
**WILDLIFE HABITAT POLICY RESEARCH PROGRAM
2008 RESEARCH PROGRAM**

Final Report

2.C. Time Sensitivity of Priority Habitats

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1. Abstract

In this study we identify where the pace and extent of urban and exurban development will soon be a significant threat to key wildlife habitat over five different time horizons – 2010, 2020, 2030, 2040, and 2050 – in six case study states. The priority habitat conservation areas, or focal areas, used in this analysis are those identified in the six states' State Wildlife Action Plans. In 3 of the 6 case study states (Georgia, Missouri, and Tennessee) we found that the focal areas identified in the states' Wildlife Action Plans will likely lose a high proportion (>10 percent) of area due to conversion to residential development, and this loss will occur in the next 10-30 years. In many cases, these focal areas already have been reduced substantially from their historical extent. As a result, the loss of additional amounts of habitat in these focal areas beyond 5-10 percent is considered to be significant enough to consider it “high” or “substantial” loss. Colorado, New Hampshire, and Tennessee will likely face high loss of focal areas in more localized areas. Montana, on the other hand, is not likely to suffer large loss of focal areas due to residential development in the next 10-40 years. It will be important to update this analysis as states refine their focal areas over time. This methodology is easily repeatable for other states that have developed spatial expressions of priority habitat conservation areas. The information on when and where habitat loss will likely occur in focal areas can assist state fish and wildlife agencies, conservation partners, and local decision-makers in making informed decisions about how to allocate limited financial and staff resources.

2. Introduction

Initial estimates suggested that it would cost between \$5 billion and \$8 billion a year over 30 years to secure a national system of habitat conservation areas in the United States.¹ More recent investigations suggest that this estimate may be significantly higher than originally thought, in the range of \$12 billion a year over a 30-year period.² It is estimated that federal and state spending on land conservation in the U.S. totaled approximately \$32 billion over a ten year period (1992 – 2001)³ and approximately \$3.8 billion additional dollars are directed annually to compensatory mitigation under key federal programs nationwide.⁴ The U.S. is running an annual \$5 billion conservation deficit if we hope to protect a network of conservation areas that would sustain our native species of plants, animals, and natural communities.⁵

But is 30 years a realistic timeframe for our nation to protect the habitat necessary to protect species from extinction and buffer us against the impacts of global climate change? Unlike other industrialized nations, the U.S. is expected to continue experiencing significant population growth in the coming decades. The country's population topped 300 million in late 2006 and is expected to add an additional 100 million people – reaching 400 million – by 2037. Experts suggest that approximately two million new housing units a year will be built to meet the demand of our next 100 million residents.⁶

Development due to urbanization, exurbanization, and associated infrastructure will be among the most significant threats to wildlife conservation in the coming 30-40 years. Between 1980 and 2000, the footprint of development in the United States grew at a rate of 1.60 percent a year. A 2005 study found that over the next 15 years, the rate of urban and suburban housing densities

is expected to be 2.2 percent a year, while the rate of exurban development is expected to be 14.3 percent a year.⁷

Fortunately, in 2000, Congress passed legislation – the Conservation and Reinvestment Act – that was designed to fill a long-standing gap in funding for the 90 percent of wildlife species that are neither hunted nor fished.⁸ The Act created the State Wildlife Grants Program, which provides federal funding to every state for conservation efforts that prevent wildlife from becoming endangered. In order to be eligible for the funding, the states were required to develop a statewide wildlife action plan – a proactive, comprehensive strategy for conserving wildlife before they become more rare and more costly to protect. All 50 states and 6 territories submitted final plans to the U.S. Fish and Wildlife Service on or before October 1, 2005. As required, the plans identify species in greatest need of conservation in each state and include: information on the distribution and abundance of wildlife species; descriptions of locations and relative condition of key habitats and community types essential to species conservation; descriptions of problems which may adversely affect species or their habitats; and descriptions of priority conservation actions that can conserve species and habitats. Since the funding started flowing through the program in 2001, the State Wildlife Grants Program has provided the states with \$548 million (FY2001-FY2008).⁹

In summary, as a nation we now have a clearer picture of the states' self-identified conservation priorities, as well as an estimate of what it would cost to conserve a national system of habitat conservation areas and the conservation deficit we face if we hope to protect a comprehensive network of protected areas to sustain our biological resources.

3. Purpose

The overall goal of this study was to provide six pilot study states with a clearer understanding of the amount of time they have to achieve the conservation of priority habitat conservation areas outlined in their State Wildlife Action Plans. Armed with information about the likely time to conversion of their focal areas, state fish and wildlife agencies, conservation partners, and local decision-makers will be in a more informed position to determine how to allocate their limited financial and staff resources. A minor goal was to provide general recommendations on how other states could conduct a similar analysis.

4. Summary of Results

In general, we found that in 3 of 6 case study states, the focal areas identified in the states' Wildlife Action Plans will likely lose a high (>10 percent) proportion of area due to conversion to residential development and that this loss will occur in the next 10-30 years. Because, in most cases, these focal areas have already been reduced substantially from their historical extent, loss of additional habitat beyond 5-10 percent is considered to be very significant.

We found that, in many cases, much of the area represented in the states' focal areas had already been developed by 2000. This was particularly true in specific focal areas of Colorado (as high as 38.7 percent), Georgia (as high as 9.7 percent), Missouri (as high as 9.0 percent), and New Hampshire (as high as 16-18 percent). In Montana and Tennessee, on the other hand, the states'

had lost 0.1-1.6 percent and 4.13 percent, respectively, of their focal areas by 2000. This led us to conclude that in undertaking their analysis, these six case study states likely did not incorporate spatially explicit data on threats from development into their plans.

In Colorado, between 2010 and 2050, about half of the focal areas identified in the state's Wildlife Action Plan will likely experience over 10 percent loss of habitat. Particularly sensitive to development are the Metropolitan Front Range, Mesa County Agricultural Lands, South Park, Upper Arkansas Valley, Headwaters of the San Juan & Navajo Rivers, San Juan Skyway, Rio Grand River Corridor, Delta County Agricultural Lands, and the Wet Mountain Valley.

In Georgia, the state's focal areas will likely increase from 10 to 16 percent converted between 2010 and 2050. A substantial portion of focal areas near the Atlanta and Savannah metro areas will face conversion of over one-quarter (some greater than half) of their area and many of these areas immediately face these conversions in the next 10 or so years. A number of other smaller focal patches that are dispersed throughout the state will also face substantial conversion.

Focal area loss will likely increase from 9 to 12 percent statewide in Missouri between 2010 and 2050. Most of the state's focal areas will face less than 10 percent loss of habitat, but some key areas, particularly near the St. Louis and Kansas City metropolitan areas, will have 25-50 percent loss of habitat by 2050. Also, conservation areas near Branson will likely lose from 10 to 35 percent of the habitat in the focal areas due to development.

Roughly 6 percent of Montana was included in the state's focal areas. These areas (both statewide or individual patches) will not likely have much loss from residential development (<2 percent) between 2010 to 2050.

New Hampshire will likely see up to 22-25 percent loss of its focal areas by 2050, although roughly 2/3 of the conversion had already taken place by 2000. In other words, on average about 16 percent of the focal areas identified in New Hampshire's State Wildlife Action Plan were directly or indirectly lost to development at the time that the plan was developed (some of the "highest tier" sites had lost as much as 34-42 percent of their area). Between 2010 and 2050, most of the new conversion of focal areas will occur in the southern portion of the state near Portsmouth (see Figure A4.4.).

Tennessee's focal areas will likely face relatively low to moderate levels of conversion (<5 percent) between 2010 and 2050. Some specific focal areas near Nashville and Chattanooga, however, will face substantial conversion (25-50 percent) by 2050.

A. Future activities

A number of the case study states are currently revising their State Wildlife Action Plans and refining their focal area maps. For example, Montana is engaged in a planning effort called "crucial areas and connectivity assessment." It is important to update assessments such as this one to reflect the most current expression of focal areas. In addition, similar assessments of the sensitivity of specific state focal areas to conversion from residential development could be conducted following the methods outlined here. We believe that providing a quantitative analysis

of the likely loss of focal areas over time and the geographic narrowing of specific locations of concern are useful to guide conservation efforts across the country. Future iterations of the State Wildlife Action Plans should, where possible, undertake spatial analysis of likely future threats to focal areas. In addition, we recognize that there are other threats to focal areas, such as climate change and energy development, but these were not part of our scope of work on this effort, but would be important to consider in future refinements.

5. Approach

The overall project goal – to identify the locations of critical habitats at risk from conversion and estimate the time to conversion – was achieved by analyzing the spatial intersection of projected growth patterns with datasets of six states’ focal areas. For the purposes of this report, “priority habitat conservation areas” and “focal areas” are used interchangeably to describe those clearly defined geographic areas identified in the State Wildlife Action Plans that represent areas of ecological and/or conservation importance. “Priority habitat,” on the other hand, is defined as those geographic areas identified in the State Wildlife Action Plans that depict the location or distribution of habitat *types* that are considered a priority for wildlife species (i.e., land cover maps of the state that indicate the locations of distinct wildlife habitat types). These maps may depict large portions of the state but do not necessarily suggest that all of that land needs to be under some more restrictive land use.¹⁰

The following approach was used to reach our results.

A. Preparation of development maps

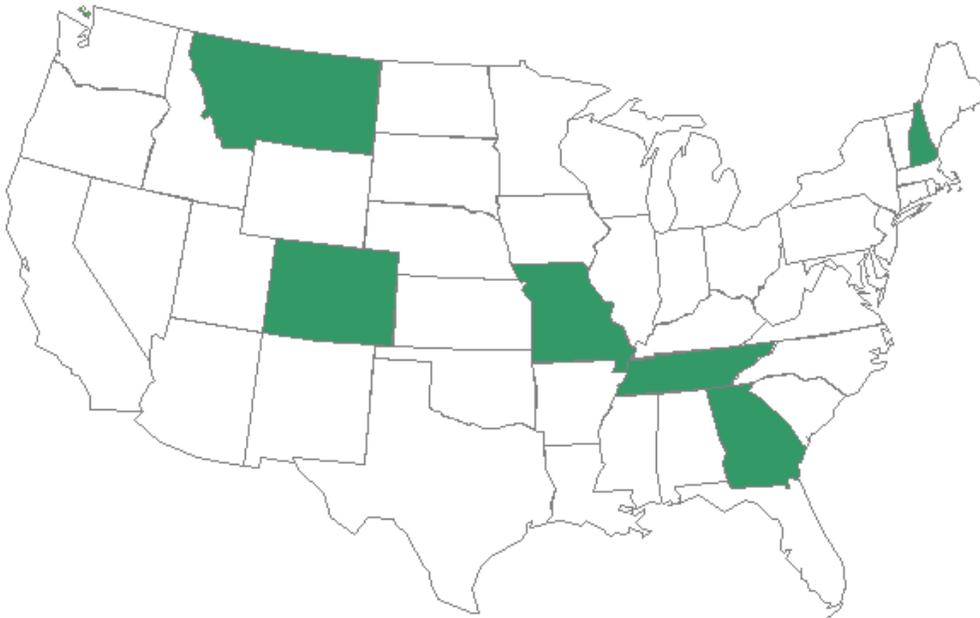
Projected urbanization and exurbanization data were based on an existing model, the Spatially Explicit Regional Growth Model (SERGoM). SERGoM was developed to forecast the pattern, location, and extent of current and future housing development across the country.¹¹ SERGoM provides the detailed patterns of nationwide forecasted growth patterns and is consistent with scenarios specified by the Intergovernmental Panel on Climate Change.

