

MANITOBA CHIMNEY SWIFT INITIATIVE GUIDE FOR MONITORING CHIMNEY SWIFT NEST SITES: HOW TO IDENTIFY STAGES OF NESTING AND DETERMINE BREEDING SUCCESS.

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Introduction

Chimney Swifts (*Chaetura pelagica*) are gregarious insectivores that winter in the upper Amazon basin and summer in eastern North America.¹ In the summer range, mature Chimney Swifts typically breed in urban settings from Texas and Florida through to southern Manitoba and southeastern Saskatchewan.¹ Near the northern periphery of the range, breeding Chimney Swifts arrive in southern Manitoba in mid- to late May. By late August, the nesting season is complete and the Chimney Swifts have begun their migration south.

Due to significant population declines, the Chimney Swift was listed, in the spring of 2009, as 'Threatened' on Schedule 1 of the federal *Species at Risk Act*¹. Monitoring breeding Chimney Swifts provides valuable information regarding habitat use, breeding success, and changes in local population size over time. The Manitoba Chimney Swift Initiative (MCSI) monitored nest sites in St. Adolphe, MB (49° 40' 27" N, 97° 6' 38" W; 15 km south of Winnipeg), between 2007-2010. These observations provide the basis for interpreting Chimney Swift nesting behaviour in Manitoba.

Activity patterns in the St. Adolphe nest sites changed as Chimney Swifts progressed through the various stages of nesting: arrival, nest-building through egg-laying, incubation, feeding brooded juveniles, feeding non-brooded juveniles, fledging, pre-migration, and migration.⁶ The sequences and time intervals associated with entries into and exits from a chimney reflected the various activities. Differences in some Chimney Swift breeding behaviour occur along the geographical north-south gradient of the summer breeding range (i.e., from Manitoba⁶ to Texas²). This variation is seen primarily in nest building and feeding rates, and these factors must be considered when interpreting observations made throughout the species' range. This guide presents information and recommendations on how to monitor Chimney Swift nest sites to identify the stages of nesting and determine breeding success.

Nest data from St. Adolphe.

In St. Adolphe, five nest sites located in four buildings along Main St. were observed for 350 hours between 2007-2009⁶ and 253 hours in 2010 (Table 1). Data collected spanned the duration of the Chimney Swift breeding seasons, from arrival to migration. Times of entry and exits at the nest sites were recorded and used to interpret the dates at which various stages of nesting began (phenology).

The five nest sites are close to each other (< 200 m) and the local Chimney Swifts interact throughout the breeding season. Before incubation starts, the number of Chimney Swifts using a chimney during the day does not always reflect the number of

birds at that chimney in the roosting hour. Birds may temporarily share another nest site for the night. Site sharing is even more common later in the breeding season, after a nest failure, and in the post-breeding pre-migration phase.

Until you are aware of all the dynamics of the local Chimney Swift population that you are monitoring, some “confusing” events may take place with birds arriving and departing. For new areas being monitored, collect complete information as often as possible; interpretation can follow.

What is in this guide?

In addition to providing the phenology for the 2010 season (Table 1) and start-up suggestions for monitoring (data sheet - Appendix 1), this guide includes: A) a basic description of behaviour and trends for each stage of nesting; B) a depiction of the dates that the various stages of nesting typically spanned in St. Adolphe (Figure 1⁶); C) a summary of observed patterns of use (entry/exit sequences), and examples of the associated time intervals, for each stage of nesting (Table 2); and D) examples of typical data collected during monitoring at various stages of nesting and for a nest failure (Appendix 2).

Why are you monitoring? Establish your goals.

The protocol of individual monitoring programs is designed to achieve specific goals.

The Manitoba Breeding Bird Atlas⁴ survey is valuable to map the distribution of species but observations are often limited to opportunistic sightings with few linkages to where

the birds actually are nesting. The MCSI⁵ protocol of methodical weekly monitoring is effective for tracking occupancy and establishing season-long activity trends. Following one nest site on a focal point basis using intense monitoring schedules over a breeding season, as was done in St. Adolphe, provides an opportunity to assess nest phenology, breeding success, and the number of fledglings. Some phases of nesting are brief, such as a single day of fledging, and can be missed altogether if there are gaps in the monitoring schedule.

Who is monitoring? Commit sufficient resources - people and their time – to meet your goal.

Anybody with the patience to stare at a chimney rim for an hour, and repeat the task every few days, can monitor Chimney Swifts effectively. It is a task well suited for urban dwellers and rural adventurers alike. You must be realistic about the time you have available to gather data. It is better to have good quality data, but less of it, than overextend resources to gather questionable or unreliable information. The best understanding of nest site and community dynamics comes from daily observation of the Chimney Swifts, particularly when difficult transitions (e.g., egg-laying to incubation, or nest failures) are being tracked. “Best practices” for detailed data collection are emphasized here; options for collecting less detailed but still valid data are available at: <http://www.naturemanitoba.ca/CHSW.html> .

Local knowledge contributed by community members provides valuable insights into the Chimney Swifts status. Relationships with local bird watchers, landowners, government

representatives etc. should be cultivated by monitors. Extending the courtesy of informing landowners of your activities and requesting permission to monitor chimneys is common sense and good etiquette. A buddy system provides company, plus a second set of eyes to help observe the birds and to record data.

Where do you monitor? Distinguish between a roost site and a nest site.

How do you decide what chimneys to observe? An ideal candidate chimney for observation should be:

- uncapped – caps block access.
- unlined – metal lining inside the chimney is slippery and does not allow the birds to cling or attach nests.
- suitable diameter – minimum interior diameter is 25-30 cm to accommodate the outstretched wings^{2, 3, 4, 5} but this is difficult to assess from the ground. The chimney exterior needs to be at least 2.5 X 2.5 standard bricks wide.
- close to trees (often Manitoba Maple) which have some dead branches. The small diameter twig ends are broken off and used as nesting material.
- constructed before the 1960s. In rural Manitoba, churches appear to be ideal structures as a history of brickwork was associated with these buildings. Similarly, old government buildings such as post offices and schools with suitable chimneys are good sites to monitor.

