

House Wren Breeding Range Expansion in the Piedmont of the Upper Pee Dee Region of the Carolinas

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Abstract

The House Wren (*Troglodytes aedon*) has slowly expanded its breeding range to the upper Pee Dee region of the Carolinas within the last 25-30 years. The current range front in the Piedmont now extends from northwest Chesterfield County in South Carolina (SC) to Anson and Montgomery counties in North Carolina (NC) and eastward to the fall line at Rockingham, Richmond County, NC, where breeding was confirmed in 2017. Within this occupied area, House Wrens breed in residential areas of nearly all towns with a human population of ≥ 850 persons.

The direction of recent range expansion to Rockingham is most consistent with movement from the Piedmont (i.e., from the west-northwest), although movement from the Sandhills (i.e., from the northeast) cannot be ruled out. The current breeding distribution of House Wren in the upper Pee Dee region of the Carolinas exhibits aspects of both stepwise movements and leap-frog range expansion.

Introduction

Most range expansions by avian species within southeastern North America are closely associated with altered habitats (Greenlaw et al. 2014), including habitats modified by anthropogenic activities in the upper Pee Dee region of the Carolinas (McNair 2013, McNair 2016, McNair 2017). In North Carolina, the House Wren (*Troglodytes aedon*) was scarce as a breeder in the Coastal Plain until the 1970s (LeGrand et al. 2018).

Odum and associates investigated the breeding expansion of House Wren in southeastern North America (Odum and Burleigh 1946, Odum and Johnston 1951, Odum et al. 1993). The initial breeding range expansion into North Carolina to the Piedmont occurred in the 1920s to the early 1930s (Odum and Burleigh 1946, Odum and Johnston 1951, Seriff 2018). House Wrens also expanded their breeding range from Virginia into the extreme eastern Coastal Plain south to Beaufort, NC (Burleigh 1937).

House Wrens continued their breeding range expansion in a series of sequential steps to the Piedmont of South Carolina, and then Georgia, reaching Athens in 1950 (Odum and Johnston 1951). This physiographic province ends in eastern Alabama, where breeding has only been confirmed at one site within the Auburn-Opelika metropolitan statistical area in 2000 (Haggerty 2009, Hill 2018). Breeding House Wrens have not reached the Coastal Plain of South Carolina or Georgia, except at isolated sites in a few of the largest cities along the fall line at Columbia, Augusta, and Macon (Cely 2003a, Waters and Belger 2002, Schneider 2013). In the southeastern plains of Alabama, House Wrens have apparently nested at only one very isolated site in 2005 at Lake Dannelly, a rural area along the Alabama River in 2005 (Haggerty 2009).

In North Carolina, House Wrens still occur along or near the coast, with a spotty distribution in the northern half of the Coastal Plain. In the southern Coastal Plain of North Carolina, a wide gap in breeding distribution still exists between birds that nest in non-anthropogenic habitats (i.e., recently burned pocosins) in the lower Coastal Plain and in anthropogenic habitats (i.e., cities and towns where nest boxes have become more widely available) along the fringe of the upper Coastal Plain in the Sandhills subregion (LeGrand et al. 2018; McNair and Stanback in press).

The breeding range of the House Wren in the northern Piedmont of North Carolina had spread eastward to the fall line by the 1960s and 1970s (Hader 1969, LeGrand et al. 2018). Breeding in Raleigh was first documented in 1924 (Pearson 1934) and likely began in Chapel Hill during 1933-1935, where they are now well-established (Odum et al. 1935, Hader 1969, Mason et al. 2007).

