Searching for Black Swift (*Cypseloides niger*) Nests in Southern British Columbia

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Black Swifts (*Cypseloides niger*) are thought to breed throughout southern British Columbia, however few nests have been described in the region. Population trend estimates from British Columbia show significant declines, prompting the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to assess Black Swift as Endangered in Canada. We identified potential nesting locations and searched for nests at 16 sites in southern British Columbia between 2001 and 2015. Two active Black Swift nests were discovered during surveys: Brandywine Falls south of Whistler, and Highfalls Creek Falls northwest of Squamish. The Brandywine Falls nest was revisited annually from 2009 to 2015, and the nest was active during at least five of the seven years of monitoring. Evening surveys were not effective for detecting Black Swift nest attendance.

Key Words: Black Swift; *Cypseloides niger*; aerial insectivore; nesting; British Columbia; Brandywine Falls; Highfalls Creek

Introduction

The Alaskan and Canadian breeding range of Black Swift (*Cypseloides niger* (Gmelin, 1789)) includes southeastern Alaska, mountainous areas of southwestern Alberta, and the southern half of British Columbia (American Ornithologists' Union 1998). However, nesting has not been confirmed in Alaska (Johnson *et al*. 2008), and few Black Swift nest sites have been documented in Alberta (Bent 1940; Kondla 1973; Holroyd and Holroyd 1987) and British Columbia (Jobin 1955; Beebe 1959; Grant 1966; Campbell *et al.* 1990; Tyson 2004; Levesque 2015). Using Breeding Bird Survey (BBS) data, Partners in Flight has estimated that British Columbia has 86% (60 000) of the North American breeding population of Black Swifts (Partners in Flight Science Committee 2013). The main challenges in locating Black Swift nests are the cryptic and inaccessible nest locations often situated near waterfalls and deep canyons (Lowther and Collins 2002) and long foraging sessions resulting in infrequent nest attendance (Marín 1999).

The Black Swift is an aerial insectivore; a group of birds that is experiencing population declines in Canada (Nebel *et al.* 2010). Based on BBS data, the long-term (1973 to 2012) population trend estimates that Black Swifts in Canada have declined at an annual rate of 6.5% (Environment Canada 2014). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has assessed the Black Swift as Endangered (COSEWIC 2015). Long-term monitoring of Black Swift nests in California has documented a breeding range contraction at coastal sites (Roberson and Collins 2008). The causes of the decline in the Black Swift population are poorly understood.

Increasing the number of known Black Swift nesting locations is a conservation priority for this species. Annual nest site fidelity is very high, with many sites being used for decades (Kondla 1973; Collins and Foerster 1995; Levad *et al*. 2008; Levesque 2015); this strongly suggests that nest sites are important habitat and are in need of protection. Because Black Swifts spend most of their time in flight, nest sites are the only locations to answer basic questions regarding life history traits such as longevity, age of first breeding, and annual and lifetime productivity.

Currently, the best available monitoring program for estimating population trends of Black Swifts is the North America BBS. However, the BBS methodology has detectability issues for monitoring Black Swift populations in North America. This results in low confidence in survey estimates (Wiggins 2004; Levad 2007; Partners in Flight Science Committee 2013; COSEWIC 2015; Sauer *et al.* 2017), in part due to the species' limited breeding distribution and the inaccessibility of its preferred nesting habitat (Wiggins 2004). It has been argued that the Partners in Flight Black Swift population estimates based on BBS data are most likely overestimated (Levad 2007). Annual nest monitoring at multiple sites throughout the species' northern breeding range would provide a better method of determining population trends.

Given the lack of known Black Swift nesting sites in Canada, the importance of nest sites, and concerns about population declines, our objectives were to locate addi-

tional nest sites in southern British Columbia, and to comment on inventory methodology. If British Columbia is home to 86% of the North American breeding population, (up to 60 000 Black Swifts; Partners in Flight Science Committee 2013), there must be many undiscovered nest sites.

Methods

We identified potential Black Swift nesting sites in southern British Columbia by using Google to search terms such as "waterfalls" + "British Columbia". We prioritized search results by ranking images against nest site attributes observed in Colorado by Knorr (1961, 1993). If a site lacked one or more of Knorr's site attributes (high physical relief, close proximity to flowing water, inaccessible to terrestrial predators, darkness, open flight corridors to the nests, and suitable niches for nests) the site received a lower rank and was deemed a lower priority for a site visit.

