

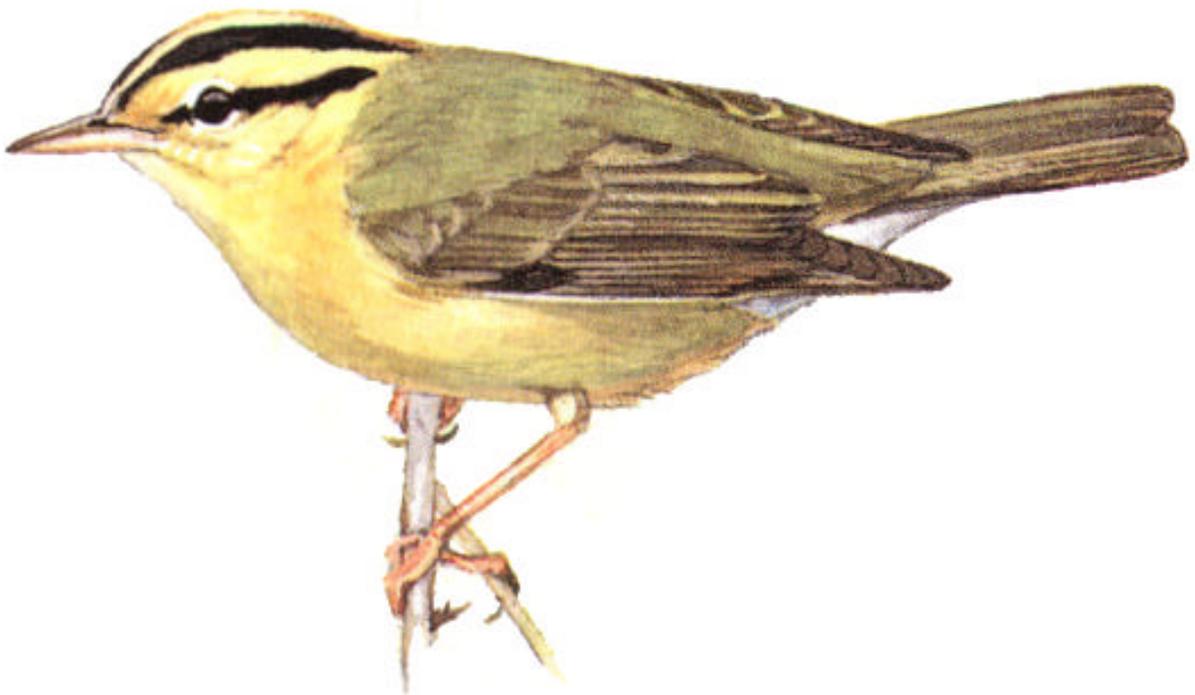


**Partners in Flight  
Bird Conservation Plan**

*for*

***The Interior Low Plateaus***

**(Physiographic Area 14)**



# **Partners in Flight Bird Conservation Plan:**

## **Physiographic Area 14: The Interior Low Plateaus**

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# INTERIOR LOW PLATEAUS BIRD CONSERVATION PLAN

## EXECUTIVE SUMMARY

Over 150 bird species nest in the Interior Low Plateaus physiographic area. The most widely distributed species include Indigo Bunting, Field Sparrow, Horned Lark, and Northern Cardinal. Fairly common birds also experiencing consistent population declines include Yellow-billed Cuckoo, Northern Bobwhite, Worm-eating Warbler, Kentucky Warbler, White-eyed Vireo, and several others. Bewick's Wren, Cerulean Warbler, and Henslow's Sparrow are among the most rapidly declining and vulnerable species.

The diversity of birds in the physiographic area reflects the diversity of habitats. The Interior Low Plateaus covers 17,846,900 ha in parts of Illinois, Indiana, Ohio, Kentucky, Tennessee, and Alabama. Subdivisions distinguish the physiographic area. Subdivisions include the Bluegrass region, the Shawnee Hills, the Western Highland Rim, Central Basin, Eastern Highland Rim, and the Tennessee Valley. Important bird habitats include western mesophytic, oak-hickory, and beech-maple forests, forested wetlands, riparian areas, grasslands, oak savannas, barrens, glades, old fields, and short rotation pine. Birds have been systematically scored by the Partners in Flight prioritization process, and grouped by the above broad habitat types for setting objectives.

In the Interior Low Plateaus, the primary bird conservation goals are to stabilize or increase populations of high priority bird species and to provide adequate habitats for two extirpated species, greater prairie chicken and swallow-tailed kite. In order to reach these goals, habitat objectives proposed in this plan include the following items:

1. sustain the existing acreage of forest (about 7,300,00 ha), with about 80% (5,820,560 ha) in hardwood forest and about 20% (1,455,140 ha) in short rotation pine management,
2. of the hardwood forest, manage approximately 400,000 ha in long rotation, sawtimber forest patches of about 4,000 ha each,
3. consolidate and manage an additional 90,000 ha of forested wetlands,
4. restore an additional 40,000 ha of native warm season grass and oak savanna habitats, and
5. continue active participation of bird conservation planning in ongoing barrens and glades management and restoration projects.

These objectives remain tentative and open for revision and discussion. Furthermore, implementation of this plan is based on several assumptions that should be tested by aggressive research design or adaptive management strategies. Assumptions that should be tested include tract size requirements in the Interior Low Plateaus for all habitats, nest productivity and survivorship of key species under different habitat types and management regimes, and the success of various restoration techniques for some habitats. The vast majority of bird conservation recommendations should be integrated into traditional land management objectives that include agriculture, economics, forestry, and game management.

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## **Acknowledgements**

The idea of Partners in Flight bird conservation plans is that they should be living documents, constantly updated and improved as we learn more about bird management and conservation in the physiographic area. Thus the reason this document is considered Version 1.0. The plan still needs much more work, especially north of the Ohio River, and we encourage those who wish to contribute to do so.

Those contributing significantly to Version 1.0 of this plan include John Castrale, J. Dan Webster, Dan Whitehead, David Pashley, Don Orr, and Keith Hudson. Others have been actively involved with local and regional meetings to help clarify the Partners in Flight prioritization process and determine conservation priorities. These people, unfortunately, are too numerous to mention here. We thank all those that have contributed to this plan.

## Section 1: The Planning Unit

### ***Background:***

The Interior Low Plateaus physiographic area occupies almost 18,000,00 ha (44,000,000 acres) across portions of Illinois, Indiana, Ohio, Kentucky, Tennessee, and Alabama. Subdivisions distinguish the Interior Low Plateaus and include the Western Highland Rim, Pennyroyal Plateau, Eastern Highland Rim, Tennessee Valley (or Southern Highland Rim), Central Basin, Shawnee Hills, Bluegrass, and Kentucky Knobs (Figure 1; figures referenced in this document can be viewed at <http://www.cast.uark.edu/pif/main/mainmap.htm>). Topography is generally hilly and rolling, but also includes swampy alluvial valleys, deeply entrenched rivers and streams, and karst plains. The area's major waterways are the Ohio, Cumberland, Tennessee, Kentucky, Wabash, and Licking Rivers. Elevations range from 100 m to 320 m (325 feet to 1,050 feet) above sea level. Caves, glades and barrens are among the most biologically important natural characteristics of the physiographic area.

The area's diverse landscape captures plant community diversity from both the mid-western and eastern United States; important bird habitats include upland hardwoods such as western mesophytic, oak-hickory, and beech-maple forests, forested wetlands, grasslands, tallgrass prairies, oak savannas, barrens and glades, and short-rotation pine (Figure 2). A terrestrial vegetation community classification has been developed (Weakly et al. 1998). Oak-hickory forests occur on 31% of the physiographic area, while another 10% is occupied by other forest cover types. Corn, soybean, and other row crops occupy about 40% of the landscape, while pasture and mixed croplands occupy about 14% of the area. Other land uses include irrigated agriculture, prairies, water, and urban areas (Table 1).

Historically, tallgrass prairie habitats in the Interior Low Plateaus, while not dominant anywhere, were probably most common in the north and northwest portions of the area, and diminished in size and abundance towards the south and southeast. Currently, prairie habitats are rare and scattered. Dominant native grasses include big and little bluestem, Indian grass, and side-oats grama.

Oak savannas historically occurred throughout the Bluegrass subdivision and sporadically throughout the northern portions of the physiographic area. Currently, oak savanna habitats are rare and scattered. Blue ash, burr oak, chinquapin oak, Shumard oak, white ash, and shellbark hickory are dominant tree species of savanna habitats. The understory consists of cane, wild ryes, other grasses, and legumes. Historically, savannas were maintained by large herbivores and fires.

Barrens and glades represent a stable, semi-open habitat in the Interior Low Plateaus. Historically and today, the majority of these habitats occur in portions of the Western Highland Rim and Pennyroyal, throughout the Central Basin, and in portions of the Eastern Highland Rim. Relatively thin soils support dominant tree species such as red cedar, blackjack oak, and post oak. These habitats support viable populations of many globally important plant species, including the Tennessee coneflower.

Forested wetlands occur along floodplains of major rivers and smaller tributaries throughout the Interior Low Plateaus. Bottomland oak and hickory species, sycamore, cottonwood, green ash, willow, American elm, Kentucky coffeetree, sugarberry and honey locust dominate riparian habitats. Near small tributaries, yellow poplar, beech, and holly become increasingly common floodplain tree species. Forested wetlands in the Shawnee Hills of south central Indiana often are dominated by red maple, silver maple, and box elder.

Western mesophytic, oak-hickory, and beech-maple forests were historically the most abundant forest cover types in the Interior Low Plateaus. Western mesophytic and oak-hickory forests remain the dominate forest cover in the Western Highland Rim, Pennyroyal, Shawnee Hills, and Kentucky Knobs. Throughout, hardwood forests are dominated by white oak, black oak, northern red oak, and shagbark hickory. Drier ridgetops are dominated by blackjack oak, scarlet oak, post oak, southern red oak, chestnut oak, and pignut hickory. In mesic ravines, beech, yellow poplar, bitternut hickory, sugar maple, and white ash become dominant. Within the mature forest, patches of shrub-scrub habitats and natural regeneration were maintained historically by fire, grazing herbivores, windstorms, and winter ice. Beech-maple forests occur primarily in the Shawnee Hills.

***Conservation issues:***

Widespread habitat loss and changes in habitat quality have negatively affected many bird species populations in the Interior Low Plateaus. Habitats have been converted to agriculture, urban, or industrial development. Future predictions indicate a consistently growing infrastructure to support increased human populations, industrial growth, and urban developments (Tennessee Valley Authority 1997). Successful bird habitat restoration and management must be integrated across a wide variety of local economic development needs, land ownership patterns, existing habitat types, and successional

stages. To further complicate these issues, the course of natural succession in many parts of the Interior Low Plateaus remains difficult to predict (Martin et al. 1993).

Specific conservation issues vary depending on habitat type and location, although habitat fragmentation and reduced habitat quality is a potentially critical issue across all types. Historically in the southeast, grassland ecosystems were relatively small and isolated patches within a forest dominated landscape. These habitats have been converted to cool season grass pastures, row crop agriculture, or urban development. Nevertheless, remnant southeastern grasslands (including prairies, barrens and glades, and savannas) remain centers of global importance. The loss of these grasslands in the southeast has resulted in steep population declines of many species.

In oak savanna habitats, the original understory has been replaced by cool season grasses. Tree species regeneration is extremely low because of advancing age of existing trees, continuous grazing by livestock, and mowing operations that remove most seedlings. As a result, many savannas are now being replaced by pasture. Barrens and glade habitats have diminished in both size and quality because of increasing urbanization, grazing, trash dumping, or a lack of ecological disturbance that results in succession to more heavily forested conditions. Barrens, in particular, are more easily converted to agricultural lands or succeed to forest. Glade habitats are less suitable for agriculture, but are grazed (often by goats) or used as trash dumps. Both habitats are encroached upon by increasing urbanization. In areas where oak savannas, barrens, and glades are neglected, woody stem encroachment soon overtakes the community.

Forested wetlands have been inundated by large reservoirs throughout the Interior Low Plateaus major river systems. As a result, many floodplain habitats are completely or partially submerged. Where floodplain forests occur, many are isolated patches surrounded by row crop agriculture. Furthermore, flood control work on the major rivers and their tributaries have altered natural hydrology. Altered hydrology affects habitats in different ways, ranging from too dry to too wet, and flood conditions at unpredictable times of the year.

