Marsh Monitoring Report 2025

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Beaverhill Bird Observatory

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Introduction

Foundational to The Prairie and Parkland Marsh Monitoring Program, that exists under the umbrella of wetland research initiatives of Bird Studies Canada, is the recognition of the immense importance of wetland areas to bird populations and environmental health at large (Bird Studies Canada, 2010).

At the Beaverhill Bird Observatory, a Marsh Monitoring protocol, aligned with the guidelines of the Prairie and Parkland Marsh Monitoring Program, was established in the spring of 2022 with 8 survey points along the west shore of Lister Lake between the weir and the lookout. This year, callback surveys were conducted at 8 new points on the eastern side of Lister Lake, in addition to the 8 points on the western side of the wetland.

The eastern side of the Lake has not gone unexplored. In 2017, Jeremy Lambe conducted an extensive series of surveys surrounding Lister Lake (Lambe, 2017). One of Lambe's routes served as a basis for the 8 new points in this report, but 7 out of his 8 points were altered to improve proximity to and coverage of the lake (all but "MMP2-3") (Lambe, 2017). Lambe surveyed the points only once and did not incorporate a callback recording, so this report will also be unique in those aspects (Lambe, 2017).

Presented in this report are the findings of call-and-response surveys and habitat assessments from both sides of Lister Lake in 2025.

Site Description

In 2025, 16 points were monitored around the Beaverhill Bird Observatory's major wetland, Lister Lake. The area known and henceforth referred to as "Lister Lake" comprises two large waterbodies and their surrounding wetland habitats (Table 1, Figure 1).

Site 1, the western side of Lister Lake, comprises points MMP1-1 to MMP1-8. These points may be accessed through navigating the established trails (*Harrier Highway*) and net lanes of the Beaverhill Bird Observatory, then using a GPS device or app to arrive at the precise survey point.

Site 2, the eastern side of Lister Lake, comprises points MMP2-1 to MMP2-8. These points span the north and east shores of the southern waterbody of Lister Lake and cut through the centre of the entire wetland. This site is most easily accessed by vehicle, leaving the front

gates of the BBO and driving west down Township Road 510. Take the first left to travel south down Range Road 183, then the first left to travel east along Highway 626. Following the natural curve of the highway to the north, a final western turn at a second natural curve on the highway will lead to a dead-end dirt road near the eastern shore of the lake.

West Side		East Side	
MMP 1-1	53.378778ºN, -112.515972ºW	MMP 2-1	53.365003ºN, -112.513959ºW
MMP 1-2	53.378389ºN, -11 2.519861ºW	MMP 2-2	53.365567ºN, -112.510399ºW
MMP 1-3	53.377528ºN, -112.522306ºW	MMP 2-3	53.367470ºN, -112.508120ºW
MMP 1-4	53.376556ºN, -112.525083ºW	MMP 2-4	53.369177ºN, -112.510666ºW
MMP 1-5	53.375972ºN, -112.526611ºW	MMP 2-5	53.370930ºN, -112.512985ºW
MMP 1-6	53.374333ºN, -112.528167ºW	MMP 2-6	53.371969ºN, -112.516416ºW
MMP 1-7	53.372056ºN, -112.529111ºW	MMP 2-7	53.372037ºN, -112.520092ºW
MMP 1-8	53.370250ºN, -112.530194ºW	MMP 2-8	53.372089ºN, -112.523827ºW

Table 1. Coordinates of every Marsh Monitoring Point (MMP) surveyed in this project. NOTE: The existing waypoints in the BBO's GPS for what are referred to as the "west side" points are labelled as "MMP1" to "MMP8" (ie. not as "MMP1-1" to "MMP1-8" as in this paper). The newly-created/"east side" points have been labelled in the GPS as "MMP2-1" to "MMP2-8".

