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HISTORICAL WINTER STATUS OF THREE UPLAND *AMMODRAMUS* SPARROWS IN SOUTH CAROLINA

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Abstract. Museum specimens can be a resource to ornithologists who wish to examine the status of birds because they may provide reliable field data that document the historical status of birds of management interest. We compared the historical winter status of Le Conte's (*Ammodramus leconteii*), Henslow's (*A. henslowii*), and Grasshopper (*A. savannarum*) sparrows in South Carolina based on specimens collected by Arthur T. Wayne and Leverett M. Loomis in the late 19th and early 20th centuries. In comparison to Henslow's and Grasshopper sparrows, Le Conte's Sparrow was abundant during "incursion" years (4–5 fold increase above the maximum annual count for any other year), inland (Piedmont), and on the coast, and had a significantly higher proportion of females. Le Conte's Sparrow was less common on the coast than Henslow's Sparrow during non-incursion years. Henslow's and Grasshopper sparrows were not regular winter residents in the Piedmont. Compared to their present known winter status in South Carolina, Le Conte's and Henslow's sparrows were much more abundant 70–115 years ago. This change in past and current winter abundance could be attributed to breeding range contractions and reductions of eastern populations because of habitat loss, to similar events on the winter range, or a combination of factors on both the breeding and winter range. These problems and possible biases associated with specimen data are discussed. This study demonstrates the usefulness of historical museum data toward detecting changes in the population status of selected species.

Key words: abundance, *Ammodramus henslowii, Ammodramus leconteii, Ammodramus savannarum,* distribution, Grasshopper Sparrow, Henslow's Sparrow, Le Conte's Sparrow, South Carolina, winter.

Museum specimens can be a resource to ornithologists and other individuals who wish to examine the status of birds because they may provide reliable field data that document the historical status of birds of management interest. We use a museum approach in historical ornithology to understand long-term bird populations of three secretive sparrows pertinent to the Savannah River Site (SRS) and the southeastern United States. The data are not from the SRS directly, but they are from the general region (South Carolina). Therefore, the results of our analyses are relevant to managers assessing status of these sparrows in the SRS.

Ammodramus sparrows that occupy upland habitats in winter are secretive, and prefer open areas with dense groundcover. Consequently, these sparrows are difficult to detect on their winter range. Odum and Hight (1957), Norris (1963), Johnston (1969), and Maxwell et al. (1988) used mist-nets at isolated locations in South Carolina (Savannah River Site, Aiken and Barnwell counties), Florida (Gilchrist County), and western Texas to determine the winter status of Le Conte's (*A. leconteii*) and Grasshopper (*A. savannarum*) sparrows in specific habitats. Snead et al. (1957, 1958), Imhof (1960), and Viers (1974, 1978, 1980, 1981, 1982, 1983) counted both of these sparrows on winter bird population study plots in Alabama (Jefferson County) and Louisiana (Natchitoches Parish) to determine their status at two air fields. Recent research has expanded our knowledge of the winter status of Le Conte's, Henslow's (*A. henslowii),* and Grasshopper sparrows in the north Gulf coastal plain of the southeastern United States (McNair 1998, unpubl. data; Plentovich et al. 1998; R. Carrie et al., unpubl. data; M. Woodrey et al., unpubl. data). However, knowledge of the historical winter status of these sparrows is limited. Observers on Christmas Bird Counts, for example, seldom detect these species (Lowther 1996, Vickery 1996; Butcher and Lowe 1990 in Pruitt 1996 and references therein; contra Herkert 1997). Most other historical sources of information have also been inadequate (e.g., for Henslow's Sparrow, see Pruitt 1996; for Le Conte's Sparrow, see Walkinshaw 1968, Lowther 1996).