Western mesophytic, oak-hickory, and beech-maple forests remain abundant habitats. The most heavily forested areas occur in the Shawnee Hills of Indiana, the Highland Rim in Indiana (Brown County Hills), and the Western Highland Rim of Tennessee. More deforestation has occurred within the Bluegrass, Eastern Highland Rim, and Tennessee Valley subdivisions of the Interior Low Plateaus. The quality of remnant forests has changed dramatically in the last two centuries. In the late 1800's and early

1900's, much of the forest was cut for charcoal for the iron ore industry or, further north, was cleared for subsistence farming. More recently, especially north of the Ohio River, the lack of fire and grazing has resulted in dense understories. Generally, forest regeneration has occurred on private, non-industrial lands and has not been managed by professional foresters. As a result, forests generally have a closed canopy with little mid or understory development. At the other extreme, many forests have been high-graded repeatedly.

Chip mills, for pulp wood harvest, are increasingly controversial in the Interior Low Plateaus. Although it is difficult to determine the long term impact to Interior Low Plateaus forests, increasing global demands for pulp products could have the greatest affect on the Western Highland Rim. Large areas of young to mid-succession hardwoods would be cleared for pulp wood. Two issues are the lack of quality hardwood restoration or reforestation of these areas and economic incentives for conversion to pine plantations. A proposed alternative is an incentive program to promote sawtimber production and value added forest industry.

North of the Ohio River, fewer incentives exist to convert to pine plantations. Instead, Virginia and shortleaf pine forests grow to about 40 to 60 years old and begin to become susceptible to insects and fungal disease.

### ***Conservation opportunities:***

Landscape bird conservation planning and management decisions are dictated largely by the subdivisions within the Interior Low Plateaus (Ford and Roedel in press). Each subdivision has a landscape management strategy to

- 1) manage and maintain existing habitats,
- 2) restore or consolidate habitats, or
- 3) provide a combination of these conservation strategies.

Management and maintenance of existing western mesophytic forest, for example, is the landscape objective for much of the Western Highland Rim. The Central Basin, Bluegrass, Kentucky Knobs, Pennyroyal, and Shawnee Hills require a restoration and consolidation strategy for grassland, early succession, and mature forest habitats. A mixture of the two strategies is necessary for the Eastern Highland Rim and the Tennessee Valley.

Three elements are necessary to begin implementation of Partners in Flight objectives in the Interior Low Plateaus. Each element is discussed in this plan for each broad habitat type. First, high priority species and species assemblages should be determined for each subdivision. Second, historically available habitats and the most likely management opportunities to restore or replicate those as viable nesting bird habitats should be understood. Third, the present distribution and local abundance of high priority species across the Interior Low Plateaus should be understood.

Bird Conservation Areas, Important Bird Areas, and habitat specific management recommendations, such as described in The Flight Plan (Pashley 1998), are ultimate management designations for sites that will help achieve Interior Low Plateaus bird conservation objectives. However, habitat restoration and management for high priority bird species must be integrated with existing land management programs, economic incentives, and landowner objectives. Opportunities to match bird conservation with existing incentive programs are discussed below for each habitat type.

## **Section 2: Avifaunal analysis**

### *Species prioritization*

Over 150 bird species nest regularly in the Interior Low Plateaus physiographic area. Breeding Bird Atlas results from Indiana (Castrale et al. 1998), Ohio (Peterjohn and Rice 1991), Kentucky (Palmer-Ball 1996), Tennessee (Nicholson 1997), and northern Alabama (Ford, unpublished data) indicate that indigo bunting, Carolina chickadee, American robin, northern cardinal, and mourning dove are among the most common and widely distributed species across the Interior Low Plateaus. Approximately 39% of all species nest in early successional or semi-open lands habitats. Specifically, these habitats include grasslands, oak savanna, old fields, barrens, glades, early succession forest (natural or managed regeneration), and edge habitats. Typical species include indigo bunting, yellow-breasted chat, field sparrow, and prairie warbler.

Approximately 34% nest in mid to late succession forest habitats, which may range from small woodlots to extensive forested tracts. In small woodlots, typical species may include at least 4 woodpecker species, Eastern Wood-pewee, and Red-eyed Vireo. Larger forested tracts may include Acadian Flycatcher, Wood Thrush, Cerulean Warbler, and Kentucky Warbler.

Approximately 19% of the species are dependent on water and wetland habitats. Typical species include great blue heron, wood duck, and belted kingfisher. An additional 8% require forested wetlands. Species in these habitats include Swainson's warbler and Prothonotary Warbler.

The Partners in Flight prioritization process was developed to guide conservation actions among diverse birds and habitats (see Hunter et al. 1993, Carter et. al. 2000). The system ranks each species based on 7 measures of conservation vulnerability: relative abundance, size of breeding and non-breeding ranges, threats during breeding and non-breeding seasons, population trend, and relative density. In addition, the percentage of a species global breeding population that occurs in a physiographic area has been provided. To further refine species prioritization within a physiographic area, population trends and area importance are examined independently of total scores (for a summary, see Fitzgerald in prep).

Birds were prioritized according to this scheme in the Interior Low Plateaus (Table 2). Category I lists highest priority birds and included 20 species which received a total Partners in Flight score of 22 or more. Habitat requirements for these species ranged widely from grassland and early succession to forested wetlands and mature western mesophytic forest. Category IIa provides a list of slightly lower priority species, and included another 9 species with slightly lower total scores (19 to 21), but combined with a high score for area importance and population trend. These species largely reflected early succession habitats. Category IIb reflects responsibility for long term conservation of those species, indicated by a large percentage of population that occurs within the Interior Low Plateaus. Acadian flycatcher, orchard oriole, and eastern bluebird are in Category IIb.

Two species are listed in Category III; these species received high global concern scores, or Watchlist Species (e.g. Pashley et al. 1997), regardless of their status in the Interior Low Plateaus. Category IV lists federally threatened and endangered species and Category V lists species of state and local concern. Combined, these categories include 4 species.

### *Conservation area size considerations*

Bingham and Noon (1997) advised that a key challenge for conservationists is to estimate in a scientifically-defensible manner the size and composition of habitats which will meet critical life history requirements for species of interest. They suggested focusing habitat conservation efforts on species with the largest area requirements. In so doing, a reasonable size estimate could be determined for a conservation preserve that would also provide sufficient habitat for other species with smaller area requirements.

In order to systematically and consistently estimate required habitat areas for the conservation of source bird populations, Twedt et al. (1997) used Hamel's (1992) estimates of mean densities of breeding birds taken from Breeding Bird Survey data in their Mississippi Alluvial Valley Conservation Plan. From these density estimates they extrapolated to estimate the area required for 500 breeding pairs, then doubled that to approximate an area of suitable, interior habitat surrounded by a 1 km buffer zone of similar land use. For consistency of application across physiographic areas and among bird conservation plans, the same procedure has been followed in this plan. For some species, a patch size has been estimated for suitable habitat that could support 500 breeding pairs. We then doubled that to create a total area encompassing the core area and approximately a 1 km buffer zone (Appendix 2).

### *Habitat maps in this report*

Figures in this plan depicting the location of contiguous tracts of each habitat type were created from USFS FIA forest inventory data compiled within the past 8 years (Arkansas 1995, Louisiana 1991, Oklahoma 1993, Texas 1992) and shown at a 1 sq km resolution. Though all states have been surveyed after 1990, data contained in the USFS FIA database cannot be expected to be fully current in 1998. Forest areas and locations presented in tables and figures may not reflect present stand conditions. Many areas shown as contiguous forest tracts may well be smaller and more fragmented than they appear in this report.

The database upon which figures and hectare estimates used in this plan were derived was produced by analysis of satellite imagery and assignment of a habitat type classification based on USFS forest inventory data at a 1 sq km scale. While that resolution is rather coarse, it represents a very useful first hierarchical level of identification of habitat tracts in the region. The potentially important large tracts of forest can be easily pinpointed on regional maps at the 1 sq km scale and follow-up actions focused directly on those areas.

### *Management within conservation areas*

The first step after a potential large tract is located should be a thorough survey of that area, either through an aerial reconnaissance or through consultation with local owners, to avoid restricted access commonly found on the ground where private industry lands are often leased to hunting clubs. After a determination is made that a large tract of intact forest exists, ownership of specific stands can be determined and contacts made to initiate the process of negotiating for conservation and protective management of this valuable and vulnerable habitat for birds and other native wildlife. The many avenues of cooperative partnership contracts and agreements for habitat conservation discussed in this plan and elsewhere in PIF documents are then brought into play.

Hunter et al. (1997) make the important point that within large areas of any habitat type managed for conservation, efforts must ensure that all seral stages and natural vegetative diversity occur in order to supply the entire range of needs of bird species using the area. In addition, Hunter et al. (1997) point out that extant forest remnants are often less than ideal for conservation; that is, a large contiguous forest tract may be quite elongate and narrow or well dissected and, effectively, fragmented, with a large linear edge and little buffered interior habitat. While recommended conservation areas for certain species may seem large for the maintenance of 500 breeding pairs, the high level of dissection of large forest parcels makes the number of recommended areas for habitat and species conservation conservative.

Field verification of forests may prove that tracts of some habitat types in the largest size classes no longer occur. Where large tracts of optimal habitat are no longer available, Robbins et al. (1989) have determined that smaller habitat patches in close proximity to other similar areas could serve to attract and retain area-sensitive species. However, they caution that core areas of protected habitats should be selected to maximize the critical microhabitat requirements of concern species.

## **Section 3: Habitats and Objectives**

Breeding birds are grouped into 7 priority habitat-species suites for the Interior Low Plateaus (Table 3). Each of these habitats, western mesophytic, oak-hickory, beech-maple forests, forested wetlands, riparian habitats, grasslands, oak savannas, barrens/glades/old fields, and short rotation pine, is discussed below.

## **Western mesophytic, oak-hickory, and beech-maple forests**

### *Status and importance*

Western mesophytic forest and oak-hickory forest, along with oak-hickory pine forests, cover approximately 6,133,400 ha (15,155,631 acres) or about 34% of the Interior Low Plateaus (Figure 3). Western mesophytic forest and oak-hickory forest have been described by Braun (1950) and Kuchler (1964). Ecological differences are discussed by Bryant et al. (1993). Beech-maple forests cover approximately 999,100 ha (2,468,776 acres) of the Interior Low (Figure 4).

In the Interior Low Plateaus, the highest forest acreage remains in the Western Highland Rim and the Shawnee Hills. Although the Shawnee Hills subdivision is heavily forested in Illinois and Indiana, these forests are highly fragmented and may be at the threshold of no longer supporting source populations for most vulnerable mature forest species (Robinson 1992, Robinson et al. 1993). Other subdivisions are not as heavily forested. In the Eastern Highland Rim, Tennessee River Valley, Kentucky Knobs, Pennyroyal, and Bluegrass subdivisions, forested areas are restricted to relatively small and isolated woodlots, deep ravines, and riparian zones. These areas require extensive reforestation efforts to eventually support remnant populations of forest birds. The continued persistence of many forest birds may be dependent upon immigration from other forested areas such as the Ozark Highlands (Robinson et al. 1995).

In addition to size and distribution, forest structure, and possibly content, are important. Oak-hickory forest content includes dominant tree species such as white oak, northern red oak, black oak, shagbark hickory, and bitternut hickory (Bryant et al. 1993, Weakly et al. 1998). Co-dominant tree species may include pignut hickory, white ash, black walnut, black cherry, chinquapin oak, American basswood, and American elm. Black hickory, mockernut hickory, southern red oak, overcup oak, Shumard oak, blackjack oak, chestnut oak, and post oak may be important in the southern extent of this forest type's range. Beech-maple forests include ash, a variety of hickories, white and red oak, basswood, and American elm (Weakly et al. 1998).

Forest structure, when compared to forest content, better characterizes bird habitats. However, management of both content and structure successional patterns is difficult to determine because of the long history of human disturbance (Bryant et al. 1993). In the Interior Low Plateaus, forest structure varies considerably and is dependent on site conditions as well as past management practices. In many areas, past forestry and landuse practices have resulted in marginal bird habitats.

In many places, forest structure is defined by a closed and tightly packed canopy, with little to no regeneration. Individual tree crown development is inhibited and few or no canopy openings exist. Such conditions limit the ability of the forest to recover from poor past management, and also may limit bird utilization (see Ford 1996). Historic and current logging abuses include high-grading, in which commercially important and mature oaks often are selectively harvested, especially from non-industrial private lands without long term forestry plans. Stands where oaks are selectively harvested become dominated by other fast-growing hardwoods, such as sweetgum and yellow poplar. In much of the northern part of the Interior Low Plateaus, such as south central Indiana, fire suppression has resulted in beech-maple regeneration that inhibits oak regeneration.