Most sites in Manitoba appear to be within 2 km of a river and being close to water may be important.

Chimney Swifts use a variety of sites depending on the time of year and their nesting status. Roost sites are used primarily for resting in at night, but they may also be used in the day as shelter during inclement weather. Roosts may be: 1) seasonally occupied sites which are used by non-breeding adults and juveniles; or 2) occasionally occupied sites where migratory transients or dispersing Chimney Swifts roost. By contrast, nest sites (natal chimneys) are used routinely by a pair of breeding adult Chimney Swifts, and subsequently their offspring, during the during the day in addition to nighttime resting. Prior to nesting, adult Chimney Swifts may inspect and even roost in multiple potential nest sites to assess their suitability. Therefore, a single hour long observation session at a chimney will not provide conclusive evidence that it is active. Three monitoring sessions, including a combined daytime/roosting hour period, spanning two days are needed to assess a site's status (details to follow).

What do you need to monitor a nest site? A direct view of a chimney rim and simple, inexpensive equipment.

An unobstructed view of a chimney rim and as much of the surrounding skyline as possible is required. Take into consideration shadows that may be generated as sunlight fades, overhanging branches obscuring entry/exit flight paths, and having a safe place to sit where passing pedestrians or traffic do not interfere with your sight lines. Being comfortable is important as well. If you are too close, you will strain your neck and miss overhead birds. If you are too far away, you will strain your eyes and may miss entries/exits. Facing west is a challenge at sunset.

The basic equipment includes:

- data sheets (Appendix 1) fastened to a hard board. A 3 ring binder with elastics to hold sheets down if it is windy is useful - if one sheet gets full, it is easy to flip to a new one without taking your eyes off the chimney.
- large face digital watch with seconds displayed. You need to read accurate times quickly.
- pencil – retractable is good to generate more lead when the tip breaks.
- comfortable chair that holds a water bottle.
- comfort items such as insect repellent, sunscreen, sunglasses, sunhat, etc.
- binoculars are recommended for all observers. Even though ideal locations and distances for observations do not require the use of binoculars to monitor the chimney rim, unexpected behaviours may require closer or lengthy observations.

Attend to all your needs before your observation period begins, since you cannot divert your attention from the chimney rim for a second without risking a missed event.

Chimney Swifts are fast flyers and can be missed easily with even a momentary lapse in concentration. This is why monitoring companions are particularly useful: one person can do some task while the other watches the chimney. Be careful not to get involved in detailed conversations, forgetting to pay attention to the chimney top.

When do you monitor a nest site? In the breeding season; daytime and evening.

The breeding season is approximately mid-May to mid-August in St. Adolphe. Local knowledge may suggest slightly different dates in your area.

Roosting hour sessions are used generally for monitoring Chimney Swifts because this is when birds enter the chimney to rest for the night. It may also be convenient for most monitors with jobs. These observations occur from ½ hour prior to sunset to ½ hour after sunset. Severe weather may shorten the observation time or move monitors into less ideal observation positions (e.g., under shelter or in a car), but every effort should be made to adhere to the “½ h before – ½ h after” sunset protocol to allow data to be comparable among areas, days, or years.

Daytime observations are reserved generally for monitoring potential or active nest sites. These sessions typically last 60 minutes and may occur at any time of the day, although birds may be less active in the heat of summer days or during heavy rain or high winds. Shorter daytime observations may be sufficient to confirm the birds are still present after a storm. A longer daytime observation session might be required if an interval is being established e.g., the time between an exit and a subsequent entry.

Combined daytime/roosting hour observations start at least ½ hour before the roosting hour, i.e., 1 hour ahead of sunset, and include both daytime and roosting behaviours. Longer, combined daytime/roosting hour sessions are useful particularly after fledging

because some Chimney Swifts may arrive earlier than 30 minutes before sunset (Appendix 2).

What will you observe? Chimney Swifts entering and exiting nest sites.

Nesting is a hidden activity so all you will observe are entries and exits of Chimney Swifts at a nest site and their aerial activities in the vicinity. Chimney Swifts have been described as “flying cigars” – they have short, bristled tail feathers and long, tapered wings which beat rapidly as the birds fly with agility to collect insects in the air.¹ Their feet are adapted to clinging onto rough surfaces – you will never see them perching on wires or branches. Males and females are identical in appearance. They are dark coloured and a lighter throat patch may be evident. Adults moult in the summer and you may notice feathers missing from the wings, giving a ragged-edge appearance. Recently fledged juveniles have smooth wing edges (intact wing margins).

A. Entries into a chimney

Chimney Swifts that are unfamiliar with a site, including juveniles, may fly repeatedly around the chimney top before attempting a cautious foot first entry. Veer-offs from the rim and slow air speeds characterize this behaviour. Alternately, the birds may drop in a slow descent from a considerable height and “stall” at the opening before dropping in. Experienced flyers, or ones familiar with a site, usually have considerably faster - sometimes head first - entries. Indeed, some birds fly so fast toward the opening that the event will be over in less than a second.

Feet first or head first, slow or fast, the entry style is often distinct enough that you can identify individual birds. But entry style may also be influenced by wind conditions (i.e., direction and speed) so preferred patterns of entry may change. Chimney Swifts usually are deterred from entering a chimney if other perching birds e.g., grackles or pigeons, are on the rim. The Chimney Swifts may veer away from the chimney top and return later, or they may circle repeatedly before attempting an entry.

Early in the nest building stage, Chimney Swifts usually approach a chimney in pairs; one bird may quietly enter while the partner flies off, vocalizing. During entries for partner change-up during incubation, few vocalizations are heard. Do not rely on vocalizations to alert you to the presence of Chimney Swifts at any time.

B. Exits from the chimney

Variation in exit style is also seen. Chimney Swifts may burst up out of a chimney or exit slowly, banking away after barely clearing the rim. Typically, a bird will clear the top after a moderate ascent and then descend in a short arc before gaining altitude and choosing a bearing to depart the area. Individual Chimney Swifts tend to develop a preference for their exit trajectory and direction, which may become evident after repeated monitoring sessions. Winds also have an influence on exit strategies. Other birds perched on the chimney rim may disrupt exit as well as entry patterns.

