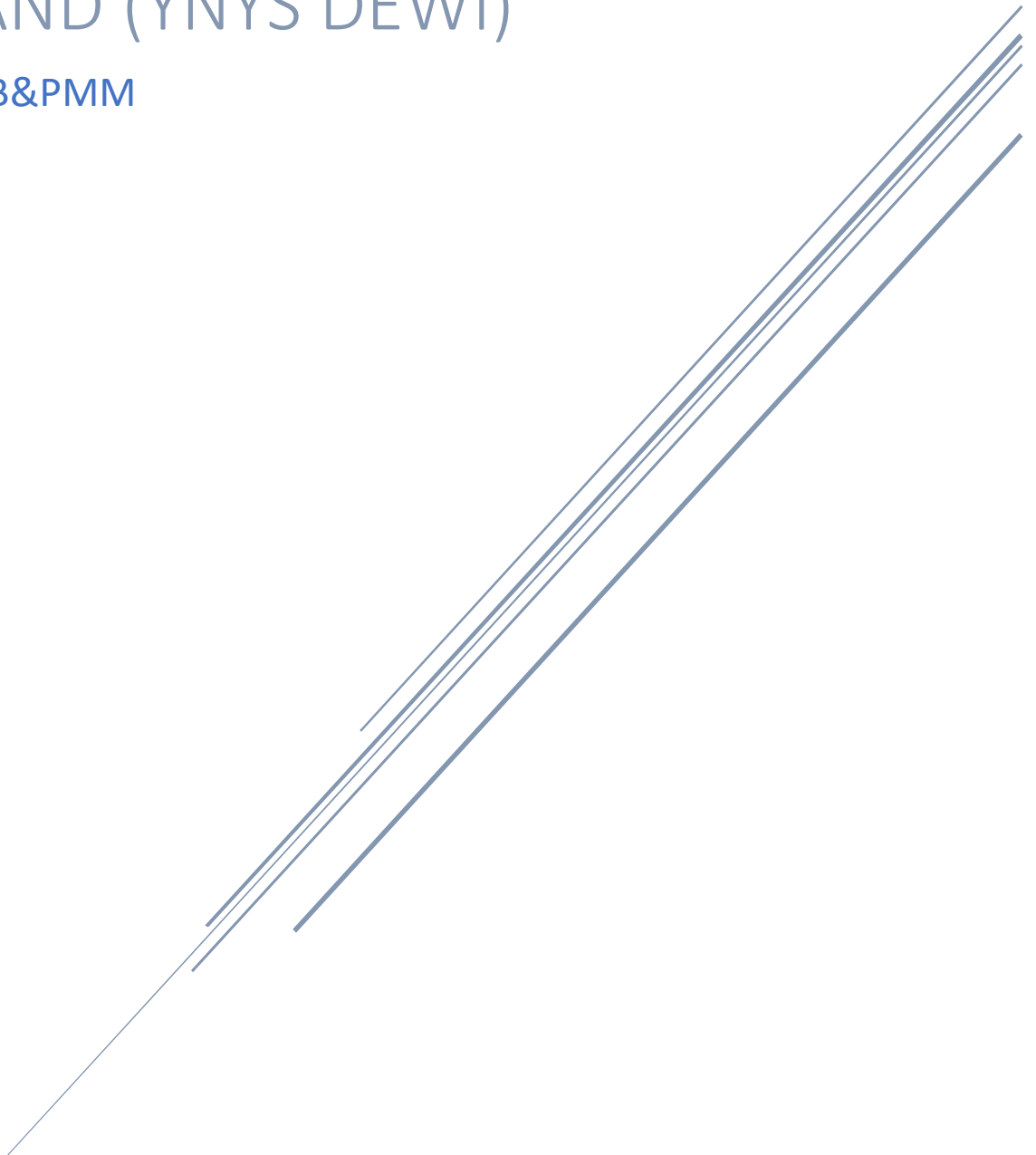


LONG-TERM MONITORING OF THE ESTABLISHING STORM PETREL (*HYDROBATES* *PELAGICUS*) COLONY ON RAMSEY ISLAND (YNYS DEWI)

