



**MISSOURI BIRD
CONSERVATION PLAN
TECHNICAL SECTION**



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CALL TO ACTION

Birds play significant roles that are necessary for healthy ecosystem function. Insect-eating birds control pests that would otherwise decimate agricultural crops and natural vegetation. Other birds scavenge carcasses and metabolize disease to remove it from the system. Others assist with dispersing seeds that would otherwise not fall far from the tree or plant, and they also act as pollinators. In addition to these systematic roles, birds are one of life's more beautiful pleasures enjoyed by humans. Millions of people around the world enjoy watching and feeding birds; they are a gateway for many to learn more about the outdoors and nature.

Birds are everywhere. Urban or rural, in every corner of the globe, one finds birds. Wildlife watching is among the fastest growing outdoor pursuits in the United States, numbering 86 million participants in 2016 – 45 million of these are birdwatchers in particular. For context, anglers number nearly 36 million and hunters 11.5 million (U.S. Department of the Interior, U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau 2016). In Missouri, residents' ranking of future interests in outdoor activities showed the greatest interest in wildlife viewing (77%; Dietsch et al. 2018). Between 2015 and 2018, over 197,000 birder checklists were submitted to eBird¹ in Missouri alone. Wildlife viewing and birding hold great promise for the future of Missourians experiencing and appreciating nature.

Birds are also an economic driver. Wildlife watchers spent nearly \$76 billion on travel, equipment, and other expenses in 2016. In 2011 in the U.S. alone, birding expenditures created 666,000 jobs, \$31 billion in employment income, and \$13 billion in local, state, and federal tax revenue (U.S. Fish and Wildlife Service 2013). These U.S. figures do not include the thousands of guided birdwatching tour employment opportunities that provide an economic "leg up" for many in some economically depressed parts of the world where bird abundance and diversity are staggering.

Unfortunately, many birds are experiencing alarming declines. Despite their important roles and enjoyment by millions, most North American bird species have experienced significant declines over the last few decades; some are still declining. Some birds that have always been considered common are showing precipitous global population declines ranging from 30-77% since 1970 (Sauer et al. 2017A) and have been given special designation by Partners in Flight² as Common Birds in Steep Decline³. Eight of 29 species highlighted in this Bird Plan have this designation, including Eastern Meadowlark and Northern Bobwhite. Why the declines? The transient and/or migratory nature of most bird species and their ability to quickly adapt to changing environments due to the mobility of flight make pinpointing exact

¹ eBird.org is a online database of birder checklists that grows by over 100 million bird sightings annually worldwide. eBird's growth and massive dataset is now allowing them to contribute to avian science, monitoring, research, and conservation planning.

² Partners in Flight is a network of over 150 organizations across the Western Hemisphere that work together to promote and advance landbird conservation through science, research, planning, policy development, land management, monitoring, education, and outreach to halt and reverse bird population declines before species are listed as threatened or endangered. They maintain the Avian Conservation Assessment Database, which scores various threats to landbird species throughout their annual life cycles.

³ Common Bird in Steep Decline is a Partners in Flight designation as part of the Avian Conservation Assessment Database (Partners in Flight 2019) with the criteria of species with continental population decline of 50% or more since 1970 (Partners in Flight 2019).

reasons quite difficult. Common causes discussed by the ornithological community include large-scale land-use change, habitat modification and loss, widespread pesticide use's effects on insect prey, and lack of land management disturbance. These widespread changes have taken place over the same time frame as many bird species' recorded declines, and they pose significant threats to the long-term sustainability and health of resident and migratory bird populations in Missouri and at larger nationwide and worldwide scales.

But it's not all bad news. The silver lining is that we can change this. The conservation community, including private landowners and the general public, can make a difference for birds at large and small scales. Conservation work, habitat management, and the resiliency and adaptability of birds provide us the opportunity to make significant habitat gains and improvements for many of these species *within as little as a decade or two*. Also, bird conservation partnerships in Missouri are strong and have a successful track record of cooperation and effective project implementation. But conservation partners cannot effectively tackle threats and habitat challenges individually. A united effort involving agencies, organizations, and the public is necessary to make substantial gains for birds, especially the most threatened species. Missouri conservation agencies, organizations, and the public concerned about bird declines have not previously had a state-specific reference to learn which bird species and the breeding habitat they require are our highest priorities. The need for targeted, statewide collaboration and partnership spurred a multi-organizational effort to create this Missouri Bird Conservation Plan.

BACKGROUND AND CONCEPT

The Missouri Bird Conservation Plan (hereafter Bird Plan) is composed of a Technical Section and an Outreach Section. The Technical Section strategically focuses bird conservation efforts to promote and grow collaboration among conservation partners and the public to achieve common, high-level goals that will maintain and grow sustainable bird populations in Missouri. Further, the Bird Plan provides context for statewide bird conservation by assigning a Missouri Concern Score to priority bird species and their habitats within Missouri's primary natural community types. The Bird Plan also recommends research and monitoring needs. The separate Outreach Section of the Bird Plan will organize high-level goals for birder outreach and education in the state.

By assigning Missouri Concern Scores and broad management guidelines for species of regional concern, the Bird Plan provides a single reference resource for field staff and conservation planners across Missouri that clearly outlines the state's most threatened bird species and their level of statewide concern, their land management needs, and threats to these species and their habitats in Missouri. The Bird Plan is meant to both provide context and to encourage and grow land-management and research collaborations to focus the collective resources of the conservation community in Missouri. These collaborations will more effectively address the needs of our most threatened bird species and also work to keep common birds common.

To this end, a multi-organizational team of technical experts (hereafter the Technical Team) was convened, each with expertise and experience in specific bird species or species guild response to

habitat management. The Technical Team was asked to gather information on and research species within their respective species or guild expertise and come to the Technical Team meetings prepared to discuss and determine a Missouri Concern Score and management guidelines for each species.

Scope of the Missouri Bird Conservation Plan

The Bird Plan acts as a high-level bird conservation resource and reference for land managers on public and private land, conservation planners, private landowners, and the general public. The Bird Plan provides context for which breeding bird species in Missouri are the most threatened and information on their habitat needs, which can be used to guide management actions, goals, and objectives. The Bird Plan can be used as a tool to inform management at a local or statewide scale, individually or, ideally, to identify common goals and objectives that multiple conservation partners and the public can focus on together.

The Bird Plan is a scaled-down version of larger, more sweeping North American or regional bird conservation plans. The Partners in Flight (PIF) Landbird Conservation Plan 2016 Revision is a ten-year plan for Canada and the continental United States that outlines assessments and tools and makes recommendations to address continental threats, reverse long-term population declines, and prevent landbirds from becoming at risk (Rosenberg et al. 2016). The Bird Plan also highlights and references the PIF Avian Conservation Assessment Database (Partners in Flight 2019), which assigns each species scores for various criteria at a continental scale (see SPECIES SCORING section below) and highlights Continental and Regional Watchlist Species that need special attention and targeted conservation actions. This Bird Plan also focuses on landbirds⁴. Regional conservation plans like the Upper Mississippi Great Lakes Joint Venture's Waterbird Plan (Soulliere 2018), Waterfowl Plan (Soulliere 2017), and Shorebird Plan (Russell 2016), in addition to the Lower Mississippi Valley Joint Venture's Forest Resources Plan (LMVJV Forest Resource Conservation Working Group 2007) focus on species guilds' conservation goals and species-specific concern levels for many birds not included in this Bird Plan.

Migratory bird species face very different and sometimes dire threats and challenges during migration and on the wintering grounds outside of Missouri's borders. The Bird Plan's habitat management resources focus on work recommended for the breeding season while these migratory birds are present in Missouri. The continental and regional resources and data used by the Technical Team to derive a Missouri Concern Score is based on breeding season data, so the focus was on that portion of a bird's life cycle. Though, as we increasingly appreciate, birds that breed outside of Missouri's border use various natural communities (forest, grassland, wetland) as stop-over and refueling sites along migration. Future planning and research continues to hone habitat conservation efforts and land management recommendations on stop-over sites and the wintering grounds, and these data will be integrated into future iterations of the Bird Plan. Support for conservation efforts beyond Missouri's borders are outlined in the FULL LIFE-CYCLE CONSERVATION section below.

⁴ Landbirds are species having principally terrestrial life cycles (Rich et al. 2004).

Future Iterations of the Bird Plan

The Missouri Bird Plan will be reviewed every five years to maintain an up-to-date list of the state's priority bird species and create opportunities to outline new threats, species trends, and research and monitoring needs.

How the Plan is Organized

The Bird Plan Technical Section includes the following information, each portion meant to provide context for conservation concern or guide land management actions.

The section *Species Scoring* defines species scores, how they work, and the process used by the Technical Team to derive the Missouri Concern Scores.

The section *Nationwide Conservation Priorities – How Missouri Fits* outlines the North American Bird Conservation Initiative's priorities for landbirds in response to their major threats and how Missouri fits within priorities at a state scale.

The section *Brief Guide to Partners in Flight Scores and Missouri Concern Score* explains nationwide and regional threat-scoring assessments and how a state-level Missouri's Concern Score was stepped down with Missouri-specific data taken into consideration.

Species accounts are bird by bird profiles that include that species' Missouri Concern Score, regional conservation priority designations, Broad Management Guidelines, and other information relevant to their sustainability or restoration. This section provides science-based, team-developed guidance on how to focus management efforts across conservation agencies and organizations to create, improve, and maintain breeding habitat for Missouri's most-threatened species.

Species accounts are organized by natural community for easy reference by land managers. Bird species are grouped by natural community habitat in which they nest. Each natural community type has a brief introduction outlining its importance to breeding birds and broad management considerations that incorporate the management needs of the target species into an overall management strategy beneficial to the entire suite. Bird species addressed in this Bird Plan are grouped as Grassland Birds; Savanna, Woodland, and Early-successional Forest Birds; Forest Birds; Wetland Birds; and Generalist Birds.

The section *Research and Monitoring Needs* outlines high-level priority research or data gaps that were identified in the process of building the Bird Plan for our most threatened species. This section encourages collaboration and partnership between agencies and organizations to fill the highest priority data gaps that inform management.

The section *Next Steps – Outreach Section* discusses plans and goals for the second and final portion of the Bird Plan to be initiated with a separate planning team and audience after the completion of the Bird Plan's Technical Section.

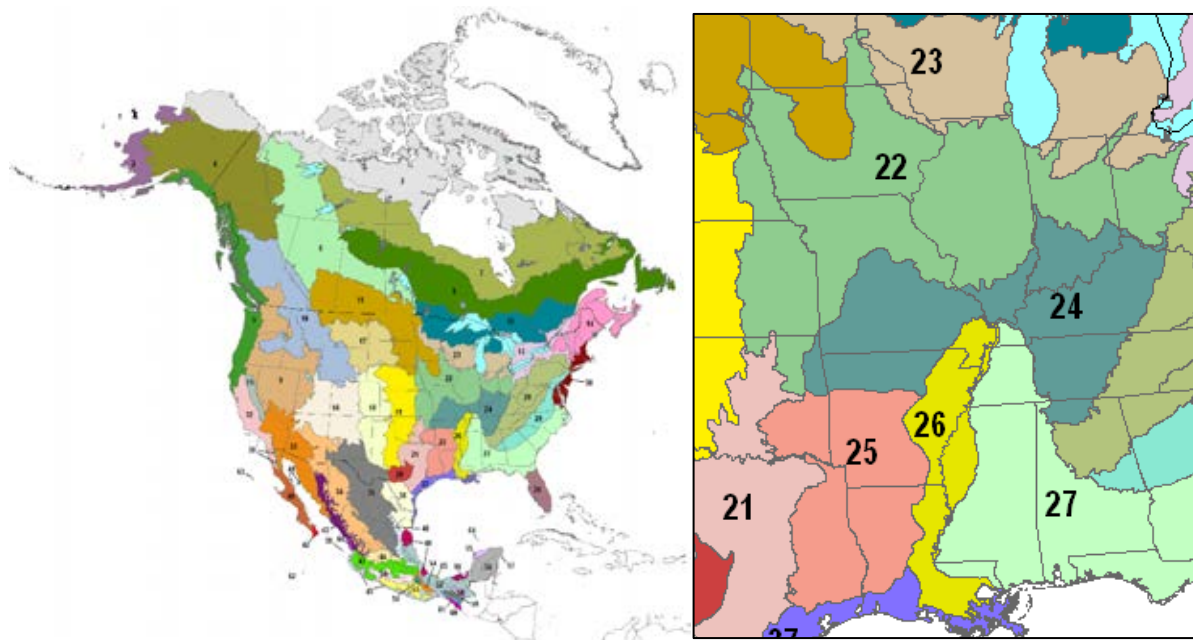
The Appendix is a separate reference document that provide species-specific range maps, eBird abundance maps (where available), and Breeding Bird Survey trends at varying scales.

Species Scoring – Context and Missouri Concern Score

The scoring system used in the Bird Plan is derived from the Avian Conservation Assessment Database, or ACAD, compiled by Partners in Flight (PIF). The ACAD is a massive database of concern scores for all North American landbird species. It compiles continental scores for various aspects of a migratory bird's life: population size, breeding distribution, non-breeding distribution, threats on the breeding grounds, threats on the non-breeding grounds, and global population trend. Each of these scores is on a scale of 1 to 5 (1 = lowest level of concern, 5 = greatest level of concern). Each 1-5 score is then summed to reflect a Continental Concern Score for a species' global population to provide context and an index of how threatened a species is at a global scale.

This Continental Concern Score for each species is then “stepped down” to a regional scale by Bird Conservation Region (BCR). Bird Conservation Regions are designated by ecoregion⁵ to coordinate bird conservation efforts more effectively across an entire ecoregion rather than within state boundaries. Migratory Bird Joint Ventures facilitate the regional step-down of global PIF scores with other regional experts in the BCR. Their decisions on regional scores are based on many considerations, including region-specific monitoring data and expert knowledge of populations and threats in that particular region.

Figure 1. Bird Conservation Regions and coverage of BCRs 22, 24, and 26 in Missouri (Bird Studies Canada and North American Bird Conservation Initiative)⁶ 2014).



⁵ Bird Conservation Regions are drawn by the Commission on Environmental Cooperation and were adopted by the North American Bird Conservation Initiative to better facilitate cooperation and partnerships within ecologically similar units to make bird conservation planning, implementation, and evaluation more efficient (North American Bird Conservation Initiative 2019).

⁶ The North American Bird Conservation Initiative is a forum of government agencies, private organizations, and bird initiatives helping partners across the continent to meet common bird conservation objectives (North American Bird Conservation Initiative 2016).

Missouri Concern Score

To further step down the regional bird concern scores to encourage focused statewide conservation effort, a Missouri-specific score (Missouri Concern Score) was then assigned by the Technical Team. Existing continental and even regional scores may not accurately reflect species occurrence and/or threats at a state scale. This is due to wide size variations in bird ranges and because BCRs are designated by ecoregion and not state boundaries. For example, some species identified as regional priority species at a regional BCR scale are not relevant in Missouri because the birds do not or rarely occur in the state or their occurrence is very low here and thus, not as relevant as at a regional scale. Conversely, for other species, Missouri may account for a large percentage of that species' entire range, so that bird may be a higher priority for statewide conservation.

Species deemed Regional Watchlist Species from the two BCRs that cover a majority of Missouri were compiled as a starting list for consideration in the Bird Plan (Table 1). These two BCRs are BCR 22: Eastern Tallgrass Prairie and BCR24: Central Hardwoods, which cover nearly equal proportions of the state. Missouri's Bootheel is part of BCR26: Mississippi Alluvial Valley, and that BCR's priority species were also considered, where appropriate. Partners in Flight (PIF) Regional Watchlist Species are defined based on score criteria outlined by PIF in the ACAD based on the relevance of a BCR to the bird species' global population and its regional threats. Regional Watchlist Species with ranges that did not include Missouri were removed from this list. Species were also removed if < 5% of their global population occurred within either BCR. Twelve birds are regional priorities in both BCRs. Four Missouri state-endangered species were priorities in both BCRs and were also included in the list for Bird Plan consideration.

To assign the Missouri Concern Score, the Technical Team discussed each species included in this starting list of regional concern birds. The Team considered a variety of statewide data (including Robbins 2018), state and regional North American Breeding Bird Survey⁷ (BBS) data and trends, and eBird⁸ Abundance Maps (Fink et al. 2018) for each species to determine the level of concern in the state by assigning scores (Table 2) by consensus.

Special Circumstance Birds

Five species are included in the Bird Plan but were not assigned a Missouri Concern Score based on their extremely low breeding populations in Missouri, which the Technical Team found were caused by two special circumstances. These circumstances are removal of historic habitat due to major land-use change by humans, and Missouri's location at the edge of a species' range. These five birds were given the designation of Special Circumstance to keep them as priorities in the Bird Plan and to continue to track their occurrence. However, a Missouri Concern Score was not assigned as this could elevate these species' priority over others that will more greatly benefit from increased conservation investment. The

⁷ The North American Breeding Bird Survey (BBS) is a long-term, large-scale international avian monitoring program initiated in 1966 to track the status and trends of North American bird populations through standardized roadside surveys, conducted annually.

