Barn Swallow Nesting Biology at Bri Mar Stable, Hadley, Massachusetts During 2019

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Abstract

The Barn Swallow (*Hirundo rustica*) has declined throughout the northeastern U.S. from 1966 – 2017. Modern farming techniques, declining insect populations, or mortality associated with climate changes have been postulated as probable causes of these declines. There is little evidence that loss of nesting sites has an important influence on regional population levels. Nonetheless, plans by the U.S. Fish and Wildlife Service (USFWS) for the removal of an unused horse stable that supports a large breeding colony of Barn Swallows on the Fort River Division of the Silvio O. Conte National Fish and Wildlife Refuge in Hadley, Massachusetts, have raised controversial questions regarding the regional importance of this colony. In 2019 we mapped 51 active Barn Swallow nest locations within the former Bri Mar Stable. The maximum number of simultaneously active nests was 40 on 4 June, with a later pulse of 26 nests on 24 July. Banding data indicated that most of the late season nests represented second broods of pairs that had nested earlier at the site. If the stable is removed, as proposed by the USFWS, active nest sites used in 2019 would be eliminated, potentially forcing any returning adults that had previously used these sites to ultimately relocate to nearby structures on the refuge or to other colonies in the general region. Deployment of 18 seed nests (nests built in previous years that were physically moved, prior to the 2019 nesting season) into a nearby structure, coupled with vocalization playbacks, may have contributed to selection of this alternate site by 6-7 pairs; this building had been used by smaller numbers of nesting swallows in previous years. Preliminary surveys of other barns and structures near the stable found at least 1 other breeding colony of possibly comparable size. If the USFWS does proceed with the removal of the existing stable, we believe it will be possible to maintain a regional Barn Swallow population that is comparable to current levels.

Introduction

The Barn Swallow (*Hirundo rustica*) is a widespread, common species that occurs throughout most of the world. In North America, USGS Breeding Bird Survey data (Sauer et al. 2017) indicate that, over a 45-yr period (1970–2014), the overall population of this species in the United States and Canada has decreased by an estimated 38% (Rosenberg et al. 2016). The Canadian population has declined approximately 80% since 1970, leading the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to assess the Barn Swallow as Threatened (COSEWIC 2011).

Population trends within the Barn Swallow's North American range vary geographically (Fig. 1). Numbers are increasing in the southern tier of states from Arizona east to North Carolina. All of the Canadian provinces, California, and northwestern, midwestern, northeastern and mid-Atlantic states generally show declining populations (with trends that are less pronounced in the midwest). In Massachusetts, Barn Swallows have clearly declined; based on 29 Breeding Bird Survey routes, there has been an estimated 1.1% annual decline in abundance of the species from 1966-2017 (Fig. 2; Sauer et al. 2017). These declines were not reflected by Massachusetts Breeding Bird Atlas data, which showed a stable or increasing state-wide breeding distribution between 2 atlas periods (1974-1979 and 2007-2011), although Walsh and Petersen (2013) nonetheless commented that the species merited "further monitoring and conservation action." The Barn Swallow is not one of 95 birds listed as "species of greatest conservation need" in the 2015 Commonwealth of Massachusetts Wildlife Action Plan.

The causes of Barn Swallow declines are unclear. At a global scale, BirdLife International (2016) stated that "The main threat to the species is the intensification of agriculture. Changes in farming practices such as the abandonment of traditional milk and beef production have resulted in a loss of suitable foraging areas. In addition, intensive livestock rearing, improved hygiene, land drainage and the use of herbicides and pesticides all reduce the numbers of insect prey available. Suitable nest sites for Barn Swallows are often scarcer on modern farms. The species is susceptible to changes in climate with bad weather in the wintering areas as well as the breeding grounds affecting breeding success (Tucker and Heath 1994). It is occasionally hunted for sport and nests are sometimes removed as a nuisance. In North America, introduced House Sparrows (*Passer domesticus*) are serious nest- site competitors, taking over nests and destroying eggs and nestlings (Turner and Christie 2012)." In Canada, COSEWIC (2011) concluded that "the main causes [of decline] . . . are thought to be: 1) loss of nesting and foraging habitats due to conversion from conventional to modern farming techniques; 2) large-scale declines (or other perturbations) in insect populations; and 3) direct and indirect mortality due to an increase in climate perturbations

