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APPENDICES

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NBCI 2.0. . .the unified strategy to restore wild quail

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The Problem For Bobwhites

Northern bobwhites (*Colinus virginianus*) were once common, even abundant, on farms, rangelands, and forests across more than 30 states. Bobwhites have declined an average of 3% per year since 1966, and have virtually disappeared from some northern states. The last strongholds are portions of the western states with significant native habitats and quail-friendly land-use patterns, or other locales where bobwhite management is a priority on agricultural or plantation lands. Over most of the species' range, the decline of wild bobwhite populations has relegated quail hunting to memories. The next few decades may be our last opportunity to halt the declines, stem widespread localized extinctions of bobwhites, and restore populations sufficient to create new memories for many.

Not Just Bobwhites

An entire suite of species that live alongside bobwhites in native grasslands and shrublands also is in long-term decline, for example grasshopper, Bachman's, and Henslow's sparrows (Fig. 1). Across the bobwhite's vast range and among the various types of grassland habitats, its bird neighbors change, but not the shared theme of widespread, long-term population declines. Declining species that share habitats bobwhites use include lesser and greater prairie-chickens, loggerhead shrike, yellow-breasted chat, field sparrow, vesper sparrow, Bell's vireo, dickcissel, prairie warbler, red-cockaded woodpecker, brown-headed nuthatch, eastern meadowlark, eastern kingbird, Bewick's wren, golden-winged warbler, blue-winged warbler, painted bunting, orchard oriole, and eastern towhee, among many other species of concern.

Why These Declines?

The causes of these declines are the same: long-term habitat loss or degradation at the national scale. Bobwhites thrive in habitats with a diversity of primarily native grasses, forbs, legumes, and brush, along with some bare ground. In arid environments such as western Texas, Oklahoma, and Kansas, mature grassland/shrubland plant communities provide optimal conditions for bobwhites. But ideal bobwhite habitat conditions are classified as 'early successional' in the lifespan of a plant community in 'rich' environments, i.e., those with high rainfall, fertile soils, and long growing seasons.

For most of the 19th and 20th centuries, typical land uses created habitats that favored bobwhites. But with the advent of modern agricultural and silvicultural practices following World War II, along with the elimination of the cultural use of fire to manage forests and fields, the diverse herbaceous ground cover these species need has mostly vanished. Grazing lands throughout the East were converted from native, clump-grass forages to aggressive, sod-forming, exotic forages on pastures that provided poor quail habitat. Rowcrop agriculture intensified to bigger fields with fewer fencerows and weeds … and poorer habitat. Modern silviculture practices transformed millions of hectares (acres) of southern forests into dense pine plantations, and nearly eradicated fire. Societal sentiments against logging impeded forest management on millions of other hectares (acres) which, when combined with the elimination of fire, erased quail habitats. The cumulative result across dozens of states is that changing land management practices have degraded habitats for grassland birds across three of the largest land-use types.

Consider, for example, the near complete functional demise of the pine-barrens of the mid-Atlantic, the vast longleaf pine savannah ecosystem of the deep Southeast, the oak savannahs of the Midsouth, the shortleaf pine-bluestem ecosystem of the Midwest, and the tall- and mixed-grass prairies across the bobwhite's entire range. These disparate ecosystems that once provided vast, high-quality habitat that supported abundant bobwhite populations share a functional dependence on frequent fire and/or animal grazing, which set back vegetative succession to sustain a ground cover of vegetation with the appropriate

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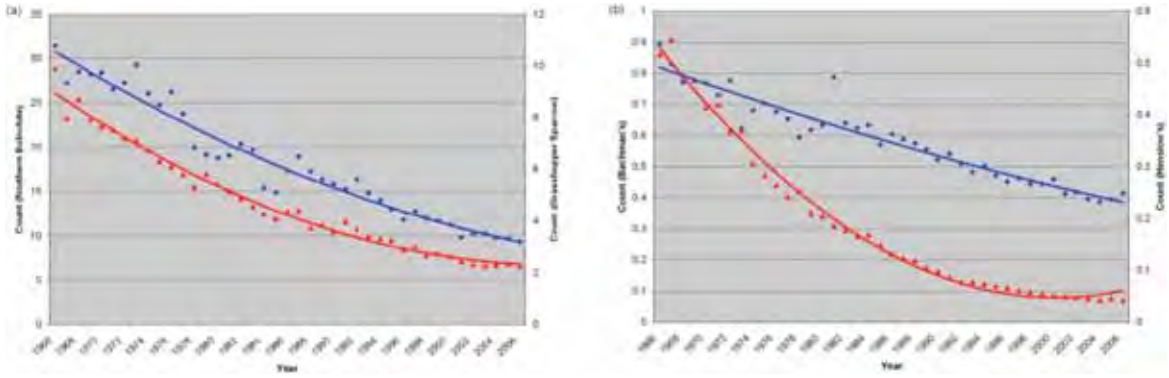

Fig. 1. (a) Population trends (mean annual BBS counts) for the northern bobwhite (blue) and grasshopper sparrow (red), and (b) population trends (mean annual BBS counts) for Bachman's sparrow (red) and Henslow's sparrow (blue) indicating a common habitat cause for declines.

structure and composition for bobwhites. To halt the decline of bobwhites and return recreational opportunities to 1980-era levels, as called for in the original 2002 Northern Bobwhite Conservation Initiative (NBCI 2002), landscape-scale habitat restoration is needed on farms, forests, and other private and public lands along with the return of natural disturbance cycles, such as prescribed fire, at the appropriate scale and frequency.