Nest searches were conducted at potential nesting sites following methods in Schultz and Levad (2001) within the known breeding season in British Columbia (early June to early September; Campbell *et al.* 1990). Surveyors searched potential nest sites for the presence of active nests or signs of occupancy (i.e., presence of adults) during midday and in favourable weather. Nest searches were conducted during the day by methodically scanning all of the substrate surrounding waterfalls using 10 × 42 binoculars and a 15–45 × 60 field scope. Once all of the visible substrate had been searched for nests, the observer(s) moved to a new vantage point and continued scanning the substrate. When additional observers were present, they watched the general area around the waterfall and recorded the presence/absence of adult Black Swifts. Once a nest was located, the site was revisited in following years, when possible, to determine site fidelity and re-occupancy.

Evening surveys followed methods in Schultz and Levad (2001) and were conducted to determine whether Black Swifts were using the waterfall for nesting or roosting. Observers positioned themselves at the bottom of the waterfall when possible, and watched for Black Swifts returning to or leaving the waterfall during the last two hours of daylight. The survey was terminated once it was too dark to observe Black Swifts.

Between 2001 and 2015, 16 potential Black Swift nesting sites were surveyed on Vancouver Island (n = 7), Vancouver/Sea to Sky area (n = 6), and the southern interior (n = 3; Figure 1). All sites, including those deemed low suitability, were surveyed at least once in daylight. During daytime surveys, we conducted 30 h of nest searching (scanning substrate) and 42 h of watching for adult Black Swift flying near or into the waterfalls.

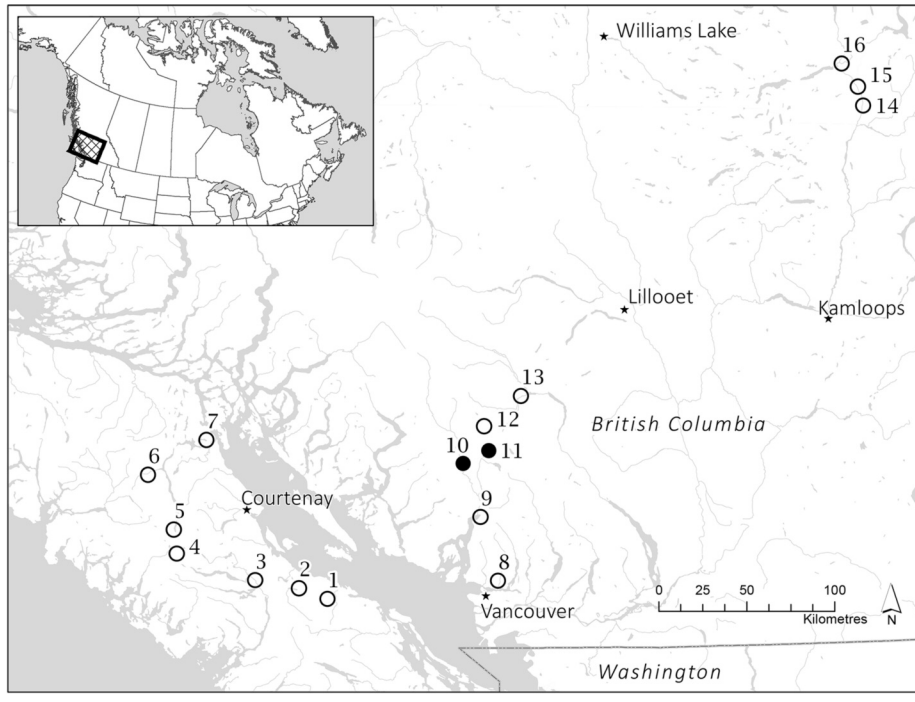

FIGURE 1. Black Swift (*Cypseloides niger*) nesting surveys were conducted at seven sites on Vancouver Island: 1 Englishman River Falls, 2 Little Qualicum Falls, 3 Stamp Falls, 4 Della Falls, 5 Myra Falls, 6 Lady Falls, 7 Elk Falls. Surveys were conducted at six sites in the Vancouver/Sea to Sky area: 8 Lynn Canyon, 9 Shannon Falls, 10 Highfalls Creek, 11 Brandywine Falls, 12 Alexander Falls, 13 Nairn Falls. Surveys were conducted at three sites in the southern interior: 14 Spahats Falls, 15 Moul Falls, and 16 Helmcken Falls. Solid circles ● indicate nest locations, open circles ○ indicate survey sites where nests were not found.

