U.S. Fish & Wildlife Service

Tree swallow nest box monitoring, Bethel, Alaska, 2025

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Yukon Delta National Wildlife Refuge
Bethel, Alaska
2025

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Keywords:

Aerial insectivore, Banding, Bethel, Nest box monitoring, *Tachycineta bicolor*, Tree Swallow

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ABSTRACT

Aerial insectivores have experienced widespread population declines. Several causes for these populations declines have been proposed, however, in western Alaska, there is limited information about the demographic rates of the Tree Swallow. Studying demographic vital rates, phenology, interannual variability, and long-term population fluctuations could aid in understanding the Tree Swallows in northern latitudes. In 2025, Tree Swallow nest monitoring in Bethel, AK resumed to continue data collection and to engage in community outreach. Nest box occupancy rate was 74.3% (26/35). Mean initiation, hatch, and fledge dates were 27 May, 17 June, and 8 July, respectively. Mean clutch size was 5.89 ± 0.12. Out of the 26 active boxes, 22 had successful fledglings (84.6%). We successfully captured and banded 26 new adults and 118 chicks, and recaptured an additional 6 previously banded Tree Swallows. Future monitoring efforts will continue to expand our understanding of breeding parameters, contributing to population trends, and continue our successful community involvement outreach project as staffing allows.

INTRODUCTION

Aerial insectivores (nighthawks, nightjars, swifts, swallows and some species of flycatchers) are experiencing widespread population declines, up to 70% in some species (McCracken 2008, Nebel et al. 2010). Although members of this group differ in many life history traits, they all specialize in capturing insects while in flight. Several causes for population declines have been proposed including climate change (Stenseth and Mysterud 2002), resultant changes in insect prey availability and abundance (Stenseth and Mysterud 2002, Jones and Cresswell 2010), and habitat modification and loss (Robinson et al. 1995, Murphy 2003). The widespread use of agricultural pesticides that reduce insect abundance (Benton et al. 2002) can be toxic to insectivores (Longcore et al. 2007). Many aerial insectivores are also long distance migrants, which is a high-risk strategy, and they may face considerable hazards or experience harmful energy depletions along their migratory pathways (Taylor and Anderson 1973, Sillett et al. 2002, Newton 2007). Michel et al. 2015 found that populations of certain aerial insectivores are declining as a result of large-scale but complex, species- and region-specific environmental conditions (e.g. climate, land use), while a single primary cause of aerial insectivore declines as a whole appears unlikely.

Because of concerns about aerial insectivores, Boreal Partners in Flight (BPIF), an organization of professional ornithologists operating in Alaska and far western Canada that functions as a regional working group for International Partners in Flight, decided to focus greater efforts on swallow research and created the Alaska Swallow Monitoring Network. The Tree Swallow (*Tachycineta bicolor*) was selected as a favorable aerial insectivore species to study due to their tolerance for human disturbance, willingness to use man-made nest boxes, fidelity to their nest sites, continent-wide range, and the fact that there is already a large body of research to build upon. This species can serve as a model for better understanding challenges facing more sensitive taxa that are less tolerant of disturbance and in greater decline and can also serve as a bio indicator for contamination and impacts of climate change.

Although Tree Swallows are one of the most studied birds in the world, there is currently very little Tree Swallow nesting information for western Alaska. The main scientific goal of our study is to establish a Tree Swallow nest box monitoring program in Bethel, Alaska as part of a larger monitoring network across the state to better understand the challenges facing aerial insectivores, investigate the impacts of climate change on boreal birds, and obtain insights on breeding ecology and population trends of Tree Swallows in Alaska.

A second goal of this project is provide outreach and education about bird ecology and conservation. Community involvement in refuge projects on the Yukon Delta National Wildlife Refuge is generally limited due to the remoteness of field study sites. Tree Swallow nest box monitoring, however, fits well with a more urban setting due to their willingness to use man-made nest boxes and their high tolerance of human disturbance. This project gives us the opportunity to involve local students, university students, community residents, and refuge staff in meaningful scientific research, and provides a focal point for learning about avian conservation. The experiences and learning opportunities of this project may also help people understand how climate change may impact wildlife in the sub-Arctic regions.

