Manitoba Chimney Swift Initiative
(MCSI)

Guidelines for Creating Chimney Swift Nesting or Roosting Chimneys in Manitoba

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Background

Since its inception in 2007, the Manitoba Chimney Swift Initiative (MCSI) and a complement of volunteers have sought out and documented nesting and roosting sites for the Chimney Swift (COSEWIC – Threatened), throughout the species' Manitoba summer range. We have been particularly diligent in recording the locations and year to year activity of occupied chimneys, recognizing the potential for loss of these chimneys due to deconstruction, capping, or lining as more efficient heating systems are installed. Such loss of nesting and roosting sites has been implicated in the rapid decline of the Chimney Swift population in the national status report (COSEWIC 2007). Additionally, there appears to be unoccupied chimney habitat available in some areas (Zanchetta *et al.* 2014) and nesting success appears to be below sustainable levels elsewhere (Stewart and Stewart 2010; Stewart and Stewart 2013). Nonetheless, retaining, restoring, and replacing chimneys as habitat has become a focus of many Chimney Swift recovery groups in eastern Canada and the USA. Recognising that habitat loss in Manitoba further imperils this Threatened species regardless of other threats, the MCSI has embarked on a program of monitoring, research, and outreach leading to the development of these guidelines.

Chimneys used by Chimney Swifts generally are classified as nest sites or roost sites. Bird Studies Canada classifies them on the basis of the number of birds using the site in early summer (generally during migration in late May and early June), with a nest site being occupied by no more than 3 birds at a time and a roost as occupied by more than 3 birds. However, under this definition, "nest site" status is nullified when a clutch of more than 2 hatches to join two parents; the role of helper birds at a nest site must also be established by daytime monitoring. CWS Quebec Region defines nest chimneys as being occupied by five or fewer birds and roost sites as being occupied by six or more birds. Again, this definition does not allow for changes through the season as the young hatch (parents + a helper + 3 fledglings = roost) or allow for small roosts. Because MCSI is considering Chimney Swift habitat for the whole season when the birds are in Manitoba, we have used different definitions which incorporate the behaviour of the birds using the site.

Strictly speaking, roosts are sites used by swifts in which a nest is not constructed. More generally,

ROOST SITES:

- Are not used by Chimney Swifts throughout the day but only in the evening through to sunrise as birds enter to rest for the night. Roosting entries typically occur approximately ½ hr prior to ½ hr after sunset. Birds typically depart within ½ hr of sun-up;
- Often occur in larger chimneys.

NEST SITES:

- Are used (entries/exits) by Chimney Swifts throughout the day;
- Will contain evidence of a small twig/saliva nest, eggs, or young;
- Have only 2 to 3 birds overnighting, depending on the presence of helpers, until the eggs hatch (clutch size ranges from 2-7); after fledgling, the juveniles, parents, and helpers if present, may be seen entering in the evening to spend the night;
- Usually are found in smaller chimneys.

COMBINED NEST/ROOST SITES:

- In a combined roost/nest site (none has been identified in Manitoba), 2-3 birds may enter and exit during the day before fledging, with a great many more entries occurring by roosting birds in the evening.

Notwithstanding the foregoing generalities, a nesting chimney can look like a roost at the end of the nesting season if the parents and fledglings remain at a natal site, and a large roosting chimney with dozens of overnighting birds can still contain a nest.

In Manitoba, the known Chimney Swift breeding range extends from Pine Falls and Lac Du Bonnet (in the northeast), to Wasagaming and Dauphin (in the northwest), and from Brandon, Souris, and possibly as far south as Melita (in the southwest) east to Carman, Portage la Prairie, Winnipeg, St. Adolphe, Otterburne, La Broquerie, and Steinbach (Fig. 1) (see also http://www.mbchimneyswift.ca/Documents/2014_sites.pdf). In general, their Manitoba range corresponds to the broad parkland transition ecozone between the prairie and boreal ecosystems, although there are some occurrences south of the parklands, especially in towns with older uncapped chimneys, and extensive riparian woodlands.

Although their broad range encompasses much of southern Manitoba, in recent years Chimney Swifts have been recorded at a few widely scattered locations within that range. From 2010 – 2014, despite the large volume of data collection for the Manitoba Breeding Bird Atlas (~300,000 records and >40,000 hours of survey effort), Chimney Swifts were recorded in only 36 atlas survey squares (Table 1) and nearly all sightings were in towns or suburbs. Anecdotal evidence suggests recent population declines in Manitoba (Taylor and Holland 2003, COSEWIC 2007).

The MCSI began building free standing towers for Chimney Swifts in 2007, based on the success of this approach in Texas and other southern American states. The failure of these Manitoba towers to attract swifts prompted seven years of monitoring with human observers, video cameras, temperature probes, and other methods. Through this process, the MCSI has become aware of the need for a more region-specific approach, which takes into account the Manitoba context and differences in Chimney Swift behaviour and demography here versus more southerly portions of the breeding range. Free-standing towers generally have met with failure in other Canadian provinces as well, providing further evidence for the need for alternative artificial towers or chimneys in northern portions of the Chimney Swift range.

