COSEWIC
Assessment and Status Report

on the

Red-headed Woodpecker
Melanerpes erythrocephalus

in Canada

ENDANGERED
2018

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Previous report(s):

COSEWIC 2007. COSEWIC assessment and update status report on the Red-headed Woodpecker *Melanerpes erythrocephalus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 27 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Page, Annett M. 1996. COSEWIC status report on the Red-headed Woodpecker *Melanerpes erythrocephalus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-50 pp.

Production note:
COSEWIC would like to acknowledge Barbara Frei for writing the status report on Red-headed Woodpecker, *Melanerpes erythrocephalus,* in Canada, prepared under contract with Environment and Climate Change Canada. This report was overseen and edited by Marcel Gahbauer, Co-chair of the COSEWIC Birds Specialist Subcommittee.

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COSEWIC
Assessment Summary

Assessment Summary – April 2018

Common name
Red-headed Woodpecker

Scientific name
Melanerpes erythrocephalus

Status
Endangered

Reason for designation
This boldly-patterned woodpecker, which inhabits open deciduous forests, has experienced a substantial long-term population reduction. This decline is associated primarily with reduced quality of breeding habitat, particularly the loss of standing dead trees needed for nesting, fly-catching, and food caching. Other threats include increased competition for nest sites from native and non-native bird species. The Canadian population is now likely less than 6,000 mature individuals, almost all in Manitoba and Ontario. It appears to not be self-sustaining, and ongoing declines may accelerate given that numbers are also decreasing in adjacent parts of the U.S. range.

Occurrence
Saskatchewan, Manitoba, Ontario, Quebec

Status history
Designated Special Concern in April 1996. Status re-examined and designated Threatened in April 2007. Status re-examined and designated Endangered in April 2018.

COSEWIC
Executive Summary

Red-headed Woodpecker
Melanerpes erythrocephalus

Wildlife Species Description and Significance

Red-headed Woodpecker is a medium-sized bird, approximately 20 cm long. It is easily recognized by its crimson head, neck, throat, and upper breast, which contrast with its stark white and black upperparts. In flight, large white patches are visible on the wings, formed by the inner secondaries and tertial feathers. Red-headed Woodpecker is sexually monomorphic, with males and females externally indistinguishable. Juvenile birds are recognizable by the lack of uniform colouration on their head, neck, throat and upper breast, which ranges from brownish-grey to mottled crimson.

Red-headed Woodpecker plays an important ecological role within deciduous forest ecosystems across its range. As a primary excavator, it creates numerous nest holes, many of which may later be used by other species, including secondary cavity-nesting birds, mammals, insects, and amphibians. Cavity creation also plays a role in the deterioration of standing dead wood to fallen dead wood, an important part of the forest ecosystem cycle. In addition, because of the species' dependence on mast crops, it is significant in maintaining the deciduous forest ecosystems of eastern North America by dispersing large quantities of acorns and beechnuts during feeding and caching.

Distribution

Red-headed Woodpecker occurs only in North America. In Canada, its range is primarily in southern Manitoba and southern Ontario, with small numbers extending into Saskatchewan and southern Québec. In the United States, the species ranges from New England to the Great Plains, and south to Florida and the Gulf states. Partially migratory, Red-headed Woodpeckers typically withdraw from the northern part of their range to winter in the United States, although yearly dynamics fluctuate widely and may be influenced by the abundance of hard mast.

Habitat

Red-headed Woodpecker can be found in a variety of treed habitats, including deciduous woodlands, open woodlots, parks, golf courses, cemeteries, treed agricultural and urban areas, savannah-like grasslands with scattered trees, riparian forests, wetlands, beaver ponds, burned areas, and along forest edges and roadsides. During the breeding period, dead limbs or snags are required for nesting, and an open canopy is preferred.

Biology

Red-headed Woodpecker is a monogamous species, with rare occurrences of cooperative breeding reported. The nesting period of Red-headed Woodpecker begins around the second week of May and extends to around the third week of August. Clutch size range from 3 to 10 eggs, but is typically 4 to 7. Incubation lasts 12-14 days, and fledglings remain in the nest for 24-27 days. Red-headed Woodpecker is an omnivorous generalist; its diet includes seeds, nuts, berries, fruit, insects, invertebrates, and even eggs and nestlings of other birds. It is also an expert flycatcher, and spends much of its foraging time in summer capturing insects on the wing. It is one of only four woodpecker species worldwide that commonly caches food items, and the only woodpecker known to cover stored food.

Population Sizes and Trends

The current Canadian population estimate of Red-headed Woodpecker based on Breeding Bird Survey (BBS) data is 6000 mature individuals, or approximately 3000 pairs. However, provincial Breeding Bird Atlas (BBA) estimates from Ontario, Manitoba, and Québec (data for Saskatchewan are lacking but likely negligible) collectively suggest a lower estimate of approximately 4000 to 4500 mature individuals for Canada, and are considered more likely to be accurate for this species than BBS data..

The BBS shows a significant long-term annual rate of decline of -1.88% per year (95% credible interval [CI]: -3.91, -0.16) between 1970 and 2016 for Red-headed Woodpecker in Canada, amounting to -58.2% in total (95% CI: -84.0, -7.0). Declines have been steepest in Ontario, with a significant decline of -3.42% per year (95% CI: -5.00, -1.42) between 1970 and 2016, or -79.8% in total (95% CI: -90.6, -48.1). Over the most recent three-generation period (2004-2016), the trend for Canada is -1.44% per year (95% CI: -6.19, 3.50). However, the wide confidence interval highlights the substantial variability from year to year, and the average annual rate of decline over the past three generations has remained close to the long-term estimate, which corresponds to a decline of 20% over three generations (12 years).

Threats and Limiting Factors

The main threats to Red-headed Woodpecker are habitat degradation and ecosystem modifications, particularly the loss of standing dead wood critical for nesting, flycatching, and food caching. This is primarily due to suppression of disturbances that may lead to the creation of standing dead wood such as fire, dead wood removal for aesthetic reasons, or through harvesting activities, and other human-driven modifications to the ecosystem that reduce standing dead wood. The species faces other threats, including interference competition for nest sites with European Starlings (*Sturnus vulgaris*), loss of American Beech trees (*Fagus grandifolia*) as a result of Beech Bark Disease, habitat degradation due to agricultural intensification or changes to agricultural management, mortality from collisions with structures or motor vehicles, and possible chemical exposure. Red-headed

Woodpecker may also have limited ability to recover from population declines due to low fecundity, and the ephemeral nature of highly decayed dead wood that the species requires as a weak primary cavity nester. Strongly negative population trends in many adjacent states suggest that the potential for rescue from the United States is declining.

Protection, Status and Ranks

Red-headed Woodpecker is protected in Canada under the *Migratory Birds Convention Act* and *Species at Risk Act* (listed as Threatened), and provincially under Québec's *Loi sur les espèces menacées ou vulnérables* (listed as Threatened), Ontario's *Endangered Species Act, 2007* (listed as Special Concern), and Manitoba's *Endangered Species and Ecosystems Act* (listed as Threatened). Red-headed Woodpecker is not federally listed under the US *Endangered Species Act*, but is listed by six states and protected under the *Migratory Bird Treaty Act*. It is also recognized as being at risk on several non-legal status rankings across its range, including as Near Threatened on the IUCN Red List, as a common species in steep decline on the Partners in Flight species assessment database, and as a "D" Yellow Watch List species in the Partners in Flight 2016 Landbird Conservation Plan Revision. In Canada, the vast majority of suitable Red-headed Woodpecker habitat is under private ownership, with limited habitat protected in publicly, federally, or provincially owned and managed parks. Some Red-headed Woodpeckers are found in Important Bird Areas, particularly in Manitoba.

TECHNICAL SUMMARY

Melanerpes erythrocephalus

Red-headed Woodpecker

Pic à tête rouge

Range of occurrence in Canada: Saskatchewan, Manitoba, Ontario, Québec

Demographic Information

Generation time (average age of parents in the population)	Approximately 4 years
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Yes, observed
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Decline of approximately 14% over 8 years, inferred from long-term rate of decline of 1.88% per year.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Decline of approximately 20% over 12 years, inferred from long-term rate of decline of 1.88% per year.
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Unknown, but decline projected to continue and potentially at an accelerated rate, based on ongoing threats.
[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; suspected to be under 30%, based on the rates of decline inferred over the past three generations, but rate of decline may increase given threats assessed.
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	a. No b. Yes, partially c. No
Are there extreme fluctuations in number of mature individuals?	No.

Extent and Occupancy Information

Estimated extent of occurrence (EOO)	Approximately 1.5 million km^2
Index of area of occupancy (IAO) (Always report 2x2 grid value).	Unknown, but likely exceeds the 2,000 km^2 threshold for distribution-related status criteria
Is the population “severely fragmented” i.e., is >50% of its total area of occupancy in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?	a. No b. No
Number of “locations”* (use plausible range to reflect uncertainty if appropriate)	Unknown, but greater than 10

* See Definitions and Abbreviations on COSEWIC Website and IUCN (Feb 2014) for more information on this term

Is there an [observed, inferred, or projected] decline in extent of occurrence?	Unknown
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	Yes, inferred from ongoing declines and changes in distribution
Is there an [observed, inferred, or projected] decline in number of subpopulations?	No
Is there an [observed, inferred, or projected] decline in number of “locations”?	Yes, inferred from ongoing declines and changes in distribution
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat?	Yes, observed decline in habitat quality
Are there extreme fluctuations in number of subpopulations?	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 subpopulation)

Subpopulations (give plausible ranges)	**N Mature Individuals**
	Likely ~10 in Saskatchewan
	~3000-4000 (range of estimates 1600-4000) in Manitoba
	~1000-1400 (range of estimates ~600-2250) in Ontario
	Likely <10 in Québec
Total	Most likely 4000-4500 (range of estimates ~2250-6250)

Quantitative Analysis

Is the probability of extinction in the wild at least [20% within 20 years or 5 generations, or 10% within 100 years]?	Unknown; analysis not conducted

Threats (direct, from highest impact to least, as per IUCN Threats Calculator)

Was a threats calculator completed for this species? Yes; key threats were identified as:

i. Other Ecosystem Modifications (IUCN 7.3) – medium to high threat
ii. Invasive Non-Native/Alien Species (IUCN 8.1) – medium threat
iii. Logging & Wood Harvesting (IUCN 5.3) – low to medium threat
iv. Housing and Urban Areas (IUCN 1.1) – low threat
v. Annual & Perennial Non-Timber Crops (IUCN 2.1) – low threat
vi. Roads & Railroads (IUCN 4.1) – low threat
vii. Fire and Fire Suppression (IUCN 7.1) – low threat

What additional limiting factors are relevant?

i. Availability of dead wood for nesting
ii. Low fecundity

Rescue Effect (from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	US population is declining significantly, with long-term declines of >80% in five of eight states bordering Canada where the species occurs regularly, including significant declines of >45% over the past three generations in each of Minnesota, Michigan, and New York.
Is immigration known or possible?	Yes, possible
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes
Are conditions deteriorating in Canada?[+]	Yes
Are conditions for the source population deteriorating?[+]	Yes
Is the Canadian population considered to be a sink?[+]	Uncertain, but likely at least in part
Is rescue from outside populations likely?	Unlikely, as populations in states bordering Canada are declining.

Data Sensitive Species

Is this a data sensitive species? No

Status History

COSEWIC: Designated Special Concern in April 1996. Status re-examined and designated Threatened in April 2007. Status re-examined and designated Endangered in April 2018.

[+] See Table 3 (Guidelines for modifying status assessment based on rescue effect)

Status and Reasons for Designation:

Status:	**Alpha-numeric codes:**
Endangered	Meets Threatened, C1, but designated Endangered because the Canadian population is likely a sink dependent on immigration from a declining population in the United States.

Reasons for designation:
This boldly-patterned woodpecker, which inhabits open deciduous forests, has experienced a substantial long-term population reduction. This decline is associated primarily with reduced quality of breeding habitat, particularly the loss of standing dead trees needed for nesting, fly-catching, and food caching. Other threats include increased competition for nest sites from native and non-native bird species. The Canadian population is now likely less than 6,000 mature individuals, almost all in Manitoba and Ontario. It appears to not be self-sustaining, and ongoing declines may accelerate given that numbers are also decreasing in adjacent parts of the U.S. range.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. May meet criteria for Threatened, A3bce and A4bce, because decline in total number of individuals over the past three generations is below 30%, but rate of decline may accelerate based on projected threats from loss of habitat and competition with introduced and native taxa.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable. EOO exceeds thresholds, and IAO likely does as well.
Criterion C (Small and Declining Number of Mature Individuals): Meets criteria for Threatened, C1, as there are fewer than 10,000 individuals, and there is an estimated decline of 20% over the past three generations.
Criterion D (Very Small or Restricted Population): Not applicable. Total number of mature individuals exceeds thresholds.
Criterion E (Quantitative Analysis): Analysis not conducted.

PREFACE

Red-headed Woodpecker was first assessed by COSEWIC as Special Concern in 1996, and reassessed as Threatened in 2007, due to ongoing decline of a small population. This updated status report adds new information that has become available since the previous report, including results from the second Québec Breeding Bird Atlas, and the first Manitoba Breeding Bird Atlas. Long-term population trends for the species, as estimated from Breeding Bird Survey data, continue to show a significant decline in Canada and the majority of adjacent states, although short-term trends are more variable. Several new studies provide information on the species' biology, potential threats, and limiting factors, including information on habitat use, nest success, and fecundity specific to Canada as a result of research in central and southern Ontario. The species is newly included on the Partners in Flight Yellow Watch List, a list of the 86 North American bird species that are of highest conservation concern at the continental (range-wide) scale. A draft Recovery Strategy under the *Species at Risk Act* is in development, but has not yet been released for review.

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 (2018)

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 and Climate Change Canada
Canadian Wildlife Service
Environnement et Changement climatique Canada
Service canadien de la faune
Canada

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

COSEWIC Status Report

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific Name: *Melanerpes erythrocephalus*

English Name: Red-headed Woodpecker

French Name: Pic à tête rouge

Classification: Class: Aves, Order: Piciformes, Family: Picidae

The woodpecker family is a well-resolved evolutionary unit characterized by zygodactyl feet, stiff rectrices, and chisel-like beaks. There is yet to be molecular phylogenetic research on Red-headed Woodpecker; it has been suggested that it is a sister species to Puerto Rican Woodpecker (*M. portoricensis*; Frei *et al*. 2017).

Morphological Description

Red-headed Woodpecker is a medium-sized bird, 19.4 to 23.5 cm long, and with a mass of 56 to 91 g. It shows the highest degree of monomorphism of all North American woodpecker species, with males and females externally indistinguishable, featuring a crimson head, neck, throat, and upper breast, which contrast with the stark white and black upperparts (Kilham 1978, 1983). In flight, large white patches are visible on the wings, formed by the inner secondaries and tertial feathers. The tail is generally black, except for the outermost rectrices, which are white. The uppertail and rump are also white. The bill is light grey, becoming darker terminally. The iris is reddish-brown in adults. The legs and feet are olive-grey (Frei *et al.* 2017).

Juvenile birds in their first fall and winter can be distinguished from adults by the lack of uniform colouration of their head, neck, and upper breast, which ranges from greyish-brown, to mottled, to crimson red (with little or no brown colouration). The secondaries are white and can be distinguished from those of adults by a subterminal black band (complete in juvenile plumage but variable after preformative moult). The underparts of immatures are generally whitish with variable amounts of dusky streaking, especially on the flanks. The back and tail are generally brownish-black, and the iris is greyish-brown (Pyle 1997).

Population Spatial Structure and Variability

There are no recognized subspecies of Red-headed Woodpecker (Short 1982), and its population genetics have not been studied. Clinal variations have been reported, specifically regarding size and colour (western and northern birds are slightly larger and more frequently have a red tinge on the belly; Frei *et al.* 2017). Although there is a gap in the Canadian distribution between south-central and northwestern Ontario, the range is continuous through the United States, and there is no basis for defining separate subpopulations.

Designatable Units

No subspecies have been described for Red-headed Woodpecker (Short 1982), and the range for this highly mobile species is not disjunct (Figure 1). Hence, the species is treated as one designatable unit.