The objectives of this project are to:

1. Monitor nest box occupancy, nesting phenology (arrival date, clutch initiation date, hatch date, fledging date), and nesting success (clutch size, hatching rate overall nest success) at 30 or more nest boxes per year in Bethel for greater than three consecutive breeding seasons.

2. Capture, band, and recapture nesting adults at 30 or more nest boxes per year to monitor return rates, site fidelity, and, if sample size is adequate, adult survivorship. If personnel resources allow, band chicks to monitor natal site fidelity.

3. Annually recruit 1-2 students (undergraduate level) and more citizen scientists to assist with nest box monitoring from May through July.

4. Use the Tree Swallow project as an example for educating others about science, avian ecology and conservation, and the potential impacts of climate change through the use of oral presentations, classroom visits, written articles or reports, and field trips.

5. Contribute data to the statewide database for the Alaska Swallow Monitoring Network to be used for comparisons of nesting phenology and reproductive success across the state and continent.

STUDY AREA

Bethel, Alaska (60°47'N, 161°45'W) is a city located on the Yukon Delta National Wildlife Refuge (YDNWR) along the Kuskokwim River, on the northwestern edge of the Tree Swallow's breeding range (Figure 1). The surrounding landscape is predominantly flat wet tundra with low lying hills (Ferrians 1965). The city is surrounded by many small ponds, lakes, and marshes that are characteristic of the Yukon-Kuskokwim Delta (Doolittle et al. 1990). During the summer, average high temperatures are 16.7°C (62°F) average low temperatures are 6.7°C (44°F), and precipitation is most frequent and at greatest levels during the summer months (US Climate Data 2026).

