

Nongame Session

Determination of Management Unit Priorities for Nesting Songbird Objectives

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Abstract: Partners in Flight, the Neotropical Migratory Bird Conservation Program, has generated interest among land managers to integrate songbird management into traditional management objectives. Confusion often exists, however, about which bird species or species assemblage to manage on any particular management unit. I describe 1 method for land managers to determine breeding bird priorities for any particular management unit and provide, as an example, nesting songbird priorities and management recommendations for the Cheatham Wildlife Management Area in Tennessee. Abundance and frequency of occurrence of several bird species was analyzed at different geographic scales to show the management area's importance to the species.

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The desire to integrate breeding bird habitat management recommendations into traditional forestry and wildlife management has been well illustrated by the voluntary attendance and cooperation of land managers at national, regional, and state levels since the start of Partners in Flight, the Neotropical Migratory Bird Conservation Program (e.g., Finch and Stangel 1993). However, population trends and resultant priority rankings for birds are detected at a scale different from the traditional land management unit (see Hunter et al. 1993, Thompson et al. 1993).

Furthermore, nesting songbirds encompass a wide range of species that require a full spectrum of habitats that occur within a region. As a result, any habitat manipulations a land manager prescribes will hamper breeding potential for some birds, but benefit breeding potential for others. These factors, in addition to a general lack of site specific surveys and a lack of life history information for many birds, have caused a consistent point of confusion between ornithologists and land managers who often remain unclear about which species or species assemblage would best be managed on a particular management unit.

The objectives of this paper are to: 1) describe 1 method by which land managers can determine bird species and species assemblages of priority for their management unit; and, 2) recommend management actions that could in-

tegrate nesting songbird requirements into specific management objectives at the Cheatham Wildlife Management Area (WMA), Tennessee. I gratefully acknowledge the volunteer efforts of the members of the Tennessee Ornithological Society who collected these data and to Kirk Miles and Geoff Call for assisting count compilations. William C. Hunter, Charles P. Nicholson, Greg Wathen, and Mike Carter greatly improved an early draft of the manuscript.

Methods

Breeding bird priority ranking, distribution, and relative abundance information was available and compiled or sampled at 3 different scales: the Interior Low Plateaus physiographic province and its subdivisions in Tennessee; Cheatham County, Tennessee; and the Cheatham WMA. The Interior Low Plateaus physiographic province occupies 12 million ha of middle Kentucky, middle Tennessee, and northern Alabama. The area is characterized by rolling hills of moderate relief and is dominated by oak (*Quercus* spp.) and hickory (*Carya* spp.), primarily central hardwood forests (Martin et al. 1993). The Western Highland Rim, Central Basin, and Eastern Highland Rim are subdivisions of the Interior Low Plateaus in Tennessee. Martin et al. (1993) summarized historical and current vegetative communities in these subdivisions.

Cheatham County, Tennessee, occupies about 791 square km at the edge of the Western Highland Rim. Oak-hickory forests occupy 61% of the total land area of the county (Vissage and Duncan 1990). Cheatham WMA is located centrally in Cheatham County and occupies 7,955 ha; 97% of the WMA is forested and 3% is maintained for wildlife openings. The forested area is about 80% oak-hickory forest of ≥ 80 years, about 10% oak-hickory forest of 40 to 50 years, and about 10% pine or natural forest regeneration areas of < 10 years. For management purposes, the area is segregated into 18 compartments of about 400 ha each (Tenn. Wildl. Resour. Agency 1993).

Concern scores were developed for bird species and species assemblages to determine management priorities in the Interior Low Plateaus (Hunter et al. 1993). The Tennessee Breeding Bird Atlas (Nicholson *in press*) provided information regarding breeding bird frequency of occurrence and distribution in the subdivisions of the Western Highland Rim, Central Basin, and Eastern Highland Rim of Tennessee. Frequency of occurrence data were based on miniroutes (roadside counts) in Atlas blocks covering 1/6 of every U.S. Geological Survey topographic map. Individual miniroute results were expressed as the number of 15 3-minute roadside counts recording a particular species (see Nicholson *in press*). All Breeding Bird Atlas data were collected between 1986 and 1991.

Miniroutes were distributed more intensively throughout Cheatham County in 1993 and 1994 to determine breeding bird distribution and relative abundance in habitats that surrounded the Cheatham WMA (Ford and Connors 1993). These miniroutes replicated the protocol from the Tennessee Breeding Bird Atlas. Each year, 195 stops were completed on 13 miniroutes.