Chimney Swifts leaving a nest site often vocalize during the nest building and feeding stages. Quiet exits are characteristic during incubation. Communication between partners and other Chimney Swifts in the vicinity is ongoing.

What information does entry/exit data give you? The number of Chimney Swifts present and their activity patterns.

The number of Chimney Swifts using a chimney can often be derived from the sequence of entries versus exits, adjusted for consecutive use. For example, an entry followed by exit followed by entry (↓ ↑ ↓) means at least 1 bird used the chimney; an entry followed by entry followed by exit (↓ ↓ ↑) indicates 2 birds used the chimney.⁶ A Chimney Swift inside the nest site prior to monitoring would be indicated by an exit as the first event. Similarly, a Chimney Swift is inside the nest site at the end of monitoring when the total exits are less than the total entries, adjusted for sequence, during the observation period.

Establishing the number of adults using the chimney is important for recognizing helpers at a nest site. Helpers are young, non-breeding Chimney Swifts that are believed to assist the breeding pair with various duties.² There is little published information on the frequency of helpers in Manitoba. No helpers were present in the 2007-2009 seasons at St. Adolphe⁶ but in 2010 an extra bird, believed to be a helper, moved among 3 active nest sites throughout the nesting season (Table 1). The helper appeared to be associated primarily with nest building and feeding activities.

The only conclusive way to determine the presence of a helper at a nest site is to observe three or more consecutive entries/exits in the daytime⁶ prior to fledging. However, the breeding pair might follow a slightly different pattern than the helper and a “2 + 1” pattern of use may suggest that 3 Chimney Swifts are active at a nest site. For example, at the St. Adolphe Church, in the nest building stage on June 9, 2010, (a) two birds exited within 1 minute of each other; (b) a single bird entered 5 minutes later; (c) two entered 1 second apart about 45 minutes later; and (d) one bird exited 30 minutes later. Three consecutive entries (b and c) indicated 3 individuals were using the site. Even without this sequence, however, two nearly simultaneous exits followed by a single entry (a and b) and 2 nearly simultaneous entries followed by a single exit (c and d) suggest 2 birds were closely associated and there was a helper (third bird) at the site.

The times of entries and exits, recorded to the nearest second, yields four intervals: A) between consecutive entries; B) between an entry and an exit, referred to as the “duration in the chimney” or the “turnaround time” for partner change-ups; C) between consecutive exits; and D) between an exit and an entry, referred to as the “between-visit” interval.⁶ Precise times may also allow you to identify site sharing; if a nearby chimney is monitored also, a departure at one site may “align” with an arrival at the other.

The patterns of use, that is sequential entries and exits vs. alternate entries and exits, and the predominant time intervals will be used to identify the stages of nesting (Table

2; next section). Although there is a seasonal progression of these patterns, using the entry/exit observations to make sense of nesting progress is not straight forward.

Making sense of the monitoring data. Identification of stages of nesting.

In addition to providing information on the number of birds using the site, your data can be interpreted to identify the stages of nesting. First, it is important to identify the factors that make interpretation of the data complicated. As mentioned above, some “exploratory” behaviour may occur while Chimney Swifts locate and commit to a nest site, so the status of a nest site should not be based exclusively on a single observation period. Chimney Swifts tend to socialize at dusk³ and leave nests unattended for short periods. With the presence of helpers, the frequency or rate of entries/exits increases, with a consequent decrease in the duration of the between-event time intervals. For example, at the Church on July 22, 2010, the feeding rate of non-brooded young was 6 times per hour compared to the typical 4 times per hour when no helper is involved. Furthermore, the transitions between some stages of nesting can be subtle e.g., from egg-laying to incubating and from incubating to feeding, so repeated observations are beneficial to establish a new stage of nesting has begun.

Seasonal changes in activity patterns are expected as the birds progress through the stages of nesting. Other variation in behaviour is due to:

- daily variation in local conditions or events, e.g., rainfall, temperature, insect availability, presence of other species on the chimney.

- large scale weather patterns e.g., between-year differences of arrival/departure dates.
- geographical gradients that result in shifts of the rates of activity over the breeding range. Feeding rates in Manitoba are approximately four times higher for non-brooded juveniles compared to Texas.^{3,6}
- secondary arrival of Chimney Swifts in mid- to late June. Typically, these birds distribute themselves among unoccupied sites and may attempt to nest. Over the years, all the late-arriving birds we observed have failed although one pair progressed to feeding brooded juveniles before failing.
- nest failure, which results in abandonment or greatly declining daytime use of a site.

Despite the challenges and caveats in interpretation, there are some typical trends that occur as Chimney Swifts progress through the stages of nesting. For breeding pairs of Chimney Swifts that arrive in St. Adolphe in May (no helper present), the typical range of dates for the stages of nesting are presented here (Figure 1) as a guide. There may be variation. For example, at Brodeur Bros. in 2010, nest building began on 1 June, incubation started 25-28 June; hatching occurred on 16 July, and the juveniles fledged on 16 Aug. The length of nest building, incubation, and feeding stages all approached, or exceeded, the maximum expected duration. The dates for these events and fledging were later than previously reported. The arrival, start of nest building, and departure dates were within the illustrated range.

Below, the general behavioural characteristics (published previously⁶) are *printed in italics*, followed by 'best practice' monitoring recommendations, and rationale.

Arrival: mid- to late May. *Pairs typically entered the chimney within a few minutes of each other, during the roosting hour to rest for the night.*

- Start roosting hour monitoring by early to mid-May and continue to observe a potential site until the end of May. Sites should be visited every 4-5 days or weekly at least.
- Unoccupied sites have to be monitored at the roosting hour until late June to verify no late migrants have arrived. Chimney Swifts arriving in St. Adolphe as late as June 20th have attempted to nest.

Nest Building: late May to early June. *Pairs of Chimney Swifts entered and exited the chimney during the roosting hour or slightly before. Daytime visits also occurred.*

Chimney Swifts did not always travel in pairs but often entered or exited the chimney individually. The duration in the chimney and the between-visit interval both varied considerably, 1-70 and 1-50 min. respectively.