In the southern North Carolina Piedmont, House Wrens were first reported during the breeding season at Davidson in 1928 (Pearson 1934, Seriff 2018) and first nested at Charlotte and New London (Stanly County) in 1933 and 1943 (Clarkson 1940, Trott 1943, Seriff 2018), respectively. Further east, however, Breeding Bird Survey (BBS) data (three routes: Biscoe, Wilgrove, and Uwharrie National Forest, the latter route now inactive) yielded records beginning in the early 1990s, although these routes did not commence until then (Sauer et al. 2017). LeGrand et al. (2018) and Seriff (2018) stated that House Wrens bred across the entire North Carolina Piedmont, but that confirmed nest records were lacking from Anson, Montgomery, and Richmond counties (LeGrand and Seriff, pers. comm.). Breeding House Wrens from the eastern Piedmont of South Carolina in the upper Pee Dee region are unknown (Post and Gauthreaux 1989, McNair and Post 1993, Cely 2003b).

The purpose of this study was to document the breeding status of House Wrens in the Piedmont of the upper Pee Dee region of the Carolinas and their pattern of spread in anthropogenic environments. In this paper, I document their breeding status within a portion of a six-county area of the upper Pee Dee region. This includes unpublished breeding evidence of House Wrens from several towns in Anson and Montgomery counties, NC, in 1994 and establishment of a breeding population in 2017-2018 at Rockingham, NC, the largest city along the fall line in close proximity (18 km) to the South Carolina state line.

Using 2018 data, I address one question: Is the current breeding distribution in the study area more consistent with a leap-frog (Odum and Burleigh 1946, Odum and Johnston 1951, Odum et al. 1993) or a step-wise range expansion? This requires me to determine whether the presence of breeding House Wrens in cities and towns at the edge of the species' range is related to the local size or density of the human population and how this may influence the direction and rate of the current range expansion.

Field Site Description

The upper Pee Dee region as defined herein includes six counties or portions thereof in two states, and a total of 29 cities and towns ranging in human population size from 110 in McFarlan, NC to 9080 in Rockingham, NC (Table 1). The number of housing units is typically a better measure of urbanization than population censuses (Brown et al. 2005), and data for each variable are available down to the level of cities and towns (U.S.

Census Bureau 2017). However, in this study both variables are strongly correlated for the above-mentioned 29 cities and towns (Spearman's $r = 0.96$, $P < 0.0001$), although Polkton (Anson County, NC) and Wallace (Marlboro County, SC) have disproportionately low numbers of housing units compared to their populations. Nonetheless, I used population census data as the measure of urbanization for locations in the upper Pee Dee region because of its greater familiarity to most people.

Table 1. Population Size of 29 Cities and Towns Sampled for House Wrens. Towns and cities are within a six-county area near and at the edge of their breeding range in the Upper Pee Dee Region of the Carolinas. Cities and towns are listed in order by physiographic province, state, and county

Physiographic Province	State	County	City or Town	Population Size ^a
Piedmont	NC	Montgomery	Troy	3,414
Piedmont	NC	Montgomery	Star	868
Piedmont	NC	Montgomery	Biscoe	1,679
Piedmont	NC	Montgomery	Mount Gilead	1,171
Piedmont	NC	Anson	Peachland	411
Piedmont	NC	Anson	Polkton	3,444
Piedmont	NC	Anson	Ansonville	591
Piedmont	NC	Anson	Wadesboro	5,467
Piedmont	NC	Anson	Lilesville	501
Piedmont	NC	Moore	Robbins	1,180
Piedmont	SC	Chesterfield	Pageland	2,704
Piedmont	SC	Chesterfield	Jefferson	742
Piedmont	SC	Chesterfield	Mount Croghan	194
Piedmont	SC	Chesterfield	Ruby	351
Piedmont	SC	Chesterfield	Chesterfield	1,452
Fall Line	NC	Montgomery	Candor	832
Fall Line	NC	Anson	Morven	460
Fall Line	NC	Anson	McFarlan	110
Fall Line	NC	Richmond	Cordova	1,775 ^b
Fall Line	NC	Richmond	Rockingham	9,080
Fall Line	SC	Marlboro	Wallace	2,606 ^c
Fall Line	SC	Chesterfield	Cheraw	5,780
Sandhills	NC	Moore	Carthage	2,438
Sandhills	NC	Richmond	Norman	132
Sandhills	NC	Richmond	Ellerbe	986
Sandhills	NC	Richmond	Hoffman	560
Sandhills	NC	Richmond	East Rockingham	3,885 ^b
Sandhills	NC	Richmond	Dobbins Heights	822
Sandhills	NC	Richmond	Hamlet	6,391

^a U.S. Census Bureau (2017): Resident population estimate of 1 July 2016.

