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Population status of the endemic Pitcairn Reed Warbler *Acrocephalus vaughani* on Pitcairn Island, South Pacific

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Research Article

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Summary

Reed warblers are widespread throughout Eurasia, Africa, and Australasia, and many species undertake long seasonal migrations. By contrast, other species of the genus *Acrocephalus* are sedentary and endemic to single oceanic islands. The Pitcairn Reed Warbler *Acrocephalus vaughani* is confined to the small volcanic island of Pitcairn in the South Pacific Ocean, and no population assessments have ever been conducted for this species. Due to its restricted range, the presence of invasive species, and the loss of natural habitat, the species is considered as globally "Endangered", but its actual conservation status is entirely speculative. We conducted transect surveys and nest monitoring in the austral summer of 2022/23 and present abundance estimates for the species. We counted between 51 and 158 reed warblers along 54 transects that were each 100 m long and covered all habitats and roughly 13% of the vegetated island area. Using binomial mixture models accounting for imperfect detection and habitat variation in abundance, we estimated that Pitcairn may hold 1,568 (95% confidence interval 812–3,237) Pitcairn Reed Warblers, and that the species appeared to be most abundant in introduced Rose Apple *Syzygium jambos* stands. Based on the monitoring of 49 nests, of which only four failed to fledge any young, we estimated that Mayfield nest survival rate was 0.69 and estimated productivity was 1.07 (± 0.39 standard deviation) fledglings per nest. Assuming that Pitcairn Reed Warblers have similar annual survival probabilities as other island reed warblers, the productivity appears sufficient to maintain the population and there is no indication that the species has decreased significantly over the past three generations. Given the limited extent of occurrence, and the stable current population size between 442 and 2,774 mature individuals, we recommend that the global conservation status of the Pitcairn Reed Warbler be classified as "Vulnerable".

Introduction

Reed warblers of the genus *Acrocephalus* are widespread across the Palaearctic, Africa, and Australasia, and while many temperate species are long-distance migrants, more than half of the species in the genus are sedentary and endemic to oceanic islands or island groups (Leisler and Schulze-Hagen 2011). In the South Pacific Ocean, 15 range-restricted species exist on more than 20 island groups (Cibois et al. 2011), and one of these species is the Pitcairn Reed Warbler *Acrocephalus vaughani*.

The Pitcairn Reed Warbler has never been studied in detail, but was classified as "Endangered" in 2008 due to its small population size restricted to a single island, and the presumption of ongoing population decreases (BirdLife International 2023). Pitcairn Island used to harbour thousands of seabirds and potentially other landbirds, but the introduction of invasive species (i.e. feral cats *Felis catus* and Pacific rats *Rattus exulans*) has led to the loss of many seabirds and potentially endemic landbird species (Graves 1992; Brooke 1995). The Pitcairn Reed Warbler is therefore the only remaining endemic bird species on Pitcairn (Williams 1960; Howell and van der Vliet 2014), and its population is potentially affected by habitat loss and invasive species. Although rat eradication was attempted on Pitcairn in 1997 and 1998, the operations were not successful and rats and feral cats remained on Pitcairn in 2023 (Brooke 2019). A thorough understanding of the population status is therefore a high priority for the Pitcairn Reed Warbler (BirdLife International 2023).

Birds on species-poor oceanic islands often have larger ecological niches than congeners in continental areas that are exposed to greater interspecific competition (Keast 1970). While continental members of the *Acrocephalus* group typically prefer wetland vegetation, island-endemic *Acrocephalus* warblers are often habitat generalists that can occur both in grassy as well as in woody vegetation (Komdeur 1992; Thibault and Cibois 2006; VanderWerf et al. 2016; Bell 2018). Pitcairn Island is an extinct volcano in the subtropical South Pacific Ocean, with both grassy and shrubby vegetation and no permanent freshwater bodies or swamp vegetation. Given that no other native songbirds occur on Pitcairn, the Pitcairn Reed Warbler may use all habitats on Pitcairn equally (Graves 1992; Howell and van der Vliet 2014). However, concern over the loss of certain plant species or habitats which might be preferred by Pitcairn Reed Warblers requires a better understanding of reed warbler abundance in relation to the dominant habitat types on Pitcairn.