EST_BB&PMM



2274 Words

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Introduction

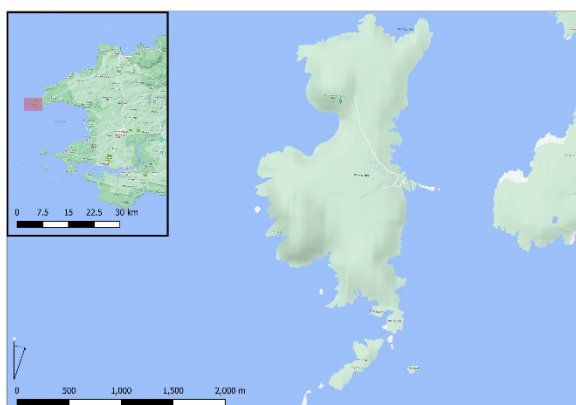
Rationale

Situated just off the Welsh mainland in Pembrokeshire Coast National Park, Ramsey Island (Ynys Dewi) has long been less ecologically rich than others nearby thanks to an invasive population of brown rat (*Rattus norvegicus*). Rats are a particular threat to ground- and burrow-nesting seabirds, and are believed to have been on Ramsey for around 200 years, resulting in the limited numbers (or total lack) of the species nearby islands are famous for, such as Manx shearwaters (*Puffinus puffinus*), Atlantic puffins (*Fratercula arctica*) and storm petrels (*Hydrobates pelagicus*). In the late 1990s, specialists from New Zealand were brought in to eradicate the rats, and the island was declared officially rat-free in 2000.

Since then, the meagre Manx shearwater population has grown, and storm petrels were recorded nesting on the island for the first time in 2008. However, while the shearwater population is regularly thoroughly surveyed, the petrels are less so. This is partly owing to the much smaller size of the population making surveys (and therefore estimates) more difficult, and partly because storm petrels are less responsive to the necessary acoustic playback methods (necessary because the birds live in underground burrows by day, and only leave at night) (Bell et al., 2019).

The Site

Ramsey (51°51'42"N 5°20'34"W) has multiple designations to its name, including a SSSI, a Special Protection Area for chough (*Pyrrhocorax pyrrhocorax*), and a Natura 2000 site (RSPB, 2022). It is owned and managed by the RSPB, and as such sports a population of just two humans living in the island's listed farmhouse (British Listed Buildings, 2022); however, from Easter to October 31st tourists can visit from the nearby mainland. In addition to the farmhouse, there are a handful of other manmade structures, such as a cornmill and lime kiln, a Medieval well and cemetery (Dyfed Archaeological Trust, 2022), and several prehistoric cairns (BBC, 2018).



Habitats include heathland, cliffs, coast and ocean. The short grassland habitat is maintained via grazing by a flock of Welsh mountain sheep and Welsh Mountain ponies, allowing seabirds, who feed on the insects in such habitats, to thrive. Several nationally or internationally important plants thrive in the small shallow ponds on the heathland (RSPB, 2022).

Figure 1. Map of the study site, and (inset) location in West Wales

Research Aims and Objectives

Research Aims

To establish the status of the Ramsey petrel population, and to monitor their ongoing status, a repeatable census protocol is needed that can be carried out annually. This will create data that land managers can use to set conservation priorities, and to help monitor the health of Ramsey's overall ecosystem.

Petrels have been surveyed on other islands, but various issues arise in the attempt; in particular, the issue of responsiveness to audio playback (Soanes, Thomas and Bolton, 2012; Wood et al., 2017; Bell et al., 2019). As not all petrels will respond to audio stimulus, researchers must use a 'correction factor', which will estimate the population size based on the proportion of responsive breeding burrows. However, this correction factor is itself highly variable, between petrel populations and even between seasons for the same population (Soanes, Thomas and Bolton, 2012). As such, a Ramsey-specific correction factor needs to be calculated (Bell et al., 2019).

The correction factor itself may be calculated in any number of ways, each of which has been used by various researchers and will give differing population estimates once applied (Soanes, Thomas and Bolton, 2012; Wood et al., 2017).

Research Questions

1. Which statistical method results in the most precise population estimates of storm petrels on Ramsey Island when used to calculate the correction factor?
2. What is the specific correction factor for Ramsey?
3. What is the current population size/abundance of storm petrels on Ramsey Island, and with ongoing monitoring, how will this change?

Justification

Petrels are newly-recorded on the island since the rat eradication; however, the estimated arrival of rats is up to 200 years ago on shipwrecks (Bell et al., 2019). As such, it may well be that they had originally bred there as they do on Skomer, Skokholm and other nearby islands.

Various causes have been suggested for seabird extirpations from islands, including rat and mouse infestations. However, scientists are still debating the full impact of invasive rodents (Towns, Atkinson and Daugherty, 2006; Ruffino et al., 2009), making this study a useful contribution to the field, examining as it will the establishment of a species when the only fundamental change has been rat eradication.

