Least Flycatcher Nesting Habits and Nest Failure 2022-2025

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Introduction

The Beaverhill Natural Area (BNA) in central Alberta, Canada is a high-quality candidate for critical habitat for Least Flycatchers (*Empidonax* minimus) (Van Brempt et al. 2023). Understanding the nesting habits of the breeding population is essential in maintaining the suitability of the habitat and sustaining the productivity of the area. The most recent International Union for Conservation of Nature (IUCN) evaluation of the Least Flycatcher classified it of *Least Concern* (BirdLife International 2021). Despite the lack of Action Recovery Plan, the Least Flycatcher is experiencing relatively rapid population decline (Rosenberg et al. 2019). This is unsurprising, considering 73.1% of aerial insectivores are declining by 31.8% (Rosenberg et al. 2019). Pardieck *et al*. (2018) identified a decline of 18% over ten years. Although this decline does not qualify this species for any official classification, it should encourage the study of Least Flycatcher productivity and nesting, to develop a more complete understanding of the decline and factors that contribute to it, before the species is listed as a Species-at-Risk.

Since 2022, local breeding population of Least Flycatchers at the Beaverhill Natural Area have exhibited high breeding densities and high rates of nest success (Van Brempt et al. 2023). Monitoring of Least Flycatchers in this area has previously revealed interesting nesting behaviour, including higher rates of nest reuse than is thought typical for open-cup nesting passerines (Dykstra 2024, Otterbeck et al. 2019, Wuczyński & Hałupka 2024). Nest reuse in this species is particularly unusual, since birds with small body size that construct open-cup nests in the mid-canopy have been found to experience higher predation risk (Erckmann et al. 1990, Redmond et al. 2007, Martin 1995, Lack 1954). A high percentage of nests maintain structural integrity between one or two breeding seasons has previously been thought to contribute to nest reuse in the Beaverhill Natural Area (Dykstra 2024). Such structural retention has not been previously observed elsewhere, indicating that the BNA could offer a specific set of conditions, including weather between breeding seasons and nest building materials that makes it an ideal location for nest reuse (Dykstra 2024). The high diversity and abundance of arthropods in the Beaverhill Natural Area has been hypothesized to contribute the abundance of spiders and the frequent use of spiderwebs in nests which strengthen nest structure and increase durability between breeding seasons (Dykstra 2024).

Least Flycatchers typically construct open-cup nests in upright forks or near the base of horizontal branches (Briskie 1988). These nests are often made from fine grasses or other plant materials, reinforced with spiderwebs, and lined with cotton, grasses, feathers, or hair (Bent 1942, Harrison 1978, Briskie 1988). Their choice of nesting materials can be opportunistic; for example, in 1986, one nest was observed to be lined with multiple layers of dragonfly wings (Briskie 1988). This study aims to investigate nesting success, continue to assess the rate of nest reuse, and factors that contribute to nest failure in the Beaverhill Natural Area.

Methods

Survey methods

The study area covered approximately 15 ha in the Beaverhill Natural Area, based on previously identified Least Flycatcher nest locations. The study area was a mixed age deciduous forest, with trembling aspen (*Populus tremuloides* Michx.) and balsam poplar (*Populus balsamifera* L.) as the dominant species, in the Aspen Parkland Region.

A total of 43 nest sites from 2022, 2023, and 2024 were within the study area, and were surveyed and located using GPS points in May of 2025. Where nest structures could be identified, images were taken with a CIMELR brand ALS5005 dual lens industrial endoscope camera, fastened to a telescopic pole. Nests were rated on a scale of one to five (Table 1) based on the images taken, and the view of the nests through binoculars from the ground.

New nests were found by intensive searching through the study area, following Least Flycatcher territorial singing, contact calls, and defense displays. Brown-headed Cowbirds (*Molothrus ater*) a brood parasite were followed as they searched for Least Flycatcher nests (Briskie et al. 1990). Individuals carrying food or nesting material were also used as indicators of nest location, as per methods described by Van Brempt et al. (2023). Nest searching occurred at least four days a week, beginning the third week of May 2025, and continuing until the third week of June 2025. Old nests that were found before being occupied in 2025 were assigned an origin of “Before 2025”, and nests that were found lined and occupied were assumed to be newly constructed for the 2025 breeding season.

