Birds of Poplar River Project

~ FIRST RESULTS ~

Early results from a co-produced research project by the
National Audubon Society and the Poplar River First Nation

AUTHORS

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ABOUT THE NATIONAL AUDUBON SOCIETY

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ABOUT POPLAR RIVER FIRST NATION

Poplar River First Nation is located in Northern Manitoba, Canada. Poplar River is an Anishinaabe Community and signatory to Treaty 5 with the Government of Canada. The area they consider to be their Traditional Territory is approximately 2 million acres and stretches eastward from Lake Winnipeg encompassing the watershed of the Poplar River.

The people of Poplar River have lived and cared for this Land for thousands of years and it is their goal to build a healthy, vibrant, self-sufficient community and to continue to protect this land for the next generations to come. Learn more at prfn.ca.

SUGGESTED CITATION

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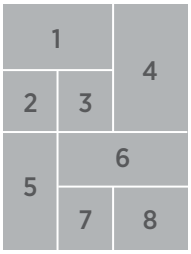
INSIDE FRONT COVER PHOTOS



1) **Mallard.** Robert Bunch / Audubon Photography Awards
2) **Common Yellowthroat.** Randy Streufert
3) **American Kestrel.** David Zieg
4) **Rusty Blackbird.** Linette Mansberger
5) **Pileated Woodpecker.** Gary Kunkel
6) **Ring-billed Gull.** Daniel Marasco
7) **Song Sparrow.** Pat Ulrich / Audubon Photography Awards
8) **Winter Wren.** Caroline Samson / Audubon Photography Awards

FRONT COVER PHOTOS

Background: Pimachiowin Aki - Canada.
Hidehiro Otake. © Pimachiowin Aki

Inset left: Tennessee Warbler.
Ben Cvengros

Inset center: Bald Eagle.
Stephen November / Audubon Photography Awards

Inset right: Golden-crowned Kinglet.
Gary Robinette

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Common Goldeneye.

Mick Thompson

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EXECUTIVE SUMMARY

PURPOSE

The Boreal Forest of Canada is one of the most important regions in the Western Hemisphere for birds. Climate change and increasing industrialized development threaten boreal habitat and traditional ways of life for Indigenous peoples. In a collaborative effort to better understand the abundance and distribution of songbirds within the Boreal, Indigenous Guardians in the Pimachiowin Aki World Heritage Site and scientists from Audubon's Boreal Conservation program have launched a bioacoustics research project within the traditional territory of the Poplar River First Nation in eastern Manitoba, Canada. The research meets the goals set by the land management plan for the Pimachiowin Aki by the Poplar River First Nation and ties directly to other important research areas, such as climate change and habitat quality. This report contains the results from that pilot bird monitoring program.

HIGHLIGHTS

The use of autonomous recording units (ARUs) allows for ongoing remote collection of audio data from surrounding landscape, including bird songs and calls. Those data can later be retrieved and analyzed to determine the presence of birds in the area and serve as an archive of the overall bioacoustics landscape that can be repeated and compared over time to help understand changes taking place within the ecological communities.

This project exemplifies Indigenous-led conservation and land stewardship efforts within Canada. The program's process can be used as blueprint for similar projects in other locations in the Boreal, demonstrating the effectiveness of such collaborations.

RESULTS, CONCLUSIONS, OR RECOMMENDATIONS

Seventy-one bird species were detected by the ARUs. All but one of those breed in this region and three of those detected are listed as endangered, threatened, or of special concern by the Committee on the Status of Endangered Wildlife of Canada—the Common Nighthawk, Eastern Whip-poor-will, and Canada Warbler.

At least 18 of the species detected have more than 70% of their breeding range confined to the Boreal Forest biome, meaning their survival is heavily reliant upon the health of this vibrant landscape. The continuation of the project—monitoring these species' status over time—will be very important. This is especially true as climate change impacts bird habitat within Pimachiowin Aki and throughout their entire migratory flyway. It is also true for certain species who have been identified as highly vulnerable to range loss under a 3-degree climate warming scenario.

Further work should continue to better understand how Indigenous Knowledge about birds can be incorporated with Western science approaches to gain a more comprehensive understanding of bird ecology in the Boreal. Long-term financial support of Indigenous-led conservation and Indigenous Guardians programs should be a high priority of federal and provincial governments.

BACKGROUND

North America's Boreal Forest is one of the world's largest intact forest ecosystems (Wells et al. 2020) and one of the most important regions for birds in the Western Hemisphere, nicknamed "North America's bird nursery" due to its globally important role in producing migratory birds. More than 300 species rely on it for nesting habitat, with the total population estimated at 3–5 billion individual birds during peak summer nesting season (Wells and Blancher 2011, Blancher and Wells 2005). However, its size and remote nature make research difficult and often expensive. As a result, there is a dearth of consistent data on birds over time, particularly in regions that lack existing infrastructure and easy access. Mounting evidence suggests, however, that many boreal landbirds are experiencing significant population declines (Wells et al. 2014, Wells 2007). Some species, such as the Rusty Blackbird and Olive-sided Flycatcher, are estimated to have decreased more than 80% over the last 40 years (Environment Canada 2016; Greenberg and Matsuoka 2010, Wells 2007). Climate change and increasing development pressure related to industrialized timber harvesting, mining, oil and gas extraction, road and pipeline networks, and hydroelectric impoundments threaten further losses of boreal habitat and bird abundance (Cadieux et al. 2020; Wells et al. 2020, Gauthier et al. 2015; Venier et al. 2014).

Photo by Bastian Bertzky. © IUCN

Pimachiowin Aki.

Loss and fragmentation of intact forested landscapes are associated with losses of ecosystem services (e.g., carbon storage and sequestration), reduced biodiversity, and population declines among forest-dwelling species (Betts et al. 2017; Watson et al. 2018). Furthermore, widespread loss of intact forests diminishes the cultural identities and well-being of forest-dwelling Indigenous Peoples, whose livelihoods are deeply rooted in functioning forested ecosystems (Watson et al. 2018). Globally, 61% of intact forested landscapes overlap with Indigenous Peoples' lands (Fa et al. 2020), making them central players concerning the future of the world's forests (Garnett et al. 2018). Indeed, Indigenous Knowledge and land use practices will be fundamental to slowing the rate of global deforestation and mitigating climate change (Mistry and Berardi 2016; Fa et al. 2020). Yet, contested land boundaries and insecure tenure rights continue to impede Indigenous stewardship and governance over their ancestral lands. Increasingly, however, the international community is supporting Indigenous title and rights over these lands and the role of Indigenous governance in achieving effective conservation outcomes (Artelle et al. 2019; Moola and Roth 2019). For example, in 2002, four Anishinaabeg First Nations —Poplar River First Nation, Little Grand Rapids First Nation, Pauingassi First Nation, and Bloodvein First Nation—united together with the shared goal of protecting their ancestral lands through a UNESCO World Heritage Site designation (PAC 2020). The region, collectively referred to as Pimachiowin Aki (Anishinaabemowin for "Land that Gives Life"), encompasses a vast network of Boreal Forest woodlands, wetlands, and waterways that begin on the eastern shoreline of Lake Winnipeg in Manitoba and extend into northwestern Ontario (Figure 1).

FIGURE 1. Map of Pimachiowin Aki UNESCO World Heritage Site. Located on the border of Manitoba and Ontario, Canada; inset map shows its location within the Boreal Forest biome (depicted in green).

Photo by Bastian Bertzky. © IUCN

Pimachiowin Aki.

PIMACHIOWIN AKI – NATURAL AND CULTURAL HERITAGE

The 29,000 km^2 region has played an integral role in supporting the spirituality and livelihood of Anishinaabeg and their immediate predecessors for at least 7,000 years, with some estimates dating as far back as 9,000 years (Petch 2010). Caring for the land and maintaining a healthy, sustainable relationship with it is has forever been central to the way of life for Anishinaabeg. This is exemplified through the cultural tradition of *Ji-ganawendamang Gidakiiminaan* (Keeping the Land), which is "a set of beliefs, values, knowledge, and practices that guide relations with the land and all life placed on the land by the Creator" (PAC 2018). The region features an impressive collection of natural life, both in terms of diversity and abundance, and is an excellent representation of the Boreal Shield: an ecozone that extends from Alberta to Newfoundland (Figure 2), which has been particularly hard hit by human disturbances in recent decades. Recognizing how exceptional Pimachiowin Aki is in terms of both cultural significance and natural values, it was quickly determined that the potential future World Heritage Site should be nominated as a "mixed" cultural and natural site.

CULTURAL SIGNIFICANCE

Anishinaabeg are highly mobile people, utilizing resources and maintaining cultural sites throughout vast landscapes rather than at singular locations. Traditionally, people moved to where resources were most abundant at various times throughout the year, dispersing widely during the winter, sharing

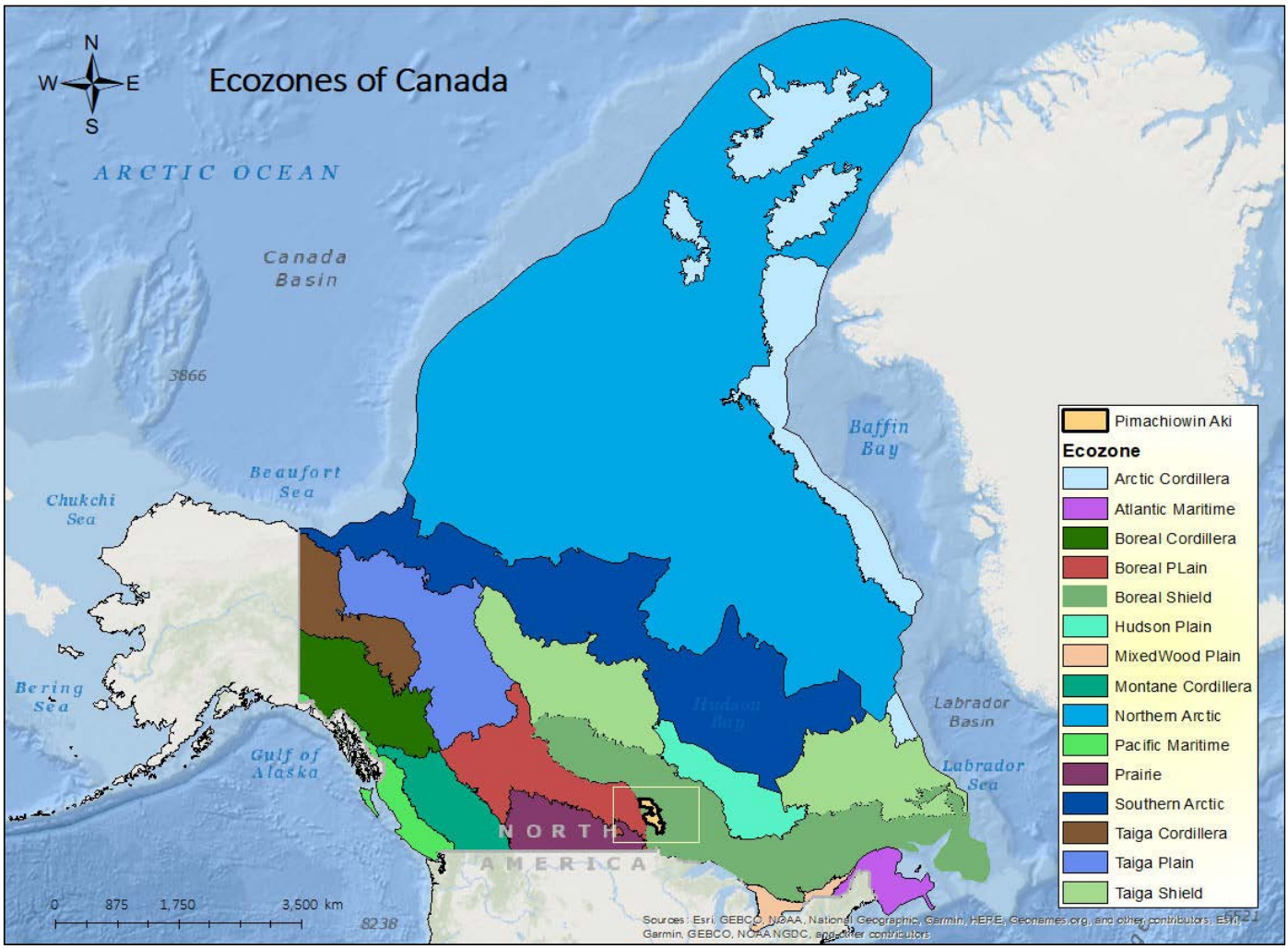

FIGURE 2. Ecozones of Canada.

productive fishing sites during spring and fall, and gathering in larger settlements during summer (Hamilton 2010). Waterways such as lakes and rivers often provided the most efficient mode of travel and transport, which is reflected by the large number of culturally significant sites identified on or near them. The need to preserve these sites, as well as the routes to access them, played a significant role in determining both the size and shape of the area ultimately nominated to become a World Heritage Site.

