PO Box 189
Minitonas, Manitoba R0L 1G0
204 525 2479
LPCorp.com

September 11, 2020

Ms. Shannon Kohler
Director, Environmental Assessment and Licensing
Manitoba Conservation and Climate
1007 Century Street
Winnipeg, MB
R3H 0W4

Dear Ms. Kohler,

Re: 2020 Fauna Monitoring Study LP Swan Valley SMARTSIDE Siding Mill

Please find enclosed a copy of the 2020 Fauna Monitoring Study, submitted in compliance with Environment Act Licence 2954 RR, clause 25.

The results of the 2020 study (FERIT, August 2020), as with the 2015 study (Stantec, October 2015), 2010 study (Stantec, January 2011), 2005 study (TetrES 2006), 2000 study (TetrES 2000) and 1997 study (TetrES 1998), found no evidence of harmful effects to biota from exposures to OSB/SmartSide plant emissions. The report concludes:

> "Results of the 2020 Fauna survey are consistent with previous surveys since baseline data was collected 25 years ago in 1995. The current conclusion, similar to that reported in Stantec (2015), is that there is no evidence that emissions from the Minitonas mill is having a negative effect on local bird populations. Further monitoring is highly unlikely to detect any emission-related effects on birds, mirroring the conclusions of the previous reports from 2000, 2005, 2010, and 2015. As concluded in the 2015 report, landscape-level change, including land clearing and timber harvest, is likely the principal cause of any detected changes."

Once again, with the completion of the 2020 study, combined with the five previous monitoring studies, we submit that our obligation to monitor the impact of mill operations on local fauna has been fulfilled. Given the report's key observations and conclusions that long-term monitoring data do not suggest that changes in bird populations are attributed to LPC mill emissions and that further studies are not anticipated to yield any new insights into the impact of mill operations, we respectfully request that the requirement to conduct any further studies be discontinued, in accordance with clause 25 of Environment Act Licence 2954 RR.

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204 525 2479
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If you have questions or comments or require additional information, please contact Mr. Lyle Sagert at (204) 525-2479 x.2117.

Sincerely,

[redacted]

Kevin Betcher,
Plant Manager
LP Swan Valley SmartSide

Cc: Lyle Sagert, Plant EHS Manager
Al Hambley, Environmental Operations Manager, LP Corp.
Eshetu Beshada, Environmental Engineer, MB Conservation & Climate

2020 Fauna Monitoring Report:

Louisiana Pacific Canada
LP SmartSide Manufacturing Facility

Minitonas, Manitoba




Report to:
Louisiana-Pacific Canada

August 2020

FERIT Environmental Consulting

2020 Fauna Monitoring Report: Louisiana Pacific Canada

LP SmartSide Manufacturing Facility

FERIT Environmental Consulting

Prepared for:

Louisiana Pacific Canada

Prepared by:

Dr Robert S. Rempel

FERIT Environmental Consulting

379 Black Bay Rd,

Thunder Bay, Ontario, P7A 1P4

August 14th, 2020

Contents

Acknowledgements

This project was a team effort involving important contributions and advice from Allan Hambley, Brian Nickel, Enid Cumming, Lyle Sagert, Matthew Harris, and Paul LeBlanc. Brian Nickel coordinated the field work, including collection of roadside survey and aspen plot acoustic recordings with Leanne Kalinowich. Enid Cumming interpreted the acoustic recordings.

Background and Objectives

As part of the licensing requirement for the LP Swan Valley SmartSide© manufacturing facililty (formerly Oriented Strand Board (OSB)) mill near the town of Minitonas, Manitoba, Louisiana-Pacific Canada Ltd. (LPC) developed and implemented a flora and fauna monitoring plan beginning in 1997, with baseline data collected in 1995 (Stantec 2015). A key focus of the plan was to determine if mill emissions were having any measurable effect on the local bird fauna, with monitoring to occur every 5 years under requirements stipulated in an Environment Act License issued by Manitoba Conservation and Water Stewardship (formerly Manitoba Environment) for the mill (License No. 2954 RR (2015)).

Monitoring was initiated in 1995 by Stantec (formerly Tetr*ES* Consultants), and in 1996 a monitoring plan was created, along with selection of target species (Tetr*ES* 1996a). Stantec conducted monitoring studies under this plan in 1997, 2000, 2005, 2010, and 2015 (Stantec 2015). Stantec had found no measurable effect of mill emissions on bird fauna over this time period (Stantec 2015). The purpose of this 2020 study is to continue the monitoring program with another year of data to assess if these conclusions are still valid.

LPC has also conducted bird monitoring in support of forest ecosystem management planning (FEMP) in the Duck Mountains FMU, and this work involves the development of songbird habitat models (i.e., resource selection functions) by FERIT. With a goal to consolidate bird monitoring and various biodiversity assessment support, LPC approached FERIT to conduct the statistical assessment of the 2020 Minitonas mill monitoring results, including review of the survey protocols. The objective of the 2020 analysis is to establish through mature aspen bird surveys (based on point count protocols) and roadside surveys (based on Breeding Bird Survey (BBS) protocols) if there have been any significant changes in focal bird populations that could be attributable to LPC's OSB mill emissions. FERIT recommended an approach where analyses would be consistent with previous years to ensure validity of long-term trend analyses, but also to allow inclusion of additional statistical approaches where appropriate to strengthen the overall assessment.

Methods and Study Area

Data Restructuring

A new Excel database to incorporate the 2020 Aspen Woodlot Monitoring (AWM) survey results was created based on the Excel data files provided by Stantec. These files provided bird count values for Aspen plots for the years 2000, 2005, 2010, and 2015, and identified observations by species, treatment class (exposed versus reference plot), and distance class (birds < 50 m versus > 50 m from observer). Raw data for years 1995 and 1997 were not available; however, summary values of bird density by treatment (but not distance) were found in the Appendix of the Stantec (2015) report, and these values were entered (copy and paste) into the data sheet. Values for the 2020 survey year were then added to this new data sheet. To assess if data were consistent from the Excel sheets with the 2015 report, statistical summary tables were generated using R code (R Core Team 2020; RStudio Team 2020), and density values for previous years using all observations (< 50 m and > 50 m) were equivalent to density values reported in the 2015 report. Likewise, a new database to incorporate the 2020 data for Road-Side Monitoring (RSM) survey was created based on Excel data files provided by Stantec that included survey dates 1995, 1997, 2000, 2005, 2010, and 2015.

The previous studies used the terms Control and Experimental to refer to treatment classes; however these terms are not strictly correct as "Control" sites do not actively control for random variation in site condition, and "Experimental" sites do not actively manipulate site conditions with experimental treatments. Instead I used the terms "Reference" and "Exposed" to label sites > 10 km from the mill and <=10 km from the mill, respectively, where "Exposed" indicates greater exposure to mill emissions.

Target Species Selection

As reported by Stantec (2015), 6 target species were selected in 1997 based on the initial study by Tetr*ES* (1996a; 1996b) that were representative of mature woodlot habitat and were common breeders (Table 1). These species were consistently monitored over the study years and used in the 2020 analysis. Dominant vegetation in the woodlots was trembling aspen (*Populus tremuloides*) with associated understory vegetation typically consisting predominantly of hazelnut (*Corylus* sp.), red-osier dogwood (*Cornus stolonifera*), willow (*Salix* sp.) and wild rose (Rosa sp.).

In contrast the RSM route follows roads that traverse a variety of local habitat types such as aspen-woodlot edges, open agriculture fields, pasture areas, shelterbelts, woodland stream areas, wet ditch and low-marshy areas (Stantec 2015), so 5 target species were selected that were representative of these habitat types (Table 1). As noted by Stantec (2015), target species were also selected to represent different feeding habits as mill emissions could affect populations differentially based on diet. Note that analysis of roadside survey data was also conducted for those species used in the AWM.

Table 1. Target species used in the Aspen Woodlot Monitoring (AWM) and Roadside Monitoring (RSM) components.

Target Species	Latin name
Aspen Woodlot Monitoring (AWM)	
American Redstart	*Setophaga ruticilla*
Least Flycatcher	*Empidonax minimus*
Ovenbird	*Seiurus aurocapilla*
Red-eyed Vireo	*Vireo olivaceus*
Veery	*Catharus fuscescens*
White-throated Sparrow	*Zonotrichia albicollis*
Roadside Survey Monitoring (RSM)	
Alder Flycatcher	*Empidonax alnorum*
American Crow	*Corvus brachyrhynchos*
American Goldfinch	*Spinus tristis*
Clay-colored Sparrow	*Spizella pallida*
Red-eyed Vireo	

Survey Design

Aspen Woodlot Monitoring (AWM): The purpose of the AWM survey was to test if mill emissions were having a negative effect on breeding bird local abundance. Data were collected for 2 treatment classes: *exposed* (4 mature aspen sites <= 10 km from the mill), and *reference* (3 mature aspen sites > 10 km from the mill). A key principal of the survey design was to compare bird densities in mature aspen woodlots, so if part of a site had been logged then the plots were re-positioned within the woodlot, and if most of the woodlot had been logged then a new site was obtained, if one was available.

In 2020 two new woodlot sites were obtained, and plots were repositioned in one woodlot (Figure 1). Site C4 is a reference site and is located 4 km from C2 and 11 km from the Mill. Within woodlots 5 sampling stations (plots) 100 m apart were positioned if room were available, but in a few cases only 3 or 4 plots could be accommodated within the woodlot. In general plots were positioned along a transect that started 50 m from the woodlot edge.

Roadside Survey Monitoring (RSM): Roadside surveys were originally designed and approved by the Canadian Wildlife Service (CWS) based on standard CWS/USGS protocols for designing BBS routes, but note that the LPC route is not integrated into the standard set of BBS routes that are surveyed annually. The same 50 km route was traversed over all study years (Figure 2). BBS routes are assessed by the CWS by ecoregion (Smith et al. 2019), and their purpose is to assess broad trends in abundance over time. In any year abundance can go up or down for multiple reasons, including year specific weather patterns, factors occurring on the overwintering grounds, and factors occurring within the study area. For this monitoring study, the purpose of the RSM component was to evaluate if general trends in relative abundance in the LPC route differed substantively from trends of the nearby BBS routes of Lenswood, Ruthenia, Swan, and Zelena (Figure 2) and from trends assessed at the ecoregional level (i.e., the Manitoba portion of the Boreal Taiga Plains - BCR 6). Note that the assessment of 4 nearby BBS routes was new to 2020.

