COSEWIC
Assessment and Status Report

on the

Black Swift
Cypseloides niger

in Canada

ENDANGERED
2015

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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Black Swift — Photo courtesy of Amar Athwal.

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COSEWIC
Assessment Summary

Assessment Summary – May 2015

Common name
Black Swift

Scientific name
Cypseloides niger

Status
Endangered

Reason for designation
Canada is home to about 80% of the North American population of this bird species. It nests in cliff-side habitats (often associated with waterfalls) in British Columbia and western Alberta. Like many other birds that specialize on a diet of flying insects, this species has experienced a large population decline over recent decades. The causes of the decline are not well understood, but are believed to be related to changes in food supply that may be occurring at one or more points in its life cycle. The magnitude and geographic extent of the decline are causes for conservation concern.

Occurrence
British Columbia, Alberta

Status history
Designated Endangered in May 2015.

COSEWIC
Executive Summary

Black Swift
Cypseloides niger

Wildlife Species Description and Significance

The Black Swift is the largest swift in North America. Canada is home to over 80% of the population. It has an almost entirely blackish plumage, has long, pointed wings and is the only North American swift with a notched tail. As well as having many unusual life-history traits compared to other landbird species (single egg clutch, extended maturation, remote waterfall and cave-nesting sites), the Black Swift may be a sensitive indicator for climate change. This is because its waterfall nesting sites are likely to be impacted by decreased snow pack and glacial melt. The Black Swift feeds exclusively on flying insects.

Distribution

The global breeding range of the subspecies that occurs in Canada shows a disjunct distribution: a northern range (from southeastern Alaska, northwestern British Columbia and southwestern Alberta, south through northwestern Montana, northern Idaho, and northern Washington), and scattered populations south of this (in Oregon, California, Utah, Colorado, northern New Mexico, southeastern Arizona). This subspecies also breeds in Mexico as far south as Oaxaca and Veracruz and possibly other areas in Mexico. Other subspecies occur elsewhere in Mexico, the Caribbean and Central America.

Habitat

Often foraging at high altitude, Black Swifts fly over open country and forests in mountainous areas and lowlands, pursuing aerial insects. They nest near or behind waterfalls and in caves, located in canyons and sometimes on sea cliffs. Their nest sites are characterized by presence of flowing water, high relief, inaccessibility, darkness, and an unobstructed flight path.

Biology

Little is known about the biology of the Black Swift. The species is believed to be monogamous and long-lived. The oldest known individual was 16 years old. Age at first breeding is unknown but, given other life history characteristics, may be from 3-5 years. It is one of only two landbirds in Canada to lay a single egg clutch, and has an extremely long fledgling period (7 weeks). Canadian birds migrate south, likely to spend the winter in South America. However, the precise winter range of Canadian birds is unknown.

Population Sizes and Trends

The population size of the *borealis* subspecies in Canada is hard to determine, but is estimated at 15,000 to 60,000 mature individuals. Canada is believed to harbour about 81% of the North American population, the vast majority of which occurs in British Columbia. Less than 0.1% of the North American population occurs in Alberta.

Across their range in Canada and the United States, Black Swifts are showing negative population trends. The Canadian population appears to have declined by more than 50% over the 40-year period between 1973 and 2012. A generation time ranging between 6.25 and 16.5 years yields a cumulative population loss of -72% to -96% over three generations, with expert opinion suggesting that the value is most likely around -89% (average annual trend of -6.5% over 33 years). The rate of decline has lessened in recent years; the 10-year short-term trend (2002-2012) estimate was -4.6% per year, which is equivalent to an overall decline of about 38% over the most recent decade. During this period, there was a 25% probability that the population declined by >50%, and a 45% probability that it declined by 25-50%.

Threats and Limiting Factors

The most important threats to the Black Swift are largely unknown but are believed to be: 1) airborne pollutants that reduce aerial insect food availability and/or potentially cause reproductive failure in swifts; and 2) climate change that could reduce stream flow at nest sites or lead to temporal mismatches between aerial arthropod phenology and the swift's breeding cycle. Other threats such as problematic native species, logging, annual and perennial non-timber crops, livestock farming and ranching, hydroelectric dams and water management, and recreational activities were considered as being negligible.

Protection, Status, and Ranks

The Black Swift is considered a continental Watch List species by Partners in Flight and is listed as Special Concern by many bird conservation region and state bird conservation plans. IUCN lists the species as Least Concern and it is a bird of conservation concern in the United States. According to NatureServe, it is considered apparently secure globally and apparently nationally secure in Canada and the United States, but these assessments are dated. It is listed as critically imperilled, imperilled or vulnerable in some states, but apparently secure in British Columbia and unranked in Alberta.

TECHNICAL SUMMARY

Cypseloides niger

Black Swift | Martinet sombre

Range of occurrence in Canada: Alberta, British Columbia

Demographic Information

Generation time (usually average age of parents in the population Using formula [1/estimated annual adult mortality rate] + estimated age of first reproduction	6.25-16.5 yrs; most likely 10.3 yrs
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Yes
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Unknown
Estimated percent reduction in total number of mature individuals over the last 3 generations. Based on results from the Canadian Breeding Bird Survey (see **Fluctuations and Trends**)	>50%
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased?	No
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence	718,238 km^2
Index of area of occupancy (IAO) (2 x 2 km grid value)	3372 km^2
Is the population severely fragmented?	No
Number of locations	>10
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence?	Unknown
Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy?	Probably (inferred)
Is there an [observed, inferred, or projected] continuing decline in number of populations?	Not applicable
Is there an [observed, inferred, or projected] continuing decline in number of locations?	Probably (inferred)

Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat? Decline in area, quality and extent of non-breeding habitat in South America, including food supply.	Likely
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population	**N Mature Individuals**
British Columbia	~15,188 - 56,537
Alberta	~188 - 300
Total 81% of population in North America is in Canada	~ 15,000 - 60,000 (rounded)

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	Unknown

Threats (actual or imminent, to populations or habitats)

Threats are poorly understood, but the most important ones are believed to be:

- Airborne pollutants that reduce aerial insect biomass and/or potentially cause reproductive failure in swifts.
- Climate change: drought or storms and flooding and/or extreme temperatures that could reduce stream flow at nest sites or lead to temporal mismatches between aerial arthropod phenology and the birds' breeding cycle.
- Other threats such as problematic native species, logging, annual and perennial non-timber crops, livestock farming and ranching, hydroelectric dams and water management, and recreational activities were deemed to be negligible.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? In adjacent states, the Black Swift is listed as critically imperilled in Idaho and Montana, imperilled in Alaska and Oregon, and vulnerable in Washington.	Population is small and declining in adjacent jurisdictions in the USA
Is immigration known or possible?	Possible
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely? Unlikely, given the high site-fidelity shown by adults, plus much smaller populations of swifts in the US, which are themselves also declining.	No

Data Sensitive Species

Is this a data sensitive species?	No

Current Status

COSEWIC: Designated Endangered in May 2015.

Status and Reasons for Designation:

Status: Endangered	**Alpha-numeric code:** A2b
Reasons for designation: Canada is home to about 80% of the North American population of this bird species. It nests in cliff-side habitats (often associated with waterfalls) in British Columbia and western Alberta. Like many other birds that specialize on a diet of flying insects, this species has experienced a large population decline over recent decades. The causes of the decline are not well understood, but are believed to be related to changes in food supply that may be occurring at one or more points in its life cycle. The magnitude and geographic extent of the decline are causes for conservation concern.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Meets Endangered A2b, because the estimated population decline over the last 3 generations (about 30 years) exceeds the threshold level of 50%.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable. Exceeds thresholds for extent of occurrence and area of occupancy.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. Exceeds thresholds for population size.
Criterion D (Very Small or Restricted Population): Not applicable. Exceeds thresholds for population size, area of occupancy and number of locations.
Criterion E (Quantitative Analysis): Not done.

PREFACE

There is only one subspecies of Black Swift that occurs in Canada: *Cypseloides niger borealis.* This assessment is based on a status report prepared for the *borealis* subspecies.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2015)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.

** Formerly described as “Not In Any Category”, or “No Designation Required.”

*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

Environment Canada
Canadian Wildlife Service

Environnement Canada
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Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific name: *Cypseloides niger* (Gmelin 1789)
English name: Black Swift
French name: Martinet sombre
Classification: Order Apodiformes, subfamily Cypseloidinae

Morphological Description

The Black Swift is one of eight species in the genus *Cypseloides* (Eisenmann and Lehmann 1962; Mayr and Short 1970). It is the largest swift species in North America, weighing up to 45 g and having a length of 18 cm (Lowther and Collins 2002). It has long, pointed wings and is the only North American swift that has a slightly notched tail. The tail notch may be slightly deeper in males than females, but otherwise the sexes are similar. In adults, the plumage is almost entirely blackish except for the sides of the forehead, which are whitish (Howell and Webb 1995). Feathers on the belly have varying amounts of white edging, and these are more prominent in females than males.

In the field, the distinguishing features compared to other North American swifts are the Black Swift's larger size, slower flight with discernible wingbeats (and tendency to glide) and completely blackish plumage. By contrast, Vaux's Swift (*Chaetura vauxi*) and Chimney Swift (*Chaetura pelagica*) are smaller, and have a pale throat and chin, which contrasts with their overall dark plumage. The Black Swift is unlikely to be confused with the White-throated Swift (*Aeronautes saxatilis*), which has large white patches contrasting with dark plumage. In Central and South America, identification of the Black Swift is more problematic because of similar-sized swifts (Lowther and Collins 2002).

Population Spatial Structure and Variability

Very little is known about the population structure or genetic variation of the Black Swift. Although birds are similar in appearance across the continent, there is some variation in body size, and, as is typical of many species, there is a cline in increasing body size from south to north (Marín 1999a). It is important to note that the three putative subspecies (*Cypseloides niger borealis, C. n. costaricensis, and C. n. niger*) have not been formally recognized using DNA analyses and the variation in size could simply be due to a clinal latitudinal trend following 'Bergmann's rule' (Gill 1995; Meiri and Dayan 2003). The smallest putative subspecies occurs in the West Indies (*Cypseloides niger niger*), followed by Costa Rican birds (*C. n. costaricensis*), and then northern birds (*C. n. borealis*) in the United States and Canada.

Designatable Units

There is only one designatable unit in Canada. There is no evidence for discreteness within populations in Canada and no molecular work has been completed on the species.

Special Significance

The Black Swift has many unusual and intriguing facets to its life history and reproductive biology (Holroyd 1993). Its dramatic nesting habitat occurs at remote, inaccessible waterfalls and caves in montane areas and, in a few cases, sea cliffs (Lowther and Collins 2002). Its single egg, extended incubation and fledging periods, possibly intermittent incubation, and low frequency of chick provisioning (Marín 1997a; Collins 1998; Marín 2008) are more reminiscent of a small seabird (e.g., storm-petrel *Oceanodrama* spp.) than of a landbird. As an aerial insectivore, the Black Swift forages on a time-limited, spatially unpredictable food supply that includes nuptial-flight swarms of ants (Marín 1999b; Lowther and Collins 2002). Canada is home to over 80% of the population. No Aboriginal traditional knowledge is presently available.

DISTRIBUTION

Global Range

The Black Swift's global breeding range (including all subspecies) shows a disjunct distribution: a large northern range, scattered subpopulations south of this, and then a continuous large range in Mexico, and through Central America, with scattered permanent localized resident populations in the West Indies (Figure 1).

