Distribution and Nesting Habitat of Least Bitterns and Other Marsh Birds in Manitoba

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Abstract: Call-response surveys were conducted to better delineate and estimate the population of least bitterns (*Ixobrychus exilis*) in southern Manitoba, Canada. Other marsh bird species whose populations are believed to be declining due to wetland loss throughout, or in parts of, their range were also surveyed; these included the Virginia rail (*Rallus limicola*), yellow rail (*Coturnicops noveboracensis*), sora (*Porzana carolina*), pied-billed grebe (*Podilymbus podiceps*), and American bittern (*Botaurus lentiginosus*).

Surveys were conducted during the 2003 and 2004 breeding seasons at 141 sites within 46 different wetlands in the southern portion of the province. Habitat was assessed as percent vegetation cover within a 50-m radius around the calling sites, and forest resource inventory data were used in a Geographic Information System to determine the landscape composition within a 500-m radius around the sites and within a 5-km radius around the marshes surveyed. Logistic regression analyses were used to evaluate the relationship between the presence of the target species and the site and landscape characteristics.

The sora was the most abundant and widely distributed target species, and was encountered on 330 occasions and in 39 of the surveyed wetlands. Yellow rails were not detected during either year of the surveys. Use of the call-response survey protocol lead to a significant increase in the number of Virginia rails detected; however, significantly fewer American bitterns, pied-billed grebes, and soras were recorded after the conspecific calls were broadcast than during the passive listening period. Significantly more American bitterns and soras were detected during the first and second rounds of the call response surveys than during the third round. A significantly higher number of soras, pied-billed grebes, and American bitterns were detected in the evening than in the morning survey periods.

Least bitterns were encountered on 26 occasions at 15 sites within 4 wetlands, and were associated with tall shrub cover and *Typha* spp. The logistic regression models showed that the presence of American bitterns was negatively related to the amount of cultivated land and positively associated with the increasing amounts of wet meadow, marsh, and tall shrubs within the identified buffers. The pied-billed grebe was associated with increased amounts of *Typha* spp., wet meadow, and tall shrubs; and the Virginia rail was associated with increased amounts of wet meadow and marsh.

Key Words: least bittern, *Ixobrychus exilis*, Virginia rail, *Rallus limicola*, yellow rail, *Coturnicops noveboracensis*, sora, *Porzana carolina*, pied-billed grebe, *Podilymbus podiceps*, American bittern, *Botaurus lentiginosus,* call-response surveys, habitat, Manitoba

Introduction

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed the least bittern (*Ixobrychus exilis*) as Threatened in 2001. A recovery plan has yet to be drafted for the species, but COSEWIC status reports have cited the loss of wetland habitat as the primary threat facing the least bittern (Sandilands and Campbell 1988; James 1999). In Canada, the least bittern breeds primarily in Ontario, and to a lesser extent in southern Quebec and Manitoba and in New Brunswick (James 1999).

There is a paucity of information on the least bittern in Manitoba and in the rest of its range due to the species' secretive nature and to the lack of a standardized species-specific survey method for it (James 1999). Considerable debate exists in the literature regarding the efficacy of call-response surveys in detecting secretive marsh birds. Gibbs and Melvin (1993) and Bogner and Baldassarre (2002) showed that using call-response surveys resulted in increased detection of least bitterns, whereas Lor and Malecki (2002) showed the opposite.

This study tested a modified call-response survey protocol developed by Conway (2002) in order to better estimate and delineate the population of least bitterns in Manitoba. Additionally, other marsh birds whose populations are believed to be declining due to wetland loss throughout, or in parts, of their range were surveyed. These species included the Virginia rail (*Rallus limicola*), yellow rail (*Coturnicops noveboracensis*), sora (*Porzana carolina*), pied-billed grebe (*Podilymbus podiceps*), and American bittern (*Botaurus lentiginosus*). This study also examined the association between the presence of these species and various habitat characteristics at three spatial scales across the landscape.

Methods

Call-response Surveys

Marshes were selected for the 2003 survey based on the presence of historical records of least bittern occurrences (Koes and Taylor 2002). In 2004, the first marshes surveyed were those at which least bitterns were detected in 2003. Additional marshes were added to the survey in both years in order to include a variety of vegetation types and marsh sizes and to ensure that a broad geographic range was surveyed. In total, 141 sites within 46 different wetlands were surveyed during the two breeding seasons.