We examined whether there were opportunities to refine or update the current SERGoM model (v3.0) with additional data specific to each case study state. The hope was that we could refine growth patterns by incorporating individual state policies such as statewide growth plans. Potential data sets were considered, including: new and expansion transportation projects, population projections, conserved and protected private (i.e., conservation easements) and public lands, urban growth boundaries, and land use and cover. We queried state government offices, including departments of transportation, offices of smart growth and planning, regional councils of government, demography and economic growth agencies, and state GIS clearinghouses and committees. However, very little information was found that would be useful to modify growth scenarios, especially that which was available in an accessible, easy to use, spatial (ArcGIS) format. Although we were able to obtain county-level population projections for a number of states (i.e., Colorado and Missouri), their estimates ended at 2030 and were not substantially different than those used in the existing SERGoM maps. For these reasons, there was not a sufficient difference to warrant generating new maps of housing density (i.e., projected development).

B. Preparation of priority habitat conservation area maps

The project team selected six case study states (see map below) using a variety of criteria. First, each State Wildlife Action Plan was reviewed to determine if the state conducted spatially explicit mapping of focal areas,¹² whether maps were publicly available,¹³ and whether the maps could be downloaded as GIS shape files (as of July 2008).¹⁴ Second, we sought to select a set of states that represented a range of geographic diversity. We ranked our original selection of 11 states based on growth pressure using state-level population projections from the U.S. Census (1995-2025)¹⁵ and assigned high, medium, and low threat to states based on county-based data on the percentage of land projected to be converted to higher density housing.¹⁶ Finally, we selected six states, the majority of which had medium to high rates of growth, as well as one or two with low growth. Based on this analysis, we selected six states as the focus of our case studies: Colorado, Georgia, Missouri, Montana, New Hampshire, and Tennessee (Figure 5.1).

Figure 5.1. Case study states selected for analysis: Colorado, Georgia, Missouri, Montana, New Hampshire, and Tennessee.



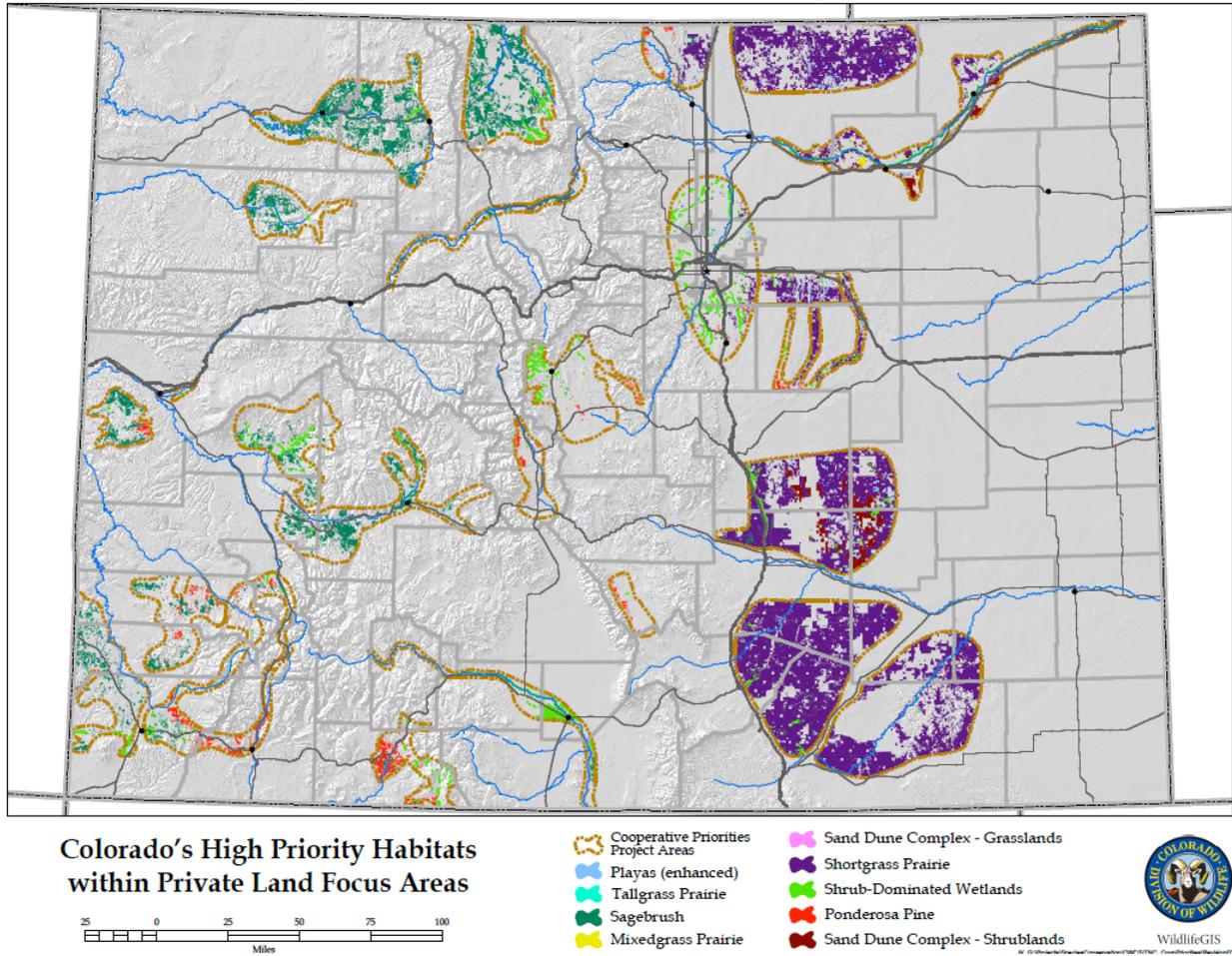
Because we wanted to ensure that we were accurately presenting the states' findings, we conducted one-on-one phone interviews with the State Wildlife Action Plan coordinators in each of the case study states. Our primary objective in carrying out the interviews was to determine how states self-define the data and mapping they have produced. We asked each State Wildlife Action Plan coordinator which of their maps or data sets (alone or in combination) best represents the state's focal areas. We asked if the focal area maps or information included terrestrial and freshwater habitats and, if not, whether or not separate maps or information on these areas was developed (see Appendix A).

Here we provide a brief overview of the sources of focal area maps used in our analysis.

Colorado

The focal area map utilized in Colorado was the state’s “High Priority Habitats within Private Land Focus Areas” (Figure 5.2) outlined in the state’s “Comprehensive Wildlife Conservation Strategy.”¹⁷ Colorado derived these maps from intersecting conservation focus areas with priority habitats identified in the Southwest Regional GAP ecological systems.

Figure 5.2. Colorado’s focal areas: High Priority Habitats within Private Land Focus Areas from “Colorado’s Comprehensive Wildlife Conservation Strategy.”



Georgia

Georgia’s State Wildlife Action Plan, “A Comprehensive Wildlife Conservation Strategy for Georgia,”¹⁸ identifies 172 “Potential Conservation Opportunity Areas”¹⁹ (Figure 5.3). These focal areas were identified using The Nature Conservancy planning efforts based on several weighted factors including: 1) Providing multiple benefits for high priority species/habitats; 2) Addressing un(der)funded needs; 3) Overall importance of Georgia efforts; 4) Timeliness or urgency, connections with other Conservation Actions; 6) Building public support for wildlife conservation; and 7) Probability of success.

Figure 5.3. Georgia’s focal areas: Potential Conservation Opportunity Areas from “A Comprehensive Wildlife Conservation Strategy for Georgia.”