The northernmost part of the breeding range for the putative northern subspecies *C. n. borealis* extends from northwestern British Columbia and southwestern Alberta southwards through northwestern Montana, northern Idaho, and northern Washington. Although the summer range includes southeastern Alaska, the species has never actually been confirmed breeding there (Gabrielson and Lincoln 1959; Armstrong and Gordon 1995; Andres *et al.* 1999). Still, it is considered an uncommon probable breeder in southeastern Alaska from the Stikine River southwards in river valleys of the southern mainland as well as adjacent islands (Kessel and Gibson unpubl. report *in* USGS 2014). Local scattered breeding populations occur in Washington (Smith *et al.* 1997), northern Idaho (Dumroese *et al.* 2001), northwestern Montana (Hunter and Baldwin 1962; Montana Bird Distribution Committee 1996), Oregon (Gilligan *et al.* 1994; Adamus *et al.* 2001) and California (Foerster and Collins 1990; Small 1994), as well as Utah (Knorr 1962; Behle *et al.* 1985), southeastern Arizona (Knorr and Knorr 1989), west and central Colorado (Knorr 1961; Boyle 1998), and north-central New Mexico (Johnson 1990). The breeding distribution also includes the states of Oaxaca (Rowley 1966; Binford 1989) and Veracruz (Collins and Landy 1968) in southern Mexico. Because observations have been made in other Mexican states (Baja California, Durango, Mexico, San Luis Potosi, Tlaxcala; Collins and Landy 1968) and Zacatecas (Webster 1958), the possibility exists that there are other breeding sites in Mexico.

Figure 1. Distribution map for Black Swift showing breeding and non-breeding range in North America, Central America and the Caribbean (from Lowther and Collins 2002, used with permission). The South American winter range (largely unknown) is not shown.

For the putative southern subspecies *C. n. costaricensis*, the breeding range includes the highlands of Mexico (Rowley 1966; Collins and Landy 1968). Black Swifts also breed through Guatemala, Honduras (Monroe 1968; Howell and Webb 1995) and Costa Rica (Stiles and Skutch 1989; Marín and Stiles 1992; Marín and Sánchez 1998). *C. n. niger* breeds locally in the West Indies, where it is a permanent resident in Cuba, Jamaica, Hispaniola, Puerto Rico, Monserrat, Guadeloupe, Dominica, Martinique, St. Lucia, St. Vincent, Barbados and Grenada (Bond 1941; Raffaele *et al.*1998).

Winter Range

For many years, it was assumed that the winter range of North American breeding Black Swifts was in parts of northern and western South America (Lowther and Collins 2002). Although migrating Black Swifts were seen and collected in Cauca Department of Colombia in the early 1990s (Stiles and Negret 1994), it was not until 2012 that geolocators placed on four birds confirmed that Black Swifts (at least those that breed in Colorado) spend the winter in the Amazon rainforest of Brazil (Beason *et al.* 2012). There was also a sighting of a Black Swift in Tambopata, Peru in 2012 (RMBO 2013). However, there is no information on whether Black Swifts that breed in Canada winter in the same region, and indeed the wintering area of birds from different breeding areas in North America remains to be determined.

Canadian Range

In Canada, the Black Swift occurs across much of British Columbia, including Vancouver Island but not the Queen Charlotte Islands (Campbell *et al.* 1990; Figure 2). According to the British Columbia Breeding Bird Atlas (2013), it occurs from the extreme southern part of the province north in the central interior to Williston Lake. Farther west, where moist coastal climate intrudes into the northern interior, the Black Swift occurs farther north, along the lower Stikine River at Telegraph Creek and the Bell-Irving River (Figure 2). Its centre of abundance is the southwest coast from Vancouver Island (east coast) from Victoria to the Campbell River and Fraser Lowlands (Campbell *et al*. 1990).

Small numbers also occur in extreme southwestern Alberta, including Banff and Jasper National Parks (Semenchuk 1992; Federation of Alberta Naturalists 2007; Figure 3).

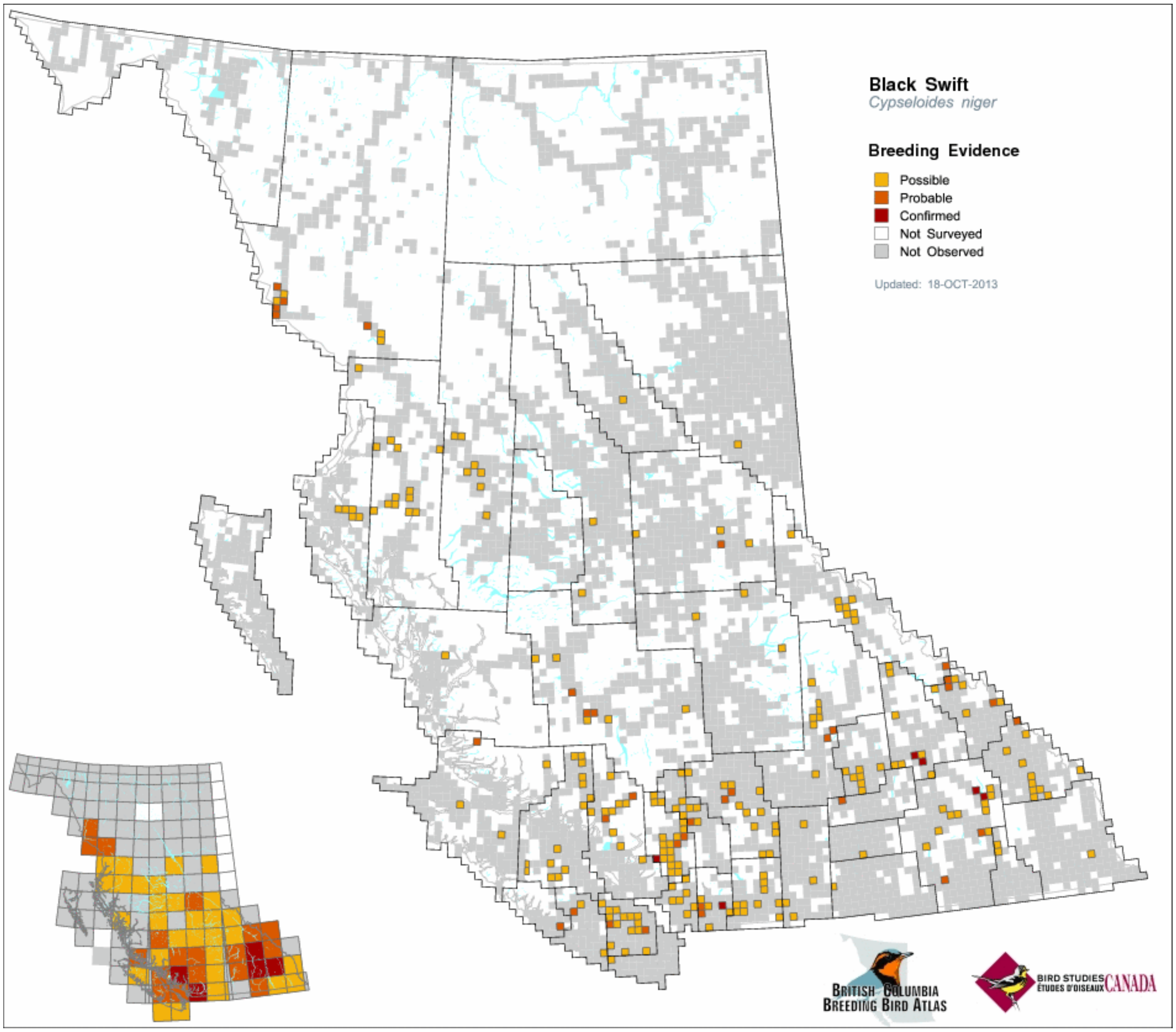

Figure 2. Breeding records from the British Columbia Breeding Bird Atlas (2008-2012; Breeding Bird Atlas of British Columbia 2013).

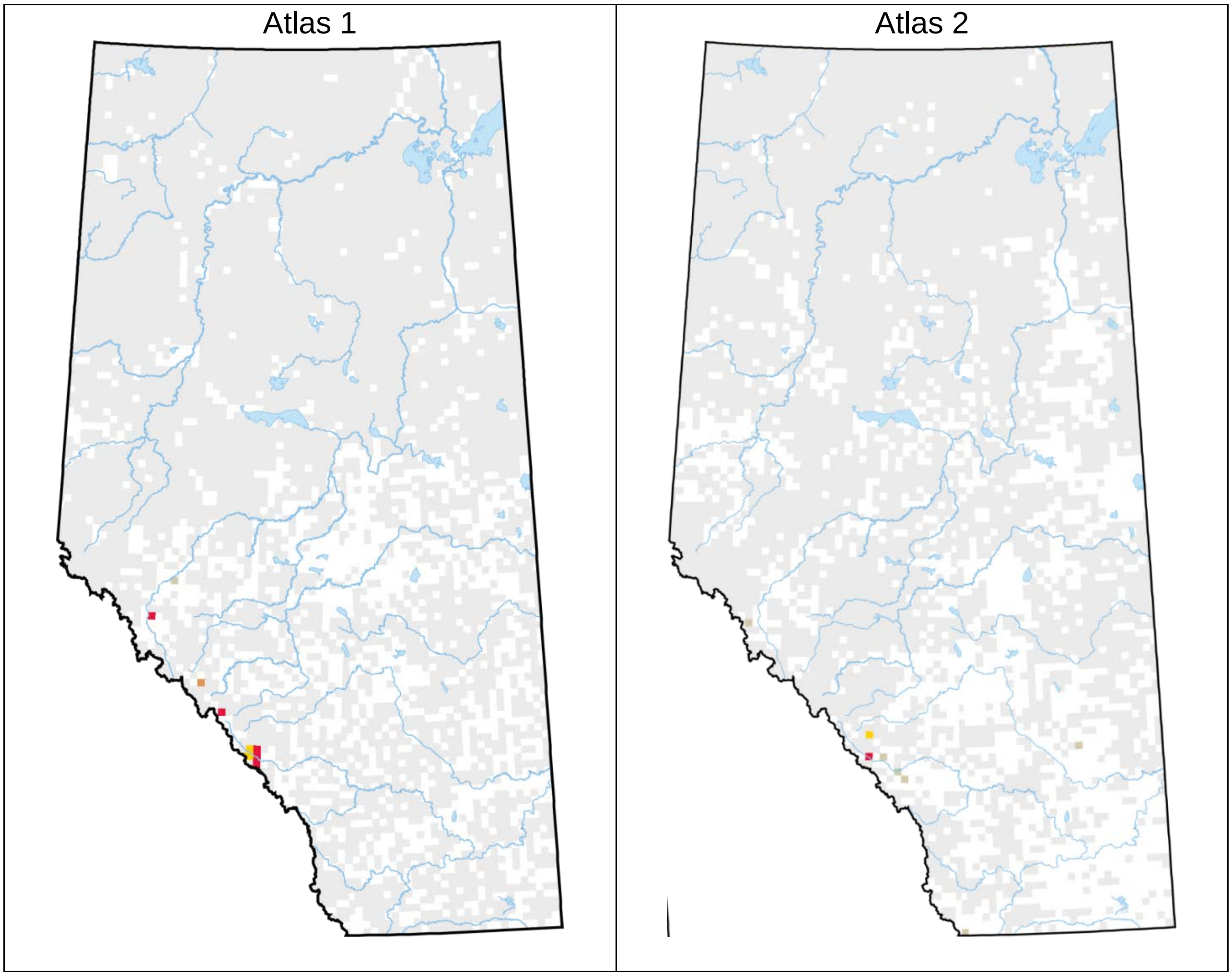

Figure 3. Breeding records from the Alberta Breeding Bird Atlas, comparing Atlas #1 (1987-1991) and Atlas #2 (2000-2005). Grey squares received some level of survey coverage.

