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An Ecological Framework for Developing Wildlife Conservation Strategies in the Central Hardwoods Bird Conservation Region

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Abstract: We present a framework for using Landtype Associations (LTAs), or subdivisions of ecological subsections, to develop integrated conservation strategies for priority bird and other taxa of conservation concern in the Central Hardwoods Bird Conservation Region, using the Missouri Ozarks as a prototype. We profile LTAs amenable to the conservation of species in grassland, shrub-savanna, woodland-forest and wetland landscapes, provide examples of priority species associated with each, suggest conservation strategies at biologically appropriate spatial scales, and evaluate conservation opportunities and limits based upon current land use characteristics and socioeconomic factors.

Key words: Landtype associations, ecological hierarchy, bird conservation, comprehensive wildlife conservation strategies

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During the early 1990s, ornithologists associated with Partners in Flight, a North American landbird conservation initiative, developed a process for identifying bird species breeding in North America that were most in need of conservation attention (Hunter et al. 1992). Since its inception, the process has been revised, improved, and reviewed (Carter et al. 2000, Panjabi et al. 2001), and variations of it have been employed to set priorities for shorebirds and waterbirds as well as land birds (Brown et al. 2000, Kushlan et al. 2002). The prioritization process can be applied at various spatial scales and to both political and ecological units. The current national and international bird conservation initiatives under the auspices of the North American Bird Conservation Initiative (NABCI) have agreed to use ecologically-based Bird Conservation Regions (BCRs) as the common geographic currency for species assessment, planning, and evaluation (U.S. NABCI 2000). Each initiative has drafted lists of priority bird species for each BCR; the combined lists can represent many different taxa affiliated with habitat ranging from wetlands through grasslands to forests. Lists of priority land birds, shorebirds and waterbirds for BCRs in the Southeastern United States are available from Chuck Hunter, U.S. Fish and Wildlife Service, Atlanta, Georgia. Priority waterfowl at the BCR scale are provided by the North American Waterfowl Management Plan Committee (2004).

BCRs encompass fairly large ecological regions dominated at least historically by similar vegetative patterns across broad spatial scales (e.g., the eastern tallgrass prairie, sonoran desert, central hardwoods, etc.). Many priority bird species are still affiliated with the general vegetation types that characterize an ecoregion as large as a BCR. Even where the historic vegetation has been dramatically altered or reduced in extent, current bird ranges often overlap the distribution of the once-dominant vegetation types. It's easy, therefore, to see the logic of managing for "shortgrass prairie birds" in the shortgrass prairie ecoregion. However, within BCRs, a variety of habitat types typically occur in addition to the regionally dominant vegetation. Wetlands may be embedded in grassland landscapes, shrubby glades and bogs within forests, etc. (U.S. NABCI 2000).

To better facilitate bird conservation planning within BCRs, priority species are grouped by general habitat affinities, such as grasslands, shrub lands, forests, and wetlands. Priority species also can be relegated to finer habitat designations within those general categories, such as different types of forests (e.g., bottomland hardwoods or pine savanna-woodlands) or wetlands (e.g., mudflats or emergent marsh). The resulting sets of species are referred to colloquially as "species suites." Now that the state wildlife agencies are developing Comprehensive Wildlife Conservation Strategies (CWCS), lists of animals of conservation concern and the habitats on which they depend are being produced in addition to the existing priority bird lists. In addition, all taxa and habitats can be linked to ecological landscapes with the potential to support them. This facilitates a shift from single species-based conservation strategies to habitat, community, and landscape-based approaches, which is suggested as a more efficient way to use limited financial and logistical resources (Lambeck 1997, Kautz and Cox 2000, Margules and Pressey 2000, Groves 2003).