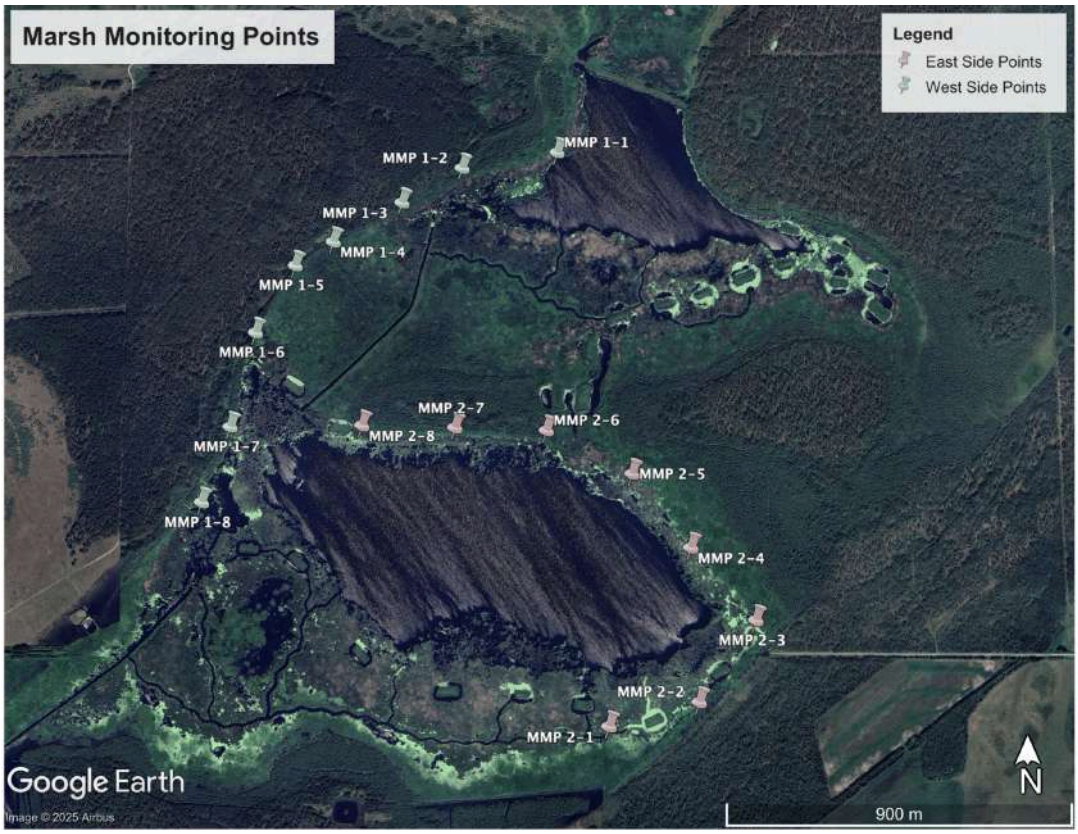

Figure 1. Map showing the location of the west and east Marsh Monitoring Points.

Methods

Surveys and habitat assessments were adapted from the protocols of The Prairie and Parkland Marsh Monitoring Program (Beaverhill Bird Observatory, 2022; Bird Studies Canada, 2010). Surveys were conducted between May 20th and June 30th, ensuring that at least four days elapsed between consecutive surveys at the same set of points. Each side was surveyed four times. Three of the surveys (surveys #1, #3, and #4 in this project) on each side were morning surveys, beginning as early as 30 minutes prior to sunrise. One of the surveys on each side (surveys #2 in this project) was an evening survey, beginning as early as 18:00. Surveys were conducted alternating between moving "forward", proceeding from point #1 to point #8, and "backward", proceeding from point #8 to point #1. Surveys could only be conducted if weather permitted, preventing surveys from occurring at times of active precipitation or if wind speeds exceeded a 3 on the Beaufort Scale (19km/h).

There are 10 "primary" bird species focused on in these surveys: Nelson's Sparrow (NESP), American Bittern (AMBI), Least Bittern (LEBI), Yellow Rail (YERA), Virginia Rail (VIRA), Sora (SORA), Eared Grebe (EAGR), Horned Grebe (HOGR), Red-necked Grebe (RNGR) and Pied-billed Grebe (PBGR). "Additional species", any other bird species seen or heard during the surveys, were also noted for each location.

Surveys were performed as follows. Upon arrival at each of the MM points, a tripod with an attached speaker was set up facing the interior of the nearest waterbody or wetland area. Then, a 15-minute recording was played. The recording contained 7 segments. It began with 5 minutes of silence, punctuated by a voice announcing each passing minute. Minutes 5-10 constituted the "active" portion of the recording. In the active portion, calls from five of the ten primary birds were played for 30 seconds, followed by 30 seconds of silence. Minute 5-6 was dedicated to the Yellow Rail, 6-7 the Sora, 7-8 the Virginia Rail, 8-9 the American Bittern, and 9-10 the Pied-billed Grebe. Minutes 10-15 were also passive, and the entire 15-minute recording was closed with a loud beep. The timing and location of every individual of every primary species was recorded on the datasheet. Data on the date, time, location, temperature, wind strength and direction, background noise level, cloud cover, precipitation, and the tripod's cardinal orientation were also taken for each point.

Following the completion of the surveys, Habitat Assessments were performed at every point. Determined for each site was the constituent habitat types and vegetation types within

each circular survey area (r=100m, A=31 416m^2). Vegetation height and water depth was determined by walking in a straight line (unless there were vegetation obstacles) for 50m, recording data at 5m intervals. If vegetation was too difficult to navigate, these parameters were estimated.

Results

Eight out of the ten primary species were observed in the surveys: Nelson's Sparrows, Yellow Rails, Virginia Rails, Soras, American Bitterns, Eared Grebes, Horned Grebes, and Pied-billed Grebes. While 7 out of these 8 species were observed at both sides, Horned Grebes were only observed on the east side of Lister Lake.

In total, Primary Species were observed 284 times throughout the 16 surveys conducted on both sides of the Lake. Observations from the western side accounted for 133 (46.83%) of the total, and observations from the eastern side accounted for 151 (53.17%) of the total. There were 55 secondary species observed throughout all 8 surveys, 49 of which were observed at the west side and 39 of which were observed at the east side. Appendix B shows the full additional species list.

On the western side, there were 86 SORA observations, 15 PBGR observations, 12 VIRA observations, 7 YERA observations, 7 AMBI observations, 4 NESP observations, and 2 EAGR observations. On the eastern side, there were 77 SORA observations, 29 EAGR observations, 17 PBGR observations, 12 VIRA observations, 5 NESP observations, 5 HOGR observations, 4 AMBI observations, and 2 YERA observations (Table 2; Figure 2). Figure 3 illustrates the species percentages for either side of Lister Lake. Appendices A1 and A2 show the species detections for all sites for all surveys conducted.

Species	West Side	East Side	Total
NESP	4	5	9
AMBI	7	4	11
SORA	86	77	163
YERA	7	2	9
VIRA	12	12	24
PBGR	15	17	32
EAGR	2	29	31

HOGR	0	5	5
Total	133	151	284

Table 2. Grand totals for observations of Primary Species observations.