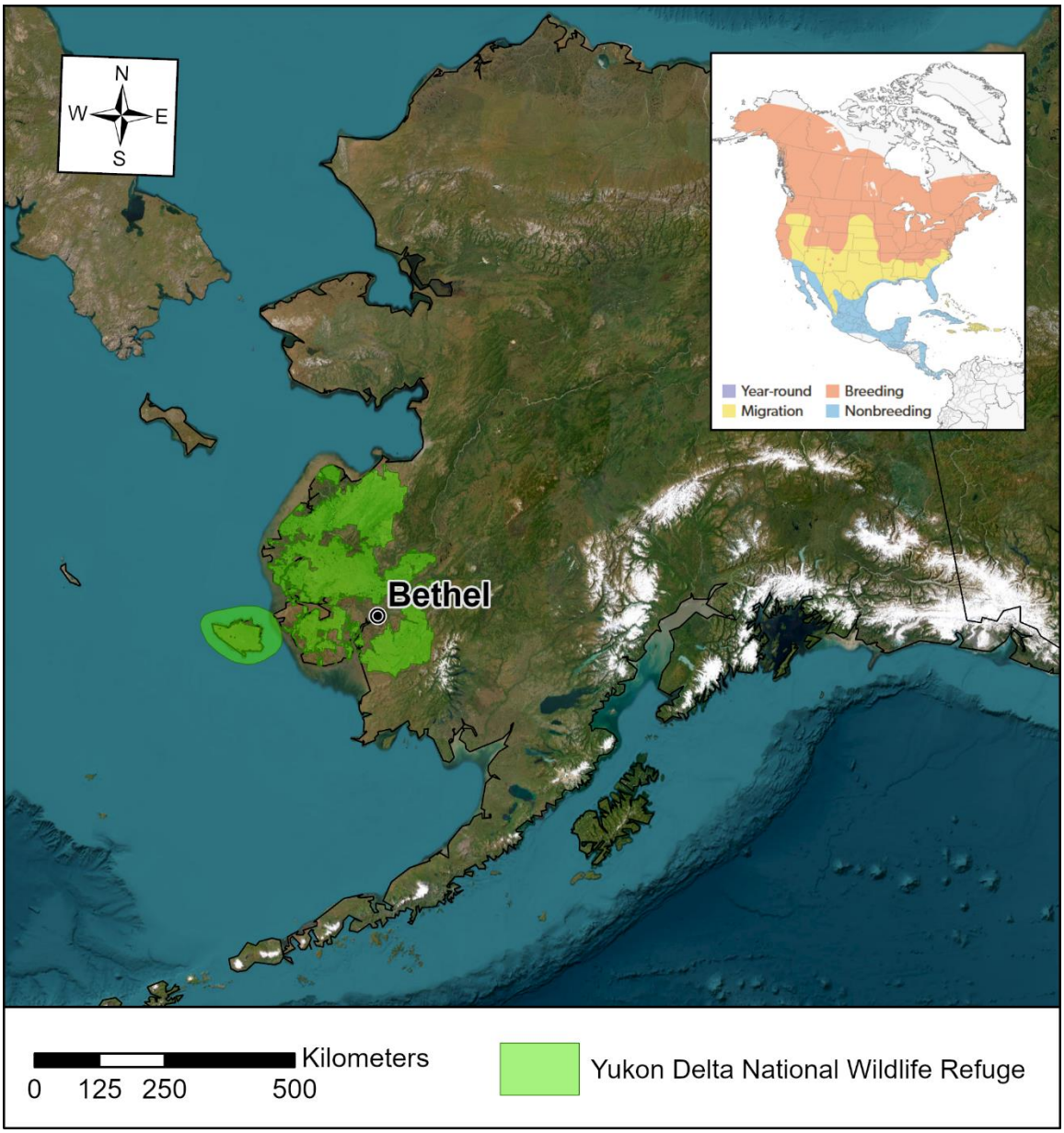

Figure 1. Location of Bethel, Alaska and the Yukon Delta National Wildlife Refuge. The inset map shows the Tree Swallow's distribution across North America.

The use of swallow nest boxes is widespread and well established among the villages of the Yukon-Kuskokwim Delta. Many currently exist in a variety of shapes and sizes in Bethel, AK, but there are 35 boxes monitored annually for this study (Figure 2).

Figure 2. Locations of monitored Tree Swallow nest boxes in Bethel, Alaska, 2025

METHODS

Nest Boxes

Thirty-five nest boxes were reused and repaired for maintenance before monitoring. Nest boxes were mounted onto trees, metal poles, wooden posts, deck railings, or walls in our study areas on USFWS facilities and on a locally owned business (Stan Corp's home and shop). We did not include nest boxes on private residences in 2025 because we were unable to obtain permission from the homeowners in time for monitoring. Nest box design follows the protocol described by the Alaska Songbird Institute, Swallow Ecology Project Manual (2023 2nd edition, Appendix A), that included a hinge on the side creating a swinging side wall to open and examine the contents. Each nest box is marked with a unique number identification and their locations were recorded with GPS coordinates.

Nest Monitoring

We followed the nest monitoring protocols described by Alaska Songbird Institute, Swallow Ecology Project Manual (2023 2nd edition). Monitoring of the nest boxes began in early May (07 May 2025) before swallows began building nests. Key dates obtained from monitoring included clutch initiation, onset of incubation, hatch date, and fledge date. Reproductive parameters obtained from monitoring included clutch size, brood size, and nesting success. The schedule for checking nests varied according to nesting phenology and was usually every third day but more often during expected hatching and fledging periods. Nests were not checked during the first half of the incubation period to avoid disturbing the birds which could cause nest abandonment.

Adult Capture and Banding

Tree Swallows were banded to facilitate data collection on return rates, site fidelity, and survivorship. Adults were captured in the nest box after chicks were removed from the nest box. Adult females were targeted for capture during late incubation (after day 8) or soon after the chicks hatched as they would sit very tight on the nest and could be trapped simply by walking up to the box, covering the hole, and gently removing the bird through the side door. Adult males were targeted for capture during the early brood-rearing period (up to approximately day 5). Usually both adults could be captured during this window of time while intensive feeding of the chicks occurred. To capture adults that were not sitting in the nest box when we first arrived, a trap door was set up over the hole of the box using a piece of cardboard with rock taped to one side. The trap door is taped to the inside of the nesting box above the entrance hole and propped up with a piece of stiff grass. Upon entry, the swallow would knock the grass over, causing the door to close and trapping the swallow in the box. The box was monitored until the trap was triggered, at which time a bander approached the box, carefully opened the side door and removed the adult. The trap was then reset and monitored in an attempt to capture the second adult of a mated pair while the first adult was being banded.

