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**Original Article**

# Duration of nest-building in passerine birds: the roles of latitude, nest size, and nest type

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Nest building is a crucial yet understudied aspect of the avian breeding cycle. The duration of this process can impact reproductive success, and natural selection is expected to optimize it. However, factors shaping the evolution of nest-building duration remain unclear. Using a large dataset comprising 853 populations of 591 songbird species breeding worldwide, we examined key factors influencing nest-building period length. Our findings reveal that species breeding at higher latitudes or in environments with a greater number of potential predators construct their nests more quickly. Additionally, open and smaller nests, as well as those built by both parents, are completed faster than domed or larger nests, or those constructed solely by females. These results provide new insights into the selective pressures shaping nest-building strategies across songbird species.

**Keywords:** enclosed nests; latitudinal gradient; nest building period; parental care; sex roles.

## Introduction

In many animals, both invertebrates and vertebrates, nests are essential structures critical for successful reproduction (Hansell 2005, 2007; Deeming 2023). In birds, for example, nests provide a secure environment for eggs and chicks by offering protection from predators, weather, and other environmental hazards. Moreover, they also help regulate temperature, supporting the delicate process of egg incubation and offspring brooding. Hence, it is not surprising that nearly all bird species use some form of nest during breeding, which vary from simple scrapes on the ground to massive, elaborate structures (Collias and Collias 1984; Hansell 2000; Sheard et al. 2024). Moreover, the type and design of avian nests are driven by climatic conditions (Perez et al. 2020; Colombo et al. 2024) and have important consequences for species egg characteristics (Nagy et al. 2019; Hung et al. 2022), life history traits (Street et al. 2022; Taylor et al. 2024), ecological success (Medina et al. 2022), and clade diversification (Zenil-Ferguson et al. 2023). These findings reveal how critical nests are to the ecology and evolution of birds.

Although nest building is often a critical prerequisite of successful reproduction, it has received less attention compared with other stages of the breeding cycle, such as incubation or chick rearing (Guillette and Healy 2015). However, some birds undertake thousands of trips covering tens or hundreds of kilometers to gather nesting material and spend many hours constructing their nests (Collias and Collias 1967; Collias 1986; Gauthier and Thomas 1993). Time and energy dedicated to nest building thus constitute a non-negligible proportion of the overall costs of breeding (reviewed in Mainwaring and Hartley 2013), with energetic demands of construction comparable to those of incubation (Withers 1977). Consequently, energy allocated to nest building might be lacking in later phases of reproduction. Within species, an experimental study of Pied Flycatchers (*Ficedula hypoleuca*) demonstrated that increased female investment in nest building can negatively impact subsequent investment in eggs and nestlings. More specifically, females that spent longer periods building their nests devoted less time to incubation and fed their offspring less frequently, ultimately producing smaller fledglings (Moreno et al. 2010). Thus, duration of the nest-building phase can have a significant effect on a bird's reproductive success, and natural selection can be expected to optimize it. This within species optimization should lead to the correlation between nest building duration and key ecological factors at the interspecific scale. However, these key factors driving the evolution of the length of nest building across species remain unclear.

Nest predation is one of the most important selective factors, affecting the duration of developmental periods in birds (Remeš and Martin 2002; Martin et al. 2011; Remeš et al. 2020). The risk of nest depredation accumulates over time, and thus it pays to shorten any developmental period to reduce the chance of nest discovery and destruction by predators, especially in environments with high ambient nest predation risk (eg, high density and/or diversity of nest predators; Matysioková and Remeš 2022). By the same logic, shortening the nest building period might reduce the probability of nest discovery before the eggs have been laid. This is critical, because predators are known to revisit previously discovered nests, which could result in nest contents depredation once eggs or chicks are present (Weidinger 2010). This selection at the within-species level on short nest building periods in environments with high ambient nest predation risk would then lead, over evolutionary time scales, to a negative correlation between the duration of nest building and nest predation risk

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**Table 1.** Summary of hypotheses we suggest to explain the evolution of the nest building period in birds.

