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EXECUTIVE SUMMARY

The Henslow's sparrow (Ammodramus henslowii) is a small (12.1 – 13.3 cm total length), short-tailed sparrow with large flat head and a large gray bill. The species has a greenish cast to the face, thin dark stripes on the breast, and the edges of the scapulars, tertials, and coverts are edged reddish. Henslow's sparrows are shy and secretive and occupy much of the northeastern quarter of the United States during the breeding season and most of the southeastern Atlantic and Gulf coast states during the winter. Ideal breeding habitat consists of tall dense grass, a well developed liter layer, standing dead vegetations, available singing perches, and little or no woody vegetation. In 1983 a breeding population was discovered in on the coastal plain of North Carolina. It is believed that Henslow's sparrows started nesting within the coastal plain of the state during the 1960s or 1970s, after timber companies had cleared forested lands and replanted with pines. While there are two large populations currently breeding on the coastal plain, few others are known.

This study was initiated to survey a variety of early successional and open habitats on the Albemarle-Pamlico Peninsula to assess the general status of the Henslow's sparrow and to assess the status and abundance of other avian species detected within the same habitats. Thirty two 300 m transects were established within open habitats on Pocosin Lakes National Wildlife Refuge, Swan Quarter NWR and the Weyerhaeuser Company J&W management tract and adjacent lands. Survey were conducted by experienced technicians using a standard variable width transect technique 3 times from 25 June to 14 July 2001. Surveys resulted in 1552 detections of 56 species. The habitats surveyed supported a variety of avian species, but the Henslow's sparrow was not among them. Lack of suitable habitat is the primary reason for there absence. Presently there is a large breeding population within 5km of our western most study site, but this population is utilizing the extremely large patches of almost ideal habitat on the Voice of America antennae fields.

BACKGROUND

Context

The Henslow's sparrow (Ammodramus henslowii) is a small (12.1 – 13.3 cm total length), short-tailed sparrow with large flat head and a large gray bill. The species has a greenish cast to the face, thin dark stripes on the breast, and the edges of the scapulars, tertials, and coverts are edged reddish. Henslow's sparrows are shy, secretive, and are most often detected by the male's song, an insect like "tsi-lick". Its breeding range covers much of the northeastern quarter of the United States and continues south along the coastal plain into North Carolina. The winter range covers most of the southeastern Atlantic and Gulf coast states. (Smith, 1992; Rising, 1996)

Henslow's sparrows are a grassland bird requiring large grassy or weedy fields and meadows (Hyde, 1939). Extensive habitat evaluation has characterized the ideal breeding habitat as having tall dense grass, a well developed liter layer, standing dead vegetations, available singing perches, and little or no woody vegetation (Pruitt, 1996).

Historical nesting records exist for Henslow's sparrows in the northern piedmont and northern mountains of North Carolina, but no confirmed breeding has occurred in these areas for over 35 years. In 1983 a breeding population was discovered in on the coastal plain of North Carolina. It is believed that Henslow's sparrows started nesting within the coastal plain of the state during the 1960s or 1970s, after timber companies had cleared forested lands and replanted with pines. The first few years after clearing resulted in suitable breeding habitat for the species. Currently, 2 large breeding populations of Henslow's sparrow exist in North Carolina. These sites, located at the Voice of America antennae fields on the coastal plain, are cleared pocosin maintained by mowing and burning. The 1200+ ha and 800+ ha sites annually support approximately 100 and 50 individuals respectively (Lynch and LeGrand, 1985)

Many habitats exist on the Albemarle-Pamlico peninsula that may support Henslow's sparrows. The species responds quickly to habitat changes and may only be found in selected habitat types during a single breeding season (Whitmore, 1973). Open areas on Pocosin Lakes National Wildlife Refuge and Swanquarter NWR, as well as the dynamic habitat of the Weyerhaeuser Company J&W management tract looked promising. Many of these areas had not been systematically surveyed or had been surveyed while exhibiting a different land cover type.

Objective

The primary objective of this study was to survey a variety of early successional and open habitats on the Albemarle-Pamlico Peninsula to assess the general status of the Henslow's sparrow. A second objective was to assess the status and abundance of other avian species detected within the same habitats.

METHODS

Study Area

The Henslow's sparrow survey area included portions of the Pocosin Lakes NWR, Swanquarter NWR, and Weyerhaeuser Company J&W management tract and adjacent lands (Figure 1).

Pocosin Lakes NWR

Pocosin Lakes NWR is situated on the Albemarle-Pamlico Peninsula, in Hyde and Washington Counties, North Carolina. The portions of the refuge used in this study include firebreaks and early successional habitat on or near the Pungo unit, just south of Lake Phelps. The 4856 ha Pungo unit was established in 1963 for waterfowl management. Activities on the remainder of the refuge, established in 1990, include management of pocosin habitat, wetland restoration, and reforestation of Atlantic white cedar. Prior to inclusion into the National Wildlife Refuge system, the study area had been ditched, drained and cleared for agricultural practices. Managed lands are now reverting back to a pocosin type habitat, dominated by dense bracken fern (Pteridium aquilinum), wax myrtle (Myrica cerifera), and sweet bay (Magnolia virginiana). The fire breaks, just south of shore drive, on the southwestern shore of Lake Phelps, are dominated by dense grasses, sedges, rushes, and forbs.

