Best Management Practices for Excluding Barn Swallows and Chimney Swifts from Buildings and Structures

Photo: R. Kimpel (flickr.com/creative commons)

ontario.ca/speciesatrisk

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This document includes best available information as of the date of publication and will be updated as new information becomes available. If you are interested in providing information for consideration in updates of this document, please email esapermits@ontario.ca.

1.0 Introduction & Purpose

This document was produced on behalf of the Ontario Ministry of Natural Resources and Forestry (MNRF) to provide information about best management practices (BMPs) that may be relevant to activities that may affect Barn Swallow or Chimney Swift.

The purpose of this document is to provide information on methods that can be used outside of the period each year in Ontario when the species are active and carrying out important life processes relating to breeding, nesting and rearing to exclude Barn Swallow (*Hirundo rustica*) and Chimney Swift (*Chaetura pelagica*) from buildings and structures. The intended audience is proponents who need to implement exclusion measures once they have determined that Barn Swallow or Chimney Swift nest in a building or structure that requires alteration. Knowledge that the structure is used for nesting may have been determined by observations of nesting activity or by the presence of an old nest.

The information contained in this document is a summary of BMPs that was gathered from technical experts, peer-reviewed literature and guidance documents from other jurisdictions. Wherever possible, detailed specifications have been provided, including materials, proper installation methods, diagrams or pictures, and an evaluation of the advantages and disadvantages of each exclusion method.

This BMP document is intended to provide:

- General information on Barn Swallow and Chimney Swift and their nesting habits;
- Information on the effectiveness of a variety of exclusion methods; and
- Factors to consider when planning and implementing an exclusion method, the costs of materials, and where to find more information.

This BMP document is not intended to provide guidance on the applicability of legislation, eligibility for regulatory exemptions, or the need for approvals. The person(s) undertaking the activity will need to determine which exclusion method is appropriate for the circumstance and may need to consult a person with relevant expertise or the relevant approval agencies (e.g., MNRF). All necessary approvals must be obtained prior to undertaking the activity.

1.1 How to Use This BMP

This document contains separate sections for Barn Swallow and Chimney Swift. Each section includes a description of the species, their nests, the types of structures used for nesting, and a variety of exclusion methods that could be employed. Note that the exclusion methods described may not be appropriate for every circumstance, and in some cases a combination of methods may be the best approach. The details provided in this BMP are intended to assist in determining which exclusion method, or methods, would be the most effective for the circumstance. Note that all exclusions must be monitored to ensure that members of the species do not enter the work area. If, despite the measures employed, a member of the species enters the building or structure to establish nests (or to rest or roost in the case of Chimney Swift), any part of the activity that would harm or harass a member of the species must be suspended and the local MNRF district should be consulted.

1.2 The Endangered Species Act, 2007 (ESA)

The Endangered Species Act, 2007 (ESA) provides the legislative framework for the protection of species at risk in Ontario. Section 9 of the ESA includes prohibitions against activities such as killing, harming, harassing, capturing or taking a living member of a species that is listed as extirpated, endangered or threatened on the Species at Risk in Ontario (SARO) List. Section 10 of the ESA includes prohibitions against damage or destruction of the habitat of an endangered or threatened species.

The ESA contains provisions that enable the Minister to issue permits and enter into agreements to authorize activities that would otherwise be prohibited and Ontario Regulation 242/08 sets out conditional exemptions from prohibitions under the Act for certain activities. Ontario Regulation 242/08 sets out conditions for the maintenance, repair, modification, replacement or demolition of a building or structure that is habitat for Barn Swallow (section 23.5) or a chimney that is habitat for Chimney Swift (section 23.8). Among other conditions, the regulation requires the creation of replacement habitat, minimization of adverse effects and that steps are taken to exclude the birds from entering the building, structure or chimney during the species' active season. General information about ESA prohibitions related to the alteration of a structure that is habitat for Barn Swallow or Chimney Swift can be found using the links provided below.

Alter a structure that is habitat for Barn Swallow
(https://www.ontario.ca/page/alter-structure-habitat-barn-swallow)

Alter a chimney that is habitat for Chimney Swift
(http://www.ontario.ca/page/alter-chimney-habitat-chimney-swift)

For additional information, visit the government website or read the full text of the legislation on e-Laws using the links provided below.

How species at risk are protected
(https://www.ontario.ca/page/how-species-risk-are-protected)

Endangered Species Act, 2007
(http://www.ontario.ca/laws/statute/07e06)

Ontario Regulation 242/08
(http://www.ontario.ca/laws/regulation/080242)

Photograph of a Chimney Swift perched on a post (MNRF)

2.0 General Information on Barn Swallow

The Barn Swallow is a medium-sized bird (15-18 cm long) with a steely blue back, wings and tail, a rusty red forehead and throat, and a buffy orange belly (Photo 1). Their distinctive long forked tail is a key feature that can be used to identify this species of swallow. Their wingspan is roughly 30 cm across and they weigh 17 to 20 grams. This agile flyer feeds while in flight, snatching insects close to the ground or water. Barn Swallows usually nest in close proximity to humans, and their chattering calls are often heard throughout their nesting season.