Results

Twelve of the 16 sites visited met all of Knorr's (1961, 1993) physical requirements for Black Swift nesting habitat. Adult Black Swifts were observed flying over three sites on five occasions, and one adult was seen flying into an active nest on three occasions (Table 1). Active Black Swift nests were located at Brandywine Falls and Highfalls Creek Falls (Table 1).

During daytime surveys on 26 July 2004, an adult Black Swift was observed attending a nest behind Brandywine Falls in Brandywine Provincial Park, approximately 14 km south of Whistler (50.036ºN, 123.119ºW). Brandywine Falls is a plunge type waterfall that drops 70 m into a large pool. The nest was approximately 25 m below the crest of the waterfall, and was positioned behind the eastern edge of the falls. The nest was positioned on a small ledge on a larger section of undercut rock that was approximately 2 m from the main flow of the waterfall. The nest was made entirely of moss, and the nest and rock surface immediately surrounding the nest was wet (Figure 2).

TABLE 1. Summary of sites visited, survey dates, effort, and Black Swifts (*Cypseloides niger*) observed during day, evening, and nest monitoring surveys, 2001 to 2015.

Site name	Date	Nest searching (h)	Watching falls (h)	Black Swifts observed	Number of observers	Total time at site (h)
DAY SURVEYS						
English River Falls	27 Jun 2004	2.0	0.0	0	1	2.0
Little Qualicum	13 Jun 2004	1.0	1.0	0	1	2.0
Stamp Falls	28 Jun 2004	1.0	1.0	0	2	2.0
Della Falls	3 Aug 2001	3.0	6.0	0	2	9.0
Myra Falls	29 Jun 2004	1.0	1.0	0	2	2.0
Myra Falls	7 Aug 2004	1.0	1.0	0	2	2.0
Lady Falls	8 Aug 2004	2.0	2.0	0	2	4.0
Elk Falls	7 Aug 2004	1.5	1.5	0	2	3.0
Lynn Canyon	7 Aug 2010	2.0	2.0	0	2	4.0
Shannon Falls	26 Jul 2004	1.0	0.0	0	1	1.0
High Falls Creek	25 Jul 2015	2.0	2.0	5* 1†	2	4.0
Brandywine Falls	26 Jul 2004	2.0	2.0	1†	1	4.0
Brandywine Falls	2 Aug 2004	0.0	9.0	1‡ 1†	3	9.0
Brandywine Falls	3 Aug 2004	1.0	1.0	1§	2	2.0
Brandywine Falls	5 Aug 2004	1.5	1.5	5* 1§	2	3.0
Alexander Falls	3 Aug 2004	1.0	1.0	0	2	2.0
Narin Falls	4 Aug 2004	2.0	2.0	0	2	4.0
Spahat Falls	21 Aug 2010	1.0	1.0	0	2	2.0
Moul Falls	22 Aug 2010	1.0	2.0	0	2	3.0
Helmcken Falls	21 Aug 2010	2.0	2.0	0	2	4.0
EVENING SURVEYS						
English River Falls	13 Jun 2004	0.0	2.0	6*	1	2.0
English River Falls	21 Jul 2004	0.0	3.0	0	1	3.0
English River Falls	27 Jun 2004	0.0	2.5	1*	1	2.5
English River Falls	5 Aug 2004	0.0	4.0	2*	2	4.0
Myra Falls	29 Jun 2004	0.0	4.0	0	2	4.0
Myra Falls	7 Aug 2004	0.0	4.0	0	2	4.0
Lynn Canyon	26 Jul 2013	0.0	2.0	0	1	2.0
Brandywine Falls	3 Aug 2004	0.0	4.0	1§	2	4.0
Alexander Falls	2 Aug 2004	0.0	4.5	0	3	4.5
NEST MONITORING						
Brandywine Falls	23 Jul 2009	1.0	1.0	1‡ 1†	2	2.0
Brandywine Falls	8 Aug 2010	1.0	1.0	0	2	2.0
Brandywine Falls	30 Aug 2011	0.5	0.5	n/a	2	1.0
Brandywine Falls	5 Aug 2012	1.0	1.0	1‡ 1§	2	2.0
Brandywine Falls	3 Aug 2013	1.0	1.0	1§	2	2.0
Brandywine Falls	2 Aug 2014	1.0	1.0	1§	2	2.0
Brandywine Falls	25 Jul 2015	1.0	1.0	1†	2	2.0

*Adult Black Swift(s) flying above the waterfall.
†Adult Black Swift(s) at nest.
‡Adult Black Swift observed flying into the nest.
§Black Swift nestling observed, no adult at nest.
n/a, unable to view nest due to high water.