Swanquarter NWR

Swanquarter NWR is situated on the south side of the Albemarle-Pamlico Peninsula, on the northern shore of the Pamlico Sound in Hyde County, North Carolina. The refuge was established in 1932 and consists of approximately 5341 ha of irregularly flooded brackish marsh and 1295 ha of forested wetlands, which provide habitat and protection for endangered species and migratory waterfowl. The brackish marsh is dominated by dense black needlerush (Juncus roemerianus) with high marsh patches of salt meadow grass (Spartina patens), salt grass (Disticlis spicata) and salt bush (Baccharis halmifolia and Iva frutescens).

Weyerhaeuser Company's J&W management tract and adjacent lands

The J&W management tract is located on the extreme western end of the Albemarle-Pamlico Peninsula, in Beaufort, Martin, and Washington Counties, North Carolina. The area was originally dominated by tall pocosin and hardwood swamps before being ditched, drained, and cleared for agricultural practices and other land uses prior to acquisition by Weyerhaeuser. Presently, most of this area is an active pine plantation managed on a 30-35 year rotation schedule. Loblolly pines (Pinus taeda) are planted at relatively low densities (<1,200 stems/ha), commercially thinned twice during matura-

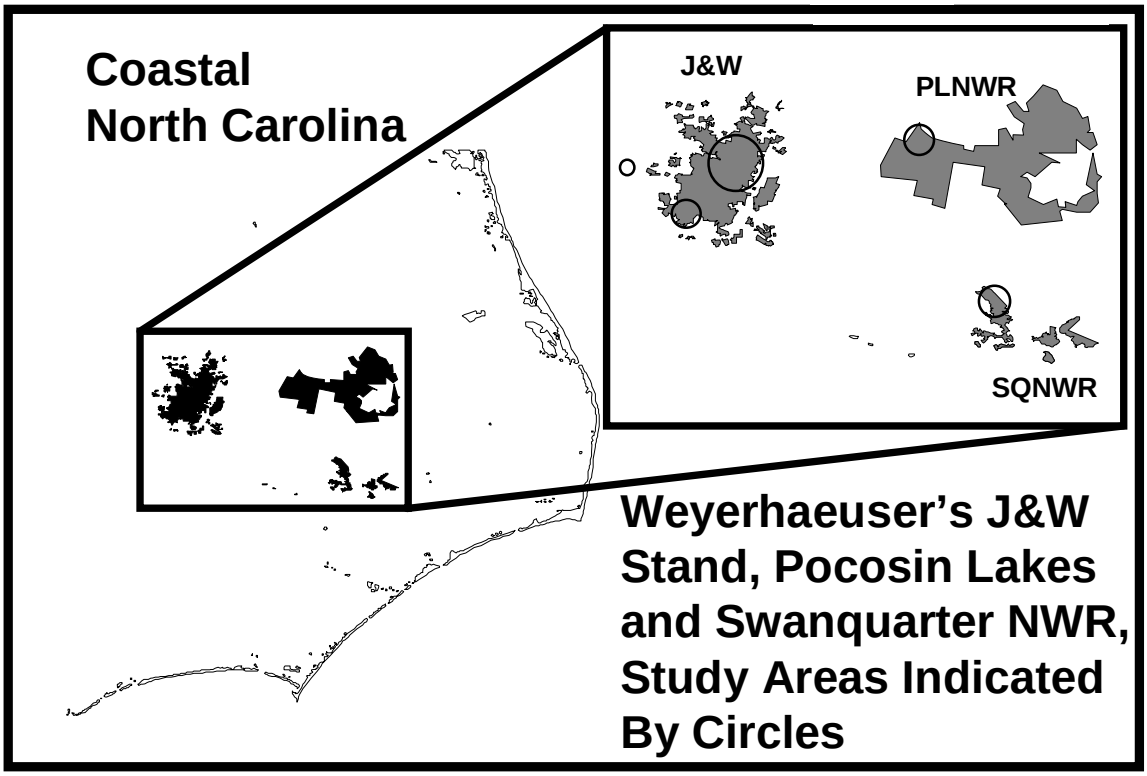

Figure 1. Map of coastal NorthCarolina and the Albemarle-Pamlico Peninsula showing study sites (indicated by circles) witin the Weyerhaeuser company J&W management tracct and adjacent lands, Pocosin Lakes National Wildlife Refuge, and Swanquarter NWR.

tion, and then harvested by clearing all pine and hardwood stems. Young pine plantations, 1-6 years after planting, are characterized by young pines, shrubs, grasses, and forbs.

Surveys

Birds were surveyed along 32 300 m transects, broken into 100 m segments, established within the early successional habitat on the PLNWR and the J&W management tract and adjacent lands, and within the high marsh habitat on the SQNWR. Three transects were established in the firebreaks and 7 within the early successional pocosin habitat at Pocosin Lakes NWR (Figure 2). At Swanquarter NWR, 4 transects were established within the high marsh habitats (Figure 3). All 18 transects established on Weyerhaeuser properties were within early successional pine plantation habitat (Figure 4) (see Table 1 for a list a survey transects, habitat, and ownership).

Transect start, end and 100 m segment points were marked with numbered wire flags and flagging tape and the position recorded with a Garmin eTrex GPS unit. Birds were surveyed from 25 June to 14 July 2001, and between sunrise and 5 hours after sunrise. Survey were conducted by experienced technicians using a standard variable width transect technique (Emlen, 1971). The observer would walk slowly and steadily along the transect line, looking and listening for birds within 150 m (perpendicular distance) of the transect line. All birds encountered were identified to species and recorded on field data sheets. Also recorded was the initial method of detection (visual, aural, or flush), transect segment of bird location, substrate in use by the bird, detection distance and distance off of the transect line. Distances were either estimated to the nearest 5 m or measured, using a Ranging 200 rangefinder, when birds were visually detected and stationary.

