

COSEWIC
Assessment and Status Report

on the

Band-tailed Pigeon
Patagioenas fasciata

in Canada



SPECIAL CONCERN
2008

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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COSEWIC Assessment Summary

Assessment Summary – November 2008

Common name

Band-tailed Pigeon

Scientific name

Patagioenas fasciata

Status

Special Concern

Reason for designation

This large pigeon has suffered long-term declines throughout its range in the western mountains of North America, due in part to overhunting. Harvest has been severely limited in Canada for the past 16 years. Although population surveys (e.g. Breeding Bird Survey and mineral site counts) have low precision, they do suggest a stabilization of the population in the last decade. The species is long-lived (up to 22 years) and has a slow reproductive rate; females typically lay only one or two eggs per year. Forestry may negatively affect habitat in the long term, creating dense second-growth forests with few berry-producing shrubs; the pigeons also are susceptible to disturbance at isolated mineral sources needed for their nutrition.

Occurrence

British Columbia

Status history

Designated Special Concern in November 2008. Assessment based on a new status report.



COSEWIC
Executive Summary

Band-tailed Pigeon
Patagioenas fasciata

Species information

The Band-tailed Pigeon is a largish (40 cm long and 350 g) pigeon. It is dark overall, with a purple-grey head and distinctive white crescent on the hindneck. In flight the tail appears dark with a lighter grey band across the tip. The bill (with black tip), feet and legs are yellow. One subspecies occurs in Canada: *P. f. monilis* Vigors 1839. This subspecies is referred to as the Pacific Coast race.

Distribution

The Band-tailed Pigeon breeds in western regions of the Americas from coastal British Columbia to northern Argentina. In Canada, the breeding range of the Band-tailed Pigeon is restricted to British Columbia, mainly on the south coast. Its range in British Columbia expanded northward along the coast and eastward into the Southern Interior in the 1980s, but it has since largely disappeared from the Interior. Most of the Canadian breeding population winters in California, but a few remain for the winter in British Columbia.

Habitat

In British Columbia, the Band-tailed Pigeon breeds from near sea level to 760 m elevation in edges and openings in mature coniferous, mixed and deciduous forests, city yards and parks, wooded groves, open bushland, golf courses and orchards. In the Interior, it occurs in montane forests. Mineral sites are critical seasonal habitat as sources of sodium. Areas with flowering and berry-producing trees and shrubs provide foraging habitat.

Biology

Band-tailed Pigeons are long-lived birds with low annual reproductive potential. Clutches usually contain one egg but some pairs may nest twice each year. Pairs nest solitarily and are dispersed across the landscape. Local breeding populations may aggregate at good foraging sites and mineral sites. Large flocks (50-200) form in late summer prior to the southward migration. Individuals are dependent on mineral sites as a source of sodium.

Population sizes and trends

Population sizes in Canada and elsewhere are unknown. The Canadian population has been estimated to be 2,500-10,000 mature individuals by some, but those numbers are not based on any population census. Mark-resighting data from mineral sites suggest several tens of thousands or more is a reasonable estimate of current populations in Canada. Extrapolations from Breeding Bird Surveys suggest that there are between 43,000 and 170,000 birds in Canada, but these are not precise or robust estimates.

Once much more abundant in western North America than at present, the Band-tailed Pigeon has undergone several periods of decline, although data for significant historical (prior to 1960s) declines are all from the USA. All indicators of populations (anecdotal reports, harvest statistics, counts, BBS) suggest long-term declines from the 1960s through the early 2000s, and BBS data in particular show a significant decline of 11.2% per year over the last 3 generations (18 years). Unfortunately BBS data have low power and precision for this flocking species. The causes of historical continental declines are uncertain, but excessive harvest in the USA is thought to be a major cause. Habitat loss is likely a contributing factor in Pacific Coastal population declines. A recent survey method using counts at mineral sites is proving to be adequate for short-term population trend estimation; it is now the standard population monitoring methodology and is showing an increasing trend in the Pacific Flyway over the last 5 years.

Limiting factors and threats

Limiting factors include low annual productivity (countered by high adult survival) and dependence on mineral sites. Threats within British Columbia include loss and degradation of breeding habitat and mineral sites through residential and industrial development, disturbance at mineral sites, chemical contamination at foraging and mineral sites, disease, and predation on nests by invasive species. Former additional threats to pigeons breeding in British Columbia but wintering elsewhere include inappropriate hunting regulations and behavioural attributes that make them vulnerable to hunters; but better regulations have removed this threat at present.

Special significance of the species

The Band-tailed Pigeon has a long history of importance in the old (prior to 1916) market hunting days as a bird harvested for food, and in the last 100 years as a game bird for sport hunters. Currently, few hunters pursue this pigeon in Canada, but it is observed with delight by bird watchers.

Existing protection or other status designations

Many nesting areas are protected in national park reserves, provincial parks, civic parks, watershed protected areas, and other forest reserves. Critical mineral sites in Canada are mainly privately owned (especially in agricultural and inland areas) and subject to changing land use. Mineral sites on federal (estuaries, marine beaches) or provincial and municipal lands are not specifically managed for Band-tailed Pigeons. North American populations are monitored and hunting regulations are scrutinized annually by wildlife managers in Canada and the USA so as to avoid overharvest.

The Band-tailed Pigeon is on the BC Blue List, is protected in BC under the *BC Wildlife Act*, and is protected in Canada by the *Migratory Birds Convention Act* (1994).



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 (2008)

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.



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

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SPECIES INFORMATION

Name and classification

Scientific name: *Patagioenas fasciata* Say 1823

English name: Band-tailed Pigeon

French name: Pigeon à queue barrée

Aboriginal name: Akoigh homin – Chinook (lower Columbia River, Washington), name described by Audubon (1827-1838)

Classification: Class – Aves
Order – Columbiformes
Family – Columbidae
Genus – *Patagioenas*
Species – *fasciata*

Classification follows the American Ornithologists' Union (AOU 2005). First described by Say in 1823 as *Columba fasciata*, the generic name was changed from *Columba* to *Patagioenas* in 2003 (Banks *et al.* 2003). There are two groups of Band-tailed Pigeon that have been considered in the past as separate species (AOU 1983): the *fasciata* group breeds from British Columbia south to Nicaragua; the *albilinea* group is resident from Costa Rica south to Argentina.

Vernacular names: Known as the Blue Rock by some due to its similarity to the Rock Pigeon (*Columba livia*) (Keppie and Braun 2000); some British Columbia hunters refer to this species simply as Wild Pigeon or Pigeon.

Six subspecies are recognized but are separated by morphology and geography, rather than genetics. One subspecies occurs in Canada, *P. f. monilis* (Vigors 1839). This subspecies is referred to as the Pacific Coast race (Braun 1994), but it also occurs in Interior British Columbia. This subspecies is dark and richly coloured compared with other subspecies (Keppie and Braun 2000) and was validated most recently by Gibson and Kessel (1997).

Morphological description

At 33-40 cm long and with a mean body mass of 342-364 g, the Band-tailed Pigeon is a relatively large member of the Columbidae (Keppie and Braun 2000). It is very similar in size and appearance to the Rock Pigeon (*Columba livia*), especially at a distance. The Band-tailed Pigeon is dark overall, with a purple-grey head and distinctive white crescent on a patch of iridescent green-bronze on the hindneck. Wings are dark greyish with very dark grey primaries. In flight the tail appears dark with a lighter grey band across the tip; hence the name "Band-tailed". Underparts are lighter grey. Bill is yellow with a black tip, except in the *albilinea* group in which it is all yellow. Feet and legs are yellow (Keppie and Braun 2000).

Sexes are similar in colour but females are duller than males. Adult males are up to 7% larger than adult females (Keppie and Braun 2000). Juveniles are similar to females but are duller and lack the white crescent on the hindneck (Sibley 2003). Flight is usually swift and direct. Wings produce a clapping sound on takeoff. Song is a deep, owl-like *hu-whooo, hu-whooo...* (Sibley 2000).

Designatable units

There is only one subspecies found in Canada and it is restricted almost entirely to one ecoregion.

DISTRIBUTION

Global range

The Band-tailed Pigeon breeds from southwestern British Columbia to northern Argentina, primarily in the western portions of the continents (Keppie and Braun 2000) (Figure 1; note this figure under-represents distribution in British Columbia). There are two disjunct breeding populations in North America, the Pacific Coast Population and the Four-Corner Population. The Pacific Coast Population (*P. f. monilis*) occurs from coastal British Columbia, the Georgia Depression of southern Vancouver Island and the lower Fraser River valley (and presumably the Interior of British Columbia) south along coastal Washington and Oregon and most of the mountainous areas of California; breeding may occur as far north as southeastern Alaska in some years. The Four-Corner Population (*P. f. fasciata*) spans along the Rocky Mountains in Utah, Colorado, Arizona and New Mexico, south through the Sierra Madre ranges of Mexico and the western mountain ranges of Central America. There is evidence of limited interchange between the two populations (Schroeder and Braun 1993).

Canadian range

In Canada, the breeding range of the Band-tailed Pigeon is restricted to British Columbia (Godfrey 1986; Campbell *et al.* 1990), but the Band-tailed Pigeon is a casual visitant to most provinces as far east as New Brunswick (Bell 1941; Wilson 1968; McLaren 1981; Adams and Krebs 1985).