All nests were surveyed every three to five days, beginning three weeks after the first Least Flycatcher was captured during the Beaverhill Bird Observatory’s (BBO) Spring Migration Monitoring program. The first Least Flycatcher was caught on May 7th, 2025, and regular surveys began on May 28th, 2025. The first survey of old nests was completed on May 21st, 2025. All nests were empty on June 15th, 2025. In total, 42 nests were extant in any condition from 2022 to 2025. At each survey, all nests were surveyed regardless of their rating (see Table 1) and evaluated based on their structural condition. Nests were only excluded from a survey if it was significantly structurally compromised, or fallen out of a tree (via predation, weather etc.).

Egg lay dates were estimated within one day when clutches were surveyed before the end of laying, based on the laying frequency of Least Flycatchers (one egg per day), and an average clutch size of three to five eggs (Briskie & Sealy 1990). If this was not possible (ie. laying had completed before discovery), the latest possible lay date was estimated by subtracting the number of eggs in the clutch from the observation date. Nests with nestlings had an estimated lay date that was calculated by subtracting the age of the nestlings (in days) from 14 days prior to the first observation, assuming a 14-day incubation period (Davis 1959). Nestling age was assessed using photos taken with the pole camera, and an aging guide by Jacklin (2017), developed in the BNA. Once nestlings were close to fledging and exhibiting behaviours such as flapping their wings and peering over the edge of the nest (12-15 days old), age was assessed using binoculars to reduce the risk of premature fledging.

Nest success was classified as nests that had successful or presumed successful fledging at least one young. Although no nestlings were seen actively fledging, if the nest was observed empty, and nestling age was appropriate for fledging, nest success was assumed. Nest failure was characterized by eggs disappearing from the nest (predation, falling from the nest in a weather event), or active nests becoming compromised (i.e. pulled apart, fallen from tree). Nest parasitism by Brown-headed Cowbirds was also classified as nest failure, as no Least Flycatchers survived the event.

Table 1. Class variable scale of Least Flycatcher nest condition, assigned at every survey based on image taken and views from the ground.

Condition		**Example**
1	Extremely damaged; walls slumped or missing	
2	Poor condition; extremely misshapen with some walls slumped	
3	Decent condition; mostly round or slightly misshapen with walls in tact	
4	Good condition; round and with walls in-tact, but not lined	
5	Complete and lined; mostly round with new lining of feathers and nesting material	

Statistical Methods

Statistical analysis was completed using Excel data analysis tools (Microsoft Corporation 2018), and RStudio using the R base package (R Core Team 2022) and *ggplot* (Wickham 2016).

Results

In total, there were 14 active nests in the study area in 2025. Five of these nests were reused, two from 2024, one from 2023, and two from before 2025 that were discovered in May of 2025. Six active nests were successful, one was parasitized by a Brown-headed Cowbird that was raised by the Least-Flycatcher hosts, two nests were destroyed after occupancy but before egg laying, and five nests failed at various stages of egg and nestling development.

Only 43% of our small sample of active nests were successful. All failed nests, except for the one brood parasitized, were assumed predated, since the timing of failed nests were not correlated with high wind or heavy rain events that occurred during the breeding season. Two predation events occurred before eggs were laid, which could also be occurrences of intraspecific nest kleptoparasitism.

Nest Condition

Out of 43 nest sites from previous years of study within the study area, 22 nests were found present in any condition, and 21 nests could not be found, and were assumed to be gone. Nine nest sites from 2022 were included in the study area. Only four of those nests were still present, and only one nest was in good condition (condition 4), while three were structurally damaged (condition 1). 21 nest sites from 2023 were included in the study area, 12 of which were present. Seven nests were in poor condition (condition 2), three were in decent condition (condition 3), and two were in good condition (condition 4). 13 nest sites from 2024 were included in the study area, and six of them were present. Two nests were severely damaged (condition 1), two were in decent condition (condition 3) and two were in good condition (condition 4). Eight old nests were found prior to the 2025 breeding season that had not been found in previous years. Only two were in poor condition (condition 1, and condition 2), two were in decent condition (condition 3), and four were in good condition (condition 4). 20 nests were found, eight from previous breeding seasons, and twelve constructed for the 2025 season, making the total number of reusable nests 51. Overall, out of the 51 old nest sites, 30 were present in any condition (58.82%).