In this study we provide the first quantitative assessment of this endemic species' population status and quantify abundance in relation to main habitat types. We conducted repeated transect surveys to count reed warblers and monitored nests to assess productivity and the potential impact of invasive species on breeding success. We use the results to provide a revised assessment of the conservation status of the Pitcairn Reed Warbler.

Methods

Study area

Pitcairn Island (412 ha, 25.07°S, 130.10°W) is an extinct volcano in the subtropical Pacific Ocean with a permanent human population of ~40 people. Human occupation and the presence of domestic livestock have completely altered the native vegetation. Although originally covered by Tuamotu tropical moist forest (Dinerstein et al. 2017), the main habitats of the island now comprise shrub dominated by stunted trees up to 15 m tall, and several stands of larger trees and remnants of indigenous vegetation in steep and inaccessible ravines. The present vegetation resembles a large tropical garden as a consequence of intermittent cultivation since early Polynesian visitation (Waldren et al. 1995). Over 300 species of higher vascular plants have been recorded, of which 75% are introduced and cover approximately 95% of the vegetated surface area (Kingston and Waldren 2003). Most cultivated land is associated with natural terraces within the crater area, whilst the steep outer slopes are dominated by grassy fern communities with only small areas of level ground holding shrubs. Native plants rarely form closed canopy woodlands, except small copses of *Hibiscus tiliaceus* and *Pandanus tectorius* (Waldren et al. 1995; Kingston and Waldren 2003).

Small gravel roads and walking paths provide access to all parts of the island, with an extensive network of dirt tracks within the crater area of the extinct volcano, and single tracks along the outer slopes of the crater to the eastern and western margins of the island. No access routes exist to the south coast and introduced species form a dense impenetrable scrub.

The island has a subtropical climate with erratic rainfall patterns and a pronounced hot season in January and February, which may focus the breeding season of the Pitcairn Reed Warbler to the period between September and December as for similar species on other South Pacific Islands (Brooke and Hartley 1995; Brooke et al. 1996; Thibault and Cibois 2006).