Swallows were banded with a standard aluminum Federal leg band (size 1) on the right tarsometatarsus. Codes for these classifications and assessments are included on the banding data sheet (see Appendix B and C). Measurements were taken to the nearest millimeter of culmen, wing chord, and flat wing. Description of these measurements are included in the study plan (Sowl 2018). Mass was measured in grams using an electronic scale. After banding, a swallow was held for up to thirty minutes in a cotton drawstring bag, while waiting for its mate to be trapped. If the weather was cool and damp, the banded swallow was held for a lesser period of time, depending on conditions. If the second swallow was not trapped within thirty minutes of the first capture, the trap door was removed from the box and the first swallow was released. Attempts were made to capture the second adult on another day. Banding data was recorded on banding sheets.

Chick Banding

Chicks that were large enough for banding were removed from the nest box, placed in a cotton bag, taken to the banding locations (usually inside of a vehicle), and banded. Chicks were banded at approximately 9-12 days of age, and were measured and banded to study growth rates and look at natal site fidelity. Growth rates can be influenced by environmental conditions and insect availability; therefore, developmental landmarks were used to assess when chicks were ready to receive a band. The ideal time to band is when the primary feathers were breaking through their sheaths and legs had lengthened and become scaly. A leg gauge was used to determine if the legs of the chick had slimmed down and lengthened enough for banding with size 1 band. Morphometric measurements were taken for culmen flat wing, longest exposed primary, and mass. Fat deposition was also assessed. All chicks within the same brood may not be at the same developmental stage and it was common to have one or two chicks that were less developed than the rest. In this case, we banded the chicks that met the criteria for banding and returned a day or two later to band the less developed chicks. The banding

and measuring of chicks was done quickly, because they are extremely sensitive to the weather conditions and also to minimize stress to the parents.

Summary Statistics

Data was recorded on field data sheets and later entered into a Microsoft Excel spreadsheet. We used Program R (R core team) to estimate our predicted hatch dates and fledge dates, in addition, morphometric means were calculated.

RESULTS

Nest Box Monitoring

The first Tree Swallow was observed in Bethel on 30 April 2025. We monitored a total of 35 nest boxes from 29 April – 17 July 2025. Nest box occupancy was 74.3%, with 26 of the 35 boxes containing active nests. Of the 26 active nest boxes, 23 successfully hatched eggs (88.5%), two nests were abandoned (7.7%), and one contained all inviable eggs (3.8%). Out of the 23 hatched nests, 21 nests successfully fledged (91.3%; Table 1).

The earliest clutch was initiated on 23 May 2025 and the latest on 5 June 2025, with a range of 13 days of egg laying. Mean clutch initiation date was 27 May 2025 and the mean number of days per incubation period was 17 days, ranging between 15 and 20 days. The mean hatch date was on 17 June 2025, and all nests hatched between 17 June and 23 June 2025. The mean fledging date was 8 July with the earliest chicks fledging on 2 July and latest on 15 July. The mean age of nestlings at fledging day was 20 days old, with a minimum and maximum of 18 and 26 days, respectively.

A total of 153 eggs were laid and 134 (87.5%) of those eggs hatched. Mean clutch size was 5.89 ± 0.12. Of the 127 hatchlings, 121 chicks successfully fledged (95.3%) with a mean of 4.65 ± 0.42 fledglings per nest. Out of the 26 occupied boxes, 22 boxes successfully fledged at least one chick, resulting in an 84.6% success rate from incubation to fledging.

Table 1. Breeding phenology (Initiation Date, Hatch Date, Fledge Date), clutch size (Eggs), number of eggs hatched, number of chicks fledged, and nest fate from the active Tree Swallow boxes in Bethel, Alaska, 2025. Nests are listed in order of hatch dates.

