

## SPECIES OCCURRENCE OF MARSH BIRDS AT CAPE COD NATIONAL SEASHORE, MASSACHUSETTS

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**ABSTRACT** — We initiated an inventory and a field test of a protocol that could be used for monitoring marsh birds at the Cape Cod National Seashore in eastern Massachusetts during 1999 and 2000, as part of a more comprehensive national effort. Using cassette tapes during call broadcast surveys, we visited a total of 78 survey points at freshwater, brackish, and salt marsh sites three times on the ground or in canoes during the breeding season (May-June), fall migration (September to November), and twice during winter (December-January). Observer bias on our marsh bird surveys appeared negligible. Although both auditory and visual detection of most species was low (mean < 0.3 birds per replicate-survey point), we confirmed the presence of seven marsh species, including American Bittern (*Botaurus lentiginosus*), Least Bittern (*Ixobrychus exilis*), American Coot (*Fulica americana*), King Rail (*Rallus elegans*), Pied-billed Grebe (*Podilymbus podiceps*), Sora (*Porzana carolina*), and Virginia Rail (*Rallus limicola*). We suspected breeding of Least Bitterns and Soras at Great Pond in Provincetown, and for Virginia Rails at Hatches Harbor, Provincetown. The most frequently detected species were Soras, Pied-billed Grebes, and Virginia Rails. We recommend using call broadcast surveys for these cryptic species to enhance their probabilities of detection.

### INTRODUCTION

Marsh birds are often recognized as one of the least well-monitored avian groups because road access into large marsh lands is limited, marsh vegetation densities are often high, and marsh birds vocalize infrequently and rarely fly (Eddleman et al. 1988, Gibbs and Melvin 1993, Ribic et al. 1999). Interest in monitoring populations of marsh birds has increased because they had not been included in any completed bird conservation plans (Conway and Gibbs 2001, Ribic et al. 1999, U.S. Fish and Wildlife Service 1986, U.S. North American Bird Conservation Initiative 2000); however they are being added to the North American Waterbird Conservation Plan (see [<sup>1</sup> USGS Patuxent Wildlife Research Center, Department of Environmental Sciences, Clark Hall, University of Virginia, Charlottesville, VA 2290, \[rme5g@virginia.edu\]\(mailto:rme5g@virginia.edu\); <sup>2</sup> 104 Biological Sciences East, USGS Arizona Cooperative Fish and Wildlife Research Unit, Tucson, AZ 85721, \[cconway@ag.arizona.edu\]\(mailto:cconway@ag.arizona.edu\); <sup>3</sup> Cape Cod National Seashore, National Park Service, 99 Marconi Site Road, Wellfleet, MA 02667 \(current address: Great Smoky Mountains National Park, 1314 Cherokee Orchard Road, Gatlinburg, TN 37738\), \[steven\\\_hadden@nps.gov\]\(mailto:steven\_hadden@nps.gov\).](http://</a></p></div><div data-bbox=)

www.nawcp.org). Monitoring of population trends of marsh birds may prove useful to land managers, as they may serve as potential bioindicators of the quality of freshwater, brackish, and salt marsh wetlands that have declined dramatically during the 20<sup>th</sup> century (Tiner 1984). Although we know little about their population status, many marsh birds are legally hunted, including American Coots (*Fulica americana* Gmelin), Common Moorhens (*Gallinula chloropus* Bangs),