Levad (2010) listed three confirmed and eight probable breeding sites for British Columbia. They include: 1) Clinton, Cariboo Region (Beebe 1959); 2) Harland Creek Falls, Vernon, Okanagan (Grant 1966); 3) Quesnel Lake, north arm on an inaccessible high cliff (Jobin 1955); 4) a high cliff north of Kleena Kleene (Jobin 1955); 5) Marble and Sinclair Canyons and over Helmet Falls (Kootenay National Park; Poll *et al*. 1984); 6) Redemption Cave, in the vicinity of Bowron Lake Provincial Park; 7) Cascade Falls; and 8) Brandywine Falls. Nest record cards are available for many of these sites (Chutter pers. comm. 2013; Ramsay pers. comm. 2013). Another possible nest site is Hotspring Cove on the west coast of Vancouver Island, where a Black Swift was seen flying from a cliff outside a cave (Campbell *et al.* 1990).

Nesting sites in Alberta include: 1) Johnston Canyon, which was first discovered in 1919 (variable numbers of breeding birds, ranging from 8-13 pairs in 1975 to just 1 pair in 2013); 2) Maligne Canyon (Holroyd and Holroyd 1987); 3) Brazeau Lake Cave (this may be an erroneous record; Levad 2010); and 4) Athabasca Falls in Jasper National Park. Cliffside Cave in the Snaring Karst of Jasper National Park and a cave in Leyland Mountain near Cadomin are also possible breeding sites (Rogers pers. comm. 2013). There are also records of Black Swifts during the breeding season at Waterton National Park (Sissons pers. comm. 2013 to Patrick Nantel).

Extent of Occurrence and Area of Occupancy

Based on a minimum convex polygon, the Canadian extent of occurrence is 718,238 km^2. The index of area of occupancy (IAO) was calculated as 3372 km^2, based on occurrence within 843 grid cells (2 x 2 km) in British Columbia and Alberta.

Search Effort

The species has several detectability issues. First, it is largely airborne, flying at high altitude often out of range of human vision. Second, Black Swifts nest in remote, roadless, often inaccessible locations – many of which can only be reached by helicopter or water. Third, nest ‘colonies’ may comprise only one or two pairs and so confirming nest sites is challenging. In addition, adult birds often visit nest sites only late in the evening and are hard to see as they swoop behind veils of water at their typical waterfall nest sites (Altman 2003).

Black Swifts are detected in low numbers on the Breeding Bird Survey (BBS). There are 57 routes in Canada where the species has been detected at least once over a 40-year period (1970-2012). There are at least four reasons why the absolute counts are low for the Black Swift compared to other species: 1) most nest sites occur in remote mountainous areas that are not well transected by roads where BBS surveys take place; 2) Black Swifts often nest in small aggregations and may not be readily visible; 3) Black Swifts forage at high altitude, and are difficult to see and identify; and 4) at the time of the BBS survey (end of May to first week in July), some swifts may still be migrating in some areas, especially in the northern part of the range, so the survey is not counting all breeding birds in a given area. This means that population trends for Black Swift are imprecise, but not necessarily biased. Despite these limitations, the BBS still provides the best long-term, standardized and widespread data for monitoring Black Swift population trends over large geographic areas.

Since the early 1980s and 1990s, Breeding Bird Atlas projects have been conducted in many parts of Canada and the United States. These involve systematic visits to 10 x 10 km squares where evidence of breeding is recorded, providing good information on species' distribution, though there is a bias towards areas that are most readily accessible. Fieldwork for the first British Columbia Breeding Bird Atlas was completed in 2012 (British Columbia Breeding Bird Atlas 2013). In some regions, atlas fieldwork has also been repeated 10-20 years later, enabling a comparison of breeding distributions between time periods. The Breeding Bird Atlas of Alberta project was first conducted in 1987-1991 and then repeated in 2000-2005 (Semenchuk 1992; Federation of Alberta Naturalists 2007).

Some long-term counts have been conducted of Black Swift numbers at nesting sites in Alberta. Censuses at Johnston Canyon in Banff National Park, Alberta have been conducted since 1975 (Holroyd and Rogers pers. comm. 2013). Counts were also conducted at Maligne Canyon in the 1980s, but only a small number of birds bred there (Holroyd and Holroyd 1987).

Some recent attempts have been made to more systematically survey nest sites for Black Swifts. However, surveying swifts at colony nest sites can be challenging and counting birds can be very difficult, because they visit nests sporadically and often in poor light conditions (Levad 2010). In 2003, a coordinated effort involving 100 volunteers was initiated in northwestern California, western Washington, Oregon, British Columbia, and southern Alaska to survey waterfalls for Black Swifts (Altman 2003). Surveyors were asked to count swifts for a 2-hour period close to dusk at waterfall nest sites once in July and again in August. If each observer surveyed a minimum of one waterfall, this would amount to 400 hours of observations. This effort resulted in many new colonies being discovered, and there are now at least 100 sites in the United States and Canada where Black Swifts are known to breed (Levad 2010). As part of this effort, two new colonies were confirmed in British Columbia (Brandywine Falls by Levesque pers. comm. 2013; and near Mission, Tyson 2004). Paul Levesque and Mike Shepard followed up on surveys orchestrated by Bob Altman in 2004 (Levad 2010). As a result, 153 records (including incidental observations) were submitted by 60 volunteers in British Columbia.

Low numbers of Black Swifts (i.e., < 50 birds annually) are recorded at migration monitoring stations in British Columbia (e.g., Rocky Point Bird Observatory; Nightingale pers. comm. 2013 and Vaseux Lake Bird Observatory; Cannings pers. comm. 2013 and Mackenzie Nature Observatory). Too few swifts are counted at these sites to produce reliable population trends.

HABITAT

General

Because Black Swifts are airborne at high altitudes for most of their lives, it is difficult (and sometimes not meaningful) to adequately describe their habitat away from the nest site. They have been recorded from sea level to 2600 m in British Columbia (Campbell *et al.* 1990), from sea level to 2300 m in California (Small 1994), and from 2100 to 3700 m in Oaxaca, Mexico (Hunn *et al.* 2001). In favourable weather, they forage at high altitudes – often beyond the limits of sight (Rathbun 1925). In Colorado, Black Swifts have been recorded foraging at altitudes of 4300 m (Knorr 1961). However, during stormy weather, when the barometric pressure drops, they can forage at lower altitudes and may congregate to feed on insect swarms (Lowther and Collins 2002). During rainy weather they may forage low over lakes and other waterbodies. For example, in southeastern Alaska, Black Swifts forage over freshwater marshes along the Chickamin River (MacDonald and MacDonald 1975).

The Black Swift's range encompasses many biogeoclimatic zones in British Columbia. Much of the Canadian range lies within the Northern Rockies Bird Conservation Region (known as BCR 10), which is dominated by a variety of coniferous forests. Lying in the rain shadow of the Cascade Range and Sierra Nevada, the Great Basin Bird Conservation Region (BCR 9) is a dry region dominated by grasslands, sagebrush and other xeric shrubs in the lowlands. There are some extensive wetlands. In the highest elevations, Lodgepole Pine (*Pinus contorta*) and Subalpine Fir (*Abies lasiocarpa*) occur on north-facing slopes and open Ponderosa Pine (*Pinus ponderosa*) in upper elevations. By contrast, the Northern Pacific Rainforest Bird Conservation Region (BCR 5) has high precipitation and mild temperatures due to the oceanic influence. Dominant forest trees include Western Hemlock (*Tsuga heterophylla*), Sitka Spruce (*Picea sitchensis*), Western Red Cedar (*Thuja plicata*), and in the south Douglas-fir (*Pseudotsuga menziesii*). Deciduous forests occur along large rivers on the mainland (NABCI 2000).

Nesting and Roosting

Black Swift nesting sites are typically at montane waterfalls (Knorr 1961; Levad 2010), but there are also a few records of alternative nest sites, including caves (Davis 1964; Northern British Columbia Caving Club 2003; Rogers, pers. comm. 2013), small 'cave-like' boulder configurations within streams (Foerster and Collins 1990; Johnson 1990; Hurtado 2002), and sea caves along cliffs in California (Legg 1956).

Five characteristics of Black Swift nest sites were listed by Knorr (1961). Foerster and Collins (1990) found these requisites were met at all the sites they examined in southern California. They include: 1) a variable quantity of running water; 2) high relief so swifts can depart the nest at foraging altitude; 3) inaccessibility to terrestrial predators; 4) darkness (the nest must not be exposed to the sun); and 5) an unobstructed flight path (flyway free of obstructing trees, etc.). These requirements were confirmed by Levad *et al.* (2008), who examined 291 nest sites and found that the probability of sites being occupied by Black Swifts was higher if they had stream flow, nest platforms, high topographic relief, and aerial access to nests. Recent research demonstrates that Black Swifts have specific temperature and humidity requirements for nest site microhabitat. Gunn *et al.* (2012) found that the mean temperature at nine sites in Colorado and New Mexico was 9.4^{o} C and at a site in California it was 13.4^{o} C, and relative humidity values were high (89.7% and 92.8%, respectively).

Migration

Black Swifts fly over many different habitats on migration. It is probable that the flight is non-stop based on the fact that other swift species can spend long periods airborne (e.g., recently Alpine Swifts, *Tachymarptis melba,* have been recorded flying non-stop for 200 days; Liechti *et al.* 2013). Whether migration is non-stop may depend on food availability and weather en route.

The routes taken by Canadian Black Swifts migrating to their non-breeding grounds is unknown. Some birds may migrate over the Pacific Ocean, at least for the southern part of their journey. Lowther and Collins (2002) suggested that Black Swifts migrate from southern Mexico over the Pacific Ocean to Costa Rica based on records at sea off Chiapas (Buchanan and Fierstine 1964) and Guatemala (Davidson 1934). They then cross over the Pacific Ocean to southern Colombia (Lowther and Collins 2002). Following breeding, most migrant Black Swifts are seen over coastal lowlands, but flocks have also been seen over the Sierra Nevada at 3300 m (Small 1994).

Winter

The wintering range of Canadian Black Swifts is unknown. However, it is believed that they migrate to South America.

Information derived from four Black Swifts fitted with geolocators from nest sites in Colorado showed that they spent the winter in the southern lowlands of Amazonas, Brazil (with some records in Colombia, Peru and Venezuela). The geolocator 'kernels' include a large positional error (e.g., ~365 km for latitude and ~66 km for longitude; McKinnon *et al.* 2013), so conclusions regarding habitat use must be viewed with considerable caution. Nevertheless, 86% of the land cover in the 50% kernel densities for the birds was composed of closed to open broad-leaved evergreen or semi-deciduous forest, with only 2-10% of the kernel density areas being regularly flooded and in closed to open broad-leaved forest. Only 2% of the land cover used was a mosaic of cropland vegetation and forest shrubland/grassland, closed to open shrubland or grassland, areas of bare ground and open areas (Beason *et al.* 2012).

One wintering record of note is a group of 15 Black Swifts that roosted on a cliff along the Rio Cauca, Colombia. In late September and October, these birds foraged over the adjacent plains in the Andean foothills, which were seeded to grass for intensive cattle rearing (Stiles and Negret 1994).

Habitat Trends

Climate change has been predicted to have various impacts on the nesting habitat of the Black Swift. In British Columbia, precipitation as rainfall is predicted to increase modestly in the 2020s compared to the 1961-1990 baseline (median +4%), while spring snowfall is predicted to decrease substantially (median -30%, range -56% to -2%; Pacific Climate Impacts Consortium, PCIC 2012). This would result in lower snow packs and earlier spring thaw and run-off. In the western United States, snow packs could be reduced by up to 80%; earlier spring thaws could increase the elevation of the snowline by 400 m and the length of the snow season could be reduced by 30 days compared to the historical average (Gunn *et al*. 2013). Gunn *et al.* (2013) suggested that this could influence the temperature and humidity at Black Swift nest sites, diminishing the quality of their nesting habitat and rendering sites unsuitable or reducing breeding success.