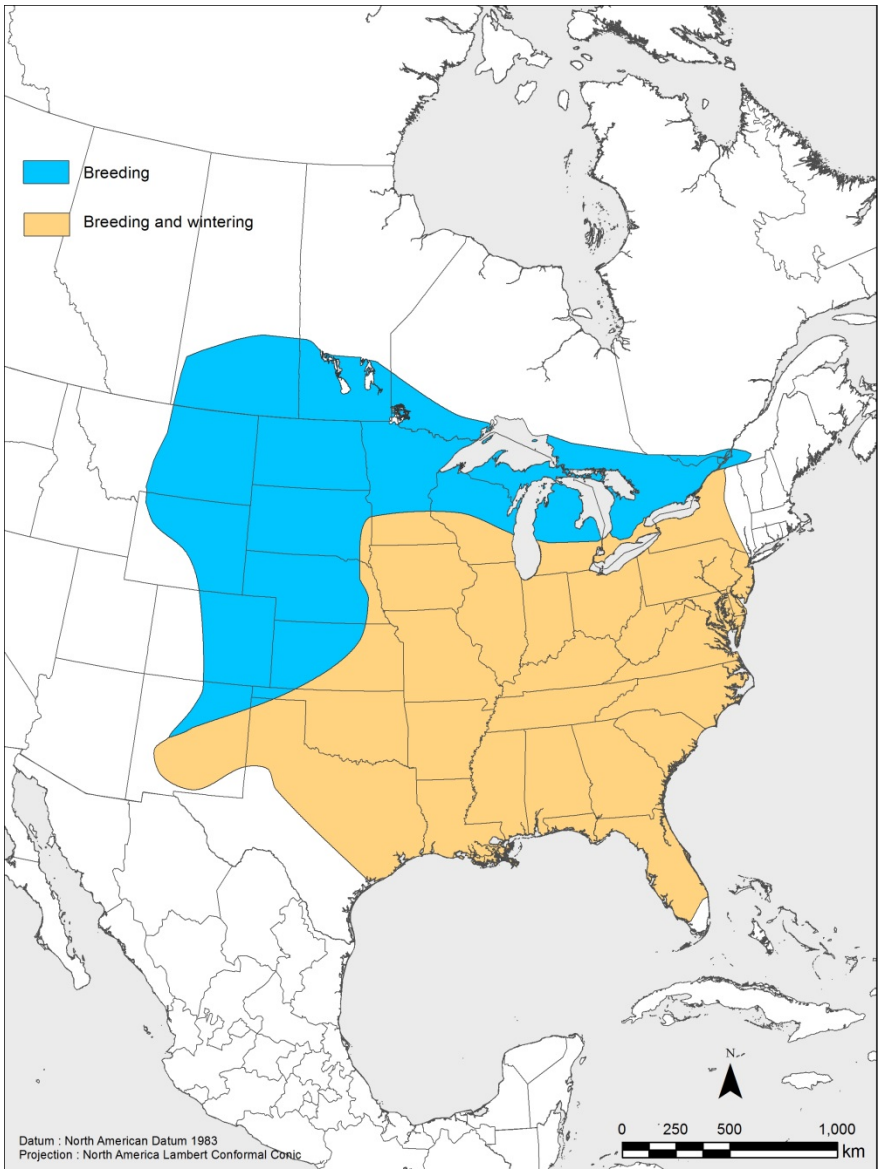

Figure 1. Range of Red-headed Woodpecker in North America, showing areas where only breeding occurs (blue), and areas where both breeding and wintering take place (orange) (courtesy of Environment and Climate Change Canada).

Special Significance

Red-headed Woodpecker is a primary cavity nester, annually excavating cavities that may provide nesting and roosting sites for many other species in subsequent years (Frei *et al.* 2017). The species also plays a significant role in maintaining the deciduous forest ecosystems of eastern North America by dispersing large quantities of acorns and beechnuts during feeding and food caching (Frei *et al.* 2017). No Aboriginal Traditional Knowledge particular to this species is currently available.

DISTRIBUTION

Global Range

Red-headed Woodpecker is endemic to North America. Its range extends northward to the southern parts of Saskatchewan, Manitoba, Ontario, and Québec; westward to the eastern parts of Montana, Wyoming, Colorado and the centre of New Mexico; southward to the Texas panhandle to the Gulf states of Louisiana, Mississippi, Alabama, and Florida; and eastward to the Atlantic seaboard states of Georgia, South Carolina, North Carolina, Virginia, Delaware, Maryland, New Jersey, New York, Connecticut, Massachusetts and Vermont. The core of the range is in the Midwestern United States (Frei *et al.* 2017; Figure 1).

The species withdraws from the northern portion of its range in winter (Bock and Lepthien 1975), generally overwintering from Oklahoma, eastern Kansas, southern and eastern Iowa, southeastern Minnesota, south-central Wisconsin, southern Michigan, western New York, western and central Pennsylvania, and Maryland south through the remainder of breeding range; the species is rare in winter in southern Ontario, with most occurrences restricted to the extreme southwest (Frei *et al.* 2017; Sutherland pers. comm. 2017). In some winters Red-headed Woodpeckers can be found in central Texas and southern Louisiana (Rappole and Blacklock 1985; Frei *et al.* 2017; Figure 1). Winter abundance of Red-headed Woodpeckers can be unpredictable, with the species being locally common in one year and absent in another (Smith and Scarlett 1987). The yearly dynamics are believed to be influenced by the local abundance of hard mast (e.g., acorns and beechnuts). If the supply at a given site is not sufficient to last the whole winter, Red-headed Woodpeckers will continue their migration and ultimately choose sites where food resources are sufficiently abundant (Graber and Graber 1977; Smith 1986).

Canadian Range

Breeding Bird Survey (BBS) data from 1970 to 2014 indicate that 0.6% of the breeding population of Red-headed Woodpecker occurs in Canada, an apparent decline from 0.8% from 1970 to the 1990s. Its Canadian range generally includes southern Manitoba and southern Ontario, with a small number of occurrences in southern Saskatchewan and southwestern Québec (Gauthier and Aubry 1996; Smith 1996; Manitoba Avian Research Committee 2003; Woodliffe 1987, 2007; AONQ 2018; Figure 1), but density can be low

near the limits of the range (e.g., Figures 2, 3). The species was a confirmed, albeit rare, breeder in New Brunswick as recently as the 20th century, with three sightings in the first Maritime Breeding Bird Atlas (1986-1990), and one in the second (2006-2010; Stewart *et al.* 2015). It is considered accidental in British Columbia, southern Alberta, and Nova Scotia (Godfrey 1986; Campbell *et al.* 1990); it has only once been recorded breeding in Alberta (Red Deer in 2004; Federation of Alberta Naturalists 2007), and in Nova Scotia there were two sightings of two individuals at the same site over three days during the second Maritime Breeding Bird Atlas (Stewart *et al.* 2015). In winter, Red-headed Woodpecker is occasional in southern Manitoba, rare in southern Ontario, and irregular in Québec, New Brunswick, Nova Scotia, and southern Alberta (Godfrey 1986; Cyr and Larivée 1995). Winter sightings usually involve individuals visiting feeding sites in urban areas or agricultural areas (Cyr and Larivée 1995; COSEWIC 1996).

In Saskatchewan, Red-headed Woodpecker is rare in the southern part of the province, particularly in the Cypress Hills, and the aspen parkland and prairies to the east (Godfrey 1986; Smith 1996). As of 1996, Red-headed Woodpecker had been reported breeding in 24 atlas squares (3% of the province), and confirmed in only two of them (Smith 1996). Sawatsky (pers. comm. 2016) believes the current population is fewer than 10 mature individuals.

In Manitoba, the species occurs mainly in the southern part of the province, mostly in the Prairie Pothole Bird Conservation Region, especially in the agricultural areas on the northeastern edge of Riding Mountain National Park, north of Winnipeg in the Interlake Area, and along the Minnesota border west of Sprague; it is largely absent from areas dominated by boreal forest (Manitoba Avian Research Committee 2003; Artuso *et al.* 2016; Figure 4). In the recent Breeding Bird Atlas of Manitoba (2010-2014), Red-headed Woodpecker was found in 315 atlas squares (Artuso *et al.* 2016).

In Ontario, the species' distribution is discontinuous in the southern part of the province, with many gaps between occurrences (Sutherland pers. comm. 2017). It occurs uncommonly at sites on the southern Canadian Shield, near large urban centres, such as Toronto and Hamilton, and in certain intensively farmed areas (Woodliffe 2007). The species is a regular breeder, albeit in small numbers, in northwestern Ontario (i.e., Lake of the Woods area) and eastern Ontario, along the Ottawa River Valley (Woodliffe 2007). During the first Breeding Bird Atlas of Ontario (1981-1985), Red-headed Woodpecker was present in 732 atlas squares, making the species uncommon but widespread (Woodliffe 1987). Despite greater search effort, the species was found in only 330 squares in the second Breeding Bird Atlas of Ontario (2001-2005; Figure 3), with a southward range contraction in both the core and northern edge of its range in the province, and a retraction of the eastern edge, compared to the first atlas (Woodliffe 2007).

In Québec, Red-headed Woodpecker is rare and is now only an occasional breeder in the regions along the southern St. Lawrence valley, such as the Outaouais, Montréal, Montérégie, and the Eastern Townships (Gauthier and Aubry 1996). During the first Breeding Bird Atlas of Québec (1984-1989) Red-headed Woodpecker was present in 26 atlas squares (Gauthier and Aubry 1996). This decreased to four atlas squares in the

second atlas (2010-2014), with the species confined to the Brome-Missisquoi and Gatineau regions, with the latter being where the only confirmed breeding record for the province was reported (AONQ 2018; Figure 2). These recent data suggest a provincial population of fewer than 10 mature individuals.

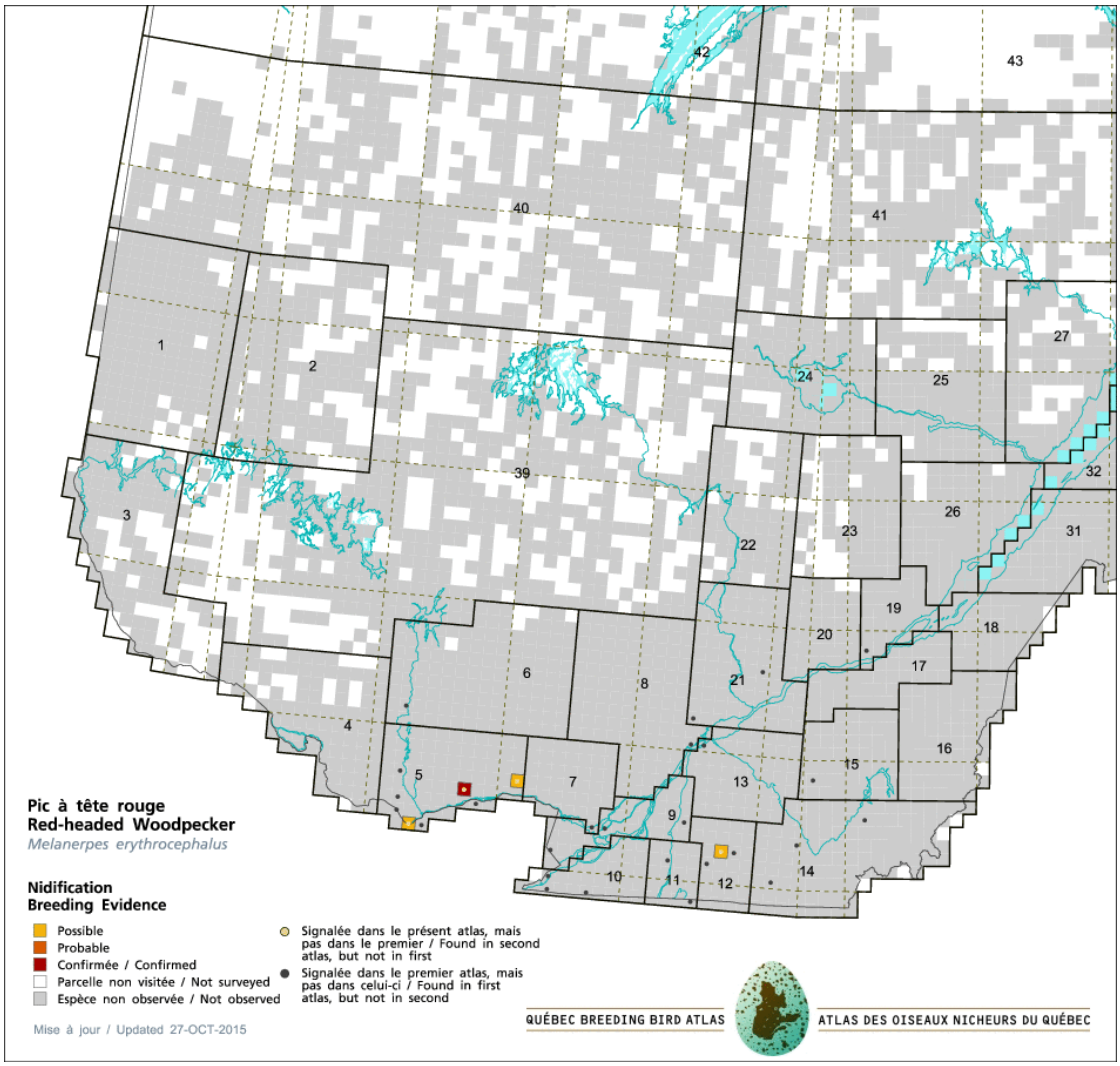

Figure 2. Red-headed Woodpecker breeding distribution in Québec during 2010 – 2014, based on the Québec Breeding Bird Atlas. Black dots depict 10 x 10 km squares where Red-headed Woodpeckers were recorded during 1984-1989, but not 2010-2014 (Atlas of the breeding birds of Québec 2016).

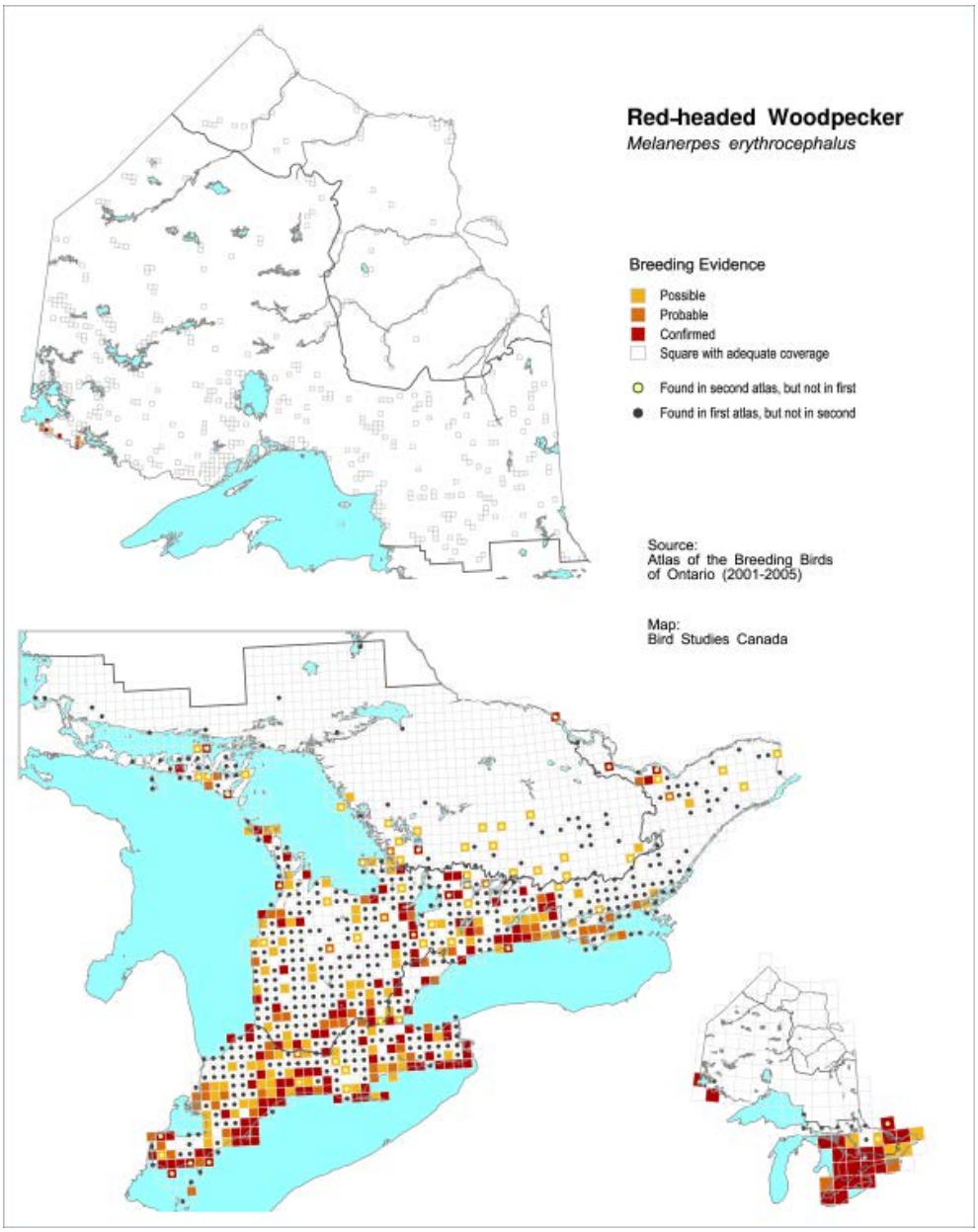

Figure 3. Red-headed Woodpecker breeding distribution in Ontario during 2001 - 2005, based on the Ontario Breeding Bird Atlas. Black dots depict 10 x 10 km squares where Red-headed Woodpeckers were recorded during 1981-1985, but not 2001-2005 (Bird Studies Canada *et al*. 2006).