Reasons for Hope

While declines have been precipitous and sustained, there are reasons to be optimistic. First, bobwhite populations still exist across significant portions of their range in sufficient numbers so they can respond, in time, to sound and targeted habitat initiatives. Second, where bobwhites are locally extinct but habitat is sufficiently restored, translocation of wild bobwhites has become a viable option for recovering populations locally. Third, habitats managed to be suitable for bobwhites overlap with myriad species in decline so that increasing bobwhite habitat engenders wide support and collaboration across the conservation community. Native grassland habitats managed for other popular species such as grassland songbirds, cottontail rabbits, ring-necked pheasants, elk, and wild turkey can also benefit bobwhites.

The First Step: the 2002 Northern Bobwhite Conservation Initiative

Sometimes a crisis is necessary for a change. Even as conservationists were proudly heralding myriad other wildlife restoration success stories throughout the mid- and late-20th century, a half-century of land-use changes had quietly reduced bobwhite populations to non-huntable levels in many parts of their range. By the end of the 20th century, this 'unfinished business' of wildlife conservation resulted in the fading of an American culture and a treasured rural heritage. In 1998, following a half century of failed *laissez faire* quail management, the directors of the 16 southeastern state fish and wildlife agencies took a definitive step – to go it together, instead of alone – by issuing a charge to develop a regional recovery strategy.

Bobwhite conservation found hope in March 2002. That month, the Southeast Quail Study Group (SEQSG), on behalf of the Southeastern Association of Fish and Wildlife Agencies (SEAFWA) published the 'Northern Bobwhite Conservation Initiative' (NBCI 2002). Nearly 60 biologists had collaborated to describe the problems of bobwhites, prescribe habitat management solutions, and lay out a blueprint of restored acreages needed to meet desired population recovery goals for bobwhite restoration. The overall vision was to restore bobwhite populations to at least 1980-era levels.

The 9 years since completion of NBCI 2002 have fundamentally changed quail conservation. NBCI 2002 garnered regional and national attention, causing bobwhite restoration to become a national priority and a common topic of the national conservation dialogue. Results included close collaboration with Partners in Flight songbird conservationists; Congressional support of bobwhites in the 2002 Farm Bill; creation of the Conservation Reserve Program's (CRP) CP33 'Habitat Buffers for Upland Birds' practice, the CP36 Longleaf Pine Initiative, and the CP38 'State Acres for Wildlife Enhancement' practice by the USDA Farm Service Agency; the 9-state, $1.5 million bobwhite restoration research project by the USDA Natural Resource Conservation Service; and an increase in state quail initiatives from 2 to 18.

On the ground, several state wildlife agencies began linking their quail restoration plans to NBCI 2002, resulting in notable examples of NBCI 2002 fulfilled, such as in Scott and Cass counties, Missouri. Success in these counties was measured by an increase in habitat, anecdotes and data about population response by quail, and ultimately, a marked increase in quality quail hunting that made the Sikeston, Missouri Chamber of Commerce news.

Positive results created additional opportunities, demands, and expectations for collective action that in turn required state-centered infrastructure and capacity that did not exist. The states and the bobwhite community forged ahead with another round of 'firsts,' such as selecting the University of Tennessee as the national operational center for NBCI. Meanwhile, all components of the Initiative were expanded range-wide in scope. The SEQSG now is the National Bobwhite Technical Com-

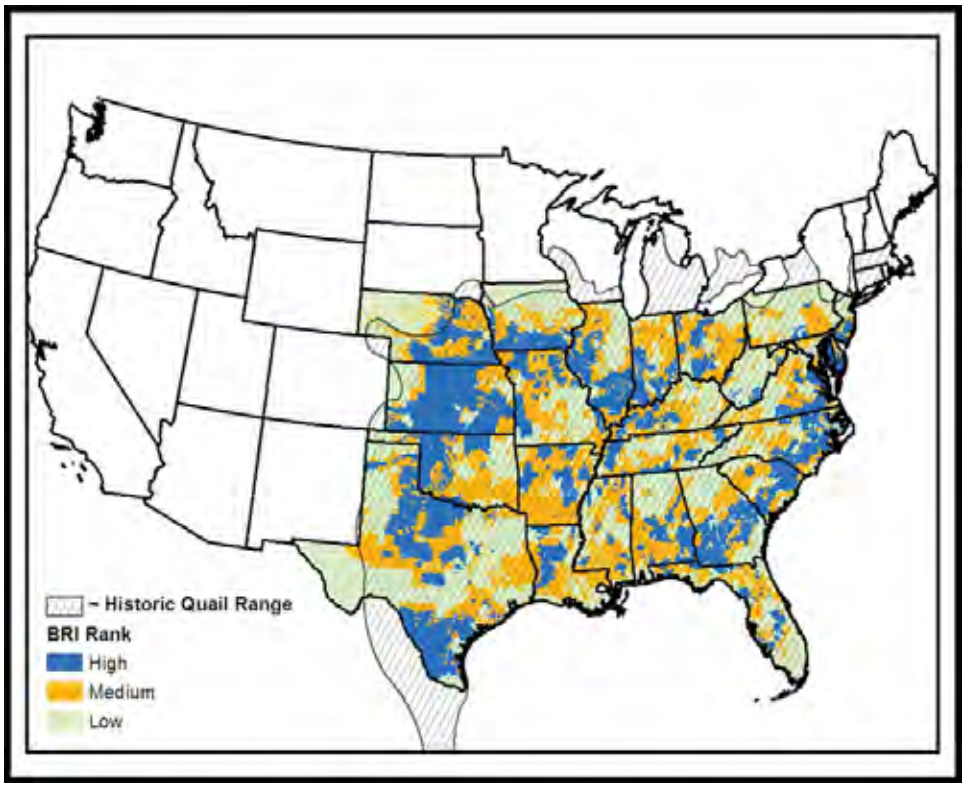

Fig. 2. The National Bobwhite Conservation Initiative's BRI indicating the potential for habitat restoration benefiting bobwhites and grassland songbirds. Across 17 Bird Conservation Regions (BCRs), 29.1% of the landscape was identified as having high potential for bobwhite management.

mittee (NBTC), expanded from the 16 SEAFWA states to include 25 states across the bobwhite's core range, and the jurisdictions of the Midwest, Northeastern, and Western Associations of Fish and Wildlife Agencies. The original SEAFWA Directors' NBCI 2002 Committee has grown into the national NBCI Management Board, and the regional 2002 'Northern Bobwhite Conservation Initiative' now is the 'National Bobwhite Conservation Initiative'.