The only detailed information on the historical winter status of these three species in the Southeast is from South Carolina. Arthur T. Wayne (1888, 1894, 1910, 1918; Brewster 1886) collected many specimens of all three species during winter on the coast (Beaufort and Charleston counties) in the late 19th and early 20th centuries (1884–1927). Leverett M. Loomis (1879, 1882, 1885, 1886, 1891) collected many specimens of Le Conte's Sparrow inland (Chester County), during the late 19th century (1879–1892), and fewer Grasshopper and Henslow's sparrows (Loomis 1891, Post and Gauthreaux 1989). The collecting activities of Loomis and Wayne overlapped during eight winters (1884–1892). The publications of both men focused on Le Conte's Sparrow, which was not discovered in South Carolina until the 1880s (Loomis 1882, Brewster 1886), later than Grasshopper and Henslow's sparrows (cf. Baird et al. 1874).

We evaluate the historical winter status of these three upland *Ammodramus* sparrows in South Carolina by assessing specimen evidence collected by Wayne and Loomis, and the associated information available from their publications. We focus on Wayne's data from Charleston County.

METHODS

We recorded the specific localities, years, and numbers for each species of upland *Ammodramus* sparrow collected by Wayne and by Loomis. For Wayne, we treated the data from Charleston and Beaufort counties separately; data from Beaufort County are too limited to permit detailed analyses. These data and additional information on sex and age were extracted from specimen labels or from Wayne's journals, which are deposited in the Charleston Museum. We verified or checked this information when possible with the published accounts by Wayne and Loomis. We found no discrepancies.

Our analyses assume that each species is approximately equally conspicuous and difficult to detect on the winter range, where birds are usually flushed individually (see Grzybowski 1983a,b for data on Grasshopper and Le Conte's sparrows; McNair 1998, pers. obs.) (although see Odum and Hight 1957 and Norris 1963, who stated that local Le Conte's Sparrows flushed less readily). Hence, we assume that each species is approximately equally collectible. We used Chi-square tests in our analyses.

RESULTS

Distribution and Abundance

Wayne collected Grasshopper, Henslow's, and Le Conte's sparrows on the coast of South Carolina in Charleston County at a minimum of 14, 20, and 17 sites, respectively, from a total of 42 sites. The distribution of sites where Le Conte's and Grasshopper sparrows were collected was significantly different ($\chi^2 = 10.81$, $P < 0.01$). Pairwise combinations between the other two species were not different (Le Conte's vs. Henslow's: $\chi^2 = 3.36$, $P > 0.05$; Grasshopper vs. Henslow's: $\chi^2 = 1.03$, $P > 0.05$).

Over 42 winters, Wayne collected Grasshopper, Henslow's, and Le Conte's sparrows on the coast of South Carolina in Charleston County in 20, 24, and 18 years, respectively (Table 1). The frequency of occurrence among species over these years was not significantly different ($\chi^2_2 = 0.90$, $P > 0.05$), nor were any pairwise comparisons between species.

Le Conte's Sparrow had three incursion years (4–5 fold increase above the maximum annual count for any other year: 1893–1894, 1909–1910, 1917–1918), when Wayne (1894, 1910, 1918; journals) collected a total of 116 birds in Charleston County (yearly maxima of 34–42, daily maxima of 6; Table 1). Neither Henslow's or Grasshopper sparrows had incursion years.

Henslow's Sparrow (77 birds) was significantly more numerous than Le Conte's (44 birds) or Grasshopper (33 birds) sparrows in Charleston County during Le Conte's non-incursion years ($\chi^2_2 = 25.67$, $P < 0.01$). The maximum number of Henslow's, Le Conte's, and Grasshopper sparrows collected during non-incursion years was 7, 9, and 5 birds (daily maxima of 4, 5, and 2), respectively.

During non-incursion years in Charleston County, Wayne collected Henslow's Sparrows on about twice as many days (66) as Le Conte's (34 days) and Grasshopper (30 days) sparrows. The greater abundance of Henslow's Sparrow during Le Conte's non-incursion years compared to the other two species is based on this difference, and not on the daily average of collected birds: 1.17 birds/day each for Grasshopper and Henslow's sparrows and 1.29 birds/day for Le Conte's Sparrow. During incursion years, Wayne's daily average of Le Conte's Sparrow was 1.63 birds/day. Although Wayne did not collect any birds in 10 winters, all three *Ammodramus* sparrows were collected over approximately the same number of years.