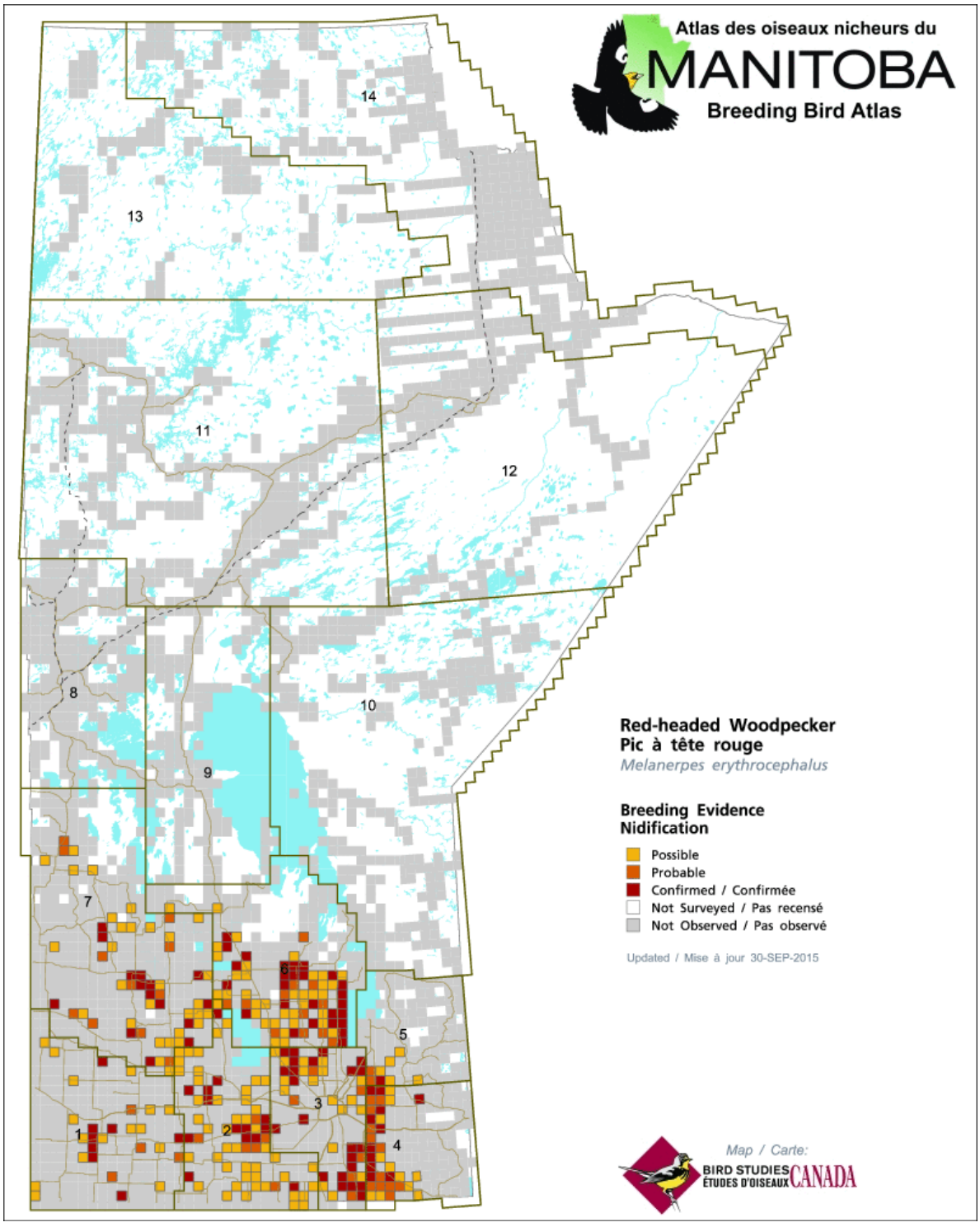

Figure 4. Red-headed Woodpecker breeding distribution in Manitoba during 2010 - 2014, based on the Manitoba Breeding Bird Atlas (Artuso *et al*. 2016).

Extent of Occurrence and Area of Occupancy

Extent of occurrence (EOO) is approximately 1.5 million km^2 within Canada (Figure 5). This is much larger than 317,850 km^2 in the previous status report (COSEWIC 2007), but the difference is due to a change in methods rather than a true expansion of range.

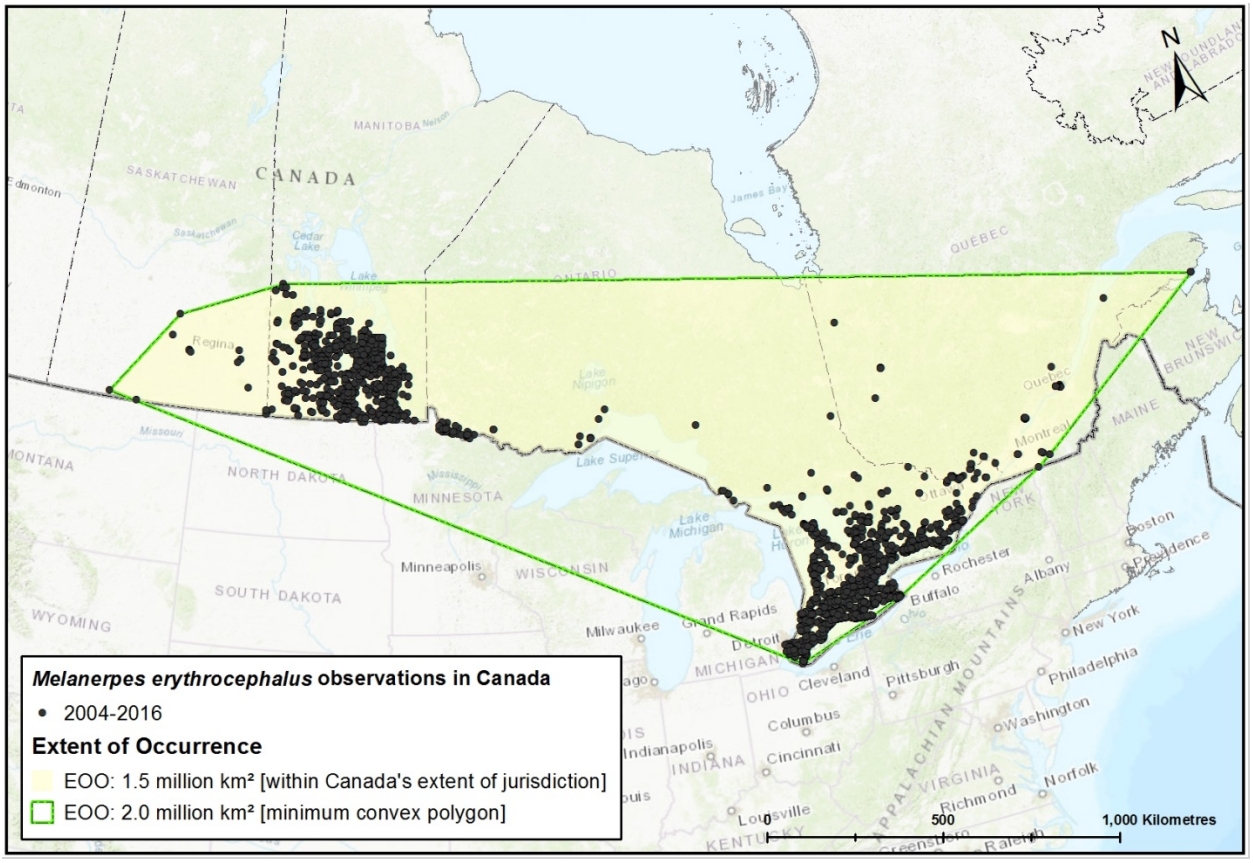

Figure 5. The extent of occurrence (EOO) of Red-headed Woodpecker in Canada, mapped as the minimum convex polygon within Canada's extent of jurisdiction (in pale yellow). Distribution is based on records from within the regular breeding range of Saskatchewan, Manitoba, Ontario, and Québec from 2004-2016, but excluding occasional records from Alberta, New Brunswick, and Nova Scotia. Map prepared by J. Wu, COSEWIC Secretariat (2018).

Index of area of occupancy (IAO) is unknown. Given the range of population estimates from ~1100 to 3100 pairs (see **Abundance**), the maximum IAO based on a 2x2 km grid would be 4400 km^2 to 12,400 km^2, if each pair is in a different grid cell. As there is some clustering of pairs in areas of suitable habitat, it is possible that IAO might be below 2000 km^2, especially if the population is near the low end of the range of estimates. The previous status report (COSEWIC 2007) reported a smaller range of 217 to 4250 km^2, but as with EOO, the difference is due to a change in calculation methods.

Search Effort

Distributional information for Red-headed Woodpecker was primarily compiled using recent breeding bird atlas data, as well as BBS data. Breeding bird atlases are fairly well-suited to survey this species, as it can be predictably found locally in suitable habitat (Artuso pers. comm. 2016). However, accessing suitable habitat may be a limitation, as forest blocks with appropriate habitat may be well away from roads on private property (Sutherland pers. comm. 2017). Standardized breeding bird atlases are currently available for three of the four provinces where Red-headed Woodpecker is regularly found (Ontario, Québec, and Manitoba). The first standardized breeding bird atlas for Saskatchewan was launched in 2017; previous data from the province were through the Saskatchewan Bird Atlas project, which was an informal data collection effort based on atlas squares corresponding to the National Topographic System 1: 250 000 grids, rather than the 10 x 10 km grid used in standardized breeding bird atlases.

HABITAT

Habitat Requirements

Breeding habitat

Red-headed Woodpecker can be found in a variety of treed habitats, commonly including deciduous woodlands, particularly those dominated by oak and beech (Reller 1972), open deciduous forests or woodlots, groves of dead or dying trees, flood plain forests, orchards, cemeteries, urban parks, golf courses, sparsely treed pastures or agricultural areas, savanna-like grasslands with scattered trees, beaver ponds, timber stands treated with herbicides, and forest edges or along roadsides (DeGraaf *et al.* 1980; Short 1982; Godfrey 1986; Rodewald *et al.* 2005; Frei *et al*. 2017, Derbyshire 2018). In Manitoba, Red-headed Woodpecker is strongly associated with Trembling Aspen (*Populus tremuloides*) copses containing snags or trees with dead limbs in grazed cattle lots (Manitoba Avian Research Committee 2003; Artuso pers. comm. 2016). In eastern Ontario, Red-headed Woodpeckers are strongly associated with Beaver ponds and meadows in Frontenac Provincial Park (Derbyshire 2018). Although distinct habitat preferences may differ across the range and habitat types, Red-headed Woodpecker breeding habitat is characteristically composed of woodlands or areas with tall trees of large circumferences, high basal area, a low density of stems in the understorey, and a high density of snags and dead limbs that are used for perching, nesting, and food caching (Bond 1957; Conner and Adkisson 1977; Kahl *et al.* 1985; Rodewald *et al.* 2005; King *et al.* 2007; Frei *et al.* 2013, 2017). Data from US studies indicate that summer territories range from 3.1 to 8.5 ha (Venables and Collopy 1989), up to 11.4 ha (Kilgo and Vukovich 2012).

Red-headed Woodpecker density is often correlated with either natural or anthropogenic disturbances that alter the characteristics of the forest habitat to make it more favourable for the species, namely the creation of snags, opening of the canopy, and removing the understorey (Frei *et al.* 2017). For example, removal of 50% of oak trees

during selective thinning for prairie restoration on a reserve in Ohio immediately attracted nesting birds (Birdlife International 2016). Red-headed Woodpecker abundance increased marginally following timber-thinning operations, and dramatically following prescribed burn operations, in a savanna restoration project in Wisconsin, USA (King *et al.* 2007). Similarly, savanna restoration using prescribed burns in east-central Minnesota resulted in greater Red-headed Woodpecker abundance, corresponding positively with both snag abundance and dead to live canopy ratio (Davis and Miller 2018). Yet this study also demonstrated that repeated burns eventually caused the number of snags to decline substantially, potentially reducing habitat suitability for deadwood-dependent species such as Red-headed Woodpecker (Davis and Miller 2018). An examination of different snag creation approaches in Jack Pine (*Pinus banksiana*) stands in Upper Michigan found that snags produced by prescribed burns had a greater abundance of cavities and foraging excavations overall than snags produced by topping or girdling, although this study had no species-specific conclusions for Red-headed Woodpecker (Weiss *et al.* 2018). Red-headed Woodpecker abundance is positively related to snag densities and the overall availability of decaying trees (King *et al.* 2007).

Migration habitat

Little information is available on habitat use by Red-headed Woodpecker during migration (Frei *et al.* 2017). Scattered reports of migratory habitat use include: extensive use of shelterbelts during its spring migration on the Great Plains (Martin 1980), forming loose flocks to feed on mast and fruit in orchards, oak hummocks, and urban areas in Florida (Stevenson and Anderson 1994), and a greater use of forest edges during fall migration (Twomey 1945). In Ontario, Red-headed Woodpecker is reported to use wooded areas and scrubby thickets on migration, as well as the shorelines of some of the Great Lakes (COSEWIC 1996). In Manitoba, the species is generally found in open deciduous woodland with numerous dead or diseased trees, as well as in urban parks during its migration (Manitoba Avian Research Committee 2003).

Winter habitat

In the northern part of its wintering range, Red-headed Woodpecker occurs mainly in open, mature woodlands, such as oak stands, oak-hickory stands, maple stands, ash stands, and beech woods (Frei *et al.* 2017). The presence of this species is positively correlated with the abundance of acorns and beechnuts (Frei *et al.* 2017). Recently, King and Liebhold (2017) demonstrated that the winter abundance of Red-headed Woodpecker and other woodpecker species is higher in areas corresponding with high Emerald Ash Borer (*Agrilus planipennis*) populations. They suggest that Red-headed Woodpecker and some other bird species may be feeding on Emerald Ash Borer larvae and that this enhanced food supply has a strong positive effect on populations (King and Liebhold 2017). In winter, unlike in other seasons, Red-headed Woodpecker makes more use of the inner parts of the forest and is less abundant along its edges (DeGraaf *et al.* 1980). In most Canadian provinces and in the northeastern states, wintering records of this species mainly involve individuals at feeding stations in areas consisting mostly of oak forest or farmland (Cyr and Larivée 1995; COSEWIC 1996). In southern states, such as Florida, the species

usually prefers pine stands and mixed pine-oak stands, but also makes use of flooded forests, which have a high density of snags (Lochmiller 1979). Adult winter territories are usually smaller than the summer territories, ranging from 0.2 to 2.0 ha (Kilham 1958; Moskovits 1978; Williams and Batzli 1979a).

Habitat Trends

It is hypothesized that Red-headed Woodpecker populations declined with the massive deforestation of the mature hardwood forests following the arrival of settlers, yet there is little evidence in the historical ornithological record to substantiate this claim (COSEWIC 1996; Manitoba Avian Research Committee 2003; Frei *et al.* 2017). In rural areas, potential nesting sites also disappeared due to firewood cutting, clear-cutting, intensive farming, the loss of riparian forests, and channelling of rivers (Ehrlich *et al.* 1992; Melcher 1998; Frei *et al.* 2017). Other factors that have contributed to the reduction in Red-headed Woodpecker habitat in North America include reforestation of large areas of farmland in the eastern United States (which resulted in young forests), the loss of small orchards, forest fire suppression, the widespread disappearance of the American Chestnut (*Castanea dentata*), and agricultural intensification, including the removal of hedgerows and expansion of large monoculture fields (Peterjohn 1989; Peterjohn and Rice 1991; Frei *et al.* 2017). For example, data from the first Ohio Breeding Bird Atlas suggest that population declines there were associated with reforestation of previously cleared land (Peterjohn and Rice 1991). In agricultural and urban areas, the main cause of habitat degradation is the loss of potential nest sites due to removal of snags and dead branches for aesthetic and safety reasons (Pulich 1988; Frei *et al.* 2017). In addition, fungal diseases such as Beech Bark Disease could have contributed substantially to the decline in Red-headed Woodpecker habitat in eastern North America (Houston and O'Brien 1998).

In Manitoba, the recent disappearance of Red-headed Woodpecker from many city parks appears to be influenced by both the natural falling of dead trees and their systematic removal (COSEWIC 1996; Manitoba Avian Research Committee 2003). The preferred habitat in the province, Trembling Aspen and Bur Oak (*Quercus macrocarpa*) stands with grazed understorey and standing snags, may often fill with dense shrubby understorey if grazing is stopped, rendering the habitat unsuitable for Red-headed Woodpecker (Artuso pers. comm. 2016).

BIOLOGY

The most comprehensive source of Red-headed Woodpecker biology, ecology, and general life-history information is the recently updated Birds of North America account (Frei *et al.* 2017), although most of the data summarized there are from the United States. Research on Red-headed Woodpecker in Canada is largely limited to the work of B. Frei in southern and central Ontario.