*Priority species, species suites, and habitat requirements*

Cerulean warbler, yellow-billed cuckoo, whip-poor-will, eastern wood-pewee, wood thrush, worm-eating warbler, Louisiana waterthrush, and Kentucky warbler are included in the upland oak-hickory and beech-maple bird species assemblage on the basis of high concern scores in the Partners in Flight prioritization scheme (scores >22, Carter et al. in press). Other species with moderate to low concern scores that benefit from quality upland hardwoods management include Acadian flycatcher, red-eyed vireo, black-and-white warbler, hooded warbler, summer tanager, and scarlet tanager. The most frequently encountered birds on forest point counts are yellow-billed cuckoo, eastern wood-pewee, red-eyed vireo, wood thrush, and Kentucky warbler (Roedel et al. 1997).

One species assemblage that occupies the mid to upper canopy includes cerulean warbler, eastern wood pewee, summer tanager, and scarlet tanager. Mature oak-hickory forests are optimal habitats for each of these species (Hamel 1995). Preferred forest characteristics include a canopy closure of approximately 80%, and trees with spreading, well-developed crowns. Cerulean warblers, potentially the most habitat specific of this assemblage, require mature and old-growth deciduous forests in mesic areas (Lynch 1981, Hands, Drobney, and Ryan 1989, Robbins, Fitzpatrick, and Hamel 1992). Cerulean warblers consistently use trees that have larger diameters than average in the forest (Robbins, Fitzpatrick, and Hamel 1992).

A mature hardwood forest species assemblage, consisting of cerulean warbler, worm-eating warbler, and black-and-white warbler occurred on 6% of the Breeding Bird Atlas blocks of Kentucky, Tennessee, and Alabama of the Interior Low Plateaus (Ford and Roedel in press). This species

assemblage was most widely distributed in the Western Highland Rim, which accounted for 50% of all occurrences of all three species. Approximately 11% of the Atlas blocks with this assemblage occurred in the Eastern Highland Rim. The remaining hardwood species assemblage blocks were scattered widely and at the edges of the Bluegrass region and the Shawnee Hills. Other locations included the Ohio River and its tributaries. This species assemblage did not occur historically in the Central Basin or the barrens of the Eastern Highland Rim (Ford and Hamel 1988).

For this same species assemblage north of the Ohio River, cerulean warblers occurred in 37 Breeding Bird Atlas blocks (15 %) in the Interior Low Plateaus portion of Indiana. Of these, most occurred in the Shawnee Hills. The species is considered locally common in the Ohio portion of the Interior Low Plateaus (Peterjohn and Rice 1991), and is distributed throughout the Shawnee Hills portion of southern Illinois (Bohlen 1989). Worm-eating warbler occurred on 50 Atlas blocks (20%) in the Interior Low Plateaus portion of Indiana. Of these, most occurred in Highland Rim subdivision. Black-and-white warbler occurred sporadically north of the Ohio River in the Interior Low Plateau. In Indiana, the species occurred on 27 Atlas blocks (8%) mostly in the Shawnee Hills and Highland Rim. Similar distribution occurred in the Ohio portion of the Interior Low Plateaus (Peterjohn and Rice 1991), and Black-and-white warblers are rare in southern Illinois with only a few scattered nest records (Bohlen 1989).

In recent years, bird population and distribution reflected by Breeding Bird Atlas surveys, the Breeding Bird Survey, and independent studies represent a dramatic change among hardwood bird species (see Bohlen 1989, Castrale et al. 1998, Mengel 1965, Nicholson 1997, Palmer-Ball 1996, Peterjohn and Rice 1998). For example, cerulean warblers have declined dramatically in the Interior Low Plateaus. Mengel (1965) regarded the species as common in central Kentucky in the mid-1960's. By the 1990's, however, cerulean warblers are uncommon, rare, or absent throughout central Kentucky (see Palmer-Ball 1996). The reduced area and fragmentation of mature forest, shorter rotation cycles of commercial forests, changes in tree species composition, and nest parasitism by brown-headed cowbirds have been suggested as major limiting factors (Robbins, Fitzpatrick, and Hamel 1992).

Forest tract size is critical for cerulean warblers. In Maryland, 3,000 ha (7,500 acres) seem to be a minimum tract size for cerulean warbler populations (Robbins, Dawson, and Dowell 1989). Hamel (1992) proposed a minimum of 4,000 ha (10,000 acres) based on East Gulf Coastal Plain work in Tennessee. In the heavily fragmented forest landscape of the Mississippi Alluvial Valley, conservation

planning efforts recommend a goal of 8,000 ha (20,000 acres) per forest patch for sustainable populations of cerulean warbler (Twedt et al. in press). The degree to which forest management affects cerulean warbler populations within these tracts is undetermined, although it seems probable that these birds can be sustained with most ongoing forest and wildlife management.

Eastern wood-pewees forage high in mature forest tree canopies (Hespenheide 1971). Anderson and Shugart (1974) found that pewees select habitats based on several variables, including a low number of small trees and a relatively high number of mid to large trees. Pewees occur in forests with many canopy openings and their occurrence is not limited by tract size (Robbins, Dawson, and Dowell 1989). Summer tanagers, a species with a relatively low concern score, including open woodlands of a variety of types, which includes oak-hickory, mixed oak-pine, as well as some residential areas. Tract size is relevant in that the probability of occurrence increased with tract size and dropped to less than 50% in forests less than 40 ha (Robbins, Dawson, and Dowell (1989). Scarlet tanagers usually require large tracts of mature hardwood. Robbins, Dawson, and Dowell (1989) found the greatest probability of occurrence in forests greater than 3,000 ha (7,500 acres) and less than 50% in forests of 12 ha (30 acres).

Another species assemblage with high concern scores requires a well developed forest mid-story for nesting, foraging, and singing perches. Within this species assemblage are yellow-billed cuckoo, wood thrush, red-eyed vireo, and hooded warbler. Yellow-billed cuckoos are most numerous around forest openings and in shrubby woodlots resulting from fire and other disturbances, although cuckoos occur in extensive forest patches as well (Castrale et al. 1998). In Tennessee, nests vary from 0.9 m to 6.7 m above the ground (average of 3.1 m). The plant most often used was hackberry, but cedars, elms, willows, and pine were also used (Nicholson 1997). Cuckoos seem most numerous in semi-open habitats where thickets are intermixed with patches of woods (Palmer-Ball 1996)

Wood thrush occurs in many types of deciduous forest as well as mixed hardwood-pine forests. However, all forest types must have a well shaded understory, small trees with low, exposed branches, and a fairly open forest floor with decaying leaf litter (James et al. 1984). Robbins, Dawson, and Dowell (1989) found that probability of occurrence increases with patch size, at least 500 ha (1,250 acres). However, wood thrush frequently occur in forests less than 1.6 ha (4 acres) In Tennessee. Nest height ranges from 1.4 to 7.6 m (average of 3.0 m) and were placed most often in dogwood, beech, hackberry, maples, and elms (Nicholson 1997). Occurrence is greatly reduced in very young forests and disturbed forests that lack understory cover (Castrale et al. 1998, Palmer-Ball 1996)

Red-eyed vireos occur in a variety of forest habitats, including mature and second-growth forests, and prefer stands with numerous saplings in the understory (Lawrence 1953), but do not occur in pure coniferous forests. Nest height ranges from 0.8 to 7.6 m (average 2.7 m) and the most common plants were oak, maple, hickory, and dogwood (Nicholson 1997). In Indiana, the only gaps in distribution were urban areas or intensively cultivated areas (Castrale et al. 1998). Hooded warblers require woodlands with a thick, shrubby understory. In the Interior Low Plateaus, this species generally occurs in moist forested ravines (Nicholson 1997), although singing males are common in the margins of relatively dry, even aged cuts or in selectively logged areas (Castrale et al. 1998, Palmer-Ball 1996). In Tennessee, nest heights range from 40 to 180 cm above ground (average 85 cm) and have been placed in sprouts or saplings of many deciduous trees as well as hydrangea, blueberry, cane, and cohosh plants (Nicholson 1997). In Kentucky, hooded warbler abundance decreases westward and they become uncommon to rare at Land Between the Lakes (Palmer-Ball 1996).

Within forests, streamside management zones provide habitats for Acadian flycatcher and Louisiana waterthrush. Both species are sensitive to forest size. For Louisiana waterthrush, Robbins, Dawson, and Dowell (1989) found forest area to be a significant predictor of this species in that tracts less than 360 ha (900 acres) had a much lower probability of occurrence of this species. Louisiana waterthrush often define linear territories along streams (Eaton 1958).

Another species assemblage requires well developed ground cover for ground nesting as well as a dense mid-story or canopy overhead. Within this species assemblage are whip-poor-will, worm-eating warbler, Kentucky warbler, and black-and-white warbler. Whip-poor-wills occur most commonly in many upland deciduous or mixed forest types, although rarely in pure pine stands. Tract size is apparently not important and, in fact, nearby openings may be important for foraging (see Castrale et al. 1998, Nicholson 1997, Palmer-Ball 1996).

Worm-eating warblers occupy forested hillsides and ravines with numerous saplings and shrubs in the understory. Common forest types include mixed mesophytic or cove forests, chestnut oak, and oak-hickory forests. This species is sensitive to forest fragmentation; the probability of its occurrence dropped to less than 50% when forests were less than 150 ha (375 acres). In Missouri, worm-eating warblers were nesting only in tracts 800 ha (2,000 acres) or greater (Wenny et al. 1993). Kentucky warbler is a forest interior species as well (Whitcomb 1981); their probability of occurrence peaks at 300 ha (750 acres) or greater (Robbins, Dawson, and Dowell 1989). However, Gibbs and Faaborg (1990)

found little difference in nesting success or density between fragmented and unfragmented forests. Kentucky warbler's habitat preference is moist woodlands with relatively open overstory of large trees and low, dense understory foliage (Anderson and Shugart 1974); they frequently occur along streams and ravines in dense ferns. This species requires moderate to dense shrub layers (see Castrale et al. 1998), and can occupy a site only a year or two after selective logging (Palmer-Ball 1996).

Black-and-white warblers are most common in mature or fairly mature forests with slopes, rather than forests with no relief, and often nest on slopes or ravines (Palmer-Ball 1996). This species is area sensitive, and rarely occurs in tracts 200 ha (500 acres) or less (Robbins, Dawson, and Dowell 1989). An inexplicable low number of black-and-white warblers occur on the heavily forested northern portion of the Western Highland Rim in Tennessee (Nicholson 1997) and this species is sparsely distributed in Indiana (Castrale et al. 1998).

Western mesophytic forests are also important for many transient birds. Individual migrants orienting towards the South Atlantic coast or Gulf of Mexico in autumn and likely pass across this physiographic area. These birds presumably depend on forest tracts for resting and foraging during their journey. Likewise, many spring migrants orienting northeastward from the Gulf of Mexico also are likely to depend on Interior Low Plateaus forests for resting and foraging.

### *Habitat and population objectives*

Forest bird species within the Interior Low Plateaus cannot be considered secure without an increase in both mature hardwood forest acreage and the average forest patch size. The heavily forested Western Highland Rim provides the best opportunity for management and maintenance of existing tracts. In addition, opportunities exist in the Western Highland Rim for management towards higher quality oak-hickory stands. The Shawnee Hills of southern Illinois (especially at the Shawnee National Forest) and Shawnee Hills/Highland Rim of Indiana (especially Hoosier National Forest) provide opportunity to connect forest patches to increase forest tract size.

The forest habitat objective for the Interior Low Plateaus is to provide 100 areas of sustainable source populations of mature hardwood forest birds. One preferred distribution of populations may be 40 in the Western Highland Rim of Tennessee, 30 north of the Ohio River in Illinois and Indiana, and 30 throughout the remainder of the physiographic area. In the Western Highland Rim, for example, the

number of mature hardwood forest species assemblage sites in the Western Highland Rim should be increased from the existing 22 sites to 40 sites. Each site is defined as a block of approximately 3,000 ha to 4,000 ha (7,500 to 10,000 acres), within which a core of about 1,200 ha (3,000 acres) of mature hardwood forest is managed for cerulean warblers and other forest wildlife. Active forestry and traditional wildlife management is acceptable within the core area, as well as in the surrounding landscape. The minimum percentage of lands necessary in forest is unknown; a valid minimum assumption may be approximately 70% of the block in a predominantly forested landscape and 80% in largely deforested areas (see Robinson et al. 1996).