Bird Observations

Aspen Woodlot Monitoring: Bird were surveyed using a 5-min fixed distance point-count method. In previous years birds were surveyed between late May and early June, from sunrise to ~ 11:00 AM. In 2015 birds were surveyed between June 10th and June 11th, while in 2020 birds were surveyed between June 9th and 13th during the peak of the "dawn chorus" (no earlier than ½ hour before sunrise and no later than 9:00 AM) on rain-free days with little wind. In previous years observations were recorded by observers in the field, but in 2020 observations were made by interpreting songbird recordings made with CVX omni-directional microphones. During the 5-min survey period all birds detected in <= 50 m and > 50 m distance bands were recorded; for interpreted recordings, the location of distance bands was based on perceived loudness of the vocalizations.

Roadside Survey Monitoring: The protocols for bird observations followed the same time of month and time of day restrictions as used in the AWM but using a 3-min observation period. In previous years observations were made by observers in the field stopping at each of the 50 roadside stops, but in 2020 recordings were made at each stop using the CVX recorder on June 12th and 13th. Traffic noise can impede interpretation of recordings and create a bias relative to field observations, so recordings were made longer than 3-min, and then later a 3-min sound clip with relatively low traffic noise was extracted for interpretation.

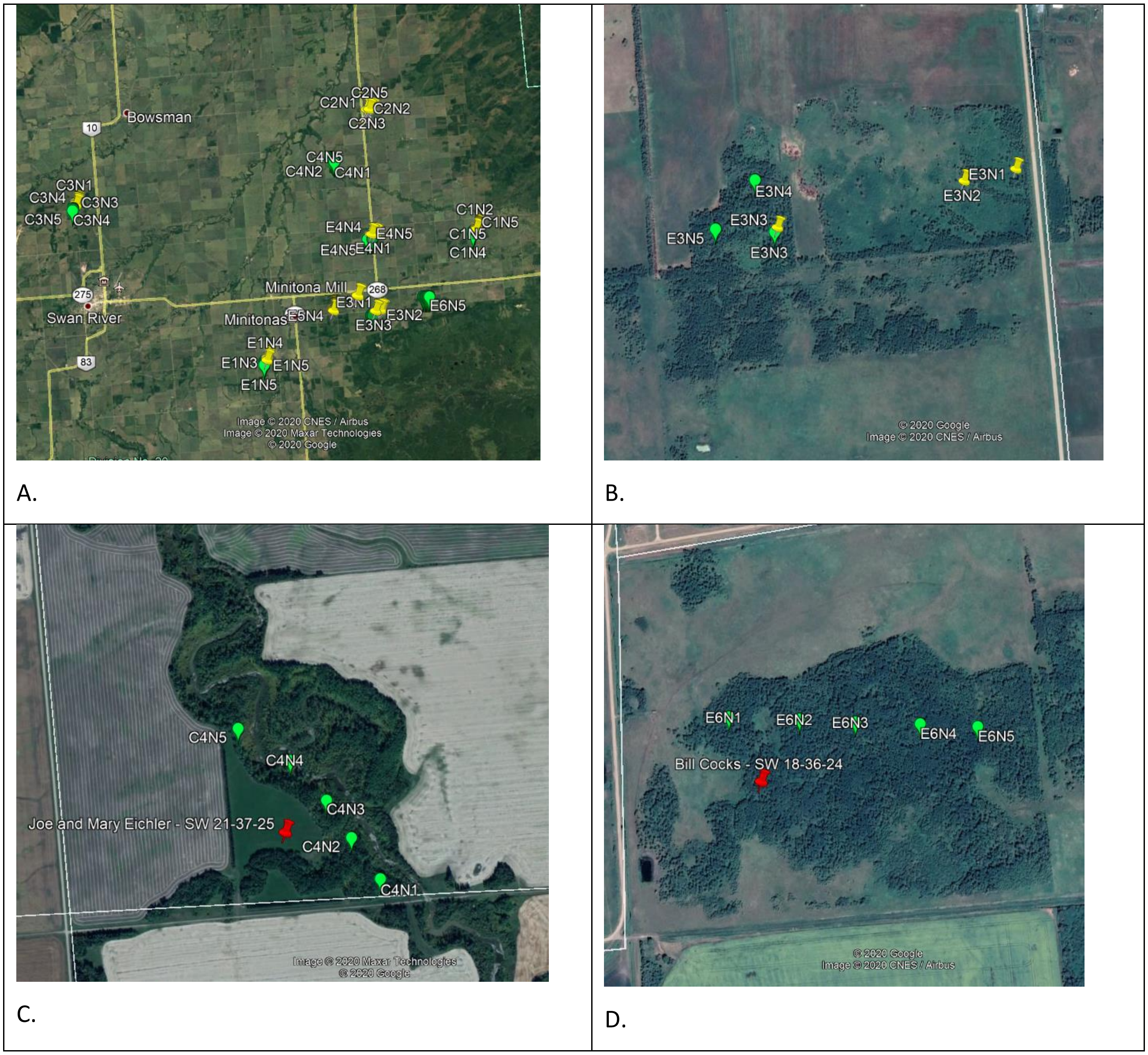
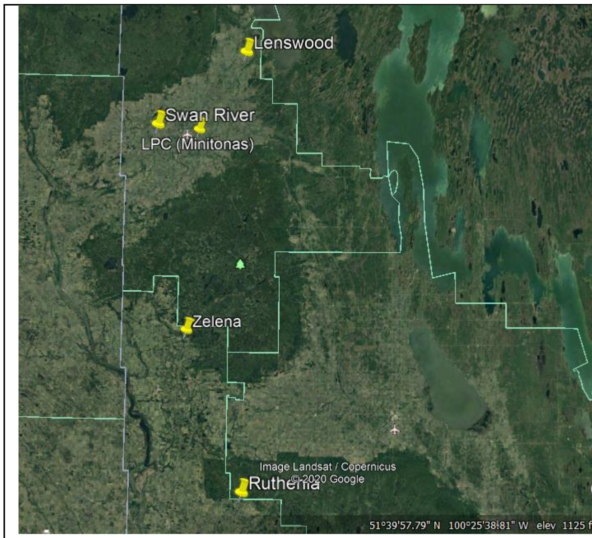


Figure 1. A) Changes to Aspen Woodlot Monitoring site locations between 2015 (yellow) and 2020 (green); B) repositioned plots in E3; C) new reference site (C4); D) new exposed site (E6)



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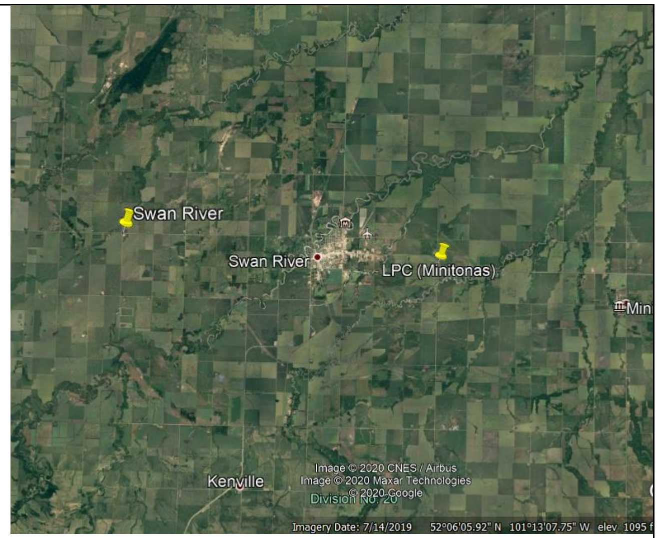

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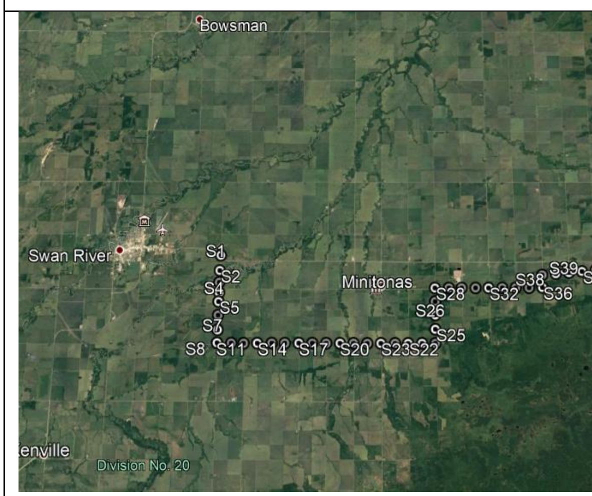

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Figure 2. Roadside Survey Monitoring (RSM) locations. A) location of the 4 BBS routes relative to the LPC route; B) location of Swan River BBS Route relative to the LPC route; C) location of 50 stops within the LPC route; D) location of LPC route relative to the mill.

Density and Trend Analysis

Density Between Treatments Within Aspen Sites: The focus of statistical analysis in 2020 was to test for effects of mill atmospheric depositions on target species density. Bird densities were compared between reference and exposed sites for only those years after the mill had been active for at least 4 years (i.e., 2000, 2005, 2010, 2015, and 2020). Additionally, for 1995 and 1997 sample size was small and variance high, there was no replication for the reference site in 1995, and distance bands were not estimated. Only observations judged to occur <= 50 m from the observer were included in the statistical analysis because plots were generally 100 m apart, so birds could potentially be heard faintly from neighboring plots and thus double counted. This distance restriction also increases the precision of the density estimates because all birds within the 0 – 50 m band are likely detectable through vocalization. Some potential observations at greater distances could be missed as sound loudness attenuates exponentially with distance (Hobson et al. 2002; Yip et al. 2017), so detection rates and effective distance area would need to be accounted for if the 50 - 100 m band was included in the analysis. To assess the effect of this restriction on relative density estimates I created scatter plots of density comparing the 2 approaches (Figure A 1).

