

Black Swift Survey Protocols in Canada: Site Occupancy, Nest Searching, and Site Habitat

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Background

In Canada, Black Swifts (*Cypseloides niger*) breed in mountainous habitat in the southern half of British Columbia (BC) and southwestern Alberta (AB) and may nest on the coast of BC in sea caves. Nesting colonies and single nests have been located at breeding sites¹ across their range (Lowther et al. 2020). Nests are constructed with moss and mud in rock ledges/crevices behind or alongside waterfalls or seeps, in wet, narrow canyons, and in wet cave and sea cave entrances. Black Swifts are aerial insectivores that feed exclusively on flying insects and, as a result, spend long periods of time on the wing, often at high altitudes (COSEWIC 2015).

Flying adult Black Swifts may be confused with other swift species, swallows, and bats. Black Swifts have longer wings, black plumage, and high flight speeds. Black Swift flight is distinctive from other swift species and involves slower wing beats that often transition to short glides with extended wings tilted downwards. Nestlings are black with white edging on flight and contour feathers (Pyle 1997).

Black Swifts arrive at their Canadian breeding grounds in mid to late May and early June in BC (Campbell et al. 1990). The most complete nesting phenology information available in Canada has been recorded at a breeding colony in Johnston Canyon, AB. At this site, the earliest arrival at a nest was documented on May 30. Potential egg-laying² and incubation³ dates ranged from June 13 to July 26 (n = 30). Nestling dates were from July 17 to September 18 (n = 91), and approximate fledging dates were between August 28 and September 18 (n = 11) (Rogers, pers. comm.). Clutch size is one egg. Replacement clutches, in Colorado, have been documented infrequently (n = 7) after the first egg disappeared from the nest and rarely (n = 1) after the second egg disappeared (Hirshman et al. 2007). This information does not exist for nests in Canada.

Active Black Swift nests are notoriously difficult to locate, and few confirmed nests have been located in Canada (Levesque and Rock 2017). The main challenges are that nests are cryptic, the sites are often inaccessible, and the adults have low rates of nest attendance. Annual breeding site fidelity is high with many sites being used for decades (Kondla 1973; Collins and Foerster 1995; Levad et al. 2008; Levesque 2015; Gunn et al. 2020; Rogers, pers. comm.). Documentation of Black Swifts using Johnston Canyon as a breeding site dates back to 1919 (Bent 1940; Kondla 1973; Holroyd 1993).

Black Swift survey protocols include conducting **Site Habitat**, **Site Occupancy**, and **Nest Searching** surveys. **Site Habitat** surveys are conducted at all potential breeding sites to inform our understanding of Black Swift nesting habitat and variation between years (or months). Due to the challenges in locating and confirming active breeding sites and nests, detections of adult Black Swifts flying into or from suitable nesting habitat is the most successful approach to determining site occupancy. If **Site Occupancy** is confirmed, conduct additional **Nest Searching** surveys to search for nests in the areas where birds were detected. If **Site Occupancy** is unconfirmed, **Nest Searching** surveys still should be conducted because they allow for a further opportunity to detect

¹ Breeding site is the geographic locale containing one or more nests (such as a waterfall or canyon).

² Dates on which viable eggs were visible or adults were believed to be sitting on eggs or engaged in an incubation posture.

³ The period between laying and the “start” of incubation has been observed to be up to a week (Hirshman et al. 2007).

active nests and confirm occupancy⁴. All surveys should be conducted by qualified observers, who are experienced field ornithologists, due to challenges with identifying fast-moving and cryptic Black Swifts.

The following protocols are adapted from Schultz and Levad (2003) and Levad et al. (2008), and are expanded to include new information about optimal survey timing for increased detection rates (Levesque and Rock 2018).

1) Site Habitat Survey

Timing/Conditions

Site habitat information is collected to inform nesting habitat suitability in Canada and to assess site potential before conducting occupancy surveys. At sites where multiple occupancy surveys may be required (i.e., sites with long canyons or multiple waterfalls; see Site Occupancy Surveys section), complete a site habitat survey for each canyon segment/waterfall tier. Site habitat surveys can be conducted at any time during the breeding season, at any point during the day, and on repeated visits. They can be conducted when initially scouting survey sites. Surveyors should position themselves with a clear view of the potential nesting areas and any known or suspected nests. Collecting habitat data in canyon habitat can be challenging because there can be few safe vantage points for observations (use caution when accessing sites; see Safety Considerations section). Surveys can be conducted by one or more individuals.

The level of light exposure at the potential nesting habitat (feature), moss cover, availability of nest niches, water flow, temperature, and humidity are thought to be important site attributes for nesting Black Swifts (Knorr 1961; Gunn et al. 2012). Microclimate site attributes at the feature likely are influenced by site characteristics such as canopy cover, mist, and water temperature. Availability of crevices/nesting pockets also may be a limiting resource for breeders. Recording the substrate type at the feature is important because some rock types (e.g., limestone) are more likely to have suitable niches for Black Swift nests. Familiarity with the most common rock types would be helpful, but, if you are unsure, photographs of the substrate can be useful. Rock identification guides are available online (e.g., <https://www.learner.org/wp-content/interactive/rockcycle/types.html>).

Following Levad et al. (2008), assess the presence of six habitat characteristics (below) and score by qualitatively assigning a numeric rating ranging from 1 to 5 based on increasing abundance or extent. Score the characteristics within 30 m of the feature (where habitat is available). The criteria for each habitat characteristic are presented in the corresponding data form.