In British Columbia, the Band-tailed Pigeon is an uncommon to locally abundant resident on the south coast, including southern Vancouver Island, becoming uncommon to a locally common transient farther north along the coast (Campbell *et al.* 1990). According to BBS data, highest numbers in British Columbia occur in the southwest mainland and on southern Vancouver Island (Figure 2). BBS data suggest that Band-tailed Pigeons are 2-3 times less abundant (birds/km of survey route) in British Columbia compared to the western United States (Keppie and Braun 2000), confirming a general trend to smaller numbers with increasing latitude within North America. It occurs rarely on the Queen Charlotte Islands. Across the southern Interior of British Columbia, it has been seen as far east as Sparwood and Mount Robson (Rocky Mountains), with more scattered sightings through the central interior north to Fort St. James and Hazelton (Campbell *et al.* 1990).

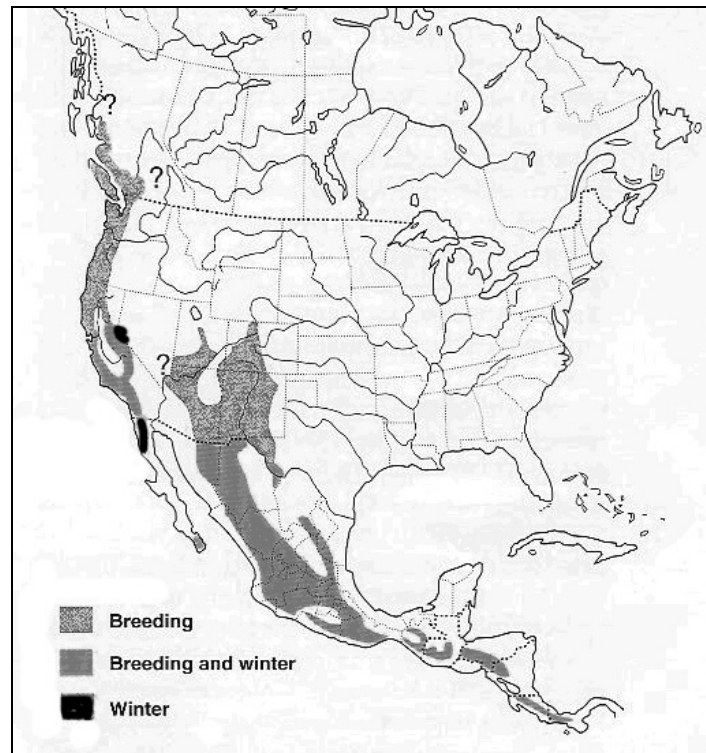


Figure 1. Distribution of the Band-tailed Pigeon in North and Central America; the species is also found in South America (see text for details; map modified from Keppie and Braun 2000).

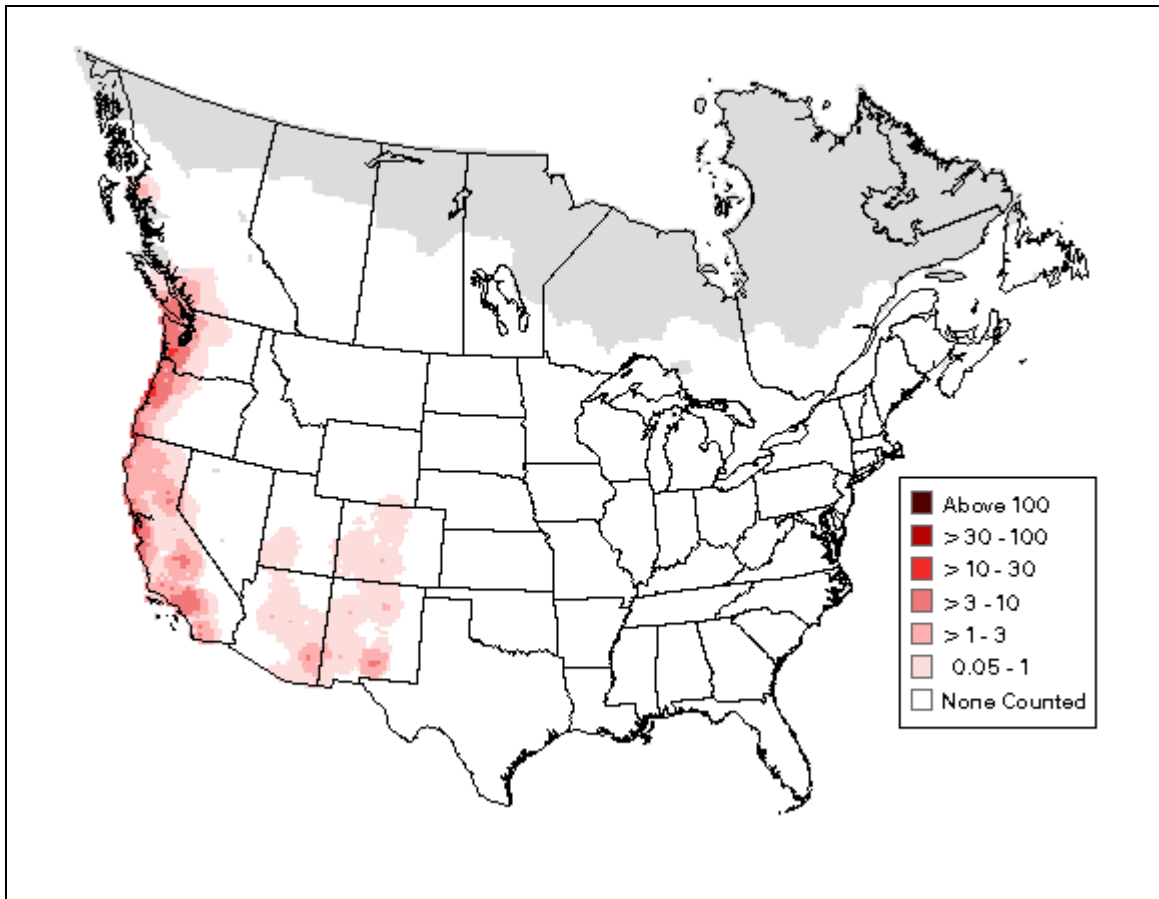


Figure 2. Distribution and relative abundance of the Band-tailed Pigeon from Breeding Bird Survey data, 1994-2003. Grey areas in northern Canada are not covered by the Breeding Bird Survey. Website: http://www.mbr-pwrc.usgs.gov/bbs/htm03/ra2003_red/ra03120.htm.

In British Columbia, the documented breeding range is much smaller than the extent of known occurrences. Confirmed breeding is limited to southern Vancouver Island and the southern mainland coast north to Alta Lake and west to Tofino (Campbell *et al.* 1990). Breeding populations are most abundant in the Georgia Depression Ecoprovince; almost all of 98 breeding records cited by Campbell *et al.* (1990) were from that ecoprovince. Band-tailed Pigeons typically nest as pairs scattered across suitable habitat, so there are no significant breeding aggregations in British Columbia. Records of breeding are largely lacking from the Interior, northern Vancouver Island, the central mainland coast and north coast. Note that Campbell *et al.* (1990) report the breeding range in British Columbia is much smaller than that shown on range maps in Godfrey (1986) and the American Ornithologists' Union (1983). It is very likely, however, that the Band-tailed Pigeon breeds in smaller numbers (than on the southwest coast) in local areas of the central and north coast and the western edge of the southern Interior of British Columbia.

The British Columbia population may have expanded its range northward and eastward since the first half of the 20th century (Campbell *et al.* 1990). In the first half of the 20th century, the Band-tailed Pigeon was known only as a summer visitor to the Gulf Islands, the Fraser Lowlands, and the Coast Range east to Spuzzum and north to Terrace (Munro and Cowan 1947). Small winter populations, first noticed by McTaggart-Cowan (1940), now occur regularly in local areas of the Georgia Depression, mainly in rural areas near agricultural areas or where stands of Garry Oak (*Quercus garryana*) and Pacific Madrone (*Arbutus menziesii*) occur (Campbell *et al.* 1990). Wintering numbers have declined in the past decade (Christmas Bird Count data). The first Okanagan Valley records were from the late 1960s (Cannings *et al.* 1987) but the species remains casual there. The expansion into the Southern Interior seems to have been only temporary; John Woods (pers. comm.) reports that the species appeared around Revelstoke about 1980 and became reasonably common in the Kootenays over the next five years, but he has seen none since 1990.

HABITAT

Breeding habitat

In coastal British Columbia, the Band-tailed Pigeon breeds from sea level to 760 m elevation. It typically breeds in natural and human-made habitats including edges and openings in mature coniferous, mixed and deciduous forests, city yards and parks, wooded groves, open bushland, golf courses and orchards (Campbell *et al.* 1990). Elsewhere in the Pacific Coast region, Band-tailed Pigeons inhabit predominantly temperate, coniferous rainforest from sea level to 300 m elevation (Keppie and Braun 2000). Various forest types and structural stages are used, particularly those which include Douglas-fir (*Pseudotsuga menziesii*), Sitka Spruce (*Picea sitchensis*), Western Redcedar (*Thuja plicata*), Western Hemlock (*Tsuga heterophylla*) and Red Alder (*Alnus rubra*) (Jeffery 1989; Braun 1994). Oak (*Quercus* spp.), including Garry Oak, as well as Pacific Madrone, are also thought to be important during breeding, particularly further south through to California (Keppie and Braun 2000).