Statistical inference was assessed using both non-parametric and parametric analysis. The non-parametric Kruskal-Wallis (KW) test is the non-parametric equivalent of a one-way ANOVA and does not require assumptions concerning the distribution of the response data. However, a one-way KW can only consider one factor, and thus cannot consider variance contributed by year to year effects. In contrast, a mixed-effects ANOVA allows us to include year to year variance as a random factor but requires normally distributed response data. This is important because year to year changes could overwhelm the treatment effect. Stantec (2015) found that the bird observations were not normally distributed, and that the problem could not be rectified through data transformation, hence they used the KW test. The distribution of density values on the 2000-2020 data was assessed after first transforming density using the natural log transformation (log x+1). The Q-Q plots revealed that the normality assumption was met reasonably well for all species except Veery (Figure A 2); American Redstart and Ovenbird displayed a low level of kurtosis, and as ANOVA is moderately tolerant to non-normality, ANOVA was applied to the density data. To test effect of emissions on bird density a mixed-effect ANOVA was used with treatment as a fixed factor and year as a random factor. The design was unbalanced due to the different number of exposed versus reference sites, so the R package Linear Mixed-Effects Models (*lmer* and *lmertest*) (Bates et al. 2015; Kuznetsova 2017) was used because it can accommodate unbalanced designs through the use of Type III sum of squares. The KW test was used when normality assumption was not met (i.e., for Veery), and to provide continuity and a comparison to the ANOVA results.

In addition to the statistical tests, scatter plots with 95% confidence were calculated in R using the *summarySE* function (Hope 2013) to help visually identify where differences in density are likely to be significant versus non-significant, regardless of whether parametric or non-parametric tests are used. Both graphs and tests of significance were performed in R using the *ggplot2* package (Wickham 2016) and the native *kruskal* function.

Local and Regional Trends along Roadside Survey Routes: Roadside surveys provide long-term and short-term trend analysis and are used in this study to assess if yearly abundance and trends over time are consistent with other surveys. In previous years, assessments compared results from the local LPC route with trends observed within the Manitoba portion of the Boreal Taiga Plains, while in 2020 trends were additionally compared to abundance and trends observed in 4 nearby routes. This provides an assessment parallel to the comparisons of reference (far from the mill) and exposed (near the mill) used in the Aspen Woodland Monitoring surveys. Annual data for the nearby Lenswood, Ruthenia, Swan, and Zelena routes were obtained from the USGS website (NA BBS – USGS 2020), and trend lines for the period 1995 to 2019 were estimated using the *loess* function in R, similar to the method used to estimate trends by the USGS. The local LPC results were then overlaid after the smoothed Loess curve had been generated. LPC data were not used to calculate the trend line because these observations were used to visually assess if the LPC data were falling within the range of data found in the nearby BBS routes, and thus needed to be independent of the trend line calculation. Sample size was too small to calculate a valid trend line using LPC data alone.

Alongside this nearby route analysis, short-term (2007-2017) and long-term annual trends for the Manitoba portion of the Boreal Taiga Plains (1970 – 2017) were presented using more sophisticated analysis conducted by the CWS (Smith et al. 2019). This analysis provided trend indices, percent change over time, and statistical probability of a decrease in abundance over time.

Results

Density Between Treatments Within Aspen Sites: In 2020, 59 species were observed in the aspen woodlots (Table 1) representing an increase of 20 species relative to 2015 when 39 species were observed. American Redstart, Least Flycatcher, Red-Eyed Vireo, Ovenbird, White-Throated Sparrow, Song Sparrow, and Black-and-white Warbler were the 7 most frequently observed species (Table 2). Across the 5 survey periods between 2000 and 2020, densities for the 6 target species were similar between reference treatment (far from the mill) and exposed treatment (near the mill) survey sites (Figure 3). Only American Redstart revealed a small, but marginally significant difference between sites (p = 0.049) (Table 3). Average density was higher in the reference site (1.945 and 1.187 at reference and exposed sites, respectively), and year to year densities were almost always lower at the exposed sites (Figure 3; Table 3). Note, however, that the difference in density between reference and exposed sites is decreasing over time, ending with a slightly higher density of American Redstart in the exposed sites in year 2020 (Figure 4). Densities of White-throated sparrow approached significant difference, with average densities in the reference site (0.288/ha) almost half of those in the exposed sites (0.486/ha) (Table 3).

Comparison of p-values from the non-parametric KW test versus the parametric ANOVA revealed similar results (Table 3), and with no difference in statistical inference except for American Redstart. For this species, the increased power of the mixed-effect ANOVA resulted in a slightly smaller p-value (0.049) than that resulting from the KW test (0.056), thus pushing the inference to a statistically significant effect of treatment on density. For Veery, because of the small occurrence rate, with no occurrences in 4 of the 5 surveys years for the reference site (Figure 3), the assumption of normality was not met (Figure A 2), so inference should be based on the KW test (p = 0.302) rather than the ANOVA test (p = 0.227) (Table 3). This of course does not change the inference of a non-significant effect of treatment on density.

Local and Regional Trends along Roadside Survey Routes: In 2020, 44 species were observed along the LPC route (Table 2), representing an increase of 5 species from 2015 when 39 species were observed. Clay-colored Sparrow, Song Sparrow, American Crow, Savannah Sparrow, Red-eyed Vireo, Common Yellowthroat, and Alder Flycatcher were the 7 most frequently observed species (Table 2). Roadside monitoring revealed that for the 6 target species the number of observations along the LPC route was higher in 2020 relative to 2015, while on average there was little difference in abundance on the LPC route relative to the 4 nearby routes (Figure 5). The local trend line for the 4 nearby routes provides a moving average to estimate trend over time. American Goldfinch and Clay-Colored Sparrow had observation rates slightly higher than the local trend line, Alder Flycatcher and American Crow had observation rates above and below local trend line, and Red-eyed vireo had observation rates slightly lower than the local trend line (Figure 5). The local trend lines were generally consistent with the annual trend calculated for the Manitoba portion of the Boreal Taiga Plains (Figure 5). However, for Clay-Colored Sparrow the local numbers appear to be rising, but at the broader scale there is a high probability of a downward trend (Table 4).

For the AWM target species, more birds were observed in 2020 relative to 2015 along the LPC route for American Redstart, Ovenbird, Red-eyed vireo, and White throated sparrow, but no observations were recorded for Veery in 2020 (Figure 6). Local trends for these target species also revealed that densities were within the range of the nearby routes, but with observation rates for Ovenbird slightly higher than the trend line average, and rates slightly lower for Red-Eyed Vireo (Figure 6). For American Redstart, the number of observations appeared stable over time within the LPC route, but both locally and at the regional scale there is a significant upward trend (Figure 6; Table 5).

Table 2. Counts of all 59 species observed in the Aspen Woodlots, and 44 species observed along the LPC RSM route, sorted by total count. Primary target species are set in bold, and additional analysis species for the RSM survey that are also AWM species are set in italic.

Bird species observed in the Aspen Woodlot Monitoring (AWM)	Reference	Exposed	*Bird species observed in the Roadside Survey Monitoring (RSM)*	Count
American Redstart	**107**	**98**	**Clay-colored Sparrow**	79
Least Flycatcher	**54**	**90**	Song Sparrow	51
Red-Eyed Vireo	**62**	**81**	**American Crow**	46
Ovenbird	**49**	**76**	Savannah Sparrow	44
White-Throated Sparrow	**17**	**42**	**Red-eyed Vireo**	39
Song Sparrow	19	32	Common Yellowthroat	36
Black-and-white Warbler	22	25	**Alder Flycatcher**	33
Brown-headed Cowbird	17	27	Western Meadowlark	31
American Robin	18	18	American Robin	24
Ruffed Grouse	14	21	Black-billed Magpie	19
Clay-colored Sparrow	13	21	**American Goldfinch**	16
American Goldfinch	12	19	Red-winged Blackbird	15
Yellow Warbler	16	13	Vesper Sparrow	12
Black and White Warbler	8	13	Yellow Warbler	11
Common Yellowthroat	9	7	*Ovenbird*	10
House Wren	4	12	*White-throated Sparrow*	10
Veery	3	12	Common Raven	9
Hermit Thrush	5	8	House Wren	9
Baltimore Oriole	5	7	*Least Flycatcher*	9
Chipping Sparrow	4	8	Mourning Warbler	9
Common Raven	3	7	Brown-headed Cowbird	8
Nashville Warbler	2	8	Barn Swallow	7
Alder Flycatcher	4	4	Canada Goose	7
Chestnut-sided Warbler	5	3	*American Redstart*	6
Tennessee Warbler	3	5	Chipping Sparrow	6
Great-crested Flycatcher	0	7	House Sparrow	6
Yellow-Bellied Flycatcher	2	5	Eastern Kingbird	5
American Crow	0	6	Killdeer	5
Northern Flicker	5	1	Brewer's Blackbird	4
Black-capped Chickadee	3	2	Northern Flicker	4
Ruby-throated Hummingbird	4	1	Black-capped Chickadee	3
Canada Warbler	2	2	Baltimore Oriole	2
Cedar Waxwing	1	3	Cedar Waxwing	2
Magnolia Warbler	1	3	Sedge Wren	2
Rose-breasted Grosbeak	3	1	European Starling	1
White-breasted Nuthatch	2	2	Hawk sp.	1
Wilson's Warbler	1	3	Hermit Thrush	1

Bird species observed in the Aspen Woodlot Monitoring (AWM)	Reference	Exposed	*Bird species observed in the Roadside Survey Monitoring (RSM)*	Count
Downy Woodpecker	0	3	Mallard	1
Palm Warbler	3	0	Nashville Warbler	1
Warbling Vireo	3	0	Ruffed Grouse	1
Black-billed Magpie	0	2	Sandhill Crane	1
Connecticut Warbler	1	1	Sora	1
Hairy Woodpecker	1	1	Swainson's Thrush	1
Northern Waterthrush	1	1	Tree Swallow	1
Palm Warber	0	2		
Red-tailed Hawk*	2	0		
Red-Winged Blackbird	2	0		
Vesper Sparrow	1	1		
Yellow-rumped Warbler	0	2		
Barn Swallow	1	0		
Common Snipe	1	0		
Eastern Kingbird	0	1		
Great Horned Owl	0	1		
Le Conte's Sparrow	0	1		
Pileated Woodpecker	1	0		
Red-tailed Hawk	0	1		
Savannah Sparrow	0	1		
Swainson's Thrush	0	1		
Yellow-bellied Sapsucker	0	1		

Table 3. Comparison of bird density between the reference and exposed sites over the survey periods 2000-2020, under Kruskal-Wallis (KW) and mixed-effect ANOVA tests.