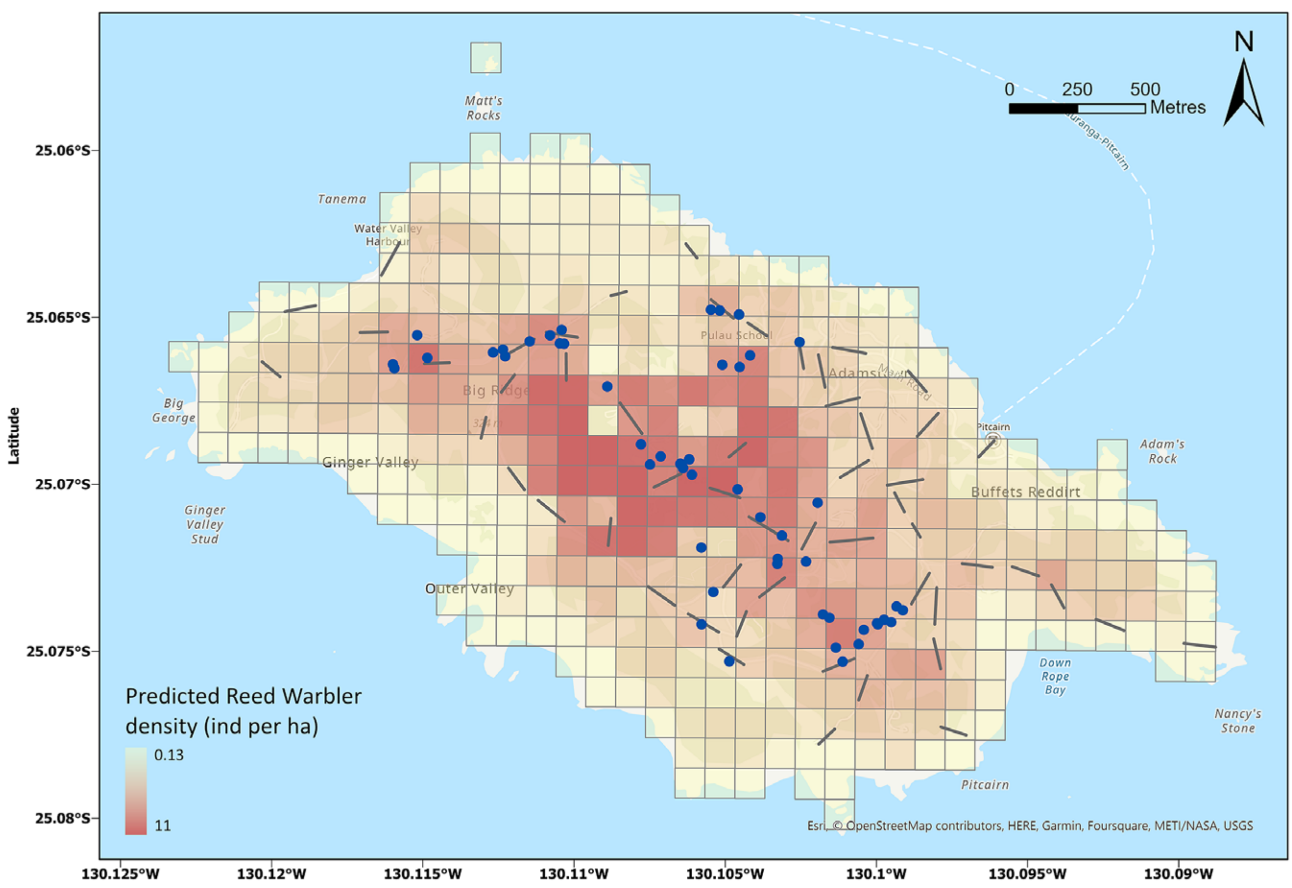

Figure 1. Map of Pitcairn Island showing 54 transects along which Pitcairn Reed Warblers *Acrocephalus vaughani* were counted (grey lines) and locations of monitored nests (blue points). The density of Pitcairn Reed Warblers was predicted based on the habitat composition of 1-ha grid cells and the habitat-specific abundance relationships estimated from binomial mixture models (see Table 1).

Population monitoring

Guided by other population assessments of island-endemic reed warblers (Hering and Fuchs 2009; Johnson *et al.* 2018), we established 100 transects along the entire road and trail network across Pitcairn Island with each transect ~100 m in length (Figure 1). Of these 100 transects only 54 were used for bird surveys because they were spaced a minimum of 50 m apart, while all 100 were used to characterise vegetation. We visually estimated the proportion of cover by the following key habitat types for each transect: Rose Apple *Syzygium jambos*, Common Lantana *Lantana camara*, Sea Hibiscus *Hibiscus tiliaceus*, Pandanus *Pandanus tectorius*, grass fern (almost entirely introduced grass species and native ferns), garden scrub (50% or more coverage of crop or horticultural species), and mixed scrub (no habitat type reaches more than 50% and generally comprising a mix of native species). The area along transects over which reed warblers were surveyed covered approximately 13% of the island's vegetated area (Figure 1).

Transect surveys were conducted from 24 November to 23 December 2022. We recorded all reed warblers that were detected visually or acoustically by a single observer (NA) while walking slowly and quietly along the transect (average time spent on each transect was three minutes, range 1–7 minutes). For each detection where the birds were visible, we recorded the age group as either adult (recognised by white panels on primaries) or young birds with uniformly grey-brown primaries (Graves 1992; Thibault and Cibois 2006; Howell and van der Vliet 2014; Johnson et al. 2018). The observer (NA) conducted four surveys on each transect within four weeks to maximise the chance that the transect "populations" were demographically closed during the survey period. The four surveys on each transect were conducted during different times of the day, with one survey per transect in each of the following four time periods: early morning (before 07h30), late morning (07h30–11h00), midday (11h00–14:00), and afternoon (14h00–18h00); all times UTC -8. For each survey we recorded the date and time, and the wind strength (calm, moderate, strong, extreme) to account for variation in detection probability at different times and with different noise levels.

Estimation of reed warbler abundance

We estimated the abundance of reed warblers along 54 transects using binomial mixture models (Royle and Nichols 2003; Kéry et al. 2005; Royle et al. 2005). Briefly, these models consist of two components which link the ecological state of interest (abundance of birds) and the observation process (detection probability) in a hierarchical fashion. The abundance component is modelled as a random Poisson process and estimates the size of the "superpopulation" of birds, conceptually the total number of birds whose home range overlaps with the area around a transect where they can be detected by the observer (Royle and Nichols 2003; Kéry et al. 2005; Kéry and Schaub 2012). The observation model component is conditional on the number of birds estimated on each transect and estimates the probability of detecting an individual bird during a given survey based on repeated counts at a given transect using binomial trials for each bird.