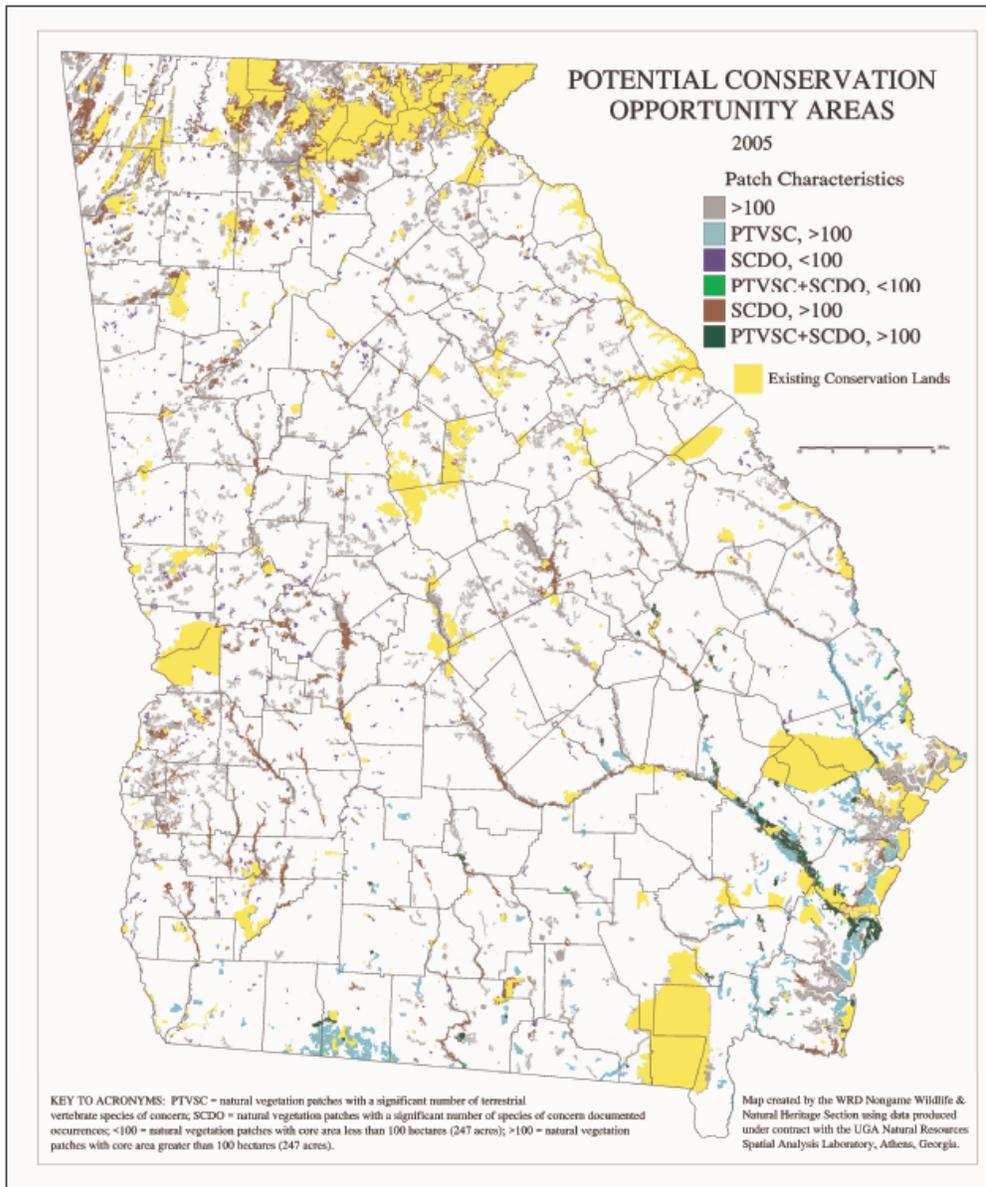
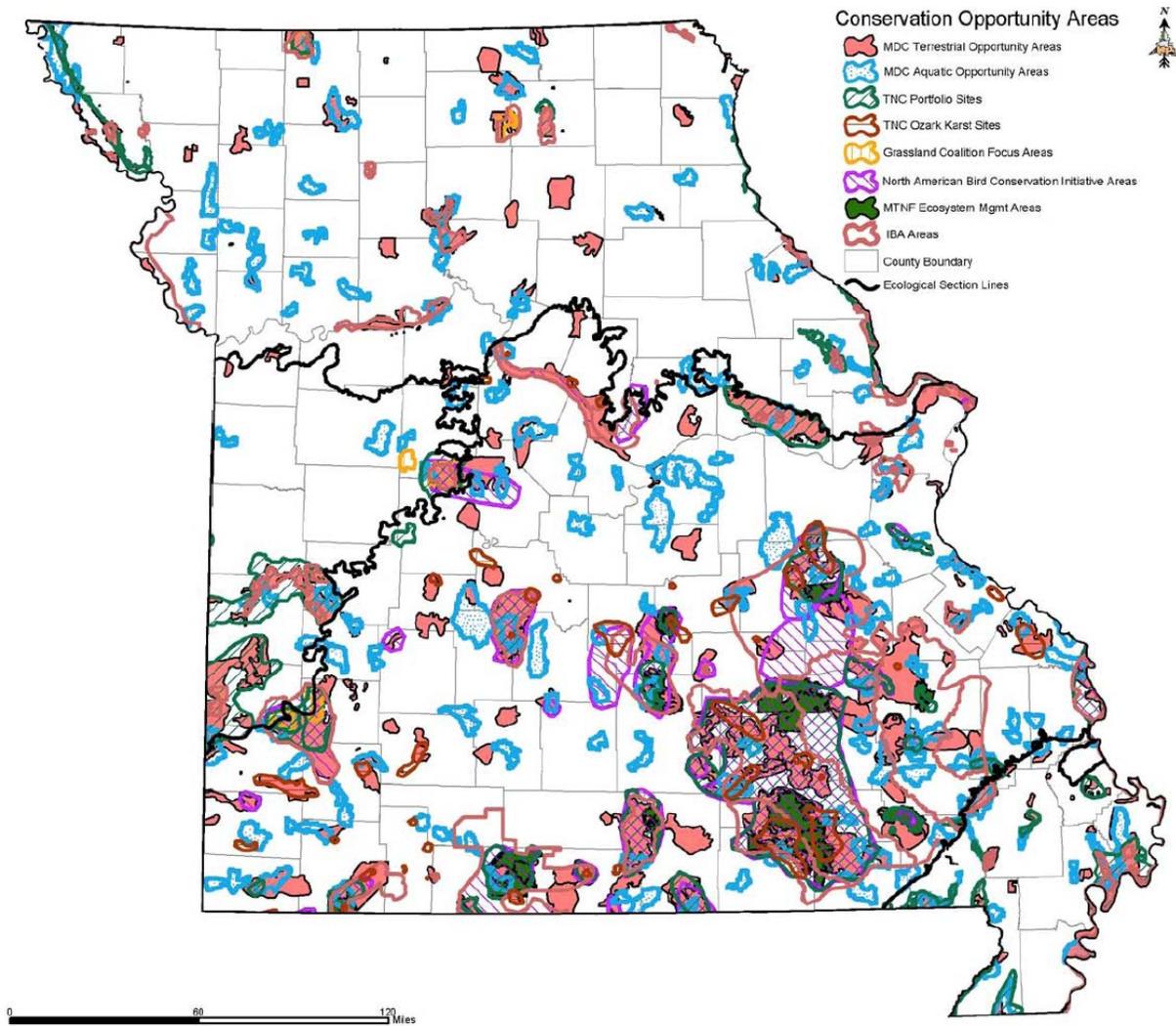


Figure 2. Potential conservation opportunity areas

Missouri

Missouri’s “Comprehensive Wildlife Conservation Strategy”²⁰ uses the Missouri Natural Heritage Database to identify land type associations to develop “targets (species, natural communities and landscapes)” for conservation purposes. GIS was used to prioritize these data to create terrestrial and aquatic conservation opportunity areas – “geographies that best represent the native ecosystems, species and ecological processes of all Land Type Association Types in all of Missouri’s Ecological Sections.” Finally, the conservation areas were combined with stakeholders’ definitions of important habitat to create the Conservation Opportunity Areas dataset. This dataset describes “key habitats and communities that sustain species of conservation concern and *all wildlife*.” These Conservation Opportunity Areas were used to represent the state’s focal areas.

Figure 5.4. Missouri's focal areas: Conservation Opportunity Areas from Missouri's "Comprehensive Wildlife Conservation Strategy."



Montana

Montana's "Comprehensive Fish and Wildlife Conservation Strategy"²¹ identifies 19 unique patches of "terrestrial focus areas"²² that were used for our analysis of focal areas.

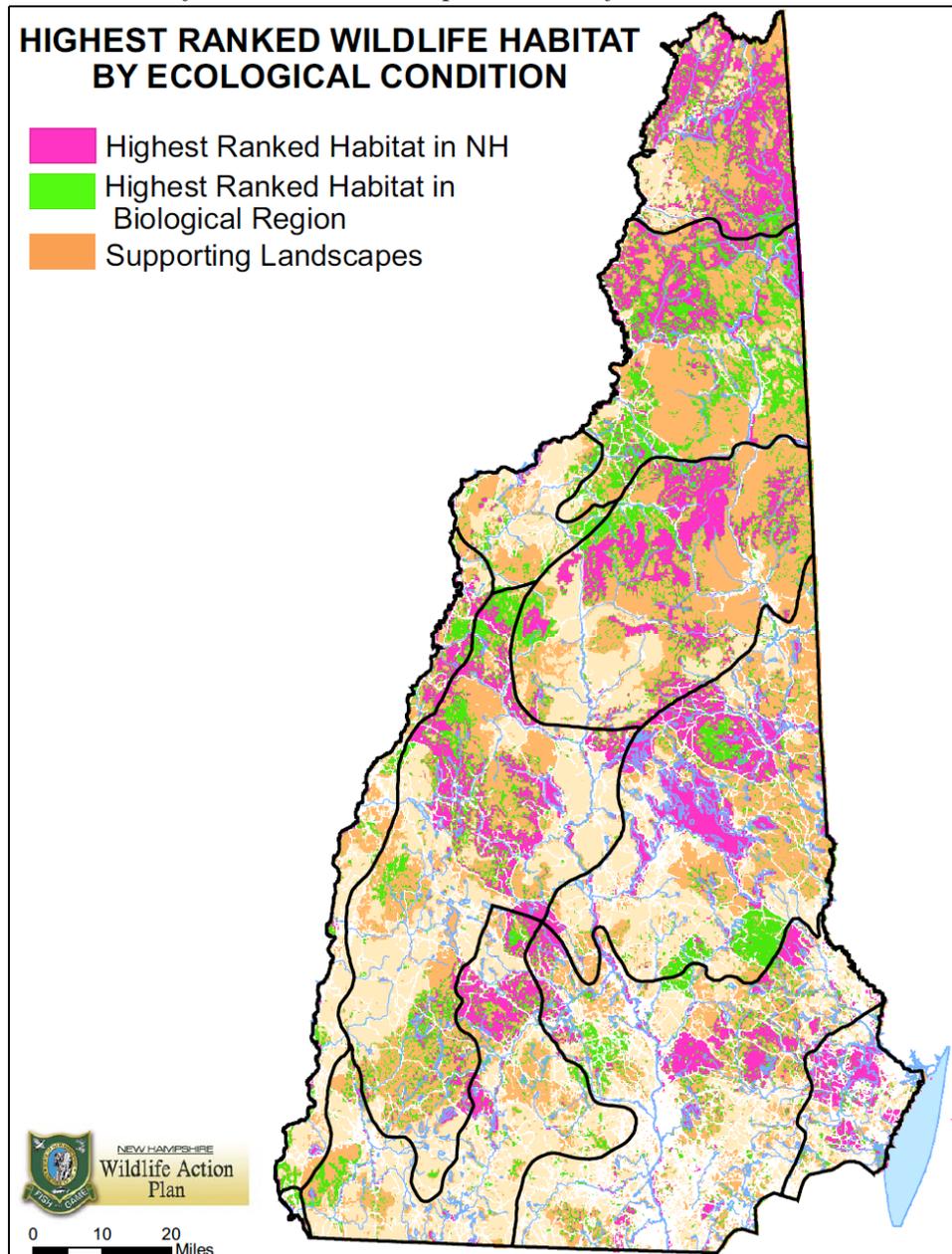
Figure 5.5. Montana's focal areas: Terrestrial Focus Areas from Montana's "Comprehensive Fish and Wildlife Conservation Strategy."