The Barn Swallow is a long-distance migrant that spends the winter in Central and South America, returning to Canada to nest and raise their young each spring. Nests are constructed soon after returning to Ontario and may remain active into late August, particularly if the pair raises a second brood of young.

Barn Swallows occur throughout Ontario where suitable nesting sites can be found. As their name suggests, Barn Swallows nest almost exclusively on human-made structures, of which barns are commonly used. A study in British Columbia found that 57 percent of nests were between 2.4 and 3.5 m above the ground with the range falling between 0.3 to 30 m (Campbell et al. 1997). Their cup-shaped nests are built with mud pellets and then lined with grass or feathers (Photo 2). Nests are typically placed individually, unlike the groupings of ball-shaped nests of the Cliff Swallow (*Petrochelidon pyrrhonota*). Nest construction takes an average of one to two weeks, but nest sites and old nests are often re-used. The male and female may make over 1,000 trips to collect mud.

Historically, Barn Swallows nested on cliffs or in caves, but with the availability of new structures they have been able to attach their nests to a vertical or horizontal surface with a prominent overhang. Within a building or structure, Barn Swallow pairs may nest alone (i.e., a single nest) or in loose colonies where appropriate conditions are found. While they are tolerant of neighboring nests within a structure, they are often spaced 2-4 m apart or closer if separated from other Barn Swallows by a visual barrier. Barn Swallows are highly tolerant of human activity and will often return to nest in the same location year after year.

Photo 1: Adult Barn Swallows
(D. McCullough, flickr.com/creative commons)

Photo 2: Barn Swallow nest under overhang
(J.N. Stuart, flickr.com/creative commons)

2.1 Types of Nest Structures Used by Barn Swallows

Barn Swallow nests are almost exclusively found on human-made structures such as barns, bridges, culverts, sheds and other structures that have an overhang and ledge (Brown and Brown 1999). Nests can be found either outside or inside the structure; typically attached to a vertical wall or raised ledge under an overhang (Photo 3). Overhead protection provides shelter and is an important feature. Barn Swallows are very resourceful birds, so nests may show up in unusual or unexpected locations. Some of the more unusual nest site locations that have been observed include moving oil pumps, and moving trains and cars (Brown and Brown 1999). This BMP focuses on the most commonly used nesting structures, which are divided into four categories (buildings, bridges, culverts and open structures) as described below.

Photo 3: A Barn Swallow nest on a ledge under the eaves of a building (L. Kruschenske)

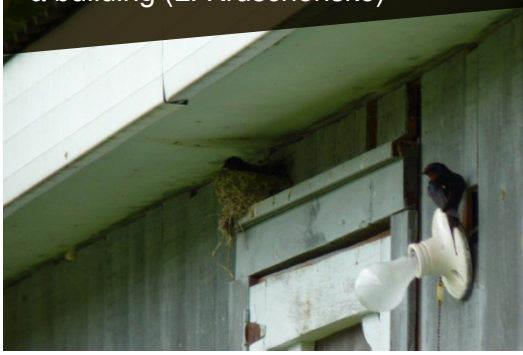


Photo 4: Barn Swallow nests on framing materials inside building (L. Sarris)

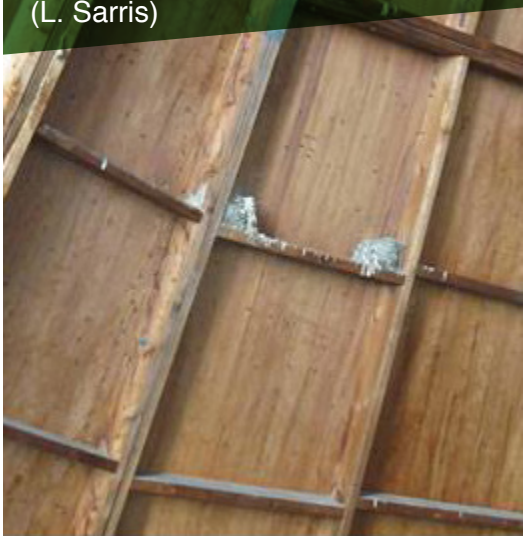
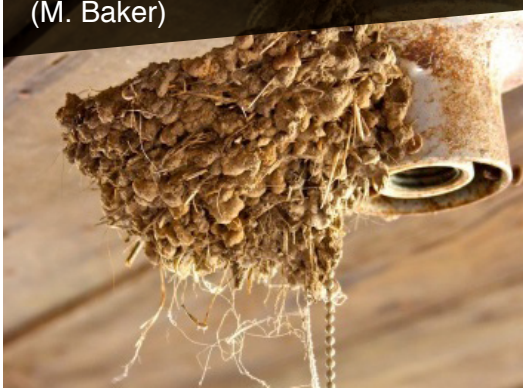


Photo 5: Barn Swallow nest on ceiling-mounted light fixture (M. Baker)



2.1.1 Buildings

Nests can be found in or on a wide variety of buildings. Examples of buildings that are commonly used by nesting Barn Swallows include barns, garages, sheds, boathouses, salt and sand domes, houses, cottages and commercial buildings. In some areas, boathouses offer preferred nesting habitat.