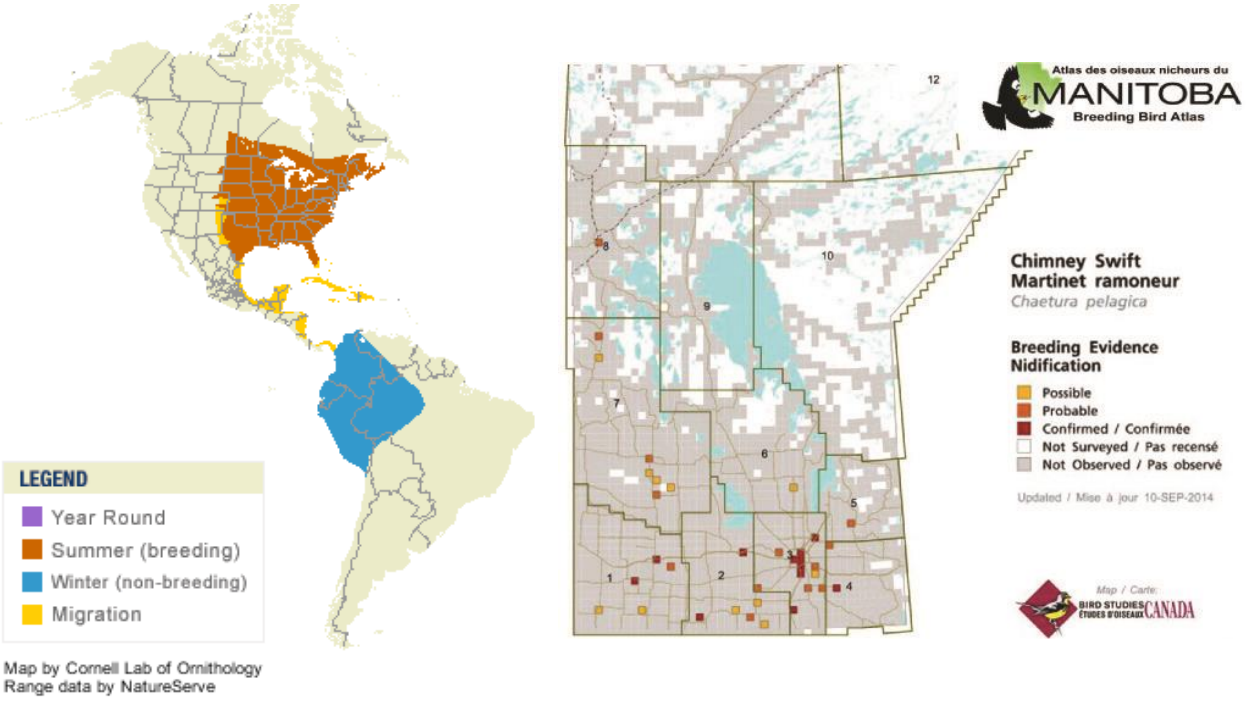


Figure 1. Distribution of the Chimney Swifts. (left) Full range (Cornell Lab of Ornithology 2014). (right) Documented occurrences from Manitoba atlas data, 2010-2014 (after Manitoba Breeding Bird Atlas 2014).

Table 1. Summary of Chimney Swift occurrences in Manitoba by atlas region and survey squares (10 km x 10 km) as documented by the Manitoba Breeding Bird Atlas, 2010-2014 (Manitoba Breeding Bird Atlas 2014).

Atlas Region	Highest Breeding Evidence	Category	# Squares
1: Southwest	adult entering nest	Confirmed breeding	5
2: South Central	adult entering nest	Confirmed breeding	6
3: Red River Valley	adult entering nest	Confirmed breeding	13
4: Southeast	adult entering nest	Confirmed breeding	2
5: Nopiming / Winnipeg River	visiting probable nest	Probable breeding	1
6: Southern Interlake	seen in suitable habitat	Possible breeding	1
7: Mountain	visiting probable nest	Probable breeding	7
8: The Pas / Flin Flon	seen in suitable habitat	Possible breeding	1
Total			**36**

This document outlines the MCSI's current vision for arresting the decline of Chimney Swifts in Manitoba by detailing strategies, based on best available recent information, that will halt, prevent, or mitigate ongoing loss of potential nesting and roosting chimneys. This is not an exhaustive and numeric review of success rates of different designs in various areas. Rather, it is a summary of general concepts and considerations based on observations of occupied Chimney Swift habitat in Manitoba and learning from experiences elsewhere (especially elsewhere in Canada or northern USA) where conditions are most similar to those in southern Manitoba. We recognize that considerable monitoring, research, and mitigative efforts will be required to secure a future for this species in Manitoba.

Regional Considerations

Much of the written material on nesting Chimney Swifts refers to situations in more southerly bioregions (ecoregions reflecting much different climatic conditions than those at the swift's northern and western range limits in Manitoba). In this respect, Chimney Swifts in Manitoba occupy a bioregion unlike those occupied elsewhere in North America (compare Fig. 1 to Figs. 2-4).