Little information is available on habitat trends, particularly the quality of foraging habitat. This is because the airspace habitat over which Black Swifts forage is exceptionally varied and includes montane areas, forests, grasslands and anthropogenic landscapes. Where Black Swifts forage at low altitude, it is possible that their insect food supply is influenced by local factors such as pesticide use and the eutrophication of water bodies.

Most nest colonies in Canada are in montane forested areas, but foraging habitat presumably includes adjacent valleys, where the predominant land use activity that influences invertebrate biomass and diversity is apt to be logging. Though there are few data on how logging affects invertebrate food supply, logging may initially increase terrestrial invertebrate biomass (because of downed debris and slash), but following regeneration into dense homogeneous stands, invertebrate biodiversity declines. For example, ants, the flying phases of which are thought to be important in the diet of Black Swifts (see Interspecific Interactions below), are strongly dependent on the size of woody structures (trees, logs and stumps; Ministry of Environment 2012).

The combined effect of logging and a problematic native species may be even more significant; 16.3 million ha of forested lands are currently being affected by the Mountain Pine Beetle (*Dendroctonus ponderosae*). Although the beetle is native to British Columbia the current outbreak is unprecedented and has been facilitated by a series of mild winters (likely due to anthropogenically induced climate change) and fire suppression. Not only are trees (mostly Lodgepole Pine) being killed over a very large area, but combined with salvage logging operations, the Mountain Pine Beetle may impact watershed hydrology by increasing run-off and resulting in accelerated erosion and changes in timing of peak flow in some watersheds (Austin *et al.* 2008). As well as affecting hydrology (and potentially Black Swift nest sites), deforestation due to Mountain Pine Beetle and salvage logging may result in an initial surplus of invertebrates for insectivores, but later when trees have died, a diminished food supply, as has been demonstrated for cavity-using birds (Martin *et al.* 2006; Norris and Martin 2008; Norris *et al.* 2013). Although speculative, in the case of Black Swift there is a possibility that changes to forest structure and condition caused by Mountain Pine Beetles or other bark beetles could influence Carpenter Ant (*Camponotus* spp.) communities and thus potential food supply.

Aerial invertebrate biodiversity is strongly related to land cover type and is greater over native or semi-natural habitat than over agricultural cropland (Attwood *et al.* 2008; Ghilain and Bélisle 2008). Moreover, within agricultural landscapes, it has been demonstrated that the more homogeneous and structurally simple the landscapes are, the lower the abundance and diversity of aerial invertebrates and thus the lower the food supply for aerial insectivores (e.g., Evans *et al.* 2007; Ambrosini *et al.* 2002). However, many of these studies sampled aerial invertebrates close to the ground and thus may not reflect the species composition and abundance of invertebrates higher in the air column where Black Swifts tend to forage (Mahony pers. comm. 2014). There may also be a seasonal effect of land cover type. Although Paquette *et al.* (2013) found no difference in aerial invertebrate prey for Tree Swallows (*Tachycineta bicolor)* between cropland and other cover types in the early part of the breeding season, invertebrate biomass declined over the summer in cropland, suggesting that cropped areas may be an ecological sink for swallows.

Livestock grazing appears to have a positive effect on food supply for aerial insectivores. In a study of foraging Barn Swallows (*Hirundo rustica*), Evans *et al.* (2007) found the abundance of aerial invertebrates over pasture to be double that over silage, and more than three and a half times greater over pasture than over cereal fields. Similarly, Barn Swallows in northern Italy were strongly dependent on livestock (Ambrosini *et al.* 2002). Grazing by livestock is widespread in British Columbia. However, in interior Douglas-fir forests, Whitehorne *et al.* (2011) found lower densities of aerial insectivores in grazed areas than in ungrazed. They did not offer an explanation as to causality.

The effect of land conversion on aerial invertebrate biomass could potentially affect food supply for Black Swifts at critical times, such as prior to breeding or migration. In parts of the North Okanagan (Swan Lake, north of Vernon), Black Swift flocks are seen regularly in late spring (Siddle 2013). In the Okanagan and Similkameen valleys, more than 50% of most native land cover types were lost to urban and agricultural use between 1938 and 2003 (Lea 2008). While much of this land conversion took place more than 200 years ago, there is ongoing loss of native land cover. For example, the viticulture industry expanded by 20% between 2004 and 2006, and is predicted to expand by another 35% (Lea 2008). Although native habitats have greater invertebrate biodiversity than vineyards in the southern Okanagan (Rambaldini and Brigham 2011), there is no information on how this could affect transitory Black Swifts.

Loss of habitat due to agriculture may also occur in the Black Swift's wintering areas in South America (Soares-Filho *et al.* 2006). Changes in land cover (with its associated pesticide use in the case of row crops) could then impact the diversity and abundance of aerial invertebrate species that are important in the diet of Black Swifts.

In the Amazon lowlands, where at least some Black Swifts spend the winter (Beason *et al.* 2012), forest cover was largely intact (see Soares-Filho *et al.* 2006) until recently. However, over the last 10 years there has been significant deforestation in the western and southwestern Amazon (Hansen *et al.* 2013). Meanwhile, in the eastern Amazon basin, deforestation is increasing – mostly as a result of livestock ranching and row crops (notably soybean; Soares-Filho 2006). Soares-Filho *et al.* (2006) estimated that 40% of Amazonian forests will be eliminated by 2050. Although the rate of deforestation in the Brazilian Amazon is decreasing (Hansen *et al.* 2013), Brazil still accounts for 47.8% of humid forest loss globally (Hansen *et al.* 2008).

Because the precise wintering areas (and habitat needs) of Canadian Black Swifts are unknown, it is difficult to speculate further on the potential impacts of deforestation in the wintering areas.

BIOLOGY

Life Cycle and Reproduction

Birds return to their northern breeding areas in British Columbia in late April to early June, peaking in mid- to late May (Campbell *et al.* 1990) or mid-June in Alberta (Semenchuk 1992).

Black Swifts show high site-fidelity, returning to the same nesting colonies each year (Dobkin *et al.* 1986; Collins and Foerster 1995). One female was recaptured for seven successive years at a colony in Colorado (Beason pers. comm. 2013). The only data on natal philopatry comes from three females, which all hatched and were later recaptured, at the same colony (Beason pers. comm. 2014).

The longevity record for a Black Swift is an individual that lived to 16 years, 1 month (Lowther and Collins 2002). Because of very few banding returns, this could be a low estimate.

Although little is known about the Black Swift's annual survival, Collins and Foerster (1995) thought that it has a high survival rate compared to other landbirds. Wiggins (2004) estimated a value ranging between 0.88 and 0.92 for adults, based on similar species of swifts elsewhere. For example, the Biscutate Swift (*Streptoprocne biscutata*) of South America reportedly has an adult survival rate of 0.88 (Pichorim and Monteiro-Filho 2010). In the Eurasian Swift (*Apus apus*), adult survival rate was 0.84 to 0.85 in a long-term study of a population in England (Cramp 1985).

For Black Swift, Lowther and Collins (2002) suggested that its age of first breeding was 1 year. However, given its life-history characteristics (especially its clutch of only one egg), it seems probable that this species has delayed age at first breeding, and that an age of 3-5 years is a more reasonable estimate (Jason Beason, Carolyn Gunn, Kim Potter, Charles Collins, pers. comms. 2013).

Based on the above information, Black Swift generation time can be estimated based on the IUCN's (2011) equation [1/adult mortality + age of first reproduction], and using various combinations of age at first reproduction and survival/mortality to give a probable range (see Table 1). The IUCN guidelines state that "if reproduction typically occurs by 12 months, use 0, not 1; if it occurs between 12 and 24 months, use 1, etc."

Table 1. Various estimates of Black Swift generation time using different combinations of age at first reproduction and survivorship/mortality.

Survival Rate	Age at first breeding	Mortality Rate	1/Mortality	Generation Time (1/Mortality + age at first breeding)
0.84	0	0.16	6.25	6.25
0.85	0	0.15	6.67	6.67
0.88	0	0.12	8.33	8.33
0.92	0	0.08	12.50	12.50
0.84	1	0.16	6.25	7.25
0.85	1	0.15	6.67	7.67
0.88	1	0.12	8.33	9.33
0.92	1	0.08	12.50	13.50
0.84	2	0.16	6.25	8.25
0.85	2	0.15	6.67	8.67
0.88	2	0.12	8.33	10.33
0.92	2	0.08	12.50	14.50
0.84	3	0.16	6.25	9.25
0.85	3	0.15	6.67	9.67
0.88	3	0.12	8.33	11.33
0.92	3	0.08	12.50	15.50

Survival Rate	Age at first breeding	Mortality Rate	1/Mortality	Generation Time (1/Mortality + age at first breeding)
0.84	4	0.16	6.25	10.25
0.85	4	0.15	6.67	10.67
0.88	4	0.12	8.33	12.33
0.92	4	0.08	12.50	16.50

For example, using survival estimates from the Eurasian Swift (above), the minimum generation time would be (1/(1-0.84)) +0 (i.e., breeds at 12 months old) = 6.25 years. The maximum generation time based on the upper survival rate value suggested by Wiggins (2004) would be (1/1-0.92)) + 4 (i.e., breeds at 5 years old) = 16.5 years.

Using the lower value suggested by Wiggins (2004) and survival rate for the Biscutate Swift and age of first breeding of 3 years, the generation time would be (1/ 1-0.88) + 2 = 10.3 years. Because calculations of Black Swift generation time depend on demographic parameters that are largely unknown, these estimates should be used cautiously.

Nests are usually constructed of moss, without the use of saliva as in other swift species. Sea cliff nests are quite different and constructed of mud or sometimes seaweed (Lowther and Collins 2002).

The time of laying of the single egg clutch varies with location, but is much later than most other temperate bird species. Typically, laying dates are earlier in more southern parts of the range, and also earlier at lower elevation than high elevation sites (Wiggins 2004). In British Columbia, eggs are laid from late June to July, with young in the nest from 18 July to 10 September (Campbell *et al.* 1990). In southern California, eggs are laid between early and late June (61 of 87 nests – Foerster 1987; Marín 1999b), whereas in Colorado the earliest egg was laid on 19 June, with the earliest date of hatching being 17 August (Boyle 1998). Based on an 11-year study in Colorado (160 nesting attempts), on average egg-laying began on 28 June and incubation started on 1 July (Hirshman *et al.* 2007).

In California, the average incubation period was 24 days (Marín 1997b); the same was recorded in Colorado by Murphy (1951) and slightly longer (27 days) in California (Legg 1956). In Colorado, Hirshman *et al.* (2007) recorded the average incubation period as 26 days. For two nests in Costa Rica, Marín (1999a) recorded incubation periods of 28-30 days.

Based on a long-term study in Colorado, the nestling period was 48 days (considerably longer than most other landbird species), with the average fledging date being 13 September (Hirshman *et al.* 2007). Overall nesting success was 72%. Replacement clutches were apparently laid after the loss of the first egg in 7 out of 35 cases, and in one case a third egg was laid to replace the loss of a second egg (Hirshman *et al.* 2007).

In other cypseloidine swift species that lay a single egg clutch, incubation may be intermittent (Marín 2008), but it is not known whether this phenomenon occurs in Black Swifts. Unlike other swift species, which bring individual boluses carried in their mouths to their chicks at frequent intervals, Black Swifts feed their chicks infrequently, bringing the equivalent of several boluses of food in their esophagus (Lowther and Collins 2002; Collins pers. comm. 2013).