Nest outcome based on origin

The outcome of the nests (success versus failure) was investigated based on year of origin. In both successful and failed categories, newly constructed nests (2025) accounted for slightly over half of the nests (Figure 1, 62.5% and 60% in failed and successful nests, respectively).

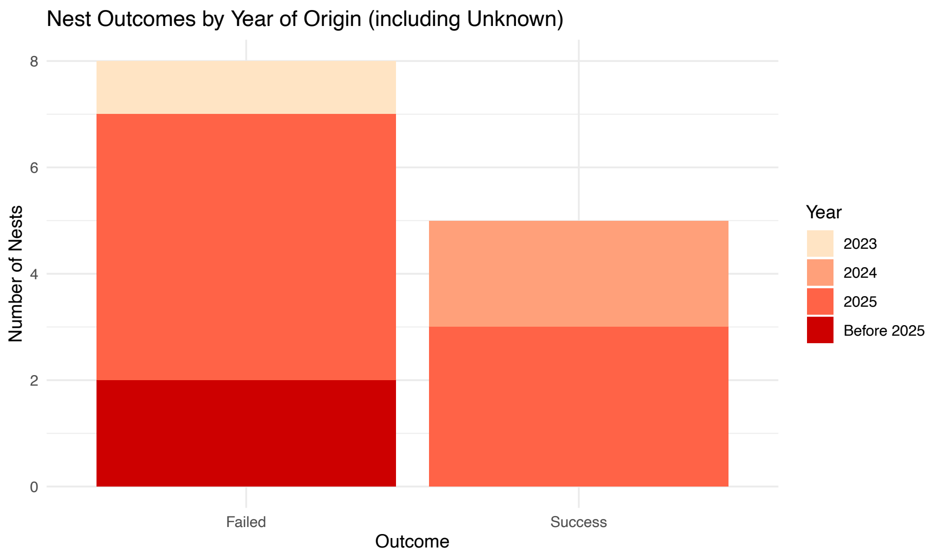

Figure 1. *Bar graph showing number of nests active in 2025 with each outcome (failed or success), based on year of nest origin.*

Out of the eight nests that failed, five were constructed in 2025, one was constructed in 2023, and two were constructed before 2025 with an unknown year of origin (Figure 2).

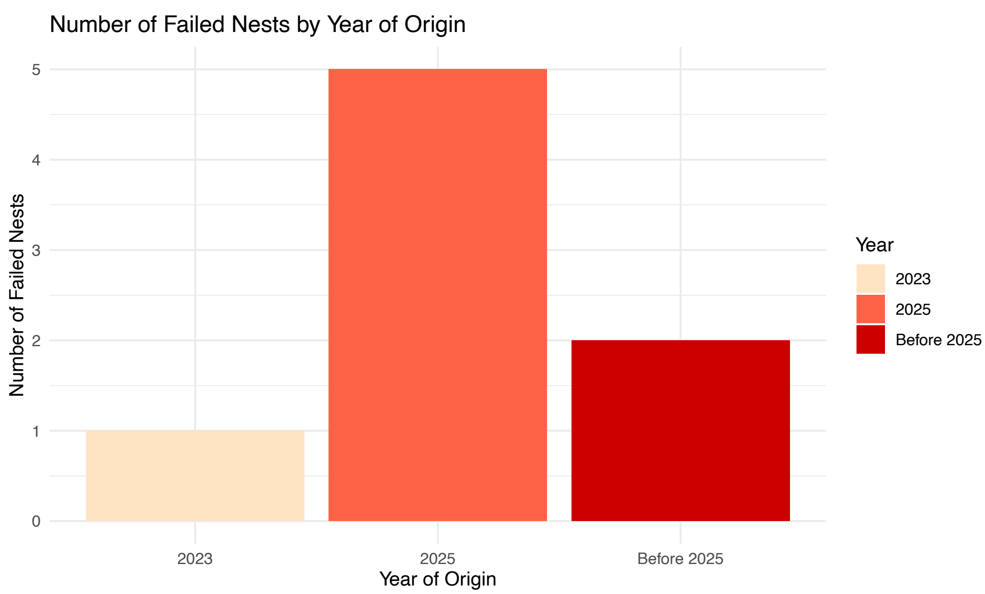

Figure 2. *Bar graph showing number of nests active in 2025 from each year of origin that failed in the 2025 breeding season.*

Nest outcome by initial condition

The initial condition evaluated at each nest when they were surveyed was assessed in relation to the nest outcome (Figure 3). The one active nest found in decent condition (condition 3) failed, half of nests found in good condition (condition 4) failed and half were successful. Nests that were found after they were lined and occupied were mostly unsuccessful (62.5%). The small sample size of all categories reduces the statistical power of these results.