^b U.S. Census Bureau (2017): Resident census of 1 April 2010—Census-designated places (CDP).

^c U.S. Census Bureau (2017): Resident census of 1 April 2000—CDP and unincorporated community.

Survey Effort

Rockingham—I surveyed Rockingham, NC for breeding House Wrens on five dates from 28 April to 29 May 2017. I returned to Rockingham on 28 and 30 October 2017 to examine contents of nest boxes. If the nest box was accessible, I could determine whether a male was paired by the presence of a distinct and lined nest cup, which is constructed solely by the female (Kennedy and White 1992, Alworth and Schieber 2000, Johnson 2014).

Based on the area occupied by wrens in 2017, I surveyed a larger study area (316 ha) in a residential section of Rockingham in 2018 in which I anticipated House Wrens may be present. I surveyed the study area weekly between 06:30 DST and 09:45 DST from 6 May to 17 June, by driving slowly (6-20 km/hr) with the windows down, stopping frequently, and occasionally walking, listening for singing males. Median survey time was 140 minutes (Q1-Q3 = 130-158 min, min-max = 90-185 min, $n = 7$).

All cities and towns—In 2018, I surveyed singing male House Wrens at the aforementioned 29 cities and towns twice each from mid-April to early May and recorded whether potential breeding birds were present or absent. This includes other areas of Rockingham outside the above study area. Territorial male House Wrens in the central Piedmont of North Carolina may begin singing in early April and start nest-building in early to mid-April (Stanback et al. 2013; Stanback 2018), although some males may not establish territories and begin singing until mid-May.

I visited each city and town again twice each from mid-May to early June to record whether breeding House Wrens were present or absent. Five cities and towns in Richmond County (Cordova, East Rockingham, Ellerbe, Hamlet, Rockingham) received more frequent surveys. In addition, I twice surveyed portions of Florence, located in the middle Coastal Plain of South Carolina. With a population of 38,288 (U.S. Census Bureau 2017), Florence is the largest city within the Pee Dee region.

Generally, I drove slowly (10-20 km/hr, when possible) through each town searching for House Wrens, supplemented by walking in residential areas with the most favorable habitat (semi-open shrubby vegetation with nest boxes). Surveys occurred during all daylight hours because male House Wrens are voluble all day (Johnson 2014), although most surveys occurred during morning. I made no adjustments for differences in detectability for time of day. Surveys took longest in the largest cities and the time of each survey was recorded to the nearest five minutes. Total survey time was 85.2 hours (median = 35 min; Q1-Q3 = 20-55 min, min-max = 10-180 min, $n = 112$).

House Wrens were recorded as present after early May if males sang at the same sites in the same town over a period of at least 10 days. I expected males to be more numerous than females at or near the breeding range front (Summerour 1986, Odum et al. 1993, Stanback et al. 2013; McNair, this study). Since unmated males may build dummy nests, the presence of singing males without additional evidence does not constitute evidence of breeding. Nonetheless, I did conclude that breeding occurred if I detected at least four to five singing males within a town since I presumed at least one of these males would be paired with a female (Odum et al. 1993; this study). I did record any additional breeding evidence (e.g., females present, adults delivering food to young in nest boxes), although this was not the focus of these surveys.

Results

Rockingham 2017

A small breeding population was present in Rockingham, Richmond County, NC. I discovered six House Wren territories and confirmed breeding at two of the four sites where I was able to examine all nest boxes (Table 2). All sites were located in one neighborhood of Rockingham, but only two territories were contiguous. All six territories contained nest boxes (and five of six territories contained bird feeders).

Table 2. Six House Wren territories with single singing males in Rockingham, Richmond County, North Carolina in 2017.