In Beaufort County, Wayne (1888, 1910; journals) collected 36 Henslow's Sparrows (daily maximum of 5) in January and February 1888 in an old rice field near Yemassee. During this expedition, he also collected three Grasshopper and one Le Conte's sparrows at the same site. Wayne's daily average in Beaufort County of Henslow's Sparrow was 2.25 birds/day.

In the Piedmont at Chester County, Loomis (1882, 1885, 1891) collected at least 66 Le Conte's Sparrows and saw many others during four consecutive incursion winters (1881–1885). In one incursion winter (1884–1885; Brewster 1886, Loomis 1886), Le Conte's Sparrow was present inland, but absent on the coast, indicating that Le Conte's Sparrows incursions do not always reach the coast. In the following five winters (1885–1890), Loomis (1886, 1891) collected or saw five birds in three seasons, compared to the two birds that Wayne collected in two seasons on the coast. Over all years, Le Conte's Sparrow occurred in 7 of 13 (54%) winters in the interior, not significantly different from its frequency of occurrence on the coast (43%; $\chi^2 = 0.43$, $P > 0.05$). Extreme dates of occurrence of Le Conte's Sparrow in the interior were 11 November (1881) to 30 March (1885) (non-incursion years only: 19 December 1889 to 3 March 1888), where the maximum count was 12 on 10 December 1881 (Loomis 1882).

Loomis (1885) collected at least 15 specimens of Henslow's Sparrow during autumn and spring migration. Unlike Le Conte's Sparrow, Hen-

TABLE 1. NUMBER OF BIRDS BY SEX RATIO AND NUMBER OF DAYS BIRDS WERE COLLECTED PER YEAR BY A.T. WAYNE OVER 42 WINTERS (1883–1925) FOR EACH OF THREE SPECIES OF UPLAND *AMMODRAMUS* SPARROWS ON THE COAST OF SOUTH CAROLINA IN CHARLESTON COUNTY

	Number of birds (number of days birds were collected)			
Winter year	Grasshopper	Henslow's	Le Conte's	Total
1883–1884	1[a]/0[b]			1
1884–1885		1/0		1
1885–1886	5/0 (4)	7/0 (4)	0/1	13 (8)[c]
1886–1887	1/0	1/0		2 (2)
1887–1888	1/0	2/3 (3)		6 (3)
1888–1889				
1889–1890				
1890–1891				
1891–1892		1/0		1
1892–1893		0/1		1
1893–1894		0/1	7/25/8U[d] (18)	41 (19)
1894–1895		2/4 (4)		6 (4)
1895–1896	1U			1
1896–1897	0/1/1U (2)	1/0	0/7 (5)	10 (8)
1897–1898		1/1 (2)	1U	3 (3)
1898–1899	0/1	2/0 (2)	1U	4 (3)
1899–1900	1/0	2/0 (2)		3 (3)
1900–1901	1U			1
1901–1902				
1902–1903	1/1 (2)	2/0/2U (3)	0/3/1U (3)	10 (7)
1903–1904	2U (2)		0/2 (2)	4 (4)
1904–1905		2/4 (5)	1/1 (2)	8 (5)
1905–1906	1U	1/1 (2)		3 (3)
1906–1907	0/1	2/2 (3)	0/1/1U (1)	7 (5)
1907–1908	0/1	2/3 (5)	2/1 (3)	9 (7)
1908–1909				
1909–1910		0/1	5/32/5U (35)	43 (35)
1910–1911		2/2 (4)		4 (4)
1911–1912	0/1		0/1	2 (2)
1912–1913	1/2 (3)		2/7 (8)	12 (11)
1913–1914				
1914–1915	2/0 (2)	1U		3 (3)
1915–1916				
1916–1917				
1917–1918			5/26/3U (18)	34 (18)
1918–1919				
1919–1920				
1920–1921	1/0			1
1921–1922	2/1 (3)	2/5 (7)	0/1/2U (3)	13 (12)
1922–1923		3/2 (4)	1/2/4U (2)	12 (6)
1923–1924	2/0 (2)	3/3/1U (7)	0/1	10 (10)
1924–1925		1/0		1
Subtotal	18/9/6U	40/33/4U	23/111/26U	na[e]
TOTAL	33 (32)	77 (66)	160 (105)	270 (193)

[a] male.
[b] female.
[c] total number of days birds were collected each year may be less than sum for all three species because individual birds of different species may be collected on the same day.
[d] U = Unknown.
[e] na = not applicable.

slow's was not found in winter. Loomis (1891) stated the Grasshopper Sparrow was a rare straggler during winter (December through March), with occasional arrivals in February during favorable weather; he listed only five occurrences in December and January.