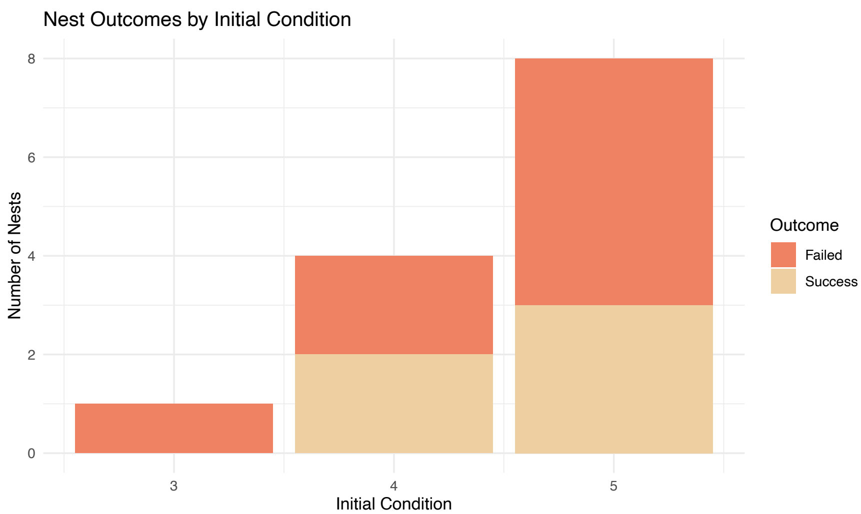

Figure 3. *Bar graph showing number of nests with each outcome (failed or success), binned by initial condition rating*

Nest longevity

Initial conditions were split by year of origin (Figure 4). Almost half of the nests that were no longer present were from 2023. Condition one nests were from 2024 and 2022, while almost all of condition two nests were from 2023. Condition three and four nests originated in all previous years of study (2022, 2023, 2024). There is no correlation between year of origin and initial condition.

Figure 4. Bar graph showing number of nests found in each condition (x axis) in May 2025, filled by the year of origin..

Egg laying initiation

Egg lay dates, calculated by laying sequence and hatch date, was graphed by Julian dates and nest outcome to identify patterns (Figure 5). Nests that were destroyed before egg laying were excluded from the analysis. Nine out of twelve nests that had eggs were laid between day 152 (June 1) and 158 (June 7). Of the nine, five nests were successful, three nests failed, and one was parasitized by a Brown-headed Cowbird. The three remaining nests had egg lay dates of Julian day 164 (June 13), 165 (June 14), and 171 (June 20). Two of those nests failed, and one was successful. The average lay date for successful nests was day 155.6 (approximately June 4, n=6). The average lay date of failed nests (including the parasitized nest) was day 160.2 (approximately June 9, n=6). However, when the three outliers are excluded, the average lay date for successful nests was day 155 (June 4, n=5), and for failed nests was day 156.3 (June 5, n=4).