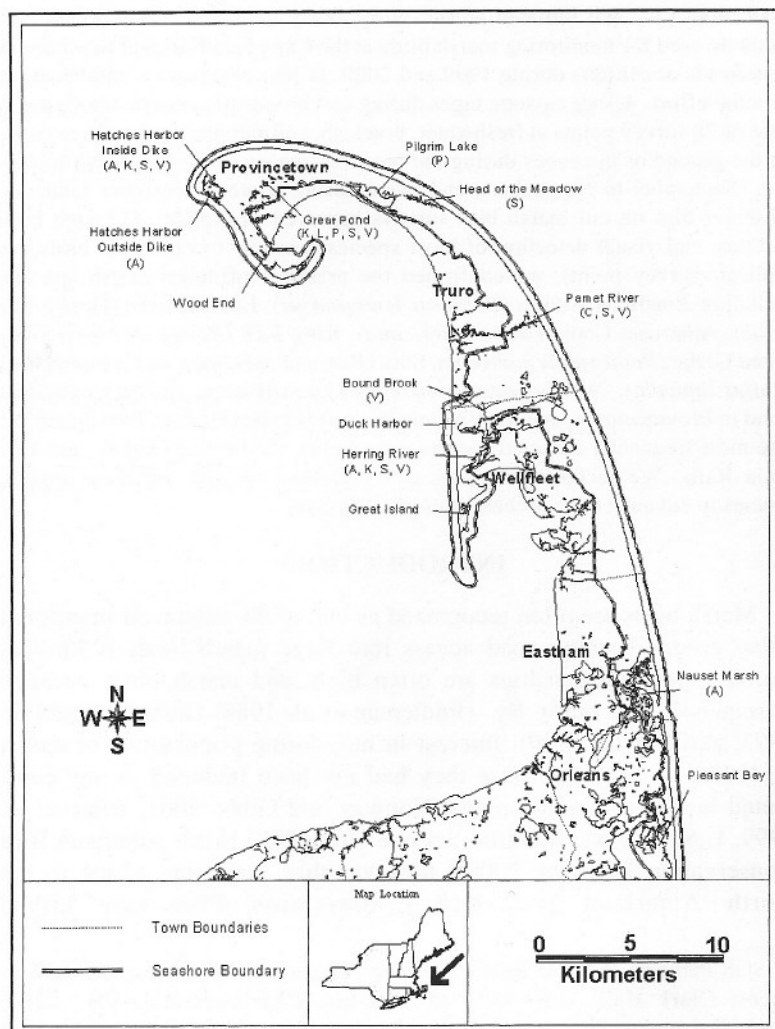


Figure 1. Locations of marsh bird surveys during 1999 – 2000 within Cape Cod National Seashore. Letters in parentheses indicate at least one individual of that species was detected on one or more surveys. Species codes as follows: A = American Bittern; C = American Coot; K = King Rail; L = Least Bittern; P = Pied-billed Grebe; S = Sora; V = Virginia Rail.

Clapper Rails (*Rallus longirostris* Gmelin), King Rails (*Rallus elegans* Audubon), Sora (*Porzana carolina* Linnaeus), and Virginia Rails (*Rallus limicola* Linnaeus). In contrast, bitterns, moorhens, Pied-billed Grebes (*Podilymbus podiceps* Linnaeus), and ironically the hunted rails, are often found on state or regional (see Therres 1999) lists of endangered, threatened, or "special concern" species, and are of management concern to the U.S. Fish and Wildlife Service (Trapp 1995). Hence, many authors have recommended that standardized methods be developed to more effectively monitor regional marsh bird populations (Conway and Eddleman 1994, Gibbs and Melvin 1993).

The National Park Service and the U.S. Fish and Wildlife Service have recently become interested in developing long-term monitoring protocols for flora, fauna, and other natural resources on their lands. Hence, we initiated and tested an inventory and protocol for marsh birds within the boundaries of the Cape Cod National Seashore (CCNS, see Fig. 1) in eastern Massachusetts. Our effort was part of a cooperative U.S. Geological Survey – National Park Service monitoring program intended to develop protocols for monitoring key natural resources for coastal parks in the United States (U.S. Department of the Interior 1996). Similar to most national parks, a comprehensive inventory of the marsh bird fauna had never been conducted on CCNS.

Table 1. Marsh characteristics and point survey summary at Cape Cod National Seashore, 1999-2000.

