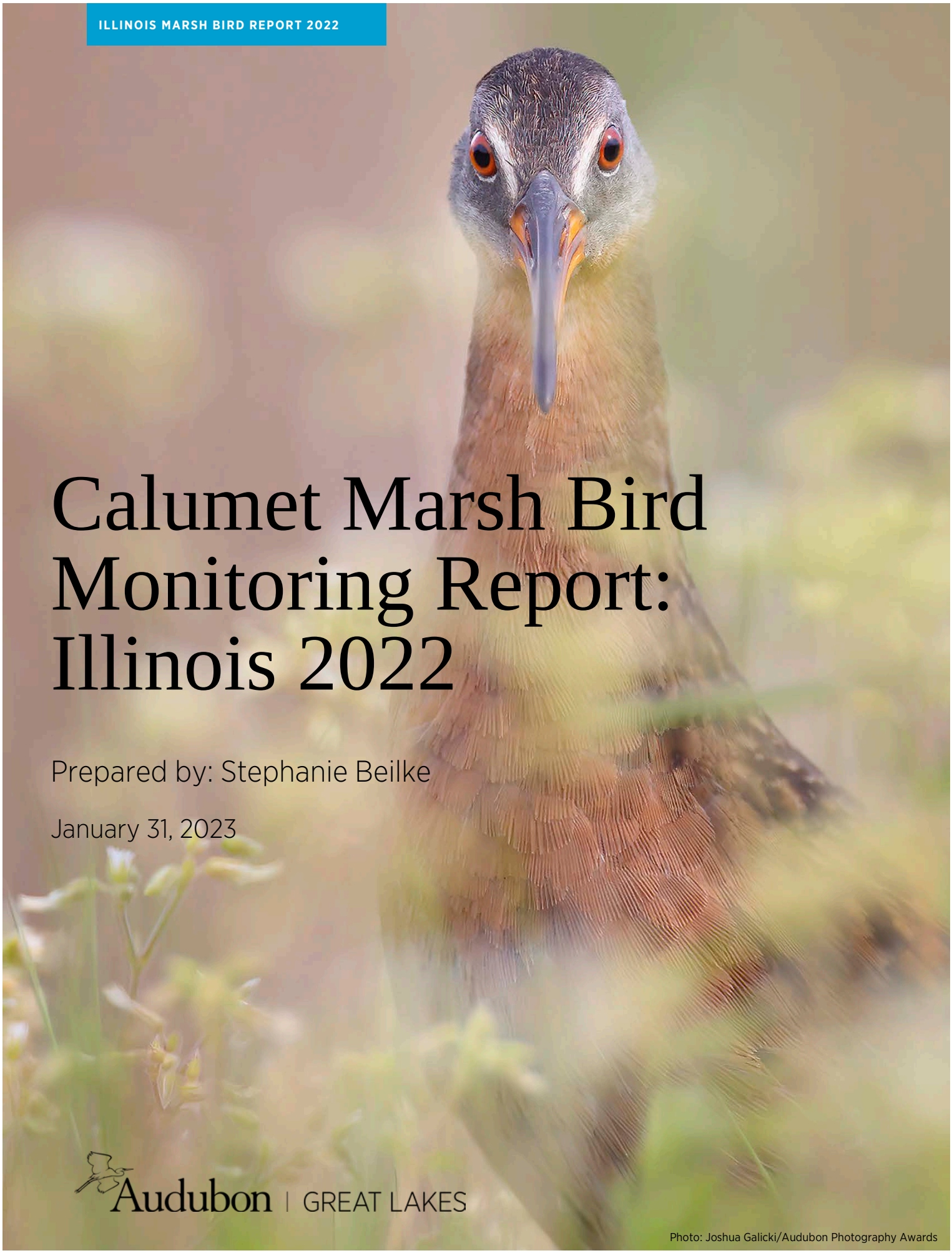

Calumet Marsh Bird Monitoring Report: Illinois 2022

Prepared by: Stephanie Beilke

January 31, 2023

Audubon | GREAT LAKES

Photo: Joshua Galicki/Audubon Photography Awards

Contents

Marsh bird surveys were conducted under permits granted by the Chicago Park District, Forest Preserves of Cook County, Northeastern University and the Illinois Nature Preserves Commission.

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Executive Summary

Ten bird monitors conducted 294 surveys at 98 points across 15 wetland sites, including three Illinois Nature Preserves between 1 May through 15 June 2022. Surveyors detected twelve of seventeen focal marsh bird species. We recorded 775 detections of focal marsh bird species, with Marsh Wren (286 detections) and Swamp Sparrow (125) being the most frequently detected species. Marsh bird occupancy was highest at Big Marsh and Hegewisch in 2022. Average marsh bird occupancy increased at Burnham Prairie, Eggers Grove, Indian Ridge, and Marian Byrnes in 2022 compared to 2021, which may be related to water level fluctuations between 2020-2022. In 2020, water levels were high before receding significantly in 2021-2022, resulting in exposed mud and thus stimulating the seed bank which caused vegetative regrowth and a change in structure.