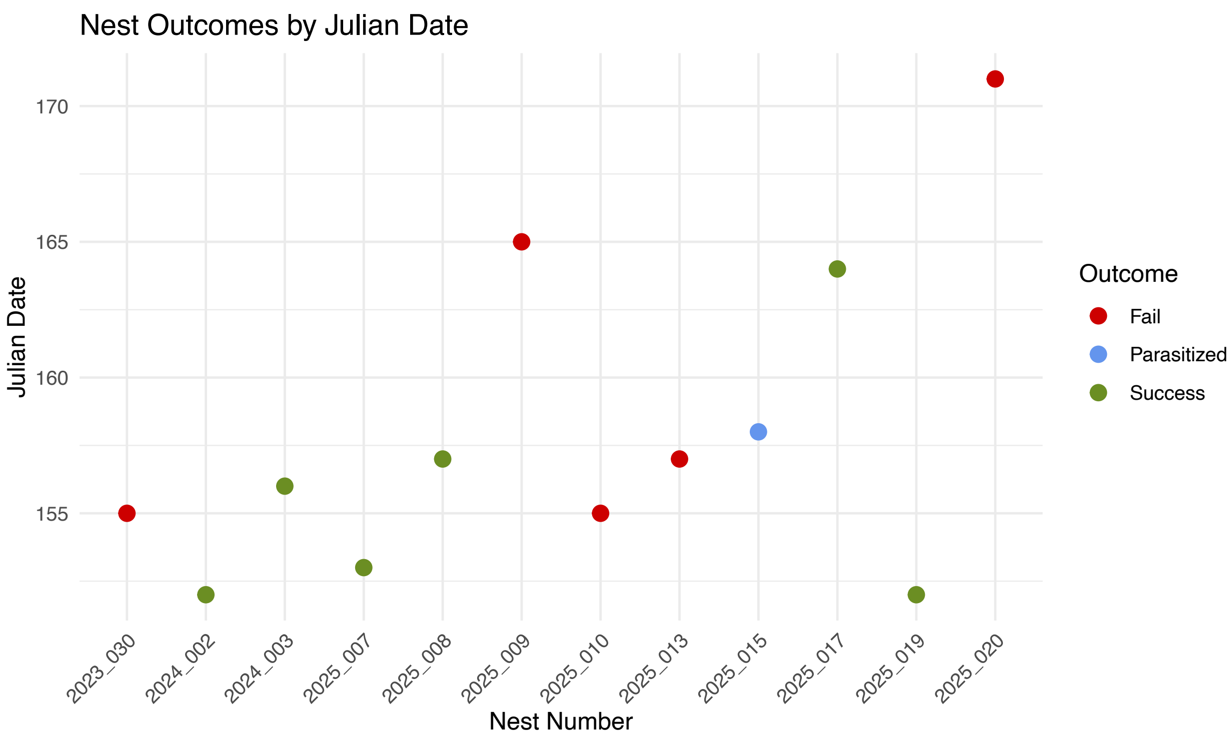

Figure 5. *Scatter plot showing nests that had eggs laid in them, plotted based on the latest possible lay date, and coloured based on overall outcome.*

A one-way ANOVA was completed to assess statistical significance ($p > 0.05$) in Julian lay dates across outcome categories (fail, parasitized, success). The ANOVA results were insignificant ($F = 0.968$, p-value = 0.416). A Tukey HSD Post-hoc test was also completed to evaluate pairwise differences. The adjusted p-values were insignificant for failed, parasitized, and successful nests (adjusted p-values = 0.914, 0.385, 0.928, respectively). The confidence intervals also all included zero, indicating insignificant results.

Discussion

Nest structural retention between years

Nest structural retention has been previously found to be high in the Beaverhill Natural Area (Dykstra 2024). The 2025 breeding season found a smaller proportion of nests from previous years maintained their structural integrity, though it was still more than half of old nests in the study area (59%). While no conclusion can be drawn from this in comparison to other breeding areas of Least Flycatchers, since studies in other areas have not presented structural retention between breeding seasons, it is still notably high. Previous literature indicates that the absence of nest reuse in open-cup nesters is due to exposure to the elements between breeding seasons, increasing the risk of nest damage in adverse weather, attributed to reduced structural stability (Batisteli 2021, Mezgaiski 2007). These results are congruent with last year's study (Dykstra 2024), where higher proportion of nests survived the winter condition between years, providing ample nests available for reuse.

Interestingly, the structural retention from previous breeding seasons does not change significantly between years, despite some nests experiencing three winters, and others experiencing one. 44.44% of old nests from 2022, 57.14% of nests from 2023, and 46.15% of old nests from 2024 maintained structural integrity until 2025. This indicates that the amount of time since construction, and number of winters were not significant in nest deterioration. This generates more nests in the BNA for nest reuse by Least Flycatcher, since nests from at least three years previous are still available to use again.

Nest outcome based on origin

Nest outcome was not found to have any correlation to nest origin, since both successful and failed nests were similar proportions of reused and new nests. Slightly over half of both failed (62.5%) and successful (60%) nests were newly constructed nests, indicating that fewer of reused nests accounts for the difference in successful nests. This corroborates results from Dykstra (2024), which found that risk of failure was not increased by reusing old nests. This study's results, when interpreted with the results from Dykstra 2024, indicate that the advantage to nest success, of reusing nests was not different compared to constructing new nests. As well, there is no increased risk to reusing nests, meaning that both nesting strategies provide equal opportunities for nest success or failure.