New Hampshire

Our analysis utilized the “Highest Ranked Wildlife Habitat by Ecological Condition” outlined in the “New Hampshire Wildlife Action Plan”²³ to represent the state’s focal areas.

Figure 5.6. New Hampshire’s focal areas: Highest Ranked Wildlife Habitat by Ecological Condition from the “New Hampshire Wildlife Action Plan.”



Tennessee

Tennessee's Comprehensive Wildlife Conservation Strategy²⁴ identifies "priority terrestrial habitat areas" (Figures 5.7, 5.8, and 5.9).²⁵ Tennessee GAP data and NatureServe ecological systems were used to identify the focal areas. For our focal area analysis, we combined all the state's priority areas and identified unique patches of priority areas that were at least 1 square km in size.

Figure 5.7. Tennessee's focal areas: Priority Terrestrial Habitat Areas from Tennessee's "Comprehensive Wildlife Conservation Strategy." Western Tennessee.



Figure 5.8. Tennessee's focal areas: Priority Terrestrial Habitat Areas from Tennessee's "Comprehensive Wildlife Conservation Strategy." Central Tennessee.



Figure 5.9. Tennessee's focal areas: Priority Terrestrial Habitat Areas from Tennessee's "Comprehensive Wildlife Conservation Strategy." Eastern Tennessee.



National-level analyses: The project team will complement the six pilot state analyses with a nationally consistent data set that allows us to extend our analysis to states that have not identified spatially explicit priority habitats or focal areas. This analysis will rely upon maps of terrestrial ecological systems developed by NatureServe.²⁶ This mid-scale ecological classification is being used as the basis for the nationwide interagency LandFire vegetation mapping effort.²⁷ The Northeastern Association of Fish and Wildlife Agencies is also using the classification to create a regionally consistent view of priority habitats from state wildlife action plans.

Ecological systems maps will allow for an analysis of consistent data that transcend state boundaries and will reveal the proportion of key ecological systems that are projected to be converted due to development over the selected time periods.

C. Conduct overlay analysis

The projected development data were overlaid with the priority habitat conservation areas to target locations where growth is projected to conflict with the conservation of these areas over the five different time horizons.

To conduct the overlay analysis, we converted the estimated housing density at each location into two measures of impact on wildlife habitat that capture estimated amount of human modification of habitat by human development. The first is the amount of land cover that is modified by humans, or *human modification of cover (HMc)*. This is an estimate of the visible “footprint” or spatial impact of development that causes modification to land cover types, including and around structures and roads. Note that this measure quantifies modifications associated with not just the housing unit, but the general transportation and utility infrastructure needed by residential development. As such, it provides a general estimate of the effects of

not only housing density but also roads (and utility corridors, etc.).

The second metric is an estimate of both the direct (*HMc*) as well as effective or functional aspects that are due to both visible modifications to cover, as well as proximal effects associated with human activities such as lights, noise, sound, pets, etc. These effects typically decline as a function of distance away from housing units, roads, and other associated infrastructure.²⁸ This effect is referred to as the human modification function (*HMf*). We used a distance of 100 m radius from each housing unit structure, which others have concluded to be representative of general ecological effects.²⁹

We used estimates of *HMc* and *HMf* that were developed from interpretation of high-resolution aerial photography from over 300 plots or “chips” that were randomly located throughout the public-private land interface in the southern Rockies ecoregion (Table 5.1). Although there is some regional variation in effects of land use on habitat, these estimates provide useful and robust measures of effects and are fairly robust given common development patterns. Future research, however, could pursue developing regionally-specific estimates.

Table 5. 1. Mean and standard deviation of the area (in hectares) of human modification per residential unit for rural, exurban, and suburban residential density classes (Leinwand 2009).

Class of housing density	Human modification cover			Human modification functional		
	50% (median)	10%	90%	50% (median)	10%	90%
Rural	0.79	0.28	2.72	4.65	2.16	10.46
Exurban	0.25	0.09	1.19	2.65	1.21	4.59
Suburban/ Urban	0.13	0.06	0.35	0.33	0.13	0.55

We converted housing density into two raster layers that depict the proportion of habitat affected by *HMc* and *HMf* on a cell by cell basis. This raster was then overlaid onto the priority habitat layers and the proportion affected of each cell was computed.

7. Deliverables

Final technical report: A final technical report will be developed that estimates the likely time to permanent conversion of the priority habitat conservation areas in the six case study states. The report will outline our methods, results, and provide recommendations for action.

In each of the six states we have developed: 1) One or more tables (with the exception of Tennessee) depicting the proportion of priority habitat conservation areas lost at the different time intervals (i.e., 2000, 2010, 2020, 2030, 2040, 2050); 2) A series of 6 maps (with the exception of Montana) showing the loss of focal areas from estimated human modification at the different time intervals (i.e., 2000, 2010, 2020, 2030, 2040, 2050); and 3) Additional maps for each state summarizing significant findings.

We anticipate that a final draft of the technical report will be completed by the end of August/September 2009. After the report has been formatted, it will be provided to the list of

contacts we have developed, which includes: state wildlife action plan coordinators, state natural heritage programs, state departments of nature preservers, state offices of planning/smart growth, and state transportation planners, among others.

Article(s) in peer-reviewed literature: The results of the analysis of terrestrial ecological systems will be developed into two articles. The first will be tailored for publication in *Conservation Letters* and will tentatively cover long-term trends in extent of terrestrial ecological systems in the U.S., extending back historically, and looking into the coming decades. The second article will be submitted to *Conservation Biology* for inclusion in a possible series documenting the status of ecological systems. This paper will focus on threats to ecological systems from urban/exurban development.

Technical presentation: A technical presentation, developed for the WHPRP final meeting, will be updated based on this final report. It will be delivered at appropriate venues, including the International Symposium on Urban Wildlife and the Environment in June 2009.

Outreach materials: The results of our study potentially will be used to develop two graphically compelling outreach outlets tailored for a non-technical audience that include “users,” such as wildlife policymakers, managers, and practitioners. These include: 1) Full-color, state-by-state summaries of the status of each state’s terrestrial ecosystems tailored for incorporation into NatureServe’s LandScope and other efforts to communicate the threats of development on habitat and species; and 2) A full-color book documenting the status of terrestrial ecosystems in the U.S. Development of these materials is under discussion within NatureServe and will be dependent on our securing additional funds.

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APPENDICES

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APPENDIX A: Charts and Maps of Focal Areas Lost Due to Development (2000, 2010, 2020, 2030, 2040, 2050)

1. Colorado
2. Georgia
3. Missouri
4. Montana
5. New Hampshire
6. Tennessee

For each state, three different analyses are provided: 1) One or more tables (with the exception of Tennessee) depicting the proportion of priority habitat conservation areas lost at the different time intervals (i.e., 2000, 2010, 2020, 2030, 2040, 2050); 2) A series of 6 maps (with the exception of Montana) showing the loss of focal areas from estimated human modification at the different time intervals (i.e., 2000, 2010, 2020, 2030, 2040, 2050); and 3) Additional maps for each state summarizing significant findings.

1. Colorado

Slightly more than 5 percent of Colorado was included in the state's focal areas. The likely loss of focal areas ranges from 0.3 percent to 74.5 percent by 2050. The focal areas that will likely be under most pressure from development are: Metropolitan Front Range (74.5 percent), Mesa County agricultural lands (64.9 percent), South Park & Mosquito Range (34.1 percent), Upper Arkansas Valley (26.4 percent), Headwaters of the San Juan & Navajo Rivers (25.4 percent), and San Juan Skyway (23.1 percent) (see Table A1.1.).

The spatial distribution of development pressure from 2000 to 2050 can be seen in Figures A1.1-A1.7. Figure A1.7 shows focal areas that are likely to undergo development that would result in relatively high loss of habitat. These "red" areas should be among the top areas to be considered for conservation. Additional analysis was conducted in three areas that are likely to experience particularly severe loss of focal area: the Front Range near Denver, South Park (Park County), and the headwaters of the San Juan River (Mineral and Archuleta Counties) (Figure A1.8).

Table A1.1. The proportion of focal areas lost through human modification due to residential development over time in Colorado. The focal areas are those identified in Figures A1.1-A1.6. “Proportion lost to development (cover, %)” refers to the percentage of each focal area lost to residential development alone. “Proportion lost to development (functional, %)” refers to that lost due to residential development and its related indirect effects (i.e., footprint of development and human activities).

Focal area	Area (km ²)	#	Proportion lost to development (cover, %)						Proportion lost to development (functional, %)					
			2000	2010	2020	2030	2040	2050	2000	2010	2020	2030	2040	2050
Laramie Foothills	146.3	0	0.7	0.8	0.8	0.9	1.0	1.0	4.4	5.3	5.9	6.4	6.8	7.0
Metropolitan Front Range	103.8	1	4.5	11.0	19.7	28.3	35.7	41.0	24.5	48.4	61.4	64.7	71.2	74.5
Huerfano Uplands	3,277.0	2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.3	0.3	0.3	0.3
Prairie Canyon Lands	1,726.5	3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.3	0.3	0.3
Elbert & Arapahoe Co. Riparian Corridors	265.3	4	0.2	0.3	0.3	0.3	0.3	0.4	1.7	2.1	2.2	2.4	2.4	2.5
Peak to Prairie	2,437.3	5	0.3	0.4	0.5	0.6	0.6	0.6	2.1	3.2	3.6	3.8	3.9	3.9
Western High Plains	1,682.5	6	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.5	0.5	0.5	0.5
Mesa Co. Ag Lands	1.1	7	4.4	6.6	7.3	7.7	7.6	7.7	38.7	57.8	62.4	64.9	64.9	64.9
San Miguel & Dolores Co. Sagebrush	126.0	8	0.2	0.2	0.2	0.2	0.2	0.2	1.5	1.5	1.5	1.5	1.5	1.5
Delta Co. Ag lands	81.0	9	1.5	1.5	1.5	1.5	1.5	1.5	10.6	11.4	11.3	11.3	11.3	11.3
Glade Park	148.4	10	0.6	0.6	0.6	0.6	0.6	0.6	3.7	3.8	3.8	3.8	3.8	3.8
Southwest Canyons	157.1	11	0.7	0.7	0.7	0.7	0.7	0.7	4.9	5.0	5.0	5.0	5.0	5.0
San Juan Skyway	173.4	12	3.2	3.4	3.5	3.5	3.5	3.5	20.6	22.7	23.1	23.1	23.1	23.1
Rio Grande River Corridor	114.5	13	2.4	2.6	2.6	2.6	2.6	2.6	15.1	16.4	16.6	16.7	16.8	16.9
North Park	692.1	14	0.2	0.2	0.2	0.2	0.2	0.2	1.6	1.6	1.6	1.6	1.6	1.6
Upper Yampa River Basin	655.2	15	0.6	0.6	0.6	0.6	0.6	0.6	4.0	4.1	4.1	4.1	4.1	4.1
Upper White River Basin	138.2	16	0.4	0.4	0.4	0.4	0.4	0.4	2.4	2.4	2.5	2.5	2.5	2.5
Upper Arkansas Valley	18.1	17	4.0	4.0	4.0	4.0	4.0	4.0	27.3	26.4	26.4	26.4	26.4	26.4
Wet Mountain Valley	11.7	18	1.5	1.7	1.7	1.7	1.7	1.7	9.0	10.0	10.0	10.0	10.0	10.0
South Park & Mosquito Range	27.1	19	1.9	2.6	3.3	4.1	4.5	4.5	13.6	20.4	27.2	32.7	34.1	34.1
South Platte River Corridor	522.8	20	0.4	0.4	0.4	0.4	0.4	0.4	2.9	3.0	3.0	3.0	3.0	3.0
Arapahoe Grasslands	223.4	21	1.0	1.0	1.1	1.2	1.4	1.4	6.2	6.4	7.1	7.7	8.4	8.8
Headwaters of the San Juan & Navajo Rivers	145.1	22	2.0	2.5	2.8	3.1	3.2	3.2	14.8	18.8	21.8	24.4	25.4	25.4
Gunnison Basin	348.6	23	1.0	1.1	1.1	1.1	1.1	1.1	6.7	7.0	7.0	7.0	7.0	7.0
Upper Colorado River Corridor	73.2	24	1.9	2.0	2.3	2.6	2.8	3.0	11.1	12.6	14.0	14.6	16.1	16.3