Site Number	Search Effort	Female Detected	Other Breeding Evidence	Breeding Confirmed
1	Incomplete (back yard inaccessible in autumn)	no	3 dummy nests	No
2	Incomplete (2 nest box contents inaccessible)	no	2 dummy nests	No
3	Complete	no	2 dummy nests	No
4	Complete	no	1 dummy nest, 1 complete nest	Yes
5	Complete	no	1 dummy nest, 1 complete nest with 1 infertile egg	Yes
6	Complete	no	1 dummy nest	No

Rockingham 2018

One to three singing male House Wrens were present in Rockingham from 15-29 April during late morning and afternoon surveys conducted within the area originally surveyed in 2017. In the expanded study area of 2018, from 20-25 singing males (0.06-0.08/ha or 1 male per 12.64-15.8 ha) were present each week from 6 May to 17 June. Many territories were contiguous. The daily maximum number of singing males detected was 33 on 20 May, when some areas peripheral to the study area were also covered, almost reaching Roberdel, a suburb of Rockingham.

All Cities and Towns 1994

During complete surveys on 14 May in Montgomery County, 17 singing male House Wrens (two active nests examined) were present at Troy and seven singing males (one active nest) were present at Mt. Gilead. G.W. Kelly (Mt. Gilead) informed me that House Wrens had been breeding at nest boxes in his yard since at least 1992. At Wadesboro, Anson County, two singing male House Wrens were present on 15 June 1994.

All Cities and Towns 2018

House Wrens were present at seven cities and towns in 2018, six of them in the Piedmont and the other along the fall line at Rockingham (Figure 1). On 27 April, breeding was confirmed (by examination of complete old nests from 2017) at Wadesboro, Anson County, NC, and on 28 April at Pageland, Chesterfield County, SC. Single singing males visited Lilesville, Anson County, on 27 April and Candor, Montgomery County, from 1-4 May but did not remain.

House Wrens were absent south of an approximate line extending from Pageland in northwestern Chesterfield County, SC, to Wadesboro in Anson County, NC, then east to Rockingham. This absence includes the nearest and largest cities and towns in South Carolina (Chesterfield in the Piedmont; Cheraw and Wallace along the fall line) and North Carolina (Hamlet in the Sandhills).

The smallest town occupied by House Wrens was Star in northeastern Montgomery County, NC where nine singing males were present on 4 May and thereafter. However, Robbins, the larger more easterly town in the Piedmont of northern Moore County, NC, was not occupied. Within the area encompassed by the seven occupied cities and towns, the only town larger than Star without House Wrens was Polkton in Anson County. House Wrens were absent from 22 cities and towns, including Hamlet, the largest of all seven localities in the Sandhills, just 8 km east of Rockingham. House Wrens were also absent from Florence, SC.

Discussion

This study confirms that House Wrens have expanded their breeding range across almost the entire Piedmont within the upper Pee Dee region of the Carolinas. My observations suggest that House Wrens have nested for at least 24 years in the southeastern Piedmont of North Carolina at Mount Gilead and Troy (Montgomery County) and Wadesboro (Anson County). At some point, House Wrens also extended their breeding range in the Piedmont of South Carolina to Pageland, Chesterfield County (Post and Gauthreaux 1989, McNair and Post 1993). This particular breeding site could have been overlooked before, because coverage and effort were deficient during the South Carolina atlas in the upper Pee Dee region (Cely 2003b).

In the Piedmont of Richmond County, NC, where breeding House Wrens were absent, LeGrand et al. (2018) suggested that the House Wren is an uncommon summer resident. No towns are located in that section of the county, however, where House Wrens do not breed in non-anthropogenic habitat (McNair, pers. obsv.).

House Wrens also do not nest in the Piedmont of Moore County where only one town is present (Robbins), even though this study documents new evidence that House Wrens now breed in Star, a smaller town further to the west in the Piedmont of northeastern Montgomery County.