Wetland Site <sup>1</sup>	Area (ha) <sup>2</sup>	Latitude	Longitude	No. survey points	Total no. replicate-points <sup>3</sup>
HHID	33.4	42°04'55"N	70°13'55"W	4	48
HHOD <sup>4</sup>	33.9	42°03'47"N	70°14'11"W	9	27
WOOD <sup>4</sup>	76.5	42°02'01"N	70°12'10"W	6	18
GP	10.9	42°03'55"N	70°11'59"W	5	60
PL	51.9	42°03'37"N	70°07'53"W	6	48
HM	60.2	42°03'26"N	70°05'50"W	5	40
PR	62.5	41°59'52"N	70°02'04"W	8	96
BB/DH	1096	41°57'37"N	70°03'45"W	4	32
HR	51.6	41°56'15"N	70°03'30"W	4	44
GI <sup>4</sup>	57.8	41°54'43"N	70°04'07"W	4	12
NM <sup>4</sup>	209	41°49'20"N	69°57'11"W	18	54
PB <sup>4</sup>	141	41°45'11"N	69°56'22"W	5	15
Total				78	494

<sup>1</sup> Wetland site codes: HHID = Hatches Harbor Inside Dike; HHOD = Hatches Harbor Outside Dike; WOOD = Wood End; GP = Great Pond (Provincetown); PL = Pilgrim Lake; HM = Head of the Meadow; PR = Pamet River; BB/DH = Bound Brook-Duck Harbor; HR = Herring River; GI = Great Island; NM = Nauset Marsh; PB = Pleasant Bay (north section).

<sup>2</sup> Areas approximated using GIS. Only emergent marsh vegetation estimated, not open water. Location data based on approximate middle of the survey area.

<sup>3</sup> Totals based on the number of survey points x the number of surveys in both 1999 and 2000.

<sup>4</sup> Marshes that are either salt or brackish. These were only surveyed in Fall 1999 (3 replicates).

On outer Cape Cod, relatively few records of rails and bitterns are known historically (Bailey 1968; Hill 1965; Veit and Petersen 1993). The only breeding records are of a Clapper Rail in Eastham in 1956 (Veit and Petersen 1993), a King Rail at South Wellfleet in 1979 (Veit and Petersen 1993), and a very old record (1892) of confirmed breeding of a pair of Least Bitterns (*Ixobrychus exilis* Gmelin) at Pilgrim Lake in North Truro (Hill 1965). More recently, over the past 15 years, calling records of Least Bitterns have been noted at Herring River in Harwich (Massachusetts Natural Heritage and Endangered Species Program, unpubl. data). The paucity of recent records for this region may result from both limited survey effort and relatively small marsh habitat patches for the target species. Current information on marsh bird distribution and abundance is the first step toward helping resource managers develop management plans.

In this paper, we describe methods used to inventory the presence and abundance of marsh birds (bitterns, rails, coots, grebes, and moorhens) during three survey periods (breeding season, fall migration, and winter) within CCNS. Because no systematic inventory had ever been conducted for marsh birds in the Seashore, we considered ours to be an initial inventory. Of special interest to Park personnel and the bird-watching public is evidence for breeding activity by any marsh bird species. The objectives, then, include both an attempt to detect marsh birds within CCNS wetlands and to evaluate the methods used.

## METHODS

Cape Cod National Seashore includes 19,700 ha of diverse plant communities and ecosystems such as beach-dune systems, upland pine-hardwood forests, low ericaceous shrublands, salt marshes, tidal rivers and ponds, and freshwater "kettle" ponds (USDI 1996). Because of time and logistical constraints, we restricted our marsh bird surveys to wetlands most likely to contain marsh birds, i.e., salt or brackish marshes > 20 ha or freshwater marshes with > 0.5 ha of emergent vegetation. Therefore, we limited our sampling of estuarine wetlands to the large Nauset Marsh complex, Pamet River, Pleasant Bay (north), Wood End, Great Island-Jeremy Point, and the tidal marsh restoration areas of Hatches Harbor and Herring River (Fig. 1, Table 1). We also surveyed freshwater (or brackish) ponds/lakes as follows: Great Pond (including Lily Pond), Provincetown, Bound Brook / Duck Harbor in Wellfleet, and the Head of the Meadows complex (Fig. 1, Table 1).