For the remainder of the Interior Low Plateaus, source populations should be verified through initiatives such as The Cerulean Warbler Project and independent research. Large, mature tracts of oak-hickory forest (>4,000 ha) should be identified and managed on a site by site basis. However, management of at least 60 large forest tracts that harbor source populations throughout the other subdivisions of the Interior Low Plateaus is the primary objective.

Management units and other lands cooperating with Partners in Flight manage tracts and stands within the above mentioned patches for a variety of purposes. Forest habitat characteristics for the above bird species assemblages include:

1. well spaced canopy openings,
2. large (>50 cm dbh) individual trees with mature, spreading crowns, that are dominant (>50%) in the canopy on appropriate site conditions (for much of the Interior Low Plateaus, some site conditions within a forested tract may only support canopy trees of a dbh of 25 to 30 cm because of thin, rocky soils and narrow ridgetops),
3. patches of dense mid-story,
4. mature forests on slopes or in ravines,
5. patches of dense ground cover, and
6. a minimum forest tract size that could range from 16 ha to 4,000 ha (40 acres to 10,000 acres).

Management unit or stand specific habitat objectives are to create those conditions over the majority of the core forest tracts. On cooperating public lands, managers should attempt to provide this range of conditions. On cooperating private lands, maintenance of these conditions over most of the hardwood forest available may be sufficient.

### *Implementation recommendations and opportunities*

Identification, prioritization, and management of 100 hardwood forest patches, each of 3,000 ha to 4,000 ha (7,500 to 10,000 acres), is required to stabilize and increase the forest bird species assemblage in the Interior Low Plateaus. To accomplish this task, many steps remain. The first step is to identify sites already on partners' lands and integrate management techniques that conserve, manage, or enhance mature forest bird populations. Forest bird management recommendations have been provided to several areas, including Land Between the Lakes, Cheatham Wildlife Management Area, Shawnee National Forest, Hoosier National Forest, state forests in Indiana, Pennyroyal State Forest, and the Tennessee National Wildlife Refuge. On these areas, management recommendations should be implemented and monitoring should continue to evaluate change.

Several areas exist where cerulean warblers and the remainder of the species assemblage occur, but do not have management plans for birds. These areas include the Natchez Trace Parkway, Mammoth Cave National Park, Jefferson Proving Grounds, Mucatatuck National Wildlife Refuge, Wheeler National Wildlife Refuge, most forest products industry lands, and almost all non-industrial forest lands. Management plans need to be developed for these public and private lands. Bird conservation plans must be developed in cooperation with land managers and traditional management objectives. Several locations are proposed south of the Ohio River in Kentucky, Tennessee, and Alabama. Site specific plans have been determined for some of middle Tennessee (Appendix 3).

Sites should be identified which are currently not under partnership management, and attempts made to work with private landowners for mature hardwood management. One such program is the Southern Forest Initiative of The Nature Conservancy. The Conservancy will inventory industry lands, monitor bird and other vertebrate populations, and provide management recommendations over long term agreements. Conservation opportunities range from outright acquisition and donations to cooperative timber management programs and conservation easements.

Broad-based incentive programs include the development of a sawtimber incentive program for private non-industrial landowners in Tennessee. The program, in its infancy, may provide a basis for promoting sawtimber logs in Tennessee and value-added industry for the state. Kentucky has recently passed forestry legislation that may assist private, non-industrial landowners to produce sawlog timber. Forest bird management should be added to logger education program and best management practices.

Although now treated within the Interior Low Plateaus area, the east bank of the Mississippi River in southern Illinois is actually a part of the Ozark Highlands. This narrow, forest stringer is composed of forests more complex in structure and content than those of the adjacent Shawnee Hills. This is one of the few areas in southern Illinois where working towards a larger forest tract may be possible. Likely sites need to be identified that can connect forest patches.

The ownership patterns include significant public and corporate lands, as well as a large number of non-industrial landowners. Many are interested in maintaining mature forests in a residential or rural setting. As a result, proactive land planning with county governments is a viable strategy in many areas.

Stand and forest tract management to achieve bird habitat objectives requires intensive silviculture, adaptive management, and further research. Although birds are probably not as dependent on tree species composition as structure, oaks are an important part of forest management in the Interior Low Plateaus. Reestablishing oaks to these forests may require group-selection or even-aged (especially, shelterwood) silvicultural approaches, as oaks are generally shade intolerant and will not regenerate in large numbers where other trees dominate the canopy. The lack of fire and other disturbances that historically favored oaks over other hardwoods, as well as other prevalent factors leading to oak decline, raises questions about whether oaks can ever return to their former dominance even with aggressive regeneration efforts (Bryant et al. 1993).

Even-aged approaches in particular, especially long-rotations (e.g., 100 years) and relatively large treatment areas, can lead to less forest fragmentation in largely forested landscapes (Thompson et al. 1992). The Western Highland Rim and Shawnee Hills may be the only subdivisions of the Interior Low Plateaus where this is appropriate. An even-aged approach allows consolidation of large patches of mature forest at all times, even as the location of these patches change over time, while larger patches of early-successional habitat are similarly provided over time. In contrast, uneven-aged approaches, harvesting similar total volume of timber as described above, may actually lead to more widespread forest fragmentation and development of detrimental edge effects, including the need for more permanently open roads (Thompson 1993).

A combination of both uneven-aged and even-aged timber management can provide stability for mature forest species and some early-successional species depending on the intensity of timber harvest and the objectives of the landowner. However, the effects on forest-interior bird nesting success from uneven-aged and combined silvicultural approaches are harder to predict and may require greater

monitoring efforts to correct problems as they arise then with even-aged silvicultural approaches (Thompson et al. 1996).

Deer populations exceeding carrying capacity may be another factor affecting vulnerable breeding species (deCalesta 1994, Leimgruber et al. 1994). Deer at high densities can strip away vegetation layers important for understory nesting birds. Liberal limit, either-sex hunts for deer are intended to bring high-density populations to below carrying capacity levels. Management recommendations often provided to private landowners and implemented on public lands to increase deer populations on public hunt areas (e.g., through edge creation, food plots) may be counterproductive to breeding birds. These recommendations should be carefully reviewed in the future with respect to forest distribution patterns, as well as current and projected physiographic area deer populations. On a similar note, continued emphasis in farm programs to keep cattle out of woodlots and riparian zones are of major importance.

#### *Evaluation of assumptions*

Implementation of this plan is based on several assumptions which require further research or adaptive management strategies. These assumptions include the following items:

1. 100 blocks of 3,000 ha to 4,000 ha (7,500 to 10,000 acres) are sufficient to sustain source populations of target species,
2. maintenance of 80% of a landscape in mature hardwood forest, in conjunction with other land uses (including pine plantations or short rotation hardwood management), will maintain source populations of target species,
3. within hardwood stands, silviculture can create desired forest habitat conditions,
4. breeding bird habitat objectives will sustain nonbreeding bird populations with high concern scores, and
5. breeding bird atlas analysis of hardwood bird species assemblages is an effective method of determining areas of management and conservation priorities (see Ford and Roedel in press).

## **Forested wetlands**

### *Status and importance*

Major Interior Low Plateaus forested wetlands occur in the floodplains of the Ohio, Tennessee, and Cumberland Rivers. A smaller acreage occurs throughout the narrow floodplains of tributaries to these major rivers. Many bottomland forest types reach their northernmost range in the Ohio River system and some trees (such as cypress and tupelo) do not occur throughout the area. Floodplain forests can include cypress, tupelo, oak, sweetgum, blackgum, hickory, sycamore, silver maple, and birch forests. In some portions of the Interior Low Plateaus, beech-holly forests may be present on transition sites or the edge of floodplains (see Martin et al. 1993).

Other forested wetland types in the Interior Low Plateaus are maintained by underground water and periodic flooding. These are small pockets of isolated forests, which occur most commonly in the Eastern Highland Rim, within and to the north of the historical barrens landscape. Similar conditions occur in the Tennessee Valley of northern Alabama, although these areas are smaller and typically remain in mud flats, marsh, and emergent vegetation.

Most forested wetlands in the Interior Low Plateaus have been replaced by row crop agriculture or impounded water for hydroelectric power. In the Ohio River floodplain, fragmented forested wetlands occur in relatively small blocks within an agricultural landscape. Most of these forests are composed of bottomland hardwood oaks and hickories. In much of the Tennessee River and Cumberland River system, floodplains are now under permanent water and are not restorable. In the Alabama portion of the Tennessee Valley, floodplain forests are small and isolated in a largely agricultural landscape. Those forest patches mostly consist of cypress, cypress-tupelo, or pure tupelo stands.

### *Priority species, species suites, and habitat requirements*

Wood thrush, cerulean warbler, prothonotary warbler, and Swainson's warbler are included in the forested wetland bird species assemblage on the basis of high concern scores (>22) in the Partners in Flight prioritization process (Carter et al. in press). Habitat associations for both wood thrush and cerulean warbler are described elsewhere in this plan and will not be discussed in detail here. Other species with low to moderate concern scores that would benefit from bottomland hardwood management include Acadian flycatcher, northern parula, yellow-throated warbler, and American redstart.

Acadian flycatcher is most abundant in extensive forests of the Interior Low Plateaus (Palmer-Ball 1996), and, generally, is more frequent in large tracts than in smaller tracts (Robbins, Dawson, Dowell 1989). In Indiana, Kentucky, and Tennessee, for example, Atlas distribution was closely tied to large areas of mature forests (see Castrale et al. 1998, Palmer-Ball 1996, Nicholson 1997). In Tennessee, this species is among the most abundant along the Duck River (Nicholson 1997). It nests on horizontal limbs, far from the trunk at an average height of 3.9 m. The most commonly used nest trees were deciduous, with beech, dogwood, and sweetgum most often used in Tennessee (Nicholson 1997).

Prothonotary warblers are a common to abundant nesting species throughout the Interior Low Plateaus (see Palmer-Ball 1996, Castrale et al. 1998, Peterjohn and Rice 1991, and others). The species occurs commonly in the Tennessee and Cumberland systems. In Tennessee, water presence is the single most important variable for nesting habitat. Nests are usually never more than 100 m from the water, the species nests in a variety of cavities and will accept nest boxes (Petit et al. 1987). In west Tennessee, highest densities occurred in tupelo forests with high snag density and low herbaceous cover (Ford 1990), similar to conditions in the Tennessee Valley of northern Alabama. Tennessee River densities of appropriate habitat were 3 pairs per km of river (Petit 1986). Extensive research has taken place in the Interior Low Plateaus, especially around Kentucky Lake (see Petit 1986, Petit 1989). Nicholson (1997) speculated that the loss of prothonotary warblers was because of reservoirs and clearing for agriculture.

Swainson's warbler occurs sporadically in the Interior Low Plateaus, almost solely in Kentucky (Palmer-Ball 1996). The species occurs in floodplain forests with giant cane or thick brush abundance, as well as in wet thickets after logging (Palmer-Ball 1996). In Tennessee, the species has a rare, sporadic occurrence. Tennessee records from the Interior Low Plateaus include 1940's records in Montgomery and Cheatham Counties (Ganier 1940), but few records since that time.

### *Habitat and population objectives*

In fragmented systems, the first measure in setting objectives is to establish a desired minimum forest patch size. In the lower Mississippi Alluvial Valley, patch size goals are designed to maintain or restore habitats in three size categories. These are forests between 4,000 ha and 8,000 ha (10,000 and 20,000 acres), forests between 8,000 ha and 40,000 ha (20,000 and 100,000 acres), and forests greater than 40,000 ha (100,000 acres). These sizes were considered necessary to support healthy populations of Swainson's warbler, cerulean warbler, and swallow-tailed kite, respectively. Patch sizes were large in consideration of other management actions that may be desirable within the habitat block (e.g. forestry or open lands management) and because of the severe isolation of forested patches (Twedt et al. in prep.).

In the Kentucky portion of the Ohio River floodplain, most topographic maps were classified as no or very little forest cover to a good mixture of forest and open lands. Three quadrangles were classified as predominate or nearly complete forest cover, and included adjacent upland forests as well as forested wetlands (Palmer-Ball 1996). Similar conditions exist north of the Ohio River (see Castrale et al. 1998, Peterjohn and Rice 1991).

Swallow-tailed kite habitat restoration should be one consideration for habitat and population objectives. Swallow-tailed kites nested historically in Kentucky and Indiana (Audubon 1861), but have been extirpated from this region since the late 1800's (Mengel 1965). In other parts of its range, swallow-tailed kite populations include at least 80 pairs in 40,000 ha (100,000 acre) forested block (Cely and Sorrow 1990). One desirable forested wetland habitat goal, therefore, is to reestablish one breeding population of swallow-tailed kite in the Ohio River floodplain.