Before coordinated and efficient conservation can be implemented, planners must identify those places within BCRs where habitat conditions can be expected to meet the needs of each suite of species. For many priority bird species this often requires not only that the habitat structure be attractive to the species, but that certain spatial requirements are met as well (Gibbs and Faaborg 1990, Wenny et al. 1993, Robinson et al. 1995, Porneluzi and Faaborg 1999, Robinson et al. 1999, Winter and Faaborg 1999). While various forms of management practices alter habitat structure in a standardized fashion, the habitat response can vary depending upon the characteristics of the landscape in which the treated area is embedded. In addition, the ability to meet spatial requirements is often a function of the physical and socio-economic potential of the landscape as well.

In general, the potential habitat communities, range of patch sizes, and the spatial arrangements of patch types that can be supported in a landscape are largely dependent upon topography, geology, and climatic factors (Fig. 1). Topography affects the movement of water and can mitigate the drying effect of the sun and in turn influences fire patterns and other disturbance regimes. Geology affects soil types and depth, which, in conjunction with climatic factors, influences vegetation patterns. Combinations of these factors are used to define Landtype Associations (LTAs) within the National Hierarchical Framework of Ecological Units, and when mapped,

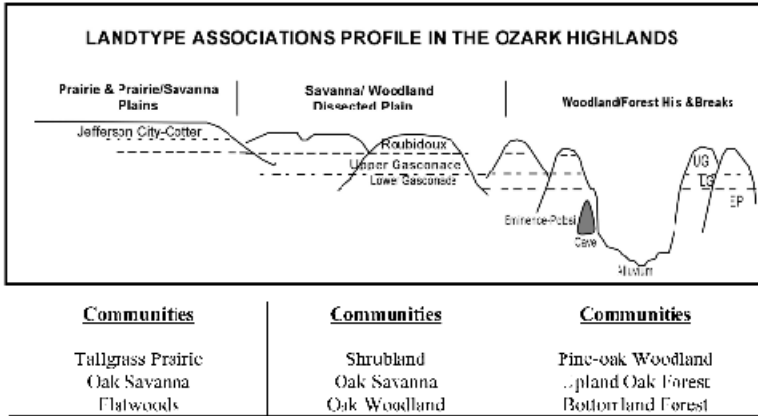
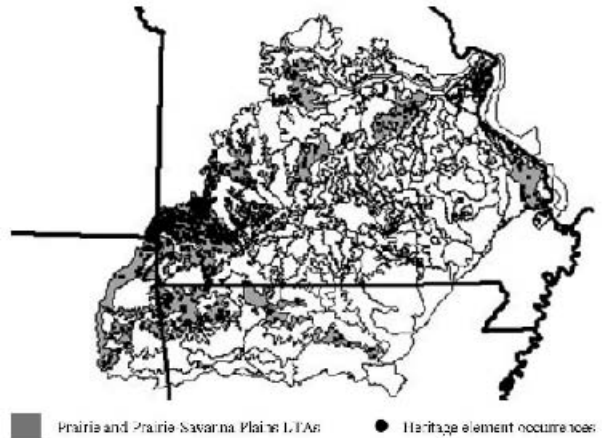


Figure 1. Cross-sectional profiles of landtype associations in the Ozark portion of the Central Hardwoods Bird Conservation Region and associated natural communities.

typically range in size from several hundred to tens of thousands of hectares (Cleland et al. 1997, Nigh and Schroeder 2002).

In this paper, we examine how LTAs and ecological patterns within LTAs can be used as decision support in planning and implementation of conservation strategies for birds and other wildlife within the Central Hardwoods Bird Conservation Region (CHBCR). The CHBCR includes the Ozark Highlands to the west of the Mississippi River and Interior Low Plateaus to the east. Prior to European settlement, both physiographic areas supported large expanses of grasslands, grass-shrub lands, savannas, and oak and pine forests and woodlands, with wetlands associated primarily with the floodplains of the larger rivers (Martin et al. 1993, McNab and Avers 1994, Nigh and Schroeder 2002). We will provide examples of landscapes where each of those vegetation types were historically dominant, discuss how ecological patterns within the landscapes can affect the distribution and abundance of select species of conservation concern, and provide suggestions for the design and implementation of conservation strategies. To date, LTAs have only been mapped for the Ozark region. Therefore we draw examples from there, but believe the implications are germane to similar landscapes in the Interior Low Plateaus as well. Information regarding landtypes is derived from Nigh and Schroeder (2002); literature regarding the habitat needs of priority bird species in the CHBCR is reviewed and summarized in Fitzgerald et al. (2000), Fitzgerald and Pashley (2000), Ford et al. (2000), and Fitzgerald et al. (2003). Examples of other species of conservation concern and their habitat and landscape affiliations are drawn from the Missouri Department of Conservation's Comprehensive Wildlife Conservation Strategy. More in-depth discussion of Missouri's native habitat types, natural communities, their range of variation, and plant and animal associations can be found in Nelson (2005).