Data Analysis

All data from field sheets were entered into an Excel spread sheet. Data was associated with the recorded positions to produce GIS data layer of the survey transects and detections. Average species richness was calculated for each habitat type by averaging the species richness value for each survey round conducted within each habitat type. Average bird abundance was calculated for each habitat type by averaging overall abundance values for each survey round conducted within each habitat type.

To determine bird densities in the different habitats, a correction factor was calculated for each habitat type. Habitat specific correction factors were calculated for the bird community as a whole and for individual species with adequate sample sizes. Average density was calculated for all birds and individual species by averaging densities calculated for each survey round. Firebreak transect were situated in narrow habitat patches. To assure only birds from the habitat patch were included in analyses all birds detected greater than 50 m from the firebreak transect were excluded from the data set.

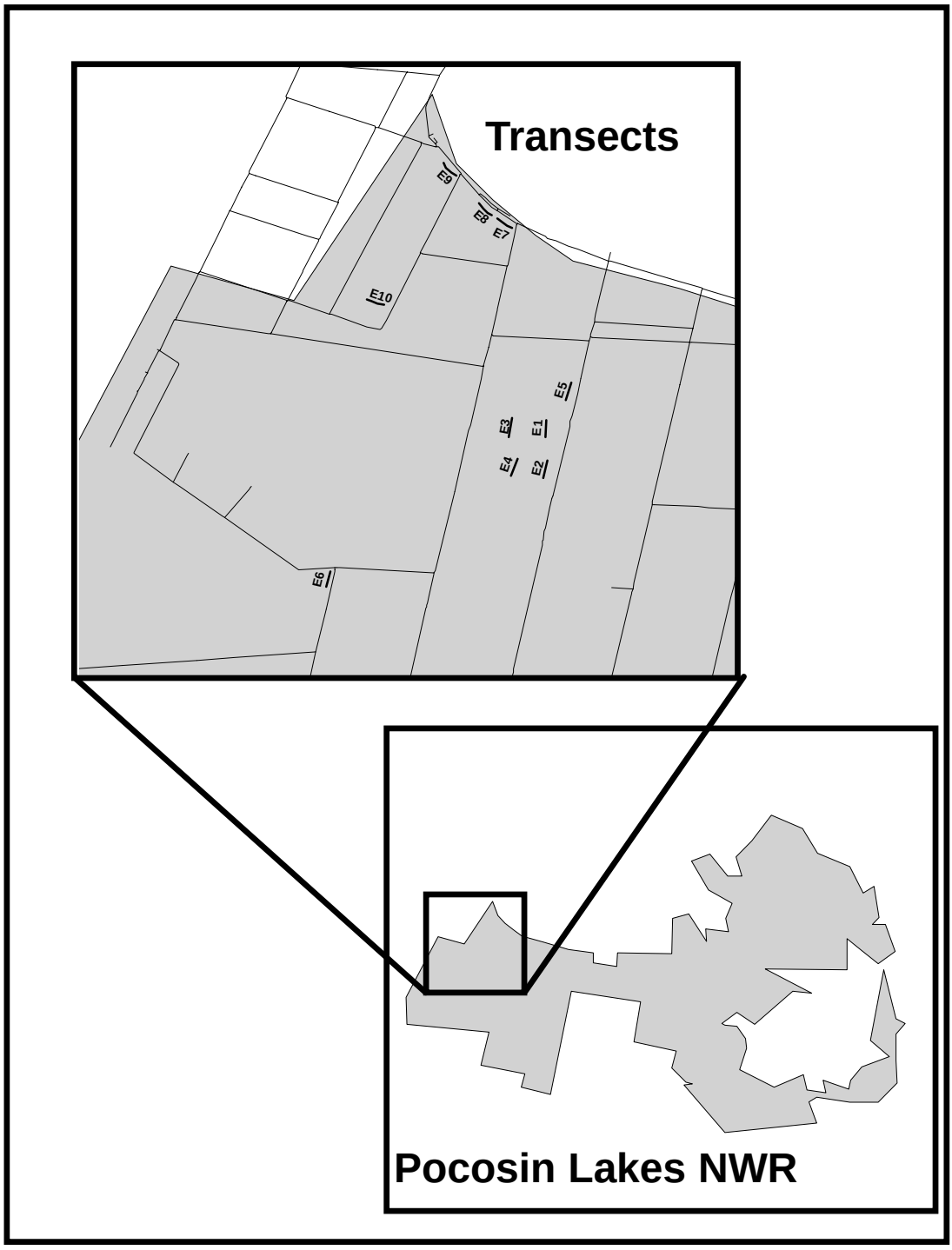

Figure 2. Map showing transect locations and numbers within Pocosin Lakes National Wildlife Refuge.