Kentucky Breeding Bird Atlas data indicate that cerulean warblers were present in at least 5 areas adjacent to the Ohio River (Palmer-Ball 1996). In the Lower Mississippi Alluvial Valley, cerulean warbler populations are estimated to require 8,000 ha (20,000 acre) forested blocks (Twedt et al. in prep). If this minimum patch size requirement is applicable to the Ohio River floodplain, a habitat goal is to establish and maintain 5 patches of 8,000 ha (20,000 acres), potentially around existing cerulean warbler locations.

Much of the Cumberland and Tennessee floodplains in Tennessee have been permanently inundated from dams that generate electric power. As a result, most of the floodplain is underwater, which leaves narrow strips of bottomland hardwood forest. The size and importance of these strips are

currently unknown, although opportunities to provide continuous habitat from lake edge to upland forest would benefit many species. Tributary floodplains are important bird habitats in this region. One habitat goal is to establish at least 2 continuous blocks of 8,000 ha (20,000 acres) on each of 2 tributaries in Tennessee, the Duck River and Big Sandy River, Tennessee.

In northern Alabama, much of the Tennessee River floodplain is inundated by Wheeler Dam and reservoir, and remaining patches of bottomland hardwood forests are generally small and dominated by wet site trees, such as tupelo. The best opportunities for maintenance or restoration of bottomland hardwood forests may occur in the Elk River watershed or the floodplain of the Tennessee River near Wheeler National Wildlife Refuge. A habitat goal for this portion of the floodplain is to create one continuous 8,000 ha (20,000 acre) block around a core at the Wheeler National Wildlife Refuge, and expand this area northeast toward Huntsville to mitigate expanding urbanization in both bottomland and upland forest.

These considerations relate only to quantity and distribution of habitat patches, and do not address the quality of habitat within those patches. Generally, the majority of forest patches should be mature hardwood stands of mixed oak-hickory-sweetgum, with scattered stands of cypress-tupelo, marsh, and dead tree swamp interspersed throughout. Within these patches, some portion for agriculture and moist soil management for waterfowl and shorebirds is acceptable in proportion to contiguous forest habitats. The most desirable hydrology is a natural flood regime in which flooding occurs during non-growing seasons and the land is dry during most growing seasons. Hydrology restoration actions may include breaching levees, creating new meanders in rivers, and destroying excessive beaver ponds.

#### *Implementation recommendations and opportunities*

The U.S. Fish and Wildlife Service has instituted ecosystem management teams in each of the major watersheds of the Interior Low Plateaus, including the Ohio, Cumberland, and Tennessee Rivers. These teams can provide mechanisms to integrate migratory bird conservation planning and implementation, especially in floodplain habitats.

In the Western Highland Rim along the Tennessee River, the Tennessee National Wildlife Refuge has proposed an ecosystem management project that incorporates the interests of area landowners. A portion of this project considers bottomland hardwood management where appropriate,

especially in terms of restoration or silviculture that would provide larger diameter trees with a more fully developed crown.

The Cumberland Compact, a non-governmental organization, has recently started a project to conserve habitats on the main stem and tributaries of the Cumberland River. The organization will prioritize areas of natural resource importance and work with landowners for implementation of objectives.

Plan opportunities exist on at least 4 tributaries to the Tennessee River, the Elk River, Buffalo River, Duck River and the Big Sandy River. The Elk River flows through south central Tennessee into northern Alabama. The Tennessee Conservation League and several of its partners have developed a natural resource assessment of the watershed, which includes areas to further investigate as potential bird conservation areas (Roedel et al. in prep.). The Buffalo River is a state scenic river that relies heavily on boating and fishing tourism in the local economy. As a result, much of the watershed remains in fairly high quality habitat and opportunities exist to build in bird and floodplain habitat conservation.

The Duck River has potential to increase public lands management rapidly as part of the Columbia Dam project and associated lands from the Tennessee Valley Authority. Furthermore, The Conservation Fund has an active Greenways program established on portions of the Duck River that will build in bird conservation incentives as priorities in the watershed emerge. The Big Sandy River includes a high percentage of public lands and forest industry lands in its watershed, and as a result, cooperative agreements and projects may increase the quantity and quality of floodplain habitats.

Throughout the Interior Low Plateaus, there is increasing opportunity to promote reforestation of marginal farm lands with cottonwood and oak, a practice which allows an economic return from the cottonwood in 10 to 20 years but also provides a long term incentive for sawtimber oak.

Finally, to accomplish proposed objectives in the Alabama portion of the Tennessee Valley, the Wheeler National Wildlife Refuge acquisition boundaries may need to be re-examined to determine if expansion is possible.

#### *Evaluation of assumptions*

Implementation of the above plan is based on several assumptions. Assumptions that need to be tested include the following:

1. proposed patch sizes and numbers are appropriate to sustain source target bird populations,
2. river to upland habitat connections are valuable to birds, and
3. cottonwood reforestation with an oak understory is valuable to birds.

## **Riparian woodlands**

### *Status and importance*

The term riparian refers to streamside areas. Riparian woodlands may also be called greenbelts, stream corridors, streamside management zones, or streamside buffers. In the Interior Low Plateaus, riparian habitat may be dominated by tree and shrub species more typical of uplands, such as oak-hickory or beech-maple, or may occur as forested wetlands in narrow floodplains. Upland riparian habitats are often important habitats for both aquatic and terrestrial fauna, especially in those lands where there is high topographic relief.

Riparian vegetation is considered essential for minimizing erosion from upslope areas from entering and seriously changing water quality (National Association of Conservation Districts 1994). The importance of minimizing erosion through maintenance of riparian habitats is perhaps most important in areas being developed for residential or industrial use. However, maintenance of riparian vegetation adjacent to areas mined, farmed, or timbered remains necessary to reduce runoff and erosion, and minimize environmental contamination from applied chemicals.

### *Priority species, species suites, and habitat requirements*

Within largely forested landscapes, acadian flycatcher, cerulean warbler, Swainson's warbler, and Louisiana waterthrush are most common in riparian habitats within largely forested landscapes. Acadian flycatchers and Louisiana waterthrushes appear consistently when streamside management zones are at least 42 m to 84 m (150-300 feet) wide, with somewhat open understory, adjacent to recently regenerated loblolly pine plantations in coastal plain, piedmont, and Ouachita studies (Dickson et al. unpubl. manu., Tassone 1981, Melchoirs and Cicero 1987, Tappe et al. 1994).

In agricultural landscapes, or along major floodplains maximum numbers of the most area-sensitive species occurred in streamside management zones of at least 84 m (300 feet) in width (Keller et al. 1993). At the edge of the Western Highland Rim and the Central Basin in Tennessee, Louisiana waterthrush occurred rarely, perhaps as a result of very narrow streamside forest zones and grazing may have been limiting factors (Ford and Hamel 1986).

Landbirds are among the wildlife species now frequently targeted by natural resource managers when developing guidelines for streamside management zones within riparian habitats. Maintaining the width of riparian habitats as “bigger is better” would be an optimum strategy for vulnerable landbirds, if this group of species constituted the only consideration for making management decisions (Dickson and Warren 1994). Effective conservation in most managed landscapes, however, requires that the best information be made available to balance economics with the needs of wildlife. For this reason, both managers and biologists should review Wigely and Melchoirs (1994) and Melchoirs (in press) for management opportunities as well as important caveats for interpreting existing data on wildlife use of retained riparian vegetation in actively managed landscapes.

#### *Habitat and population objectives*

It remains unclear whether wider streamside management zones in heavily managed landscapes are suitable or optimal habitat for most or any vulnerable bird species. Reproductive success may be low in fragmented conditions where birds are vulnerable to a high degree of nest parasitism and depredation.

On the basis of simple indices for species richness and diversity, riparian habitats do not always support more species or numbers of birds than adjacent non-riparian forests (e.g. Smith 1977, Gates and Giffen 1991, Murray and Best 1995). Nevertheless, many of the most vulnerable species occurring in the Southeast are found in forested riparian habitats but are not present in upslope forests.

Flexibility in managing riparian habitats is enhanced when large landscapes are under cooperative management. Relative width recommendations, for example, could depend on the nature of dominant landuse patterns. Narrower streamside zones would be adequate where adjacent lands are dominated by mature or maturing stands. Short-rotation plantations with many early regeneration patches present during every decade would benefit more from moderate to wide zones. Finally, agricultural areas would be likely to require the widest zones if vulnerable landbirds are an important consideration for management.

### *Implementation recommendations and opportunities*

Melchoirs (in press) organized existing data into three categories particularly useful for developing management recommendations: (1) streamside management zones in managed (usually short-rotation pine) forest stands, (2) riparian forest habitats in otherwise agricultural or developed landscapes, and (3) moisture/elevation gradients in largely forested landscapes. Landowner objectives may largely define the role of streamside management zones for any larger landscape.

Debates about the importance of streamside management zones are likely to continue. Nevertheless, existing suggest that riparian habitats provide opportunities to support vulnerable landbirds away from major forested wetlands.

The following quote and other recommendations from Melchoirs (in press) are particularly relevant mapping conservation strategies:

. . . one should not expect the same roles on lands owned by individuals, corporations, and the public. Regardless of ownership and from a landscape perspective, variable-width SMZs [streamside management zones] seem intuitively appropriate given the wide variation in stream, floodplain, and slopes. SMZ dimensions should roughly correlate to these features, increasing from the upper end towards the lower end of a watershed. Even narrow SMZs on ephemeral or intermittent streams are important and can contribute to the diversity of the bird community in a managed forest. Fixed-width SMZs may not always encompass important habitat features in areas where topography and habitats are variable (Melchoirs and Cicero 1987); and flexibility in management seems important from an operational perspective (Wigley and Melchoirs 1994).

Such flexibility is important as the economic costs and benefits of timber, birds, and streamside management zones remain largely conjectural and in need of further validation. Recommendations for streamside management zone width and condition beyond those outlined in state-sanctioned Best Management Practices, need to be presented to private landowners as optional.

Ongoing and future efforts to provide financial incentives, conservation easements, and partnerships through public-private programs like the Farm Bill's Forest Stewardship provisions (U.S.D.A. Forest Service) and Partners for Wildlife (U.S. Fish and Wildlife Service) are critical to stabilize or enhance riparian habitat throughout the Southeast.

### *Evaluation of assumptions*

Implementation of this plan is based on several assumptions which require further research within the context of different landscapes. Research could clarify the following four items regarding streamside management zones:

1. optimum vegetative structure,
2. desired plant species composition,
3. maximum active management advisable within riparian habitats, and
4. a standard minimum width of riparian habitats necessary to minimize erosion and conserve birds.

### **Grasslands and savannas**

#### *Status and importance*

Interior Low Plateaus habitats included historical expanses of tallgrass prairie and blue ash-oak savanna, which ranged in size and abundance from large and fairly common in the northwest corner to small and scattered in the southeast. The relatively flat areas in the Pennyroyal of Kentucky, for example, was a mixture of tallgrass prairie and barrens habitats, mixed with small woodlots and forested riparian zones. Throughout the Bluegrass region, much of the habitat was blue ash-oak savanna (see Martin et al. 1993).

Open grassland species such as Henslow's sparrow, bobolink, dickcissel, grasshopper sparrow and sedge wren occupy a habitat which has been altered to a large degree and completely eliminated in some areas. Habitat loss has caused restricted breeding populations or loss of greater prairie chicken, short-eared owl, and northern harrier. The long term downward population trends represent the decline in availability and quality of habitat. However, population levels and distribution data prior to the 1960's are vague and make difficult the task of evaluating change.

Large scale habitat change has occurred within grasslands across the entire physiographic area. Since the Homestead Act of 1862, grasslands have been fragmented and converted to other land uses. Currently, in the Interior Low Plateaus, areas historically inhabited by native warm season grasses, prairies and savannas have been converted to pastures dominated by fescue, row cropping, and encroached upon by woody invasion. In addition, savanna areas located across the bluegrass have been

heavily developed and fire suppression has all but eliminated the proliferation of the oak and tall grass community.

Throughout the Interior Low Plateaus, only remnants of this once expansive community exist. This spectrum of habitat preference for representative species presents an opportunity for management of a variety of grassland birds within a core area. It appears that many species are more habitat area sensitive than burn-area sensitive. Therefore, a large area, i.e. 4,000 ha (10,000 acres), can be managed with a variety of grassland successional stages that accommodate a diverse community of grassland associated birds. This provides the flexibility to incorporate a variety of management tools such as burning, mowing, and grazing. An area of this size will have a large number of ownerships. Incentives will be necessary for landowners to achieve their personal objectives and migratory bird objectives.