Life Cycle and Reproduction

Red-headed Woodpecker is generally monogamous (Frei *et al.* 2017), although there is a known case of cooperative breeding in a small, densely populated site in the United States (Atterberry-Jones and Peer 2010). The age of sexual maturity is one year (Belson 1998), and the longevity record is nine years (Clapp *et al.* 1983). Generation time is unclear, with BirdLife International (2016) reporting 5.2 years, but estimates of poor adult survivorship suggest that it might be as short as 3 years; an average of 4 years is therefore estimated for generation time.

Red-headed Woodpeckers primarily nest in dead trees or snags, or in dead portions of live trees (Frei *et al.* 2017). Both sexes take part in nest construction, although the male does the majority of the excavation (Short 1982). Nest cavities typically range from 7-12 m above the ground (Bent 1939; Frei *et al.* 2017). Characteristics of nest trees such as size, height, species, and decay class may vary across the species' range and habitat types used, although nest trees typically exceed 30 cm diameter at breast height (Frei *et al.* 2017). While nest reuse is rare for the species, adult Red-headed Woodpeckers show strong fidelity to their breeding territories (Frei *et al.* 2017).

The nesting period of Red-headed Woodpecker starts around the second week of May and ends around the third week of August (Rousseu and Drolet 2017). It is one of the latest-nesting woodpeckers in Canada, with egg dates in Ontario ranging from May 14 to July 21 (Peck and James 1983) and May 18 to July 3 (Frei 2013). Typically, a single brood is reared per season, although the species may be double-brooded in the southern part of its US range (Bent 1939; Ingold 1987; Hudson and Bollinger 2013). Throughout its breeding range, clutch size ranges from three to seven eggs, with an average of four (Short 1982; Peck and James 1983; Godfrey 1986). Both sexes incubate the eggs. Incubation generally lasts 12 to 14 days (Short 1982). The young hatch asynchronously and remain in the nest for 27 to 30 days, during which time they are tended to by both parents (Jackson 1976; Frei *et al.* 2017). The average number of fledglings in Mississippi was 2.1 for a first attempt and 2.3 for a second (Ingold 1989). In Ontario and northern New York, 2.7 $\pm$ 0.2 SE eggs hatched for a hatching rate of 59%, and 1.8 $\pm$ 0.2 SE young fledged for a fledging rate of 67%; only 39% of eggs resulted in fledged young, for an average of 1.7 fledglings per successful nest (Frei *et al.* 2015a). The fledglings are dependent on their parents for about 25 days after leaving the nest (Jackson 1976; Frei *et al.* 2017). Fledging dates average July 19 in Ontario (range early to mid-July), but are later in the southern part of the range where a second brood is often produced, e.g., from early to mid-September in Alabama (Imhof 1976), and late September in Florida for second broods (McNair 1996).

Martin (1995) reports an annual adult survival rate of 62%, but there is limited other information on Red-headed Woodpecker survivorship. The winter mortality rate from a small study (n = 14) is reported to be 7%, based on 160 h of observation from Nov-March (Doherty *et al.* 1996). Red-headed Woodpecker breeding season survivorship from May-August (n = 80) in the Loblolly Pine (*Pinus taeda*) forests of South Carolina was estimated at 72% (95% CI = 54-85%) for all birds, with higher survival rates for females (82%; CI = 54-94%) than males (60%; CI = 42-76%), with females more strongly (positively) affected

by the number of cover patches than males (Kilgo and Vukovich 2012). There are no available estimates for juvenile survival rates for the species.

Recent estimates of Red-headed Woodpecker nest success, using logistic-exposure analysis and assuming constant survival are as follows: 47% South Dakota (*n* = 17; Vierling and Lentile 2006), 56% (*n* = 27; Hudson and Bollinger 2013) and 55% (*n* = 136; Dallas 2015) in Illinois, 16-56% New York (*n* = 30; Berl *et al.* 2014), and 68% (95% CI: 53-79%) in southern Ontario (*n* = 59; Frei *et al.* 2015b). Predation accounted for a majority of nest failures including 78% in South Dakota (Vierling and Lentile 2006), 82% in New York (Berl *et al.* 2014), and 72% in Illinois (Hudson and Bollinger 2013). Snakes and mammals, such as Raccoon (*Procyon lotor*), are the most likely nest predators (Frei *et al.* 2017). In Ontario almost half of the nest failures were attributed to cavity takeover by European Starlings (*Sturnus vulgaris*), and nests with this species present were four times more likely to fail than nests without (Frei *et al.* 2015b). If unsuccessful early in the breeding season, Red-headed Woodpeckers typically re-nest within 10-12 days, sometimes in the same nest cavity (Frei *et al.* 2017).

Physiology and Adaptability

Red-headed Woodpeckers are generally tolerant of human presence near the nest (Graber and Graber 1977), and often nest in areas frequented by humans. Despite this, Red-headed Woodpeckers are highly protective of their nests and young and nest sites, and adults are easily agitated by human activity in the vicinity of their nests (Jackson 1976).

Given that much historical Red-headed Woodpecker habitat (e.g., mature hardwood forests and oak savannahs) has been lost, degraded, or altered by human activities, the species has shown adaptability in shifting its habitat use. For example, while primarily a species associated with forest edges and clearings, Red-headed Woodpecker may make use of forest interiors due to logging, burns, or other disturbances, or may use more closed canopy forests due to loss of nesting sites or interference competition (Frei *et al.* 2017). This shift in habitat use (to closed canopy forests) may lead to increased competition for nest sites and cavities with Red-bellied Woodpecker (*Melanerpes carolinus*) and Southern Flying Squirrel (*Glaucomys volans*; Adkins Giese and Cuthbert 2003). Whether the shift in habitat use is opportunistic or reactive, there is evidence that the species may show multi-scalar maladaptive habitat use, suggesting the species may be vulnerable to an ecological trap in human-altered habitats (Frei *et al.* 2013). Research across central and southern Ontario found that habitat characteristics, such as higher canopy openness and greater dead limb length were consistently in use across several spatial scales, despite these characteristics being associated with higher nest failure of Red-headed Woodpecker (Frei *et al.* 2013). It is unclear whether habitats used by the species in southern Ontario are indeed maladaptive, or whether food-based choices (i.e., greater canopy openness) supersede choice of a safe nest site (Frei *et al.* 2013). While the species shows a degree of flexibility in using anthropogenic habitats for breeding, its dependence on tree cavities for nesting gives it little flexibility to respond to human disruptions that either reduce the density of dead trees or eliminate them altogether (Frei *et al.* 2017).

Red-headed Woodpecker is regarded as an omnivorous generalist, consuming a wide variety of animal and plant-based food items, and is an expert and persistent flycatcher (Frei *et al.* 2017). It is believed that the species' diverse diet is a result of evolving in more open areas than typical forest-dwelling woodpecker species (Jackson 1976). It is hypothesized that its foraging diversity is part of what enables Red-headed Woodpecker to occupy smaller woodlots than other woodpecker species (Blake 1983; Howe 1984; Blake and Karr 1987; Frei *et al.* 2017).

The diet of Red-headed Woodpecker appears flexible, as individuals take advantage of food availability based on seasonality and location, including food sources resulting from human presence. The diet includes a wide variety of cultivated and wild fruit (apples, pears, cherries, raspberries, and strawberries), as well as corn and several types of mast (such as acorns and beechnuts; Short 1982; Frei *et al.* 2017). The animal portion of its diet consists mainly of insects, such as grasshoppers, crickets, ants, several types of beetles and their larvae, butterflies, caterpillars, wasps, and domesticated bees (*Apis mellifera*; Short 1982; Frei *et al.* 2017). Red-headed Woodpecker also feeds on bird eggs, young birds, and occasionally adult birds, as well as small rodents, lizards, and dead fish (Frei *et al.* 2017). In winter, its diet becomes more specialized, focusing on acorns and beechnuts, as well as grains, such as corn (Williams and Batzli 1979a). In winter this species infrequently visits bird feeders to eat sunflower seeds, peanut butter, and suet (Short 1982; Frei *et al.* 2017). There is also recent evidence that Red-headed Woodpecker may feed on Emerald Ash Borer larvae during the winter months (King and Liebhold 2017).

Red-headed Woodpecker is unusual among woodpeckers in its feeding behaviour, being an adept and frequent flycatcher, and one of four woodpecker species worldwide that commonly caches food. Red-headed Woodpeckers forage on a variety of substrates but generally prefer live trees, mainly trunks and branches (Frei *et al.* 2017). During the summer months the majority of the species' foraging time is spent 'flycatching', flying out from a perch to catch insects in the air (Jackson 1976; Venables and Collopy 1989; Frei *et al.* 2017). Slightly less often, Red-headed Woodpeckers engage in 'stooping' or dropping to the ground from a raised perched such as a fencepost or snag (Jackson 1976; Frei *et al.* 2017). In winter, Red-headed Woodpeckers forage on the ground, as well as in trees and shrubs where they look for small fruits and insects (Root 1988). Once they have established a winter territory, Red-headed Woodpeckers feed mainly on acorns on the ground and in trees, storing them in cavities that they excavate for this sole purpose (Kilham 1983). Red-headed Woodpeckers store food in caches during the breeding season, typically near their nest site. Cache locations are typically in dead trees or dead portions of live trees, and may include old cavities, natural cracks or crevices, or spaces under raised patches of bark (Frei *et al.* 2017). This use of caches may explain in part their breeding habitat requirement of a high density of standing dead wood at multiple scales (Frei *et al.* 2013).

Dispersal and Migration

Only Red-headed Woodpecker populations from the northern and western parts of North America migrate. These include the majority of the Canadian range, although in the

most southern parts of Manitoba and Ontario a few Red-headed Woodpeckers occasionally overwinter. The abundance and distribution of acorns and beechnuts in regions further south are believed to influence the start of migration and the selection of wintering sites (Smith and Scarlett 1987). It has been suggested that the two-year east-west pattern in high counts of this species during Christmas Bird Counts is the result of fall migrating Red-headed Woodpeckers stopping when they encounter large mast crops on prairie-forest ecotones versus continuing eastward during alternate years of mast failure (Smith 1986).

There are limited data on migratory behaviour in Canada. Reports suggest that Red-headed Woodpeckers are primarily diurnal migrants in the fall, when they can be seen migrating in small groups or as single individuals, often with Blue Jays (*Cyanocitta cristata*). Diurnal migration during fall may be associated with assessing local mast-crop abundance (Frei *et al.* 2017). Reports of spring migration are rare, as Red-headed Woodpecker is thought to migrate nocturnally (Widmann 1907; Graber and Graber 1977; Zimmerman 1989; Frei *et al.* 2017). Spring arrival varies from early March in the southern portions of the range to mid-May in Canada (Frei *et al*. 2017). Fall migrants generally leave breeding grounds in Canada by the latter part of August (Roberts 1932; Todd 1940; Pettingill and Whitney 1965; Dinsmore *et al.* 1984; Robbins and Easterla 1992). Migratory routes are not well documented; in eastern North America Red-headed Woodpeckers are known to migrate along the New England coast as well as the eastern mountain ridges of the Appalachians (Bull 1964; Potter *et al.* 1980; Hall 1983). There are limited banding recovery data for the species in Canada, with only three recoveries showing movements over 100 km, with a mean movement of 157 km and maximum of 251 km (Brewer *et al.* 2006).

Belson (1998) reports that for three juvenile Red-headed Woodpeckers monitored in Florida, initial dispersal from their natal territories varied from 0.11 to 0.67 km. However, return to natal sites appears to be low, with Ingold (1991) finding that none of 69 young returned to their natal sites in Mississippi, suggesting that juveniles may play an important role in colonizing gaps in species distribution. In comparison, the same study reported that 15 of 45 adults returned to the vicinity of their previous year's nest (Ingold 1991). In Florida, one adult male moved 1.04 km between two consecutive breeding seasons (Belson 1998).

Interspecific Interactions

Nest and adult predation

Red-headed Woodpecker nests (eggs or nestlings) are most commonly preyed upon by snakes and mammals such as Raccoon (Venables and Collopy 1989). Adult Red-headed Woodpeckers are reportedly a favoured prey item of nesting Cooper's Hawk (*Accipiter cooperii;* Vukovich and Kilgo 2009), and also preyed upon by Sharp-shinned Hawk (*A. striatus*; Vukovich and Kilgo 2009), Peregrine Falcon (*Falco peregrinus;* Errington 1933), Eastern Screech-Owl (*Megascops asio;* Graber and Graber 1977)*, and* Red Fox (*Vulpes fulva*; Errington 1937). Nest predators are scolded at the nest by adult birds, and churring calls are given to low-flying hawks (Frei *et al.* 2017).

Non-predatory interspecific interactions

Red-headed Woodpeckers are both territorial and highly aggressive (Frei *et al.* 2017). Non-predatory interactions are typically a result of competition for food resources, or cavities for nesting. Red-headed Woodpeckers often chase conspecifics or drive away other species during both the breeding and non-breeding season, especially near nest sites or food caches (Reller 1972; Frei *et al.* 2017).

Aggressive interactions for food resources have primarily been reported during the non-breeding season. During winter, Red-headed Woodpecker is reported to be especially aggressive towards Red-bellied Woodpecker, Downy Woodpecker (*Picoides pubescens*), Blue Jay, Tufted Titmouse (*Baeolophus bicolor*), White-breasted Nuthatch (*Sitta carolinensis*), and Brown Creeper (*Certhia americana*; Reller 1972; Williams and Batzli 1979a), possibly contributing to local declines in abundance of those species within Red-headed Woodpecker winter territories (Kendeigh 1982; Frei *et al*. 2017). Niche partitioning, particularly differences in foraging patterns, during the breeding season appears to be an important mechanism allowing for coexistence of Red-headed Woodpecker and its congener the Lewis's Woodpecker (*Melanerpes lewis*) where the two nest in sympatry (Vierling *et al.* 2009). Likewise, it appears that Red-bellied Woodpecker competes with Red-headed Woodpecker for hard mast food supplies over the fall and winter. Williams and Batzli (1979b) showed that Red-bellied Woodpeckers change their horizontal distribution and use different habitats when Red-headed Woodpeckers are present in the same area. During years when Red-headed Woodpeckers were present in the study area, Red-bellied Woodpeckers were only found in the lowland forests near the Sangamon River of Illinois, while in years when Red-headed Woodpeckers were absent, Red-bellied Woodpeckers used both the lowland and upland forests (William and Batzli 1979b).

The majority of aggressive interactions between Red-headed Woodpecker conspecifics and other cavity-nesting species occur during the breeding period due to competition for nest excavation sites or cavities themselves. While there is a single report from New York State of an attempted conspecific nest usurpation and/or depredation (Berl *et al.* 2013), most of the documented instances of aggression during the breeding period involve European Starling and Red-bellied Woodpecker, two species with nesting behaviour similar to that of Red-headed Woodpecker. In Mississippi, the proportion of Red-headed Woodpecker nest cavities usurped by starlings varied from 7% to 15% (Ingold 1989), and in the northern part of the species' breeding range in Ontario, almost half of Red-headed Woodpecker nest failures were likely the result of aggressive cavity usurpations or harassment by starlings (Frei *et al.* 2015b). Red-headed Woodpeckers are often aggressive in their nest defence and have been reported to successfully force starlings to abandon a usurped cavity (Ingold 1989; 1994). Red-headed Woodpeckers were reported as the aggressor in 51 of 62 interactions (82%) with European Starlings and in 117 of 137 interactions (85%) with Red-bellied Woodpeckers in Mississippi (Ingold 1989). However, persistent attempts at occupation by European Starlings can eventually succeed and result in decreased Red-headed Woodpecker nest survival (Frei pers. obs.). It has been suggested that the short breeding season of European Starling and the tendency for later nesting by Red-headed Woodpecker reduces the competition between the species in the

southern part of its range in the US (Ingold 1989, 1994; Koenig 2003). This may be different in the northern part of the species' range in Canada, where Red-headed Woodpeckers and European Starlings often initiate nests at the same time (Frei *et al.* 2015b).

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

National Surveys: The Breeding Bird Survey and Christmas Bird Count

The Breeding Bird Survey (BBS) is a large-scale survey that monitors population trends for birds in North America (Sauer *et al.* 2014; Environment and Climate Change Canada 2016). Volunteers conduct the BBS once annually at 50 three-minute point counts at 0.8-km intervals along 39.2 km long survey routes throughout Canada and the United States. At each stop, every bird seen or heard within a 400-m radius is recorded (Environment and Climate Change Canada 2016). In Canada, Red-headed Woodpecker range is fairly well covered by the BBS, although the precision of the results is reported as 'medium' by the Status of Birds in Canada (2014), partly because early detection of significant short-term decreases for the species in Canada may be difficult. This survey is believed to be a relatively effective means of monitoring Red-headed Woodpecker populations (Sauer *et al.* 2014). For example, this species is highly vocal during the BBS survey period and can therefore be readily detected during the surveys where it is found (Woodliffe 1987; Frei *et al.* 2017). However, there are areas where the roadside BBS fails to adequately survey for the species, and where habitat-driven searches would be far more successful (Artuso pers. comm. 2016; Risley pers. comm. 2017). Recently a Bayesian hierarchical modelling approach has been adopted for the analysis of BBS trends, providing a better representation of population change patterns over time than previous analytical methods (Sauer and Link 2011). The Red-headed Woodpecker BBS trends reported in this status report are based on the results of this approach.

