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**HIGH PROTHONOTARY WARBLER NEST SUCCESS IN NEST BOXES  
AT LEFLEUR'S BLUFF STATE PARK**

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**ABSTRACT**

Prothonotary Warblers (*Protonotaria citrea*) are a Nearctic-Neotropical migrant of conservation concern, and their use of nest boxes makes them an ideal bird to monitor. Nest boxes, however, could serve as an ecological trap due to increased nest loss, depredation, and nest parasitism because of their conspicuousness. A Prothonotary Warbler nest box project at LeFleur's Bluff State Park, Mississippi has been the signature conservation project of the Jackson Audubon Society since 2000. We monitored nest box use and breeding outcomes from 2019 to 2021 at 15 boxes to determine their conservation effectiveness. Nest box use across the three study years ranged between 17 and 25 nesting attempts. Among 48 successful nesting attempts, 156 fledglings were produced, resulting in an overall fledging success rate of 75.0% with the majority of nest failures attributed to high water. This

breeding success is notably higher than in studies of natural cavities, and can be largely attributed to observed lower rates of depredation and nest parasitism by Brown-headed Cowbirds (*Molothrus ater*) at our study site. We conclude that LeFleur's Bluff State Park is a high value nesting site for Prothonotary Warblers, enhanced by nest boxes.

## INTRODUCTION

The Prothonotary Warbler (*Protonotaria citrea*) is a Nearctic-Neotropical migrant of conservation concern and a habitat specialist in flooded forests, like bottomland hardwood forests, cypress-tupelo swamps, and forested riparian floodplains (Turcotte and Watts 1999, Tonra et al. 2019, Petit 2020). They breed primarily in the United States, but also have a small population in Canada where they are classified as Endangered (COSEWIC 2016). This species has undergone a 31% population decline between 1966 and 2019 (Sauer et al. 2020). Observed declines are, in large part, related to habitat loss on breeding and wintering grounds (Terborgh 1989, Petit 2020), but can also be attributed to reduction in habitat quality due to widespread alterations to hydrology (Pashley and Barrow 1993, Hoover 2009), edge effects including nest parasitism (Hoover 2003, 2009), chemical contamination (Adair et al. 2003, Reynolds et al. 2004), and building and communication tower collisions (Longcore et al. 2013).

The Prothonotary Warbler is an obligate secondary cavity nester. This makes them an ideal bird to monitor because they readily take to nest boxes (Blem and Blem 1991, Mueller et al. 2019). Nest boxes, however, could serve as an ecological trap due to increased nest loss, depredation, and nest parasitism as a result of nest box conspicuousness (Flaspohler 1996). As such,

understanding breeding outcomes is important so as to document and adaptively manage if necessary (Stojanovic et al. 2020).