Figure A1.1. Loss of focal areas in Colorado from estimated human modification due to development in 2000.

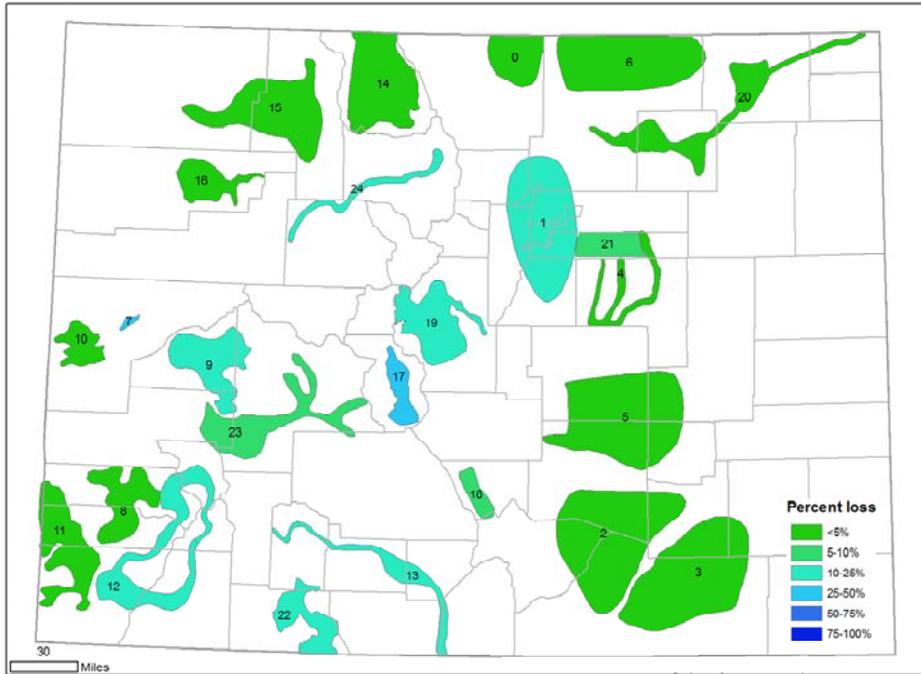


Figure A1.2. Loss of focal areas in Colorado from estimated human modification due to development in 2010.

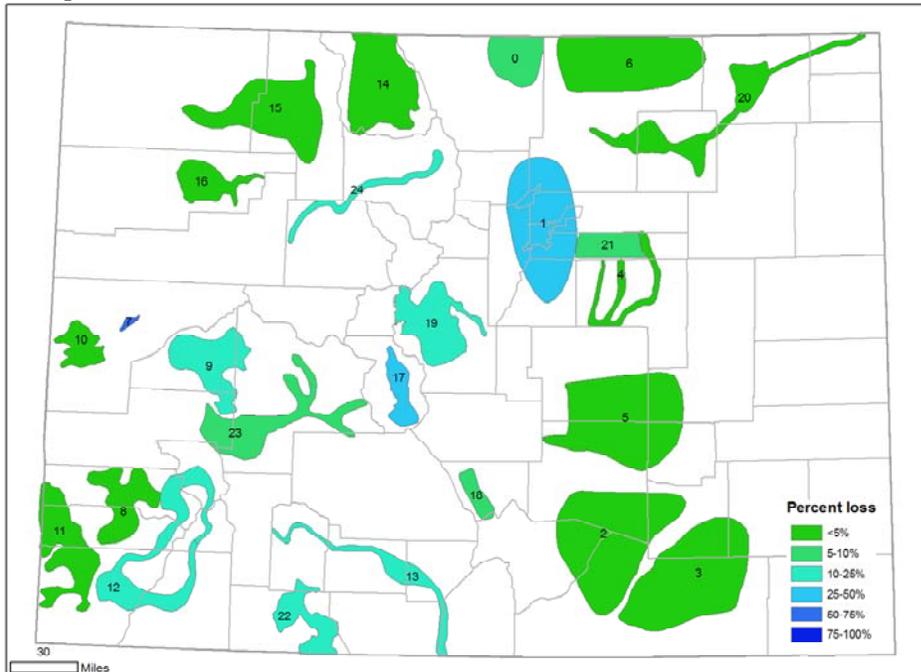


Figure A1.3. Loss of focal areas in Colorado from estimated human modification due to development in 2020.

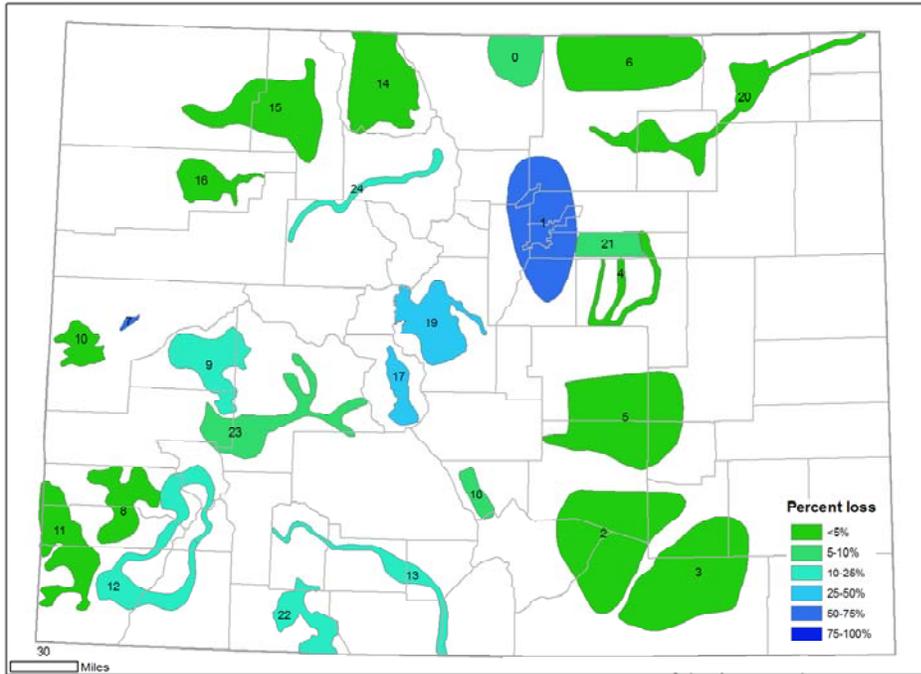


Figure A1.4. Loss of focal areas in Colorado from estimated human modification due to development in 2030.

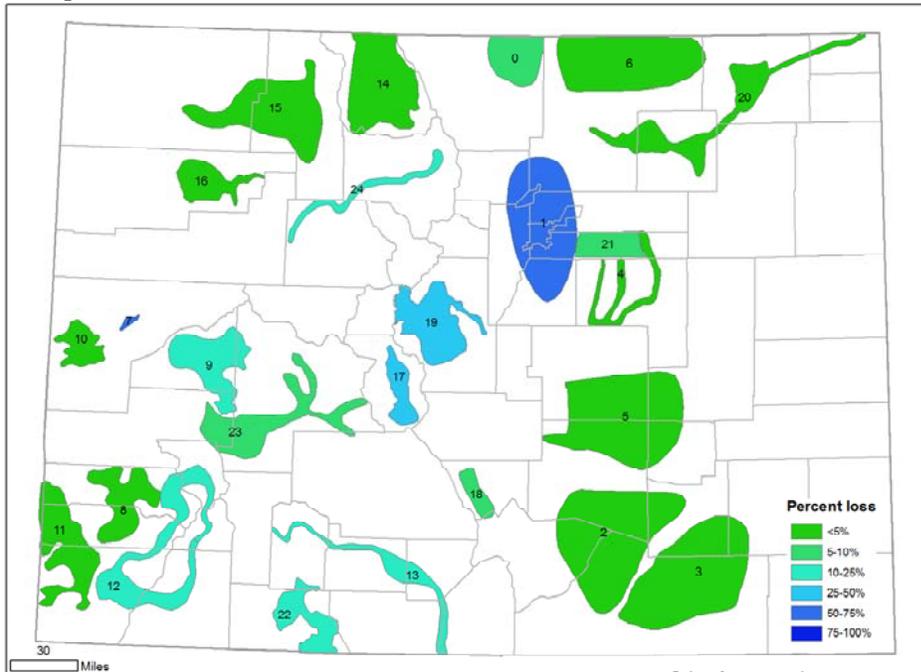


Figure A1.5. Loss of focal areas in Colorado from estimated human modification due to development in 2040.