- Shift to daytime observations (at least 1 hour) when an exit has been seen in or near the roosting hour. Such exits indicate nest building likely is underway. However, daytime confirmation is required because an evening exit may be a late-roosting Chimney Swift that has been deterred from roosting by the resident breeding birds, rather than an indication of nest building.

- Note twig collecting behaviour. During this stage, we have seen Chimney Swifts fly repeatedly into Manitoba Maples within 50 m of nest sites. The birds appeared to strike a small branch end, which vibrated, and then flew directly into the chimney. Small twigs are transferred from the Chimney Swift's feet to their beaks³ then glued, with sticky saliva, onto the inside of the chimney. Nest building continues through egg-laying and incubation^{2,3}.

Incubation: early to mid-June; incubations starts with the second-last egg laid and continues for 18-21 days^{1, 2,3}. *The adults took turns on the nest during incubation³ and in St. Adolphe, partner exchanges were quick. Turnaround times were often less than 30 sec. and 1 or 2 change-ups per hour were typical. Usually, one attending adult was in the chimney but there were short unattended periods, often around dusk.*

- Make daytime, or combined daytime/roosting hour observations to learn if incubation is occurring. Some interpretation of events will be required. For instance, it may appear that only one Chimney Swift is present when really two birds are changing-up. Identifying unique entry or exit characteristics of individuals will assist in data interpretation.

Feeding brooded young: early July; hatch (Day 1) to Day 6-7 of feeding³. *After a feeding, an adult Chimney Swift will brood or cover the nestlings to keep them warm.³ In St. Adolphe, nest site use became more active at this stage. Two entries and two exits within an hour, with quick adult turnaround times of ~ 1 min., were typical in early July.*

- Record hatching day which is Day 1 of feeding brooded young when the frequency of entries/exits increases.
- A weekly roosting hour observation will confirm the number of adults in attendance. Minimally, a breeding pair will be present but helper birds may assist with feeding the young.³

Feeding non-brooded young: mid- to late July; Day 6-7 to Day 28-30 of feeding³.

Juveniles do not require brooding by their parents after 6-7 days of age.³ Adults may simply move to the wall beside the nest and not leave the chimney³ or both adults may forage concurrently to meet the increasing energetic demands of the juveniles.³ An unattended chimney, indicated by consecutive entries or exits, was a sign of the non-brooding phase. In St. Adolphe, the time young were unattended increased as the juveniles aged (e.g., from 2 min. with ~7 day old chicks to 16 min. with ~26 day old chicks). However, the best indicator of advancing juvenile age was the increased frequency of entries/exits, typically four entries and four exits per hour. The between-visit intervals were variable, 1-17 min., as the adult Chimney Swifts sometimes used the chimney in bursts separated by lulls.

- Continue daytime and/or combined daytime/roosting hour observations to capture the intense use of the chimney at this stage. Neighbouring Chimney Swifts may indicate the presence of exposed young in the nest³ with low flyover-veer offs with head turning, or by vocal, manic, swooping dives toward the chimney top. Nest site use may become more intense in the day or two prior to fledging.

- Start increasing the frequency of observations to daily or every second day if possible, beginning the last week of July as fledging is imminent. As noted previously, the birds might be less active in the heat of the day than in cooler hours.
- Establish the baseline adult count prior to fledging because it is the only way that the number of juveniles can be calculated from roosting totals.

Fledging: end of July to early August. *Fledging was determined when juveniles were identified flying for the first time. In some cases, the adults made many entries and exits just before the young fledged e.g., 8 entries and 8 exits in an hour with turnaround times of several minutes.*

- Identify fledged juveniles to determine successful breeding. Fledglings have unique flight characteristics – rapid wing beating despite slow air speeds, low level flying, tails are often fanned out like rudders, and there is no evidence of missing wing feathers (the adults are moulting at this time).
- Try to count the number of roosting birds in the nest site the same evening when fledglings are identified in the air during the day. An increased number of roosting Chimney Swifts should reflect the presence of juveniles. It may take 2-3 evenings to verify the number of fledglings as juveniles may not all fledge on the same date and, for a few days after fledging, some may enter the chimney early to roost.
- Arrange for simultaneous roosting hour observations at all the local sites the evening of fledging. Be aware that community dynamics can change quickly.

Adults and fledglings often start visiting non-natal chimneys for varying periods or even to roost.

- Monitor the chimney nightly using combined daytime/roosting hour observations until an estimate of the number fledged is made.
- Try to track post-fledging activity in all the local sites. This is a labour-intensive period and you may not be able to obtain enough partners to watch every chimney simultaneously. Concurrent observations are more important at the roosting hour than during the day when sequential observations can be made at all the sites. Such coverage is the only way to estimate total breeding success in a community because site sharing can begin almost immediately. Presently, the between-chimney distance that allows for social interaction and group dynamics of the birds is unknown. However, the St. Adolphe chimneys, 200 meters apart at the most, are all close enough to allow for interaction among all the Chimney Swifts in town.

Pre-migration: early to mid-August. *Local birds moved among chimneys during the day and roosting hour. Local movements all took place by 15 August. At this time, group sizes seen in the air were smaller as the birds ranged farther away from the nest site area to feed. Consequently, there was less daytime use of chimneys in the 7-10 days after fledging compared to earlier stages.*

- Shift to a combined daytime/roosting hour session as daytime use declines, approximately 7-10 days post-fledging. It takes only about two days for fledged Chimney Swifts to become proficient flyers but they can still be distinguished

from adults by their smooth wing edges. All birds will soon range farther from the nest site during daytime feeding excursions, so group sizes in the vicinity of the nest site may be reduced. A shift to combined daytime/roosting hour observations enables a monitor to track local Chimney Swifts moving among chimneys, provides the best opportunity to observe early entries, and therefore, maximizes the total count of roosting birds.

