J. Field Ornithol., 59(1):67-75

INDICES TO DISTRIBUTION AND ABUNDANCE OF SOME INCONSPICUOUS WATERBIRDS ON HORICON MARSH

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Abstract.—Indices to distribution and abundance of rails, bitterns, and wrens on Horicon National Wildlife Refuge in Wisconsin were obtained from call counts supplemented by the use of playback recordings. Weekly counts were adequate to obtain indices for rails and wrens. Biweekly counts are recommended for bitterns. Initial and peak numbers of calls of Virginia Rails (*Rallus limicola*), Soras (*Porzana carolina*), and Marsh Wrens (*Cistothorus palustris*) were heard 1-2 wks later in 1982 than 1981, possibly because of colder temperatures in April 1982. Playback recordings elicited more responses from Virginia and King (*Rallus elegans*) rails silent during the 2 min before playback than from Soras, wrens, or bitterns. With the exception of Soras, birds were not evenly distributed among the five habitats sampled: deepwater cattail (*Typha* spp.), shallow water cattail, dry cattail, river bulrush (*Scirpus fluviatilis*), and sedge (*Carex* spp.). Call counts, aided by playback recordings, are recommended to obtain indices to vocal inconspicuous waterbirds in emergent marsh vegetation.

INDICES DE DISTRIBUCIÓN Y ABUNDANCIA DE AVES INCONSPICUAS DE ÁREA ANEGADIZA HORICON

Resumen.—Indices de distribución y abundancia de rálidos, alcaravanes y reyezuelos en el Refugio Nacionál Horicon de Vida Silvestre de Wisconsin fueron obtenidos a base de contaje de cantos suplementados con el uso de grabaciones. Contajes semanales son adecuados para obtener los índices de rálidos y reyezuelos. Contajes cada dos semanas se recomienda para alcaravanes. Números iniciales y los más altos (picos) de cantos de *Rallus limicola, Porzana carolina,* y *Cistothorus palustris* se escucharon de 1 a 2 semanas más tarde en el 1982 que en el 1981, posiblemente por las temperaturas bajas registradas en abril de 1982. Las reproducciones magnetofónicas provocaron más respuestas de *R. limicola* y *R. elegans* que de *P. carolina* y reyezuelos cuando todas las especies estaban en completo silencio 2 minutos antes de comenzar a utilizar las grabaciones. Con la excepción de las *P. carolina,* las especies no estaban uniformemente distribuidas en los 5 hábitats muestrados. A saber: eneas en aguas profundas (*Typha* spp.), eneas en aguas llanas, eneas en aguas secas, juncos de río (*Scirpus fluviatilis*) y juncia (*Carex* spp.). Se recomienda el uso de contajes de cantos, ayudados por el uso de grabaciones de cantos, para obtener indices de aves acuáticas que cantan, pero que son inconspicuas en vegetación emergente en terrenos anegadizos.

Rails, bitterns, and wrens are difficult to see in the emergent vegetation of wetlands and indices to densities of these birds are rarely obtained, even on areas intensively managed for wildlife. During the last two decades, tape-recorded bird calls have been used to elicit calls from many

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secretive avian species and obtain indices to their distribution and abundance (Johnson et al. 1981). In this study, we used call counts aided by playback recordings to estimate densities of Soras (*Porzana cardina*), Virginia Rails (*Rallus limicola*), King Rails (*R. elegans*), Marsh Wrens (*Cistothorus palustris*), Sedge Wrens (*C. platensis*), American Bitterns (*Botaurus lentiginosus*), and Least Bitterns (*Ixobrychus exilis*) and to obtain population indices of these waterbirds on Horicon National Wildlife Refuge (NWR) during April through June 1981–1982. Densities of the seven species were determined in five distinct habitats: deepwater cattail, shallow water cattail, dry cattail, river bulrush, and sedge.

STUDY AREA AND METHODS

Horicon NWR encompasses the northern 8390 ha of the 12,814-ha Horicon Marsh in Dodge and Fond du Lac counties, Wisconsin. Approximately one-third of the NWR was open water with no emergent vegetation and one-half was vegetated with cattail during 1981–1982.