House Wren
(Troglodytes aedon)
Photo by John Ennis

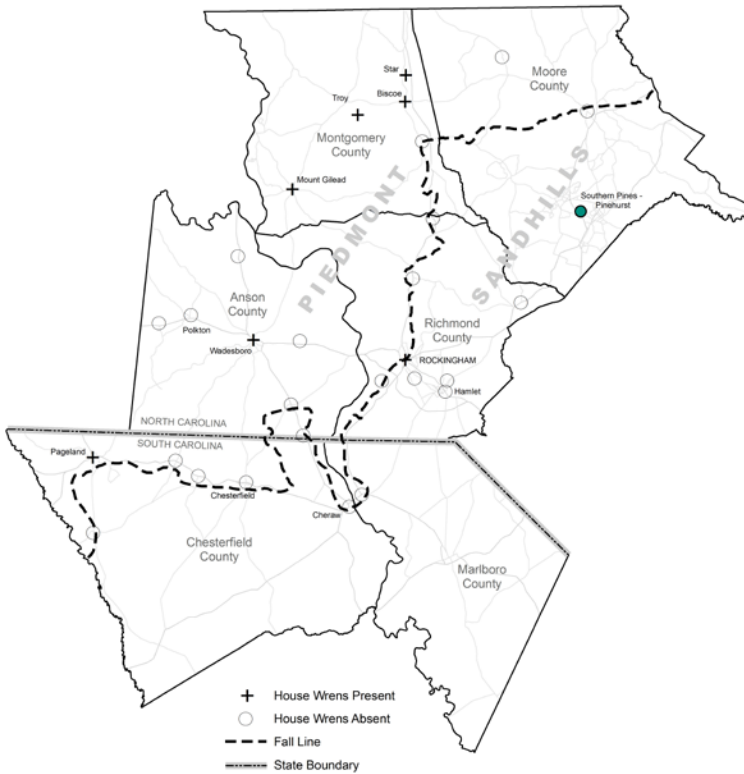


Figure 1. The breeding distribution of House Wrens in 29 cities and towns within six counties of the upper Pee Dee region of the Carolinas.

The House Wren, a short-distance migrant to the upper Pee Dee region of the Carolinas (Johnson 2014), has a different migration strategy compared to the Eastern Phoebe (*Sayornis phoebe*), a partial migrant (McNair 2016) and Cliff Swallow (*Petrochelidon pyrrhonota*), a long-distance migrant (McNair 2013). The latter two species have had an apparent density-dependent manner of dispersal to this region.

In contrast to the dispersal patterns of these two species, I do not assume that dispersal and expansion of adult House Wrens or their progeny to the upper Pee Dee region has only occurred via short-distance movements of birds from populations on the southern end of their range. Individual House Wrens may arrive near or at the breeding range expansion front in the upper Pee Dee region of the Carolinas. But without marked birds or other direct evidence, the pattern of movement and range expansion and consolidation is conjectural. In the sections below, I present my interpretations based on the best available evidence.

Range Expansion Direction

The only town where House Wrens breed in Richmond County, NC, is one section of Rockingham, along the fall line. Gaps between Rockingham and the nearest North Carolina breeding populations in the Piedmont are 27 km from Wadesboro and 40 km from Mount Gilead and 45 km from the Southern Pines-Pinehurst micropolitan statistical area in the Sandhills (McNair and Stanback in press). These breeding populations in the Piedmont were established before and are closer to Rockingham than breeding populations in the Sandhills. Therefore, it is probable that the direction of range expansion to Rockingham is most consistent with movement from the Piedmont (i.e., from the west-northwest), although movement from the Sandhills (i.e., from the northeast) cannot be ruled out.

Regardless, at their current range front, the pattern of population establishment of House Wrens at Rockingham has been similar to breeding populations at the Southern Pines-Pinehurst area (McNair and Stanback in press), that is, a small population in its first year rapidly expanded in its second year, albeit nine years later at Rockingham.