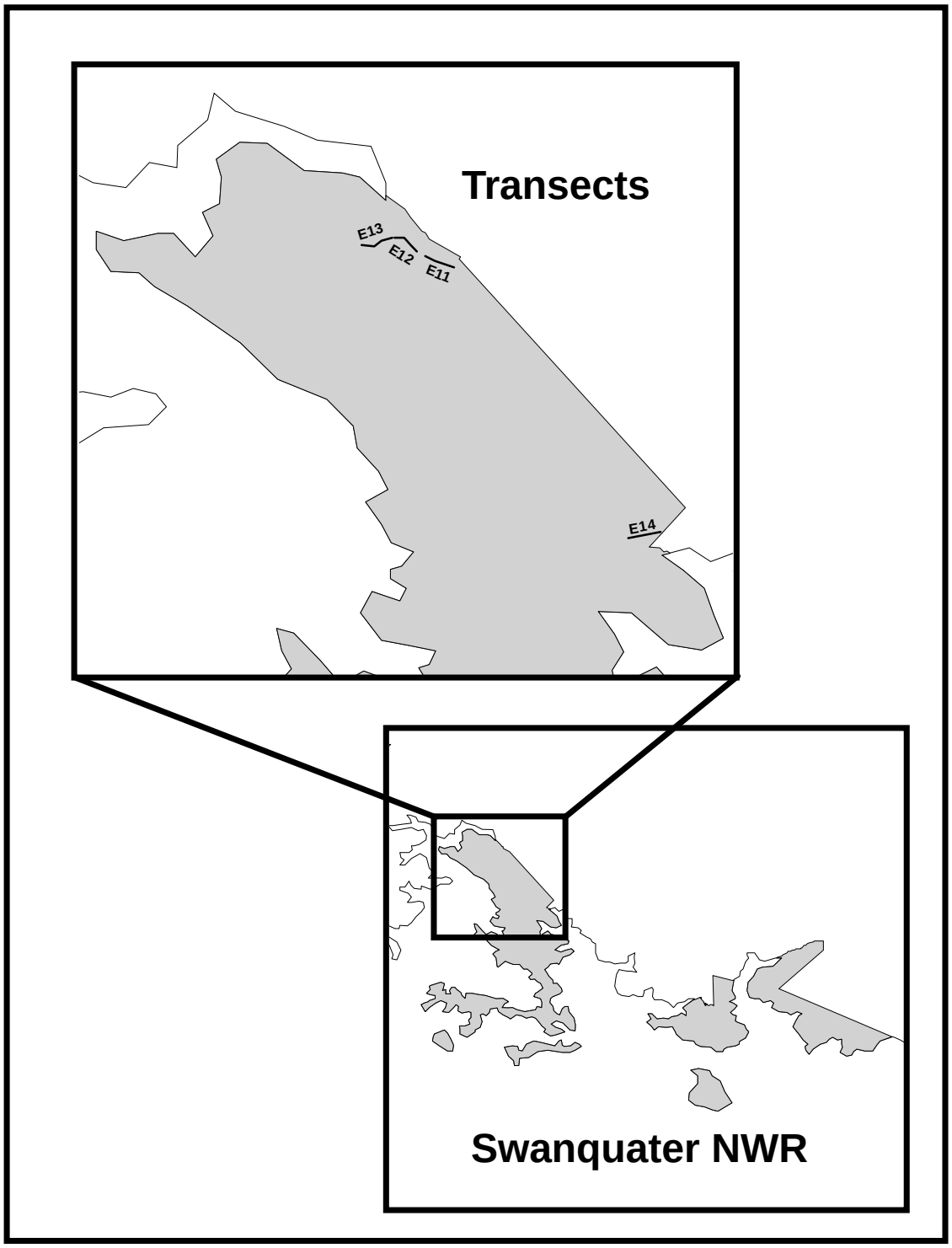

Figure 3. Map showing transect locations and numbers within Swanquarter National Wildlife Refuge.