Point counts were distributed non-randomly in selected habitats at the Cheatham WMA to determine the distribution and relative abundance of breeding birds; the number of points per habitat type were in approximate proportion to the total amount of habitat available (Ford and Connors 1993). Observers censused birds at each point for 5 minutes and differentiated among individuals heard or seen 1) during the first 3 minutes and last 2 minutes and 2) within 50 m or outside of 50 m (Ralph et al. 1993). In 1993, 144 point counts (or "stops") were conducted at the Cheatham WMA; in 1994, a subset of 104 of those counts was completed.

The percentage of the total number of stops on which a species occurred was determined for the Western Highland Rim, Eastern Highland Rim, and Central Basin, Cheatham County, and the Cheatham WMA. To make all counts comparable, analyses included only the 3-minute segment of counts, eliminated distance estimates, and used only the presence of species (as opposed to the number of individuals) at each stop.

Comparisons among the subdivisions of the Interior Low Plateau were used to determine the relative frequency of occurrence for bird species assemblages and further clarify management priorities within the Western Highland Rim. Breeding bird frequency of occurrence comparisons among the Western Highland Rim, Cheatham County, and the Cheatham WMA were used to clarify management priorities for the WMA. As a final step, the frequency of occurrence was examined for the guild of species with suitable or optimal nesting requirements in the mid-story or shrub layer of oak-hickory forests (see Hamel 1992).

Species or species assemblages of management priority for Cheatham WMA were those species 1) with high concern scores for the Interior Low Plateaus (Hunter et al. 1993), 2) with a comparably high frequency of occurrence in the Tennessee portion of the Western Highland Rim, and 3) that were encountered about equally or less frequently on the WMA compared to the Western Highland Rim. I arbitrarily defined equally encountered as $\leq 2\%$ difference in frequency of occurrence among spatial scales.

In this process, modified from Thompson et al. (1993), I assumed that non-random, habitat specific counts at the Cheatham WMA should reflect a much higher percentage of stops on which a species occurred than that detected by random roadside counts in the Western Highland Rim and Cheatham County. If in error, this assumption should favor the management unit. As a result, if species were equally or less frequently encountered on the WMA when compared to the surrounding landscape, I considered the WMA populations lower than expected.

Bird species assemblages lower than expected on the management unit were defined as songbird species of management priority. Nesting songbird objectives are to attain a higher frequency of occurrence of these species on the WMA when compared to Breeding Bird Atlas baseline data on the Western Highland Rim.

Results

Fifteen species received high to very high concern scores (>23) in the Interior Low Plateaus physiographic province (see Hunter et al. 1993). Six of these species require mature hardwood forests for nesting; 6 inhabit old fields, recent forest clearcuts, and/or early forest regeneration; and 3 inhabit open lands, grassy meadows, and pastures. About half of these species had the highest frequency of occurrence and/or were present in the highest percentage of Atlas blocks in the Western Highland Rim (Table 1).

Birds that inhabit open lands, grassy meadows, or pastures occurred most frequently in the Central Basin and the Eastern Highland Rim (see Table 1). In the Western Highland Rim and in Cheatham County, these species occurred on $\leq 2\%$ of the stops. They did not occur on the Cheatham WMA. Henslow's sparrow did not occur in Tennessee during the Breeding Bird Atlas; this species' range in the Interior Low Plateaus is generally restricted to northern middle Kentucky (Palmer-Ball 1990). However, this species was observed during June at 2 locations in the Western Highland Rim in 1994 (C. Sloan, pers. commun.).

Of the birds that inhabit old fields and/or an early stage of forest regeneration, 4 of 6 species had the highest frequency of occurrence and/or occurred in the highest percentage of Atlas blocks in the Western Highland Rim (see Table 1). In the Western Highland Rim, Bewick's wren and Bachman's sparrow occurred rarely, on $<1\%$ of all stops. Gray catbird was the only species of this group to occur more frequently in the Western Highland Rim when compared to the WMA. Prairie warbler and field sparrow had a much higher frequency of occurrence in the Cheatham WMA than in the Western Highland Rim, and blue-winged warbler was about equally encountered among spatial scales. All species in this group were least frequently encountered in Cheatham County (Table 2). The low frequency of occurrence in Cheatham County was because of the scarcity of old field habitats and forest regeneration areas; most habitats in the county were agriculture, mature forest, rural communities or suburbs.