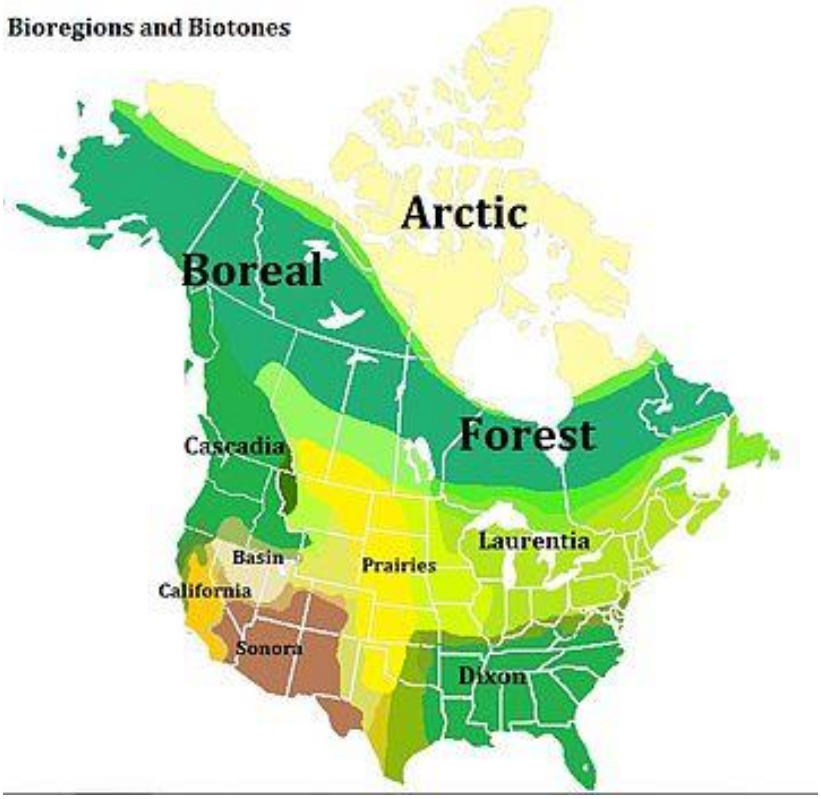
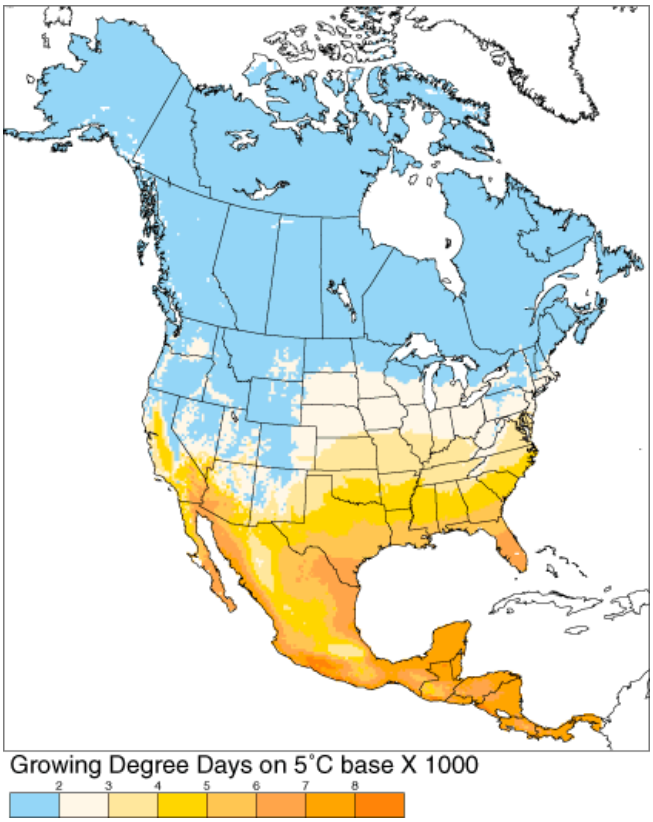


Figure 2. Chimney Swifts in Manitoba are found in the Aspen Parkland/Northern Glacial Plain (largest area of Chimney Swift occupancy), the Lake Agassiz Plain (http://www.epa.gov/wed/pages/ecoregions/ na_eco.htm#LevelIII), and a small part of the Great Lakes Forest (http://www.cas.vanderbilt. edu/ bioimages/frame.htm). Their range in Southern Manitoba occurs within a bioregion not found in eastern Canada or the United States. (source: http://en.wikipedia.org/wiki/Laurentia_(bioregion))

Figure 3. All of Canada has fewer growing degree-days than most of the American range of Chimney Swifts. Thirty-year climate normals (1951-1980) for Growing Degree Days on a 5° C base for North America. (source: http://geochange.er.usgs.gov/sw/impacts/biology/veg_chg_model/)



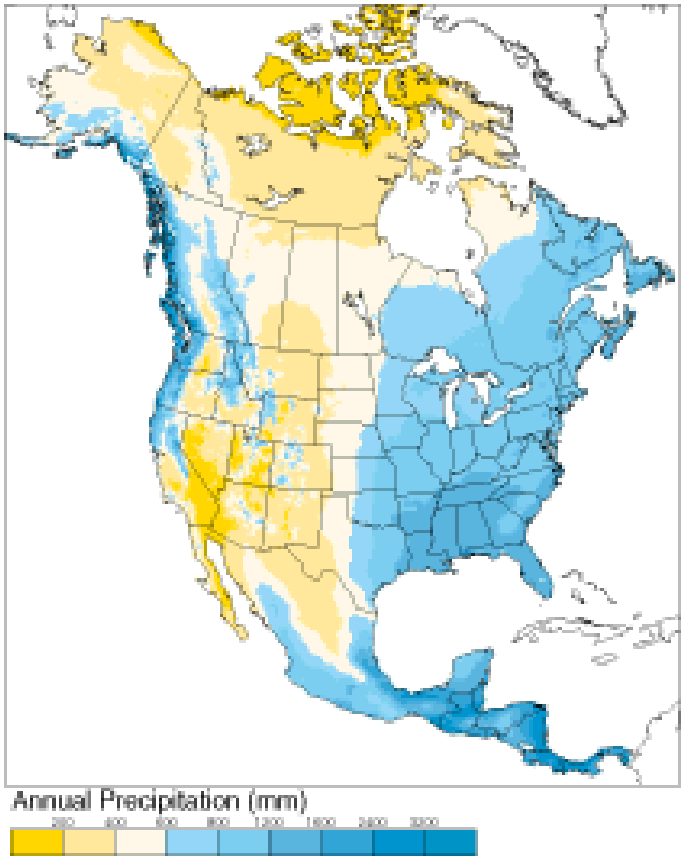


Figure 4. The Chimney Swift range in Manitoba is drier than their range in eastern Canada and USA. Thirty-year climate (1951-1980) Mean Annual Precipitation (based on Thornthwaite and Mather, 1957). (source:http://geochange.er.usgs.gov/sw/impacts/biology/veg_chg_model/)

Compared to other regions occupied by Chimney Swifts, Manitoba has shorter nesting seasons, lower annual temperatures, less precipitation, longer daylight in summer, and large areas of grasslands where only riparian areas support trees of any significant size. Chimney Swifts in temperate regions grow more slowly but to larger final sizes than do those in subtropical climes (Marin and Naoki 2010). These basic differences must be borne in mind when considering the birds' biology and effectiveness of artificial nesting structures elsewhere versus what may be required in Manitoba.