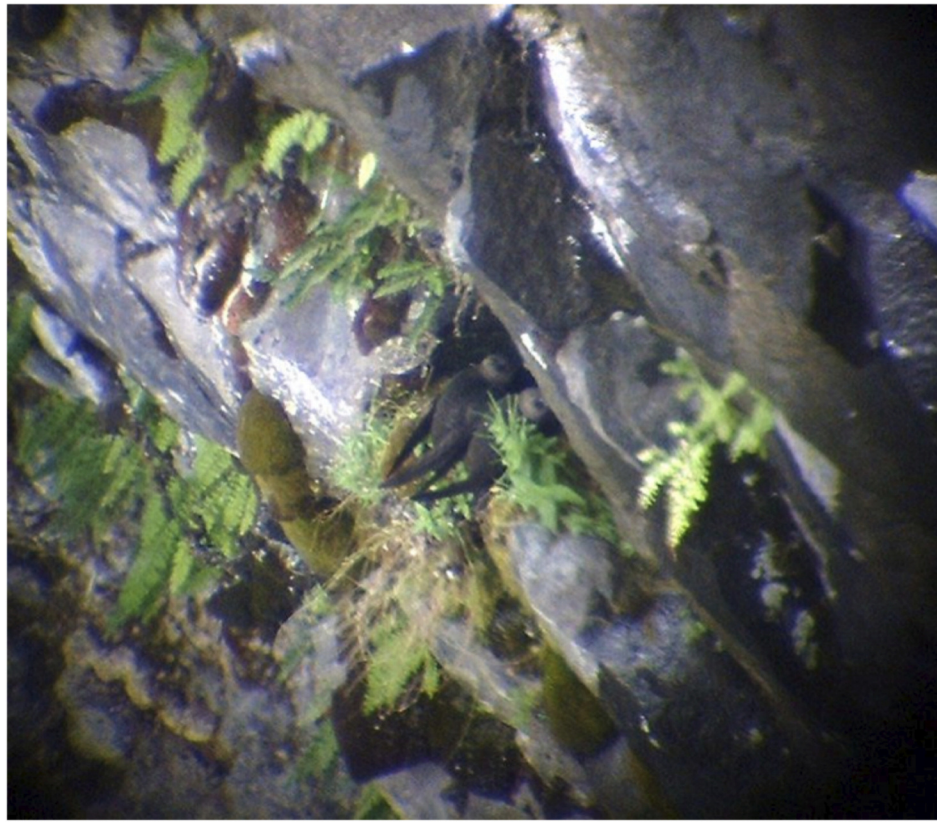

FIGURE 2. Two adult Black Swifts (*Cypseloides niger*) attending the nest at Brandywine Falls, 2 August 2004. Photo: L. Savard.

The Black Swift nest at Brandywine Falls was revisited each breeding season 2009–2015 (Table 1). The same nest used in 2004 was reused in 2009, 2012, 2013, 2014, and 2015, but was not active on 10 August 2010, and the nest could not be viewed on the 30 June 2011 visit due to high water levels obscuring the nest. Adult Black Swifts were seen flying into the active nest in 2004, 2009, and 2012.

During daytime surveys on 25 July 2015, an adult Black Swift was observed attending a nest on the eastern side of Highfalls Creek Falls, 27.3 km northwest of Squamish (49.944°N, 123.296°W). Highfalls Creek flows over a three-tiered plunge type waterfall approximately 100 m high. The upper two tiers are approximately 10–15 m high, and the lower section is approximately 80 m high. The nest was 3 m from the eastern edge of the lower tier, 15 m from the top of the lowest tier (Figure 3). This nest was made of moss, and the nest and the surrounding area was dry.

Evening surveys were conducted on nine evenings at five sites. Black Swifts were not observed flying into waterfalls during any of the evening surveys (30 observer hours); this includes four observer hours at the active Brandywine Falls nest. Black Swifts were observed flying approximately 100 m above Englishman River Falls on two of the four evening surveys.