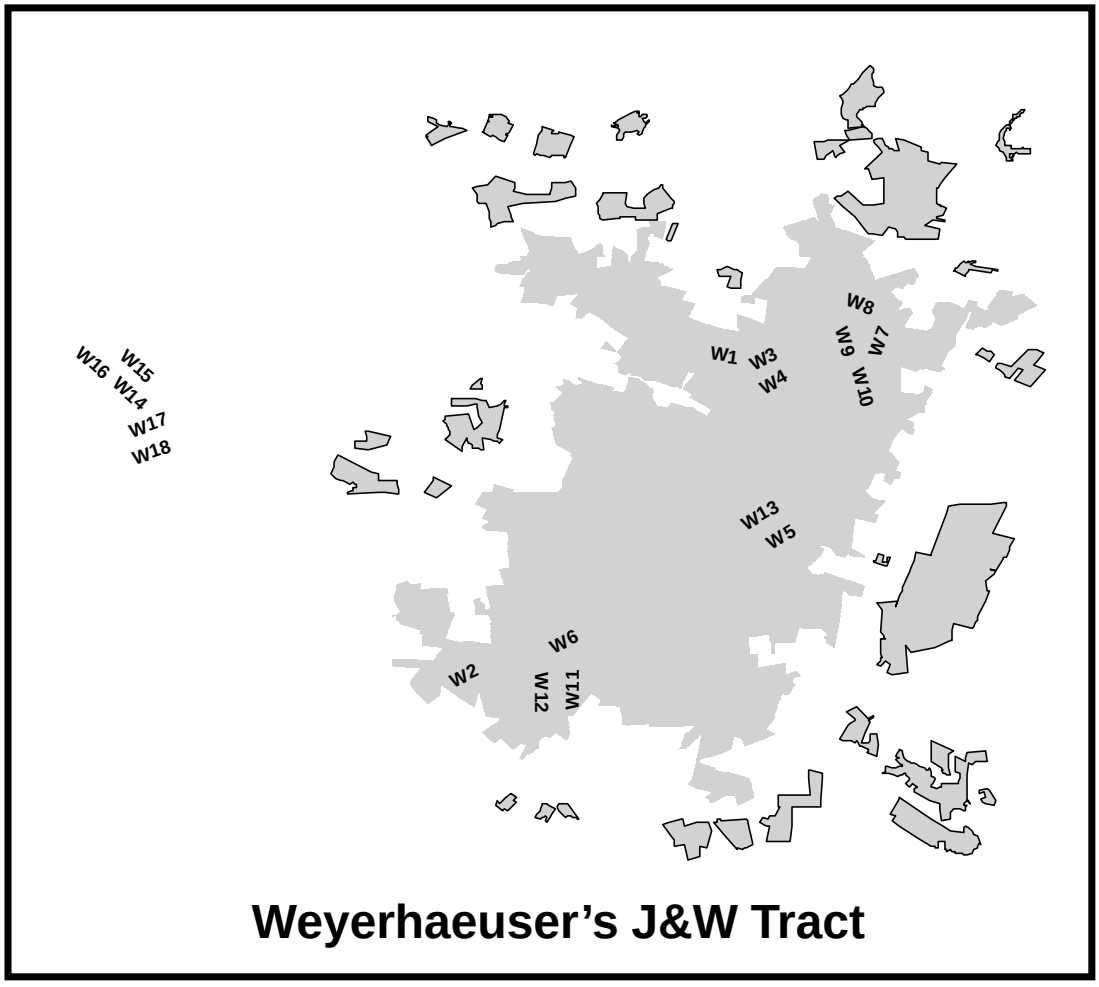

Figure 4. Map showing transect locations and numbers within Weyerhaeuser Company J&W Management Tract and adjacent lands. Transect numbers indicate transect location and orientation.

Table 1. List of transects with habitat types and ownership.

Transect	Habitat	Ownership
E1	Early Successional Pocosin	Pocosin Lakes NWR
E2	Early Successional Pocosin	Pocosin Lakes NWR
E3	Early Successional Pocosin	Pocosin Lakes NWR
E4	Early Successional Pocosin	Pocosin Lakes NWR
E5	Early Successional Pocosin	Pocosin Lakes NWR
E6	Early Successional Pocosin	Pocosin Lakes NWR
E7	Firebreak	Pocosin Lakes NWR
E8	Firebreak	Pocosin Lakes NWR
E9	Firebreak	Pocosin Lakes NWR
E10	Early Successional Pocosin	Pocosin Lakes NWR
E11	Highmarsh	Swanquarter NWR
E12	Highmarsh	Swanquarter NWR
E13	Highmarsh	Swanquarter NWR
E14	Highmarsh	Swanquarter NWR
W1	Early Successional Pine Plantation	Weyerhaeuser
W2	Early Successional Pine Plantation	Weyerhaeuser
W3	Early Successional Pine Plantation	Weyerhaeuser
W4	Early Successional Pine Plantation	Weyerhaeuser
W5	Early Successional Pine Plantation	Weyerhaeuser
W6	Early Successional Pine Plantation	Weyerhaeuser
W7	Early Successional Pine Plantation	Weyerhaeuser
W8	Early Successional Pine Plantation	Weyerhaeuser
W9	Early Successional Pine Plantation	Weyerhaeuser
W10	Early Successional Pine Plantation	Weyerhaeuser
W11	Early Successional Pine Plantation	Weyerhaeuser
W12	Early Successional Pine Plantation	Weyerhaeuser
W13	Early Successional Pine Plantation	Weyerhaeuser
W14	Early Successional Pine Plantation	Weyerhaeuser
W15	Early Successional Pine Plantation	Weyerhaeuser
W16	Early Successional Pine Plantation	Weyerhaeuser
W17	Early Successional Pine Plantation	Weyerhaeuser
W18	Early Successional Pine Plantation	Weyerhaeuser

RESULTS

Pocosin Lakes NWR

A total of 574 detections of 32 species were made along transects in the early successional pocosin and firebreak habitats. The Common yellowthroat (see Appendix I for list of species names) was the most common species observed in both habitat types and accounted for approximately 26% of all detections.

Within the early succesional pocosin habitat, 376 observations of 26 species were detected (Appendix II). Common yellowthroat, eastern meadowlark, and eastern towhee were detected most frequently. These three species accounted for 52% of all observations. Average bird abundance was 125.3 detections per survey round (det/round) and average species richness was 17.3 species detected per survey round (sp/round) (Table 2). Overall bird density was estimated to be 29.8 birds per 10 hectares (birds/10ha). Species specific densities were calculated for six species. The common yellowthroat was the most the most abundant species, reaching a density of 14.8 birds/10 ha. Indigo buntings, eastern meadowlarks, prairie warblers, eastern towhees, and field sparrows occurred at densities ranging from 1.3 to 4.0 birds/10 ha (Table 3)

Table 2. Bird abundance and species richness for the 7 early successional pocosin transects.

	Round 1	Round 2	Round 3	Average
Abundance	136	94	146	125.3
Species Richness	19	16	17	17.3

Surveys along transects within the firebreak habitat yielded 21 species comprised of 162 detections (Appendix III). Common yellowthroats, gray catbirds, eastern meadowlarks, and red-winged blackbirds were most frequently encountered, accounting for 65% of all observations. An average of 54 birds were detected during each survey round, average species richness was 13.3 sp/round (Table 4). Bird density for all species combined was 60 birds/10 ha. Four species were detected in adequate numbers for species specific density estimates. The common yellowthroat was the most abundant species, with a density of 15.6 birds/10 ha. Gray catbirds were the next most abundant reaching a density of 11.5 birds/10 ha. Red-winged blackbirds and eastern meadowlarks occurred at densities of 6.3 and 5.6 birds/10 ha respectively (Table 3).