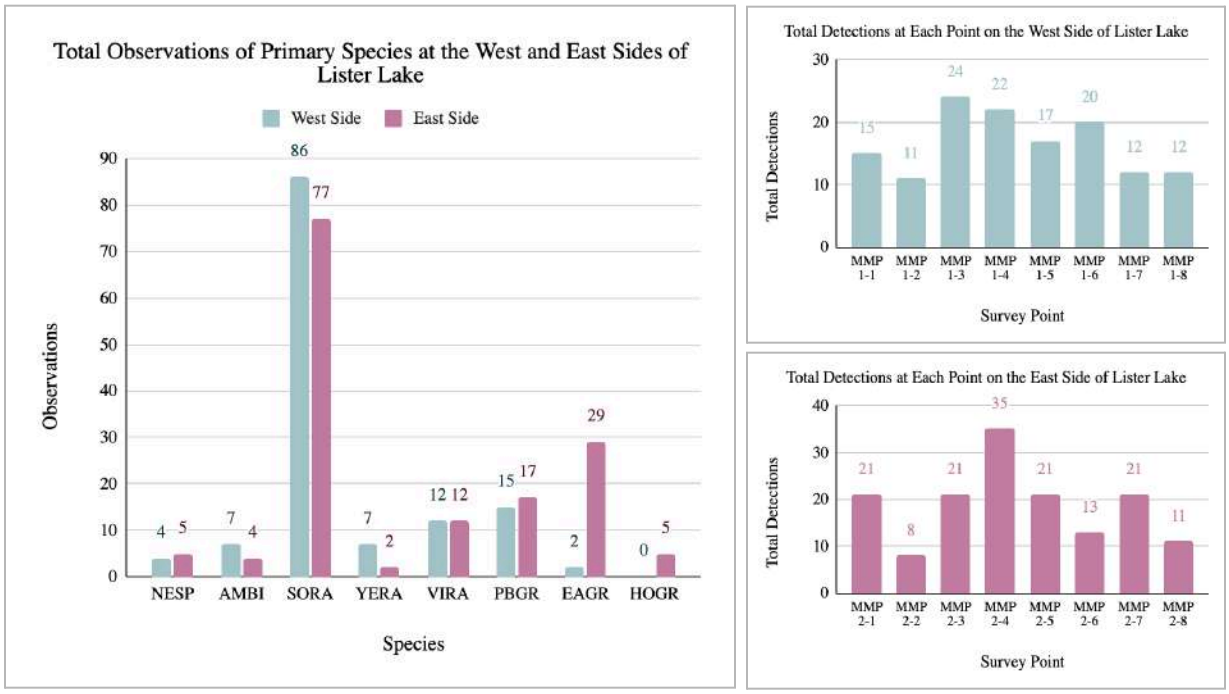

Figure 2. Charts illustrating the total observations of the primary species and the total number of detections at every survey point In 2025.

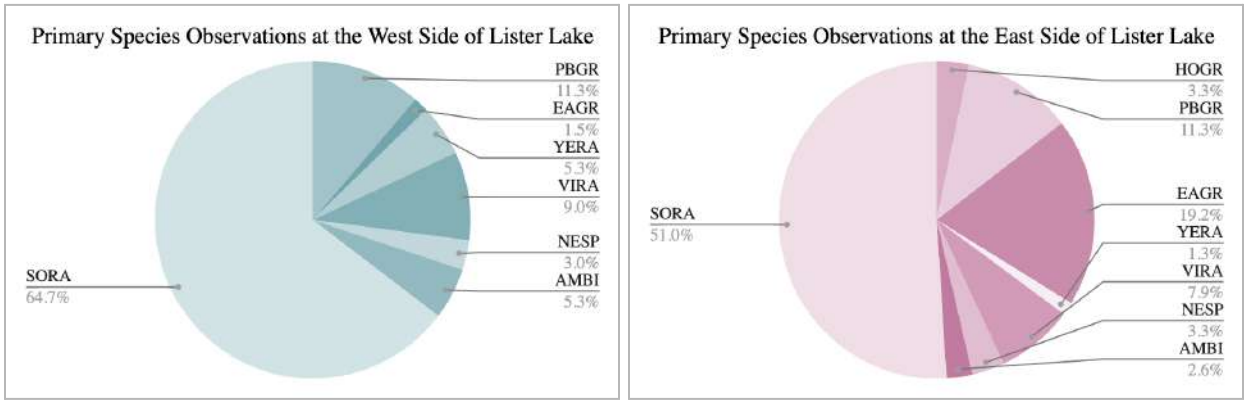

Figure 3. The proportions of Primary Species observed at either side of Lister Lake in 2025.

There were 292 “initial audio detections” of primary species, 151 at the west side and 141 at the east side in 2025. “Initial audio detections” refers to the first recorded call or song of an individual, and does not include repeated vocalizations from the same individual through the duration of the 15-minute survey. These totals do not exclude individuals deemed repeats from previous sites. Table 3 shows the timing of these initial audio detections with respect to the 7

segments of the 15-minute recording. It should be noted that detections occurring upon approaching a site are included as part of the "0-5" minute segment of the recording, and detections occurring upon departure from a site are included as part of the "10-15" segment.