Discussion

Identifying potential Black Swift nesting sites by examining images of waterfalls collected from internet searches was effective. However, site visits revealed that some required physical attributes (particularly: physical relief, suitable niches, and direct sunlight) were not reliably determined from photographs. There was a bias toward readily accessible waterfalls being well documented by the public, and remote or more inaccessible sites being undocumented.

Searching for Black Swift nests by methodically scanning substrate during daytime surveys resulted in locating two active nests. Because observers could not safely access vantage points that permitted viewing of all potential nesting substrate, some active nests could have gone undetected. The waterfalls obscured some potential nesting substrate, and this was most problematic during high water flow in June and early July. Site visits in the latter half of July and August when water volumes tend to be lower may increase success in locating active nests. Schultz and Levad (2001) also recom-

FIGURE 3. Nest location of Black Swift (*Cypseloides niger*) at Highfalls Creek Falls, denoted by the black square in the center of the image. 25 July 2015. Photo: C. Rock.

mend conducting daytime nest searches in late July and August to avoid high water flow, and they noted that adult nest attendance was more frequent in the 12 days after hatching.

Black Swift nest occupancy monitoring data in British Columbia are limited, partly due to the lack of known nest sites and partly to the lack of a formal monitoring program. Our annual monitoring of the Brandywine Falls nest (2009 to 2015) showed high annual site reuse. Although the nest was not active on 8 August 2010, at that late date it is possible that a nest was initiated, but failed. Nest failures have been documented in Colorado; Hirshman *et al.* (2007) monitored 160 Black Swift nesting attempts over an 11 year period, and observed 35 nest failures. There is likely a trade-off between surveying for nests in the latter half of July and August, when water levels have subsided, and detecting failed nesting attempts. Potential sites should therefore be surveyed for more than one breeding season to determine occupancy.

The strength of evening surveys is to detect sites where active nests are undetectable. Nesting can be confirmed by observing adult Black Swifts flying into the site to attend the nest at dusk (Foerster and Collins 1990). Evening surveys have been used to estimate the number of nests at sites and to estimate the size of regional populations (Foerster and Collins 1990; Levad *et al.* 2008). We observed Black Swifts flying well above the forest canopy during evening surveys, but we did not observe Black Swifts flying into waterfalls. Furthermore, we did not detect Black Swifts during an evening survey at Brandywine Falls while monitoring the active nest. In 2003, the American Bird Conservancy conducted an ambitious Black Swift nesting inventory that involved 103 field observers conducting 513 h of evening surveys at 82 waterfalls from northern California to southeast Alaska, with the majority of surveys conducted in Oregon, Washington, and Alaska (Altman 2003). The project resulted in the location of two nest sites, including one active nest at Cascade Falls near Mission, British Columbia located after an evening detection on 2 August 2003 (Tyson 2004). Black Swifts were observed flying into waterfalls at four additional sites, but nests were not located.

The effectiveness of evening surveys may vary spatially and temporally through the breeding season. Udvardy (1954) reported that low-pressure weather systems concentrated foraging flocks of Black Swifts in coastal areas of southern British Columbia and suggested that low-pressure systems would result in long distance, multiday foraging trips. The passage of low-pressure systems is a regular occurrence in June and July in British Columbia and could influence the frequency of evening nest attendance. In southern California, Marín (1999) noted that the timing of nest attendance shifted from mornings (8:00–12:00) to evenings (18:00–20:00) once Black Swift nestlings were 15 days old and that morning feedings were not observed after

the nestlings were 30 days old. Following the known nesting phenology in Hirshman *et al.* (2007), Black Swift nestlings would be 15 and 30 days old on 10 August and 25 August, respectively. If food deliveries are more common in the mornings during incubation and the first half of the nestling phase, conducting evening surveys during this period may result in low detection rates, assuming the timing of nest attendance in British Columbia is similar to the timing in southern California.

We recommend that determining the timing and frequency of Black Swift nest attendance throughout the nesting cycle, and in relation to weather systems, should be a research priority for the British Columbia population. If Black Swift nest attendance can be determined, the timing of nest searches could then be optimized and would increase the number of known nest sites in the region. We recommend that at least 10 to 15 active Black Swift nest sites be monitored across a range of habitat types (i.e., coastal, dry interior, and eastern British Columbia) for at least a decade to understand reproductive trends and their influence on population trends.

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