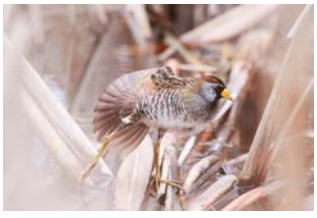
Introduction

The Calumet region, which makes up the southern shore of Lake Michigan, has historically been dominated by wetland habitats (including marshes, swales, and lakes), which were home to dense populations of breeding marsh birds and waterbirds. A lengthy history of industrialization and urbanization has highly altered the hydrology of Calumet wetlands, resulting in threats to the long-term sustainability of Calumet wetlands, in particular marshes, because of their dependence on natural and dynamic water conditions. Invasive species such as common reed (*Phragmites australus*) and narrowleaf cattail (*Typha angustifolia*) further degrade marsh conditions as reflected by documented declines of marsh-dependent bird species throughout the Great Lakes region (Tozer 2016, Tozer and Mackenzie, 2019). The need for increased scientific information that forms the basis for wetland restoration and long-term management has been widely identified as critical in the conservation community. Marsh birds serve as a primary indicator of wetland quality and their charismatic nature helps to promote public interest that serves to raise the profile of this collaborative research project.

The objectives of the Calumet Marsh Bird Survey are to provide important feedback to landowners on marsh bird populations in response to habitat restoration and to use marsh bird occupancy to inform future management actions. As a result of the collaborative marsh bird monitoring work in the Calumet region, our goal is to increase suitable marsh habitat and therefore positively influence marsh bird population trends, especially for species of concern in the states of Illinois and Indiana. In addition to quantifying marsh bird populations at Calumet wetlands, we aim to collect a variety of habitat data including water level, percent cover of emergent vegetation and open water, and aerial imagery. In a two-year analysis of species-habitat analysis, we found positive relationships between marsh bird species with % emergent vegetation cover and muskrat den density. In addition, at least one species (Swamp Sparrow) had a negative relationship with % open water and one species (Pied-billed Grebe) had a negative relationship with % invasive vegetation cover.

Methods

Sites. During 1 May-15 June 2022, we conducted marsh bird surveys at fifteen wetland sites: Big Marsh, Burnham Prairie, Deadstick Pond, Eggers Grove, Gensburg-Markham Prairie, Hegewisch Marsh, Indian Ridge Marsh, Marian Byrnes Prairie, Orland Grassland, Orland Grassland South, and Powderhorn Lake, Powderhorn North, Sand Ridge Nature Center, Whitford Pond, and Wolf Lake Management Units 5 & 9. The site formerly referred to as 136th St Marsh (previously combined with Powderhorn Lake) is now referred to as Powderhorn North.



Sora. Photo: Megan Mahon. Audubon Photography Awards.

Bird Monitoring. Marsh bird surveys were conducted by volunteer and contracted surveyors using the widely recognized "Standardized North American Marsh Bird Monitoring Protocol" (Conway 2011), developed by the U.S. Fish and Wildlife Service as a continent-wide, standardized protocol for measuring breeding marsh bird densities.

The seven primary focal species for the study are marsh-dependent species that breed in the Calumet area and tend to be "secretive" and thus not well sampled by other survey methods (Conway, 2011; Table 1). Secondary species are not as secretive, but we included them as important indicators of hemimarsh habitat (Table 1). Some secondary species may or may not respond to future hemi-marsh restoration. Three of these species are colonial or semi-colonial nesters not suited for territory mapping, and dependent upon stochastic processes out of our control (e.g. the presence of suitable rookery trees), as much as they are marsh habitat management. Black Tern, Little Blue Heron, Snowy Egret, Yellow-crowned Night-Heron, and Yellow-headed Blackbird are at the periphery of their breeding range though are included in the survey to monitor potential range shifts.

Following the Standardized North American Marsh Bird Monitoring Protocol (Conway 2011), surveyors conducted three point counts at each assigned point three times each season (May 1-14, May 15-31, and June 1-15). The number of points varied from one to thirteen depending on the size of the site and the amount of marsh habitat therein. Points were distributed at a spacing of one point per 200-m grid cell, at an accessible location within the marsh. Each point was visited for 10 minutes in sequence starting 30 minutes prior to sunrise and finishing at the latest three hours post-sunrise. At each point, a pre-recorded playback including vocalizations of each of five of the seven primary focal species were broadcast, with a five-minute period of silent listening before the recording. All visual and audio detections of primary and secondary species were recorded.