At the same time, enhanced collaboration is occurring among bobwhite conservationists and other conservation groups, including Southeastern Partners in Flight, Joint Ventures, the Midwest Pheasant Working Group, the National Wild Turkey Federation, Landscape Conservation Cooperatives, and the Western Quail Working Group.

The Next Step: NBCI 2.0

From the beginning, all involved in producing NBCI 2002 knew that it would need continual refinement and updating to stay relevant and remain a force for progress. Revising NBCI 2002 was a massive undertaking, involving 5 years of planning efforts across 25 states, dozens of agencies, more than 600 professionals, and incorporating the latest geospatial and data management technologies. The purpose of this summary report is to introduce conservation leaders, the public, and policy decision-makers to the scope, utility, and power of the new NBCI 2.0. The full report of the NBCI 2.0 is available on-line (http://www.bringbackbobwhites.org).

NBCI 2.0 is primarily an information framework (the Biologist Ranking Information or 'BRI') and a mechanism (the Conservation Planning Tool or 'CPT') for states to use to develop or refine quail habitat management and restoration plans, thus saving time and money. The BRI is state biologists' collective expert judgment of exactly where and how much they should focus resources for bobwhite conservation. The CPT is a massive data base of the latest geospatial and interactive data management technologies and planning tools. Those are 2 of the 3 major features not found in the original NBCI. The third major feature is Adaptive Resource Management (ARM), the use of estimated current and potential bobwhite population densities in a structured decision making framework to provide feedback on the effectiveness of restoration efforts. Together these improvements move the state-based NBCI 2.0 to the forefront of wildlife conservation strategies.

The original NBCI 2002 changed bobwhite conservation. This revision, NBCI 2.0, will improve our efforts. We largely know what to do; we largely know how to do it; NBCI 2.0 shows us, better than ever, *where* to do it, and gives us the tools to test our effectiveness.

The Process

The NBCI 2.0 process uses a novel combination of computer-based geospatial technology and human professional judgment to produce a 25-state geographic model of quail recovery priorities, opportunities and constraints

(Fig. 2). More than 600 professional contributors to NBCI 2.0 (10 times more experts than contributed to NBCI 2002) participated in 2-dozen state workshops. Most participants were state biologists with local field experience, ensuring that NBCI 2.0, through the BRI, is relevant to the on-the-ground habitat restoration challenges of the 21st century. Field biologists provided informed expertise unattainable by satellite imagery or geospatial data layers, such as current distributions of quail, and the economic or sociological potential for habitat management by the people who control the land, whether private or public.

The CPT also relies heavily on analysis of standard geospatial habitat data, including distribution of vegetation types, soils, land ownerships, and Farm Bill program acreage, to prioritize areas for habitat recovery. This component of NBCI 2.0 allows bobwhite data to be integrated with other complementary conservation efforts.

Biologists at 23 structured workshops evaluated over 600,000,000 acres of landscape across the core bobwhite range. The landscape was divided into 2,590-ha (6,400-ac) cells, which biologists evaluated against a list of key quail restoration criteria, including landscape features, habitat types, management opportunities, and management constraints. The High-Medium-Low rankings illuminate regionally-specific areas where opportunities to recover bobwhites have greatest potential and the least constraints.

The Plan

NBCI 2.0 is presented in 2 parts—a written report, and a GIS-based BRI and the CPT. The written report contains 5 sections.

(1). Introduction and background information.
(2). An overview of bobwhite ecology and management.
(3). A description of the BRI and CPT with the major results – findings are presented primarily by bird conservation regions (BCRs), consistent with other bird conservation plans. State and county-level data are available on the web and the GIS web mapping applications. Habitat rankings and management prescriptions are available for customized reports, data analysis or planning, using CPT interactive tools.
(4). Regional assessments of primary bobwhite conservation needs and challenges – to discuss how policy and management must adapt to local and regional conditions, opportunities and constraints for successful conservation.
(5). Monitoring and evaluation – provide recommendations on how to improve monitoring and make it integral with NBCI 2.0, to evaluate the plan's effectiveness, and continually improve it.

Spatial Estimates of Habitat Management Opportunities

In the BRI process, biologists provided recommendations as to what habitat management practices are needed by habitat type. Opportunities to manage for bobwhites and other early-successional species varied across and within regions. As such, what works in one region may have little utility in another region. For example, practices such as CP33 field borders were very important in certain regions of the country, but not in others. However, prescribed fire is the most often cited need for habitat management across the bobwhite range. With the CPT, biologists can rapidly prepare detailed reports on regionally-specific management information, and provide guidance on habitat restoration policy. Spatially-explicit habitat management recommendations also can be used to evaluate benefits to other wildlife species.