Table 3. Bird densities, calculated as birds per 10 hectares, for selected species and the overall bird community within the 4 habitat types. (NO) indicates that the species was not observed in the habitat, (IN) indicates that the species was present but in insufficient numbers to calculate density.

	Habitat			
Species	**Early Succesional Pocosin**	**Early Successional Pine**	**Firebreak**	**Highmarsh**
Indigo Bunting	2.1	2.2	IN	NO
Common Yellowthroat	14.8	29.6	15.6	4.0
Gray catbird	IN	1.1	11.5	NO
Red-winged blackbird	IN	IN	6.3	15.6
Seaside sparrow	NO	NO	NO	3.3
Eastern meadowlark	4.0	NO	5.56	NO
Prairie warbler	1.6	IN	IN	NO
Eastern towhee	3.3	3.3	IN	IN
Blue grosbeak	IN	0.8	NO	MO
Field sparrow	1.3	1.4	NO	NO
Yellow-breasted chat	NO	3.7	NO	NO
Brown-headed cowbird	NO	3.4	IN	NO
Marsh wren	NO	NO	NO	5.0
Overall bird community	29.8	21.8	60.0	35.3

Table 4. Bird abundance and species richness for the 3 firebreak transects.

	Round 1	Round 2	Round 3	Average
Abundance	60	43	59	125.3
Species Richness	17	10	13	13.3

Weyerhaeuser Company J&W Management Tract and Adjacent Lands

Surveys along transects within this early successional pine plantation habitat resulted in the 723 detections from 35 species (Appendix IV). The most frequently detected species included the common yellowthroat, eastern towhee, and indigo bunting. These 3 species accounted for 54% of the total observations. Average species richness was 24 sp/round, and average bird abundance was 241 det/round (Table 5). Overall bird density was calculated at 21 birds/10 ha. Of the 8 species that were detected in sufficient numbers to calculate species specific densities, common yellowthroats reached the highest density level (29.6 birds/10 ha). Indigo buntings, gray catbirds, eastern towhees, blue grosbeaks, field sparrows, yellow-breasted chats, and brown-headed cowbirds at densities that ranged from 0.8 birds/10 ha for blue grosbeaks to 3.7 birds/10 ha for yellow-breasted chats (Table 3).

Table 5. Bird abundance and species richness for the 18 early successional pine plantation transects.

	Round 1	Round 2	Round 3	Average
Abundance	266	212	245	241
Species Richness	24	27	21	24

Swanquarter NWR

A total of 255 detections were made on 23 species within this highmarsh habitat. Red-winged blackbirds, marsh wrens and common yellowthroats accounted for nearly 70% of all detections (Appendix V). On average 85 birds of 12.3 species were detected on each survey round (Table 6). The density for the overall bird community was estimated to be 35.3 birds/10 ha. Red-winged blackbirds were found to be the most abundant species (15.6 birds/10 ha). Marsh wrens, common yellowthroats, and seaside sparrows occurred at densities of 5.0, 4.0, and 3.3 birds/10ha respectively (Table 3).

Table 6. Bird abundance and species richness for the 4 highmarsh transects.

	Round 1	Round 2	Round 3	Average
Abundance	76	93	86	85
Species Richness	12	14	11	12.3

Several species were observed along transects within the highmarsh habitat that were not detected in the other habitat types. Species observed that were unique the high marsh habitat include least bittern, king rail, marsh wren, seaside sparrow, and a single saltmarsh sharp-tailed sparrow.

DISCUSSION

There are likely greater numbers of Henslow's sparrows breeding within the coastal plain of North Carolina now than did historically (Pruitt, 1996). However, none were detected during this study. Surveys were conducted in early successional and highmarsh patches that were not known breeding locations for Henslow's sparrow, and had either not been systematically surveyed or land cover type had changed since the last surveys. There are several possible explanations for the absence of this species along study transects.

While Henslow's sparrows may use small patches of open land, populations using these areas are generally not large enough to sustain themselves and are unlikely to return in subsequent years (Pruitt, 1996). Habitat patch sizes of 100 ha or larger are more likely to sustain returning breeding populations of Henslow's sparrows (Herkert, 1994; Zimmerman, 1988). Many of the habitat patches used in this study were did not have an area of 100 ha.

Henslow's sparrows prefer open grassy or weedy fields (Hyde, 1939). Ideal breeding habitat consists of tall dense grass, litter layer, standing dead vegetation, availability of song perches, and little or no woody vegetation (Pruitt, 1996). In Missouri, Henslow's sparrows were found to use grassland patches that had dense patches of grass 0.2 -0.4 m tall and never greater that 0.5 m tall (Kahl et al, 1985). These measurements are for grass patch of greatest density and not the greatest height of grass within the patch. Habitat characteristics are probably the greatest factor for the absence of Henslow's sparrow on the study sites. All transects within the early successional pocosin and early successional pine plantation habitats had significant amounts of woody vegetation, and lacked what would be considered dense tall grass. Transects within the firebreak habitat were dominated by dense herbaceous vegetation. However, this vegetation was quite tall, well exceeding 0.5 m. Firebreak patches were also fragmented by roads and individual patches had area less than 100 ha.

Some researchers suggest that areas with mineral soil types may support vegetation preferred by Henslow's sparrows over that supported in organic soil types (Watts pers. com., 2001). The majority of sites used in this study consisted of organic type soils. Study sites with mineral soils lacked other breeding habitat characteristics.

While no Henslow's sparrows were detected, the open lands survey did support diverse bird communities. The early successional pine plantation habitat appears to support an early successional/shrub breeding community. Early successional pocosin and firebreak habitats also supported an early successional/shrub breeding community skewed towards a grassland breeding community and the highmarsh habitat supported a wetland/saltmarsh breeding community.