TIMING OF OCCURRENCE

All three species of *Ammodramus* sparrows were collected on the coast of South Carolina in Charleston County during the same winter in 8 of 32 years (Table 1). There were no differences in species' abundance. No species pairwise

comparisons were significantly different (Grasshopper vs. Henslow's: $\chi^2 = 0.52$, $P > 0.05$; Grasshopper vs. Le Conte's: $\chi^2 = 0.04$, $P > 0.05$; Henslow's vs. Le Conte's: $\chi^2 = 0.00$, $P > 0.05$). Grasshopper Sparrows were collected on the coast over a period of seven and one-half months (20 September 1895 to 8 May 1906), longer than the other two species (5–6 months). Extreme dates of occurrence for Henslow's Sparrow were 19 October to 30 March, for Le Conte's, 9 November to 27 April (during non-incursion years only, 9 November to 27 February). Most records for Grasshopper (76%) and Henslow's (88%) sparrow were from October through January, and for Le Conte's Sparrow, from November to January (89%).

Sex and Age Ratios

Most Le Conte's Sparrows collected by Wayne on the coast in Charleston County were females (111 of 134, 83%; also see Wayne 1894, 1918), with no difference in the proportion between incursion and non-incursion years. The sex ratio of Le Conte's Sparrows was significantly different ($\chi^2 = 56.48$, $P < 0.01$) from that of both Grasshopper (males = 18, females = 9, $\chi^2 = 2.37$, $P > 0.05$) and Henslow's (males = 40, females = 33, $\chi^2 = 0.49$, $P > 0.05$) sparrows, based on an expected value of 1:1. Most Le Conte's Sparrows collected inland were not sexed; the available sample (N = 10; only four birds sexed) is too small to be useful.

The age ratios from a pooled sample of Henslow's (6 ad., 16 imm.; 27% adult) and Le Conte's sparrows (9 ad., 21 imm.; 30% adult) were not significantly different from an expected value (based on proportion of 2 adults, 4 immatures) of 1:2. The sample for the Grasshopper Sparrow was insufficient to test for differences in age ratios.

DISCUSSION

Biases Associated with Specimen Data

Interpretation of our results depends upon evaluation of the possible biases associated with the collection methods of Wayne, and to a lesser extent, with those of Loomis in the interior. We know the sites where Wayne sampled, but not their characteristics. From accounts in his journals, we know he located most sparrows with a bird dog (pointer), and then shot them as they flushed. We assume that Loomis used approximately the same methods. Wayne (1910) suggested that Grasshopper Sparrows occurred in sandier fields (drier, sparser sites), but possible habitat differences among collecting sites cannot be evaluated. Wayne sampled a large number of old field habitats, most of which were dominated by broomsedge (*Andropogon* spp.; e.g., Wayne 1894), but he provided few additional details. Inland at Chester, Loomis (1882, 1885, 1891) obtained most of his birds at one site, although he noted that Le Conte's Sparrow had the most restricted habitat. The results of Loomis and Wayne are generally consistent with other studies that document co-occurrence of the three sparrows at the same sites (Lowther 1996; D. B. McNair, unpubl. data; C. R. Chandler, pers. comm.). All three species probably have subtle microhabitat preferences within old field habitats (cf. Odum and Hight 1957).