Calling sites were selected systematically within each marsh. The initial sampling site within a marsh was selected to facilitate the development of a survey route or transect within the vegetated portion of the marsh. The number of calling sites within a given marsh varied according to the size of the marsh, the accessibility of dense emergent vegetation, and the amount of vegetated habitat within the marsh. Calling sites were separated by at least 400 m to ensure that individuals were not double counted, and to maximize the area surveyed (Conway 2002).

Sites were surveyed between 22 May and 25 July 2003 and between 20 May and 28 June 2004. Each site was visited three times during each season to determine the presence or absence of target species at a site with 90% confidence (Gibbs and Melvin 1993). Site visits were separated by 10–14 days to ensure that sampling occurred throughout the duration of the nesting season and that all target species present had a reasonable chance of being censused during this period (Bogner and Baldassarre 2002). Call-response surveys were conducted from one half-hour before dawn until 1000 hours and from 1630 hours until one half-hour after dusk. Surveys were conducted only in the absence of rain or heavy fog, and when wind speeds were less than 20 km/h to ensure that the observer could hear the birds (Conway 2002). Other environmental variables, including cloud cover, ambient temperature, lunar phase, and wind speed (using the Beaufort scale) were recorded.

A 5-min passive listening period was employed prior to conducting the call-response surveys. After the passive listening phase, calls were broadcast at 90 db one meter from the speaker, in the following order: least bittern, yellow rail, sora, Virginia rail, American bittern, and pied-billed grebe (Conway 2002). The primary advertising call and other calls associated with breeding were broadcast for each species for 1 min. Each broadcast period was followed by 30 s of silence during which the surveyor listened for and recorded responses to the conspecific calls. The observer stood 2 m away from the speaker and visually scanned the area while listening for target species. All target species heard calling or observed within the playback phase or silence between calls were recorded, as were nontarget species. Observers used their judgment to determine if the individuals they heard or saw had been previously detected.

Habitat Assessment

Habitat was assessed after all rounds of the call-response surveys were completed. The percent vegetation cover within a 50-m radius around the calling sites was visually estimated and recorded. Emergent vegetation was identified to the species level with the exception of *Typha* spp., while upland vegetation was identified to the genus level. Using ArcView 3.2, the land cover classes of the landscape surrounding the survey sites were derived from interpreted forest resource inventory data obtained from Manitoba Conservation. Habitat parameters were derived for a 500-m radius around each calling site and for a 5-km radius around the central calling site of each marsh.

Data Analysis

The efficacy of the call-response survey protocol was examined by comparing the number of each target species detected before and after the conspecific calls were broadcast. The number of individuals detected in the morning versus the evening was also compared for each species using Chi-square tests in JMP (SAS Institute Inc. 1996). Statistical significance was based on a P value of ≤ 0.05.

Stepwise logistic regression analyses were performed using landscape variables at the three spatial scales as a means of evaluating the relationship between the presence of target species and the site and landscape characteristics. Only habitat variables encountered at > 5% of the sites were used in the analyses. Sets of highly correlated variables ($P \leq 0.05$) were compared against each other, and the most significant variables were identified. Due to correlation among variables at the 50-m scale, only one 50-m scale variable (*Typha* spp.) was used in the regression model for the 500-m scale variables. The 5-km variables were analyzed in a separate logistic regression model. Variable residuals were examined for linearity of the logit and adjusted, if necessary (Hosmer and Lemeshow 1989). Models were tested with Akaike information criteria, and SAS (SAS Institute Inc. 2003) was used for the analyses.

Results

Call-response Surveys

The most abundant and widely distributed marsh bird species detected was the sora, which was recorded on 330 occasions and in 39 of the surveyed wetlands (Fig. 1). Least bitterns were detected on 26 occasions at 15 sites within 4 of the 46 surveyed wetlands (Fig. 1). Yellow rails were not encountered during the survey.

The use of conspecific calls significantly increased the detection rate of Virginia rails; however, significantly fewer American bitterns, pied-billed grebes, and soras were recorded after the conspecific calls were broadcast than during the passive listening phase (Fig. 2, Table 1). In total, the least bittern was detected only 21 times during the official survey listening period; there was no statistical difference in the numbers recorded before and after the conspecific calls were broadcast.

