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Grassland and Shrubland Birds of Gettysburg National Military Park and Eisenhower National Historic Site: Current Status and Management Recommendations

Technical Report NPS/NER/NRTR—2007/102



ON THE COVER

Eastern meadowlark (*Sturnella magna*)

Photographs by: Bob Moul

Grassland and Shrubland Birds of Gettysburg National Military Park and Eisenhower National Historic Site: Current Status and Management Recommendations

Technical Report NPS/NER/NRTR—2007/102

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Summary

Gettysburg National Military Park (NMP) and Eisenhower National Historic Site (NHS) were surveyed for grassland birds during the 2005 breeding season. These parks currently maintain a total of approximately 1,220 ha (3,015 ac) of grassland habitats within a mosaic of cultivated fields and woodlands. The grasslands are hayfields managed through agricultural leases and fields maintained by the National Park Service (NPS). Most grasslands are composed of introduced cool-season grasses, but Gettysburg NMP maintains a few fields dominated by switchgrass (*Panicum virgatum*) and is creating additional warm-season grasslands. Hayfields managed through agricultural leases support few grassland birds. The most numerous grassland bird communities are found between Seminary and Cemetery ridges in fields managed by the NPS. The parks discourage hay harvesting before July in all fields in an effort to improve the reproductive success of grassland birds.

Shrub-dominated habitats were scarce in both parks. A few areas that were harvested recently for timber supported early successional communities in Gettysburg NMP. Other shrublands were limited to narrow corridors (<10 m [32 ft]) bordering fields and drainages. No shrublands were present on Eisenhower NHS, but an abandoned pasture along Willoughby Run was reverting into a mesic shrubland.

Four species of obligate grassland birds were recorded during the 2005 surveys. A population of approximately 130 bobolinks (*Dolichonyx oryzivorus*) was primarily restricted to grasslands between Seminary and Cemetery ridges maintained by the NPS and a hayfield on Eisenhower NHS. This population is large for southeastern Pennsylvania and the surrounding region. Eastern meadowlarks (*Sturnella magna*) were most numerous in the same fields occupied by bobolinks but smaller numbers were scattered in other grasslands. Grasshopper sparrows (*Ammodramus savannarum*) were locally distributed in Conservation Reserve Program fields and other grasslands with more open vegetation. Savannah sparrows (*Passerulus sandwichensis*) were limited to one disturbed area undergoing conversion to warm-season grasses. When compared with other cultural parks in this region, the Gettysburg-Eisenhower complex supports a relatively abundant grassland bird community. This community is restricted to a portion of existing grassland habitats, but the potential exists to support a more diverse and abundant grassland avifauna.

The following recommendations provide the most immediate benefits for breeding grassland birds in these parks under the current habitat conditions and management strategies. These recommendations are based on the assumption that the current policy of delayed mowing continues in both parks: improve grassland composition on leased hayfields; increase extent of early successional stages of grasslands; reduce fragmentation of grassland habitats; and improve grassland diversity by creating additional communities of native warm-season grasses.

Because shrublands are currently scarce in both parks, the only recommendation is directed towards creating and maintaining shrub-dominated successional habitats: Explore opportunities for creating shrubby successional habitats in both parks.

Introduction

At the time of European settlement, the status of grassland birds in eastern North America was uncertain. While much of the region was forested, the presence of heath hens (*Tympanuchus cupido cupido*) in a range extending from New England south through the Mid-Atlantic states (Forbush 1927) indicates that extensive natural grasslands were present along the Coastal Plain. Grasslands probably existed elsewhere as a result of fire-maintained habitats managed by Native Americans (Askins 2000). These grasslands undoubtedly supported entire communities of grassland birds. As eastern North America was settled by Europeans, the original forests were replaced by rural agriculture, and populations of most grassland birds expanded, reaching peak levels during the nineteenth century. Where rural agricultural activities were not economically feasible, however, the farms were replaced by second-growth woodlands and the first local declines in grassland bird populations occurred (Askins 2000).

During the decades of the twentieth century, grassland birds exhibited the most consistent population declines of any group of North American birds (Peterjohn and Sauer 1999). Anecdotal evidence suggests these declines occurred for nearly a century, prompting considerable concern about the future of these species (Vickery and Herkert 1999; Askins 2000). While the widespread conversion of grasslands into other habitats contributed to these population declines, other factors, such as habitat fragmentation and unfavorable mowing regimes, were also implicated (Vickery et al. 1999). The plight of grassland birds has heightened awareness of the need for concerted conservation actions to reverse these chronically declining population trends.

While grassland birds have become the focus of increased conservation activities, the status of birds occupying shrubland habitats has received relatively little attention (Hunter et al. 2001). Yet in eastern North America, shrubland birds have also exhibited consistent population declines during the past 40 years (Pardieck and Sauer 2001). These population declines primarily reflect large-scale changes in land use patterns during the previous century. Large areas of marginal farmland were abandoned and underwent secondary succession during the first half of the twentieth century, producing abundant habitats dominated by shrubs and small trees favored by shrubland birds. The maturation of these habitats, combined with fire suppression policies, allowed shrublands to succeed into mature forests and shrubland bird communities were replaced by woodland birds (Hunter et al. 2001; Lorimer 2001).

The National Park Service (NPS) can potentially contribute to grassland and shrubland bird conservation in the Mid-Atlantic Region. The NPS maintains a number of historic sites and former battlefields managed for their cultural significance with open landscapes recreating land use patterns existing at the times of the historical events. These open landscapes are frequently managed grasslands which could be maintained to benefit grassland birds, although some parks also support successional habitats that could be managed for shrubland birds.

In 2005, the NPS initiated a project exploring the potential of “cultural parks” to support significant breeding grassland and shrubland bird communities. This project involved parks within three NPS Inventory and Monitoring Program (I&M) networks, Mid-Atlantic, National Capital, and Eastern Rivers and Mountains. Five parks were selected for the focus of this study,

all of which maintain open landscapes for interpretation of historic events. Most parks were selected because they represent the most extensive grassland habitats within their networks, although some parks also support acreage of shrubby successional habitats. The five parks included in this study are: Antietam National Battlefield, Fort Necessity National Battlefield, Gettysburg National Military Park, Manassas National Battlefield, and Monocacy National Battlefield.

This report summarizes the status of grassland and shrubland bird communities in Gettysburg National Military Park (NMP) and the adjacent Eisenhower National Historic Site (NHS). The distribution and abundance of breeding birds were determined from surveys conducted during summer 2005 with the intent of developing parkwide estimates of population sizes. These population estimates were placed within the context of other parks within these NPS networks and regional populations to indicate the relative value of the Gettysburg-Eisenhower park complex for grassland and shrubland bird communities. This report provides recommendations for improving management for grassland and shrubland bird populations within these parks based on results of bird population surveys, an assessment of current habitat conditions, and an assessment of current habitat management strategies.