Figure 2. Landtype associations (LTAs) for the conservation of priority species in grasslands (prairie and prairie-savanna plains). Locations of occurrences of species of conservation concern associated with the various LTAs were derived from Missouri and Arkansas Heritage Databases.



Grasslands

Factors Affecting the Distribution of Priority Species within Grassland Landscapes

Open grassland landscapes are associated with Ozark prairie plains and Ozark prairie-savanna plains landtype associations (Fig. 2). These landscapes are typified by large smooth plains, with slight dissection along streams.

With the exception of streams and rivers, historically there were few barriers within grassland landtypes that prevent the spread of fires commonly ignited both by lightning and Native Americans. As a result, these open landscapes were dominated by large expanses of grasslands with shrubs and trees confined mainly to stream valleys or ephemeral wetlands. Priority bird species associated with large expanses of open grasslands include the greater prairie-chicken (*Tympanuchus cupido*), Henslow's sparrow (*Ammodramus henslowii*), grasshopper sparrow (*Amodramus savannarum*), and sedge wren (*Cistothorus platensis*). Nesting habitat for Bell's vireo (*Vireo bellii*) and field sparrow (*Spizella pusilla*) would have occurred in the shrubby vegetation along waterways. Other priority species in these LTAs are regal fritillary (*Speyeria idalia*), northern crayfish frog (*Rana areolata circumlosa*), prairie vole (*Microtus ochrogaster*), and prairie willow (*Salix humilis*).

Conservation Opportunities and Limiting Factors in Grassland Landscapes

The birds in this species suite have large home ranges with varied structural needs (greater prairie-chicken) or have been shown to be area- and edge-sensitive (Henslow's sparrow, grasshopper sparrow). Today, most of the land in these landtypes has been converted to non-native pastures or cropland and are fragmented by linear strips of woody vegetation along roads and fencerows. Priority projects should focus conservation where large patches of grassland (i.e., > 40 ha) with the appropriate structure can be clustered within focus areas of roughly 1000 ha or more. Objectives should include removal of the linear strips of woody vegetation that exist

away from stream corridors because they provide cover and travel lanes for predators and avian brood parasites. Perhaps the most feasible conservation strategy is to concentrate conservation efforts around tracts of public land owned and managed by conservation partners. Private land programs can be targeted in the surrounding matrix to effect change at the spatial scales required to meet the needs of priority birds. Another priority action may be to target conservation efforts in areas where clusters of occurrences of grassland species of conservation concern have been documented (Fig 2).

Due to the fragmented nature of today's prairie landscapes, most species of conservation concern now occur in relatively small and isolated populations. The ability to increase the number of individuals or populations of species of concern that can be supported in current grassland landscapes will be driven by the ability of conservation partners to affect change at appropriate spatial scales, and the amount of acreage that is ultimately brought under proper management. Although the acreage in these landtype associations is small relative to that in other LTAs (Fig. 2), we believe conservation efforts will be limited much more by socioeconomics rather than by the amount of potentially suitable acreage due to the expense and difficulty of affecting change in fragmented landscapes with valuable agricultural land and multiple private ownerships. However, because so little suitable grassland habitat exists today, any project that focuses on increasing patch size while decreasing travel lanes for predators should help to increase populations of species of concern.