Physiology and Adaptability

Little is known about the physiology of the Black Swift. Because of the long periods between bouts of food provisioning by parents, it has been speculated that young birds may go into torpor (Lowther and Collins 2002) as in some other swifts. However, torpor-like behaviour has not been observed in nestlings or adults (Gunn *et al.* 2012). The species is believed to be vulnerable to climate change, and in particular warming temperatures that could influence the microclimate of nest sites, as well as increased storm events that may affect breeding success as in other swift species (Rajchard *et al.* 2006).

Dispersal and Migration

Departure dates for Black Swifts leaving breeding areas to migrate southward vary from late August to early October for British Columbia (Campbell *et al.* 1990), to mid-September for Alberta (Semenchuk 1992), late August to September, or as late as mid-October in Oregon (Gilligan *et al.* 1994). Black Swifts departing British Columbia in late August would most likely be failed breeders.

More precise information on migration dates is available from Black Swifts fitted with geolocators in Colorado (Beason *et al.* 2012). There, fall migration was initiated between 10 and 19 September, and birds arrived in their wintering areas in South America between 28 September and 12 October. In spring, Black Swifts departed the Amazon between 9 and 20 May and arrived back in Colorado between 23 May and 18 June. According to Campbell *et al.* (1990), spring arrival dates in British Columbia are from late April, peaking in mid- to late May and extending into June. In Alberta, the first Black Swifts arrive in early June (Semenchuk 1992).

The distance travelled by Black Swifts from Colorado to their non-breeding areas in the Brazilian Amazon was up to 7025 km. On average, they flew 341 km per day on fall migration and 393 km per day on the spring migration (Beason *et al.* 2012).

Interspecific Interactions

Little is known about interspecific interactions of Black Swifts with other species. On their South American non-breeding areas, Black Swifts occur sympatrically with several other swift species. For example, in Colombia, Black Swifts were recorded roosting with White-collared Swifts (*Streptoprocne zonaris*; Stiles and Negret 1994).

Of 36 Black Swifts analyzed for stomach contents, the insect taxa identified included ants (*Lasius* spp.), yellowjackets (*Vespula* spp.), flies (9 genera of Diptera), and termites (*Zootermopsis angusticollis*). Other prey items were long-legged flies (Dolichopodidae), flesh flies (Sarcophagidae), root maggots (Anthomyiidae), crane flies (Tipulidae), midges (Chironomidae), shore flies (Ephydridae), grass-stem maggots (Chloropidae), mayflies (Ephemeroptera), caddisflies (Trichoptera), and beetles (Coleoptera; C. Cottam *in* Bent 1940). In Washington, stomach contents of Black Swifts (n=6), included caddisflies, mayflies, crane flies, other flies, beetles, termites, flying ants, aphids (Aphididae), leafhoppers (Cicadellidae), treehoppers (Membracidae), wasps, moths (Lepidoptera), and spiders (Araneae: Rathbun 1925). The stomach contents of another 5 individuals collected in Washington contained mostly leafhoppers, a fly (Syrphidae) and beetle (Elateridae; Davis 1931). Of 432 prey items identified in one bolus brought to a nest in Colorado, there were 350 mayflies (Ephemeroptera), 24 ants (Formicidae), 33 leafhoppers (Cicadellidae), and 25 other species (Beason pers. comm. 2013; Beason, Carolyn Gunn, and Kim Potter unpubl. data; Gunn *et al.* 2013).

Black Swifts have been observed feeding on Carpenter Ants in Alberta (Geoff Holroyd, pers. comm. 2013), winged ants and wasps (Hymenoptera) in Washington (C. Cottam *in* Bent 1940), winged ants in southern California (Foerster 1987; Marín 1999b; Rudalevige *et al.* 2003; Collins, pers. obs.) and Mexico (Collins and Landy 1968), and small beetles in Colombia (Stiles and Negret 1994).

The Black Swift’s diet may be varied and depend on the time of year, the influence of weather on prey availability, and whether they are feeding young (Lowther and Collins 2002). Weather could also bias the samples that have been collected from specimens in that in the past swifts were more likely to be collected for stomach-content analysis when flying at low altitude and feeding on a variety of different species in poor weather conditions than in fair weather when they tend to forage at high altitude. This could mean that the contribution of reproductive ant swarms is underrepresented. In any case, at certain times of year, Black Swifts appear to specialize on swarms of ant species (Lowther and Collins 2002; Rudalevige *et al.* 2003). In fact, all of the cypseloidine swifts are swarm feeders (Marín and Stiles 1992; Collins 1998; Collins pers. comm. 2013). At key points in the year, flying forms of ants may be critical in providing swifts with essential fat and nutrient resources to reach breeding condition and possibly for migration.

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

There are four main survey techniques that provide information on distribution, abundance and/or trends of Black Swifts in Canada: 1) standardized surveys such as the Breeding Bird Survey (BBS); 2) breeding bird atlases; 3) targeted nest site counts; and 4) migration monitoring.

Most nesting habitat is in remote, roadless areas and is largely inaccessible. In addition, Black Swifts are hard to detect because they have swift, erratic flight and seldom vocalize. They occur at low densities, often fly at high altitude, and visit nest sites infrequently, often only at dusk. They also fly across large distances to forage (e.g., 70 km radius from nest sites; Lowther and Collins 2002).

North American Breeding Bird Survey (BBS)

This is an annual survey conducted throughout the United States and Canada. Routes are randomly selected along roads. Volunteers record all birds seen or heard at listening stations at 0.78 km intervals. Although the BBS covers a large part of the species' breeding range, detection rates are low (see Search Effort).

Breeding bird atlases

Since the 1980s, Breeding Bird Atlas projects have been conducted in many parts of Canada and the United States. These involve systematic visits to 10 x 10 km squares where evidence of breeding is recorded. Five years of fieldwork for the first British Columbia Breeding Bird Atlas was completed in 2012 (British Columbia Breeding Bird Atlas 2013). Black Swifts were recorded in 247 squares in British Columbia (Breeding Bird Atlas of British Columbia database 2014). In some regions, atlas fieldwork has been repeated 10-20 years later, enabling a comparison of populations between different periods. For example, the Breeding Bird Atlas of Alberta project was first conducted in 1987-1991 (Semenchuk 1992), and then repeated in 2000-2005 (Federation of Alberta Naturalists 2007).

Targeted nest site counts

Black Swifts at breeding sites can be counted by using dedicated surveys. Altman (2003) reported on targeted surveys conducted by volunteers in British Columbia. In addition, counts have been conducted since the early 1970s in Alberta, most notably at Johnston Canyon in Banff National Park.

Migration monitoring

Migratory birds are monitored during migration at a number of sites across Canada through the Canadian Migration Monitoring Network. Several migration monitoring sites occur in British Columbia – including Rocky Point Bird Observatory, Vaseux Lake Migration Monitoring Station and Mackenzie Nature Observatory. However, few Black Swifts are counted at any of these migration monitoring sites, and no reliable population trend estimates are available from any of these stations (McCracken pers. comm. 2014).

Abundance

Because of the secretive nature of the Black Swift and the remoteness of its montane waterfall and cliff nesting sites, estimates of overall abundance are not definitive. Although the number of known nest sites has increased due to enhanced search effort, there are still fewer than 100 nest sites known in Canada and the United States (Roberson and Collins 2008).

Several population estimates have been made for the Black Swift. The British Columbia segment of the Black Swift population was originally estimated at roughly 3000-3500 birds in the early 2000s (Levad 2010). The largest numbers of migrating birds were 600 reported from Nulki Lake near Vanderhoof (29 May), 400 at the south end of Pitt Lake, east of Vancouver (late May, early June), and 200 at Parksville-Qualicum (Levad 2010).

At that time, the entire continental population (all subspecies) was estimated at 10,000-15,000 individuals (Lowther and Collins 2002). A more recent estimate by Partners in Flight (PIF) is based on calculations from the BBS (see Blancher *et al.* 2013 for methods). This analysis suggested that the global population (again for all subspecies) is 190,000 individuals.

According to the PIF database, the population of the *borealis* subspecies is about 70,000 birds, of which 81% (56,537 to 60,000) reside in British Columbia. Less than 0.1% occurs in Alberta, which would yield a population of less than 300 birds. Levad (2008) argued that the PIF landbird estimates are inflated for three reasons: 1) because most records are of singing males in the PIF database, the count index is doubled to represent the number of pairs; however, most Black Swifts breed after the BBS surveys have taken place (after 1 July); 2) the maximum detection distance (MDD) for Black Swift is too small (400 m) and if it takes into account the distance within which the species is normally seen and also how much it moves in a 3-minute time interval, then the MDD should be 800 m; 3) Black Swifts are detected on few BBS routes, only small numbers are counted and there may be biased coverage meaning that the BBS data may be deficient for this species.

The most recent PIF estimates have changed some of these adjustment factors (PIF 2013). The MDD was reduced to 200 m rather than 400 m used in the original estimate. The distance was reduced after comparing detection distances of various swift species in North America with other species, using datasets with detection distance information (Blancher pers. comm. 2014). The newest pair estimate adjustment was 1.25 rather than 2.0 as in the original estimates, and the time of day adjustment was reduced to 1.19 rather than 1.55 as in the original estimates (PIF database 2014).

The MDD chosen for estimating population sizes from the BBS has a substantial impact on the population estimates. The lower the MDD, the higher the population estimate (Thogmartin *et al.* 2006; Thogmartin 2010; Matsuoka *et al.* 2012). For the Black Swift, Levad (2008) maintained that if a more appropriate distance correction factor is used (800 m), then the global population estimate becomes 18,750 birds, which is close to the earlier estimate of 10,000-15,000 individuals made by Lowther and Collins (2002). If 81% of these birds are in British Columbia, then there would be about 15,188 individuals there, and about 188 in Alberta.

Given the number of uncertainties and range of assumptions, an estimate of between 15,000 and 60,000 birds seems reasonable for Canada.

Fluctuations and Trends

Three main sources of data can be used to estimate trends in Black Swift numbers – the BBS, breeding bird atlases, special surveys at nesting or roosting sites and potentially migration counts. All of these surveys have advantages and disadvantages (discussed under each section below). In addition, the apparent former abundance of the Black Swift in Canada can be inferred from historical accounts. Brooks and Swarth (1925) stated that the Black Swift was an "*abundant summer visitant over a large part of British Columbia. Most numerous toward the coast, and thence eastward in diminishing numbers. Occurs north to the upper Skeena Valley at Hazelton, where it is abundant, and, in small numbers, to the upper Stikine at Telegraph Creek... Common throughout Vancouver Island, but not yet reported from the Queen Charlotte Islands.*"

Breeding Bird Survey

Based on the BBS, widespread declines have occurred in populations of many species of aerial insectivores throughout North America, most markedly since the 1980s (Nebel *et al.* 2010). The BBS clearly suggests long-term declines in Black Swift numbers in Canada (Figure 4), with a 99% statistical probability that the population has declined by more than 50% between 1973 and 2012 (Table 2). Using a range of generation time of between 6.25 to 16.5 years suggests a cumulative population loss of -72% to -96% over three generations, with expert opinion for generation time suggesting the value is most likely around -89% (based on an average annual trend of -6.5% over 33 years). The trend estimate is rather imprecise (confidence intervals fall between -10.1% and -2.64%) and the BBS population trend calculated for this species has a low reliability rating. Nevertheless, using the value from the lower confidence interval (-2.64%) still yields a cumulative loss of about 59% over three generations.