Chimney Swift Habitat in Manitoba

Here, 'habitat' refers specifically to places where Chimney Swifts can build their nests and/or roost overnight. They are: (1) real chimneys (functional or retired) (Fig. 5); (2) fake or *faux* chimneys that are enclosed by or attached to buildings, but have never been functional chimneys, with matching (Fig. 6a) or contrasting cladding (Fig. 6b); and (3) free-standing towers which resemble chimneys (Fig. 7).

Figure 5. Nesting chimney on the church in St. Adolphe. This is a real chimney that is no longer in use as part of a heating system. It was restored by MCSI in 2009 when it was slated for demolition due to structural deterioration. Photo by R. Stewart.

Figure 6a. A *faux* nesting chimney on a horse barn in Council, NC. Swifts had been using the chimney on the house until it was removed. This *faux* chimney was installed in early spring 2009. Chimney Swifts occupied it that same year and produced 5 young.
(source: http://lbergman1althouse.wordpress.com/2009/08/23/newchimney-swift-towers-flyin-high-in-2009)

Figure 6b. A *faux* chimney with contrasting cladding in Shawville, Quebec. The top of the original, real chimney on Dr. S. E. McDowell Public School, which was occupied by Chimney Swifts, was demolished and the chimney lined. In 2014, volunteers of the Chimney Swift Stewardship Group and the West Quebec School Board worked together to add two wooden walls to create a *faux* roosting chimney.
(source: https://www.indiegogo.com/projects/shawville-quebec-swifts-in-distress-sos-martinets#/updates ; accessed 17 April 2016)

Figure 7. An MCSI free-standing nesting tower, in St. Adolphe, MB. It is cinder block construction with a brick cladding and a wood rain shield. The tower is about 15 m behind the trees in the foreground. Local by-laws and engineering constraints limited total height to <5 m. Local Chimney Swifts have swooped over the tower but have not yet been observed entering it. Photo by R. Stewart.

Nest Sites

Even though several free-standing towers have been erected by MCSI in Manitoba (Portage la Prairie, Starbuck, St. Adolphe, and Winnipeg - Assiniboine Park and Windsor Park), to the best of our knowledge none has been occupied by Chimney Swifts. Three privately erected towers (one in Birds Hill, MB and two in the vicinity of La Broquerie, MB) have also been unsuccessful in attracting Chimney Swifts.

Information about artificial chimneys elsewhere in the same bioregion can be gleaned from the Driftwood Wildlife Association's newsletter, *Chaetura*, which reports on swift nesting towers and artificial chimneys throughout North America. A review of the first publication in 1998 through to 2013 revealed 317 accounts of which 10 accounts are in the same bioregion as southern Manitoba. The accounts are not uniform in content nor do they represent a total history for each tower/*faux* chimney. Seven accounts mentioned 12 different towers and information on swift use was documented for only 8. In Minnesota, 4 wood towers at one location were erected in 2008 and as of 2011 had not been used, while a 12' wood and 12' concrete tower at another site were both used but an 8' wood tower was not (*Chaetura* 2010, 2011). A tower in South Dakota was erected in 1998 and was not used until it was moved to a nature preserve in 2005 when it was used (*Chaetura* 2006); there is no recent information on site occupancy. The only *faux* chimney described near Manitoba was built in Minnesota in 2001 (*Chaetura* 2002) but there are no further data.

Summarizing the data from these 10 reports on 21 towers/*faux* chimneys in Minnesota and South Dakota:

- there were 8 towers with information on use by Chimney Swifts;
- only 3 towers were used by Chimney Swifts (2 towers for 1 season, 1 tower for 2 seasons);
- if 1 tower-year is one tower used for one season, there were 4 tower-years of use out a possible total of 27 tower-years.

Towers near Peterborough, Ontario have also been used on at least one occasion (*Chaetura* 2010). They appear to be constructed of wood (http://www.kawarthafieldnaturalists.org/65.pdf; http://www.kawarthafieldnaturalists.org/66.pdf).

Free standing towers appear to be poor replacements for Chimney Swift habitat in our region. For this reason, the MCSI and this document will focus on chimneys (real and *faux*) rather than towers as the preferred nesting and roosting habitat for Chimney Swifts. However, much of what has been learned about nest-site construction comes from other regions where towers have been successful and we draw on that experience to inform our guidelines about chimneys.

Location - In general, Chimney Swifts in Manitoba are found within 2 km of a river or lake. The swifts also feed extensively on aerial insects which are more common near riparian areas.

It is recommended that nest sites be at least 10' (3 m) apart (Kyle and Kyle 2005a). The closest simultaneously occupied nest chimneys in St. Adolphe are 10 m apart, on the same building.

Chimney dimensions/clearances- There are two elevation measurements for each real chimney: the distance from the ground to the chimney top and the distance from the top of the building to the chimney top. This latter measurement is confused in the literature and it is not always clear if the distance being measured is from the roof top where the chimney emerges or from the highest part of the roof, i.e., the ridge for peaked roofs, which may be some distance beside the chimney. In Manitoba, nesting chimneys have been observed that project only about 1 m to 3 m above a flat roof whereas most are at least 2-3 m above the ridge and many meters above the surface of the roof adjacent to the chimney (Fig. 5). Overall height of nesting chimneys ranged from 7-10 m for short chimneys on single story buildings, to at least 25 m for tall chimneys like the one on the St. Adolphe church (Fig. 5).