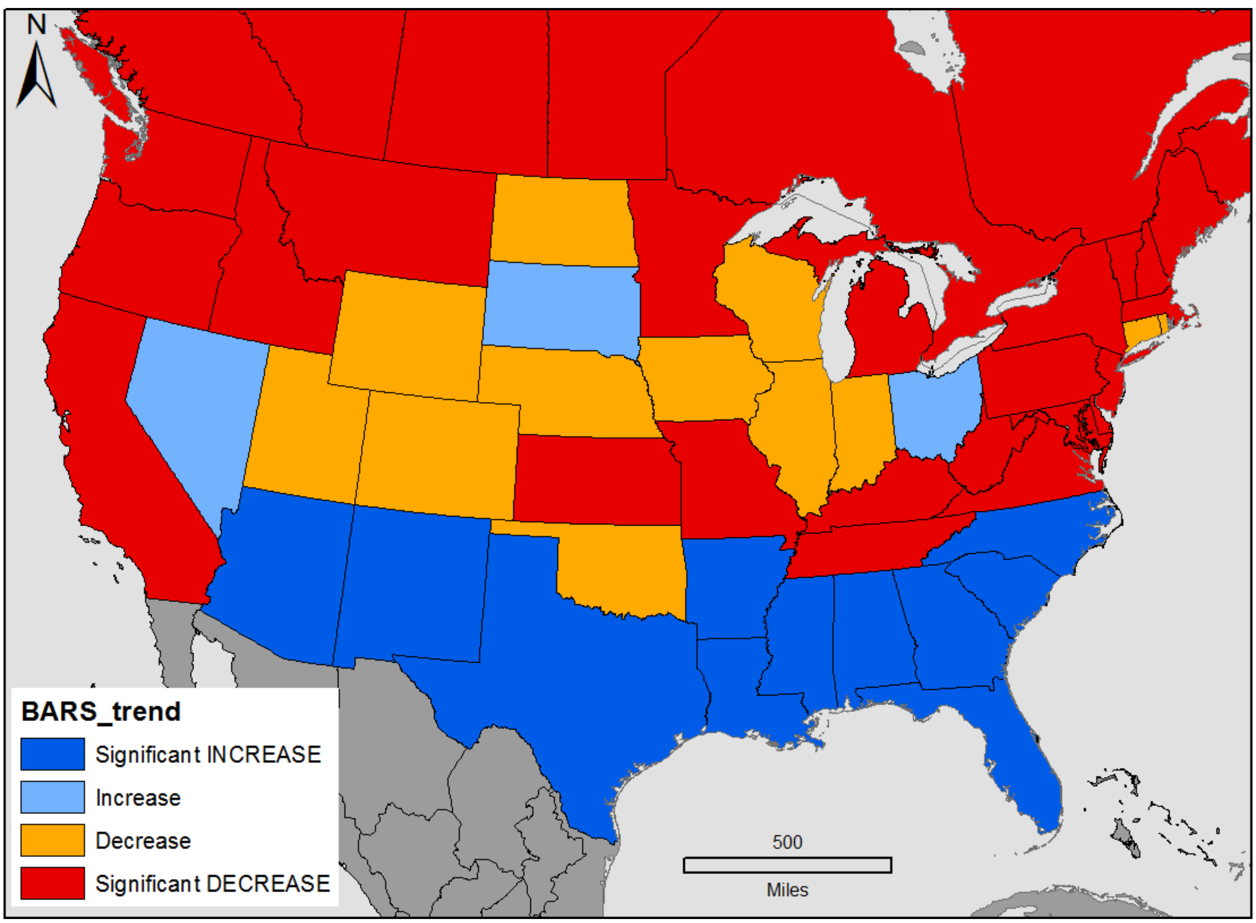

Fig. 1. North American population trends of Barn Swallow, by state and province, based on USGS Breeding Bird Survey data, 1966-2017 (https://www.mbr-pwrc.usgs.gov/, scale = states; Sauer et al. 2017).

on the breeding grounds (cold snaps).” Møller (1989) suggested that in [the Barn Swallow’s European subspecies] *H. r. rustica*, overwinter mortality was thought to be the primary factor regulating population size, although he also noted that the number of swallows in Denmark declined when dairy farming was shifted to crop production (Møller 2001). Brown and Brown (1999, 2019) proposed that “weather-related mortality during cold snaps . . . probably regulates population size, at least in northern portions of the breeding range, and may determine the northern limit of the species’ range.” Nebel et al. (2010) concluded that “the taxonomic breadth of these downward trends [among 24 species of aerial insectivores] suggests that population declines are linked to changes in populations of flying insects, and these changes might be indicative of underlying ecosystem changes.” Brown and Brown (2019) concluded that “many populations [of Barn Swallows] are probably not regulated by nest-site availability,” citing Holroyd’s (1975) observation that local numbers of breeding pairs often remain stable even when the availability of suitable nesting sites increases. Similarly, Robinson et al. (2003) found, in a study which covered all of Britain, that “there was little evidence of an association between change in the [availability of] nest-sites . . . and change in Swallow numbers.”

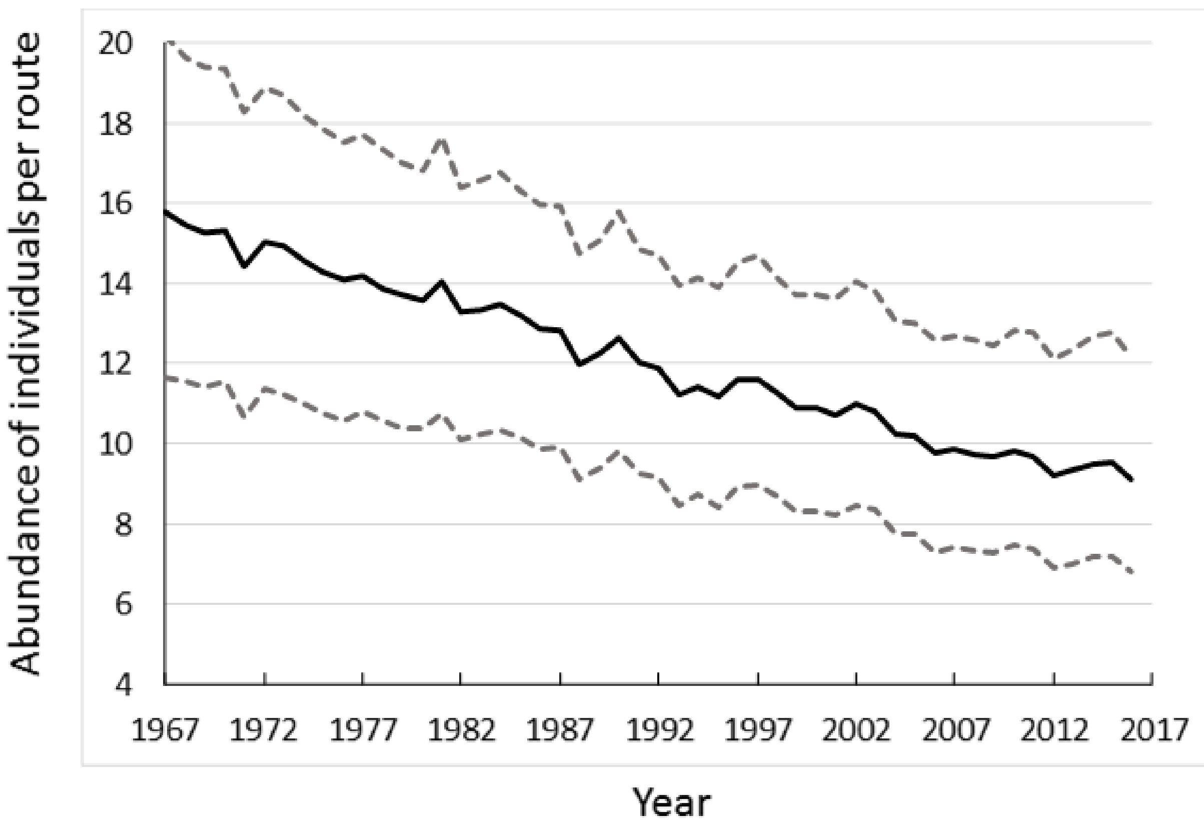

Fig. 2. Massachusetts population trends of Barn Swallow based on USGS Breeding Bird Survey data, 1967-2017 (https://www.mbr-pwrc.usgs.gov/, scale = states; Sauer et al. 2017). Y axis represents average predicted abundance of individuals per fixed survey route. Dashed lines indicate upper and lower 95% confidence intervals.