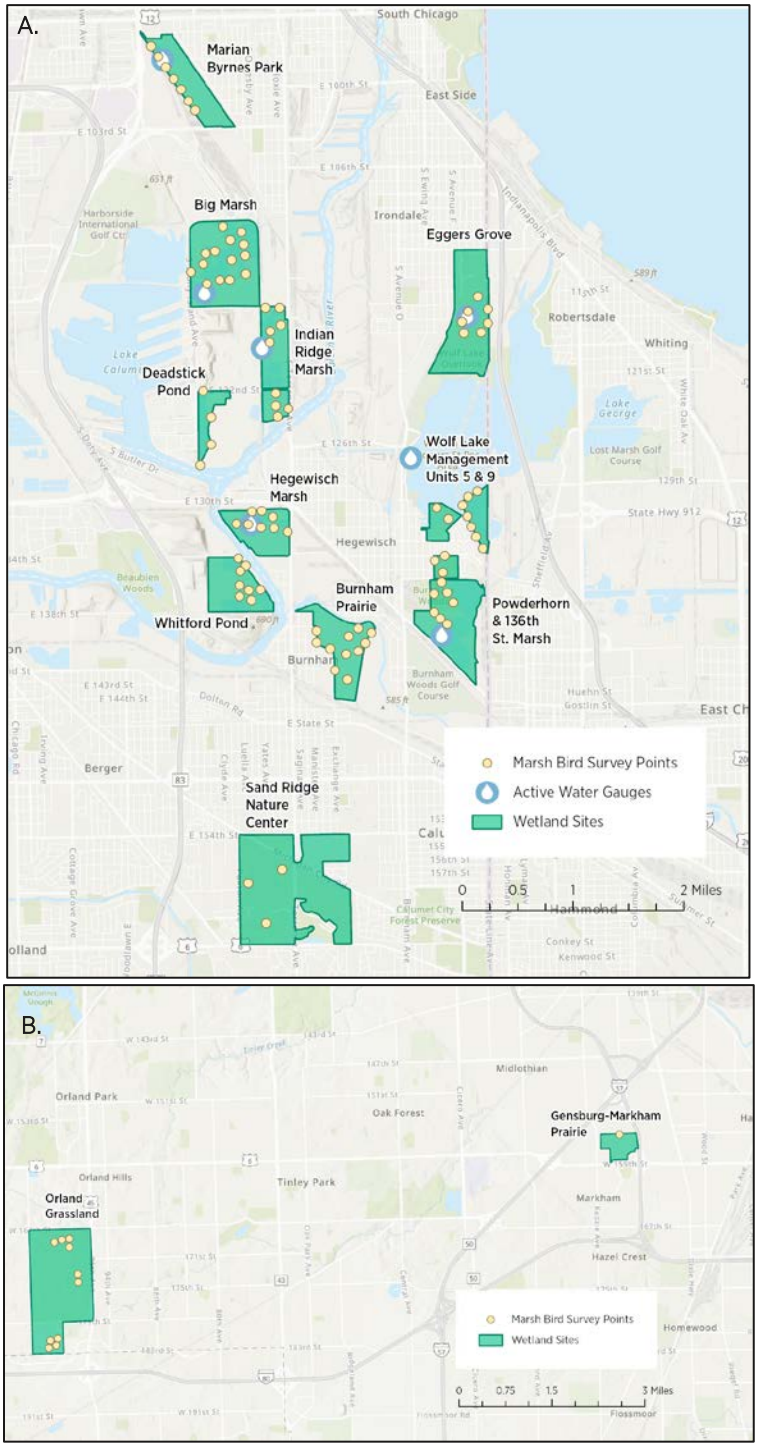


Figure 1. Marsh bird wetland sites, survey points and water gauges visited in 2022 including A) Lake Calumet sites B) wetlands southwest of the Lake Calumet region: Gensburg-Markham Prairie and Orland Grassland

Table 1. Focal marsh bird species.

PRIMARY FOCAL SPECIES	SECONDARY FOCAL SPECIES
American Bittern (*Botaurus lentiginosus*)*	American Coot (*Fulica americana*)
Common Gallinule (*Gallinula chloropus*)	Black Tern (*Chlidonias niger*)
Least Bittern (*Ixobrychus exilis*)	Black-crowned Night-Heron (*Nycticorax nycticorax*)
King Rail (*Rallus elegans*)*	Blue-winged Teal (*Anas discors)*
Pied-billed Grebe (*Podilymbus podiceps*)	Little Blue Heron (*Egretta caerulea*)
Sora (*Porzana carolina*)	Marsh Wren (*Cistothorus palustris*)
Virginia Rail (*Rallus limicola*)	Snowy Egret (*Egretta thula*)
	Swamp Sparrow (*Melospiza georgiana*)
	Yellow-crowned Night-Heron (*Nyctanassa vioacea*)
	Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*)

**American Bittern and King Rail were primary focal species not included in the audio broadcast.*

Water level monitoring. Staff gauges were installed in 2018 at the following Illinois wetlands: Big Marsh, Eggers Grove, Hegewisch Marsh, Marian Byrnes, Indian Ridge Marsh, and Wolf Lake/William Powers. Volunteer bird monitors recorded water levels at staff gauges during regular bird monitoring visits during 1 May through 15 June. We determined the mean water level value between 1 May-15 June in 2018-2022.

Habitat and management data collection. In 2022, habitat data were collected at all sites where marsh bird monitoring data were collected that year. We used a modified habitat sampling protocol adapted from the Birds Canada Marsh Monitoring Protocol (Birds Canada 2009) and collected data on habitat characteristics at each marsh bird sampling point, such as percent open water, percent emergent vegetation and dominant species present. We also contacted land managers to complete a survey to submit management data for the past five years, so it can be correlated with marsh bird occupancy.

Analysis. We estimated occupancy and detection probability parameters for focal species with the unmarked package in R 3.4.3 (Fiske and Chandler 2011). We estimated species-specific occupancy using the likelihood-based method (MacKenzie et al. 2002). We developed separate models for each species based on stacking data from repeated survey visits within years; thus, our "effective sites" were derived from 2 or 3 survey visits at each survey point annually. We treated year as a site-specific covariate in all models.