Box ID	Initiation Date	Hatch Date	Fledge Date	Eggs	Eggs Hatched	Fledged	Successful
4	May 26	Jun 14	Jul 05	6	6	6	Y
2	May 23	Jun 14	Jul 02	6	6	6	Y
25	May 25	Jun 14	Jul 05	6	6	6	Y
10	May 24	Jun 15	Jul 05	7	6	6	Y
11	May 26	Jun 15	Jul 05	5	5	5	Y
23	May 26	Jun 15	Jul 05	6	6	6	Y
9	May 27	Jun 16	Jul 10	6	6	6	Y

31	May 27	Jun 16	Jul 05	6	6	6	Y
16	May 27	Jun 16	-	7	7	0	N
8	May 26	Jun 17	Jul 05	6	6	6	Y
45	May 27	Jun 17	Jul 10	6	5	5	Y
7	May 27	Jun 17	Jul 10	6	6	6	Y
6	May 27	Jun 17	Jul 05	6	6	6	Y
21	May 27	Jun 17	Jul 13	6	5	4	Y
14	May 28	Jun 19	-	6	5	0	N
13	May 27	Jun 19	Jul 09	6	5	5	Y
40	May 28	Jun 19	Jul 08	6	6	6	Y
1	May 27	Jun 20	Jul 08	6	5	5	Y
44	May 27	Jun 20	Jul 09	6	5	5	Y
22	May 29	Jun 20	Jul 10	5	4	4	Y
20	May 29	Jun 20	Jul 09	7	6	6	Y
41	May 31	Jun 20	Jul 13	6	6	6	Y
30	Jun 03	Jun 22	Jul 13	6	6	6	Y
12	Jun 05	Jun 23	Jul 15	4	4	4	Y
19	May 23	-	-	5	0	0	N
42B	May 26	-	-	5	0	0	N
Total				153	134	121	84.6%
Mean ± SE	May 27 ± 0.6 d	Jun17 ± 0.5 d	Jul 8 ± 0.7 d	5.88 ± 0.13	5.15 ± 0.33	4.65 ± 0.42	

Adult Capture and Banding

Adult swallows were captured at each nest box from 26 – 29 June. A total of 32 adult swallows were captured, with 26 being new birds and 6 recaptures. Among the 26 newly captured swallows, 17 were females and 9 were males; and of the 6 recaptures 2 were female and 4 were males. Of the 6 recaptured swallows, 5 were banded in 2023 and 1 was banded in 2024. Overall, there were 31 After Hatch Year (AHY) and 1 Second Year (SY) swallows captured.

Table 2. Recaptured Tree Swallows in 2025 including the origin of banding year and nest box.

Band Number	Year Banded	Banded Box ID	Year Recapatured	Recaptured Box ID
1601-06706	2023	7	2025	8
1601-06725	2023	41	2025	8
1601-06746	2023	5	2025	1
1601-06797	2023	20	2025	20
1601-06747	2024	33	2025	40
2811-00974	2023	4	2025	4

Morphological measurements were similar between males and females. Mean morphometrics of adult females (n=19) were: culmen length 5.58 ± 0.1 mm, wing chord length 115.58 ± 0.84 mm, flat wing length 116.84 ± 0.87 mm, and mass 21.27 ± 0.22 grams. Mean morphometric measurements for adult males (n=13) were: culmen length 5.64 ± 0.2 mm, wing chord length 121.08 ± 1.17 mm, flat wing length 122.46 ± 1.14 mm, and mass 21.59 ± 0.24 grams (Table 3).

Table 3. Mean morphometric measurements for captured male and female adult Tree Swallows in Bethel, Alaska, 2025.

Sex	Measure ± SE	Culmen (mm)	Wing Chord (mm)	Flat Wing (mm)	Mass (g)
F (n =19)	Mean ± Std Error	5.58 ± 0.1	115.58 ± 0.84	116.84 ± 0.87	21.27 ± 0.22
M (n = 13)		5.64 ± 0.2	121.08 ± 1.17	122.46 ± 1.14	21.59 ± 0.24

Chick Banding Data

Chicks were banded from 25 June through 2 July 2025 from 22 of the 26 active nest boxes. Mean morphometric measurements of captured chicks (n=118) were: culmen length 4.84 ± 0.03 mm, flat wing length 50.24 ± 0.6 mm, longest broken primary 11.34 ± 0.46, and mass 23.32 ± 0.25 grams.

DISCUSSION

The Tree Swallow nest box monitoring in Bethel, AK was reestablished in 2025 and had a successful season, largely due to the consistent data collection and entry throughout the entire monitoring period. The project was initiated in 2017; however, monitoring efforts haven't been consistently conducted over the years due to staff turnover. Comprehensive data was collected in 2017, 2018 and partially in 2023, and nest box monitoring didn't occur 2019 – 2022 or in 2024.