Interior nests are typically attached to rafters, beams or ledges (Photo 4), but may also be attached to a protruding object such as a light fixture (Photo 5) (Campbell et al. 1997). Nests attached to vertical walls require a rough surface for attaching nesting materials, or may be supported by a crack in the wall, a protruding bolt or even a wasp or other bird's nest. Barn Swallows are willing to enter buildings through very small openings to reach nest sites. These nesting preferences should be considered when designing and implementing Barn Swallow exclusion measures so that there are no gaps that allow access to the structure's interior and that the exclusion materials used do not inadvertently create new nesting habitat in an unsuitable location.

Exterior nests are typically attached in sheltered areas such as under eaves, porches or balconies, or above doorways and windows. Barn Swallows are generally not able to attach their nests to smooth surfaces such as vinyl and aluminum siding, unless there is a ledge, vent or windowsill to provide support. Brick walls and wooden barn walls, however, provide rough surfaces to which nests can be attached.

2.1.2 Bridges and Bridge-like Structures

After barns, bridges are the second most commonly reported nesting structure for Barn Swallows in Ontario (Chin et al. 2013). Docks, piers and wharves are also included in this category. Piers may provide ideal habitat for Barn Swallows, particularly at locations along the Great Lakes. Barn Swallows in Ontario seem to prefer to nest on bridges that are over water, but they may also nest on structures over land, such as highway overpasses or pedestrian bridges. When nesting on the underside of bridges or bridge-like structures, nests are typically found on flat ledges or protruding objects (e.g., bolts, beams, girders, pipes, wires).

2.1.3 Culverts

A culvert is a tunnel that carries a stream or an open drain under a road or railroad. In the context of Barn Swallow nest structures, this category also includes underground wildlife crossings or other tunnel-like structures. Highway culverts come in many different shapes including rectangular, square, round and elliptical, and the materials may be concrete, corrugated steel or plastic. Barn Swallows are most likely to be found in concrete culverts greater than 1 m wide (Stantec Consulting Ltd., unpublished data) but are occasionally found in corrugated metal culverts, where they place their nests on large bolts on culvert walls (Erskine 1992). In concrete box culverts, nests are found on vertical walls, very close to the top of the culvert or on protruding objects (Photos 6 - 9).

2.1.4 Open Structures

Barn Swallows may nest in open structures such as picnic shelters, gazebos, carports, canopies, towers, kiosks or any structure that provides protection from the weather.

Photo 6: Entrance to concrete box culvert (Stantec Consulting Ltd.)

Photo 7: Large concrete box culvert (Stantec Consulting Ltd.)

Photo 8: Barn Swallow nests on metal girders on underside of bridge over watercourse (Stantec Consulting Ltd.)

Photo 9: Barn Swallow nest on seam between concrete blocks in concrete culvert (Stantec Consulting Ltd.)

2.2 Exclusion Methods for Barn Swallow

The implementation of Barn Swallow exclusion methods and installation of materials are to be undertaken outside of the species' active season, in accordance with an ESA authorization or the conditions outlined in section 23.5 of O. Reg. 242/08. The Barn Swallow active season is defined in the regulation as "the period of each year when barn swallow carry out life processes relating to breeding, nesting and rearing, and that begins around the beginning of May and ends around the end of August, the exact dates varying according to the area of the Province in which the barn swallow are located and the climate conditions of each year".

Barn Swallows will return to nest in the same locations year after year, and can be very persistent in their attempts to gain access to nesting sites. If Barn Swallows are excluded from a nesting site they have used before, they may move to a different location on the same structure. Barriers should prevent access to all suitable nesting sites on the structure (or within the area of the activity), regardless of historical evidence of nesting. The method of exclusion should be carefully designed, installed and monitored to ensure that Barn Swallows do not gain access. If Barn Swallows enter a building or structure to establish nests in a work area where any part of the activity may result in harm or harassment to the species, work must be stopped immediately and the local MNRF district office should be consulted.

When choosing a method to exclude Barn Swallows, a number of factors should be considered, including:

- The type of structure;
- The extent of exclusion required (the entire structure or specific parts of the structure);
- Attributes of the structure that may complicate installation of exclusion materials (e.g., height of the structure, structures over water);
- Human activities at the site (e.g., vehicular traffic, access requirements);
- Prevailing weather conditions (e.g., strong winds);
- Duration of the exclusion (e.g., how many months it will be in place);
- Cost;
- If there are other species at risk or wildlife at the site; and
- If any other legislation is applicable to the activity.

In the sections below, exclusion measures are described in detail, including installation methods, materials and suppliers. Depending on the structure, use of several exclusion methods may be required.

2.2.1 Solid Barriers

Using Solid Barriers on Buildings

Solid barriers may be used to exclude Barn Swallows from gaining access to the interior or exterior surfaces of buildings. The two main types of solid barriers are plywood sheets and corner slope panels. Corner slope panels obstruct access to the 90 degree angle at ledges or overhangs. Solid barriers are more durable and require less monitoring than flexible barriers, but costs are likely to be higher. Solid barriers may be more suited for longer term exclusion and where visual appeal is important.