Under this occupancy model parameterization, the area within 200 m of the survey point (i.e., only detections within 200 m were retained; < 3% of detections omitted) is considered closed to changes in occupancy across all surveys and within years (MacKenzie et al. 2002). Thus, if a given species is detected at a survey point (i.e. site), that point is assumed to be closed to changes in species occupancy for the duration of the breeding season. Therefore, our occupancy response variable can be considered "use" (sensu MacKenzie 2005, MacKenzie et al. 2006) because birds may be temporarily, but not permanently, absent from a given survey point at random times. In this context, our estimate of occupancy describes the proportion of survey points ever occupied, rather than the survey points that are permanently occupied (Kéry and Schaub 2012).

Least Bittern. Photo: Rick Lewis, Audubon Photography Awards.

We were interested in accounting for two processes known to influence detection probability of marsh birds during surveys (Conway 2011, Tozer 2016, Wiest et al. 2016): time of day (24 hr) and time of year (ordinal date). Both continuous explanatory variables were standardized to have a mean of zero and standard deviation (SD) of one. We assessed linear and quadratic terms (based on standardized values) for both variables, and used Akaike's Information Criterion (AIC) to compare among models, which included a null (intercept-only) model.

The model with the lowest AIC was retained as the top-ranked occupancy model for each focal species.

We used 2020-21 habitat survey data and occupancy data to conduct species-habitat analysis in 2022. We also were able to incorporate a new habitat variable, muskrat den density, which was estimated using visual assessment of aerial photography available via Google Earth.

Results

Bird monitoring. In 2022, ten bird monitors conducted 294 surveys at 98 points (Figure 1A-B) during three two-week sampling periods from 1 May through 15 June 2021. We detected all seven primary focal species (American Bittern, Common Gallinule, Least Bittern, King Rail, Pied-billed Grebe, Sora and Virginia Rail), and five of eleven secondary focal species (American Coot, Black-crowned Night-Heron, Blue-winged Teal, Marsh Wren, and Swamp Sparrow). We recorded 608 detections of focal marsh bird species during surveys, with Marsh Wren (286 detections) and Swamp Sparrow (125) being the most frequently detected species (Figure 2).

The wetland sites with the highest marsh bird species richness in 2022 were Orland Grassland (9 species), Big Marsh Park (8), Burnham Prairie (8), Eggers Grove (8), and Hegewisch Marsh (8). The site with the lowest species richness was Powderhorn North (1). Marsh Wren, Sora and Virginia Rail were detected at the most wetland sites surveyed. King Rail and American Bittern were detected at the fewest sites, but both were detected at Marian Byrnes and Orland Grassland.

Marsh bird occupancy. All but five marsh bird species were included in the species-specific occupancy analysis. King Rail, Little Blue Heron, Snowy Egret, Yellow-crowned Night-Heron, and Yellow-headed Blackbird were excluded due to low detections.

We averaged species-specific occupancy estimates at each site to estimate 'average marsh bird occupancy' annually (Figure 3). Big Marsh and Hegewisch had high occupancy in 2022 relative to other sites (Gensburg-Markham was excluded from this comparison since it only had one survey point, which biased results). Most sites showed higher average marsh bird occupancy in 2022 compared to 2021.

Water level monitoring. Water gauge data were compiled for the following sites across four years: Big Marsh, Eggers Grove, Indian Ridge Marsh, Marian Byrnes, and Wolf Lake. Mean water gauge measurements indicated that water levels were stable between 2021 and 2022 at Big Marsh, Indian Ridge Marsh and William Powers. Marian Byrnes showed a decrease in water level and Eggers Grove had an increase in water level in comparison to previous years (Figure 4).

Species-habitat associations. Six species with sufficient detections (>25 detections) were modeled to estimate species-habitat relationships with nine habitat variables that were collected via ground surveys (Table 3). The most frequent habitat variable in our top models of species occupancy was muskrat den density, as two species had positive relationships and one species had a quadratic relationship. Sora and Virginia Rail were positively associated with % emergent vegetation. Marsh Wren was positively associated with invasive vegetation, while Pied-billed Grebe was negatively associated with invasive vegetation. Swamp Sparrow was negatively associated with % open water.

Conclusions

Marsh bird monitoring results generally showed an increase in average occupancy of marsh birds in 2022 at Illinois Calumet wetlands compared to 2021. Although water levels were relatively low at most wetlands compared to high water levels in 2020, occupancy likely increased due to higher availability of emergent vegetation at wetlands in 2022. The high water in 2020 followed by low water level in 2021 created mud flats at Big Marsh and Indian Ridge Marsh which reduced habitat in 2021. However vegetative regrowth in 2022 created more habitat for breeding marsh birds.

The results from the species-habitat associations only resulted in nine significant relationships; however, we recommend continued habitat monitoring to improve these models. The finding that three species had a strong relationship with muskrat den density shows the usefulness of this variable in comparison to on the ground estimates of muskrat/beaver

presence/absence which can be harder to judge without an aerial view. In addition, this result reveals the importance of habitat manipulation by muskrats in relation to wetland bird use. The positive relationship between Marsh Wren and invasive *Phragmites* likely shows the importance of the structure that non-native vegetation like *Phragmites* and hybrid cattail provide. However, the dense structure of invasive vegetation can also have a negative impact on sensitive species such as Pied-billed Grebe, which typically benefits from more open water marsh.