Whether species are increasing or decreasing their population or range, grassland and open country bird communities exist primarily in agricultural habitats such as hay fields, pastures, or habitats created by the Conservation Reserve Program. In the Interior Low Plateaus, open country bird habitats may include reclaimed mine surfaces, strips near airfields and power line right-of-ways. These habitats, unfortunately, are often monotypic and in the case of hay fields and pasture, may be harvested during nesting season, which may result in significant nest failure (Bollinger et al. 1990, Frawley and Best 1991).

#### *Priority species, species suites, and habitat requirements*

Henslow's sparrow, field sparrow, and dickcissel are included in the grassland and open country bird species assemblage on the basis of high Partners in Flight concern scores (>22, Carter et al. in press). Other species with low or moderate concern scores that would benefit from grassland and open country habitat management in the Interior Low Plateaus include loggerhead shrike, grasshopper sparrow, bobolink, short-eared owl, northern harrier, and northern bobwhite.

A species assemblage of open lands birds consisting of grasshopper sparrow, dickcissel and loggerhead shrike occurred in 13% of Breeding Bird Atlas blocks across the Interior Low Plateaus portion of Kentucky, Tennessee, and Alabama (Ford and Roedel in press). These same species were more widely distributed north of the Ohio River, into the Eastern Highland Rim and the Shawnee Hills (see Castrale et al. 1998). The remainder of blocks occurred in the Central Basin of Tennessee and the Bluegrass region. Henslow's sparrow occurs in limited populations in Kentucky (see Palmer-Ball 1996)

and two known locations in Tennessee (Sloan in press), although populations are stable or increasing in southern Indiana (Streve Olson, J. Dan Webster, pers. Comm.).

Open Grasslands. Bird occurrence in open grasslands depends primarily on succession stage and moisture gradient; some are area sensitive species which require grasslands above a minimum acreage. Among these species, Henslow's sparrow is the most vulnerable (see Federal Register 1998, 63(174): 48162-48164). This species requires older succession grasslands, often 4 to 6 years after disturbance with dead materials and standing stalks for singing perches (Herkert 1994). Most Henslow's sparrows occur in the Illinois and Indiana portions of the physiographic area, where they are increasing in new habitats provided by Conservation Reserve Program lands and reclaimed strip mines. In Kentucky, the most common habitat is fallow fields and pasture, some of which may be marginal or suitable within 1 or 2 years (Palmer-Ball 1996). Other habitats in Kentucky include reclaimed mine surfaces and margins of airfields. In Tennessee, the only known locations are fallow fields (Sloan in press). Henslow's sparrows may be sensitive to tract size. For example, in Illinois, 56 ha (140 acres) seems to be the minimum area requirement (Herkert 1994). The birds occur in much smaller areas in most of the Interior Low Plateaus, there has been no study to indicate the level of nest success.

Dickcissels are scattered throughout the Interior Low Plateaus, but show their greatest density in the western portions of the province. Zimmerman (1982) reported dickcissel use prairie habitats as well as old field habitats with a high forb diversity. Although nest densities were greater in old fields than in prairies, predation rates were also higher in old fields (Zimmerman 1982, 1984). Dickcissels also occur in fields with small grains (Castrale et al. 1998, Palmer-Ball 1996). To achieve a greater forb density, winter and spring burns are preferred. Grazing in a rotational system may provide suitable habitat as well if managed properly.

Grasshopper sparrows inhabit drier, sparsely vegetated sites during the breeding season. Grasshopper sparrow populations have experienced steep declines as noted since the inception of the Breeding Bird Survey (BBS) in 1966 (see, for example, Castrale et al. 1998), but appear to have stabilized recently, at least in Kentucky (Palmer-Ball 1996). Mowing regimes can have a severe negative impact on grasshopper sparrow populations if conducted from mid-May to late July. Mengel (1965) reports peak nest completion from May 21-31. Vickery (1996) suggests airport facilities delay mowing within 1 km (.6 mile) of the runway until August. Light to moderate grazing is acceptable.

Prescribed fire can also be used as a tool for improving grasshopper sparrow habitats greater than one year postburn.

Bobolink breeding records throughout the Interior Low Plateaus are scattered in limited numbers throughout central Kentucky, which is the southern edge of the species range. This bird depends on hayfields and pastures and mowing should be delayed until at least mid-July and should only be hayed every 2-3 years if possible (Bollinger et al. 1990). Bobolinks are found in unmowed grasslands with a thick litter layer and a high grass-legume ratio (Bollinger et. al. 1990, Martin and Gavin 1995). Bobolinks appear to be area sensitive. Bollinger and Gavin (1992) found greater than twice the number of bobolinks on areas greater than 30 ha (75 acres) than on areas less than 10 ha (25 acres). At least one male has been observed on a reclaimed mine site, but no nesting has been confirmed (Lawless pers. obs.).

Grasslands with Shrubs. Field sparrow density is most dense in Missouri, Kentucky and Ohio according to BBS data (Carey et al. 1994). Old field and open grassland areas with a shrub or woody component are essential habitat for the field sparrow. Allowing areas to reach this successional stage while using fire, grazing and mowing on a rotational basis will maintain habitat.

Loggerhead shrikes require old field and grassland habitats with a woody component. Yosef (1994) demonstrated that shrub habitat arranged in a linear fashion such as a fence line was not as productive as shrub clumps or patches distributed throughout. Although habitat is considered limiting, it has been suggested by Anderson and Duzan (1978) that shrikes have experienced equally damaging effects of pap-DDE. Neither the field sparrow or loggerhead shrike appear to be area sensitive (Carey et al. 1994, Yosef 1996).

Open Land Mosaic. The greater prairie chicken, short-eared owl, and northern harrier are species requiring large areas of open grasslands and marshes in a landscape mosaic of 4,000 ha (10,000 acres) or greater. These species nest in large open areas including fallow fields and pastures. Greater prairie chicken has been extirpated from the Interior Low Plateaus. Northern harriers and short-eared owls can utilize reclaimed surface mines in the Shawnee Hills (Castrale et al. 1998, Palmer-Ball 1996). Recently, northern harriers were observed during the breeding season at Fort Campbell Military Base in a frequently burned training ground (Mike Roedel, pers. comm). These areas offer an array of dry upland sites and wet marsh areas interspersed with small patches of shrubs and trees. Expansive grassland habitat within the Interior Low Plateaus may support nesting individuals of these species,

although limited field work has been conducted to investigate this possibility. Short-eared owl and harrier presence depends on a mixture of successional stages throughout the landscape and cyclic small mammal populations (Holt and Leasure 1993, MacWhirter and Bildstein 1996). Management for waterfowl habitat and upland game birds can prove beneficial for this guild. Burning and wetlands management should be pursued.

### *Habitat and population objectives*

Pasture and range wildlife populations should be restored pre-1980 levels (see Capel et al. 1994). To achieve that goal nationwide, Capel et al. (1994) specifically set objectives of (1) retaining 1,600,000 ha (4,000,000 acres) of existing range dominated by native warm-season grasses and (2) restoring or converting cool-season grass pastures to native warm-season grasslands on an additional 4,092,400 ha (10,231,000 acres). Conversion to warm season grass has many benefits for conservation and management of targeted species. Furthermore, warm-season grasses are more drought-hardy and provide livestock with reliable summer forage, thus providing the southeastern livestock industry with an increased buffer against to periodic economic stress. In addition, native warm-season grasses contribute significantly to future soil quality, as the only rapid developer of topsoil in the A soil horizon, a major consideration for many southeastern soils which have been farmed for more than 200 years.

Approximately 2,465,800 ha (6,092,992 acres) of pasture, hay and mixed croplands occur in the Interior Low Plateaus (Figure 5). A short term habitat restoration goal for the Interior Low Plateaus is to provide 40,000 ha (100,000 acres) of restored native, warm-season grass and savanna habitats. At least 20,000 ha (50,000 acres) would occur ideally in 5 areas; each area would consist of 4,000 ha (10,000 acres) or more. In these landscapes, primary habitat and land use would be provided by mix of native, warm season grasses in a variety of successional stages. These 5 areas should be scattered from Illinois, Indiana, and Ohio through the Bluegrass of Kentucky, and south to the northern portions of the Western Highland Rim (Fort Campbell). The remaining 20,000 ha (50,000 acres) should occur in 500 patches of at least 40 ha (100 acres) each, and be distributed throughout the Interior Low Plateaus based on opportunity and landowner objectives.

### *Implementation recommendations and opportunities*

The foraging and nesting requirements of some breeding species (if enough native grassland is available nearby) and many migratory or wintering species can be met by farmers and ranchers. Thus, the restoration of native grass-dominated habitats along with cooperative agreements with private landowners to support compatible practices, such as timing of hay mowing to not interfere with nesting species, on lands under active production can have the greatest conservation benefit for the grassland species of highest concern. Efforts to promote large landscapes of mostly native, warm season grasses may be achieved through landowner contact programs and targeted priority zones.

The Kentucky Division of Fish and Wildlife Resources, for example, has recently begun experimental grassland restoration work in Hancock County. This project promotes native warm season grass management through the state upland game program to provide evidence regarding nest productivity and habitat utilization. Through the Natural Resource Conservation Service and other agriculture related programs, the project is expected to reach at least 200 ha (500 acres) on traditional Farm Bill customer lands. Successful implementation could increase participation and provide incentive towards larger blocks of native grassland habitats. Monitoring, seed purchase, labor, and other costs is provided by the program.

The Tennessee Wildlife Resources Agency provides a similar cost share with Quail Unlimited for public lands management. For private lands, this program may provide extra financial incentive to WHIP participants for projects such as fescue eradication, first prescribed burn, and field borders. Although no specific counties are targeted, some will have significant acreage enrolled.

Partners in Flight biologists have worked closely with game bird biologists in both states to maximize the amount of information gained regarding management of nesting birds. Further investigations should lead to minimum acreage requirements, as well as the best locations and opportunities for implementation. Tentatively, grassland restoration goals consist of blocks greater than 40 ha (100 acres).

A forest-grassland mosaic exists in much of southern Illinois and Indiana. In these areas, reforestation of tracts and connecting forest tracts is a high priority. Once these high priority areas are identified, the remainder could be converted to warm season grass. In Indiana, among the best opportunities for grasslands and open lands management is on reclaimed strip mines. For example, the Ayrshire mine property is a partnership among the Indiana Department of Natural Resources, Evansville

Audubon Society, The Nature Conservancy, Izzak Walton League, and others to manage vulnerable species.

Fort Campbell Military Reservation and Jefferson Proving Grounds provide an excellent opportunity to research priority management questions regarding minimum size and management requirements. Fort Campbell may offer the best opportunity to reintroduce greater prairie chicken to this part of its historical range, although successful introduction may be limited by perch sites for raptors and lack of quality habitat. As a minimum, a feasibility study has been recommended by the participating interests.

Small scale restoration and management of grass-dominated communities is necessary to recover many Federally and State protected plant species in the southeast and can provide benefits to vulnerable grassland birds on a limited scale. In many cases, these conservation efforts must involve cooperative agreements with private or corporate landowners. Utility right-of-ways may provide excellent opportunities for maintaining grassland habitats when appropriate management protocols are followed (DeSelm and Murdock 1993). Prairie restoration on family farms also needs to be encouraged. Such efforts are now underway in several southeastern States, including Kentucky.

#### *Evaluation of assumptions*

Landscape and stand specific grassland and savanna management recommendations were based on several assumptions. These assumptions include the following items.

1. Estimates regarding the minimum acreage requirements for birds in the Interior Low Plateaus were based on studies in the Great Plains, which may not be applicable here because of the difference in the context of the landscape. Detailed studies regarding bird species assemblage distribution based on minimum size class are needed.
2. Nest productivity is unknown under various management regimes or for various size classes; most information is based on the presence, absence, or relative abundance of species. Studies of nest productivity are needed.
3. The seed stock source for grassland species restoration is often unknown or not locally provided, which generates questions of plant genetic viability and, thus, community viability. Studies regarding the viability of restored communities, and the long term impact to sustaining bird populations, are needed.

4. Although much has been learned recently, more research is needed to clarify burn and disturbance regimes and the impact on bird populations, especially in small isolated habitats.