Nests in chimneys that have been investigated in Manitoba have been within the heated part of the building (often several meters from the top of the chimney and well below roof top level). In general, Chimney Swift nests in Manitoba and elsewhere have been in the lower third of the chimney, often as low as they can go (*Chaetura* 2012; MCSI data). The location of the nest appears to be related to heated areas of the chimney warmed by the inside of the building, and a depth low enough below the rim to avoid direct sun and rain rather than to the height of the chimney, *per se*.

Using data from the Citizen Science program Ontario SwiftWatch, Fitzgerald *et al.* (2014) modelled chimneys used by swifts and concluded height of the chimney top above the roof was a key factor, but they eliminated total height because it was correlated strongly with chimney height above the roof. They made this choice based on the management of repairing chimneys (it is easier to preserve height above the roof rather than make it deeper in the building) but clearly cannot separate the importance of the two correlated factors. Similarly, the authors discarded 'number of storeys' in favour of building type (commercial or residential) eliminating a numeric factor and again making it difficult to assess overall height. MCSI still considers it important that the chimney be adjacent to or in the heated part of the building in our region.

Most, if not all, wooden towers constructed for Chimney Swifts have their genesis in those designed and deployed with great success in Texas by Paul and Georgean Kyle (Kyle and Kyle 2005a; see also http://www.chimneyswifts.org/). They recommend a 12' (3.6 m) tall tower. Our artificial towers have all been approximately 3.6 m tall following the Kyle's design criterion and also due to structural and/or by-law constraints that precluded MCSI experimenting with taller towers. While this height has been successful in other regions (e.g., Texas and Minnesota), towers of this height have not been successful in Manitoba. We noticed that in the original St. Adolphe tower a heavy rain would wet the interior surface > 3 m down and think such wetting would pose a threat to any nest inside.

The minimum interior diameter[1] (side) of a nesting chimney is thought to be 14" (36 cm) (Kyle and Kyle 2005a). Most chimney openings we have seen used in Manitoba are typically 3-brick x 3-brick chimneys (assuming an 8" brick = 16" (40 cm) a side). Slightly smaller chimneys (2.5 x 2.5 bricks; 12") also are occupied as nest sites.

The entrance into the chimney may be smaller than the interior dimensions. In the Kyle design, such a reduction is referred to as a rain or sunshield. Its purpose is to restrict the amount of rain entering the chimney so the nests are not washed off the wall, and to prevent direct sunlight falling on the nest which might cause heat stress in the young. The Kyle design recommends a rain/sun shield opening of 6" x 11" (15 x 28 cm) and no more than half the inside diameter (14"). We have no information by which to adjust the Kyles' suggested dimensions for a rain shield.

We investigated sun angle as it may pertain to shining on nests and nestlings to assess the merit of sun shields in our area. For the latitude of St. Adolphe, we calculated that at maximum sun angle, rays would extend approximately a distance twice the width of the opening (down 50 cm for a 25 cm opening; 81 cm for a 40 cm opening). Therefore, for most nesting chimneys that might be built, being too exposed to direct sunlight is not likely an issue at our latitude and would not limit the use of the chimney.

[1] Kyle and Kyle (2005a) use the term 'diameter' in reference to a cinder block tower (page 19) and subsequently discuss towers that are 14"x14" (e.g., pages 20, 27). We therefore interpret 'diameter' to mean the side dimension and not the hypotenuse.

However, our observations of thoroughly wetted interior surfaces to almost the full depth of a 3.6 m tower did indicate the need for rain protection. We fitted a cap with small opening (15 x 28 cm) and drip-lip to the St. Adolphe tower (Fig. 8). The cap comprised wood walls that over hung the wood frame so the walls extended a short distance down the tower's brick cladding, to which they are bolted. The interior frame rested on the top of the masonry. We installed a ceiling inside the wooden walls, on top of the frame, to ensure that the birds could not enter the space between the cinder blocks and bricks. The entrance walls extended about 2 cm below the ceiling, forming a drip lip, as well as extending above, through the roof. The roof is screwed to the top of the wall unit and an epoxy/sawdust fillet seals the joint between them and the roof. The whole cap was sealed with epoxy before installation and varnished (UV protection) after it was installed. Taller structures may not require a rain cap although an overhanging rim with a lip of about 7 cm extending into the chimney, with a drip lip, might still be advantageous.

Figure 8. Rain cap for the St. Adolphe tower. The three components (left) are the walls of the cap, the ceiling with attached entrance walls, and the arched roof. The fillet seals the joint where the entrance walls go through the roof and two coats of marine varnish finished the installation (right).

Zanchetta *et al.* (2014) examined the use of tree cavities by Chimney Swifts. Their sample included similar numbers of side and top entries; some of the side entries were < 5 cm wide and the birds landed on the outside before entering. To the best of our knowledge, no one has built artificial Chimney Swift habitat with a solid top and a side entrance, although such structures are used successfully for Vaux's Swift (*Chaetura vauxi*) (Bull 2003).

The location of the chimney top relative to the roof ridge likely relates to an open flight-path to the chimney opening. Similarly, the Kyles indicate the opening should be >10' (3 m) from tree

branches (Kyle and Klye 2005a). It is important to have an unencumbered approach/departure from the chimney; the shortest chimney in St. Adolphe is obstruction-free in all directions for 40-60 m. At the same time, nest site chimneys usually are found close to large deciduous trees bearing suitable twigs for nest construction. In St. Adolphe, twigs for nest-building generally were from Manitoba maple, Japanese maple, and ash trees, many as close as 50 m from the nest site. Despite encroachment on one approach to the Main St residence in St. Adolphe, due to the proximity of a mature Manitoba maple, Chimney Swifts have three unobstructed directions with which to use. This is sufficient to accommodate entries/exits during wind events.

Roost sites

Roost chimneys likely need to be much bigger (~6 x 6 bricks) to allow concurrent passage of multiple birds. MCSI has observed roosts holding 100+ birds in Winnipeg (Assiniboine School) and Dauphin; larger roosts have been observed in other regions. In cool weather, roosting birds may cluster very densely (Figs. 9 and 10) leading us to believe the space required for a certain number of birds could vary greatly.