Migration: mid- to end of August. *When the total known population of local adult and juvenile Chimney Swifts was exceeded by roosting birds, it was obvious that some migrants had arrived. Roosting hour counts at the Church indicated aggregations of local and migrant Chimney Swifts. Chimney Swifts entered the chimney singly or in small groups, during or slightly before, the roosting hour. We interpreted repeated flyovers with veer-offs preceding a halting, foot-first entry as a migrant's first use of an unfamiliar chimney. Late in the season, exits from the chimney were rare and usually were followed by a quick re-entry. After the numbers of roosting Chimney Swifts peaked, the dispersal of migrating birds eventually reduced roosting counts to zero.*

- Continue combined daytime/roosting hour observations to count the total number of roosting birds (Appendix 2).
- Confirm the birds have left the site and migration from your area is complete with 3 consecutive monitoring sessions where no Chimney Swifts were observed.

Monitoring nest failures. *Two patterns of adult behaviour associated with nest loss were evident. The first pattern involved a gradual decline of daytime use then a relocation of the adults to a different nest site or roost. This pattern appeared to be associated with the loss of juveniles (e.g., Main St. nest in 2009). The other pattern was characterized by the abrupt abandonment of the nest site during the daytime although adults continued to roost there at night.*

- Note unexpected changes in behaviour patterns. The continuous decline in the frequency of daytime use at a nest site, or the abrupt cessation of activity, probably indicates a nest failure has occurred.
- If a nest failure is suspected, monitor the site intensively with at least 3 observation periods spread over a 24 to 36 hour period. Daytime and combined daytime/roosting hour observations will establish whether daytime abandonment has occurred and if adults continue to roost at night in the natal chimney.
- Ideally, all nest sites should be monitored within 48 hours after a severe storm that involves large amounts of wind-driven rain as nest slippage or loss of young frequently occurs under these conditions.
- Monitor the nest sites of June-arriving Chimney Swifts frequently, because they appear to have a higher likelihood of nest failure.
- Try to view the contents of a chimney cleanout trap at the beginning of a nesting season and again at season's end, to identify nesting evidence from the current season. Large pieces of nesting material or an intact nest suggest it fell. Eggshell remains indicate the number of eggs laid and/or hatched. Dead young indicate later failure, etc.

Summary

For evaluating a new site, three monitoring sessions on two consecutive days, with one combined daytime/roosting hour observation, is ideal to determine if it is occupied as a roost or nest site. At nest sites, to estimate the stage of nesting for May-arriving pairs: collect entry and exit times following the recommendations; compare the patterns of use and time intervals with those in Table 2; plus use the date ranges in Table 1 and Figure 1 as approximate guides. Chimney Swifts that arrive later in June and attempt to nest will have different dates for the stages of nesting. Pairs of Chimney Swifts involved in a nest failure, and birds at nest sites where a helper is attending, generally will display different activity patterns.

Frequent monitoring usually is required to establish the baseline number of Chimney Swifts using a nest site (breeding pair + possible helpers) and to track the progression of a nesting attempt. Subsequently, productivity or breeding success can be assessed by counting the number of fledglings in the air coupled with increased counts of roosting birds. This must be established shortly after fledging as roosting counts may start to reflect locally redistributing birds or the presence of migrants.

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Figure 1. Range of dates for the first observation of different nesting stages for May-arriving pairs of Chimney Swifts in St. Adolphe, MB in 2007-2009. (reprinted from *Blue Jay*⁶.)

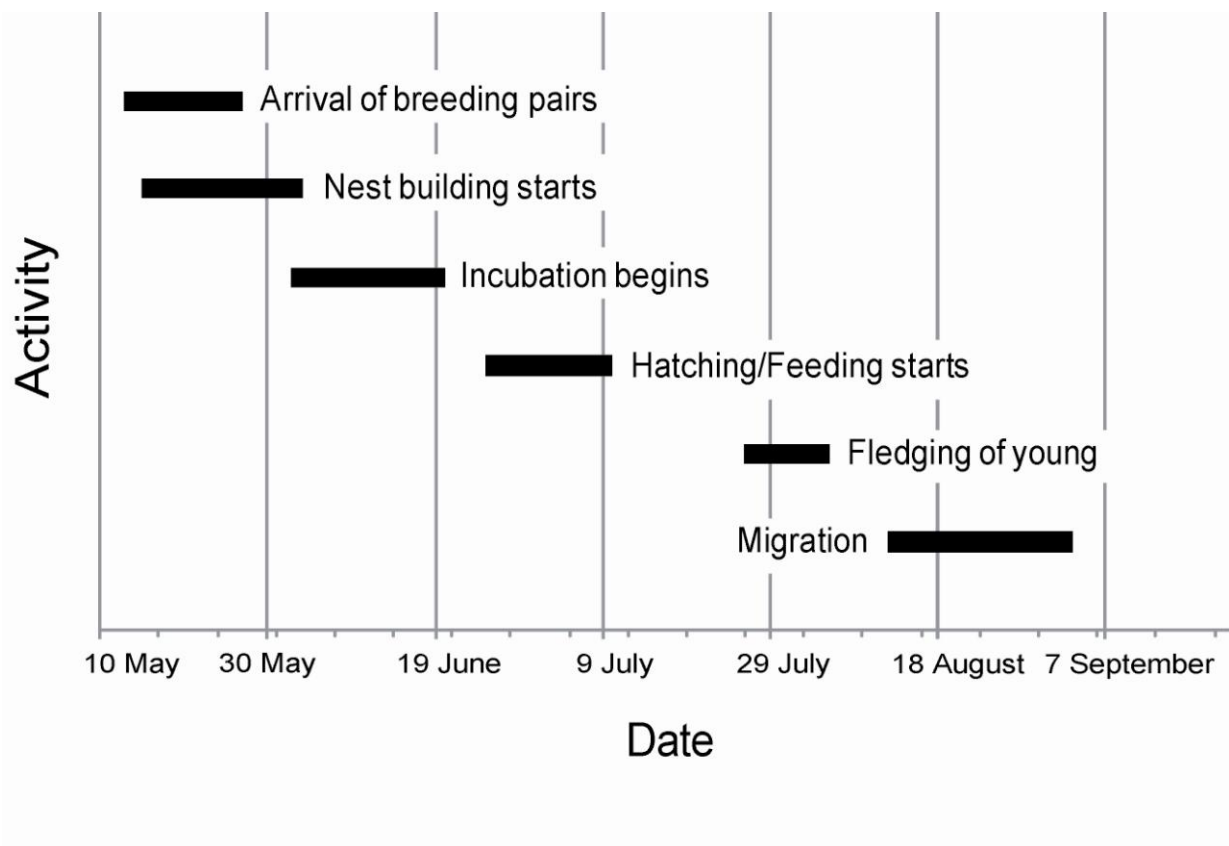


TABLE 1. Phenology for Chimney Swift nest sites in St. Adolphe, MB, 2010, based on 253 hours of observations.