The greater abundance of Le Conte's Sparrow compared to either Henslow's or Grasshopper sparrows in the Piedmont during winter is not an issue. We believe that the greater abundance of Le Conte's Sparrow compared to either Henslow's or Grasshopper sparrows on the coast during incursion years, which Wayne (1894, 1918) recognized, is a true biological event and not a result of selective collecting. During non-incursion years, Wayne collected all three species over approximately the same number of years (Table 1), and we doubt that he would deviate from this pattern in the three incursion years, as he collected Le Conte's Sparrows during both incursion and non-incursion years at the same sites (e.g., Porcher's Bluff). The greater abundance of Le Conte's Sparrow in the interior of South Carolina during both incursion and non-incursion years, which the data of Loomis and Wayne demonstrate, also supports our view that Wayne probably did not selectively collect Le Conte's Sparrow on the coast compared to the other two sparrows. While Le Conte's Sparrow was not discovered in South Carolina until the 1880s and specimens may have had more value than the other two species, any differences in motivation and collecting activities among Wayne and Loomis were probably minor, based on the similar number and length of their publications on Le Conte's Sparrow.

It is just as likely that Wayne oversampled Henslow's Sparrows and undersampled Le Conte's and Grasshopper sparrows on the coast in Charleston County during non-incursion years. We doubt that Wayne would have collected fewer Le Conte's Sparrows unless Henslow's Sparrow was more abundant.

For Grasshopper Sparrow, Wayne (1910) stated that many individuals overwintered (although the daily maximum he collected was two). His general qualitative statements were not always accurate, however (cf. Blackpoll Warbler, *Dendroica striata*; McNair and Post 1993b).

The duration of the winter period and timing of arrival of autumn migrants and wintering birds (December and January) for each of the three upland *Ammodramus* sparrows in South

Carolina in this study is consistent with other data from the Southeast (Post and Gauthreaux 1989, McNair and Post 1993a, Lowther 1996, Vickery 1996, Pruitt 1996). However, the timing of departure for these three species in late winter and early spring is not well defined because of undersampling. Wayne redirected his collecting efforts to other species after mid-winter; e.g., the sharp-tailed sparrow complex (*A. caudacutus* and *A. nelsoni*), of which he collected over 600 specimens (W. Post, unpubl. data). Habitat disturbance (e.g., prescribed winter burns; Wayne 1910, 1918) at Wayne's collection sites may also have been a factor. We are unaware of collecting biases associated with sex and age ratios for any of the three species during winter.

Winter Status of Le Conte's and Henslow's Sparrows

With the possible exception of information obtained by Audubon and Bachman on Henslow's Sparrow (Baird et al. 1874), Wayne and Loomis obtained more data on the winter status of Henslow's and Le Conte's sparrows than the combined efforts of all other individuals in South Carolina (Post and Gauthreaux 1989, McNair and Post 1993a). The absence of Henslow's Sparrow from the Piedmont during winter is consistent with data from other states, which document that their primary winter range in the Southeast is largely congruent with the lower coastal plain where the longleaf pine (*Pinus palustris*) ecosystem was dominant (e.g., Mississippi; M. Woodrey in Pruitt 1996). The local abundance of Henslow's Sparrow in favorable habitat (abandoned rice fields; cf. Brown 1879) during mid-winter and scarcity of the other two sparrows at this site in Beaufort County (Wayne 1888) was probably a normal event, not an incursion. Large numbers of wintering populations of Henslow's Sparrow also occurred in other states at the turn of the century (Pruitt 1996), which coincided with well-documented increases of breeding populations on abandoned farmland in the northeast and north-central states (Herkert 1994, Pruitt 1996).

Specimen data from several states other than South Carolina document the concentration of Le Conte's Sparrow at the eastern edge of their winter range (Florida: Brewster 1882, Wayne 1895, Howell 1932; Alabama: Brown 1879; Mississippi: Allison 1899) and migratory routes (Illinois: Ridgway 1883, Poling 1890; Wisconsin: Kumlien and Hollister 1903 in Lowther 1996) in the late 19th and early 20th centuries. Le Conte's Sparrow formerly bred as far southeast as northeast Illinois (Lowther 1996), but data supporting a parallel, widespread increase in historical eastern breeding populations of Le Conte's Sparrow are lacking.