ECOLOGICAL SIGNIFICANCE

More than 95% of Pimachiowin Aki remains intact and free of human disturbances (Lee and Hanneman 2010), a much higher level of intactness than the remainder of the Boreal Shield at 66.7% (Lee et al. 2010). The region boasts an abundance of pristine wetlands and waterways, with 3,200 large lakes, 5,000 marshes and pools, and nearly 32,000 kilometers of shoreline wetlands (PAC 2018). These features supply 6 million cubic meters of freshwater flow into Lake Winnipeg each year; helping offset damage from algae blooms that have plagued the lake in recent years (Bulloch et al. 2002). The prevalence of wetlands also means the area is rich in stored carbon, which helps offset global emissions and slow the effects of climate change. The ecosystem services of its carbon stocks are estimated in the billions of dollars (Voora and Barg 2008). The combined ecosystem services (water filtration, carbon sequestration, etc.) Pimachiowin Aki provides have an estimated value of $120 million (CDN) per year. At least 700 different types of vascular plants are present throughout Pimachiowin Aki, belonging to 110 families (ECOSTEM and WRCS-MB 2014). This includes at least seven provincially rare plant species (Jones, Harris, and Foster 2000). It is home to 43 mammal species (ECOSTEM and WRCS-MB 2014)—80% of mammals present anywhere in the Boreal Shield—and provides important habitat for at least three distinct herds of woodland caribou (Foster and Harris 2010). They are joined by 8 species of amphibian, 3 reptile species, 62 fish species, and as many as 220 bird species (ECOSTEM and WRCS-MB 2014), 14 of which are species of conservation concern (Bird Studies Canada 2014). Overall, at least 20 species listed as special concern, threatened, or endangered by the Commmittee on the Status of Endangered Wildlife in Canada (COSEWIC) are believed to occur within Pimachiowin Aki (Foster and Harris 2010).

Pimachiowin Aki - Canada.

Tim Bowman

American Crow.

Hidehiro Otake. © Hidehiro Otake

Pimachiowin Aki - Canada: Spruce Grouse.

Brad James

Black-and-White Warbler.

Tim Harris / Audubon Photography Awards

White-throated Sparrow.

UNESCO WORLD HERITAGE MIXED SITE DESIGNATION

Pimachiowin Aki was included in the federal government's shortlist of potential UNESCO World Heritage Sites, and, in 2006, the provincial governments of Manitoba and Ontario were officially enlisted as partners to form the Pimachiowin Aki Corporation. Over the next several years, individual management plans for each First Nation's ancestral lands were developed. These plans would shape a future vision for each respective region, identifying key cultural and biological sites for protection, allocating some small portions for future sustainable development, and outlining plans for managing natural resources. They would also lay out goals for increasing field research and monitoring capabilities, which are important for meeting the reporting requirements for maintaining World Heritage Site status once it has been inscribed (UNESCO World Heritage Convention 2016).

In 2018, Pimachiowin Aki was officially designated as a World Heritage Site under both cultural and natural classifications—the first such designation in Canada (UNESCO World Heritage Committee 2018). One of the Boreal Forest's most ecologically important and culturally vibrant regions became forever protected and recognized, potentially paving the way for other Indigenous Nations and communities to pursue similar goals in the future. The joint designation also fundamentally changed the way UNESCO approaches Indigenous Peoples and their relationship with the land, which should better enable Indigenous communities to pursue World Heritage Site recognition across the globe.

INDIGENOUS-LED RESEARCH

Ray Rabliauskas

Indigenous Guardian, Norway Rabliauskas, putting up an ARU in the Poplar River Traditional Territory.

While the official inscription of Pimachiowin Aki as a World Heritage Site in 2018 was cause for much celebration, the work to sustainably manage it, conduct further research, and meet goals set out in associated management plans was just beginning. The plan created by Poplar River First Nation, the northernmost of the four, prominently features research, data collection, and environmental monitoring as part of its ongoing needs (Poplar River First Nation 2011). Given the lack of information on the distribution and abundance of songbirds within the Boreal Forest (Cumming et al. 2010), developing an avian monitoring program in the region was considered a promising research opportunity. Furthermore, monitoring data collected through the project would tie directly into other research areas of interest to the Poplar River First Nation, such as climate change and habitat quality. It could also support the development of sustainable and environmentally friendly tourism opportunities that benefit local economies, such as birding trails and eco-tours.

Recent advances in technology have allowed for bird research to be conducted in ways that allow large amounts of information to be obtained without the often-prohibitive cost of sending large numbers of specially trained biologists into the field. Autonomous recording units (ARUs), for example, record audio of the surrounding landscape at preprogrammed times. This allows for ongoing remote collection of data that can be retrieved at a later date with all of the data safely stored on SD cards. Species present in the area can then be identified via analysis of the bird vocalizations recorded by the ARUs. The sound recordings obtained can also serve as a long-term archive of the overall bioacoustic landscape. They can

Seth Davis / Audubon Photography Awards

Magnolia Warbler.

be repeated and then compared over time to document and understand changes that may be taking place within the ecological communities at locations that have been acoustically monitored. In addition, the sound recording archive is a potential treasure trove of information to learn more about bird vocalizations and behavior and can be used in education and communications products to increase awareness and understanding of Indigenous-led conservation and stewardship efforts.

This type of research is particularly well suited for collaboration with Indigenous Guardians programs, whose staff may already be monitoring more remote portions of the land that would be difficult or costly to monitor by sending individual biologists to carry out traditional point counts or other survey methods. Indigenous Guardians are "community-based Lands Keepers who practice their cultural and traditional teachings on the land", through a variety of activities, including the development and implementation of wildlife and harvest monitoring programs, land and water resource planning, and upholding Traditional Ecological Knowledge from elders to younger members of the community (Reed et al. 2021). Poplar River First Nation determined that monitoring songbirds with ARUs would complement existing work being conducted by their own Indigenous Guardians program and would also support Pimachiowin Aki's stated goal of increasing its number of research partnerships. Subsequently, in 2016, through a partnership between the Boreal Songbird Initiative and Poplar River First Nation, a pilot program of ARU-driven research was started within the region. This partnership project is now continuing through Audubon's Boreal Conservation program.

PROJECT SCOPE AND EARLY RESULTS

Beginning in late spring 2016, two Songmeters (a type of ARU device designed and sold by a company called Wildlife Acoustics) were deployed by Poplar River First Nations Guardians at two sites for part of the season and then moved to two other sites, all within the Traditional Territory of the Poplar River First Nation in eastern Manitoba (Figure 3). The four survey sites were within an area extending from the eastern end of the community of Poplar River to about two kilometers upstream, near Onaguyameeth (rapids). All survey sites within 500 meters of the Poplar River and all separated from each other by at least 500 meters. The timing of deployment was intended to coincide with the peak bird breeding season, and while many additional bird species that breed further north would likely be detected as they pass through during spring and fall, this project sought to capture what birds regularly use the region for nesting and raising young. The ARUs were programmed to record 60 minutes of audio before and after dusk and before and after dawn in ten-minute segments, resulting in recordings that began at approximately 4am, 5am, 8:45pm, and 9:45 pm. A total of 11,240 minutes (187.3 hours) of recordings were obtained between May 27 and July 1, 2016. From these recordings, a sample of four ten-minute recordings from each day (two dawn recordings and two dusk recordings) and location were selected to identify the species detected. In total, 172 individual 10-minute recordings, representing 15% of the total recording time, from the period May 28 to June 20 were used to sample across the four sites (Table 1).

TABLE 1. Total ARU sampling time at Poplar River, 2016.

Survey Point	Number of Samples	Total recording time obtained (minutes)	Percent of total time sampled
1a	55	4040	36%
2	52	3120	28%
2a	43	2700	24%
2b	22	1380	12%
Total	172	11240	100%

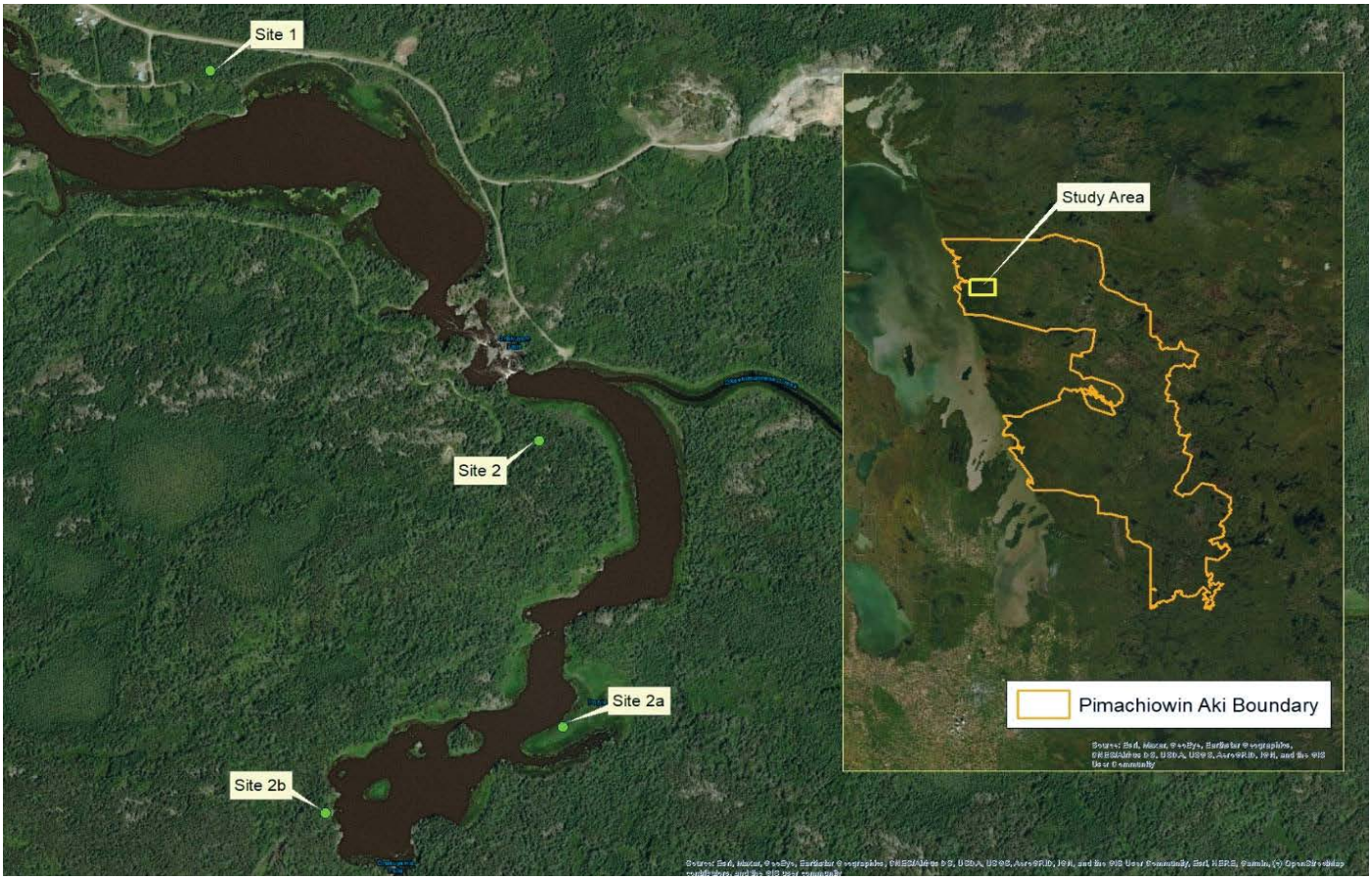

FIGURE 3. Study area map of four survey sites (1, 2, 2a, and 2b) in Poplar River and its location within Pimachiowin Aki UNESCO World Heritage Site in Manitoba, Canada.

Each of these recordings was listened to by an expert in identification of birds by their sounds (E. Barbour) and the species and estimated number of individuals detected was recorded. A spot check of recordings done independently by two other experts in bird sound identification (A. Roberto-Charron and J. Wells) for quality-control purposes, found agreement with all identifications. Note that audio detection of number of individuals is constrained to a minimum number that can be detected through simultaneous sound presentation, differences in song signal strength assumed to be a result of distance from microphones, and differences in signal strength between microphones when recording in stereo (as was the case in this study). From these samples, 71 species were detected (Appendix A). Site 1 had the greatest number of surveys (each 10-minute ARU recording equals one survey) (n = 55) (Figure 4a). Site 2a had the least number of surveys (n = 22) and the highest average number of individual detections

per survey (x = 14.5), followed closely by Site 1 (x = 12.4) (Figures 4a and b). Sites 1 and 2a also had the greatest species richness (total number of species) with 47 and 44 total species detected, respectively (Figure 5a). When the number of surveys per site was factored in, however, the sites with the greatest average number of species detected per survey were sites 2a and 2b (Figure 5b).

