



*Avian Behavior, Ecology, and Evolution*

# Feathers in nest boxes do not prevent or delay nesting by Eastern Bluebirds (*Sialia sialis*), Tree Swallows (*Tachycineta bicolor*), or Carolina Chickadees (*Poecile carolinensis*)

## Plumas en las cajas nido no previenen ni retrasan la anidación de *Sialia sialis*, *Tachycineta bicolor* o *Poecile carolinensis*

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**ABSTRACT.** Many species of birds incorporate feathers into their cavity nests. The Fear of Feathers Hypothesis proposes that a major benefit of incorporating feathers into cavity nests is to trick other birds into thinking that a predation event occurred in the cavity. Evidence has been provided supporting this hypothesis for cavity-nesting species in three families with very different ecologies: the Tree Swallow (*Tachycineta bicolor*) of North America and the Pied Flycatcher (*Ficedula hypoleuca*) and the Blue Tit (*Cyanistes caeruleus*), both of Eurasia. In 2023, I tested whether the presence of feathers in nest boxes in North Carolina (USA) affected the eventual nest site choice of 3 species of cavity-nesters belonging to different families. Specifically, I added white feathers to 192 (of 388) nest boxes. The remaining 196 nest boxes received wood chips/shavings. If Eastern Bluebirds (*Sialia sialis*), Carolina Chickadees (*Poecile carolinensis*), and Tree Swallows are dissuaded more than temporarily by the presence of feathers in potential nest cavities, one would expect to find at least one of two patterns. First, because I positioned nest boxes without feathers within 200 m of nest boxes with feathers, I expected that all 3 species would gravitate toward the nest boxes without feathers, even if they nested successfully the previous year in a box that was assigned to the feather treatment. Second, in the event that most nest boxes ultimately contained nests, I predicted that the first egg date (FED) of nests in nest boxes with feathers to be, on average, later in the spring than the FED of nests in nest boxes without feathers. I hypothesized that such a delay would result from either an initial “fear of feathers” or the earlier breeding of higher quality birds that successfully avoided nest boxes containing feathers. I found neither pattern for bluebirds, chickadees, or Tree Swallows. Although it has been found that the negative effect of feathers was short lived, all things being equal, one would expect one of the above trends to be observed. My results suggest that the addition of feathers to nest cavities does not act in a long-term manner to dissuade or delay breeding by birds living in southeastern North America.

**RESUMEN.** Muchas especies de aves incorporan plumas a sus nidos de cavidad. La Hipótesis del Miedo a las Plumas propone que un beneficio importante de incorporar plumas a los nidos de cavidad es engañar a otras aves haciéndoles creer que ocurrió un evento de depredación en la cavidad. Se han proporcionado evidencias que respaldan esta hipótesis para especies que anidan en cavidades de tres familias con ecologías muy diferentes: *Tachycineta bicolor* de América del Norte y *Ficedula hypoleuca* y *Cyanistes caeruleus*, ambos de Eurasia. En 2023, probé si la presencia de plumas en cajas nido en Carolina del Norte (EE. UU.) afectaba la eventual elección del sitio de anidación de 3 especies de que anidan en cavidades pertenecientes a diferentes familias. Específicamente, agregué plumas blancas a 192 de 388 cajas nido. Las 196 cajas nido restantes recibieron astillas de madera. Si *Sialia sialis*, *Poecile carolinensis* y *Tachycineta bicolor* se sienten disuadidas de manera más que temporal por la presencia de plumas en las cavidades potenciales de anidación, se esperaría encontrar al menos uno de dos patrones. Primero, debido a que coloqué cajas nido sin plumas dentro de los 200 m de las cajas nido con plumas, esperaba que las 3 especies gravitaran hacia las cajas nido sin plumas, incluso si anidaron con éxito el año anterior en una caja que fue asignada al tratamiento de plumas. Segundo, en el caso de que la mayoría de las cajas nido finalmente contuvieran nidos, predije que la fecha del primer huevo (FED por sus siglas en inglés) de los nidos en las cajas nido con plumas sería, en promedio, más tarde en la primavera que la FED de los nidos en las cajas nido sin plumas. Hipoteticé que tal retraso resultaría de un inicial “miedo a las plumas” o del inicio de la reproducción más temprana de aves de mayor calidad que evitaron con éxito las cajas nido que contenían plumas. No encontré ninguno de los dos patrones para *S. sialis*, *P. carolinensis*, ni para *T. bicolor*. Aunque se ha encontrado que el efecto negativo de las plumas fue de corta duración, en igualdad de condiciones, se esperaría observar una de las tendencias anteriores. Mis resultados sugieren que la adición de plumas a las cavidades de los nidos no actúa de manera a largo plazo para disuadir o retrasar la reproducción de las aves que viven en el sureste de América del Norte.

