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Breeding period and nest survival of two endemic passerines on Fernando de Noronha Archipelago, Brazil

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Abstract

Oceanic islands concentrate endemic species but also amplify demographic risk, since populations are usually small, spatially restricted and exposed to introduced predators and habitat loss. We reported the breeding period and the nesting success of two endemic passerines from Fernando de Noronha archipelago, the Noronha Elaenia (*Elaenia ridleyana*) and Noronha Vireo (*Vireo gracilirostris*), using Mayfield exposure-based nest survival. We detected that *V. gracilirostris* breeds from February to May, while *E. ridleyana* breeds from February to August, corresponding with the wet season. We estimate the success in 50 nests (*E. ridleyana* = 24, *V. gracilirostris* = 26) and 1208.5 exposure-days (*V. gracilirostris* = 766, *E. ridleyana* = 442,5). *E. ridleyana* had lower daily survival rate (0.961) and full-cycle survival (0.234) than *V. gracilirostris* (daily survival = 0.981; full-cycle survival = 0.487). Furthermore, *E. ridleyana* nests failed at about twice the rate of *V. gracilirostris* nests (mortality rate ratio *E. ridleyana/V. gracilirostris* = 2.10, 95% CI = 1.05–4.22). Compared with published estimates for other *Elaenia* and *Vireo* species, the Noronha Elaenia resembles other tropical/subtropical passerines with moderate-to-low success, whereas the Noronha Vireo appears unusually successful relative to other vireos. Our findings suggest that the *E. ridleyana* may be particularly vulnerable to nest predation. We argue that conservation of both endemic birds should treat nest survival as an early-warning demographic indicator and park managers should restore the native nesting habitat by removing exotic species, reduce invasive predators near breeding areas, and integrate reproductive monitoring into island biosecurity and tourism planning.

Introduction

Oceanic islands harbor a disproportionate share of the world's endemic biodiversity while simultaneously concentrating some of the most extinction-prone species on Earth (Kier et al. 2009; Matthews et al. 2022). Insular birds are particularly vulnerable because their populations are often small, geographically restricted, and evolutionarily naïve to novel predators and anthropogenic disturbances (Courchamp et al. 2003). As a result, islands have experienced most documented bird extinctions since human colonization, especially following the introduction of invasive mammals, habitat alteration, and increasing human occupation (Blackburn et al. 2004; Matthews et al. 2022). Understanding the demographic processes that regulate island bird populations is therefore central to both ecological theory and conservation practice.

Among demographic parameters, reproductive success is one of the most important determinants of population persistence in birds (Sanz-Aguilar et al. 2014; Ghosh et al. 2022). Nest survival integrates multiple ecological processes, including predation, food limitation, parental behavior, climatic conditions, habitat structure, and anthropogenic disturbance (Dias and Macedo 2011; Mainwaring et al. 2015; Smart 2024). In tropical birds, nesting success is frequently lower than in temperate systems, largely due to high predation pressure and prolonged nesting cycles (Mainwaring et al. 2015). However, much less is known about nest survival in tropical oceanic islands, where predator communities, ecological interactions, and environmental and climatic conditions can differ substantially from continental ecosystems. Island systems may exhibit relaxed predation pressure in some contexts (Terborgh 2022), but introduced predators such as rats, cats, and lizards can also generate severe reproductive bottlenecks for endemic birds (Courchamp et al. 2003; Kopij 2025).

The Brazilian oceanic archipelago of Fernando de Noronha represents one of the most isolated tropical island systems in the South Atlantic Ocean and supports two endemic passerines: the Noronha Vireo, *Vireo gracilirostris*, and the Noronha Elaenia, *Elaenia ridleyiana* (Fig. 1). Despite their ecological and conservation importance, remarkably little is known about the reproductive ecology of these species (Mestre et al. 2016). Both birds occupy highly modified landscapes influenced by habitat loss, invasive predators, and growing urbanization (Micheletti et al. 2020; Licarião et al. 2026). Yet no robust estimates of nesting period and nesting success have previously been available for either endemic species.

Comparative studies of nest survival among closely related taxa can reveal how species-specific life-history traits mediate vulnerability to environmental pressures. Species may differ in nest placement, parental activity, nesting period duration, anti-predator behavior, and habitat use, all of which can influence nest mortality risk (Suckow et al. 2022; Stutchbury and Morton 2022). In island systems, these differences may become especially important because endemic species often evolved under simplified predator communities (Terborgh 2022) and may respond differently to introduced threats. Consequently, even sympatric endemic birds occupying the same island may exhibit markedly different demographic sensitivities.

Estimating nest survival requires analytical approaches that account for unequal observation intervals and the fact that nests can fail between monitoring visits. The Mayfield method (Mayfield 1975) remains one of the most widely used estimators of avian nest survival because it incorporates exposure time and reduces biases associated with apparent success estimates (Oliveira et al. 2010; Zima and Francisco 2016). By estimating daily survival rates and extrapolating survival across the nesting period, the method provides a more realistic measure of reproductive performance in natural populations.

Here, we quantified nest survival and nesting success of the two endemic passerines of Fernando de Noronha using Mayfield survival analyses. Specifically, we aimed to: (1) estimate daily nest survival and overall nesting success for both endemic species; (2) compare reproductive performance between the Noronha Vireo and Noronha Elaenia; and (3) place these estimates within a broader comparative framework involving other species of *Vireo* and *Elaenia* reported in the literature. Finally, we discuss the implications of differential nest survival for the conservation of insular endemic birds in tropical oceanic islands facing increasing anthropogenic pressures and invasive species impacts.

Methods

Study area

The Fernando de Noronha Archipelago comprises 21 islands, islets, and emergent rocks in the equatorial South Atlantic, politically belonging to the state of Pernambuco, northeastern Brazil. The total land area encompasses 26 km², of which the main island, Fernando de Noronha, accounts for 17 km² (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis [IBAMA] 1990). According to the Köppen climate classification, the regional climate is Aw'a (tropical wet-and-dry), with a dry season spanning from August to January and a rainy season from February to July. The mean annual temperature is 27°C, characterized by low thermal amplitude throughout the year (IBAMA 1990; Almeida 2002; (Agência Pernambucana de Águas e Clima [APAC] 2023).

The local vegetation represents an ecotone between the Atlantic Forest and the Caatinga, predominantly exhibiting xerophytic and deciduous physiognomies similar to the latter (Batistella 1996; Silva et al. 2017). The archipelago harbors six endemic plant species, alongside a significant proportion of anthropogenic flora introduced over more than 500 years of human occupation (Micheletti et al. 2020).