SITE	ARRIVAL DATE n = number of birds observed.	NEST BUILDING	INCUBATE	FEED BROODED	FEED NON-BROODED	FLEDGE DATE n = number of juveniles fledged.	DATE OF LAST USE D = DAY R = ROOST
SE CLUB AMICAL	a. May 16 n=1; May 17 - 19 n=2	a. May 17-19; single day use					a. D: May 17-19; not a nest attempt
	b. June 20 n=3, Helper present	b. June 20. Helper presence variable until leaves ~ June 30	b. July 11 - 12. Unstable July 15 -19; long unattended periods	b. July 30. Nest failed Aug. 2 - Day 4 of feeding			b. D: July 31-Aug. 2 R: Aug. 3-16
NE CLUB AMICAL	May 16 n=2	a. May 17 - 19	a. June 23	a. July 8. Nest failed July 10 - Day 3 of feeding			D: Aug. 5-16 R: Aug. 16-26
		b. July 19	b. July 30. Nest failed Aug. 2				
BRODEUR BROS.	May 21 n=1 June 1 n=2	May 22 n=1 June 1 n=2	June 25 - 28	July 16	July 22. Helper arrives Aug. 11	Aug. 16 (n=2) - Day 32 of feeding; plus 1 broken egg + 1 dead juv. ~20 d old; no nest	D: Aug. 25 R: Aug. 27-Sept. 4
CHURCH	May 15 n=1 May 16 n=2 May 26 n=3, Helper present	May 17- 19	June 16 - 19. Helper leaves ~June 19	July 1 - 3. Helper arrives ~July 5	Date unknown. With Helper present 1 st unattended = July 19	July 28 (n=1) ~ Day 28 of feeding	D ^A : Aug. 7 R ^B : Aug. 27-Sept. 4
MAIN ST.	May 21 n=2	May 22	June 17 - 19	July 4. Nest failed July 8 - Day 5 of feeding; 1 unhatched egg + 4 dead juv., no nest observed in cleanout trap			D: July 10 R: July 31 n=1, no further obs.

^A Local, pre-migratory redistribution started Aug. 5 ; ^B Migratory CHSW present Aug. 16

Table 2. Patterns of nest site use and examples of the length of entry/exit intervals, during various stages of nesting by pairs of May-arriving Chimney Swifts, in St. Adolphe, MB. << 1 min. = < 30 sec.; <1 min. = 30 – 59 sec.; 1 min. = 60 - 119 sec. etc.; ↓ = entry ↑ = exit

Nesting Stage	Hours observed : Roosting = R; Daytime = D; or Combined D/R	Interval A: entry to entry ↓ to ↓	Interval B: entry to exit ↓ to ↑ —————	Interval C: exit to exit ↑ to ↑ - - - - -	Interval D: exit to entry ↑ to ↓ - - - - -	Examples of Sequences length of dashed/dotted lines indicate relative Intervals A-D
	Comments		"duration in" = "turnaround"		"between-visit"	
ARRIVAL Mid- to late May	Roosting	Together, 1, 17 min.	none	none	none	↓...↓
NEST-BUILDING to EGG-LAYING a. Late May b. Early June	Daytime & Roosting Nest building continues with egg-laying	Together, 1, 2, 9, 19, 30, 57, 67 min.	2, 3, 8, 18, 25, 31, 67 min.	Together, <1, 2, 3, 12 min.	6, 10, 12, 24, 28, 38, 53 min.; Entries: 1-4 X hour	a. ↓... ↓ ___ ↑ ___ ↑ b. ↓ ___ ↑ ___ ↓
INCUBATION Starts early to mid- June and continues for 18-21 days	Daytime & Combined D/R Change-up of adults on eggs	Together, < 1, 1, 2, 6, 12, 15, 30, 45 min. short unattended ~ dusk usually	<< 1, <1, 1, 2, 6, 8, 19, 20, 36 min.	Together, 3, 9, 50 min. short unattended ~dusk usually	<1, 2, 8, 12, 21, 26, 37, 44, 60, >77 min.; Change-up ~1-2 X hour	↓ ___ ↑ ___ ↓ ___ ↑
FEEDING BROODED JUVENILES Early July Hatch (= Day 1) to Day 6-7	Daytime & Combined D/R Change-up of adults feeding +brooding	5 short unattended ~ dusk usually	<1, 1, 2, 7 min.	22, 32 min. short unattended ~ dusk usually	4, 9, 13, 16, 17, 28, 40, 69 min.; Feeding frequency ~ 2 X hour with increasing trend	↓ ___ ↑ ___ ↓ ___ ↑
FEEDING NON-BROODED JUVENILES Mid- to late July Day 6-7 to 28-30	Daytime & Combined D/R Nest may be unattended; Individual bird can mimic partner exchange but it may take longer to feed and then rest	<1, 1, 2, 4, 11, 15, 17, 21 min. Early in stage - short unattended e.g., 2 min.; Late in stage - long unattended e.g., 18 min.	<< 1, <1, 1, 2, 3, 4, 6, 8 min.	Together, << 1, <1, 1, 3, 4, 7, 9, 18, 19 min.	1, 3, 7, 8, 10, 17, 19, 24, 29, 31, 32 min. Feeding frequency rises to ~4 X hour. Variable use with 2 adults foraging	↓ ___ ↑ ___ ↓ ___ ↑ (partner exchange), ↓ ___ ↑ ___ ↓ ___ ↑ (same bird), Or ↓ ... ↓ ___ ↑ ___ ↑
FLEDGING End July to Early August Day 28-30 (time intervals for day of and 1 day post- fledging)	Daytime & Combined D/R Highly variable, intense use; Involves juveniles, parents, & maybe local visitors	Together, <<1, <1, 1, 2, 5, 7, 9, 12 min. Juveniles often fly together +/- adults	<<1, <1, 1, 2, 3, 4, 5, 7 min.	Together, <<1, 1, 3, 4, 8 min.	<<1, <1, 1, 3, 4, 5, 6, 7, 10, 14, 16, 22 min. Prior to fledging, activity increases e.g., 8 entries & exits per hour	↓ ___ ↑ ___ ↓ ___ ↑ ___ ↑ ___ ↓ ___ ↓
PRE-MIGRATION Early to mid-August Variable daily pattern & between year trends	Combined D/R Daytime use wanes ~7-10 days post-fledging. As relocation among sites occurs roosting counts decrease/ increase locally	Together, <<1, <1, 1, 2, 3, 4, 5, 7, 10, 15, 23 min. Variable use: individual and group entries	<< 1, <1, 1, 2, 3, 4, 6, 8, 13, 35 min.	Together, <<1, 1, 2, 4, 5, 7, 8 min. Variable use: individual and group exits	<<1, <1, 1, 2, 3, 4, 6, 7, 10, 12, 14, 15, 18, 26, 34 min.	↑ ___ ↓ ___ ↓ ___ ↑ ___ ↓ ___ ↓
MIGRATION Mid- to end of August Variable daily pattern & between year trends	Combined D/R Local birds group then joined by migrants; Counts peak then decline to 0	Together, <<1, <1, 1, 2, 3, 4, 5, 7, 9, 11, 17, 19, 21 min. Individual and group entries	<<1, <1, 1, 2, 4, 5, 13, 20 min. Exits are rare	Together, <<1, 17, 45 min. Exits are rare	<1, 1, 2, 3, 4, 5, 8, 12, 14, 20 min. Exits are rare	↓ ... ↓ ↓ ↓ ... ↓ ↓ ↓ ↓