Thirty-five nest boxes were monitored throughout the city of Bethel. Thirty of the nest boxes were located on USFWS property, three were on a private residence, and two were at a local business shop. In previous efforts, the study design once included a total of 49 nest boxes. The remaining 14 nest boxes were not included in this year's study because we did not have contact information to gain permission from private residences that had participated in previous years. Of the 35 boxes monitored, nest box occupancy was relatively high with 74.3% occupancy rate. Of the 9 nest boxes that were unoccupied in 2025, seven had been occupied in previous years. The cause of these non-occupancies is unknown; however, swallows were observed investigating some of the unoccupied nest boxes earlier in the season but did not gather nest materials.

The six recaptured birds showed evidence of adult site fidelity during the 2025 season. Five of these were banded in 2023 and one in 2024. The two recaptured birds were found using the same exact nest box in which they were originally banded. The other four recaptured birds were found in a nearby nest box from which they were originally banded in the same area. These recaptures suggest that Tree Swallows exhibit nest site fidelity to breeding locations in Bethel, which in turn can contribute to high next box occupancy rates.

The breeding phenology for Tree Swallows in 2025 was similar to phenology in 2017. The initiation date ranged from 23 May to 6 June 2025 with a mean initiation on 27 May, hatch dates ranged from 14 June to 23 June 2025 with a mean hatch date of 17 June, and fledge dates ranged from 5 July to 15 July 2025 with a mean of 8 July (Figure 3). Across all monitoring years, the cumulative mean clutch initiation date for Tree Swallows is 28 May. The similarity between 2017 and 2025 likely reflects similar snow melt and spring conditions. Overall, the tree swallow initiation dates fall within the expected breeding range at this latitude, where initiation dates are latest in comparison to southern latitude breeders (Gow et al. 2019).

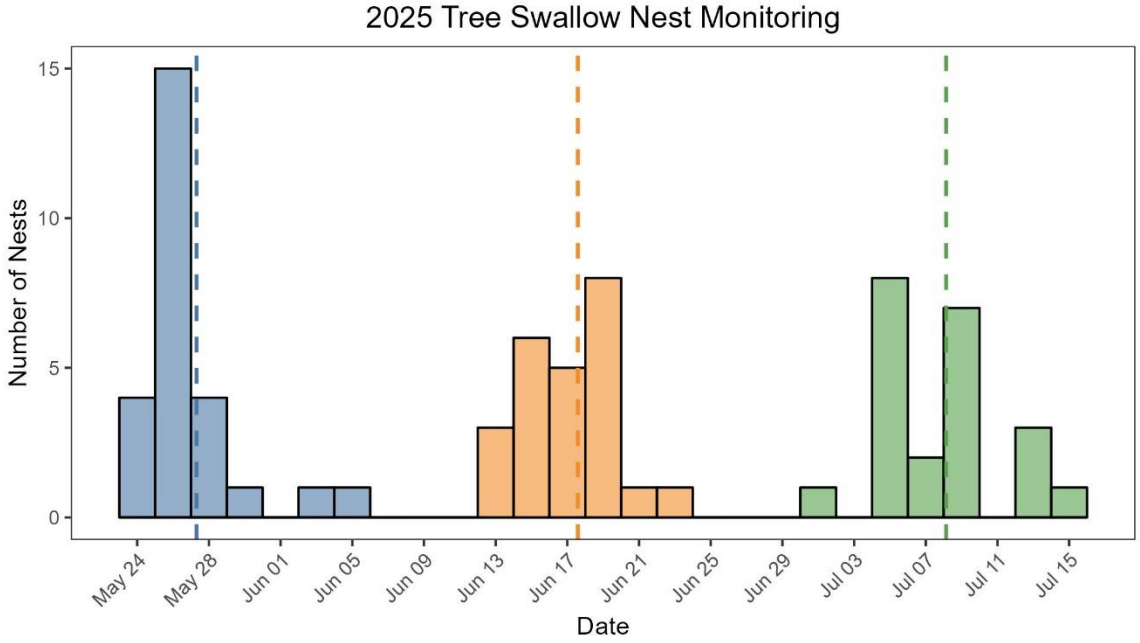

Figure 3. Frequency distribution of Tree Swallow initiation dates (blue bars), hatch dates (orange bars), and fledge dates (green bars) in Bethel, Alaska, 2025. Dashed lines indicate mean initiation date (27 May), mean hatch date (17 June), and mean fledge date (8 July).