Study Area

Gettysburg (NMP) and Eisenhower (NHS) are located adjacent to the town of Gettysburg in Adams County, Pennsylvania (Figure 1). These parks are situated within a mostly rural agricultural landscape characterized by hilly terrain where farm fields are interspersed with woodlots, riparian corridors, scattered residences, and small villages. New residential development is most prevalent near Gettysburg and along State Route (SR) 15, which is beginning to change the rural character of lands near the town. Additional development will likely occur, which may accelerate changes to prevalent land use patterns around the parks.

Gettysburg NMP consists of approximately 2,424 ha (5,990 ac) of woodlands, grasslands, cultivated fields, mowed lawns, monuments, and buildings. Elevation range is 122-239 m (400-785 ft) above sea level on gently rolling terrain within the Piedmont physiographic strata. The park is drained by a number of small headwater tributary streams within the Monocacy River Watershed. Eisenhower NHS is adjacent to Gettysburg NMP and comprises 279 ha (690 ac) of agricultural lands, residences, small woodlots, and a riparian zone along Willoughby Run. Most fields in Eisenhower NHS are cultivated or pastures. Of the total acreage in both parks, approximately 1,220 ha (3,015 ac) are in grasslands and 33 ha (82 ac) are in shrublands.

While Gettysburg NMP is considered a single administrative unit, the park was subdivided into the following areas for the purposes of this study (Figure 1):

East Cavalry Field - The East Cavalry Battlefield Site located several miles east of Gettysburg and north of SR 116 (Figure 2).

North Unit - All park lands located north of SR 116 and adjacent to Gettysburg including McPherson Ridge, Oak Ridge, the Peace Memorial, and Barlow Knoll (Figure 3).

Cemetery Hill - Park lands located east of SR 134 and west of SR 15. Also adjacent to Gettysburg, this area includes Cemetery Hill, the Gettysburg National Cemetery, Benner's Hill, and fields along Wright Avenue in the southeastern corner of the park (Figure 4).

Seminary Ridge - Park lands west of Emmitsburg Road and south of SR 116; this area includes Seminary Ridge, a portion of Warfield Ridge, and a portion of the South Cavalry Field (Figure 5).

Round Top-Wheatfield - This area is bordered by Emmitsburg Road, SR134, and SR 15 and includes Big Round Top, Little Round Top, the Wheatfield, the Peach Orchard, and the Pennsylvania Memorial (Figure 5).

A general management plan has been in place for several years and describes the specific management objectives within Gettysburg NMP (GETT 1999). Grassland habitats are maintained by mowing or haying and these activities are timed to avoid the peak breeding seasons for grassland birds. Many grasslands are managed through agricultural leases although some are maintained by NPS personnel. Other management activities, such as the removal of trees from specific sites to produce open landscapes that existed at the time of the battle, may produce additional grassland or shrubland habitats in the future. Shrubby habitats are primarily narrow corridors (<10 m [32 ft]) bordering fields and small streams, although some recently harvested woodlands have initially regenerated into disturbed shrubby successional habitats. Shrubland habitats are not actively maintained at this time.

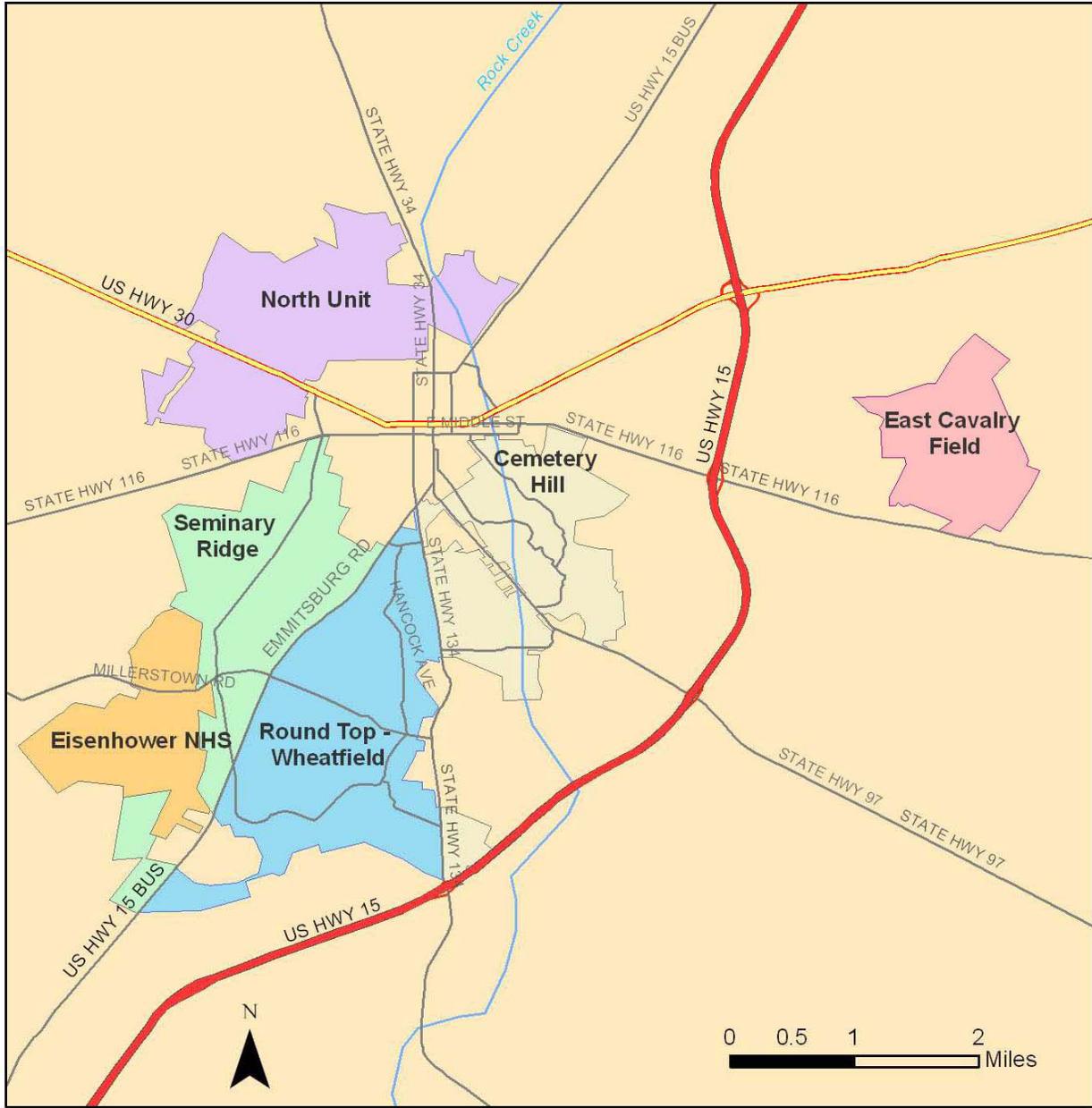


Figure 1. Map of Gettysburg National Military Park and the Eisenhower National Historic Site, including units of the Gettysburg Park cited in the text.