To block access to the interior of a barn or other building, keep all doors and windows closed and cover any holes or openings that are greater than 2.5 cm (1 inch). Inspect for loose boards, cracks in concrete, broken windows or gaps around window frames, and complete all necessary repairs. If frequent access to the building is required for people or equipment and keeping doors closed would be impractical, curtains may be used on the doors.

To block access to the preferred nesting sites on a building's exterior surfaces, such as under an overhang, porch or eaves, cover the area with a barrier that prevents access to the 90 degree angle at which birds would construct their nests (Figure 1). This will result in a concave or sloped surface (at a 45 degree angle to the building wall) that does not offer the preferred nest site conditions.

Corner slope exclusion products are available commercially in formats that are ready to install (e.g., BirdSlide® and Bird Slope™)(Photo 10). Corner slope panels can be attached with glue (e.g., Bird Barrier Bond™ or Bird Barrier Super Bond™), screws, or clips. The products come in a variety of colours and sizes and can be painted to match the exterior of the building. Detailed installation instructions are available from the supplier. Fibreglass panels (available at hardware stores) could also be used to construct a corner slope panel. Corner slope panels are fairly easy to install, offer permanent, durable exclusion and are aesthetically appealing. In situations where only temporary exclusion is needed or where cost is a concern, flexible barriers (see section. 2.2.2) may be considered instead.

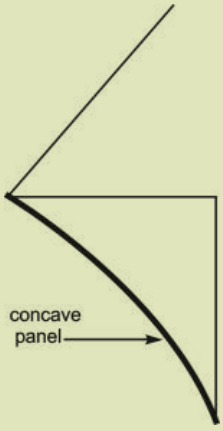


Figure 1 – Corner slope panels can be used to prevent Barn Swallows from nesting under eaves or other areas where the building provides a 90 degree angle (J. Bourne 1987)

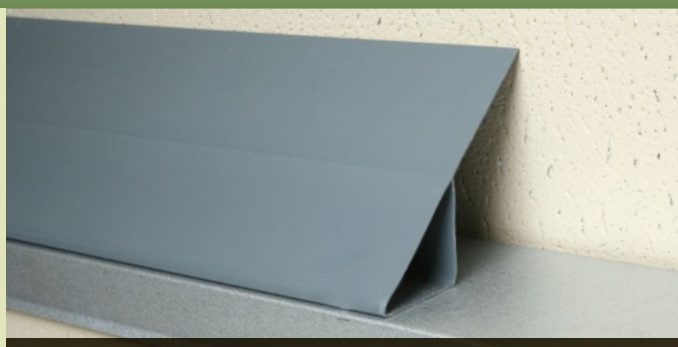


Photo 10: BirdSlide® Note that product would be inverted for prevention of nesting by Barn Swallows (www.birdbarrier.com)

Photo 11: Underside of a bridge showing girders prior to installation of plywood (L. Sarris)

Using Solid Barriers on Bridges

Plywood can be installed between the girders, with the plywood resting on the lip of the girder to eliminate access to the area where Barn Swallows typically nest (Photos 11-13). If the span between the girders is less than 1.2 m wide, 15 mm plywood can be used. For wider spans, thicker plywood should be used (e.g., 20-25 mm). Tack strips should be used to secure the plywood and prevent shifting.

If plywood will be used, consider the dimensions of the bridge because this will influence the cost of materials and ease of installation. Plywood is best suited for relatively small bridges because costs can be quite high to install plywood exclusion on large bridges.

Corner slope panels (Photo 14) may also be needed to block access to ledges, pipes and corners as described in the section above in the context of exclusion from buildings. If corner slope panels are applied to open structures, care must be taken to completely block access to all potential nesting sites.

Photo 12: Underside of a bridge showing girders after installation of plywood (L. Sarris)

Photo 13: Plywood barriers applied to the sides of a large bridge over a canal (L. Sarris)

Photo 14: Small section of BirdSlide® installed inside a girder to prevent nesting under a bridge (www.birdbarrier.com)

Using Solid Barriers on Culverts

In most cases the culvert must be kept open to allow the flow of water, so if solid barriers are used, they are only applied to specific areas of the culvert (e.g., corner slope barriers). A study in Colorado tested the use of corner slope methods in concrete box culverts (Photo 15) using the following installation methods (Tate 2010):

Commercially available BirdSlide® was installed following the manufacturer's guide, which required half inch holes to be predrilled every 12 inches along each four foot length of the product. These holes were filled with adhesive, which was also applied in a zig-zag bead down the length. The BirdSlide® was glued to the vertical wall of the culvert with the same adhesive (which allowed subsequent removal).

A second corner slope method was also tested. This method used a flexible two foot wide piece of plastic to cover the right angle with a concave arc. Each two foot by eight foot plastic panel was held in place with strips of metal track that were attached to one inch by two inch by eight foot boards with roofing nails. Construction adhesive was used to affix the boards to the culvert ceiling and wall. This method allowed subsequent removal of the metal track. The metal track was constructed of lengths of metal corner edging. These strips of track were placed on the culvert ceiling and wall less than 17 inches from the right angle at the top of the culvert so that the plastic was flexed sufficiently to be held in place.

For both corner slope methods, the holes at the ends were sealed with plastic so birds could not fly behind the BirdSlide® or plastic panels.