The future direction of Audubon Great Lakes marsh bird monitoring will be to better integrate site-level marsh bird and habitat monitoring results with individual conversations with land managers. In February 2023, with the official update to the web-based Marsh Bird Monitoring Hub, we will be reaching out to managers to schedule these conversations. We're looking forward to discussions that will help the Audubon Great Lakes team better assist managers with planning restoration actions that can have a positive impact on bird populations. In addition, we see this as an excellent opportunity for a mutual learning experience where both Audubon Great Lakes and our partners can work together toward conservation solutions for birds and people.

Table 1. Marsh bird species detected during 2022 marsh bird surveys and marsh bird species richness. Includes species detected by monitors both within and outside the survey period. Bird icons indicate that the species was observed. See Appendix I for raw species detection data.

	American Bittern	American Coot	Black-crowned Night-Heron	Blue-winged Teal	Common Gallinule	King Rail	Least Bittern	Marsh Wren	Pied-billed Grebe	Sora	Swamp Sparrow	Virginia Rail	Total Species
Big Marsh													8
Burnham Prairie													8
Deadstick Pond													4
Eggers Grove													8
Gensburg-Markham Prairie													5
Hegewisch Marsh													8
Indian Ridge Marsh													6
Marian Byrnes Prairie													6
Orland Grassland													9
Orland Grassland South													8
Powderhorn Lake													4
Powderhorn North													1
Sand Ridge Nature Center													4
Whitford Pond													4
Wolf Lake Pools 5 & 9													7
Total Species	3	5	4	8	4	3	4	15	7	13	11	13	90

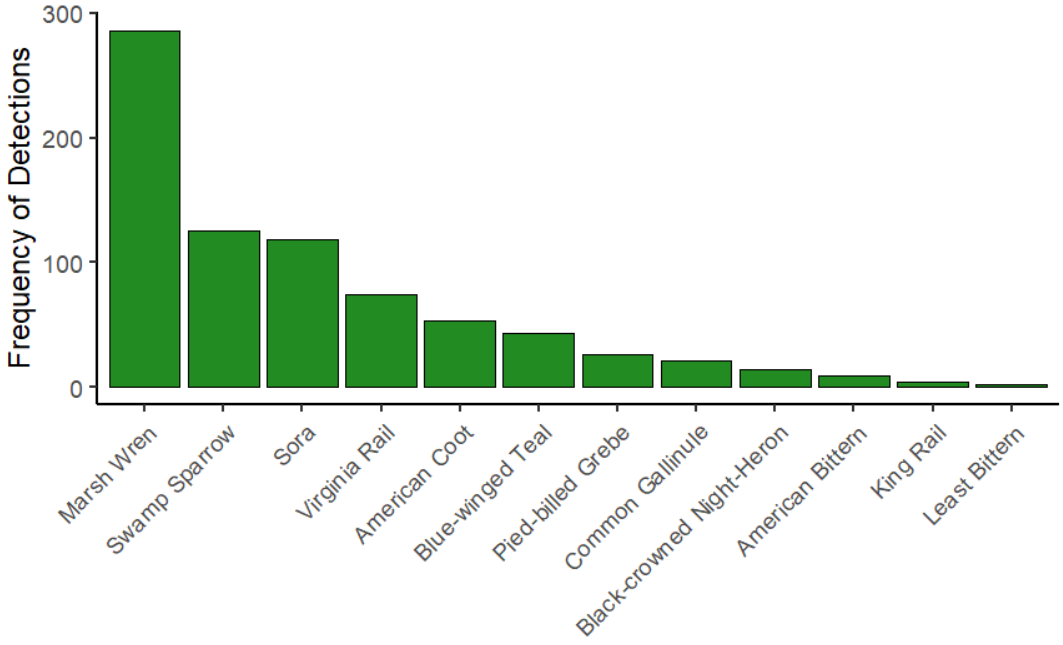


Figure 2. Combined frequency of detections per species during marsh bird surveys at all Illinois Calumet wetland sites in 2022.