Figure 2. Map of the East Cavalry unit of Gettysburg National Military Park.

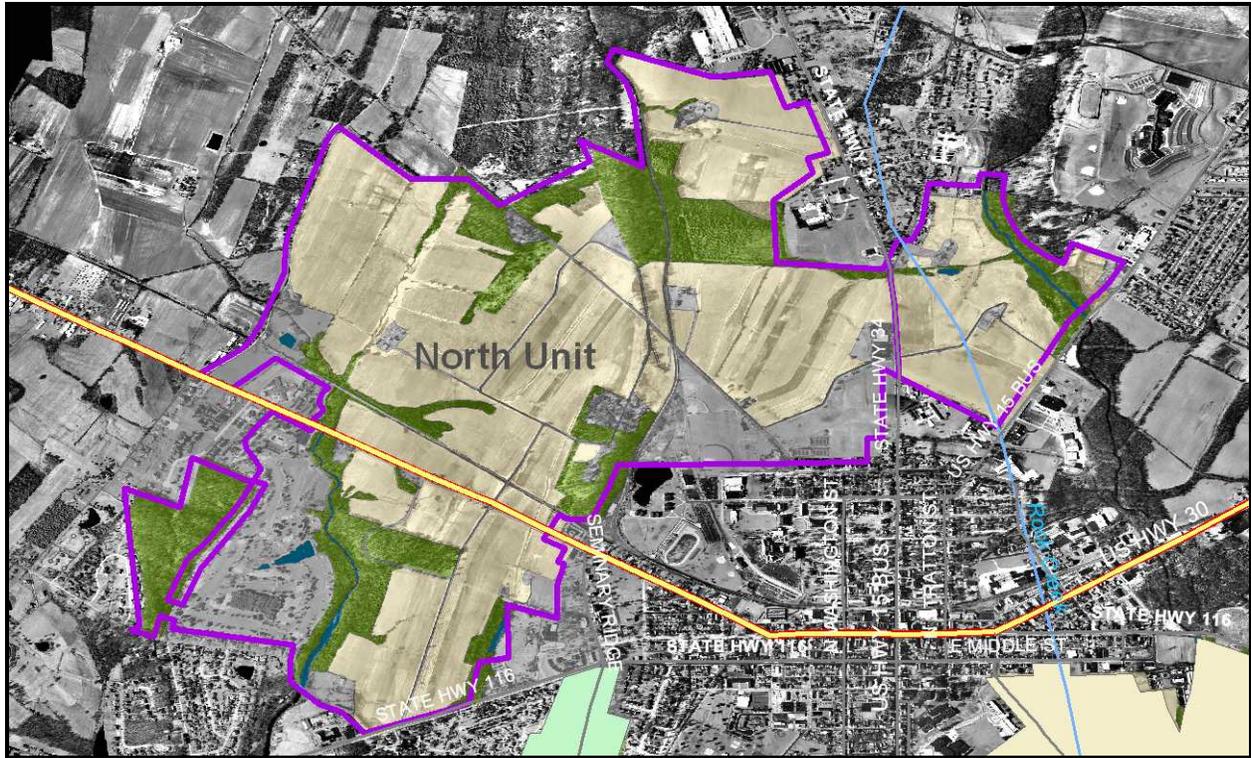


Figure 3. Map of the North unit of Gettysburg National Military Park.

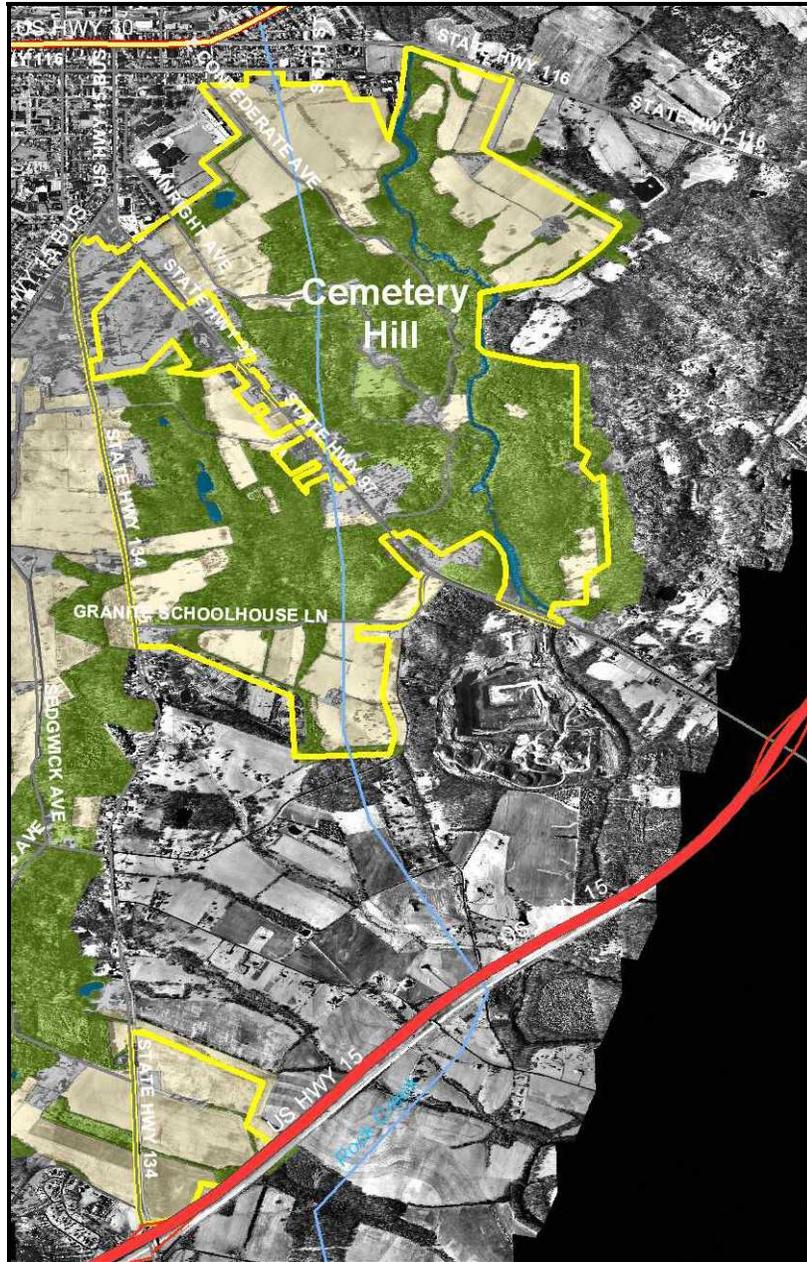


Figure 4. Map of the Cemetery Hill unit of Gettysburg National Military Park.