Photo 15: Corner slope barrier installed in a concrete box culvert to exclude swallows (D.J. Tate)

2.2.2 Flexible Barriers

Flexible barriers are often used where solid barriers are not practical or as a secondary exclusion method. They can be installed using a variety of materials including wire mesh, tarps, geotextile fabric, and barrier curtains. Materials vary in durability, cost and effectiveness. The best material to use for excluding Barn Swallows is half inch by half inch 19-gauge galvanized wire mesh (referred to as “hardware cloth” or “bird screen”) because it is reliable and durable. It is readily available at hardware stores or from wire mesh suppliers. Bird screen is relatively cost effective compared to other wire mesh products. Mesh with larger openings may allow Barn Swallows to pass through, which would render the barrier ineffective, and could present the risk of entrapment. Mesh with smaller openings may provide a rough surface for attachment of Barn Swallow nests, and could present the risk of foot entrapment.

Nylon netting or mist netting should never be used for exclusion because birds can become entangled and be injured or die while trapped (Photo 16). Netting that was used to exclude swallows from nesting on bridges in California resulted in more than 100 deaths when the birds became trapped in the netting. The state has stopped using netting on bridges and is instead using materials with slick surfaces.

Other materials such as plastic tarps, plastic mesh and geotextile fabrics require more maintenance because wind and inclement weather can cause the fabric to shift or tear, which will create gaps that Barn Swallows will use to gain access.

Photo 16: Dead swallows entangled in netting on underside of bridge-like structure (Native Songbird Care & Conservation)

Using Flexible Barriers on Buildings

When installing flexible barriers on the exterior of buildings, the following methods should be considered:

Cover the area with a flexible barrier at a 45 degree angle and ensure that the material extends 12 inches (30.5 cm) below the corner (Figure 2). Use bird screen or material that is specifically designed for this purpose (e.g., StealthNet®) (Photo 17). Attach the flexible barrier using staples, brass cup-hooks, adhesive backed hook-and-loop Velcro, cable ties, or other fasteners. Use rust-resistant fasteners to avoid rust stains on buildings. Flexible barriers may also be installed by stapling it to or wrapping it around wood laths, which are then attached to the structure. If using StealthNet®, it must be framed with the cable system as described on Bird Barrier's website (www.birdbarrier.com).

Another technique is to hang a curtain of bird screen from the eaves. The curtain should be secured three to four inches from the wall and extend down from the eaves 18 inches or more.

If flexible barriers need to accommodate passage of people or equipment, ensure that they are designed to withstand frequent motion without becoming detached.

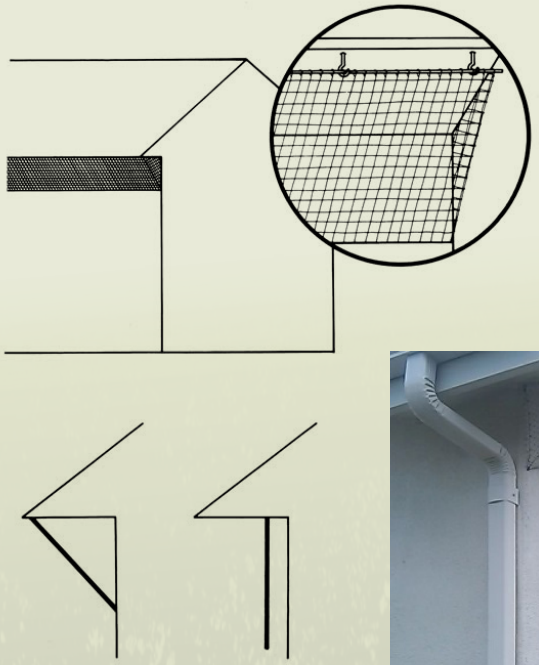


Figure 2: Diagram showing two different applications of flexible barriers to block access to the area under the eaves (secured along top and bottom edges to create a 45 degree angle or hung vertically like a curtain) (Washington Department of Fish and Wildlife 2005)

Photo 17: StealthNet® installed under the eaves of a residential building (www.birdbarrier.com)

Using Flexible Barriers on Culverts

The most effective method for excluding Barn Swallows from a culvert is a framed wire screen with a fabric apron, which is inexpensive and easy to install (Photo 18). Regular maintenance will be required to remove any debris that may become trapped on the wire screen and restrict water flow.

The following specifications should be followed (Sarris 2015, pers. comm.):

The framed wire screen should be constructed using wire mesh (half inch by half inch by 19 gauge) and pressure treated spruce (two inch by four inch lumber). If the wire mesh sheet sizes available are too small, multiple sheets can be woven together (i.e., for larger culverts). Abutting sheets of wire mesh should overlap by at least 100 mm and be tied together at 600 mm centers with galvanized wire. The tying wires must be twisted at least two times. The wire mesh should be stretched tightly across what will be the upper portion of the frame (when positioned in the culvert), with some slack toward the bottom to provide flexibility in storm events.

When securing the framed wire screen to the outside of a culvert, use fasteners spaced 600 mm apart with at least 80 mm from the edge of the concrete to prevent it from breaking off. The bottom of the screen should be 50 mm above the water surface or at the elevation at the top of the footing (whichever is higher).