| Factor | Reasoning | Predictions for the length of the nest building period |
|---|---|---|
| **Nest predation** | High risk of nest depredation selects for a shorter duration of nest exposure (Remeš and Martin 2002). | Shorter nest-building period under high risk of nest depredation. |
| | High risk of nest depredation selects for reduced activity around the nest (Matysioková and Remeš 2018). | Longer nest-building period under high risk of nest depredation. |
| **No. of builders** | More birds can complete the task of nest building faster than a single bird. | Shorter nest building period if the male contributes to nest construction. |
| **Nest type** | Domed nests are more demanding to build than open nests (Collias 1997). | Longer nest building period in domed nests. |
| **Nest volume** | Larger nests require more nesting material (Collias 1997). | Longer nest building period in larger nests. |
| **Absolute latitude** | Higher adult survival close to the Equator reduces parental effort (Wiersma et al. 2007). | Longer nest building period closer to the Equator. |
| | Shorter breeding seasons further from the Equator select for earlier egg laying (Verhulst and Nilsson 2008). | Shorter nest building period further from the Equator. |

across species. On the other hand, high ambient nest predation risk might select for reduced activity around the nest to avoid detection by visually oriented nest predators (Martin et al. 2011; Matysioková and Remeš 2018). The reasoning is that if nest-building individuals make frequent trips to and from the nest during construction, predators may notice this activity, locate the nest, and prey on its contents once they become available. This within-species selection on reduced activity around the nest during its building might lead, over evolutionary time scales, to reduced intensity of nest building (ie, fewer nest visits per day). Because to build the nest requires the delivery of a given amount of material, fewer nest visits per day will translate into longer nest building periods in species under high ambient nest predation risk. Of course, nest builders might compensate by bringing more nest material per one nest visit, but this compensation has its limits, as has been demonstrated in case of nestling feeding behavior in passerine birds (Martin et al. 2000; Martin et al. 2011).

In addition to nest predation, several other factors may influence the duration of the nest-building period. First, the number of individuals involved in the building process vary across species, driven by species-specific social and environmental factors (Remeš et al. 2015; Long et al. 2022; Wang et al. 2023). This variation can have potential consequences for the length of nest building. More specifically, in species where both males and females contribute to nest building, the process might be faster, as 2 birds working together can theoretically complete the task more quickly than a single bird (Mainwaring et al. 2021). Second, the type and size of the nest can also influence the time required to complete its construction. Larger or more elaborate nests, such as domed nests, are more challenging to build (Medina et al. 2022; Li et al. 2024) and therefore could take longer to complete. Third, energy expenditure and breeding strategies vary by latitude. Tropical species, typically selected for higher adult survival, often exhibit lower energy expenditure and overall parental investment (Wiersma et al. 2007) and thus it should be expected that they take longer to complete their nests compared with temperate species. Moreover, in higher latitudes the building process could be also sped up by relatively shorter breeding seasons compared with the tropics (Baker 1939; Wyndham 1986), whereby many bird species are selected to start reproduction as soon as possible after their arrival from the breeding grounds (Verhulst and Nilsson 2008).

To unravel drivers of nest building duration in birds, we studied the amount of time songbirds spend on building their nests in relation to relevant predictors. By analyzing a comprehensive, population-level dataset obtained from field studies conducted worldwide, we examined whether the duration of nest building is related to: (1) the risk of nest depredation, (2) the number of building individuals (both parents versus female only), (3) nest type (domed versus open nests), (4) nest size, and (5) absolute geographic latitude (ie, the distance from the Equator; see Table 1).

## Materials and methods

We collected data for this study from the literature. To keep the extent of our study manageable, we focused exclusively on songbirds (Passeriformes). Moreover, we included only species building either open or domed nests accessible from the outside, ignoring all species nesting in cavities. This decision was based on several considerations. First, the nest-building process of cavity-nesting species is inherently more difficult to observe due to the limited visibility within cavities. This limitation could generate poor-quality data and thus introduce significant noise and observational bias into our data. Second, much of the available research on cavity-nesting songbirds is based on studies using artificial nest boxes, which may not accurately reflect natural nest-building behavior. Lastly, the number of observable cases of natural cavity nesting is relatively small, further limiting the potential sample size and statistical power of our analyses. For these reasons, we believe that excluding cavity nesters ensures a more consistent and reliable dataset for addressing our research questions. To locate data on nest building behavior, we searched all major ornithological compendia (Skutch 1954, 1960, 1969; Keith et al. 1992; Poole and Gill 1992; Urban et al. 1997; Cramp 1998; Fry et al. 2000; Higgins et al. 2001, 2006; Higgins and Peter 2002; Fry and Keith 2004; Hockey et al. 2005; Safford and Hawkins 2013; Billerman et al. 2022). In this way we located articles containing data on time birds spend building their nest. We located additional articles from literature cited in the articles obtained in the above-mentioned ways and also from articles we used in our previous studies of bird breeding behavior (Matysioková et al. 2011, 2017; Matysioková and Remeš 2013, 2014, 2018).