During spring 1981, we established 25 semicircular, 1-ha plots (radius of approximately 80 m) in various marsh habitats along 19 km of refuge roads and 25 rectangular, 1-ha plots (200 m × 50 m) along 19 km of semipermanent airboat transect lines through the main pool (5680 ha) of the refuge. Emergent vegetation was present on 25 and 28 plots in 1981 and 1982, respectively.

Manci (1985) described the habitat on these plots from annual samples of vegetation, water depth, and aquatic invertebrates in late May and early June and calculated area of each habitat within plots and for the total refuge from digitized infrared aerial photographs taken in early June each year.

Cattail comprised 94% of the emergent plant habitats on Horicon NWR. Approximately 58% of the cattail habitats were classified as dry. Dry cattail contained no standing water by the end of June. Shallow water cattail comprised 26% of cattail habitat and contained standing water through mid-August. Mean water depth was approximately 5 cm in early June. Deepwater cattail was the least abundant cattail type, comprising approximately 16% of the cattail habitats. Mean water depth was 29 cm in early June. River bulrush and sedge occupied appproximately 4% and 2%, respectively, of the emergent plant habitats. River bulrush habitat contained standing water through mid-August; sedge habitat was dry by the end of June.

Heights of leafy shoots, percent cover and frequency of aquatic bed plants, and density of macroinvertebrates generally increased as water depth increased in cattail habitat; percent cover and frequency of cattail decreased with increasing water depth. Cattail, river bulrush, and sedge reached comparable heights 1–2 wks later in 1982 than in 1981, possibly because of the well below normal temperature of early April 1982 and above normal temperatures of April 1981 (National Oceanic and Atmospheric Administration 1981a,b, 1982). Dipterans (primarily Chironomidae larvae) and amphipods (primarily *Hyallela azteca*) dominated macroinvertebrate samples from deepwater and shallow water cattail and river bulrush, but neither was collected in sedge. Dry cattail contained few aquatic bed plants or macroinvertebrates.

We made a cassette recording of calls of the seven target species from the Peterson's Field Guide to Bird Songs of Eastern and Central North America (Cornell University record). We used descending, advertising calls to elicit responses from both sexes of rails (Kaufmann 1983, Meanly 1969) and male calls to elicit responses from bitterns and wrens (Bent 1926). Following 2 min of blank tape, three sequences of calls from each of the seven species were recorded consecutively on a cassette tape with a 5- to 10-s pause separating calls of different species. Two min of blank tape and an "end" signal followed.

While conducting call counts on plots with emergent plants, we also tallied numbers of other waterbirds visually observed on vegetated and open water plots (Manci 1985). We played the tape weekly during 0700–1100 h, 1 Apr.–30 Jun., at plots along roads and during 1100–1400 h, 20 May–30 Jun., at plots along airboat transect lines. We chose those times of day because the low, early sun made visual identification of certain waterbirds more difficult in the flat marsh terrain. Also, the variance of counts tends to be lower when the rapid change in bird conspicuousness near dawn is avoided (Shields 1977). Robbins (1981) suggested that both high wind and rain depress counts, so days of strong wind (>20 km/h), rain, or fog were also avoided.

At each plot, we stopped the truck or airboat at the center of the plot's baseline along the road or airboat transect line (marked with a wooden stake) and set the cassette recorder to play. We recorded the number of birds that initially called during each of three intervals: the 2 min of blank tape before the taped calls (before playback), the 3 min of taped calls (during playback), and the 2 min of blank tape following the taped calls (after playback). We also noted the habitat of each calling bird and estimated the distance of the bird (except wrens) from the wooden stake (or to the airboat plot baseline). During May–August 1980, Manci, who conducted all counts, used playback recordings and estimated distances to birds as training for the 1981 field season. Corners of plots were staked to aid in estimating distance. A range finder was used to periodically check distances to stationary objects near calling birds. After rewinding the tape-recording for the next plot, we made notes on vegetaton, individuals seen, or unusual occurrences during the count.