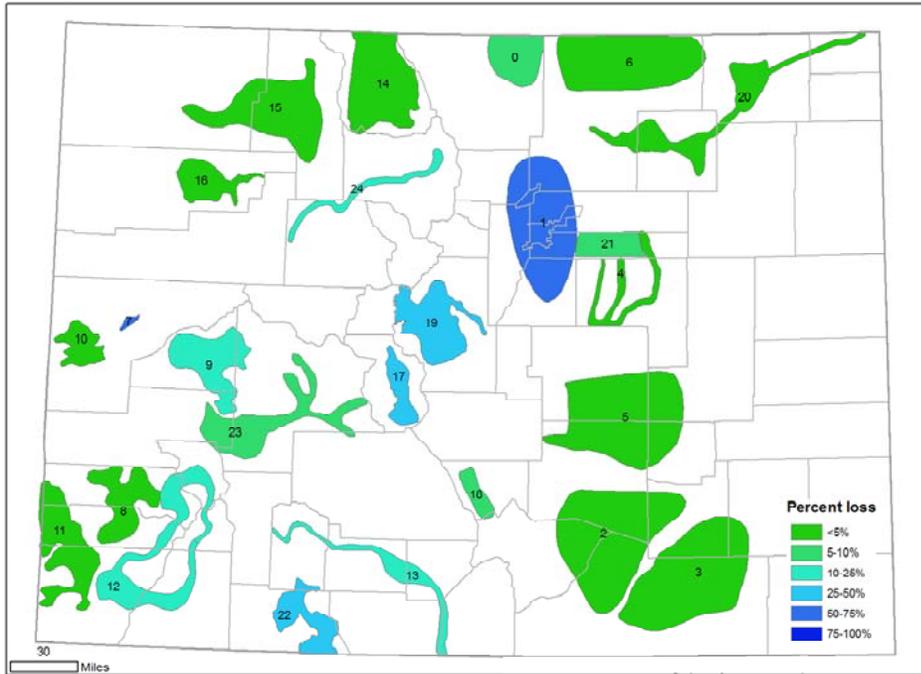


Figure A1.6. Loss of focal areas in Colorado from estimated human modification due to development in 2050.

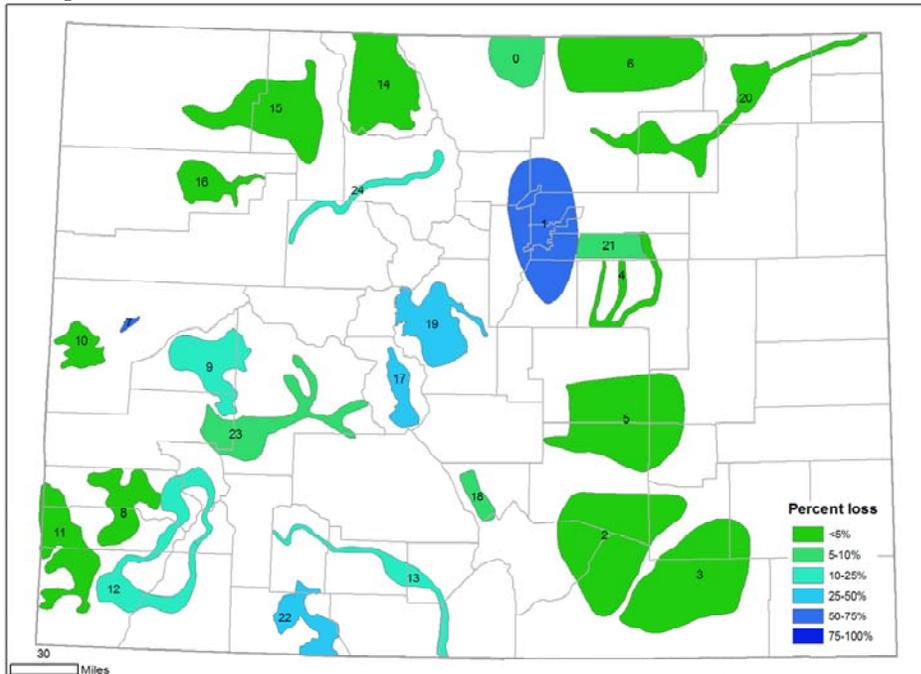


Figure A1.7. A comparison of the loss of focal areas from 2000 to 2050 on private lands in Colorado. Darker red areas have a higher percent loss with forecasted human modification due to development.

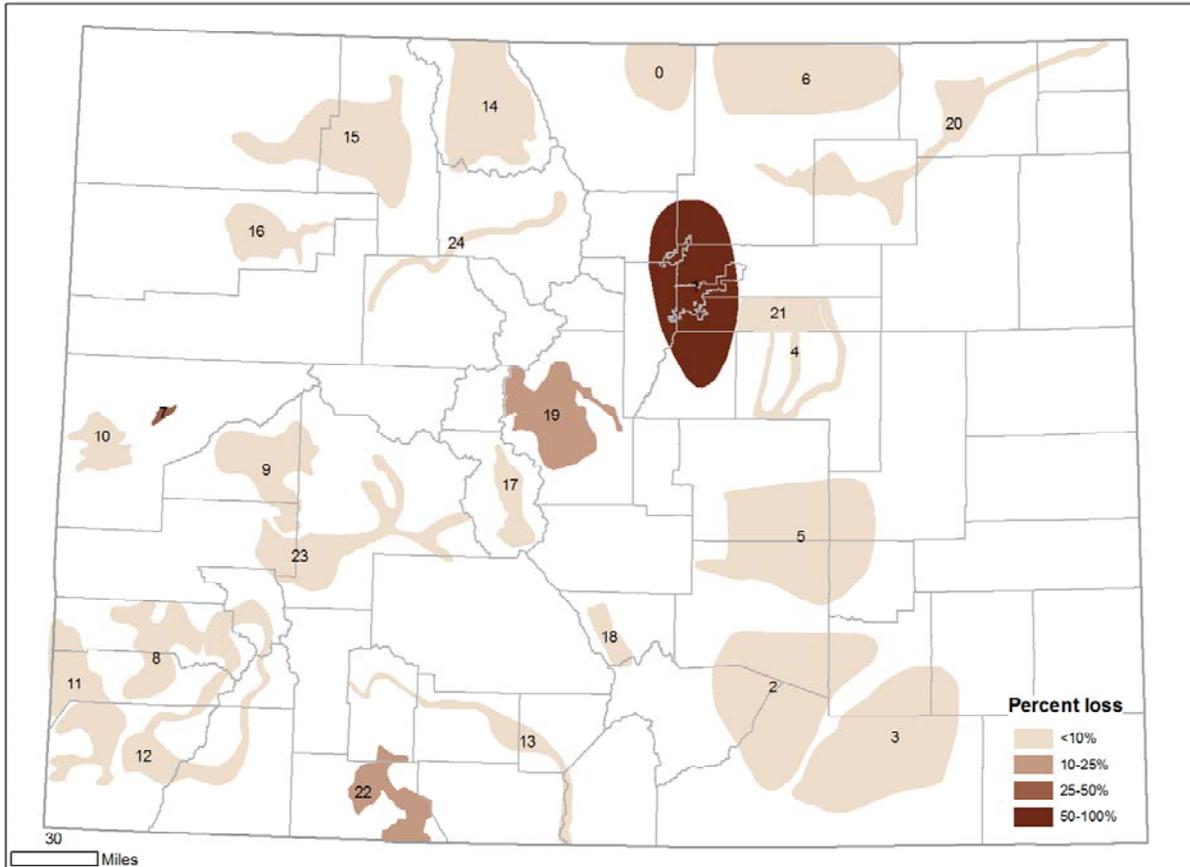
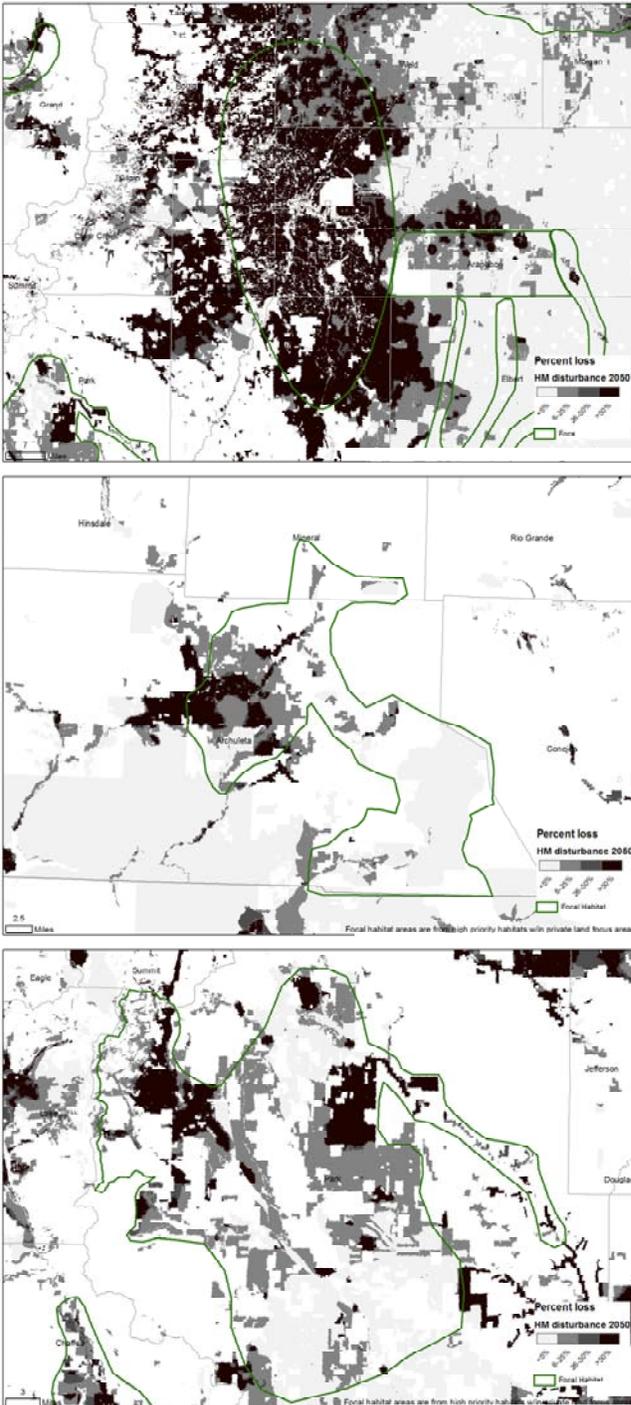


Figure A1.8. Focal areas (outlined in green) in Colorado that will be subject to substantial loss of habitat due to development from 2000 to 2050. Top: Denver metropolitan area; middle: South Park; bottom: Archuleta County (southern CO).