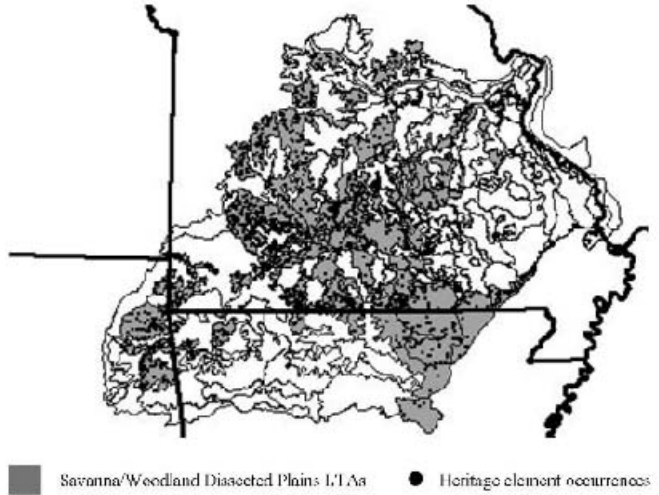
Shrub-savanna

Factors Affecting the Distribution of Priority Species within Shrub-Savanna Landscapes

Historically, native shrub lands and savanna habitats were embedded in landscapes with more varied topography and greater relief than those of grassland LTAs, but with less than those where forest and woodlands predominated. These habitats are associated with Savanna/Woodland Dissected Plains LTAs (Fig. 3). Shrub cover alone was interspersed with trees in savannas and probably never as uniform or as extensive as were open grasslands. Shrub-savanna habitats were interspersed with open woodlands on more topographically diverse sites. Shrub and savanna lands were most likely found on rolling plains, dry hillsides and broad ridges where fires could spread and edaphic factors helped to limit tree growth. The ratio of shrubs to grassland or trees varied depending upon topography, soil characteristics and susceptibility to disturbance.

Priority birds associated with shrub lands include prairie warbler (*Dendroica discolor*), blue-winged warbler (*Vermivora pinus*), northern bobwhite (*Colinus virginianus*), field sparrow, yellow-breasted Chat (*Icteria virens*), brown thrasher (*Toxostoma rufum*), and eastern towhee (*Pipilo erythrophthalmus*). While some of these species will nest in hedgerows, shrubs scattered within a grassland or savanna-woodland matrix provide more suitable habitat and are more characteristic of pre-settlement conditions. It has not been shown that priority shrub-savanna bird spe-

Figure 3. Landtype associations (LTAs) for the conservation of priority species in shrub-savanna lands (savanna/woodland dissected plains). Locations of occurrences of species of conservation concern associated with the various LTAs were derived from Missouri and Arkansas Heritage Databases.



cies require patch sizes large as some priority grassland birds, but patches of 10 ha or larger are preferred by species such as prairie and blue-winged warbler. Other birds of concern associated with these landtypes include red-headed woodpecker (*Melanerpes erythrocephalus*) and orchard oriole (*Icterus spurious*) in savannas and open woodland communities, whip-poor-will (*Caprimulgus carolinensis*) in woodlands, and Bewick's wren (*Thryomanes bewickii*) in shrub-savanna ecotones. Non-avian species of conservation concern include eastern tiger salamander (*Ambystoma tigrinum tigrinum*), broad-headed skink (*Eumeces laticeps*), and Ozark wake robin (*Trillium pusillum ozarkanum*).

Conservation Opportunities and Limiting Factors in Shrub-Savanna Landscapes

Shrubland affiliated bird species vary with regard to the required ratio of shrub to grassland; hence, a variety of site types could be required to provide habitat for each species in the suite. Today, most of the land within the LTAs that once supported shrub cover has been converted to non-native pastures, and areas that were once savanna-woodlands typically are now overgrown or over-grazed and occur as somewhat isolated, dense woodlots or in linear strips along fencerows. There are several conservation strategies on which to focus: converting non-native pastures to native grass-shrub mixes and promoting thinning and prescribed burning to open woodlots and encourage native ground flora. Patch size and matrix issues do not appear to be as stringent as in grasslands and forests, so more spatially disjunct habitat improvements can combine to make a difference. However, additional research is needed to determine whether landscape characteristics affect densities or viability of priority shrub and savanna birds or other species of conservation concern. As with grassland landtypes, the initial focus of conservation efforts should be on and around public

lands and in other areas where there are known to be clusters of populations of avian and non-avian species of concern (Fig. 3).