Environmental management is overseen by the Chico Mendes Institute for Biodiversity Conservation (ICMbio) through two distinct protected areas: the Environmental Protection Area (APA; 791.3 km²), which encompasses the urban zone, and the Fernando de Noronha National Marine Park (PARNAMAR; 109.3 km²), a strictly protected area designated for biodiversity conservation and ecotourism (Almeida 2002). This study was conducted at The Sancho Complex (*Complexo Sancho*), located within the boundaries of the Fernando de Noronha Marine National Park, comprises four interconnected sections, collectively extending approximately 2.3 kilometers in length.

Study Species and Reproductive Biology

The target species of this study are terrestrial birds endemic to the Fernando de Noronha archipelago, represented by the passerines *Vireo gracilirostris* (Fig. 1A) and *Elaenia ridleyana* (Fig. 1B), whose most abundant populations are found on the main island (Schulz-Neto 2004; Mestre et al. 2016). The Noronha Vireo, which belongs to the family Vireonidae, is threatened with extinction, classified as Vulnerable by IUCN Red List (BirdLife International 2024b), and is more abundant in areas that have been better preserved in the archipelago (Schulz-Neto 2004; Micheletti et al. 2020). It is occasionally encountered in urbanised areas, but its distribution is confined to the main island (Olson 1984; Micheletti 2020). The Noronha Elaenia is a passerine bird of the Tyrannidae family that is also threatened with extinction and classified as Vulnerable by the IUCN Red List (BirdLife International 2024a). This species is commonly observed in forested areas, though it is less prevalent in inhabited areas (Nacinovic and Teixeira 1989; Silva and Silva 2008). In contrast to the Noronha Vireo, the Noronha Elaenia occurs more broadly across the archipelago, including on secondary islands such as Ilha Rata (Olson 1984; Micheletti et al. 2020).

There is a paucity of detailed, systematic studies on the reproductive biology of either species but it is known that the Noronha Vireo breeds during the first half of the year, between March and April, with the breeding season potentially extending through July, depending on the rainy season (Silva and Silva 2008). However, there are also reports of the breeding season coinciding with the dry season, between September and October (Nacinovic and Teixeira 1989). The nest is shaped like a deep bowl and is built from soft leaves and plant fibers attached to the forks of trees. It has average dimensions of 21 × 14 mm and 18 × 12 mm, and 1 to 3 white eggs are laid in it over an average period of 15 days (Silva and Silva 2008; GMT Sobral, pers. observ.).

Elaenia has been observed breeding primarily between February and May (Antas et al. 1990), with active nests documented as late as October (Silva and Silva 2008). The construction of cup-shaped nests by the species is achieved through the arrangement of twigs into a circular structure, with the interweaving of spiderwebs serving to bind these components together (GMT Sobral, pers. observ.). There are reports of nests averaging 54.9 mm in height, 75.5 × 86.9 mm in diameter, and 33.6 mm in depth, in which an average of two white eggs with dark red spots are laid (Schulz-Neto 2004).

Data collection

A systematic search for avian nests was conducted on the trails of the Sancho Beach complex between January 2023 and December 2024. This search was conducted on a weekly basis, with three instances per week, throughout the two-year study period. During the weekly visits, a thorough inspection of all trails in the complex was conducted, involving active searches for nests or signs of reproductive activity (e.g., birds carrying material in their beaks). The area was also inspected up to 2–4 metres into the vegetation in some sections of the complex. Precautionary measures were adopted to minimise researcher interference, drawing on the researcher's experience in the study area and taking care regarding approach, clothing and the avoidance of cosmetics. As all trails in the study area were already open and accessible to visitors, no interference was observed with regard to researcher influence on the trails. In the event of locating an active nest, monitoring was conducted at intervals ranging from 24 to 72 hours, contingent upon the reproductive stage. The employment of a mirror affixed to extendable poles, with a maximum height of 6 meters, facilitated the observation of the interior of the nest in the absence of the bird. This method has previously been employed in other studies to minimise researcher interference when inspecting nests located at heights greater than 2 metres (Borges & Marini, 2010). Inspection of the interior of the nests was only carried out during periods when the parents were absent. Several nests were identified during the construction phase, allowing monitoring from the beginning of the breeding season. Other nests were found at different reproductive stages, including egg-laying, incubation, and the late fledging period.

We collected information from 52 nests, monitored over 288 sampling days, with species, nest ID, year, first observation date, last observation date and final nest status. Nest status was coded as 1 = successful and 0 = failed. Of these, two nests were excluded from the analysis because they were dismantled after construction. Nests were considered successful if they fledged at least 1 young (DeMarco et al. 2000; Marini 2009; Borges and Marini 2010). Nests that were unsuccessful (failed) were categorised as either predated or abandoned. Nests were considered predated if eggs or chicks that were not yet able to fly disappeared from the nests (Morozov 2025). Nests were also considered predated if the eggs were found to be pierced or partially damaged inside the nest, or if the chicks showed obvious signs of predation, such as missing body parts or visible physical injuries (Borges and Marini 2010). Nests were considered abandoned if nests containing eggs but no parents remained unhatched for more than 15 days (Medeiros and Marini 2007), if chicks that had died of natural causes were found in the nest (Lee et al. 2023), or if the nests were no longer in use within 30 days of construction. The analyses included a total of 50 nests, comprising 12 *E. ridleyana* nests monitored in 2023 and in 2024, as well as 13 *V. gracilirostris* nests monitored in each of the years 2023 and 2024. Nests were monitored at regular three-day intervals, which were used to calculate exposure periods in the Mayfield method.

Analysis

The Mayfield estimator was used to estimate nest survival based on exposure days, thereby reducing bias associated with apparent nest success estimates derived solely from the proportion of successful nests (Mayfield 1975). Daily survival rate

(DSR) was calculated as:

$$\varvec{D}\varvec{S}\varvec{R} = 1 - \frac{\varvec{d}}{\varvec{E}\varvec{x}\varvec{p}\varvec{o}\varvec{s}\varvec{u}\varvec{r}\varvec{e}}$$

where *d* represents the number of failed nests and *Exposure* corresponds to the total number of exposure days. Exposure days for failed nests were estimated using the midpoint assumption proposed by Mayfield (1975), assuming nest failure occurred halfway through the interval between visits. Nests were monitored at regular three-day intervals throughout the study. Overall nesting success was estimated as:

$$S = DSR^t$$

where *t* represents the duration of the nesting period. The median exposure duration of successful nests was calculated separately for each species and year and used as an estimate of nesting period length. Confidence intervals for daily survival rate were estimated using the variance formulation described by Johnson (1979) and extrapolated to full-period nesting success. Because only start and end dates were available, this analysis should be viewed as a robust first approximation.