2. Georgia

Approximately 14 percent (20,830 km²) of Georgia was included in the state’s focal area maps. Our analysis found that the proportion of focal area that will be lost to development will likely increase from 9.7 percent in 2000 to 15.9 percent by 2050 (Table A2.1). The spatial distribution of development pressure from 2000 to 2050 can be seen in Figures A2.1-A2.7, which show the proportion of habitat loss computed for each of roughly 3,020 patches. Focal area loss will be substantial around the Atlanta (Figure A2.8) and Savannah (Figure A2.9) metro areas, with a number of patches from 25 to at least 50 percent lost to anticipated development.

Table A2.1. The proportion of focal areas lost through human modification due to residential development over time in Georgia. “Proportion lost to development (cover, %)” refers to the percentage of each focal area lost to residential development alone. “Proportion lost to development (functional, %)” refers to that lost due to residential development and its related indirect effects (i.e., footprint of development and human activities).

Proportion lost to development (cover, %)						Proportion lost to development (functional, %)					
2000	2010	2020	2030	2040	2050	2000	2010	2020	2030	2040	2050
1.2%	1.6%	1.8%	2.1%	2.3%	2.4%	9.7%	12.5%	14.1%	15.1%	15.6%	15.9%

Figure A2.1. Loss of focal areas in Georgia from estimated human modification due to development by 2000.

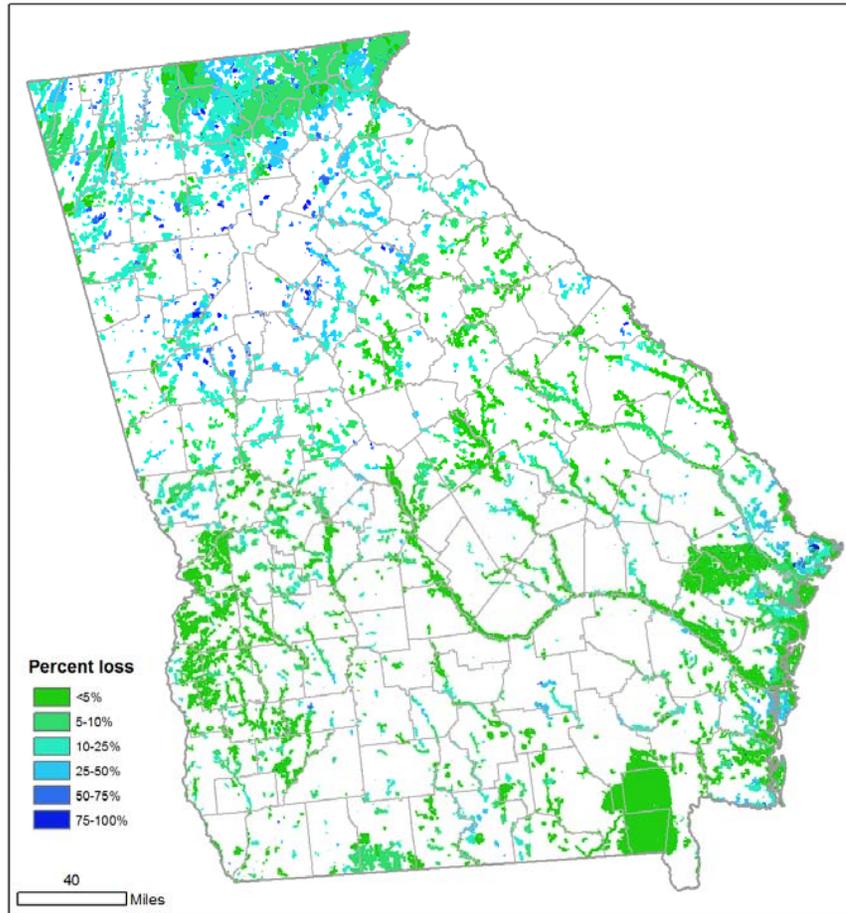


Figure A2.2. Loss of focal areas in Georgia from estimated human modification due to development by 2010.

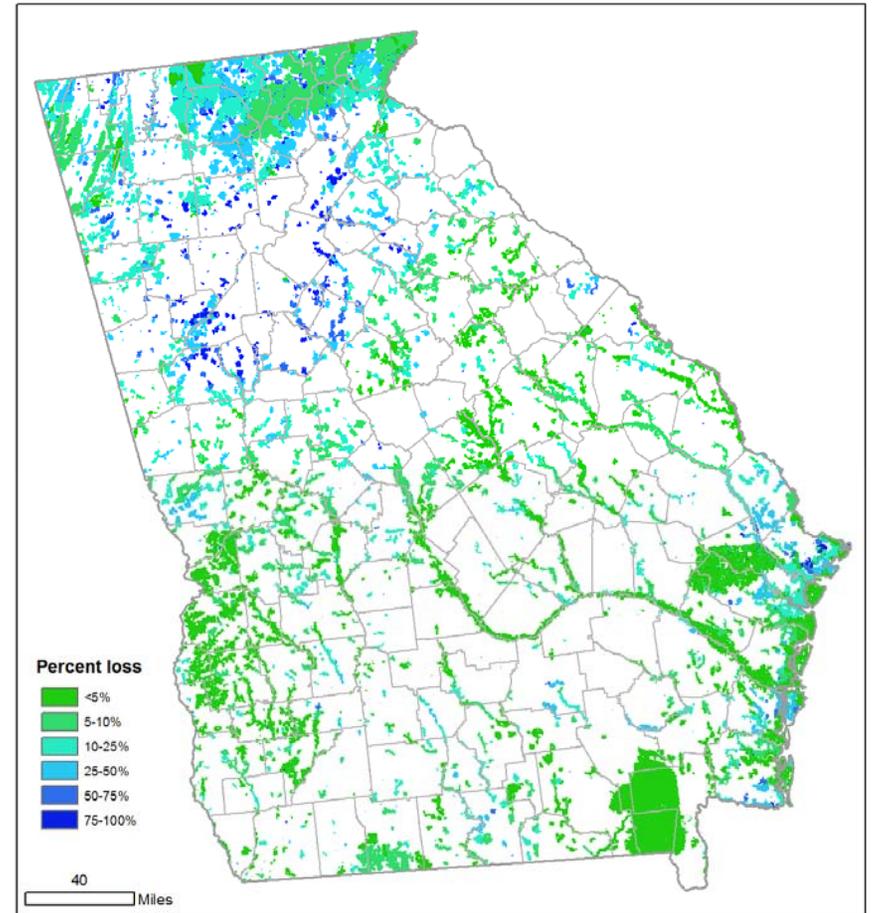


Figure A2.3. Loss of focal areas in Georgia from estimated human modification due to development by 2020.

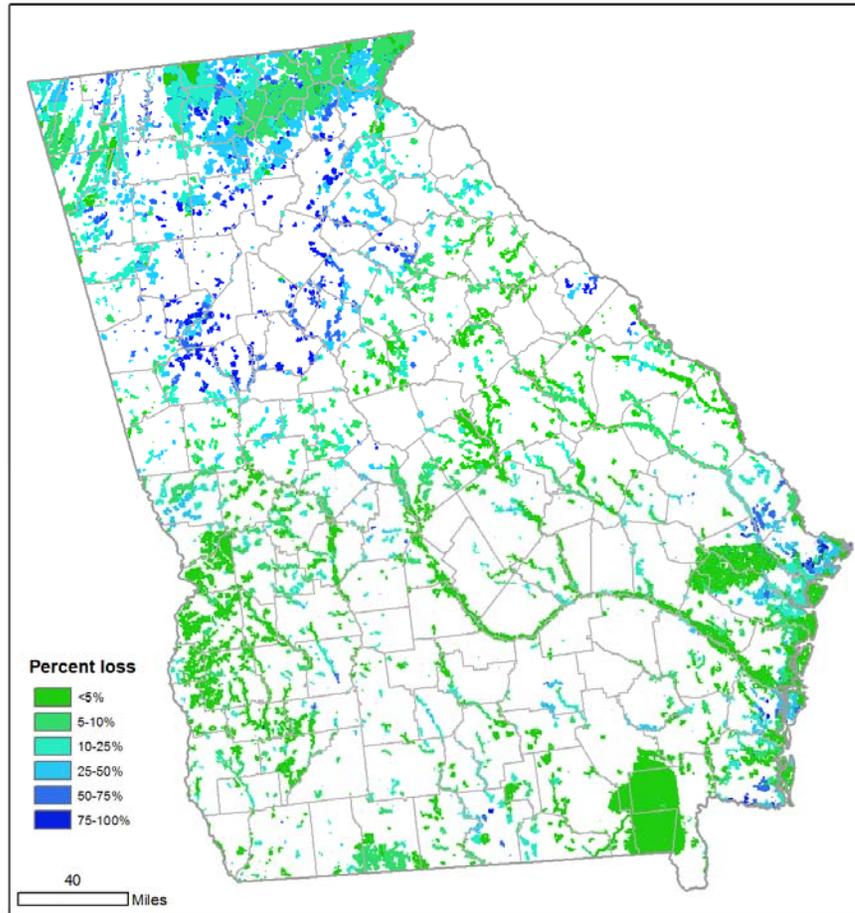


Figure A2.4. Loss of focal areas in Georgia from estimated human modification due to development by 2030.

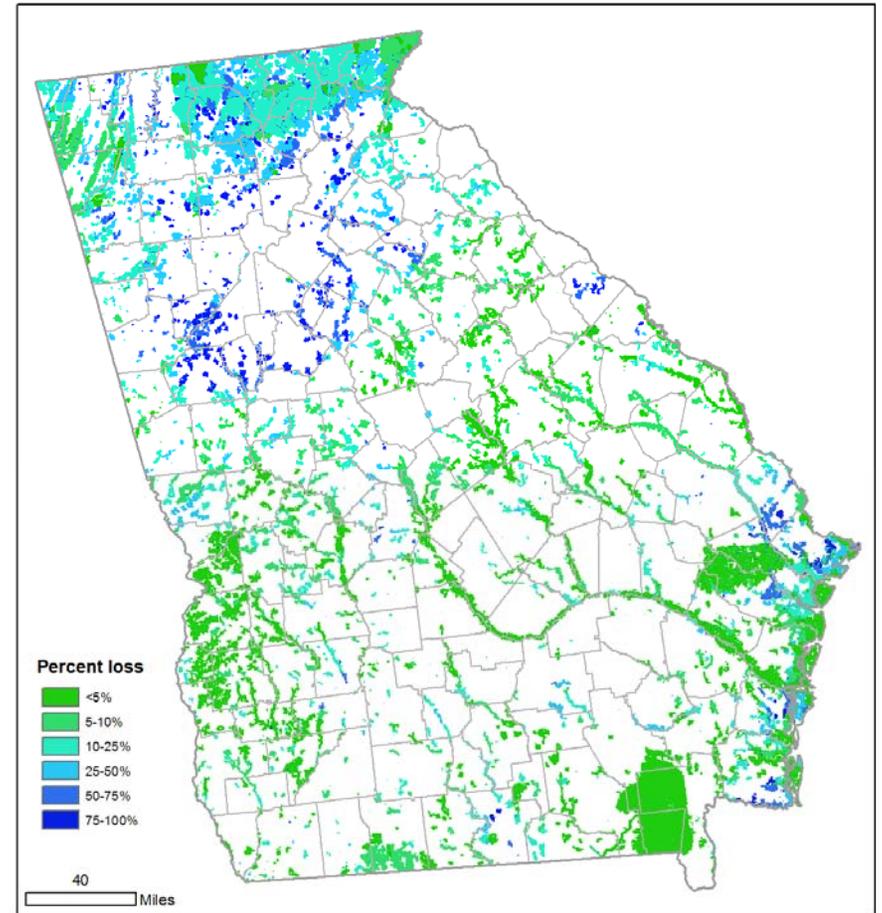


Figure A2.5. Loss of focal areas in Georgia from estimated human modification due to development by 2040.