- Flow (the amount of flowing surface water)
- Relief (the extent of relief over surrounding terrain from the top of the feature)
- Access (the extent of aerial access to or from the nest niches)
- Shading (the extent of daytime shading of potential or known nest niches)
- Niches (the number of potentially suitable or known nest niches inaccessible to ground predators)
- Moss (the amount of moss available within 30 m of the feature)

⁴ Multiple surveys at occupied sites with one known active nest did not always detect flying swifts. However, site occupancy was assessed by observing the nest (Levesque and Rock 2018; Rock and Levesque 2019).

Photo records are important for relocating the site and feature during subsequent visits. Photos depicting how to access the survey location (route to site access) should be documented with survey location indicated on a marked-up copy. Recording a track and waypoints of significant trail markers using the GPS is advisable for documenting the access route. A Google Earth layer (.kml) indicating the access route (track and waypoints) to the survey location should be prepared from the .gpx file for reference. Photos of the feature at various spatial extents (panoramic, landscape, site, and feature) will provide context for relocating the site and a reference to document the site habitat.

Information to Record

- Survey details
 - Site name⁵ [official or unofficial name of waterfall (typically includes the stream name) or canyon name], nearest town, and province/territory
 - Stream name
 - Park name (if applicable)
 - Date (yyyy/MMM/dd; e.g., 2020/JUL/17)
 - Time (24 hour format)
 - Observer(s) initials
 - Land tenure (i.e., Private; Federal; Provincial; Municipal; Unknown)
 - UTM's and datum; waypoint (recorded at the observer's survey location)
- Site details
 - Surveyor location relative to waterfall/canyon (top of falls/rim of canyon; waterfall base or canyon bottom; midway from top and bottom of waterfall/canyon)
 - Elevation (at survey location)
 - Description of surveyor location and minimum distance to feature (nearest waterfall or canyon)
 - Photo numbers for the following views taken from the survey location(s) for all sites (occupied or unoccupied):
 - Panoramic (extended view of the area, including the waterfall or canyon feature)
 - Landscape (view of area including feature)
 - Site (full view of feature, including immediate surroundings)
 - Feature (full view of feature only)
 - Access to survey location (route access or distinguishing markers at start of trailhead or along it)
 - Site access notes
- Site feature details
 - Waterfall type (plunge, horsetail, fan, cascade, segmented, tiered; see data form for description)
 - Canyon presence and position relative to waterfall(s)

⁵ If multiple surveys are needed to assess multiple waterfall tiers or canyon segments, the site naming convention should include a numeric identifier for the waterfall tier or canyon segment numbered from the most downstream tier or segment to most upstream tier or segment. In cases where bridges are used as observation points, bridge numbers (numbered in a similar manner) may be used as the locational identifier (note in sketch section).

- Description and labelled sketch of the shape of canyon and/or waterfall (e.g., horseshoe; linear; “s” shaped”)
- Waterfall aspect or canyon orientation (general, or per segment if the orientation varies across the feature, from upstream to downstream; compass degrees)
- Height (maximum of waterfall from rim/smooth-water lip to bottom of waterfall, or depth of canyon from the highest rim or peak to the water height). Height of individual tiers of waterfalls or segments of canyons should be annotated in the site notes or sketch. Minimum canyon depth (lowest rim to water height) also can be annotated
- Width of available habitat along the vertical relief (m), based on habitat characteristics described in Levad et al. (2008)
- Microclimate details
 - Nearest proximity of trees to waterfall and/or canyon rim (m)
 - Canopy cover (%) within 30 m of the feature (waterfall or rim of canyon)
 - Average canopy height (m) within 30 m of the feature (waterfall or rim of canyon)
 - Dominant canopy species (list)
 - Distance that visible mist travels from waterfall
 - Water temperature (°C) of stream (if possible), recorded in flowing water
 - Moss cover (%) within 30 m of the feature along vertical relief
 - Substrate type (type of rock)
- Habitat scoring for six characteristics thought to be present at nesting sites

Equipment

- Site Habitat Survey Data Form
- Thermometer
- Compass
- Camera
- Laser rangefinder
- Notebook and pen/pencil
- GPS (set to NAD83 or note datum used)
- Watch/timepiece
- Binoculars (it can be useful to use binoculars when examining habitat features)
- Safety equipment (see Safety Considerations section)

2) Site Occupancy Surveys

Timing/Conditions

Site occupancy is determined by observations of Black Swifts flying into or from potential nesting habitat (features) or nest sites. Once occupancy is confirmed in a given year, no further surveys are required at the site. However, additional surveys can inform colony size and nest success. Surveys at the site repeated in subsequent years can inform site use and demographics.

Because Black Swifts are difficult to detect at their breeding sites and nests, the recommended survey standards for timing (seasonal, time of day) reflect those periods with highest detectability at the site. Occupancy surveys should be conducted within the incubation and nestling periods. Surveys are best conducted between **25 June and 25 August**. However, Black Swift activity at nesting sites may occur earlier or later than this period (see Background). There is a trade-off between surveying in August, when water levels are lower and more nesting substrate is visible for nest searching, and detecting nesting attempts that occurred earlier in the season and failed. A minimum of three repeat surveys are recommended per site throughout the nesting season to account for this trade-off⁶.