From original articles resulting from our literature search we extracted the time which birds spend building their nest (in days). In some cases, authors distinguished between the time necessary to build the first (early) and the second (late) nest. In those cases, we used the average of those 2 numbers ($N = 87$). We also extracted information on which sex builds the nest (only the female or both parents) from these same articles. Because only in a minority of studied nests were built by either only the male ($N = 13$) or whole group of birds ($N = 10$), we excluded those populations from our dataset. Further, we obtained information on nest type (open versus domed) excluding 17 species, which used predominantly mud to build their nests. We excluded those species because mud needs time to dry and harden for structural stability and birds have to wait after adding a fresh layer of mud until it dries (Collias and Collias 1984). If information on either the sex that builds the nest or nest type was missing in the original article, we used data provided in compendia listed above or other original studies.

Where available, we also collected data on nest dimensions (length, width and height in cm) to estimate nest volume calculated as: length × width × height (in $cm^3$). While this approach is not ideal and does not provide accurate physical volume of the nests it allows us to compare relative sizes between species. Moreover, is a subsample of populations, we were able to obtain also nest mass (in grams). Nest volume and nest mass correlated closely (Pearson's $r = 0.90$ on $\log_{10}$-transformed variables, $N = 93$ populations), further supporting our claim that nest volume is a good proxy variable for the overall amount of material used in nest construction. Geographic latitude of each study location was determined using Google Earth, based on information obtained from the original articles. Annual adult survival rates were primarily sourced from Beauchamp (2022) and supplemented with data from additional references (Scholer et al. 2020; Beauchamp 2021, 2023; Oteyza et al. 2021; Silva et al. 2024). Adult body mass (g) was obtained predominantly from Dunning (2008), supplemented with data from additional references (birds.com.pk, Facchinetti et al. 2011; Billerman et al. 2022). In 6 species we were not able to get information on body masses and we used body masses of closely related species of similar size instead.

We obtained data on the probability of nest depredation, or daily nest predation rate, from the literature (Matysioková and Remeš 2022). However, we were able to obtain that data only for 532 out of the final number of 853 populations. Thus, to increase the number of populations for which we had an estimate of the risk of nest depredation, we also quantified the number of potential nest predators as in Matysioková and Remeš (2022). Briefly, this procedure included identifying families of birds and mammals that include potential nest predators. Then, using range data for these predatory species, we found out how many of them occurred alongside the studied population using geographic coordinates of those populations. We assumed that higher number of species known to depredate avian nests meant higher risk of nest depredation at a given locality, as was true in a previous global study (Matysioková and Remeš 2022). This was further evidenced by a significant positive correlation between the number of potential nest predators and daily nest predation rates in our present dataset ($r = 0.2$, $N = 532$, $P < 0.001$). We thus had 2 estimates of nest predation rates. First, daily nest predation rates are the realized predation rates in concrete populations of birds, and are the result of an interplay between the ambient predation risk and species anti-predator responses. Second, the number of species of potential nest predators present is a direct proxy of the ambient nest predation risk, thus probably indexing predation pressure on the nests that imposes selection on anti-predator defenses. We used both these variables as predictors in our models to obtain a comprehensive understanding of the potential role of nest predators in the evolution of nest building duration across species of songbirds.

We used phylogenetic comparative methods to fit statistical models at the level of populations. More specifically, we fitted single-predictor and multiple-predictor regression models with phylogeny and species identity as random factors using the phyr package for the R language (Li et al. 2020). We used a new global phylogeny of birds available via the clootl package for R (https://github.com/eliotmiller/clootl, accessed 15 Dec 2024; McTavish et al. 2025). As a response variable, we always used $\log_{10}$-transformed length of the nest building period. As predictors, we used nest type (open versus domed), nest builders (female-only versus both parents), absolute latitude (absolute degrees from the equator, either north or south, as a measure of the distance from the equator), annual adult survival probability, adult body mass (g), nest volume ($cm^3$), and the number of potential nest predator species. To improve the distribution of variables so that they better approached the normal distribution, body mass and nest volume were $\log_{10}$-transformed. We scaled all predictor variables (their mean was subtracted and they were divided by 1 standard deviation) to allow for proper comparison of regression coefficients. For this purpose, binary predictors were coded as 0 versus 1, which generates regression coefficients on a scale comparable to continuous variables (Schielzeth 2010).

First, we fitted single-predictor models to get insight into bivariate relationships between predictors and the length of nest building. Second, we needed to navigate an unavoidable tradeoff whereby including more predictors into the comparative analysis reduces the number of populations entering the statistical model, because many species have a missing value for the added predictor(s). To resolve this tradeoff, we fitted 2 multiple-predictor models. The first one included only variables for which we had data for almost all populations, resulting in a model with 824 populations. The second one included in addition nest volume, because this predictor was statistically significant in bivariate models, resulting in a model with 380 species. We estimated repeatability within species of the duration of nest building as an intraclass correlation coefficient using the ICCbare function from the ICC package for R (Wolak et al. 2012), including only species with at least 2 studied populations available ($N = 161$ such species). We estimated the phylogenetic signal of species averages of the $\log_{10}$-nest building period as Pagel's lambda using the phylosig function from the phytools package (Revell 2024). This value shows how much the trait follows the phylogeny, from random (white noise) evolution (value = 0) to Brownian evolution along the phylogeny (value = 1).