Twenty-three species were detected on at least 10% of all 173 recording samples (Table 2). The species detected most frequently across all sample recordings (on more than half of all recordings) were White-throated Sparrow and Swainson's Thrush. Species detected on more than 30% of all recordings were Blackburnian Warbler, Ovenbird, Bald Eagle, American Crow, and Song Sparrow. Twelve of the 71 total species detected were detected at all four survey points (Table 3). Only two of the twelve species (Common Goldeneye and Northern Flicker) were not among the most frequently detected species. An additional 19 species of the 71 total species detected were detected at three of the four survey points (Table 4). Species detected at three or four of the survey points may be species that are spatially widespread within the study area even if some have low abundance or low acoustic detectability.

Bird vocalizations and species detections were greatest during the post-dawn surveys (approximately 5am) and lowest during the post-dusk surveys (approximately 9:45pm) (Figures 6a and 6b). The average number of bird species detected followed this same trend across sites, with site 2a having the greatest species richness during the pre-dawn, post-dawn, and post-dusk survey periods compared to the other sites (Figure 7). While the post-dawn period was associated with the greatest number of bird species and overall vocalizations, each survey period tended to be associated with different groups of vocalizing birds at each site (Figures 8 to 11). For example, at site 1, the five most common species detected during the pre-dawn surveys were Song Sparrow, White-throated Sparrow, Swainson's Thrush, Mourning Warbler and Ovenbird (Figure 8a), while the Black-and White Warbler, Red-eyed Vireo, Common Raven, Magnolia Warbler, and White-throated Sparrow were the most common species detected during the post-dawn period that site (Figure 8b).

TABLE 2. Species detected on 10% or more of 172 sampled recordings across four survey sites in study area within Poplar River First Nation traditional territory in alphabetical order. Note that detection probability can be relate to abundance, vocal activity, detectability distance, and specific acoustic characteristics of vocalizations.

Species	% of surveys detected
American Crow	0.32
Bald Eagle	0.34
Black-and-white Warbler	0.17
Blackburnian Warbler	0.40
Brown Creeper	0.10
Chipping Sparrow	0.12
Common Raven	0.27
Golden-crowned Kinglet	0.16
Magnolia Warbler	0.29
Mourning Warbler	0.27
Nashville Warbler	0.17
Ovenbird	0.35
Pileated Woodpecker	0.13
Pine Siskin	0.12
Red-eyed Vireo	0.28
Ring-billed Gull	0.18
Ruffed Grouse	0.16
Song Sparrow	0.32
Swainson's Thrush	0.51
Tennessee Warbler	0.17
White-throated Sparrow	0.57
Winter Wren	0.17
Yellow-rumped Warbler	0.22

Greg Pasek

Red-eyed Vireos.

TABLE 3. Species detected on at least one sample recording from each of the four survey points in study area within Poplar River First Nation Traditional Territory between May 28 and June 20, 2016.

Species Detected at all Four Survey Points
American Crow
Bald Eagle
Blackburnian Warbler
Common Goldeneye
Common Raven
Magnolia Warbler
Northern Flicker
Pileated Woodpecker
Pine Siskin
Red-eyed Vireo
Swainson's Thrush
White-throated Sparrow

Wendy Davis / Audubon Photgraphy Awards

Common Raven.

Jeff Reiter / Audubon Photgraphy Awards

Northern Flicker.

TABLE 4. Species detected on at least one sample recording from three of the four survey points in study area within Poplar River First Nation Traditional Territory between May 28 and June 20, 2016.

Species Detected at Three Survey Points
Bay-breasted Warbler
Belted Kingfisher
Black-and-white Warbler
Brown Creeper
Canada Warbler
Chipping Sparrow
Common Nighthawk
Golden-crowned Kinglet
Mallard
Mourning Warbler
Nashville Warbler
Ovenbird
Ruffed Grouse
Song Sparrow
Tennessee Warbler
White-winged Crossbill
Winter Wren
Yellow Warbler
Yellow-rumped Warbler

Gary Robinette

Yellow Warbler.

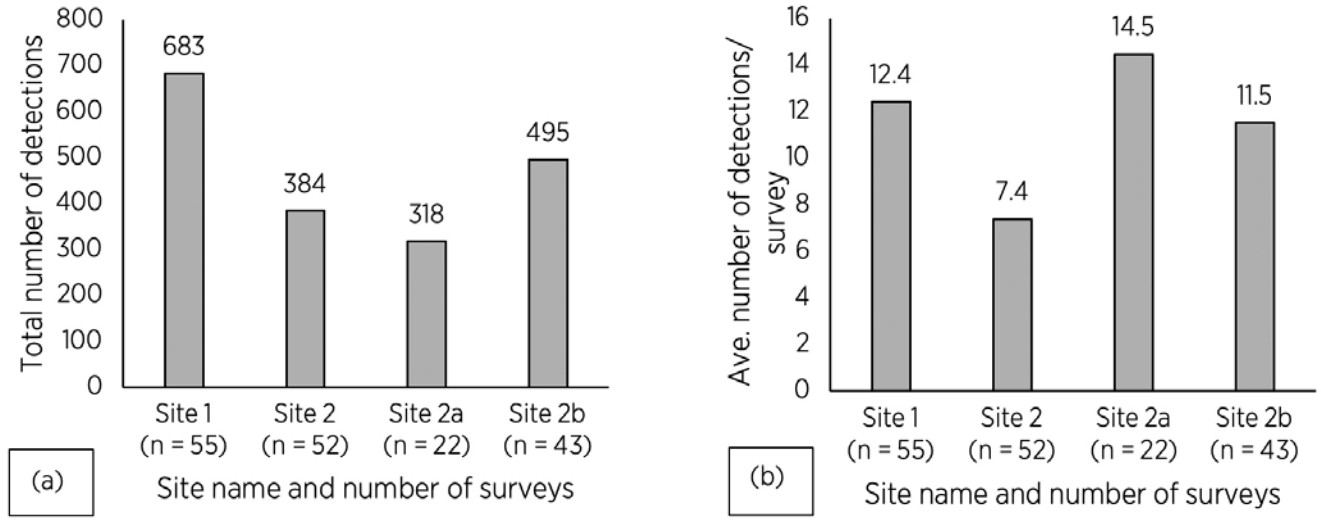

FIGURE 4. Total number of individual bird detections by site number (a) and (b) the average number of individual bird detections per survey for each site.

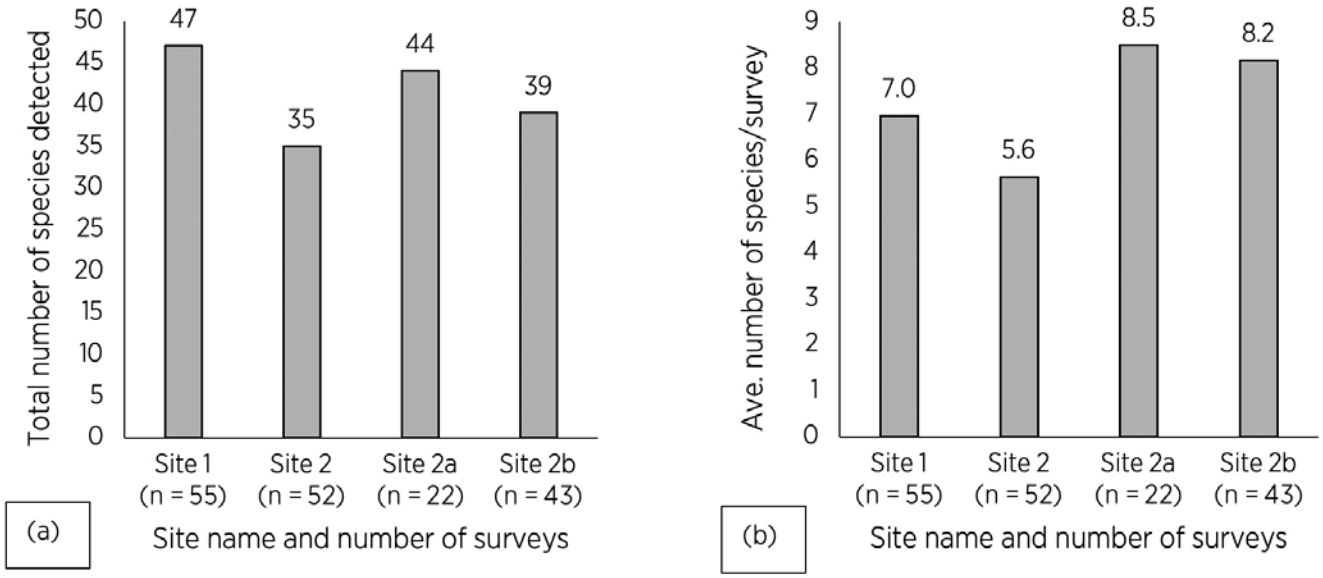

FIGURE 5. Total number of species detected by site number (a) and (b) the average number of species detected per survey for each site.

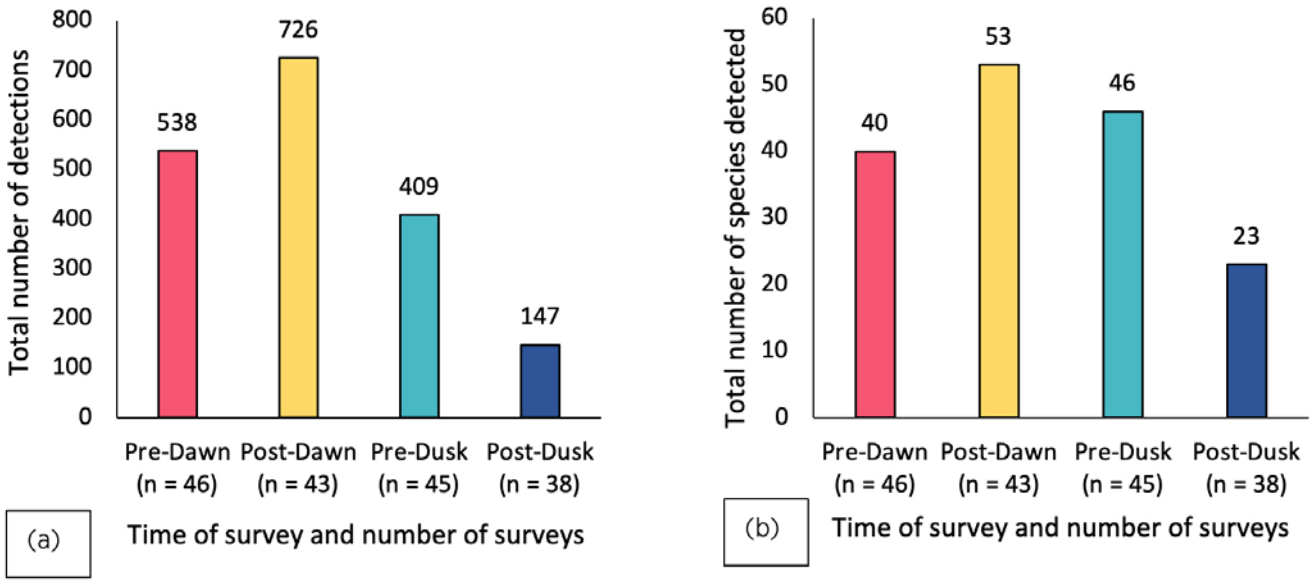

FIGURE 6. Total number of individual detections (a) and (b) total number of species detected at different survey times, including pre-dawn (approximately 4am), post-dawn (~ 5am), pre-dusk (~8:45pm), and post-dusk (~9:45pm).

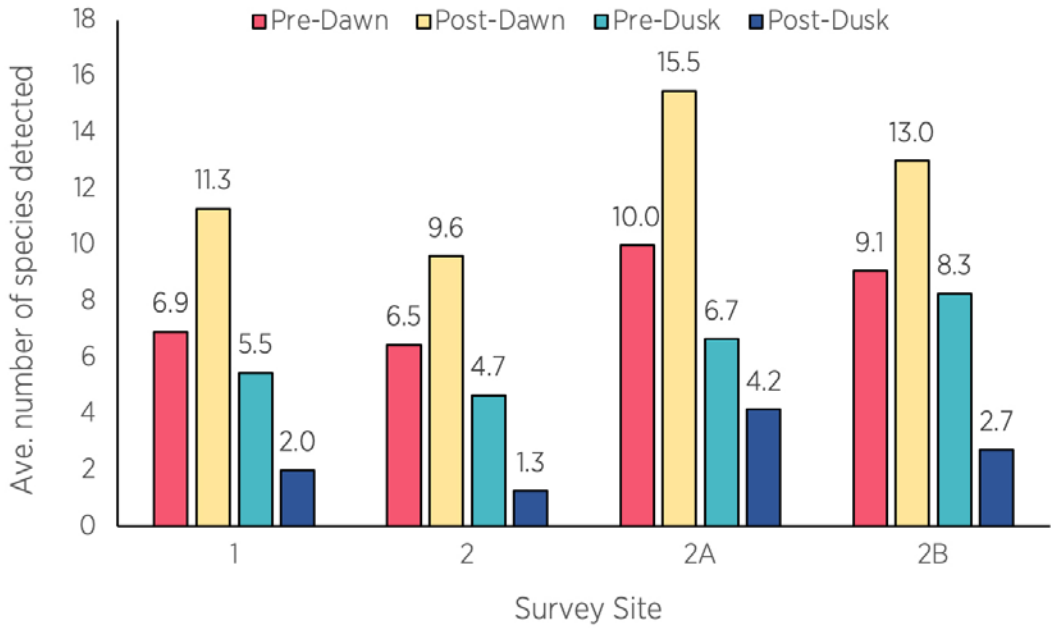

FIGURE 7. Average number of species detected at each site during different survey times, including pre-dawn (approximately 4am), post-dawn (~ 5am), pre-dusk (~8:45pm), and post-dusk (~9:45pm).