The three occupancy surveys should span the nesting phases (egg laying, incubation, nestling) to account for differences in activity, changes in weather, and differences in feeding patterns (i.e., ideally one survey near the end of June, one survey in mid to late July, and one survey in mid to late August). Each survey period has its strengths. Surveys in late June to early July (during egg laying/incubation periods) are useful for detecting birds that may fail in nesting early during the nesting period. Those in mid to late July (incubation/nestling) are timed as the water flow reduces to detect birds that may be attending nests. Surveys in mid to late August (nestling), when water levels are lower, are advantageous because surveyors may access additional survey locations with improved visibility and nestlings are larger, more active, and may be more visible.

Occupancy surveys should be conducted at dawn, beginning **30 minutes before sunrise** and ending **60 minutes after sunrise** when Black Swift adults leave their nest or roost sites to forage. Evening surveys also have been used to determine site occupancy and abundance across the species' range in the United States (Foerster and Collins 1990; Levad et al. 2008). Evening surveys are conducted during the final hours of daylight, beginning two hours before sunset and ending once it is too dark (~30 minutes after sunset) to observe Black Swifts returning to their nest or roost sites (Levad et al. 2008). While evening surveys also can detect Black Swifts, evening detection rates in British Columbia were 3.5 times lower compared to those at dawn for surveys conducted in late June, July, and August (Levesque and Rock 2018). Evening surveys may be effective in late June and early July when Black Swifts are displaying and courting early in the breeding season (Holroyd, pers. comm.), particularly at breeding colonies with more than one active nest where there is a higher probability of detecting at least one adult. However, to ensure that surveys are conducted during the period with the highest detectability, evening surveys are not a replacement for dawn surveys, but could be conducted in addition to dawn surveys.

⁶ A detection rate analysis may modify this number in the future.

Sunrise and sunset times for given locations can be calculated by most handheld GPS devices to provide an accurate local sunrise time. If a device is not available, the information can be downloaded from various websites (e.g., National Research Council Canada: <https://nrc.canada.ca/en/research-development/products-services/software-applications/sun-calculator>). Local site topography also can affect the light levels at the survey location. Using a light meter to measure the ambient light levels at the site is useful for evaluating how local light may be influenced by topography and for determining what light levels may prompt Black Swift departure or arrival.

Where possible, surveys should be conducted by two or more surveyors in order to increase detection rates and allow for greater and overlapping coverage of the potential habitat. Ideally during occupancy surveys, observers should be positioned downstream of waterfalls (outside of the spray zone) and below the waterfall to enhance the detectability of the birds against the lighter sky and the white of the waterfall. Observers should continuously monitor the waterfall feature and adjacent habitat and the sky directly above the feature for Black Swift movement by uninterrupted scanning of the area with the naked eye. If more than one surveyor is present, surveyors should discuss individual areas of focus and observer orientation to maximize coverage. At sites with multiple waterfall tiers, either additional surveyors need to be spaced downstream from each waterfall or the surveyor(s) must complete surveys along the entire waterfall complex over multiple survey days to adequately survey the habitat. For sites visited for the first time, it is recommended that the survey site be accessed the day before the dawn survey to determine and mark a safe access route and to identify the best vantage point for the survey. Nest Searching (see section below) and Site Habitat surveys also can be conducted during this initial visit. If access to the bottom of the falls is not possible, select a location that provides the best view of the falls, ideally below the top of the falls to increase visibility of birds in flight contrasted against the sky or waterfall. If access below the falls is not possible due to safety concerns, viewing locations above the falls may be sufficient for detections.

The survey methodology is similar for canyons. However, the length and path/layout of potential habitat sections of the canyon will determine the observer positioning required. Similar to waterfalls, observers should be positioned to enhance detectability and to maximize the lighter sky as a background, often at the base of the mouth/widening of the canyon. Depending on site, terrain, and access, observers also could be positioned along the canyon rim. Completing a survey at one end of the canyon or section may not be adequate to determine occupancy⁷. Either additional surveyors should be spaced along the canyon at a minimum of 50 m intervals⁸ during a single survey, or multiple surveys should be completed along the lengths of canyon habitat at a minimum of 50 m intervals, over more than one survey day unless occupancy is confirmed.

Surveys should be conducted under suitable weather conditions (see Table 1). Surveys should not be conducted in high winds (> 19 kph; Beaufort Scale 3 or higher), heavy precipitation (e.g., prolonged light rain, hard rain, or snow), fog, or other conditions (i.e., heavy forest fire smoke) that could reduce or inhibit surveyor ability to detect Black Swifts.

⁷ Observers positioned 180 m apart at a canyon had differing numbers and times of detections (Rock and Levesque 2021).

⁸ Minimum distance of 50 m selected based on comparisons of number and timing of detections at different positions along a canyon (Rock and Levesque 2021).

Site occupancy is determined by observations of Black Swifts flying to or from potential nesting habitat (features) or nests. For example, Black Swifts exiting a waterfall, seep, canyon, or cave in a direct or indirect flight path would be recorded as “fly from feature” (FFF). In some cases, the bird’s origin on or within the feature may not be obvious or known, but there is an assumption that the bird has left the feature based on flight path, height, and trajectory.

Information to Record

Black Swifts fly at very high speeds when entering and leaving waterfalls or canyons. Record observations on a digital audio recorder during the survey and transcribe results to a data form after conducting the survey. This enables continuous viewing and reduces the chances of false-negatives in data. Data forms should be carried as well to ensure that survey details, sketches, and additional details can be recorded at the beginning and end of the survey.