More specifically, in southern Washington, mature Douglas-fir stands (95-190 years old) were preferred to wet old-growth (250-700 years) or young stands (55-80 years old) (Manuwal 1991). In southern Oregon, Band-tailed Pigeons were more abundant in mature (80-120 years old) and old-growth (200-525 years old) Douglas-fir forests, than in young forests (40-72 years old) (Carey *et al.* 1991). In Oregon, nests were in closed-canopied, conifer forests (69%); sapling or pole-sized stands (55%); in stands with 150-500 trees/ha (71%); 16-32 cm diameter at breast height (DBH) (69%); and on mid-slopes (59%) (Leonard 1998). Such details are lacking for British Columbia.

Little is known about habitats in interior parts of British Columbia except that Band-tailed Pigeons occur in montane forests (Campbell et al 1990). In the USA, the Interior region population nests in montane forests with highest densities occurring between 1,600 to 2,700 m elevation (Braun 1994). A variety of forests are used, but those dominated by Ponderosa Pine (*Pinus ponderosa*) and oak seem preferred; however, they are also found in Lodgepole Pine (*P. contorta*), Douglas-fir and spruce (*Picea* spp.) (Braun 1994; Keppie and Braun 2000).

Nest location and nest stand characteristics vary greatly across its range (Braun 1994). The nest is typically located on a sturdy tree limb, averaging 1.2 m from tree bole (range 0-7.1 m) and 8.9 m from the ground (range 1.8-54 m) (Keppie and Braun 2000). Tree species does not seem important for determining nest location. In the Pacific Coast region, at least 44 different tree species were used for nesting, 43% were located in Douglas-fir (Keppie and Braun 2000). In British Columbia, most nests (74%) were in coniferous trees, including Douglas-fir (33%), Western Redcedar (15%), Sitka Spruce (15%), Lodgepole Pine and Western Hemlock (n=31). All other nests (26%) were in deciduous trees including Red Alder, Pacific Crab Apple (*Malus fusca*), Paper Birch (*Betula papyrifera*) and beech. Nests were generally small, shallow platforms of loose twigs. Nests were 3-15 m from the ground; 69% were between 3-6 m, and typically located near the end of a horizontal branch (Campbell et al. 1990).

Band-tailed Pigeons require mineral sites where they drink mineralized water and ingest minerals encrusted on soils (Passmore 1977; Keppie and Braun 2000); they may also peck at salt licks on rangeland (Packard 1946). Mineral sites are typically water springs originating from underground sources where water comes in contact with and dissolves mineral deposits (Appendix 1). Use of mineral sites is most notable in Coastal populations, in Interior populations mineral needs may instead be satisfied by abrasion of highly basic grit (Braun 1994).

Band-tailed Pigeons show strong fidelity to mineral sites (Jarvis and Passmore 1992; Sander and Jarvis 2000). Almost all Band-tailed Pigeons (99%) are thought to occur within 50 km of a mineral site; in one California study, 65% of locations of pigeons with radio-transmitters were within 5 km of mineral sites and 90% were within 9 km (Casazza and Overton 2006).

Mineral sites along marine shores are almost always in estuaries (Sanders and Jarvis 2000; see Appendix 1 for a BC example). Mineral sites are almost always very small (area of pools or length of beach) relative to the surrounding similar area. Used mineral sites have more suitable cover (trees and shrubs) and are less frequently disturbed than unused sites with similar mineral concentrations (Sanders and Jarvis 2000). Mineral sites are likely the most sparsely distributed and critical habitat for Band-tailed Pigeons.

There are no data on home range size in Canada. Home ranges in California have been calculated to range from about 2000-6000 ha (Casazza *et al.* 2001); in Oregon they averaged about 11000 ha (Leonard 1998)

Winter habitat

In winter, Band-tailed Pigeons occur in both deciduous and coniferous woodlands, favouring open woods and edges where berries and oak acorns occur. In Canada, winter distribution overlaps with the distribution of madrone and Garry Oak, on the south coast of British Columbia, both of which are important winter food supplies (Campbell *et al.* 1990). The small Canadian winter population also freely uses backyard bird feeders.

Migratory habitat

In British Columbia, fall migrant Band-tailed Pigeons frequent open conifer areas adjacent to farmland, shoreline areas where mineral sites occur, riparian areas and suburban and residential areas where they frequent bird feeders and feed on acorns, fruit and berries. Railway yards, rail lines and farmyards where they feed on spilled grain and newly sown crops are also used (Campbell *et al.* 1990).

Migrant flocks use regenerating clearcut areas in managed forests, especially in late summer and early fall; logging practices may be creating suitable foraging habitat in otherwise unsuitable continuous coniferous forest. Migrant flocks are often observed perched in tall dead conifers near foraging areas.

Habitat trends

There are few data on how changes in agriculture and land-use practices may have affected the species (Keppie and Braun 2000). Band-tailed Pigeons use various forest successional stages for various purposes, but there is little quantitative information available on relationship to forest management activities and landscape patterns. Given widespread landscape changes over the past 50 years these relationships need much further investigation, particularly at landscape scales (The Nature Conservancy 2001).

Even so, it is clear that the massive conversion of low elevation forests to agriculture, urban and industrial environments in coastal British Columbia over the last several decades has removed substantial amounts of nesting habitat for Band-tailed Pigeons. As an indicator of the scale of change in habitat, on southeastern Vancouver Island and the Gulf Islands natural habitats were estimated to have been reduced by 80% (Ward *et al.* 1998) and Garry Oak ecosystems were reduced by 95% (Fuchs 2001) since European colonization. Symptomatic of ongoing changes in habitat in coastal British Columbia, several woodlots that contained nesting Band-tailed Pigeons in the 1960s and 1970s in the lower Fraser River valley are now industrial complexes or subdivisions and useless for Band-tailed Pigeons.

Band-tailed Pigeons are most noticeable in British Columbia when they aggregate at favoured feeding areas from spring through fall, or when they occur in relatively large flocks during the fall migration. These locations are typically in agricultural fields (e.g., Fraser River valley, Saanich Peninsula, Sidney Island, Metchosin) or in clearcuts where deciduous fruit-bearing shrubs are abundant (e.g., Nimpkish Valley, Brem Bay; Campbell *et al.* 1990). However, the suitability of these or other sites depends entirely on the quality of the food resource. In agricultural areas, it depends mainly on the crops available; in forested areas it depends on the abundance of arbutus berries, Garry Oak acorn crops, and the seral stage of cutblocks. Therefore, the suitability of any one site typically changes over time depending on rates of succession (for forests) or crops planted (in farmlands).

Habitat protection/ownership

Band-tailed Pigeons nest in individual pairs scattered across suitable habitat and there are no known significant breeding aggregations. A multitude of provincial parks, ecological reserves, and wildlife areas, national wildlife areas controlled by the Canadian Wildlife Service, national park reserves, Department of National Defence lands, municipal parks and reserves, and other protected areas undoubtedly provide habitat protection for a substantial number of breeding pairs. For example, of the 444 protected terrestrial areas in coastal British Columbia (Ministry of Environment 2006), many will provide habitat for Band-tailed Pigeons (Table 1). Alpine areas, rock bluffs and high-elevation areas in these protected areas would obviously be unsuitable.

Of 11 mineral sites (a critical habitat for Band-tailed Pigeons) described for British Columbia, four sites were marine mud flats, which are presumably controlled by the federal government. Of those four sites, adjacent perch trees were on private land (2), or controlled by municipal government. Four mineral sites were entirely on private land, two are on BC Crown land and one site is within a BC provincial park (Overton 2003).

BIOLOGY

Some aspects of the biology of the Band-tailed Pigeon have been well-studied compared to many other North American bird species. Research has been mainly prompted by wildlife management concerns related to hunting and population estimation (e.g., Neff 1947; Kautz and Braun 1981; Jarvis and Passmore 1992; Casazza *et al.* 1998), life history studies (e.g., Leonard 1998), and use of mineral springs (e.g., Passmore 1977; Sanders 1999). Much of the research on Band-tailed Pigeons in the 1970s focused on distribution, movement patterns, and local abundances as wildlife managers became aware of declining numbers (e.g., Schroeder and Braun 1993). Even so, the lack of understanding of this pigeon's biology has led to inappropriate harvest management regimes in the USA in decades past (Mathewson 2005).

Life cycle and reproduction

The Band-tailed Pigeon is likely socially monogamous, but few data are available (Keppie and Braun 2000). Length of the pair bond is unknown (Braun 1994). Pairing occurs early upon arrival on breeding grounds, or may form on winter ranges or during migration (Peeters 1962; Curtis and Braun 2000). Some late pairing may occur up to June; however, these are probably yearlings. Yearlings are capable of breeding but likely nest later than older birds (Keppie and Braun 2000).

Table 1. Protected areas in Vancouver Island and the Lower Mainland regions of coastal British Columbia with suitable habitat for Band-tailed Pigeons. (No assessment of the extent of suitable habitat or number of birds present is made for any area. For example, much of Garibaldi PP is alpine and unsuitable for Band-tailed Pigeons, whereas most of Indian Arm PP contains suitable habitat.)