In riverine marshes, or in small wetlands (< 3 ha), we either sampled one point or spaced our points at regular intervals, usually 200 m. In larger areas such as at Wood End and in the Great Island-Wellfleet Harbor-Jeremy Point region, we spaced out points at larger distances,

with an attempt to obtain a survey point for approximately each 10 ha of marsh. In the Nauset Marsh complex, we sampled the larger marshes by using one to three points spaced at least 200 m apart along the edge of each island, then running parallel transects toward the marsh interior, with points spaced at 200 m intervals.

Because of the scarcity of prior records for marsh birds in salt marsh areas on Cape Cod, we restricted our breeding season (May 10 to June 30, 2000) and winter (mid December 1999 and mid January 2000) surveys to freshwater and tidal river sites (Table 1). In fall (September 15 to November 24, 1999), we also sampled salt marshes. We repeated surveys during Fall 2000 to confirm results from Fall 1999 at four freshwater marshes: Hatches Harbor Inside Dike, Great Pond, Pamet River, and Herring River. We conducted three replicate surveys at each point during both the breeding season and fall migration (four replicates in 2000) and two replicate surveys during winter, at approximately two-week intervals. We did not conduct surveys during rain, fog, or when winds exceeded 20 kph. Surveys were conducted from sunrise to 1100 h.

Global Positioning System (GPS) locations were recorded for all points, and, at most, orange plastic (PVC) pipes were used to provide field markers to facilitate relocation points. Cassette recordings of the common calls of 11 marsh bird species (species lists from Massachusetts Audubon Society and CCNS) were obtained from Cornell Laboratory of Ornithology's Library of Natural Sounds. The cassette tape began with a 5-min silent period (passive), followed by 30 sec of recorded calls of each species consisting of approximately 10 sec of calling followed by 5 sec of silence, repeated twice. We included a 30-sec silent period between each pair of species calls. We used separate tapes for breeding and non-breeding season survey periods because we wanted to detect potential migrants during fall and winter. The order of 9 species calls for the breeding season tape was: Least Bittern, Clapper Rail, Sora, Virginia Rail, King Rail, American Bittern (*Botaurus lentiginosus* Montagu), Common Moorhen, American Coot, and Pied-billed Grebe, resulting in a 14-min survey at each point. The nonbreeding season tape included 11 species in the following order: Black Rail (*Creciscus jamaicensis* Gmelin), Least Bittern, Clapper Rail, Yellow Rail (*Coturnicops noveboracensis* Gmelin), Sora, Virginia Rail, King Rail, American Bittern, Common Moorhen, and Pied-billed Grebe (a 16-min total survey duration).

Observers recorded the period during the broadcast sequence in which each bird was detected, i.e., during a conspecific call bout, a silent period, etc. Observers also were trained in the field to recognize and record calls at the fixed radii of 50 and 100 m distances. We included the 100 m radius because we wanted to determine whether there may be problems of independence of points established at the 200

m intervals we had established. Because none of the 9 observers had previous marsh bird survey experience, each observer was trained using cassette tapes for species identification at least 6 times during a one-week period before beginning field work. Because detection probabilities may vary among observers (Nichols et al. 2000), we used a double-observer method at a subset of 13 survey points during the breeding season to evaluate the extent of observer bias on our surveys. At these points, observers independently recorded birds detected, keeping separate field records. A sound-level meter was used periodically to ensure that broadcast volume was consistent (72-92 decibels at 1 m distance from speaker) and that tape deterioration was not occurring. We used a Sony Sport box tape player (brand name not endorsed by the U.S. government) from an elevated (1-1.5 m) position (except when using the canoe, see below).

We used a canoe to survey Pilgrim Lake (6 points), Pamet River (8 points), and Herring River (4 points). Survey points in these locations were placed on the open water-emergent vegetation interface. The tape was played without leaving the canoe. A small motorboat was used to travel between transect lines in Nauset Marsh because of the large number of points, the distances between points, and the large number of ponds in the marsh.