The Christmas Bird Count (CBC) is the largest and oldest program for monitoring winter bird populations in North America (Sauer *et al.* 1996). The CBC takes place annually between December 14 and January 5, with more than 40,000 volunteers recording all species that they encounter within circles 24-km in diameter located throughout North America (Sauer *et al.* 1996). Although a summary of the data is available for 1900 to 2015 (National Audubon Society 2010), trend analyses are currently available only from 1966 to 2012. Trends are corrected for search effort by dividing the number of birds observed by the number of observer-party hours (Sauer *et al.* 1996). CBC data provide a measure of changes in abundance of wintering populations over time for Red-headed Woodpecker, which should be taken with a cautionary note that the CBC was not initially intended for population monitoring (Dunn *et al.* 2005).

Provincial Breeding Bird Atlases

Provincial Breeding Bird Atlases (BBA) are intensive five-year surveys aimed at documenting the distribution and relative abundance of breeding birds across large spatial extents (i.e., Canadian provinces). Surveys are volunteer-based, with experienced observers recording levels of breeding evidence (possible, probable, and confirmed) for all species within standardized 10 x 10 km squares. Observers typically aim for a minimum of 20 hours of effort per square, but actual effort time is variable, making presence/absence data more robust than abundance data. Some atlases (e.g., Ontario, Québec, Maritimes) have been replicated ~20 years after the original effort, making them valuable for comparing temporal and spatial changes in the distribution of breeding birds. A comparison of the abundance index (i.e., the number of 10 km x 10 km squares per 100 km x 100 km block surveyed where the species was observed, divided by the total number of squares per block surveyed) of the two survey periods provides Red-headed Woodpecker population trends over the period between the two surveys. The methods used during breeding bird atlases are well-suited for surveying Red-headed Woodpecker because it is easily detectable by its call during the breeding season (Frei *et al.* 2017), and because the species occurs mainly in the southern parts of provinces, which are typically very well-covered during atlas surveys (Cadman *et al.* 1987, 2007).

The Ontario Breeding Bird Atlas projects for 1981-1985 (Cadman *et al.* 1987) and 2001-2005 (Cadman *et al*. 2007) are an important source of data for estimating Red-headed Woodpecker population trends in the province, especially given analysis in the second atlas of changes over time.

Similarly, the two Québec Breeding Bird Atlases between 1984-1989 and 2010-2014 provide insight to the changes in the small numbers of Red-headed Woodpecker found in that province (Gauthier and Aubry 1996; AONQ 2018). Additionally in Québec, the SOS-POP (Suivi des espèces en péril) has surveyed bird species at risk since 1994. This database is jointly managed by the Regroupement QuébecOiseaux and the Canadian Wildlife Service, with sightings entered into SOS-POP being incorporated into the Centre de données sur le patrimoine naturel du Québec (CDPNQ) database, managed by the Ministère des Forêts, de la Faune et des Parcs.

The first Manitoba Breeding Bird Atlas was recently completed (2010-2014) and provides the most comprehensive dataset for Red-headed Woodpecker abundance and occurrence in the province (Artuso *et al.* 2016). As this was the first atlas for Manitoba, no trends for the species are available, but the data serve as a baseline against which future population changes can be compared (Figure 4).

As the first formal Saskatchewan Breeding Bird Atlas is underway for 2017-2021, there are no formal atlas data available yet for the province. Some data are available from the previous Saskatchewan Bird Atlas, an ongoing project since the 1970s, with informal data collected from a wide variety of sources (Government of Saskatchewan 2012), but data are limited in quantity and detail, precluding their use for trend calculations.

Canadian Migration Monitoring Network (CMMN)

The Canadian Migration Monitoring Network involves the cooperative efforts of 25 bird-banding and observatory stations across Canada that are active during spring and/or fall passerine migration periods. Stations collect abundance data (e.g., Daily Estimated Totals) using standardized protocols and monitor migrating birds, either by capture or observation, repeated daily and annually (Bird Studies Canada 2016). While there are currently nine monitoring stations operating within the breeding range of Red-headed Woodpecker, the abundance of migrants is too low to generate meaningful long-term trends.

Abundance

The global Red-headed Woodpecker population is currently estimated to be 1.2 million mature individuals (600,000 pairs) based on BBS data from 1998-2007 (Partners in Flight Science Committee 2013), with the vast majority breeding in the USA. Based on the same analysis, the Canadian population was estimated to be 8,000 mature individuals. However, the data quality rating (yellow) is lower for the Canadian estimate, due to fewer data resulting in less certainty in the estimates (Partners in Flight Science Committee 2013). The Ontario population was estimated at 3,000 individuals, with an average of 0.01 birds/route (present at 19/221 routes), and the Manitoba population was estimated at 5,000 individuals with an average of 0.03 birds/route (present at 12/66 routes).

Considering that the above abundance estimates are based on an average of BBS data from 1998-2007 (~15 years ago), and that the long-term trend is -1.88% per year (Table 1), it can be inferred that the current Canadian population is closer to 6,000 individuals, or approximately 3,000 pairs. Similarly, considering provincial trend estimates for the same time period, this would place the current Ontario estimate at approximately 1,800 individuals and the Manitoba estimate at approximately 4,200 individuals.

Table 1. Long-term and short-term (three-generation) population trends for Red-headed Woodpecker in Canada, based on Breeding Bird Survey data; bolded trends are statistically significant (Environment and Climate Change Canada unpub. data 2017). Trends are not available for Québec or Saskatchewan.

Period	Region	Years	Annual % Rate of Change (95% Lower/ Upper CI)	Cumulative % Change (95% Lower/Upper CI)	Probability of decline >30%	Number of routes
Long-term	Canada	1970 – 2016	**-1.88 (-3.91, -0.16)**	**-58.2 (-84.0, -7.0)**	0.906	84
	Ontario	1970 – 2016	**-3.42 (-5.00, -1.42)**	**-79.8 (-90.6, -48.1)**	0.994	54
	Manitoba	1970 – 2016	-1.18 (-3.95, 1.49)	-42.1 (-84.3, 97.8)	0.634	30
Short-term	Canada	2004 – 2016	-1.44 (-6.19, 3.50)	-16.0 (-53.5, 51.1)	0.248	75

Period	Region	Years	Annual % Rate of Change (95% Lower/ Upper CI)	Cumulative % Change (95% Lower/Upper CI)	Probability of decline >30%	Number of routes
	Ontario	2004 – 2016	-3.01 (-8.04, 2.56)	-30.7 (-63.4, 35.4)	0.515	45
	Manitoba	2004 – 2016	-1.02 (-6.74, 5.20)	-11.6 (-56.7, 83.8)	0.230	30

Results from the provincial breeding bird atlases indicate lower population estimates. Data from the second Ontario Breeding Bird Atlas (2001-2005) suggest a minimum of 1,000 mature individuals (based on presence/absence in 10 x 10 km squares) and a maximum of 3,800, based on extrapolations from atlas point counts, although since this estimation was made the numbers have undoubtedly continued to decrease (Cadman pers. comm. 2016). Applying the BBS trend estimate as above, this can be extrapolated to a current range of 593 to 2255 mature individuals in Ontario, and the lower end of this range appears more likely (Risley pers. comm. 2017). Based on the recent Québec Breeding Bird Atlas and the SOS-POP, an estimated 0-3 Red-headed Woodpecker pairs occur in Québec (Shaffer pers. comm. 2016). From the recent Manitoba Breeding Bird Atlas (2010-2014), the average of three different estimations (average number of mature individuals per BBA square, point count abundance/region, and point count abundance/BCR) yielded a minimum provincial estimate of 1,621 ± 198 SE mature individuals, although the actual number is believed to be between 3,000 and 4,000 because in many cases point count detections likely indicated the presence of a pair or cluster of pairs (Artuso *et al.* 2016, pers. comm. 2016). There is no recent population estimate available for Saskatchewan, but the species is considered very rare in the province, generally with no more than one or two sightings per year, and several years can pass between observations (Sawatsky pers. comm. 2016). Together, the provincial BBA estimates (QC, ON, MB) suggest that the number of mature Red-headed Woodpeckers in Canada could range from approximately 2,250 to 6,250, and most likely is around 4,000 to 4,500. The BBA estimate is therefore approximately two-thirds to three-quarters of that derived from the BBS. The BBA estimates are likely to be more accurate than BBS for this species in Manitoba and Ontario, given the more thorough coverage of the atlas surveys.

Fluctuations and Trends

Historical and Qualitative Trends

Range-wide

Numbers of Red-headed Woodpeckers are strongly influenced by human land use and activities, and as such populations have fluctuated widely since the first European settlers arrived in North America (Frei *et al.* 2017). The high abundance in the 18th and 19th centuries is attributed to the increase in open farmlands, fencerows, and small woodlots, which provided the species ample habitat in the eastern and central regions of North America (Peterjohn 1989; Frei *et al.* 2017). However, as forest clearing continued in

the early 20th century, Red-headed Woodpecker populations declined, in parallel with the disappearance of the extensive mature oak-beech forests that had produced large quantities of hard mast that the species relied upon (Forbush 1927; Frei *et al.* 2017). Red-headed Woodpecker populations rebounded from the 1950s to the 1970s, as the species benefited from a pulse of standing dead wood following demise of many American Elms (*Ulmus americana*) that had succumbed to fungal Dutch Elm Disease (*Ceratocystis ulmi*; Kendeigh 1982). This population surge was short-lived, and Red-headed Woodpecker populations have since declined again.

Québec

It is suggested that Red-headed Woodpecker was likely more abundant in Québec in the 19th century than in the late 1970s (Ouellet 1974). This species was, at one time, reported as a regular breeder at certain sites on Montréal Island, such as Mount Royal, where it nested for a prolonged period (i.e., 1936-1968; Ouellet 1974). Nesting Red-headed Woodpeckers were recorded for 29 sites from 1960-1996, compared with only seven from 1997-2004, and three in 2005-2015 (SOS-POP; Shaffer pers. comm. 2016; AONQ 2018). The last breeding record for the species from the SOS-POP database was in 2010, suggesting that the species is now a rare, sporadic breeder in this province (Shaffer pers. comm. 2016).

Ontario

Although there are no historical data on Red-headed Woodpecker numbers in Ontario, this species was once regarded as relatively abundant in the southern parts of this province (Macoun and Macoun 1909; Taverner 1919). However, it began to decline in the early 1900s, and by the 1960s, its numbers had already declined appreciably in many parts of its range where it was once common, such as the Kingston area and Point Pelee National Park (Peck and James 1983; COSEWIC 1996).

Manitoba

Although considered rare to uncommon in the 1800s (Seton 1891), Red-headed Woodpecker populations increased rapidly in the early 1900s in the province, peaking in the 1960s (Manitoba Avian Research Committee 2003). Since the 1980s, the provincial population has been in decline, and the species has disappeared from some areas (COSEWIC 1996; Artuso pers. comm. 2016).

Saskatchewan

There are few historical data to identify a long-term trend for Saskatchewan, but Red-headed Woodpecker is now generally rare in the province and believed to be declining further (Sawatsky pers. comm. 2016). There is a general perception that the species was more abundant prior to the introduction of the European Starling (COSEWIC 1996).

Recent and Quantitative Trends

Breeding Bird Survey

Long-term BBS data for Canada show a significant long-term decline of -1.88% per year (95% CI: -3.91, -0.16) between 1970 and 2016, which equates to a long term cumulative decline of -58.2% (95% CI: -84.0, -7.0) (Table 1, Figure 6; Environment and Climate Change Canada unpub. data 2017). This appears to be driven largely by a significant long-term decline in Ontario of -3.42% per year (95% CI: -5.00, -1.42), amounting to a cumulative loss of -79.8% (95% CI: -90.6, -48.1). In Manitoba, there was a non-significant decline of -1.18% per year (95% CI: -3.95, 1.49) over 1970-2016, with a cumulative change of -42.1% (95% CI: -84.3, 97.8). Data for Saskatchewan and Québec are too sparse to derive trend estimates.

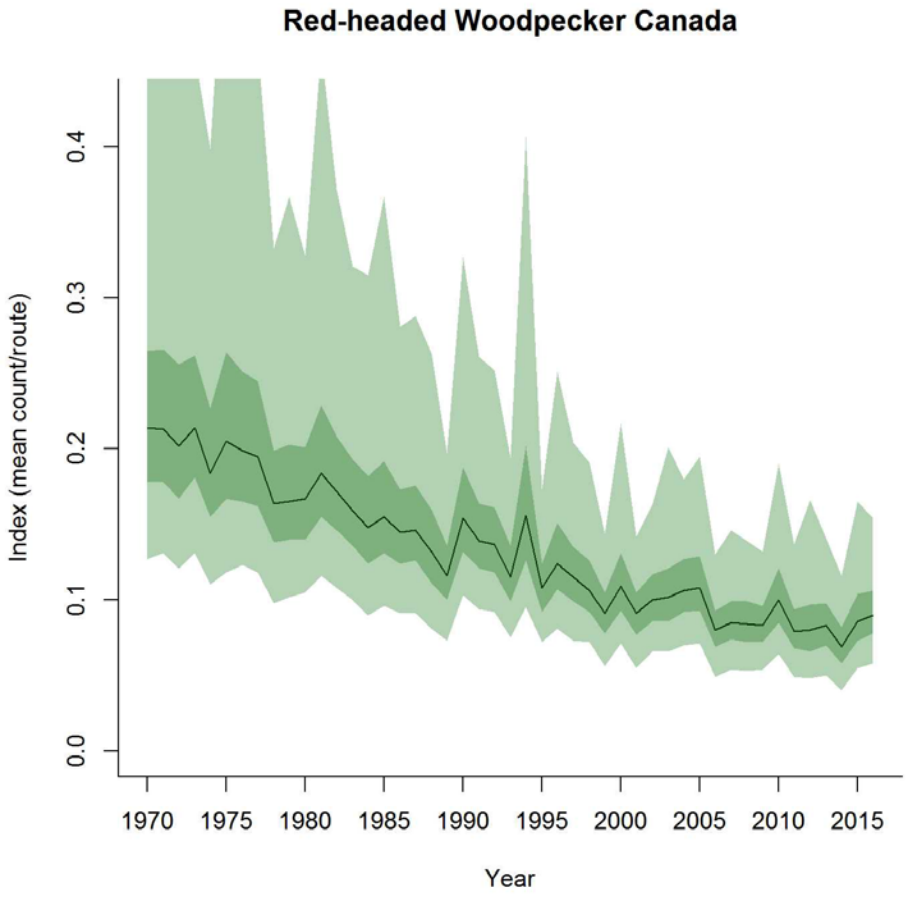

Figure 6. Annual index of population abundance for Red-headed Woodpecker, based on Breeding Bird Survey data from 1970-2016. Light and dark green shaded areas depict upper and lower 95% and 50% credible intervals, respectively (Adam Smith, Environment and Climate Change Canada, unpublished data).

For the most recent three generations (2004-2016), the Canada-wide trend is -1.44% per year, but with broad uncertainty (95% CI: -6.19, 3.50). This reflects some degree of annual variation among rolling 12-year (three generation) trends (Figure 7), although estimates have remained below zero for all 35 years of coverage. Considering these fluctuations, a cumulative decline of 20% over the past three generations can be inferred from the long-term trend of -1.88% per year. Short-term (2004-2016) provincial trends are not significant, at -3.01% per year (95% CI: -8.04, 2.56) in Ontario, and -1.02% per year (95% CI: -6.74, 5.20) in Manitoba.