MCSI has no experience with making roost sites nor does it know of such attempts elsewhere in Canada. One free-standing roost in Indiana, which has been successful, appears to be 4-bricks square or, assuming 8" (20 cm) bricks, about 32" wide (81 cm) (*Chaetura* 2011). A roost in Perryville, MO is 2-bricks wide inside (suggesting it is at least 3-bricks wide outside) (Fig. 10). The Robbie Tufts Nature Centre in Nova Scotia has a free-standing roost preserved from a former home (Kyle and Kyle 2005b). The chimney appears to be 5-bricks wide, or about 40" (101 cm) (http://www.wolfville.ca/experiencing-wolfville/things-to-do/robie-tufts-nature-centre). Most roosting sites of 10 or more birds appear to be about 4' x 4' (1.2 x 1.2 m) and all are two stories tall or taller.

Figure 9. A mass of Chimney Swifts clinging to a wall in cool early spring air in Texas. Birds were 3 deep in some places of the swarm. Photo by T. Amo, reprinted from *Chaetura* 2011.

Figure 10. Not all roosts, such as this one in Perryville MO, are spacious. Photo by G. Schechter, San Francisco.
(source: http://en.wikipedia.org/wiki/Chimney_swift)

Construction Considerations

Materials

The material used to construct a Chimney Swift nesting chimney affects the structure's thermal properties and gripping surfaces as discussed below.

All occupied chimneys we have examined have brick outer surfaces. The interior surface needs to be rough enough for the nest to adhere and to allow the birds to cling and climb. We have used parging (rough stucco) but rough lumber (or boards with many shallow saw cuts as in wood duck boxes) and natural brick/mortar surfaces would be other options. A surface like clapboard siding installed upside down may provide many small ledges for nest support. Internally, clay and metal liners have been condemned universally as being unsuitable as they provide poor gripping surfaces for the birds and nests. Clay liners have mortar seams which may serve as a ledge on which to cling and/or attach a nest but pre-fledging juveniles **must** have rough surfaces on which to "walk" up when they are learning to fly. MCSI has two observations suggesting that (at least partially) clay-lined chimneys may be used occasionally – one site as a possible nest site (daytime entry observed; it is possible that deteriorated clay liners may provide suitable texture for gripping onto areas other than mortar seams) and the other as roosting habitat (roosting hour entry seen). Nonetheless, too little is known about the ability of clay liners to support the nest and birds that their use is not endorsed by MCSI.

Predator exclusion

In Texas, towers are built on short legs which allow ventilation and discourage entry by snakes (potential predators); in Manitoba, this type of predation is unlikely. In some situations, it may be useful to install an anti-predator band of metal flashing (~60 cm wide) around the chimney top to prevent entry from the top by raccoons, squirrels or other potential predators. Raccoons entering a chimney can dislodge a nest even without predatory intentions. One tower in Manitoba near Bird's Hill was invaded by mice, after a heat source was installed, apparently entering through the ventilation holes in the bottom (S. Versluis, pers.com.).

Temperature

Chimneys that are surrounded by a building, for most of their height, have an internal temperature which is similar to the ambient temperature of the building in which they are enclosed. MCSI monitored daily temperatures (basement cleanout trap) in a chimney located centrally in a house and also in a free-standing cinder block 3.6 m tower located nearby. The tower had much more variable internal temperatures than did the portion of the real chimney inside the building (Fig. 11). Similarly variable temperatures were recorded in other free-standing towers that we monitored. From that, we concluded that greater daily variation is to be

expected in all free-standing units and that this may be a factor in why no towers have been occupied in Manitoba to date.

In occupied chimneys that have been inspected in Manitoba, all nests were well below the attic or roof line. On one occasion, the nest was below the level of the main floor i.e., in the basement, of a 2-story house. We have no data to compare the relative location of nests in Manitoba chimneys to those elsewhere in the swifts' range. It may be critical in our climate that nests be situated well down the chimney, to benefit from warmer internal areas of these buildings, or in the case of an external chimney, from warm adjacent walls.