SITE 1 MOST COMMONLY DETECTED SPECIES BY TIME OF SURVEY

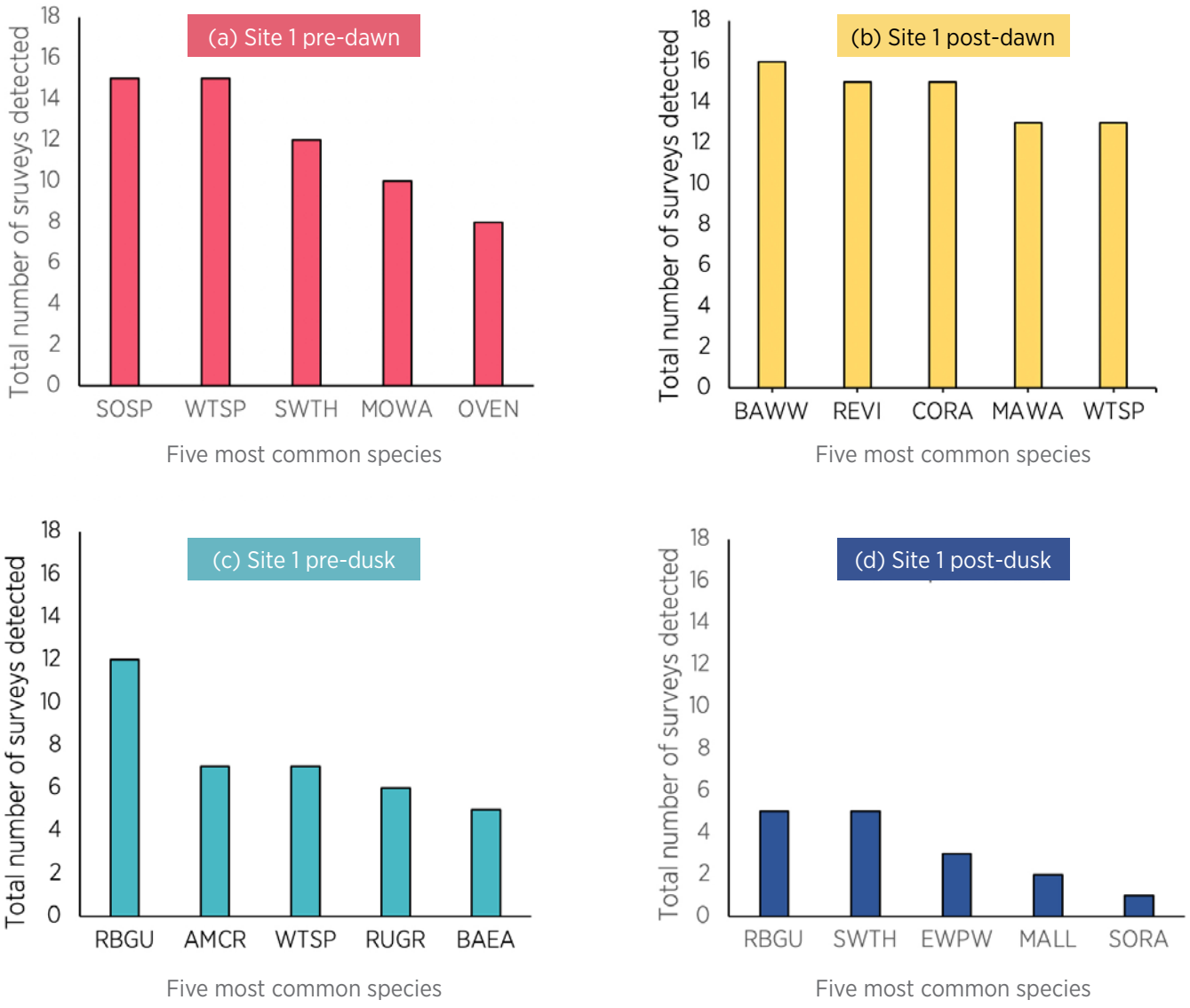

FIGURE 8. Five most prevalent species detected at site 1 during 10-minute autonomous recording unit surveys conducted at four different times of day, including: (a) pre-dawn: Song Sparrow (SOSP), White-throated Sparrow (WTSP), Swainson's Thrush (SWTH), Mourning Warbler (MAWA), and Ovenbird (OVEN); (b) post-dawn: Black-and-White Warbler (BAWW), Red-eyed Vireo (REVI), Common Raven (CORA), Magnolia Warbler (MAWA), and WTSP; (c) pre-dusk: Ring-billed Gull (RBGU), American Crow (AMCR), WTSP, Ruffed Grouse (RUFG), and Bald Eagle (BAEA); and post-dusk: RBGU, SWTH, Eastern Whip-poor-will (EWPW), Mallard (MALL), and Sora (SORA).

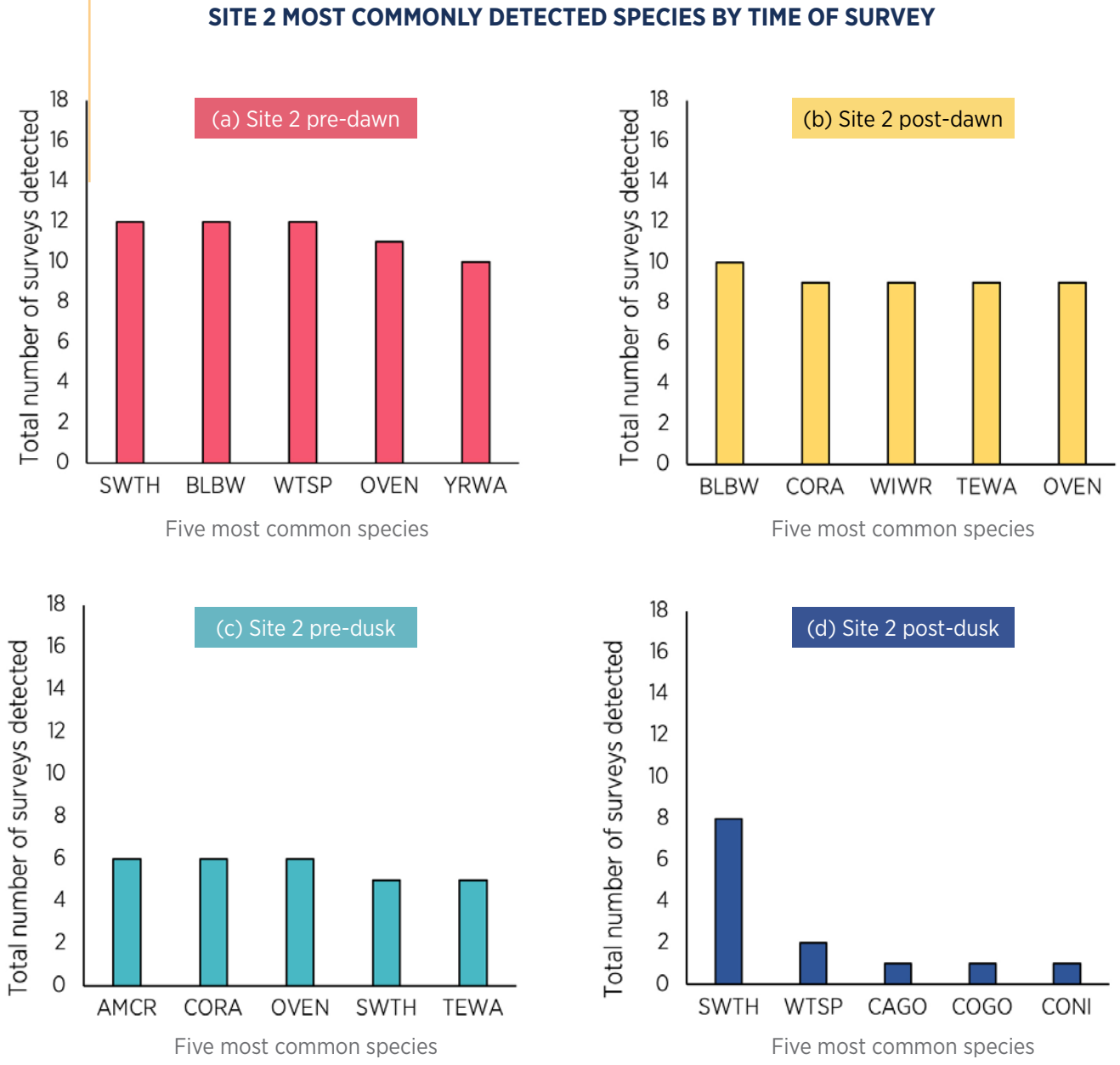

FIGURE 9. Five most prevalent species detected at site 2 during 10-minute autonomous recording unit surveys conducted at four different times of day, including: (a) pre-dawn: Swainson's Thrush (SWTH), Blackburnian Warbler (BLBW), White-throated Sparrow (WTSP), Ovenbird (OVEN), and Yellow-rumped Warbler (YRWA); (b) post-dawn: BLBW, Common Raven (CORA),Winter Wren (WIWR), Tennessee Warbler (TEWA), Ovenbird (OVEN); (c) pre-dusk: American Crow (AMCR), CORA, OVEN, SWTH, and TEWA; and post-dusk: SWTH, WTSP, Canada Goose (CAGO), Common Goldeneye (COGO), and Common Nighthawk (CONI).

SITE 2A MOST COMMONLY DETECTED SPECIES BY TIME OF SURVEY

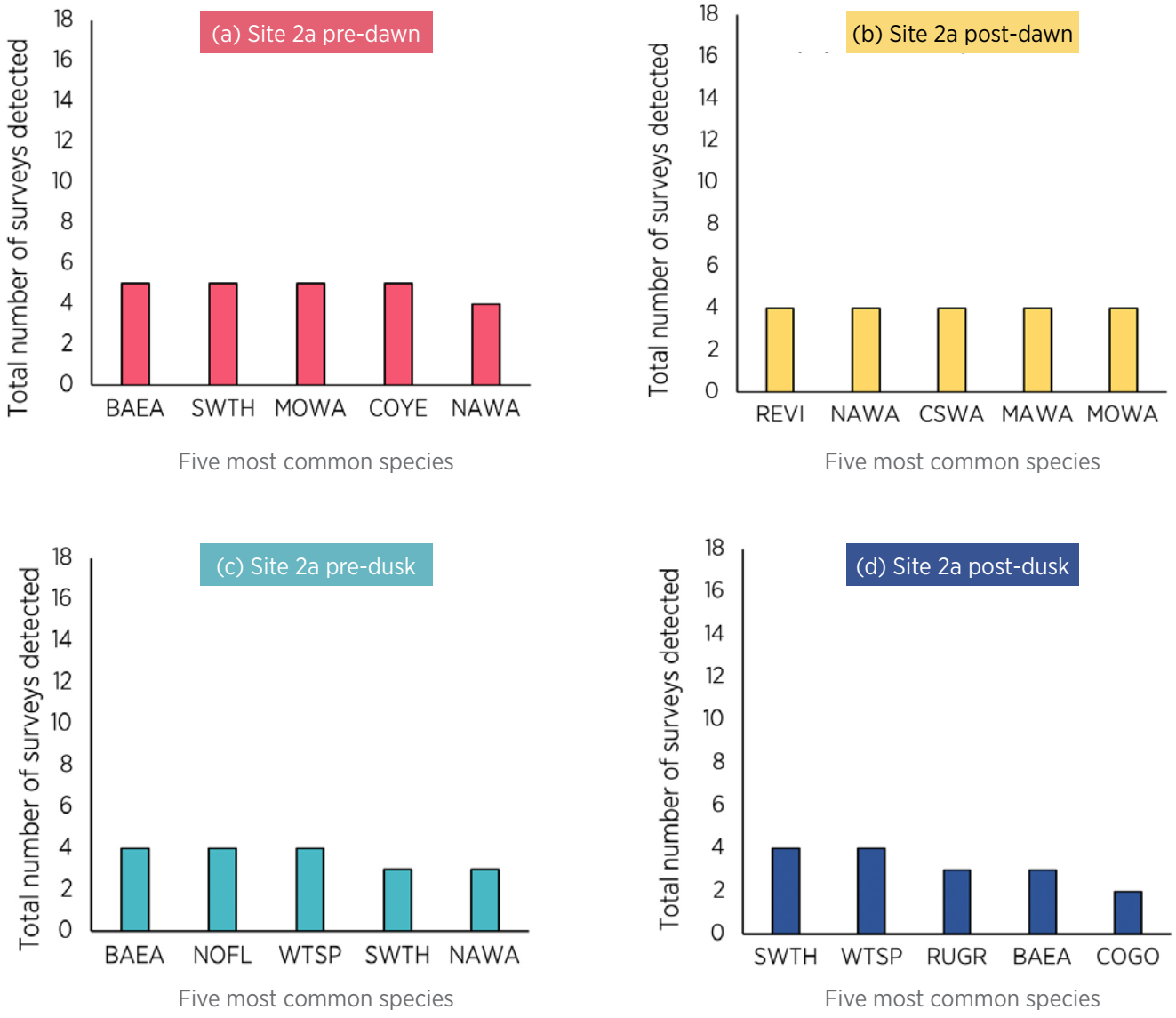

FIGURE 10. Five most prevalent species detected at site 2a during 10-minute autonomous recording unit surveys conducted at four different times of day, including: (a) pre-dawn: Bald Eagle (BAEA), Swainson's Thrush (SWTH), Mourning Warbler (MOWA), Common Yellowthroat (COYE), and Nashville Warbler (NAWA); (b) post-dawn: Red-eyed Vireo (REVI), NAWA, Chestnut-sided Warbler (CSWA), Magnolia Warbler (MAWA), and MOWA; (c) pre-dusk: BAEA, Northern Flicker (NOFL), WTSP, SWTH, and NAWA; and post-dusk: SWTH, WTSP, Ruffed Grouse (RUGR), BAEA, and Common Goldeneye (COGO).