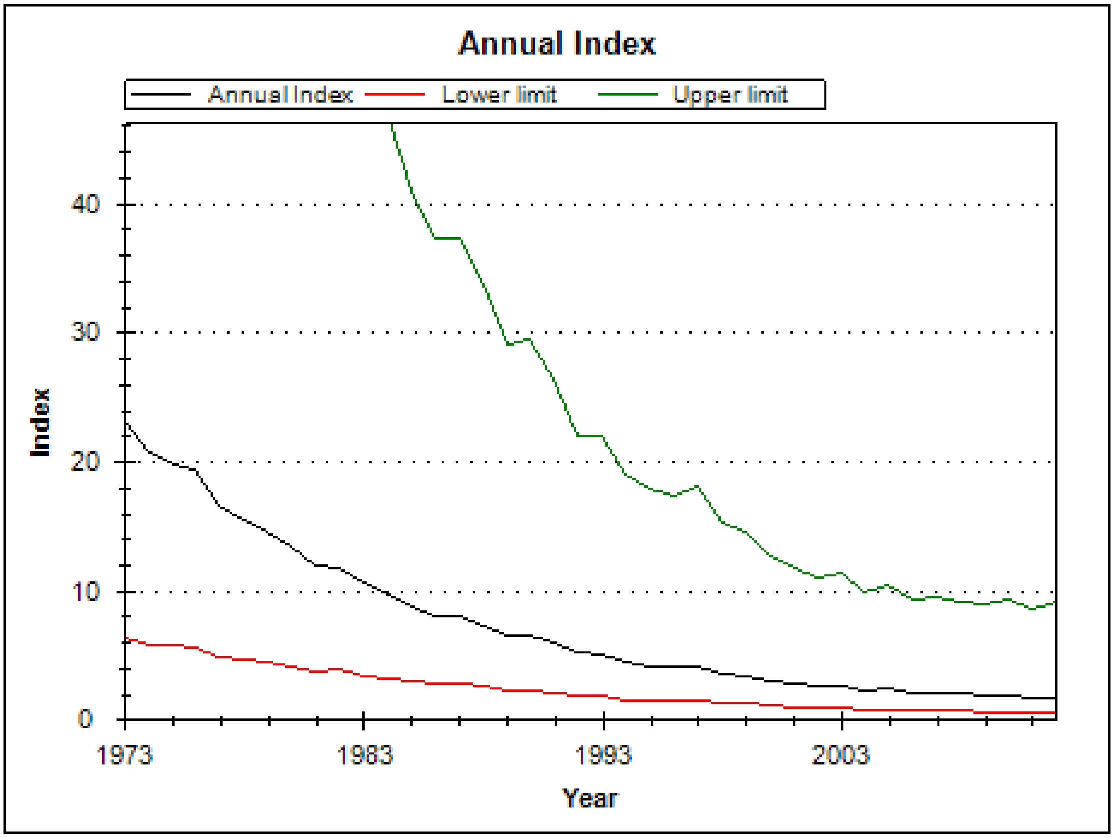

Figure 4. Trends in Black Swift numbers from the Canadian Breeding Bird Survey (1973-2012; Environment Canada 2014).

Table 2. Trend results from the Canadian analysis of the North American Breeding Bird Survey for long-term (1970-2012) and short-term (2002-2012) time periods (Environment Canada 2014).

Region	Time period	Annual % Trend	Lower 95% CL	Upper 95% CL	N	Probability decrease	Probability >50% decrease	Probability 25-50% decrease
Canada	1973-2012	-6.5	-10.1	-2.64	57	0.998	0.99	0.006
	2002-2012	-4.6	-10.9	5.65	46	0.873	0.418	0.449

When the 10-year rolling trend indices are plotted, it is apparent that the rate of decline has lessened in recent years (Figure 5). The 10-year short-term trend (2002-2012) estimate was -4.6% per year, which is equivalent to an overall decline of about 38% over the most recent decade. During this period, there was a 25% probability that the population declined by >50%, and a 45% probability that it declined by 25-50% (Smith pers. comm. 2014; Table 2).

BBS data from the United States portion of the species' range also suggest a long-term negative trend (-6.8% per year; see Table 3). Survey-wide (Canada and the United States combined) indicate that the continental population of Black Swifts declined significantly at an average rate of -6.5% per year (confidence limits -9.78,-3.24) between 1968-2012 (Table 3). Again, however, the reliability rating of these trends is considered to be low.

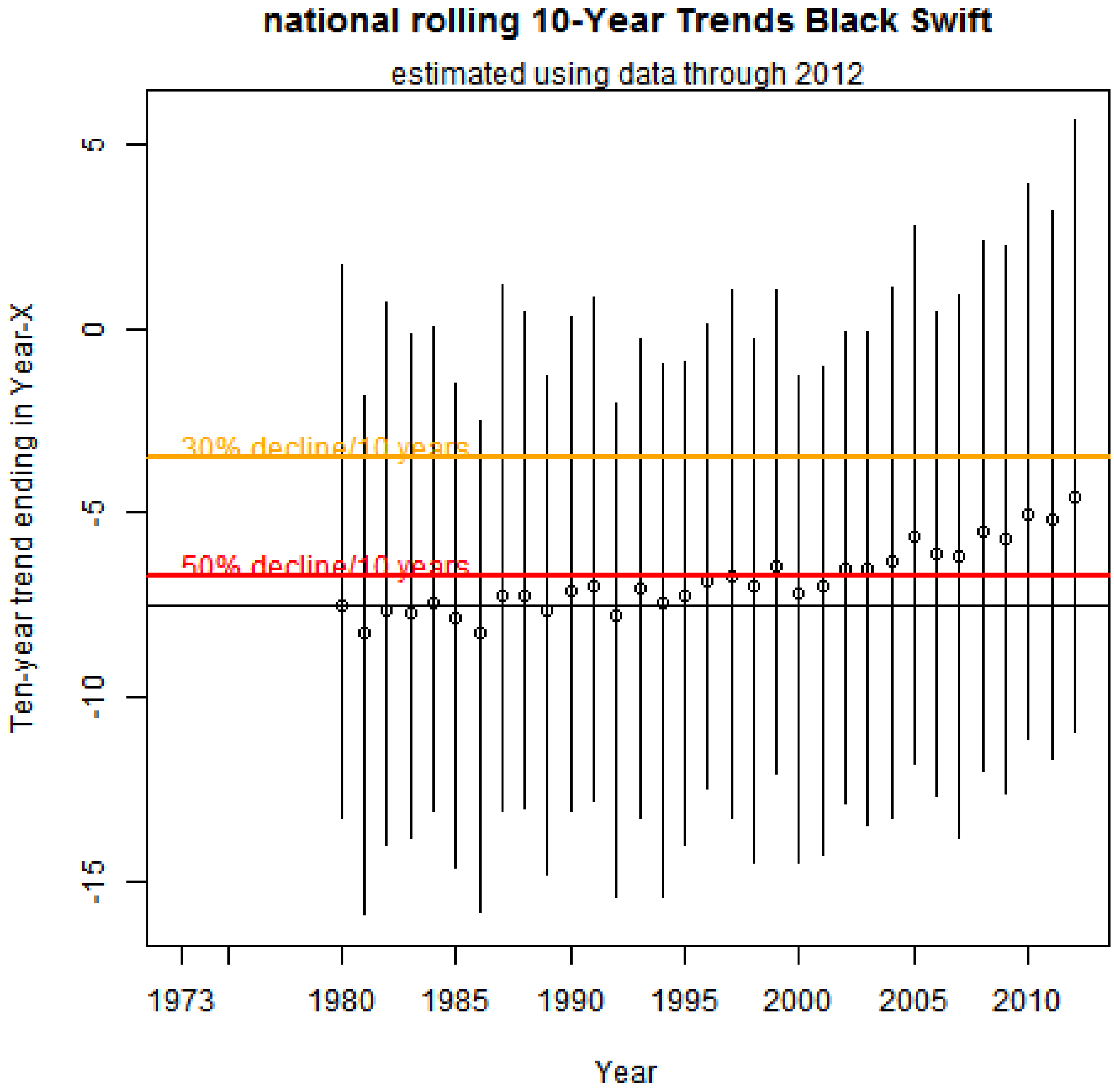

Figure 5. Ten-year rolling average in Canadian trends in Black Swift numbers from the Breeding Bird Survey (Adam Smith, pers. comm. 2014).

Table 3. Black Swift population trend analysis results produced by the United States Geological Survey for the North American Breeding Bird Survey (Sauer *et al.* 2014).

Region	**1968-2012**			**2002-2012**	
	N	**Annual % Trend**	**(95% CI)**	**Annual % Trend**	**(95% CI)**
British Columbia	56	-6.47	(-9.97, -2.94)	-4.31	(-10.21, 5.65)
California	27	-3.64	(-11.04, 3.28)	-2.28	(-20.07, 16.68)
Washington	27	-7.66	(-12.27, -3.14)	-7.32	(-17.96, 0.36)
Canada	58	-6.47	(-9.97, -2.94)	-4.31	(-10.21, 5.65)
United States	64	-6.83	(-11.13, -2.79)	-5.66	(-15.40, 3.69)
Survey-wide	122	-6.5	(-9.78, -3.24)	-4.36	(-9.90, 5.00)

In summary, despite the limitations of the data, it seems likely that the Black Swift population in Canada has declined by >50% over the past three generations.

Breeding bird atlases

The Alberta Breeding Bird Atlas concluded that there was little change in distribution and abundance between the first atlas and the second (Federation of Alberta Naturalists 2007; Figure 3). However, breeding records were recorded in 8 squares in the first atlas, versus only 2 squares in the second, suggesting a decline.

Long-term counts at nesting sites

Counts of nesting birds at Johnston Canyon in Banff National Park revealed variable numbers from the first record in 1919 to the present day (Figure 6). The peak number of birds was in 1981 and 1982 when there were 12 nests. Between 2006 and 2013, there was only one nest (Rogers pers. comm. 2013). It is possible that the decrease in breeding birds at Johnston Canyon is due to a decline in local habitat quality and does not represent the status of the species elsewhere.

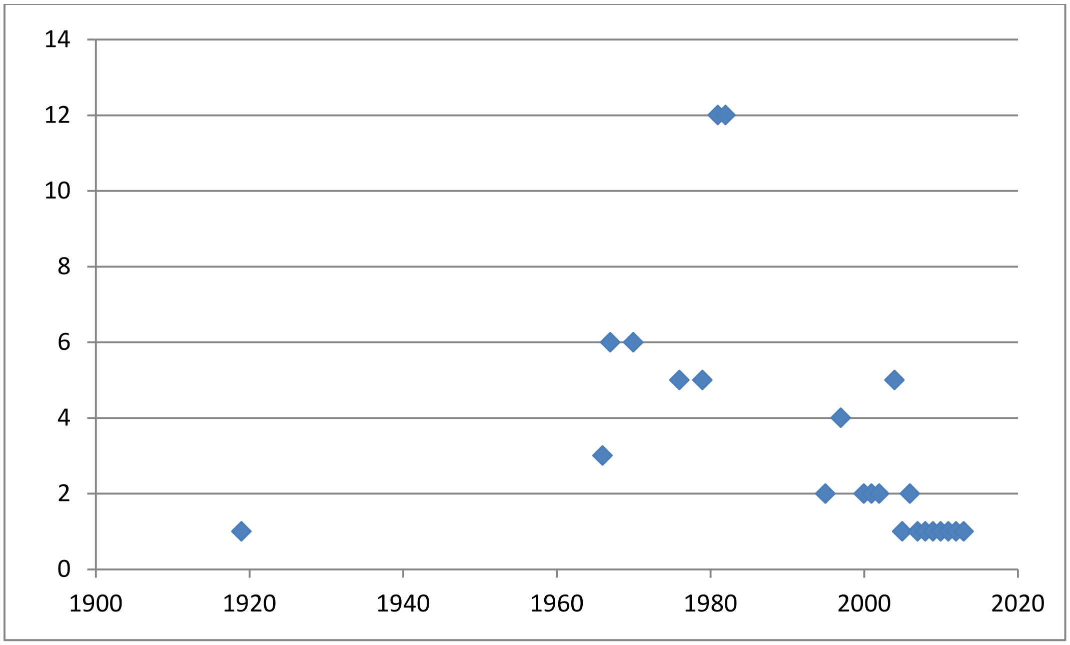

Figure 6. Counts of Black Swift nests at Johnston Canyon, Banff National Park (1919-2013; Rogers pers. comm. 2013).