As with grasslands, much of the native shrub and savanna communities have been converted for agricultural uses and, as a result, very few high-quality native shrub-savanna communities exist today. Again, the expense of providing incentives to private landowners to convert their land to native habitats or purchasing lands or easements will limit the ability to restore habitat for species of concern. However, there appear to be more opportunities for conservation action due to the larger amount of land in shrub-savanna LTAs than in former prairie landscapes, and the lack of need to have habitat parcels clustered to meet large home range and other stringent spatial requirements. Any substantial habitat improvements are likely to increase populations of species of concern.

Forest and Woodlands:

Factors Affecting the Distribution of Priority Species within Forest and Woodland Landscapes

Forest and woodlands are associated with rugged terrain. The inherent topographic roughness and shaded aspects that result can serve as fire breaks and direct the flow of water and nutrients. Woodlands typically are associated with higher, drier, more exposed positions and forests with lower or more mesic and fertile site types. Woodlands and forests often are juxtaposed within a landscape. While forest and woodland communities form the matrix, native grass and shrub communities are often interspersed in varying degrees. Forest-woodland LTAs are shown in Figure 4.

The kinds of native forest and woodland communities vary greatly with topography, natural and human-made disturbance intervals, and edaphic factors. Not

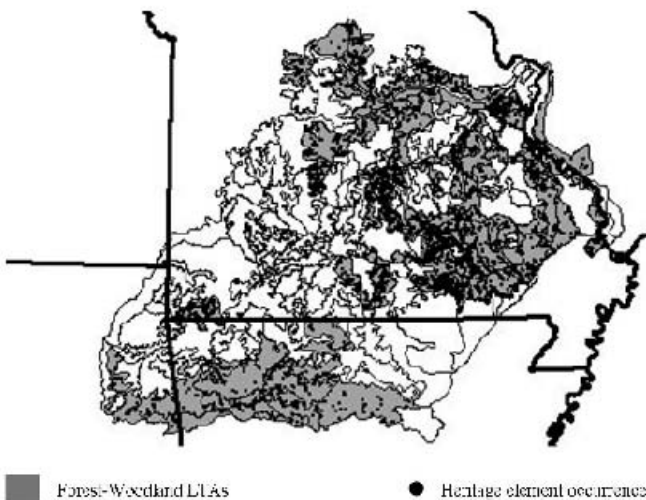


Figure 4. Landtype associations (LTAs) for the conservation of priority species in forests and woodlands. Locations of occurrences of species of conservation concern associated with the various LTAs were derived from Missouri and Arkansas Heritage Databases.

surprisingly, there is a high number of priority species associated with the habitat types. Pine and pine-oak woodlands have been greatly reduced in extent as a result of wide-spread logging and fire suppression. Red-cockaded woodpeckers (*Picoides borealis*) have been extirpated and Bachman's sparrow (*Aimophila aestivalis*) now only occurs sporadically. Yellow-throated warblers (*Dendroica dominica*) are associated with open-grown pine and eastern wood-pewee (*Contopus virens*) with openings in both oak and pine-oak woodlands. Other target species for pine-oak woodlands include shrubby sundrops (*Oenothera fruticosa* spp *fruticosa*), and buck moth (*Hemileuca maia*).