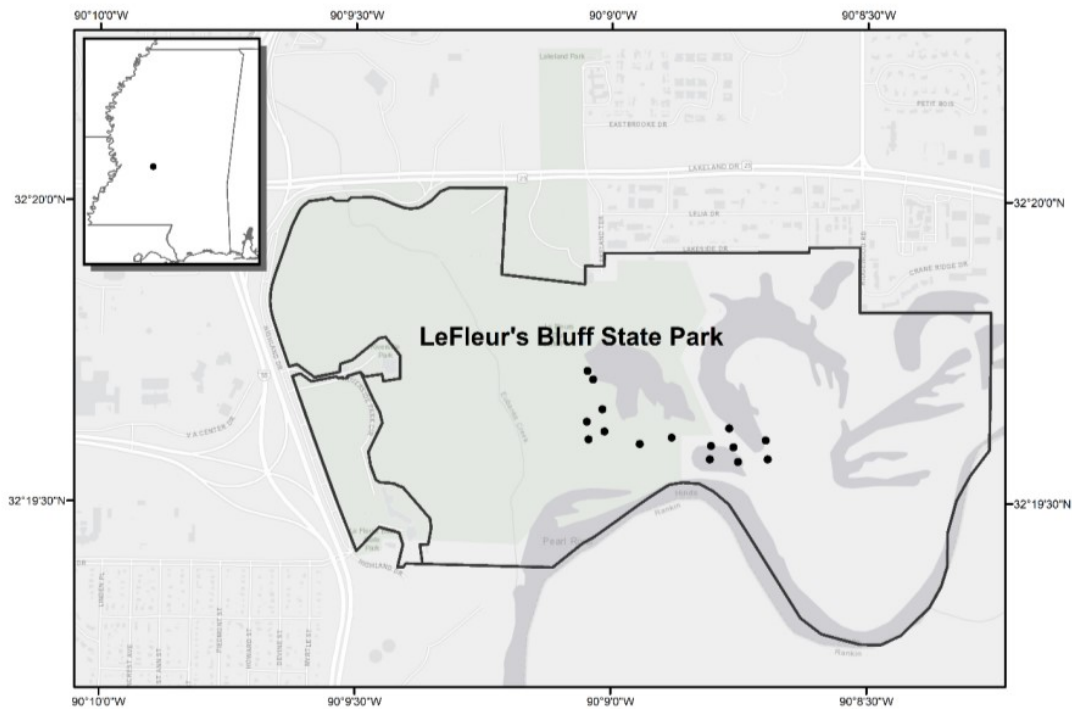
A Prothonotary Warbler nest box project at LeFleur's Bluff State Park, Mississippi has been the signature conservation project of the Jackson Audubon Society since 2000. Initiated by Reese and Louise Partridge, Mary Stripling, and Skipper Anding, nest boxes have been maintained continuously for over two decades. From 2019 to 2021, we monitored nest box use and breeding outcomes to gather breeding productivity metrics and determine their conservation effectiveness. Here we present the summary of these first three years of monitoring.

## **PROJECT LOCATION**

LeFleur's Bluff State Park in Hinds County, Mississippi is a 123-hectare protected area that borders the Pearl River near Jackson. It is recognized by the National Audubon Society as an Important Bird Area. The park contains swamp and lakefront forest that is suitable Prothonotary Warbler nesting habitat. This, along with being easily accessible, makes it an ideal project site. We know through direct observation that Prothonotary Warblers here use the nest boxes that we have provided since 2000 in addition to natural tree cavities. In addition to the 15 nest boxes monitored as part of this project, 10 additional nest boxes are located elsewhere in the park that are not monitored.

## **METHODS**

Fifteen nest boxes in fixed locations were distributed in the park (Figure 1). For continuity of results, the boxes have not been moved during the three years of this study. The nest boxes are constructed using various kinds of wood, mostly based on availability (eight cypress, four cedar, and three treated pine). The



**Figure 1.** Study site at LeFleur’s Bluff State Park, Hinds County, Mississippi including the locations of 15 nest boxes (black dots) monitored during the project.

dimensions are 12.7 cm x 12.7 cm for the base and 15.24 cm high with 3.18-cm entrance holes. They were attached to poles placed in standing water, but close to dry land. The boxes were mounted on 2.44 m poles of 1.91 cm diameter metal conduit that were sunk 0.61 to 0.76 m into the mud. Two of the 15 boxes were predator guarded with inverted 18.98 l buckets placed on the underside of the nest boxes. The predator guards were installed for experimental purposes.