SITE 2B MOST COMMONLY DETECTED SPECIES BY TIME OF SURVEY

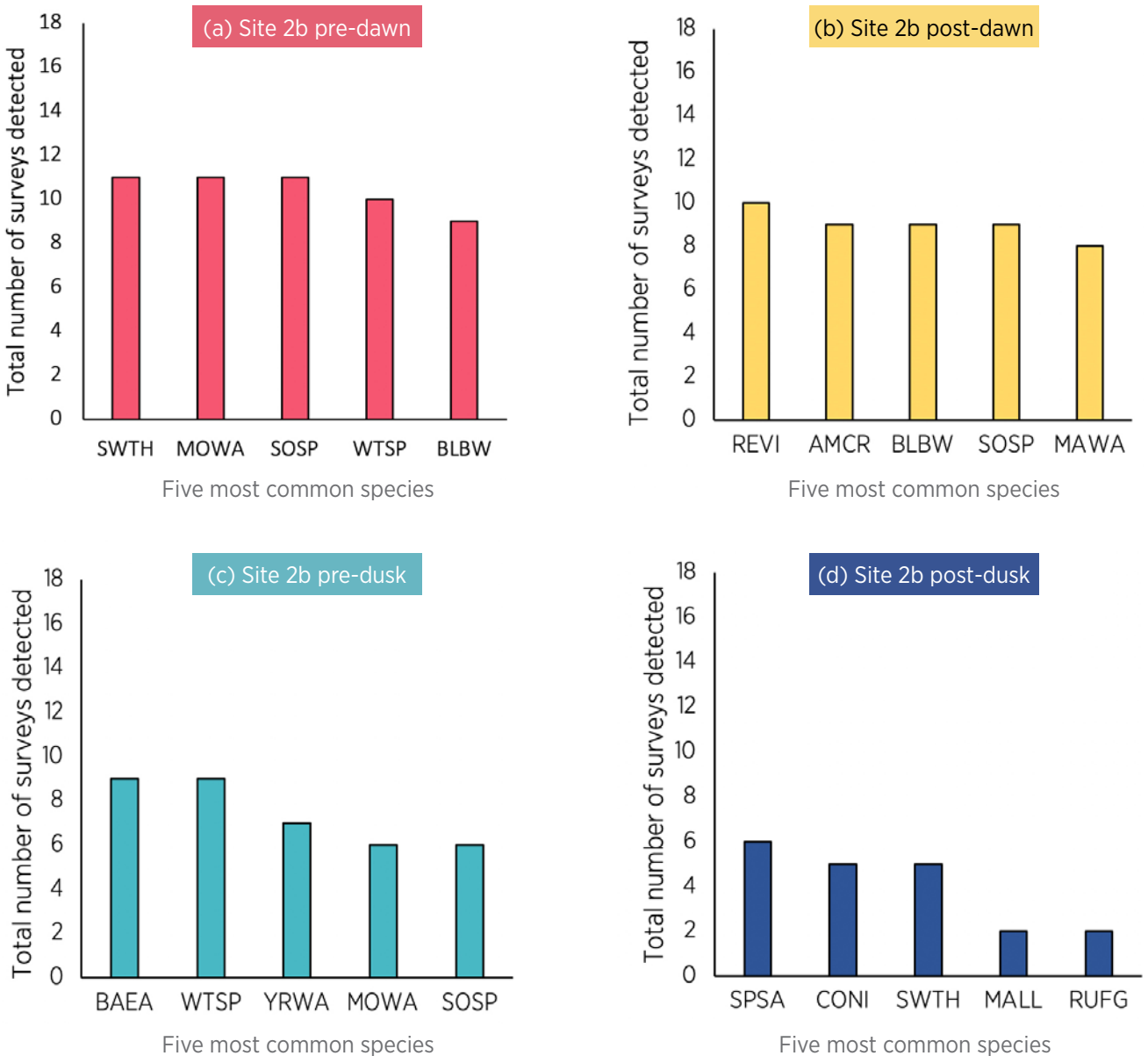

FIGURE 11. Five most prevalent species detected at site 2a during 10-minute autonomous recording unit surveys conducted at four different times of day, including: (a) pre-dawn: Swainson's Thrush (SWTH), Mourning Warbler (MOWA), Song Sparrow (SOSP), White-throated Sparrow (WTSP), Blackburnian Warbler (BLBW); (b) post-dawn: Red-eyed Vireo (REVI), American Crow (AMCR), BLBW, SOSP, Magnolia Warbler (MAWA); (c) pre-dusk: BAEA, WTSP, Yellow-rumped Warbler (YRWA), MOWA, and SOSP; and (d) post-dusk: Spotted Sandpiper (SPSA), Common Nighthawk (CONI), SWTH, Mallard (MALL), and Ruffed Grouse (RUFG).

RESEARCH HIGHLIGHTS AND CONSIDERATIONS

Seventy-one bird species, representing 26 taxonomic families, were detected using ARU devices to survey four sites on the Traditional Territory of the Poplar River First Nation during the spring of 2016. All but one of the species detected (Gray-cheeked Thrush) is presumed to be a breeding species based on multiple detections over many days well past the normal migration period. Gray-cheeked Thrush, a known late spring migrant, was detected at the beginning of the survey period in late May. Blackpoll Warbler, another late spring migrant, may have been detected during migration through the area but was included as a possible breeder. The 71 species detected included 19 of the 27 species of New World wood warblers that breed in the Boreal Forest biome. Several species detected may be near the northern limits of their current distribution including Great Blue Heron, Barred Owl, Eastern Whip-poor-will, Veery, Black-throated Green Warbler, Canada Warbler, and American Goldfinch.

Three bird species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered, threatened or of special concern were detected; Common Nighthawk, Eastern Whip-poor-will, and Canada Warbler (Table 5). The Eastern Whip-poor-will is also listed as Near Threatened on the IUCN Redlist. The Canada Warbler also appears on the Partners in Flight Watchlist. Blackpoll Warbler is listed as Near Threatened on the IUCN Redlist and Wilson's Warbler is on the Partners In Flight list of Common Birds in Steep Decline.

Some of the species detected in the study are among those that have more than 70% of their breeding range confined to the Boreal Forest biome including Bufflehead, Common Goldeneye, Common Loon, Greater Yellowlegs, Spotted Sandpiper, Yellow-bellied Flycatcher, Philadelphia Vireo, Canada Jay, Hermit Thrush, Swainson's Thrush, Blackpoll Warbler, Cape May Warbler, Magnolia Warbler, Mourning Warbler,

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Ovenbird.

Tennessee Warbler, Swamp Sparrow, White-throated Sparrow and White-winged Crossbill. These species are particularly characteristic of and reliant upon the Boreal Forest biome. Monitoring of the status of these species for which the lands within the Boreal Forest biome have such a major responsibility toward ensuring their survival, will be particularly important.

Surveys conducted after dawn and before dusk were associated with the greatest number of species detections (Figure 6b and Appendix A). Conducting surveys before dawn and after dusk, however, allowed for the detection of certain species that were more vocal during these time periods. For example, Eastern Whip-poor-wills and Common Nighthawks, both members of the Nightjar family, are crepuscular—they are most active at dawn and dusk—but will also forage during moonlit nights, and were detected most frequently during the post-dusk survey period. Swainson's Thrush, known for singing later into the evening than most songbirds (Mack and Yong 2020), was detected during all four survey periods, but was most vocal before dawn and after dusk. It was evident from the graphs depicting each site's five most common species (Figures 8 to 11) that species compositions varied considerably among survey periods. Most species vocalized before and after dawn, but some with greater frequency before dawn than after dawn and vice versa. It was interesting to note the patterns each species exhibited in timing of their vocalizations and how each contributed in their own way to the dawn chorus. These results demonstrate the value in conducting ARU surveys at multiple times of day to maximize detection of the greatest number of breeding bird species.

Surveying multiple sites within the Traditional Territory of the Poplar River First Nation was another important factor for maximizing species detection rates. The greatest number of vocalizations detected was at Site 1, which was also associated with the greatest species richness with 47 species from 23 families; however, this could be related to greater survey effort at site 1 rather than the site's habitat characteristics. In general, species richness values were comparable across sites despite differences in survey effort and the number of detections. Similarly, the average number of species detected per survey was comparable among sites 1, 2a, and 2b (approximately 12 to 14), while site 2 was considerably lower (~7). Surveys conducted at sites 2a and 2b likely benefited from their positions next to the river, which made it possible to detect species using forest and open water habitats. Additional research regarding habitat and species occupancy rates would be needed, however, in order to understand how site characteristics influence bird use in the area.

TABLE 5. List of bird species (and number of surveys detected) that are listed as Threatened, Special Concern, or Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC – federal level), the Species at Risk Act (SARA – federal level), and the Government of Manitoba (provincial-level).

POPLAR RIVER SPECIES	TOTAL	COSEWIC	SARA	Provincial
Common Nighthawk	12	Threatened	Threatened	Threatened
Eastern Whip-poor-will	4	Threatened	Threatened	Threatened
Canada Warbler	8	Threatened	Threatened	Threatened

CLIMATE CHANGE AND PROJECTED RANGE SHIFTS OF BIRD SPECIES OF POPLAR RIVER

An important consideration related to future monitoring of bird distribution and abundance through the use of ARUs or other techniques is in relation to changes to bird distributions that may happen under different climate change scenarios. The global average temperature has warmed by 1.5°F over the past 130 years, and more than half of that has occurred in only the last 35 years. Climate-related shifts in bird distributions along latitudinal and elevations gradients are expected for species breeding in the Northern Hemisphere, where increases in temperature are projected to be greatest (La Sorte et al. 2014). National Audubon Society's recent study, ***Survival by Degrees***, found that over two-thirds of North American birds are moderately or highly vulnerable to a global average temperature increase of 3.0°C by 2080 (Wilsey et al. 2019). The 3.0°C increase is the scenario predicted to occur using current high-emissions estimates, while two other potential climate warming scenarios in the study are associated with 1.5°C and 2.0°C increases, representing a climate stabilization and an intermediate scenario, respectively. Species classified as having moderate or high vulnerability to the 3°C climate scenario were projected to experience the greatest range losses, while also not being able to compensate for those losses by gaining new, additional range (Bateman et al. 2020).