A sizable colony of Barn Swallows has nested at Bri Mar Stable (hereafter, "stable"), Fort River Division, Silvio O. Conte National Fish and Wildlife Refuge, Hadley, Massachusetts in recent years, and plans by the U.S. Fish and Wildlife Service (USFWS) to remove this structure, outside of the breeding season, due to concerns over public and employee safety, administrative directive to reduce the USFWS' structural footprint, threat to adjacent buildings, and lack of value to the refuge's overall mission have raised questions regarding the importance of this colony to the regional population of this declining species. How does the colony in the stable compare in size to other nesting sites in the general vicinity? Would removal of the stable affect some, or all, of these pairs, and would the regional population be impacted? Are there ways to mitigate the proposed removal of the stable, perhaps including attraction of displaced pairs or first-time breeders to alternative nesting sites that could be protected? If the regional population of Barn Swallows is not regulated by nest site availability, then what other factors might be examined as important to the species' conservation? Can Barn Swallows serve as a flagship species on the refuge and within the Connecticut River watershed to increase public awareness of aerial insectivore declines?

In 2019 Mass Audubon's Bird Conservation Department, in collaboration with the Silvio O. Conte Refuge, conducted a focused study of Barn Swallow breeding ecology at Bri Mar Stable, aiming to collect data that may inform decisions regarding future plans of the refuge. The study included three primary elements: (1) record, map and characterize active nests within the stable at frequent intervals throughout the nesting season, (2) capture, band, and release adult and fledgling Barn Swallows in order to quantitatively evaluate the number of individuals using the stable, including assessment of the phenology of breeding activities during 2019 and establishment of a marked population for potential future study in 2020, and (3) conduct preliminary surveys of nesting activities in nearby barns and other structures located in the general vicinity of Hadley. This report presents the results of these efforts, and makes recommendations for future research in 2020.

Field Site Description

The Silvio O. Conte National Fish and Wildlife Refuge project area encompasses the 7.2 million-acre watershed of the Connecticut River. Land acquisition, a traditional conservation tool, is limited to specific high priority sites located in four states. The refuge uses innovative partnerships to improve conservation efforts, research important questions, foster conservation leadership and inform citizens about critical issues. Priority sites are strategically connected to the existing mosaic of conservation land already within the watershed. Presently, the refuge totals 37,795 acres located in 22 different locations in the 4 states (Connecticut, Massachusetts, New Hampshire, and Vermont) within the watershed. The Fort River Division, located in Hadley, Massachusetts, occurs in the eastern portion of the Pioneer Valley. In 2009, the USFWS acquired the 66.5 acre Zuckerman ownership for $2.1 million and added it to the Fort River Division of the refuge; the property had been slated to become 56 house lots. Four structures were included in the purchase; three of these, a residence, a shop building, and a former indoor horse exercise arena with an attached 1,600 ft^2 hot walker room (hereafter referred to as the Boat House), are considered to be key assets for refuge operations in the four state area. The fourth structure is the Bri Mar Stable (42°26'24"N, 72°34'12"W), a 30-year-old, two-story building, with each floor approx. 11,250 ft^2 in extent (Fig. 3). The USFWS has evaluated two alternatives that would result in the demolition and removal of the stable by the close of Fiscal Year 2020, ending on 30 September 2020.

Approximately 58% of the Fort River Division is composed of pasture and grasslands . Within 2.5 mi of the stable are approximately 4,800 acres of agricultural land that is potentially used for foraging by nesting Barn Swallows (Brown and Brown 2019).

Fig. 3. Location of Bri Mar Stable, Conte National Wildlife Refuge, Hadley, Massachusetts.

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Methods

Prior to the 2019 breeding season, we mapped the location of 82 sites within Bri Mar Stable that were considered, based on evidence of exploratory nesting activities during previous years, to be potential Barn Swallow nest locations. These sites were inspected, using a telescopic mirror, at approximately one-week intervals from 7 May – 13 August. At each of the 51 sites that were used at some point in 2019 we recorded the characteristics of the nests' supporting structures (hanging fluorescent light fixtures, metal conduit leading to the fluorescent light fixtures, wooden framing, PVC drainage pipe, artificial nest bowls made of wood or clay, and metal-caged stall lights). To facilitate mapping of nest locations, the interior of the stable was gridded into 78 12 ft X 12 ft units; distances to the center of each of these grid cells was calculated as a straight line to the nearest access opening to the stable (approx. 5 ft wide by 8 in high). Distances of the 51 used nest sites relative to the nearest access openings, 2 of which were located at either end of the stable, were calculated as straight lines using GIS.

In order to develop and test possible techniques that might be used to attract displaced swallows or first time breeders to nest at locations where they could be effectively protected, in 2019 the refuge installed 18 "seed nests" (actual Barn Swallow nests that had been physically moved, prior to the nesting season, from their original locations) in the Boat House. Twelve of these seed nests were obtained from the western third of Bri Mar Stable, and 6 were recovered and relocated within the Boat House itself. At 5 of the sites (42%) from which nests had been removed from Bri Mar Stable prior to the 2019 season, new nests were built during 2019. Three of these rebuilt nests were used in 2019, including one where 2 clutches were laid.

Additionally, 264 potential nest site contact points were placed by the USFWS within the Boat House. The contact points attempted to mimic nest site supports that were used by Barn Swallows in the stable. These were evenly attached within each of two sizes of wooden hanging structures (8 ft X 8ft and 4 ft X 4 ft), and consisted of readily available hardware materials: A = conduit; B = electrical box; C = wire mesh; D = wooden shelf (5 in X 5.5 in); E = hurricane brace; and F = corner bracket (Fig. 4).

During mornings we used playbacks of Barn Swallow vocalizations that were continuously presented in the Boat House to encourage pairs to enter the structure and perhaps build nests within the building. Once several active nests had been established in the Boat House, use of playbacks was terminated in late July.

A total of 134 swallows were captured, using 36-mm mesh Japanese mist nets, banded and released within the stable on nine dates (7 May, 28 May, 13 Jun, 28 Jun, 9 Jul, 19 Jul, 25 Jul, 1 Aug, 13 Aug). Using criteria provided by Pyle (1997), 46 individuals were identified as females, and 44 birds were identified as males; 44 birds (including recent fledglings and some adults that were captured late in the season after recession of secondary sexual characters and occurrence of excessive tail feather wear) could not be sexed. Banding was conducted under authorization of Federal (Master Bird-Banding Permit 09996) and State (Massachusetts Scientific Collecting Permit 196.19SCB) permits issued to the senior author.