**Key Words:** Carolina Chickadee; cavity nest; Eastern Bluebird; Fear of Feathers Hypothesis; Tree Swallow

### INTRODUCTION

Secondary cavity-nesting birds face a very real danger when investigating potential nest cavities. Nesting cavities may contain stinging insects, venomous reptiles, or predatory mammals or birds (Slagsvold and Wiebe 2021). Predators may also revisit

cavities at a later time to prey on contents (Sonerud 1985, Wiebe et al. 2020). Slagsvold and Wiebe (2021) proposed that cavity-nesting songbirds should avoid cavities containing the remains of predation events. This led to their Fear of Feathers Hypothesis, which states that cavity-nesting birds can dissuade usurpation, at

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least temporarily, by incorporating light colored feathers into their nests. Light colored feathers are presumably easier to see in the darkness of a nest cavity (Veiga and Polo 2005, Sanz and Garcia-Navas 2011, Ruiz-Castellano et al. 2018).

Slagsvold and Wiebe (2021) looked specifically at the latency of several cavity-nesting bird species to enter a nest cavity either containing white feathers or other items. The species they considered were Tree Swallows (*Tachycineta bicolor*), Pied Flycatchers (*Ficedula hypoleuca*), and Blue Tits (*Cyanistes caeruleus*). I tested two other corollaries of the Fear of Feathers Hypothesis: even if the negative effect of feathers is short-lived, either occupancy or nest date should differ between nest boxes containing feathers vs. wood chips/shavings. Specifically, I added either feathers or light-colored wood chips/shavings to every other nest box around Davidson, NC, USA prior to the 2023 breeding season. I recorded whether Eastern Bluebirds (*Sialia sialis*), Carolina Chickadees (*Poecile carolinensis*), and Tree Swallows were less likely to occupy nest boxes containing feathers (vs. wood chips/shavings). I hypothesized that because both Eastern Bluebirds (hereinafter bluebirds) and Carolina Chickadees (hereinafter chickadees) are year-round residents in the study area, and because approximately half of the nest boxes to which they had access did not have feathers, both species should have the ability to avoid nest boxes with feathers if they so wished. Because Tree Swallows are migratory, I predicted that they would have less time to assess potential nest sites, be less familiar with alternative nest sites, and be more willing to accept nest cavities containing feathers. Additionally, because Tree Swallows typically use feathers (especially white feathers) in their nests (Winkler et al. 2020), I concluded that they would be less bothered by the presence of feathers in a nest cavity.

Because of the high eventual occupancy of nest boxes at my study sites, it is possible that I would not observe a difference in occupancy of boxes containing feathers versus those containing wood shavings/chips. This however does not preclude a role for feather avoidance. If nest boxes containing feathers are less preferred, and if older/more experienced/higher quality individuals are more likely to avoid less-preferred nest boxes, I might expect the inhabitants of nest boxes lacking feathers to initiate breeding earlier than lower quality individuals (e.g., first year birds) who are more likely to be less discriminating when choosing nest sites. Consequently, I hypothesized for both bluebirds and chickadees that the first egg dates (FED) of nests in nest boxes assigned to the wood chips/shavings treatment would be earlier than the FEDs of nests in nest boxes assigned to the feather treatment. I had no explicit prediction regarding feathers and the FEDs of Tree Swallows.

## METHODS

I conducted this study near the town of Davidson, Mecklenburg County, NC, USA (35° 30' N, 80° 50' W). Sites included a variety of habitats, both rural and suburban. Specifically, I monitored several hundred nest boxes on six golf courses, two passive parks, a corporate campus, hay fields on a farm, and the Davidson College campus.

The nest boxes I used were cylindrical woodcrete Schwegler 1B nest boxes (Schorndorf, Germany) pole-mounted at a height of 1.75 m and equipped with an ERVA stovepipe-style predator guard. Each box had a floor area of approximately 105 cm<sup>2</sup> and

was outfitted with a removable front plate containing a 38 mm diameter entrance hole. The bottom of the entrance hole was ~130 mm from the bottom of the nest box. At any given site, nest boxes were about 200 m from one another. All nest boxes were installed within a 12 km radius of Davidson College, Davidson, NC. Furthermore, all boxes had been erected for at least 10 years and most had been occupied in 2022.