Nest outcome by initial condition

All successful nests were nests found in initial conditions of 4 or 5 (Table 1). Of active nests, none were in poor condition (conditions 1 or 2). This contrasts last year's study, which found poor condition nests had equal success to other quality nests (Dykstra 2024). Nest reuse in any condition is interesting, since open-cup nests are highly susceptible to predation, which typically deters nesting birds from returning to the same nesting locations in consecutive years (Weidinger and Kočvara 2010, Martin 1995).

Egg laying initiation

Egg laying initiation dates were largely within one week of each other (June 1st to June 7th). Of the nine nests that had similar lay dates, five were successful, one was parasitized by Brown-headed Cowbirds and one nest failed. The three remaining nests had a latest possible lay date of June 13th, 14th, and 20th. Two of these nests failed, while one was successful. The three outlier lay dates are nests that were found later in development, meaning that the estimated lay dates were the least accurate of all the lay dates calculated, which may account for the difference.

It is interesting to note that the Beaverhill Bird Observatory, who's nets overlap with the study area, caught Least Flycatchers in, or growing into juvenile plumage from July 11th to August 20. This may account for a spread in egg laying initiation and may indicate that nesting strategy is not related to timing of egg laying. Some other factors, such as double brooding or renesting of failed pairs in both types of nests (reported by Hoffman (1901), Bent (1942), Walkinshaw (1996) and Briskie and Sealy (1987)) or late arrival could create spread in egg laying initiation dates with no significant effect on nest reuse.

Nest failure

In the 2025 breeding season, over half of the nests in the study area failed (eight out of fourteen). The failure was attributed to presumed predation in five nests, which is typical in passerines, and particularly Least Flycatchers according to previous literature (Martin 1993, Thompson 2007, Briskie & Sealy 1989). There is a known population of Northern Flying Squirrels (*Glaucomys sabrinus*) in the BNA, which have been found by Bradley & Marzluff (2003) to frequenly predate on passerine eggs. Other observations have also found Flying Squirrels to be prevalent predators of passerines at the nestling stage (see: Bradley & Marzluff 2003, Jackson 1961, Godin 1977). Corvids have also been found to predate on passerine nests, and open nests in particular incur a high rate of corvid predation (Capstick & Madden 2021). Breeding Common Ravens (*Corvus corax*) have been observed in the BNA during Least Flycatcher breeding season, as well as observations of American Crows (*Corvus brachyrhynchos*). During breeding, predation is the primary cause of egg or nestling loss in many species and contributes largely to mortality of small landbirds in general (Newton. 1998). Briskie and Sealy (1989) reported that predation accounted for 83% of nest failure in their study, which is congruent with other research that found nest predation to be responsible for 50-98% of nest losses in open-cup nesting forest passerines (Gates & Gysel 1978, Donovan *et al*. 1995, King *et al*. 1996, Annand & Thompson 1997, Hoover & Brittingham 1998, Manolis *et al*. 2002, Phillips *et al*. 2005, Mattsson & Niemi 2006). Wilcove (1985) found that open cup nests were particularly at risk of predation, especially those placed above 1-2m. Due to Least Flycatchers typically nesting 0.6-15.2m (2-50ft) in the canopy, they are remarkably vulnerable to predation (Cornell Lab of Ornithology n.d.).

It is important to consider the possible impact of researchers' survey activity on both parental and predator behaviour. Previous literature has investigated higher human activity at the nest area, drawing the attention of potential predators (Skutch 1949, Martin et al. 2000, Matysioková and Remeš 2018, Arslan and Martin 2024). Incubating parents may increase the length of incubation bouts to reduce the amount of times they leave and return to the nest, so that predators have a lower chance of spotting them (Matysioková and Remeš 2018). When completing pole-camera surveys, parents on or around the nest are typically flushed off, retreating to nearby canopy for the duration of the survey. This increases the amount of activity at the nest site, and the number of times parents and leaving and returning, increasing risk of discovery by predators. It then must be considered that the act of surveying nests every three to five days increases the rate of discovery by predators. While nest survey techniques and frequency did not change from previous years, where there was significantly less predation, the study area size was reduced in 2025. Although no conclusion can be reached with confidence, the geographic condensing of survey activity may have concentrated predator activity on the study area.