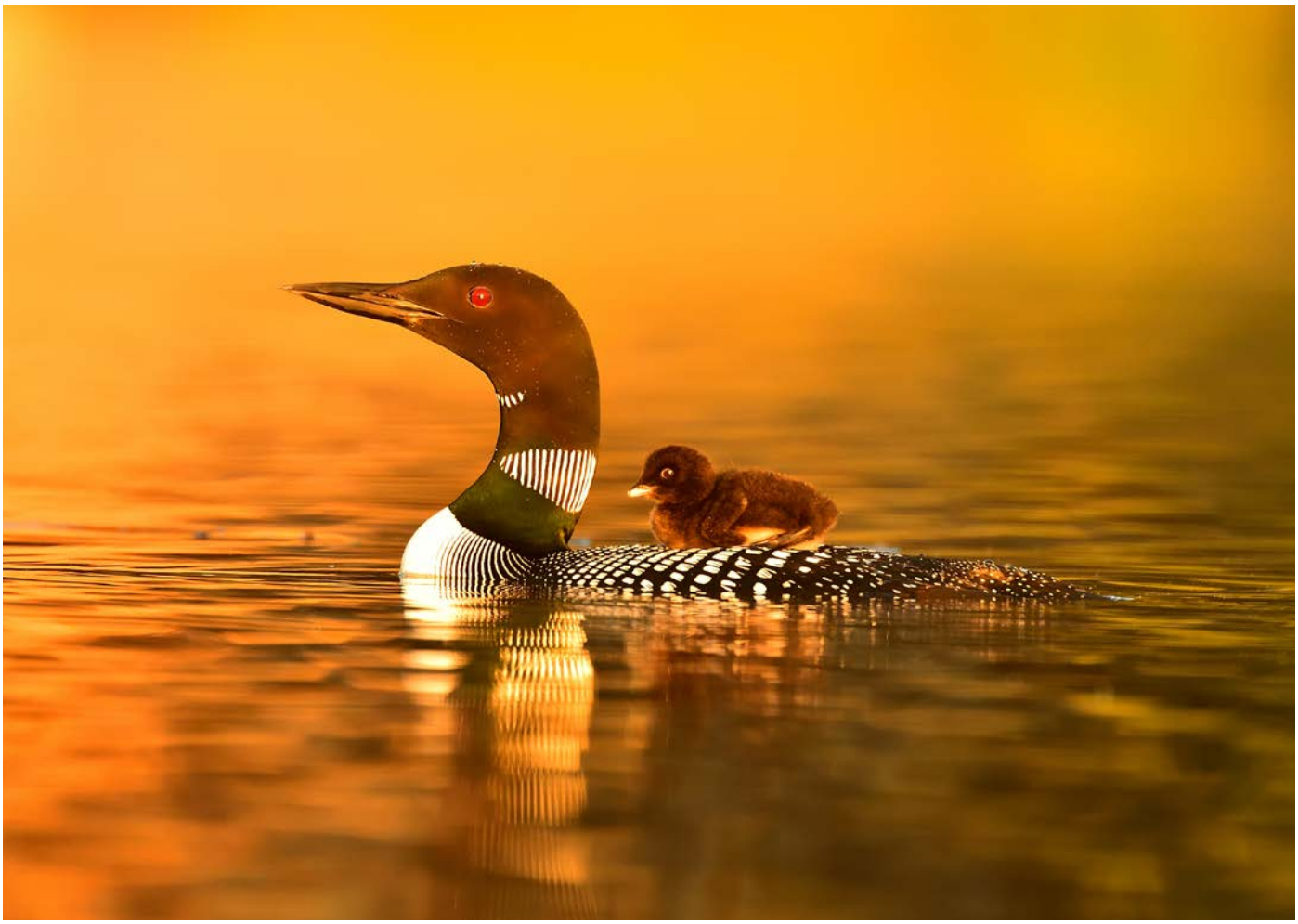
Certain habitat groupings of birds were found to be particularly vulnerable, including 100% of 16 Arctic bird species and 98% of the 48 Boreal Forest species included in these habitat groupings. This includes species, such as Canada's only endemic breeding birds—Harris's Sparrow, which will face likely extinction if projected losses of 100% of its current range, with zero gains of additional range, become a reality. Many species detected at Poplar River, such as Bay-breasted Warbler, Cape May Warbler, Canada Warbler, and Blackburnian Warbler, to name but a few, are also part of the boreal bird habitat group that was identified as being highly vulnerable to range losses under a 3°C climate warming scenario. To gain insight into how the distribution of bird species that currently occur within Pimachiowin Aki may change in the future, we compared the breeding ranges of the species we detected during ARU surveys of the Traditional Territory of the Poplar River First Nation with their predicted ranges in 2055 as modeled by Audubon's Survival by Degrees analyses (Wilsey et al. 2019).

Of the 70 breeding species detected, 24 (34%) were species that are predicted to show no or only limited change in distribution within Pimachiowin Aki as a result of climate change (Table 6). These are species for which the Poplar River First Nation Traditional Territory is expected to serve as a long-term refugia. One species detected, Red-winged Blackbird, is predicted to show a gain in distribution as a result of climate change. The remaining 45 species (Table 7) are expected to all show significant losses in distribution within the Poplar River First Nation Traditional Territory. Gray-cheeked Thrush was detected during the ARU surveys; however, the breeding range of that species is further north and the detections were likely occurred during migration. Therefore, Gray-cheeked Thrush was not included in the climate analysis. The results from this ARU-based bird inventory will provide an important baseline against which future changes can be assessed to see if these model projections hold true or if changes are happening at a different rate or direction than predicted.

These vulnerability assessments, however, are based on a scenario where the current high carbon emissions we currently produce are maintained into the future. The good news is that we can change these outcomes. Indeed, if we achieved the 1.5°C scenario through reduced carbon emission controls, then 76% of North American birds considered at high or moderate vulnerability will drop by at least one climate vulnerability rating. Furthermore, another 38% of North American species included in the report will not be vulnerable to net range losses. More results can be found in the full report, ***Survival by Degrees***, on the National Audubon Society website. Next, we explore the report's findings for three species detected at Poplar River that are currently listed as endangered, threatened, or as a species of special concern.

TABLE 6. Species predicted to maintain distribution within Pimachiowin Aki over next 25 years based on Audubon Climate modeling.

American Bittern	Canada Goose	Marbled Godwit	Ring-billed Gull
American Coot	Cedar Waxwing	Nashville Warbler	Rose-breasted Grosbeak
American Crow	Chipping Sparrow	Northern Cardinal	Ruffed Grouse
American Kestrel	Clay-colored Sparrow	Northern Flicker	Sandhill Crane
American Redstart	Common Loon	Northern Harrier	Sedge Wren
American Robin	Common Nighthawk	Northern Waterthrush	Sharp-tailed Grouse
American Woodcock	Common Raven	Osprey	Song Sparrow
Bald Eagle	Common Yellowthroat	Ovenbird	Swamp Sparrow
Bank Swallow	Gray Partridge	Peregrine Falcon	Tree Swallow
Barred Owl	Great Horned Owl	Pied-billed Grebe	Warbling Vireo
Belted Kingfisher	Hairy Woodpecker	Pileated Woodpecker	Yellow Warbler
Black-billed Cuckoo	Hooded Merganser	Red-breasted Merganser	Yellow-headed Blackbird
Black-capped Chickadee	Horned Lark	Red-eyed Vireo	
Blue Jay	Long-eared Owl	Redhead	
Blue-winged Teal	Mallard	Red-tailed Hawk	



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Common Loon.

TABLE 7. Species predicted to show major declines in distribution within Pimachiowin Aki across 25 years based on Audubon Climate modeling.

Alder Flycatcher	Connecticut Warbler	Golden-crowned Kinglet	Red-breasted Merganser
American Black Duck	Dark-eyed Junco	Great Gray Owl	Red-breasted Nuthatch
American Three-toed Woodpecker	Nashville Warbler	Greater Yellowlegs	Red-necked Grebe
	Northern Cardinal	Green-winged Teal	Ring-necked Duck
American Wigeon	Northern Flicker	Hermit Thrush	Ruby-crowned Kinglet
American Woodcock	Northern Harrier	Herring Gull	Ruffed Grouse
Bay-breasted Warbler	Northern Waterthrush	Hooded Merganser	Rusty Blackbird
Black Tern	Osprey	Le Conte's Sparrow	Sandhill Crane
Black-and-white Warbler	Ovenbird	Least Flycatcher	Savannah Sparrow
Black-backed Woodpecker	Peregrine Falcon	Lesser Scaup	Sharp-shinned Hawk
Black-billed Magpie	Pied-billed Grebe	Lincoln's Sparrow	Solitary Sandpiper
Blackburnian Warbler	Pileated Woodpecker	Magnolia Warbler	Sora
Blackpoll Warbler	Red-breasted Merganser	Merlin	Spotted Sandpiper
Blue-headed Vireo	Red-eyed Vireo	Mourning Warbler	Spruce Grouse
Bonaparte's Gull	Redhead	Nashville Warbler	Surf Scoter
Boreal Chickadee	Red-tailed Hawk	Northern Goshawk	Swainson's Thrush
Boreal Owl	Ring-billed Gull	Northern Hawk Owl	Swamp Sparrow
Broad-winged Hawk	Rose-breasted Grosbeak	Northern Pintail	Tennessee Warbler
Brown Creeper	Ruffed Grouse	Northern Saw-whet Owl	Veery
Bufflehead	Sandhill Crane	Northern Shoveler	White-throated Sparrow
Canada Jay	Sedge Wren	Northern Waterthrush	White-winged Crossbill
Canada Warbler	Sharp-tailed Grouse	Olive-sided Flycatcher	White-winged Scoter
Canvasback	Song Sparrow	Orange-crowned Warbler	Willow Ptarmigan
Cape May Warbler	Swamp Sparrow	Ovenbird	Wilson's Snipe
Chestnut-sided Warbler	Tree Swallow	Palm Warbler	Wilson's Warbler
Clay-colored Sparrow	Warbling Vireo	Peregrine Falcon	Winter Wren
Common Goldeneye	Yellow Warbler	Philadelphia Vireo	Yellow Rail
Common Loon	Yellow-headed Blackbird	Pine Siskin	Yellow-bellied Flycatcher
Common Merganser	Eastern Whip-poor-will	Purple Finch	Yellow-bellied Sapsucker
Common Tern	Evening Grosbeak	Red Crossbill	Yellow-rumped Warbler

COMMON NIGHTHAWK

Connor Charchuk

The Common Nighthawk was detected during surveys at sites 2, 2a, and 2b and is a species that is estimated to have declined by 61% throughout its range between 1966 and 2014 (Sauer et al. 2017). It breeds throughout most of the southern half of Canada and south throughout the United States and mountainous regions of Central America (Brigham et al. 2020) (Figure 12a). It relies on semi-open habitats, e.g., openings in forest related to wetlands, fires, and timber harvesting, for breeding and roosting, and is positively associated with wetland habitats for foraging (Vala et al. 2020). Declines in insect populations linked to pesticide use and habitat loss/modifications are likely contributors to the species' population decline; however, it is not fully understood (Canada and Environment Canada 2016). Range losses associated with climate change are expected to be minimal (~1%), with 99% of the current range maintained, and 20% of range gained (Figure 12b) (primarily in Canada) (Wilsey et al. 2019).

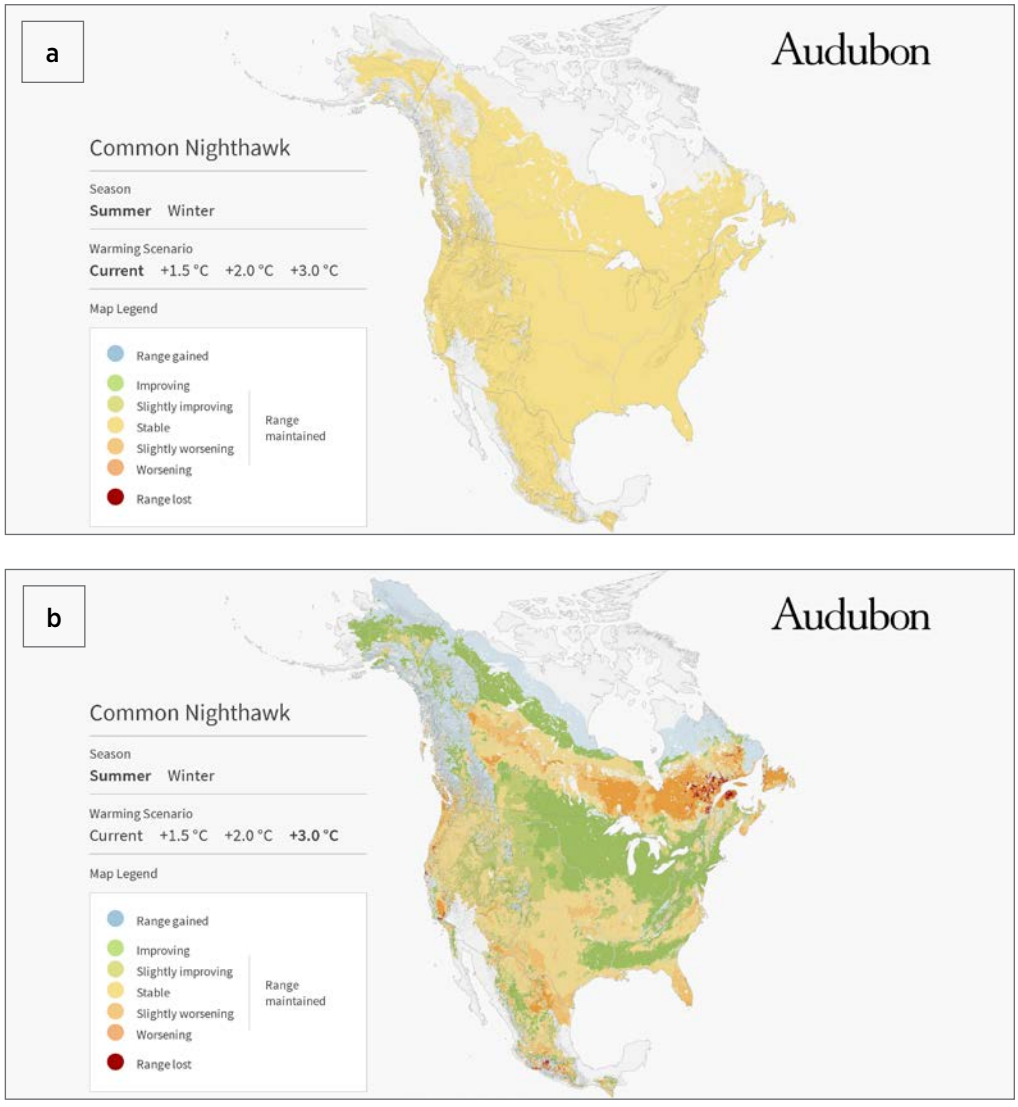

FIGURE 12. Common Nighthawk (a) current range and (b) net gain (blue) or loss (red) of range associated with 3.0°C climate warming. Source: Audubon, Visualization by Stamen Design.