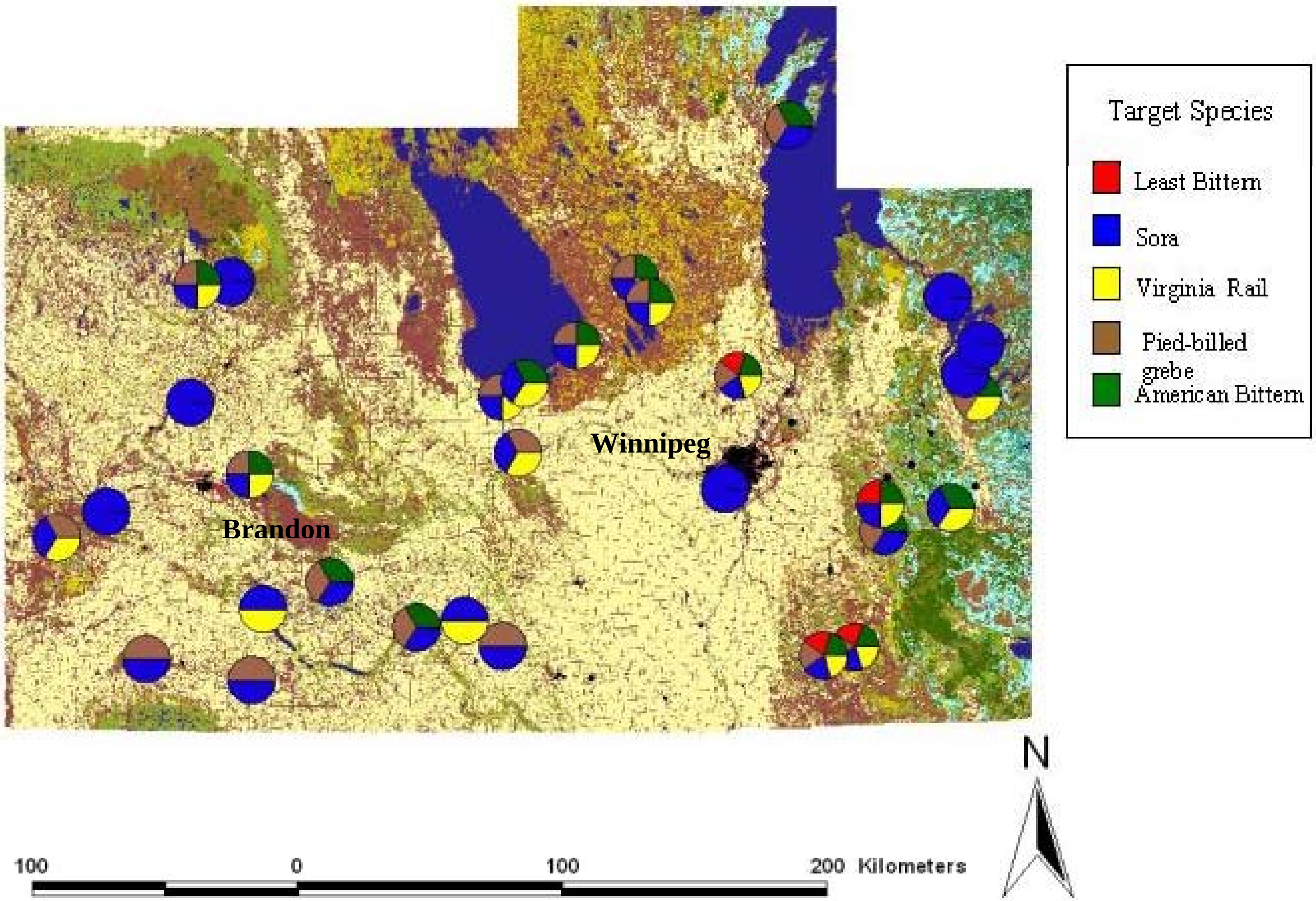

Figure 1. Distribution of target species within the 5-km buffers surrounding non-overlapping study sites.