- Survey details
 - Site name⁹ [official or unofficial name of waterfall (typically includes the stream name) or canyon name], nearest town, and province/territory
 - Date (yyyy/MMM/dd; e.g., 2020/JUL/17)
 - UTM’s and datum (recorded at the observer’s survey location)
 - Observer initials and orientation (in degrees)
- Start and end time (24 hour format)
- Sunrise time (as indicated by GPS/website)
- Light level at start and end of survey (optional; Ev)
- Air temperature (°C)
- Sky, wind, weather conditions, and moon phase (see Table 1)
- Black Swift detections and bird behaviour
 - Codes: FTF = fly to feature/nest; FFF = fly from feature/nest; ON = adult on nest, attending egg or nestling; RST = resting/clinging to feature; FAL = flying aloft; and OT = other (e.g., vocalizations and chasing/social interaction)
 - Time of bird detection(s) (24 hour format)
- Light level at time of bird detection(s) (recommended; in Ev)
- Flight path of bird (assists with nest searches)
- Presence, type, and number of recreational users/pedestrian traffic visible during the survey
- Presence and number of potential nest predators (e.g., corvids, raptors, small mammals)
- Other species at risk, bats, and riverine bird species (e.g., Harlequin Duck, American Dipper, and merganser species)
- Occupancy survey results (determined based on detections)
 - Codes: OC = confirmed occupied (detected birds FTF, FFF, RST, or ON); MA = may be occupied but not confirmed (detected birds in area FAL but no other confirmation that site is occupied); ZZ = no detections (no birds detected at or near the site)
- See Site Habitat survey to document site access

⁹ If multiple surveys are needed to assess multiple waterfall tiers or canyon segments, the site naming convention should include a numeric identifier for the waterfall tier or canyon segment numbered from the most downstream tier or segment to most upstream tier or segment. In cases where bridges are used as observation points, bridge numbers (numbered in a similar manner) may be used as the locational identifier (note in sketch section).

Equipment

- Site Occupancy Survey Data Form
- Digital audio recorder
- Headlamp and backup light source (i.e., flashlight; ensure they are turned off during surveys or on red lamp)
- Thermometer or portable weather instrument (e.g., Kestrel units)
- Light Meter [optional; recording in Exposure Value (Ev) at 100 ISO light sensitivity]
- Compass
- GPS (set to NAD83 or note datum used)
- Watch/timepiece
- Notebook and pen/pencil
- Binoculars (although surveys are completed by scanning with the naked eye, can be useful to use binoculars outside of the survey window when examining habitat and identifying other species at risk and riverine bird species)
- Safety equipment (see Safety Considerations section)

Table 1. Codes for wind speed, sky, moon phase, and weather conditions.

Beaufort	Wind Speed Indicators*	Sky	Moon Phase	Weather
0	Smoke rises vertically	1 clear	1 Full	N No Precipitation
1	Wind direction shown by smoke drift	2 scattered clouds (<50%)	0.5 Half	F Foggy
2	Wind felt on face; leaves rustle	3 scattered clouds (>50%)	0.25 Quarter	M Misty Drizzle
3	Leaves and small twigs in constant motion	4 unbroken clouds	0 New	D Drizzle
4	Raises dust and small branches are moved			LR Light Rain
5	Small trees in leaf begin to sway			HR Hard Rain
6	Large branches in motion			LS Light Snow
7	Whole trees in motion			S Snow
				LFS Light Forest Fire Smoke
				HFS Heavy Forest Fire Smoke

* Beaufort scale values with corresponding wind speed values; 0 = < 2 km/hr; 1 = 2-5 km/hr; 2 = 6-11 km/hr; 3 = 12-19 km/hr; 4 = 20-28 km/hr; 5 = 29-38 km/hr; 6 = 39-49 km/hr; 7 = 50-61 km/hr

3) Nest Searching

Timing/Conditions

In Canada, Black Swifts lay eggs from mid June to early July, and nestlings fledge during the last week of August and first two weeks of September (see Background). High water flow and spray can obscure views of nesting substrate. Reduced water flow from **mid July to mid August** allows the best period to conduct nest searches. Nest searches can take place any time after sunrise to sunset, and can be conducted by one or more observers. Nest Searching surveys can be conducted when initially scouting survey sites. Due to the challenges in locating and confirming active nests, Nest Searching surveys should not be used as a substitute to Site Occupancy surveys.

Nests can be located by systematically scanning the substrate with a spotting scope. Once all of the substrate has been scanned, the observers will need to reposition to a new vantage point and continue scanning the substrate from different angles (best angles to view inside available niches to determine whether a nest is present) and locations (allow all visible substrate to be scanned for nest niches cumulatively). Binoculars often are not effective for locating nests and should not be used as a replacement to a spotting scope.

Observers should look for whitewash and/or green algae staining (see Figure 1) that is often on the substrate below active Black Swift nests. Lichen (including, but not limited to, Elegant Sunburst Lichen; *Xanthoria elegans*) or moss species also may be noted below or near the nest(s). A handheld spotlight, used in conjunction with a spotting scope, can be useful for illuminating Black Swift nests situated in deep crevices or pockets in the rock that are otherwise not visible (e.g., Figure 2). Likewise, flash photography or infrared technology (e.g., FLIR camera) can detect eyeshine or thermal signatures, respectively, in dark recesses. Ensure that these light sources are not shone on the nestling and/or adults for any period of time to avoid disturbing the birds. Record the time spent searching for nests and the total unit effort (number of observers x time period). Ensure that located nests are correctly identified as Black Swift nests. They can be similar to other cup-nesting¹⁰ bird species that could be using a niche for nesting (e.g., Townsend's Solitaire nests identified by the presence of grass, not moss, in nests even though they may have whitewash and green moss below; Pacific-Slope Flycatcher nests identified by the presence of moss, grass, bark, lichen, feathers, etc.).