	Species							
Recording Minute	NESP	AMBI	SORA	YERA	VIRA	PBGR	EAGR	Total Callbacks per TIme Interval
0-5 (Passive)	9	8	69	8	3	8	2	107
5-6 (YERA)	1	0	10	0	0	0	0	11
6-7 (SORA)	0	0	45	0	3	2	0	50
7-8 (VIRA)	1	0	18	0	10	0	0	29
8-9 (AMBI)	0	0	10	0	0	0	0	10
9-10 (PBGR)	1	1	8	0	0	7	0	17
10-15 (Passive)	0	3	34	3	7	18	3	68
Total Callbacks by Species	12	12	194	11	23	35	5	292

Table 3. Time stamps of the first audio detections of all* individuals of a Primary Species at every site surveyed. Species only observed visually were not included. Individuals believed to be repeats from previous sites still had their detections recorded anew for the current site. Minutes 0-5 and 5-10 are passive, not including any calls. Minutes 5-10 are dedicated to five of the primary species, with each minute containing 30 seconds of a species' call followed by 30 seconds of silence. *One SORA and one VIRA did not have their timestamps recorded on the data sheets, and as such these two individuals are absent from this table.

Habitat assessments were performed on July 7th, 11th, 13th, and 14th. Diagrams of all survey sites are presented in Figure 4, and Appendices C and D break down the habitat makeup at every site. On average, the sites at the west side of the lake were composed of approximately 12.7% open water/floating plants, 0.7% exposed mud/rock, 45.4% herbaceous emergent vegetation, 16.3% shrubs, and 25% trees. On average, the sites at the east side were composed of approximately 16.9% open water/floating plants, 0.7% exposed mud/rock, 62.5% herbaceous emergent vegetation, 9.7% shrubs, and 10.2% trees.

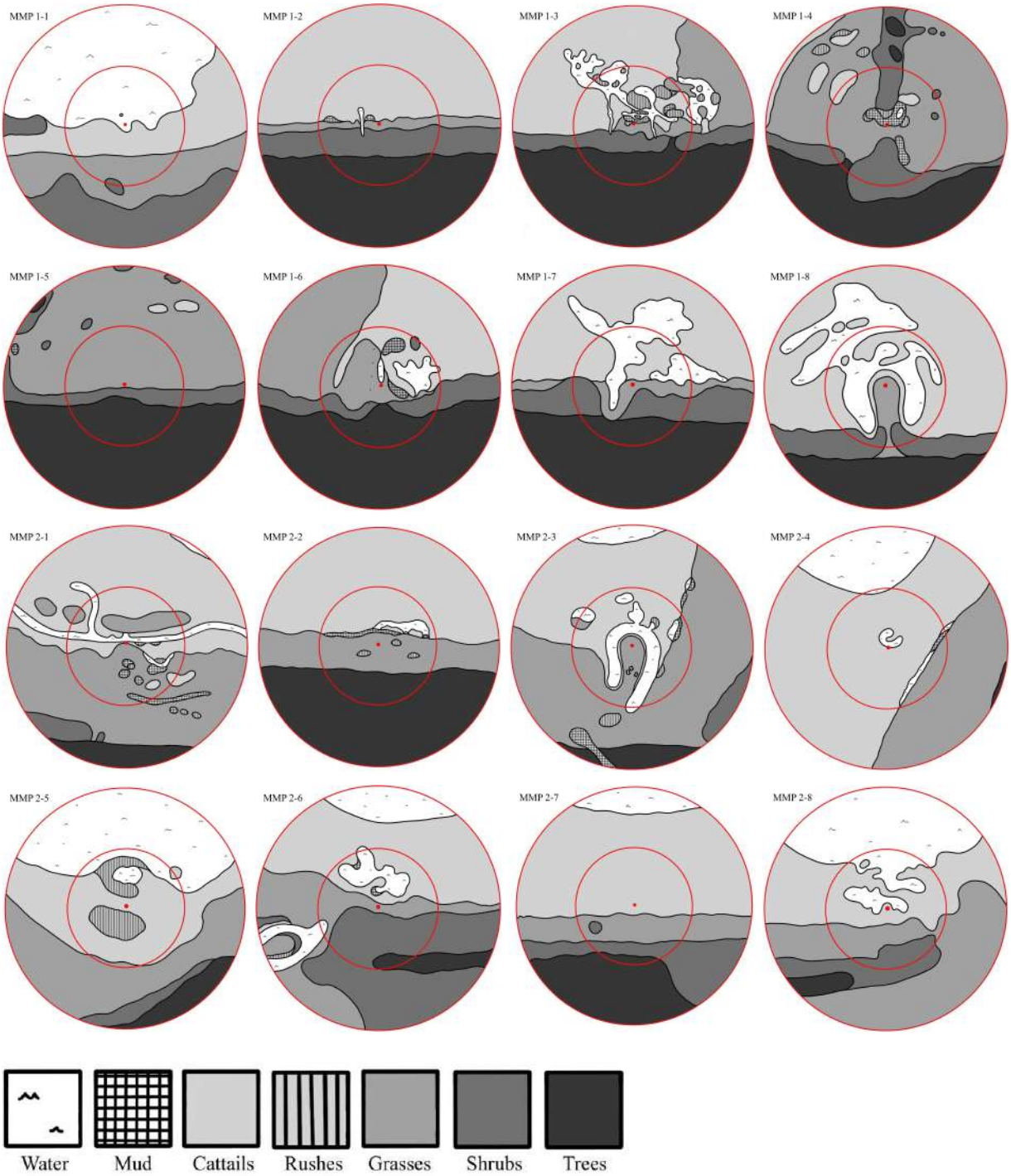

Figure 4. Habitat drawings of every survey site, accompanied by a legend.

Discussion

2025 was the fourth year of MMP surveys on the west side of Lister Lake and the first year on the east side. With 4 years of data we can compare the abundance of marsh birds over

this time. Since the same number of points were surveyed for the same number of times, the total counts were used for the comparison.