Our methods ensured that no bird in the same location was counted more than once in the three sequential intervals. Two birds close to one another (such as a pair of Soras) possibly would be counted as one bird if one called during playback only and one after playback only. However, density estimates were not inflated by repetitive calling of the same individual during individual or sequential intervals. Pairs of Soras and Virginia Rails often called together during the same period but were easily distinguished and tallied as two individuals.

We calculated a population density estimate (total individuals heard per ha of habitat) for each species during the first 4 or 2 wks (always consecutive) of highest numbers heard on road plots. Two peak weeks were used if the total counts of the first and fourth weeks were less than 40% of the total counts of the second and third weeks. Plots along airboat routes were included in the analysis if peak activity occurred when airboat routes were run (i.e., the third wk of May through June). We used analysis of variance (ANOVA) to determine if densities of Soras, Virginia Rails, and Marsh Wrens varied between years, among habitats, or among peak weeks of counts. If density varied by habitat, the least significant difference (LSD) test was used to determine differences among habitats. A *t*-test was used to test for differences between years for the same habitat and differences between airboat plots and road plots for the same habitat. We also used the distance estimates of Soras and Virginia Rails to compute point transect estimates using a Fourier series (program TRANSECT; Laake et al. 1979), which corrects for decreasing detectability with distance from the observer. Distances to birds on three plots each year were not included in these estimates because the habitat was not continuous. (A ditch parallel to the road separated the observer from the emergents.)

RESULTS

No rails, bitterns, or wrens were heard on plots prior to mid-April. In 1981, peak numbers of Soras were heard the first week of May, while peak numbers of Marsh Wrens and Virginia Rails were heard the third week of May. In 1982, we heard initial and peak calling of Soras, Virginia Rails, and Marsh Wrens 1–2 wk later than in 1981. Sedge Wrens initially called in mid-May of both years and numbers peaked by the first week in June. We first heard bitterns calling in early May; peak numbers were heard within 1 wk. The peak response of 17 King Rails heard on plots was early to mid-June.

Playback recordings elicited more response from Virginia Rails, King Rails, and possibly Least Bitterns that were silent during the 2 min before playback than from Soras, wrens, and American Bitterns (Table 1). Fewer than 7% of all birds were initially detected in the 2-min interval after playback. The total number of birds heard on the plots probably would not increase appreciably by lengthening the interval after playback.

Soras were the only species heard calling in all five habitats (Table 2). Density of Soras, 1.3 birds/ha, did not vary between years (ANOVA, $n = 68$, df = 1, $P = 0.113$), among the five habitats (df = 4, $P = 0.943$), or among the four weekly replicate counts (df = 3, $P = 0.343$).

We heard Virginia Rails calling only in deepwater cattail, shallow water cattail, and river bulrush (Table 2). Density, 1.4 birds/ha, did not vary between years (ANOVA, $n = 56$, df = 1, $P = 0.117$), among the three habitats (df = 2, $P = 0.528$), or between the 2 weeks of peak counts (df = 1, $P = 0.834$).

Density estimates from program TRANSECT for Soras ($\bar{x} = 1.2$/ha, SE = 0.2, $n = 52$) and Virginia Rails ($\bar{x} = 1.7$/ha, SE = 0.3, $n = 28$) were similar (*t*-tests, df = 1, $P > 0.05$) to our other estimates for each species (Table 2). Goodness of fit tests for each species were acceptable

TABLE 1. Number of individuals initially detected before, during, or after playback recordings of calls of seven waterbirds on Horicon NWR. The data are combined totals of the four consecutive weekly counts of greatest numbers heard for each species during 1981–1982.

	Number of individuals initially detected		
Species	Before playback (2 min)	During playback (3 min)	After playback (2 min)
Sora	61	43	10
Virginia Rail	4	61	10
King Rail	1	9	2
Marsh Wren, male	353	206	29
Sedge Wren, male	8	6	0
American Bittern, male	4	3	2
Least Bittern, male	3	4	0

(df = 3, $P > 0.05$) indicating the distance data fit the Fourier series model used to estimate densities from program TRANSECT.