Information to Record

- Survey details
 - Site name (see Site Occupancy Surveys)
 - Nearest town; Stream name
 - Province/territory
 - Date (yyyy/MMM/dd)
 - Observer(s) initials
 - UTM's (recorded from observer survey location)
 - Land tenure (i.e., Private; Federal; Provincial; Municipal; Unknown)
- Survey start and end time (24 hour format); Total survey time (hour:minutes)
- Number of observers [to calculate survey effort (observers x search time)]

¹⁰ American Dipper nests are identified by a large domed or ball-like structure with a side entrance. They are made from moss with some grass and leaves, and built close to water on a rock ledge, river bank, behind a waterfall, or under a bridge.

- Optical equipment used (type, model, and magnification)
- Number of nests located (for breeding colonies)
- Presence and number of potential nest predators (e.g., corvids, raptors, small mammals)
- Photo numbers for the following nest or roost images taken from the survey location:
 - Feature segment (segment of waterfall/canyon with nest)
 - Nest (view of nest if visible)
 - Roosting location (if evident)
- Nest ID (i.e., site name_province_nest#; permanently assigned)¹¹
- Nest status (egg; nestling; 1 or 2 adult(s); 1 or 2 adult(s) + nestling; empty nest cup; unknown, active in previous year but not current year; other, explain in notes section)
- Presence of whitewash, green algae staining, lichen (e.g., *Xanthoria elegans*), and/or moss below or near nest(s)
- Nest height¹² measured from top of falls/rim of canyon directly above the nest to nest (m)
- Nest aspect (degrees)
- Horizontal distance (m) and bearing (degrees) to nest from surveyor
- Presence (Yes) or absence (No) of direct sunlight on nest during survey, or unknown if light conditions at the time of survey do not allow for inference
- Nest(s) site sketch and photos – including position relative to waterfall/canyon

Once found, Black Swift nests can be difficult to relocate for future monitoring, especially at colony breeding sites where location and nest identification details can become confused easily. Printed photographs of a site or digital images on a tablet can be very helpful for relocating nest niches and recording the precise location of new nests by simply drawing on or marking up the image. If visiting the site for the first time and/or previous photographs of a site are not available, draw a detailed map/sketch in a notebook, and take a site photo using a cell phone/tablet and mark up the image concurrently. Photographs of the site also should be taken using a high-quality camera (i.e., DSLR). All photographs need to be downloaded, and the location(s) and assigned number(s) of the nest(s) need to be marked on the image(s) as soon as possible (e.g., Figure 3). Nest map images should be printed or loaded to a tablet, and should be used during future site visits.

Equipment

- Nest Searching Survey Data Form
- Spotting scope and tripod (scope with a 15-45x zoom magnification recommended)
- Hand held spotlight (≥ 600 lumens)
- Laser rangefinder
- Compass
- Binoculars
- Camera
- FLIR camera (optional)
- Notebook and pen/pencil
- GPS (set to NAD83 or datum noted)
- Watch/time piece
- Safety equipment (see Safety Considerations section)

¹¹ Nest numbers should be assigned in the order they are located per site. The nest ID should remain permanently assigned between years, regardless of nest activity.

¹² Height from nest to bottom of falls/canyon may fluctuate with changing water levels.

Safety Considerations

Safety risks are numerous and have the potential to be life threatening. For safety reasons, there should be two observers present at all sites, and both observers should conduct surveys from the same location or within close range. A task hazard analysis should be conducted prior to beginning work. Consult with employer or organization for accepted best practices and standards for mitigating the following potential risks:

- Working remotely
- Poor light conditions
- Steep/uneven terrain
- Wildlife encounters
- Substrate type
- Poor communication
- Exposure
- Falling rock
- Fatigue
- Slips/trips/falls
- Working near water

Working remotely

Ensure that a safety check-in schedule and journey management plan is established. A reliable check-in person should be identified and aware of your survey and travel plans. An appropriate First Aid Kit should be carried in a pack or on person at all times. Reflective or brightly coloured clothing could be worn to increase visibility of surveyor in remote locations.

Poor light conditions

Lighting conditions are poor while hiking to access sites for dawn (or evening) surveys. Always carry a primary and backup light source (i.e., headlamp or flashlight) with spare batteries because you will be hiking to the site in the dark during dawn surveys or leaving the site in the dark during evening surveys.

Steep/uneven terrain

Survey sites should be scouted in daylight prior to the dawn survey. A marked route to the survey site (e.g., with reflective tape or flagging tape) will be very helpful for locating the survey before first light. The tape should be removed prior to departing the site.

Wildlife encounters

Understand risks associated with wildlife encounters (e.g., bear, cougar, deer, moose, snake, tick, etc.). Carry wildlife deterrents (bear bangers and launcher, bear spray, air horn, etc.) and ensure crew is trained on how to avoid and respond to wildlife encounters, use wildlife deterrents, and respond to wildlife attacks, especially in bear/cougar country. Scan the area for signs of wildlife (i.e., scat, fresh diggings, ravens or turkey vultures circling to indicate a kill site, or ripe wild berries) during hike in/out, after arrival at the site, and before beginning the survey. Be vigilant while conducting surveys. The steep terrain may limit your ability to move away from predators; plan potential egress route(s) prior to starting the survey.