The gap between the wire screen and the water surface should be blocked with a fabric apron (e.g., silt fence geotextile material) that is secured to the bottom of the wire screen. The fabric apron should overlap the bottom of the wire screen by 100 mm and should be woven through the mesh. The fabric should be cut into vertical strips that are 100 mm wide and extend below the water line.

Another option that can be used for culverts is a flexible curtain barrier installed inside the culvert. This is done by attaching a curtain along the ceiling of the culvert, hanging parallel to the culvert wall at a distance of five inches from the wall. At each of the culvert ends, the curtain should be secured to prevent birds from establishing nests between the curtain and the culvert wall.

A study of swallow exclusion from concrete box culverts in Colorado (Tate 2010) found that a curtain of dangling vertical strips was effective at excluding birds from nesting in culverts (Photo 19):

Flexible strip curtains were constructed using six mil plastic sheeting (cut into vertical strips that hung approximately two feet in length) and wood. The plastic sheeting was stapled to the one inch side of one inch by two inch by eight foot lumber. Along the full length of the culvert, the eight foot sections of curtain were glued to the top of the culvert within five inches of the wall. At each end of the culvert, the curtain was secured to the wall to prevent swallows from getting between the curtain and the wall.

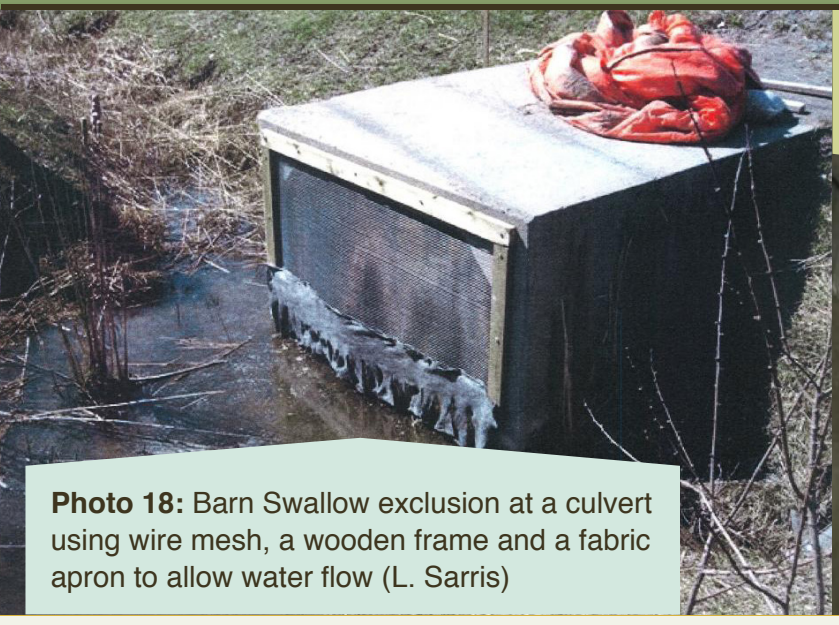


Photo 18: Barn Swallow exclusion at a culvert using wire mesh, a wooden frame and a fabric apron to allow water flow (L. Sarris)

Photo 19: Flexible strip curtains in a concrete box culvert in Colorado (Tate 2010)

Using Flexible Barriers on Bridges and Piers

Plastic tarps and geotextile fabric may be used to exclude Barn Swallows from bridges and piers, but are not 100 percent effective and are susceptible to weather related damage. Birds have been observed nesting in the seams and folds of the exclusion material (Sarris 2015, pers. comm.). Rigorous monitoring and maintenance are required for this exclusion method.

If geotextiles are used, the material should enclose the entire soffit of the bridge, including the fascia, abutments and piers of the bridge, and be secured with continuous edge strips consisting of 50 mm by 100 mm pressure treated spruce. The edge strips should form a neat edge and be securely fastened to the concrete using screws or nails at 600 mm spacing, set back at least 80 mm from any concrete edge to prevent the concrete from breaking off during installation.

The use of geotextile materials or plastic tarps is challenging because of the likelihood for damage by wind and rain. However, for large bridges with multiple nesting sites, these materials offer some advantages over wire nettings. For example, these materials are available in larger sheets, and geotextiles can even be custom sized. If multiple sheets are required the abutting strips should overlap by at least 100 mm and be tied together at 600 mm centres using UV protected, nylon zip ties.

If any ledges, drain pipes or other suitable nesting features remain exposed after tarping, they should be covered with wire mesh. During installation, care should be taken to ensure that the wooden framing used to secure the tarps or geotextiles does not inadvertently create ledges for nesting.

Using Flexible Barriers on Open Structures

Flexible barriers can also be used to exclude Barn Swallows from open structures (e.g., picnic shelters, carports) if access to the structure is not required for the duration of the activity. However, this may not offer a practical solution for long term use because the barriers would also restrict access by people.