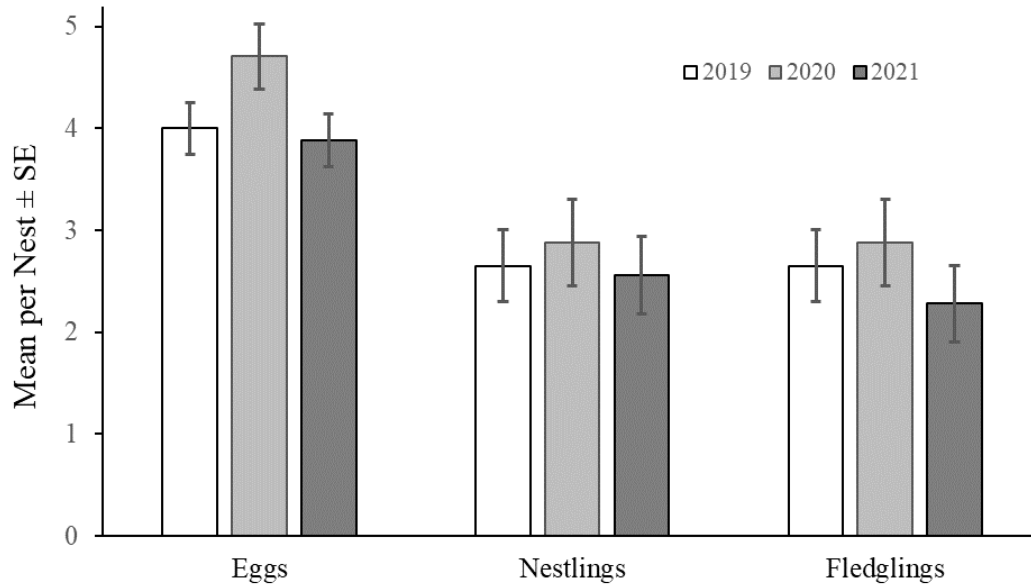
Nest boxes were checked once a week during the breeding season from 21 May to 21 July in 2019, 12 May to 22 July in 2020, and 31 March to 28 July in 2021. During each check, we categorized the contents as nest-building, building complete but no eggs, eggs (and number of eggs), chicks (and their age and number), or recently fledged. If we suspected that nestlings were

close to the end of the 10-day nestling period, we did not approach the box to avoid force fledging young birds. We considered a nest active when it had at least one egg. We considered the nest successful when the chicks were either gone from the nest after the estimated fledge date, there was no evidence of deaths from predation or flooding, there were clusters of unremoved fecal sacs, and/or if fledglings were observed in close proximity to the box. A Chi-square test was used to estimate differences in nesting success across years, calculated using the `chisq.test` function in R version 4.2.1 (R Core Team 2022). Averages (means) and standard errors (SE) were hand-calculated in Microsoft Excel (Microsoft Corporation 2018).

## **RESULTS**

Prothonotary Warblers across the three study years used the 15 study boxes 24 times in 2019, 17 times in 2020, and 25 times in 2021. Across the three years, all boxes were used at least twice, although in any given year between one and three boxes among the 15 went unused. Nest box #6 was used the most frequently across the study (used seven times). Nest box #15 was used the least frequently (used twice). All other boxes were used between three and six times.

Average clutch size ranged between 3.88 ( $\pm 0.26$  SE; 2021) and 4.71 ( $\pm 0.32$  SE; 2020) eggs each year, with between 1.32 and 1.83 eggs per nest not hatching (Figure 2). Breeding productivity ranged from an average of 2.28 ( $\pm 0.38$  SE; 2021) to 2.88 ( $\pm 0.42$  SE; 2020) fledglings per nest each year (Figure 2). Across the three years, 15 boxes produced at least 156 fledgling Prothonotary Warblers among 48 successful nesting attempts (the number of fledglings was undetermined from three successful nests). Across the three years and 64 nesting attempts where fates were determined (in two nesting attempts, fates were not



**Figure 2.** Prothonotary Warbler nesting metrics in nest boxes at LeFleur's Bluff State Park from April to July in 2019, 2020, and 2021.

determined), overall nesting success was 75.0%. Nest success was similar in 2019 (82.6%, N = 23) and 2020 (81.3%, N = 16), but was notably lower in 2021 (64.0%, N = 25). However, differences across the three years were not statistically significant ( $\chi^2 = 2.657$ ,  $p = 0.265$ ). Among the 16 failed nesting attempts, 14 (87.5%) were lost during the egg stage, whereas two (12.5%) were lost during the nestling stage. Of these 16 failed nesting attempts, nine were lost to flooding (56.3% of losses; 14.1% of all nesting attempts), three nests didn't hatch (18.8% of losses; 4.7% of all nesting attempts), one nest was taken over by Carolina Wrens (*Thryothorus ludovicianus*; 6.3% of losses; 1.6% of all nesting attempts), and in three nests the eggs or chicks disappeared from unknown reasons, but likely were predator-related (18.8% of losses; 4.7% of all nesting attempts).