Proposed Protocol

Protocol Outline

Surveys will take place during the summer months (June-July) to coincide with the maximum likely storm petrel burrow occupancy of the year. This will also make fair weather conditions most likely.

Potential breeding burrows will initially be identified by combining prior survey data, maps of suitable habitat (rockfalls, scree, cliffs, walls), and use of an infrared camera to view storm petrels emerging to fly at night. These identified sites will then become the setting of subsequent survey work.

The recorded call that will be used was taken on Skokholm in 2010 by the British Wildlife Recording Society, and has also been used on Skomer by NRW (Wood et al., 2017). That same study found success playing the recording for 10 seconds at each potential breeding crevice at approximately 75dB (standardised with a Maplin handheld decibel meter) using an MP3 player (EasyAcc® Mini Portable Speaker, mp3 track on micro-SD card). Given that recording quality and volume has been shown to affect response rate, these parameters will remain consistent throughout to control for such variation.

Next, the Ramsey-specific correction factor to be applied to the ultimate survey results will be determined from a 'calibration' survey. Selected assumed-occupied sites (AOSs – forming a calibration plot) representing different habitats will be sampled using repeated visits, and binomial data (response/no response) collected. Confidence intervals (assuming the probability of each petrel responding is equal and unchanging between visits) will be calculated. There are numerous ways to then analyse these data to reach the correction factor – this study will trial three:

- Minimum estimate method (Ratcliffe et al., 1998). Assumes every active nest site will be detected, so the number of recorded AOCs after ten visits is the accurate total number of sites.
- Asymptote estimate method (Mitchell et al., 2004; Brown, 2006). Cumulative detected AOSs are plotted against visit number, then both axes undergo reciprocal transformation. The estimated asymptote is the reciprocal of the y-intersect.
- Du Feu method (du Feu, Hounscome and Spence, 1983). A virtual 'mark-recapture' method. A 'mark' is an AOS from which a response is received; a 'recapture' is one that gets another response on another day.

Whichever analytical method yields the most accurate result for the calibration plot will subsequently be used to determine Ramsey's correction factor.

Finally, using a mapped route about the island that can thus be repeated in following years, the main survey itself will use the same methodology as the calibration plot; but applied to all sites, and only once each (i.e. no repeat visits over ten days.) The correction factor will then be applied to these results to reach the final population estimate.

In subsequent years, this process may be repeated. To standardise the results and allow comparison, while the correction factor will be recalculated each year, the statistical method will remain the same after the first.

Evaluation

The best response rates from storm petrels seem to be at night (Soanes, Thomas and Bolton, 2012), but that's a difficult time to survey because of safety considerations (weather, tides and lighting would all make Ramsey more dangerous to navigate at night). Some AOSs may be inaccessible – nearby Skomer and Skokholm have been surveyed with infrared and/or drones in such areas, which is an option, but yields less accurate data (Wood et al., 2017).

In general, owing to the storm petrel's very specific behaviour (underground by day, flying over cliffs by night), playback is overwhelmingly used as the sample method of choice by researchers (du Feu, Hounscome and Spence, 1983; Ratcliffe et al., 1998; Mitchell et al., 2004; Brown, 2006; Soanes, Thomas and Bolton, 2012; Wood et al., 2017; Bell et al., 2019). It allows a (relatively) non-invasive way of sampling *in the burrow*; this also allows for occupied burrows to be mapped, and for researchers to log breeding pairs specifically, rather than all con-specifics including visitors. This gives a much more complete view of the petrels on Ramsey Island itself, not simply the petrels in Pembrokeshire Coast National Park.

Existing Protocols

Ordinarily, a detailed population study such as this might use a more traditional mark-recapture method, and ring the birds. There are huge advantages to such work, chief among them the ability to track individual birds across the year, and to gather other data such as age, sex, condition, etc (Sutherland, 2006). However, there are issues when applying this to storm petrels. Catching alone is extremely difficult. Studies have been done with mist-nets, but these attracted high numbers of non-breeding birds (Wood et al., 2017). Cannon netting using search lights would likely be effective, but requires high effort expenditure and comes with welfare considerations, both of which make repeatability an issue. Additionally, tag observation would be impossible without recapture, as the petrels only emerge at night.

Similarly, simple point counts are rendered impossible by either burrows or darkness.

Anticipated Data

Data Storage

Data will be recorded on datasheets such as these. At the end of the session, these data will be immediately transferred to a backed-up master copy, where they will be checked for any entry errors. The data will be numerical, from which both tables and graphs can be constructed.