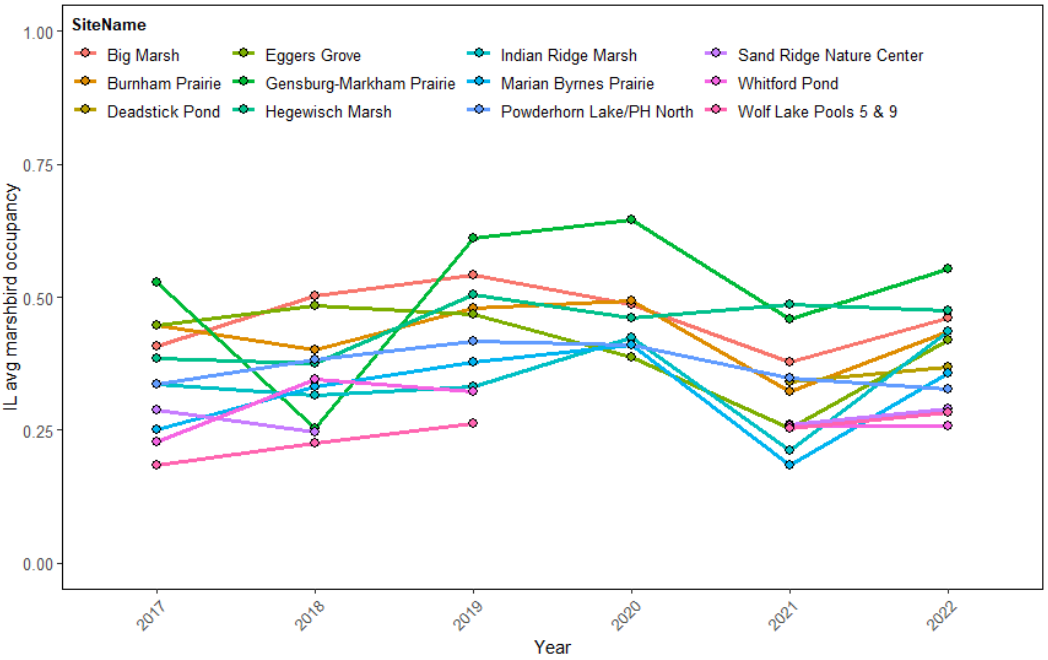


Figure 3. Average marsh bird occupancy at wetland sites for 2017-2022 Illinois Calumet marsh bird surveys. Not shown: Orland Grassland. Note that Powderhorn Lake and Powderhorn North were combined in this visualization.

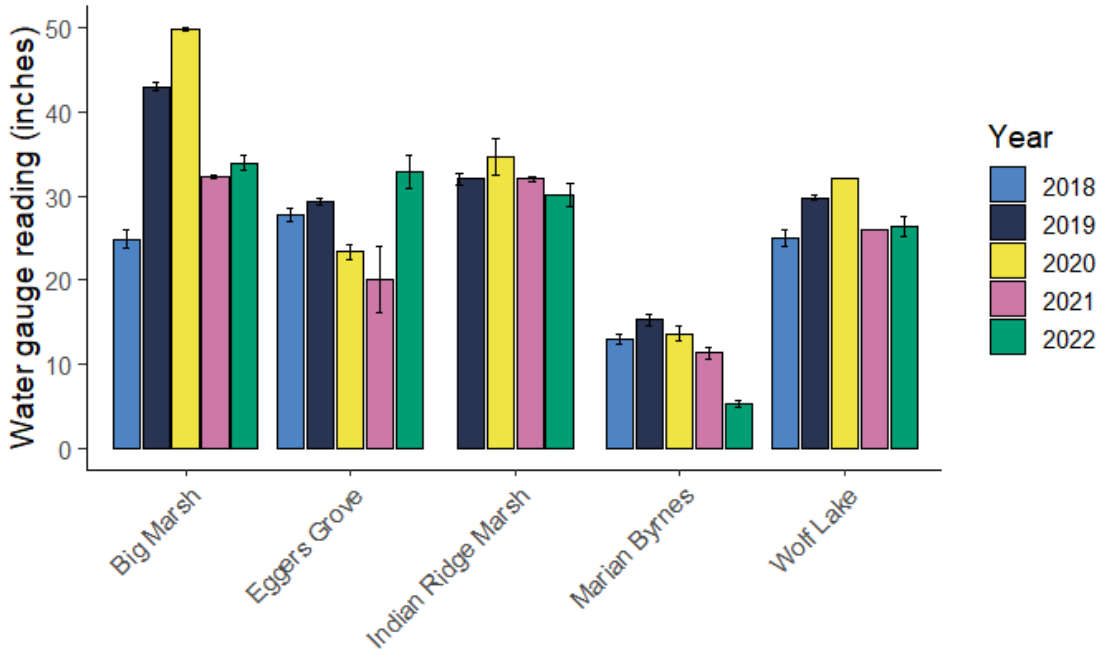


Figure 4. Mean water level recorded at staff gauges at Illinois Calumet marshes during 1 May-15 June 2018-2022, for gauges with at least three years of data.

Table 2. Top models for marsh bird-habitat associations using 2020-2021 occupancy data. += positive relationship, -=negative relationship. X = covariate supported for > 1 species, Q = quadratic effect. See Appendix II for more detailed information on individual species-habitat associations.

Species	***% open water***	***% emergent veg***	***% trees***	***% invasive veg***	***% native veg***	***Muskrat den density***	***Interspersion class***	***Wetland type***	***Muskrat/beaver***	***Carp***
Common Gallinule						**+**				
Marsh Wren				**+**		**+**				
Pied-billed Grebe				**-**		**Q**				
Sora		**+**							X	
Swamp Sparrow	**-**									
Virginia Rail		**+**								

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Appendix I. Raw marsh bird results for Illinois Calumet Wetlands.

Raw marsh bird species detections per visit at Illinois Calumet wetlands in 2022.