The average number of detections per survey point for the western side of the lake was 16.625 detections/point, and the eastern side was 18.875 detections/point. The eastern side had a higher average detection than the western side in every previous Marsh Monitoring survey conducted in the natural area (Figure 5). The average detections in 2024 and 2025 were higher than the previous two years.

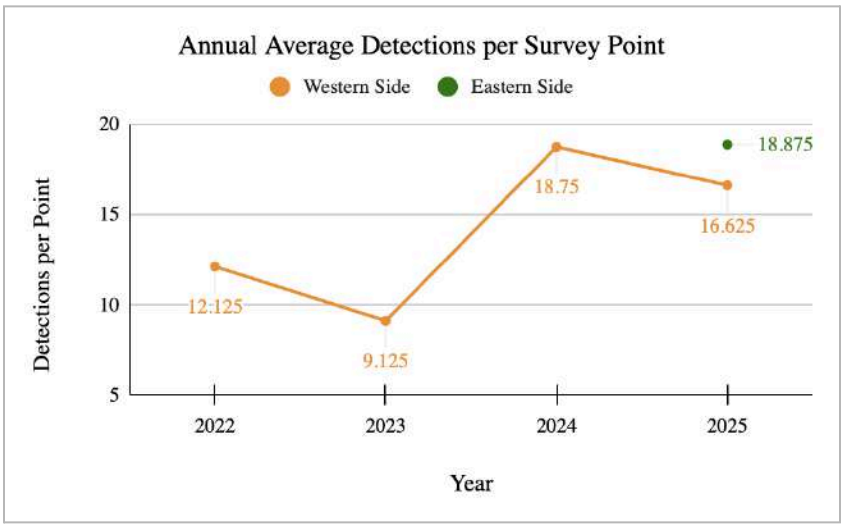

Figure 5. Average number of detections per survey point for every year the MMP surveys have been conducted at the BBO. All previous studies have occurred at the same 8 points on the western side of Lister Lake, shown in orange. The average for the new 8 points on the eastern side of the lake is shown in green. The values were calculated by dividing the total number of Primary Species observations by 8.

Species detections also varied over the four years of surveys (Figure 6). Soras were the most commonly detected species in all four years. However, they were much more abundant in 2024 and 2025 than in the previous two years, possibly due to the lower lake levels and more extensive area of emergent vegetation on the west side of Lister Lake. Yellow Rails, a species-at-risk, was not present in the first two years but was detected in the last two years, especially on the west side of Lister Lake. The two species of grebes were more common on the east side of Lister Lake where the survey points are closer to open water, and this appears to be a main contributing factor to the high average detection value discussed above.

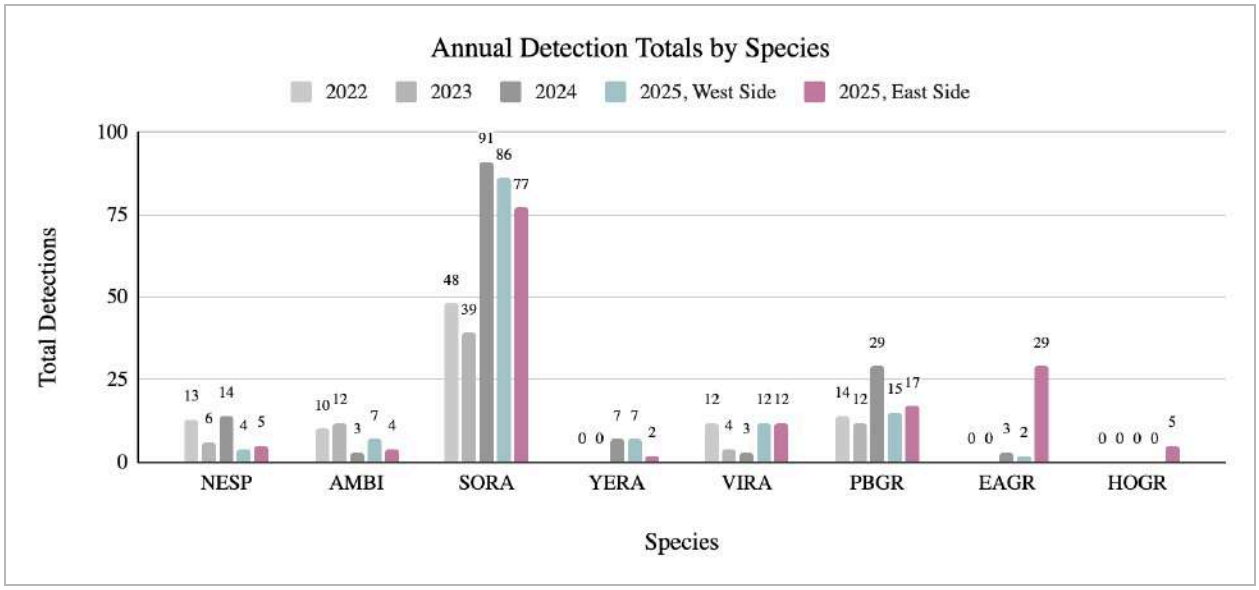

Figure 6. A comparison of the total detections for each species from every year the Marsh Monitoring surveys have been conducted at the BBO. Both the west side (the same 8 points that have been surveyed in previous years) and the east side (the newly-added 8 points) are shown.