The early successional pine plantation habitat supported many species of birds that are indicative of the early successional/shrub breeding communities and was the only habitat in which yellow-breasted chats were detected (Appendix 4). This habitat also had the greatest species richness. Watts et. al. (1997) found that species richness is greater in older shrub habitats than in younger grassland habitats.

The early successional pocosin and firebreak habitat within Pocosin Lakes NWR also supported many species associated with an early successional/shrub breeding community, but also supported species more associated with grassland breeding communities, such as grasshopper sparrows and many eastern meadowlarks (Appendix 2 and 3). These two species decline dramatically as a grassland matures into a shrub type habitat (Watts et. al., 1997). Species richness was also found to be lower in these habitats than in the early successional pine plantation habitat.

Highmarsh habitats within the Swanquarter NWR supported many species form the wetland/saltmarsh breeding community. Species, which are considered wetland/saltmarsh breeders, observed only in this habitat included least bittern, king rail, Virginia rail, seaside sparrow, marsh wren and saltmarsh sharp-tailed sparrow. The presence of the saltmarsh sharp-tailed sparrow was unexpected. While this species winters in the area, there are no confirmed breeding records in North Carolina. The site of observation is approximately 280km south of the nearest know breeding location on the Delmarva Peninsula of Virginia. Attempts were made, by the authors to relocate this individual, but searches were unsuccessful.

The habitats surveyed supported a variety of avian species, but the Henslow's sparrow was not among them. Lack of suitable habitat is the primary reason for there absence. Presently there is a large breeding population within 5km of our western most study site, but this population is utilizing the extremely large patches of almost ideal habitat on the Voice of America antennae fields (Lynch and LeGrand, 1985; Wright, 1998).

ACKNOWLEDGEMENTS

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Appendix I. List of species detected during transect surveys with scientific name and mode of migration

Common Name	Scientific Name	Migration Mode
Least bittern	*Ixobrychus exilis*	Neotropical migrant
Green heron	*Butorides virescens*	Neotropical migrant
King rail	*Rallus elegans*	Temperate migrant
Virginia rail	*Rallus limicola*	Temperate migrant
Greater yellowlegs	*Tringa melanoleuca*	Temperate migrant
Killdeer	*Charadrius vociferus*	Temperate migrant
Northern bobwhite	*Colinus virginianus*	Resident
Mourning dove	*Zenaida macroura*	Temperate migrant
Turkey vulture	*Cathartes aura*	Temperate migrant
Red-tailed hawk	*Buteo jamaicensis*	Temperate migrant
Yellow-billed cuckoo	*Coccyzus americanus*	Neotropical migrant
Belted kingfisher	*Ceryle alcyon*	Resident
Northern flicker	*Colaptes auratus*	Temperate migrant
Common nighthawk	*Chordeiles minor*	Neotropical migrant
Chimney swift	*Chaetura pelagica*	Neotropical migrant
Ruby-throated hummingbird	*Archilocus colubris*	Neotropical migrant
Eastern kingbird	*Tyrannus tyrannus*	Neotropical migrant
Great-crested flycatcher	*Myiarchus crinitus*	Neotropical migrant
Eastern wood-pewee	*Contopus virens*	Neotropical migrant
Acadian flycatcher	*Empidonax virescens*	Neotropical migrant
Blue jay	*Cyanocitta cristata*	Temperate migrant
American crow	*Corvus brachyrhynchos*	Resident
European starling	*Sturnus vulgaris*	Resident
Brown-headed cowbird	*Molothrus ater*	Resident
Red-winged blackbird	*Agelaius phoeniceous*	Temperate migrant
Eastern meadowlark	*Sternella magna*	Temperate migrant
Orchard oriole	*Icterus spurius*	Neotropical migrant
Baltimore oriole	*Icterus galbula*	Neotropical migrant
Common grackle	*Quiscalus quiscula*	Temperate migrant
American goldfinch	*Carduelis tristis*	Temperate migrant
Grasshopper sparrow	*Ammodramus savannarum*	Temperate migrant
Saltmarsh sharp-tailed sparrow	*Ammodramus caudacutus*	Temperate migrant
Seaside sparrow	*Ammodramus maritimus*	Temperate migrant
Chipping sparrow	*Spizella passerina*	Temperate migrant
Field sparrow	*Spizella pusilla*	Temperate migrant
Song sparrow	*Melospiza melodia*	Temperate migrant
Eastern towhee	*Pipilo erythrophthalmus*	Temperate migrant
Northern cardinal	*Cardinalis cardinalis*	Resident

Appendix I. Continued

Common Name	Scientific Name	Migration Mode
Blue grosbeak	*Guiraca caerulea*	Neotropical migrant
Indigo bunting	*Passerina cyanea*	Neotropical migrant
Summer tanager	*Piranga rubra*	Neotropical migrant
Purple martin	*Progne subis*	Neotropical migrant
Barn swallow	*Hirundo rustica*	Neotropical migrant
Tree swallow	*Tachycineta bicolor*	Temperate migrant
Northern rough-winged swallow	*Stelgidopteryx ruficollis*	Neotropical migrant
White-eyed vireo	*Vireo griseus*	Neotropical migrant
Prairie warbler	*Dendroica discolor*	Neotropical migrant
Common yellowthroat	*Geothlypis trichas*	Neotropical migrant
Yellow-breasted chat	*Icteria virens*	Neotropical migrant
Gray catbird	*Dumetella carolinensis*	Neotropical migrant
Brown thrasher	*Toxostoma rufum*	Temperate migrant
Carolina wren	*Thryothorus ludovicianus*	Resident
Marsh wren	*Cisothorus palustris*	Temperate migrant
Eastern tufted titmouse	*Baeolophus bicolor*	Resident
Blue-gray gnatcatcher	*Polioptila caerulea*	Neotropical migrant

Appendix II. List of species and numbers of birds detected during each survey round along the 7 transects within the early successional pocosin habitat.