In addition to Mayfield daily survival estimates, we derived daily failure rates as the complement of the daily survival rate (1 – DSR) to facilitate interpretation in terms of daily nest mortality risk. Species-level differences in nest failure risk were quantified using the daily mortality rate ratio, calculated as the ratio between species-specific failure rates aggregated across all exposure days. Confidence intervals for the rate ratio were obtained using a log-transformed approximation, and statistical significance was assessed using a z-test. As a complementary comparison, we also computed apparent nesting success based on the proportion of nests that reached a successful outcome, and evaluated interspecific differences using Fisher's exact test. These additional analyses were used to contrast exposure-based survival estimates with simpler proportion-based metrics that do not account for variable observation effort

Results

Nesting period

The reproductive activities resulting in active nests occurred during the months of February through August for Noronha Elaenia and from February through May for Noronha Vireo. March and April were the months with the highest number of active nests, with the Noronha Elaenia accounting for 71% and the Noronha Vireo accounting for 85% of breeding activity during those months (n = 39: *E. ridleyana* = 17; *V. gracilirostris* = 22). March was the month with the highest breeding peak for both the Noronha Elaenia and the Noronha Vireo (Fig. 2). The daily individual performance of the nests exhibited variation across the months for each species (Fig. 3); however, there was an accumulation of successful nests in the months mentioned above. Conversely, unsuccessful nests occurred concomitantly with the months previously specified, a probable consequence of the elevated prevalence of active nests during those months.

Nesting success

Of the total number of nests analysed, 38% were successful (n = 19: ER = 7; VG = 12) while 62% were unsuccessful. Successful Elaenia nests account for 29% of the total number of nests, while the Vireo accounts for 46% (see Table 1). Vireo exhibited a higher estimated daily survival rate (DSR) throughout the entire reproductive cycle, about double the full-cycle Mayfield nesting success, and a substantially higher median survival rate than Elaenia (see Table 1 for details). To understand species survival over time, a survival curve (Fig. 4) was plotted.

Of the unsuccessful nests, 84% (n = 26: ER = 15; VG = 11) were predated, 16% (n = 5: ER = 2; VG = 3) were abandoned during the construction or incubation phase, and 3% (n = 1: ER = 1; VG = 0) experienced natural chick mortality. In 2023 and 2024, *E. ridleyana* had 8 and 9 failures in 217 and 225 exposure-days, respectively, whereas *V. gracilirostris* had 8 and 6 failures in 464 and 302 exposure-days (Table 1).

The estimated daily failure rate was therefore 0.038 for *E. ridleyana* and 0.018 for VG. The daily mortality rate ratio was 2.10 (95% CI = 1.05–4.22; z = 2.09, P = 0.037). Apparent success showed the same direction of effect but was not statistically significant (Fisher, P = 0.255), reinforcing that exposure-based survival estimates provide a more sensitive and appropriate measure of nesting success under variable observation effort.

To understand the differences and similarities between the results of this article and other published data on reproductive success for the genera *Elaenia* and *Vireo*, a comparative table was compiled (Table 2).

Table 1
Results of the nesting success of *Elaenia ridelyana* (ER) and *Vireo gracilirostris* (VG) at Fernando de Noronha Archipelago, Brazil. t = duration of the nesting period in days; DSR = Daily Survival Rate.

Species	Year	N	Successes	Failures	Exposure	Period (t)	DSR	Survival median
VG	ALL	26	12	14	766.0	39	0.981	0.487
ER	ALL	24	7	17	442.5	37	0.961	0.234
VG	2023	13	5	8	464.0	41	0.982	0.490
ER	2023	12	4	8	217.0	31	0.963	0.312
VG	2024	13	7	6	302.0	38	0.980	0.466
ER	2024	12	3	9	225.5	37	0.960	0.221

Table 2
Comparative nest survival of the genus *Elaenia* and *Vireo*. N nests = number of monitored nests; DSR = Daily Survival Rate.

Taxon	Site	Source	N nests	DSR	Nest success	Notes
Elaenia ridleyana	Fernando de Noronha, Brazil	This study	24	0.961	0.234	Mayfield; endemic island passerine; 37-d proxy nesting period
Elaenia parvirostris	East-central Argentina	Gonzalez et al. 2024	99	-	0.390	Apparent success; predation caused most failures
Elaenia spp. / open-cup passerines	Chilean rainforest	Willson et al. 2005	-	0.945	0.200	Open-cup shrub habitat; predation/parasitism important
Vireo gracilirostris	Fernando de Noronha, Brazil	This study	26	0.981	0.487	Mayfield; endemic island vireo; 39-d proxy nesting period
Vireo atricapilla	Central Texas, USA	Campomizzi et al. 2013	38	0.8600	0.010	No cowbird trapping; parasitism/predation context
Vireo atricapilla	Central Texas, USA	Campomizzi et al. 2013	38	0.9300	0.110	With cowbird trapping
Vireo griseus	Central Texas, USA	Campomizzi et al. 2013	53	-	0.070	White-eyed Vireo; without cowbird trapping
Vireo griseus	Central Texas, USA	Campomizzi et al. 2013	53	-	0.230	White-eyed Vireo; with cowbird trapping
Vireo griseus bermudianus	Bermuda	Mejías and Wilson 2023	42	-	0.240	Breeding success, not Mayfield; introduced predators likely important

Discussion

Species-specific nest survival on a predator-simplified but invasion-prone island

The Noronha Vireo exhibited breeding activity from February through early June, with the highest concentration of active nests occurring between March and April. The Noronha Elaenia, on the other hand, showed reasonably constant breeding activity between late February and June. Regarding the breeding season of the species, the data from this study are consistent with those presented in the literature (Antas et al. 1990; Silva and Silva 2008). The two co-occurring endemic passerines on Fernando de Noronha differ in reproductive performance although both breed primarily during the same months (with a breeding peak between March and April). *V. gracilirostris* had high daily survival, and a full-cycle success estimate near 49%, whereas *E. ridleyana* had a lower daily survival and success near 23%. Because daily nest survival compounds over the entire nesting cycle, even a difference of 0.02 in DSR (0.981 versus 0.961) translates into a large difference in fledging survival.