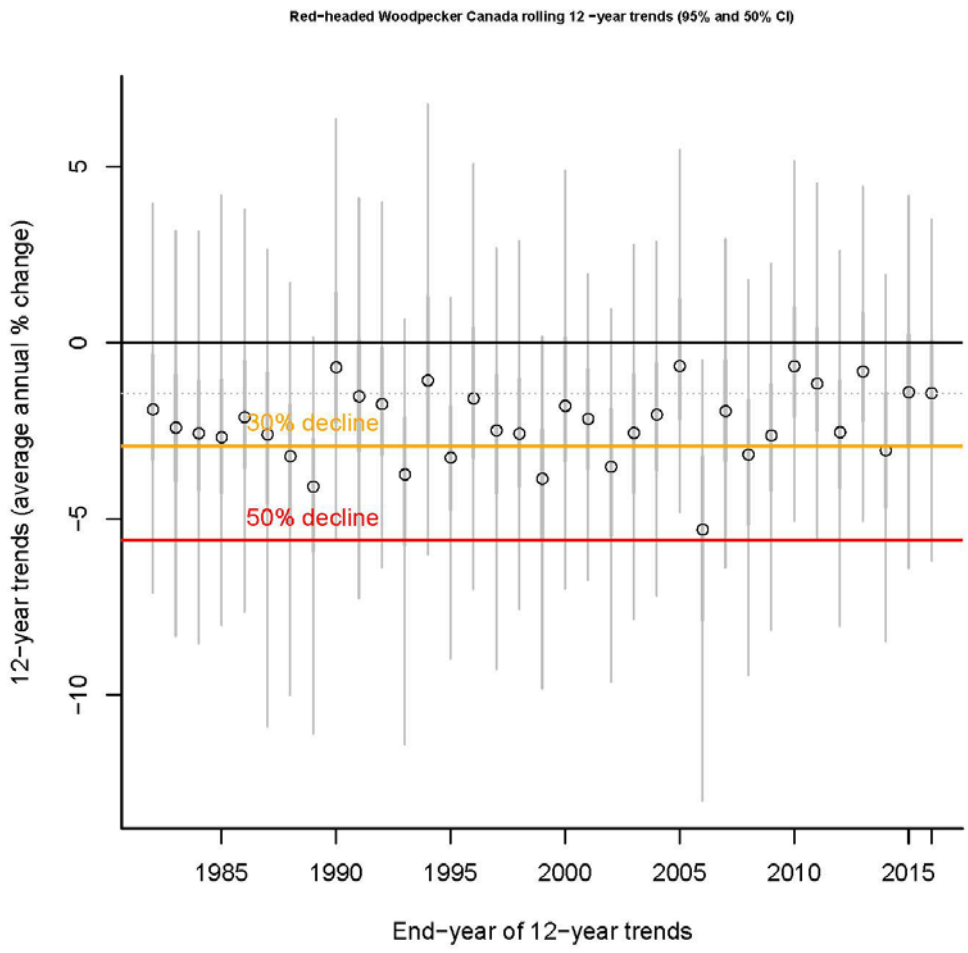

Figure 7. Rolling 12-year (three generation) trends for Red-headed Woodpecker in Canada from 1970-1982 through to 2004-2016, based on Breeding Bird Survey data (A. Smith unpubl. data 2017). The vertical axis represents the last year of the 12-year rolling trend (e.g., 1982 is the trend for 1970-1982). Thick and thin grey vertical error bars depict 50% and 95% credible intervals, respectively. Orange and red horizontal lines depict 30% and 50% cumulative short-term decline rates, which represent COSEWIC thresholds for listing a species as Threatened and Endangered, respectively. The dotted grey horizontal line represents the annual rate of change over the past three generations (-1.44%).

The status of the population can also be evaluated through considering the annual rate of change, either growing (>1), remaining stable (1), or declining (<1). The mean annual rate of change for Red-headed Woodpecker across years is 0.98, with a 5-year mean of 0.88, and 10-year mean of 0.77 (Table 2) (Environment Canada 2014).

Table 2. Rate of population change in 1-year (N_t/N_{t-1}), 5-year (N_t/N_{t-5}), and 10-year (N_t/N_{t-10}) intervals, or moving windows, for Red-headed Woodpecker in Canada between 1970 and 2012, based on a hierarchical Bayesian model of Breeding Bird Survey data (Environment Canada 2014). Population growth occurs when the rate of change during the time interval is >1, population decline occurs when the rate of change during the time interval <1, and the population is stable when =1.

Year (N_t)	1-year interval	5-year interval	10-year interval
1971	0.99	NA	NA
1972	0.95	NA	NA
1973	1.07	NA	NA
1974	0.85	NA	NA
1975	1.06	0.91	NA
1976	0.97	0.89	NA
1977	1.02	0.95	NA
1978	0.85	0.75	NA
1979	0.99	0.87	NA
1980	1.00	0.82	0.75
1981	1.08	0.92	0.82
1982	0.95	0.86	0.82
1983	0.93	0.94	0.71
1984	0.93	0.88	0.77
1985	1.01	0.89	0.73
1986	0.96	0.79	0.72
1987	1.00	0.83	0.71
1988	0.90	0.80	0.75
1989	0.92	0.80	0.70
1990	1.21	0.96	0.85
1991	0.91	0.91	0.71
1992	0.99	0.90	0.75
1993	0.88	0.89	0.71

Year (N_t)	1-year interval	5-year interval	10-year interval
1994	1.17	1.13	0.90
1995	0.78	0.73	0.70
1996	1.06	0.85	0.77
1997	0.96	0.82	0.74
1998	0.96	0.89	0.80
1999	0.90	0.69	0.78
2000	1.01	0.89	0.65
2001	0.97	0.82	0.69
2002	1.04	0.89	0.73
2003	0.98	0.90	0.81
2004	1.04	1.04	0.72
2005	0.99	1.02	0.91
2006	0.82	0.87	0.71
2007	1.00	0.83	0.74
2008	1.01	0.86	0.77
2009	0.99	0.81	0.85
2010	1.06	0.87	0.89
2011	0.89	0.95	0.82
2012	1.01	0.96	0.80
Mean rate of change (1970-2012)	**0.98**	**0.88**	**0.77**
Mean % decline (1970-2012)	**2.23% / year**	**12.15% / 5 years**	**23.39% / 10 years**
Mean rate of change (2002-2012)	**0.99**	**0.91**	**0.80**
Mean % decline (2002-2012)	**1.39% / year**	**9.04% / 5 years**	**20.44% / 10 years**

Christmas Bird Count

Abundance indices derived from CBC data for Red-headed Woodpecker in Canada between 1970 and 2015 show large fluctuations between the 1970s and the mid-1980s, followed by a decline and levelling off at all-time low numbers (Figure 8). For the period between 1966 and 2012, CBC data show a continental, non-significant decline of -0.26%/year (95% CI: -1.21, 0.40) in North America (Smith pers. comm. 2017).

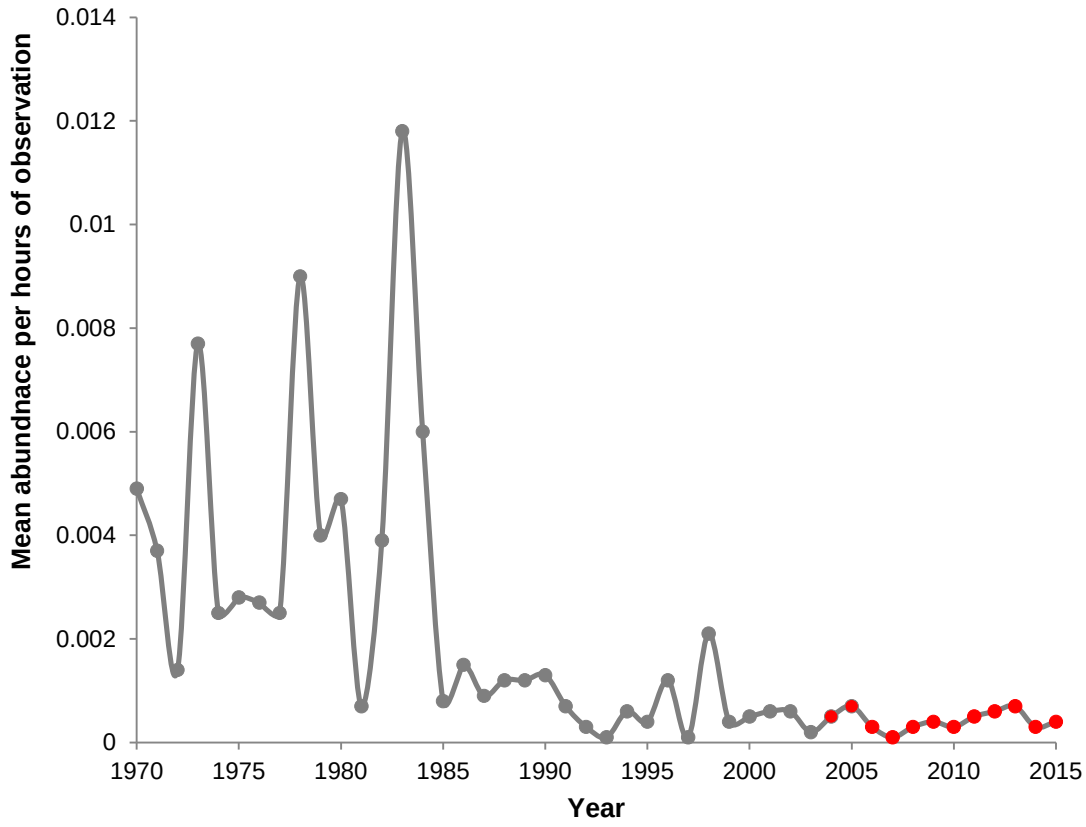

Figure 8. Mean abundance per hours of observation of Red-headed Woodpeckers in Canada between 1970 and 2015, as recorded on the Christmas Bird Count (National Audubon Society 2010). The trend for the most recent 12 years is highlighted in red.

Provincial Breeding Bird Atlases

In Ontario, the percent of well-sampled atlas squares occupied by Red-headed Woodpecker fell 66% between the two atlas projects, from 19.6% (732/3,727) in 1981-1985, to 6.6% (220/4,990) in 2001-2005 (Woodliffe 1987, 2007), with notable declines in the Southern Shield and northernmost areas of the Lake Simcoe-Rideau regions (Figure 3). The decline of the species in Ontario is also apparent from the comparison of the abundance indices for the two periods. The number of survey squares in which the species was observed fell in 33 of the survey blocks between atlas periods and rose in only 3 (2-tailed Wilcoxon signed rank sum test = -4.5, $P \leq 0.001$; COSEWIC 2007). In Québec, the percent of well-sampled atlas squares occupied by Red-headed Woodpecker fell 94% between the two atlas projects, from 1.05% (26/2,462) in 1984-1989, to 0.07% (4/5,568) in 2010-2014 (Gauthier and Aubry 1996; AONQ 2018).

Population Trends Outside Canada

Long-term BBS data show a significant annual rate of decline of -1.75% per year (95% CI: -1.98, -1.53) between 1970 and 2016 for Red-headed Woodpecker across the United States, equating to a cumulative decline of -54.8% (95% CI: -59.3, -50.0) (Environment and

Climate Change Canada unpub. data 2017). The short-term (2004-2016) rate of decline for the species in the United States is not statistically significant (-0.40%, 95% CI: -1.04, 0.20). Red-headed Woodpecker shows range contraction over the last few decades, a pattern that is especially pronounced at the northern edge of their range (Frei *et al.* 2017; Figure 9).

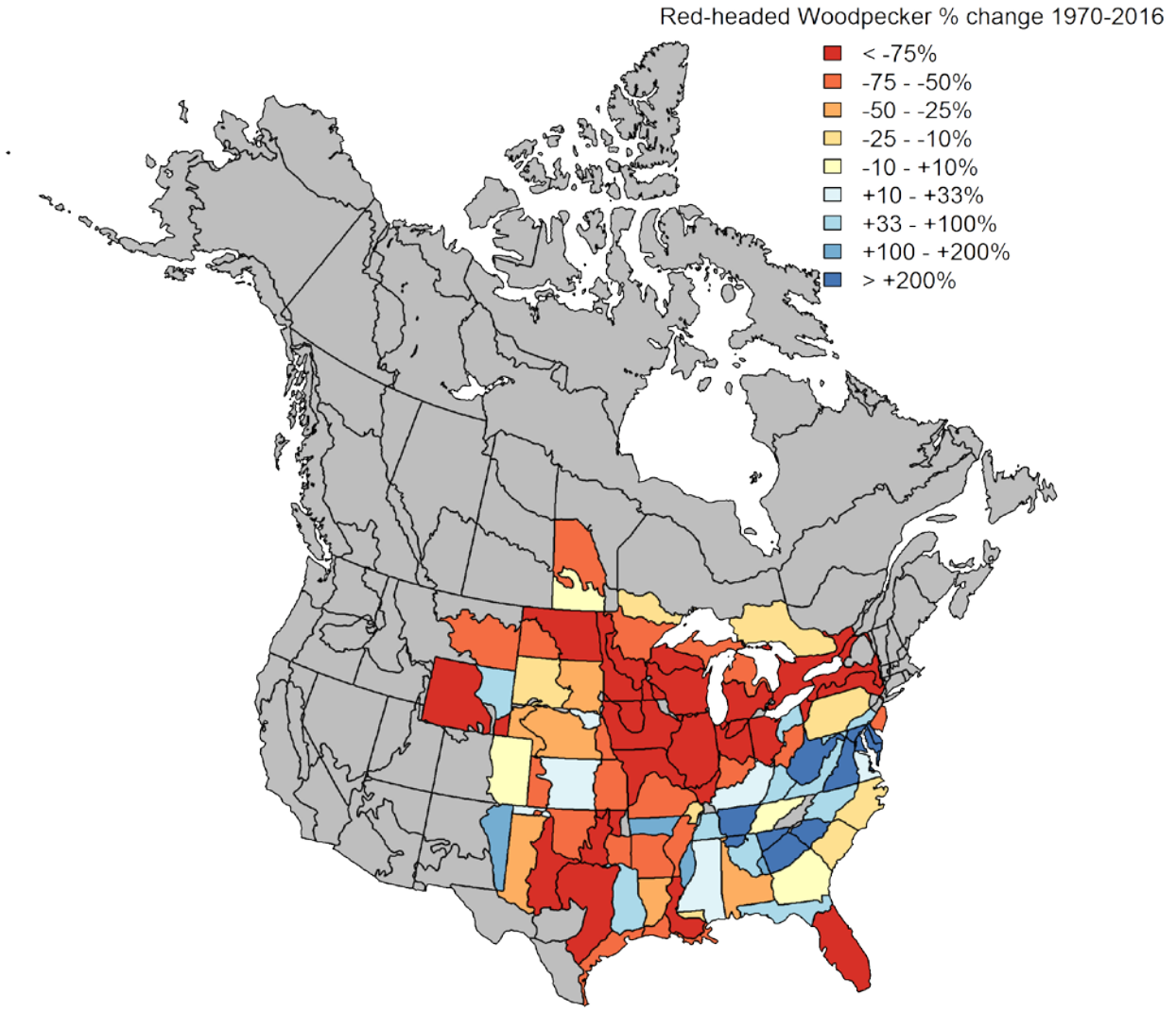

Figure 9 Estimated long-term (1970-2016) population change for Red-headed Woodpecker based on Breeding Bird Survey, for each of the political / Bird Conservation Region strata within the sampled range of the species (A. Smith unpubl. data 2018).

Hierarchical modelling of BBS data from 1970 to 2016 shows that Red-headed Woodpecker numbers are in decline in all eight states that border the Canadian range, with estimates of cumulative declines ranging from -26% in Pennsylvania to -97% in New York, and also exceeding -80% in four other states (North Dakota, Minnesota, Wisconsin, and Michigan; Table 3). The trends over the past three generations (2004 to 2016) are also estimated to be negative in all of these states, including significant declines exceeding -45% in Minnesota, Michigan, and New York (Table 3). These declines are corroborated by

results in states which have undertaken second breeding bird atlases, all of which have fewer survey blocks reporting Red-headed Woodpecker presence in the second atlas. This includes New York (-70% decline between 1980-1985 and 2000-2005; Berl *et al.* 2014), Michigan (-61% decline between 1983-1988 and 2002-2008; Chartier *et al.* 2011), and Ohio (-27% decline between 1982-1987 and 2006-2011; Batdorf 2012).

Table 3. Long-term and short-term (three-generation) population trends for Red-headed Woodpecker in states bordering Canada, based on Breeding Bird Survey data; bolded trends are statistically significant (Environment and Climate Change Canada unpub. data 2017).

Period	Region	Years	Annual % Rate of Change (95% Lower/ Upper CI)	Cumulative % Change (95% Lower/Upper CI)	Probability of decline >30%	Number of routes
Long-term	Montana	1970 – 2016	-1.61 (-4.89, 1.79)	-52.5 (-90.0, 126.0)	0.696	11
	North Dakota	1970 – 2016	**-3.95 (-6.00, -1.74)**	**-84.3 (-94.2, -55.5)**	0.997	35
	Minnesota	1970 – 2016	**-6.21 (-7.11, -5.28)**	**-94.8 (-96.6, -91.8)**	1.00	65
	Wisconsin	1970 – 2016	**-4.28 (-5.23, -3.26)**	**-86.6 (-91.5, -78.2)**	1.00	80
	Michigan	1970 – 2016	**-4.65 (-5.88, -3.29)**	**-88.8 (-93.8, -78.5)**	1.00	60
	Ohio	1970 – 2016	**-1.89 (-2.91, -0.79)**	**-58.4 (-74.3, -30.5)**	0.977	71
	Pennsylvania	1970 – 2016	-0.65 (-2.45, 1.25)	-25.9 (-68.0, 77.3)	0.449	57
	New York	1970 – 2016	**-7.64 (-9.87, -5.41)**	**-97.4 (-99.2, -92.3)**	1.00	36
Short-term	Montana	2004 – 2016	-2.05 (-10.7, 4.14)	-22.0 (-74.4, 62.7)	0.372	11
	North Dakota	2004 – 2016	-3.90 (-9.92, 2.63)	-37.9 (-71.5, 36.6)	0.625	33
	Minnesota	2004 – 2016	**-5.84 (-8.37, -2.93)**	**-51.4 (-65.0, -30.0)**	0.975	63
	Wisconsin	2004 – 2016	-1.43 (-4.82, 2.36)	-15.8 (-44.7, 32.3)	0.211	76
	Michigan	2004 – 2016	**-4.94 (-9.01, -0.85)**	**-45.6 (-67.8, -9.7)**	0.851	43
	Ohio	2004 – 2016	-0.18 (-2.54, 3.13)	-2.14 (-26.6, 44.8)	0.012	53
	Pennsylvania	2004 – 2016	-0.60 (-6.47, 5.74)	-7.0 (-55.2 (95.4)	0.211	47
	New York	2004 – 2016	**-7.04 (-12.9, -1.26)**	**-58.4 (-81.1, -14.1)**	0.931	33

Summary of Fluctuations and Trends

Breeding Bird Survey data, Breeding Bird Atlas data, and Christmas Bird Count results show widespread long-term declines in the Red-headed Woodpecker population in

Canada, especially in Ontario. Short-term trends are less reliable given small sample sizes and fluctuations from year to year, but overall they suggest that at best, the rate of decline has slowed slightly over the past three generations.