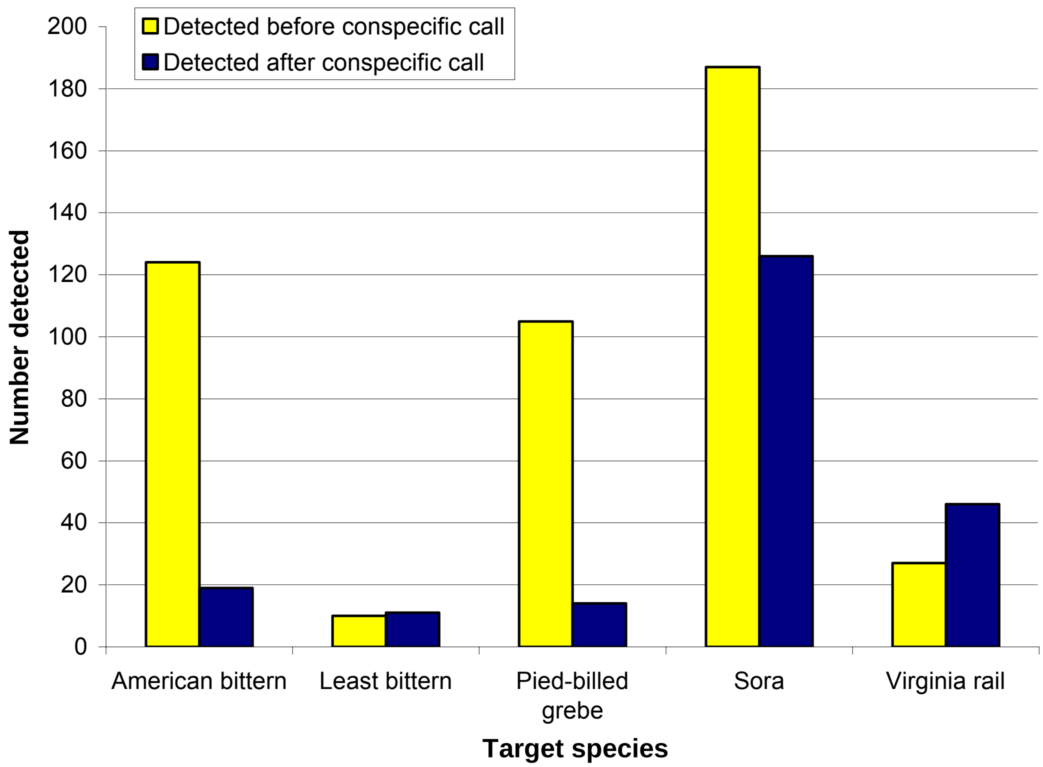

Figure 2. Number of individuals of each target species detected before and after conspecific calls were broadcast.

Significantly more American bitterns and soras were detected during the first and second rounds of the call response surveys than during the third round (Fig. 3, Table 1). Although detection rates for the pied-billed grebe were not statistically significant different between survey rounds based on the criterion used in this study, they may be biologically significant. A significantly higher number of American bitterns, pied-billed grebes, and soras were detected in the evening than in the morning survey periods (Fig. 4, Table 1).

Table 1. Results of Chi-square tests that compared number of detections before and after call broadcast, round of call-response survey in which target species were detected, and survey period (AM/PM) in which target species were detected.

	Number of detections before and after call broadcast (P)	*Round of call-response survey in which target species were detected (P)*	*Survey period in which target species were detected* (AM/PM) *(P)*
American bittern	< 0.001	< 0.001	< 0.001
Least bittern	0.83	0.87	0.12
Pied-billed grebe	< 0.001	0.06	0.002
Sora	< 0.001	< 0.001	0.008
Virginia rail	0.03	0.77	0.29