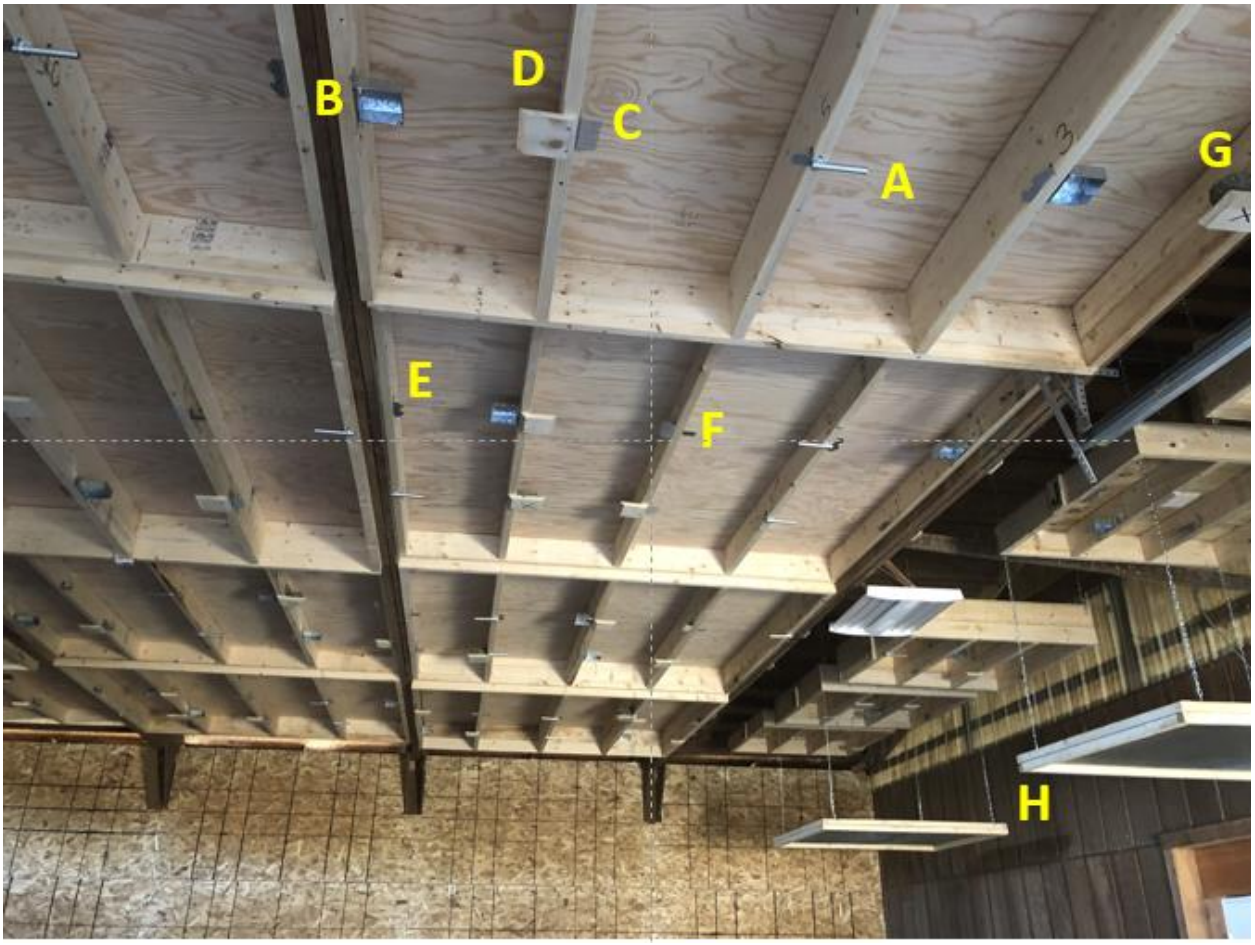

Fig. 4. Partial view of the interior of the Boat House, showing examples of contact points (A-G) and fecal capture screens (H). A = conduit; B = electrical box; C = wire mesh; D = wooden shelf; E = hurricane brace; F = corner bracket; G = wooden shelf with seed nest.

Results

Distribution of Nests and Phenology of Breeding Activity

A total of 82 potential nest site locations of various types and condition were mapped within Bri Mar Stable at the start of the 2019 breeding season (Fig. 5). Thirty-one of these locations were not used in 2019. Twenty-five (81%) of these unused nests were well developed and typical Barn Swallow nests; we do not know whether these nests were not used in 2019 because of the availability of other more suitable sites, the presence of parasites, or some other influence. All of the remaining 51 locations were used for actual nesting at least once during the season. Of the 51 nest sites that were used during 2019, 27 (52.9%) were located on hanging fluorescent light fixtures, 9 (17.6%) on metal conduit leading to the fluorescent light fixtures, 7 (13.7%) on wooden framing, 3 (5.8%) on PVC drainage pipe, 3 (5.8%) on artificial nest bowls made of wood (n=1) or clay (n=2), and 2 (3.9%) on metal-caged stall lights.

The majority (94%) of the 51 nest sites that were used within Bri Mar Stable in 2019 were located in the eastern and western ends of the structure; only 3 nests were located in the stable's "middle" portion (Fig. 5). Distance of nest sites to the closest entrance into the stable averaged 30.6 ft (SD = 20.8). The number of nests found within each grid cell generally decreased away from the nearest access opening to the stable.