⁸ eBird.org is a massive online database of birder checklists that grows by over 100 million bird sightings annually worldwide. eBird's growth and massive dataset contribute to avian science, monitoring, research, and conservation planning.

five Special Circumstance Species are Greater Prairie-Chicken, Ruffed Grouse, Bachman's Sparrow, King Rail, and Brown-headed Nuthatch. More information can be found below.

- **Greater Prairie-Chicken** is near-extirpated from the state due to the lack of large-scale quality grassland habitat and connected patches of grassland intermingled with ag crops that are usable for ground-nesting birds for nesting, brood rearing, feeding, and resting. Continuous land-use changes since the 1800s and the loss of native prairies have caused prairie-chicken numbers to plummet, showing sharp declines every decade since the late 1800s. Since 2005, some long-time local remnant flocks in central, southwest, and north Missouri have disappeared. Restoration efforts at Wah'Kon-Tah Prairie, including releasing prairie chickens trapped in Kansas in 2012, have not achieved a self-sustaining population. Upper Osage Grasslands COA maintains a small breeding population but the largest remaining leks are found in the Grand River Grasslands predominately on Dunn Ranch, which extends north into Iowa.
- **Ruffed Grouse** were near state extirpation due to a loss of early-successional forest habitat across their Missouri range, but translocations of the species are currently underway. One hundred grouse were translocated from Wisconsin in 2018 (year 1 of 3 of the project). Ruffed Grouse will be considered for concern scoring in future iterations of the Bird Plan after the translocation effort is complete and we know more about the health of the introduced population.
- **Bachman's Sparrow** is a state-endangered bird near extirpation that has used Missouri glades over the last decades in the absence of shortleaf pine-dominated woodland with an open structure that allows for the grass component necessary for nesting. The most recent reported detection of the species in Missouri was in 2013 in glade habitat that was historically reliable for this species' detection. Missouri maintains more glade habitat today than in the previous few decades, so declines may be occurring elsewhere in the Bachman's range or life cycle.
- **King Rail** is a state-endangered bird that has experienced long-term declines due to range-wide habitat loss and degradation (Cooper 2008). Although a remnant population has persisted in northeast Missouri primarily on public lands and privately-owned wetland easements, it appears to have been trending downward since the large-scale floods of 1993. Little is known about their current occurrence in the state as recent marsh bird research efforts detected very few King rails (Hill 2014, Fournier 2017), indicating a potential need for future, more targeted research that includes a focus on food needs and availability, as well as habitat use.
- **Brown-headed Nuthatch** is extirpated from Missouri and a candidate for potential future reintroduction. An effort to reintroduce Brown-headed Nuthatches has been discussed by various bird conservation partners for the last decade; Missouri's pine-woodland habitat restoration emphasis, availability of that natural community, the support of multiple key partners, and the species' status elsewhere in its range has prompted a more thorough investigation of the viability of a restoration project. Habitat and source-population abundance analyses are underway with partners at the U.S. Forest Service and University of Missouri to consider the viability of such an effort.

NATIONWIDE CONSERVATION PRIORITIES – HOW MISSOURI FITS

The North American Bird Conservation Initiative (NABCI) recently released their National Bird Conservation Priorities (NABCI 2019) which identifies priority actions and five major themes for conservation efforts that are nationwide but relevant to bird conservation in Missouri. Below, we outline these NABCI priorities (verbatim in italics) and touch on Missouri's role in this broader bird conservation strategy.

Habitats in Crisis – Land-use changes over the past few decades have been substantial. Habitat loss and degradation have presented challenges to bird conservation through history and some of those challenges continue today. Urbanization and development, the aggregation of agricultural landscapes, forest loss and fragmentation through parcellation are just a few examples of changes in landscapes that birds rely on annually. NABCI's National Bird Conservation Priorities document outlines four habitats in

the U.S. that are in crisis: oceans, coasts, grasslands, and aridlands. Grasslands are the most imperiled natural community in Missouri and nationwide; less than 1% of Missouri's native prairie remains. Grasslands are a priority in Missouri and are thus addressed first in this Bird Plan with six priority grassland birds included therein.

Theme 1: Land and Water Conservation – *Subthemes: 1) Support existing protected areas, 2) Improve management of public lands and waters, 3) Support conservation on private lands, 4) Promote sustainable agricultural and forestry practices, 5) Restore functional natural processes, and 6) Increase environmental resiliency and adaptability.* Missouri's State Wildlife Action Plan outlines a network of Missouri's Priority Geographies and Conservation Opportunity Areas (COAs) compiled with input from multiple conservation agencies and organizations in Missouri and works to focus management at a landscape scale in areas that provide the largest return on conservation investment for wildlife and other natural resources. Land management by conservation agencies and organizations in Missouri work toward all subthemes mentioned above. This Bird Plan works to inform public land management by providing context for Missouri's land managers to work toward the improvement or addition of breeding habitat for our state's most threatened birds.

A major land management theme identified by the Technical Team through the Species Scoring exercise was the need to address a decrease in habitat disturbance and management over the past few decades. Disturbance management is management practices that mimic natural disturbances like prescribed burning, tree thinning, conservation grazing, or a combination thereof, which are necessary to maintain some of our most threatened natural communities in the state: grassland, early-successional forest, savanna, and woodland (Missouri Department of Conservation 2015). A lack of disturbances like these on public and private land has caused many natural communities to change in Missouri over the last several decades. In the Eastern Tallgrass Prairie BCR portions of the state, public grasslands lack necessary fire and woody stem control. In the Central Hardwoods BCR portions of the state, many acres of open early-successional forest, savanna, and woodland have succeeded to a closed-canopy condition that suppresses the grass-forb groundlayer that birds in these communities use for nesting substrate. For example, a lack of diverse forest ages in the state has resulted in 62% of Missouri's forested area residing in the 40-80 year age class; a lack of age-class diversity leads to a lack of forest diversity and a lack of resiliency with changing weather patterns and rising temperatures (Shifley et al. 2014).

Private land management and partnerships are essential to Missouri's conservation landscape. Land management guidelines in this Bird Plan are encouraged for private landowners interested in managing for our most threatened birds. About 93% of our state is in private land ownership; we need the help of Missouri landowners to improve the landscape on a scale large enough to make a positive impact for bird conservation.

Theme 2: Research and Evaluation – *Subthemes: 1) Establish and support strong monitoring and evaluation programs, 2) Develop best management practices and conservation plans, and 3) Promote and support biological and social science research.* This Bird Plan Technical Section brought together technical experts from land-management conservation partners to discuss Missouri's most threatened species and assign a Missouri Concern Score for each. Through this process, research and monitoring

needs and gaps arose; these are identified as conservation partner priorities in the RESEARCH AND MONITORING section. The Technical Team supports only objective-driven monitoring efforts that inform habitat management through a fuller understanding of a species' distribution or occurrence across a landscape.

Theme 3: Engagement and Partnerships – *Subthemes: 1) Empower community- and incentive-based conservation through partnerships, 2) Expand conservation networking and partnerships, 3) Support and develop collaborative international efforts, and 4) Ensure the relevancy of bird conservation.* Missouri has a strong network of bird conservation partners, and we work to continue to grow and strengthen those partnerships. This Bird Plan's Technical Section and future Outreach Section will strengthen existing partnerships by coordinating our highest land management and outreach priorities for our most threatened birds to ensure their relevancy.

Full Life-Cycle Conservation (Subthemes 2 and 3) – For migratory birds, the breeding season accounts for only one-third of a bird's life cycle. While the importance of this productive time of year cannot be overstated, conservation efforts and habitat management on the breeding grounds is only one part of a migratory bird's conservation story. Of roughly 335 bird species that typically occur in Missouri annually, 50% of these species leave Missouri's borders and 33% leave the U.S. in the non-breeding season for up to eight months of the year. If we are serious about the conservation of short- and long-distance migrant birds, we cannot ignore the threats they face when they are beyond our borders.

Missouri participates in Southern Wings, an Association of Fish and Wildlife Agencies (AFWA) program that identifies and vets bird conservation projects on the wintering grounds with partners to provide a safe outlet for state agencies to support projects that benefit their priority migratory birds. Southern Wings has grown to include over 30 states working together to assist migratory birds in the non-breeding season.

Some bird species in the Bird Plan face threats on the wintering grounds that are out of Missouri conservation partners' control. For threats that are published in the scientific literature and have a known and severe impact on a species' populations, they are noted in the Bird Plan. Much more research is needed to learn about the scope of threats on migratory stop-over sites and overwintering habitat in Mexico, Central America, and South America. Migratory bird tracking technology is a burgeoning field of ornithological research and each year more is learned about these topics thanks to hemispheric research initiatives like the Motus Wildlife Tracking System and advances in bird-tracking technology that use transmitters light enough to attach to small songbirds and follow their movements over long distances. See RESEARCH AND MONITORING for more information.

Theme 4: Addressing Threats – *Subthemes: 1) Support bird-friendly efforts to reduce emissions and atmospheric carbon, 2) Control invasive species, and 3) Minimize direct anthropogenic threats to birds and their habitats.* Missouri has a strong network of conservation partners battling invasive species through the multi-agency/organization Missouri Invasive Plant Task Force. The promotion of native plants is a strong theme in Missouri across the conservation community, namely through the Missouri

Prairie Foundation’s Grow Native!⁹ program. Anthropogenic threats, including window strikes, power lines, and communications towers, kill many birds each year. Relatively simple fixes can avoid some of this mortality and should be implemented wherever possible. Coordinated programs to curb anthropogenic threats to birds will be addressed in the Bird Plan’s Outreach Section, initiated after the completion of this Technical Section.

Theme 5: Policy and Funding – *Subthemes: 1) Generate and maintain resources for bird conservation, 2) Develop policies that benefit birds, and 3) Strengthen policy compliance.* The Bird Plan focuses on bird species status, habitat management, and research and monitoring needs; policy and funding are not included in the scope of this plan.

Table 1. List of priority species considered in the Bird Plan comprised of Regional Watchlist Species in BCR22 and BCR24 and other species deemed priority.

Common Name	Primary Breeding Habitat ¹ (Habitat Clarification)	Priority in BCR22 (Eastern Tallgrass Prairie)	Priority in BCR24 (Central Hardwoods)	Priority in BCR26 (Lower Miss. Alluvial Valley)	State Endangered
Greater Prairie-Chicken	Grassland	X			X
Eastern Kingbird	Grassland	X	X		
Grasshopper Sparrow	Grassland	X			
Henslow's Sparrow	Grassland	X	X		
Bobolink	Grassland	X			
Eastern Meadowlark	Grassland	X	X		
Dickcissel	Grassland	X			
Northern Bobwhite	Eastern Forest (Grasslands, Woodlands)	X	X		
Yellow-billed Cuckoo	Eastern Forest (Open woodlands)	X	X		
Chuck-will's-widow	Eastern Forest (Open woodlands)		X		
Eastern Whip-poor-will	Eastern Forest (Open woodlands)	X	X		
Red-headed Woodpecker	Eastern Forest (Open woodlands)	X	X		
Eastern Wood-Pewee	Eastern Forest (Open woodlands)		X		
Bachman's Sparrow	Eastern Forest (Open woodlands, glade)		X		X
Orchard Oriole	Eastern Forest (Open woodlands)		X		
Blue-winged Warbler	Eastern Forest (Open woodlands)		X		
Brown Thrasher	Eastern Forest (Scrub)	X	X		
Field Sparrow	Eastern Forest (Scrub)	X	X		
Eastern Towhee	Eastern Forest (Scrub)		X		
Yellow-breasted Chat	Eastern Forest (Scrub)		X		
Prairie Warbler	Eastern Forest (Scrub)		X		
Chimney Swift	Eastern Forest (Urban)	X	X		
Blue Jay	Eastern Forest		X		
Bewick's Wren	Desert Scrub (Open woodlands)		X		
Wood Thrush	Eastern Forest		X		
Worm-eating Warbler	Eastern Forest		X		
Kentucky Warbler	Eastern Forest		X		
Cerulean Warbler	Eastern Forest		X		X
Prothonotary Warbler	Eastern Forest (Bottomland forest)		X	X	
Common Grackle	Habitat Generalist	X	X		
King Rail	Not assigned by PIF (Wetland)	X			X
Green Heron	Not assigned by PIF (Wetland Generalist)	X	X		
Ruffed Grouse	Forest Generalist				
Brown-headed Nuthatch *extirpated	Eastern Forest		X		

¹ Primary Breeding Habitat outlined in Partners in Flight Avian Conservation Assessment Database. Habitat clarification from Cornell Lab of Ornithology’s AllAboutBirds.org.

⁹ GrowNative! is a Missouri Prairie Foundation native plant marketing and education program that works to increase awareness of the conservation value and use of native plants in urban, suburban, and rural areas with the goal of significantly increasing the demand and use of native plants in the lower Midwest.

BRIEF GUIDE TO PARTNERS IN FLIGHT SCORES AND MISSOURI CONCERN SCORE

The five scores of Population Trend (MO), Threats to Breeding (MO), Relative Density (MO), Population Size (Global), and Breeding Distribution (Global) in Table 2 add up to a Missouri Concern Score (blue column). The Technical Team started with these same scores by species at the regional scale (by Bird Conservation Region, or BCR) and adjusted scores where necessary at the state level. Therefore, bird scores do not differ substantially from the Regional Concern Score, but the Technical Team considered all known state-specific information and altered them where appropriate. The two global scores included in the Missouri Concern Score are pulled directly from the PIF Avian Conservation Assessment Database (ACAD; see Species Scoring section for context) and reflect range-wide data also used to calculate the BCR Regional Concern Scores. *Please note: PIF ACAD scores are science-based and complex. For more information on the intricacies of these scores and how they were derived, reference the PIF ACAD Species Assessment Handbook (Panjabi et al. 2017). Score definitions below are pulled from this reference.*

Population Trend, MO: Indicates vulnerability due to the direction and magnitude of changes in population size based primarily on Breeding Bird Survey data trends and statewide expert knowledge of species or species guilds.

Threats to Breeding, MO: Assesses vulnerability due to the effects of current and probable future extrinsic conditions that threaten the ability of populations to survive and successfully reproduce in the breeding season based on statewide expert knowledge of species or species guilds.

Relative Density – Breeding, MO: Reflects the mean density of a species within a given area (state) relative to density in the single region (each relevant BCR) in which the species occurs in its highest density. The underlying assumption of this score is that conservation action taken in regions where the species occurs in highest density will affect the largest number of birds per unit area.

Population Size, Global: Indicates vulnerability due to the total number of breeding-aged adult individuals in the global population. Evaluation of population size is based on the assumption that species with small breeding populations are more vulnerable to extirpation or extinction than species with large breeding populations.

Breeding Distribution, Global: Indicates a species' vulnerability due to the geographic extent of its range in the breeding season (a separate non-breeding distribution score exists but was not considered for the Missouri score). The underlying assumption is that species with narrowly distributed populations are more vulnerable to individual risks and threats than species with widely distributed populations, and that this vulnerability can vary seasonally as migratory populations re-distribute.

MO Concern Score: Reflects the sum of the scores described above to reflect the level of concern for Missouri priority bird species.

Table 2. Missouri Concern Scores reflect the sum of five scores: Population Trend (MO), Threats to Breeding (MO), Relative Density – Breeding (MO), Population Size (Global), and Breeding Distribution (Global). Each score’s scale varies slightly, but in general 1=least concern/lowest threat level and 5=greatest concern/highest threat level.

Natural Community	Common Name	MO Concern Score ¹	Population Trend, MO	Threats to Breeding, MO	Relative Density - Breeding, MO	Population Size, Global	Breeding Distribution, Global
GRASSLAND BIRDS	Eastern Kingbird	15	5	3	4	2	1
	Grasshopper Sparrow	15	5	4	3	2	1
	Henslow's Sparrow	17	2	4	5	4	2
	Bobolink	11	1	4	2	2	2
	Eastern Meadowlark	17	5	4	5	2	1
	Dickcissel	16	4	3	5	2	2
SAVANNA, WOODLAND, AND YOUNG-FOREST BIRDS	Northern Bobwhite	16	5	4	4	2	1
	Yellow-billed Cuckoo	16	5	3	5	2	1
	Chuck-will's-widow	16	5	3	4	2	2
	Eastern Whip-poor-will	18	5	3	5	3	2
	Chimney Swift	16	5	4	4	2	1
	Red-headed Woodpecker	17	5	3	5	3	1
	Eastern Wood-Pewee	14	3	3	5	2	1
	Bewick's Wren	17	5	5	3	2	2
	Brown Thrasher	15	4	3	5	2	1
	Eastern Towhee	15	4	3	4	2	2
	Field Sparrow	17	5	3	5	2	2
	Yellow-breasted Chat	13	3	3	4	2	1
	Orchard Oriole	13	2	3	5	2	1
	Blue-winged Warbler	15	3	3	4	3	2
	Prairie Warbler	18	5	3	5	3	2
	FOREST BIRDS	Blue Jay	14	4	3	4	2
Wood Thrush		14	3	3	4	2	2
Worm-eating Warbler		15	2	3	5	3	2
Prothonotary Warbler		13	3	3	2	3	2
Kentucky Warbler		15	2	3	5	3	2
Cerulean Warbler		18	5	4	4	3	2
WETLAND BIRDS	Green Heron	15	5	3	3	3	1
GENERALIST BIRDS	Common Grackle	16	5	4	5	1	1
SPECIAL CIRCUMSTANCE BIRDS ²	Ruffed Grouse	-					
	Greater Prairie-Chicken	-					
	King Rail	-					
	Bachman's Sparrow	-					
	Brown-headed Nuthatch *extirpated	-					

¹ MO Concern Score = sum of other five scores: MO Population Trend, MO Threats to Breeding, MO Relative Density, Global Population Size, and Global Distribution.