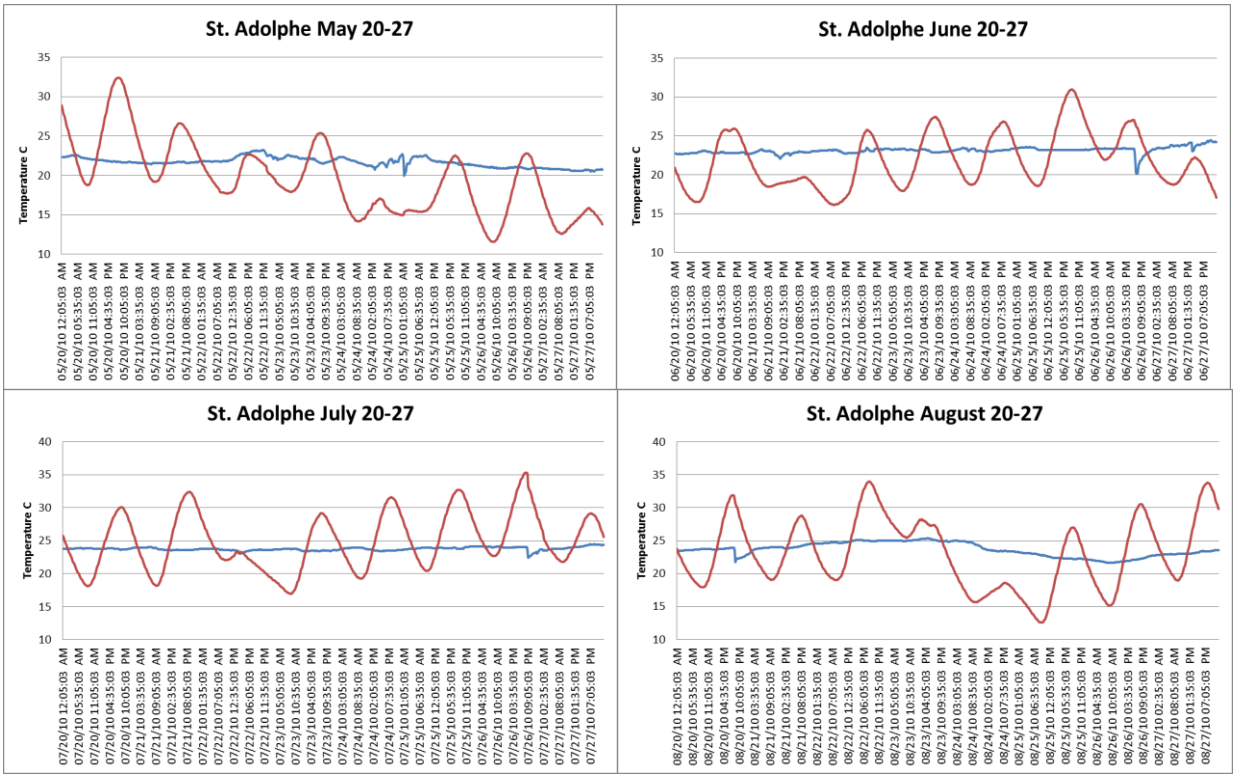


Figure 11. Consistent interior temperatures (blue) of the Main St., St. Adolphe chimney, which is surrounded completely by an occupied residential building, and variable temperatures (red) in a cinder block tower approximately 15 m to the NE.

Clearly (Fig. 11), an internal chimney temperature between 20 and 25° C is acceptable to Chimney Swifts and allows successful nesting. While overheating may cause mortality among eggs and hatchlings (Kyle and Kyle 2005a), successful fledging of Chimney Swifts was observed in Texas during extended periods of 38-42°C ambient, from insulated, ventilated, reflective towers. Interior chimney temperatures were thought to be less than ambient but were not stated (Kyle and Kyle 2005a). Temperatures inside MCSI towers exceeded 30° C (Fig. 11) but, although cooling nesting habitat may be a concern in some areas, it is unlikely to be an issue for Chimney Swift structures in Manitoba. Huggins (1941) measured internal temperatures of four

Chimney Swift eggs and obtained mean temperature of 35.2°C, ranging from 34.9 to 35.4°C. Bull (2003) cited Fisher (1958) to say that Chimney Swift resting body temperature was 39.8 to 40.5°C.

Vaux' Swifts fledged from one nest box which reached 41°C (Bull 2003). Most nest boxes did not reach this extreme temperature. All nest boxes showed more extreme temperatures than did comparable natural tree cavities. Natural cavities had lower maximum temperatures (difference: 9.6°C) and higher minimum temperatures (difference: 7.1°C). Bull (2003) considered temperatures over 40-43°C to be lethal to Vaux's Swift based on data for other birds.

There is little information about suitable minimum internal chimney temperatures for nesting Chimney Swifts. In an unpublished study in Quebec, the regulated temperature inside an occupied insulated tower was lowered on three days when ambient temperature was about 9°C. In all three cases the birds left the chimney when the temperature fell to 13°C and returned later when it was raised. There is no information on the temperature at which birds returned or on the number or status of the birds (Gauthier *et al*., 2007). Until better information is available, it seems prudent to consider 15°C as the lowest temperature to which a chimney interior should fall to remain attractive to Chimney Swifts.

Artificial towers offer some passive buffering to temperatures. MCSI compared internal temperatures at a number of towers near Winnipeg to ambient temperatures recorded at the Winnipeg airport. Internal temperatures exceeded average ambient temperature by about 2 degrees, with marginally less variation. A similar pattern was reported in Quebec where neither height nor insulation greatly affected the temperatures in the towers (Gauthier *et al*., 2007). In both provinces, most towers warmed up a little over ambient and stayed a bit above the ambient minimum.

Air Flow

In Texas, ventilation is required to prevent overheating and is provided in the Kyles' design through a grid of 3/8" holes drilled in the floor of the tower. Total area is about 29 square inches (Kyle and Kyle 2005a). Holes larger than that diameter may pose a risk of predator entry. In the MCSI-built towers, ventilation has been a by-product of small gaps around a removable block, for clean-out access, at the base of the tower. Total area is unlikely to exceed about 10 square inches. With a cross-sectional area of the chimney around 196 square inches (14 x 14) the ratio of ventilation from the bottom to chimney opening is ~20:1. The same ratio in the Kyles' design is ~7:1. It is not clear if the successful concrete chimney in Minnesota is ventilated (*Chaetura* 2010, 2011).

Gauthier *et al*., (2007) cited Tyler (1940) as noting that the chimneys most frequently occupied by Chimney Swifts were not used for combustion purposes, but were connected to the basement of a building and had a flow of warm air. Bowman (1952) noted that the flow of warm air in an

unused chimney made the chimney particularly attractive to swifts, especially on cool spring nights. While both these authors focused on temperature, MCSI has speculated that warm updrafts from attached chimneys help investigating swifts judge the potential suitability of a chimney for roosting and/or nesting. An updraft would signify to the birds there was some depth in the structure below the dark entrance. An attached or warmed chimney would have greater convection updrafts than a shorter chimney or free-standing tower that may lack air intake at the bottom. The amount of venting provided to permit airflow detectable to investigating birds may need to be balanced against any cooling effect it would have. If most tower heating is from incident solar energy on the walls of the chimney, internal cooling convection would be facilitated by air intake from the bottom, especially on the contra-lateral side.