## Results

Altogether we found information on the length of the nest building period in 853 populations of 591 species of songbirds breeding worldwide (Fig. 1). In 54.2% of species only females built the nests while in 36.9% of species the task was shared between the sexes in the breeding pair. In 4.4% of species the sex that built the nest differed between populations and in the remaining 4.6% the sex of the nest builder was unknown. Most of the species (77.2%) used open nests for breeding with domed nests being much less common (21.8%). Birds spent from 1 to 45.5 days building their nests (mean ± SD = 7.6 ± 5.25, median = 6.0, $N = 591$ species). The repeatability within species of the $\log_{10}$-transformed nest building period was 0.51 ($N = 423$ populations of 161 species with at least 2 studied populations), while the phylogenetic signal of the species-averaged values of this variable was $\lambda = 0.70$ ($N = 591$ species). Some families showed consistently long nest building periods, including Furnariidae, basal Tyrannoidea (Tityridae, Onychorhynchidae, and Rhynchocyclidae), Monarchidae, and Corvidae. On the contrary, species in other families had comparatively short periods, for example Pipridae, Cotingidae, Alaudidae, Cisticolidae, Acrocephalidae, Emberizidae, Thraupidae, and Passerellidae. Other families demonstrated both short and long

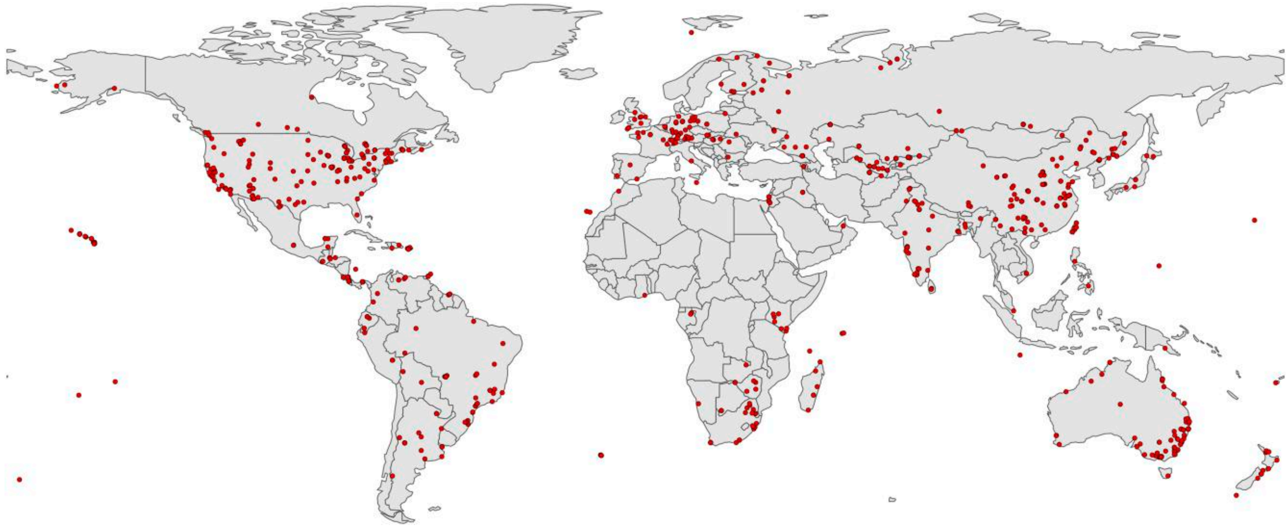

**Fig. 1.** Geographic distribution of 853 passerine populations from which data on the duration of the nest building period were obtained.

nest building periods, for example Tyrannidae, Turdidae, Muscicapidae, Nectariniidae, Motacillidae, Fringillidae, and Parulidae (Fig. 2).