Of the 6 species that inhabit mature forests, 4 had the highest frequency of occurrence and/or occurred in the highest percentage of Atlas blocks in the Western Highland Rim (see Table 1). However, 2 species were not comparable in this process; Whip-poorwill, a nocturnal species, was not sampled adequately for comparisons and Swainson's warbler does not nest regularly in the Western Highland Rim. Yellow-billed cuckoo, wood thrush, great crested flycatcher, and cerulean warbler all occurred with equal frequency between the Western Highland Rim and the Cheatham WMA and, thus, were lower than expected. All bird species of this group were least frequently encountered in Cheatham County (Table 3).

Two of the above groups of birds (as opposed to individual species) were consistently lower than expected on the Cheatham WMA when compared to the Western Highland Rim. First, open lands bird species assemblages did not occur on the Cheatham WMA. However, this group was most frequently en-

Table 1. Bird species that received a score of high or very high concern (>23 out of a possible 35) in the Interior Low Plateaus physiographic province (Hunter et al. 1992). Frequency of occurrence (FREQ) data were based on the percentage of total stops on Atlas miniroutes (N) on which a species occurred and the presence of species in Breeding Bird Atlas blocks (PRES) was based on the percentage of total Atlas blocks (N) in which a species was observed (see Nicholson *in press*). An asterisk indicates those species with a higher frequency of occurrence and/or higher percentage of Atlas blocks in the Western Highland Rim.

Species	Western Highland Rim		Central Basin		Eastern Highland Rim	
	FREQ N = 1,980	PRES N = 135	FREQ N = 1,785	PRES N = 122	FREQ N = 1,140	PRES N = 77
Mature hardwood forests						
Yellow billed cuckoo (<i>Coccyzus americanus</i>)	17	99	17	95	14	99
Wood thrush* (<i>Hylocichla mustelina</i>)	15	99	6	78	10	88
Great crested flycatcher (<i>Myiarchus crinitus</i>)	8	93	7	91	9	97
Cerulean warbler* (<i>Dendroica cerulea</i>)	0.7	24	0.9	12	2	14
Whippoorwill* (<i>Caprimulgus vociferus</i>)	0.3	53		15	0.09	27
Swainson's warbler* (<i>Lymothlypis swainsonii</i>)	0.7					
Old field and/or early forest regeneration						
Field sparrow (<i>Spizella pusilla</i>)	24	99	31	100	27	99
Prairie warbler* (<i>Dendroica discolor</i>)	9	88	6	74	10	82
Gray catbird* (<i>Dumetella carolinensis</i>)	4	81	4	71	3	74
Blue-winged warbler* (<i>Vermivora pinus</i>)	2	42	1	16	0.5	16
Bewick's wren* (<i>Thryomanes bewickii</i>)	0.2	5	0.1	2		1.3
Bachman's sparrow (<i>Aimophila aestivalis</i>)		.01				
Open lands, grassy meadows, pastures						
Loggerhead shrike (<i>Lanius ludovicianus</i>)	2	65	2	75	0.9	52
Grasshopper sparrow (<i>Ammodramus savaannarum</i>)	0.7	16	1	28	3	42
Henslow's sparrow (<i>Ammodramus henslowii</i>)	Did not occur					

Table 2. Birds of high concern in the Interior Low Plateaus that inhabit old fields and/or early forest regeneration habitats during nesting and their relative abundance in the Western Highland Rim, Cheatham County, and the Cheatham Wildlife Management Area. Frequency of occurrence data were based on miniroutes for the Western Highland Rim and Cheatham County, and point counts in the Cheatham Wildlife Management Area. Data reflect the percentage of total stops on which a species occurred.

Species	Western Highland Rim	Cheatham County	Cheatham WMA
Field sparrow	24	17	27
Prairie warbler	9	3	21
Gray catbird	4	1	<1
Blue-winged warbler	2	<1	4
Bewick's wren	<1		
Bachman's sparrow	<1		

Table 3. Birds of high concern in the Interior Low Plateau that require mature hardwood forest habitats for nesting and their relative abundance in the Western Highland Rim, Cheatham County, and the Cheatham Wildlife Management Area. Frequency of occurrence data reflect the percentage of total stops on miniroutes on which a species occurred in the Western Highland Rim and Cheatham County, and point counts in the Cheatham WMA.

Species	Western Highland Rim	Cheatham County	Cheatham WMA
Yellow-billed cuckoo	17	13	16
Wood thrush	15	7	17
Great crested flycatcher	8	4	10
Cerulean warbler	<1	<1	<1
Whippoorwill	Not adequately sampled		
Swainson's warbler	Does not nest regularly in Western Highland Rim		

countered outside the Western Highland Rim and requires large expanses of pasture or grasslands. Large areas of open land are not pertinent to the traditional land management objectives of the Cheatham WMA; open lands bird species may be a priority for targeted public-private partnerships that can provide large areas of open habitat.