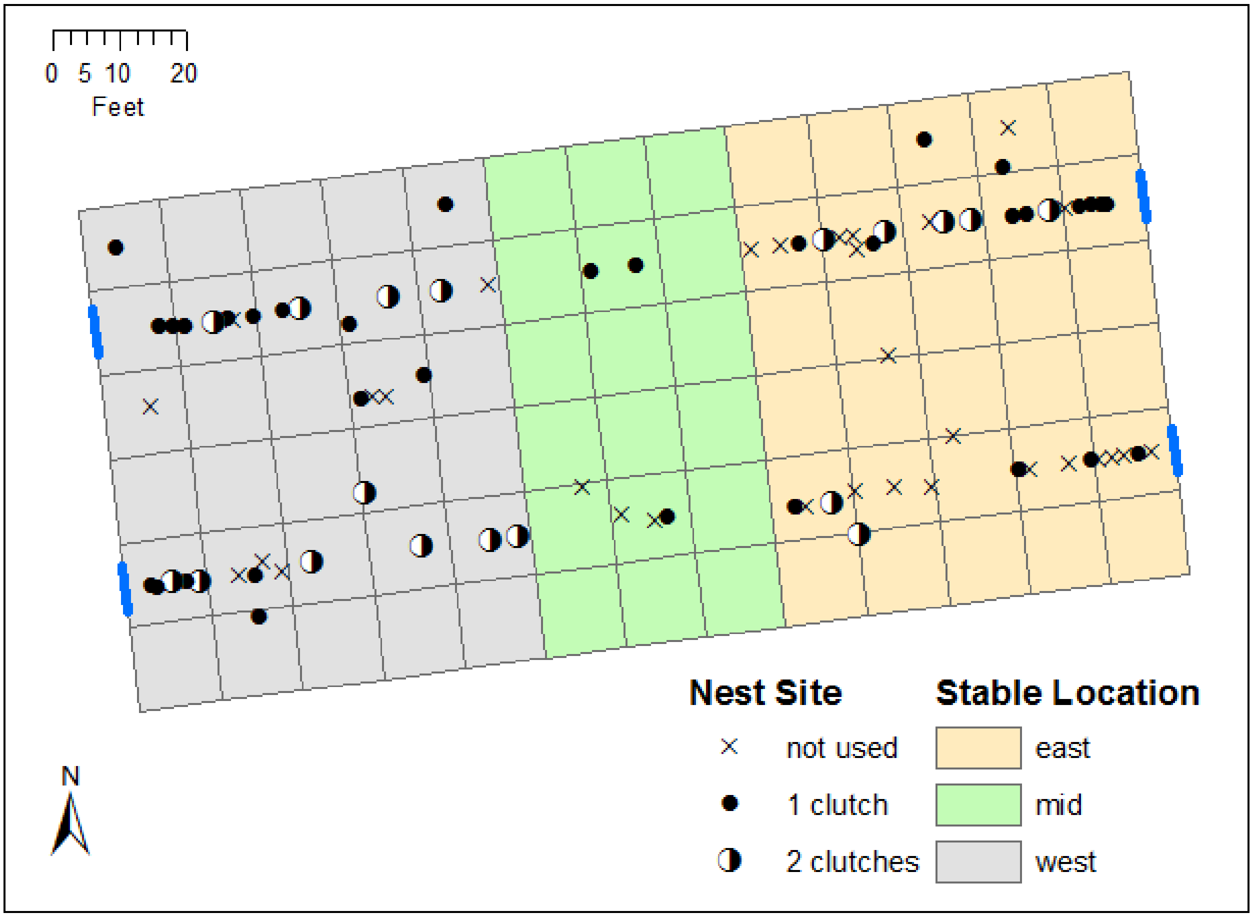

Fig. 5. Distribution of Barn Swallow nests in Bri Mar Stable, 2019. Unused sites reflect locations where swallows had shown evidence of possible nest site selection in previous years. Bold blue lines at either end of diagram indicate access windows into the structure.

Based on distances of nests to the stable's access openings, there was no evidence that swallows preferred one end of the structure over the other (Wilcoxon 2-sample test, Z = -0.104, P = 0.92). There was no difference in the distances between access openings into the stable and nest sites that were used once vs. twice in 2019 (Wilcoxon 2-sample test, Z = 1.82158, P = 0.07).

Brown and Brown (2019) noted that "Active nests can be as close together as 0.1 m". In Bri Mar Stable we found 2 active nests that were located on either side of a 1.5 inch thick ceiling joist.

Approximate nest densities in the 3 sections of the stable were 0.006 nests / ft^2 (western end, 4,661 ft^2), 0.001 nests / ft^2 (middle section, 2,799 ft^2), and 0.005 nests / ft^2 (eastern end, 4,661 ft^2). Calculated at a finer scale of 28 occupied 12 ft X 12 ft grid cells, densities ranged from 0.05 nests / ft^2 to 0.007 nests / ft^2, with a mean of 0.02 nests / ft^2 (SD = 0.01).

A total of 69 nesting attempts were recorded at 51 sites. Thirty-three (65%) of the 51 sites supported a single nesting attempt, and 18 (35%) were used in 2 consecutive attempts (Fig. 5). We have no way of knowing whether sites that were used during 2 nesting attempts were occupied by the same pair in each case. Other researchers have found that reuse of nests that were occupied earlier in the same year varies, ranging from 12% of 50 nests in Manitoba (Barclay 1988), 45% of 137 nests in Kansas (Anthony and Ely 1976), and 81% of 16 nests in Oklahoma (Iverson 1988). Shields (1984) found that 53% of marked birds in New York reused the same nest for a second nesting attempt.

The maximum number of simultaneously active nests present within Bri Mar Stable during 2019 was 40, as counted on 4 June (Fig. 6). A second wave of nesting within the stable was evident beginning during the first week of July, peaking at approximately 26 simultaneously-active nests on 24 July. These totals do not include the approximately 2 nests that were present on the second floor of the stable building, which could not be regularly accessed due to safety concerns posed by the rotting plywood floor, or the 6 seed nests that were used in the nearby Boat House that were monitored on the same schedule as the stable.

Of the 26 nests that were active on 24 July, 16 (62%) had been used earlier in the season during the initial pulse of nesting. We have no way of certainly knowing (a) whether these "second wave" nests represented second broods from some of the original 40 pairs, (b) whether some (all?) of the nests initiated in July resulted from late breeders that had not earlier nested in the stable during 2019, or (c) were birds that had been displaced or relocated from elsewhere within the local landscape. However, banding data (see below) suggests that most late breeders in 2019 had nested earlier in the season within the stable.

Clutch size at Bri Mar Stable in 2019 ranged from 2-7 eggs (mean = 4.43, SD = 0.99). A total of 306 eggs were known to have been laid. Excluded from these values was a single nest containing 2 inviable "runt" eggs (see Czechowski and Zduniak 2008, Mulvihill 1987, and Rothstein 1973 for reviews of this rare phenomenon). Hatching and fledging success was high; of 69 nesting attempts, we recorded only 1 complete nest failure. Because we wished to avoid undue disturbance of nests containing about-to-fledge young, we did not consistently attempt to record whether a nesting attempt included unhatched eggs.