Nest-building period showed statistically significant correlations with absolute geographical latitude, nest volume, nest type, the number of nest builders, and the number of potential nest predators, although not all predictors were significant in both single-predictor and multiple-predictor regression models (Fig. 3). Birds breeding farther from the Equator (both to the north and to the south) spent considerably less time constructing their nests than those breeding in lower latitudes. Birds also spent more time building domed and larger nests compared with open and smaller ones. These predictors were statistically significant in both single- and multiple-predictor models (Tables 2 and 3). On the other hand, 2 parents built the nest significantly longer than a sole female in single-predictor models (Table 2), while this relationship was not statistically significant in multiple-predictor models (Table 3). Similarly, birds built nests significantly longer at places with many potential nest predators compared with places with fewer predators (Table 2), but this effect was again not statistically significant in multiple-predictor models (Table 3). In contrast, adult body mass never significantly predicted the length of the nest building period (Tables 2 and 3).

## Discussion

Nest building plays a vital role in the avian breeding cycle, with considerable variation in the time invested across species. Our findings indicate that these differences can be at least partly explained by nest volume, nest type, the number of builders, and the prevalence of potential nest predators in the surrounding environment. However, the most significant factor predicting variation in the duration of nest-building periods is absolute geographic latitude (ie, distance from the Equator).

Energy expenditure and breeding strategies vary widely with absolute latitude. Tropical species, typically found to have higher adult survival, tend to exhibit lower energy expenditure and reduced parental effort (Wiersma et al. 2007; Martin 2015). This is reflected in smaller clutch sizes (Jetz et al. 2014), lower incubation attentiveness (Martin 2002; Matysioková and Remeš 2014), and longer developmental periods (Martin et al. 2007; Remeš and Matysioková 2016; Remeš et al. 2020). Our results reveal that tropical species also take a less intense approach to nest building, as it generally takes them longer to complete their nests. This result would fit previous empirical observations, detailed above, that tropical species have slow life history with reduced parental investment. However, if slow life history was the cause of our observed relationship between absolute latitude and the duration of nest building, we should find long nest building periods in species with high annual adult survival, but we found no such relationship. This could suggest another reason for shorter nest building periods further from the equator, namely shorter breeding season at higher latitudes compared with the tropics (Baker 1939; Wyndham 1986). The logic is that birds breeding in arctic and temperate regions face severe time constraints and are under a strong selective pressure to expedite nest construction, enabling them to begin laying eggs as quickly as possible (Verhulst and Nilsson 2008). This could be facilitated by longer daylight hours further from the Equator, allowing birds to dedicate more time each day to nest building.

Our results confirm that larger nests are built over more days regardless of bird size. This makes sense in the light of 2 observations made within species. First, larger nests required more nesting material and thus more visits to the nest in House Wrens (*Troglodytes aedon*; Kennedy and White 1992). Second, taller nests required significantly more time to be built than shallower nests in Blue Tits (*Cyanistes caeruleus*; der Weduwen et al. 2021). A positive relationship between nest size and nest-building time could also explain why birds tend to construct smaller nests as the breeding season progresses, given the time constraints they face (Herranz et al. 2005; Botero-Delgadillo et al. 2017). Behavioral traits are under optimizing selection and thus it must pay birds to build larger nests when this requires longer time investment. Larger nests might provide better insulation (Collias and Collias 1984), better protection from inclement weather, and more space for larger clutches (Collias and Collias 1984; Møller et al. 2014).

Our data also revealed that domed nests required more time to complete than open nests, similarly as found by Medina et al. (2022). This is likely due to their greater structural complexity, supported by recent evidence that species building domed nests evolved larger brains compared with those constructing simpler nests (Li et al. 2024). Domed nests require more time to complete,