The lower survival rate of the *E. ridleyana* may be explained by several non-exclusive mechanisms. One potential explanation for this observation is the strategy employed in nest-building, encompassing not only the architectural design of the nests but also the reproductive behavior exhibited by the species (Stacey 1982; Møller 1990; Grégoire el al. 2003; Magrath et al. 2010; Mainwaring et al. 2014; Lambrechts and Deeming 2024; Silva et al. 2024). *E. ridleyana* may, for example, build its nests in more exposed vegetation, closer to edges, trails, or habitats modified by humans, differing from the strategies used by other birds to select safer nesting sites, such as more isolated shrubs (Mainwaring et al. 2014). It was observed that the nests of the Noronha Vireo were located at the tips of small trees, which made them more isolated, whereas those of the Elanias were on less isolated tree branches. Thus, the location, position, and structure of their nests may make them more vulnerable to predators, such as invasive rats, cats, or Mabuya lizards. Other factors may also be critical to reproductive success, such as the behavior of adults and chicks during the breeding season (Magrath et al. 2010), as well as incubation duration and the length of time chicks remain in the nest (Martin 2000). In this regard, the Noronha Elaenia may exhibit behavior that makes the nest and nestlings more conspicuous, or it may have a longer incubation period and longer time the nestlings remain in the nest. More detailed research on the reproductive biology of both species is needed to clarify these issues.

The finding that 84% of cases of reproductive failure among the birds studied were associated with predation (with the Elaenia being preyed upon more frequently than the Vireo) also clearly explains the lower survival rate observed in the *E. ridleyana* (whose set of reproductive strategies makes it more susceptible to predation). In the majority of passerine birds, nest predation has been identified as the primary factor contributing to breeding failure (Nilsson 1984; Martin 1993; Remeš et al. 2012). Furthermore, it has been acknowledged as a significant contributing factor to the decline of bird populations (Ricklefs 1969; Wilcove 1985).

The native terrestrial biota of Fernando de Noronha is home to five species, including the passerines that are the focus of this study (Serafini et al. 2010). Currently, the mabuia (*Trachypelis atlantica*), a small lizard, is the sole species considered a potential native predator. Predation by mabuia is most likely opportunistic and sporadic, occurring when both parents are away from the nest for extended periods or abandon the eggs. During nest monitoring, it was observed that the mabuyas were unable to approach the nests on several occasions, as they were quickly driven away by the birds.

However, following the colonization of the archipelago by humans, various exotic terrestrial vertebrates (including amphibians, reptiles, birds, and mammals) have been introduced (Micheletti et al. 2020; Pernambuco 2022), and new introduced species continue to be documented even today (Toledo et al. 2026).

The introduction of mammalian predators has been identified as a contributing factor in approximately fifty percent of island bird extinctions (Caut et al. 2008). Rats, in particular, have been noted as notable predators, especially with regard to the populations of insular species, including their eggs and chicks (Caut et al. 2008). The presence of rats is a pervasive issue in Fernando de Noronha. Rats have been thoroughly documented even in the most remote regions of the archipelago, where human communities are not present. It has been argued that the current proliferation of rats in the archipelago may pose a significant challenge to the conservation and survival of endemic passerine bird populations such as the Noronha Elaenia and

the Noronha Vireo (Micheletti et al. 2020). Our findings suggest that Elaenia may be particularly vulnerable to the impact of these predators.

Comparison with other Vireo and Elaenia systems

The Noronha Vireo daily survival rate (0.981) is higher than published Black-capped Vireo values from central Texas under high brood-parasitism pressure (0.86 without cowbird trapping; 0.93 with cowbird trapping), and its full-period success (~ 0.49) is higher than several *Vireo* examples where cowbirds or introduced predators were prominent (Table 2). By contrast, *E. ridleyana* success (~ 0.23) falls within the broad range reported for open-cup Neotropical/subtropical passerines and is lower than the apparent success reported for Small-billed Elaenia in Argentina (~ 0.39), where predation was the main cause of failure (Table 2). The comparison must be interpreted cautiously because studies differ in methods, nesting-period definitions, nest-stage inclusion and whether values are Mayfield, model-based or apparent/breeding success. The strongest comparison is therefore daily survival rate when available. Nevertheless, the pattern is informative.

Why the Noronha Vireo appears comparatively successful

The Noronha Vireo estimate is high relative to many published *Vireo* examples (Table 2). In continental North America, Black-capped and White-eyed Vireos can experience low period survival where Brown-headed Cowbird parasitism is intense; cowbird trapping can improve daily survival but does not always restore high period success (Farrell et al. 2011). In Bermuda, the endemic White-eyed Vireo subspecies also shows strong conservation relevance because introduced predators were likely the primary cause of many failures (Mejías and Wilson 2023). Noronha lacks Brown-headed Cowbirds, which removes a major reproductive pressure affecting several *Vireo* systems. The island may therefore provide a comparatively favourable reproductive setting for Noronha Vireo if nest predators are locally controlled or if Vireo nesting behaviour reduces predator access. This does not mean that the population of Vireo is secure. A species can have relatively high nest success and still be threatened if its range is small, adult survival declines, suitable habitat is limited, or predator pressure increases. For island endemics, demographic safety depends on the full life cycle: nest survival, fledgling survival, juvenile recruitment, adult survival, dispersal opportunities and the spatial distribution of habitat (Murray 2001).

Conservation implications

The results support five conservation priorities for Fernando de Noronha. First, nest monitoring should become a permanent demographic indicator for both endemic passerines. Annual abundance counts alone may miss early recruitment declines. A practical target is to monitor several nests per species per breeding season with standardised visit intervals, nest stage, habitat, nest height, substrate and outcome. Second, the lower *E. ridleyana* survival suggests that *E. ridleyana* should be treated as the more demographically sensitive of the two passerines until proven otherwise. Conservation planning should map *E. ridleyana* nesting habitat, identify whether failures cluster near trails, settlements, forest edges or invasive plant patches, and protect high-success breeding microhabitats. Third, predator management should be linked directly to nest outcomes. Cats and rats are repeatedly identified as major concerns on Fernando de Noronha (Gaiotto et al. 2020), and invasive-species studies from the archipelago indicate widespread cats and substantial rat densities in at least some areas (Russell et al. 2018). Nest cameras should be deployed on a subset of *E. ridleyana* and *V. gracilirostris* nests to quantify the predator guild. This is essential because management differs if failures are mainly rats, cats, lizards, birds, ants, weather or abandonment.

Fourth, habitat restoration should focus on native shrub and secondary forest structure rather than generic tree planting. For open-cup passerines, the details of branch architecture, foliage density, canopy cover, nest height and distance from edges can determine predator access. Restoring dense native vegetation around breeding territories may buffer nests from tourism disturbance and reduce predator movement along edges. Fifth, tourism and infrastructure planning should incorporate breeding-season buffers. Both species are single-island endemic; small increases in disturbance, vegetation clearing or predator subsidies can have island-wide consequences. Waste management, cat feeding, food waste around restaurants and trail expansion should be evaluated as indirect drivers of nest predation.