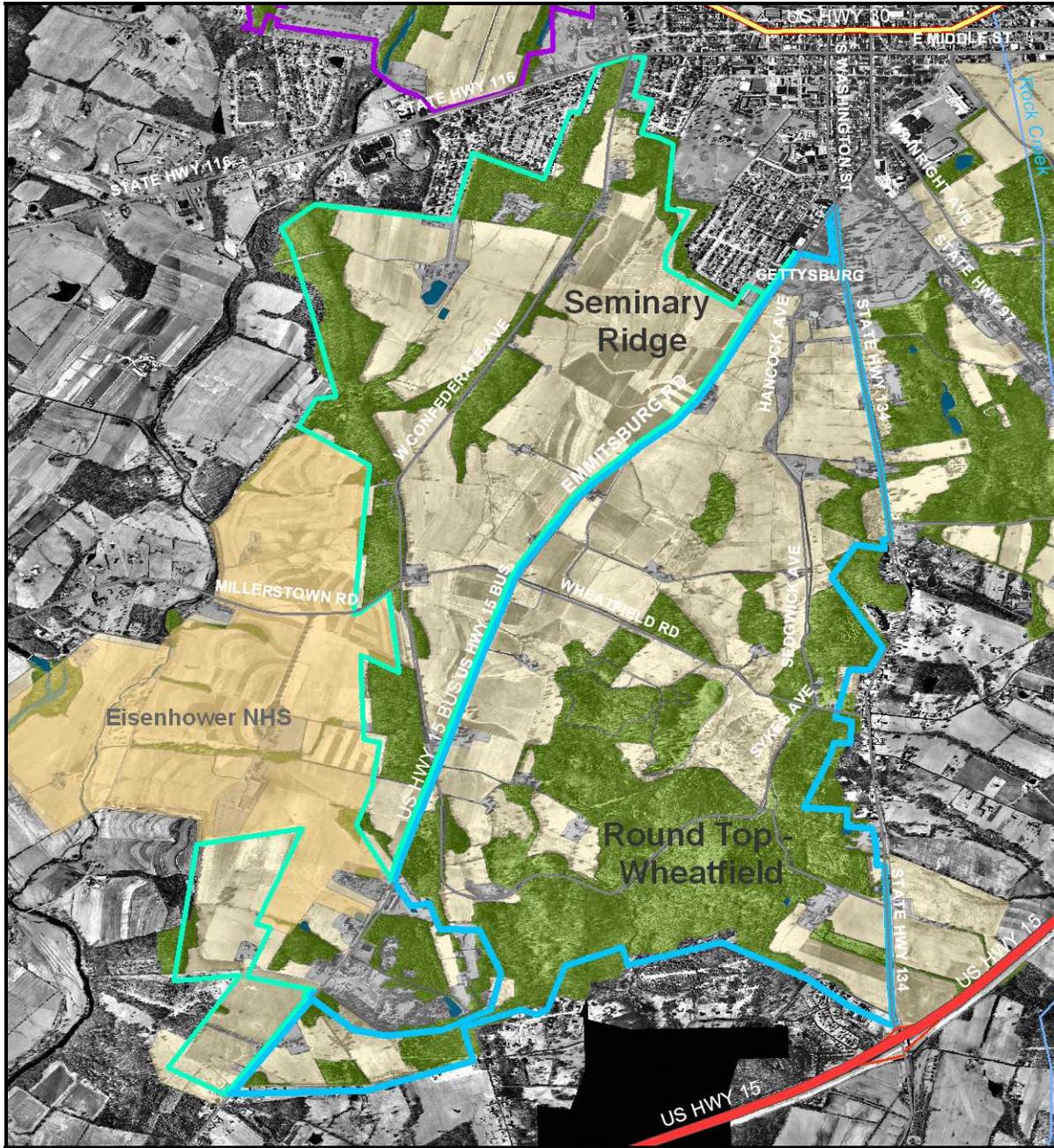


Figure 5. Map of the Seminary Ridge and Round Top-Wheatfield units of Gettysburg National Military Park and the Eisenhower National Historic Site.

Most grasslands in both parks are planted with introduced cool-season grasses. The composition and density of grasses varies among fields depending upon their management history and preferences of the farmers holding agricultural leases. Many leased hayfields are dense monocultures of timothy (*Phleum pratense*) or orchard grass (*Dactylis glomerata*). Grasslands maintained by the NPS and some hayfields have a mixed composition including orchard grass, fescues (*Festuca* spp.), brome grasses (*Bromus* spp.), timothy, bluegrasses (*Poa* spp.), and other species. While many fields supported only grasses, some are invaded by fairly extensive patches of Canada thistle (*Cirsium arvense*). Most hayfields were not disturbed by mowing prior to July 1, 2005, although some mowing occurred after that date. Pastures in both parks experience variable grazing intensity, but most are heavily grazed with only short vegetation remaining during the growing season.

Warm-season grasslands are currently restricted to Gettysburg, where a few fields were planted to dense monocultures of switchgrass (*Panicum virgatum*). Recently, the park has started to convert several cool-season grasslands to warm-season communities. During 2005, some fields were sprayed with herbicides to remove the existing vegetation; these fields were not surveyed due to the absence of grassland communities that summer. One field was previously treated with herbicides and supported an early-successional grassland community where open ground was interspersed with annual forbs and grasses and this field was included in the field surveys.

In 2005, shrublands were restricted to Gettysburg NMP where recent timber harvesting activities created some disturbed successional habitats, but these sites could not be effectively surveyed because of the presence of large limbs, brush piles, and other obstacles which prevented complete area searches. However, one area of disturbed successional habitats along the base of Warfield Ridge was surveyed. This area supported scattered shrubs and small saplings, primarily multiflora rose (*Rosa multiflora*), blackberries (*Rubus* spp.), cherries (*Prunus* spp.), and other species. The herbaceous flora was relatively dense and composed of perennial forbs including goldenrods (*Solidago* spp.), asters (*Aster* spp.), various grasses, and many other species.