I conducted the experiment in two phases. In the first, I placed 20 Canada Goose (*Branta canadensis*) body feathers (grayish tan) into 192 of 388 nest boxes in mid/late October of 2022. By placing feathers into nest boxes in October, I hoped that bluebirds and chickadees would encounter feathers if they scouted nest boxes during the fall or winter. In mid-February 2023, I revisited all 388 nest boxes and discovered that in most cases feathers had been removed. Consequently, I added approximately 100 ml of white feathers (from a newly purchased Ramesses feather pillow) to all boxes in which I placed feathers in October 2022. The mean length and width of the feathers was 50.87 mm x 22.83 mm (n = 23). Unfortunately, I do not know when the original feathers were removed between October 2022 and February 2023. In February 2023, in addition to placing feathers into approximately half of the boxes, I placed approximately 100 ml of aspen wood chips/shavings (Sophresh Natural Aspen small animal bedding) into 196 nest boxes not assigned to the feather treatment. Although none of the birds were choosing among paired boxes (one with feathers and the other with wood chips/shavings), I believe I minimized any spatial bias by systematically alternating between feathers and wood chips/shavings at each of my sites. I used wood chips/shavings instead of empty boxes for two reasons. First, I wanted to control for the presence of something inside the nest box. Second, because the wood chips/shavings were light in color, both nest box treatments featured a light-colored material on the floor of the nest box.

I checked each nest box weekly from early March through late July of 2023 (chickadees and bluebirds begin nest-building in early March and typically begin laying in mid-to late March, Tree Swallows often begin nest building in mid-March and begin egg-laying in early April). In early March, most feathers were still inside the assigned boxes. I considered a nest box to contain an active nest when I found at least one egg in the nest/nest box. Nest starts that were abandoned prior to egg-laying were not considered to have been “chosen.” I also excluded nest boxes that experienced a takeover. For example, if a chickadee started building a nest on feathers, but the box was taken over by a pair of bluebirds that eventually initiated laying prior to 16 May, I excluded both nests from my analysis (this occurred only once).

I focused on the three species that are the most common spring occupants of nest boxes in the Davidson area: bluebirds, chickadees, and Tree Swallows. Bluebirds and chickadees are both secondary cavity nesters and year-round residents in North Carolina. Although Carolina Chickadees, like Black-capped Chickadees (*Poecile atricapillus*) are weak excavators (Foote et al. 2020), they frequently breed in nest boxes (Mostrom et al. 2020). Because of small sample sizes, I excluded from analyses nests of other species such as the Tufted Titmouse (*Baeolophus bicolor*; 2 nests) and Brown-headed Nuthatch (*Sitta pusilla*; 9 nests).

For my analyses I considered only nestings occurring in the first part of the breeding season (spring), which I defined as running

from 1 Mar through 15 May. For all 3 species, I used the values of the FED (based on days since 28 February 2023). Consequently, a nest with an FED of 20 March had a FED value of 20.

## RESULTS

I recorded 32 Tree Swallow nests, 50 chickadee nests, and 244 bluebird nests in the 388 experimental nest boxes. Specifically, I recorded 17 cases where Tree Swallows laid in a nest box containing feathers and 15 cases where they chose a nest box containing wood shavings. This difference was not statistically different ( $\chi^2 = 0.125$ ,  $df = 1$ ,  $P = 0.72$ ). I found a similar result for chickadees ( $n_{\text{feather}} = 21$ ,  $n_{\text{wood}} = 29$ ,  $\chi^2 = 1.280$ ,  $df = 1$ ,  $P = 0.26$ ) and for bluebirds ( $n_{\text{feather}} = 118$ ,  $n_{\text{wood}} = 126$ ,  $\chi^2 = 0.262$ ,  $df = 1$ ,  $P = 0.61$ ). I then compared the mean FED for Tree Swallows, chickadees, and bluebirds, respectively, using nest boxes with feathers vs. those with wood chips/shavings. I found no significant difference in the laying date of any of these three species when they used nest boxes containing feathers vs. wood chips/shavings. Specifically, the mean spring FED for Tree Swallows nesting in boxes containing feathers was 54.706 (SEM = 1.79), the mean spring FED of Tree Swallows nesting in boxes containing wood chips was 57.333 (SEM = 1.904). This difference was not statistically significant ( $t = 1.006$ ,  $df = 30$ ,  $P = 0.32$ ). For chickadees, the mean spring FED in boxes containing feathers was 31.143 (SEM = 1.838); the mean spring FED in boxes containing wood chips was 31.241 (SEM = 1.564). Again, the difference was not statistically significant ( $t = 0.041$ ,  $df = 48$ ,  $P = 0.97$ ). Finally, for bluebirds, the mean spring FED in boxes containing feathers was 37.636 (SEM = 1.129); the mean spring FED in boxes containing wood chips was 35.778 (SEM = 1.093). Again, the difference was not statistically significant ( $t = -1.182$ ,  $df = 242$ ,  $P = 0.24$ ). Although I have no data on the latency to enter nest boxes after initial inspection, these results suggest that breeding birds in southeastern North America do not view feathers in a potential nest cavity as a long-term threat to their life or reproductive success.