² Special Circumstance Birds were not scored due to extremely low breeding populations caused by various circumstances. See SPECIAL CIRCUMSTANCE BIRDS section of the Missouri Conservation Bird Plan for more info.

Example Species Account: Below is sample format of a Species Account you will find in each of the sections below. Each section includes a brief description of the information you will find in that portion of each Species Account.

<p>Species Name</p>		<div style="border: 1px solid black; width: 100%; height: 100%; text-align: center; vertical-align: middle;"> <p>Species Photo</p> </div>
<p>Bird Conservation Region (BCR) priority designations listed here (Partners in Flight 2019). Priority designation definitions can be found in Footnotes on each page. If species is State Endangered, listed here. Percent global population trend since 1970 listed here (Breeding Bird Survey; Sauer et al. 2017)</p>		
<p>MO Concern Score: XX</p>	<p>Map: Bird Conservation Regions of the state in which the species is a Regional Priority (BCRs 22, 24, 26; Partners in Flight 2019)</p>	
<p>Broad Management Guidelines (BCR(s) for which management is recommended): General management recommendations for this species listed here with relevant citations or references for more detailed information.</p>		
<ul style="list-style-type: none"> • Other high-level, relevant conservation information for this species listed here with relevant citations or references to the APPENDIX, where noted. 		

GRASSLAND BIRDS

Grassland birds¹⁰ are the most imperiled species guild in North America due to habitat loss or conversion, and Missouri is no exception to these widespread land-use changes. Nearly 15 million acres of native prairie historically existed in Missouri; today, less than one-half of one percent of these grasslands remain (Missouri Department of Conservation 2015). Unplowed remnant tallgrass prairies are a globally rare natural community type with a high level of native plant and invertebrate species diversity, many species of which only occur on prairie remnants. Research has shown that native grassland plantings on former crop grounds do not match the diversity, composition and soil characteristics of remnant prairies, even after 30+ years post-planting. Fortunately for grassland birds, they are not restricted to remnant prairie alone, but have adapted to a wide gradient of grassland types, from remnant prairie to native grassland plantings with a variety of management approaches. Grassland birds certainly thrive on remnants, and preserving prairie is the best-case scenario for conserving this community type. However, restoration and management of native grasslands is essential to the reversal of severe grassland bird declines over the last half-century.

The biggest threats to publicly-owned grassland natural communities, and thereby grassland birds, are habitat fragmentation and lack of disturbance which leads to woody species encroachment (trees and excessive shrubs) and contributes to the spread of invasive species. Grassland bird nest success has been shown to decrease with grassland patch size (a measure of habitat fragmentation) in the Midwest for many of the grassland bird species outlined in this Bird Plan (Midwest reviewed in Herkert et al. 1996 and Ribic et al. 2009). Maintenance of open landscapes through continued and appropriate disturbance regimes is key to curb threats of woody encroachment and invasive species. Alternatively, the biggest threat to privately-owned grasslands is conversion to agricultural crop monocultures, which provides no

¹⁰ "Prairie" is a specific grassland community defined as unplowed historic remnants dominated by native grasses and forbs with sparse shrubs and trees, while "grassland" is defined more broadly as open areas dominated by grasses and forbs with sparse shrubs and trees that have been planted or cultivated previously. "Grassland birds" in this Bird Plan include birds that nest in both prairie and grassland.

habitat value to grassland bird species. Second to this threat is conversion to non-native cool-season grass monoculture pasture, which provides little habitat value.

Missouri boasts 12 prairie natural community types, which occur in different ecoregions of the state. These prairies support similar yet distinct suites of characteristic species, usually based on soils, bedrock geology, topography, hydrology, and regional climate patterns. Like Missouri's prairie and grassland communities, grassland birds are diverse in their ranges and breeding habitat composition needs. Some grassland birds are found in many grassland types, while others are found primarily in one type (e.g., Bobolink are found primarily in glaciated grasslands of northern Missouri). Disturbance within a grassland system, such as prescribed fire or conservation grazing, creates diverse plant communities. It is vital that Missouri grasslands (public or private) be managed to accommodate a diversity of native plant species and structure to provide habitat diversity for multiple life stages of grassland birds. For example, Henslow's Sparrows require tall, dense grass with a well-developed litter layer, whereas Grasshopper Sparrows prefer moderately-open grasslands with patchy bare ground. This emphasizes the importance of a mosaic of patchy vegetative structure through varied and staggered management regimes. As a general rule, no single management prescription is appropriate for all of Missouri's diverse prairie types, nor should an entire grassland parcel be managed in the same way at the same time to provide for a spectrum of habitat needs of multiple grassland bird species. Diverse management practices are encouraged. Any management tool, whether prescribed fire or conservation grazing, will positively affect some species and affect others negatively. By dividing a grassland unit into sizeable sections that are treated at different times of year and/or with different tools, refugia are maintained for species that may be negatively impacted in the short term and a wider diversity of species can be supported overall. Habitat diversity equals plant, insect, and bird diversity. Broad Management Guidelines are briefly outlined by species below. These guidelines act as a reference to managers to learn more about what breeding habitat our most threatened species need, but a mosaic of those habitats within a grassland system is the goal for a healthy balance of species diversity.

Grassland birds benefit most from conservation actions that protect intact, remnant prairies and restore/reconstruct native grasslands. Prescribed fire and conservation grazing, where appropriate, are effective management tools to maintain openness and diversity in vegetative structure when used in the proper rotation and duration, respectively. Focusing native grassland restoration and grassland acquisition efforts on and near existing parcels of native prairie and grassland within targeted Conservation Opportunity Areas (COAs) is our most effective course of action for focused and collaborative grassland bird conservation.

The majority of Missouri's grasslands are privately owned. Therefore, it is critical to engage private grassland owners and operators in grassland conservation. Various state, federal, and non-governmental programs exist to assist landowners (e.g. Environmental Quality Incentives Program, the Wetland Reserve Program, Conservation Reserve Program, MDC's Landowner Assistance Program, among others) which have all provided habitat that benefits grassland birds (McCoy et al. 1999, Jacobs et al. 2012). Market-based solutions may also be options for landowners, including the National Audubon Society's Conservation Ranching ("bird-friendly beef") Program or using warm-season grass to diversify forage for cattle. Proactive restoration or reconstruction of additional grasslands is also critically important. Such

efforts may involve limited land acquisition but will, in most instances, require cooperation with private landowners. Improving working grasslands will require providing training in sustainable production techniques and innovative approaches which address underlying economic realities faced by producers. While large-scale grassland systems are the best-case scenario and necessary for area-sensitive grassland birds, there is evidence that even small grassland patches provide nesting habitat for some grassland birds (Walk et al. 2010).

Eastern Kingbird

Regional Priority in BCR22 and BCR24
38% global population decline since 1970



MO Concern Score: 15

Broad Management Guidelines (BCR22, BCR24): Maintain open grassland areas with scattered shrubs or trees for foraging perches.

Grasshopper Sparrow

Common Bird in Steep Decline • Regional Priority in BCR22¹¹
68% global population decline since 1970



MO Concern Score: 15

Broad Management Guidelines (BCR22): Maintain open grasslands and prairies with patchy habitat structure including patchy bare ground. On private lands, diversify farm-level forages by converting one-quarter to one-third (or more where possible) of fescue acres to native forages. Rotational grazing systems can provide periods of intensive grazing to create the bare ground needed, followed by rest and recovery periods (Missouri Department of Conservation 2019).

- Missouri grassland bird surveys (see RESEARCH AND MONITORING for more information) indicate more Grasshopper Sparrows present on private grasslands that are more heavily grazed than public land. This species is not often detected in thick vegetation without adequate disturbance/open space/patchy bare ground.

¹¹ **Common Bird in Steep Decline:** Species' populations have declined continentally by an estimated 50% or more since 1970

Henslow's Sparrow

Watchlist – Yellow (R) • Regional Priority in BCR22 and BCR24 •
Regional Stewardship Species in BCR22¹²
10% global population decline since 1970 (BBS)



MO Concern Score: 17

Broad Management Guidelines (BCR22, BCR24): Maintain relatively large areas of tall, dense grass, well-developed litter layer, standing dead vegetation, and sparse to no woody vegetation. Longer burn interval for structure needs, but the system will require disturbance to keep shrubs at bay. Densities lowest 1-2 years post-fire and greatest 3+ years post-fire and required field size of 50-75 acres or greater in Illinois (Herkert 1994). At least three-year burn rotation and conservation grazing on private pasture (Missouri Department of Conservation 2019).

- Managing grassland habitat for Henslow's is especially important in Missouri. A large percentage of the Henslow's Sparrow's global population is found in the two major BCRs in Missouri (57% in Eastern Tallgrass Prairie BCR, 13% in Central Hardwoods BCR), illustrating the potential importance of conservation efforts in Missouri, as the state hosts a relatively sizeable proportion of this species' breeding range. See APPENDIX for more.

Bobolink

Watchlist – Yellow (D) • Regional Priority in BCR22¹²
60% global population decline since 1970



MO Concern Score: 11

Broad Management Guidelines (BCR22): Maintain hay fields and/or meadows with mix of grasses and broad-leaved forbs. On public land, haying and mowing are strongly discouraged during breeding season (May through mid-July) to avoid nest destruction and fledgling mortality. On private land, delay mowing as long as possible in the breeding season; leave part of a field uncut as refugia; mow sections of the field from the inside out or use a flushing bar to allow adults and young fledged birds an opportunity for escape from mowing implements.

- Timing of haying is a major threat to this species; multiple haying events during the breeding season (May through mid-July) destroy nesting habitat, nests, and fledglings.
- Missouri's positive BBS trend differs substantially from the U.S. and Eastern Tallgrass Prairie trends, possibly due to insufficient monitoring data. See APPENDIX for more.

¹² **Watchlist (Yellow-R):** Species' range is restricted and small populations are in need of constant care

Regional Stewardship Species: >25% of the global population found in the Bird Conservation Region (Partners in Flight 2019)

Watchlist (Yellow-D): Species shows steep declines and faces major threats (Partners in Flight 2019)

Eastern Meadowlark

Common Bird in Steep Decline • Regional Priority in BCR22 and BCR24¹³
77% global population decline since 1970



MO Concern Score: 17

Broad Management Guidelines (BCR22, BCR24): Maintain prairie, grassland, fallow fields, pastures, harvested cultivated fields. Uses a variety of grassland types. Rotational disturbance for a mosaic of vegetative structure encouraged.

- Meadowlarks are a Common Bird in Steep Decline, meaning they've shown precipitous declines over the last 50 years. While exact reasons for these declines are unknown, large-scale land-use changes like the conversion of grasslands to croplands and expansion of non-native fescue monoculture are likely causes. We must acknowledge that even seemingly common birds are experiencing declines and be vigilant of their continued trends in the state. See APPENDIX for more information on trends at various scales.
- Lack of nest productivity data in agricultural pasture compared to managed native grassland communities.

Dickcissel

Regional Priority and Regional Stewardship Species in BCR22¹³
14% global population decline since 1970



MO Concern Score: 16

Broad Management Guidelines (BCR22): Maintain a variety of grassland habitats with dense cover, including a high proportion of forbs important for singing perches. Uses a variety of grassland types. Rotational disturbance for a mosaic of vegetative structure encouraged.

- A high 33% of global population found in Eastern Tallgrass Prairie BCR.
- Lack of nest productivity data in agricultural fields compared to managed native grassland communities.
- Of all priority Missouri species, this one needs the most attention on the wintering grounds. Dickcissels are seen as agricultural pests in their non-breeding range and communal roosts are sprayed with fumigants in Venezuela (Basili and Temple 1999a, Basili and Temple 1999b).

¹³ **Common Bird in Steep Decline:** Species' populations have declined continentally by an estimated 50% or more since 1970
Regional Stewardship Species: >25% of the global population found in the Bird Conservation Region

SAVANNA, WOODLAND, AND YOUNG-FOREST BIRDS

Missouri is part of a broad transition zone between the Great Plains to the west and Eastern Deciduous Forest to the east. Soil, geography, regional climate, and fire history created a gradient of upland vegetation from open prairies and glades to forest. Today, Missouri still hosts a mix of wooded natural communities that have adapted to periodic fire and shaped by droughty soils and reflect this broad ecotone. Savanna is defined as grasslands interspersed with open-grown scattered trees, groupings of trees of various age, and shrubs with a tree canopy generally less than 30%. Woodlands are defined as highly variable communities with a tree canopy ranging from 30-100% with a sparse understory and a dense ground flora rich in forbs, grasses, and sedges (Nelson 2010). Savanna and woodland natural communities support a suite of bird species that require open wooded areas with a shrubby or grass-forb vegetative layer. These birds generally require either shrubby vegetation for nesting or they forage in open areas and nest in the canopy. Many of the birds that are found in savanna and woodland communities also nest in young forest¹⁴, so we've included information about management for that forest age here. Young forest is a forest age class and not a natural community, but parts of its vegetative structure are similar to the structural elements of savanna and woodland that breeding birds use. Breeding habitat requirements vary by species across a range of openness in wooded communities that is created and maintained by varying levels of disturbance (generally fire or tree harvest/deadening, or a combination thereof; Hanberry and Thompson 2019).

The biggest threats to these habitat types is succession to a closed-canopy condition that does not allow for the growth of nesting substrate due to a lack of tree harvest, fire, or both. Prior to European settlement, it is estimated that 6.5 million acres of savanna and almost 18 million acres of woodland existed in Missouri (Nelson 2010). Decades of fire suppression, ownership fragmentation, heavy grazing, and agriculture all caused much of these open wooded landscapes (savanna and woodland) across Missouri's Ozark Highlands to become overgrown woodland communities not useful to birds that require an open canopy and an understory mix of shrubs, forbs, and/or grasses. There are no savanna-woodland obligate bird species, as many species found in these natural communities exist across a wooded gradient in a matrix of savanna and open woodland. The southeast Missouri Ozarks were also historically home to a large area of shortleaf pine-dominated woodland. Non-sustainable logging denuded the Ozarks from the late 1800s through the 1920s and most of the pineries were cut over. Subsequent severe wildfires, decades of subsistence farming, free-range livestock grazing, and near-annual human-set fires eliminated the pine seed trees, and subsequent pine regeneration, such that many former shortleaf pine-dominated sites are now dominated by scarlet and black oaks.

A diversity of management actions (fire and tree harvest) implemented at varying frequencies within wooded landscapes is important when working to maintain breeding habitat for a diverse suite of bird species. As examples of the breeding habitat diversity within wooded systems, Prairie Warbler requires open areas at least three acres in size with a shrub component for nesting (Shake et al. 2012). Such habitat can be created by a variety of forest management actions, but it is ephemeral; open, shrubby

¹⁴ Young forest, or early-successional forest, describes forest consisting mostly of small tree seedlings and saplings created by a variety of disturbances such as tree harvest that removes most overstory trees, major wind events, extreme wildfire, large-scale insect or disease outbreaks, or established through tree planting or natural succession of abandoned agricultural lands.

habitat develops into denser stands of tree saplings after about 10 years. The Missouri Ozark Forest Ecosystem Project¹⁵ (MOFEP) has shown that densities of Prairie Warbler, Yellow-breasted Chat, and Indigo Bunting peak dramatically in even-age clearcut stands in a forested landscape three years post-harvest and are barely detected 7+ years post-harvest (Kendrick et al. 2014) and absent from MOFEP sites 14 years post-harvest (Morris et al. 2013) due to succession of shrubs into thick saplings. Open woodland and savanna management provide less-ephemeral habitat as long as it is periodically burned (Roach et al. 2019, Hanberry and Thompson 2019). Other shrub-nesters, like Yellow-breasted Chat and Blue-winged Warbler, do not require expanses of contiguous disturbed areas as large as Prairie Warblers require; they will nest in smaller shrubby openings. By contrast, Red-headed Woodpeckers nest in snags in very open woodlands with little understory and Eastern Wood-Pewees will nest in the canopy across a much wider gradient of open savanna to closed forest with openings. Based on their breeding habitat requirements, each of these birds will thrive under varying management scenarios. Again, while species-specific Broad Management Guidelines are provided below, a diversity of community management types and frequency of disturbance will create a mosaic of tree ages, structures, and openings that provide breeding habitat for a broader suite of bird species.

Savanna, woodland, and young-forest management described here will make the landscape more resistant and resilient to other threats by removing senescing trees, regenerating or releasing more vigorous trees, and often increasing tree species diversity and structural diversity. Woodland management that focuses on promoting shortleaf pine is doubly effective: increasing acreage of woodland habitat and increasing the dominance of a tree species that is well-adapted to Missouri's climate projections (Wang et al. 2016, Jin et al. 2017). Other large threats to these wooded systems include pests, pathogens, and invasive plant species, all of which may increase in frequency and severity with climate change. Savanna and woodland habitats are generally more resilient to such threats when diverse in both tree species and sizes and are part of a diverse landscape mosaic of structures and ages.

¹⁵ The Missouri Ozark Forest Ecosystem Project is a 100-year landscape-scale experiment studying the effects of even-age, uneven-age and no harvest management on the multiple biota, including the composition, density, and reproductive success of breeding songbirds, in the southeast Missouri Ozarks.