Species	Treatment	N	Density	SE	KW χ^2	KW *p* value	ANOVA *t* value	ANOVA *p* value
American Redstart	Reference	14	1.945	0.330	3.647	0.056	2.059	0.049
	Exposed	21	1.187	0.256				
Least Flycatcher	Reference	18	0.763	0.751	0.051	0.821	-0.191	0.849
	Exposed	25	0.916	0.991				
Ovenbird	Reference	13	0.959	0.757	0.008	0.929	-0.003	0.998
	Exposed	21	0.921	0.661				
Red-eyed vireo	Reference	16	0.986	0.650	0.359	0.549	0.599	0.553
	Exposed	24	0.859	0.636				
Veery	Reference	15	0.051	0.143	1.064	0.302	-1.233	0.227
	Exposed	19	0.161	0.308				
White-Throated Sparrow	Reference	15	0.288	0.358	2.920	0.088	-1.749	0.090
	Exposed	22	0.486	0.384				

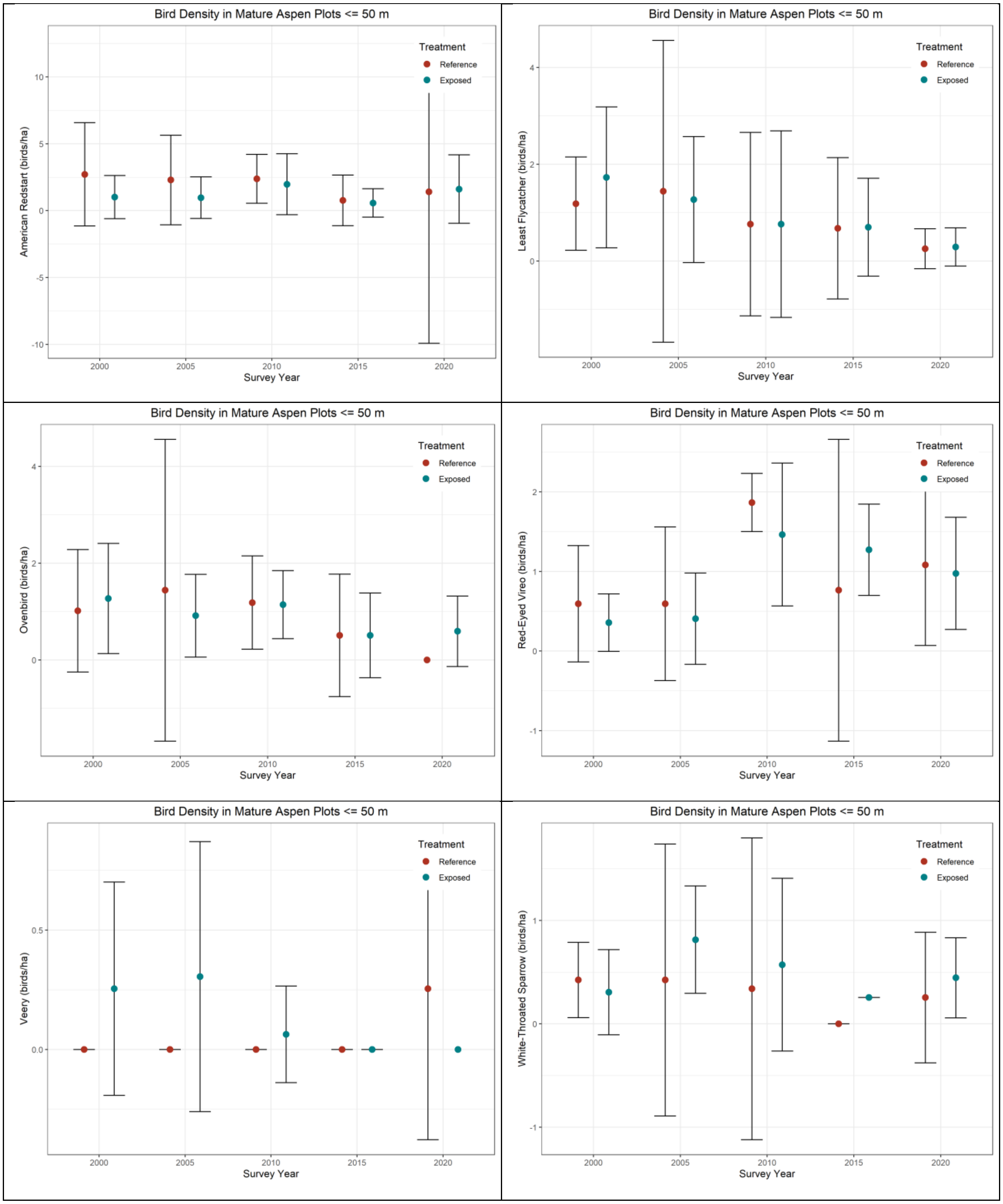


Figure 3. Comparison of Relative density in Mature Aspen Woodlots for period 2000-2020, with 95% confidence intervals.

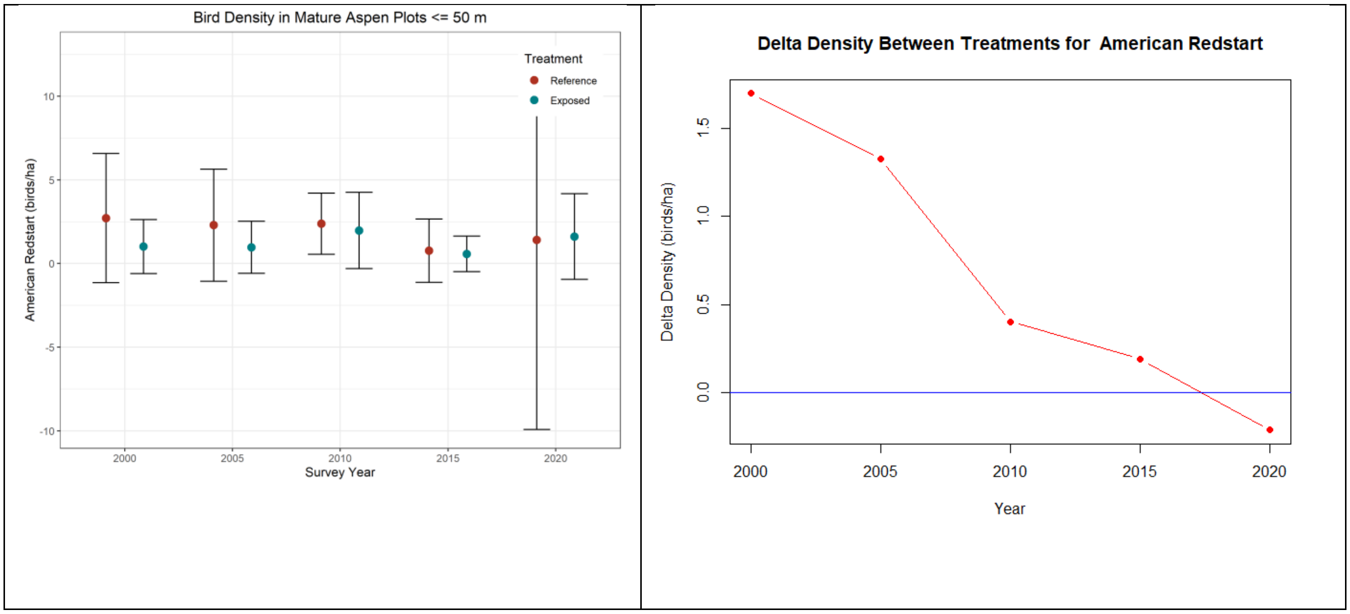


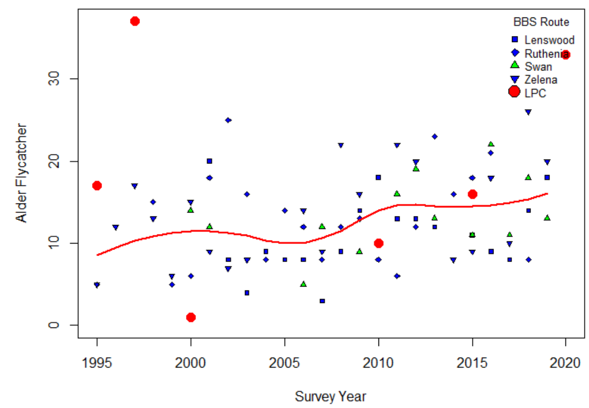
Figure 4. Difference in density between reference and exposed sites, over time, for American Redstart. A) relative density between treatments; B) difference in density between treatments. For year 2020 value is negative because exposed sites have a slightly higher average density than reference sites.

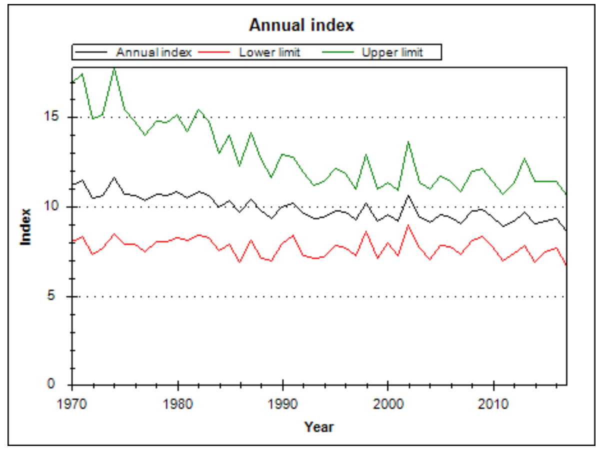
Table 4. Long-term (1970-2017) and short-term (2007-2017) BBS trends for RSM target species in the Manitoba portion of the Boreal Taiga Plains (BCR 6).