The Tree Swallows had high nesting success in 2025, with most of the occupied nest boxes fledging at least one chick. During the nestling period (hatch to fledging), fledging success largely depends on summer weather because chicks require constant feeding and warmth. Weather conditions during the nestling period in 2025 were generally warm and sunny, which likely contributed to the high success of chicks fledging. Extended periods of rain followed by decreased temperatures can reduce insect availability, which limits

the food resources for chicks. We observed chick mortality from two nest boxes that resulted from consecutive days of inclement weather. Two additional occupied nest boxes failed to hatch their eggs, and we observed the swallows continued incubating the eggs beyond the incubation period suggesting these eggs were inviable which then led to abandonment.

Due to disjointed project efforts, return rates, site fidelity, and adult survivorship cannot be calculated until 2 more consecutive years data are collected.

Future Recommendation

Hiring two interns to monitor the Tree Swallow nest boxes for the entirety of the season is imperative to the project's success for monitoring all the important date criteria. Without monitoring, trapping dates cannot be estimated. Ensure all data is entered into excel in a timely fashion. The project needs to be active for more than three consecutive years to be able to determine return rates, site fidelity, and adult survivorship using Cormack-Jolly-Seber (CJS) models.

ACKNOWLEDGEMENTS

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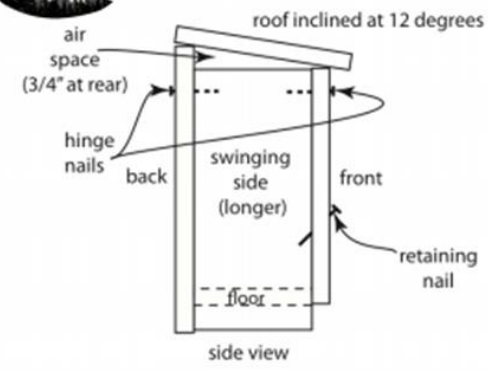
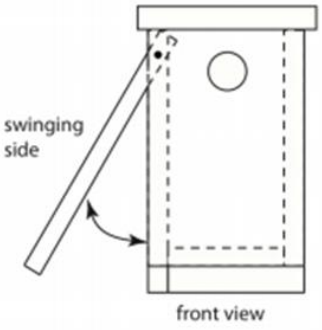
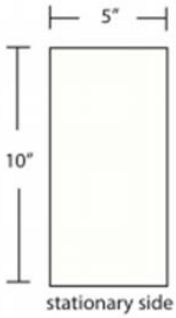
APPENDIX A. TREE SWALLOW NEST BOX PLAN

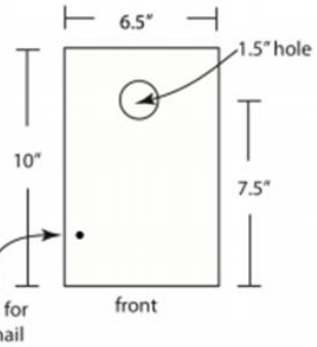
ALASKA SONGBIRD INSTITUTE

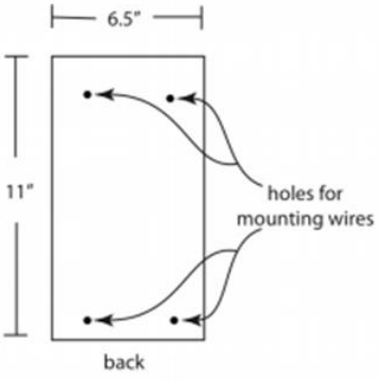
Tree Swallow (*Tachycineta bicolor*)
Nest Box Plans