Nest failure interestingly also occurred prior to egg laying, characterized by a physically compromised nest. Two nests failed this way and could be explained by nest kleptoparasitism by other nesting songbirds. Daryeau et al. (1993) reported two instances of female Least Flycatchers collecting materials from old nests and transporting them to a new nest in a nearby tree. Other passerines have been observed collecting nesting material from active nests, such as Cedar Waxwings (*Bombycilla cedrorum*), reported by Macqueen (1950) to have visited a Least Flycatcher nest three times to pull a Least Flycatcher nest apart. Nest kleptoparasitism has been observed at all stages of the nesting cycle, from nest building to post-fledging in several species (Jones et al. 2007). Jones et al. (2007) also observed Cerulean Warblers (*Dendroica* cerulea), Red-eyed Vireos (*Vireo olivaceus*), Blue-grey Gnatcatchers (*Polioptila caerulea*), Northern Parulas (*Parula americana*), Black-throated Green Warblers (*D. virens*), American Redstarts (*Setophaga ruticilla*), and Orchard Orioles (*Icterus spurius*) stealing nesting material from other passerine nests. While only Red-eyed Vireos nest in the Beaverhill Natural Area, it is a plausible hypothesis that other nesting passerines would source nesting material from other nests to construct new nests.

Of two nests parasitized by the Brown-headed Cowbird, one was also predated. Least Flycatchers are high-quality hosts of Brown-headed Cowbirds, as they readily accept the foreign eggs (Briskie et al. 1990). While this nest increased the proportion of nests that failed within the study area, nest parasitism by Brown-headed Cowbirds was uncommon, and was not unusually high compared to other years in the BNA.

Conclusion

The 2025 breeding season study of Least Flycatchers in the Beaverhill Natural Area highlights both the unique nesting ecology of this species in the region and the persistent challenges to nest success. Structural retention of nests remained high compared to typical open-cup nesters, with more than half of old nests still intact, supporting previous findings that the BNA provides conditions conducive to nest durability and reuse. However, reuse did not significantly affect nest outcome, with both reused and newly constructed nests showing similar proportions of success and failure. Reuse also did not significantly affect nesting timing, with the lay dates of nests averaging the same across both types of nest sites.

Nest predation was the dominant cause of failure, consistent with other literature investigating small passerine nesting success. Additional potential pressures, including nest kleptoparasitism and survey-related disturbance, may also contribute to reduced productivity. Conclusions about specific causes of nest failure cannot be reached without more intensive observations, although it should be considered that survey activities impact the rate of nest failure. Egg laying initiation showed little variation, with most clutches beginning in early June, and no significant relationship was found between timing and nest outcome.

Overall, this study found the persistence of old nests between years and consequently nest reuse within the Beaverhill Natural Area . Nest reuse appeared to offer no advantage and posed no additional risks when compared to constructing new nests. High predation rates and suspected nest kleptoparasitism were causes for failure. While nest failure in open-cup nesting passerines had historically been attributed to predation, the increased number of predator-related nest failures compared to previous years should be contemplated. Frequent nest surveys, and related parental and predator behaviour associated with survey activity, are important to consider when analyzing the low fecundity of the study area.

Recommendations

There is more to learn about Least Flycatcher nesting behaviour in the Beaverhill Natural Area, as such a dense breeding population offers potential for large sample sizes. The wide temporal spread of juvenile birds could imply interesting breeding behaviour, such as double brooding via male polygyny (reported in other areas by Hoffman (1901), Bent (1942), Walkinshaw (1996) and Briskie and Sealy (1987)), as well as changing breeding and migration timing (Van Brempt et al. 2025). To investigate these breeding behaviours further, colour banding and specific nest observation could provide information on specific nesting habits of the species in the BNA. Additional studies could develop understanding of nest clustering and the social dynamic of Least Flycatchers in the Beaverhill Natural Area. Site-specific research on the hidden-lek hypothesis (see Tarof et al. 2005, Fletcher & Miller 2006, Tarof 2001) could reveal social behaviour in Least Flycatchers in a high-density breeding area. Finally, predation could be analyzed in the context of nest clusters, to understand potentially high rates of predation and how they relate to their relative position within clusters. Ultimately, this study should encourage future investigations to take a more cautious approach to survey techniques, to reduce the risk of anthropogenic influence on nest predation. Looking for avian predators before checking nests and checking nests less frequently should be considered.

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