We heard Marsh Wrens calling in all three cattail habitats and river bulrush, but not sedge (Table 2). Marsh Wren density varied by habitat (ANOVA, $n = 148$, df = 3, $P < 0.001$), but not between years (df = 1, $P = 0.267$) or among the four weekly replicate counts (df = 3, $P = 0.094$). Marsh Wren densities were highest in shallow water cattail (5.5 birds/ha) and deepwater cattail (5.1 birds/ha), and lowest in dry cattail (1.6 birds/ha).

Yearly differences in density by habitat were only detected for Marsh Wrens in shallow water cattail (6.2 birds/ha in 1981, 4.9 birds/ha in 1982; t-test, df = 1, $P < 0.05$). Density estimates obtained along roads were similar to estimates obtained along airboat routes for individual species in given habitats (t-tests, df = 1, $P > 0.05$).

We observed few King Rails, bitterns, and Sedge Wrens (Table 2), which precluded statistical tests for differences in years, habitats, or weeks. Sedge Wrens were only heard calling in sedge. King Rails and Least Bitterns were only heard calling in deepwater and shallow water cattail, and American Bitterns were heard only in shallow water and dry cattail.

Of the seven waterbirds, Marsh Wrens were the most abundant species on the refuge both years and Soras were the most abundant rail (Table 3). The population index was similar (t-tests, df = 1, $P > 0.05$) between years for all seven species.

DISCUSSION

Playback recordings rarely have been used to obtain indices of waterbird densities with the exception of rails (Glahn 1974, Griese et al. 1980, Johnson and Dinsmore 1986, Marion et al. 1981, Tyser 1982). In our study, the similarity in density estimates obtained from total counts on plots and the point transect estimate suggests that the cassette recorder,

TABLE 2. Density (calling individuals/ha) of seven waterbirds in five habitats at Horicon NWR, combined data from 1981 and 1982.

Species	Sampling period	Habitat[a]	Plots[b] (n)	Relative frequency[c] (%)	Density $\bar{x}$	Density SE
Sora	Late April–late May	DWC, SWC, DRC, RVB, SED	68	69	1.3	0.1
Virginia Rail	Mid-May–mid-June[d]	DWC, SWC, RVB	56	82	1.4	0.1
King Rail	Mid-May–mid-June	DWC, SWC	96	15	0.2	0.1
Marsh Wren, male	Mid-May–mid-June	DWC	64	98	5.1 A[e]	0.2
		SWC	32	100	5.5 A	0.3
		DRC	36	72	1.6 C	0.2
		RVB	16	88	3.0 B	0.4
Sedge Wren, male	Mid-May–mid-June	SED	8	100	1.8	0.2
American Bittern, male	Early–mid-May	SWC, DRC	14	36	0.4	0.1
Least Bittern, male	Early–mid-May	DWC, SWC	18	28	0.4	0.2

[a] DWC = deepwater cattail, SWC = shallow water cattail, DRC = dry cattail, RVB = river bulrush, SED = sedge.

[b] No. of plots that contained species' habitat during the sampling period of peak counts (either 4 or 2 wks depending on species [see text]; plots along airboat transect lines are included in analysis if peak counts were obtained after 20 May).

[c] Percentage of plots in which species was detected.

[d] Mid- to late May 1981, early to mid-June 1982.

[e] Different letters denote density differed by habitat (LSD, $P < 0.01$).

TABLE 3. Estimated populations of seven waterbirds at Horicon NWR, 1981–1982.

Species	Population index[a] 1981 $\bar{x}$	1981 SE	1982 $\bar{x}$	1982 SE
Sora	4088	743	5097	728
Virginia Rail	1873	511	2422	303
King Rail	157	98	278	113
Marsh Wren, male	13,397	1337	10,072	1154
Sedge Wren, male	120	24	164	33
American Bittern, male	1134	567	1177	567
Least Bittern, male	628	314	556	278

[a] Area (ha) of species' habitat on refuge × density.

without any extra amplification equipment, elicited responses from rails without decreased detectability within 80 m (the radius of the road plots) of the observer.