Poor communication

Cell reception is often not available at remote sites. Safety communication devices (e.g., satellite phone, 2-way radio, InReach, or Spot) ensure that help can be requested in the event of an incident.

Exposure

Pack appropriately for your hike in, survey, and hike out. The air temperatures at potential breeding sites are very stable and cool, even in the summer months (~10 °C), and mist from waterfalls can dampen clothing. Include wet gear and warm clothing. Understand and monitor for signs of hypothermia (weak pulse, slowed or weak breathing, lack of coordination, confusion).

Falling rocks

Overhead hazards like loose rocks pose risks to surveyors. Wildlife and other people can dislodge rocks above you. Consider the terrain and potential for falling rocks when determining whether a hard hat or helmet is necessary.

Fatigue

Conducting field work during the early morning can be a change from typical schedules, and back to back survey dates can lead to exhaustion. Ensure that crews are receiving adequate rest between surveys and that breaks are possible. Pack in food and water in case overnight stays are required.

Slips/Trips/Falls

Wear appropriate footwear (and ankle support) for mountainous hiking on wet, rocky terrain. Make sure that crews have enough time to reach sites before surveys so that there is no need to rush. Do not stand closer than 3 m from drops of greater than 1.5 m. Watch footing on wet, moss-covered trails and on slippery rocks or during stream crossings. Be aware of undercut banks or edges.

Working near water

Stream crossing is not advisable during high water seasons. If crossing streams or travelling upstream is necessary to position for surveys, surveyors should wear appropriate Personal Protective Equipment (PPE) including boots, poles, personal flotation devices (PFDs). Pack belts should be unclipped during crossings. Watch for changing water levels over the course of the day and following rain or melting events or due to regulation of hydro sites.

Acknowledgements

We thank Jennifer Carpenter, Barb Johnston, Helena Mahoney, Jennifer Reimer, and Julien St-Amand (Parks Canada), Geoffrey L. Holroyd (Beaverhill Bird Observatory and Canadian Wildlife Service (retired)), Jason Rogers (Independent Biologist), Amy Seaman (Montana Audubon), and Rob Sparks (Bird Conservancy of the Rockies) for reviews and improvements to the protocol. Funding for field studies that tested the effectiveness of dawn surveys relative to evening surveys was provided by Environment & Climate Change Canada.

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Figure 1. Whitewash, algae staining, moss, and/or lichen can be useful for locating Black Swift nests. Whitewash droppings and moss below a nest in southeastern British Columbia (left; Photo credit: Christine Rock). Green algae staining below a nest in southwestern Alberta (right; Photo credit: David Laskin).



Figure 2. Black Swift nests situated in deep cracks or pockets in the rock may not be visible to the naked eye or with binoculars (left). Use of a spotting scope and handheld spotlight can confirm whether crevices or pockets contain nests (right). The red circle depicts two views of the same nest located in central British Columbia. Photo credit: Leslie Bol.

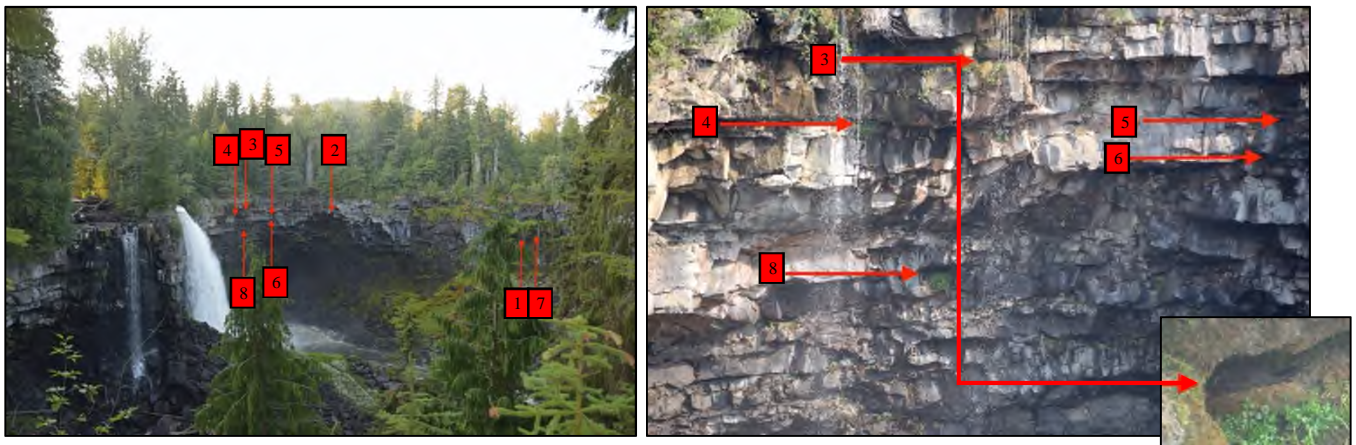


Figure 3. Photos depicting nest(s) should be taken and labelled with nest identification information to ensure that Black Swift nests can be relocated. Photo credit: Paul Levesque (left), Christine Rock (right).