The Noronha Vireo currently shows relatively high nest survival, whereas the Noronha Elaenia shows lower reproductive performance and about twice the daily nest mortality. This difference creates a clear conservation message: the two endemics

should not be managed as demographically equivalent. *E. ridleyana* requires targeted diagnosis of nest-failure mechanisms, and both species require long-term reproductive monitoring tied to invasive predator control, habitat restoration and tourism planning. Nest survival can function as a sensitive early-warning indicator for the persistence of Fernando de Noronha endemic passerines.

Declarations

Competing Interests

The authors declare that they have no competing interests.

Author Contribution

GS – Conceptualization (ideas; formulation or development of general research objectives and goals), investigation (methodology, field data collection), literature review, writing, and manuscript revisionGA – Formal analysis (statistical analyses of the study, including the preparation of figures), writing, revision, and editing of the manuscriptLA – Conceptualization (ideas; formulation or development of general research objectives and goals), fieldwork (support with specific data collection), and editing of the manuscriptCL – Conceptualization (development of general research objectives and goals), securing funding (financial and logistical feasibility of the project), and research project administration (bureaucratic procedures and administrative coordination)BM – Literature review and partial writing of the manuscriptRC – Conceptualization, methodology (facilitation of field operations), and manuscript reviewMG – Conceptualization, validation (verification of the general reproducibility of research results), supervision (oversight of the planning and execution of research activities), and manuscript review.

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Figures

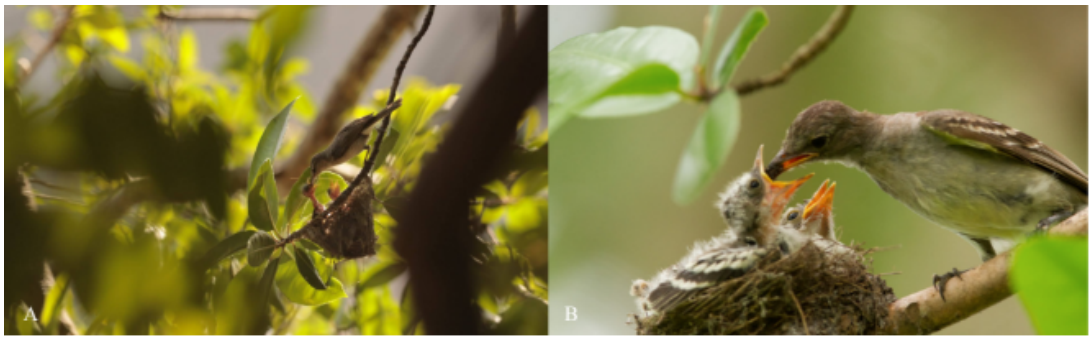


Figure 1

The endemic passerines of Fernando de Noronha archipelago. (**A**) The Noronha Vireo, *Vireo gracilirostris* (Photo: Heideger Nascimento) and (**B**) the Noronha Elaenia, *Elaenia ridleyana* (Photo: Aves de Noronha project collection)

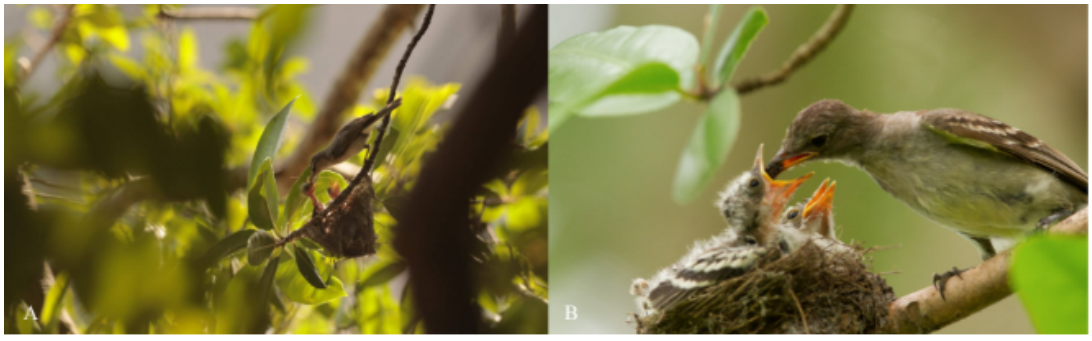


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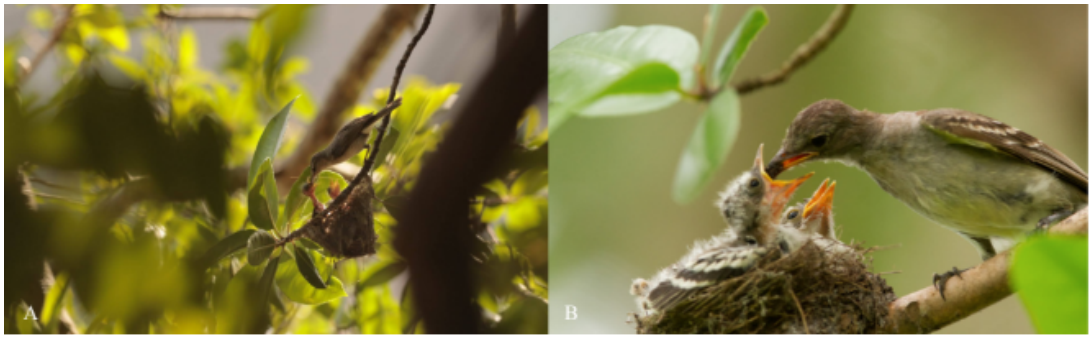