To account for variation in detection probability, we included environmental variables that are known to affect the detectability of songbirds, namely the day of the season, the time of day, and the strength of the wind (Kéry 2008; Schmidt et al. 2013; Parashuram et al. 2015). We used those variables in a model assessing the abundance of reed warblers in relation to habitat composition, which was based on a linear combination of all seven main vegetation types around the island (Supplementary material Table S1). We fitted this model using the function "pcount" in the R package *unmarked* (Fiske and Chandler 2011), with a Poisson distribution and a maximum "superpopulation" size (K) of 20. We used Akaike's Information Criteria (AIC) to ensure that the full model including all habitat types was not over-specified (Table S1), and present the parameter estimates on the original log scale with standard errors. We checked the goodness-of-fit of the full model by calculating the discrepancy between observed data and data generated by the model in 5,000 bootstrap simulations, and report the P value of the chi-squared statistic indicating lack of fit (Kéry and Royle 2016).

Extrapolation of global population size of Pitcairn Reed Warbler

The binomial mixture models that we used estimate the abundance of reed warblers that can occur in the area around a transect. As this area is not unambiguously defined, the abundance estimates cannot be transformed into density estimates without making an explicit assumption about the area that is being sampled. Following a similar assessment of Henderson Reed Warblers *Acrocephalus taiti* on Henderson Island (Bond et al. 2019), we assumed that reed warblers within 50–100 m of each transect were potentially detectable on each transect on Pitcairn. This distance is a combination of both detection and movement distance, and should be appropriate for a small songbird with a quiet call that cannot be heard more than 50 m under ideal conditions (Graves 1992; Oppel et al. 2014). We emphasise that this distance is not empirically determined, and does not yield a robust estimation of density, but this assumption provides reasonable upper and lower limits of likely densities that facilitate a qualitative extrapolation of the global population size of the Pitcairn Reed Warbler (Sillett et al. 2012; VanderWerf et al. 2016).

We used Sentinel-2 satellite imagery of the most recent cloud-free image of Pitcairn (9 June 2022) as the basis for remotely sensed image classification of habitat (Claverie et al. 2018). Two composite raster images were produced combining bands 2, 3, 4, 5, 6, 7, 8a, 11, and 12, with one using the 20 m resolution versions of each band with an output resolution of 20 m and another with a 10 m resolution output using the 10 m resolution versions of bands 2, 3, and 4, alongside the 20 m resolution images of the other bands (see https://sentinel.esa.int/web/sentinel/missions/sentinel-2/instrument-payload/resolution-and-swath). Training samples for the image classification were created by drawing regular polygons over the 100 survey transects for which habitat was recorded on the ground. We used transects with 75% or greater cover of a single habitat type as a representative sample of that habitat type. We then used an iterative approach using maximum likelihood classification to produce maps using different combinations of training samples on both the 10 m and 20 m resolution composite raster images. These maps were then inspected for accuracy by the observer who had carried out habitat classifications on the ground, and the habitat map was chosen that best represented vegetation composition on the ground. We then created a regular 100 × 100 m grid across the island, and estimated the proportion of the main habitat types for each grid cell from the island-wide habitat map (Murray et al. 2018; Jones et al. 2020).

We then estimated the abundance of reed warblers in each grid cell based on the habitat-specific abundance relationships derived from our transect surveys and the parameters estimated by the binomial mixture model. Based on the assumed area surveyed on our 100 m transects (with a 50 m detection radius, the surveyed area

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was 1.79 ha, and with a 100 m detection radius the area was 5.14 ha), we scaled estimated abundances for each 1 ha grid cell by dividing by the assumed survey area. We then summed the abundance of Pitcairn Reed Warblers across all 412 grid cells covering the island to derive a global population estimate (Sillett et al. 2012). We report the total extrapolated global population size of Pitcairn Reed Warblers with 95% confidence intervals (CIs) for two detection distances of 50 m or 100 m around each transect. As the global conservation status of a species is determined by the number of mature individuals (IUCN 2017), we estimated the number of mature individuals by multiplying the total extrapolated population size with the minimum and maximum proportion of adult birds observed during each of our four survey rounds. We present these estimates as range of median abundance, and CI from the lowest lower confidence limit to the highest upper confidence limit.