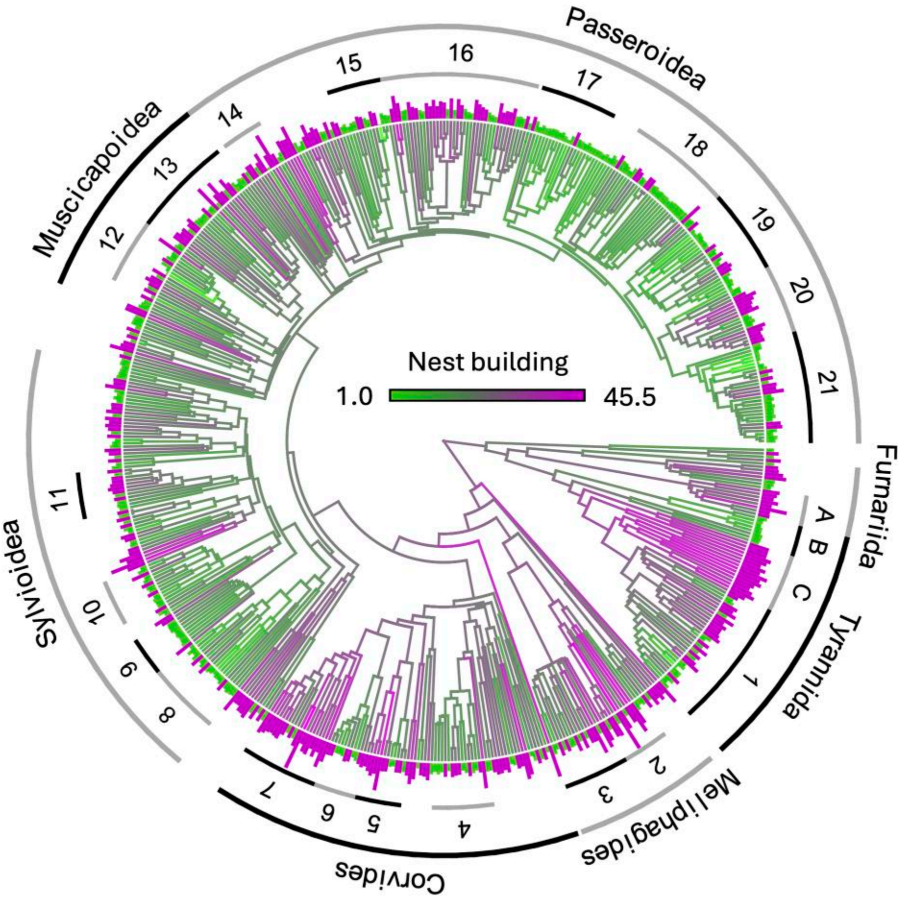

**Fig. 2.** Phylogenetic distribution of the duration of the nest building period in passerine birds ($N = 591$ species). We marked 21 families with at least 10 species: 1—Tyrannidae, 2—Acanthizidae, 3—Meliphagidae, 4—Vireonidae, 5—Monarchidae, 6—Laniidae, 7—Corvidae, 8—Alaudidae, 9—Cisticolidae, 10—Acrocephalidae, 11—Pycnonotidae, 12—Turdidae, 13—Muscicapidae, 14—Nectariniidae, 15—Motacillidae, 16—Fringillidae, 17—Emberizidae, 18—Thraupidae, 19—Passerellidae, 20—Icteridae, and 21—Parulidae. We also marked several smaller clades with either conspicuously long or short building periods: A—Furnariidae, B—Pipridae and Cotingidae, C—Tityridae, Onychorhynchidae, and Rhynchocyclidae. Higher taxa are denoted along an outer circle (taxonomy follows Fjeldså et al. 2020). The length of the nest building period ranged from 1.0 (green) to 45.5 days (magenta). It has been reconstructed along the branches of the phylogeny using the "plotBranchbyTrait" function from the "phytools" package (Revell 2024) for visualization purposes. The height of bars around the tips of the phylogeny are proportional to the length of the nest building period, with green color denoting species with the length below the median (median = 6.0 days), while magenta color denotes species falling above the median length of the nest building period.

but they offer superior insulation, shielding offspring from cold and heat and also provide protection against solar radiation (Collias 1997; Martin et al. 2017; Englert Duursma et al. 2018), and thus are considered adaptations to extreme environments. Consequently, birds have evolved to build domed nests despite the greater time investment required.

Nest predation is the leading cause of nest failure in birds (Remeš et al. 2012a, b; Matysioková and Remeš 2022). Consequently, birds breeding under higher predation risk are expected to adjust their behavior to mitigate this threat. One common strategy is to shorten the period during which the nest is exposed to predators (Remeš and Martin 2002; Martin et al. 2011; Remeš and Matysioková 2016; Remeš et al. 2020). However, reducing the exposure time often requires increased parental activity around the nest, such as delivering food to the incubating female to maximize time spent warming the eggs (Matysioková et al. 2011; Matysioková and Remeš 2014) or feeding chicks more intensively to accelerate their growth (Tremblay et al. 2003; but see Martin et al. 2011). Conversely, if the nest predators are mostly visually oriented, elevated predation risk may favor reduced parental activity around the nest to avoid detection of parents (Matysioková and Remeš 2018) which would lead to prolonged developmental periods. Interestingly, contrary to our expectations, the speed at which birds constructed their nests did not appear to be consistently influenced by predation risk (at least as estimated in this study): birds took longer time to build their nests with more potential predators around only in the single-predictor model, while this relationship was not significant in multiple-predictor models. One possible explanation is that although predators might revisit nests they find during construction, the predation risk associated with exposing an empty nest may not be significant enough to drive strong selection for faster building or lower activity around the nest. Instead, other selective pressures may play a more prominent role. Further studies could resolve this issue by directly studying the frequency of nest building visits, and better quantifying ambient nest predation risk, for example by identifying major nest predators using time-laps nest monitoring and censusing these predators in the habitats where birds breed.