EASTERN WHIP-POOR-WILL

Photo Credit

The Eastern Whip-poor-will was detected at site 1 and is listed as threatened at the federal and provincial level. It is estimated to have declined throughout most of its range by 69% between 1966 and 2014 (Sauer et al. 2017). The species breeds throughout the eastern United States from the northern edge of the Gulf Coast States north to Canada, where it reaches its northern limit in southern Manitoba east to southern Quebec (Cink, Pyle, and Patten 2020) (Figure 13a). The reasons for its population decline are not well understood; however, similar to the related Common Nighthawk, a probable contributor is declines in insect populations (Canada and Environment Canada 2016). It also relies on semi-open habitats, e.g., openings in forest related to wetlands, fires, and timber harvesting, for breeding and roosting, and is positively associated with wetland habitats for foraging (Vala et al. 2020). Range losses associated with climate change are expected to around 81%, with 19% of the current range maintained, and 44% of range gained (primarily in Canada) (Wilsey et al. 2019).

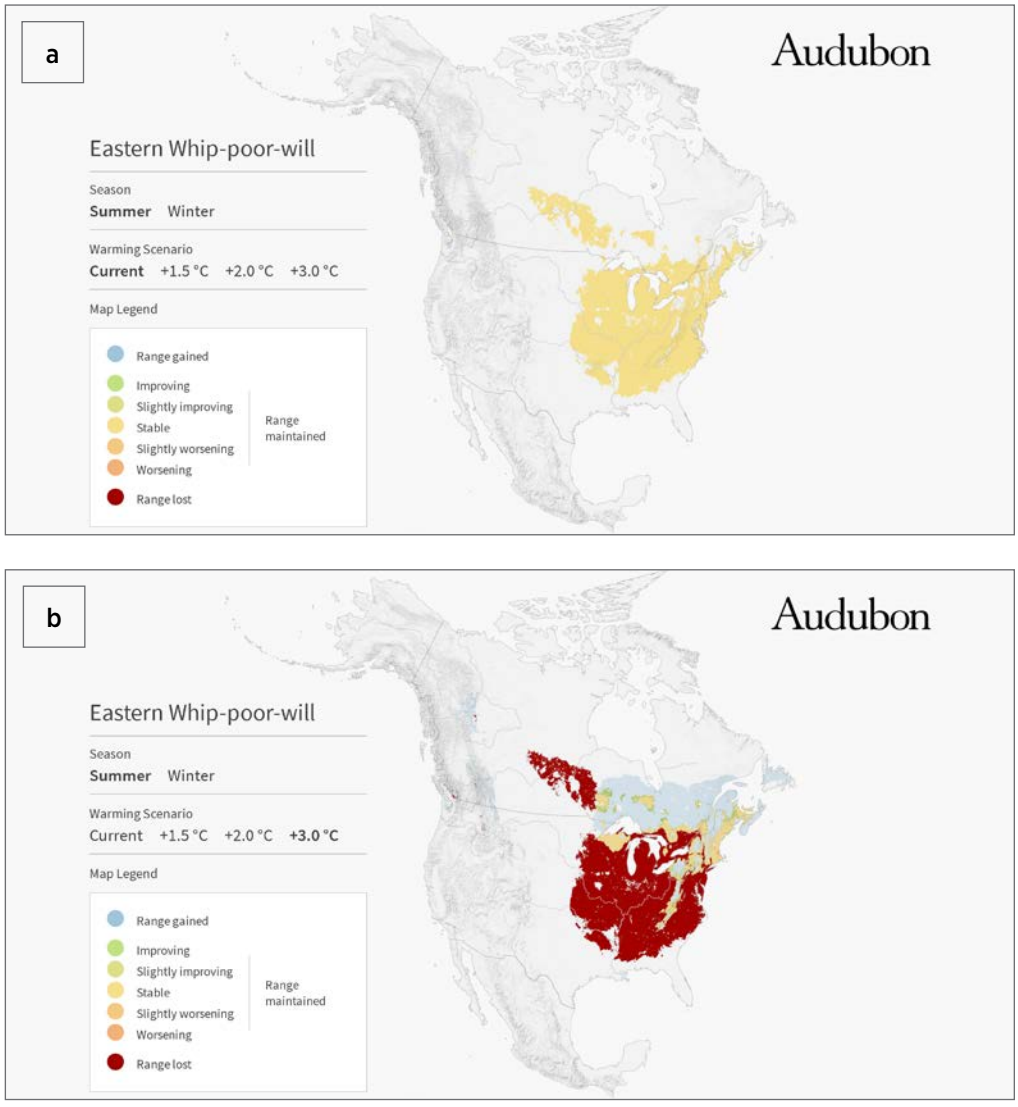

FIGURE 13. Eastern Whip-poor-will current range (a) and (b) net gain (blue) or loss (red) of range associated with 3.0°C climate warming. Source: Audubon, Visualization by Stamen Design.

CANADA WARBLER

Dale Bonk

The Canada Warbler was detected at sites 1, 2a, and 2b and is listed as threatened at the federal and provincial level. It has experienced an estimated 71% population decline between 1970 – 2010 (Sauer et al. 2017). Canada Warblers breeds across most of the Boreal Forest of Canada, southeastern Canada, and the northeastern U.S. (Reitsma et al. 2020) (Figure 14a). The species is most common in mixed forests with heavy understory shrub growth (Reitsma, Hallworth, and Benham 2008); although, it uses a wide range of deciduous and forested wetland habitats across its range (Becker, Wood, and Keyser 2012; Grinde and Niemi 2016). Loss of forested habitat, increased forest fragmentation, and disturbance are likely factors contributing to the species' steep population declines (Westwood et al. 2019). Increased protection of intact forested landscapes, away from roads and human disturbance, in the breeding and wintering range will be necessary to slow current population losses (Céspedes and Bayly 2019; Westwood et al. 2019). Current range losses associated with climate change are expected to around 95%, with 5% of the current range maintained, and 63% of range gained (primarily in Canada) (Figure 14b) (Wilsey et al. 2019).

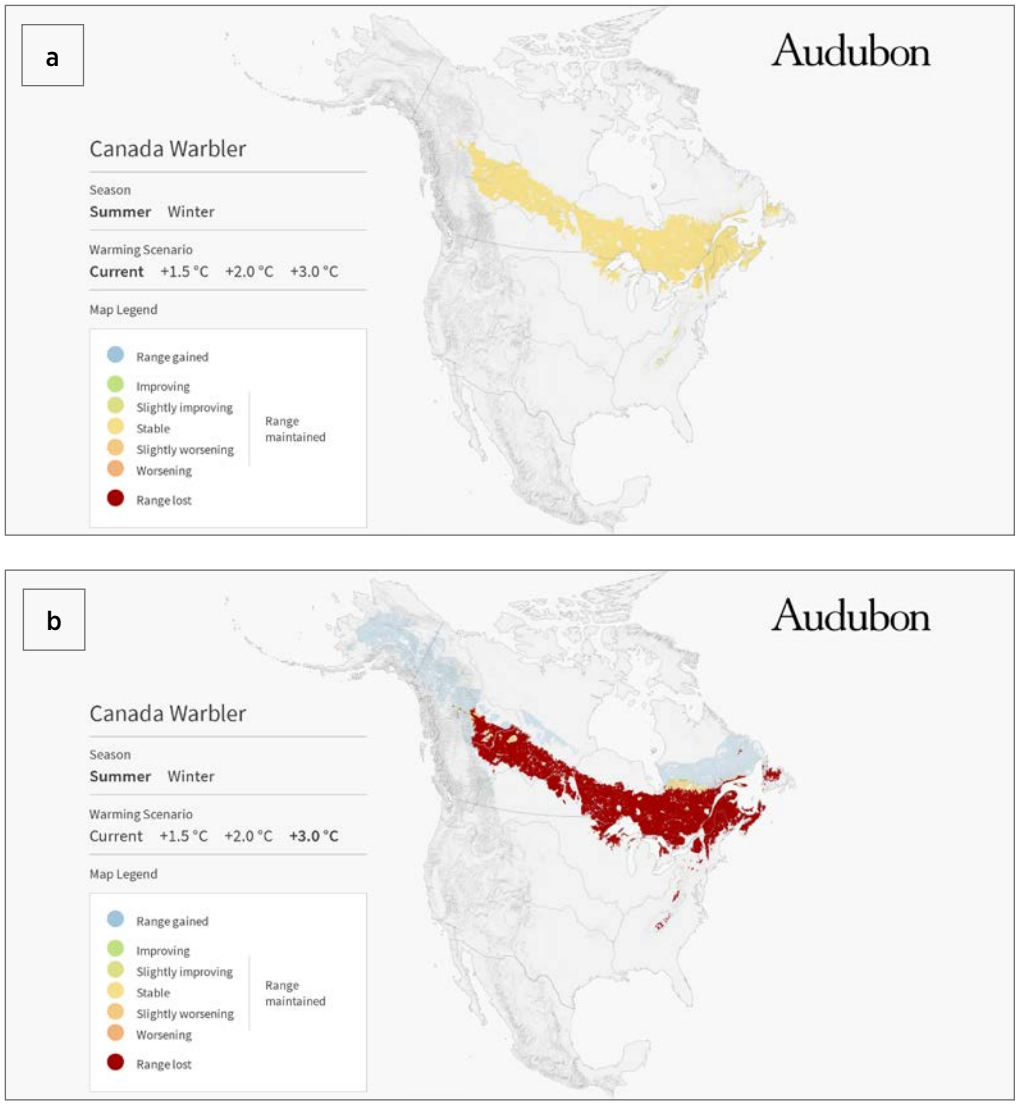

FIGURE 14. Canada Warbler current range (a) and (b) net gain (blue) or loss (red) of range associated with 2.0°C climate warming. Source: Audubon, Visualization by Stamen Design.

NEXT STEPS

Since the 2016 season, monitoring with ARU units has continued on Poplar River First Nation's Traditional Territory. The recordings from the years 2017–2021 have not been processed to add to the baseline knowledge of the birds of the territory. These recordings will be analyzed to identify the species present using new automated bird identification machine learning algorithm processes which are very time and cost efficient. The 2016 results reported here from a human expert listening to a sample of the total recordings will also be compared to an analysis of the total set of recordings using the machine learning algorithm to better understand the strengths and weaknesses of both approaches. We will also deploy ARU units in 2022 at the same locations and dates as they were in 2016 to see whether any changes in the species or relative abundance or detectability are evident and if any changes are consistent with projections of changes in bird numbers predicted from climate change.

This work is a model of a successful collaboration between Indigenous Guardians and Western scientists. Further work should continue to better understand how Indigenous Knowledge about birds can be brought together with results from Western science approaches to gain a fuller understanding of the birds and ecology of the Poplar River First Nation Traditional Territory and other Indigenous Traditional Territories. Long-term financial support of Indigenous Guardians programs and Indigenous-led conservation should be a high priority of federal and provincial governments.

Mick Thompson

Swainson's Thrush.

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APPENDIX A. SPECIES LIST

TABLE A1. List of species present by family and the sites where they were detected during spring 2016 bird surveys using autonomous recording units in Poplar River, MB.