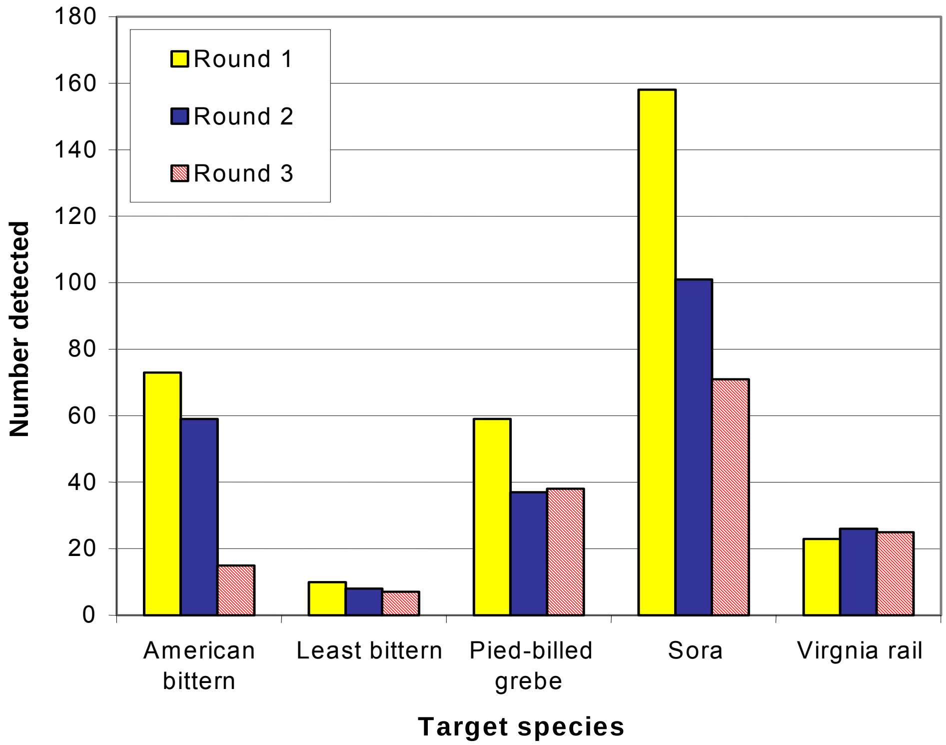

Figure 3. Number of individuals of each target species detected during each survey round.

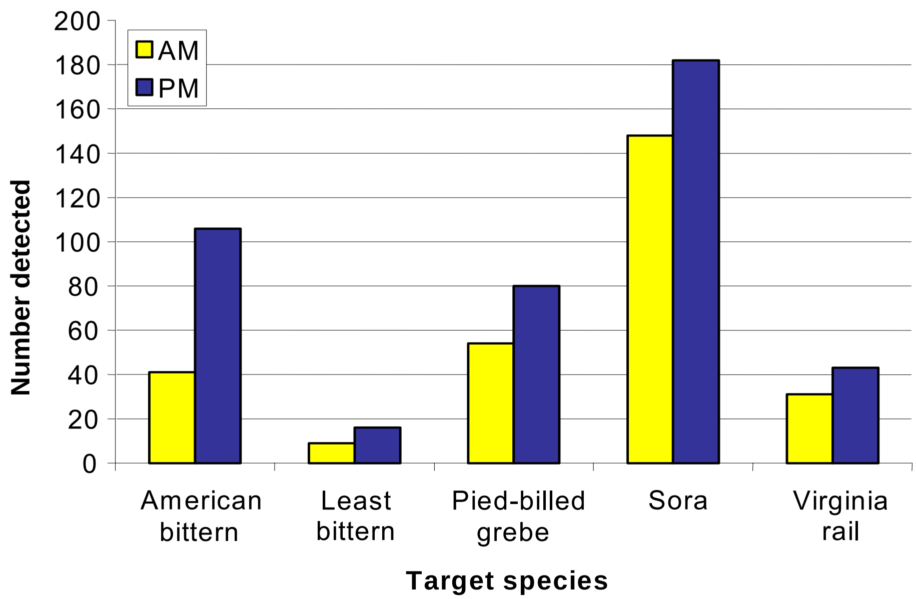

Figure 4. Number of individuals of each target species detected during each survey period (AM vs. PM).

Habitat Assessment

Tables 2–4 show the habitat composition of the area within a 50-m, 500-m, and 5-km radius around the calling sites, respectively. Results of the logistic regression analyses showed that at the 50/500-m scale, the American bittern selected sites that had lower amounts of cultivated land cover and higher amounts of wet meadow than sites that were not selected (Table 5). At the 5-km scale, the species selected for marsh habitat and tall shrubs.

The least bittern was positively associated with *Typha* spp. and tall shrub at 50/500-m scale. No variables were significant at the 5-km scale.

Typha spp. and tall shrubs were positively associated with the presence of the pied-billed grebe at the 50/500-m scale. At the 5-km scale, the species selected for areas of wet meadow.