Methods

Yahner et al. (2001) conducted inventories of Gettysburg NMP and Eisenhower NHS with the goal of identifying 90% of the bird species occurring in these parks and determining their breeding status and spatial distributions. Bird inventories consisted of fixed-distance and unlimited-distance point counts, vehicular road surveys for diurnal raptors and vultures, nocturnal surveys for owls in both parks, and a survey for loggerhead shrikes (*Lanius ludovicianus*) in Eisenhower NHS. These surveys were conducted throughout the year over a 2-year period. Point count survey sites were randomly selected from a systematic grid system established for each park, with 75 points in Gettysburg NMP and 15 in Eisenhower NHS. These points were also stratified by major habitat cover type, spatial location (interior vs. edge), and elevation so that the number of points were representative of the habitats present within the park. This inventory produced a list of bird species and seasonal measures of relative abundance expressed as mean numbers of birds detected per point. These results provide no estimates of total breeding bird populations occupying grassland or shrublands in either park.

Shrubland and grassland habitats were identified from information provided by the park's Resource Manager and a visual inspection of both parks. Bird surveys were conducted in Gettysburg NMP on the following dates: 19 and 26 May; 9, 13-15, and 21 June, and 1 July 2005. Bird surveys in Eisenhower NHS were conducted on 23 June 2005. The fields were surveyed using the area search methodology of Stewart and Kantrud (1972). The initial survey path was around the perimeter and located 50 m (164 ft) inside and parallel to the field boundary, deviating ± 50 m (164 ft) from this path as necessary to adequately survey all habitats. Small fields were surveyed from a single path around the perimeter. In larger fields, additional survey paths were located as necessary inside of the initial path until all habitats were located within 50 m of one survey path. Each area search was conducted until the field was completely surveyed. Survey time generally varied proportionally with field size but was also influenced by field shape and the numbers of birds present. Fields <10 ha (25 ac) in size were surveyed in approximately 30 minutes, while the largest fields required 1-2 hours to complete each area search. Walking speeds were normally 2-3 km (1.25-1.85 mi) per hour but could vary depending on the number of birds present in a field.

Grassland surveys focused on obligate grassland birds as defined by Vickery et al. (1999). Birds associated with wooded edges and other habitats, habitat generalists such as crows (*Corvus* spp.), and aerial insectivores were not included. In shrubby successional habitats, bird surveys tallied all species occupying these habitats but did not include aerial insectivores and other species observed only in flight. When encountered during area searches, each bird was identified to species and gender whenever possible based on plumage and/or behavioral traits. When gender could not be positively assigned in the field, individuals were classified as unknown. Each time an individual bird was detected, it was recorded up to a maximum of five detections. One "detection" was defined as a distinct vocal cue such as a song or call note, or visual cues such as a bird observed on a perch or in flight.

The area search methodology was intended to survey habitats as thoroughly as possible but some birds were undoubtedly missed during these surveys. The Chao 1 (bias corrected) estimator (Chao 1984) was used to develop population estimates that incorporated estimates of birds

present but not detected during these surveys. Numbers of individuals noted by one detection and two detections were input into the Chao 1 formulas to develop estimates of total population size, variance, and 95% confidence intervals for the more numerous species. Species represented by small numbers lacked sufficient sample sizes to use the Chao 1 estimator; for these species the observed totals are presented without correction for detectability.

Results

Gettysburg National Military Park Grassland Birds

During 2005, breeding grassland birds were most numerous in fields maintained by NPS personnel and fields dedicated to the Conservation Reserve Program (CRP). Hayfields managed under agricultural leases tended to be dense monocultures of cool-season grasses designed to maximize hay production. This vegetative cover was generally too dense to support grassland birds, although red-winged blackbirds (*Agelaius phoeniceus*) were plentiful in some fields. The distribution of grassland habitats and the grassland avifauna in Gettysburg NMP during 2005 is summarized below.

East Cavalry Field

Most agricultural lands were devoted to cultivated crops. Grasslands tended to be fairly narrow (<50 m [164 ft] wide) strips bordering the margins of cultivated fields, along small intermittent drainages, near monuments, and along contours. These grassy strips were too narrow to support breeding grassland birds. The few breeding grassland birds noted in this area were restricted to a cool-season pasture located on an easement property (Table 1).

North Unit

This portion of the park also had considerable acreage devoted to cultivated fields. Except for narrow (<30 m [164 ft] wide) grassy corridors, grasslands were mostly absent between McPherson Ridge and the Peace Memorial. Grasslands near the administration building off SR 34 include fields planted to switchgrass and CRP fields where the vegetative cover was too dense to support grassland birds. Hayfields near Barlow Knoll had potential breeding habitats, but these fields were surveyed in early July after they had been recently mowed and only a few eastern meadowlarks (*Sturnella magna*) remained in the area.

Cemetery Hill

The Cemetery Hill area was primarily wooded. The CRP field at Benner Hill supports a small population of grasshopper sparrows (*Ammodramus savannarum*) and eastern meadowlarks, but this field had been recently sprayed to control Canada thistles. This spraying may have influenced the numbers of grassland birds detected during the survey. A similar grassland bird community occupied a lightly grazed pasture near Culp's Hill. The CRP fields along Wright Avenue supported many invasive weeds as well as grasses, but these fields were also occupied by small populations of grasshopper sparrows and meadowlarks.

Round Top-Wheatfield

From the perspective of grassland birds, some of the best grassland habitats in the park were located north of Wheatfield Road in fields maintained by the NPS. Sizable populations of bobolinks (*Dolichonyx oryzivorus*) and eastern meadowlarks occupied several fields dominated by cool-season grasses extending from the Pennsylvania Memorial south to United States

Table 1. Distribution of obligate grassland birds within Gettysburg National Military Park.

Species	East Calvary	North Unit	Cemetery Hill	Seminary Ridge	Round Top-Wheatfield	Total
savannah sparrow (males)				8		8
grasshopper sparrow (males)	4		7	8	7	26
grasshopper sparrow (females/unknown)			4	6	2	12
bobolink (males)	5			18	35	58
bobolink (females)	2			11	22	35
eastern meadowlark (males)	3	2	5	5	29	44
eastern meadowlark (females/unknown)			2	1	27	30

Avenue. Smaller numbers of grasshopper sparrows were found in a single field along Hancock Avenue where the grasses were shorter and more open.