APPENDIX 1. EXAMPLE OF DATA COLLECTION SHEET FOR MONITORING NEST SITES.

MANITOBA CHIMNEY SWIFT INITIATIVE – ST ADOLPHE OBSERVATIONS 2011

DATE: _____

LOCATION: SE / NE CLUB AMICAL BRODEUR BROS. CHURCH MAIN ST. OTHER

TIME OF OBSERVATION: _____ to _____ DURATION OF OBSERVATION: _____ min.

DAYTIME or ROOSTING HOUR (- ½ hr; sunset; + ½ hr) OBSERVATION NO.: _____ SUNSET: _____

Name of Observer(s): _____

WEATHER:	% Cloud Cover =		Wind dir. = None light mod. strong		Temp. °C =		Precipitation =
Real Time (hour:min.:sec)	Entry (↓) or Exit (↑)	Entry/Exit speed: Fast (F), Average (A), or Slow/Flutter (S/FL)	Dir. of approach or departure: N S E W	Vocal (V) or Quiet (Q)	Flying with other swifts? No. =	Adult (A) or Juvenile (J)	COMMENTS e.g., presence of predators; height of foraging in airspace; local disturbance

TOTAL ENTRIES: TOTAL EXITS: TOTAL OBS. IN AIRSPACE: MAX. IN CHIMNEY:

NO. IN CHIMNEY AT START OF OBS.: NO. IN CHIMNEY AT END OF OBS.:

STATUS: ROOST – May; June; July; Aug.; Sept.; Resident Redistributed Locals Non-resident migrants

NEST - Arrival Nest building – Egg-laying Incubation Feeding brooded Feeding non-brooded

No. Fledged =

Appendix 2. Chimney Swift real-time entry and exit data, by nest site and date, for various stages of nesting in St. Adolphe, MB, 2007-2009. All observations start and end at hour:minute:00 seconds

Nest site	Roost (R) or Daytime (D)	Date	Start time	End time	Time of entry (↓)	Time of Exit (↑)	Turnaround Time in Chimney ↓ to ↑ (min.)	Between -visit Interval ↑ to ↓ (min.)	Comments
ARRIVAL STAGE									
NE Club Amical	R	May 16/07	8:39 PM	9:39 PM	9:07:00				
Church	R	May 27/09	8:52 PM	9:52 PM	9:24:00	9:27:35			
Church	D&R	May 30/08	8:23:00 PM	9:56:00 PM	9:28:14	9:29:53			
NEST BUILDING & EGG LAYING STAGE									
NE Club Amical	R	May 26/09	8:51 PM	9:51 PM		8:59:20			
						8:59:22			Unattended
					9:37:24			~38	
					9:37:24				
NE Club Amical	D	June 13/09	11:43 AM	12:43 PM	11:46:00				Bad weather (June 6: frost, June 8: 11 mm rain) & no day activity may have accelerated nest building.
						11:53:58	~8		
					12:14:53			~21	
						12:23:17	~8		
					12:25:08			~2	
						12:33:57	~9		
					12:34:15			<1	
						12:42:07	~8		
Main St	D	June 30/09	10:45 AM	11:55 AM	11:11:31				More typical late stage nest-building
						11:25:29	~15		
					11:36:10			~11	
						11:54:06	~18		
INCUBATION STAGE									
Main St	D&R	July 3/09	8:30 PM	10:10 PM	8:33:49				
						8:35:51	~2		
						9:25:56			Unattended
					9:27:12			~1	
					9:39:30				
Main St	D	July 17/09	10:48 AM	11:48 AM	11:46:51			>58 start to ↓	
						11:47:47	~ 1		

NE Club Amical	D	June 30/09	12:05 PM	2:09 PM	12:29:49				
							12:30:12	<1	
						12:55:46			~26
Brodeur Bros.	D	July 19/09	12:42 PM	1:52 PM	12:43:29				
							1:00:25	~2	44
						1:44:25			
							1:44:52	<1	
Brodeur Bros.	D	July 19/09	12:42 PM	1:52 PM	12:43:29		12:44:00	~1	~28
							1:12:12		
							1:14:14	~2	
						1:49:25			~35
Brod. Bros. ^a	D&R	July 26/09	8:30 PM	9:50 PM	9:33:00		1:49:40	<<1	
							9:33:00		

Nest abandoned in day; 2 adults roost – would be missed if stopped obs. after 40 min. with no activity in roosting hour (8:50-9:50 PM).