Conclusion

In broadening the spatial scope of the Marsh Monitoring surveys at the Beaverhill Bird Observatory, a greater understanding of the wetland habitat within the natural area was gained and more comprehensive analyses can be performed. The “eastern side” of the Lister Lake wetland accounted for over half of the individual species detections (151 out of 284, 53%) and the highest average detections per point of any MMP survey conducted at the BBO. Additionally, the eastern side boasted a greater observed diversity of Primary Species, having provided the only observations of Horned Grebes in this project. Eared Grebes, as well, were also observed considerably more on the eastern side of the wetland. Although, poor visibility of open water at a number of the sites on both sides of the lake may have inhibited detection of more individuals. Nonetheless, these contributions to sample size and diversity make the east side of Lister Lake a very valuable location to survey and study in the future.

References

Beaverhill Bird Observatory (2022). *Beaverhill Bird Observatory's Marsh Monitoring Protocol: modified from Bird Studies Canada's Prairie and Parkland Marsh Monitoring Program*

Bird Studies Canada. (2010). *The Prairie and Parkland Marsh Monitoring Program – Training kit and instructions for surveying marsh birds and their habitats*, 1-27.

Lambe, J. (2017). *Marsh Bird Survey Beaverhill Lake Natural Area 2017,* 1-14. https://beaverhillbirds.com/media/1722/2017-lambe-beaverhill-lake-natural-area-marsh-bird-survey-final.pdf

Acknowledgements

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Appendix A

May 27 (AM)	Species							
	NESP	AMBI	SORA	YERA	VIRA	PBGR	HOGR	EAGR
MMP 1-1			1					
MMP 1-2		1	1		1			
MMP 1-3			5		3	1		
MMP 1-4			7	2	1			
MMP 1-5		1	4	1				
MMP 1-6		1	4		1	2		
MMP 1-7		1	3			1		
MMP 1-8			1		2			
Total	0	4	26	3	8	4	0	0

June 8 (PM)	Species							
	NESP	AMBI	SORA	YERA	VIRA	PBGR	HOGR	EAGR
MMP 1-1		1	3					2
MMP 1-2		1	2			1		
MMP 1-3		1	4	1		1		
MMP 1-4			5			1		
MMP 1-5	1			3				
MMP 1-6			4		1			
MMP 1-7			1			1		
MMP 1-8			2					
Total	1	3	21	4	1	4	0	2

June 14 (AM)	Species							
	NESP	AMBI	SORA	YERA	VIRA	PBGR	HOGR	EAGR
MMP 1-1			2					
MMP 1-2			2			1		
MMP 1-3			3		1			
MMP 1-4			4			1		
MMP 1-5	1		2					
MMP 1-6			3					
MMP 1-7			2					
MMP 1-8			3					
Total	1	0	21	0	1	2	0	0

June 27 (AM)	Species							
	NESP	AMBI	SORA	YERA	VIRA	PBGR	HOGR	EAGR
MMP 1-1			3		1	2		
MMP 1-2			1					
MMP 1-3			3		1			
MMP 1-4			1					
MMP 1-5	1		3					
MMP 1-6	1		2			1		
MMP 1-7			3					
MMP 1-8			2			2		
Total	2	0	18	0	2	5	0	0

Appendix A1. Individuals of primary species observed at every site for every survey at the west side of Lister Lake. There were three SORA detections and one PBGR detection that were noted as likely being able to be heard from points on the east side of the lake, however they were still included in counts for the west side.

June 3 (AM)	Species

June 10 (PM)	Species

	NESP	AMBI	SORA	YERA	VIRA	PBGR	HOGR	EAGR*
MMP 2-1		1	5					
MMP 2-2			2					
MMP 2-3		1	4	1		2		
MMP 2-4			3	1	2	1		8
MMP 2-5		1	3			2		
MMP 2-6	1		2			1		
MMP 2-7			2				1	2
MMP 2-8			2		1	1		
Total	1	3	23	2	3	7	1	10

	NESP	AMBI	SORA	YERA	VIRA	PBGR	HOGR	EAGR
MMP 2-1			1		1			
MMP 2-2			1			1		
MMP 2-3			3					
MMP 2-4			3		1	2		
MMP 2-5	1		2			1		
MMP 2-6			4				1	
MMP 2-7		1	2				1	5
MMP 2-8			2			1		
Total	1	1	18	0	2	5	2	5

June 16 (AM)	Species							
	NESP	AMBI	SORA	YERA	VIRA	PBGR	HOGR	EAGR
MMP 2-1			4					3
MMP 2-2						1		
MMP 2-3	1		2				1	4
MMP 2-4			1		2			
MMP 2-5			4			1		
MMP 2-6			1					
MMP 2-7			3					
MMP 2-8					1			
Total	1	0	15	0	3	2	1	7

June 22 (AM)	Species							
	NESP	AMBI	SORA	YERA	VIRA	PBGR	HOGR	EAGR
MMP 2-1			2		3			1
MMP 2-2			3					
MMP 2-3			2					
MMP 2-4	2		2				1	6
MMP 2-5			5			1		
MMP 2-6			3					
MMP 2-7			3			1		
MMP 2-8			1		1	1		
Total	2	0	21	0	4	3	1	7

Appendix A2. Individuals of primary species observed at every site for every survey at the east side of Lister Lake. There were three SORA detections and one PBGR detection that were noted as likely being able to be heard from points on the west side of the lake, however they were still included in counts for the east side. *A conservative estimate of 10 individuals was given to the EAGR seen from points 2-4 and 2-6, based on assumptions that there was overlap between the sites.