We summarized the data by species and season, giving overall numbers of detections by point-replicates, and then by season for both visual and auditory detections.

## RESULTS

We surveyed 36 points in seven freshwater marshes (surveyed during breeding season, fall migration, and winter) and 42 points in five saltwater marshes (surveyed during fall 1999 only, see Table 1). Four hundred ninety-four (494) broadcast call surveys by 9 observers were performed between 23 September 1999 and 9 November 2000 at 78 survey points (Table 1). All seven of the freshwater marsh sites yielded at least one marsh bird detection while only two of the five brackish or salt marsh sites did. Of the 78 total survey points, 33 points (42%) yielded at least one detection during the four periods. Only three of those points were in salt marsh habitats.

### Species detected

We confirmed the presence of 7 out of the 11 most-likely marsh bird species (American Bittern, American Coot, King Rail, Least Bittern, Pied-billed Grebe, Sora, and Virginia Rail) on CCNS (Table 2). Six species were documented from calls elicited by broadcast calls, whereas

the American Coot was detected visually. The most commonly detected marsh birds were Sora (15 detections), Pied-billed Grebes (13), and Virginia Rails (12). Great Pond in Provincetown (22 detections) and Hatches Harbor Inside Dike (15) had the most frequent detections.

*American Bittern* — Of the 12 marshes we surveyed, this bittern was detected in four (33%). A total of 11 detections were made at 7 different survey points, of a total of 494 replicate-points (2.2% detection rate). This was the only species detected during winter surveys (see Seasonal Aspects below).

*American Coot* — One American Coot was detected at Pamet River (8% of marsh sites) during Fall 1999 at one point, for a detection of only 0.2% (one of 494).

*King Rail* — King Rails were detected at 3 of the 12 marshes (25%), with a total of 3 detections at 3 survey points (0.6% of 494).

*Least Bittern* — Of the 12 marshes, Least Bitterns were found at only Great Pond in Provincetown ((8%). Two detections on two survey dates in spring 2000 (0.4% of total) indicates that this species may be a suspected breeder there.

*Pied-billed Grebe* — Grebes were detected at two of the 12 marshes (17%). Nine detections were recorded only in the fall period (7.8% of 494). Multiple counts of birds at Great Pond may have resulted from one or more birds remaining at the site for > 1 week (Table 2).

*Sora* — Soras were the most frequently detected species of marsh bird, being detected 15 times (3% of 494) at five of the 12 (42%) marshes. A Sora was detected at one survey point on 3 different surveys in spring 2000 at Great Pond, suggesting possible breeding.

*Virginia Rail* — Of the 12 marshes, Virginia Rails were detected at 5 (42%). With 12 detections, this species was the second most-detected marsh bird species (2.4% of 494). One pair may have bred in 2000, because 3 detections were made at Hatches Harbor during May-June (Table 2).

## Seasonal Aspects

*Fall Migration* - We conducted 234 surveys at 78 points at 12 marsh locations during Fall 1999. Five individuals of three species (King Rail, Virginia Rail, Sora) responded vocally to the call broadcast. In addition, nine individuals (five species) were detected visually (Table 2). Of a total of 126 replicate-survey points in Fall 1999, the probability of a marsh bird being detected auditorally was 0.04 versus 0.07 visually.

We conducted follow-up surveys in Fall 2000 at four of the freshwater marsh sites where we had had detections during Fall 1999. We limited our surveys to a subset (21 points) of the original 78 survey points that had produced > 1 detection in previous surveys at the site:

Great Pond/Lily Pond in Provincetown (5 points), Hatches Harbor Inside Dike (4 points), Herring River (4 points), and Pamet River (8 points). We conducted four replicates (only three at Herring River due to poor weather conditions) at these four locations in Fall 2000 (total of 80 surveys). Nine individuals (3 species) responded vocally to the tape playback, and 17 individuals (4 species) were observed (Table 2). At this selected subset of freshwater marshes in Fall 2000, the probability of detecting marsh birds increased to 0.26 (visually) and 0.09 (auditorally) over the course of 84 replicate-survey points.