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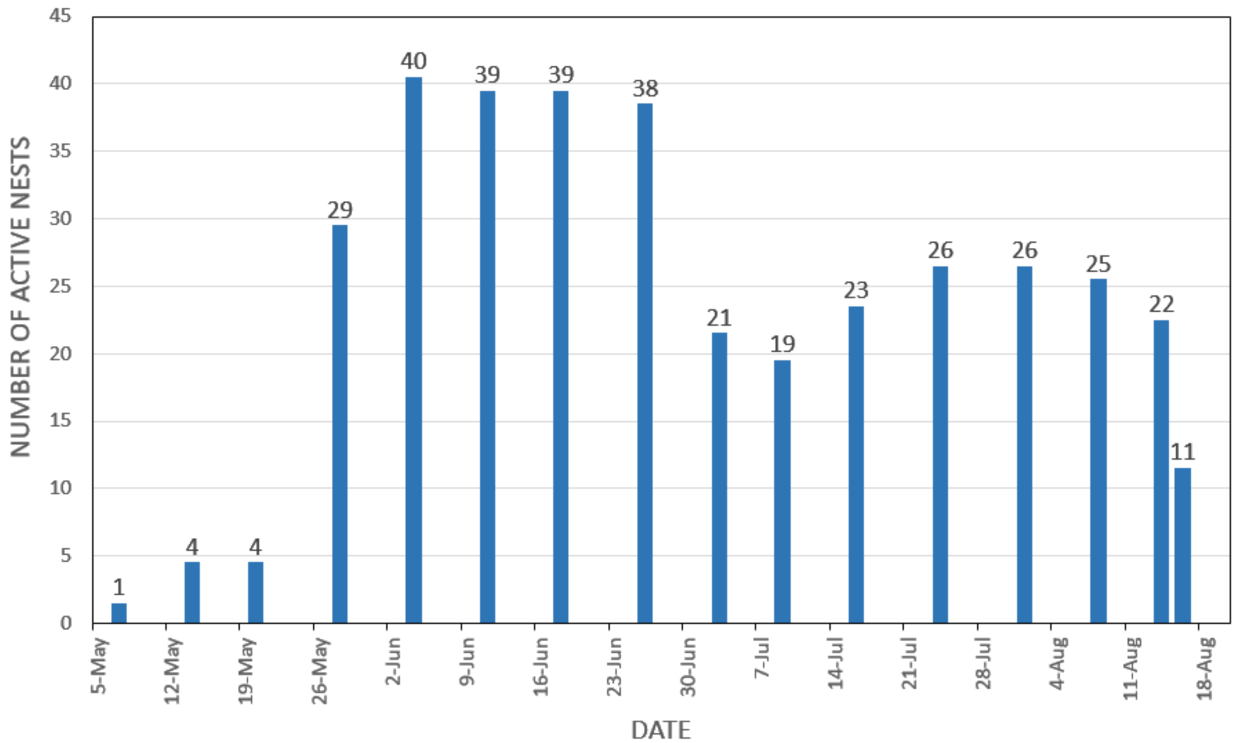

Fig. 6. Approximate nesting phenology of Barn Swallows at Bri Mar Stable, 7 May – 16 August 2019.

Weisheit and Creighton (1989) described adverse impacts of House Sparrows on nesting Barn Swallows. At one nest site in the stable, a recently-vacated House Sparrow nest was removed on 18 June, and the site was almost immediately occupied by a Barn Swallow pair which had laid a clutch of 5 eggs eight days later. At an additional nest site where we removed the early stages of House Sparrow nest construction, there was no subsequent use by Barn Swallows (or House Sparrows).

We saw no evidence of infanticide. Brown and Brown (2019) stated that "infanticide is more common in large colonies, which apparently attract unmated males." At a colony of >50 nests in Nebraska, Hoskin (1988) found that 78.3% of 69 nests failed; most failures were presumed due to infanticide or conspecific egg destruction. Based on banding data (see below) there was no evidence of a biased sex ratio in the Bri Mar Stable colony in 2019, which might have been expected if there were substantial numbers of unmated males.

Of the 18 seed nests deployed within the Boat House, 6 (33%) were occupied in 2019, including 1 that was used for two consecutive broods. None of the artificial nest site contact points placed within the Boat House were used. However, three of the artificial structures placed in offsite locations within the area had successful brooding where, in the absence of deployed seed nests, the electrical boxes were the contact point of preference for nest building.

Banding

A total of 134 swallows were banded and released at Bri Mar Stable on nine dates in 2019, including 49 birds that were initially captured on the west end of the stables, 60 birds that were initially captured on the east end of the stables, and 25 birds that were initially captured in the Boat House (Table 1). Banding efforts were not consistent among the various portions of the stables, so differences in capture numbers do not reflect controlled comparisons.

Table 1. Initial capture totals, by age classification, in Bri Mar Stable and the Boat House in 2019. HY = hatching year (recent fledglings, hatched in 2019); AHY = after hatching year (birds hatched in 2018 or earlier).

AGE	Boat House	Stables - E	Stables - W
AHY	9	50	40
HY	16	10	9

There was considerable movement of individuals among the 3 banding locations – not surprising considering the close proximity of the different sites; in fact, Stables – East and Stables – West are at opposite ends of the approx. 156 ft long Bri Mar Stable building, and the center of the Boat House is located only 240 ft from the stable's center. Of 40 birds initially captured in Stables – West, 24 were recaptured on at least 1 subsequent date in Stables – East. Of 50 birds initially captured in Stables – East, 24 were recaptured on at least 1 subsequent date in Stables – West. One of the 25 birds captured in the Boat House was also captured in Stables – West.

There were 165 recaptures of adults, representing 105 individuals. Predictably, the frequencies of recaptures increased over the course of the season as more and more birds had previously been captured and banded (Fig. 7). There was a noticeable decline in the number of adults that were captured on 9 July; between 28 June and 9 July many nests fledged, and associated adults and juveniles began to spend less time inside the stable area where nets were erected. The first hatch year (HY) birds (juveniles capable of sustained flight) were captured on 28 June. The relative absence of newly banded adults beginning in early July suggests that the second wave of nest initiations observed during July (see Fig. 6) was dominated by birds attempting to raise a second brood, as opposed to immigrants that were newly arrived from other sites.