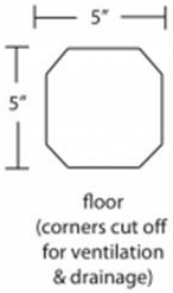


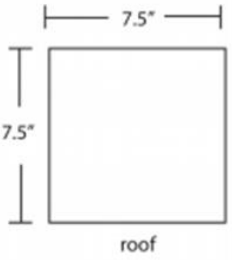












APPENDIX B. TREE SWALLOW ADULT BANDING SHEET

ADULT Banding Sheet ___ of ___ Year_____________ Site_____________

data entered?	bander	scribe	Nest Box #	Band number	Date (Month/Day)	Disposition	Species	Age	How Aged	Sex	CP	BP	Fat	Culmen (nares to tip)	Wing Chord	Flat Wing	Mass	PP molt	PP Wear	Mite holes	Condition				Note #

Disposition:
1 - Newly Banded
R - Recaptured
4 - Band Destroyed
5 - Band Replaced
8 - Band Lost

Condition:
04 - dead, band left on bird
05 - dead, band removed
07 - live release, band left on bird
08 - live release, band removed

Spp:
TRES - Tree Swallow
VGSW - Violet-green Swallow

Age:
AHY - after hatch year
SY - second year
ASY - after second year

Sex:
U - unknown
M - male
F - female

BP/CP:
0 - absent
8 - present

How Aged:
P - Plumage

PP Molt:
0 - no molt
1 - juvenile
2 - symmetrical
3 - adventitious

PP Wear:
0 - no wear, light edging
1 - very little wear; no fraying/nicks
2 - slight wear, some nicks
3 - moderate wear, nicks, tips are worn
4 - heavy wear, most featheres nicked, tips worn noticeably
5 - excessive wear; feathers ragged; shafts exposed below vane; tips broken

Fat: primarily use furculum if areas don't coincide

	Furculum	Abdomen
0	No fat, concave	No fat
1	Trace of fat	Trace
2	Thin layer	Thin Layer
3	1/2 filled in small patches	Not covering in all areas
4	Filled, level with clavicles	Covering, slightly mounded
5	Slightly bulging	Well mounded
6	Bulging greatly	Greatly distended mound
7	Large fat pads of furculum and abdomen meet	

Mite holes: Record acutal number for ≤ 10. Otherwise record >10.

NOTES: Birds sexed by presence of BP/CP and aged by plummage (P). Otherwise, add note. Also add a note to carefully describe the presence of bot fllies, pox, or other anomolies.

APPENDIX B. TREE SWALLOW ADULT BANDING SHEET (CONTINUED)

ADULT Banding Sheet ___ of ___ Year_____ Site_____

Note #	Notes

APPENDIX C. TREE SWALLOW CHICK BANDING SHEET

CHICK Banding Sheet ___ of ___ **Year_____** **Site_____**

data entered?	bander	scribe	Nest Box #	Band number	Date (Month/Day)	Disposition	Species	Age	Sex	Fat	Culmen (nares to tip)	Flat Wing	Longest Broken Primary (mm)	Mass	Condition	NOTES (if more space is required, number in the next column and continue on the back)	Note #

Disposition:
1 - Newly Banded
R - Recaptured
4 - Band Destroyed
5 - Band Replaced
8 - Band Lost

Condition:
04 - dead, band left on bird
05 - dead, band removed
07 - live release, band left on bird
08 - live release, band removed

Spp:
TRES - Tree Swallow
VGSW - Violet-green Swallow

Age:
L - chick (in nest)

Sex:
U - unknown

Fat: primarily use furculum if areas don't coincide

	Furculum	Abdomen
0	- No fat, concave	No fat
1	- Trace of fat	Trace
2	- Thin layer	Thin Layer
3	- 1/2 filled in small patches	Not covering in all areas
4	- Filled, level with clavicles	Covering, slightly mounded
5	- Slightly bulging	Well mounded
6	- Bulging greatly	Greatly distended mound
7	- Large fat pads of furculum and abdomen meet	

NOTES: Add a note to carefully describe the presence of bot fllies, pox, or any other anomolies. Also note the number of chicks banded from each box. (For example 4 of 6 chicks banded, or 6 of 6 chicks banded).

APPENDIX C. TREE SWALLOW CHICK BANDING SHEET (CONTINUED)

CHICK Banding Sheet ___ of ___ Year_____ Site_____

Note	Notes