The data will be shared with the RSPB, Pembrokeshire Coast National Park, and Natural Resources Wales.

Playback Response Rate Calibration Datasheet												
Habitat	Site	Burrow	1	2	3	4	5	6	7	8	9	10
		<i>Date</i>	<i>21/6</i>	<i>22/6</i>	<i>23/6</i>	<i>24/6</i>	<i>25/6</i>	<i>26/6</i>	<i>27/6</i>	<i>28/6</i>	<i>29/6</i>	<i>30/6</i>
Rockfall	Name1	4	0	0	0	1	0	1	1	0	0	0
Wall	Name2	8	1	0	0	0	0	0	1	0	1	1
...	...	...	...	...	...	...	...	...	...	...	...	...

Playback Survey Datasheet			
Site	Habitat	Responses	Date
Carreg-Gwylan	Rockfall	3	21/7/22
Allt Felin Fawr	Rockfall	0	21/7/22
Trwyn Bendrog	Wall	1	22/7/22
...	...	...	...

Analysis

The calibration data will be analysed in the three methods previously outlined, and the most appropriate and accurate results will give the correction factor that will be used in previous results. It is expected that either the asymptote estimate method or the du Feu method will be the one chosen; Wood et al. (2017) found the former to be most accurate, and Soanes, Thomas and Bolton (2012) found the latter, but no literature could be found comparing the two to one another.

On repeating the surveys in subsequent years, it is expected that the storm petrel population will grow (Oien, 2014; Guðríðarsson, 2018; Bolton, 2020a; 2020b; Gravesham Borough Council, 2021; RSPB, 2022). Results will be displayed in example tables and graphs such as Table 1 and Figure 2.

Table 1. Predicted population growth displayed in a sample table

TIME (YRS)	ABUNDANCE (PAIRS)
1	14
2	26
3	50
4	120
5	250
...	...

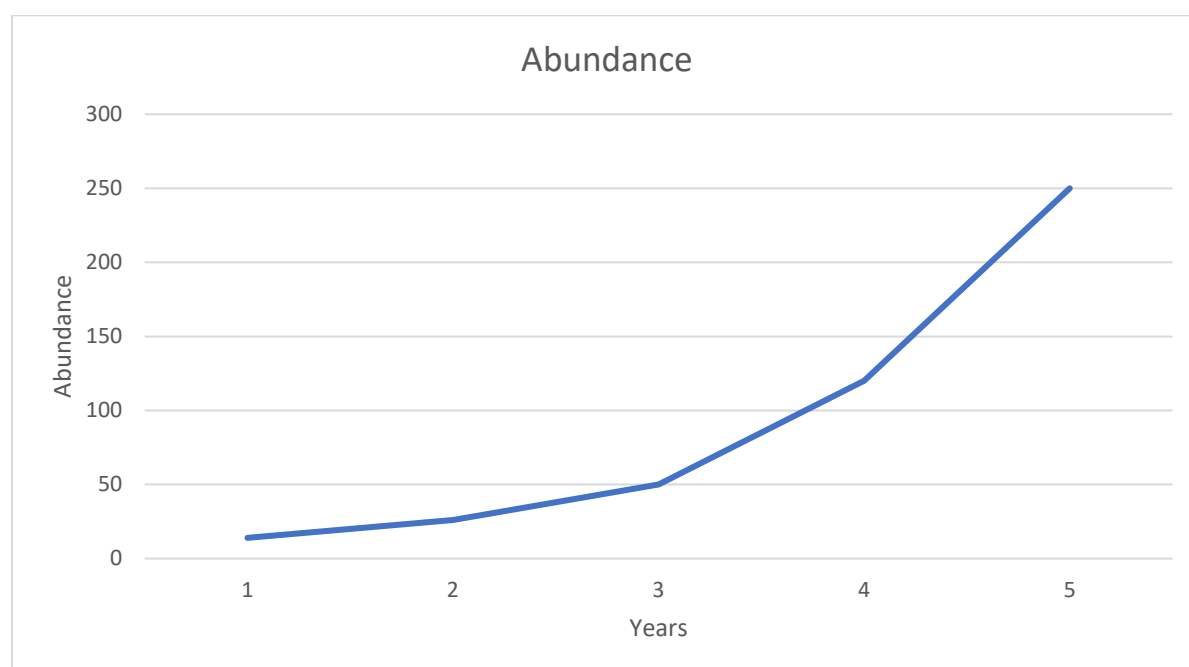


Figure 2. Example graph depicting the projected population growth

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