Numerous species prefer well-developed forest of varying character. Cerulean warblers (*Dendroica cerulea*) are found in bottomland forests and on ridge tops in oak associations while worm-eating warblers (*Helmitheros vermivorus*) are found on shrubby slopes. Kentucky warblers (*Oporornis formosus*) are associated with understory vegetation and wood thrush (*Hylocichla mustelina*) with the mid-canopy of more mesic site types. Acadian flycatchers (*Empidonax virsecens*) nest in bottomland forests and along drainages in more mesic uplands. The now rare Swainson's warbler (*Lymnophylis swainsonii*) also is found in bottomlands, but most often near remnant stands of giant cane (*Arundinaria gigantea*). Yellow-throated warbler is associated with sycamore (*Platanus accidentalis*) in riparian areas and prothonotary warbler (*Protonotaria citrea*) with snags along rivers. Several shrub species mentioned previously breed in early successional forests and woodlands with their presence varying and dependent upon the spatial and structural characteristics of the disturbed areas. Other targets for Ozark upland and bottomland hardwood forests include long-tailed salamander (*Eurycea longicauda*), four-toed salamander (*Hemidactylum*), Ozark zig-zag salamander (*Plethodon dorsalis angusticlavius*), Ringed Salamander (*Ambystoma annulatum*), wood frog (*Rana sylvatica*), golden mouse (*Ochrotomys nuttalli*), Goldie's fern (*Dryopteris goldiana*) and running buffalo clover (*Trifolium stoloniferum*).

Conservation Opportunities and Limiting Factors in Forest and Woodland Landscapes

While much of the land that was forested historically remains so today, the forest and woodland communities have been dramatically altered by wide-spread logging in the early part of the 20th century and fire suppression in subsequent decades. Most forests and woodlands are even-aged and over-stocked. Conservation efforts are needed to insure that the range of forest types and structural diversity required to support the varied needs of forest and woodland species are available across and within ecologically appropriate site types. Mapping ecological communities at spatial scales smaller than landtype associations would help planners better understand and quantify the ecological potential of forest and woodland landscapes. Clusters of records of species of conservation concern also can be used to identify higher priority sites for conservation (Fig. 4).

While forests and woodlands still cover vast expanses of some landscapes in the BCR, forests in other areas occur as relatively small, isolated patches surrounded

by pasture or cropland. Research within the Central Hardwoods region has shown that reproductive success of forest birds is lower in fragmented landscapes, especially where agriculture and urbanization are interspersed. Maintaining native habitat types across large landscapes will be critical to insure that forest and woodland bird populations remain viable in coming decades. Management and use of private forests varies greatly in scale and intensity, and there is a need to increase outreach and education efforts regarding management of forest habitats for species of conservation concern.

Predicting the population response of forest-woodland birds to changes in forest structure and extent in coming decades is difficult due to the complexities associated with categorizing and quantifying management prescriptions, especially on private land, mapping the interspersed forest and woodland community types across landscapes, and the diversity of habitat associations of priority bird species. However, an effort is now underway to develop spatial models of bird habitat suitability across the CHBCR that will aid in that effort. In addition, the U.S. Forest Service and some state agencies are working to restore and enhance forest and woodland structure at spatial scales of hundreds to thousands of acres. It is expected that numbers of some species will increase and others will decline with the change in habitat structure as overgrown woodlands are opened up by thinning and prescribed fire. More research and monitoring programs are needed to quantify the change in the abundance of priority species that are likely to result from those management prescriptions. While there are ample opportunities to protect priority species and their associated communities in forest-woodland LTAs, the increase in urbanization of rural areas can be expected to decrease the forested land base, increase fragmentation effects, and drive up land prices, all of which will make conservation efforts more difficult in coming years. Some species of forest and woodland-associated birds, at least, are more likely to decline than increase as a result.