Northern Bobwhite

Common Bird in Steep Decline • Regional Priority in BCR22 and BCR24¹⁶
83% global population decline since 1970



MO Concern Score: 16

Broad Management Guidelines (BCR22, BCR24): Shrub obligate that utilizes large landscapes of native grassland (not fescue) year-round; also uses large savanna and open woodland landscapes and croplands interspersed with suitable herbaceous and woody cover.

- Recent Missouri research suggests that Bobwhite nest success, brood survival, and adult survival is superior in large, well-managed native grassland landscapes compared to more traditional small scale, strip-crop type management. Managing for large areas of diverse herbaceous and low-growing shrubby cover while reducing fragmentation by tall trees is key.
- Bobwhites respond fairly quickly to management improvements: <https://extension2.missouri.edu/g9432>.
- Global scores are relatively low because globally this bird is still relatively abundant in parts of its range and has a wide distribution. Missouri lacks the expansive rangelands of other states within the species' range within both BCRs.
- The Breeding Bird Survey is not well-suited to monitoring for quail, but focused spring and fall counts continue in Missouri (see RESEARCH AND MONITORING).

Yellow-billed Cuckoo

Common Bird in Steep Decline • Regional Priority in BCR22 and BCR24¹⁶
54% global population decline since 1970



MO Concern Score: 16

Broad Management Guidelines (BCR22, BCR24): Woodland management and maintain riparian forest.

- Declines may be influenced by woodland habitat loss due to succession to overgrown woodland and a closed canopy.
- Variation year to year in this species' abundance, in addition to broad breeding and wintering ranges, tempers statewide concern for this species.

¹⁶ **Common Bird in Steep Decline:** Species' populations have declined continentally by an estimated 50% or more since 1970 (Partners in Flight 2019)

Chuck-will's-widow

Common Bird in Steep Decline • Regional Priority in BCR24¹⁷
63% global population decline since 1970



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MO Concern Score: 16

Broad Management Guidelines (BCR24): Woodland management; maintain open habitats, maintain down and dead wood.

- Chuck-will's-widow and Eastern Whip-poor-will surveys were conducted in the Missouri Ozarks in 2014 and 2015. Preliminary analysis indicates Chuck-will's widow and Eastern Whip-poor-will were most abundant at sites with moderate canopy cover (40-80%) in a 500-m radius and greater amounts of pine woodland (up to 70%) in the landscape. Also, Chuck-will's-widow were more abundant where a moderate proportion of the landscape was/had been prescribed burned. The relationship with pine woodland may reflect the combination of tree harvest and prescribed fire that result in a greater percentage of pine in the landscape more so than the abundance of pine versus deciduous trees.

Eastern Whip-poor-will

Watchlist – Yellow (D) • Regional Priority in BCR22 and BCR24 •
Regional Stewardship Species in BCR24¹⁷
69% global population decline since 1970



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MO Concern Score: 18

Broad Management Guidelines (BCR22, BCR24): Woodland management; maintain open habitats, maintain down and dead wood.

- Similar trends and impacts as Chuck-will's-widow.
- Chuck-will's-widow and Eastern Whip-poor-will surveys were conducted in the Missouri Ozarks in 2014 and 2015; see preliminary results in Chuck-will's-widow account above.
- Widespread concern and anecdotal observations of this bird's decline from the public and research community, especially in the northern half of the state, possibly due to habitat loss in the removal of wooded habitat corridors or effects of pesticides on food availability.

¹⁷ **Common Bird in Steep Decline:** Species' populations have declined continentally by an estimated 50% or more since 1970

Watchlist (Yellow-D): Species shows steep declines and faces major threats

Regional Stewardship Species: >25% of the global population found in the Bird Conservation Region (Partners in Flight 2019)

Chimney Swift

Watchlist – Yellow (D) • Regional Priority in BCR22 and BCR24¹⁴
67% global population decline since 1970



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MO Concern Score: 16

Broad Management Guidelines (BCR22, BCR24): Maintain snags in open wooded areas for nesting and roosting. In urban areas, retain chimneys for roosting and nesting, where possible.

- Originally a woodland bird but has adapted well to urban settings and human disturbance likely due to an abundance of nesting and roosting locations in human-made structures.
- Population declines may be reflective of a decrease in artificial (human-made) nesting and roost sites (chimneys) due to conversion to electric heating of buildings and homes and extensive capping of chimneys/other open shafts in urban areas that the birds historically used.

Red-headed Woodpecker

Watchlist – Yellow (D) • Regional Priority in BCR22 and BCR24¹⁸
67% global population decline since 1970



MO Concern Score: 17

Broad Management Guidelines (BCR22, BCR24): Maintain savanna or very open park-like woodland; maintain snags for nesting.

- Savanna species; savanna is one of the rarest natural communities in Missouri.
- Missouri may be an important state for nonbreeding habitat (eBird non-breeding abundance map in APPENDIX).

Eastern Wood-Pewee

Regional Priority in BCR24
44% global population decline since 1970



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MO Concern Score: 14

Broad Management Guidelines (BCR24): Require mature trees for canopy nesting, common across a broad wooded spectrum.

- Large percentage of the global population found in Central Hardwoods BCR (19%).
- Declines of this seemingly common bird may be surprising, but declines follow a continental downward trend in many aerial insectivores. Anecdotally, Pewees may be adapting to/increasing in wooded urban areas due to tree maturation, and these areas are not well sampled by BBS given a lack of urban sampling routes. However, this species is highly detectable given its frequent vocalizations throughout the breeding season, and declines have been detected where BBS has sampled long-term, generally in rural areas.

¹⁸ **Watchlist (Yellow-D):** Species shows steep declines and faces major threats (Partners in Flight 2019)

Bewick's Wren

Regional Priority in BCR24
31% global population decline since 1970



MO Concern Score: 17

Broad Management Guidelines (BCR24): Maintain open woodland, scrubby habitats; Bewick's wrens nest in and are commonly detected near abandoned cars and farm equipment. eBird spatial and temporal models show this bird associated with grasslands, woody savanna, deciduous forest, and, to a lesser degree, urban and crop landcovers.

- The Eastern subspecies (*T. b. bewickii*) is the only form of Bewick's that occurs in Missouri; the eastern population has shown steep declines in the last four decades. See APPENDIX for more.
- Lack of information on nest productivity and habitat requirements are challenges to conservation planning for this species.

Brown Thrasher

Regional Priority in BCR22 and BCR24
37% global population decline since 1970



MO Concern Score: 15

Broad Management Guidelines (BCR24): Mid-successional forest, edge habitat, variety of shrubby habitats.

Eastern Towhee

Regional Priority in BCR24
43% global population decline since 1970 (BBS)



MO Concern Score: 15

Broad Management Guidelines (BCR24): Maintain early-successional forest or savanna and woodland. Leaf litter important for foraging and nesting, so annual burning is not encouraged.

Field Sparrow

Common Bird in Steep Decline • Regional Priority in BCR22 and BCR24¹⁹
62% global population decline since 1970



MO Concern Score: 17

Broad Management Guidelines (BCR22, BCR24): Maintain open fields with scattered shrubs, early-successional forest, savanna and open woodland management. Markedly greater densities in areas <1 year since prescribed burn in the Missouri Ozarks (Reidy et al. 2014).

- Shown a very sharp decline in Missouri (BBS). Missouri River Bird Observatory grassland bird monitoring data indicates less of a steep decline since 2014 (MRBO). BBS trends may be picking up on a loss of grassland habitat in general.
- Southern half of Missouri provides important wintering habitat.

Yellow-breasted Chat

Regional Priority in BCR24
11% global population decline since 1970



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MO Concern Score: 14

Broad Management Guidelines (BCR24): Maintain early-successional forest, savanna and woodland management.

- Leave even-aged (clearcut) stands ~6-7 years post-harvest in the Ozarks (Kendrick et al. 2014).
- Disturbance-dependent species but are found at greater densities with increasing forest on the landscape (10-km radius; Reidy et al. 2014).

Orchard Oriole

Regional Priority in BCR24
23% global population decline since 1970



MO Concern Score: 13

Broad Management Guidelines (BCR24): Savanna, woodland management; maintain small groves of trees for nesting in open landscapes.

¹⁹ **Common Bird in Steep Decline:** Species' populations have declined continentally by an estimated 50% or more since 1970 (Partners in Flight 2019)

Blue-winged Warbler

Regional Priority in BCR24
22% global population decline since 1970



MO Concern Score: 15

Broad Management Guidelines (BCR24): Maintain open landscapes with scattered shrubs or early-successional-stage forest with disturbance (tree harvest, fire, or combination thereof) to maintain shrubby openings.

Prairie Warbler

Watchlist – Yellow (D) • Regional Priority in BCR24²⁰
53% global population decline since 1970



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MO Concern Score: 18

Broad Management Guidelines (BCR24): Early-successional forest, glade, savanna, and open woodland management. Requires larger patches of open, shrubby habitat for nesting (minimum 3 acres) and avoids edges. Maintain 3-6 year disturbance rotation to set back succession and maintain early-successional openings at least 3 acres in size.

- Less flexible on habitat requirements of shrubby, early-successional forest than other disturbance-dependent birds due to greater habitat-size needs.
- Leave even-aged (clearcut) stands ~6-7 years post-harvest in the Ozarks (Kendrick et al. 2014).
- Disturbance-dependent species, but are found at greater densities with increasing forest on the landscape (10-km radius; Reidy et al. 2014).

FOREST BIRDS

Depending on soils, topography, and geographic region, 10 different upland and five bottomland forest natural communities occur in Missouri. Across these diverse forests, a range of structure can occur. For the purpose of this Bird Plan, a mature forest (canopy trees 50+ years old) is defined as canopy cover ranging from 80-100%; a shade-tolerant subcanopy of trees, shrubs, vines, and other vegetation; and a relatively sparse ground flora due to a lack of sunlight reaching the forest floor (Nelson 2010). Upland forests are relatively common in Missouri, especially in the Ozarks. Bottomland forest, on the other hand, has declined substantially over the past 200 years. Bottomland hardwood forest is dominated by wetland-adapted oak and hickory species and were once a major component of the state's Bootheel region and lower Grand River but have declined by over 90% due to conversion to agriculture; these forests provide high-quality breeding habitat for Prothonotary Warbler. Young forest, or early-

²⁰ **Watchlist (Yellow-D):** Species shows steep declines and faces major threats (Partners in Flight 2019)

successional forest (generally fewer than 15 years old, defined in a footnote on page 21) provides a different set of habitat conditions important for a different suite of bird species outlined in the SAVANNA, WOODLAND, AND YOUNG-FOREST BIRDS section. Forest birds nest across forest strata: on the ground in leaf litter; in or near shrubs or vegetation on the forest floor; and in the subcanopy or canopy, some species preferring small gaps in the forest.

Fragmentation of forest, habitat loss via forest conversion, and poor forest management are the major threats to forests in Missouri. Mature forest bird species respond to forest fragmentation and forest patch size differently; some will nest in fragmented forest patches, while other species require large contiguous forest blocks. Forest fragmentation can have negative effects on forest-obligate birds' nesting success due to both increased nest parasitism by Brown-headed Cowbirds and increased predation rates (Robinson et al. 1995, Thompson et al. 2002), and that fragmentation may drive smaller fragments to act as reproductive sinks (Donovan et al. 1995). Cowbird parasitism is less of a concern in more contiguous forested landscapes like the Missouri Ozarks; only 1% and 4% of nests in forest and clearcuts, respectively, were parasitized based on 20 years of MOFEP data; Morris et al. 2013). Ovenbird display the strongest negative response to management actions at multiple scales, even within the heavily forested Missouri Ozarks (Morris et al. 2013, Kendrick et al. 2014). However, some species that we commonly believe to be forest-obligate birds will readily use young-forest openings during portions of the breeding season, especially post-breeding with their young (Anders et al. 1997, Anders et al. 1998, Burke et al 2017).

A diversity of forest management practices can create mature-forest breeding habitat for a suite of bird species. Uneven-aged forest management can maintain large areas of mature forest habitat while still promoting forest health, tree regeneration, and commercial harvest revenue. Uneven-aged management removes trees singly or in groups and retains a good portion of the existing forest within harvested sites. Following harvest, these areas are comprised of several vertical forest layers, including a well-developed leaf litter layer and small openings that can be used by birds for nesting, perching, and foraging. In managed forests, the purposeful retention of cavity trees, standing dead trees, and downed dead trees also provides nesting habitat for many forest-interior birds. Sustainable and prescribed even-aged management can also diversify forest-dominated landscapes; see the SAVANNA, WOODLAND, AND YOUNG FOREST section above.

These forest management practices also help make forests more resilient. Diversity in forest management creates a landscape mosaic of forest, woodland, savanna, and young forest. Almost all forest management promotes climate resiliency by removing senescing trees, regenerating or releasing more vigorous trees, and often increasing species diversity and structural diversity. Other large threats to these wooded systems include pests, pathogens, and invasive plant species, all of which may increase in frequency and severity with climate change. Forest and woodland habitats are generally more resilient to such threats when they are made up of diverse tree species and sizes and are part of a diverse landscape mosaic of forest and woodland structures and ages.

Blue Jay

Regional Priority in BCR24
24% global population decline since 1970



MO Concern Score: 14

Broad Management Guidelines (BCR24): Maintain a variety of wooded habitats, including urban treed environments.

- Blue Jays being threatened may seem surprising, but the trend data are fairly shocking. Declines likely due to West Nile Virus. Despite this, Blue Jays have adapted to urban areas, where potential trends may not be well captured by BBS given a lack of urban sampling routes. Still, declines have been detected where BBS has sampled long-term, generally in rural areas. See APPENDIX for more.

Wood Thrush

Watchlist – Yellow (D) • Regional Priority in BCR24²¹
60% global population decline since 1970



MO Concern Score: 14

Broad Management Guidelines (BCR24): Interior forest with a well-developed midstory of saplings for nesting and a fairly open forest floor. Early-successional forest matrix benefits post-fledgling stage by providing abundant food and cover (Anders et al. 1997, Burke et al. 2017).

- Missouri's Wood Thrush BBS trend is fairly stable but displays a lot of annual variation with fairly wide error bars. The U.S. trend is steeply declining. See APPENDIX for more.

Worm-eating Warbler

Regional Priority in BCR24 • Regional Stewardship Species in BCR24²¹
26% global population increase since 1970 (BBS)



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MO Concern Score: 15

Broad Management Guidelines (BCR24): Closed forest with steep southwest-facing slopes for nesting and uses areas with understory shrubs and oak regeneration.

- Large percentage of global population in the Central Hardwoods BCR (27%).
- Worm-eating Warblers have a small global population and are very particular about habitat and nest-site selection, which makes preserving suitable Missouri habitat important.
- Demonstrated adverse effects of fire due to need for leaf litter and shrub/regeneration habitat components.

²¹ **Watchlist (Yellow-D):** Species shows steep declines and faces major threats

Regional Stewardship Species: >25% of the global population found in the Bird Conservation Region (Partners in Flight 2019)

Prothonotary Warbler

Watchlist – Yellow (D) • Regional Priority Species in BCR2 and BCR26²²
38% global population decline since 1970 (BBS)



MO Concern Score: 13

Broad Management Guidelines (BCR24, BCR26): Maintain and restore bottomland hardwood forest.

- Prothonotary Warblers are found in bottomland hardwood forest and riparian corridors along river and stream systems across most of the state. Efforts to restore bottomland hardwood forest will attract this species.
- Steep declines in the Mississippi Alluvial Valley BCR where most of Missouri’s Prothonotary habitat is located.

Kentucky Warbler

Watchlist – Yellow (D) • Regional Priority in BCR24 •
Regional Stewardship Species in BCR24²²
29% global population decline since 1970 (BBS)



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MO Concern Score:15

Broad Management Guidelines (BCR24): Forest with shrubby/oak regen openings for nesting.

- Large percentage of global population in the Central Hardwoods BCR (29%).
- Appear to be increasing in Missouri, likely due to forest succession (Breeding Bird Survey Missouri trend below).

Cerulean Warbler

Watchlist – Yellow (D) • Regional Priority in BCR24²²
State Endangered
72% global population decline since 1970 (BBS)



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MO Concern Score: 18

Broad Management Guidelines (BCR24): Mature riparian mature forest with heterogenous canopy structure, including both mature trees and gaps.

- Large percentage of global population in the Central Hardwoods BCR (17%). Missouri is a stronghold for Cerulean Warbler habitat outside of the extensive Appalachian population.
- Increased flood events due to increases in large precipitation events may benefit them in creating gaps and increasing riparian forest heterogeneity.
- Species is not well sampled with BBS road-based surveys. More information on numbers in Missouri; habitat needs have not been extensively studied and these data will inform their state-endangered status. Effort to fully replicate Robbins’ 1992-2006 canoe-based Cerulean surveys will continue. See RESEARCH AND MONITORING for more.