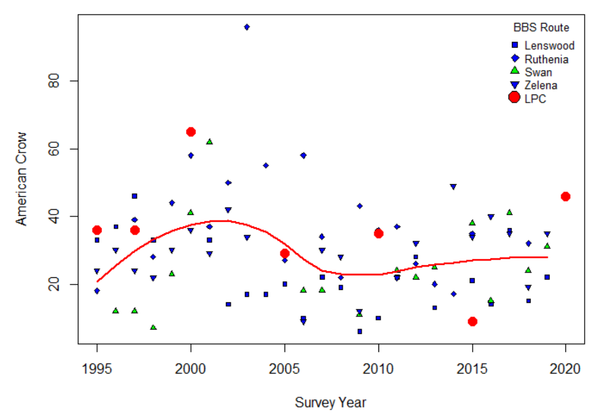
Species Common Name	Long-term trend	Overall Reliability	Prob. Decrease	% Change	Short-term trend	Overall Reliability	Prob. Decrease	% Change
Alder Flycatcher	-0.559	Medium	0.872	-23.2	-0.47	Medium	0.666	-4.6
American Crow	0.306	Medium	0.242	15.4	0.921	Medium	0.224	9.6
American Goldfinch	-0.626	High	0.931	-25.6	-0.332	Medium	0.657	-3.28
Red-eyed Vireo	2.4	Medium	0	205	2.18	High	0.001	24.1
Clay-colored Sparrow	-1.32	Medium	1	-46.4	-1.58	High	0.992	-14.7

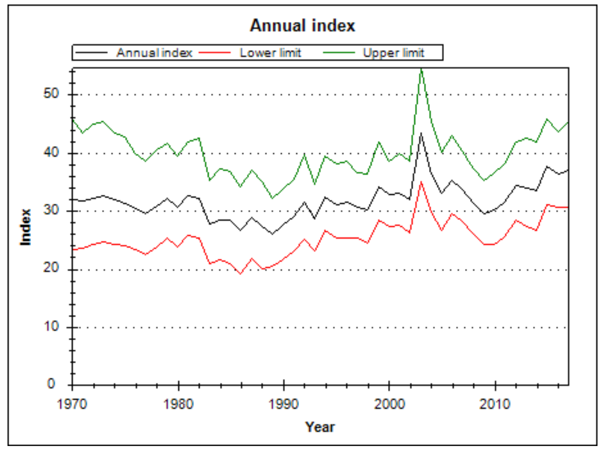
Table 5. Long-term (1970-2017) and short-term (2007-2017) BBS trends for AWM target species in the Manitoba portion of the Boreal Taiga Plains (BCR 6).

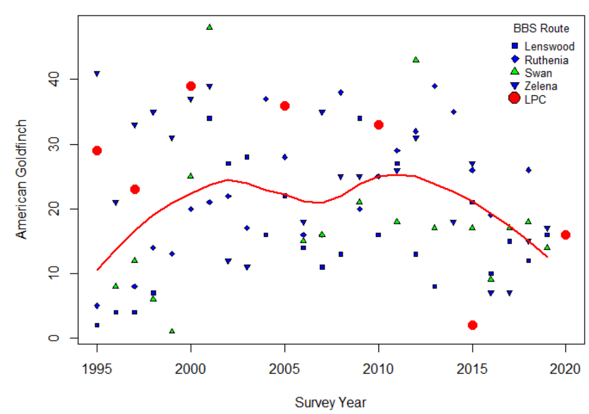
Species Common Name	Long-term trend	Overall Reliability	Prob. Decrease	% Change	Short-term trend	Overall Reliability	Prob. Decrease	% Change
American Redstart	3.11	Medium	0	321	3.35	Medium	0.003	39
Least Flycatcher	-1.15	Medium	0.998	-41.8	-1.43	Medium	0.96	-13.4
Ovenbird	1.03	Medium	0.052	61.6	-0.461	Medium	0.617	-4.52
Red-eyed Vireo	2.4	Medium	0	205	2.18	High	0.001	24.1
Veery	1.41	High	0.021	93.1	1.47	Medium	0.115	15.7
White-throated Sparrow	0.338	Medium	0.232	17.2	-1.44	Medium	0.903	-13.5

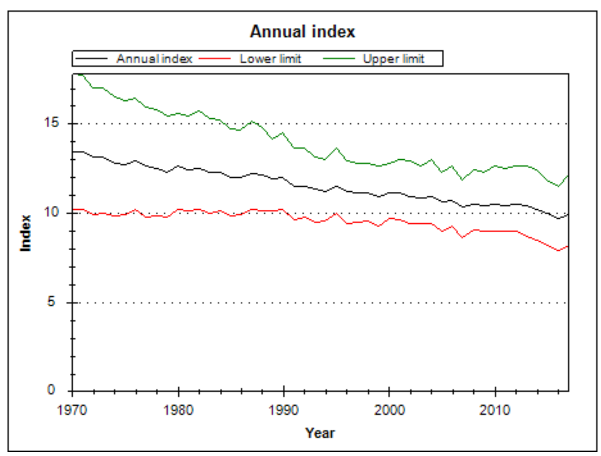

BBS Route
Lenswood
Ruthenia
Swan
Zelena
LPC
Alder Flycatcher
Survey Year


Annual index
Annual index
Lower limit
Upper limit
Index
Year


BBS Route
Lenswood
Ruthenia
Swan
Zelena
LPC
American Crow
Survey Year


Annual index
Annual index
Lower limit
Upper limit
Index
Year


BBS Route
Lenswood
Ruthenia
Swan
Zelena
LPC
American Goldfinch
Survey Year


Annual index
Annual index
Lower limit
Upper limit
Index
Year

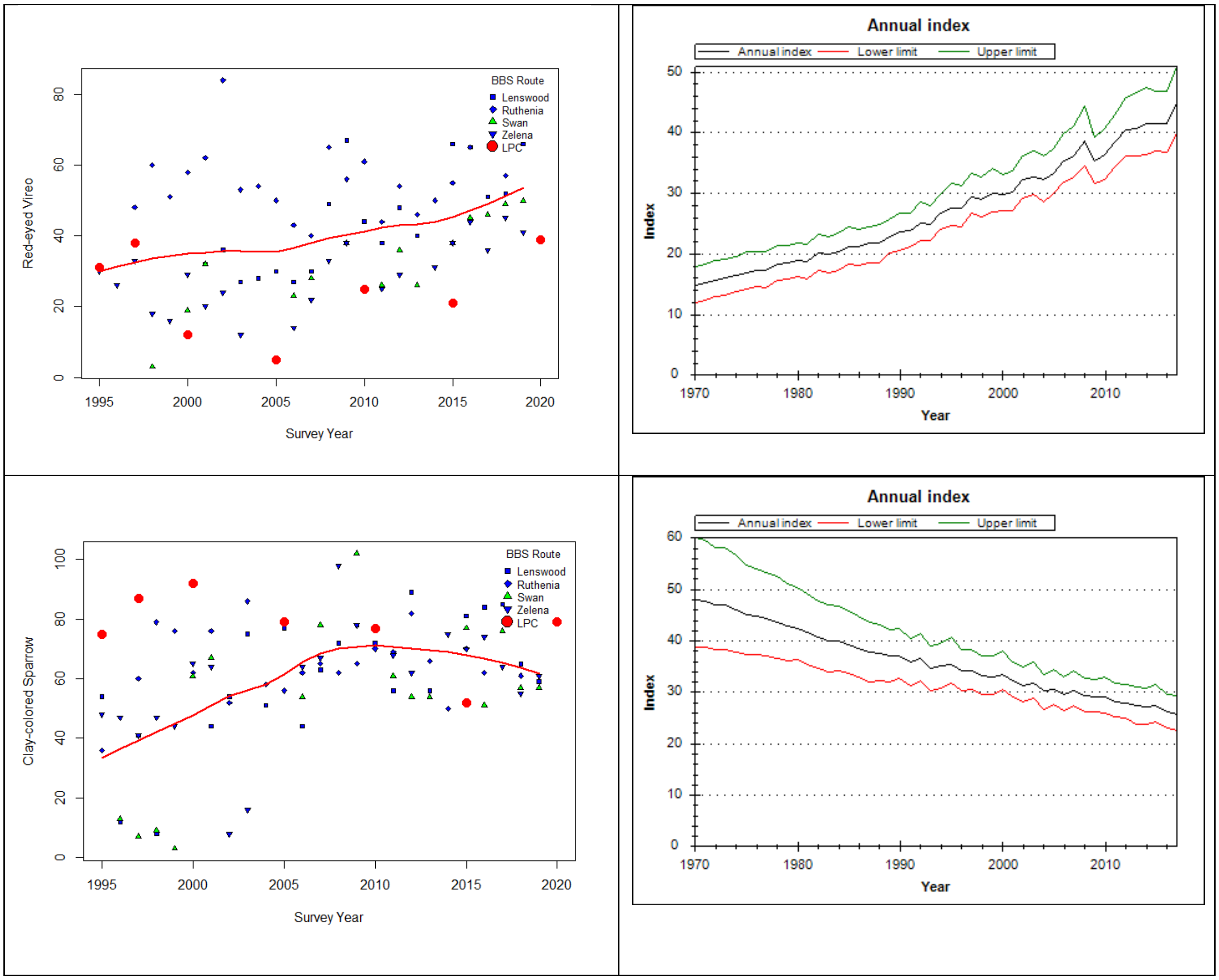
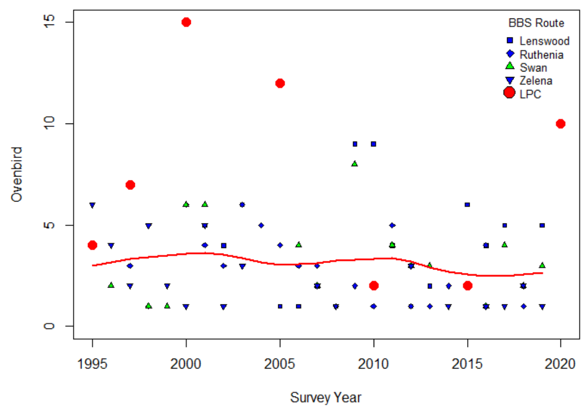
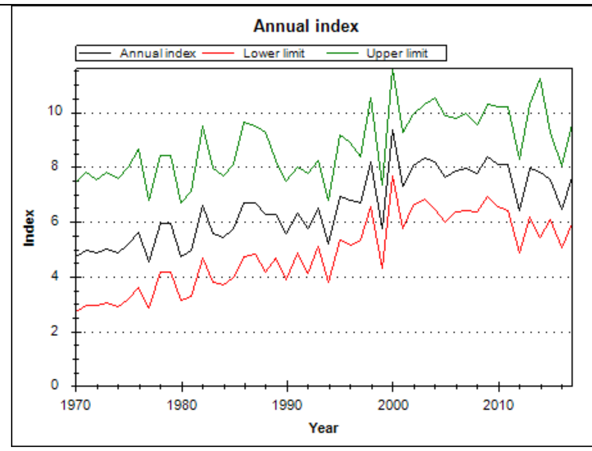
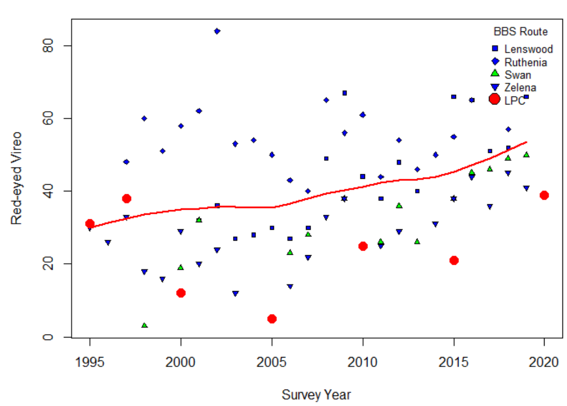
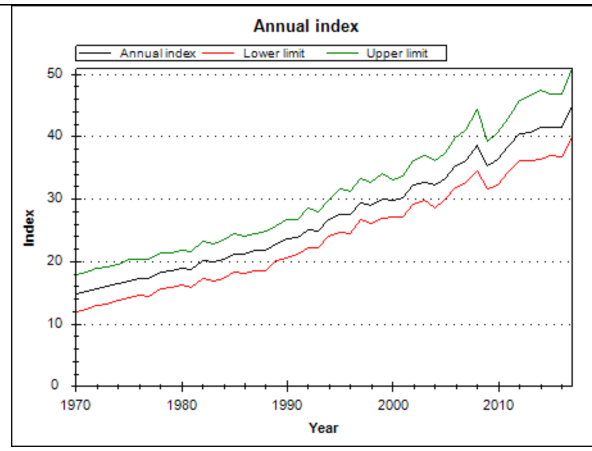