Rescue Effect

Because adult Black Swifts show high site fidelity to breeding sites, it seems unlikely that adults from Oregon or Washington would breed in British Columbia, or those from Montana would breed in Alberta. The only data on natal philopatry comes from three Black Swifts recaptured at Fulton Resurgence Cave in Colorado that all hatched at the same colony (Beason pers. comm. 2014), suggesting high site fidelity of juveniles as well. According to the BBS, Black Swifts are declining in most states adjacent to Canada for which there are sufficient data for trend analyses (Table 3). Thus, while rescue is theoretically possible, the chance of it happening is unlikely, given the small population in the adjacent states, plus the general population decline that seems to be occurring there.

THREATS AND LIMITING FACTORS

Very little is known about threats to the Black Swift. What is known is largely speculative and based on information from other aerial insectivores. Possible threats were assessed using the IUCN threats calculator (Salafsky *et al.* 2008; Master *et al.* 2012; Appendix 1) and only the most plausible ones are summarized below. The overall threat score was calculated as ranging between High and Medium.

The important threats are discussed below in order of threat impact score. The most important of these were: 1) airborne pollutants (pesticides) that influence aerial invertebrate biomass; and 2) drought or storms and flooding and/or extreme temperatures that could affect the habitat suitability of nest sites or lead to changes in aerial arthropod phenology in relation to swift breeding. Other threats such as problematic native species, logging, annual and perennial non-timber crops, livestock farming and ranching, hydroelectric dams and water management, and recreational activities were considered as being negligible.

Pollution (air-borne pollutants)

Pesticides were identified as one of the most important threats to Black Swifts and considered to have high to medium impact, be pervasive in scope, serious-moderate in terms of severity, and high (continuing) in terms of timing. However, it is important to point out that their effects are largely unknown.

Pollutants could cause direct mortality of swifts through ingestion of poisoned insects, have detrimental effects on their reproduction or result in declines in their invertebrate food supply. There is evidence to suggest that there have been global declines in aerial invertebrates, based on long-term datasets of invertebrate indicators such as once-common butterflies and moths in the United Kingdom (Thomas *et al.* 2004; Conrad *et al.* 2006).

Pesticides have been suggested as a possible threat to aerial insectivores generally (McCracken 2008; Nebel *et al.* 2010), but only recently has evidence accumulated to demonstrate food-mediated effects. For example, widespread use of DDT has been linked to diet changes and long-term population declines in Chimney Swifts (Nocera *et al.* 2012). DDT is still being detected in migratory bird species (e.g., Elliot *et al.* 2007) and could enter the food chain of Black Swifts during the non-breeding season.

Of emerging significance is the use of neonicotinoid insecticides, which have recently replaced the more acutely toxic organophosphates and carbamates of the 1990s (Mineau and Palmer 2013). Neonicotinoids are highly toxic to bees (Mineau and Palmer 2013) and other hymenoptera, such as ants (Mineau pers. comm. 2013). Ants are in the same order as bees (Hymenoptera) and exposure to neonicotinoid pesticides has recently been shown to alter their behaviour, fitness and community dynamics (Barbieri *et al.* 2013). In the Netherlands, a widely used neonicotinoid insecticide, imidacloprid, has been linked with declines in insectivorous bird populations (Hallman *et al.* 2014). While it is important to note that the introduction of neonicotinoids postdates the onset of population declines of aerial insectivores, their widespread use could piggy-back on the effects of other insecticides. Recent research demonstrates that pesticide dust from agricultural fields in the American mid-west can be transported over very large areas and kill insects far removed from the original source (Mineau pers. comm. 2013). Were these pesticides to impact ant populations (e.g., by disrupting their ability to perform nuptial flights), then there could be repercussions on swift food supply, because ants are believed to be an important component of Black Swift diet.

Climate Change and Severe Weather (drought, storms and flooding and temperature extremes)

Although the overall impact of climate change was scored as negligible, it had a pervasive scope, and scored high (continuing) in terms of timing. However, the effects are largely unknown.

Aerial insectivores and high-elevation breeding birds are the guilds that have been identified as being most susceptible to climate change (NABCI, US Committee 2010). The Black Swift falls into both of these categories and was listed as one of three aerial insectivores that are highly vulnerable to climate change in the United States (NABCI, US Committee 2010). According to the threats calculator, climate change was predicted to have negligible impact over the next 10 years, but over the long-term its impacts could be significant (Appendix 1).

Climate change has the potential to impact the Black Swift indirectly and directly. First, and probably most significant, is the possibility that warming trends will result in changes in insect prey phenology or peaks of abundance that may affect survival or breeding performance of Black Swifts. The temporal mismatch between peak numbers of invertebrates and chronology of breeding has been investigated in some bird species. In Great Tits (*Parus major*) in the United Kingdom, birds do not seem to be able to quickly adapt to changing phenology of caterpillar abundance in response to climate warming (Visser *et al.* 2006). In Tree Swallows, the start of egg-laying was related to flying insect biomass during the laying period and not to the timing of the seasonal peak in food supply (Dunn *et al.* 2011). Earlier breeding Tree Swallows have larger clutches and fledge more young, so with warming trends the timing of egg-laying is now on average nine days earlier than in the 1950s (Dunn *et al.* 2011). It is not known whether the onset of the breeding season in Black Swifts has changed over time or whether there have been changes in insect phenology that might affect the species.

Climatic warming could also influence the phenology of aerial insect flights that may be critical for Black Swifts during the breeding season, particularly during incubation and chick-provisioning. While Black Swifts are pre-adapted to exploiting an ephemeral and unpredictable food source, temporal and spatial changes in insect abundance due to climate change could affect reproductive success of swifts. For example, Carpenter Ants overwinter as reproductives and emerge in the spring (Hölldober and Wilson 1990; Lindgren 2013). The timing of their reproductive flights may be critical to Black Swifts attaining pre-breeding condition. Other ants in the genus *Formica* have reproductive flights in mid-summer (Higgins pers. comm. 2013) and these could be important for provisioning of Black Swift chicks. Changes in the phenology of flights in relation to warming temperatures could have repercussions for Black Swift breeding success.

Second, climate change is predicted to decrease glacier ice extent and change the rate of annual snow pack melt, meaning that there is reduced snowmelt in the spring to maintain stream flow at mountain nest sites (NABCI, US Committee 2010; Mahony pers. comm. 2014). The rate of annual snow pack melt may occur earlier in the spring and in addition, shifts in winter precipitation from snow to rain are predicted, meaning that snow packs have less volume and that spring release of water will be lower (Mahony pers. comm. 2014). For example, in Glacier National Park, Dan Casey (in Marks and Casey 2004) failed to relocate a Black Swift nesting site at a waterfall first recorded in July 1962 (Hunter and Baldwin 1972). They suggested that reduced water flow, because of reduced ice from glaciers, may explain the disappearance of this waterfall. More generally, climate warming will reduce stream flow, which will result in habitat change (e.g., forest species composition and structure) and could affect invertebrate biomass. Moreover, warming temperatures could influence the moisture and humidity levels critical to the microclimate of Black Swift nest sites (Gunn *et al.* 2012).

The periodicity and frequency of storms and flooding are also predicted to increase with climate change (Environment Canada 2006; Solomon *et al.* 2007). While storms could create new habitat for Black Swifts, including nest sites (e.g., through avalanches, etc.), they could also destroy existing suitable nest sites.

Severe cold/wet weather is known to cause mass mortality in various aerial insectivores (Newton 2007), including swifts (e.g., COSEWIC 2007). The frequency or severity of extreme weather events could increase with climate change. Generally, swifts and swallows seem to be susceptible to mass mortality caused by extreme weather, because it leads to hypothermia and starvation (e.g., Cucco *et al.* 1992; Martins and Wright 1993; Butler 2000; Kolunen and Peiponen 1991; Newton 2007; Ramaskrishnan *et al.* 2013). Newton (2007) listed three specific time periods during which migrants may be most vulnerable: 1) storms or other adverse weather on migration; 2) cold, wet spells in the spring that could cause mortality or adversely affect breeding success; and 3) unseasonable cold weather prior to autumn migration from the breeding areas.

Little is known of the effects of the El Niño-Southern Oscillation (ENSO) or North Atlantic Oscillation (NAO) on aerial insectivores, but Rajchard *et al.* (2006) found a relationship between the NAO and Common Swift breeding success. Garcia-Perez *et al. (*2014) found relationships between both ENSO and NAO and the annual survival rate of Barn Swallows in Washington State. However, weak support was found for ENSO effects on survival probabilities of Purple Martin (*Progne subis*) in Pennsylvania (Stutchbury *et al.* 2009).

Moreover, survival of House Martins and Common Swifts in Italy has been linked to the winter Normalized Difference Vegetation Index (NDVI) in the wintering areas in Africa (Ambrosini *et al.* 2012). An index of primary productivity, the NDVI is believed to determine secondary productivity, including the abundance of flying insects, which in turn influences winter mortality in aerial insectivores. Further evidence that the survival of aerial insectivores is influenced by weather in the non-breeding areas comes from swallows and martins in the United Kingdom, where survival is linked to rainfall in the non-breeding areas in Africa (Robinson *et al.* 2008).

Number of Locations

As a complete inventory of all nesting sites is not available in Canada, the number of locations cannot be estimated. However, there would clearly be many more than 10 locations, given that each breeding location (nesting colony) would be defined by a separate threatening event.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

Black Swifts and their nests are protected by the *Migratory Birds Convention Act* (1994). Birds breeding in National Parks are also protected by the *National Parks Act*.

Non-Legal Status and Ranks

According to NatureServe, Black Swift is considered apparently secure globally (G4) and apparently secure nationally in the United States (N4) and Canada (N4; NatureServe 2013). The global rank and the US national rank were last reviewed in 1996; Canada's national rank was reviewed more recently (2011).

Despite its national status of 'apparently secure' in the US, the Black Swift is listed as critically imperilled (S1) in Idaho and Montana, and as imperilled (S2) in Alaska, California, New Mexico, Oregon, Utah, and Wyoming. It is vulnerable (S3) in Colorado and Washington. The species is unranked in Alberta (SU), and while it is considered apparently secure in British Columbia (S4) this status is currently under review.

The Black Swift is considered a continental Watch List species by Partners in Flight and the National Audubon Society (Berlanga *et al.* 2010) and is listed as Special Concern by many bird conservation region and state bird conservation plans. IUCN lists the species as of Least Concern (BirdLife International 2014), and it is a bird of conservation concern in the United States (USFWS 2008). It is yellow-listed in British Columbia (Government of British Columbia 2013).

Habitat Protection and Ownership

Some Black Swift breeding sites in Canada occur within National Parks, but most do not occur within protected areas. The ones in protected areas include Banff National Park, Jasper National Park (Holroyd and Holroyd 1987) and Kootenay National Park (Rogers pers. comm. 2013). The nest site in Banff National Park occurs in an area classified as Zone II Wilderness and is further designated as “declared wilderness,” even though the canyon receives over a hundred thousand visitors each year (Lepitski pers. comm. 2015). Maligne Canyon in Jasper National Park is considered protected and managed (Nantel pers. comm. 2014).