## DISCUSSION

After nearly 20 years of nest box placement at LeFleur's Bluff State Park, we began monitoring associated nesting outcomes of Prothonotary Warblers in 2019. To our knowledge, this is the only long-term monitoring project for this species in Mississippi and, therefore, helps to fill an existing gap in knowledge. Up until 2019, we knew that the birds were using the nest boxes but had no data to quantify nesting outcomes.

Our study demonstrated relatively high nest box use, nesting success, and breeding productivity in this population using nest boxes. In Louisiana, similar nest success metrics have been noted across multiple study sites and similar years using predator-guarded nest boxes with 3.18-cm cavity openings (E. I. Johnson and K. Percy, unpublished data). Nesting success in our nest boxes appeared to be roughly twice that observed in natural cavities studied elsewhere, largely because of Brown-headed Cowbird (*Molothrus ater*) and predator exclusion techniques (i.e. 3.18-cm cavity openings and predator guards) (Flaspohler 1996, Cooper et al. 2009). Nest boxes are also known to enhance breeding densities, thus, improving their conservation value (Twedt and Henne-Kerr 2001, Slevin et al. 2018). However, we did not specifically measure breeding densities in this study. This may be a topic for future research.

Because of early spring flooding in 2019 and Covid-19-related park closures in 2020, late starts hampered data collection. This likely resulted in an undercount of nesting attempts. Spring flooding in 2019 may have also resulted in unaccounted early-season nest losses, such that our estimate of 82.6% success was biased high. Even so, with 81.3% and 64.0% success in 2020 and 2021, respectively, this suggests that nesting success is typically fairly high at the site. Flooding is an uncontrollable cause of nest failure. At our site it was the biggest limiting factor in nesting



success, especially in 2021 when the site experienced flooding both at the beginning of the nesting season and again in June during the peak of nesting. A number of factors have the potential to increase flood risk to nesting Prothonotary Warblers. Examples include local changes to hydrology and flood control by decision-makers, as well as the existential threat of climate change which is projected to increase the severity of flooding (IPCC 2022).

Nest loss because of predation was not found to be a serious issue despite the large raccoon population and our limited use of predator guards. We assessed that raccoons were common in the park based on the number of raccoon tracks that we observed there. Nest boxes were not placed in close proximity to tree branches, denying easy access by raccoons, snakes, and other predators. The three instances where the contents disappeared from nest boxes were suggestive of a snake or flying squirrel being the culprit, as the nests themselves were intact and undamaged.

Prothonotary Warblers compete with other secondary cavity nesters for both natural and artificial nest sites. At our site, these included Eastern Bluebirds (*Sialis sialis*) and Carolina Wrens. Across our three-year study period, there was only one instance (in 2021) of Carolina Wrens usurping a nest box. Prothonotary Warblers are also subject to nest parasitism by Brown-headed Cowbirds. The 3.18-cm nest entrance used in our boxes successfully kept out cowbirds. In 2019, one nest box was inadvertently used with a 3.81-cm nest entrance. This allowed Eastern Bluebirds to nest in this box. The nest box was replaced with one that had a 3.18-cm entrance hole after the Eastern Bluebirds fledged.

We conclude that LeFleur's Bluff State Park is a high value Prothonotary Warbler nesting site. We plan to continue the project as a long-term study, and we are looking for potential partners to possibly band birds to better understand between-year site fidelity. By demonstrating the importance of LeFleur's Bluff State Park to

nesting Prothonotary Warblers, we hope to keep this habitat unaltered from development.

#### **ACKNOWLEDGMENTS**

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#### **LITERATURE CITED**

- Adair, B. M., K. D. Reynolds, S. T. McMurry, and G. P. Cobb. 2003. Mercury occurrence in Prothonotary Warblers (*Protonotaria citrea*) inhabiting a National Priorities List site and reference areas in southern Alabama. *Archives of Environmental Contamination and Toxicology* 44:265-271.
- Blem, C. R., and L. B. Blem. 1991. Nest-box selection by Prothonotary Warblers. *Journal of Field Ornithology* 62:299-307.

- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2016. COSEWIC status appraisal summary on the Prothonotary Warbler *Protonotaria citrea* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Canada. 16 p.
- Cooper, R. J., L. A. Wood, J. J. Gannon, and R. R. Wilson. 2009. Effects of timber harvest and other factors on a floodplain forest indicator species, the Prothonotary Warbler. *Wetlands* 29:574-585.
- Flaspohler, D. J. 1996. Nesting success of the Prothonotary Warbler in the upper Mississippi River bottomlands. *Wilson Bulletin*. 108:457-466.
- Hoover, J. P. 2003. Multiple effects of brood parasitism reduce the reproductive success of Prothonotary Warblers, *Prothonotaria citrea*. *Animal Behaviour* 65:923-934.
- Hoover, J. P. 2009. Prothonotary Warblers as indicators of hydrological conditions in bottomland forests. *Proceedings of the Fourth International Partners in Flight Conference: Tundra to Tropics*. p. 128-137.
- Intergovernmental Panel on Climate Change (IPCC). 2022. *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (H. O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama, Editors). Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK.
- Longcore, T., C. Rich, P. Mineau, B. MacDonald, D. G. Bert, L. M. Sullivan, E. Mutrie, S. A. Gauthreaux, Jr., M. L. Avery, R. L. Crawford, A. M. Manville, E. R. Travis, and D. Drake. 2013. Avian mortality at communication towers in the United

- States and Canada: which species, how many, and where? *Biological Conservation* 158:410-419.
- Microsoft Corporation. 2018. Microsoft Excel. Retrieved from <https://office.microsoft.com/excel>.
- Mueller, A., D. Twedt, and E. K. Bowers. 2019. Rapid adoption of nestboxes by Prothonotary Warblers (*Protonotaria citrea*) in mesic deciduous forest. *Canadian Journal of Zoology* 97:1109-1115.
- Pashley, D. N., and W. C. Barrow. 1993. Effects of land use practices on Neotropical migratory birds in bottomland hardwood forests. In *Status and Management of Neotropical Migratory Birds* (D. M. Finch and P. W. Stangel, Editors). U.S. Forest Service General Technical Report RM-229, Fort Collins, CO, USA. p. 315-320.
- Petit, L. J. 2020. Prothonotary Warbler (*Protonotaria citrea*), version 1.0. In *Birds of the World* (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. <https://doi.org/10.2173/bow.prowar.01>.
- R Core Team. 2022. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.
- Reynolds, K. D., S. L. Skipper, G. P. Cobb, and S. T. McMurry. 2004. Relationship between DDE concentrations and laying sequence in eggs of two passerine species. *Archives of Environmental Contamination and Toxicology* 47:396-401.
- Sauer, J. R., W. A. Link, and J. E. Hines. 2020. The North American Breeding Bird Survey, Analysis Results 1966 - 2019: U.S. Geological Survey data release.
- Slevin, M. C., A. E. Matthews, and T. J. Boves. 2018. Prothonotary Warbler demography and nest site selection in natural and artificial cavities in bottomland forests of Arkansas, USA. *Avian Conservation and Ecology* 13:5.

- Stojanovic, D., G. Owens, C. M. Young, F. Alves, and R. Heinsohn. 2020. Do nest boxes breed the target species or its competitors? A case study of a critically endangered bird. *Restoration Ecology* 29:e13319.
- Terborgh, J. 1989. *Where Have All the Birds Gone? Essays on the Biology and Conservation of Birds that Migrate to the American Tropics*. Princeton University Press, Princeton, NJ.
- Tonra, C. T., M. T. Hallworth, T. J. Boves, J. Reese, L. P. Bulluck, M. Johnson, C. Viverette, K. Percy, E. M. Ames, A. Matthews, M. C. Slevin, R. R. Wilson, and E. I. Johnson. 2019. Concentration of a widespread breeding population in a few critically important nonbreeding areas: Migratory connectivity in the Prothonotary Warbler. *Ornithological Applications* 121:1-15.
- Turcotte, W. H. and D. L. Watts. 1999. *Birds of Mississippi*. University of Mississippi Press and Mississippi Department of Wildlife, Fisheries and Parks, Jackson, MS, p. 369-370.
- Twedt, D. J., and J. K. Henne-Kerr. 2001. Artificial cavities enhance breeding bird densities in managed forests. *Wildlife Society Bulletin* 29:680-687.