		Visit 1	Visit 2	Visit 3	Total
Big Marsh	American Coot	10			**10**
	Blue-winged Teal	4	5	7	**16**
	Common Gallinule			1	**1**
	Marsh Wren	15	22	25	**62**
	Pied-billed Grebe	3			**3**
	Sora	31	13	5	**49**
	Swamp Sparrow	15	4	7	**26**
	Virginia Rail	10	8	4	**22**
	Total	**88**	**52**	**49**	**189**
Burnham Prairie	Black-crowned Night-Heron			1	**1**
	Common Gallinule	1			**1**
	Least Bittern		1		**1**
	Marsh Wren	7	22	20	**49**
	Pied-billed Grebe	3	5	2	**10**
	Sora	5	1	1	**7**
	Swamp Sparrow	12	10	12	**34**
	Virginia Rail	4	1		**5**
	Total	**32**	**40**	**36**	**108**
Deadstick Pond	Marsh Wren	4	1	4	**9**
	Sora	2			**2**
	Swamp Sparrow	7		1	**8**
	Virginia Rail	1			**1**
	Total	**14**	**1**	**5**	**20**
Eggers Grove	American Coot	6			**6**
	Black-crowned Night-Heron	3	1	5	**9**
	Blue-winged Teal	7			**7**
	Marsh Wren	2	4	4	**10**
	Pied-billed Grebe	4	2		**6**
	Sora	3	2		**5**
	Swamp Sparrow	2			**2**
	Virginia Rail	2		1	**3**
	Total	**29**	**9**	**10**	**48**

Gensburg-Markham Prairie	**American Coot**	3			**3**
	Marsh Wren	2	3		**5**
	Pied-billed Grebe	2	1		**3**
	Sora	2	1	1	**4**
	Virginia Rail	1	1		**2**
	Total	**10**	**6**	**1**	**17**
Hegewisch Marsh	**American Coot**	11			**11**
	Blue-winged Teal	10			**10**
	Common Gallinule	5	7	6	**18**
	Marsh Wren	3		14	**17**
	Pied-billed Grebe	2	1		**3**
	Sora	5	1	1	**7**
	Swamp Sparrow	3		1	**4**
	Virginia Rail	3	1	1	**5**
	Total	**42**	**10**	**23**	**75**
Indian Ridge Marsh	**Black-crowned Night-Heron**	1		3	**4**
	Blue-winged Teal	5	1		**6**
	Marsh Wren	9	8	7	**24**
	Sora	16	3		**19**
	Swamp Sparrow	3	1	2	**6**
	Virginia Rail	5	4		**9**
	Total	**39**	**17**	**12**	**68**
Marian Byrnes Prairie	**American Bittern**	1			**1**
	Blue-winged Teal	6	2	3	**11**
	King Rail			2	**2**
	Marsh Wren	7	9	12	**28**
	Sora	7	8		**15**
	Virginia Rail	6	4	1	**11**
	Total	**27**	**23**	**18**	**68**
Orland Grassland	**American Bittern**	9	1		**10**
	Blue-winged Teal	1	2	2	**5**
	King Rail	1		2	**3**
	Least Bittern			2	**2**
	Marsh Wren	1	11	2	**14**
	Pied-billed Grebe		2	2	**4**
	Sora	4			**4**
	Swamp Sparrow	12	1	1	**14**
	Virginia Rail	5	3	4	**12**

	Total	**33**	**20**	**15**	**68**
Orland Grassland South	**American Bittern**	1		1	**2**
	Blue-winged Teal	3		2	**5**
	King Rail	1			**1**
	Least Bittern			2	**2**
	Marsh Wren	8	15	29	**52**
	Sora	1			**1**
	Swamp Sparrow	4	7	12	**23**
	Virginia Rail		2	3	**5**
	Total	**18**	**24**	**49**	**91**
Powderhorn Lake	**Common Gallinule**		1		**1**
	Least Bittern		1		**1**
	Marsh Wren	3	5	5	**13**
	Swamp Sparrow	3	3	4	**10**
	Total	**6**	**10**	**9**	**25**
Powderhorn North	**Marsh Wren**		1	1	**2**
	Total		**1**	**1**	**2**
Sand Ridge Nature Center	**Marsh Wren**		2		**2**
	Sora	2			**2**
	Swamp Sparrow		1	1	**2**
	Virginia Rail		1		**1**
	Total	**2**	**4**	**1**	**7**
Whitford Pond	**Marsh Wren**		2	2	**4**
	Sora	2			**2**
	Swamp Sparrow	5			**5**
	Virginia Rail	1			**1**
	Total	**8**	**2**	**2**	**12**
Wolf Lake Pools 5 & 9	**American Coot**	43			**43**
	Black-crowned Night-Heron			1	**1**
	Blue-winged Teal	1			**1**
	Marsh Wren	2	2	2	**6**
	Pied-billed Grebe	1			**1**
	Sora	3	1		**4**
	Virginia Rail		1		**1**
	Total	**50**	**4**	**3**	**57**
Total		**398**	**223**	**234**	**855**

Appendix II. Species-habitat associations.