Rescue Effect

In Canada, Red-headed Woodpecker is at the northern edge of its range, and on the periphery of larger populations in the United States to the south. Although there is no direct evidence of immigration from the United States, some immigration almost certainly takes place, especially given the persistence of the Canadian population despite the low fecundity of the species in Ontario (Frei *et al.* 2015; see **Limiting Factors**). However, the United States population has also been steadily declining, with particularly significant losses in several states bordering Canada. Therefore, although rescue of the Canadian population from the United States is theoretically possible, it seems increasingly unlikely.

THREATS AND LIMITING FACTORS

Threats

The Canadian population of Red-headed Woodpecker is vulnerable to the cumulative effects of various threats, especially the multiple factors that result in loss of standing dead wood required for nesting. These are categorized below, following the IUCN-CMP (International Union for the Conservation of Nature – Conservation Measures Partnership) unified threats classification system (based on Salafsky *et al*. 2008). They are listed in order of severity of impact (greatest to least), ending with those for which scope or severity is unknown. The overall threat impact is considered to be high, corresponding to an anticipated further decline of between 10 and 70% over the next ten years (see **Appendix 1** for details).

<u>IUCN 7, Natural System Modification (low to high threat impact):</u>

Other Ecosystem Modifications (IUCN 7.3)

The removal of dead trees from urban/residential developments, and ‘cleaning’ of forested parks or urban areas for aesthetic or safety reasons can reduce the availability of nesting opportunities for Red-headed Woodpecker. Changes to disturbance cycles can also be problematic by facilitating reforestation of previously disturbed areas, which results in a high basal area, high canopy cover, and low snag density that are unsuitable for breeding Red-headed Woodpeckers (Frei *et al.* 2017).

Reductions in insect populations (through pesticide use or other factors) may also be a threat to Red-headed Woodpecker. While it is an omnivorous generalist, aerial insects are important prey during the breeding season (Frei *et al.* 2017), and Red-headed Woodpecker may therefore be influenced by the same factors driving the widespread declines of aerial insectivores, although the contribution of these factors is unclear (Böhning-Gaese *et al.*

1993; Nebel *et al.* 2010). Red-headed Woodpecker often nests in habitats with greater canopy openness (see **Habitat Requirements**), supporting the possible importance of flycatching as a feeding strategy for the species (Frei *et al.* 2013, 2017).

Fire and Fire Suppression (IUCN 7.1)

Red-headed Woodpeckers favour conditions found following fire, and the loss of this disturbance from the landscape has likely had negative ramifications for the species. For example, fire suppression in oak woodlands has contributed to a proliferation of highly competitive shade-tolerant trees that may increase the basal area, and under- and mid-storey vegetation, rendering the habitat unsuitable for nesting Red-headed Woodpeckers (Nowacki and Abrams 2008; Berl *et al*. 2015).

IUCN 8, Invasive & Other Problematic Species & Genes (medium threat impact):

Invasive Non-Native/Alien Species (IUCN 8.1)

A detailed overview of the interference competition faced by Red-headed Woodpecker for nest sites can be found in the **Non-predatory interspecific interactions** section above.

Several tree diseases, including Chestnut Blight (Van Drunen *et al.* 2017), Dutch Elm Disease, and Beech Bark Disease (Cale *et al.* 2017; Stephanson and Coe 2017), are documented across the range of Red-headed Woodpecker. These diseases may have a short-term positive effect on Red-headed Woodpecker by increasing the amount of standing dead wood in the landscape, but this resource pulse would be quickly followed by a longer lull leading to a decreased availability in nest sites (McLaughlin and Greifenhagen 2012; Frei *et al.* 2017). In addition, beech trees provide an important food resource for Red-headed Woodpeckers and their disappearance may be one of the many reasons for the species' declines (Graber and Graber 1977; Peterjohn 1989).

European Starling is a well-documented interference competitor for Red-headed Woodpecker, and the degree to which they may drive nest failure may vary greatly throughout the species' range and across habitat types. In the single study of Red-headed Woodpecker in Canada (southern and central Ontario), almost half of all nest failures were a result of aggressive cavity usurpations or harassment by starlings, and nests where they were present were four times more likely to fail than those where they were absent (Frei *et al*. 2015). Large-scale analyses failed to find correlations between Red-headed Woodpecker declines and European Starling numbers (Koenig 2003, Koenig *et al*. 2017), but did not account for the overarching confounding effect of changes in forest cover, which similarly affects both species.

Problematic Native Species (IUCN 8.2)

Red-bellied Woodpecker is considered a potential interspecific competitor for Red-headed Woodpecker, and appears to be expanding northward into the Canadian range of Red-headed Woodpecker, especially as the latter is contracting southward. There is little

evidence that interactions between these two species may cause population-level declines in Red-headed Woodpecker (Ingold 1990; Koenig *et al*. 2017), but there is a lack of Canadian research on this topic. Cooper's and Sharp-shinned Hawks are known predators of both adult and juvenile Red-headed Woodpeckers. Koenig *et al.* (2017) demonstrated correlations between increases in forest-dwelling accipiters and decreases in Red-headed Woodpecker, but did not address the confounding effect of changes in forest cover, which inversely affect accipiter and Red-headed Woodpecker populations.

IUCN 5, Biological Resource Use (low to medium threat impact):

Logging & Wood Harvesting (IUCN 5.3)

Whether through intentional logging or smaller-scale wood harvesting activities in forests and woodlots, the removal of dead wood and destruction of nesting sites (e.g., snags and dead tree limbs) likely contributes to the Red-headed Woodpecker's population decline (Frei *et al.* 2017). As Red-headed Woodpecker is a weak cavity-nester that needs highly decayed wood for nest site excavation, habitat may become unsuitable for a long time once dead wood is removed. It has therefore been suggested that forest management practices such as short-rotation harvests and firewood cutting may reduce the distribution and quality of forest stands with a supply of high densities of dead wood, especially of older decay classes, reducing suitable breeding habitat for Red-headed Woodpecker (Berl *et al.* 2015). The majority of logging and wood harvesting activities affecting this species are private or small-scale logging in woodlots, rather than commercial operations.

IUCN 1, Residential & Commercial Development (low threat impact):

Housing and Urban Areas (IUCN 1.1)

There is a risk of continued habitat loss and degradation due to urbanization, particularly in natural treed areas adjacent to developed areas, or in sparsely treed anthropogenic habitat the species is frequently found in, such as parks, campgrounds, cemeteries, and golf courses. Research in Illinois suggests avoidance by Red-headed Woodpeckers of highly urbanized areas for nesting; this avoidance is likely driven by a lack of nesting and feeding habitat (i.e., lower decay class of trees, lack of standing dead wood, lower density of mast trees; Anderson and LaMontagne 2016). Habitat degradation due to increased land use intensity in anthropogenic habitats used by Red-headed Woodpeckers includes loss of standing dead wood for aesthetic/safety reasons (see *Biological Resource Use - Logging and wood harvesting*). Lastly, while not noted as being particularly vulnerable to building strikes, Red-headed Woodpecker has been documented by the Fatal Light Awareness Program (FLAP) as victims of collisions in the Greater Toronto Area and Ottawa region (FLAP 2016). Note that this species generally occurs in rural settings in Canada, with urban occurrences largely limited to the migration period.

Commercial and Industrial Areas (IUCN 1.2) and Tourism and Recreation Areas (IUCN 1.3)

Effects are similar to those caused by housing and urban areas, but with a much smaller scope, and therefore expected to have a negligible impact.

IUCN 2, Agriculture & Aquaculture (low threat impact):

Annual & Perennial Non-Timber Crops (IUCN 2.1)

Agricultural intensification (including conversion to row crops) and removal of woodlots and hedgerows in agricultural landscapes can reduce availability of habitat. Additionally, while Red-headed Woodpeckers often use treed farmland habitat, or small woodlots associated with the agricultural landscape, these habitats may be vulnerable to intensification (e.g., removal of hedgerows, extension of fields, increased agricultural inputs, etc.), thus reducing the quality of the habitat for the species and potentially leading to maladaptive habitat use (Frei *et al*. 2013).

Livestock Farming & Ranching (IUCN 2.3)

Many Red-headed Woodpeckers occur in, or adjacent to, cattle yards and pastures, particularly in southern Manitoba and to a lesser extent in Ontario. Livestock grazing is positively associated with Red-headed Woodpecker occurrence, presumably through creating and maintaining open breeding and feeding habitat for the species. As such, the removal of the cattle and subsequent forest regeneration growth (particularly high density of woody shrubs) degrades the habitat for the species. Thus the threat lies in the changes in the management of these areas, such as intensification (higher stocking rates, cutting down trees and snags) or de-intensification (overgrowth by shrubs), both of which can reduce suitability of the habitat for Red-headed Woodpecker. In southern Ontario, there is a trend toward a decline in extent of pasture, which may be influencing the species' population in this region.

Wood and Pulp Plantations (IUCN 2.2)

The creation of tree plantations may replace open habitat preferred by this species on marginal farmlands and other open areas, without providing suitable nesting sites, but the scope and impact of this threat are likely negligible.

IUCN 4. Transportation & Service Corridors (low threat impact):

Roads & Railroads (IUCN 4.1)

Red-headed Woodpecker declines have been associated with mortality from collisions with motor vehicles, given that they forage by roadsides and have a low, undulating flight pattern (Frei *et al.* 2017).

Utility & Service Lines (IUCN 4.2)

Although there is anecdotal evidence of Red-headed Woodpeckers suffering from collisions with utility lines, it is unlikely this is a frequent occurrence. New utility lines may result in some habitat loss. This species sometimes uses wooden utility poles as nesting sites, which could have a negative impact on nestlings, as high mortality has been reported among hatchlings in nests built in telephone poles that had recently been treated with creosote (Frei *et al.* 2017). The species was also on a list of sensitive species killed at communication towers with estimated annual mortality <1% of estimated population size (Longcore *et al*. 2013).

IUCN 3, Energy Production and Mining (negligible threat impact):

Oil and gas drilling (IUCN 3.1), mining and quarrying (IUCN 3.2), and renewable energy (IUCN 3.3) all have potential to cause loss or degradation of habitat for Red-headed Woodpecker if they occur in areas used by the species. However, the scope and therefore effect are currently considered negligible for all of these activities.

IUCN 6, Human Intrusions and Disturbance (unknown threat impact):

Recreational Activities (IUCN 6.1)

Relatively few nest sites are likely to be exposed to recreational activities. Although there is no evidence to indicate that Red-headed Woodpecker is affected by them, the nature of the interaction is best classified as unknown.

IUCN 9, Pollution (unknown threat impact):

Agricultural & Forestry Effluents (IUCN 9.3)

Red-headed Woodpecker mortality has occasionally been reported as a result of pesticide or chemical exposure (Frei *et al.* 2017). For instance, a Red-headed Woodpecker population on Manitoulin Island disappeared following pesticide use in the region in the mid-20th century (COSEWIC 1996). There is also potential of chemical exposure for the species through its diet on insect prey, but this is largely unknown and under-researched.

IUCN 11, Climate Change & Severe Weather (unknown threat impact):

Habitat Shifting & Alteration (IUCN 11.1)

As a short-distance migrant, Red-headed Woodpecker may be less sensitive than long-distance migrants to some impacts of climate change such as phenological mismatches and unpredictable storms during migration. Yet climatic events may still affect the species, such as the exceptional weather event on the southwestern shore of Lake Michigan in May 1996 that resulted in 2,981 dead birds, including five Red-headed Woodpeckers (Diehl *et al.* 2014). However, the overall effects of climate change (e.g., habitat shifts) are unknown at present as their scope, severity, and timing remain unclear.

Limiting Factors

Red-headed Woodpecker is, in many ways, a generalist species that appears to be flexible in its diet choice and habitat use. Yet there are various natural history traits or other factors that might limit survival and reproduction, and thus play a role in the species' capacity to slow or reverse population declines.

Availability of Dead Wood for Nesting

Red-headed Woodpecker is a weak primary cavity nester that typically relies on softer or older dead wood to excavate a new cavity for nesting each year (Jackson 1976). Older dead wood is ephemeral in nature, especially in human-managed areas where it may be removed for safety or aesthetic reasons prior to its availability to Red-headed Woodpeckers (Rodewald *et al*. 2005). In addition to its reliance on standing dead wood for a nesting site, the species also appears to require a certain proportion of standing dead wood at or surrounding the nest site for perching, nesting, and food caching; once availability drops below a certain level, the number of individuals present may decline (see **Habitat Requirements**; Bond 1957; Conner and Adkisson 1977; Kahl *et al.* 1985; Rodewald *et al.* 2005; King *et al.* 2007; Frei *et al.* 2013, 2017; Berl *et al.* 2015). Reports that every small patch of suitable habitat is occupied in certain part of the species' range support the conclusion that Red-headed Woodpecker numbers may be limited by habitat availability, particularly by the amount of dead wood (Artuso pers. comm. 2016).

Low Fecundity

Recent research on Red-headed Woodpecker populations in Ontario and in northern New York found unusually low fledging success (39%), equivalent to an average fecundity of 0.43 female fledglings per female per year (Frei *et al.* 2015a). This fledging success is lower than any other reported for other Red-headed Woodpecker populations (50%; Ingold 1989) or other *Melanerpes* spp. (55% for Red-bellied Woodpecker; Boone 1963, and 52% for Lewis' Woodpecker (*Melanerpes lewis*); Zhu *et al*. 2012), and is below the majority of the estimated minimum thresholds needed to offset mortality for Red-headed Woodpecker, which range from 0.26-1.24 female fledglings per female per year (Frei *et al.* 2015a). One case of similarly low fledging success in this genus (40%) is reported for Lewis' Woodpeckers in south-central Idaho (Newlon and Saab 2011). However, the larger clutch size of Lewis' Woodpecker, as compared to other *Melanerpes* species (Koenig 1987), resulted in an average of 2.3 fledglings/nest (Newlon and Saab 2011), which is higher than the 1.8 fledglings/nest for Red-headed Woodpecker in Ontario and northern New York (Frei *et al.* 2015a). While annual fecundity may naturally be lower at the periphery of a species' range compared to the range core (Sagarin and Gaines 2002), there may be other, as yet unquantified, reasons leading to the species' low fecundity observed in the Canadian study. Conservation actions focusing on mechanisms to enhance reproductive success may therefore be important (Frei *et al.* 2015a).

Number of Locations

The number of locations for this species in Canada is unknown, but given that the most serious threats are likely site-specific conditions and management, there are clearly more than 10 locations.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

Like most other migratory birds in North America, Red-headed Woodpecker and its nests are protected from harm through the Canadian *Migratory Birds Convention Act* (1994) in Canada and the US *Migratory Bird Treaty Act* (1916) in the United States. Red-headed Woodpecker was listed as *Threatened* under Schedule 1 of the *Species at Risk Act* (SARA; S.C. 2002, c. 29) in 2009. The species is listed in provincial endangered species legislation in three provinces. In Québec it was listed as *Threatened* under the *Loi sur les espèces menacées ou vulnérables (RLRQ, c E-12.01) (LEMV) (Act respecting threatened or vulnerable species) (CQLR, c E-12.01).*in 2009, in Ontario it was listed as *Special Concern* under the *Endangered Species Act*, *2007* (ESA; S.O. 2007, Chapter 6) in 2008, and it is listed as *Threatened* in Manitoba under the *Endangered Species and Ecosystems Act* (C.C.S.M. c. E111). Currently the species is not listed on provincial species-at-risk lists in Alberta (listed as accidental in the latest 2010 assessment), or in Saskatchewan. The species is also listed as at risk in six states, but is not federally listed in the United States under the *Endangered Species Act* (Table 4).