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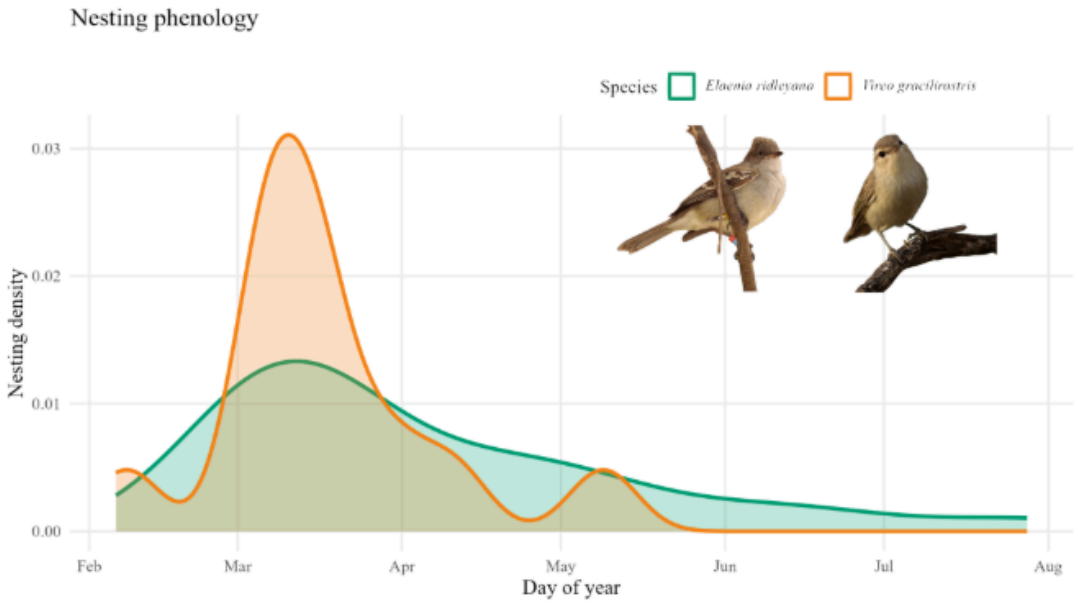


Figure 2

Nesting phenology of *Elaenia ridleyana* and *Vireo gracilirostris* in Fernando de Noronha Archipelago, Brazil. Curves represent kernel density estimates of nest initiation dates based on the day of the year. Higher curve density indicates periods of greater nesting activity. (Photo: Aves de Noronha project collection)

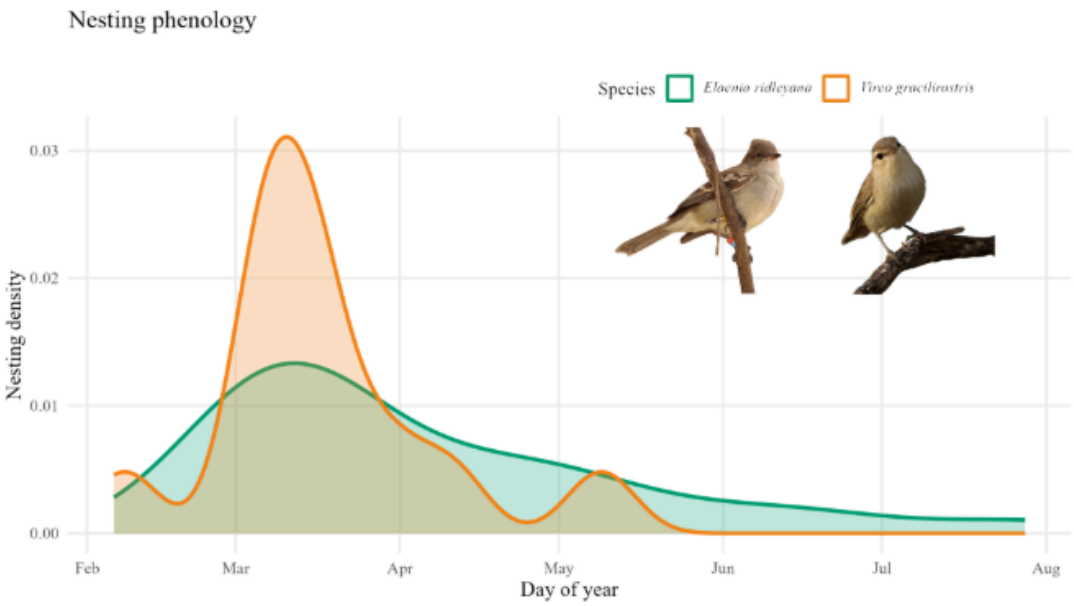


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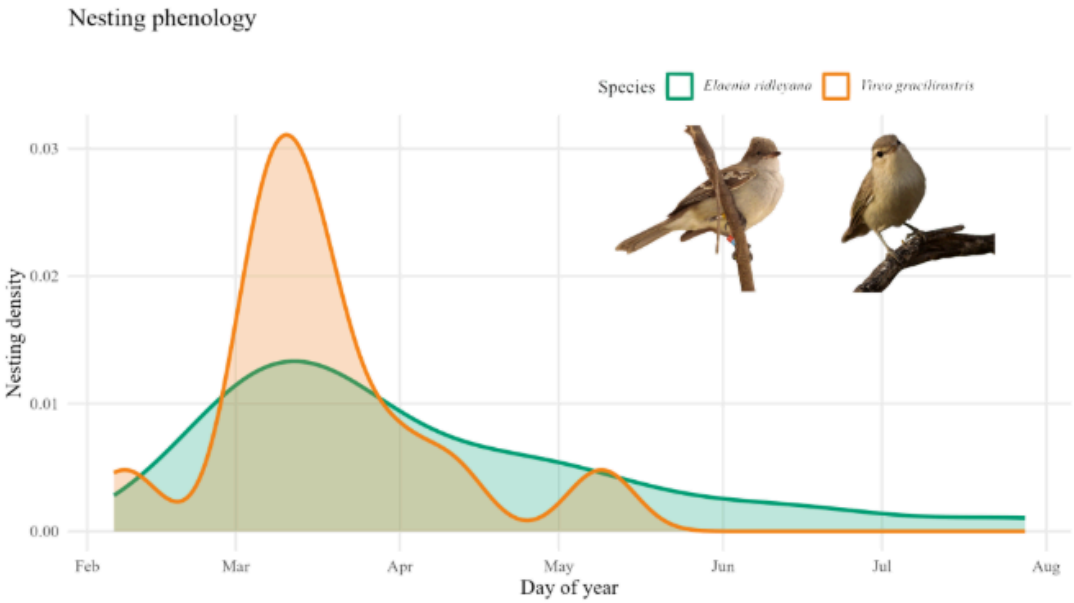