Nest monitoring and productivity

We found nests by searching opportunistically and following birds that displayed behaviour consistent with breeding. Detected nests were marked with a handheld GPS device, and monitored from a distance every 2–6 days to examine whether they were still active. We attempted to ascertain the number of eggs or chicks in each nest by carefully holding a mirror attached to a pole over each nest (Williams 1960), and recorded the fate of each nest until all chicks had fledged or until the nest had failed.

As most nests were found during the chick-rearing stage, when few nest failures occur in the related Henderson Reed Warbler (Brooke and Hartley 1995), we calculated Mayfield nest survival rates (Mayfield 1975) by first calculating the exposure time of each nest between the date it was found and the date of fledging or failure (assumed to be at the midpoint between two subsequent nest checks), and dividing the number of nest failures by the total exposure time of all nests. We then exponentiated the daily nest survival rate by the time interval between laying and fledging to calculate the overall nest success probability. The incubation length of reed warblers on Pitcairn and Henderson was 14–15 days (Williams 1960; Brooke and Hartley 1995), and we used our own observations to determine the length of the chick-rearing period.

We calculated the fledging rate as the average number of observed fledglings for all successful nests, and calculated productivity as the product of nest success probability and fledging rate. We present productivity as the mean ± 1 standard deviation.

Results

Estimation of reed warbler abundance

We observed on average 1.67 reed warblers (range 0–8) on each of the 216 transect surveys, with a much greater number during early morning (158 birds on 54 transects) than during any other time of the day (51–79, respectively). Of 342 birds that could be identified to an age class, 226 were adults, and the proportion of mature individuals ranged from 54% to 86% of the counted individuals for each of the four survey rounds.

Binomial mixture models exploring habitat relationships indicated that reed warbler abundance was highest in Rose Apple and garden scrub and lowest in pandanus and grass fern (Table 1), and there was no evidence for a lack of fit of the model ($\chi^2 = 10.97$, $P = 0.298$).

Based on these habitat relationships, we estimated habitat-specific densities ranging from 1.71 warblers/ha in open grass fern to 10.57 warblers/ha in pure Rose Apple stands under the assumption of a 50 m detection distance (Figure 1). These densities, combined with the habitat composition across Pitcairn, resulted in a global population extrapolation of 1,568 (95% CI 812–3,237) Pitcairn Reed Warblers in December 2022 (Figure 1). Assuming a longer detection distance of 100 m would result in a global population of only 544 (282–1,124) Pitcairn Reed Warblers. As these estimates include both mature and immature birds, we used the proportion of 54–86% of adults to calculate a global population of 853–1,344 (442–2,774) mature individuals (or 296–467; 95% CI 153–963 if the detection distance was 100 m).

Table 1. Habitat relationships (mean parameter estimate on log scale with standard error) of Pitcairn Reed Warbler abundance on Pitcairn in 2022 based on 54 survey transects and binomial mixture models. Approximate area of each habitat on Pitcairn was determined from remote-sensing data.

Habitat		Area (ha)	Parameter
Rose Apple	*Syzygium jambos*	126.06	3.47 (± 0.86)
Lantana	*Lantana camara*	22.13	3.16 (± 0.95)
Garden vegetation		17.41	3.02 (± 0.85)
Mixed scrub vegetation		48.25	2.8 (± 0.85)
Hibiscus	*Hibiscus tiliaceus*	20.74	3.00 (± 1.59)
Pandanus	*Pandanus tectorius*	36.36	2.85 (± 1.95)
Grass fern vegetation		71.32	2.76 (± 1.62)

Nest monitoring and productivity

We found 50 nests with contents (eggs or young), which were generally located towards the distal portions of smaller branches at a mean height of 8.9 m (range 2.5–30 m). The average nest tree height was 11.8 m (range 2.5–35 m). Almost half of the nests (46%) were built in *Syzygium jambos*, 18% in *Hibiscus tiliaceus*, and 10% in *Cordyline fruticosa.* The remaining nests were spread between *Homalium taypau* and *Mangifera indica* (three nests each), *Thespesia populnea* (two nests), and *Citrus aurantifolia*, *Ficus microcarpa*, *Glochidion comitum*, *Pandanus tectorius*, *Persea americana*, and *Prunus domestica* (one nest each). Nests had circular to oval shapes, with approximate dimensions from one nest that could be measured as follows: length 12.4 cm, width 8.0 cm, height 6.3 cm, cup diameter 6.0 cm, and cup depth 4.0 cm. Nest-building material included fibres from various species, especially the leaf sheaths remaining at the base of *Pandanus tectorius* stems and the "leaf skeletons" of *Homalium taypau.*