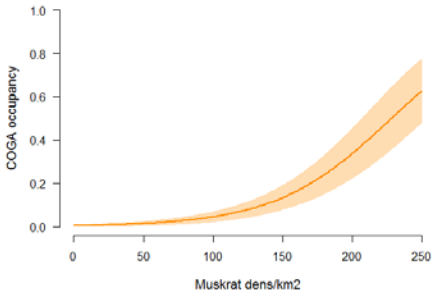
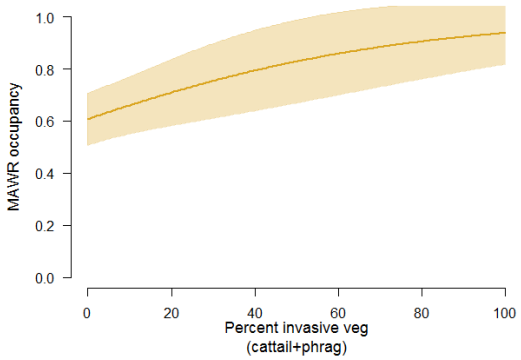


Fig. 1. Common Gallinule association with muskrat den density, Illinois 2020-21.



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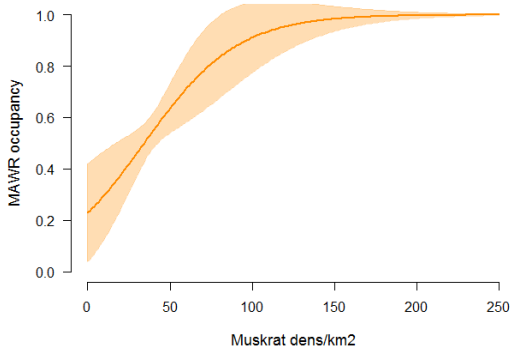
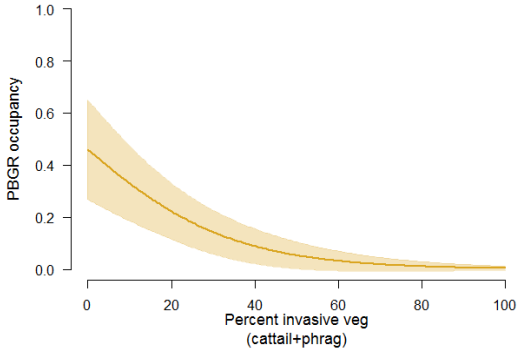


b.

Fig 2a-b. Marsh Wren (MAWR) habitat associations, Illinois 2020-21.



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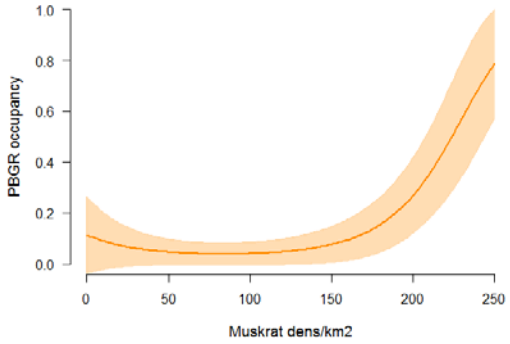
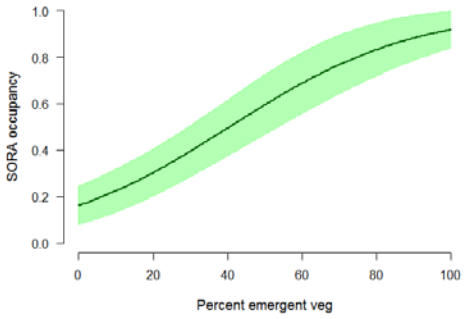
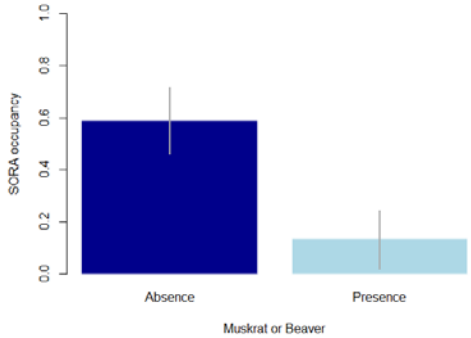


b.

Fig 3a-b. Pied-billed Grebe (PBGR) habitat associations, Illinois 2020-21.



a.



b.

Fig 4a-b. Sora habitat associations, Illinois 2020-21.

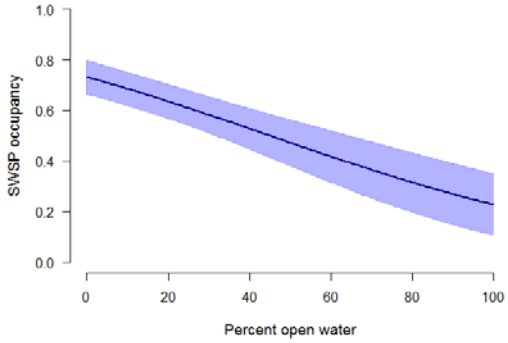


Fig 5. Swamp Sparrow association with % open water, Illinois 2020-21.

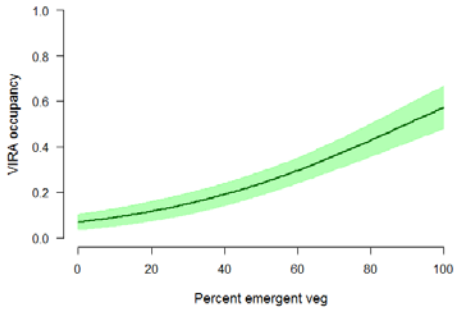


Fig 6. Virginia Rail association with % emergent vegetation, Illinois 2020-21.