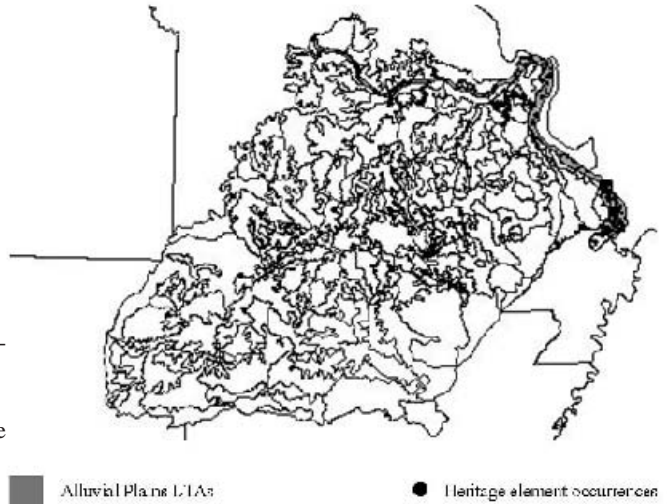
Wetlands

Factors Affecting the Distribution of Priority Species within Wetland Landscapes

The landtypes that support the majority of wetland types in the Ozarks and Central Hardwoods Region are associated with alluvial plains along the region's large rivers (Fig. 5).

The priority wetland bird species use a wide variety of wetland types ranging from mudflats to marshes to open water. During the breeding season, least bittern (*Ixobrychus exilis*), king rail (*Rallus elegans*), American coot (*Fulica americana*), and pied-billed grebe (*Podilymbus podiceps*) are the highest priorities. All four of these species, as well as transient American bitterns (*Botaurus lentiginosus*), require tall emergent wetland (marsh) conditions, with coot and grebe more closely associated with some combination of open water and marsh. Transient and wintering priorities, such as horned grebes (*Podiceps auritis*) and many species of dabbling and diving ducks are associated more with open water than with submerged vegetation. Prothonotary warbler and yellow-crowned night heron (*Nyctanassa violacea*)

Figure 5. Landtype associations (LTAs) for the conservation of priority species in wetlands (alluvial plains). Locations of occurrences of species of conservation concern associated with the various LTAs were derived from Missouri and Arkansas Heritage Databases.



are found in wet-mesic bottomland forests. Several priority shorebird species forage on sandbar/mudflats and in shallow water during migration. Other wetland species of concern include great plains toad (*Bufo cognatus*) and plains spadefoot (*Spea bombifrons*).

Conservation Opportunities and Limiting Factors in Wetland Landscapes

In order to provide habitat for all the wetland-associated priority species, a variety of wetland types must be made available. However, much of the land that supported wetland habitat types has been drained and converted to row crop agriculture. Very little natural vegetation remains. Natural hydrologic processes have been altered to sustain agriculture and commercial navigation interests. However, recent acquisitions of relatively large tracts by public conservation agencies and public-private partnerships offer hope that both the hydrology and a variety of wetland habitat types will be restored and managed in coming years at a spatial scale that can support a variety of wetland types needed to conserve all of the species of conservation concern. This will require an increased understanding of how fluvial landforms and current hydrology offer opportunities for sustaining the various wetland habitats and mapping areas where it may be possible to restore large tracts of bottomland forests.

As in other landtypes where very little native vegetation exists today, any substantive amount of habitat restoration should help to increase populations of priority species. Because most drained wetlands have been developed or converted to agricultural land, restoration of wetlands must focus on wetland restoration incentive programs (like WRP), land acquisition and management. Again, conservation efforts will be limited by the expense of the incentive programs and acquiring agricultural

lands. Wetlands have also been lost to the channelization and impoundment of river systems, which creates flood control capacity and navigable rivers for barge traffic, both important services for agriculture and the public in general. Therefore, wetland conservation efforts are complicated politically by the need to balance the conservation interests with the needs of the agricultural and commercial navigation communities on the Mississippi and Missouri rivers, and the management of the Tennessee and Cumberland rivers for recreational purposes in the Interior Low Plateaus.

Summary

The landscape profiles of the Ozark region and their attendant species of conservation concern are summarized in Figure 1. Assessing historic patterns of vegetation within and among landtype associations can help to prioritize species and delineate focus areas to promote conservation of appropriate suites of birds and other species of conservation concern in the landscapes with the greatest ecological potential to support them. Consideration of the habitat needs and spatial requirements of priority species in conjunction with current land use and socioeconomic patterns allow planners to identify both opportunities and barriers to conservation efforts. Assessments with an ecological framework can help conservation planners and those who implement conservation actions to set more realistic population goals and habitat objectives.

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