*Winter 1999-2000* - We conducted 72 surveys at 36 points at 5 freshwater marsh locations. One American Bittern vocalized during the broadcast of the American Bittern call at Herring River on 12/16/99. Also, American Bitterns were observed on three dates (12/07/99, 12/10/99, and 01/05/00) in the Hatches Harbor Inside Dike location. An unknown species of rail was observed along Herring River on 12/16/99.

*Breeding Season* - We conducted 108 surveys at 36 points at seven marshes. Eleven individuals responded vocally to the call broadcast,

Table 2. Detections of marsh birds during breeding, fall, and winter periods at Cape Cod National Seashore, 1999-2000.

Species <sup>1</sup>	Date/season	Location(s) <sup>2</sup>	No. of individuals	Detection method <sup>3</sup>
AMBI	BREEDING	0		
	FALL			
	10/29/99	HHID	1	V
	10/03/00		1	V
	11/09/00		1	V
	10/08/99	HHOD	1	V
	10/29/99		1	V
	10/05/00	HR	1	V
	11/05/99	NM	1	V
	WINTER			
	12/16/99	HR	1	A
	12/07/99	HHID	1	V
	12/10/99		1	V
	01/05/00		1	V
AMCO	BREEDING	0		
	FALL			
	11/17/99	PR	1	V
KIRA	WINTER	0		
	BREEDING			
LEBI	05/10/00	GP	1	A
	FALL			
	10/06/99	HHID	1	A
	10/31/99	HR	1	A
	WINTER	0		
PBGR	BREEDING	0		
	FALL			
	05/25/00	GP	1	A
	06/08/00		1	A
PBGR	WINTER	0		
	BREEDING	0		
	FALL			
	09/22/00	GP	3	V, A
	10/04/00		3	V
	11/08/00		2	V
	10/01/99	PL	1	V
WINTER	0			



including King and Virginia Rails, Sora, and Least Bitterns. We detected one Sora and one Virginia Rail visually (Table 2). Only at Great Pond (Sora and Least Bittern) and Hatches Harbor Inside Dike (Virginia Rail) did we make at least two detections during three spring surveys, suggesting breeding activity. Of a total of 108 replicate-survey points made during the breeding season, the probability of an auditory detection was 0.10 compared to only 0.02 for visual detection.

### Sampling methods

Using the double-observer method (Nichols et al. 2000) at 13 points, we recorded 21 species (two marsh birds and 19 others) with no discrepancies between the two observers either in the numbers of species or individuals. Given our initial results, we discontinued using two observers on subsequent surveys.

We also assessed the effect of the 50 versus 100 m fixed-radius point survey results. Of the 22 individuals that responded vocally to the tape, 16 were located within 50 m of the survey point, five were beyond 50 m, and one moved from beyond 50 m to within 50 m during the playback

Table 2, continued.

SORA	BREEDING			
	05/10/00	GP	2	A
	05/25/00		1	A
	06/08/00		1	A
	06/19/00	HHID	1	V
	FALL			
	09/22/00	GP	1	A
	10/04/00		1	V
	09/18/00	HHID	1	V
	10/19/99	HM	1	A
	09/21/00	HR	1	A
	10/05/00		2	A, V
	10/02/99	PR	1	V
	09/19/00		1	A
	10/02/00		1	V
	WINTER	0		
	VIRA	BREEDING		
05/11/00		BB/DH	1	A
06/08/00		GP	1	A
05/16/00		HHID	1	A
06/01/00			1	A
06/19/00			1	V
FALL				
09/18/00		HHID	1	A
10/03/00			1	V
10/18/00			1	A
10/31/99		HR	1	A
11/16/99			1	A
10/02/99		PR	1	V
11/17/99			1	V
WINTER		0		

<sup>1</sup> Species codes: AMBI = American Bittern; AMCO = American Coot; KIRA = King Rail; LEBI = Least Bittern; PBGR = Pied-billed Grebe; SORA = Sora Rail; VIRA = Virginia Rail.