Range Expansion Rate

Using closest distance measurements (Google Earth Pro 7.3.1), from the initial establishment of House Wren breeding populations in the Piedmont cities of North Carolina in the 1920s to early 1930s (Pearson 1934, Odum and Johnston 1951), it took 84 years for the breeding range to expand from Raleigh ~100 km southwest to the Southern Pines-Pinehurst area. It took 95 years for the range to expand ~105 km from Salisbury southeast to Rockingham. As such, estimated mean rates of expansion are 1.1-1.2 km/yr. This is slower than the rate at which Eastern Phoebe and Cliff Swallows have expanded their breeding range south into the Pee Dee region of South Carolina in recent years (McNair 2013, McNair 2016, McNair 2017).

House Wrens, like Eastern Phoebe and Cliff Swallows, rely on anthropogenic structures for their nest sites in this region. The rate of expansion to reach Rockingham or the Southern Pines-Pinehurst area has been about 14 times slower compared to the 17 years (from 1933 to 1950) it took for House Wrens to expand their range ~271 km from Charlotte, NC, southwest to Athens, Georgia (Odum and Burleigh 1946, Odum and Johnston 1951, Odum et al. 1993), an estimated mean rate of expansion of 15.9 km/yr.

Leap-frog or Step-wise Range Expansion

Odum and Johnston (1951; see Fig. 1 therein) postulated that the breeding range expansion of House Wrens exhibited the leap-frog pattern, in which large gaps occur between establishment of breeding sites at cities and towns near or at the breeding range front before any backfilling may occur at smaller settlements. Thus, cities and towns constitute primary habitat, with cities occupied before towns, while semi-rural anthropogenic environments such as farmyards feature secondary habitats which are filled later. Kennedy and White (2013) suggested that developed areas with abundant nest boxes may be the source of House Wren emigrants to surrounding rural areas.

Where historical information is available from the Carolinas west to Alabama, House Wrens appear to have first occupied the largest metropolitan areas, and then smaller towns, followed by colonization in semi-rural areas such as the now fairly widespread

populations in exurbs and around farmyards near Charlotte and Davidson, NC (LeGrand et al. 2018, Seriff 2018; Stanback 2018). However, available evidence is not fully convincing because observations may be confounded by the geographic bias of greater observer effort in larger cities and towns (Brimley 1939, LeGrand 1975, Keyes 2010).

In the upper Pee Dee region of the Carolinas, breeding House Wrens have occupied partly open residential areas of cities and towns with a minimum human population size of ~850 individuals, with the exception of Polkton in Anson County, NC. Polkton has a disproportionately low number of houses compared to its population, although its population is larger than five of the seven towns occupied by House Wrens in this study. However, the size of its commercial district is smaller than the smallest town (Star) occupied by breeding House Wrens (McNair, pers. obsv.) even though its population is four times larger. This suggests that the size of a town's commercial district embedded in surrounding residential areas may be an important cue for potential settlement of breeding House Wrens.

Confirmed breeding records of House Wrens from rural areas of south-central North Carolina are still unknown. Thus, the leap-frog pattern of range expansion (Johnston and Odum 1951) appears to be more strongly supported than the step-wise pattern along the current range front of south-central North Carolina, although the slow rate, narrow gaps between occupied cities and towns, long-term site-occupancy at several sites, and non-simultaneous colonization makes it increasingly difficult to distinguish between leap-frog and step-wise processes.

The future expansion of the House Wren breeding range front in the upper Pee Dee region of the Carolinas will probably occur in Chesterfield and Cheraw, Chesterfield County, SC, and Hamlet, Richmond County, NC. The gaps between these three unoccupied towns and the nearest towns occupied by House Wrens (Pageland, Wadesboro, Rockingham) are narrow, but I expect colonization will not be simultaneous and it is difficult to predict how soon. Firm population estimates derived via 2018 surveys are available from Rockingham, NC, and from five golf courses at Pinehurst, NC (McNair and Stanback in press). Suitable House Wren habitat and nest strata at these sites are not saturated. In contrast, firm population estimates are unavailable from other occupied sites.