Second, mature forest bird species assemblages were also consistently lower than expected on the WMA and provide opportunities for integrated management with traditional objectives at the WMA. Yellow-billed cuckoo, wood thrush, great crested flycatcher, and cerulean were lower than expected and nest in the canopy, mid-story and/or shrub layer of relatively mature hardwood forests (see Hamel 1992). I investigated further the frequency of occurrence for the guild of birds that nest in the mid-story or shrub layer of oak-hickory forests.

Hamel (1992) listed 21 species that occur in mature oak-hickory forests and have suitable or optimal nesting requirements in the mid-story and/or shrub layer. The frequency of occurrence was examined for each of these, although

Table 4. Bird species that have suitable or optimal habitats in pole or sawtimber oak-hickory forests and nest in the mid-story and/or shrub layer (Hamel 1992). Frequency of occurrence data were based on the percentage of total stops on which a species occurred on mini-routes in the Western Highland Rim and Cheatham County, and point counts on the Cheatham Wildlife Management Area. Species are grouped as those with an approximately equal (within 2%) or higher frequency of occurrence in the Western Highland Rim as compared to the Wildlife Management Area (I), those species with lower frequency of occurrence on the Western Highland Rim when compared to the Wildlife Management Area (II), and those species with very low samples (III).

Species	Western Highland Rim	Cheatham County	Cheatham WMA
I. Northern cardinal (<i>Cardinalis cardinalis</i>)	55	48	24
Rufous-sided towhee (<i>Pipilo erythrophthalmus</i>)	30	16	22
Carolina wren (<i>Thryothorus ludovicianus</i>)	29	30	23
Blue jay (<i>Cyanocitta cristata</i>)	25	13	16
Blue-gray gnatcatcher (<i>Polioptila caerulea</i>)	24	13	26
Yellow-billed cuckoo	17	13	16
Carolina chickadee (<i>Parus carolinensis</i>)	17	14	8
Wood thrush	15	6	17
Downy woodpecker (<i>Picoides pubescens</i>)	12	9	8
Kentucky warbler (<i>Oporornis formosus</i>)	7	4	7
II. Tufted titmouse (<i>Parus bicolor</i>)	34	41	47
Summer tanager (<i>Piranga rubra</i>)	16	9	23
Red-eyed vireo (<i>Vireo olivaceus</i>)	15	16	20
Acadian flycatcher (<i>Empidonax vireescens</i>)	14	8	21
Worm-eating warbler (<i>Helmitheros vermivorus</i>)	2		13
Hooded warbler (<i>Wilsonia citrina</i>)	2	<1	10
III. Ruby-throated hummingbird (<i>Archilochus colubris</i>)	2	<1	<1
Hairy woodpecker (<i>Picoides villosus</i>)	2	<1	<1
American redstart (<i>Setophaga ruticilla</i>)	1		

mourning dove (*Zenaida macroura*) was excluded because it rarely nests in extensive forests and eastern screech owl (*Otus asio*) was excluded because of an inadequate sample of this nocturnal species. Of the remaining 19 species, 10 were lower than expected at the Cheatham WMA (higher or approximately equal frequency of occurrence in the Western Highland Rim), whereas 6 species had the highest frequency of occurrence on the WMA. The comparable frequency of occurrence was variable in Cheatham County and consistently lower there for neotropical migratory species. Three species occurred rarely at all scales (Table 4).

Discussion

Traditional land management objectives have emphasized either a huntable surplus of game species or a minimum viable population of rare or endangered species. This approach to management has placed a disproportionate emphasis on rare species as compared to the ecological importance of maintaining the

unique value of large populations of common species (Hutto et al. 1987). Furthermore, management emphasis on minimum viable populations may be insufficient to maintain ecological balance or sustainability in some natural systems (Conner 1988). Recent interest in ecosystem management has also emphasized the importance of sustainable populations.

A basic goal of the Partners in Flight—Neotropical Migratory Bird Conservation Program is to maintain and restore bird populations (see Finch and Stangel 1993). Management emphasis has been placed on those species that are not yet rare or endangered but have experienced dramatic population declines in recent years. In the southeast, the Partners in Flight initiative has developed concern scores for all nesting species including neotropical migratory birds, short distance migrants, and permanent resident birds.

The Western Highland Rim is an important area for sustaining relatively high populations of forest birds in the Interior Low Plateaus. However, future development by industry, urban expansion, and agriculture may eventually limit populations of breeding birds. Long term sources of sustainable bird populations may be provided by land managers cooperating with Partners in Flight objectives. One objective for management units may be that breeding birds should be encountered more frequently on the management unit when compared to a political unit (such as a county) or a regional unit (such as a physiographic province and/or subdivision). A bird species assemblage less frequently encountered on a management unit provides a management opportunity for achieving nesting songbird objectives.