Table 4. Conservation status of Red-headed Woodpecker in Canada and the United States (from NatureServe 2015).

Jurisdiction	IUCN Status*	Country/Province/State Listing
IUCN	**Near Threatened**	
Global	G5	
Canada	N4B	Threatened
Alberta	SU	
Manitoba	S2B	Threatened
Ontario	S4B	Special Concern
Québec	S1B	Threatened
Saskatchewan	S1B, S1M	
United States	N5B, N5N	
Alabama	S5	
Arkansas	S4B, S4S5N	
Colorado	S3B	
Connecticut	S1	Endangered
Delaware	S1	Endangered

Jurisdiction	IUCN Status*	Country/Province/State Listing
District of Columbia	S1N, SHB	
Florida	SNR	
Georgia	S4	
Illinois	S5	
Indiana	S4	
Iowa	S5B	
Kansas	S5B	
Kentucky	S4B, S4N	
Louisiana	S4	
Maryland	S4	
Massachusetts	S1B, S2N	
Michigan	S5	
Minnesota	SNRB, SNRN	
Mississippi	S4S5	
Missouri	SNRB, SNRN	
Montana	S3B	
Nebraska	S5	
New Hampshire	SNA	
New Jersey	S2B, S2N	Threatened
New Mexico	S3B, S3N	
New York	S2?B	Special Concern
North Carolina	S4B, S4N	
North Dakota	SNRB	Species of Conservation Priority (Level 1)
Ohio	S5	
Oklahoma	S4S5	
Pennsylvania	S4B, S4N	
Rhode Island	S1B, S1N	
South Carolina	SNR	
South Dakota	S5B	
Tennessee	S4	
Texas	S3B	
Vermont	S1B	
Virginia	S4B	
West Virginia	S2B, S3N	
Wisconsin	S3B	Special Concern
Wyoming	S3B	

*N (at start of rank) = National; S = Subnational; B = Breeding; and N (at end of rank) = Nonbreeding. 1 = Critically Imperilled; 2 = Imperilled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NA = Not Applicable; NR = Not Ranked; U = Unrankable (due to lack of information or conflicting information); ? = inexact numeric rank.

Non-Legal Status and Ranks

Red-headed Woodpecker is categorized as *Near Threatened* on the IUCN Red List (BirdLife International 2016), and as a common species in steep decline on the Partners in Flight species assessment database (Partners in Flight Science Committee 2012). As detailed in the Partners of Flight 2016 Landbird Conservation Plan Revision, Red-headed Woodpecker was recently listed as a "D" Yellow Watch List species, on a list of the 86 bird species that are of highest conservation concern at the continental (range-wide) scale (Rosenberg *et al.* 2016). "D" Yellow Watch List species are those facing moderate to high threats, for which an overarching goal is to reverse population declines (Rosenberg *et al.* 2016). On a scale of low (1) to very high (5) relative vulnerability, Red-headed Woodpecker was listed as high (4) for population size, and very high (5) for population trend, with an estimated 68% population loss (Rosenberg *et al.* 2016). For the distribution of threats, the Red-headed Woodpecker's relative vulnerability was low (1) for breeding distribution, with a medium (3) level of threat regarding its ability to reproduce and survive in its breeding and non-breeding areas (Rosenberg *et al.* 2016). Continental threats for the species are identified as urbanization and changing forest conditions (Rosenberg *et al.* 2016). The 'half-life' of Red-headed Woodpecker (i.e., the estimated number of years until an additional 50% of the global population is lost if current population trends continue into the future) is estimated at >50 years (Rosenberg *et al.* 2016).

The NatureServe Status Rank for Red-headed Woodpecker in Canada is N4B (Apparently Secure when breeding; Table 4). It is likewise ranked S4B (Apparently Secure) in Ontario, but it is ranked as S2B (Imperilled; breeding) in Manitoba, S1B (Critically Imperilled; breeding) in Québec, and S1B, S1M (Critically Imperilled; breeding, migrant) in Saskatchewan (Table 4). In the United States, Red-headed Woodpecker is nationally listed as Secure, but it is listed as Vulnerable, Imperilled, or Critically Imperilled in 15 states (Table 4).

Habitat Protection and Ownership

In Canada, the vast majority of suitable Red-headed Woodpecker habitat is under private ownership, although there is potential habitat in publicly owned areas such as in city parks and golf courses. The protected public lands where Red-headed Woodpecker is believed to be regularly occurring include certain national parks, national wildlife areas, and national historic sites, such as the Trent-Severn Waterway, Bruce Peninsula National Park, Prince Edward Point National Wildlife Area, Long Point National Wildlife Area, Big Creek National Wildlife Area, St. Clair National Wildlife Area, Navy Island National Historic Site, and Point Pelee National Park in Ontario, and Riding Mountain National Park in Manitoba. Yet there is limited knowledge on the importance of these areas to the breeding population. For example, while Red-headed Woodpecker is an annual spring and fall migrant in Point Pelee National Park, with 30-40 individuals present each year, there was a single known nesting site in 2011 with no known nests in nine previous years (Parks Canada Agency 2012). Likewise, Red-headed Woodpecker sightings in Riding Mountain National Park

occur primarily on the periphery of the park, as the species is most likely nesting in treed agricultural areas directly surrounding the park, rather than in the park itself (Artuso pers. comm. 2016; Frey pers. comm. 2016).

However, certain provincial parks in Manitoba and Ontario appear to be of importance in the conservation of Red-headed Woodpecker populations. For example, in Ontario, the Rondeau Important Bird Area was created in part because of the large population of this species in Rondeau Provincial Park (Cheskey and Wilson 2001). Other provincial parks where Red-headed Woodpecker occurs include: Frontenac Provincial Park, Pinery Provincial Park, and Lake of the Woods Provincial Park in Ontario, and Saint Ambroise Beach Provincial Park in Manitoba.

Important Bird Areas (IBAs) represent only a small proportion of the protected lands in Canada, and as such support a small portion of the Red-headed Woodpecker's breeding range, particularly in Ontario and Manitoba (IBA Canada 2016). IBAs for migrating Red-headed Woodpeckers (spring and fall) include: Cabot Head IBA, Long Point Peninsula and Marshes IBA, Point Pelee IBA, all found in Ontario (IBA Canada 2016). Two IBAs reporting breeding Red-headed Woodpeckers are Port Franks Forested Dunes IBA in Ontario with 5-10 nesting pairs, and Kinosota-Leifur Shoreline IBA in Manitoba with approximately 100 nesting pairs (3% or more of the Canadian population), where it is considered a keystone species for the IBA (IBA Canada 2016).

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BIOGRAPHICAL SUMMARY OF REPORT WRITER(S)

Barbara Frei is a conservation biologist broadly interested in the behaviour and conservation of species-at-risk in human modified landscapes. She completed her B.Sc. at Carleton University (2005), and her M.Sc. (2009) and Ph.D. (2014) at McGill University. Her doctoral research focused on the habitat use, breeding ecology, and community interactions of Red-headed Woodpeckers in southern Ontario, where she led a public outreach and education campaign on the conservation of the species. She is currently a Postdoctoral Researcher at McGill University, using solution-focused research to determine drivers of bright spots for ecosystem services and biodiversity in agroecosystems of Canada. She is involved in numerous scientific communication and conservation initiatives, and is the current Director of the McGill Bird Observatory.

COLLECTIONS EXAMINED

No collections were examined for the preparation of this report.

Appendix 1. Threat Calculator results for Red-headed Woodpecker.

THREATS ASSESSMENT WORKSHEET

Species or Ecosystem Scientific Name	Red-headed Woodpecker
Element ID	**Elcode**
Date :	02/08/2017
Assessor(s):	Barbara Frei (writer), Marcel Gahbauer (Birds SSC Co-chair), Dave Fraser (Facilitator), Bruno Drolet (CWS Quebec), Mike Cadman (CWS Ontario), John Brett (ECCC Recovery lead), Lea Craig-Moore (CWS Prairie region), Christian Artuso (Bird Studies Canada), Joanna James (COSEWIC Secretariat)
References:	Draft threats calculator produced by ECCC RHWO Recovery Team (2017)

Overall Threat Impact Calculation Help:

		Level 1 Threat Impact Counts	
Threat Impact		**high range**	**low range**
A	Very High	0	0
B	High	1	0
C	Medium	2	1
D	Low	3	5
Calculated Overall Threat Impact:		Very High	High

Assigned Overall Threat Impact:	**B = High**
Impact Adjustment Reasons:	Some threat categories are inter-related, but there are sufficiently many concerns that high seems appropriate.
Overall Threat Comments	One designatable unit based on the biology of this species.

Threat		**Impact (calculated)**		**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
1	Residential & commercial development	D	Low	Small (1-10%)	Extreme (71-100%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
1.1	Housing & urban areas	D	Low	Small (1-10%)	Extreme (71-100%)	High (Continuing)	Urbanization generally represents loss of habitat, as suitable nesting and feeding habitat is typically limited. Building collisions likely are a source of mortality, but probably an infrequent one, as Red-headed Woodpecker is not known to be particularly vulnerable, and the species largely avoids urban areas where the risk is greatest.
1.2	Commercial & industrial areas		Negligible	Negligible (<1%)	Extreme (71-100%)	High (Continuing)	Scope much smaller than housing & urban areas, but effects similar to those described above.
1.3	Tourism & recreation areas		Negligible	Negligible (<1%)	Serious (31-70%)	High (Continuing)	Scope negligible, and effects less severe than in preceding categories because such developments may be more likely to retain suitable habitat for the species.
2	Agriculture & aquaculture	D	Low	Restricted (11-30%)	Moderate (11-30%)	High (Continuing)	
2.1	Annual & perennial non-timber crops	D	Low	Restricted (11-30%)	Moderate (11-30%)	High (Continuing)	Agricultural intensification can reduce availability of habitat; this is currently a greater threat in the Prairies, given that some agricultural land is reverting to woodland in Ontario. Continued use of sites where habitat quality has been reduced can result in poor reproductive success.
2.2	Wood & pulp plantations		Negligible	Negligible (<1%)	Serious - Moderate (11-70%)	High (Continuing)	Tree plantations remove open habitat preferred by this species and do not provide suitable nesting sites (because trees will be harvested and are generally too young and dense to provide suitable habitat).
2.3	Livestock farming & ranching		Unknown	Restricted (11-30%)	Unknown	High (Continuing)	Livestock grazing is positively associated with Red-headed Woodpeckers, where it is at a scale that allows for suitable habitat (scattered old trees) to remain available. However, intensification of this land use (higher stocking rates, cutting down trees and snags) or de-intensification (overgrowth by shrubs) can reduce habitat suitability for Red-headed Woodpecker. In southern Ontario, there is a trend toward a decline in extent of pasture.
2.4	Marine & freshwater aquaculture						
3	Energy production & mining		Negligible	Negligible (<1%)	Extreme (71-100%)	High (Continuing)	
3.1	Oil & gas drilling		Negligible	Negligible (<1%)	Moderate (11-30%)	Moderate (Possibly in the short term, < 10 yrs/3 gen)	Some habitat loss and degradation due to shale gas fracturing is possible.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3.2	Mining & quarrying		Negligible	Negligible (<1%)	Extreme (71-100%)	High (Continuing)	There has been a large increase in mining activity in the transition area between the boreal forest and parkland in Manitoba, which overlaps with this species' distribution. Areas that are actively quarried would become unsuitable for this species.
3.3	Renewable energy		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	Habitat loss and degradation may result from expansion of solar farms, but scope is negligible, and in many cases the resultant displacement may be trivial given the size of most current projects.
4	Transportation & service corridors	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	
4.1	Roads & railroads	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	It is likely that all individuals of this species encounter roads. The species may be susceptible to vehicle collisions due to low flight patterns, and there is anecdotal evidence of such encounters, but there are no published studies addressing frequency or population implications.
4.2	Utility & service lines		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	Almost all individuals of this species are likely to encounter utility lines. Although there is anecdotal evidence of Red-headed Woodpeckers suffering from collisions with utility lines, there is no evidence of this being a frequent occurrence. New utility lines may result in some habitat loss. This species sometimes uses wooden utility poles as nesting sites, which could have a negative impact on nestlings, as there is some evidence of creosote-covered telephone poles being associated with nest failure and nestling mortality.
4.3	Shipping lanes						
4.4	Flight paths						
5	Biological resource use	CD	Medium - Low	Restricted - Small (1-30%)	Serious (31-70%)	High (Continuing)	
5.1	Hunting & collecting terrestrial animals						
5.2	Gathering terrestrial plants						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
5.3	Logging & wood harvesting	CD	Medium - Low	Restricted - Small (1-30%)	Serious (31-70%)	High (Continuing)	Logging and wood harvesting can be highly detrimental by removing nesting opportunities, especially if standing dead wood is removed, because Red-headed Woodpecker is a weak excavator that requires highly decayed trees. While commercial logging in Ontario requires retention of cavity trees, and may be neutral or even beneficial for Red-headed Woodpecker, private or small-scale logging of woodlots may pose a greater threat.
5.4	Fishing & harvesting aquatic resources						
6	Human intrusions & disturbance		Unknown	Small (1-10%)	Unknown	High (Continuing)	
6.1	Recreational activities		Unknown	Small (1-10%)	Unknown	High (Continuing)	Few nest sites are likely exposed to recreational activities, and there is no evidence to indicate that they are affected by them.
6.2	War, civil unrest & military exercises						
6.3	Work & other activities						
7	Natural system modifications	BD	High - Low	Large - Restricted (11-70%)	Serious - Moderate (11-70%)	High (Continuing)	
7.1	Fire & fire suppression	D	Low	Small (1-10%)	Serious (31-70%)	High (Continuing)	Red-headed Woodpeckers benefit from openings caused by disturbance, and the loss of fire from the landscape (e.g., fire suppression in oak woodlands) has allowed for growth of denser forests that provide less suitable habitat.
7.2	Dams & water management/use		Not a Threat		Neutral or Potential Benefit		Flooded areas with dead trees may provide suitable habitat for this species.
7.3	Other ecosystem modifications	BD	High - Low	Large - Restricted (11-70%)	Serious - Moderate (11-70%)	High (Continuing)	Snag/dead tree removal and changes to disturbance cycles may be reducing the availability of nesting opportunities. Additionally, insect declines may be reducing availability of important prey during the breeding season.
8	Invasive & other problematic species & genes	C	Medium	Pervasive (71-100%)	Moderate (11-30%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
8.1	Invasive non-native/alien species/diseases	C	Medium	Pervasive (71-100%)	Moderate (11-30%)	High (Continuing)	Tree diseases, including Chestnut Blight, Dutch Elm Disease, and Beech Bark Disease, may benefit Red-headed Woodpecker in the short term by increasing the amount of standing dead wood in the landscape, but subsequent loss of these trees could result in decreased availability of nest sites. European Starling competes for nest sites with Red-headed Woodpecker, and in southern and central Ontario has been shown to be the dominant cause of Red-headed Woodpecker nest failure.
8.2	Problematic native species/diseases		Unknown	Unknown	Unknown	High (Continuing)	Red-bellied Woodpecker is a potential interspecific competitor and is expanding northward into the Canadian range of Red-headed Woodpecker, but there is little evidence that interactions between these two species may cause population-level declines. Cooper's and Sharp-shinned Hawks are known predators of both adult and juvenile Red-headed Woodpeckers, and have been increasing in numbers, but it is unclear whether this change simply correlates with Red-headed Woodpecker declines or has a causative role.
8.3	Introduced genetic material						
8.4	Problematic species/diseases of unknown origin						
8.5	Viral/prion-induced diseases						
8.6	Diseases of unknown cause						
9	Pollution		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	
9.1	Domestic & urban waste water						
9.2	Industrial & military effluents						
9.3	Agricultural & forestry effluents		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	The vast majority of Red-headed Woodpeckers are exposed to pesticide use, but the potential for direct effects on Red-headed Woodpecker health and mortality is not well understood. Potential vulnerability in relation to effects of effluents on insect prey are addressed under 7.3.
9.4	Garbage & solid waste						
9.5	Air-borne pollutants						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
9.6	Excess energy						
10	Geological events						
10.1	Volcanoes						
10.2	Earthquakes/tsunamis						
10.3	Avalanches/landslides						
11	Climate change & severe weather		Unknown	Unknown	Unknown	Moderate (Possibly in the short term, < 10 yrs/3 gen)	
11.1	Habitat shifting & alteration		Unknown	Unknown	Unknown	Moderate (Possibly in the short term, < 10 yrs/3 gen)	As a short-distance migrant, Red-headed Woodpecker may be less sensitive than long-distance migrants to some impacts of climate change such as phenological mismatches and unpredictable storms during migration. However, other effects of climate change (e.g., habitat shifts) may affect the species but their scope, severity, and timing are uncertain at present.
11.2	Droughts						
11.3	Temperature extremes						
11.4	Storms & flooding						
11.5	Other impacts						
Classification of Threats adopted from IUCN-CMP, Salafsky *et al*. (2008).							