At the 50/500-m scale, the Virginia rail selected areas that had higher percentages of wet meadow than areas that were not used. At the 5-km scale, the species was positively associated with marsh habitats.

None of the measured habitat variables were found to significantly contribute to the logistic regression model for the sora.

Table 2. Mean percentage (SD) of habitat components within a 50-m radius around the calling site.

	American bittern		*Least bittern*		*Pied-billed grebe*		*Sora*		*Virginia rail*	
Absence (0)/Presence (1)	0	1	0	1	0	1	0	1	0	1
No. of 50-m radius buffers	72	66	126	15	81	57	44	94	101	37
Tall shrubs (%)	3.2 (1.0)	6.3 (1.1)	4.0 (0.8)	12.7(2.3)	4.4 (1.0)	5.1 (1.2)	3.6 (1.3)	5.2 (0.9)	3.9 (0.9)	6.8 (1.4)
Typha spp. (%)	34.7 (2.4)	35.3 (2.5)	34.0 (1.8)	48.0 (5.1)	32.0 (2.2)	39.3 (2.6)	30.8 (3.0)	37.0 (2.0)	34.0 (2.0)	37.8 (3.3)
Open water (%)	39.7 (2.4)	28.3 (2.5)	33.9 (1.9)	31.7 (5.4)	31.5 (2.3)	38.2 (2.7)	34.9 (3.1)	33.9 (2.2)	34.8 (2.1)	32.7 (3.4)

Table 3. Mean percentage (SD) of habitat components within a 500-m radius around calling sites.

	American bittern		*Least bittern*		*Pied-billed grebe*		*Sora*		*Virginia rail*	
Absence (0)/Presence (1)	0	1	0	1	0	1	0	1	0	1
No. of 500-m radius buffers	72	66	126	15	81	57	44	94	101	37
Linear features	5.0 (3.8)	4.6 (3.0)	4.9 (3.4)	4.2 (2.8)	5.0 (3.3)	4.6 (3.6)	4.2 (3.3)	5.1 (3.5)	4.7 (3.6)	5.3 (3.0)
Cultivated land	13.8 (19.4)	7.2 (14.3)	10.6 (17.9)	8.6 (11.4)	9.4 (18.1)	12.4 (16.4)	6.7 (13.2)	12.5 (18.9)	10.0 (17.4)	12.4 (17.6)
Moist prairie	8.8 (11.9)	5.2 (11.6)	7.5 (12.1)	2.7 (6.8)	6.2 (11.3)	8.4 (12.6)	6.0 (10.3)	7.6 (12.5)	7.4 (11.8)	6.4 (11.9)
Water	10.3 (16.2)	14.3 (16.3)	13.3 (16.6)	0.2 (0.5)	15.7 (17.2)	7.2 (13.5)	16.4 (17.3)	10.3 (15.5)	13.7 (16.8)	8.2 (14.2)
Wet meadow	5.3 (10.6)	13.4 (19.2)	9.2 (16.0)	10.6 (14.9)	10.3 (17.0)	7.6 (13.8)	5.9 (12.1)	10.7 (17.1)	7.4 (13.3)	14.1 (20.8)
Tall shrubs	8.5 (21.4)	10.3 (19.4)	7.1 (17.2)	28.1 (32.1)	4.5 (9.3)	16.2 (28.4)	4.7 (10.4)	11.5 (23.4)	8.1 (18.3)	12.7 (25.1)
Marsh	29.4 (30.1)	28.6 (29.3)	29.7 (27.3)	17.5 (33.2)	27.0 (25.3)	31.8 (31.7)	36.1 (27.2)	25.7 (28.1)	29.6 (27.7)	27.4 (29.4)

Table 4. Mean percentage (SD) of habitat components within a 5-km radius around calling sites.