In birds, the primary tool used for nest building is the beak (Sheard et al. 2023). Due to the minimal sexual dimorphism in beak morphology among songbirds, both males and females are

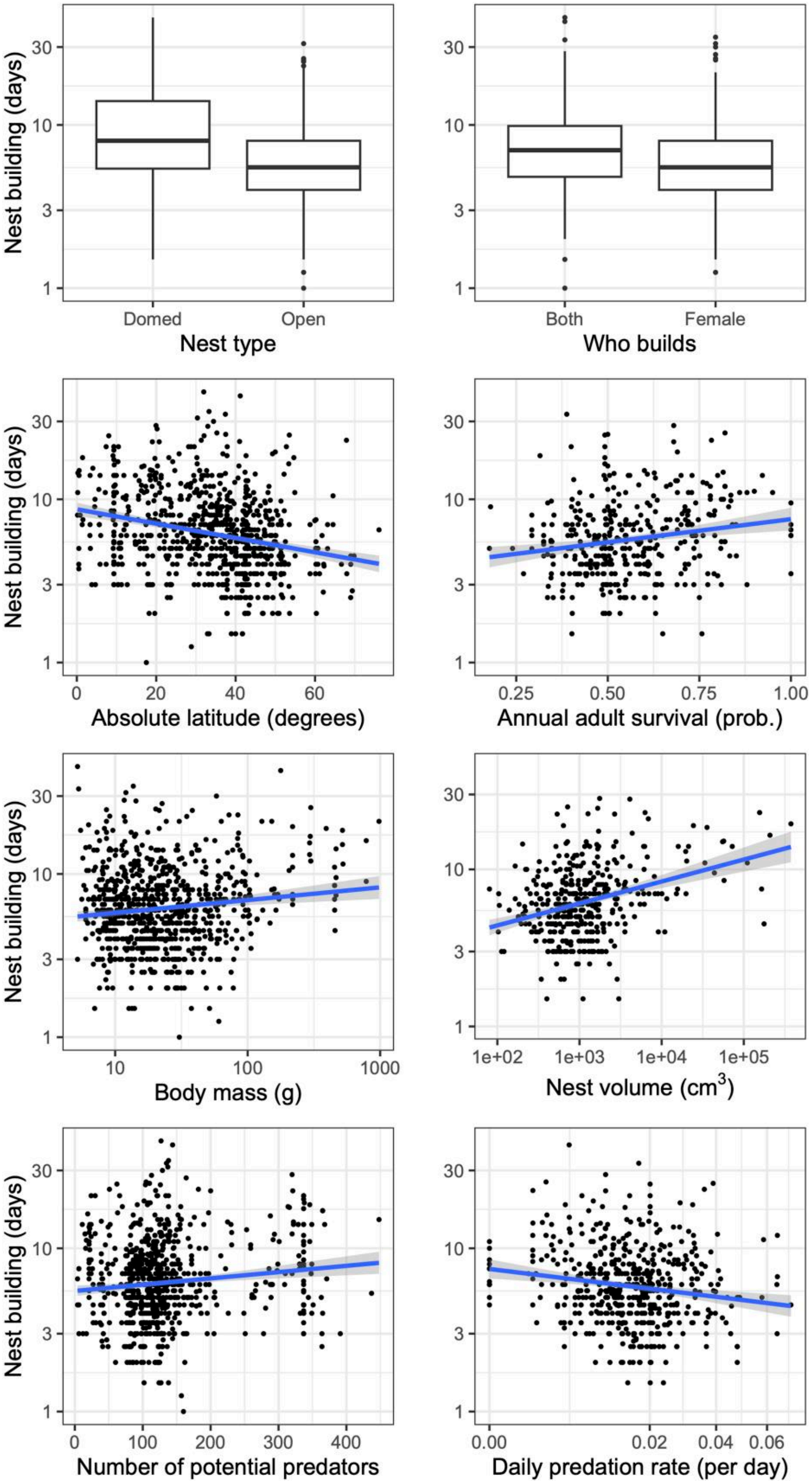

**Fig. 3.** Relationships between the duration of the nest building period and our predictor variables. Sample sizes differ among traits and are listed in Table 2. In case of scatterplots, a simple linear regression line with 95% confidence limits is fitted for illustration purposes.

equally capable of contributing to nest construction. Therefore, it is reasonable to expect that a pair working together would complete the task more quickly than a female working alone. However, we did not consistently observe such a relationship in our study. On the contrary, it took longer for both parents than to a lone female to build the nest in the single-predictor model