Further south, at large isolated cities, we also lack population estimates for the Auburn-Opelika metropolitan statistical area, Alabama (Haggerty 2009), Macon and Augusta in Georgia (Waters and Belger 2002, Schneider 2013), and Columbia, SC (Cely 2003a) where wide gaps exist between them and the nearest confirmed breeding sites. Confirmed breeding records at three of these four cities were documented in 2000 and 2003, but not thereafter (Breeding-season records of single singing males were present at Auburn each year from 2016-2018; Hill 2018). In contrast, House Wrens were confirmed breeding at Macon in three different years (2004, 2005, 2010; Schneider 2013). As such, House Wrens have not persisted and established themselves at three of these four large cities (or the isolated rural site in the Coastal Plain of Alabama; Haggerty 2009) even though their scale and habitat stability are otherwise highly favorable for long-term site occupancy. This inconsistency of long-term site occupancy along what is largely the former range front weakens the theoretical leap-frog pattern of range expansion for the House Wren in southeastern North America.

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Literature Cited

- Alworth, T., and I.B.R. Schieber. 2000. Nest building in House Wrens (*Troglodytes aedon*): A reexamination of male and female roles. *Journal of Field Ornithology* 71:409-414.
- Brimley, C.S. 1939. More gaps in our knowledge of North Carolina birds. *Chat* 3:85-89.
- Brown, D.G., K.M. Johnson, T.R. Loveland, and D.M. Theobald. 2005. Rural land-use trends in the conterminous United States, 1950-2000. *Ecological Applications* 15:1851-1863.
- Burleigh, T.D. 1937. Bird life on the North Carolina coast. *Auk* 54:452-460.
- Cely, J. 2003a. House Wrens nesting in Columbia, South Carolina. *Chat* 67:143-145.
- Cely, J.E. 2003b. The South Carolina breeding bird atlas 1988-1995. South Carolina Department of Natural Resources, Columbia, SC. 305 pp.
- Clarkson, E.B. 1940. Notes on the birds of Charlotte. *Chat* 4:59.
- Greenlaw, J.S., B. Pranty, and R. Bowman. 2014. The Robertson and Woolfenden Florida Bird Species: An Annotated List. FOS Special Publication 8. Florida Ornithological Society, Gainesville, FL. 435 pp.
- Hader, R.J. 1969. Species list of birds of Wake County, North Carolina. *Chat* 33:53-71.
- Haggerty, T.M. (Editor). 2009. Alabama breeding bird atlas project 2000-2006. Alabama Ornithological Society. Available online at: <http://www.una.edu/faculty/thaggerty/BBA%20Homepage.htm>.
- Hill, G. E. 2018. Unpublished data. Personal communication to the author. Department of Biological Sciences, Auburn University, AL.
- Johnson, L.S. 2014. House Wren (*Troglodytes aedon*). In *The Birds of North America* (P.G. Rodewald, Ed.). Cornell Lab of Ornithology, Ithaca, NY. Available online at: <https://birdsna.org/Species-Account/bna/species/houwre>. DOI:10.2173/bna.380. Accessed February 2018.
- Kennedy, E.D., and D.W. White. 1992. Nest building in House Wrens. *Journal of Field Ornithology* 63:35-42.
- Kennedy, E.D., and D.W. White. 2013. Bewick's Wren (*Thryomanes bewickii*), version 2.0. In *The Birds of North America* (P.G. Rodewald, Ed.). Cornell Lab of Ornithology, Ithaca, NY. Available online at: <https://birdsna.org/Species-Account/bna/species/bewwre>. DOI:10.2173/bna.315. Accessed March 2018.
- Keyes, T.S. 2010. Pages 292-293 in *The Breeding Bird Atlas of Georgia* (T.M. Schneider, G. Beaton, T.S. Keyes, and N.A. Klaus, Editors). University of Georgia Press, Athens, GA. 520 pp.
- LeGrand, H.E., Jr. 1975. Distribution and abundance of the wood warblers in North Carolina during the spring, nesting, and fall seasons. *Chat* 39:45-54.
- LeGrand, H., J. Haire, N. Swick, and T. Howard. 2018. *Birds of North Carolina: Their distribution and abundance*. Available online at: <https://ncbirds.carolinabirdclub.org>. Accessed February 2018.
- Mason, J., C. Moorman, G. Hess, and K. Sinclair. 2007. Designing suburban greenways to provide habitat for forest-breeding birds. *Landscape and Urban Planning* 80:153-164.