<sup>2</sup> Location codes: BB/DH = Bound Brook-Duck Harbor; GP = Great Pond; HHID = Hatches Harbor Inside Dike; HHOD = Hatches Harbor Outside Dike; HR = Herring River; NM = Nauset Marsh; PL = Pilgrim Lake; PM = Pamet River.

<sup>3</sup> Detection method: A = auditory; V = visual confirmation

period. Given the low detection rates beyond 50 m, and the fact that we had no detections during any survey at consecutive points in the same marsh, we do not feel that this method violates the assumption of independence of survey point results (i.e., contiguous 100-m circles with points spaced at 200-m intervals).

### Timing of responses

When we examined the sequences on the tapes when species responded, only in one of 25 cases did a bird (Pied-billed Grebe) respond during the passive period. Thus, call broadcasts appeared to increase detection probability of marsh birds during the breeding season. The broadcast stimulus did not appear to be highly conspecific. In only four of 25 cases did a bird respond only during the bout with a conspecific call (one American Bittern, one King Rail, two Soras). In 10 cases, birds responded to two or more species calls in the sequence.

## DISCUSSION

The limited number of detections of the seven marsh bird species we recorded is not surprising given the few records from earlier ornithological accounts on Cape Cod (Hill 1965, Nikula 1983, Veit and Petersen 1993). Our evidence suggests that a pair of Least Bitterns, Soras, and Virginia Rails may breed within the Seashore, all in marshes near Provincetown. We recommend further investigation to confirm nesting, because Soras are rare in Massachusetts (Crowley 1995) and Least Bitterns are listed as Endangered (Massachusetts Endangered Species Act, M.G.L.C. 131A, Massachusetts Division of Fisheries and Wildlife, Westborough). With respect to winter records, the only possible overwintering we suspected was of an American Bittern at Hatches Harbor. One bittern was detected on two dates in December 1999 and one in January 2000; this bird may have been the same individual that occupied the site in the fall (detected on all three fall surveys). Like Least Bitterns, American Bitterns are also considered Endangered in Massachusetts (Massachusetts Endangered Species Act, M.G.L.C. 131A), thus additional monitoring information might prove useful as a first line of detection as range expansions or contractions occur (e.g., with climate change).

We believe that the survey protocol used here has broad applicability to marsh bird inventories and monitoring throughout North America. Using call broadcasts with tape recordings appears to enhance the detectability of this cryptic group of birds (Gibbs and Melvin 1993), especially during the breeding period. Conway and Gibbs (2001) reported large geographic, seasonal, and species-specific variation in the effectiveness of call broadcast at increasing detection probability of

marsh birds. Detection probabilities of some marsh birds may still be low with call broadcast surveys (Gibbs and Melvin 1993), but we would have only detected one marsh bird aurally had we relied exclusively on passive survey methods. Marsh bird specialists argue that call broadcasting may introduce biases in surveys, however, we argue that these are probably offset by increased rates of detection, especially in areas with low bird densities.

Our results suggest that observer bias associated with marsh bird surveys may be minimal using the double-observer method. At 13 points, 21 individual birds (two marsh birds) were detected with no differences found either in species or individual detections. Vocalization probability is probably lower, more variable, and problematic for marsh birds (Conway and Gibbs 2001) than for breeding forest birds. The advantage of the double-observer method described by Nichols et al. (2000) would seem to accrue where the primary source of variation in survey detections is observer differences (Sauer et al. 1994), not vocalization probabilities.

The methods developed and implemented here can be effectively used to inventory and monitor marsh birds within the National Park Service's coastal lands at least in the northeast and probably elsewhere. Using call broadcast surveys is cost effective since tape recorders are inexpensive, are easily portable in the field, and tapes can be produced at low costs. The design for a monitoring program should include a power analysis to estimate the sampling intensity and duration necessary to detect a given population change (e.g., 25%) at a given probability level.

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