Black Swift Site Habitat Survey	
Survey Details	
Site Name: _____	Date (yyyy/MMM/dd): _____ Time (24hr): ____: ____
Nearest Town: _____	Observer(s) Initials: _____
Stream Name: _____	Land Tenure (circle): <u>Private</u> ; Federal; Provincial; Municipal; Unknown; _____
Province: _____	Observer Location: Zone: _____ Easting: _____
Park Name: _____	Wpt: _____ UTM datum _____ Northing: _____
Site Details	
Survey Location from Waterfall/Canyon (circle): <u>Top of Falls/Rim of Canyon</u> ; Bottom of Falls/Valley; Midway; Other: _____	
Elevation at Survey Location: _____ m;	Surveyor Distance to Waterfall/Canyon (minimum): _____
Observer(s) Location Description: _____	
Photos ID (note photo #): Panoramic: _____; Landscape: _____; Site: _____	
Feature: _____; Access to survey location: _____ (see box below for recording site access notes)	
Site Feature Details	
Waterfall Type (see desc. below): <u>Plunge</u> ; Horsetail; Fan; Cascade; Segmented: <u>Y</u> / N; Tiered: <u>Y</u> / N; Canyon Present: <u>Y</u> / N / Unknown	
Canyon Location Relative to Waterfall (circle): <u>Falls Upstream of Canyon</u> ; Falls Below Canyon; Falls within Canyon; Not Applicable	
Shape of Canyon and/or Waterfall (e.g., describe & sketch below): _____	
Waterfall Aspect/Canyon Orientation: General: _____°; Segment/Tier A: _____°; Segment/Tier B: _____°; Seg./Tier C: _____°	
Width of Potential Habitat Along Vertical Relief: _____ m; Notes: _____	
Maximum Height of Waterfall/Canyon (top falls/canyon rim to water/valley bottom): _____ m (value may change over season)	
Sketch of Waterfall/Canyon (include heights per waterfall tier or canyon segments with numeric identifier numbered downstream to upstream):	
Microclimate Details	
Canopy at Waterfall/Canyon Rim: Cover _____%; Avg Height: _____ m; Proximity of trees to Waterfall/Canyon: _____ m	
Dominant Canopy Species: _____; Moss Cover: _____ %	
Distance Mist Travels from Waterfall _____ m; Substrate Type: _____; Water Temp.: _____ °C	
<p><i>Waterfall Types (from Conly 1993):</i></p> <p><i>Plunge: water is free-falling, no contact with underlying rock</i></p> <p><i>Horsetail: water is in contact with underlying rock for the majority of the falls</i></p> <p><i>Fan: water is free-falling but widens as it descends</i></p> <p><i>Cascade: water flows over broad face, with many small leaps or segments</i></p> <p><i>Segmented: water is divided into multiple streams that descend parallel to one another</i></p> <p><i>Tiered: descending streams of water broken into distinct falls</i></p>	<p style="text-align: center;"><u>Site Access Notes (Track # & waypoints, landmarks):</u></p>

* Please submit completed forms to Canadian Wildlife Service, Species at Risk Biologist, E. Gross (eric.gross@canada.ca). Data contributes to BLSW recovery efforts. (continued)

Black Swift Site Habitat Survey

(continued)

Site Name: _____ **Province:** _____ **Date (yyyy/MMM/dd):** _____

Site Habitat Scoring

Check rating level that applies within 30 m of the feature:

Total Rank: _____

1) Flowing Surface Water

Rank: _____

No Flowing Water (1) _____ Flows weak (2) _____ Flows moderate, little spray (3) _____
 Flows moderate, some spray (4) _____ Flows heavy, much spray (5) _____

2) Relief (commanding view) from Top of Feature over Surrounding Terrain:

Rank: _____

Falls at Bottom of terrain (1) _____ Little view from falls (2) _____ Moderate view from falls (3) _____
 Good view from falls (4) _____ Commanding view from falls over terrain (5) _____

3) # Suitable Nest Niches (Pockets or Ledges) and Accessibility of Ground Predators:

Rank: _____

No suitable present (1) _____ Few &/or all accessible (2) _____ Some &/or most accessible (3) _____
 Some and/or most inaccessible (4) _____ Many and/or all inaccessible (5) _____

4) Unobstructed Aerial Access to or from Nest Niches:

Rank: _____

No clear access (1) _____ Clear to ¼ niches (2) _____ Clear to ½ niches (3) _____
 Clear to ¾ niches (4) _____ Clear to all niches (5) _____

5) Shading of Niches:

Rank: _____

Sunlit all day (1) _____ Sunlit >3hr/day (2) _____ Sunlit 1-3hr/day (3) _____
 Sunlit < 1hr/day (4) _____ Shaded all day (5) _____

6) Moss Availability (within 30 m of the Feature):

Rank: _____

No moss present (1) _____ Trace moss (2) _____ Scattered moss (3) _____
 Frequent Moss (4) _____ Abundant Moss (5) _____

Notes:

Habitat Scoring (from Levad et al. 2008):

- 1) Flowing surface water (amount of flowing surface water during late summer)
- 2) Relief (extent of relief or commanding view over surrounding terrain as estimated from the top of the waterfall or canyon)
- 3) Niches (number of suitably sized crevices that are available and inaccessible to ground predators)
- 4) Access (the extent of aerial access for adults departing or arriving at nest niches)
- 5) Shading (the amount of shading of potential nest niches over the course of the day)
- 6) Moss (amount of moss available at the nest site)