Forest bird species, including those of early forest regeneration stages, provide the best opportunities for management at the Cheatham WMA. The Cheatham WMA appears to be achieving goals for most birds that inhabit forest regeneration areas and many birds of mature forests (see also Ford and Connors 1993). However, slight modifications to silvicultural techniques may increase nesting and population potential of birds that nest in the mid-story or shrub layer. Therefore, the recommended songbird objectives for the Cheatham WMA are to: sustain populations of birds that inhabit forest regeneration areas, increase the frequency of birds that inhabit mature hardwood forests to greater than that on the Western Highland Rim, maintain populations of both groups of birds in anticipation of changes to the surrounding landscape, and implement management practices to accomplish the above, without detracting from traditional management objectives.

The primary management objectives of the Cheatham WMA are to increase and maintain a white-tailed deer (*Odocoileus virginianus*) population of about 1 per 4 ha, increase and maintain a wild turkey (*Meleagris gallopavo*) population of about 1 per 14 ha, improve the quantity and quality of habitat for small game and nongame as a result of managing for deer and turkey, increase the merchantability and utilization of timber compatible with the needs of wildlife, and develop and maintain an access system for the public (Tenn. Wildl. Resour. Agency 1993).

Even-aged cuts, generally ranging in size from about 6 to 12 or more ha, have been the preferred forestry and wildlife management technique at the Cheatham WMA (Tenn. Wildl. Resour. Agency 1993). Although these cuts provide foraging and/or nesting habitat opportunities for a range of species, including some with high concern scores, breeding bird species assemblages may benefit from slight modifications to the existing even aged management plan.

In compartments where even aged cuts are planned, bird species assemblages may benefit by placing cuts at the edge of compartments and adjoining even aged cuts between compartments over time. This planning would result in square to rectangular forest regeneration areas of increased size to 12 to 24 ha or more, but of slightly different ages. All cuts should minimize the amount of newly created edge (a square opening is better than a long, linear opening) to minimize brown-headed cowbird (*Molothrus ater*) parasitism (Robinson et al. 1993).

Specific management actions within even aged stands can benefit bird species. Robbins et al. (1993) suggested that clumping snags near the forest edge instead of scattering them through the harvest area may reduce cowbird parasitism by eliminating perch sites. Clumping snags at the edge of even aged cuts may benefit breeding birds as well. Slash piles that remain after cutting may provide habitat opportunities for Bewick's wren (see Hamel 1992). In even aged cuts converted to pine and with a long rotation age, the development of a hardwood mid-story would benefit many species, such as wood thrush.

About half the birds in the species assemblage that nests in the mid-story and shrub layer of mature oak-hickory forests were encountered equally or less frequently on the WMA than at the regional scales. Exceptions were the Acadian flycatcher and worm-eating warbler, which occurred more frequently on the WMA. These species have benefited from wide low intensity management zones along streams and reduced logging on steep hillsides. Adjoining clearcuts on or near the edges of compartments, with uneven aged techniques employed near the center of compartments, would continue to accrue benefits for Acadian flycatcher and other species.

Even-aged cuts could be eliminated in 3 compartments near the center of the WMA, affecting approximately 1,200 ha or 15% of the total management unit. In these areas, silvicultural practices could be employed to encourage mid-story and/or shrub layer development and maintain a relatively closed canopy. For example, a combination of silvicultural crown thinning, single tree selection, or shelterwood cuts may provide increased mid-story and shrub layer development over time and maintain enough canopy closure to sustain canopy nesting species such as cerulean warbler. These practices may be appropriate for severely to moderately fragmented landscapes (Robinson et al. 1993). The addition of scattered group selection or patch cuts throughout the compartment would provide for the desired oak regeneration as well as economic justification for the cut. However, logging roads should be low impact, as narrow as possible, and revegetated in these compartments (Robinson et al. 1993).

Integration of the above management recommendations would provide benefits to nesting songbirds and have minimal impact to priority game species. For example, white-tailed deer would benefit from increased browse in the shrub layer and larger, concentrated escape cover, wild turkey may benefit from scattered group selection cuts, shelterwood cuts, or patch cuts, and small game would benefit from larger forest regeneration areas. A commitment to annual monitoring of bird populations, as well as target game species, will be necessary to determine the beneficial impacts of suggested management recommendations and to determine future research and management needs.

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