Although most researchers count birds near sunrise or sunset, we used playbacks later in the day because we incorporated call counts into counts of other waterbirds (Manci 1985) and believed it was more important to cover a larger area of wetland than to sample only a small area near dawn or dusk. Sampling by visual observation early to mid-morning to cover a large area in one day may increase variance because birds may be more conspicuous near dawn. In addition, sampling near dawn more than once or twice a week would be difficult because early morning fog is common on Horicon Marsh during the summer and glare of the early morning sun on clear days hampers visual identification of waterbirds. Playback recordings may aid in eliciting responses from some species of waterbirds such as rails that normally would be less vocal during mid-day. Although comparison of density estimates between studies is subject to many variables, Glahn (1974) reported similar densities of Soras (1.6 calls/ha) and Virginia Rails (1.5–3.0 calls/ha) by using playback recordings during the first 3 h after sunrise and the last 3 h before sunset in cattail marshes near Fort Collins, Colorado. Glahn (1974) also reported that the earliest date of calling responses of Soras and Virginia Rails coincided with emergence of the first shoots of cattail above water. Our observation of a 1- to 2-wk delay in initial and peak calling activity of Soras, Virginia Rails, and Marsh Wrens in 1982 compared to 1981 may be related to the corresponding 1- to 2-wk delay in growth of emergents in 1982, which may have been caused by excessive cold temperatures of early April 1982 (Manci 1985).

Weekly counts appeared adequate to estimate densities of Soras, Virginia Rails, and wrens. We recommend at least semiweekly counts on Horicon Marsh for bitterns around peak dates because their calling activity rapidly peaked and declined and so few were observed. Because our objectives did not include indices to population densities of birds in upland grass communities, we had only one plot in a grassland habitat, which was flooded in April 1982. No Sedge Wrens or American Bitterns were heard or seen on that plot during the study, but some were heard calling in several other grassland areas on Horicon NWR. More grassland plots may have provided a density estimate for Sedge Wrens and/or American Bitterns. American Bitterns are known to nest in grasslands and feed on mice, snakes, and grasshoppers (Bent 1926); future surveys for this species and Sedge Wrens should sample grassland habitats. The relative scarcity of King Rails on Horicion Marsh was expected, because the species is at its northern limit in Wisconsin (Meanly 1969).

The distribution of waterbirds in wetland habitats of Horicon Marsh has important implications for design of population surveys. In both years of our study, Virginia Rails were not detected in dry cattail and Marsh Wren densities were lower in that habitat than in wet cattail habitats. Lumping counts from all cattail habitats would have produced larger variances and would have disguised the importance of the wet cattail habitats for these two species. The differential use of dry cattail by Virginia Rails and Soras may be related to their foraging ecology. Virginia Rails feed primarily on aquatic invertebrates while Soras feed primarily on seeds; Soras in Iowa marshes fed primarily on smartweed seeds during the summer (Horak 1970). Dry cattail contained few aquatic invertebrates but many seed-producing plants such as smartweeds (*Polygonum* spp.) (Manci 1985).

Playback recordings can be a helpful and inexpensive means of supplementing samples for indices to densities of inconspicuous, but vocal, waterbirds. Proper identification of waterbird calls is reinforced at each stop when the cassette tape is played. Rarer waterbirds, such as the King Rail at Horicon Marsh, might not be detected without call counts and playback recordings.

ACKNOWLEDGMENTS

This research was funded by the U.S. Fish and Wildlife Service, contract 14-16-008-80-075. We thank Horicon NWR managers J. E. Toll and J. R. Lennartson and staff: D. D. Haugen, D. F. Thompson, D. L. Gutierrez-Haugen, and H. L. Kurth. We are grateful for assistance from faculty, staff, and students of the Department of Wildlife Ecology, University of Wisconsin, Madison, especially R. E. Trost for statistical advice and S. A. Temple for helpful advice and review of an earlier draft of the manuscript.

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Received 4 Mar. 1987; accepted 5 Sep. 1987.