## DISCUSSION

Neither Tree Swallows, Carolina Chickadees, nor Eastern Bluebirds demonstrated an aversion to breeding in nest boxes containing unsoiled light-colored feathers (vs. light-colored wood chips/shavings). Of course, Slagsvold and Wiebe (2021) did not demonstrate a permanent aversion to using nest boxes containing feathers. What they showed was that the three species in question were initially hesitant to enter a nest box containing feathers. Indeed, they argued that even a short-term hesitancy could allow nest box owners to return to the site and chase away potential usurpers (Slagsvold and Wiebe 2021). If the effect of feathers lasted only 20 minutes, it is possible that any hesitancy on the part of investigating species was short-lived enough that it did not affect eventual settlement. That said, given that other nest boxes that did not contain feathers were installed in the same areas, one might expect some effect on either occupancy or the timing of egg laying.

Tree Swallows present an interesting case. On one hand, because these birds are migratory, they typically have little knowledge of the state of potential nest cavities upon their arrival on the breeding grounds. Their lack of knowledge of feather-free cavities, along with strong selection for quickly choosing a nest site, could result in a greater willingness to ignore potential issues

with their initial choice of nest site. Then again, the fact that I added feathers to nest boxes around the time of Tree Swallow arrival means that they often had substantial time to familiarize themselves with the condition of local nest boxes. Additionally, because Tree Swallows famously incorporate feathers, especially white feathers, into their nests (Winkler et al. 2020), one should perhaps not be surprised by a lack of aversion to nesting in boxes containing light-colored feathers.

Although Stanback (*unpublished data*) found no evidence that inspection of nest cavities by bluebirds during the non-breeding season increases the probability of their use the following spring, one might suspect that, as year-round residents, chickadees and bluebirds would at least have greater knowledge of the state of nest cavities in their home range and/or breeding territory. If either of these two species exhibited an aversion to feathers in potential nest sites, it seems likely that they could take steps to avoid feathers if they chose to.

Given that the vast majority of nest boxes were occupied in 2023, it is also possible that many individuals were forced to nest where they might not prefer to. If individuals exhibited any aversion (even a short-term aversion) to choosing a nest box containing feathers, we would expect to see that the FEDs of nests in nest boxes without feathers would be earlier than those in nest boxes with feathers. This was not the case for any of the three species examined.

Prior research has demonstrated that two of the species studied here (bluebirds and Tree Swallows) exhibited no aversion to odor cues of nest predators. Specifically, Stanback et al. (2019) showed that bluebirds did not avoid cavities containing either raccoon (*Procyon lotor*) or house mouse (*Mus musculus*) urine. Similarly, Tree Swallows demonstrated no aversion to house mouse urine (Stanback and Rollfinke 2023). Although it is true that no one has tested bluebirds or Tree Swallows with simultaneous visual and odor stimuli, shown to be critical together (Monkkonen et al. 2009), the fact that neither bluebirds nor Tree Swallows appear to be averse to either predator odors or feathers suggests the strength of selection to accept otherwise acceptable nest cavities, even if they were to show some initial hesitation to enter nest boxes containing feathers (à la Slagsvold and Wiebe 2021).

Specifically, my findings suggest that even if these three species were to show initial hesitation to enter a nest box containing feathers, adding feathers to a nest does not prevent subsequent use of the nest box in any permanent way. This is not to say that any hesitation by other species (or the same species in other places) would not translate into a noticeable aversion to nesting in cavities containing light-colored feathers.

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**Data Availability:**

*The data and code that support the findings of this study are available on request from the author.*

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