Common Name	Round 1	Round 2	Round 3	Total
Killdeer	0	0	2	2
Northern bobwhite	9	9	13	31
Mourning dove	5	2	7	14
Yellow-billed cuckoo	1	0	0	1
Belted kingfisher	0	0	1	1
Common nighthawk	2	1	0	3
Eastern kingbird	2	2	3	7
Great-crested flycatcher	0	0	1	1
Red-winged blackbird	4	1	5	10
Eastern meadowlark	15	16	19	50
Orchard oriole	2	0	0	2
Baltimore oriole	0	0	1	1
Common grackle	8	5	0	13
Grasshopper sparrow	3	0	0	3
Chipping sparrow	2	0	0	2
Field sparrow	4	7	5	16
Song sparrow	0	0	2	2
Eastern towhee	12	9	21	42
Blue grosbeak	3	2	2	7
Indigo bunting	9	5	12	26
Barn swallow	0	4	3	7
White-eyed vireo	0	1	0	1
Prairie warbler	14	2	0	16
Common yellowthroat	37	26	42	105
Gray catbird	2	2	7	11
Brown thrasher	2	0	0	2
Total	136	94	146	376

Appendix III. List of species and numbers of birds detected during each survey round along the 3 transects within the firebreak habitat.

Common Name	Round 1	Round 2	Round 3	Total
Green heron	0	1	0	1
Northern bobwhite	1	0	0	1
Mourning dove	2	0	2	4
Yellow-billed cuckoo	1	0	0	1
Eastern kingbird	2	2	1	5
Great-crested flycatcher	1	0	0	1
Brown-headed cowbird	0	0	1	1
Red-winged blackbird	6	5	6	17
Eastern meadowlark	3	5	7	15
Orchard oriole	2	3	0	5
Common grackle	3	2	1	6
Eastern towhee	4	3	2	9
Northern cardinal	2	0	0	2
Indigo bunting	1	0	1	2
Purple martin	0	0	1	1
Barn swallow	2	3	2	7
Northern rough-winged swallow	0	0	5	5
Prairie warbler	5	0	0	5
Common yellowthroat	18	12	12	42
Gray catbird	6	7	18	31
Carolina wren	1	0	0	1
Total	60	43	59	162

Appendix IV. List of species and numbers of birds detected during each survey round along the18 transects within the early successional pine plantation habitat.

Common Name	Round 1	Round 2	Round 3	Total
Killdeer	4	4	2	10
Northern bobwhite	5	3	3	11
Mourning dove	0	2	7	9
Turkey vulture	2	0	0	2
Red-tailed hawk	0	1	0	1
Common nighthawk	0	1	0	1
Chimney swift	5	8	43	56
Ruby-throated hummingbird	0	1	1	2
Eastern kingbird	3	4	6	13
Great-crested flycatcher	0	2	0	2
Eastern wood-pewee	6	2	2	10
Acadian flycatcher	1	0	0	1
Blue jay	0	1	0	1
American crow	0	0	2	2
Brown-headed cowbird	13	3	0	16
Red-winged blackbird	1	0	0	1
American goldfinch	2	4	5	11
Field sparrow	21	12	16	49
Song sparrow	0	3	0	3
Eastern towhee	42	31	34	107
Blue grosbeak	10	11	6	27
Indigo bunting	23	28	23	74
Summer tanager	2	1	0	3
Barn swallow	0	4	11	15
Tree swallow	1	0	4	5
White-eyed vireo	0	1	1	2
Prairie warbler	1	0	1	2
Common yellowthroat	81	64	64	209
Yellow-breasted chat	17	5	2	24
Gray catbird	11	12	11	34
Brown thrasher	1	1	0	2
Carolina wren	11	2	1	14
Eastern tufted titmouse	2	0	0	2
Blue-gray gnatcatcher	1	0	0	1
Eastern bluebird	0	1	0	1
Total	266	212	245	723

Appendix V. List of species and numbers of birds detected during each survey round along the 4 transects within the highmarsh habitat.

Common Name	Round 1	Round 2	Round 3	Total
Least bittern	0	0	1	1
Green heron	0	0	1	1
King rail	0	0	1	1
Virginia rail	0	3	0	3
Greater yellowlegs	0	4	0	4
Killdeer	0	4	2	6
Mourning dove	1	0	0	1
Northern flicker	1	1	0	2
Chimney swift	0	2	0	2
Ruby-throated hummingbird	0	0	1	1
Eastern kingbird	1	4	1	6
Great-crested flycatcher	1	0	0	1
European starling	1	0	0	1
Red-winged blackbird	39	35	39	113
Common grackle	1	0	0	1
Saltmarsh sharp-tailed sparrow	0	1	0	1
Seaside sparrow	10	7	7	24
Eastern towhee	0	1	0	1
Barn swallow	3	2	0	5
Northern rough-winged swallow	0	9	5	14
Common yellowthroat	13	10	6	29
Carolina wren	1	0	0	1
Marsh wren	4	10	22	36
Total	76	93	86	255