Photograph of four young barn swallows with their mouths open, perched on a branch (Mark Peck)

2.2.3 Curtains

Using Curtains on Buildings

For commercial buildings such as warehouses, garages, hangars, salt/sand domes and other buildings that require frequent passage (e.g., equipment, vehicle and/or pedestrian traffic), keeping the doors closed at all times is impractical, and Barn Swallows are likely to enter the building if doors are left open. In these situations, industrial curtains or "strip doors" can be used to exclude Barn Swallows but allow for passage of people or equipment. In addition to use in doorways, they may be used to enclose an area containing machinery and equipment. Curtains may also be considered for use on bridges, but the cost could be prohibitive. Installation would be difficult and labour intensive for large or high bridges that are over water.

Curtains can be very effective in preventing birds from entering buildings if installed correctly with no gaps. If there is an opening one inch (2.5 cm) or greater, birds will be able to enter the building. Birds can be persistent and have been known to nest in parking garages by waiting for a car to trigger the automatic door.

Strip doors are commercially available (Photo 20) or they can be constructed by hanging vinyl strips (ranging from 6 inches to 16 inches wide) like a curtain across the entryway. The strips are typically installed on a track and should overlap by at least five cm (Gorenzel and Salmon 1994).

Strip doors or curtains can be used to exclude Barn Swallows from boathouses but the design should ensure that if the water level drops, access will not be enabled at the bottom of the door (Photos 21-23). Specially designed products for boathouses are referred to as marine roll-up doors.

Photo 20: Vinyl strip door installed in a doorway allows passage of people and equipment (Liftow Ltd., http://www.liftow.com)

Photo 21: Curtain door installed in boathouse doorway (Marina Screen, http://www.marinascreen.com)

Photo 22: Large industrial curtain door on a commercial building (http://www.qsd-inc.com)

Photo 23: Curtain door on salt/sand dome storage building (http://gatewayindustrial.com/salt-dome/doors.html)

Photo 24: PTFE sheets applied to piles and junction points (Delwiche et al. 2010)

2.2.4 Slick Surfaces

Barn Swallows require a rough surface to which they can adhere their mud nests, so the application of a smooth coating or material may prevent them from building nests. Slick surfaces can be used to prevent the establishment of nests in or on buildings, bridges, culverts and open structures, while still allowing the birds to access the structure. This method is sometimes referred to as surface modification treatment.

Using Slick Surfaces on Buildings

Slick surfaces may be a solution for long term application on the exterior walls of a building, particularly for residential or commercial buildings where aesthetic appeal is important. It is important that no rough edges are left exposed that could be used as a nest site. A typical application of this method is under the eaves of a building. Polytetrafluoroethylene (PTFE) and polyethylene (PE) plastic sheeting has proven to be effective (Conklin et al. 2009; Delwiche et al. 2010), but sheet metal may also be used. An advantage to flexible plastic sheeting is that it can be wrapped around the circumference of vertical structures (e.g., posts, pillars). Silicone paint is not effective as swallows have been able to attach their nests to surfaces painted with this material (Delwiche et al. 2010).

Slick surfaces may also be used inside buildings, but if birds have already gained access to the interior, it will be challenging to apply slick surfaces to all potential nesting locations. This method is only practical in situations where there is only a small amount of suitable nesting habitat.

Using Slick Surfaces on Bridges

A study to test the effectiveness of exclusion methods for Cliff Swallows on bridges found that PTFE plastic sheeting was effective (Delwiche et al. 2010). Swallows attempted to attach mud, but the mud would not adhere to the surface. The specific methods used are described below:

PTFE sheeting (10 mil gauge) was attached to the underside of bridges where nests are commonly built, such as at the juncture of vertical supports and overhead surfaces. This included the upper portion of pier walls and piles and the horizontal area above the junction. The bridges were cleaned with a pressure washer prior to installation of the sheets. Butyl sealant strips (a product used in roof construction) were used to stick the sheets to the bridge surfaces.

The PTFE sheets covered the top 61 cm of each pile's circumference and extended along the underside of the bridge at least 18 cm from the top of the pile. The sheets were cut to a length of 1.83 m for ease of handling. Butyl adhesive strips were applied along the edges and at set distances along each sheet to ensure consistent adhesion. The paper backing of the butyl strips was removed and the sheets were pressed against the bridge surfaces. The sheets overlapped by three to six mm to provide continuous coverage.

Photograph of a male Barn Swallow (Mark Peck)

2.2.5 Deterrents

Most bird deterrents are not effective in excluding Barn Swallows. Bird spikes that deter birds from landing or nesting on ledges are usually sized for larger birds. Swallows are small and can land or nest between the spikes.

Some deterrents may work for a short time, but birds will adapt to scare devices rendering them ineffective. Bird deterrents that will not effectively exclude Barn Swallows from buildings and structures include pyrotechnics (bird bangers), audio playback of predator calls or alarm calls, predator decoys (e.g., plastic owls or snakes), flash tape, repel strips and scare eyes. Flashing light has proven somewhat effective at deterring Barn Swallows from nesting at commercial operations, but the success rate is not high enough to achieve complete exclusion. For these reasons, deterrents may be considered in combination with other methods, but should not be used as the primary exclusion method.

2.2.6 Monitoring

The effectiveness of any exclusion method depends on regular monitoring. Barriers should be checked regularly to make sure that they are still firmly attached, there are no tears or openings, and the barrier materials have not inadvertently created new nesting sites. For example, Barn Swallows may be able to nest on some types of wire mesh and the wooden framing used to hold flexible barriers in place. Barriers should be checked at least once per week prior to the active season; and checked every three days during the active season. Barriers should also be inspected promptly after high wind and rain.