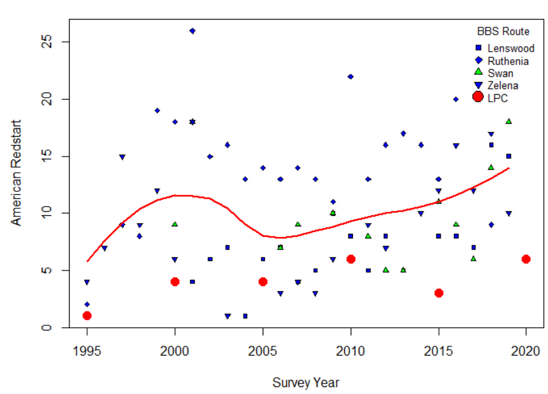
Figure 5. Annual trends (1995-2019) for the 5 RSM target species. Local trend (red line on left) based on 4 nearby BBS routes, with LPC RSM results overlaid as red dot. Long-term annual index (right) is for the Manitoba portion of the Boreal Taiga Plains (1970-2017).

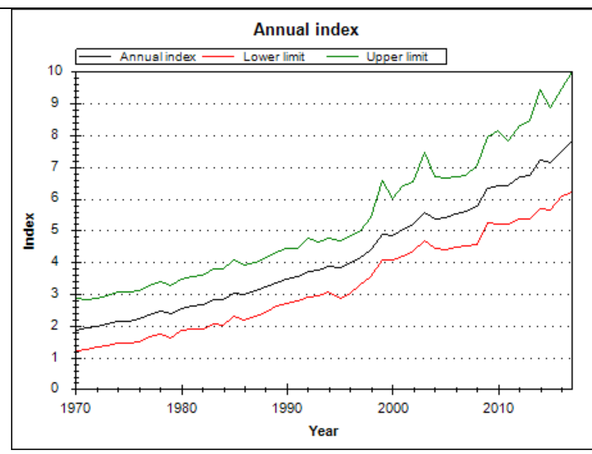

Ovenbird
Survey Year
BBS Route
Lenswood
Ruthenia
Swan
Zelena
LPC


Annual index
Annual index
Lower limit
Upper limit
Index
Year


Red-eyed Vireo
Survey Year
BBS Route
Lenswood
Ruthenia
Swan
Zelena
LPC


Annual index
Annual index
Lower limit
Upper limit
Index
Year


American Redstart
Survey Year
BBS Route
Lenswood
Ruthenia
Swan
Zelena
LPC


Annual index
Annual index
Lower limit
Upper limit
Index
Year

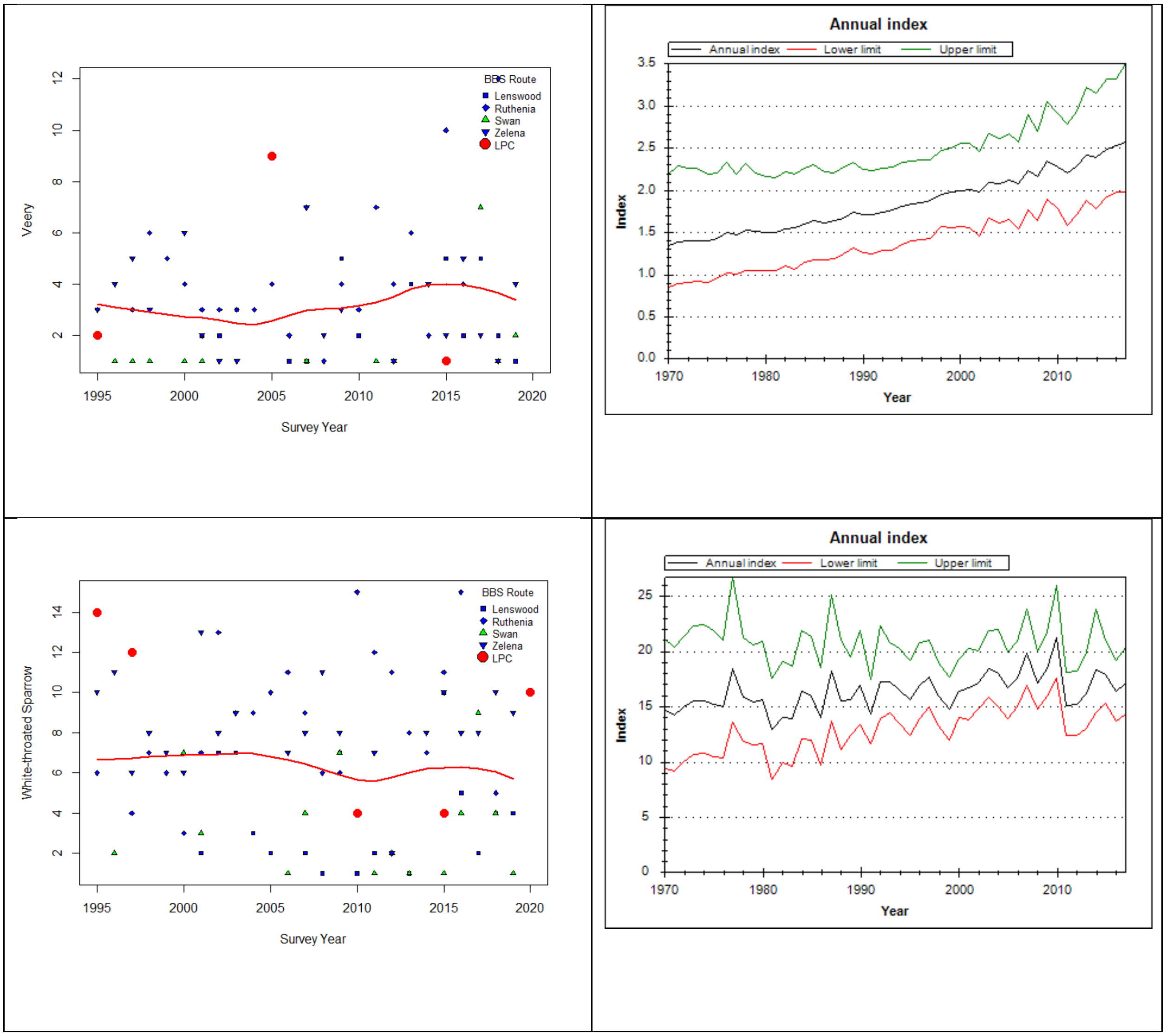


Figure 6. Annual trends (1995-2019) for the 5 AWM target species. Local trend (red line on left) based on 4 nearby BBS routes, with LPC RSM survey results overlaid as red dot. Long-term annual index (right) is for the Manitoba portion of the Boreal Taiga Plains BBS routes (1970-2017). Plots for Red-eyed vireo given in the previous figure.