Vancouver Island	Area (ha)	Lower Mainland	Area (ha)
Strathcona Provincial Park	122500	Garibaldi Provincial Park	194650
Brooks Peninsula Provincial Park	51631	Golden Ears Provincial Park	62540
Pacific Rim National Park	50000	Pinecone Burke Provincial Park	38000
Cape Scott Provincial Park	22294	Clendinning Provincial Park	30330
Carmanah Walbran Provincial Park	16450	Skagit Valley Provincial Park	27948
Tahsis Kwois Provincial Park	10972	Tantalus Provincial Park	11351
Schoen Lake Provincial Park	8430	Indian Arm Provincial Park	6826
Hesquiat Peninsula Provincial Park	6689	East Redonda Island Ecological Reserve	6212
Woss Lake Provincial Park	6634	Cypress Provincial Park	3012
Nimpkish Lake Provincial Park	3950	Spiipiyus Provincial Park	2979
Lower Tsitika River Provincial Park	3745	Inland Lake Provincial Park	2763
Clayoquot Arm Provincial Park	3491		
Clayoquot Plateau Provincial Park	3155	Cultus Lake Provincial Park	2561
Gowlland Tod Provincial Park	1219	Liumchen Ecological Reserve	2161
		Sasquatch Provincial Park	1217
		Bowen island Ecological Reserve	397
Total Area (ha)	311160	Total Area (ha)	392947

In North America, Band-tailed Pigeons breed mainly between March and September (Keppie and Braun 2000). The Band-tailed Pigeon may have multiple broods; two broods per season are not unusual in the USA, and three broods are possible depending on food availability (Baicich and Harrison 1997; Keppie and Braun 2000). In western Oregon, 81 radio-tagged birds had on average 1.69 nests/year; 54% initiated ≥ 2 nests/year and 10% had 3 successful nests/year (Leonard 1998). Autumn nesting in the USA is thought to be locally common if conditions are right, particularly if food is abundant (Zeigler 1971; Leonard 1998; Keppie and Braun 2000). In British Columbia, it is likely that experienced pairs could produce two broods. Evidence provided by March and Sadleir (1972, 1975) suggest two broods/year, but it is unknown how common that is.

Generally, earlier nesting occurs with decreasing latitude. In British Columbia, 51% of 27 nests were initiated between 1-29 May. Eggs could be found as early as 6 March (but this date is exceptionally early) and young in the nest could be found as late as 7 September (Campbell *et al.* 1990). Evidence from studies of internal organs showed a peak nesting cycle in early to mid summer in British Columbia (which contrasts with Campbell *et al.* 1990), at a time associated with the beginning of wild fruit crops (March and Sadleir 1972). Peak crop gland activity (which should coincide with feeding of younger nestlings) in British Columbia was found to occur in August (March and Sadler 1970), a much later date than expected by dates for eggs reported by Campbell *et al.* (1990).

Nests are flimsy, flat to saucer-shaped structures made of small, loosely intertwined twigs (Baicich and Harrison 1997). Nests are built mostly by the female over a 2-6 day period. Reuse of the nest is rare; distance between successive nests of radio-tagged birds averaged 657 m \pm 754 SD (range 10-3,712 m) (Leonard 1998).

Clutch size is typically one egg (Baicich and Harrison 1997); 95% in the Pacific Coast region had single eggs (n=219) (Keppie and Braun 2000). In British Columbia, 89% of 27 clutches had one egg and 11% had two eggs (Campbell *et al.* 1990). Both sexes incubate during a 16-22 day period (Baicich and Harrison 1997; Keppie and Braun 2000). Young are fed crop milk by adults, a curd-like substance formed in the lobes of the crop of both parents (Beams and Meyer 1931). The nestling period lasts 22-30 days (Baicich and Harrison 1997; Keppie and Braun 2000). In British Columbia, dates for 14 broods ranged from 15 April to 10 July with most occurring between 9-23 June; calculated dates for fledging were 24 March to 7 September.

There are few data available on nest success. In western Oregon, nest success (% of nests that \geq 1 young fledged) was 0.689; nest success did not seem dependent on nest commencement date (Leonard 1998). Estimated annual reproductive success in western Oregon was 1.26 immatures/pair (Leonard 1998).

Physiology, foraging and nutrition

The Band-tailed Pigeon eats plant material. Across its range, over 98% of its diet consists of grain seeds, fruits, oak acorns, pine nuts, and flowers and fresh buds of trees and shrubs (Neff 1947; Jarvis and Passmore 1992; Keppie and Braun 2000). There are no known diet differences between sexes or with immatures after leaving the nest (Keppie and Braun 2000).

Band-tailed Pigeons feed on the ground in open areas, particularly in agricultural lands, and in sparse to closed-canopied stands in fruit and nut-bearing areas (e.g., natural forests, orchards and semi-urban areas) (Keppie and Braun 2000). Diet changes seasonally. In general, Band-tailed Pigeons eat grains and seeds in spring, arboreal buds and flowers in early summer, berries and fruit in summer, and acorns and grains in autumn through winter.

During spring and early summer in British Columbia, the Band-tailed Pigeon may feed on waste grain in rail yards. By mid-June, the Band-tailed Pigeon switches to wild fruits (especially cascara and elderberries) once nesting commences (March and Sadleir 1972, 1975). Both wild and domestic fruits are taken, especially *Rubus* spp., *Prunus* spp., cascara (*Rhamnus purshiana*), madrone and elderberries (*Sambucus* spp.) (Keppie and Braun 2000). In September, on Vancouver Island, British Columbia Red Elderberry is a favoured food (J.M. Cooper unpub. data).

Band-tailed Pigeons feed intermittently throughout the day, but mostly during early morning (Braun 1976; Keppie and Braun 2000). They typically feed in small flocks, feeding on a single food source until depleted (a factor that makes them vulnerable to harvest, see Population Sizes and Trends), then moving on to a new food type or new location (Keppie and Braun 2000). If undisturbed, Band-tailed Pigeons generally feed to satiation. Full crops require considerable processing time, which may explain long roosting periods that typically follow feeding. In Colorado, Band-tailed Pigeons spent over 80% of the time either resting or preening while observed at bait stations (Curtis and Braun 2000).

Feeding areas may be some distance from nesting areas (Keppie and Braun 2000). In Oregon, 25 radio-tagged individuals travelled an average of 5.0 km \pm 7.4 SD to feeding areas located in riparian or moist bottomlands, maximum distance travelled was 51.6 km (Leonard 1998). Food availability affects timing and duration of nesting (Gutierrez *et al.* 1975) and probably nesting success (Braun 1994).

In British Columbia, mean body mass is 12-15% greater in early September than in mid-summer (March and Sadleir 1975), at a time just before fall migration. This suggests that birds “fatten” up before migrating southward.

Mineral requirements

Previously, it was believed that Band-tailed Pigeons were selecting mineral sites for calcium (March and Sadleir 1972; Jarvis and Passmore 1992; Braun 1994). During the breeding season, serum calcium is in high demand for egg development in females and in both sexes for crop milk that is fed to squab. However, mineral sites in western Oregon had, on average, lower amounts of calcium than many of the fruits that Band-tailed Pigeons fed on (e.g., elderberry and cascara) (Sanders 1999).

It is now believed that Band-tailed Pigeons may visit mineral sites in search of sodium (Sanders and Jarvis 2000). In mid-summer, individuals feed predominantly on fruits, which are generally low in minerals but high in potassium. The high potassium content of fruits may cause an electrolyte imbalance, which sodium could counter and neutralize. The potassium/sodium ratio increases about 5 fold when Band-tailed Pigeons switch from Red Elderberry to cascara. Since electrolyte balance is essential for cellular functions and osmotic/acid-base relationships (National Research Council 1994) and absorption and retention of sodium can be reduced by excessive potassium (Rugangazi and Maloiy 1988), mineral sites are essential for maintaining Band-tailed Pigeon physiology processes during seasons when potassium intake (heavy foraging on cascara berries) is high (Sanders and Jarvis 2000; Mathewson 2005)

In addition to the specific mineral content at mineral sites, Band-tailed Pigeons seem to use sites that have adjacent and available perch habitat, minimal development and human activity, and a tradition of congregation and use of the site (Sanders and Jarvis 2000; Casazza 2006). Mineral site visitation may be more common in the Pacific Coast region, than in the Interior, as summer diet may be more varied in the Interior and mineral-rich grit may be more abundant (Keppie and Braun 2000). Mineral sites are probably the most critical foraging habitats for Band-tailed Pigeons as they are used regularly (in British Columbia once every 7-15 days, A. Breault pers. comm.) but are in very limited supply (e.g., 1/3,846 km² in western Oregon, Sanders and Jarvis 2000). Curiously, they are not thought to be a limiting factor for the Pacific Coast region population by some researchers (e.g., Sanders 1999). In British Columbia, at least ten mineral sites have been documented (Casazza *et al.* 2002; Overton 2003).

Behaviour

The Band-tailed Pigeon is gregarious most of the time with flocks typically ranging from tens of birds to over 1,000 (Keppie and Braun 2000). While flocks of several thousand are not uncommon in parts of its range (Russell and Monson 1998), very few flocks of 1,000+ have been reported in Canada (Campbell *et al.* 1990). It is likely territorial during the breeding season as nests are well-dispersed (Curtis and Braun 1983).

The Band-tailed Pigeon is somewhat nomadic in response to food availability. Gathering at mineral sites may have social implications as well as satisfying physiological needs (Jarvis and Passmore 1992; Sanders 1999).

Survival and recruitment

Band-tailed Pigeons are relatively long-lived and annual survival is high (Keppie and Braun 2000) but all data are from the USA. Wild birds are known to have lived ≥ 22 years (Jarvis and Passmore 1992). Estimated mean annual survival rates for adults, calculated by banded bird recoveries, were 73% in Colorado (Kautz and Braun 1981) and 64% in Oregon (Jarvis and Passmore 1992). About 1/4 to 1/3 of most USA populations are juveniles or yearlings (Braun *et al.* 1975; Slosson and Goss 1982; Jeffrey 1989; Jarvis and Passmore 1992). There are no data on age structures available for British Columbia. Considering that birds often breed at one year of age and can live to be 20 years old, the mean generation time for an unharvested population is estimated to be 6 years.