Playback

MCSI has yet to experiment with audio play-back recordings of Chimney Swift vocalizations which appear to have been effective in attracting Chimney Swifts to nest sites in other regions. Airborne Chimney Swifts are vocal and some form of intraspecific communication is no doubt occurring. Playbacks of vocalizations were thought to be of use for some Minnesota towers but not others (*Chaetura* 2010, 2011, see also Finity and Nocera 2012). A CD of Texas vocalizations is available for purchase from the Google Store at the Driftwood Wildlife Association site, www.ChimneySwifts.org , and suggestions for its use are outlined by Kelly Applegate in *Chaetura (*2010*).*

Site Networks

MCSI is considering the concept of a network of chimneys in which, if Chimney Swift population numbers are sufficient, a roost site may be associated with several satellite nest sites. For some species, including Chimney Swifts, there may be some benefits to nesting communally, meaning in separate chimneys in close proximity. If so, Chimney Swifts should habitually choose areas with more potential nesting sites than those that have only one or two widely spaced nesting options. Use of a cluster of chimneys has been called a 'colony' but the term has been misconstrued to mean multiple breeding pairs occupy the same chimney (Steeves *et al*. 2014). Here we prefer the term 'network' to avoid this misinterpretation and to suggest greater spatial separation than say, in a bank swallow (*Riparia riparia)* colony. Distances between adjacent nesting chimneys are usually measured in meters rather than centimeters (Steeves. *et al* 2014 citing Dexter 1969, MCSI data).

A network of potential nesting sites confers many advantages to the birds. It is well known that many nesting birds require one or more alternate nest sites within their nesting home-range, often in relatively close proximity to one another. Within a breeding season, the availability of alternate nesting sites allows the pair to choose their preferred site for nesting in the spring and permits switching sites quickly should local conditions change. Between seasons, for birds that return to the same area year after year, foreknowledge of a number of potential nesting sites

confers the advantage of remaining within the same nesting home-range while choosing the most suitable from a number of nesting sites without having to seek out a new breeding area each year. Most swifts in Ohio tended to use the same nest site year-to-year with no apparent competition for that site (Steeves *et al.* 2014 citing Fisher 1958 and Dexter 1969). The reduced competition for nest sites suggests there is a social aspect to the nesting network which reduces stress among network members.

A network of nesting sites near a roost allows non-breeding birds in the roost to become familiar with nesting sites and their occupants and facilitates the transition of non-breeders to breeders as former occupants fail to return. Our data indicate that where both types of chimneys are occupied, nesting sites generally are within 2.5 km of a roost. The maximum distance observed in Manitoba (records to 2011) was ~6.5 km, however this sample undoubtedly is biased by the fact that some roosting chimneys that are used sporadically or by just a few birds have not yet been discovered or identified.

Direct observations in St. Adolphe showed that swifts from five neighbouring nesting sites often fed together, sometimes roosted together, and neighbouring pairs seemed to be aware of newly hatched young in nearby chimneys. Two of these sites were on the same building, about 10 m apart; the rest were within 100 m. Such social cohesion suggests that a network of nest sites may be much more desirable than widely spaced or individual chimneys.

Follow-up

It should go without saying but is worth repeating: there **must** be careful monitoring after construction of new roosting or nesting chimneys. Clearly, the construction of habitat suitable for Chimney Swifts in Manitoba is an experiment in progress. It is essential that considerable effort be devoted to monitoring the colonization and use of renewed or newly constructed habitat to assess the success of the design and to improve upon it. Secure access at the bottom for inspection should be installed in existing chimneys and included in the construction of new ones at every opportunity.

Contact Information

MCSI may be contacted at mbchimneyswift@gmail.com for general inquiries and monitoring information and mcsi.outreach@gmail.com for habitat stewardship and outreach/educational issues. Also visit our website at http://www.mbchimneyswift.ca/index.html.

MCSI RECOMMENDATIONS FOR CREATING CHIMNEY SWIFT NESTING OR ROOSTING CHIMNEYS IN MANITOBA

When looking to preserve or create habitat for Chimney Swifts, the first priority is to maintain and restore real chimneys that have been recently known or suspected to be occupied by nesting or roosting Chimney Swifts. These chimneys still may be in use as part of a heating system or not.

When preservation/restoration is not possible, the priority is to construct *faux* chimneys that mimic real ones (including ventilation) except that they do not serve as a heating system exhaust.

Tall, free-standing towers are a poor third choice as long-term habitat. MCSI advocates that towers not be built in Manitoba until considerably more research has been completed to ensure they can be made useable in northern climes. Beyond being erected for research purposes, towers may serve as a stop-gap measure to be replaced with a real or *faux* chimney at the earliest opportunity.

Real chimneys or *faux* chimneys, in or attached to a building, are vastly superior to free standing towers because:

- they will have at least one warm side, better satisfying temperature stability requirements.
- they are simpler to build, are structurally strong and can be built much higher than free-standing towers.
- incorporating walls of an existing building reduces the cost of the Chimney Swift structure.
- a network of chimneys (including potential roost and nest chimneys) can more easily be considered for inclusion in the construction of several single-dwelling houses and can be readily incorporated in the construction design of larger commercial or multi-family buildings.

Any chimney that is created for swifts should:

- provide stable, warm temperatures;
- allow airflow from the bottom;
- have sufficient depth or a cover to minimize exposure to direct rain and sunshine;
- contain a rough surface for birds to cling to and nest attachment;
- have sufficient depth for pre-fledging flight practice within the nest site;
- provide secured access at the bottom to confirm occupancy;
- be within a kilometer or two of open water or riparian habitat (feeding sites);
- allow unobstructed approach/departure areas (no obstacles within 50 m);
- provide nearby access to large deciduous trees to provide twigs for nesting purposes; and
- guard against predator intrusion, such as metal sheathing (> 60 cm band) on the upper sides of the chimney's exterior to deter raccoons, squirrels and other potential predators.

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