²² **Watchlist (Yellow-D):** Species shows steep declines and faces major threats
Regional Stewardship Species: >25% of the global population found in the Bird Conservation Region (Partners in Flight 2019)

WETLAND BIRDS

Like grasslands, wetlands as a natural community have suffered massive loss and alteration. Missouri has experienced some of the highest rates of wetland loss in the nation with an estimated 13-15% of the state's original 4.8 million acres of wetland habitat remaining. Wetlands are the most productive ecosystem year-round and offer critical habitat for over 200 Missouri species of conservation concern, including birds. There are 26 recognized varieties of wetland natural communities in Missouri ranging from bottomland forests to marshes to fens. Over 200 Missouri species of conservation concern, including birds, use wetlands for part of their habitat needs. Of 415 bird species recorded in Missouri, more than a quarter of those that regularly breed or pass through the state depend on wetlands for part of their life cycle (Missouri Department of Conservation 2015), including numerous shorebird, waterfowl, and waterbird species during spring and fall migrations. According to eBird, up to nearly 300 bird species have been recorded on Missouri's public wetlands; wetlands are the most-visited eBird Hotspots in Missouri. Major threats to wetlands are loss through conversion to agriculture and overall alterations to the natural system's flow and health/function, as well as invasive species.

Wetland conservation and management in Missouri has been extensively outlined in the Missouri Department of Conservation's Wetland Planning Initiative (MDC 2015a, MDC 2015b). The Wetland Planning Initiative is comprised of a Strategic Guidance Document that represents MDC's philosophy on how to accomplish wetland conservation and an Action Plan that will continue to evolve as we learn from our wetland conservation actions in conjunction with state conservation partners. The Wetland Planning Team is currently developing conceptual models that define our understanding of wetland systems and assessments to define the current state of our wetland systems and identify limiting factors. Once completed, results of various wetland and wetland-dependent species assessments will help set objectives with partners that improve our wetlands at various scales (area, region, and statewide). Other results will include management recommendations for many wetland-dependent species, including birds.

Regional conservation plans specific to waterfowl (Soulliere et al. 2017), shorebirds (Russell et al. 2016), and waterbirds (Soulliere et al. 2018) outline the trends and management recommendations of these bird guilds, and are beyond the scope of this Bird Plan. Green Heron is a wetland/wet-area generalist that is more detectable on BBS surveys than most wetland birds and is the only wetland bird identified as a Missouri priority species in this Bird Plan. Due to its greater occurrence on BBS surveys than other wetland species, its population declines are tracked and it is designated as a Regional Watchlist species nearly statewide.

Green Heron

Common Bird in Steep Decline • Regional Priority in BCR22 and BCR24²³
Global population trend unknown due to few monitoring data



MO Concern Score: 15

Broad Management Guidelines (BCR22, BCR24): Maintain marshes, streams, and pond and lake edges.

- Threats to this species and reasons for its decline are relatively unknown. Green Heron is not well sampled with BBS' road-based protocol given their habitat requirements, but declines are clear.

GENERALIST BIRDS

Common Grackle

Common Bird in Steep Decline • Regional Priority in BCR22 and BCR24²³
54% global population decline since 1970 (BBS)



MO Concern Score: 16

Broad Management Guidelines (BCR22, BCR24): Nests in scattered trees in a wide variety of habitats.

- BBS trend may not be wholly representative based on this bird's increased use of urban areas and neighborhoods for breeding due to tree maturation.
- Greater threats may lie south of Missouri on the wintering grounds where large roosts have been historically poisoned for pest control (Dolbeer et al. 1995, Stansley and Roscoe 1999).

SPECIAL CIRCUMSTANCE BIRDS

The Special Circumstance designation is assigned to bird species that have very small breeding populations in Missouri as a result of special circumstances. The Technical Team defined these special circumstances as (1) removal of most historic habitat in Missouri due to major land-use change by humans, and (2) Missouri's location at the edge of a species' range (species was likely never abundant in Missouri). These five species remain important to Missouri conservation, and the tracking of their occurrence is useful. A Missouri Concern Score is not assigned, because the Technical Team determined that other species will more greatly benefit from increased conservation investment.

²³ **Common Bird in Steep Decline:** Species' populations have declined continentally by an estimated 50% or more since 1970 (Partners in Flight 2019)

Ruffed Grouse

No priority designation

31% global population increase since 1970

Translocation effort to central Missouri River hills underway; 2018 marked year one of three of this effort.

Broad Management Guidelines (BCR24): Even-aged early-successional forest; forest edges in forested matrix.



Greater Prairie-Chicken

Watchlist – Yellow (D) • Regional Priority in BCR22²⁴

State Endangered

Global population trend unknown due to few monitoring data

Broad Management Guidelines (BCR22): Large open areas of mid- and tallgrass prairie with minimal trees.



- Two reintroduction attempts have been made over the last 10 years to sustain a breeding population of Greater Prairie-Chickens in Missouri (2008-2012, birds translocated from Kansas to Wah’Kon-Tah Prairie; 2013-2017 birds translocated from Nebraska to Grand River Grasslands in Missouri and Iowa). Due to land-use change and grassland fragmentation, Missouri currently lacks sufficiently large, well-managed (treeless) grassland landscapes to support a sustainable population into the future.

King Rail

Watchlist – Yellow (D) • Regional Priority in BCR22²⁴

State Endangered

Global population trend unknown due to few monitoring data

Broad Management Guidelines (BCR22): Maintain marshes and wet habitat with a mix of perennial vegetation including grasses, sedges, rushes, and cattails interspersed with small shallowly flooded pools or other waterways.



- Lack of consistent monitoring data for this species, given its secretive nature. The Mississippi Flyway and Midwest Marshbird Working Group are proposing an analysis of life-cycle needs of marshbirds, including King Rail. See RESEARCH AND MONITORING for more.

²⁴ **Watchlist (Yellow-D):** Species shows steep declines and faces major threats

Bachman's Sparrow

Watchlist – Red • Regional Priority in BCR24; does not meet 5% threshold but species is a Central Hardwoods Joint Venture priority²⁵
State Endangered
76% global population decline since 1970



Broad Management Guidelines (BCR24): Large complexes of glade restoration and open woodland management with frequent fire and grass component for nesting.

- Very low occurrence in Missouri; most recently recorded sighting in 2013. Surveys since that time and an intensive, targeted effort in 2018 on glades where Bachman's were historically reported have resulted in no detections. Future surveys will continue on Missouri glades.
- Requires very open pine woodland management in most of its range with frequent fire to keep shrubs at bay and maintain grass for nesting. The species is experiencing declines across its range and Missouri has always been at the edge of that range. Bachman's were historically found breeding on Ozark glades but an overall decline in fire on the landscape over the last 50+ years may have led to many glades becoming overgrown cedar thickets.

Brown-headed Nuthatch

Regional Priority in Central Hardwoods (BCR24)
18% global population decline since 1970 (BBS)



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This species is extirpated from Missouri and is a candidate for potential future reintroduction. The closest populations of Brown-headed Nuthatches reside in pine woodlands of the Ozark and Ouachita National Forests in Arkansas. After the extensive removal of the Missouri Ozarks' short-leaf pine forests in the late 1800s and early 1900s, this pine-obligate was no longer recorded in the state. This resident bird is relatively sedentary and a weak flyer, so large-scale dispersal from Arkansas to recolonize restored pine woodland habitat in Missouri is highly unlikely. Climate models for the Missouri Ozarks also favor short-leaf pine habitats into the future with changing temperatures and weather patterns (Wang et al. 2016, Jin et al. 2017). Brown-headed Nuthatch reintroduction to Missouri has been discussed by various bird conservation partners for the last decade. A number of circumstances have prompted a more thorough investigation of the viability of a reintroduction project: an emphasis on pine-woodland habitat restoration continues with increased management support via Missouri's Collaborative Forest Landscape Restoration Project (CFLRP)²⁶ focused on Oak and Pine Woodland Restoration; the support and partnership of multiple key partners; and the species' common status across its range. Habitat and source-population abundance analyses are underway with partners at the U.S. Forest Service and University of Missouri to consider the viability of a reintroduction. This may be one way that

²⁵ **Watchlist (Red):** Species highly vulnerable and in urgent need of special attention (Partners in Flight 2019)

²⁶ The Collaborative Forest Landscape Restoration Project is a U.S. Forest Service program to encourage collaborative, science-based ecosystem restoration of priority landscapes. Missouri's CFLRP is the Missouri Pine-Oak Woodlands Restoration Project, which focuses efforts on oak-pine woodland restoration efforts among a network of conservation partners.

conservation partners can come together to restore a lost member of a natural community that is expected to thrive in the face of a changing climate.

Broad Management Guidelines (BCR24): Shortleaf pine woodland management with snags retained for nesting. Continued focus on open pine woodland management in addition to support for the CFLRP to encourage extra funding to maintain these systems.

Extirpated Species Reintroduction Considerations

Future extirpated species' reintroductions require support on many fronts. The most important is the availability, quality, and longevity of necessary habitat to give a reintroduced population the best possible chance of success. The potential benefits of a reintroduction, to both the reintroduced species and the natural community to which it would be introduced, must be evaluated in comparison to the potential risks to the source population and the translocated individuals. Other considerations include partner support, cost, and risk. All factors require thorough investigation and support before the reintroduction of any extirpated species moves forward. An investigation is underway to evaluate shortleaf pine woodland habitat suitability in Missouri and the potential for reintroduction of Brown-headed Nuthatch by translocating birds from Arkansas. Research suggests ongoing management will sustain pine woodland in the region and that pine woodlands will likely respond positively to mostly future climate scenarios (Wang et al. 2016, Jin et al. 2017). There is broad interest in a possible reintroduction among federal and state agencies and non-governmental organizations with several partners willing to commit funding. There also appears to be little risk of any negative consequences to attempting a reintroduction. Other extirpated species may be appropriate for reintroduction in the future, but not without habitat analyses, partner support, and a proper monitoring program to track the health of reintroduced populations.

RESEARCH AND MONITORING

As the Technical Team worked through assigning a Missouri Concern Score, a few themes of needed research and monitoring rose to the surface. Missouri-specific data gaps and uncertainties exist and this section works to point those out in the hopes of future collaboration and partnership among the conservation community.

For most species of continental or regional concern, population trends are drawn from numerous data sources, but mostly from the North American Breeding Bird Survey. The Breeding Bird Survey is a road-based survey for all breeding birds on standardized 24.5-mile routes across North America during the breeding season. The Breeding Bird Survey began in 1970 and is the longest-running bird survey ever, consisting of over 2,000 routes in Canada, the United States, Mexico, even the Caribbean and Central America. Volunteers knowledgeable in bird identification conduct the routes annually. These data have provided long-term, large-scale breeding bird population trends that have fed ornithological research and awareness for the past 50 years.

A few species in the Bird Plan are not well sampled via the road-based Breeding Bird Survey due to their use of more remote habitats not easily accessed by a road-based survey, namely wetland and interior forest birds. A lack of data for some species makes it difficult to give habitat management recommendations or suggestions for conservation actions. These species are mentioned where this lack of data is suspected and for which monitoring needs exist to address data gaps. eBird is inherently filling in gaps for species and habitats that are not well sampled with BBS surveys, and regional conservation planners are beginning to use its wealth of data to more accurately map trends and statuses of many bird species. Future iterations of the Bird Plan will integrate updated regional trends and work to further integrate eBird data to fill existing statewide gaps.

Current or Recent Bird Monitoring Efforts

Grassland Bird Monitoring, Private and Public Lands (2011-present)

Grassland bird monitoring surveys have been conducted on public and private grasslands by Missouri River Bird Observatory through a contract between MRBO and MDC since 2011. An effort to analyze these data with potential effects of management or landscape variables is being explored.

Cerulean Warbler Surveys in Missouri (1992-2006, 2007-2008, 2016-2018, and future)

A large portion of Cerulean Warblers' global population breeds in riparian forest in Missouri and Arkansas, which have been poorly sampled using conventional Breeding Bird Survey methods (Robbins et al. 1998, Thompson et al. 2012). Two efforts conducted surveys that have targeted Cerulean Warblers in Missouri: Robbins' 1992-2006 canoe-based surveys (reported on by Thompson et al. 2012) and 2007-2008 point counts in upland and riparian areas across the Central Hardwoods Bird Conservation Region. In the coming years, we will work to fully replicate Robbins' 1992-2006 canoe-based surveys on stream stretches in the Missouri Ozarks. Targeted effort in the summers of 2021 and 2022 will work to resurvey as many of the original river reaches as possible for comparison to the original dataset.

Bottomland Hardwood Forest Surveys by Missouri River Bird Observatory and Missouri Department of Conservation (2015-17)

Bottomland hardwood forest bird surveys were conducted on public lands in southeast Missouri from 2015 to 2017. These surveys could be replicated to monitor large-scale changes in breeding bird occurrence.

Fall Bobwhite Covey Counts (2005-present) and Spring Bobwhite Counts and (2005-2008)

Fall bobwhite covey counts have been conducted consistently on at least 21 conservation areas and multiple private land focus areas around the state since 2005. These data are currently being analyzed to inform future management and monitoring efforts. Spring whistle counts were conducted on 19 MDC conservation areas where quail management was emphasized from 2005 to 2008. These surveys are voluntary and continue today on some of these areas.

Grassland Coalition BBS-style Paired Grassland Bird Monitoring Routes (2001-2017)

This effort used a BBS-style protocol to record all species detected at nine paired sites (managed and unmanaged) in northwest, western, and southwest Missouri to investigate potential differences in bird composition. An analysis of these data is in progress.

Missouri Ozark Forest Ecosystem Project: Breeding Bird Project (1991-present)

One-hundred-year landscape-scale experiment investigating the effects of even-age, uneven-age, and no forest management on the breeding species composition, density, and reproductive success of forest songbirds in oak-hickory-pine forest in the southeast Missouri Ozarks. Point count and nest data have been gathered annually since 1991 to study the effects of two harvests (1996 and 2011) on a 15-year rotation. This unprecedented effort has provided and continues to provide partnership opportunities with universities and many other organizations to further research of forest management and its effects on wildlife, other biota, and abiotic features.

Eagle Nest Monitoring (2015-present)

Aerial and ground surveys, including the Eagle Watch Program (citizen science).

Future Bird Monitoring Needs

Motus Wildlife Tracking Receiver Expansion

Expanding the number of Motus Wildlife Tracking System receivers in two digital fences across Missouri will add to a larger network of Motus receivers across the hemisphere and add broader coverage for existing projects and future projects to track bird and bat movements in and out of Missouri and through the Midwest. Deploying Motus transmitters on migratory birds will help learn more about migratory bird movements, migratory paths, migratory timing, and to further target Southern Wings projects. The Motus Wildlife Tracking System uses very small, lightweight “nanotags” attached to small songbirds or bats that emit a unique signal. This signal is then detected by a network of passive Motus receivers placed on the landscape that collect and store the detection data of Motus-tagged birds or bats that pass within range of the receiver. This technology is providing further knowledge on the large-scale migratory movements of small flying animals, especially migratory birds.

Landscape Health Index Bird Surveys

The Missouri Department of Conservation and the University of Missouri are working together to develop a Landscape Health Index (LHI) as a rapid assessment to evaluate the health (quality) of landscapes (e.g., COAs) over time. This LHI will work to measure whether the conservation community is successfully creating resilient natural community landscapes and associated species assemblages. The LHI will include surveys of the bird community, vegetation, herptiles, and fish, where appropriate. The

pilot bird surveys in two Priority Geographies will be conducted in breeding season 2019 and bird surveys in all nine Priority Geographies will be conducted in breeding season 2020.

Regional Marshbird Meta-Analysis

The Mississippi Flyway Nongame Bird Technical Section and Midwest Marshbird Working Group is proposing a meta-analysis focused on the annual life cycle needs of secretive marshbirds, including King Rail, within the Mississippi Flyway. The overall goal of this project is to better understand habitat requirements of marshbirds during multiple life-history events (nesting, migration, and wintering) throughout the Mississippi Flyway and evaluate how wetland management practices on public lands can influence marshbird habitat selection. Information from this project could potentially help inform limiting factors at a state scale to better manage for King Rail and other marshbirds.

Cerulean Warbler canoe surveys

See CURRENT OR RECENT BIRD MONITORING EFFORTS section above.

Birder-sourced Swainson's Warbler Occurrence, and Others Where Appropriate

To gain knowledge of Swainson's Warbler occurrence and habitat use in Missouri, birder/crowd-sourced information via Missouri birders could provide us with initial detections uploaded to eBird followed by on-the-ground verification by MDC staff and/or partners for inclusion in the Heritage Database. This approach could be a useful way to learn more about other species' occurrence to target potential habitat improvements.

Central Hardwoods Joint Venture Grassland Bird Demography Project

An analysis in the late 1990s of over 25 years of data collected via the North American Breeding Bird Survey (BBS) provided some of the earliest evidence of the precipitous decline of North American grassland bird species (Peterjohn and Sauer 1999) and those declines have continued in the decades since (Sauer et al. 2017A, Sauer et al. 2017B). Three of these species, the Northern Bobwhite, Henslow's Sparrow, and Eastern Meadowlark (all included above as scored species in this Bird Plan), spend their entire annual cycle largely within the central United States. The recovery of these species across their historic ranges requires range-wide conservation efforts; a better understanding of the factors that are negatively impacting the species throughout their annual cycles and depressing population growth; and which geographies' landscape configurations are able to contribute to viable populations. While there are estimates of population sizes and abundance across those large spatial scales, there is a significant lack of data with which to estimate with any confidence demographic attributes such as number of offspring produced, juvenile survival, and adult survival during the breeding, migration and wintering periods, and how those might be tied to habitat conditions at site and landscape scales. Four Joint Ventures, the Central Hardwoods, Mississippi Alluvial Valley, Oaks and Prairies, and East Gulf Coastal Plain, have agreed to work together on a research project needed to fill those knowledge gaps. A potential project site is in the northern part of the state and there is potential for MDC and others to play valuable roles in helping get the project on the ground in the next few years.