Since Wayne's work, Le Conte's Sparrow was not reported in South Carolina until the mid-1950s. Odum and Hight (1957) captured 10 birds in an old field in the upper coastal plain at the Savannah River Site during the winter of 1954–1955. One to four birds also occurred in this area in three other winters in the mid-1950s (Norris 1963). Since then through the 1980s, Le Conte's Sparrow was reported but five times (McNair and Post 1993a). In the 1990s, with an increase in observer effort for wintering grassland birds, Le Conte's Sparrow was found ca. 12 times over seven winters (McNair and Post 1993a; reports in Briefs for the Files of *The Chat*). All reports have been of single birds except for a local concentration during two years in the upper coastal plain at Santee National Wildlife Refuge; the high count was 11 birds on 9 March 1996 (Davis 1997). Since the mid-1950s, only ca. 25 credible records or reports of Henslow's Sparrow exist from South Carolina; ca. 13 during the 1990s over six winters (McNair and Post 1993a; W. Post, unpubl. data; reports in Briefs for the Files of *The Chat*). Most counts were single birds; the daily maximum was three. In Charleston County, we captured one Le Conte's and one Henslow's sparrow (and ca. 15 Grasshopper Sparrows) in a 40 ha old field dominated by broomsedge, *Paspalum,* and *Panicum* grasses. This field is located on James Island, near the Mt. Pleasant sites where Wayne collected many of his *Ammodramus* sparrows. Post also captured one Henslow's Sparrow during migration in late October at Mt. Pleasant. In the lower coastal plain of Georgia north of the Altamaha River, few Henslow's Sparrows have been located in old fields over the past five years (C. R. Chandler, pers. comm.). More birds, although still low numbers (maxima of 2–3 day) have been located in longleaf pine flatwoods (C. R. Chandler, pers. comm.). A few Le Conte's Sparrows have been observed with these Henslow's Sparrows.

All quantitative data on Le Conte's and Henslow's sparrows in South Carolina are from old field habitats, although Henslow's Sparrows are most abundant in pine savannas (Plentovich et al. 1998; D. B. McNair, unpubl. data; M. Woodrey and C. R. Chandler, unpubl. data). Broomsedge fields also were once an important habitat for these two species in South Carolina. Little is known about how loss of this habitat affected their populations (Lowther 1996, Plentovich et al. 1998). Wayne and Loomis sampled only old fields (primarily broomsedge). Old fields were burned frequently, often annually in late winter, then left undisturbed for one growing season, as

in Charleston County (Wayne 1894). This practice would favor regrowth of broomsedge, which probably would make the sites more favorable to the three upland *Ammodramus* sparrows. In Alabama and Louisiana, broomsedge and bermuda grass (*Cynodon dactylon*) were the dominant species in grasslands that were mowed annually or more often at two air fields, where mean counts of Le Conte's Sparrow on winter bird population study plots ranged from 3–15 birds/40 ha during winters when the species was present (Snead et al. 1957, Snead et al. 1958, Imhof 1960; Viers 1974, 1978, 1980, 1981, 1982, 1983). In the coastal plain of Alabama, man-made sites burned the previous year on lands intensively managed for timber production had the highest densities of Henslow's Sparrows (Plentovich et al. 1998). Sampling of old fields (including Charleston County), especially in the 1990s, has failed to detect substantial numbers of these sparrows in South Carolina. Wayne and Loomis evidently had little difficulty locating Henslow's and Le Conte's sparrows, and the few records and reports of these species since the mid-1950s, underscores our perception that both sparrows were much more numerous in South Carolina 70–115 years ago than they have been since (Post and Gauthreaux 1989, McNair and Post 1993a; contra Lowther 1996). This decline is consistent with elimination of large areas of grassland habitat in the Southeast since the 1950s and of their conversion to row crops (USDA 1950, 1975, 1986; Lymn and Temple 1991) and pine plantations (Fairey 1973, Pruitt 1996). The present relative scarcity of old fields as winter habitat in South Carolina has probably contributed to the decline of Henslow's and Le Conte's sparrow winter numbers. The urbanization of Charleston County has also contributed toward the local decline of both species.