Predation

Adult birds are taken by forest hawks (Sharp-shinned Hawk (*Accipiter striatus*), Cooper's Hawk (*A. cooperii*) and Northern Goshawk (*A. gentilis*)), large falcons (i.e., Peregrine Falcon (*Falco peregrinus*) and Prairie Falcon (*F. mexicanus*)) and Great Horned Owl (*Bubo virginianus*) (Keppie and Braun 2000). Beebe (1960) describes Peregrine Falcons associating with and "shadowing" large flocks of Band-tailed Pigeons in late August and September as they congregate in agricultural areas and edges of forest in the Puget Sound area.

Common Raven (*Corvus corax*), Steller's Jay (*Cyanocitta stelleri*), and tree squirrels (*Sciurus* and *Tamiasciurus* spp.) are likely the main predators of eggs and nestlings.

Dispersal/migration

Canadian Band-tailed Pigeons are mainly migratory although small numbers remain in British Columbia in winter (Campbell *et al.* 1990). Migration is thought to be mostly diurnal as large flocks have been observed during daylight, especially in autumn. Migration routes are unknown; however, birds are generally observed moving through forested areas and forest/agricultural borders (Keppie and Braun 2000).

It is believed that many British Columbian birds winter in the U.S. Pacific Coast states (Campbell *et al.* 1990), especially California. Of 57 band recoveries in British Columbia, 19 pigeons were banded in winter or spring in California, 22 in Oregon and 16 in Washington (Brewer *et al.* 2000). Data from band recoveries show movements of up to 1441 km for pigeons travelling between California and British Columbia (Brewer *et al.* 2000).

On the south coast of British Columbia, spring arrival typically begins in late February and continues through March and April; further north along the coast, migration continues into May. Spring migrants typically arrive in the Interior during late April through May. Fall migration on the coast begins in late August and peaks in September. In the Interior, most birds have left by late September, although stragglers may stay through November (Campbell *et al.* 1990).

In fall, flocks of up to 50 birds have been observed migrating over coastal subalpine areas on Vancouver Island (Martin and Ogle 1998). Vancouver Island populations seem to funnel southward in September to near Victoria, before crossing the Strait of Juan de Fuca. Daily counts at Rocky Point, just west of Victoria, from late July to mid-October show peak movements in September (Rocky Point Bird Observatory data).

The Band-tailed Pigeon shows fidelity to breeding areas as most studies in the USA found banded or radio marked birds returning to near initial capture sites (mainly mineral springs; Jarvis and Passmore 1992). Nesting birds tend to range about 15 km while foraging (Curtis and Braun 1983).

Diseases and parasites

Due to their flocking behaviour, Band-tailed Pigeons may be particularly susceptible to disease outbreaks (e.g., trichomoniasis; Stabler and Braun 1979). A Pacific Coast strain of trichomoniasis caused the deaths of 15,000-16,000 Band-tailed Pigeons in 1988 (Braun 1994). Band-tailed Pigeons may carry a number of parasites, but there are no data on effects on individual health or on populations (see review in Keppie and Braun 2000).

Adaptability

The Band-tailed Pigeon is somewhat adaptable based on its use of coastal and interior habitats and large range (British Columbia to South America). Habitats used for breeding vary markedly on a regional basis. Adaptability at more local scales is apparent with the use of new food resources (flowers and berries of deciduous shrubs) created by clearcut logging and nesting in treed suburban parkland. On the other hand, it seems very dependent on mineral sites in coastal regions.

POPULATION SIZES AND TRENDS

Search effort

No reliable population estimates are currently available (Keppie and Braun 2000) even though the need for a feasible population monitoring method was voiced as long ago as 1970 (Keppie *et al.* 1970). Populations are difficult to monitor because breeding habitat is widespread, breeding pairs do not aggregate, and a satisfactory inventory method is lacking (Keppie and Braun 2000). Population estimates were previously made from harvest reports, band recoveries (Braun 1994) and counts of singing males (Casazza *et al.* 1998). Population estimates based on harvest data were likely routinely overestimated in most cases (Mathewson 2005) and none of the above-mentioned methods are satisfactory. Breeding Bird Surveys provide data from a widespread region, but have low power and precision for this species (Casazza *et al.* 1998).

In recent years, population indices developed from annual counts at mineral licks showed promise as reliable indicators of population trends (Savage 1993; Sanders 1999; Casazza *et al.* 1998, 2002, 2005; Overton *et al.* 2006). This technique was piloted in British Columbia in 2001 when 2 mineral sites were surveyed weekly between June and September as part of a larger study that surveyed a total of 19 mineral sites in the Pacific Northwest (7 others in Washington and 10 in Oregon (Casazza *et al.* 2002). This survey method is now the standard method for monitoring Band-tailed Pigeon populations in the Pacific Flyway (A. Breault pers. comm. 2007). Three to four mineral sites in BC have been monitored by the Canadian Wildlife Service annually since 2002 (A. Breault pers. comm.).

Abundance

In the early 1970s, population estimates, calculated from harvest reports and band recoveries, were 2.9-7.1 million birds for the Pacific Coast region and < 250,000 for the Interior population (north of the Mexico border) (Braun 1994). In 1992, Pacific Coast region population estimates were revised to 2.4-3.1 million (USFWS 1996). Partners In Flight estimate 3.9 million Band-tailed Pigeons but only 25% of those (about 970,000) are in the USA and Canada (Rich *et al.* 2004); the remainder occur in Mexico, Central America and South America.

There are no accurate population estimates for British Columbia (Campbell *et al.* 1990, Canadian Wildlife Service Waterfowl Committee 2000). On Vancouver Island, populations were estimated to be about 3,500 birds in the mid-1980s (Bill Munro, BC Wildlife Branch, pers. comm. *in* Sadoway 1988), but that estimate was not based on surveys. The BC Conservation Data Centre (2007) estimates the BC population to be 2,500-10,000 individuals, but the basis for this number is limited to professional opinion. Partners in Flight (2004) estimates the BC population to be 200,000. The Partners in Flight estimate is based on Breeding Bird Survey data; a more recent estimate using this method produced figures of 43,000 to 170,000 birds depending on which detection distance figures were used (R. J. Cannings pers. comm.).

Counts of pigeon flocks with marked birds at mineral licks in the Lower Mainland (Table 2) can also be used to estimate population size. Because marked pigeons occurred only once every 7-15 days at these sites (A. Breault pers. comm.), the 2005 count of 725 pigeons at 4 mineral sites can be estimated to represent about 5,000-10,000 pigeons. If this is correct then the British Columbia population must be at least several tens of thousands.

In British Columbia, spring flocks of up to 1,000 birds, and summer/early fall flocks of 1,000-2,000, have been reported at single locations (Campbell *et al.* 1990). Flocks of 200+ birds in late summer are reported frequently from northern Vancouver Island (e.g., Nimpkish Valley from 1997-2003, J.M. Cooper unpubl. data) south through the Georgia Depression (Campbell *et al.* 1990). At Rocky Point, southern Vancouver Island, fall migrant flocks of 20-200 birds are seen daily in September (S. Beauchesne, Rocky Point Bird Observatory, pers. comm.). Relatively large numbers are also reported for late August from Vancouver Island by Mathewson (2005). These anecdotal observations, while interesting, are not useful for population estimation.

Table 2. Numbers of Band-tailed Pigeons observed between sunrise and 1200 hrs at mineral sites in British Columbia (A. Breault pers. comm.).

Year	Port Moody	Hatzic Lake	Chilliwack	Squamish	Sloquet	Total (All sites)	Total (4 sites)
2000							
2001	225	87	No data	136	134	582	582
2002	251	151	65	113	90	670	580
2003	35	61	48	44	69	257	188
2004	15	29	14	37	No data	95	95
2005	250	169	96	210	No data	725	725
2006	206	74	68	141	No data	489	489

Fluctuations and trends

Historical trends

The Band-tailed Pigeon was once much more common than it is today. Although never nearly as common as the Passenger Pigeon (*Ectopistes migratorius*), some anecdotal accounts talked of “millions of pigeons...like the wind blowing” (Wauer 1973). The veracity of this statement is uncertain, however. During the 20th century there have been 3 major periods of large apparent declines in North American populations: the early 1900s, mid-1900s and the 1970s. Although population estimates are lacking, evidence of these significant periodic declines is provided by concerns expressed by US biologists. Since Canadian Band-tailed Pigeons winter in the USA, events that occur there very likely impact Canadian breeding populations.

Potential causes for range-wide population declines remain hypothetical as none has been tested (Braun 1994). However, harvesting by hunters in the early and mid-1900s seems to have had profound implications on past and current Band-tailed Pigeon populations by reducing numbers significantly from time to time and then likely preventing recovery during years when harvest was at a more sustainable level. Band-tailed Pigeons were commonly harvested in the USA during market hunting days (Mathewson 2005) up to about the time of the *Migratory Bird Treaty Act* (1916). Band-tailed Pigeons were heavily harvested before 1916 especially during periods of superabundance due to events such as unusually high acorn crops. The first reports of declines were voiced by Chambers (1912, 1913, 1916) and Grinnell (1913) in response to an obvious overkill of pigeons in California in 1912. Hunting seasons were then closed in the USA from about 1913 to 1931 as a result of concerns for populations.