NEXT STEPS – OUTREACH SECTION

The second part of the Missouri Conservation Bird Plan is the Outreach Section. After the completion of the Technical Section, a separate team of education and outreach professionals will be assembled from multiple agencies and organizations in Missouri to discuss high-level goals for bird education and birding outreach. Like habitat management efforts, the statewide community with interests in bird conservation cannot work alone. Bird outreach and education will be brainstormed and discussed to arrive at high-level topics and goals that the bird community can spread together and reach targeted outreach or education goals. The goal is not to oversee or micro-manage bird outreach and education efforts statewide, but rather to discuss and arrive at our biggest bird conservation topics by consensus that the group would like to spread to Missouri's general public with focused group effort.

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MISSOURI BIRD CONSERVATION PLAN

TECHNICAL SECTION

APPENDIX

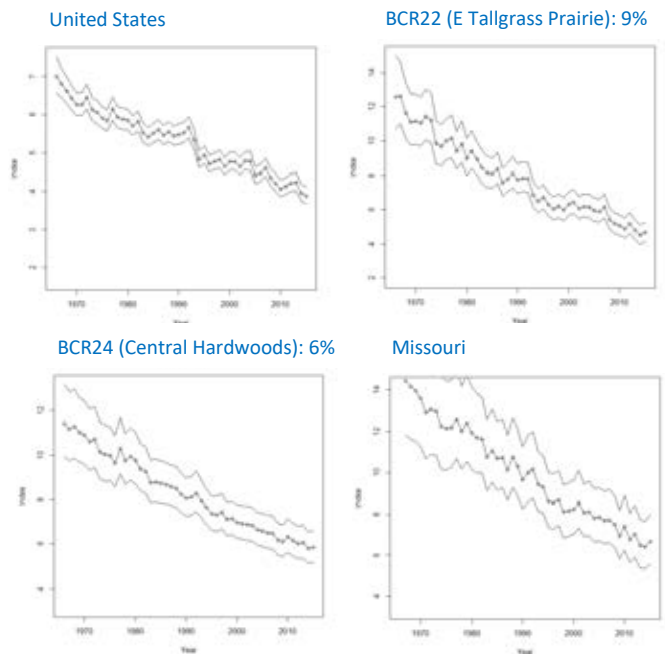
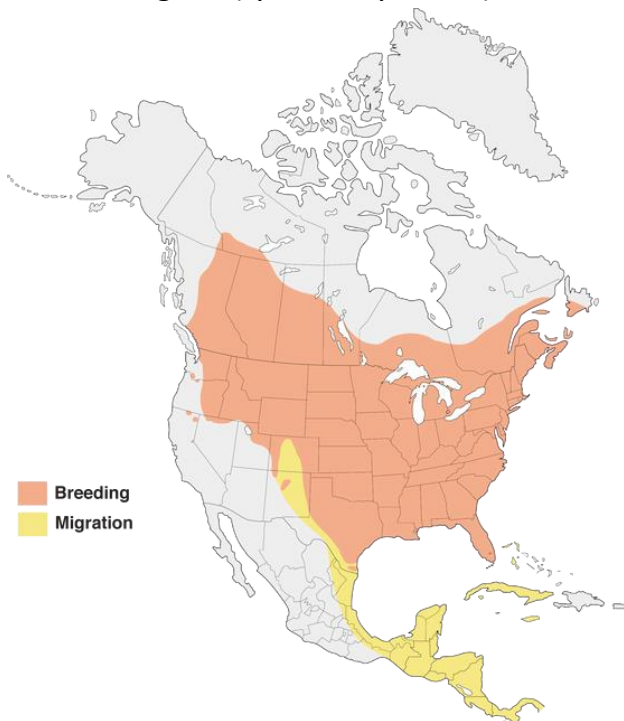
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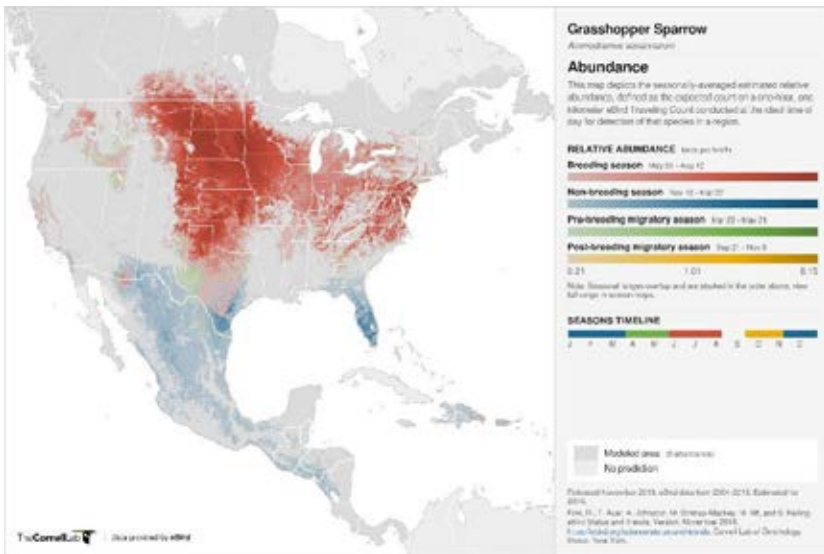
The Missouri Bird Conservation Plan Appendix includes supplementary materials that were considered in the Missouri Bird Conservation Plan Technical Team’s decision-making in the assignment of a Missouri Concern Score.

- Species below include one of two maps to show their range: a range map by Birds of North America Online (The Birds of North America 2015) or an eBird abundance map (Fink et al. 2018). Range maps show all possible areas where a species has occurred in various parts of the annual cycle. eBird abundance maps provide context of varying abundance across a species’ range.
- Graphs are a product of the latest analysis in 2015 of Breeding Bird Survey data from 1970-2015. Confidence in the data used for graphs is symbolized by graph heading color: **blue** symbolizes greatest confidence and **yellow** symbolizes medium confidence (Sauer et al. 2017). If confidence in BBS data was less than yellow, graphs are not provided nor were those graphs considered in the Technical Team’s decisions. All species include a U.S. and Missouri graph. Graphs are also provided for Bird Conservation Region (BCR) where relevant if a species is a regional priority therein (see Missouri Bird Conservation Plan for more information).
- Percentages after BCR graph heading(s) are the percentage of the global population found in each BCR according to Partners in Flight Avian Conservation Assessment Database (Partners in Flight 2019); percentages after Missouri indicate the percentage of the global population found in Missouri according to eBird (where the data are available; Fink et al. 2018)).

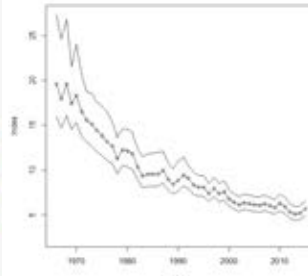
Eastern Kingbird (*Tyrannus tyrannus*)



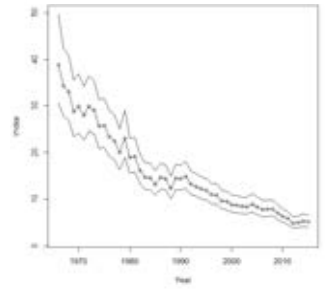
Grasshopper Sparrow (*Ammodramus savannarum*)



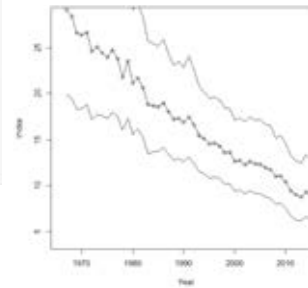
United States



BCR 22 (E Tallgrass Prairie): 9%



Missouri: 3%



Henslow's Sparrow (*Ammodramus henslowii*)



BCR 24 (Central Hardwoods): 13%

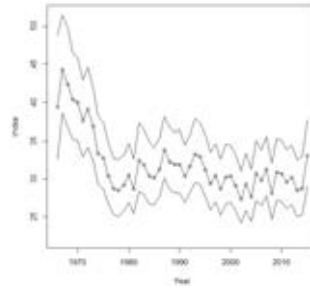


BCR 22 (E Tallgrass Prairie): 57% of global population in BCR; BBS data confidence too questionable for graph

Dickcissel (*Spiza americana*)



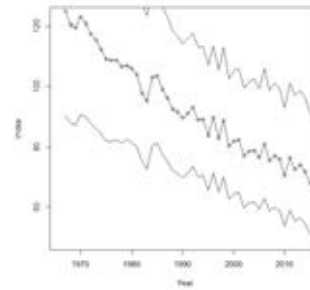
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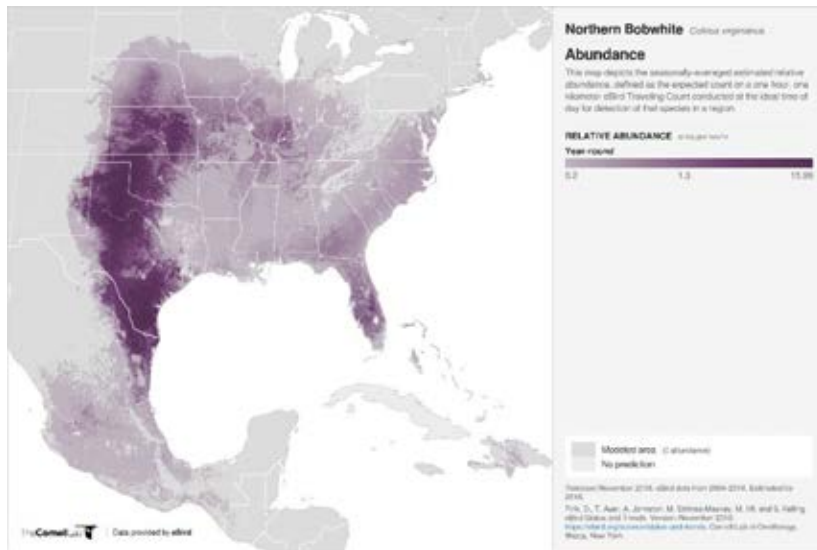
BCR 22 (E Tallgrass Prairie): 33%



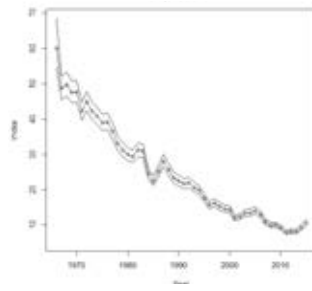
Missouri



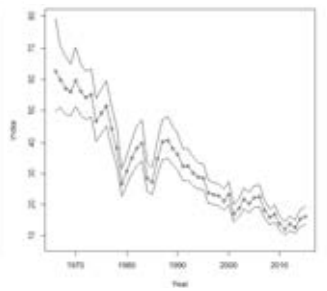
Northern Bobwhite (*Colinus virginianus*)



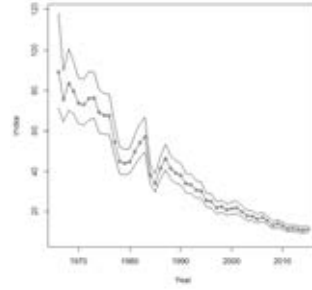
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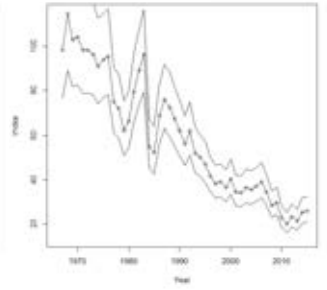
BCR 22 (E Tallgrass Prairie): 15%



BCR 24 (Central Hardwoods): 6%



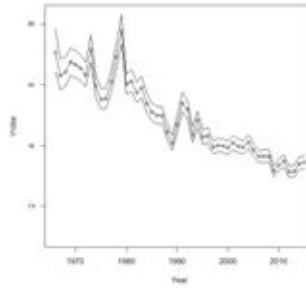
Missouri: 3%



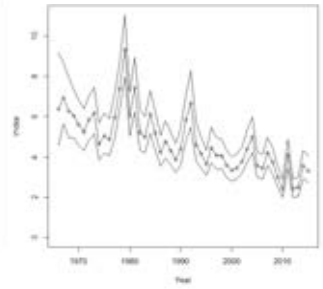
Yellow-billed Cuckoo (*Coccyzus americanus*)



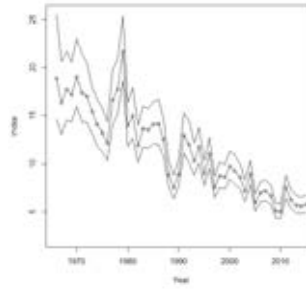
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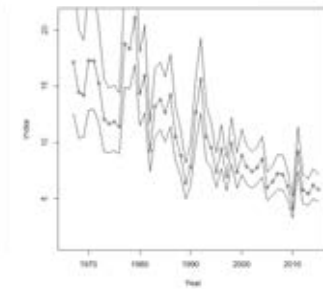
BCR 22 (E Tallgrass Prairie): 10%



BCR 24 (Central Hardwoods): 10%



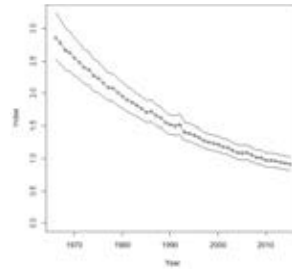
Missouri



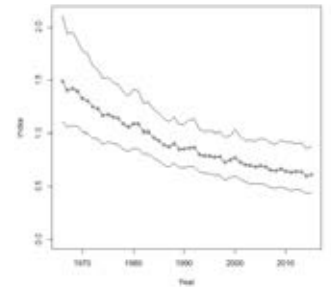
Chuck-will's-widow (*Antrostomus carolinensis*)



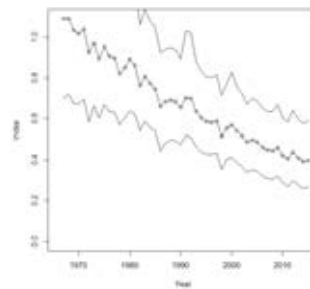
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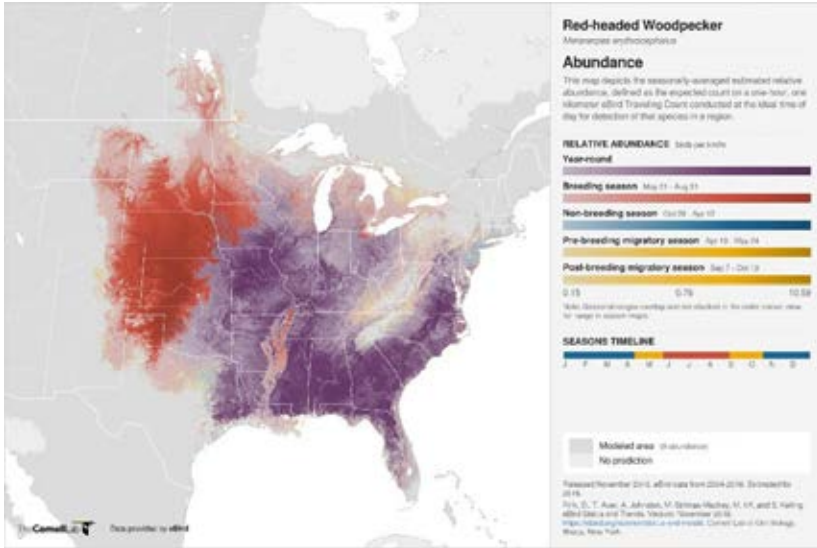
BCR 24 (Central Hardwoods): 11%



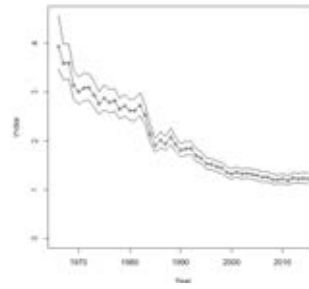
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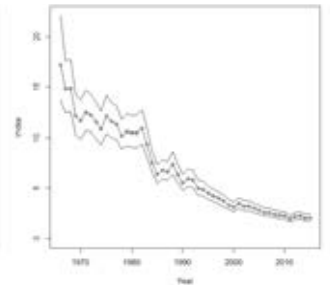
Red-headed Woodpecker (*Melanerpes erythrocephalus*)



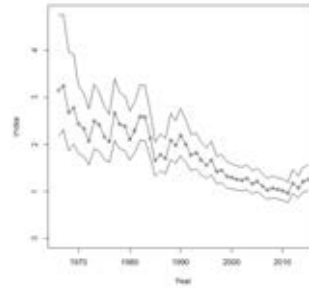
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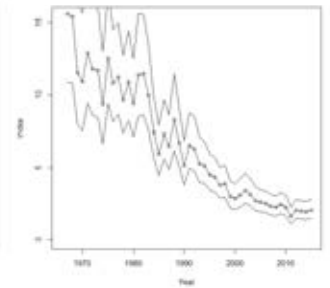
BCR 22 (E Tallgrass Prairie): 20%