Spatial Estimates of Constraints

For every management need, certain factors impede its effective application to the landscape. For instance, land ownership patterns may be a major constraint to application of habitat management across large landscapes. Therefore, in addition to ranking areas and recommending habitat management needs by habitat type, biologists provided spatial prescriptions of constraints. Recognition of these constraints is necessary to successfully design habitat restoration plans and policies, by guiding administrators to where needed management should be applied while avoiding regions where likelihood of success is lower.

Spatially-specific Current and Managed Bobwhite Densities

The ultimate goal of NBCI is to use habitat management to increase bobwhite population density to huntable levels across much of its former range. To do this, state quail biologists created a spatial layer of current estimated 'unmanaged' and future potential, 'managed,' densities of bobwhites, if given proper management implementation. Using these estimated data, NBCI 2.0 predicts we could add 2.36 million bobwhite coveys (12 birds/covey, average) to landscapes rated with High BRI potential and 2.31 million coveys in areas rated with Medium BRI potential *if* ALL the prescribed management occurred (Table 1).

Table 1 is intended to provide states a big picture view of the potential increase in quail abundance in their state if biologists' prescriptions are followed and implemented. It is more likely, however, that habitat management must begin with focused effort on smaller portions of the landscape as part of integrating NBCI 2.0 habitat and quail population goals into state focal areas. In 2010, NBCI states reported a vast range of sizes of bobwhite focal areas: from 121 to 942,837 ha (300-2,329,800 ac). In general, larger focal areas have greater potential to sustain quail hunting over the long term. Smaller focal areas have tremendous value in demonstrating what is possible, particularly in landscapes where suitable habitat is rare. A priority for NBCI 2.0 and beyond is identifying relationships among different levels of habitat restoration and subsequent improvements in bobwhite populations, quail hunting activity, rural economies, and quality of life.

Table 1 provides state-by-state BRI summarized by habitat type for areas ranked High or Medium, and corresponding number of coveys predicted to be added to the landscape. Coveys added are considered potentials

Table 1. State summary of Biologist Ranking Information (BRI) summarized by habitat type (Acres × 1,000) for areas ranked High and Moderate with associated number of coveys predicted to be added (Coveys Added) to current populations levels. Coveys added are considered potentials without a time scale, where potential is dependent on realizing the habitat management goals as stipulated in the NBCI. Coveys added depict crude estimates of population targets for states and can viewed properly as hypotheses to be tested (i.e., models) in an adaptive framework.

State	Rank	Row Crop	Range	Hardwood	Mixed Forest	Pasture	Upland Pine	Coveys Added
Alabama	High	250	1,053	1,770	366	856	2,281	63,643
	Medium	175	1,632	3,026	841	1,240	3,903	98,857
Arkansas	High	1,658	151	2,590	201	1,587	784	118,405
	Medium	2,827	966	5,159	422	2,667	5,072	222,692
Delaware	High	115	0.8	115	4.8	13	17	570
	Medium	236	1.6	154	8.2	22	12	1,039
Florida	High	320	633	266	59	687	1,471	59,312
	Medium	672	1,535	855	80	1,825	3,186	80,206
Georgia	High	1,806	1,919	1,534	255	559	3,429	118,877
	Medium	594	1,241	2,122	130	180	3,154	52,284
Illinois	High	6,196	73	3,358	2.3	2,332	6.2	22,416
	Medium	6,872	25	1,741	1.0	1,286	26	25,895
Indiana	High	2,624	74	2,227	0.8	1,026	29	64,368
	Medium	5,614	150	2,207	2.7	1,141	21	70,604
Iowa	High	2,957	230	1,222	3.9	2,944	1.6	103,494
	Medium	4,688	295	608	0.8	1,243	0.5	49,204
Kansas	High	13,176	13,354	966	25	2,074	3.3	609,170
	Medium	3,538	2,653	575	10	1,794	3.6	183,613
Kentucky	High	566	94	2,614	2.4	716	66	30,178
	Medium	1,527	298	5,115	39	1,286	103	83,633
Louisiana	High	117	980	49	104	378	2,524	30,870
	Medium	1,439	1,208	112	119	1,890	2,310	69,947
Maryland	High	586	5.6	455	18	77	130	26,545
	Medium	401	10.0	766	4.7	258	41	9,424
Mississippi	High	515	424	389	218	874	813	76,280
	Medium	795	2,019	2,130	996	2,402	2,806	211,832

Table 1. Continued.

State	Rank	Row Crop	Range	Hardwood	Mixed Forest	Pasture	Upland Pine	Coveys Added
Missouri	High	2,109	13.8	1,841	1.4	4,778	5.2	76,861
	Medium	3,789	66.4	5,662	27	6,951	133	296,591
Nebraska	High	5,662	6,114	458	4.8	152	5.9	67,099
	Medium	6,908	6,434	211	16	68	28	97,412
NewJersey	High	141	15.6	259	5.3	10	310	979
	Medium	91	20.2	150	2.0	4	38	458
NorthCarolina	High	1,981	559	1,194	169	444	1,970	73,057
	Medium	1,202	377	2,818	104	802	1,342	47,018
Ohio	High	2,800	57	1,266	3.8	923	13	2,023
	Medium	3,770	118	5,180	1.4	2,354	70	9,501
Oklahoma	High	1,975	8,759	775	63	132	237	252,262
	Medium	2,744	7,186	4,507	147	1,807	1,158	176,734
Pennsylvania	High	498	14	274	16	93	9.1	1,330
	Medium	1,592	83	3,259	98	350	116	5,433
SouthCarolina	High	1,101	568	439	358	280	1,725	34,801
	Medium	635	329	1,215	183	303	2,020	26,573
Tennessee	High	1,127	278	2,017	60	560	140	45,344
	Medium	636	712	5,492	213	943	280	120,192
Texas	High	2,457	33,566	1,129	16	2,924	996	464,552
	Medium	3,271	24,347	2,016	279	5,521	4,129	334,491
Virginia	High	1,184	190	2,472	33	99	1,209	18,667
	Medium	1,927	221	3,921	55	295	785	34,693
WestVirginia	High	211	38	1,067	1.5	99	8.8	3,066
	Medium	138	9.7	1,438	4.4	115	16	3,536
TOTAL	High	52,134	69,462	30,747	1,992	24,619	18,184	2,364,169
	Medium	56,081	51,935	60,436	3,783	36,746	30,754	2,311,862