Appendix B

Species	West	East
Red-winged Blackbird	✓	✓
Yellow-headed Blackbird	✓	✓

Species	West	East
American Wigeon	✓	
Northern Shoveler	✓	✓

Brown-headed Cowbird	✓	✓
Baltimore Oriole	✓	
European Starling	✓	
Common Grackle	✓	
Tree Swallow	✓	✓
Purple Martin	✓	
American Robin	✓	
Veery		✓
Common Yellowthroat	✓	✓
Yellow Warbler	✓	✓
Swamp Sparrow	✓	✓
LeConte's Sparrow	✓	✓
Song Sparrow	✓	✓
White-throated Sparrow	✓	✓
Clay-coloured Sparrow	✓	
Marsh Wren	✓	✓
Northern House Wren		✓
American Goldfinch	✓	
Black-capped Chickadee	✓	✓
Least Flycatcher	✓	✓
Traill's Flycatcher		✓
American White Pelican	✓	
Franklin's Gull	✓	✓
Herring Gull		✓
Forster's Tern	✓	
Black Tern	✓	✓

Ruddy Duck	✓	✓
Gadwall	✓	✓
Mallard	✓	✓
Blue-winged Teal	✓	✓
Green-winged Teal	✓	✓
Canvasback	✓	
Redhead	✓	✓
Ring-necked Duck		✓
Bufflehead		✓
Common Goldeneye	✓	✓
American Coot	✓	✓
Canada Goose	✓	✓
Great Blue Heron	✓	✓
Wilson's Snipe	✓	✓
Killdeer	✓	✓
Greater Yellowlegs	✓	
Black-legged Stilt	✓	✓
White-faced Ibis	✓	✓
Broad-winged Hawk	✓	
Northern Harrier	✓	✓
Yellow-bellied Sapsucker	✓	
Mourning Dove	✓	
Ruby-throated Hummingbird	✓	
Ruffed Grouse	✓	✓
Common Raven	✓	✓

Appendix B. Species observed (n=55) at the west (n_1=49) and east (n_2=39) sides of Lister Lake throughout the duration of the Marsh Monitoring Surveys.

Appendix C

Site	% of Major Wetland Habitats within 100m		% of Open Water Covered by Floating Plants		Dominant Herbaceous Emergent Vegetation	
MMP 1-1	Herbaceous emergent vegetation	35%	Common duckweed (*Lemna minor*)	< 1%	Common cattail (*Typha latifolia*)	50%
	Open water/floating plants	40%			Grasses and grass-like sedges	50%
	Exposed mud	-			Bulrushes	-
	Shrubs	25%			Other	-
	Trees	-			Other	-

MMP 1-2	Herbaceous emergent vegetation	50%	Common duckweed (*Lemna minor*)	25%	Common cattail (*Typha latifolia*)	95%
	Open water/floating plants	1%			Grasses and grass-like sedges	5%
	Exposed mud	1%			Bulrushes	-
	Shrubs	18%			Other	-
	Trees	30%			Other	-
MMP 1-3	Herbaceous emergent vegetation	39%	Common duckweed (*Lemna minor*)	25%	Common cattail (*Typha latifolia*)	60%
	Open water/floating plants	15%			Grasses and grass-like sedges	35%
	Exposed mud	1%			Bulrushes	5%
	Shrubs	15%			Other	-
	Trees	30%			Other	-
MMP 1-4	Herbaceous emergent vegetation	54%	Common duckweed (*Lemna minor*)	50%	Common cattail (*Typha latifolia*)	20%
	Open water/floating plants	0.4%			Grasses and grass-like sedges	75%
	Exposed mud	0.6%			Bulrushes	5%
	Shrubs	20%			Other	-
	Trees	25%			Other	-
MMP 1-5	Herbaceous emergent vegetation	50%	-	-	Common cattail (*Typha latifolia*)	5%
	Open water/floating plants	0%			Grasses and grass-like sedges	95%
	Exposed mud	1%			Bulrushes	-
	Shrubs	9%			Other	-
	Trees	40%			Other	-
MMP 1-6	Herbaceous emergent vegetation	50%	Fringed heartwort (*Ricciocarpos natans*)	70%	Common cattail (*Typha latifolia*)	50%
	Open water/floating plants	5%			Grasses and grass-like sedges	50%
	Exposed mud	2%			Bulrushes	-
	Shrubs	13%			Other	-
	Trees	30%			Other	-
MMP 1-7	Herbaceous emergent vegetation	35%	Fringed heartwort (*Ricciocarpos natans*)	75%	Common cattail (*Typha latifolia*)	80%
	Open water/floating plants	15%			Grasses and grass-like sedges	20%
	Exposed mud	-			Bulrushes	-
	Shrubs	20%			Other	-
	Trees	30%			Other	-
MMP 1-8	Herbaceous emergent vegetation	50%	Fringed heartwort (*Ricciocarpos natans*)	5%	Common cattail (*Typha latifolia*)	90%
	Open water/floating plants	25%			Grasses and grass-like sedges	10%