3.0 General Information on Chimney Swift

Chimney Swifts are medium sized birds that are sooty brown with slightly paler throats (Photo 25). They have long cigar-shaped bodies and stiff fluttering wings. These birds spend most of the day flying and feeding on insects. Unlike most birds, Chimney Swifts are unable to perch; instead they must cling to rough vertical surfaces such as the insides of chimneys or in hollow trees.

Photo 25: Underside view of adult Chimney Swift in flight (B. Holden)

Photo 26: Chimney Swift nest with recent hatchings (Bird Studies Canada).

3.1 Types of Nest Structures Used by Chimney Swift

Nests are created with small twigs, held together with the Chimney Swift's sticky saliva. The outside of the nest appears rough with protruding edges of small branches, yet the inside is smooth. Nesting begins shortly after the birds return to Ontario from their wintering grounds (late April) and nests may be active through October (Photo 26).

Chimney Swifts nest throughout Ontario, primarily where suitable human-made structures exist. As their name implies, most nests are found in masonry chimneys but nests may also be found in other structures such as barns, sheds, or wells, and in large hollow trees (Peck and James 1983). Typically, only one nest will be present within a chimney, but non-breeding individuals can be found in large numbers in chimneys during spring and fall migration and in summer months in some Ontario cities. Large numbers of birds will enter chimneys at dusk and rest there for the night. This is called roosting and may also occur during periods of inclement weather when flying insects are not available.

Photograph of an adult Chimney Swift with a nest of juvenille Chimney Swifts (MNRF)

3.2 Exclusion Methods for Chimney Swift

Chimney Swift exclusion methods are to be installed outside of the active season, in accordance with an ESA authorization or the conditions outlined in section 23.8 of O. Reg. 242/08. The Chimney Swift active season is defined in the regulation as "the period of each year when Chimney Swift carry out life processes relating to breeding, nesting and rearing, and that begins around the end of April and ends around the middle of October, the exact dates varying according to the area of the Province in which the chimney swift are located and the climate conditions of each year".

The method of exclusion should be carefully designed, installed and monitored to ensure that Chimney Swifts do not gain access. If Chimney Swifts enter a chimney or structure to establish nests in a work area where any part of the activity may result in harm or harassment to the species, work must be stopped immediately and the local MNRF district office should be consulted.

When choosing a method to exclude Chimney Swift, a number of factors should be considered, including:

- The type of structure;
- The extent of exclusion required (the entire structure or specific parts of the structure);
- Attributes of the structure that may complicate installation of exclusion materials (e.g., height and size of the structure);
- Human activities at the site (e.g., access requirements);
- Prevailing weather conditions (e.g., strong winds);
- Duration of the exclusion (i.e., how many months it will be in place);
- Cost;
- Whether there are other species at risk or wildlife at the site; and
- Whether any other legislation is applicable to the activity.

In the sections below, exclusion measures are described in detail, including installation methods, materials and suppliers. Depending on the structure, a combination of multiple exclusion methods may be required.

3.2.1 Solid Barriers

Chimney caps can be purchased at most hardware stores and come in a variety of shapes and sizes. The type of cap required will depend on the chimney size and whether it has a single flue or multiple flues (Photos 27 and 28). Chimney caps are mounted to the chimney with brackets and can be removed when the exclusion of Chimney Swifts is no longer necessary.

If the chimney is an unusual size and a cap is not readily available, then a wire cover can be constructed to exclude Chimney Swifts. Bird screen or hardware cloth can be used to block access to the chimney, but it must be securely fastened because the birds have been known to slip through small openings where the wire has become loose. The gauge of wire mesh should be selected to prevent entrapment of birds.

Photo 27: Single flue chimney cap (Woodland Direct Inc.)

Photo 28: Multiple-flue chimney cap (Woodland Direct Inc.)

Photo 29: A sagging tarp on the roof of a church (N. Finney)

3.2.2 Methods Not Recommended for Chimney Swift

Slick surfaces should never be used to exclude Chimney Swifts, as they may cause birds to fall and injure themselves. If the chimney already contains a metal liner or other slick surface, access must be blocked to prevent injury or death of a Chimney Swift that may enter the chimney.

Bird deterrents should not be used to exclude Chimney Swifts because they are ineffective. Examples include pyrotechnics (bird bangers), audio playback of predator calls, audio playback of alarm calls, electric deterrents (e.g., shock strips) and predator decoys (e.g., plastic owls).

Using flexible barriers such as tarps to exclude Chimney Swifts is not recommended because it is difficult to securely fasten a tarp to a chimney. Wind will likely cause a tarp to loosen or rain will pool on the tarp causing it to sag (Photo 29), and gaps will allow the swifts to enter the chimney. Squirrels or other birds may also create (or enlarge) openings which could then be used by Chimney Swifts.

3.2.3 Monitoring

A chimney cap or wire cover should be periodically inspected (i.e., weekly) to make sure that it has not become loose and that there are no other openings that could be used by Chimney Swift to gain access to the structure.

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