without a time scale, where potential is dependent on fulfilling habitat management as prescribed in NBCI. Taking Alabama as an example, for land rated as having High potential for restoration (High BRI), acreage breakdown by habitat type was 101,171 ha (250,000 ac) in row crop landscapes, 426,134 ha (1,053,000 ac) in rangeland, 716,294 ha (1,770,000 ac) in hardwood forests, 148,115 ha (366,000 ac) in mixed forest, 346,411 ha (856,000 ac) in pasture land, and 923,088 ha (2,281,000 ac) in upland pine landscapes. If all these acres were restored and managed per NBCI prescriptions, 63,643 coveys would be added to populations occupying these High BRI areas. If all of Alabama's lands rated as having Medium BRI potential were managed per NBCI prescriptions, 98,857 coveys would be added to the landscape. For Alabama, and many other states (Arkansas and Delaware, for example), coveys added is *greater* in lands with *lower* potential simply because there are many more acres rated as Medium than rated High. Biologists expect lower quail density on Medium BRI lands relative to High BRI lands, and it is only when there are many more acres of Medium land that those populations catch up to the greater potential of the High BRI lands. High BRI lands usually will be a higher priority for restoration because the same amount of effort and money are expected to produce more quail.

Web-based Planning

NBCI 2.0 is spatially-explicit, dynamic, updatable, extensible, and scalable to effectively impact conservation of bobwhites, grassland birds, and grassland and early-succession ecosystems. The plan is web-based and uses a GIS-data base platform so it can be easily shared with other conservation partners to permit layering of conservation efforts. User-friendly graphic user interface (GUI) tools are being created to help users access data for the areas they need, and the data base infrastructure enables states to work with NBTC (and NBCI) to add additional tools (e.g., data entry and archival) to meet other needs and conservation objectives. The updatable framework fosters long-term grassland ecosystem restoration planning that remains adaptable, timely, and useful to multiple conservation partners. Such collaboration will save time and money for state agencies.

TOOL-BOX SECTION

NBCI 2.0 Conservation Planning Tool

A primary goal of NBCI 2.0 was to produce a strategic Conservation Planning Tool (CPT) that was spatially and temporally explicit, while pragmatic, flexible and dynamic, extensible, and usable by various organizations. The strength of the CPT is the biologist ranking information (BRI) data. The CPT was designed with the biologist in mind for adding data and data extraction, but not necessarily, at least at present, for the general layperson audience. However, the CPT can be adapted easily to incorporate components more directly benefiting non-biologists (i.e., private landowners). As such, the CPT is composed of a collection of components, each with different levels of functionality depending on users and objectives: web mapping applications (WMAs); actual data available for download including the biologist ranking information (BRI) and ancillary data (e.g., NRI data, land cover classification); and a planning toolbox for ArcGIS.

Web Mapping Applications.—The WMAs are internet-based maps used for general viewing of habitat ranking informed by the revision-generated BRI as well as viewing of habitat classifications (e.g., land cover data, NRI data), farm bill practice information (e.g., summary contract and acres-by-practice information), and other relevant geospatial data (e.g., urban areas, conservation areas). Additionally, WMAs afford biologists the ability to print maps, perform simple and predefined queries, and perform routine mapping actions (e.g., calculate area or distance, identify layer attributes). All that is needed to use the WMAs is a high-speed Internet connection and browser.

Data Availability.—Most of the data used in the revision, and which are viewable via the online web mapping applications are available for download in various formats.

Planning Toolbox.—The intent of the planning toolbox is to provide biologists or more advanced users with access to ArcGIS, a suite of tools to aid in conservation planning of bobwhites and grassland birds. The toolbox can be downloaded and integrated directly into ArcGIS. It offers the most extensive range of usability and was designed to work with data generated via NBCI 2.0.

These tools will allow you to:

- query data,
- display data,
- perform geospatial analysis,
- create maps, and
- generate reports for conservation planning, agency reports, and grant applications.

BUILDING CONSERVATION AROUND NBCI 2.0

Armed with local expert evaluation of habitat restoration potential (the BRI), conservationists can simultaneously integrate bobwhite habitat restoration potential at the local, state, regional, and national levels, and provide justification for why a boundary line was drawn between adjoining landowner properties.

Example 1 (Fig. 3): Conservationists desire to identify areas where longleaf pine (LLP) and bobwhites can be restored simultaneously and, because of limited funding, areas need to be prioritized by their relative restoration potential.