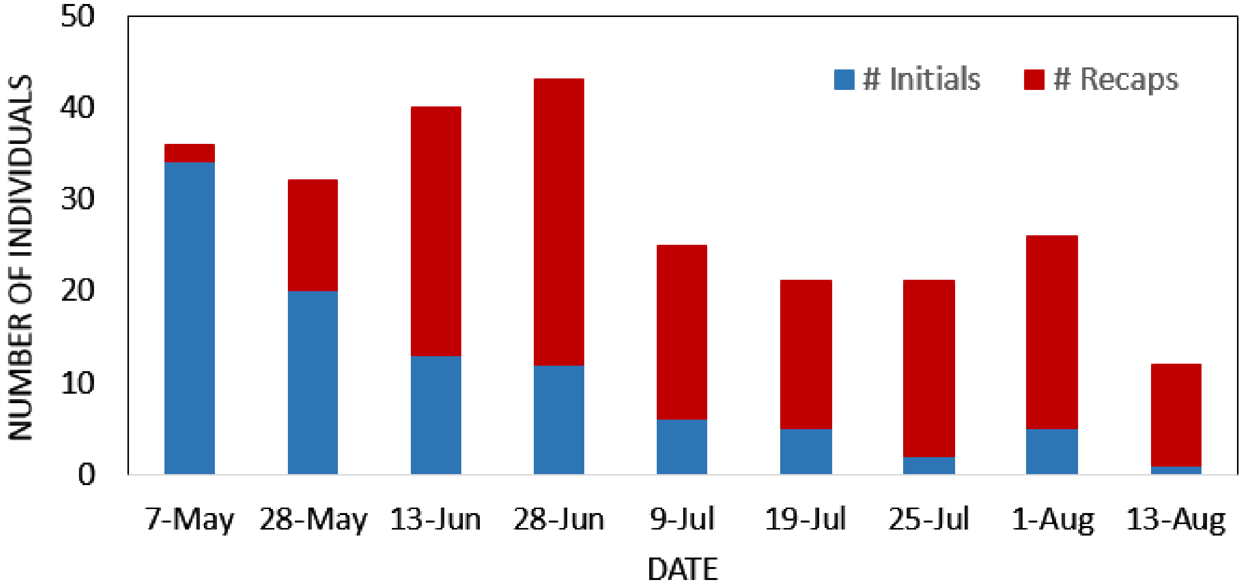

Fig. 7. Captures of adult Barn Swallows at Bri Mar Stable (including the Boat House) during 2019. "Initials" indicate birds that had previously not been banded; "Recaps" indicate recaptured birds that had previously been banded.

The proposed demolition of Bri Mar Stable was scheduled, according to the Environmental Assessment (EA) published by the USFWS, to involve a phased closure of the structure in thirds, beginning with the western portion prior to the 2019 nesting season, followed by the closure of the middle portion prior to the 2020 nesting season and, finally, the entire building would be removed after the end of the 2020 nesting season. To date, the USFWS has not made a final decision concerning the management alternatives presented in the EA, and the initially proposed time schedule has been delayed. In this study we worked under the assumption that data collected during 2019 could inform future management decisions within and around the Fort River Division of the Silvio O. Conte National Fish and Wildlife Refuge. No removal of any portion of the stable structure occurred during the 2019 breeding season.

Most 1-year-old Barn Swallows do not return to their natal colony: 0.4% (n = 679) in Kansas (Anthony and Ely 1976), 0.6% (n = 524) in Oklahoma (Iverson 1988), 1.0% (n = 1,008) in Pennsylvania (Bell 1962), 2.0% (n = 331) in New York (Shields 1984), and 2.0% (n = 1,718) in Massachusetts (Mason 1953). However, once a nesting site has been selected, reported return rates of breeders are higher, ranging from 20% in Oklahoma (Mason 1953) to 42% in New York (Shields 1984). Hasegawa et al. (2012) and Mason (1953) found that the presence of previous years' nests was an important attractant to prospecting birds, although reuse of old nests increased the problem of lowered reproductive success caused by mite infestation (Barclay 1988, Donahue et al. 2018, Turner 2004). T. Imlay, working in Nova Scotia, suggested that large colonies may be more stable over time than smaller colonies (Canadian Wildlife Service, pers. comm. dated 17 May 2019), a pattern that has been reported in other colonially-nesting birds (Kharitonov and Siegel-Causey 1988). However, Brown and Brown (2019) suggested that under historic, natural conditions, most Barn Swallows probably nested individually or in small groups; these authors considered a nesting colony of >35 nests to be unusual, and noted that "studies of coloniality in

Barn Swallows have revealed few advantages of group living." In Denmark, Møller (1987) found that the costs of coloniality were more obvious than the benefits: birds nesting in larger colonies found less food, spent more time guarding their mates and nests, experienced more extra-pair copulations, more ectoparasitism, more predation, more infanticide, and more brood parasitism. Similarly, in New York, Shields and Crook (1987) found that fewer young fledged from nests in larger groups than from solitary nests or nests in small groups, suggesting a net reproductive cost to coloniality.

Based on the distribution of Barn Swallow nests present in the Bri Mar Stable in 2019, removal of the structure would eliminate 51 sites that were used in 2019, thereby forcing any returning adults that had been associated with these nests to relocate to the Boat House or other colonies in the general region. However, even without displacement, Mason (1953) and Shields (1984) reported year-to-year return rates of breeders to a particular nesting site to be < 50%.

The Boat House, approx. 40 ft X 40 ft in size, will be maintained in future years for equipment storage, and will remain available to nesting Barn Swallows and other aerial insectivores. If this building were to eventually be occupied at a density comparable to what was observed during 2019 in either end of Bri Mar Stable, approx. 10 pairs might be predicted to nest in the structure; using average densities calculated at the finer scale of the 12 ft X 12 ft grid cells, the Boat House might support approx. 32 pairs of swallows.