## **Barrens, glades, and old fields**

### *Status and importance*

Historically, barrens and glades were scattered in relatively small patches throughout the Interior Low Plateaus (see Quarterman 1988 for a discussion of ecological differences between barrens and glades). These habitats have been diminished both in size and quality because of increasing urbanization, grazing, trash dumping, or a lack of ecological disturbance that results in succession to mature forest. Apparently, no bird species are dependent solely on barren or glade habitats. Most bird species can inhabit other early succession habitats as well, including old fields or even aged forest management. Barrens and glades, however, represent stable early succession habitats.

In the Interior Low Plateaus, barrens occur most commonly in parts of the Pennyroyal and in a long northeast to southwest strip through the Eastern Highland Rim of Tennessee and Alabama. In southern Illinois and Indiana, large barrens occupy parts of several townships and counties. Cedar glades occur almost exclusively in the Central Basin of Tennessee in a seven county area near Nashville. Barren and glade management was almost non-existent until the 1970's, when university botanists, state Heritage programs, The Nature Conservancy, and others began major campaigns to purchase, manage, and restore barrens and glade habitats. Priority sites were designed primarily to protect globally important plants, such as the Tennessee coneflower, and globally threatened ecological communities.

Old field habitats were scattered throughout the southeast historically, and occurred as a result of native American burning and natural disturbances (Buckner and Hamel in press). During the early decades of this century, old fields became common in the Southeast because of small farm abandonment and inefficient farming practices. As bird habitats, these farms replaced natural old field and shrub-scrub habitats largely lost during this same time period. Currently, old fields and shrub-scrub hedgerow habitats are diminishing. Habitat losses have been caused by more efficient farming with fewer maintained hedgerows, land conversion to housing subdivisions, or land which succeeds towards mature forest.

*Priority species, species suites, and habitat requirements*

Bewick's wren, prairie warbler, and blue-winged warbler are included in the barrens, glades, and old field habitat bird species assemblage with high concern scores in Partners in Flight prioritization process (>22, Carter et al. in press). Other species with low to moderate concern scores include northern bobwhite, white-eyed vireo, yellow-breasted chat, indigo bunting, and Bachman's sparrow. In the Interior Low Plateaus of Kentucky, Tennessee, and northern Alabama, the most frequently encountered species during point counts in this habitat were yellow-breasted chat, brown-headed cowbird, indigo bunting, prairie warbler, field sparrow, and eastern towhee (Roedel et al. 1997).

An early succession bird species assemblage consisting of prairie warbler, blue-winged warbler, and yellow-breasted chat occurred in 16% of all Breeding Bird Atlas blocks in the Interior Low Plateaus of Kentucky, Tennessee, and Alabama (Ford and Roedel in press). Of these blocks, almost half (43%) occurred in the Western Highland Rim of Tennessee, most of which were patches of even aged forest management. This species assemblage occurred also in early succession habitats such as cedar glades and barrens, and was present in the Central Basin and portions of the Eastern Highland Rim. Prairie warbler occurred on 138 Breeding Bird Atlas blocks (56%) in southern Indiana, and are considered common in southern Illinois (Bohlen 1989), but scattered in Ohio (Peterjohn and Rice 1991). Blue-winged warbler occurred on 88 blocks (36%) in Indiana. Yellow-breasted chat occurred on 222 blocks (90%) of Atlas blocks in Indiana. For all of these species, notable gaps included agriculture dominated landscapes of the Tennessee Valley, Shawnee Hills, and the Bluegrass region.

Bewick's wren populations have declined dramatically throughout the eastern United States, including those in the Interior Low Plateaus (Castrale et al. 1998, Nicholson 1997, Palmer-Ball 1995). Bewick's wrens were formerly common birds of brushy thickets in areas of otherwise sparse vegetation. In Tennessee and Kentucky, this species probably occurred historically around burned areas and clearings maintained by native Americans or early European settlers (see Palmer-Ball 1995, Nicholson 1997).

Several reasons are postulated for Bewick's wren decline: competition from house wren, severe winter weather, and loss of habitat are among the most often considered (e.g. Laskey 1966); fire may have played a role as well. However, each reason remains inadequate to explain declines in most of the Interior Low Plateaus. Bewick's wrens have recently been found in relatively high densities in slash piles of young clearcuts, most 1 to 3 years old. There are brief descriptions of birds in these habitats for

Trigg and Lyon Counties in Kentucky (Palmer-Ball 1993) and in Stewart County, Tennessee (Robinson 1989).

Prairie warblers occur in a variety of early succession habitats, such as natural communities where pine and cedar are present (such as cedar glades and barrens), forestry clearcuts, abandoned farms, old fields, unmowed apple orchards, Christmas tree farms, and others (Castrale et al. 1998, Nicholson 1997, Nolan 1978, Palmer-Ball 1995). Nolan (1978) provides the most extensive work on prairie warblers and provides many examples of prairie warbler habitat. Prior to European settlement, habitats included cedar glades, rocky cliffs, forest openings, brushland from native American or early European settler disturbances, second growth from fires, and insects (Nolan 1978). These habitats are two different types; that is, forest disturbances are temporary and succession will make this habitat unsuitable over time. The other habitats, such as cedar glades or barrens, are permanently suitable habitats with frequent disturbances.

In the Interior Low Plateaus, prairie warbler abundance may have peaked following the wave of farm abandonment. Highest densities now include recent extensive logging and young pine plantations, as well as cedar glades and barrens. Urbanization, cleaner farming, and maturation of forests has contributed significantly to the loss of habitat and population decline (Nicholson 1997).

White-eyed vireo habitats include abandoned fields and overgrown drainages, regenerating clearcuts, or heavily logged areas, brushy forest margins, and the edges of cedar glades. Atlas results revealed lowest densities in large areas cleared for pastures or agriculture (Castrale et al. 1998), including the Bluegrass of Kentucky (Palmer-Ball 1995), and portions of the Eastern Highland Rim in Tennessee (Nicholson 1997). Occurrence and average abundance were closely associated with percentage of forest cover, and highest in predominantly wooded areas with forest openings (Castrale et al. 1998, Palmer-Ball 1996).

Blue-winged warblers occur in denser habitats than many other early succession species (see Nolan 1978). They occur in shrubby second growth, with scattered taller trees. Habitats around Tennessee nests have been described as rolling hillsides covered with brush blackberries and broom sedge (Crook 1933). Breeding Bird Atlas results showed high numbers in the Interior Low Plateaus around such areas as Mammoth Cave National Park and south central Indiana, but not in cleared surrounding areas (Castrale et al. 1998, Palmer-Ball 1996).

Bachman's sparrow habitat requirements include some bare ground, native grasses and forbs, patches of blackberry thickets, scattered small trees, and, although pine is not essential, cedars and evergreens are usually present. In more recent Kentucky habitats, pines were between 1 and 10 feet tall (Palmer-Ball 1996). In Tennessee, reports are from open mature pines, grassy old fields, or edge habitats with scattered pines and young clearcuts of pine (Nicholson 1976). More recent habitats include young clearcuts replanted to pine, with a high density of grass and forbs, but significant patches of bare, rocky ground.

#### *Habitat and population objectives*

Capel et al. (1994) recommended reestablishing a combination of early-successional habitats to cover the variety of foraging, nesting, and cover needs in order to restore early-successional wildlife populations to pre-1980 levels. Specifically, Capel et al. (1994) set goals of (1) establishing 1,050,000 ha (2,625,000 acres) of 5-year idled lands in native vegetation or grass-legume mixes, (2) establishing 1,050,000 ha (2,625,000 acres) of annual vegetation (forbs or annually established cover) and (3) 1,820,000 ha (4,550,000 acres) of long-term (10-20 years) herbaceous and shrub cover. The last recommendation has the greatest potential for many nongame shrub-scrub species, especially if controlled burning is preferred over mowing as a management tool. Continual replanting of annuals for example, may have low diversity and lead to excessive erosion which may contribute to long term habitat degradation.

Over the long term, increasing residential and industrial pressures will require an aggressive restoration strategy in the Pennyroyal, Central Basin, and Eastern Highland Rim of the Interior Low Plateaus. Specific acreage and location goals may be established as more information becomes available in regard to location, management conditions, and bird response to restoration strategies.

#### *Implementation recommendations and opportunities*

Glades and barrens protection, management, and restoration remain a high priority for globally endangered plant communities. This effort provides the best short term opportunity for increased bird conservation. Bird habitats can be combined with ongoing, opportunity based, plant protection initiatives. Nesting bird occurrence and relative abundance data, for example, can be generated for sites

that are nominated for plant protection. Preserve design and protection strategies can then encompass bird conservation as well.

The most aggressive barrens research and restoration project occurs at Arnold Engineering Development Center (AEDC) in Franklin and Coffee Counties, Tennessee. The project is a joint venture between the U.S. Department of Defense (Air Force) and The Nature Conservancy. Other partners are numerous, and include Partners in Flight. The project's primary objective is to restore barrens habitats that have been degraded by woody plant invasion because of a lack of disturbance, primarily fire (Campbell and Majors, in press). Breeding birds are monitored by point counts and spot mapping. This project should help determine the best restoration strategies and management techniques that will contribute to achieving bird habitat goals throughout the original range of barrens habitat.

The Tennessee Department of Environment and Conservation and the Nature Conservancy have aggressive conservation programs for cedar glade protection. During the short term, bird conservation priorities should be included with these initiatives for preserve design and site protection strategies. As these goals further develop, bird conservation habitat goals may be more clearly defined throughout the original extent of glade habitat.

Other initiatives may include restoration of barrens habitats at the Pennyroyal State Forest in Kentucky. Small patches of barrens habitat may be restored by an active fire management program. These sites may then be monitored for both plant community response and bird nesting success.

Minimum habitat patch size may be an important management consideration for many shrub-scrub species. Although the term area-sensitive is applied most frequently to mature forest species, the concept may also apply to shrub-scrub species. Other species also may require minimum areas of relatively stable shrub-scrub habitat (i.e., succession set-back at regular intervals), but evidence is only now accumulating on this point.

A frequent management recommendation is to provide narrow shelterbelt strips (hedgerows) on farmland, with the intended result being reduction of soil erosion from wind and to provide wildlife habitat for species like rabbits and northern bobwhite. However, only the blue grosbeak, among nongame breeding species, appears to successfully use shelterbelts and this species is also the only shrub-scrub species now increasing in the Southeast. Most other species show high susceptibility to breeding failure in shelterbelt-like habitat, even when present in high numbers, undoubtedly due to the

high abundance of nest predators and brown-headed cowbirds associated with agricultural or highly fragmented landscapes.

The merits of shelterbelts for soil erosion control and game management are unquestioned. Many wintering nongame bird species appear to do well in shelterbelts, although none are high concern score species in the Interior Low Plateaus. However, if many of the breeding shrub-scrub species are to benefit from Farm Bill and related programs, opportunities to work with private landowners to restore blocks of at least 20 to 40 ha (50-100 acres) in old-field or shrub-scrub condition would be most important (see also grasslands section for state restoration initiatives).

Realistic acreage objectives need to be determined by subdivision for the Interior Low Plateaus. A continuing challenge for wildlife professionals will be considering spatial arrangements and total coverage of 5-year idled lands within larger landscapes. Cowbirds and nest predators are often supported in these habitats, along with game species. These habitats should be arranged to minimize disruption of nesting success for vulnerable species in nearby scrub-shrub habitats, while still providing the benefits intended for targeted game species.

#### *Evaluation of assumptions*

Implementation of this plan is based on the assumption that no breeding bird species seems dependent solely on barrens or glades habitat for nesting, and therefore, bird conservation plans should be tied closely to other initiatives. However, the occurrence of the same species suite in even aged forest management habitat is based primarily on presence or absence data, and not related to nest success or stability of the habitat. Therefore, while research continues regarding habitat restoration and bird community response, an important research consideration is to compare the nest success of this species suite in temporary early succession habitats (such as even aged forest management) with nest success in stable early succession habitats (such as barrens, glades, or managed old fields).

## **Short-rotation pine**

### *Status and importance*

Short rotation pine acreage has increased dramatically in the southern and western portions of the Interior Low Plateaus in response to growing demands for pulpwood products. In the northern sections of the area, pine plantations were used primarily to control soil erosion. Short rotation pine management occupies about 10 to 15% of the landscape in the Interior Low Plateaus subdivisions. The total acreage may stabilize at about 20% of the Western Highland Rim, Tennessee Valley, and Shawnee Hills, and less than 10% of the Eastern Highland Rim and Kentucky Knobs (Forest Products Industry, personal communications). These acreage estimates are based on site conditions and landowner patterns. The increasing demand for short rotation pine to provide pulp materials for building and other uses is providing incentives to non-industrial landowners to increase the land base of short rotation pine.