**Table 2.** Single-predictor models of the length of the nest building period in relation to individual predictors.

| Predictor | Estimate | SE | Z-score | P-value | N |
|---|---|---|---|---|---|
| **Nest type (Domed)** | 0.066 | 0.012 | 5.54 | **<0.001** | 853 |
| **Who builds (Both)** | 0.023 | 0.010 | 2.26 | **0.024** | 825 |
| **Absolute latitude** | −0.045 | 0.009 | −4.99 | **<0.001** | 853 |
| **Adult survival** | 0.019 | 0.015 | 1.28 | 0.200 | 388 |
| **Adult body mass** | 0.014 | 0.015 | 0.92 | 0.358 | 852 |
| **Nest volume** | 0.069 | 0.014 | 4.94 | **<0.001** | 393 |
| **Potential predators** | 0.024 | 0.011 | 2.26 | **0.024** | 853 |
| **Daily predation rate** | −0.016 | 0.012 | −1.37 | 0.170 | 532 |

*P*-values of statistically significant factors are highlighted in bold. *N* denotes the sample size of analyzed populations.

**Table 3.** Multiple-predictor models of the length of the nest building period.

| Predictor | Estimate | SE | Z-score | P-value | Estimate | SE | Z-score | P-value |
|---|---|---|---|---|---|---|---|---|
| **(Intercept)** | 0.817 | 0.096 | | | 0.836 | 0.091 | | |
| **Nest type (Domed)** | 0.061 | 0.012 | 5.00 | **<0.001** | 0.012 | 0.018 | 0.64 | 0.519 |
| **Who builds (Both)** | 0.016 | 0.010 | 1.63 | 0.103 | −0.006 | 0.013 | −0.43 | 0.669 |
| **Absolute latitude** | −0.036 | 0.011 | −3.25 | **0.001** | −0.040 | 0.014 | −2.80 | **0.005** |
| **Adult body mass** | 0.024 | 0.014 | 1.74 | 0.082 | −0.016 | 0.023 | −0.69 | 0.493 |
| **Potential predators** | −0.009 | 0.013 | −0.75 | 0.456 | −0.009 | 0.016 | −0.60 | 0.551 |
| **Nest volume** | | | | | 0.065 | 0.021 | 3.08 | **0.002** |

The model on the left includes predictors for which we had data for almost all studied species (N = 824 populations). The model on the right includes in addition nest volume (N = 380). *P*-values of statistically significant factors are highlighted in bold.

(this relationship was not significant in multiple-predictor models; see also Medina et al. 2022). Three possible explanations may account for this inconsistency. First, the male's contribution to nest building might be minimal and largely symbolic (Lovaty 1992) for example because of their bright plumage which could attract nest predators (Soler et al. 2019; but see Matysioková et al. 2017). This is consistent with observations that males are considered the sole or primary builders in only a minority of songbird species (Collias and Collias 1984; Medina et al. 2022). Second, in species where both sexes share the task of nest building, the male's contribution could allow females to reduce their own effort, conserving energy for future breeding activities and thus increasing fitness of both partners. This would be a mutually beneficial effect stemming from parental cooperation (Remeš et al. 2015) and would lead to no relationship between the number of nest builders and the duration of the nest building period. Third, rather than cooperating to optimize energy savings to boost subsequent breeding performance, birds may adopt a strategy of minimizing their individual investment, assuming their partner will compensate (McNamara and Wolf 2015). This negotiation over parental care could result in reduced collective effort and a slower nest-building process when both parents share nest building duties. This interpretation was supported only by our single-predictor model, not by our multiple-predictor models (see also Medina et al. 2022). Thus, the most likely conclusion is that the male's contribution does not shorten the nest-building period.

Taken together, our extensive global analysis of songbird nest building periods reveals that absolute geographic latitude is the primary driver of variation in construction time, with tropical species investing considerably longer. While consistent with the "slow life history" hypothesis, our findings suggest that the time constraints imposed by shorter breeding seasons at higher latitudes are a more prominent selective pressure driving faster nest construction. We also confirmed that nest volume and nest type are crucial determinants, with larger and more structurally complex domed nests consistently requiring greater time investment. Notably, the effects of nest predation risk and the number of nest builders were less consistent across statistical models, indicating a more nuanced or context-dependent influence, or that the male's contribution does not primarily serve to expedite construction. Future research could provide deeper insights by investigating the daily intensity of nest building activity across latitudes, employing more direct and localized measures of nest predation pressure, and further behavioral and physiological studies are needed to fully elucidate the costs and benefits of male contributions in biparental nest construction and their potential impact on the evolution of parental investment strategies.

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## Conflicts of interest

None declared.

## Data availability

Analyses reported in this article can be reproduced using the data provided by Matysioková and Remeš (2025).

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