Forested habitats predominated south of Wheatfield Road, especially in the vicinity of Big Round Top and Little Round Top. Grasslands near Wheatfield Road and adjacent to Emmitsburg Road were mostly hayfields managed by agricultural leases where the grassy cover was too dense to support grassland birds. However, a few fields maintained by the NPS supported small numbers of the same grassland birds found elsewhere in this area.

Seminary Ridge

In the northern portion of this area, several large fields were being converted from cool-season to warm-season grasses during 2005. Most existing grassy vegetation had been eliminated but the new vegetation was not yet established; hence, these fields generally provided unsuitable habitats for grassland birds that year. However, one field had been treated previously and supported sparse cover consisting of scattered annual forbs and grasses among patches of bare ground. These early successional grasslands supported the only breeding savannah sparrows (*Passerculus sandwichensis*) in Gettysburg NMP and small numbers of grasshopper sparrows.

Elsewhere within this portion of the park many grasslands were hayfields managed by agricultural leases with dense grassy cover that supported few grassland birds. However, several CRP fields near Millerstown Road and north towards the North Carolina Memorial supported moderate numbers of bobolinks and smaller populations of eastern meadowlarks and grasshopper sparrows. Overall, the Seminary Ridge area ranked second behind the Round Top-Wheatfield area for the numbers of breeding grassland birds within Gettysburg NMP (Table 1).

As indicated above, grassland birds were not uniformly distributed across Gettysburg NMP but showed distinct habitat preferences. These habitat preferences are described below. Parkwide population estimates are provided for each species, including a discussion of the factors potentially influencing the accuracy of these estimates:

Bobolink: Bobolinks were the most numerous breeding grassland birds counted during surveys in Gettysburg NMP. Males were very conspicuous as they performed their courtship behaviors throughout the breeding season, reflecting their strongly polygynous mating system as they

attempted to attract as many females as possible into their territories (Martin and Gavin 1995). The estimate of 58 males within Gettysburg was probably close to the true numbers present during 2005 (Table 2). Females were less conspicuous and detected more regularly later in the breeding season when they likely had young in the nest. They frequently responded to the presence of the observer within the grasslands by flying towards the observer. Hence, female bobolinks were probably undercounted and their population estimates were highly variable (Table 2). After accounting for detectability, the parkwide estimate was 106 breeding bobolinks during 2005. The young bobolinks fledged after the surveys were completed and did not complicate breeding population size estimation.

Most breeding bobolinks were encountered in grasslands managed by the NPS. These fields created relatively large tracts (generally >40 ha [100 ac]) of contiguous grasslands dominated by mixed cool-season grasses, primarily fescues, brome grass, bluegrass, and orchard grass. The annual mowing regime maintained a moderate density of grassy cover but created a fairly dense litter layer along the ground. These management activities produced preferred bobolink breeding habitats in these fields (Martin and Gavin 1995). Breeding bobolinks were concentrated within the valley between Seminary and Cemetery ridges south to Wheatfield and Millerstown roads. Away from this valley, the only other breeding pairs were noted in the East Cavalry unit.

Eastern Meadowlark: While singing meadowlarks were very conspicuous and easy to detect, silent meadowlarks posed greater challenges. Breeding females were regularly flushed during area searches, and in a few cases they were accompanied by recently fledged young. Because their initial broods fledged during June (Brauning 1992; Robbins and Blom 1996), silent meadowlarks flushed during the last half of the month probably included many young that could not be reliably distinguished from breeding females. Hence, parkwide population estimates for eastern meadowlarks should be viewed cautiously. The estimated 44 males present during 2005 are probably close to the actual breeding population (Table 2). The estimate of non-singing birds (females and unknown ages) was variable (Table 2). Given the frequent polygynous mating within many meadowlark populations (Lanyon 1995), the ratio of breeding females to males was not necessarily 1:1. A breeding population of 90-100 meadowlarks was a reasonable estimate for the entire park.

Eastern meadowlarks had similar habitat preferences as bobolinks, preferring grasslands with well-developed litter layers (Lanyon 1995). Meadowlarks were most numerous in large contiguous tracts of grasslands but were also found in smaller isolated fields. In Gettysburg NMP, meadowlarks were decidedly most numerous in the valley between Seminary and Cemetery ridges; however, smaller numbers of territorial males and pairs were found throughout the park (Table 2).

Grasshopper Sparrow: Unlike the previous species, grasshopper sparrows preferred grasslands with more open vegetation and a less-well-developed litter layer (Whitmore 1979). Their preferred habitats were locally distributed and small numbers of grasshopper sparrows occurred wherever these habitats were found during 2005. Some areas occupied by this species included CRP fields along Wright Avenue and at Benner Hill, the fields being converted to warm-season grasses near Seminary Ridge, the pasture on Culp's Hill, and one field near the Pennsylvania Memorial. However, grasshopper sparrows were absent from fields preferred by bobolinks and

Table 2. Grassland bird population estimates for Gettysburg National Military Park and Eisenhower National Historic Site during 2005.

Species	Eisenhower	Gettysburg		Total Population ¹	
savannah sparrow (males)	1	8		9	
grasshopper sparrow (males)	2	26		28.5	2.9
grasshopper sparrow (females/unknown)	1	12		13	
bobolink (males)	16	58.3	0.9	74.1	0.2
bobolink (females)	12	47.4	53.3	56.0	32.6
eastern meadowlark (males)	4	44		48.0	0.1
eastern meadowlark (females/unknown)	4	43.9	60.4	53.1	122.1

¹ When sufficient sample sizes allow, these totals include estimates of numbers of individuals missed during surveys and 95% confidence intervals; see Methods for details.

meadowlarks. Because grasshopper sparrow habitats tended to be ephemeral, their distribution and abundance probably varied annually in response to habitat availability.

Singing grasshopper sparrows were fairly conspicuous, but silent males and females were secretive and difficult to detect. Twenty-six singing males were detected during 2005 (Table 2), but some silent birds may have also been males. Hence, the total number of territorial males was probably in the range of 28-30. This species is normally monogamous (Vickery 1996), so with an assumption that most males were mated, then the total population for the park during 2005 was 55-60 grasshopper sparrows.

Savannah Sparrow: In the Mid-Atlantic Region, this species occupies the earliest successional stages of grassland habitats characterized by relatively short vegetation interspersed with patches of bare ground (Robbins and Blom 1996). These habitats were very scarce in Gettysburg NMP during 2005 and were restricted to fields near Seminary Ridge that were being converted to warm-season grasslands. A total of eight singing males were counted in these fields (Table 2). Females and non-singing birds were difficult to detect and were easily overlooked. A total population size was difficult to estimate, given that this species follows both monogamous and polygynous mating systems (Wheelwright and Rising 1993), but given the scarcity of suitable habitats, this population probably totaled no more than 15-20 savannah sparrows.