The forest products industry, however, is the primary manager of these habitats. Short rotation pine is projected to occupy about 50 to 60% of the industry land base. The remainder of industry lands will be in hardwood management. On average for industry, about 30% will be in hardwood streamside management zones, wildlife corridors, special habitats, or similar programs other than timber production, and about 10 to 15% in hardwood timber production (Forest Products Industry, personal communications). Other than industry, short rotation pine is managed by private non-industrial landowners, state forests, state Wildlife Management Areas, local parks, and others.

In short rotation pine habitats, bird species richness and abundance is greatest in years 1 through 11, and may decline rapidly in years 12 through 25 (Dickson et al. 1993), especially for high concern score birds. Prior to European settlement, these bird species were most common in barrens, glades, and large forest openings. Many bird populations may have reached unprecedented highs prior to the 1960's because of the widespread abandonment of farms and the resultant increase of old fields. However, old field habitats have succeeded to mature forests, or have changed to agriculture or urbanization (see Palmer-Ball 1996, Nicholson 1997).

Management issues for these birds are complex (see Thompson and Dessecker 1997). Nest productivity rates remain unclear for many species nesting in short rotation pine, especially in comparison to natural forest disturbances or old fields. Area sensitivity may be a management issue for these birds in that a larger patch of short rotation pine may provide better habitats than small patches.

### *Priority species, species suites, and habitat requirements*

Partners in Flight high concern score (>22) bird species for this habitat include Bewick's wren, prairie warbler, white-eyed vireo, blue-winged warbler, Bachman's sparrow, and field sparrow (Carter et al. in press). Other birds of this habitat with moderate (that is, species that should be closely monitored and perhaps managed) to low concern scores include northern bobwhite, common yellowthroat, yellow-breasted chat, indigo bunting, and eastern towhee.

Other species have been previously discussed in the barrens, glades, and old fields habitat section.

### *Habitat and population objectives*

In the Interior Low Plateaus, short rotation pine habitats occur primarily south of the Tennessee-Kentucky border. In the Western Highland Rim and Tennessee Valley, the habitat goal is to stabilize short rotation pine habitats at about 20% of the landscape. North of the Tennessee-Kentucky border, site conditions and winter weather will probably limit further conversion to these habitats to less than 10% of the total landscape. Although habitat availability shifts across the landscape, a consistent source of opportunity in short rotation pine may help stabilize some bird populations, especially as other temporary habitats (such as abandoned farms) continue to decline.

Over time, this habitat goal would stabilize potential source populations of birds such as prairie warbler and field sparrow in the Western Highland Rim and Tennessee Valley. The vast majority of short rotation pine would best be supplied by the forest products industry. Source populations must be assured in more permanent habitats, such as cedar glades and barrens, in addition to pine management; those goals are addressed in a separate section of this plan.

Some species, such as prairie warbler, yellow-breasted chat, and field sparrow, are fairly common to abundant in typical even-aged management of the Interior Low Plateaus. Other species, such as Bewick's wren and Bachman's sparrow, require specific management actions during typical clearcuts. Managed fire may be important as a management tool. Densities and locations are fairly well known for these species. As a result, short term goals for these two species should include increased inventory to more accurately monitor density, and a short term increase to increase local populations by 10 to 25%. After monitoring and research to examine population response to specific management recommendations, a new habitat and population goal should be determined.

### *Implementation recommendations and opportunities*

The forest products industry manages the vast majority of short rotation pine habitats in the Interior Low Plateaus; public lands and private non-industrial lands add minimal amounts to that acreage. As such, short rotation pine habitats are largely dependent on industry ownerships and the location of mills, as well as site conditions.

Broadly, stand management for short rotation pine include the following guidelines in the Interior Low Plateaus:

1. a rotation length of 22 to 25 years,
2. no further entry unless management requires hardwood controls,
3. maintaining pine management on the same acres over time,
4. an average size cut of less than 16 ha to 32 ha (40 acres to about 80 acres),
5. a configuration of cuts that is usually dependent on topography and soils, as well as economic needs,
6. Sustainable Forestry Initiative (SFI) guidelines recommend that adjacent clearcuts should not be executed in less than 3 years or when growth is less than 2 meters,
7. SFI guidelines recommends cuts to average no more than 48 ha (120 acres),
8. site preparation may be by either chemical or mechanical treatments and depend on site conditions,
9. soil productivity issues need additional research, indications are that soils can continue to produce short rotation pine indefinitely, but fertilization may increase over time, and
10. short rotation pine is managed predominantly in plantations of loblolly pine.

Private, non-industrial or public lands pine management may differ somewhat by longer rotations, increased entries, and cuts of less than 20 acres, depending on the objectives and knowledge of the land manager.

Opportunities to integrate bird management into short rotation pine guidelines exist for the average size of cuts, configuration of cuts, site preparation, slash piles, number of entries to the stand, soil productivity, genetically improved trees, logging decks, and snag retention and location. Some

guidelines will not be discussed further here because of economic factors and/or minimal difference as bird habitats; these are rotation length of 22 to 25 years, replanting those acres back to pine management, and the use of loblolly pine in plantations. North of the Ohio River, pine plantations that have not been managed and have degraded economically can be cut over for improved ruffed grouse management.

The average size of most pine plantations range from less than 16 ha (40 acres) to about to about 32 ha (80 acres), depending on land owner objectives. The Sustainable Forestry Initiative demands that member industries do not average even age cuts over 48 ha (120 acres). Thompson et al. (1996) suggest that in heavily forested landscapes, bird habitat management may best be accomplished by enlarging plantations and, thus, providing increased patch size of adjacent hardwood stands. In the Western Highland Rim, one recommendation is to increase average plantation size to 32 ha to 48 ha (80 to 120 acres).

In other subdivisions of the Interior Low Plateaus, such as the Eastern Highland Rim, average forest tract size is smaller and forest patches are often isolated. As a result, 8 to 16 ha (20 to 40 acre) plantations may be more appropriate. However, additional research and/or adaptive management strategies are needed to clarify bird productivity in those habitats.

The Sustainable Forestry Initiative demands that adjacent cuts not be conducted prior to three years or when adjacent trees are less than 2 meters; implementation of bird habitat objectives for short rotation pine include this recommendation.

Pine plantation configuration is often based on topographic considerations, or encourages irregular shaped to increase edge habitats for wildlife. A square cut is better than other configurations in order to reduce edge and increase interior habitats for high concern score birds. The location of cuts is critical as well. While there is always competition for the best soils, the bird habitat management recommendation for short rotation pine is to keep pine on the minimal soils and site conditions and manage mature hardwoods on the best sites, such as coves or northern aspects.

Site preparation can be by chemical or mechanical treatments. Site preparation may make a difference for bird habitats, although the impacts of site preparation on birds is poorly understood. The retention of slash piles is perhaps the biggest issue. Bewick's wren occur in slash piles, which is quickly becoming the last dependable habitat condition for this species. Poorest conditions occur when the

remaining brush and slash is bulldozed into windrows and burned. Such habitat can remain viable 3 to 5 years unless burned and thinned regularly.

Most stands in the Interior Low Plateaus do not receive a second entry unless an increasing hardwood understory requires management. No second entry probably provides the best habitat conditions for birds; the more hardwood understory that can be economically tolerated the better.

Soil productivity and genetically improved trees are issues for long term management of bird habitat conditions. The impacts of soil productivity and the resultant use of fertilizers, as well as insect productivity (food base for birds) is very poorly known. However, at a landscape level, soil productivity and genetically improved trees may result in more efficient use of the land for pine production and result in increased acreage in other, more productive bird habitats.

The distribution of snags and other trees left may affect bird nest productivity in short rotation pine habitats. Robbins (1993) speculated that snags and whips clumped at edges may provide the best amount of habitat for cavity nesters, while reducing effective perch sites for nest parasites or predators. This management recommendation remains poorly understood.

### *Evaluation of assumptions*

Landscape and stand specific habitat recommendations for short rotation pine are based on several assumptions. These assumptions include the following items.

1. Estimates regarding the percentage of forested land and the percentage of short rotation pine are accurate. Detailed studies of economic conditions and urban sprawl projections are needed.
2. Recommendations regarding increased size of pine plantation on the Western Highland Rim, as well as pine plantation size in other subdivisions, need further clarification. This recommendation assumes that the same amount of timber volume is needed from the landscape and that areas not in pine will remain longer in mature hardwood management. Additional research and/or adaptive management strategies are needed to clarify bird productivity in those habitats.
3. Recommendations for this plan assume that birds that require early successional habitats are area sensitive; that is, larger early succession tracts may result in higher nest productivity for high concern score species.

4. The effects of snags and other trees at edges of plantations, particularly predictions of increased bird nest productivity, are poorly understood. More research is needed to justify this management recommendation.
5. The difference between chemical and mechanical treatments on bird habitats is poorly known. This difference may affect at least Bewick's wren and Bachman's sparrow habitats. This research need is a high priority in the Interior Low Plateaus.
6. Industry research concerning soil productivity and genetically improved trees could benefit bird habitat planning and implementation. Research concerning these issues need to be combined with adequate bird inventory, monitoring and research.

## **Section 4: Implementation Recommendations and Summary**

The following summary includes habitats, bird species suites, and goal statements for the Interior Low Plateaus.

### I. Western mesophytic, oak-hickory, beech-maple forests: cerulean warbler, worm-eating warbler, black-and-white warbler

Goal - emphasize maintenance and management of large forested blocks (Western Highland Rim); consolidate smaller forest blocks into larger ones; consolidate early succession forest habitats; increase the proportion of older age classes; in mid-succession stands, explore silvicultural techniques to open the canopy and diversify vegetative structure for both canopy and understory species.

The forest patch objective is to provide 100 areas of sustainable source populations for mature hardwood birds species. Each area is defined as a block of approximately 3,000 to 4,000 ha (7,500 to 10,000 acres), within which a core of about 1,200 ha (3,000 acres) of mature hardwood forest is managed for cerulean warblers and other forest wildlife.

### II. Forested wetlands: - cerulean warbler, yellow-billed cuckoo, Swainson's warbler, wood thrush

Goal - restore and consolidate large forest blocks; coordinate with open lands (moist soil units, etc.) management for waterfowl and shorebirds.

One restoration goal under consideration is the establishment of appropriate habitat for swallow-tailed kite populations in the Ohio River watershed. This would require approximately 40,000 ha (100,000 acres) in a block under cooperative management, mostly for forest wetlands. Habitat goals also include 5 patches of 8,000 ha (20,000 acres) each along the Ohio River, 2 patches of 8,000 ha (20,000 acres) each on the Big Sandy and Duck River tributaries in Tennessee, and 1 patch of 8,000 ha (20,000 acres) along the Tennessee River in northern Alabama.

III. Riparian woodlands: - transients, Kentucky warbler, Swainson's warbler.

Goal - ensure protection and enhance quality of existing streamside woodlands and restore additional streamside woodlands.

IV. Grasslands and savannas: Henslow's Sparrow, grasshopper sparrow, loggerhead shrike, bobolink.

Goal - restore large blocks of greater than 40 ha (>100 acres) of native grasslands, savannas and associated wetlands (especially in the Bluegrass, Pennyroyal, and Knobs); restore appropriate disturbance regimes (e.g. fire, grazing); provide private landowners with outreach and incentive programs to encourage use of warm-season grasses and other native prairie flora.

Restore 40,000 ha (100,000 acres) of warm season grass and savanna habitats; ideally in 5 blocks, each of 4,000 ha (10,000 acres). These large blocks should occur in the north and northwest portions of the area. Throughout the rest of the area, the goal is to provide 20,000 ha (50,000 acres) in 500 patches of 40 ha (100 acres) each.

V. Barrens, glades, and old fields: blue-winged warbler, prairie warbler, Bewick's wren.

Goal - restore glades and barrens (in the Central Basin, Pennyroyal, Eastern Highland Rim) through a increased use of appropriate disturbance regimes (e.g. fire).

Bird conservation should integrate more closely with ongoing conservation programs for globally important vegetation communities. The primary objective is to increase knowledge and habitats at the Arnold Engineering Development Center in Tennessee, and expand from there.

VI. Short-rotation pine: - transients, marginal to suitable nesting habitat for other priority species such as Bewick's wren and prairie warbler.

Goal - encourage through incentives and cooperative agreements better bird management practices such as 1) adequate streamside management zones, 2) hardwood proliferation in the understory of sapling and pole stands, and 3) consolidate early succession stands as much as possible.

The goal is to sustain short rotation pine habitats, mostly on industry lands, over 30% of the Interior Low Plateaus. Ideally, this percentage is 20% on the Western Highland Rim and 10% in other areas.

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