FEEDING BROODED JUVENILES STAGE

Main St.	D	July 19/09	1:56 PM	2:56 PM	2:14:29				~Hatch day
							2:16:28	~2	
Main St.	D	July 21/09	8:35 AM	9:37 AM	9:01:25		2:53:27		~37
							2:54:43	~1	
							9:02:16	<1	~34
Main St	D	July 23/09	9:42 AM	10:42 AM	10:01:07		9:35:56		
							9:36:57	~1	
							10:01:54	~1	~16
							10:17:48		
NE Club Amical	D&R	July 8/09	8:26 PM	10:08 PM	8:26:54		10:18:34	~1	~22
							10:40:06		
							10:40:57	~1	
							8:27:30	~1	~17
							8:45:12		
							8:46:14	~1	~18
NE Club Amical	D&R	July 8/09	8:26 PM	10:08 PM	8:26:54		9:13:33		~17
							9:14:07	~1	~17
							9:30:56	~10	~8
			9:48:36						

Church	D&R	July 13/09	8:40 PM	10:04 PM	9:53:54 8:48:14	9:50:06	~2	~4	
						8:49:30	~1	~19	
					9:08:07	9:15:35	~7	~14	
					9:28:49	9:29:25	<1	~13	
					9:42:18				
FEEDING NON-BROODED JUVENILES STAGE									
Main St	D&R	JULY 25/09	8:08 PM	9:51 PM	8:08:14				
						8:09:04	~1	~17	
					8:26:01	8:28:06 8:47:27	~2		Unattended
					8:49:10 8:59:44			~2	
						9:00:44	1		Cannot identify individuals, so duration-in cannot be attributed to a specific bird; time could be longer if 1 st -arrival left 1 st ; by convention interval is most recent ↓ & ↑
					9:10:47			~10	
					9:24:33	9:11:14	<1	~13	
						9:25:38 9:25:48	~1		Unattended
					9:33:21 9:34:45			~18	
Main St	D	July 26/09	10:23 AM	11:28 AM	10:31:48				
						10:32:43	~1	~22	
					10:55:16	10:55:58	<1	~30	
					11:26:33				
Church	D	July 27/08	3:19 PM	4:19 PM	3:19:00	11:27:18	<1		Fledge July 31
						3:19:18 3:19:25	<1		Unattended
					3:32:19			~13	
					3:39:33	3:33:03	~1	~6	
						3:40:40	~1		

					3:41:00			~1
					3:59:01			
						3:59:41	<1	
						3:59:42		
Church	D	July	5:08	6:13	4:16:29			~16
		18/09	PM	PM	5:16:41			
						5:17:44	~1	
					5:35:00			~17
						5:35:17	<<1	
					5:52:17			17
						5:53:33	~1	
					6:10:58			~17
						6:11:24	<1	

FLEDGING STAGE

Church	D&R	July	8:25	9:43	8:29:10				Fledging day;
		31/08	PM	PM					1 bird in at
						8:31:00	~2		start of obs.;
					8:53:20			~22	11 entries & 8
						8:55:20	2		exits; 4
						9:03:10			roosting for
					9:05:15			~2	night (not 3 as
						9:05:50	~1		the
					9:10:00			~4	mathematical
						9:10:25	<1		difference of ↓
					9:12:20			~2	- ↑ would be).
						9:13:10	~1		
					9:16:05			~3	
						9:16:50	~1		
					9:20:27			~4	
						9:22:00	~2		
					9:22:30			<1	
					9:27:43				
					9:32:30				
					9:32:30				

PRE-MIGRATION STAGE

Church	D&R	Aug.	7:58	9:25	7:58:17				0 in at start of
		11/09	PM	PM					observation;
						7:58:46	<<1		13 entries & 8
					8:10:50			~11	exits; 5
					8:10:50				roosting =
						8:11:29	~1		natal family of
						8:11:33			3 plus 2 locals;
					8:17:16			~6	if viewed for
					8:17:16				standard
					8:17:16				roosting hour
					8:24:31				only (8:25-
						8:25:36	~1		9:25 PM), total
					8:26:50			~1	roosting would
						8:39:29	~13		= 2.
					8:40:04			~1	
						8:40:34	~1		
					8:50:23			~10	
					8:50:35				

8:51:20 ~1
8:51:20

9:02:13 ~12
9:03:03

MIGRATION STAGE

Church	D&R	Aug 23/09	7:31 PM	9:02 PM	7:31:41 7:33:12 7:52:25 8:13:56 8:18:41 8:25:39 8:28:03 8:28:32 8:29:23			9 entries; if viewed for standard roosting hour (8:02-9:02 PM) only, total number roosting = 6
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NEST FAILURE CASE STUDY – Main St.

Main St	D	July 28/09	10:32 AM	11:32 AM	10:40:45			Follows July 25-27 Feeding Non-brooded stage
						10:41:26 10:59:53	<1	Unattended
					11:18:30 11:26:29			~18
		July 29/09	9:12 AM	10:42 AM	9:39:25	11:27:08	~1	Reduced day use in rain
						9:39:45	<<1	
					10:41:17	10:41:57	~1	~61
		July 30/09	2:45 PM	4:25 PM	3:12:10			Reduced day use in rain
					3:12:10	3:17:17 3:17:46	~5	Unattended
					4:20:18	4:24:32	~4	~63
	D	July 31/09	10:25 AM	11:55 AM	0 ↓	0 ↑		Abandoned Rain
	D&R	July 31/09	8:19 PM	9:43 PM	0 ↓	0 ↑		Abandoned 0 roost
	D	Aug. 1/09	11:18 AM	12:23 AM	0 ↑	0 ↓		Abandoned

Nest slipped from chimney wall; identified in clean-out trap debris on Aug. 3, 2009, with dead juvenile ~10 to 11 days of age, plus another dead juvenile ~2 days of age which fell from nest previously.