A severe crop depredation by an estimated 200,000 Band-tailed Pigeons in California in 1930 resulted in reopening of hunting seasons in the USA in 1932, but only after most of that flock had been killed (Mathewson 2005). The high harvest and re-opening of hunting seasons was noted as a significant problem for Band-tailed Pigeons by *Nature Magazine* (1932). By the 1940s, USA populations had apparently been severely reduced from previous eras by excessive harvest and poisoning (at the time farmers thought Band-tailed Pigeons caused damage to grain fields by eating broadcast seed and/or sprouts (Neff 1947; McMillan 1949) and were sometimes poisoned in large numbers (Mathewson 2005). The commonly held belief that Band-tailed Pigeons ate newly sprouted grains/peas was debunked by Canada's James A. Munro (1924 letter cited in McMillan 1949) after his study of the issue on Vancouver Island; but this finding was overlooked by most wildlife managers.

Concerns for populations due to excessive harvest in the USA were again voiced by Neff (1947), Morse (1950) and Einarsen (1953), following a large concentration of Band-tailed Pigeons in California in 1949 (McMillan 1949) and subsequent high harvest (e.g., McMillan 1949; Mears 1949). Similar concerns may have prompted Pearse (1940) to publish concern about Band-tailed Pigeons on Vancouver Island, BC. The height of harvest in the USA culminated in 1972 when about 724,000 pigeons were taken in Washington, Oregon and California during a year of heavy local acorn crops which concentrated birds (Jarvis and Passmore 1992). The 1972 harvest of about half the estimated population of the Pacific Coast Band-tailed Pigeon population made pigeons very scarce thereafter in most parts of their range (Mathewson 2005).

Current trends

Current trends are difficult to estimate for the same reason as populations are difficult to estimate. Breeding Bird Surveys (BBS) and harvest statistics data suggest long-term downward trends through to the early 2000s; however, none of these survey methods are entirely adequate for Band-tailed Pigeons (Casazza *et al.* 2002). It is clear that populations in the USA, at least, are greatly reduced from historical levels (BBS data; Jarvis and Passmore 1992; Braun 1994; Kirkpatrick and Conway 2005; Casazza *et al.* 2006).

Trends from Breeding Bird Surveys

BBS data are widely used to determine population trends of landbirds in Canada but have low power and precision for Band-tailed Pigeons (Braun 1994, Casazza *et al.* 1998). BBS data indicate a long-term declining trend in Canada over the last 40 years, but this is not significant because of fluctuations in the annual indices (Downes and Collins 2007, Table 3, Figure 3). The annual population trend over the last 3 generations from 1988 to 2006 was -11.2% ($p < 0.05$; C. Downes, pers. comm.), suggesting a total decline of 88% over that period. Long term BBS trends in the USA are negative but nonsignificant; the annual trend over the last 3 generations in the USA is 2.45% (USGS 2007, Table 3).

Table 3. Breeding Bird Survey trends for Band-tailed Pigeon. Canadian data from Downes and Collins (2007), US data from USGS (2007).

Location	Time interval	Annual trend estimate %	P value	No. of routes
Canada	1968-2006	-4.5	NS	33
Canada	1988-2006	-11.2	<0.05	30
United States	1968-2006	-0.64	0.46	202
United States	1988-2006	2.45	0.01	174

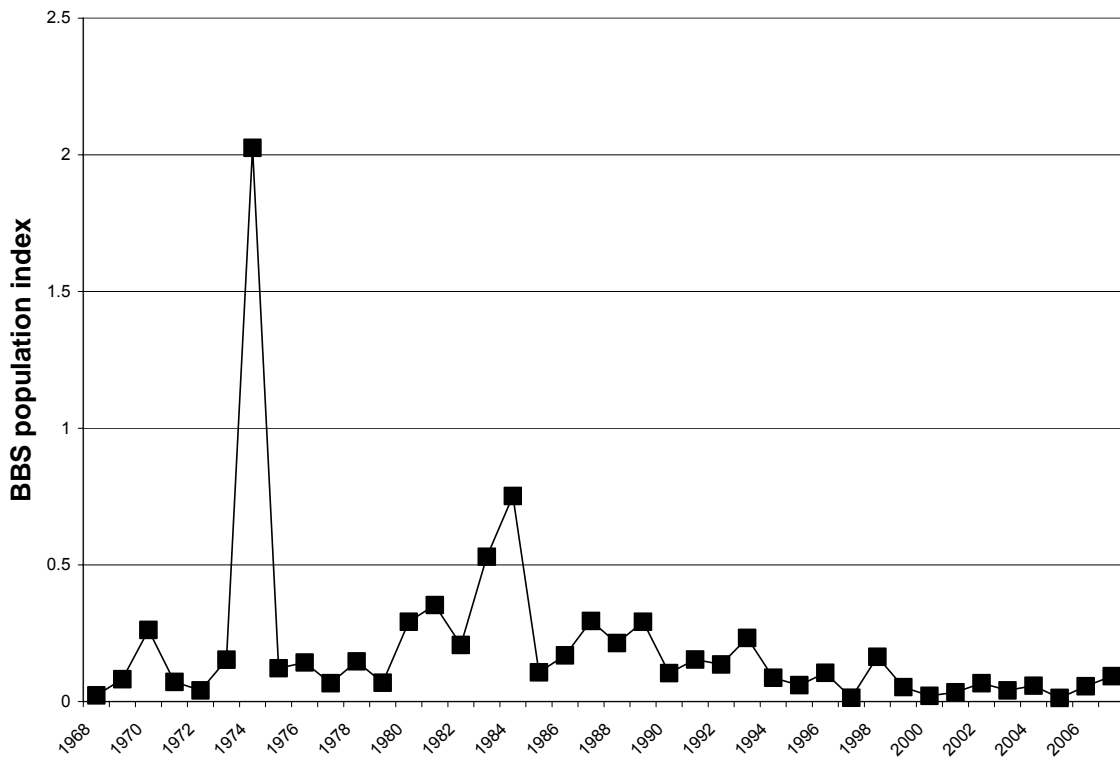


Figure 3. Annual population indices for Band-tailed Pigeon in Canada from the Breeding Bird Survey (Downes and Collins 2007).

Trends from Christmas Bird Counts

Wintering numbers in Canada are too small to produce a meaningful population trend. A recent analysis of continental CBC data generated an annual population trend of -0.31% over the last 40 years for USA and Canada combined (Butcher and Niven 2007).

Trends from harvest data

Harvest rates have declined markedly in the last few decades. In the three Pacific Coast US states, harvests dropped from 550,000 birds in 1968 to 70,000 in 1988 (Braun 1994). More recently, the total USA harvest was 24,400 in 1999, 20,900 in 2000 (USFWS 2006), 17,200 in 2003 (Canadian Wildlife Service Waterfowl Committee 2004), 20,700 in 2004 and 16,200 in 2005 (USFWS 2006b). In the Interior region of the USA, hunting surveys suggested a significant decline between 1968 and 1999: total number of hunters declined from 1129 to 161 and pigeon harvest fell from 2585 to 283 (Pacific Flyway Study Committee 2001).

In British Columbia, harvest declined from 14,000 in 1967 to fewer than 500 in 1991 (Braun 1994; Figure 4). In British Columbia, hunting seasons were closed in 1994 and reinstated in 2002. Few Band-tailed Pigeons were taken in 2002-2005 after hunting seasons were opened: an estimated 130 in 2005, 0 in 2004, 153 in 2003 and 188 in 2002 (Canadian Wildlife Service Waterfowl Committee 2003, 2004, 2005, 2006).

Reduced harvests were thought to be due in part to more restrictive limits and seasons, but also likely reflect smaller populations (Braun 1994; Pacific Flyway Study Committee and Central Flyway Webless Migratory Game Bird Technical Committee. 2001; Keppie and Braun 2000), in at least some areas. In British Columbia, although numbers harvested declined from the 1960s through the 1990s, success rate was higher during the mid-1980s to early 1990s than earlier (Cooper 2002; Appendix 2).

Trends from counts at mineral sites

Population indices developed from annual counts at mineral sites show promise as reliable indicators of population trends (Casazza *et al.* 2001; 2002; Lauridson 2005), but even this method has problems with consistency (Keppie and Braun 2000; Overton *et al.* 2005). However, current methods for counting Band-tailed Pigeons at mineral sites, including conducting surveys in July, adjusting survey days relative to recent rainfall, and assessing quality of adjacent perching habitat, have improved this survey method to the point where it is now the standard methodology for counting pigeons for trend estimation (Casazza 2006). This method is now used to estimate population trends under the Pacific Flyway Management Plan for Band-tailed Pigeons (A. Breault pers. comm.).