The decrease of wintering populations of Le Conte's and Henslow's sparrows in South Carolina has been substantial, although systematic surveys will probably detect more birds, as demonstrated by recent studies on the coastal plain of Georgia (C. R. Chandler, unpubl. data). The decrease of Henslow's Sparrow also coincides with a widespread decline of breeding populations from throughout its range since the 1960s (Askins 1993; Herkert 1994, 1997; Pruitt 1996). The decrease has been accompanied by a range contraction in the northeast United States (Pruitt 1996). Northeastern breeding birds probably wintered in the southeast Atlantic coastal plain, including South Carolina.

In contrast to Henslow's Sparrow, Le Conte's Sparrows have increased on Breeding Bird Survey routes (Price et al. 1995 in Lowther 1996). This increase has not been paralleled by increases in numbers on the winter range in South Carolina (McNair and Post 1993a). In South Carolina, Le Conte's Sparrow now occurs at the periphery of its winter range, but it is unclear if this was the case during the period of Wayne and Loomis. Le Conte's Sparrow was more numerous inland than on the coast in South Carolina (Post and Gauthreaux 1989; McNair and Post 1993a, this study) and had a female-biased sex-ratio, which is probably consistent with its occurrence on the periphery of its range. However, Gauthreaux (1982) stated that immatures are most likely to move the greatest distances, which we did not confirm. The basis for this apparent inconsistency needs further study.

Winter Status of Grasshopper Sparrow

The Grasshopper Sparrow has remained a locally uncommon winter visitor on the coast of South Carolina since the time of Wayne (1910; see Post and Gauthreaux 1989, McNair and Post 1993a), although total numbers have undoubtedly declined because of the loss of grassland habitat. The winter status of Grasshopper Sparrow in the Piedmont is less certain (Post and Gauthreaux 1989). Historically, the Grasshopper Sparrow was less abundant than Henslow's or Le Conte's sparrows. At present, the Grasshopper Sparrow is a much more abundant autumnal migrant and winter resident on the coast than the other two species (Post and Gauthreaux 1989, McNair and Post 1993a; W. Post and D. B. McNair, unpubl. data).

Management Recommendations

All three upland *Ammodramus* sparrows inhabit large, open fields with dense groundcover (Henslow's Sparrows also occur in open longleaf pine forest with suitable groundcover). Habitat management for Henslow's Sparrow should focus on restoration of dense groundcover (wiregrass *Aristida* spp., beakrush *Rynchospora* spp.) in the longleaf pine ecosystem in the lower coastal plain of the Southeast (Pruitt 1996). Additional efforts should focus on man-altered habitats such as old fields, e.g., the coastal plain of South Carolina.

Habitat management for Le Conte's and Grasshopper sparrows should focus on 1–5 yr-old moist and dry broomsedge, crabgrass (*Digitaria ischaemum*), and *Panicum* fields in the coastal plain and mid-to-lower Piedmont (cf. Dunning and Pulliam 1989, Lane 1989). Only Odum and Hight (1957) have published some details on habitats used during winter in South Carolina, that of a 4-yr old field inhabited by Le Conte's and Grasshopper sparrows in the Savannah River Site. Perhaps because it occurs at the periphery of its range, Le Conte's Sparrow prob-

ably has the most specialized habitat requirements of the three species in the Southeast. It appears, however, to tolerate more forbs among grassy vegetation than the other two species, at least in old fields (Loomis 1882, Odum and Hight 1957). Large fields should be maintained to promote habitat diversity for all three species, including trickles or runs. Most sites for the three grassland sparrows in the Southeast have been 40–80 ha (Loomis 1882, Odum and Hight 1957, Imhof 1960, Johnston 1969, Viers 1974), although Wayne (1918) collected Le Conte's Sparrows concentrated in a broomgrass field as small as 4 ha. In the absence of better information, the minimum recommended size is 40 ha, identical to breeding season requirements (Pruitt 1996).

We rarely have detailed, reliable field data in the southeastern United States that document the historical status of birds of management interest. Museum data can fill this gap, if carefully analyzed (cf. McNair 1986a,b). The present study provides an example by demonstrating the usefulness of historical museum data toward detecting changes in the population status of three secretive sparrows in South Carolina. Biases may be associated with museum data (specimens and egg sets), however, and the investigator should be aware of these pitfalls (McNair 1985, 1987, 1995; Post 1995; McNair and Post 1999, this study).

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