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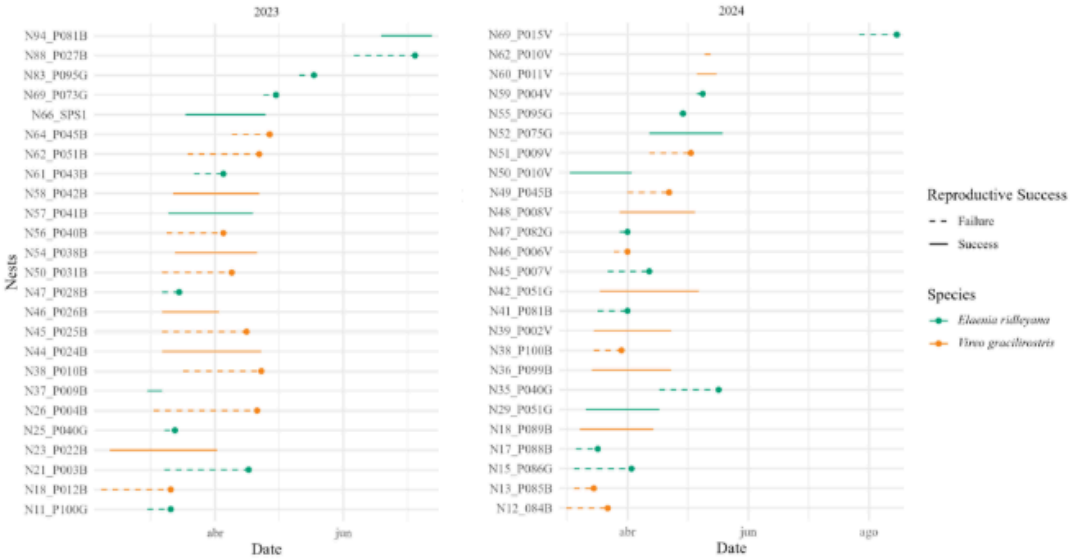


Figure 3

Monitoring timelines of individual nests of *Elaenia ridleyana* and *Vireo gracilirostris* during the 2023 and 2024 breeding seasons in Fernando de Noronha, Brazil. Each horizontal segment represents the observation period of a single nest, extending from the first to the last monitoring visit. Colors identify species, whereas line type indicates the reproductive outcome (solid = successful nests; dashed = failed nests). Points indicate the date of the final observation for each nest.

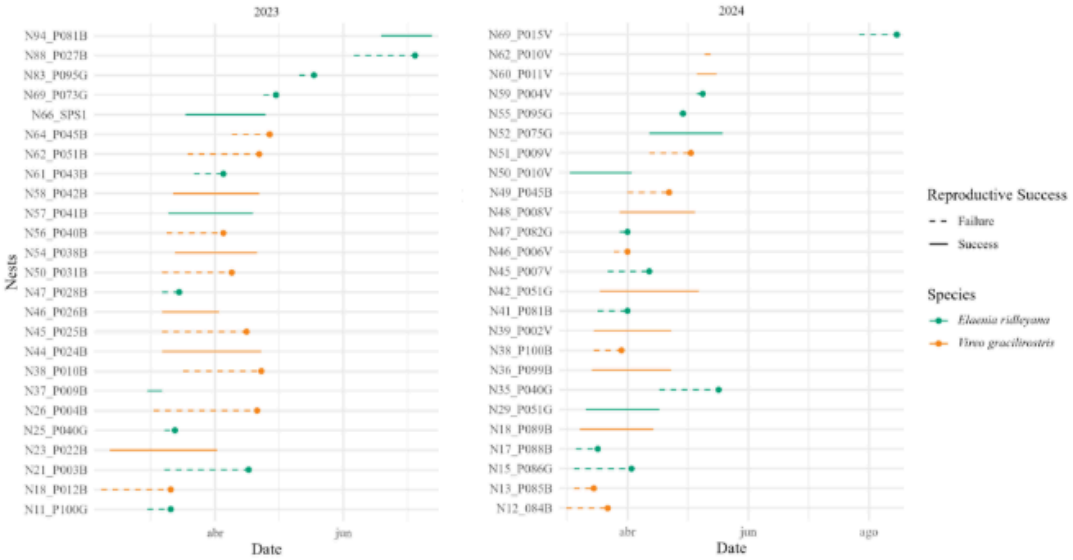


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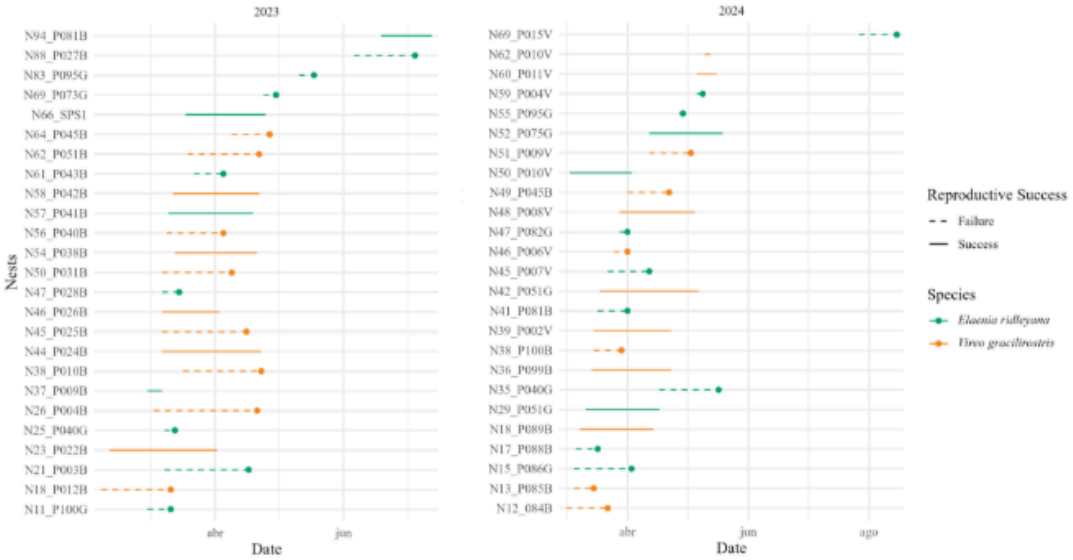