- Left panel: the entire NBCI 2.0 coverage (olive green) is shown; neon green areas are classified by state biologists (BRI ranking) as having High or Medium potential for simultaneous LLP/bobwhite restoration. Also shown in light green in map inset is historic distribution of the Longleaf Pine ecosystem.
    - Of the roughly 20 million ha (50 million ac) identified as improvable via LLP restoration, roughly one-half (26 million ac) have High

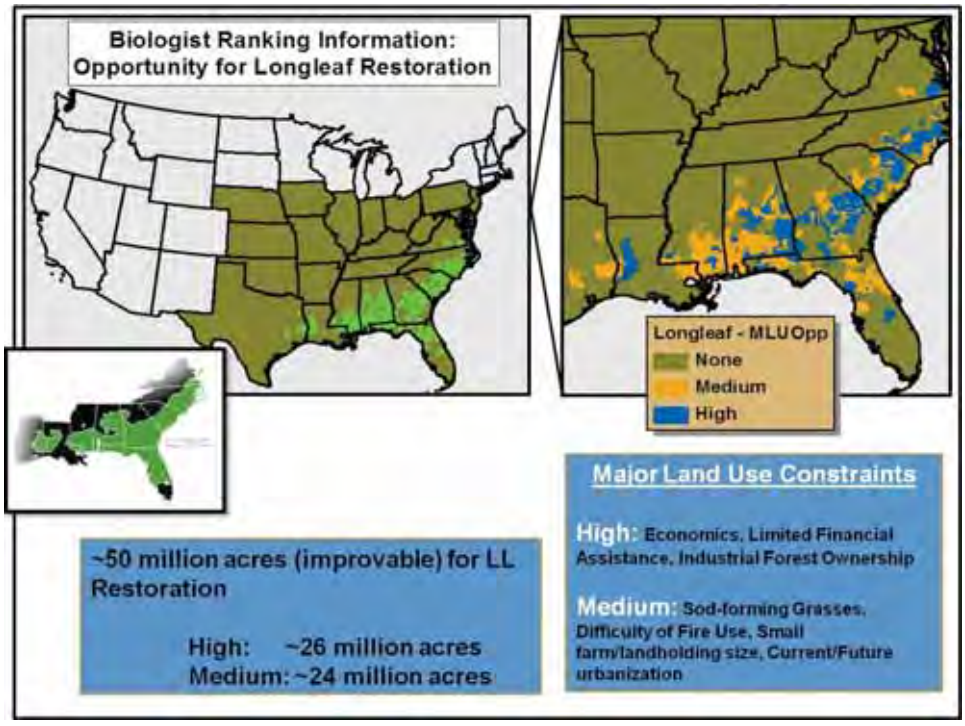

Fig. 3. The intersection of biologist ranking information (BRI) ascribing management opportunity for longleaf pine restoration, longleaf pine historic range, and potential for bobwhite response.

restoration potential and one-half (24 million ac) have Medium potential. High and Medium in BRI language are relative terms. High BRI indicates that the likelihood for successful bobwhite restoration is greater, relative to Medium-ranked areas. The details behind these disparate ratings are shown in the right panel, and described below.

To get the greatest 'bang for the buck,' conservationists must identify areas where restoration potential is relatively high. NBCI 2.0 divides the landscape by restoration potential, and backs up this designation with local, expert information on social as well as resource management opportunities and constraints.

- Right panel: Major Land Use Opportunities (MLU) are classified using the BRI ratings of High (blue), Medium (orange), and No (none) (olive green) illustrating the relative potential of the landscape for restoring bobwhites in the LLP area.
  - To get the greatest bang for the buck, conservationists must identify areas with the greatest potential for restoration, based on numerous factors, such as the condition of existing habitat and the extent to which landowners are willing, technically capable, and financially able to conduct habitat work.
  - The Major Land Use Constraints for High-BRI lands are economics and limited financial assistance (e.g., restoration is expensive and outside funds are limited) and by the presence of industrial forest owners whose primary goal is income. Relative to the constraints in Medium-BRI areas, however, local experts believe restoration is more feasible.
    - Major Land Use constraints often separate High from Medium ranked areas: the greater the constraint the greater the impediment to successful management and subsequent bobwhite response. In this case, the constraints listed in the Medium ranked areas (sod-forming grasses, difficulty of fire use, small farm/landholding size, current/future urbanization) are viewed as serious obstacles to restoration potential. For example, the potential for increased urbanization is one of the greatest sources of wildlife habitat loss.
  - Returning to the original question, conservationists in this case would recommend the High (blue) areas be funded first because they best meet management objectives for restoring longleaf pine communities and bobwhite populations.

Example 2 (Fig. 4): Conservation today attempts to understand how proposed management affects all species of plants and animals, and the environment in general. This desire translates to myriad geospatial data bases for birds, endangered species, watersheds, and urbanization. NBCI 2.0 can be integrated with any spatial data base. The detailed BRI analysis can be scaled down or up to inform large-scale conservation planning initiatives and management/planning units, such as landscape conservation cooperatives and joint ventures.