	American bittern		*Least bittern*		*Pied-billed grebe*		*Sora*		*Virginia rail*	
Absence (0)/Presence (1)	0	1	0	1	0	1	0	1	0	1
No. of 5-km radius buffers	17	17	30	5	15	19	4	30	17	17
Cultivated land	39.4 (26.9)	26.8 (25.9)	33.5 (28.1)	25.3 (17.0)	29.7 (26.9)	35.7 (27.1)	19.8 (20.5)	34.9 (27.3)	36.7 (29.2)	29.5 (24.5)
Linear features	3.1 (1.8)	2.4 (1.3)	2.8 (1.7)	2.3 (0.8)	2.7 (1.4)	2.8 (1.7)	2.9 (1.7)	2.7 (1.6)	2.8 (1.2)	2.7 (1.9)
Water	8.5 (13.0)	16.3 (23.7)	14.0 (19.0)	0 (0)	8.2 (16.9)	15.7 (20.7)	3.1 (5.2)	13.6 (20.1)	8.3 (14.4)	16.7 (22.7)
Wet meadow	5.8 (5.8)	9.0 (7.3)	6.8 (6.5)	12.3 (6.6)	4.3 (3.5)	9.8 (7.6)	1.4 (1.2)	8.2 (6.7)	4.9 (4.7)	9.8 (7.6)
Marsh	2.9 (5.1)	9.2 (8.2)	5.6 (7.3)	7.5 (8.7)	3.1 (5.9)	8.4 (7.8)	0.4 (0.7)	6.8 (7.6)	3.2 (5.1)	8.9 (8.4)
Tall shrubs	3.7 (5.7)	8.7 (11.0)	4.9 (6.6)	14.6 (16.0)	6.4 (8.0)	6.1 (10.0)	9.3 (9.6)	5.8 (9.0)	5.3 (6.4)	7.2 (11.1)

Table 5. Stepwise logistic regression models for evaluating site selection by target species at all spatial scales.

Models	*-2LL*	$\chi 2$	*AIC*	*Marsh* ß (*P*)	*Cultivated land* ß (*P*)	*Wet meadow* ß (*P*)	*Tall shrubs* ß (*P*)	*Typha spp.* ß (*P*)
American bittern (50/500 m)	176.671	3.9619	182.67		-0.0228 (0.05)	0.0391 (0.008)		
American bittern (5 km)	31.445	0.3913	37.445	0.2366 (0.008)			0.1842 (0.03)	
Least bittern (50/500 m)	79.519	1.9114	85.519				0.0322 (0.001)	0.0354 (0.01)
Pied-billed grebe (50/500 m)	170.475	4.5735	176.475				0.0360 (< 0.001)	0.0199 (0.03)
Pied-billed grebe (5 km)	39.809	4.1092	43.809			0.1698 (0.03)		
Virginia rail (50/500 m)	156.049	4.5355	160.049			0.0241 (0.04)		
Virginia rail (5 km)	41.572	4.3780	45.572	0.1281 (0.04)				

Discussion

The use of conspecific calls in the call-response surveys significantly increased only the number of Virginia rails detected. Significantly fewer American bitterns, pied-billed grebes, and soras were recorded after the conspecific calls were broadcast than during the passive listening period. Additional analysis will be conducted to better determine the efficacy of the conspecific call-response protocol in detecting these species. Consideration should be given to the fact that although detection rates for the pied-billed grebe were not statistically significant different between survey rounds based on the criterion used in this study, they may be biologically significant. The yellow rail was not detected during any of the surveys trials; therefore, night surveys may be more effective for detecting this nocturnal species (Prescott et al. 2002).

Least bitterns were detected at only 15 of the 141 sites and 4 of the 46 marshes surveyed, confirming the rarity of the species in the province. Additionally, least bitterns were not detected at a number of the sites where they had historically been recorded (Koes and Taylor 2002), suggesting that the sites used by the species vary between years or are no longer being used. The results of the habitat analysis for the least bittern agreed with those reported in the literature. Gibbs et al. (1992) reported that the least bittern utilizes shrubby sites that are densely covered with emergent vegetation including *Typha* spp. The variable ‘tall shrubs’ was initially retained in the 5-km scale model for the least bittern but was then removed. This suggests that while this variable may not have been statistically significant in this study, it may be of biological significance to the least bittern at this landscape scale.

A key variable in explaining the presence of three of the target species at the 5-km landscape scale was the presence of wetlands, which corresponds to the variables ‘marsh’ and ‘wet meadow’. These variables were positively associated with the presence of American bitterns, pied-billed grebes, and Virginia rails at the 5-km scale. These species may first select areas within the landscape that have a high percentage of wetlands, and then select sites at the 50/500-m scale that have the variables with which they are positively associated.

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