In British Columbia some Black Swift breeding sites occur in Provincial Parks such as the recently discovered site at Brandywine Falls Provincial Park. The Redemption Cave site is in the vicinity of Bowron Lake Provincial Park, and the site at Quesnel Lake occurs near three provincial parks: Bowron Lake, Cariboo Mountains and Wells Gray.

Levad (2010) listed three confirmed and eight probable breeding sites for British Columbia. They include: 1) Clinton, Cariboo Region (1958 – Beebe 1959); 2) Harland Creek Falls, Vernon, Okanagan (1964-1976? – Grant 1966, one nest); 3) Quesnel Lake, north arm (1954, nesting colony – Jobin 1955); 4) Kleena Kleene (Jobin 1955); 5) Marble Canyon Falls (Kootenay National Park, 1996, adults feeding young); 6) Redemption Cave, in the vicinity of Bowron Lake Provincial Park (2001, one nest, one dead juvenile swift); 7) Cascade Falls (2003, one nest); 8) Brandywine Falls (2004, one adult seen on nest). Nest record cards are available for many of these sites pre-1990 (Chutter pers. comm. 2013; Ramsay pers. comm. 2013).

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BIOGRAPHICAL SUMMARY OF REPORT WRITER

Dr. David Anthony Kirk is a consulting research ecologist and has worked for 25 years with the federal and provincial governments of Canada as well as non-government conservation organizations. He has always been fascinated by enigmatic bird species. He has a wide range of ecological and land use experience in different ecosystems ranging from tropical to arctic. His company (*Aquila Conservation & Environment Consulting*) specializes in science-based projects to inform the challenges of integrating human resource use with the conservation of biodiversity. This includes investigating the impact of human disturbance influences (especially agriculture and forestry) on biodiversity in anthropogenic landscapes, the application of species distribution models for use in spatial conservation planning, as well as state of the art literature reviews on current biodiversity challenges. He focuses on publication of peer-reviewed scientific articles in ecological and conservation journals as a forum for informing policy and management practice; reflecting this, David has written and/or co-authored more than 30 scientific papers and book chapters in the last 20 years. David also works extensively on the status, recovery and management of species at risk. He has written and/or co-authored 28 COSEWIC status reports and updates, as well as 9 draft recovery plans, 6 action plans and 9 management plans for species at risk, and a draft multispecies action plan for grasslands in southeastern Saskatchewan.

Appendix 1. IUCN Threats Calculator for the Black Swift.

Species or Ecosystem Scientific Name	Black Swift
Date (Ctrl + ";" for today's date):	01/11/2013
Assessor(s):	David Kirk, David Fraser, Julie Perrault, Dick Cannings, Jason Beason, Carolyn Gunn, Kim Potter, Geoff Holroyd

		Level 1 Threat Impact Counts	
Threat Impact		**high range**	**low range**
A	Very High	0	0
B	High	1	0
C	Medium	0	1
D	Low	0	0
Calculated Overall Threat Impact:		High	Medium

Threat		**Impact (calculated)**		**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
2	Agriculture & aquaculture		Negligible	Negligible (<1%)	Slight (1-10%)	Low (Possibly in the long term, >10 yrs)	
2.1	Annual & perennial non-timber crops		Negligible	Negligible (<1%)	Slight (1-10%)	Low (Possibly in the long term, >10 yrs)	May have longer term issues with this issue not captured here. Generally findings indicate that aerial invertebrates have lower diversity and abundance in homogenized agricultural landscapes. However, agricultural land is a small component of Black Swift range during breeding. K. Potter suggested that most of the area in the western Amazon basin where swifts from Colorado overwinter has not been developed - and has low road density (dirt roads etc.). There is much more extensive development in the eastern Amazon basin (see maps in Soares-Filho *et al.* 2006). However, there is a possibility that swifts from Canada overwinter in a different area that is affected by this factor. The other recent sighting of Black Swift in South America was in Tambopata National Reserve in Peru - which is within the kernel areas of the wintering birds from Colorado.
2.3	Livestock farming & ranching		Negligible	Negligible (<1%)	Slight (1-10%)	High (Continuing)	
3	Energy production & mining						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3.3	Renewable energy						Although no Black Swifts have apparently been killed by wind turbines, mortality has occurred in other swift species. For example, Vaux's Swifts and White-throated Swifts were killed by wind turbines in Washington and Oregon (Johnson and Erickson 2011). Compared to other bird species (particularly passerines and raptors) the numbers of individuals that would be killed is quite low, perhaps partly because of the height at which swifts generally forage and also because of their flight speeds and maneuverability. Recent information suggests that much larger numbers of birds (and bats) are killed by wind turbines than has previously been estimated (Smallwood 2013). However, compared to other threats to Black Swifts, this would be considered of low impact.
4	Transportation & service corridors		Negligible	Negligible (<1%)	Slight (1-10%)	High (Continuing)	
4.1	Roads & railroads		Negligible	Negligible (<1%)	Slight (1-10%)	High (Continuing)	Infrastructure also causes habitat loss and fragmentation which could cumulatively affect invertebrate food supply for swifts. It also affects run-off and thus could affect water supply to swift nesting sites. However, most Black Swift colonies are in remote areas, and often roadless.
4.2	Utility & service lines		Negligible	Negligible (<1%)	Slight (1-10%)	High (Continuing)	(same as roads) Except that effects not 'severe' but negligible.
5	Biological resource use		Unknown	Small (1-10%)	Unknown	High (Continuing)	
5.3	Logging & wood harvesting		Unknown	Small (1-10%)	Unknown	High (Continuing)	Deforestation on the breeding areas could affect aerial invertebrate biomass - generally extrapolating from agricultural areas, more homogeneous landscapes have lower aerial invertebrate biomass and food supply for aerial insectivores. It may depend on the type of logging - over time removal of older trees could affect invertebrate numbers, if average stand age decreases. It has been shown that ant nest densities in British Columbia are higher where large wood structures (trees, logs, stumps) occur and since ants are thought to be an important component of Black Swift diet, logging (which reduces wood volume) may have a negative effect. Also there could be an impact on hydrology - increased run-off and pulse events. Initially logging could result in increased volume of stream flow but later flow could dry up. Lack of transpiration is another issue. These could affect stream flow at nest sites (water is a critical component at nesting sites) or invertebrate food supply. Deforestation is occurring on east slopes coastal range in BC. Also in Amazon basin but deforestation here may be an issue over longer term (not next 10 years).
6	Human intrusions & disturbance		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
6.1	Recreational activities		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	Human disturbance probably has a negligible impact but important to note that there are different types of disturbance (people walking on trails to rock climbing, caving). Some nest sites may be disturbed by rock climbers or cavers. Although rock climbing could be a threat (Remsen 1978), many nest sites are on wet, slippery and mossy substrates and so dangerous to climb. In Johnston Canyon, Alberta, some nests can be observed at eye level from the trail and swifts remain on the nest despite numerous passers-by (Jason Rogers, pers. comm. 2013). At one site in Johnston Canyon, a stick had apparently been thrown at the nest and was lodged in a crevice (Jason Rogers, pers. comm. 2013). (A thrown rock was reported to have destroyed a nest in southern California (Foerster 1987; Lowther and Collins 2002)). There is a possibility that people using flash photography to take photographs of Black Swifts nestlings could disturb nestlings, especially if they are near to fledging, and they could fall into the creek below (Jason Rogers, pers. comm. 2013). Johnston canyon on its own is only a small percentage of the Canadian population. Human disturbance is not believed to be a a threat to nesting birds here (as 1000s of people a day go through this site and birds seem unaffected). The nesting colony in Johnston Canyon is already precarious (1 breeding pair, failed in 2013) and the decline is not believed to be related to disturbance since birds were already nesting there in the 1970s and construction equipment, including ropes on rock faces were installed and did not apparently affect the birds. In BC British Columbia Caving Club have reported some Black Swift sites. However, most caves/canyons are remote and in roadless areas.
7	Natural system modifications		Unknown	Unknown	Unknown	High (Continuing)	
7.2	Dams & water management/ use		Negligible	Negligible (<1%)	Extreme (71-100%)	Moderate (Possibly in the short term, < 10 yrs)	Effect uncertain (how many proposals are accepted) If dams built, effect would likely be extreme.
7.3	Other ecosystem modifications		Unknown	Unknown	Unknown	High (Continuing)	pine beetle kill included here as an ecosystem change - logging and forest cover issues? - would include timing and abundance of aerial insects which won't likely drive change in Black Swift abundance over next ten years. On the other hand, we do not know where swifts breed or what their foraging radius is and Mountain Pine Beetle has affected vast areas, in addition to salvage logging and effects on land cover and runoff. Policy of removing old mature trees could affect life cycle of insects that Black Swifts depend on.
9	Pollution	BC	High - Medium	Pervasive (71-100%)	Serious - Moderate (11-70%)	High (Continuing)	

Threat		**Impact (calculated)**		**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
9.5	Air-borne pollutants	BC	High - Medium	Pervasive (71-100%)	Serious - Moderate (11-70%)	High (Continuing)	Effect of pesticides is widespread. Decline in Black Swift numbers could be due to shifts in insect abundance and timing/phenology (this may possibly have a bigger impact). The consensus was that pesticides could have impact over next 10 years (severe to moderate) but really unknown. It could be as high as 70%, but telecom participants were happier with 'unknown'. Although agriculture occurs in relatively small part of Black Swifts breeding range - airborne pollutants can be detected at great distances from the original source and have impacts over large geographical areas. Despite their different life histories and geographic distributions, aerial insectivores are declining as a group. One common threat that has been identified but not proven is the role of insecticides. In particular there has been concern over the Neonicotinoid insecticides which have extremely high toxicity to invertebrates (e.g., believed to have decimated bee populations; they have also recently been shown to interfere with behaviour of ant species). These pesticides are very likely to affect other invertebrates too and thus they could have an indirect food-mediated impact on Black Swifts, but could also cause direct mortality.
11	Climate change & severe weather		Negligible	Pervasive (71-100%)	Negligible (<1%)	High (Continuing)	
11.1	Habitat shifting & alteration						this was dealt with in ecosystem change
11.2	Droughts		Negligible	Pervasive (71-100%)	Negligible (<1%)	High (Continuing)	Over the longer term this could be a larger threat to this species. Effect on invertebrate biomass will be notable here. Drought could also affect stream flow which could affect the suitability of nest sites for breeding but this was viewed as a potential threat over the long-term (outside the 10 year timeframe)

Threat		**Impact (calculated)**		**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
11.3	Temperature extremes						With warming trends, warmer winters may increase insect survival; hotter summers may shift things early and make more food available? If warmer winters result in increased survival this could have knock on effects on insect phenology. The timing of Black Swift breeding may have evolved to coincide with phenology of invertebrate populations (e.g., early summer emergence or nuptial swarming of ants) and there may be a mis-match. This may not be an issue over next 10 years but will definitely cause issues in the longer term (potential impact will be higher - see climate models). It is questionable whether or not it may be an issue in the next 10 years since the rate of climate change may be increasing. Moreover, there are some data to suggest that phenological changes in response to warming can occur within a relatively short time period. There are also data from some bird species that show that they cannot adapt as rapidly to changes in climate as can invertebrates.
11.4	Storms & flooding		Unknown	Restricted (11-30%)	Unknown	Moderate (Possibly in the short term, < 10 yrs)	Effects are likely to be very local (ie. One stream); later spring storms are more frequent; insectivore might be affected if storms move into summer (food supply).