Eisenhower National Historic Site Grassland Birds

Most agricultural fields on Eisenhower NHS were devoted to cultivated crops (Figure 5). Grassland habitats were restricted to one hayfield, located adjacent to the entrance drive leading north from the farmstead, and heavily grazed pastures, located near the farm buildings. The hayfield was dominated by cool-season grasses including orchard grass, fescues, and bluegrass and had a well-developed litter layer. This field supported a population of at least 28 bobolinks and four pairs of eastern meadowlarks (Table 2). In contrast, the pastures were cropped to within a few centimeters of the ground with only scattered bushes and thorny weeds providing vegetative cover for breeding birds. Because of this disturbance these pastures provided very

limited breeding habitats for grassland birds and only a few grasshopper sparrows and a single savannah sparrow were detected (Table 2).

Loggerhead shrike is a species of conservation concern, having undergone significant population declines and contractions across its breeding range, especially in eastern North America (Peterjohn and Sauer 1995). Breeding shrikes were initially discovered on Eisenhower NHS during 1992, providing the first confirmed breeding record for Pennsylvania since 1934 (McWilliams and Brauning 2000). Apparently permanent residents in the park, shrikes were regularly recorded there through 2000 (Yahner et al. 2001). The last published sighting was during April 2001 (Pennsylvania Birds 15:100). None were detected during this survey, and in the absence of any recent sightings, loggerhead shrikes were most likely extirpated from the park.

Gettysburg National Military Park Shrubland Birds

Successional habitats were relatively scarce in Gettysburg NMP during 2005 although some greatly disturbed sites were recently harvested for timber and inaccessible for surveys. Shrubby corridors bordering fields and drainages were scarce and narrow (<10 m [32 ft] wide), primarily providing limited edge habitats, but not sufficiently large to support shrubland bird communities. One area of shrub-dominated habitats located along the base of Warfield Ridge and north of South Confederate Avenue supported small numbers of 11 bird species (Table 3). Field sparrows (*Spizella pusilla*) and song sparrows (*Melospiza melodia*) were most numerous, indicative of an early stage shrubland bird community.

Table 3. Total numbers of breeding shrubland birds recorded in Gettysburg National Military Park during surveys of disturbed successional habitats at the base of Warfield Ridge on 13 June 2005.

Species	Total number detected
willow flycatcher (<i>Empidonax traillii</i>)	1 male
gray catbird (<i>Dumetella carolinensis</i>)	1 male
	2 unknown
northern mockingbird (<i>Mimus polyglottos</i>)	3 males
brown thrasher (<i>Toxostoma rufum</i>)	1 male
	1 unknown
common yellowthroat (<i>Geothlypis trichas</i>)	1 male
eastern towhee (<i>Pipilo erythrophthalmus</i>)	1 male
field sparrow (<i>Spizella pusilla</i>)	4 males
	3 unknown
song sparrow (<i>Melospiza melodia</i>)	4 males
	1 unknown
northern cardinal (<i>Cardinalis cardinalis</i>)	1 unknown
indigo bunting (<i>Passerina cyanea</i>)	3 males
red-winged blackbird (<i>Agelaius phoeniceus</i>)	2 males

Discussion

The four species of grassland birds encountered during the 2005 surveys are widely distributed across Pennsylvania, although bobolink and savannah sparrow are relatively scarce and locally distributed in the southeastern corner of the state (Brauning 1992). Both species are also scarce and local in adjacent Maryland (Robbins and Blom 1996). Given a breeding population of approximately 130 bobolinks (Table 2), these parks supported a locally abundant population near the southern edge of its continental breeding range. In contrast, the savannah sparrow population was relatively small (<20 individuals), occupied ephemeral habitats, and was of relatively minor regional significance.

When compared with other parks included in this study, the Gettysburg-Eisenhower complex provided the largest acreage of grassland habitats, supported the largest populations of grassland birds, and were the only parks supporting a substantial bobolink population. With grasslands covering 1,220 ha (3,015 ac), however, grassland bird densities were relatively sparse with respect to the total acreage of potential habitats. A substantial acreage of these grasslands was devoted to leased hayfields, many of which were characterized by dense monocultures that were unsuitable for breeding grassland birds. Hence, grassland birds tended to be restricted to grasslands managed by the NPS or CRP fields, especially within fields located between Seminary and Cemetery ridges. The hayfield on Eisenhower NHS also supported large numbers of bobolinks. Relatively small numbers of grassland birds were found elsewhere.

Hay mowing was not a significant factor influencing grassland bird populations in these parks. The NPS discouraged mowing activities before July in leased hayfields. Even if mowing occurred earlier, few grassland birds occupied these fields, so that early summer mowing would not markedly reduce parkwide levels of reproductive success. Fields maintained by the NPS were not normally mowed until late summer, well after breeding activities were completed, although mowing schedules varied depending upon other maintenance needs. During most years grassland birds completed their nesting efforts before these fields are mowed by the NPS.

Gettysburg NMP and Eisenhower NHS can potentially support larger populations of grassland birds. Recommendations for improving grassland management in these parks are discussed below. Breeding behavior was regularly observed for all species except savannah sparrow and recently fledged young were evident during surveys conducted in late June. While detailed studies of reproductive success were not conducted, the numbers of young birds observed suggest that these habitats are not necessarily population sinks within the source-sink population dynamics described by Pulliam (1988). These parks also may potentially support grassland birds in addition to the species noted during these surveys, particularly upland sandpipers (*Bartramia longicauda*), a species of conservation concern that has a small breeding population in fields near the park (Brauning 1992).

Shrubland habitats were currently very limited in both parks. These habitats were mostly restricted to areas recently cut for timber and typically supported early successional vegetation and bird communities. Populations of shrubland birds were relatively small and were not significant at local or regional scales. Only Gettysburg NMP had the potential to provide significant shrub-dominated successional habitats, especially if timber harvest continued and

additional open habitats were created and maintained. The acreage devoted to shrublands will likely remain small, however, so that only locally noteworthy shrubland bird populations would be expected to occur in the park.

Recommendations

Grassland Birds

The following recommendations are expected to improve management of Gettysburg NMP and Eisenhower NHS for breeding grassland birds. These recommendations are based on the assumption that the existing policy of delayed mowing will continue in all grasslands. This policy has benefited greatly the populations of breeding grassland birds in both parks. Continuing this policy is most important for fields maintained by the NPS because these fields support the majority of breeding grassland birds. However, if more diverse grassland communities are established on leased hayfields, as recommended below, then this policy will become very important for those hayfields. Whenever possible, mowing should be delayed until July in order to provide all grassland birds with an opportunity to successfully raise at least one brood of young each year based on their breeding chronology within this region (Brauning 1992; Robbins and Blom 1996). Because some species disappear from fields that are regularly mowed (Owens and Myres 1973), delayed mowing may allow additional grassland birds to become established in Gettysburg NMP.