- McNair, D.B. 2013. Cliff Swallow breeding range expansion along the Great Pee Dee River corridor in the Carolinas. *Southeastern Naturalist* 12:500-513.
- McNair, D.B. 2016. Population status of the Eastern Phoebe in south-central North Carolina: Breeding increase at water-based anthropogenic sites congruent with Breeding Bird Survey (BBS) and Christmas Bird Count (CBC) data. *Southeastern Naturalist* 15:299-314.
- McNair, D.B. 2017. Eastern Phoebe breeding-range expansion into the Pee Dee region of South Carolina. *Southeastern Naturalist* 16:516-528.
- McNair, D.B., and W. Post. 1993. Supplement to Status and Distribution of South Carolina Birds. Charleston Museum Ornithological Contribution No. 8. Charleston, SC. 49 pp.
- McNair, D.B., and M.T. Stanback. In press. House Wren breeding status in the Sandhills of Moore County, North Carolina: Has the range expansion persisted? *Chat*.
- Odum, E.P., O.S. Allen III, and H.R. Pulliam. 1993. Southward extension of breeding ranges of passerine birds in the Georgia Piedmont in relation to the reversed latitudinal gradient. *Georgia Journal of Science* 51:131-140.
- Odum, E.P., and T.D. Burleigh. 1946. Southward invasion in Georgia. *Auk* 63:388-401.
- Odum, E.P., and D.W. Johnston. 1951. The House Wren breeding in Georgia: An analysis of a range extension. *Auk* 8:357-366.
- Odum, E.P., E. Taylor, C. Coker, and A. Breckenridge. 1935. The birds of Chapel Hill, North Carolina. *Journal of the Elisha Mitchell Scientific Society* 51:312-340.
- Pearson, T.G. 1934. Eastern House Wren (*Troglodytes aedon aedon*) breeding in North Carolina. *Auk* 51:87-88.
- Post, W., and S.A. Gauthreaux, Jr. 1989. Status and Distribution of South Carolina Birds. Contributions from the Charleston Museum No. 18. 83 pp.
- Sauer, J.R., D.K. Niven, J.E. Hines, D.J. Ziolkowski, Jr., K.L. Pardieck, J.E. Fallon, and W.A. Link. 2017. The North American Breeding Bird Survey, Results and Analyses 1966-2015. Version 2.07.2017 USGS Patuxent Wildlife Research Center, Laurel, MD. Available online at: <https://www.mbr-pwrc.usgs.gov/bbs/bbs.html>. Accessed February 2018.
- Schneider, T.M. 2013. House Wren nesting in Macon. *Oriole* 78:15-17.
- Seriff, D.W. 2018. Birds of the central Carolinas. Mecklenburg Audubon Society, Charlotte, NC. 591 pp.
- Stanback, M.T. 2018. Unpublished data. Personal communication to the author. Department of Biological Sciences, Davidson College, NC.
- Stanback, M.T., J.E. Bartholomew, L.M. Bergner, E.L. Cline, P.I. Helms, P.G. McGovern, D.M. Millican, and J.E. Roth. 2013. House Wrens alter nest architecture to compensate for cavity vulnerability. *Wilson Journal of Ornithology* 125:174-178.
- Summerour, B. 1986. Observations on the Nesting of House Wrens, *Troglodytes aedon*, in Jacksonville, Alabama. *Alabama Birdlife* 33:3-13.
- Trott, J., Jr. 1943. Field notes and news. New London, N.C. (Stanly County). *Chat* 7:45.
- U.S. Census Bureau. 2017. Available online at: <https://www.census.gov/>. Accessed December 2017.
- Waters, A., and C. Belger. 2002. House Wren nests at the Fall Line. *Oriole* 67:9.