Six Barn Swallow nest sites were active within the Boat House in 2019; one was used for 2 consecutive clutches (meaning that 6-7 pairs used the Boat House in 2019). We deployed seed nests and broadcast vocalization playbacks within the Boat House to attract prospecting birds (1-year old first-time breeders, birds that were renesting after nest failures earlier in 2019, or birds that had been displaced from other nesting colonies in the region). All 7 of the 2019 Boat House nests were laid on seed nests, and all were successful. None of the manufactured contact points were used. Barn Swallows have previously been observed using the Boat House in small numbers, although census figures from previous years are somewhat vague: in 2014 there was 1 pair, in 2015 1 pair, in 2016 2 - 6 pairs, in 2017 no more than 3 pairs, and in 2018 2 pairs (D. Straley, M. Silver, G. Regmund and S. Chapko, pers. comm. from M. Silver, dated 20 Nov 2019). The 6-7 pairs observed during 2019 appear to represent a slight increase in Boat House nesting activity. As mentioned above (banding), there was at least some movement of banded individuals between the stable and the Boat House.

Nine 4 ft X 4 ft wooden structures, each with 6 artificial contact points, were placed in 4 other private farm buildings in three locations in the Hadley and Amherst area. No seed nests or vocalization playbacks were used. Prior to deployment of these structures, one of these buildings had 1 Barn Swallow nest, one had some limited evidence of past Barn Swallow use, and two, located within approx. 120 ft of each other, had no indication of prior Barn Swallow use. Artificial contact points were used by Barn Swallows in all three of the locations where the structures were installed; 3 nests, all successful, were constructed on attached electrical boxes (Fig. 8) in each of the three different locations.

Several "fecal capture screens" were also placed in the Boat House and in 2 privately-owned locations in Hadley and Amherst. The purpose of these structures was to develop a method for collecting feces produced at active nests, responding to a common complaint among private property owners who wish to protect property that was being stored in barns where there are active swallow colonies. The Barn Swallows appeared to avoid the 4 ft X 4 ft screens when they were installed prior to nest construction. However, after nests were established, fecal capture screens that were hung 3 ft below the active nests had no obvious impact on incubation or feeding of nestlings, or nesting success. The ability to manage droppings associated with Barn Swallow nests appears to be very promising, and the screens can be easily removed (4 hooks) and washed at the end of the breeding season.

In addition to observations made in Bri Mar Stable and the nearby Boat House, we also conducted preliminary, ad hoc surveys of barns and similar structures in the general vicinity of Amherst and Hadley. Because several private landowners expressed concern over the presence of swallows in their barns, apparently responding to defecation of the birds on their farm equipment and negative press reports describing the somewhat contentious debate over plans for Bri Mar Stable, some of our observations had to be made from the edges of public roads, and did not, therefore, allow for actual counts of nesting pairs.

At least ten structures were found within 4 miles of Bri Mar Stable in 2019 that appeared to be potential Barn Swallow nesting sites, although a more thorough survey is definitely warranted. Notably, at 1 location involving 3 closely-spaced buildings, a total of 93 well-developed nest sites were found on 26 June. We were unable to inspect nest contents at this colony, but observed that at least 38 (41%) of these nest sites appeared likely to be active at the time. Within Bri Mar Stable, 40 (49%) of 82 potential nest sites were active at the time of peak occupancy. Although the recorded nest conditions and phenology of birds breeding at these 2 sites might not be completely comparable, these preliminary data at least suggest that this colony may be similar in size, or possibly even larger, than the nesting group at Bri Mar Stable. At another location near to Bri Mar Stable we found 20 active nests between 31 May and 16 July, with a maximum count of 13 simultaneously active nests on 6 June; at 6 of these nest sites 2 clutches were eventually laid. Approximately 100 birds hatched and successfully fledged at this location.

Conclusions and Management Recommendations

This report does not address the question of the pending USFWS decision described in the Environmental Assessment, assess the structural integrity of the stable, or attempt to evaluate how the USFWS has approached this decision.

There is no doubt that Bri Mar Stable supports a large number of nesting Barn Swallows. However, this colony is not the only nesting group of the species within the immediate region, and there is at least 1 nearby site that supports what may be a comparably-sized colony. Efforts in 2019 that focused on developing techniques that might attract nesting pairs to new locations were promising, setting the stage for future work in 2020 aimed at monitoring ways to mitigate human actions that might impact Barn Swallows. If the existing stable is removed, we predict that at least some of the displaced birds will relocate into the nearby Boat House or other suitable locations in the general area.

Fig. 8. Barn Swallow nest constructed on artificial contact point (electrical box).

Other studies have generally failed to show that nest site availability controls regional Barn Swallow populations. Instead, factors such as the decline of low-intensity, traditional farming, use of pesticides associated with industrial agriculture, and climate-related impacts on survival at migratory stopover areas and wintering habitats seem to be the most frequent issues that are postulated. To this end, perhaps the most effective Barn Swallow conservation actions in the region could be protecting additional land as foraging habitat, adjusting the timing of mowing which would benefit grassland nesting species, pollinators, and other species of aerial insectivores, and working with local private landowners to encourage their voluntary protection and recruitment of nesting Barn Swallows and other aerial insectivores.

Research in 2020 should build on data collected in 2019. At least 3 banding sessions should be conducted during June and July to evaluate year-to-year survivorship and site fidelity. A more systematic survey of barns and stables located in the Amherst, Hadley, South Hadley, and Sunderland area should be pursued. Harvesting of seed nests from any locations where farm maintenance may require removal of swallow nests should be completed prior to the return of nesting pairs in May; similarly, if the USFWS proceeds with the proposed demolition of the Bri Mar Stable, nests located in the stable should be removed outside the nesting season and relocated into the nearby Boat House and perhaps elsewhere in the general area to attract birds to new locations. To reduce potential impacts caused by mites or other parasites present in these nests, the possibility of fumigating these seed nests prior to their deployment should be considered. Exploration of methods to quantify use of different types of agricultural fields by foraging Barn Swallows might help identify important collaborations with private landowners. Further deployment of additional artificial nest structures in suitable locations, done in collaboration with volunteers, students, private land owners, and other conservation partners, should be pursued.

Declining numbers of aerial insectivores, including Barn Swallows, represent a continent-wide issue of great conservation concern. Because of the public interest that has been engendered by the Bri Mar Stable discussion, there is an important opportunity to use Barn Swallows as ambassadors to draw attention to factors that threaten aerial insectivores. In partnership with private land owners and other conservation partners, development of press releases, lectures, and accessible educational materials could serve as conduits to engage the public in development of a "birds-to-bats" aerial insectivore project that could also prove beneficial to grassland nesting species and pollinators. We encourage all members of the birding and conservation community to seek opportunities to contribute to these goals.

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