These recommendations represent the opinions of the author as supported by the cited literature. The conceptual model for managing grassland birds in cultural parks (Peterjohn 2006a) should be consulted for additional detailed information on management activities related to the following recommendations:

Improve Grassland Composition on Leased Hayfields.

Leased hayfields composed a substantial proportion of grasslands within Gettysburg NMP but generally provide unsuitable habitats for grassland birds. Improving the diversity and structure of the grassland communities in these hayfields would substantially increase the extent of suitable grasslands within the park. One potential approach would be to convert some leased hayfields to native warm-season grasses. In addition to the more diverse grassland community, warm-season grasses mature later in the year after most birds have finished nesting. Harvesting these grasses at maturity would not conflict with grassland bird reproduction, as is the case with cool-season grasses (Peterjohn 2006a).

Other potential strategies include reducing the densities of grasses, providing for more open habitat structure preferred by grassland birds. While benefiting birds, this strategy would reduce the amount of hay produced from these fields. For leased hayfields remaining in cool-season grasses, requiring mixed grassland communities rather than monocultures would also provide greater structural diversity required by more species of grassland birds. Increasing species diversity combined with reducing the densities of grasses would provide the most suitable breeding habitats for grassland birds in these hayfields.

Increase Extent of Early Successional Stages of Grasslands.

Savannah sparrows, grasshopper sparrows, and other birds characteristic of early successional grasslands were uncommon to rare in these parks, reflecting the scarcity of these habitats. Because of their ephemeral nature, these early successional habitats will require greater effort to

maintain. Several management strategies could be followed to increase the extent of these habitats. One approach would be to dedicate two or three fields to early successional grasslands. These fields would be regularly disturbed every 2-3 years by disking or burning to expose bare ground and reduce the litter layer (Peterjohn 2006a). These management activities should occur during spring, preferably in March or April, prior to the initiation of nesting activities, to favor the reestablishment of grasses rather than forbs in these habitats. These activities would be staggered so that at least one field is always at the earliest successional stage with patches of bare ground interspersed with grassy vegetation while the other fields are slightly more mature. An alternative approach involves fields currently leased for crop production. This strategy requires taking fields out of crop production for 3 years, during which a mixed community of cool-season grasses is allowed to develop. After 3 years, the field would be plowed and returned to cultivation and another field could be placed within this rotation. If three fields are placed under this rotation system at one-year intervals, then every successional stage could exist in the park during each breeding season.

Reduce Fragmentation of Grassland Habitats.

Gettysburg NMP is one of few cultural parks sufficiently large enough to create the 40-100 ha (100-250 ac) tracts of contiguous grasslands believed necessary to support entire grassland bird communities (Herkert 1994; Winter and Faaborg 1999). However, agricultural leases produced a mosaic landscape where grasslands were interspersed among cultivated fields so that relatively few large tracts of contiguous grasslands existed in the park. Management activities should emphasize creating larger tracts of contiguous grasslands wherever possible, eliminating any dense monocultures found in leased hayfields within these tracts, and converting some cultivated fields to grasslands when necessary. These practices will have the greatest benefits in the valley between Seminary and Cemetery ridges where grassland birds were most numerous. If some croplands were converted to grasslands, then some grasslands may need to be converted to croplands elsewhere in order to retain similar amounts of leased croplands within the park.

Improve Grassland Diversity by Creating Additional Communities of Native Warm-season Grasses.

Converting some cool-season grasslands to native warm-season communities will increase the diversity of grassland habitats and may eventually attract additional grassland species. A large (>40 ha [100 ac]) tract of contiguous habitats is preferable to small fields scattered around the parks. Fields currently supporting sizable numbers of breeding grassland birds should not be the target of these habitat conversions. Instead, these activities should be directed towards fields that currently support few grassland birds.

When creating warm-season grasslands, monocultures should be avoided, especially switchgrass that forms exceptionally dense habitats unfavorable for most grassland birds. Mixed grasslands are preferred because they provide a more complex vegetative structure that is conducive for supporting a more diverse avian community. Management activities should especially pay attention to the accumulation of dense litter layers that may be avoided by many grassland birds. Hay removal and/or occasional prescribed burns will be necessary to manage the accumulation of litter in these fields. Management with fire or other sources of disturbance

will also allow for creating more open grassland communities that can support a greater variety and abundance of birds.

Shrubland Birds

An additional recommendation is provided to improve management of breeding shrubland birds. While its primary emphasis may be directed towards Gettysburg NMP because of the substantially larger acreage in that park, habitat creation could also be considered in Eisenhower NHS within a field along Willoughby Run. The conceptual model for managing shrubland birds in cultural parks (Peterjohn 2006b) should be consulted for additional information on management activities related to this recommendation.

Explore Opportunities for Creating Shrubby Successional Habitats in Both Parks.

Given the scarcity of shrublands, any effort directed towards establishing and maintaining these habitats would benefit shrubland birds. In Gettysburg NMP shrubland habitats could be created in areas of timber harvest by allowing these sites to undergo secondary succession for 3-7 years, followed by appropriate management to maintain these communities (see Peterjohn 2006b for more information). Depending upon the acreage devoted to new shrubland habitats, these areas could be managed to support the various stages of successional communities so that a few areas are recently disturbed while other areas are 4-6 years post-disturbance. Small patches (<2 ha [5 ac]) of shrubland habitats may not be heavily occupied by shrubland birds, but 5-20 ha (12-50 ac) fields can provide important habitats for these species (Rudnicki and Hunter 1993).

Eisenhower NHS provides more limited opportunities for creating shrubland habitats because of its small size. One possibility exists along Willoughby Run where a former pasture is undergoing secondary succession. Shrubs are becoming established in this field and will eventually dominate the area if it is not disturbed. Another benefit for habitat creation here is that this site would provide mesic shrubland habitats in contrast to the dry upland shrublands that would most likely be created in Gettysburg NMP.

Fortunately, shrubland creation would not necessarily compete with grassland creation in these parks. Gettysburg NMP already maintains substantial acreage of grasslands, and better management of these habitats would produce the most substantial improvements for grassland birds. Creating new shrubland habitats in Gettysburg NMP can occur in areas that are currently wooded. In Eisenhower NHS shrubland creation would occur in an area that is apparently being allowed to undergo secondary succession and would not affect the grassland habitats available elsewhere.

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