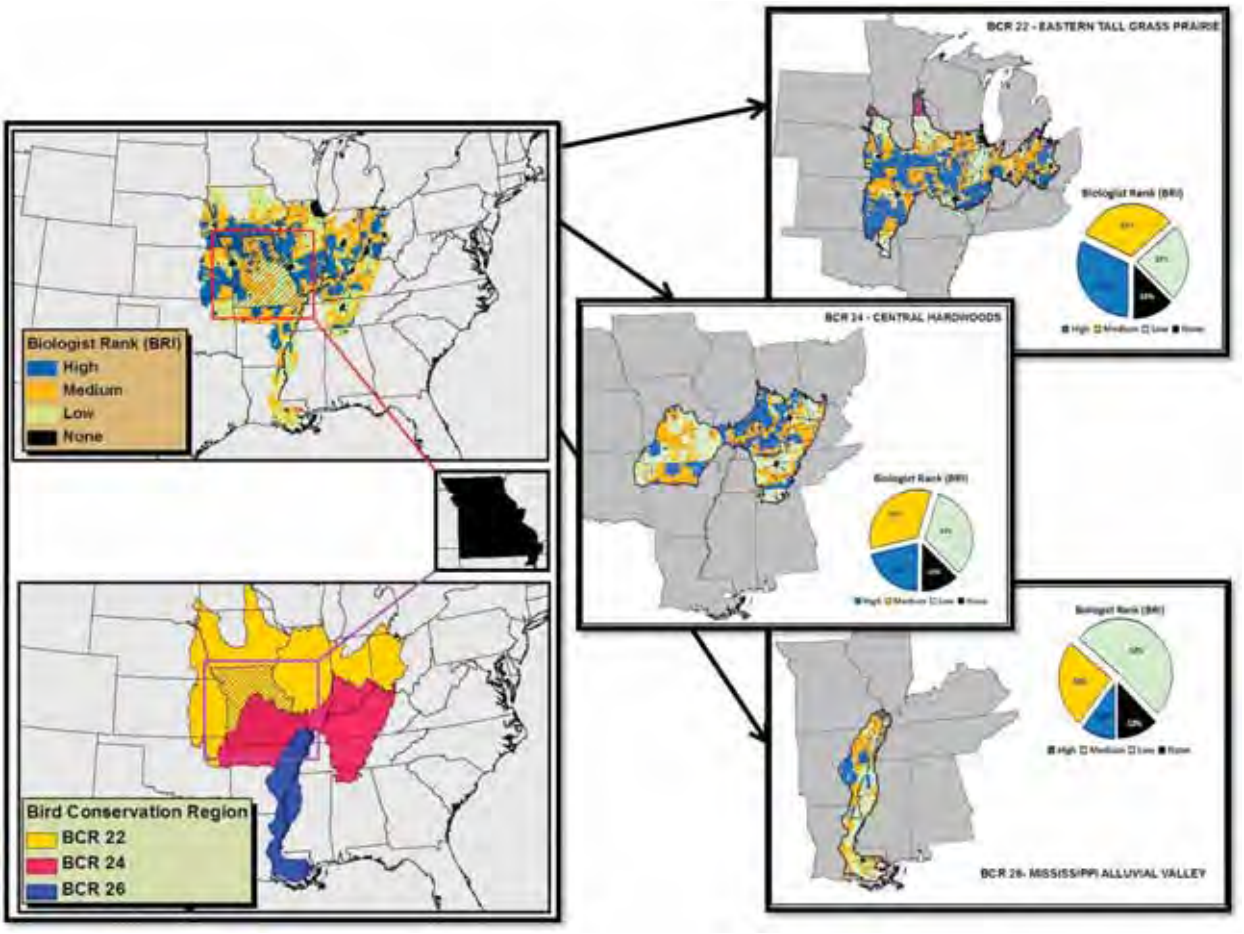

Fig. 4. Representation of the BRI summarized at the Bird Conservation (BCR) level. The conservation planning tool can be easily and seamlessly integrated into multiple conservation planning efforts or overlaid with other geospatial layers to identify priority conservation areas and target species.

Most states are covered by multiple bird conservation regions, and the CPT readily identifies common conservation (e.g., BCRs, Midwest Association of Fish and Wildlife Agencies) and political boundaries (state and county). The CPT (Fig. 5) uses data for Missouri, overlaying state biologist ranking information (BRI) classifications across the state, BCR boundaries, and BRI data for each of the BCRs.

- Upper left panel: Missouri's BRI classifications. From highest bobwhite restoration potential (High BRI) to Low BRI, and None. The None classifications are typically urban areas.
- Lower left panel: Missouri is covered by 3 BCRs.
- Right 3 panels: Considering each BCR separately, these maps show the potential for bobwhite habitat restoration. Comparing among Missouri's 3 BCRs, it is clear that Missouri biologists see the greatest potential in the Eastern Tallgrass Prairie with 32% of the landscape classified as having High potential, less potential in the Central Hardwoods with 23% of the landscape as having High potential, and relatively low potential in the Mississippi Alluvial Valley with 10% High potential.

Bobwhite management provides just one perspective on conservation, with a multitude of other factors affecting conservation priorities. For example, songbird, elk, and wild turkey brood-rearing habitat management are priorities in the Central Hardwood BCR in Missouri, translating to a value-added situation when bobwhite management is added. The NBCI conservation planning tool allows for layering of conservation priorities, improving the chances for bobwhites to be considered in decisions about management of landscapes.

Example 3 (Fig. 5). Each state is charged with crafting conservation based on a multitude of programs – such as Joint Ventures and Landscape Conservation Cooperatives – and a natural question arises. If we achieve the goals of plan X, what is ***our*** contribution to conservation of a particular plant or animal species, ecosystem, or quality of life, in the case of bobwhite hunting? Often people are motivated by such information, whether by pride in a place, or by having a role in some greater good. The NBCI 2.0 CPT allows for calculation of attainment of habitat and quail population goals for any geospatial division.