Discussion

Maintaining consistency with previous assessments was a key objective of this study. The same targets species, number of mature aspen sites, roadside survey routes, and sample periods were used in this study relative to previous years. A principal difference in method was the interpretation of acoustic recordings to record presence and number of individuals for both AWM plots and RSM stops. Previous work has shown this is effective for both point count and BBS surveys (Celis-Murillo et al. 2012; Hobson et al. 2002; Pankratz et al. 2017; Rempel et al. 2005; Rempel et al. 2016). There may be some biases, but in general results are very comparable to traditional point count surveys (Klingbeil and Willig 2015; Hobson et al. 2002; Venier and Pearce 2004). The number of species detected increased from 2015, so it is unlikely that recordings are causing birds to be missed. The ability to re-play recordings to confirm identification may help in detecting birds (Hobson et al. 2002), and recordings provide a verifiable reference. Interpreters can generally identify 0, 1, 2, or 3 individuals of a species vocalizing in at a single site, but any more than this becomes less precise.

Multiple factors can affect the estimated abundance of birds in a survey, including local weather (e.g., temperature, humidity, rain), time of day that observations were made, date within season (e.g., early in the breeding period versus late), conditions in the overwintering grounds during the previous winter, ability of the observers to detect and identify birds, method used to identify (e.g., in-field identification versus interpreted audio recordings), and habitat conditions (Alldredge et al. 2007; Stanislav et al. 2010). Unless the survey is very well standardized, as is done with BBS roadside surveys, it is difficult to compare year to year values. For these reasons, and because the focus of the study is to understand effect of the mill on bird abundance, in 2020 the analysis of the AWM survey was focused on comparisons of reference versus exposed treatment within years, or trends over time in the difference between reference and control density sites for within year estimates. Year to year variability was accounted for in the mixed-effects ANOVA, where survey year was treated as a random factor. With this approach, all the above factors, except for habitat condition and emission exposure, are common and randomized between the reference sites and exposure sites, so any detected difference in density can be attributed to either habitat condition or prolonged exposure to mill emissions. By restricting analysis to those 5 sample periods that occurred at least 4 years after the mill began operation, the power to detect an effect of mill emissions is further increased. However, a caveat remains in that changes in abundance between treatments can still be interpreted as an effect of habitat differences between reference and exposure sites, or alternatively, exposure to mill emissions. If the mill is the cause of the difference in abundance, then it would also be expected that the difference in density between reference and exposure sites would increase over time, or at least not diminish.

Analysis revealed almost no differences in bird density between reference sites and exposed sites. White-throated sparrow approached significance, with densities slightly higher in the exposed sites. Only American Redstart had significantly higher densities in the reference sites, but with marginal significance (p = 0.049). However, for every survey period since 2000 the difference between the reference site and exposed site became smaller, with density actually becoming slightly higher in the exposed sites in 2020, suggesting that cause of the effect was difference in habitat conditions, and that habitat conditions were becoming more similar over time between reference and exposed sites. There was no evidence of a decrease in biodiversity among sites, as the number of species detected in the aspen sites increased by 20 species relative to 2015. However, this is possibly an effect of using an exceptionally skilled observer in 2020 (Enid Cumming) who is very experienced in the interpretation of songbird recordings from the nearby Duck Mountains.

The objective of the LPC RSM component is to assess if the LPC route data differs substantively from the general trends, therefore suggesting an effect of mill emissions within the area surrounding the mill. Sample size is too small to calculate a trend line for the LPC route data alone. If mill emissions are affecting local bird populations, then it would be expected that abundance in the target species would be declining, even if regional or nearby populations are stable or increasing. The BBS survey is very well standardized and uses a large sample size to estimate trends so there is greater confidence in those annual indices of change in abundance over time. However, habitat conditions are quite variable across the entire Boreal Taiga Plains, and so differences in trend might be explained by differences in habitat across the broad area rather than effects of mill emission. To address this concern local trend lines were generated using 4 nearby BBS routes with similar habitat conditions as found along the LPC route, and using the same technique as does the USGS (Loess curve) to help assess if conditions in the LPC route are causing differences in average abundance and annual trend. This is not a strong test of emission effects but can provide some insight.

For every RSM target species, the number of birds detected in 2020 increased over the previous survey period, and in every case the long-term data was consistent with the annual trend line generated from nearby BBS routes. This was also true for trends in the AWM target species, where every species except Veery had higher abundance in 2020 RSM surveys, and the overall temporal pattern was consistent with the nearby BBS trend. Note that Veery had an extremely low occurrence rate, which limited its value as a target species. Over the 20 years of data, there was no evidence that local populations had been affected by mill emissions.

Among all target species, only American Redstart had abundance levels consistently lower than the nearby BBS route average, but numbers were trending slightly upwards over time, suggesting modest improvements in general habitat conditions in the area may be positively affecting this species. It is noteworthy that the Swan BBS route also had American Redstart numbers lower than the nearby route trend line. Perhaps landscape-level habitat conditions in fragmented landscapes provide poorer habitat for this interior species relative to landscapes with more contiguous mature forest (e.g., Ruthenia route near Riding Mountain Park).

Conclusions

Results of the 2020 Fauna survey are consistent with previous surveys since baseline data was collected 25 years ago in 1995. The current conclusion, similar to that reported in Stantec (2015), is that there is no evidence that emissions from the Minitonas mill is having a negative effect on local bird populations. Further monitoring is highly unlikely to detect any emission-related effects on birds, mirroring the conclusions of the previous reports from 2000, 2005, 2010, and 2015. As concluded in the 2015 report, landscape-level change, including land clearing and timber harvest, is likely the principal cause of any detected changes.

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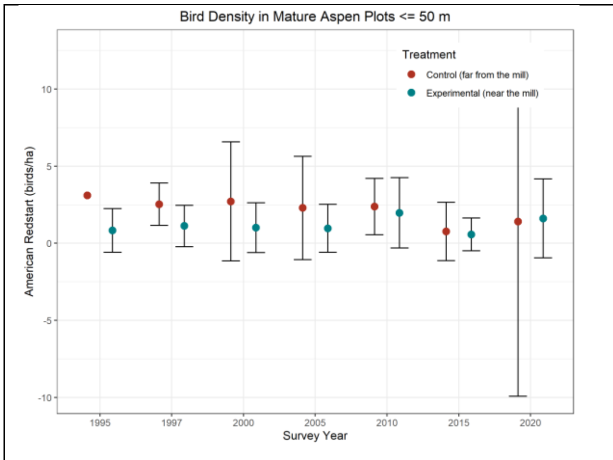
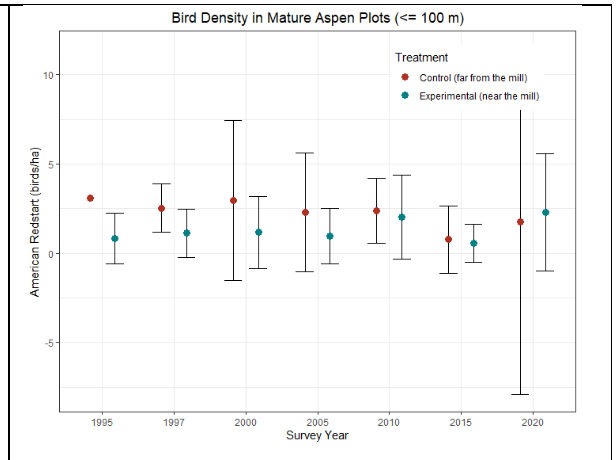
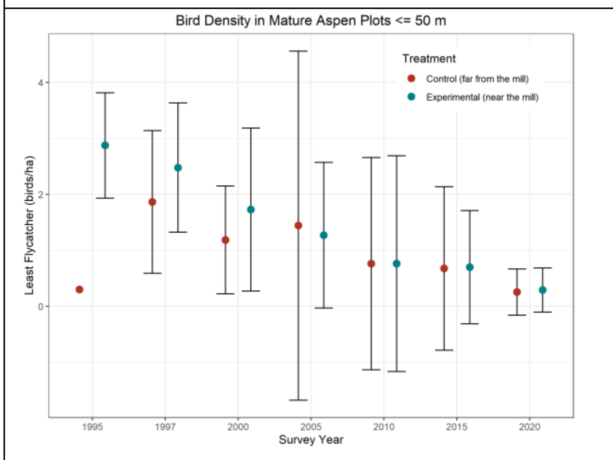
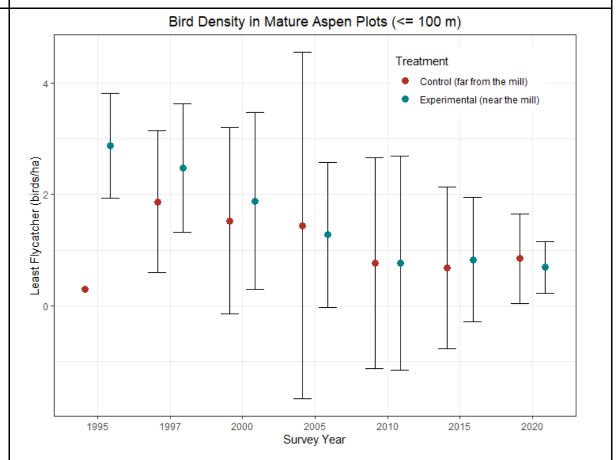
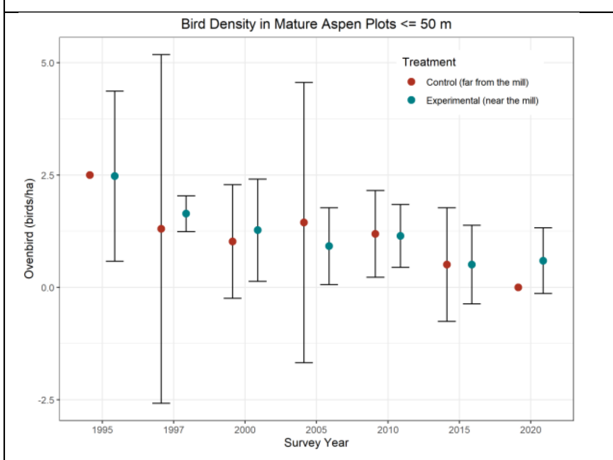
Appendix A.