Black Swift Nest Searching Survey

Survey Details

Site Name: _____	Date (yyyy/MMM/dd): _____
Nearest Town: _____	Obs: _____
Stream Name: _____	Land Tenure (circle): Private; Federal; Provincial; Municipal; Unknown
Province: _____	Obs Location Zone: _____ Easting: _____
Park Name (if applicable): _____	UTM datum _____ Northing: _____
Start Time (24hr): _____:_____	End Time (24hr) _____:_____ Total Survey Time: _____:_____
Number of Observers: _____	Optical Equip. Used (type, model, mag.): _____
Nest Located: Y / N; # of Nests Located: _____; Nest Predators Obs. (#-4 letter codes): _____	

Nest Details

If Black Swifts nest(s) are located at the site, fill in the nest details below for each nest

Nest ID (site_prov._nest #): _____ **Staining at Nest (circle):** Whitewash; Algae; Lichen; Moss; None; Unk.

Yr. First Found: ___ **Status (circle all that apply):** Egg; Nestling; 1 or 2 Adults; Empty Nest Cup; Unknown; Other (see notes)

Photos ID (note photo #): Feature segment at nest: _____; Nest: _____; Other: _____

Direct sunlight on nest: Y/Unk./No; **Horizontal Distance to Nest (from surveyor):** _____ m; **Nest Bearing** _____°

Nest Height: Top of falls/canyon rim to nest: _____ m; **Nest Aspect:** _____°; **Notes:** _____

Nest ID (site_prov._nest #): _____ **Staining at Nest (circle):** Whitewash; Algae; Lichen; Moss; None; Unk.

Yr. First Found: ___ **Status (circle all that apply):** Egg; Nestling; 1 or 2 Adults; Empty Nest Cup; Unknown; Other (see notes)

Photos ID (note photo #): Feature segment at nest: _____; Nest: _____; Other: _____

Direct sunlight on nest: Y/Unk./No; **Horizontal Distance to Nest (from surveyor):** _____ m; **Nest Bearing** _____°

Nest Height: Top of falls/canyon rim to nest: _____ m; **Nest Aspect:** _____°; **Notes:** _____

Nest ID (site_prov._nest #): _____ **Staining at Nest (circle):** Whitewash; Algae; Lichen; Moss; None; Unk.

Yr. First Found: ___ **Status (circle all that apply):** Egg; Nestling; 1 or 2 Adults; Empty Nest Cup; Unknown; Other (see notes)

Photos ID (note photo #): Feature segment at nest: _____; Nest: _____; Other: _____

Direct sunlight on nest: Y/Unk./No; **Horizontal Distance to Nest (from surveyor):** _____ m; **Nest Bearing** _____°

Nest Height: Top of falls/canyon rim to nest: _____ m; **Nest Aspect:** _____°; **Notes:** _____

Nest ID (site_prov._nest #): _____ **Staining at Nest (circle):** Whitewash; Algae; Lichen; Moss; None; Unk.

Yr. First Found: ___ **Status (circle all that apply):** Egg; Nestling; 1 or 2 Adults; Empty Nest Cup; Unknown; Other (see notes)

Photos ID (note photo #): Feature segment at nest: _____; Nest: _____; Other: _____

Direct sunlight on nest: Y/Unk./No; **Horizontal Distance to Nest (from surveyor):** _____ m; **Nest Bearing** _____°

Nest Height: Top of falls/canyon rim to nest: _____ m; **Nest Aspect:** _____°; **Notes:** _____

Nest ID (site_prov._nest #): _____ **Staining at Nest (circle):** Whitewash; Algae; Lichen; Moss; None; Unk.

Yr. First Found: ___ **Status (circle all that apply):** Egg; Nestling; 1 or 2 Adults; Empty Nest Cup; Unknown; Other (see notes)

Photos ID (note photo #): Feature segment at nest: _____; Nest: _____; Other: _____

Direct sunlight on nest: Y/Unk./No; **Horizontal Distance to Nest (from surveyor):** _____ m; **Nest Bearing** _____°

Nest Height: Top of falls/canyon rim to nest: _____ m; **Nest Aspect:** _____°; **Notes:** _____

Nest ID (site_prov._nest #): _____ **Staining at Nest (circle):** Whitewash; Algae; Lichen; Moss; None; Unk.

Yr. First Found: ___ **Status (circle all that apply):** Egg; Nestling; 1 or 2 Adults; Empty Nest Cup; Unknown; Other (see notes)

Photos ID (note photo #): Feature segment at nest: _____; Nest: _____; Other: _____

Direct sunlight on nest: Y/Unk./No; **Horizontal Distance to Nest (from surveyor):** _____ m; **Nest Bearing** _____°

Nest Height: Top of falls/canyon rim to nest: _____ m; **Nest Aspect:** _____°; **Notes:** _____

Other species nests located (4-letter code): _____ (see reverse for notes and sketch)

*Please submit completed forms to Canadian Wildlife Service, Species at Risk Biologist, E. Gross (eric.gross@canada.ca). Data will contribute to BLSW recovery efforts. (continued)

Black Swift Nest Searching Survey

(continued)

Site Name: _____ **Province:** _____ **Date** (yyyy/MMM/dd): _____

Sketch of nest location(s) *(e.g., relative location of nest with feature):*

Nest site notes *(e.g., relative location of nest with feature):*

Nest monitoring notes *(i.e., follow-up visit nest status):*