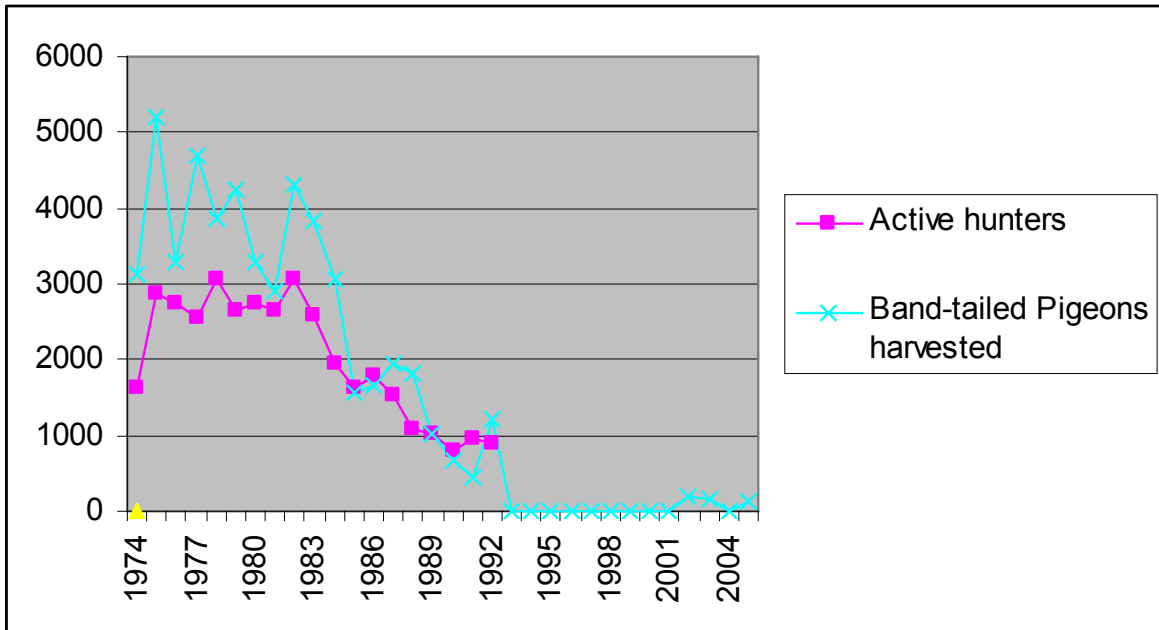


Figure 4. Number of Band-tailed Pigeons harvested in British Columbia, 1974-2005. Note that the number of hunters refers to non-waterfowl migratory bird hunters (snipe, pigeon, dove) across the entire province, so is not a precise estimate of pigeon hunters.

Range-wide (including BC) trend estimates for 2001-2005, based on mineral site surveys, indicated Band-tailed Pigeons increased approximately 11.5%/year, which was up from the 2001-2004 trend of 9.8%/year (Drut *et al.* 2006). Numbers of pigeons counted at mineral sites in British Columbia from 2001-2006 varied significantly between years but the 2006 count was about 16% higher than the short (2001-2006) term average (CWS data; A. Breault pers. comm.). It is interesting to note that the trend data from the BBS match this trend fairly closely (Figure 3).

Trends from range expansion

On a positive note, the British Columbia population seems to have expanded its range northward along the coast since the 1950s (Campbell *et al.* 1990). A similar expansion into the Interior took place in the 1980s, but the species has since largely disappeared from that area. The reasons for this expansion are not known, but may have resulted from at least temporary habitat changes conducive to the pigeon.

Rescue effect

Since most of the Band-tailed Pigeon population along the Pacific coast is in the United States, rescue effect for this migratory species is theoretically high. If hunting pressure is well managed in the USA and populations there continue to remain stable or increase, populations in Washington state could provide a source of birds for Canadian populations.

LIMITING FACTORS AND THREATS

Habitat degradation and loss

Habitat degradation and loss is an ongoing threat to Band-tailed Pigeons in North America and throughout their range (e.g., Panama - Ridgley and Gwynne 1989; Colombia - Hilty and Brown 1986), especially if food availability is affected (Braun 1994). In Canada, development of 2nd-growth mixed forested lands in the Fraser River valley and southeast Vancouver Island for urban/industrial purposes has undoubtedly resulted in loss of breeding habitat in recent decades (Cooper 2002). However, since opening up of old-growth coniferous forest is likely positive as long as a variety of seral stages are available (Marcot 1984; J. Cooper unpub. data), original logging of the southwest BC coast may have been advantageous for Band-tailed Pigeons in the mid-to late 19th century when the first European settlements were established.

Recent Pacific Coast population (mainly USA) declines are thought by some to be related to widespread habitat alteration due to forestry practices in the latter part of the 20th century, in particular replacement of more structurally variable old-growth forests by even-aged stands, but this needs more empirical study (Hansen *et al.* 1991; Braun 1994; Sanders 1999; Sanders and Jarvis 2003). Forestry practices are a likely contributor to declines (Sanders and Jarvis 1997), especially when silviculturalists spray deciduous trees to promote conifer growth as loss of deciduous vegetation reduces foraging habitat (e.g., cascara trees) (Braun 1994; Mathewson 2005).

The suitability of mineral sites may be related to the presence of perch trees and other forest cover. Removal of that habitat feature may render mineral sites less suitable (Casazza 2006; Overton *et al.* 2006). The Hatzic mineral site is devoid of trees but is screened by marsh vegetation; pigeons using this site are particularly flighty and spend little time on the ground when visiting the site (A. Breault pers. comm.; Appendix 1). Most inland mineral springs may be on private lands and are thus vulnerable to development. One mineral site in BC along a gravel road was paved over recently and rendered unsuitable (CWS unpub. data).

Productivity

Band-tailed Pigeons have low annual reproductive potential (1-egg clutches, but may nest twice per year). Recovery of populations to former levels is hampered by this reproductive limitation.

Behaviour

Band-tailed Pigeons are known to fly in to good foraging areas or mineral sites even when repeatedly shot at. This behaviour, unlike with waterfowl which learn to avoid heavily hunted areas or to avoid hunters, in combination with their tendency to concentrate at good foraging areas makes the Band-tailed Pigeon unusually susceptible to harvest. This trait is not as limiting as it once was as hunting seasons and limits are now well-regulated.

Disease

Band-tailed Pigeons are susceptible to the protozoan parasite *Trichomonas gallinae* (Stabler and Braun 1979). A Pacific Coast strain of trichomoniasis is particularly virulent, and caused the deaths of 15-16,000 pigeons in 1988 (Braun 1994).

Disturbance

Disturbance at mineral sites is becoming an increasingly high concern (Casazza 2006; Overton *et al.* 2006). Some (20%) long-used mineral sites in Oregon are known to have been abandoned by Band-tailed Pigeons, likely largely due to human disturbance (Overton *et al.* 2006). In British Columbia, biologists counting Band-tailed Pigeons at mineral sites in the 2000s found regular disturbance (paving, regular presence of joggers, industrial activity, traffic, photographers) at some sites.

Hot springs used by Band-tailed Pigeons are especially vulnerable due to increasing use by humans. Anecdotal reports from hot spring users and landowners reported to Overton *et al.* (2006) indicate a general decline in use by Band-tailed Pigeons over the past several decades; all hot spring sites in Oregon have been abandoned by Band-tailed Pigeons. Some hot springs in British Columbia used by people were recently found to have low concurrent use by Band-tailed Pigeons (Overton 2003). One of the BC hot spring mineral sites had a road built to it recently and pigeon use was expected to decline because of easier access for humans (Overton 2003), although pigeons did concentrate in relatively high numbers by 2005/2006 at a nearby location (A. Breault pers. comm.).

Contaminants

The Band-tailed Pigeon is likely exposed to a wide range of chemical contaminants due to its use of agricultural areas for foraging and estuaries for mineral sites. There are few data on effects of chemicals but one study found >0.50 ppm mercury in pigeons exposed to grain treated with a fungicide with no obvious effect (Braun *et al.* 1977). Large-scale poisonings occurred in the past when foraging flocks were targeted specifically. Avicides are readily available to farmers and could be used against pigeons.

Industrial activities have polluted the marine environment (and mineral sites) in some places. For example, in Port Moody, BC, Port Moody Arm contains the Pigeon Cove mineral site and was determined to be an environmental hotspot in 1992. Pollutants there included cadmium, chromium, copper, lead, and zinc as well as organic compounds oil and grease hydrocarbons and polycyclic aromatic hydrocarbons originating from petroleum facilities. Polychlorinated biphenyls (PCBs, used to produce plastics, inks, paints and pesticides but banned since the mid-1970s) persist in low concentrations throughout Port Moody Arm) (Pacific Streamkeepers Federation 2003).

Invasive species

Introduced vertebrate predators pose a serious conservation threat to many bird species. Although unproven, it seems likely that rats (*Rattus* sp.), domestic cats (*Felis catus*) and Gray Squirrels (*Sciurus carolinensis*) may predate Band-tailed Pigeon nests in some cases.

Hunting

Like other long-lived birds with small clutch sizes (e.g., many seabirds), Band-tailed Pigeon populations are most susceptible to factors that affect adult survival, including mortality from hunting. Hunting is not currently a threat in Canada as hunting effort and harvest is very low, the hunting season is short (15 days), and the hunting season is set for a date after most Band-tailed Pigeons have left the country. Canadian populations are exposed to hunting in the USA; however, current harvest in the USA has been greatly reduced by shortened seasons and lower bag limits.

In past times, hunting mortality was excessive but current harvest rates of 1-2% (e.g., 14,400 from a Pacific Flyway population of ca. 1 million) are unlikely to affect populations.

Climate change and natural climate cycles

Climate change is likely to benefit Band-tailed Pigeons in Canada if Pacific Coast summers become longer and warmer, and coastal forests in British Columbia develop higher densities of madrone, Garry Oaks, and other pigeon food source plants.