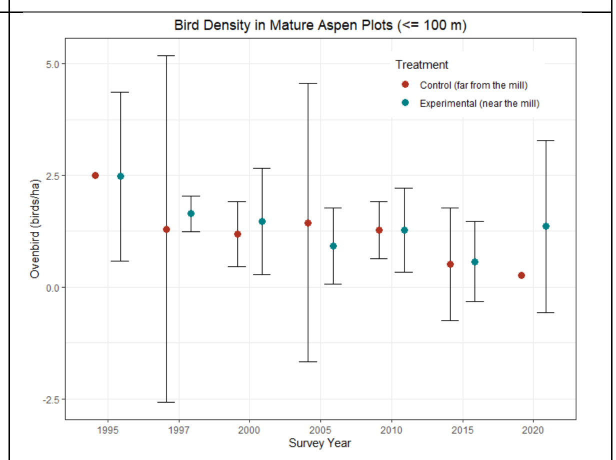

Bird Density in Mature Aspen Plots <= 50 m
Treatment
Control (far from the mill)
Experimental (near the mill)
American Redstart (birds/ha)
Survey Year
1995
1997
2000
2005
2010
2015
2020


Bird Density in Mature Aspen Plots (<= 100 m)
Treatment
Control (far from the mill)
Experimental (near the mill)
American Redstart (birds/ha)
Survey Year
1995
1997
2000
2005
2010
2015
2020


Bird Density in Mature Aspen Plots <= 50 m
Treatment
Control (far from the mill)
Experimental (near the mill)
Least Flycatcher (birds/ha)
Survey Year
1995
1997
2000
2005
2010
2015
2020


Bird Density in Mature Aspen Plots (<= 100 m)
Treatment
Control (far from the mill)
Experimental (near the mill)
Least Flycatcher (birds/ha)
Survey Year
1995
1997
2000
2005
2010
2015
2020


Bird Density in Mature Aspen Plots <= 50 m
Treatment
Control (far from the mill)
Experimental (near the mill)
Ovenbird (birds/ha)
Survey Year
1995
1997
2000
2005
2010
2015
2020


Bird Density in Mature Aspen Plots (<= 100 m)
Treatment
Control (far from the mill)
Experimental (near the mill)
Ovenbird (birds/ha)
Survey Year
1995
1997
2000
2005
2010
2015
2020

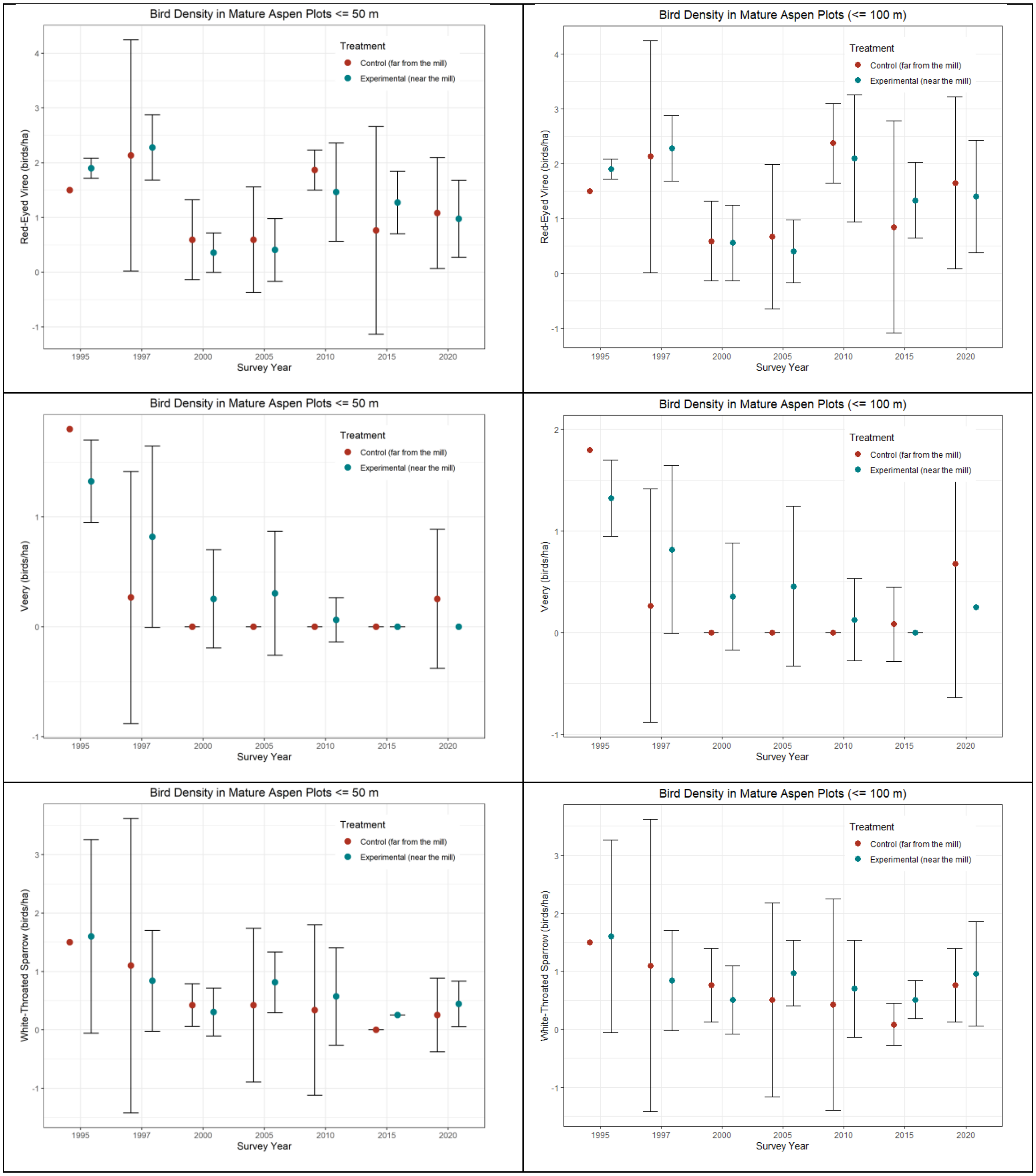


Figure A 1. Comparison of densities using <= 50 m observations versus all observations <= 100 m. Control refers to Reference sites, and Experimental to Exposed sites. Note that for years 1995 and 1997 distance bands were not estimated, so both graphs are the same for those 2 years.

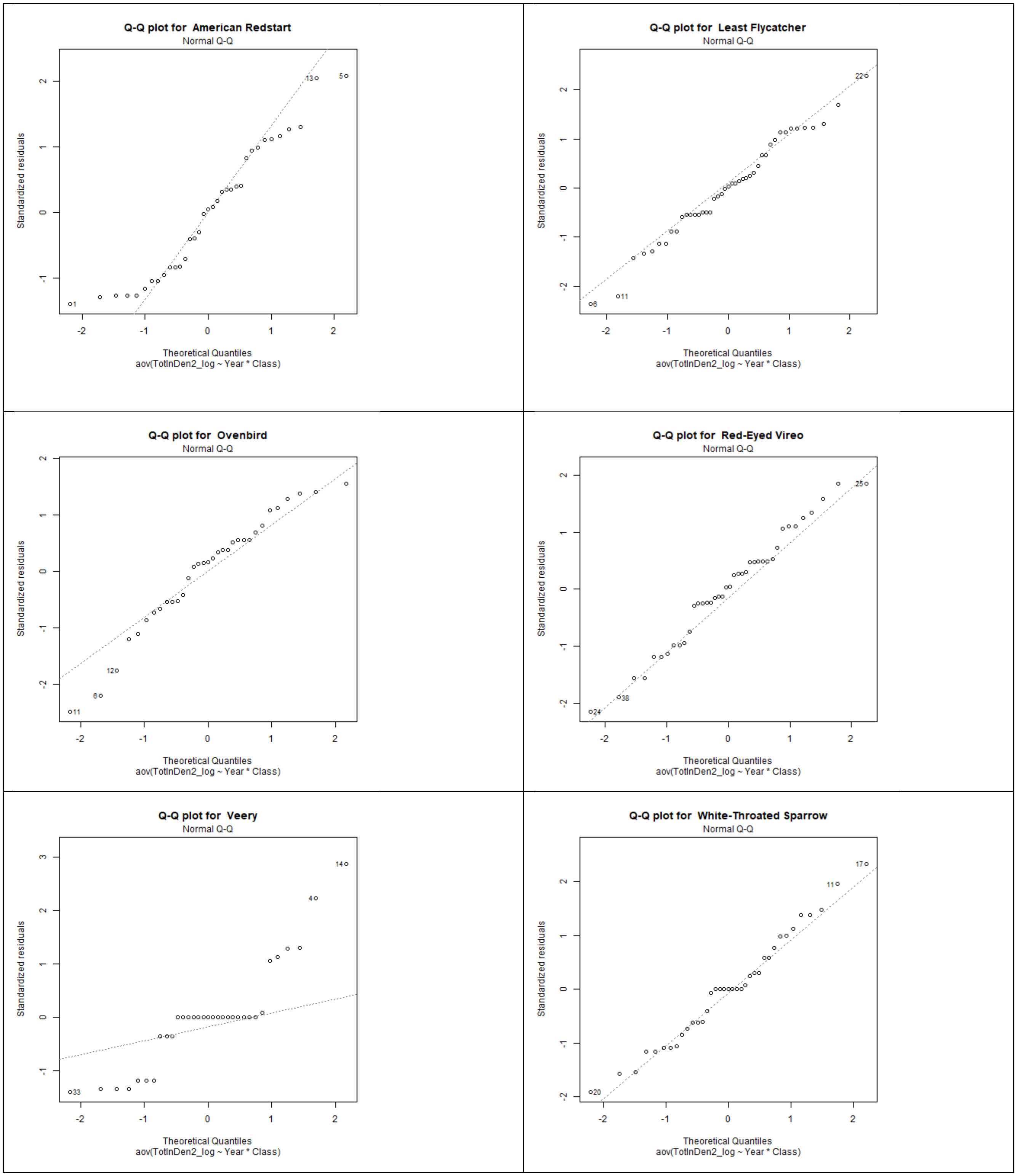


Figure A 2. Test of normality using Q-Q scatter plots. A variable with normal distribution will tend to follow the reference line.