Family	Species Common Name *Latin Name*	Sites Present	Survey Periods Detected	Total # of Detections	Total # of Surveys Detected	Percent of Surveys Detected
Accipitridae	Bald Eagle *Haliaeetus leucocephalus*	1, 2, 2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk, Post-Dusk	72	58	33.5
Alcedinidae	Belted Kingfisher *Megaceryle alcyon*	1, 2, 2a	Post-Dawn, Pre-Dusk	7	5	2.9
Anatidae	Bufflehead *Bucephala albeola*	1, 2b	Pre-Dawn, Post-Dawn	2	2	1.2
	Canada Goose *Branta canadensis*	2	Post-Dawn	2	1	0.6
	Common Goldeneye *Bucephala clangula*	1, 2, 2a, 2b	Pre-Dusk	1	1	0.6
	Common Merganser *Mergus merganser*	2a	Pre-Dawn, Pre-Dusk, Post-Dusk	16	12	6.9
	Mallard *Anas platyrhynchos*	1, 2a, 2b	Pre-Dawn, Pre-Dusk, Post-Dusk	16	14	8.1
Ardeidae	Great Blue Heron *Ardea herodias*	1, 2	Pre-Dawn, Pre-Dusk	2	2	1.2
Bombycillidae	Cedar Waxwing *Bombycilla cedrorum*	2a, 2b	Pre-Dawn, Post-Dawn	8	6	3.5
Caprimulgidae	Common Nighthawk *Chordeiles minor*	2, 2a, 2b	Post-Dawn, Pre-Dusk	87	46	26.6
	Eastern Whip-poor-will *Antrostomus vociferus*	1	Pre-Dusk, Post-Dusk	12	4	2.3
Certhiidae	Brown Creeper *Certhia americana*	2, 2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk	22	18	10.4
Corvidae	American Crow *Corvus brachyrhynchos*	1, 2, 2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk	130	55	31.8
	Blue Jay *Cyanocitta cristata*	1	Pre-Dusk	1	1	0.6
	Canada Jay *Perisoreus canadensis*	1	Pre-Dawn, Post-Dawn, Pre-Dusk	8	8	4.6
	Common Raven *Corvus corax*	1, 2, 2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk, Post-Dusk	13	12	6.9

Family	Species Common Name *Latin Name*	Sites Present	Survey Periods Detected	Total # of Detections	Total # of Surveys Detected	Percent of Surveys Detected
Fringillidae	American Goldfinch *Spinus tristis*	1	Post-Dawn	3	2	1.2
	Pine Siskin *Spinus pinus*	1, 2, 2a, 2b	Post-Dawn, Pre-Dusk	28	21	12.1
	Purple Finch *Haemorhous purpureus*	2a, 2b	Post-Dawn	4	3	1.7
	Red Crossbill *Loxia curvirostra*	2	Pre-Dusk	1	1	0.6
	White-winged Crossbill *Loxia leucoptera*	2, 2a, 2b	Post-Dawn	11	4	2.3
Gavidae	Common Loon *Gavia immer*	1	Pre-Dusk, Post-Dusk	2	2	1.2
Icteridae	Red-winged Blackbird *Agelaius phoeniceus*	1, 2a	Pre-Dawn, Post-Dawn, Pre-Dusk	12	9	5.2
Laridae	Herring Gull *Larus argentatus*	1	Pre-Dusk	2	1	0.6
	Ring-billed Gull *Larus delawarensis*	1	Pre-Dawn, Post-Dawn, Pre-Dusk, Post-Dusk	117	32	18.5
Paridae	Black-capped Chickadee *Poecile atricapillus*	1, 2a	Post-Dawn	6	5	2.9
Parulidae	American Redstart *Setophaga ruticilla*	1, 2	Post-Dawn, Pre-Dusk	3	3	1.7
	Bay-breasted Warbler *Setophaga castanea*	1, 2, 2b	Post-Dawn, Pre-Dusk	4	4	2.3
	Black-and-white Warbler *Mniotilta varia*	1, 2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk	37	29	16.8
	Blackburnian Warbler *Setophaga fusca*	1, 2, 2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk, Post-Dusk	94	69	39.9
	Blackpoll Warbler *Setophaga striata*	1	Pre-Dawn	4	1	0.6
	Black-throated Green Warbler *Setophaga virens*	1	Pre-Dawn, Post-Dawn	4	4	2.3
	Canada Warbler *Cardellina canadensis*	1, 2a, 2b	Post-Dawn, Pre-Dusk	8	7	4.0
	Cape May Warbler *Setophaga tigrina*	2, 2b	Post-Dawn, Pre-Dusk	26	12	6.9
	Chestnut-sided Warbler *Setophaga pensylvanica*	2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk	22	21	12.1

Family	Species Common Name *Latin Name*	Sites Present	Survey Periods Detected	Total # of Detections	Total # of Surveys Detected	Percent of Surveys Detected
Parulidae continued	Common Yellowthroat *Geothlypis trichas*	2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk	32	27	15.6
	Magnolia Warbler *Setophaga magnolia*	1, 2, 2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk, Post-Dusk	62	50	28.9
	Mourning Warbler *Geothlypis philadelphia*	1, 2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk	53	46	26.6
	Nashville Warbler *Leiothlypis ruficapilla*	1, 2, 2a	Pre-Dawn, Post-Dawn, Pre-Dusk	37	29	16.8
	Northern Waterthrush *Parkesia noveboracensis*	2a	Pre-Dusk	1	1	0.6
	Ovenbird *Seiurus aurocapilla*	1, 2, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk, Post-Dusk	77	61	35.3
	Tennessee Warbler *Leiothlypis peregrina*	1, 2, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk	36	29	16.8
	Wilson's Warbler *Cardellina pusilla*	1, 2a	Pre-Dawn, Post-Dawn	2	2	1.2
	Yellow Warbler *Setophaga petechia*	1, 2, 2a	Pre-Dawn, Post-Dawn	3	3	1.7
	Yellow-rumped Warbler *Setophaga coronata*	2, 2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk	44	38	22.0
Passerellidae	Chipping Sparrow *Spizella passerina*	2, 2a, 2b	Post-Dawn, Pre-Dusk, Post-Dusk	12	11	6.4
	Song Sparrow *Melospiza melodia*	1, 2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk, Post-Dusk	75	55	31.8
	Swamp Sparrow *Melospiza georgiana*	2a, 2b	Pre-Dusk	4	2	1.2
	White-throated Sparrow *Zonotrichia albicollis*	1, 2, 2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk, Post-Dusk	185	98	56.6
Phasianidae	Ruffed Grouse *Bonasa umbellus*	1, 2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk, Post-Dusk	27	27	15.6
Picidae	Hairy Woodpecker *Dryobates villosus*	2b	Post-Dawn	1	1	0.6
	Northern Flicker *Colaptes auratus*	1, 2, 2a, 2b	Post-Dawn, Pre-Dusk	16	16	9.2
	Pileated Woodpecker *Dryocopus pileatus*	1, 2, 2a, 2b	Post-Dawn, Pre-Dusk	23	22	12.7
	Yellow-bellied Sapsucker *Sphyrapicus varius*	1, 2	Post-Dusk	2	2	1.2

Family	Species Common Name *Latin Name*	Sites Present	Survey Periods Detected	Total # of Detections	Total # of Surveys Detected	Percent of Surveys Detected
Rallidae	Sora *Porzana carolina*	1	Pre-Dusk, Post-Dusk	2	2	1.2
Regulidae	Golden-crowned Kinglet *Regulus satrapa*	2, 2a, 2b	Post-Dawn	8	4	2.3
	Ruby-crowned Kinglet *Corthylio calendula*	2	Post-Dawn, Pre-Dusk	9	9	5.2
Scolopacidae	Greater Yellowlegs *Tringa melanoleuca*	2a, 2b	Pre-Dawn, Pre-Dusk	2	2	1.2
	Spotted Sandpiper *Actitis macularius*	1, 2b	Post-Dawn, Pre-Dusk, Post-Dusk	14	12	6.9
Sittidae	Red-breasted Nuthatch *Sitta canadensis*	2, 2a	Post-Dawn	2	2	1.2
Strigidae	Barred Owl *Strix varia*	1, 2a	Pre-Dawn, Post-Dusk	3	3	1.7
Troglodytidae	Winter Wren *Troglodytes hiemalis*	1, 2, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk	32	30	17.3
Turdidae	Gray-cheeked Thrush *Catharus minimus*	1, 2a	Pre-Dawn, Post-Dawn, Post-Dusk	6	4	2.3
	Hermit Thrush *Catharus guttatus*	1, 2	Pre-Dusk, Post-Dusk	4	3	1.7
	Swainson's Thrush *Catharus ustulatus*	1, 2, 2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk, Post-Dusk	158	89	51.4
	Veery *Catharus fuscescens*	2	Pre-Dusk	1	1	0.6
Tyrannidae	Alder Flycatcher *Empidonax alnorum*	2a	Pre-Dawn, Post-Dawn, Post-Dusk	8	6	3.5
	Yellow-bellied Flycatcher Empidonax flaviventris	1, 2b	Post-Dawn, Post-Dusk	2	2	1.2
Vireonidae	Blue-headed Vireo *Vireo solitarius*	1	Post-Dawn	1	1	0.6
	Philadelphia Vireo *Vireo philadelphicus*	1	Post-Dawn	1	1	0.6
	Red-eyed Vireo *Vireo olivaceus*	1, 2, 2a, 2b	Pre-Dawn, Post-Dawn, Pre-Dusk	88	48	27.7

Poplar River.

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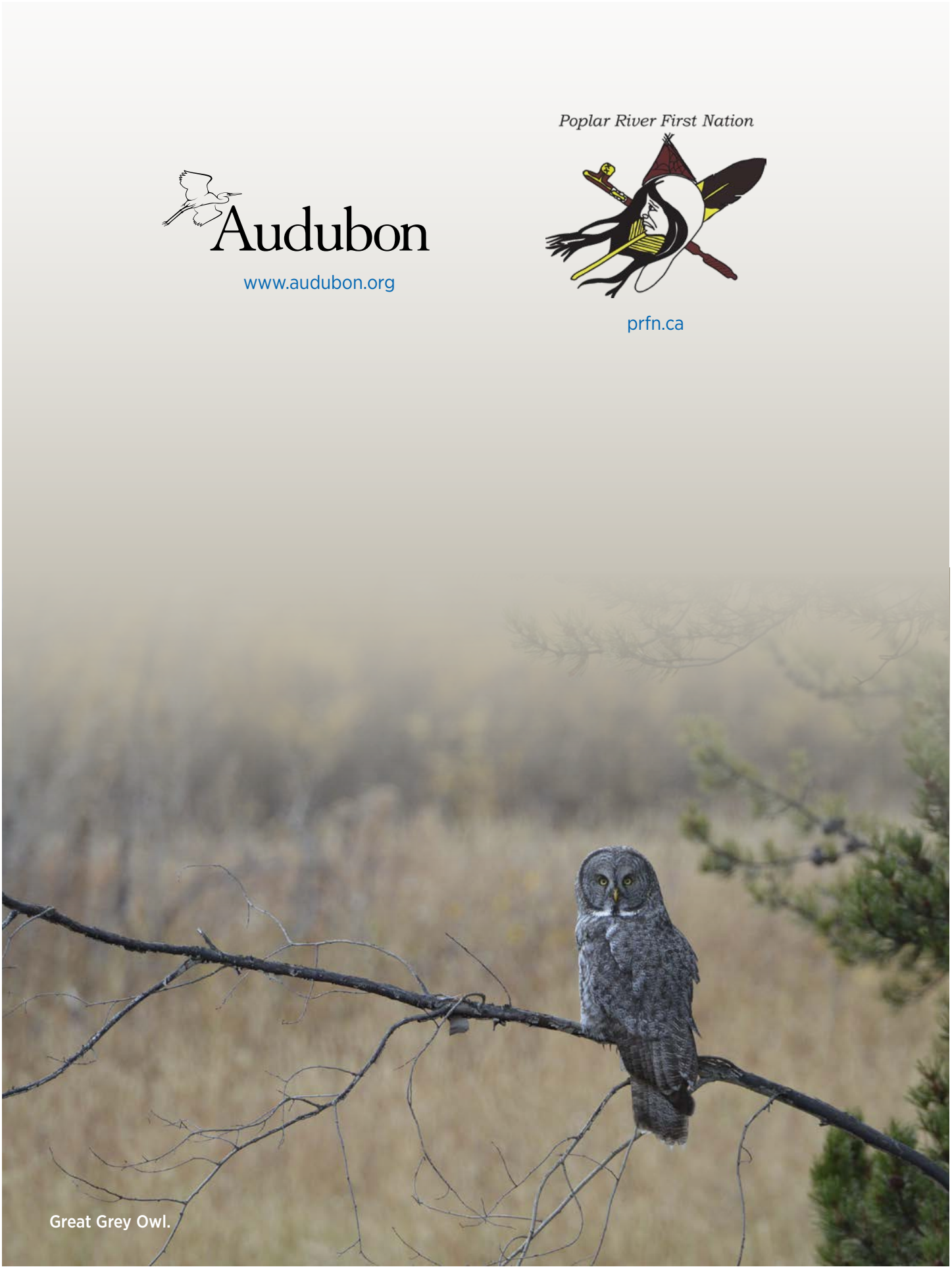

Great Grey Owl.

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