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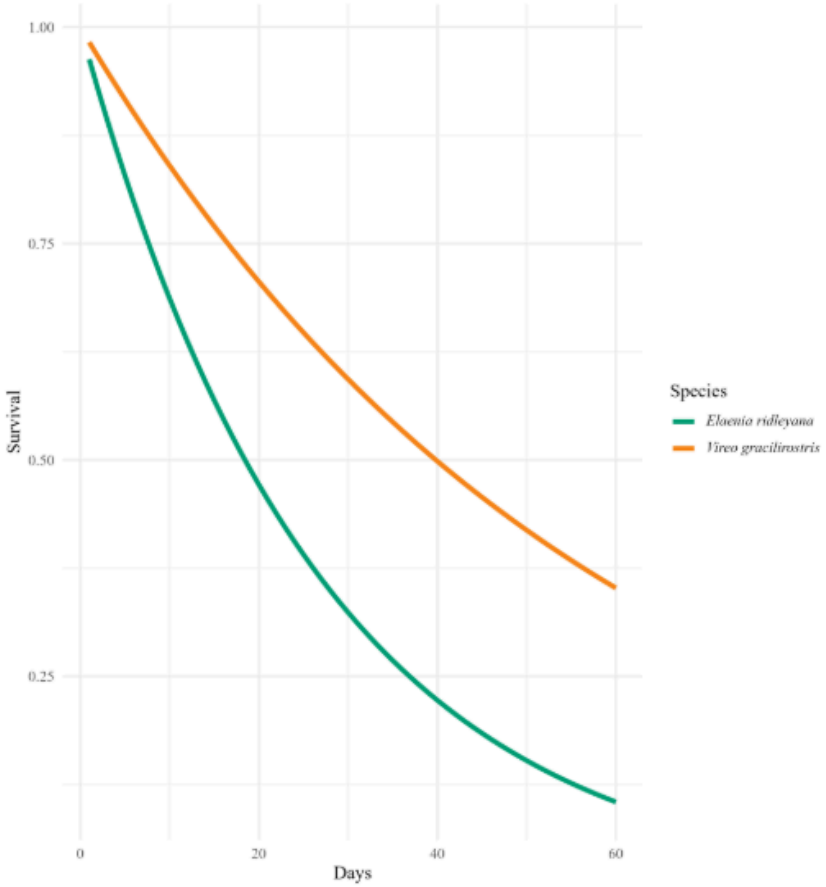


Figure 4

Estimated Mayfield survival curves for Elaenia ridleyana and Vireo gracilirostris in Fernando de Noronha, Brazil. Curves represent the estimated probability of nest survival throughout a 60-day nesting period, assuming a constant daily survival probability.

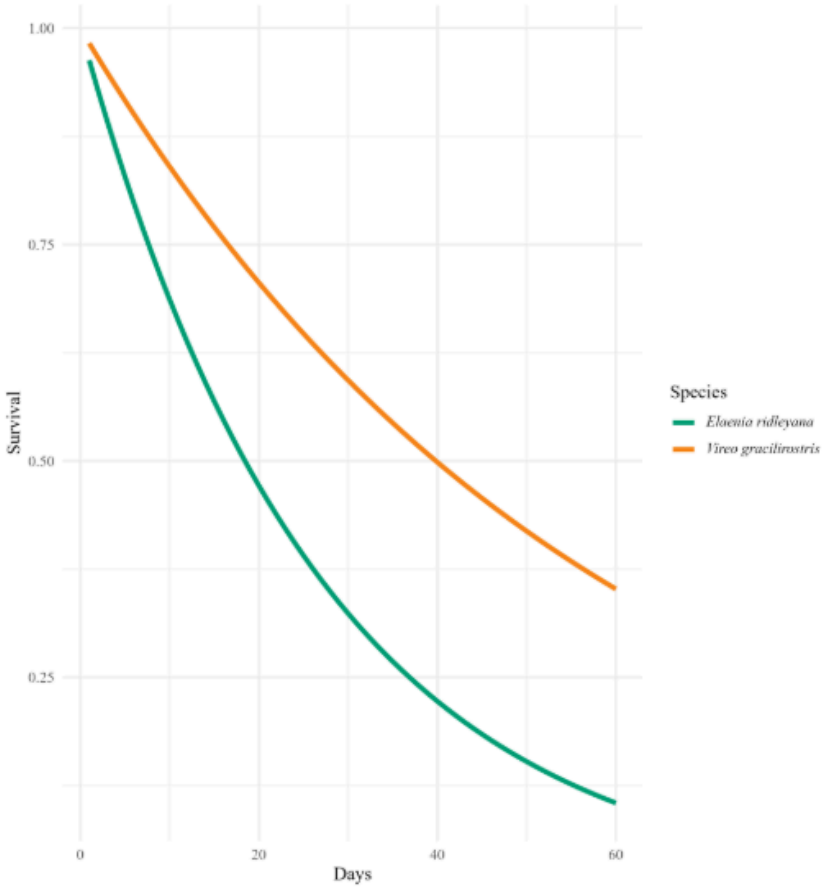


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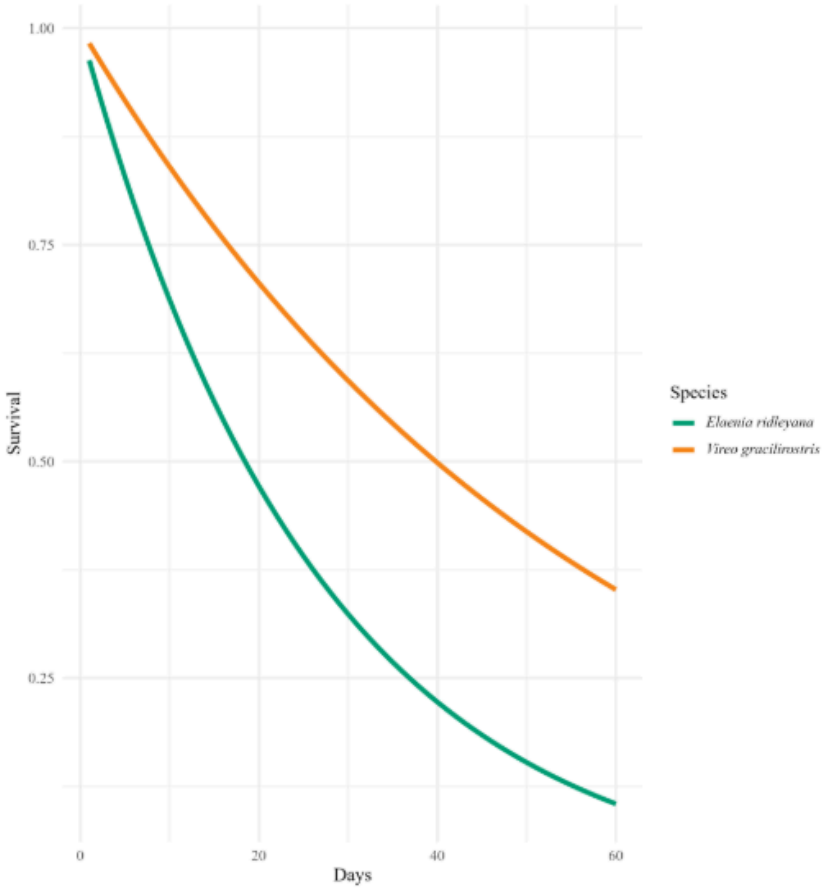


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