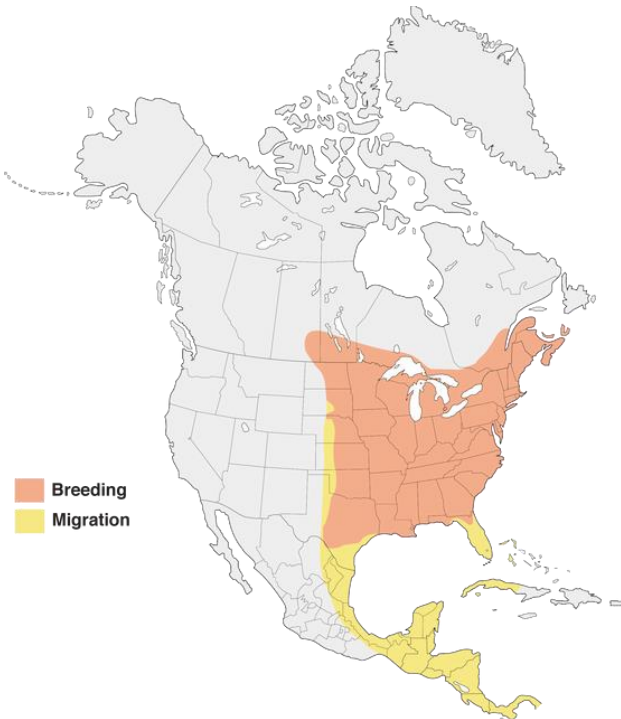
BCR 24 (Central Hardwoods): 6%



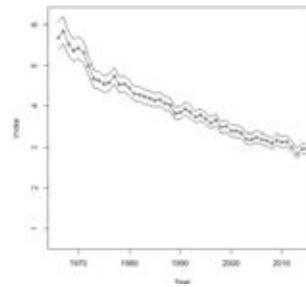
Missouri: 5%



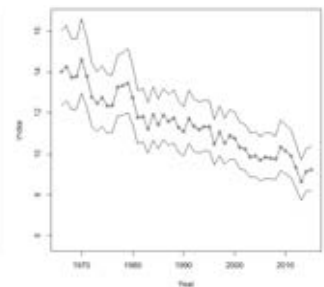
Eastern Wood-Pewee (*Contopus virens*)



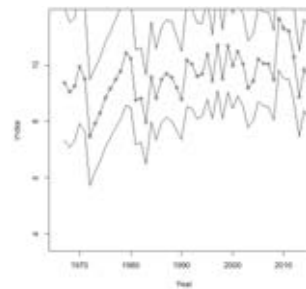
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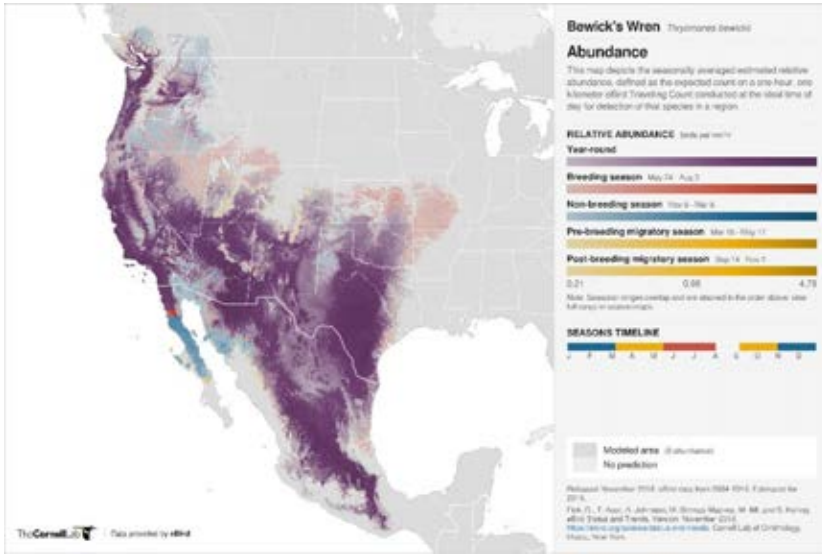
BCR 24 (Central Hardwoods): 20%



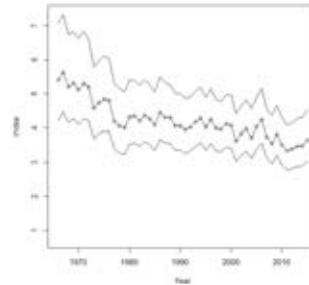
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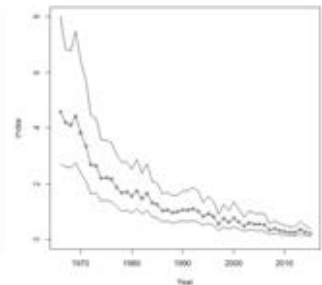
Bewick's Wren (*Thryomanes bewickii*)



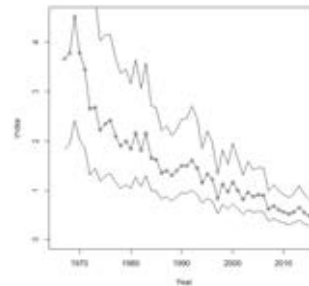
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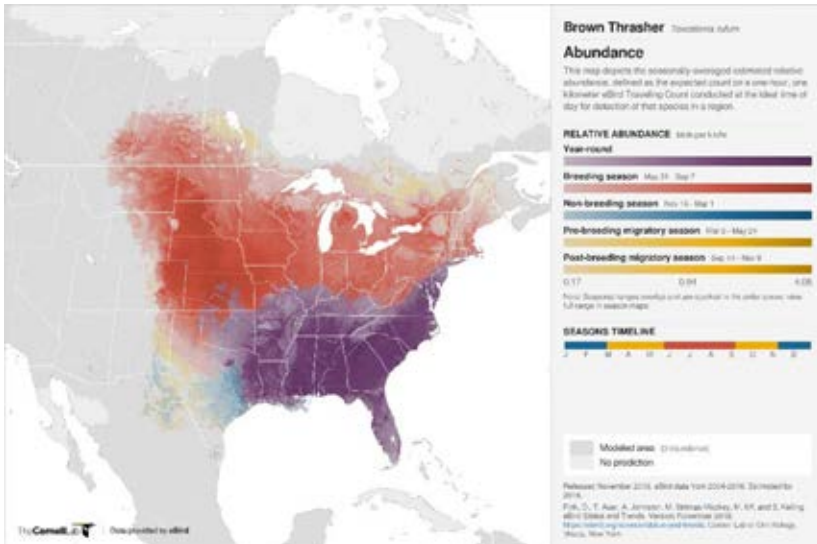
BCR 24 (Central Hardwoods)



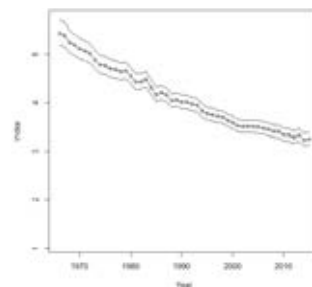
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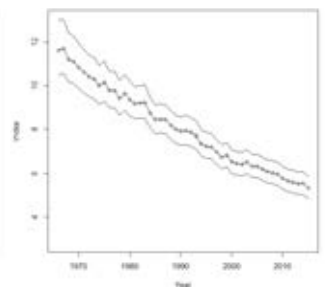
Brown Thrasher (*Toxostoma rufum*)



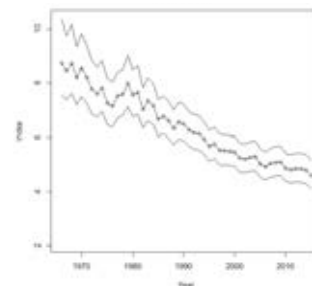
United States



BCR 22 (E Tallgrass Prairie): 17%



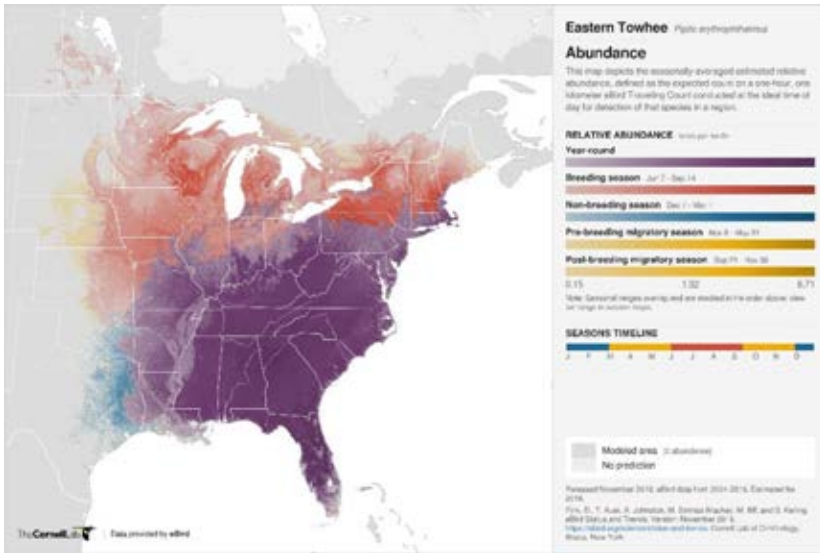
BCR 24 (Central Hardwoods): 8 %



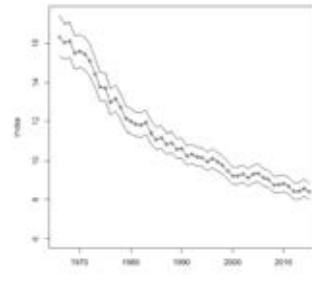
Missouri: 4%



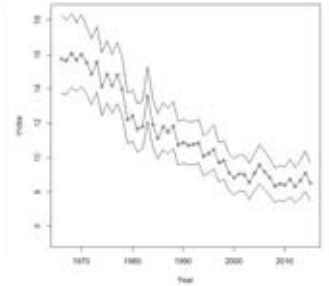
Eastern Towhee (*Pipilo erythrophthalmus*)



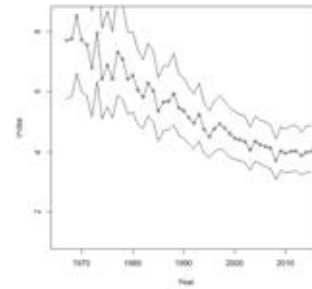
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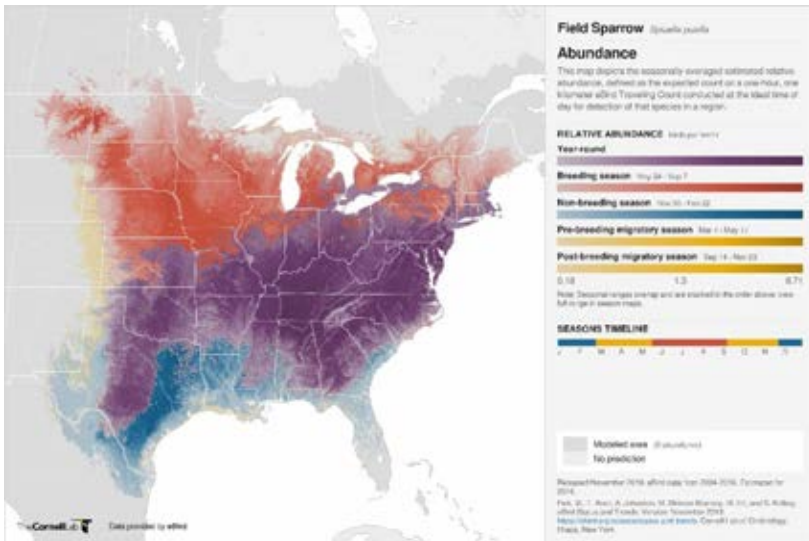
BCR 24 (Central Hardwoods): 9%



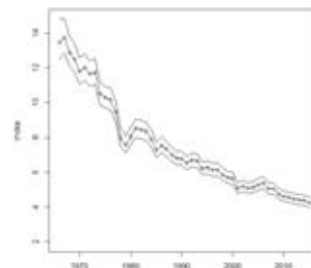
Missouri: 6%



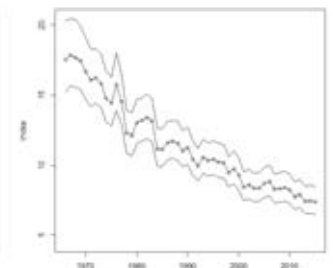
Field Sparrow (*Spizella pusilla*)



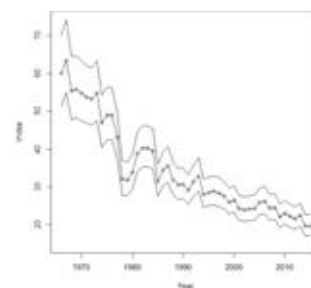
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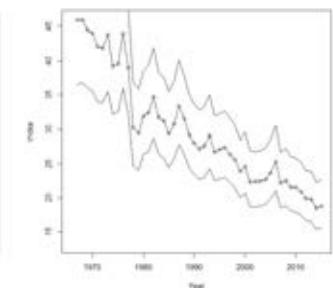
BCR 22 (E Tallgrass Prairie): 19%



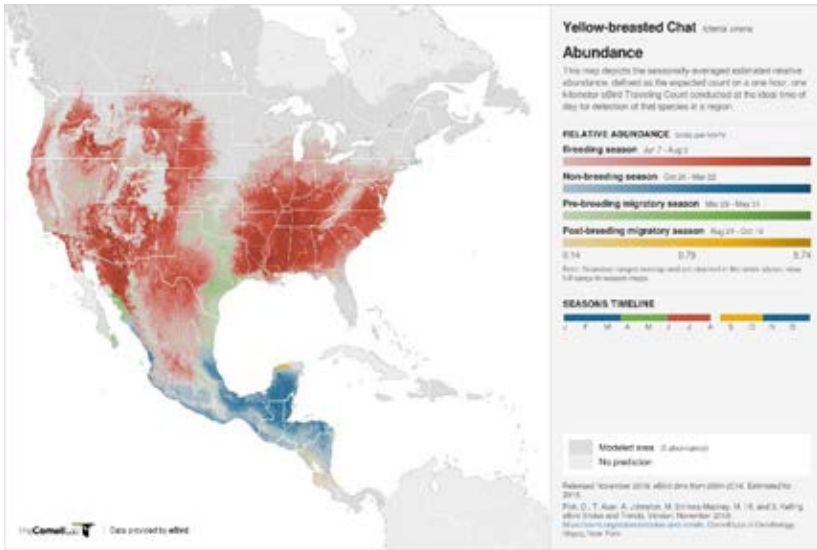
BCR 24 (Central Hardwoods): 22%



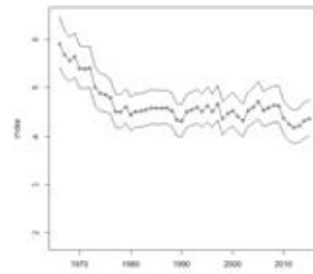
Missouri: 7%



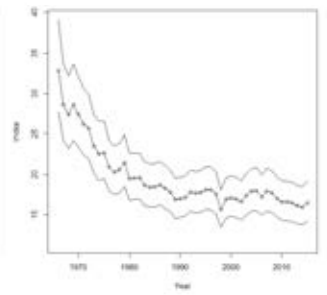
Yellow-breasted Chat (*Icteria virens*)



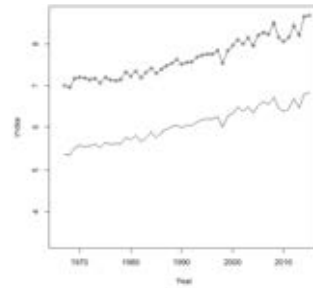
United States



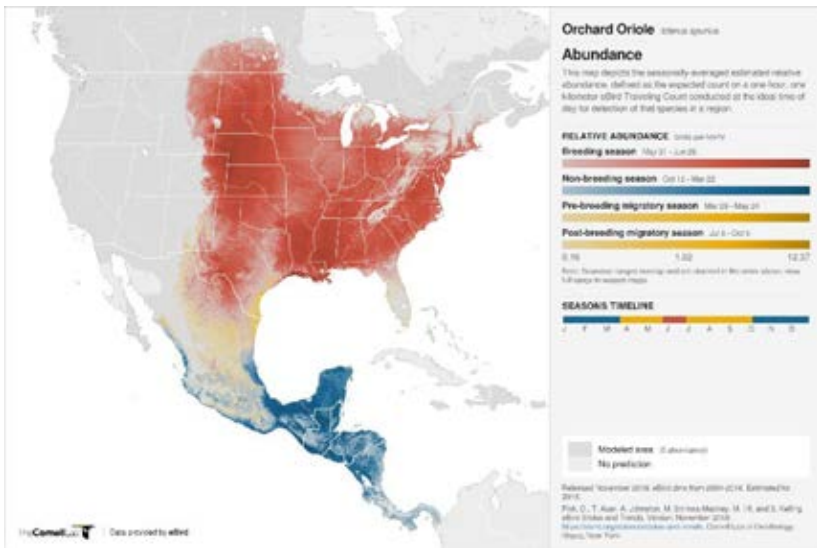
BCR 24 (Central Hardwoods): 12%



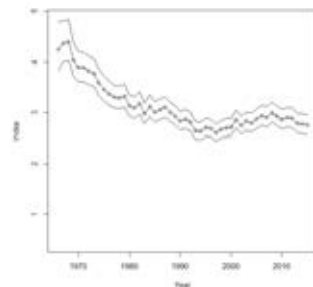
Missouri: 3%



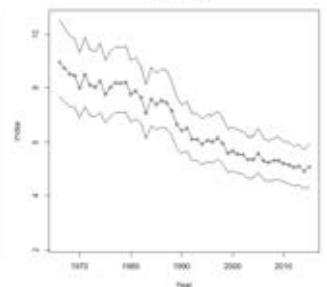
Orchard Oriole (*Icterus spurius*)