SPECIAL SIGNIFICANCE OF THE SPECIES

Importance to people

The Band-tailed Pigeon has a long history of being sought after by hunters, both market hunters prior to about 1916 and sport hunters since then (e.g., Morse 1957). Pigeon hunting was a relatively popular hunting activity in the US Pacific Northwest states and some of the southwest interior states for many decades in the 20th century. In British Columbia, the history of Band-tailed Pigeon hunting is essentially unknown, but it was occasionally written about by outdoor writers (e.g. Cramond 1967). It likely mirrors that of the US but on a much smaller scale. In recent years, with hunting season closures, reduced seasons, and reduced hunting opportunity (Cooper 2002), Band-tailed Pigeon hunting in British Columbia has been reduced to a non-issue. When hunting seasons were closed in 1994, only one formal complaint was received by the BC Ministry of Environment (M. Chutter pers. comm.).

Band-tailed Pigeons are also popular with non-hunters. They are sought out by birders and photographers, and are occasionally seen at backyard feeders in urban areas.

Pigeon Cove, in Port Moody, BC is a popular park with considerable natural heritage remaining. Band-tailed Pigeons are known to use the cove as a mineral lick (Overton 2003) and the cove and nearby Pigeon Creek are likely named for the pigeons that occurred there in abundance in times past. Although we have not confirmed this, Band-tailed Pigeons were likely hunted there, as has been known for many other mineral sites documented by Mathewson (2005). Numbers in the area must have been formerly large as it is unlikely to be coincidence that the Band-tailed Pigeon is found on the Port Moody coat of arms and is the official bird of Port Moody (City of Port Moody 2005a,b).

Ecological role

The Band-tailed Pigeon is known to provide prey for a variety of raptors, but the Peregrine Falcon is the most frequently reported predator (Keppie and Braun 2000). Migrant and wintering flocks are known to concentrate foraging on specific sites where food is abundant and may influence foraging by other species that seek the same food if most of that food is consumed.

ABORIGINAL TRADITIONAL KNOWLEDGE

An Internet-based search for Aboriginal traditional knowledge (ATK) of Band-tailed Pigeon found little information. Some USA First Nations had names for the Band-tailed Pigeon and likely harvested them at times. No information was found for Canada.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

International conventions and agreements

Migratory Birds Convention Act, 1994

The *Migratory Birds Convention Act, 1994* (MBCA) is the updated statute that implements the 1916 Migratory Birds Convention between Canada and the United States.

Convention on International Trade in Endangered Species (CITES).

This species is not listed by CITES (2006).

Federal and provincial legislation

British Columbia Wildlife Act

Band-tailed Pigeons are protected under the *British Columbia Wildlife Act* (section 34).

Canadian national legislation

The Band-tailed Pigeon is protected under the *Migratory Birds Convention Act, 1994*. Except during legal hunting seasons, it is illegal to capture or kill the species without a permit.

Status designations

National and sub-national designations

The Band-tailed Pigeon is Blue-listed by the British Columbia Conservation Data Centre (BC CDC 2007). NatureServe ranks the Band-tailed Pigeon as G4 (Global) and S3S4B (British Columbia).

IUCN Red List

The Band-tailed Pigeon is listed (2001) by the IUCN as a species of Least Concern (IUCN 2006).

Partners In Flight

Partners In Flight has listed the Band-tailed Pigeon as a Priority landbird for the British Columbia portion of Northern Pacific Rainforest Bird Conservation Region (Partners In Flight BC 2006).

TECHNICAL SUMMARY

Patagioenas fasciata

Band-tailed Pigeon

Range of Occurrence in Canada: BC

Pigeon à queue barrée

Demographic Information

Generation time (average age of parents in the population)	6 yrs
Estimated percent reduction in total number of mature individuals over the last 3 generations.	88
Projected percent reduction in total number of mature individuals over the next 10 years.	Unknown
Observed percent reduction in total number of mature individuals over any 10 years-period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible?	Unknown
Are the causes of the decline understood?	Unknown
Have the causes of the decline ceased?	Unknown
Observed trend in number of populations	
Are there extreme fluctuations in number of mature individuals?	No
Are there extreme fluctuations in number of populations?	No

Number of mature individuals in each population

Population	N Mature Individuals
	20,000-170,000
Grand Total	20,000-170,000

Extent and Area Information

Estimated extent of occurrence (km ²)	95,000 km ²
Observed trend in extent of occurrence Expanded in 1980s into BC Interior, then contracted	Stable
Are there extreme fluctuations in extent of occurrence?	No
Estimated area of occupancy (km ²) Estimated as half of EO	47,000 km ²
Observed trend in area of occupancy	Stable
Are there extreme fluctuations in area of occupancy?	No
Is the extent of occurrence or area of occupancy severely fragmented?	No
Number of current locations	not applicable
Trend in number of locations	
Are there extreme fluctuations in number of locations?	
Observed trend in area of habitat Breeding habitat declining in the Lower Fraser River valley and southeast Vancouver Island, perhaps increasing in other coastal forests	Stable

Quantitative Analysis

	not done
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Threats (actual or imminent, to populations or habitats)

Habitat degradation and loss through conversion of forests to urban/industrial uses, silvicultural treatment, and conifer monocultures.

- Vulnerable to disturbance at mineral sites and loss of those sites.
- Susceptible to disease outbreaks.
- Behaviourally unsuited to high hunting pressure when aggregating at food sources or mineral sites but current hunting regulations seem to now accommodate this issue.
- Inhabit areas with sometimes high level of chemical contaminants (agricultural areas, estuaries) but no evidence of effects on individuals or populations.

Rescue Effect (immigration from an outside source)

Status of outside population(s)?

USA: Stable populations in the USA

Is immigration known or possible?

Yes

Would immigrants be adapted to survive in Canada?

Yes

Is there sufficient habitat for immigrants in Canada?

Likely

Is rescue from outside populations likely?

Likely

Current Status

COSEWIC: Special Concern

Designated Special Concern in November 2008

Status and Reasons for Designation**Status:**

Special Concern

Alpha-numeric code:

Not applicable

Reasons for designation:

This large pigeon has suffered long-term declines throughout its range in the western mountains of North America, due in part to overhunting. Harvest has been severely limited in Canada for the past 16 years. Although population surveys (e.g. Breeding Bird Survey and mineral site counts) have low precision, they do suggest a stabilization of the population in the last decade. The species is long-lived (up to 22 years) and has a slow reproductive rate; females typically lay only one or two eggs per year. Forestry may negatively affect habitat in the long term, creating dense second-growth forests with few berry-producing shrubs; the pigeons also are susceptible to disturbance at isolated mineral sources needed for their nutrition.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals):

Trend data have low precision.

Criterion B (Small Distribution Range and Decline or Fluctuation):

Not applicable. Distribution too large.

Criterion C (Small and Declining Number of Mature Individuals):

Not applicable. Population too large.

Criterion D (Very Small Population or Restricted Distribution):

Not applicable. Population and distribution too large.

Criterion E (Quantitative Analysis):

None available.

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Few biologists in Canada know much about the Band-tailed Pigeon and the report writer has relied a great deal on published literature and unpublished reports, most of it originating from the USA, for information presented in this report. André Breault of the Canadian Wildlife Service, and USA's Mike Casazza and Corey Overton are the only people studying the Band-tailed Pigeon in Canada, as far as the report writer is aware. The report writer owes a great deal to the efforts of these three dedicated biologists.

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Mark Nyhof provided the hard-to-get photo of a Band-tailed Pigeon on its nest for the cover.

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BIOGRAPHICAL SUMMARY OF REPORT WRITER

John Cooper is a leading ornithologist in British Columbia and has authored over 200 books, academic papers, technical reports, and popular articles on birds and other wildlife. John is a founding partner of Manning, Cooper and Associates Ltd, a consulting company with three offices in British Columbia. MCA specializes in biodiversity studies, forest biodiversity management and policy development, and environmental impact assessments. John is regularly consulted on the status and conservation of birds in British Columbia by the provincial and federal governments, industry, and NGOs. He is co-author of the reference books *The Birds of British Columbia* and has contributed to COSEWIC and conservation of species at risk as author or co-author of COSEWIC status reports for Peregrine Falcon, Northern (Queen Charlotte) Goshawk, Streaked Horned Lark, Spotted Owl and Black-footed Albatross. He has developed SARA Management Plans for Peale's Peregrine Falcon, Lewis's Woodpecker and Flammulated Owl. John has also been the lead or sole author of 12 BC provincial status reports on birds at risk. John is an active volunteer on the Garry Oak Ecosystem Recovery Team, which is leading recovery efforts for several extirpated or rare birds in southwestern British Columbia. John is also a long time hunter whose passion for wildlife was kindled by past generations of outdoorsmen and outdoorswomen.

COLLECTIONS EXAMINED

None.

**Appendix 1. Mineral sites used by Band-tailed Pigeons in British Columbia:
Port Moody (top), Hatzic (bottom).**



Appendix 2. Number of hunters, number of Band-tailed Pigeons (BTPI) harvested, and success rate for British Columbia, 1974-1992 (Canadian Wildlife Service harvest data; Cooper 2002).

Year	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Active hunters	1625	2867	2734	2564	3075	2642	2742	2656	3050	2579	1936	1623	1780	1545	1083	1009	785	965	898
BTPI harvested	3127	5200	3292	4684	3847	4244	3282	2896	4315	3839	3079	1577	1650	1934	1805	1036	675	457	1214
BTPI/hunter	1.92	1.81	1.20	1.83	1.25	1.61	1.20	1.09	1.41	1.49	1.59	0.97	0.93	1.25	1.67	1.03	0.86	2.11	0.74