We monitored 49 nests to completion that were discovered during the building ($n = 4$), incubation ($n = 3$), and chick-feeding ($n = 42$) stages. For three nests the interval between incubation start and fledging could be observed, and was on average 35 days (range 29–43 days). Out of the 49 nests, 45 fledged at least one young, and the Mayfield nesting success was 69%. Of the 45 nests that fledged young, we were able to determine the fledged brood size in 35 nests, and the mean number of fledglings was 1.5 (range 1–3 fledglings per nest). The productivity of Pitcairn Reed Warblers was therefore 1.07 (± 0.39) fledged young per nesting attempt.

Discussion

The Pitcairn Reed Warbler is a relatively common and widespread songbird on Pitcairn, and we provide the first quantitative

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assessment of a global population size of 442–2,774 mature individuals. Given that past crude estimates also guessed a population size of 1,000–2,000 individuals in 1998 (BirdLife International 2023), there is no evidence that suggests a significant population decrease over the past 25 years. Combined with the reasonably high productivity of the species, which does not suggest ongoing population decreases, we consider the Pitcairn Reed Warbler globally "Vulnerable" to extinction based on criteria D (<1,000 mature individuals).

Our assessment was based on some assumptions that could influence the extrapolated population size. We used a distance of 50 m around transects to define the area in which we sampled reed warbler abundance, and our estimates would decrease substantially if that area was 100 m. However, past descriptions of reed warbler vocalisations and territory sizes (Williams 1960; Graves 1992; Brooke and Hartley 1995) render it unlikely that reed warblers would be detected >50 m from a transect, and we therefore consider our extrapolations realistic. The density of the Pitcairn Reed Warbler that we extrapolated is higher than that of the Henderson Reed Warbler (Graves 1992; Bond et al. 2019), and much higher than closely related species that became extinct (Cibois et al. 2008), but within the density range of extant island-endemic reed warbler species (Thibault and Cibois 2006). Our estimates are fairly imprecise due to the relatively small number of transects that could be accommodated on the island: we originally established 100 transects and conducted 400 surveys, which resulted in more precise estimates of similar order of magnitude, but because several of those transects were within 30 m of each other and could have led to individuals being counted on more than one transect, we discarded some of the data to reduce the risk of pseudo-replication.

The comparatively high density of the Pitcairn Reed Warbler may be a consequence of its flexibility in habitat use and the availability of introduced plant species. One of the introduced and cultivated tree species (Rose Apple) emerged as the habitat where reed warblers were most abundant. The introduction and cultivation of certain plants may have benefitted the Pitcairn Reed Warbler and may explain the higher density than on Henderson Island where fewer introduced plant species occur (Waldren et al. 1999). We observed Pitcairn Reed Warblers in most habitat types, with the only notable absence or low density in open grass fern fields and dense *Pandanus* monocultures. Unlike reed warblers on the Society Islands, which are restricted to bamboo vegetation and are threatened by destruction of key habitat (Cibois et al. 2008; VanderWerf et al. 2016), the Pitcairn Reed Warbler appears to be tolerant to a variety of habitats. While the preservation of the island's introduced Rose Apple and native hibiscus woodlands would likely benefit the Pitcairn Reed Warbler, the versatility in habitat use should be some insurance against stochastic extinction for both the Pitcairn Reed Warbler and several other reed warblers on islands with low species richness (Steadman 2006).