United States



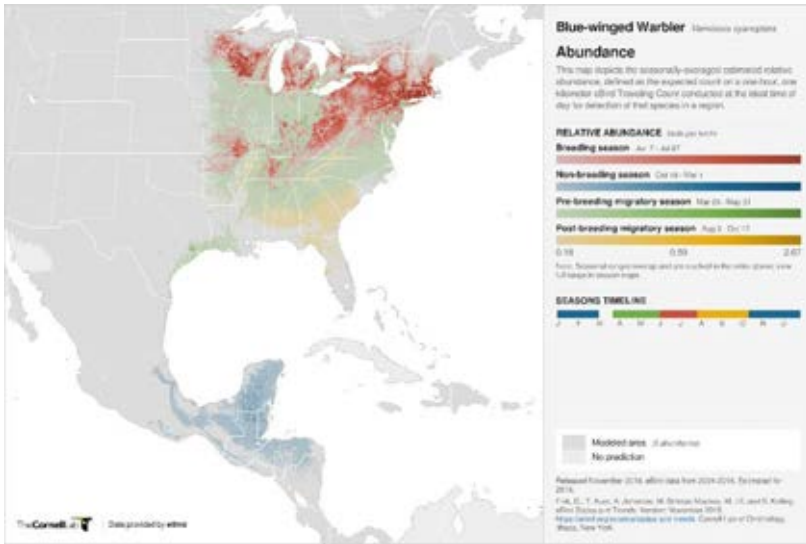
BCR 24 (Central Hardwoods): 9%



Missouri: 3%



Blue-winged Warbler (*Vermivora cyanoptera*)



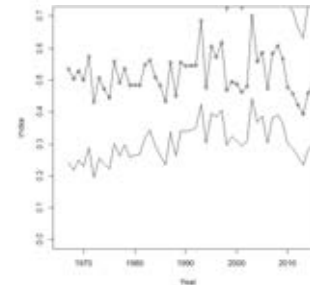
United States



BCR 24 (Central Hardwoods): 14%



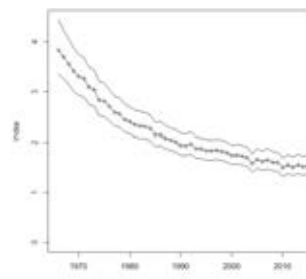
Missouri: 4%



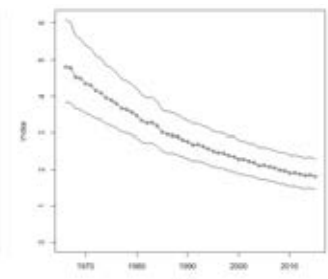
Prairie Warbler (*Setophaga discolor*)



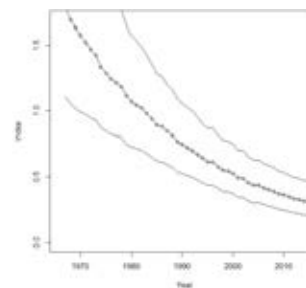
United States



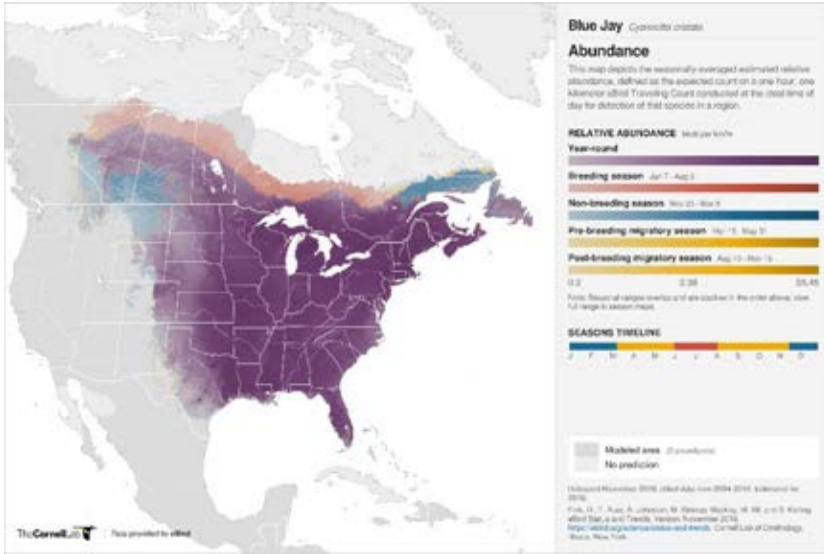
BCR 24 (Central Hardwoods): 12%



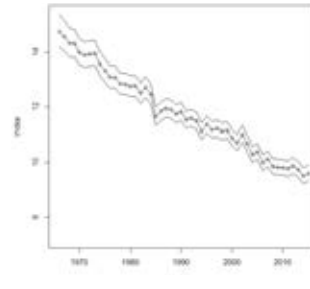
Missouri



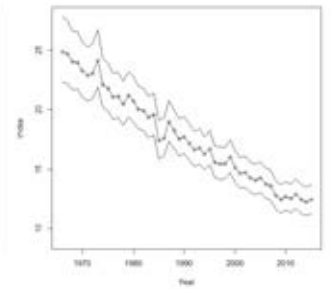
Blue Jay (*Cyanocitta cristata*)



United States



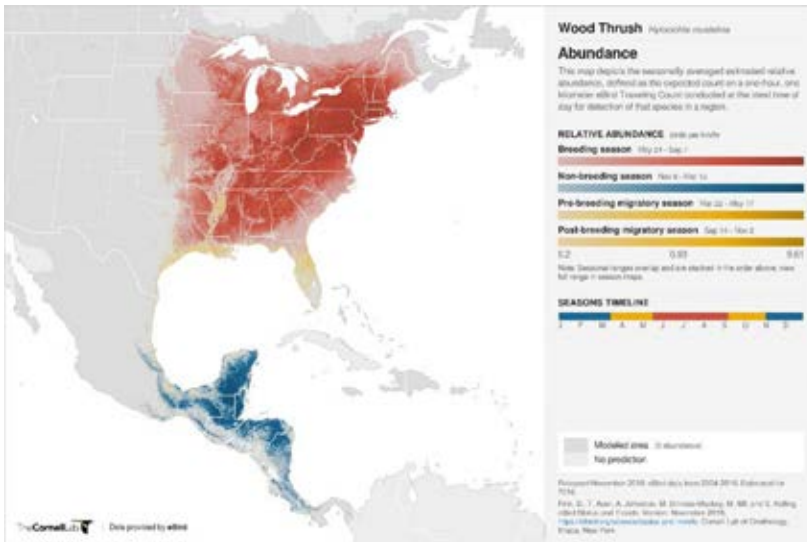
BCR 24 (Central Hardwoods): 6%



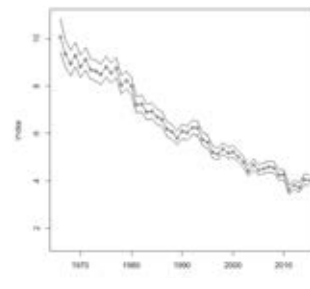
Missouri: 4%



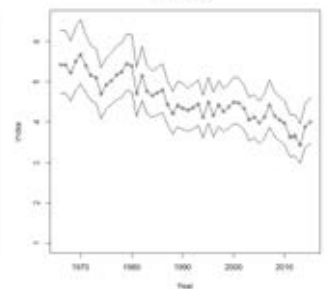
Wood Thrush (*Hylocichla mustelina*)



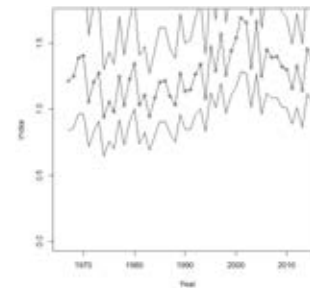
United States



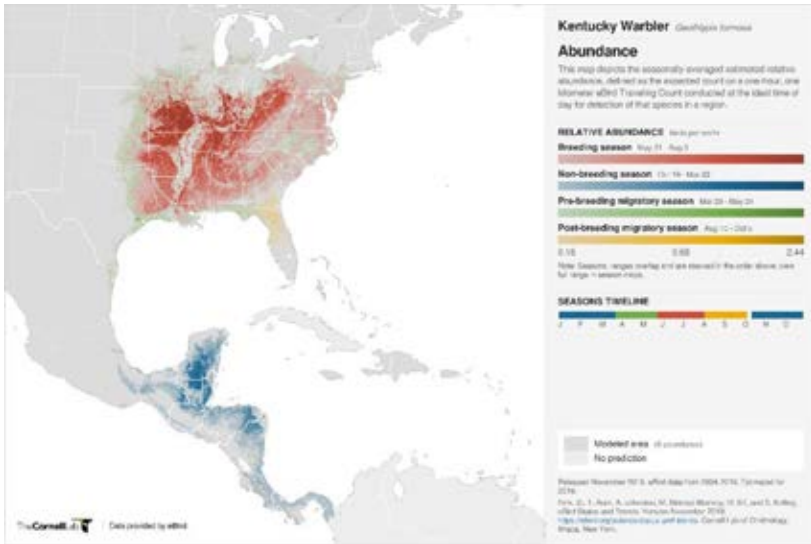
BCR 24 (Central Hardwoods): 9%



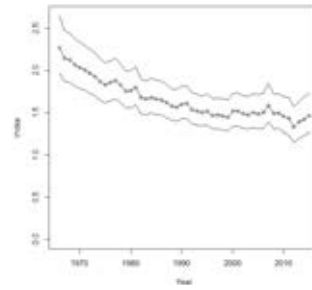
Missouri: 4%



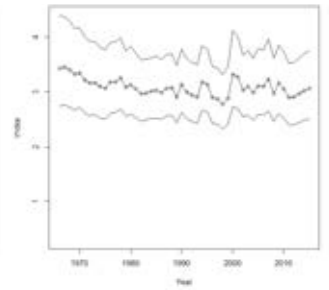
Kentucky Warbler (*Geothlypis formosa*)



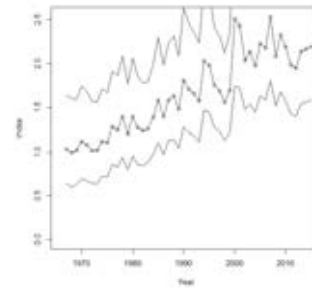
United States



BCR 24 (Central Hardwoods): 29%



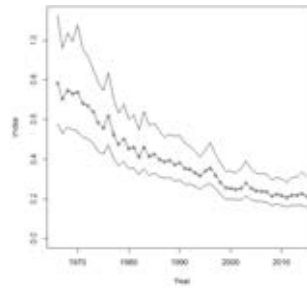
Missouri: 17%



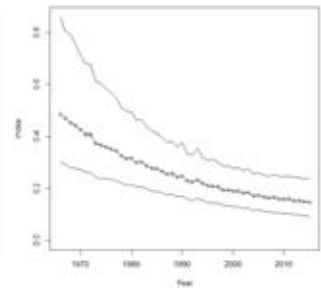
Cerulean Warbler (*Setophaga cerulea*)



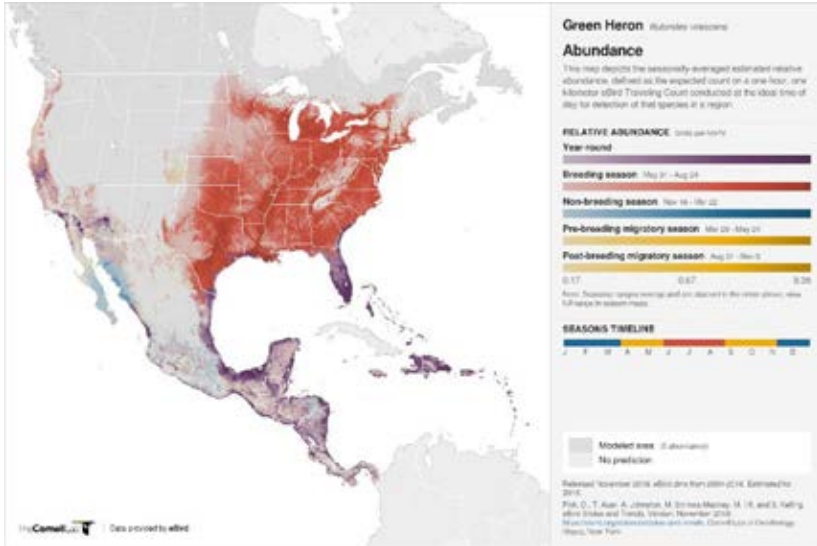
United States



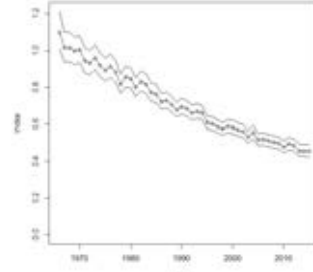
BCR 24 (Central Hardwoods): 17%



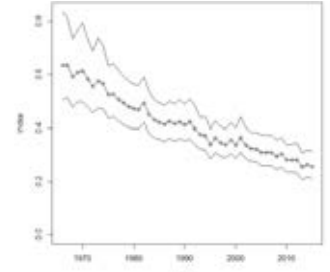
Green Heron (*Butorides virescens*)



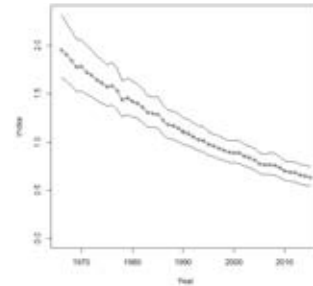
United States



BCR 22 (E Tallgrass Prairie): 5%



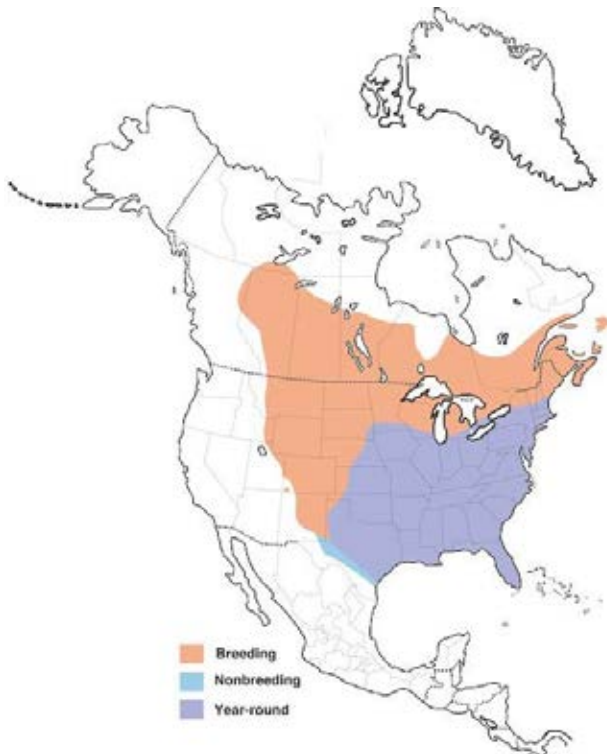
BCR 24 (Central Hardwoods): 5%



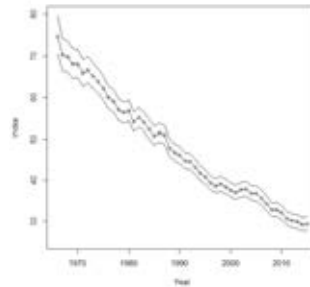
Missouri: 3%



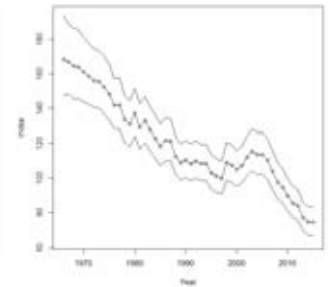
Common Grackle (*Quiscalus quiscula*)



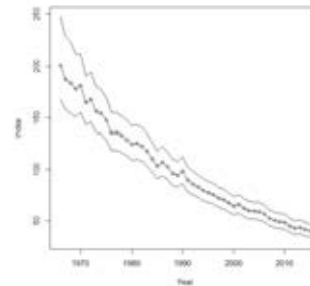
United States



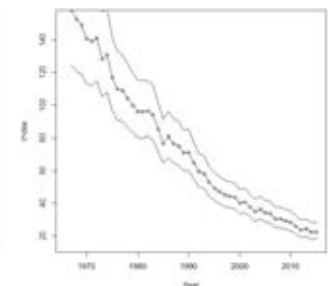
BCR 22 (E Tallgrass Prairie): 20%



BCR 24 (Central Hardwoods): 6%



Missouri



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