	Exposed mud	-			Bulrushes	-
	Shrubs	10%			Other	-
	Trees	15%			Other	-

Site	% of Major Wetland Habitats within 100m		% of Open Water Covered by Floating Plants		Dominant Herbaceous Emergent Vegetation	
MMP 2-1	Herbaceous emergent vegetation	87%	Fringed heartwort (*Ricciocarpos natans*)	5%	Common cattail (*Typha latifolia*)	50%
	Open water/floating plants	5%			Grasses and grass-like sedges	50%
	Exposed mud	0.5%			Bulrushes	*
	Shrubs	2.5%			Other	-
	Trees	5%			Other	-
MMP 2-2	Herbaceous emergent vegetation	45%	Fringed heartwort (*Ricciocarpos natans*)	33.5%	Common cattail (*Typha latifolia*)	69%
	Open water/floating plants	15%	Common duckweed (*Lemna minor*)	33.5%	Grasses and grass-like sedges	30%
	Exposed mud	5%	White water-crowfoot (*Ranunculus aquatilis)*	3%	Bulrushes	1%
	Shrubs	*			Other	-
	Trees	35%			Other	-
MMP 2-3	Herbaceous emergent vegetation	75%	Fringed heartwort (*Ricciocarpos natans*)	20%	Common cattail (*Typha latifolia*)	40%
	Open water/floating plants	15%	Common duckweed (*Lemna minor*)	20%	Grasses and grass-like sedges	58%
	Exposed mud and rock	0.25%			Bulrushes	2%
	Shrubs	3%			Other	-
	Trees	6.75%			Other	-
MMP 2-4	Herbaceous emergent vegetation	84.6%	Fringed heartwort (*Ricciocarpos natans*)	5%	Common cattail (*Typha latifolia*)	60%
	Open water/floating plants	15%			Grasses and grass-like sedges	35%
	Exposed mud	0.2%			Bulrushes	5%
	Shrubs	0.2%			Other	-
	Trees	-			Other	-
MMP 2-5	Herbaceous emergent vegetation	50%	-	-	Common cattail (*Typha latifolia*)	50%
	Open water/floating plants	35%			Grasses and grass-like sedges	45%
	Exposed mud	-			Bulrushes	5%
	Shrubs	7%			Other	-
	Trees	8%			Other	-

MMP 2-6	Herbaceous emergent vegetation	45%	Common duckweed (*Lemna minor*)	5%	Common cattail (*Typha latifolia*)	50%
	Open water/floating plants	19.85%			Grasses and grass-like sedges	50%
	Exposed mud	0.15%			Bulrushes	*
	Shrubs	30%			Other	-
	Trees	5%			Other	-
MMP 2-7	Herbaceous emergent vegetation	60%	-	-	Common cattail (*Typha latifolia*)	80%
	Open water/floating plants	5%			Grasses and grass-like sedges	20%
	Exposed mud	-			Bulrushes	-
	Shrubs	15%			Other	-
	Trees	20%			Other	-
MMP 2-8	Herbaceous emergent vegetation	53%	-	-	Common cattail (*Typha latifolia*)	40%
	Open water/floating plants	25%			Grasses and grass-like sedges	60%
	Exposed mud	-			Bulrushes	-
	Shrubs	20%			Other	-
	Trees	2%			Other	-

Appendix C. Habitat assessment results for every survey site. *The species is present but in trace quantities.

Appendix D

	Water Depth (cm)								Vegetation Height (cm)							
	MMP 1-1	MMP 1-2	MMP 1-3	MMP 1-4	MMP 1-5	MMP 1-6	MMP 1-7	MMP 1-8	MMP 1-1	MMP 1-2	MMP 1-3	MMP 1-4	MMP 1-5	MMP 1-6	MMP 1-7	MMP 1-8
0m	20	0	0	0	0	0	0	0	0	90	60	70	90	80	50	5
5m	20	0	0	10	0	0	0	0	0	90	60	70	90	80	50	150
10m	20	0	0	20	0	20	10	20	0	200	0	70	90	100	175	0
15m	30	0	10	20	0	30	10	30	0	200	200	110	90	100	175	0
20m	30	0	35	20	0	30	15	20	0	200	200	110	90	100	175	200
25m	30	0	35	20	0	30	15	20	0	200	200	70	90	100	175	0
30m	30	0	5	20	0	30	20	20	0	200	200	70	90	100	175	0
35m	40	0	5	20	0	30	20	20	0	200	200	70	90	100	175	200
40m	40	0	5	20	0	30	30	20	0	200	200	70	90	100	175	200
45m	40	0	5	20	0	30	30	20	0	200	200	70	90	100	175	200
50m	40	0	5	20	0	30	40	40	0	200	200	70	90	100	175	0

	Water Depth (cm)								Vegetation Height (cm)							
	MMP 2-1	MMP 2-2	MMP 2-3	MMP 2-4	MMP 2-5	MMP 2-6	MMP 2-7	MMP 2-8	MMP 2-1	MMP 2-2	MMP 2-3	MMP 2-4	MMP 2-5	MMP 2-6	MMP 2-7	MMP 2-8
0m	0	0	0	0	0	0	0	5	20	80	20	200	250	225	200	200
5m	45	0	0	20	0	0	0	25	175	120	20	200	250	225	200	0
10m	90	0	0	20	0	0	0	40	0	120	175	200	250	225	200	0
15m	45	5	25	20	0	30	0	30	175	200	0	200	250	0	200	200
20m	0	10	40	20	20	35	0	25	40	200	0	200	250	0	200	200
25m	0	20	30	20	20	35	0	60	40	200	0	200	250	0	200	0
30m	0	0	25	20	20	40	0	60	40	200	175	200	250	225	200	0
35m	10	0	25	20	20	10	0	60	200	200	175	200	250	225	200	0
40m	10	0	25	20	20	10	0	60	200	200	175	200	250	225	200	0
45m	10	0	25	20	20	10	0	60	200	200	175	200	250	225	200	0
50m	10	0	10	20	45	10	0	60	200	200	175	200	0	225	200	0

Appendix D. Water depth and vegetation height along a straight 50m transect of every site.