Besides habitat loss, the introduction of invasive predators has led to the extinction of many island endemics in Polynesia, including several reed warblers (Steadman 2006; Cibois et al. 2008). However, reed warblers seem to be less susceptible to the arrival of introduced predators than other species groups (Thibault et al. 2002), and several reed warbler species exist on islands with and without predators (Cibois et al. 2011). We found no evidence of nest predation by invasive rats, possibly because nests were located on distal branches that may not support rodents, and the Pitcairn Reed Warbler may therefore not be at an immediate risk of extinction due to the presence of introduced rats. However, cat predation is a potential threat to adult birds on Rimatara (Thibault and Cibois 2006), because reed warblers regularly forage on the ground. Although Graves (1992) asserted that Henderson Reed Warblers foraged much more on the ground than the shyer Pitcairn Reed Warbler, our observations indicate that even Pitcairn Reed Warblers spent ~15% of their time on the ground, similar to other Pacific reed warblers. Temporary cat removal from Pitcairn during a previous rat eradication attempt in 1997 led to a temporary increase in reed warbler populations (BirdLife International 2023). Thus, while the Pitcairn Reed Warbler currently appears to be capable of coexisting with both cats and rats, it is possible that the population might increase if both species were removed from the island. However, the introduction of other invasive predators (such as the Brown Tree Snake *Boiga irregularis*) may put the Pitcairn Reed Warbler at grave risk of extinction (Reichel et al. 1992; Wiles et al. 2003; Camp et al. 2009).

The risk of cat predation on adult reed warblers is significant, because many insular reed warblers appear to have a K-selected life history strategy with high annual survival and low productivity (Thibault and Cibois 2006; Cibois et al. 2011). Nightingale Reed Warbler *Acrocephalus hiwae* annual survival probability was estimated as 72% (Fantle-Lepczyk et al. 2018), and Brooke and Hartley (1995) assumed that annual survival could be 85–90% for Henderson Reed Warbler based on values from the Seychelles Warbler *Acrocephalus sechellensis* (Komdeur 1992; Brooke and Hartley 1995). In the latter species, both productivity and survival were related to territory quality, and birds in medium-high quality territories had similar productivity to Pitcairn Reed Warblers. We therefore conclude that the annual survival in those territories (88–91%) (Komdeur 1992) could potentially reflect the annual survival probability of Pitcairn Reed Warblers unless predation by cats has a significant impact on survival.

As suspected for the closely related Henderson Reed Warbler (Brooke and Hartley 1995), where fledglings are fed for at least six weeks after fledging, the Pitcairn Reed Warbler may not have second broods due to the very long post-fledging parental care that is typical for tropical passerines (Tarwater 2010). Seychelles Warblers stayed for approximately four months in parental territories (Komdeur 1992), and we observed family groups and fledglings with their parents for extended periods without any indication of a second nesting attempt on Pitcairn. Our estimate for nest survival may be fairly high because most nests were only found at the chick stage, when almost no nests failed in Henderson Reed Warblers (Brooke and Hartley 1995), and nest failure rate may be much higher during early incubation periods. Despite the potentially optimistic estimate of nesting success, our estimate of productivity is likely accurate if most pairs only raise one brood (even if they require more than one nesting attempt). Productivity estimates for Henderson and Nightingale Reed Warblers (Brooke and Hartley 1995; Fantle-Lepczyk et al. 2018) were not adjusted for nest exposure, and were substantially higher than what we found for Pitcairn Reed Warblers. However, our relatively low fledging rate of 1.5 fledglings per successful nest was also much lower than Henderson Reed Warbler's 2.29 fledglings per successful nest (Brooke and Hartley 1995), and Nightingale Reed Warbler's 1.95 (Fantle-Lepczyk et al. 2018), and more similar to the threatened Rimatara Reed Warbler *Acrocephalus rimitarae* with 1.25 (Thibault and Cibois 2006). We may have missed some chicks as most nests were too high and could not be inspected, and fledglings hid in very dense vegetation where it would have been difficult to find them, so it is possible that the actual number of fledged chicks is higher than what we observed.

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Assuming a relatively high adult survival and high juvenile survival due to long parental care (Tarwater 2010), our estimates of productivity would likely be sufficient for population stability (Fantle-Lepczyk et al. 2018). However, we caution that population growth rate cannot be estimated due to the lack of data on annual survival probability, and assumptions about population stability are therefore speculative. Nonetheless, given the lack of evidence for a major population decrease between previous estimates and our current assessment, and the apparent flexibility in habitat use of the Pitcairn Reed Warbler, we consider it plausible that the Pitcairn Reed Warbler population is currently stable. The species is nonetheless "Vulnerable" to extinction primarily due to its very limited geographical occurrence on a single island where it is prone to the effects of human activities and its status could potentially deteriorate within a very short time period.

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