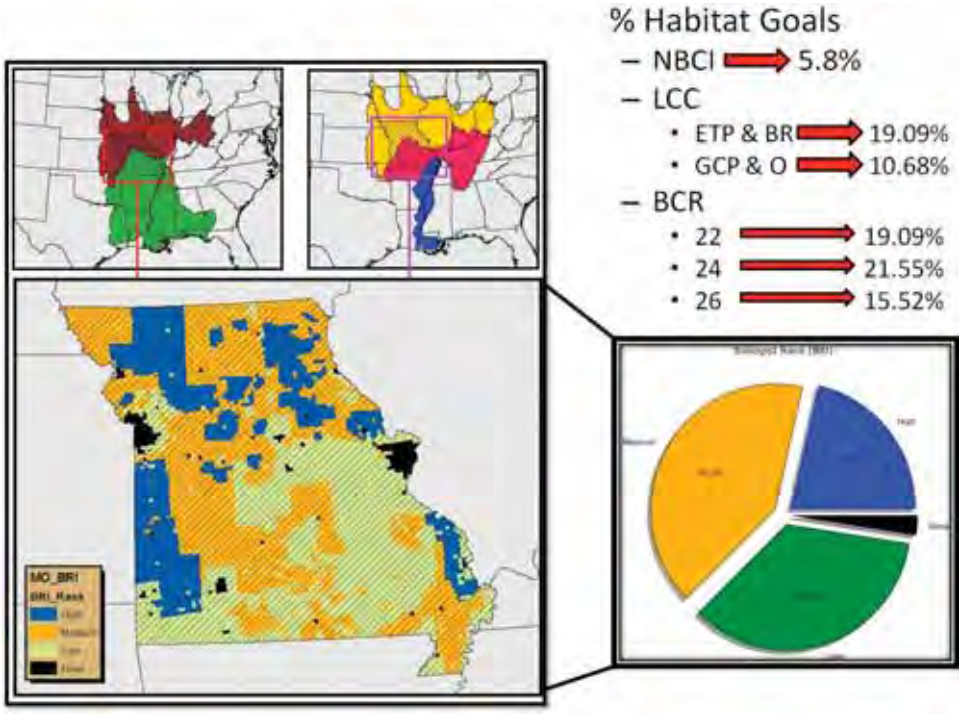

Fig. 5. The BRI summarized at the state level for Missouri and the percent of habitat goals that are reached if NBCI 2.0 management prescriptions are fully achieved by Missouri in the NBCI 2.0 range, landscape conservation cooperative (LCC, upper left map) range, and bird conservation region (BCR, upper right map) range.

According to the CPT, Missouri has the potential to meet a number of the NBCI 2.0 habitat goals.

- Pie chart: Missouri biologists' rating for their state: 21.4% of the landscape has a High potential for bobwhite restoration (BRI), 41.0% has Medium potential, 35.1% has Low potential, and 2.5% None (e.g., urban areas).
  - For the entire NBCI 2.0 range, the portion within Missouri's border contributes 5.8% toward the initiatives habitat goal.
  - For landscape conservation cooperatives (LCCs), the portion within Missouri's border contributes 19.09% toward the habitat goal of the entire area of the Eastern Tallgrass Prairie and Big Rivers LCC (ETP & BR) and 10.68% toward the habitat goal of the entire area of the Gulf Coastal Plains and Ozarks LCC (GCP & O).
  - For BCRs, the portion within Missouri's border contributes 19.09% toward the habitat goal of the entire area of BCR 22 (Eastern Tallgrass Prairie) (same as ETP & BR LCC because Big Rivers contribution is insignificant), 21.66% for the entire area of BCR 24 (Central Hardwoods), and 15.52% for the entire area of BCR 26 (Mississippi Alluvial Valley).

Many states want to know 'their part' in the big picture and how they stack up against other states. NBCI 2.0 has a tool for computing state contributions to habitat and quail population restoration, whether for a county, state, or Bird Conservation Region.

MONITORING AND ADAPTIVE MANAGEMENT

An original goal of NBCI 2002 was to restore bobwhite populations to 1980-era densities on improvable acres, yet due to the lack of reliable bobwhite density data for 1980 an alternative approach was required. Therefore, NBCI 2.0 relies on expert knowledge to develop spatially-explicit estimates of (a) current bobwhite densities on the landscape and (b) managed (potential) target densities. Managed densities are based on the assumption that management recommendations, as highlighted in the BRI and the CPT, are applied to the landscape and have the presumed effect on quail populations. Both current (unmanaged) and managed densities provided by the CPT provide a rough estimate of the additional quail that can be produced by implementation of NBCI at multiple scales. These estimates are provided for each state delineated by habitat type and summarized by BCR in the full plan.

NBCI 2.0 sets a new standard for evaluation of restoration by calling for measurement of quail population density in an adaptive resource management (ARM) framework. This section provides guidance on approaches to measuring bobwhite density on focal areas managed for bobwhites and calls for development of a comprehensive and flexible monitoring strategy to assess plan progress, evaluate specific management actions, and augment future conservation plans and management decisions. This sets

the course for evaluation of what is working and what is not working, providing guidance for hunters, field biologists, administrators, and policy-makers.

It is important to view NBCI 2.0 bobwhite population density estimates as management hypotheses – as new density data are collected, current and target densities can be adapted and new hypotheses can be proposed and tested. Therefore, NBCI 2.0 was designed to lend itself to adaptive resource management. With experience implementing NBCI in different regions of the bobwhite range, the density estimates can be tested and improved by appropriate monitoring.

In short, habitat restoration as prescribed in NBCI 2.0 is the fundamental means to increase bobwhite abundance, while bobwhite density is the metric for evaluating the success of and subsequently improving the NBCI program, through an ARM approach.

Future Improvements

NBCI 2.0 is a significant a step forward, but the revision process has only begun. The process developed should alleviate the need for punctuated changes every 5 or 10 years. Instead, by providing a framework for continual improvements, NBCI can remain relevant indefinitely, as new opportunities for habitat creation are developed and functionality of the CPT, itself, is improved as listed below.

- Planning for climate change; improving or creating geospatial layers associated with mined lands, urban growth models, and public lands.
- Refining the CPT to meet state biologists' and other conservationists' needs.
- Incorporating areas where active bobwhite management projects are being undertaken.
- Assessing and incorporating other grasslands species' models to optimize conservation efforts.
- Developing spatially explicit data for Farm Bill practices and coalescing 'true' density estimates for predicting bobwhite population response using objective methods.

For More Information

The full report of NBCI 2.0 is available on-line (www.bringbackbobwhites.org).

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