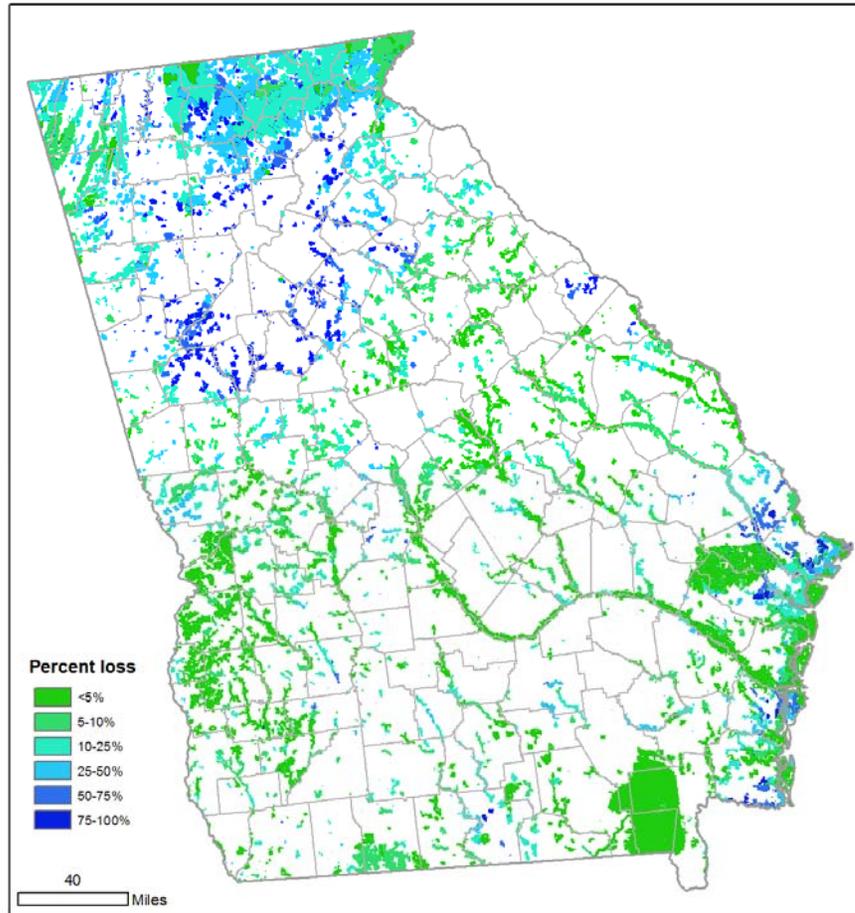


Figure A2.6. Loss of focal areas in Georgia from estimated human modification due to development by 2050.

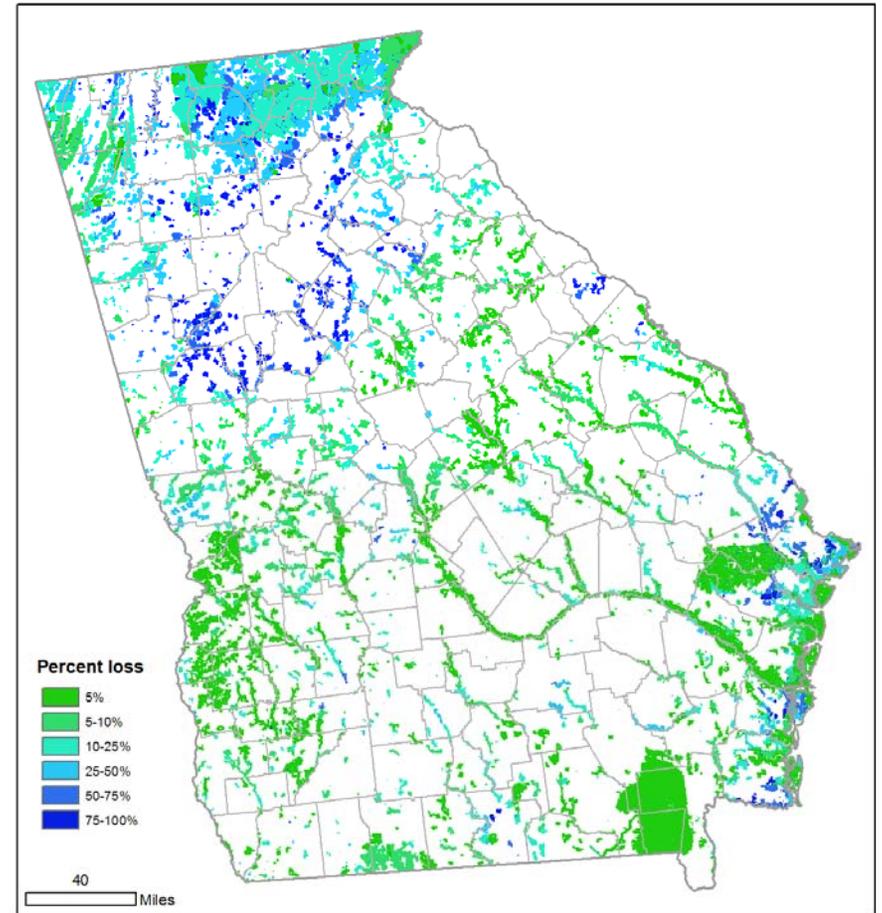


Figure A2.7. A comparison of the loss of focal areas in Georgia from estimated human modification due to development from 2000 to 2050.

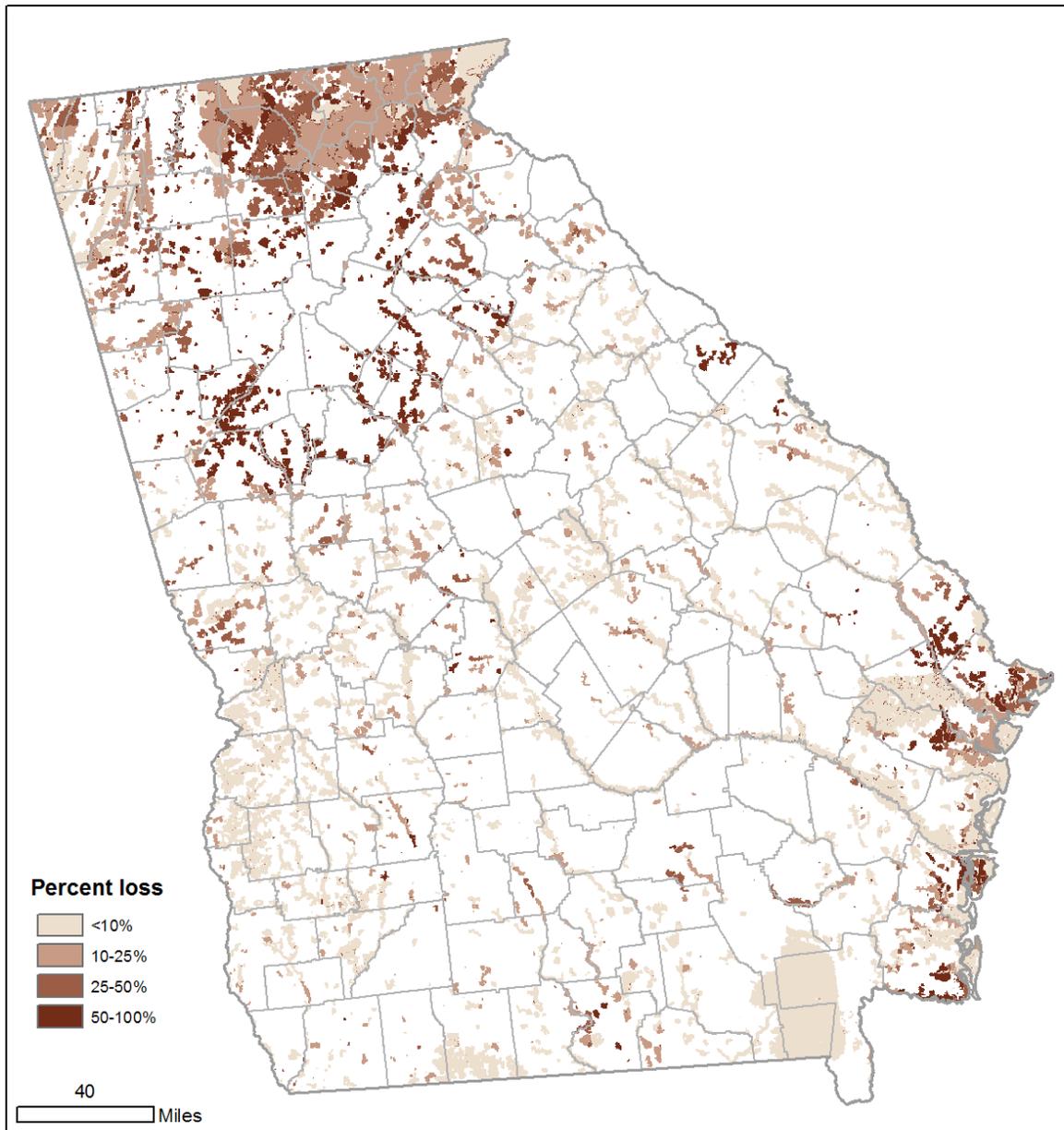


Figure A2.8. Focal areas lost from 2000 to 2050 in the Atlanta, Georgia metropolitan area.

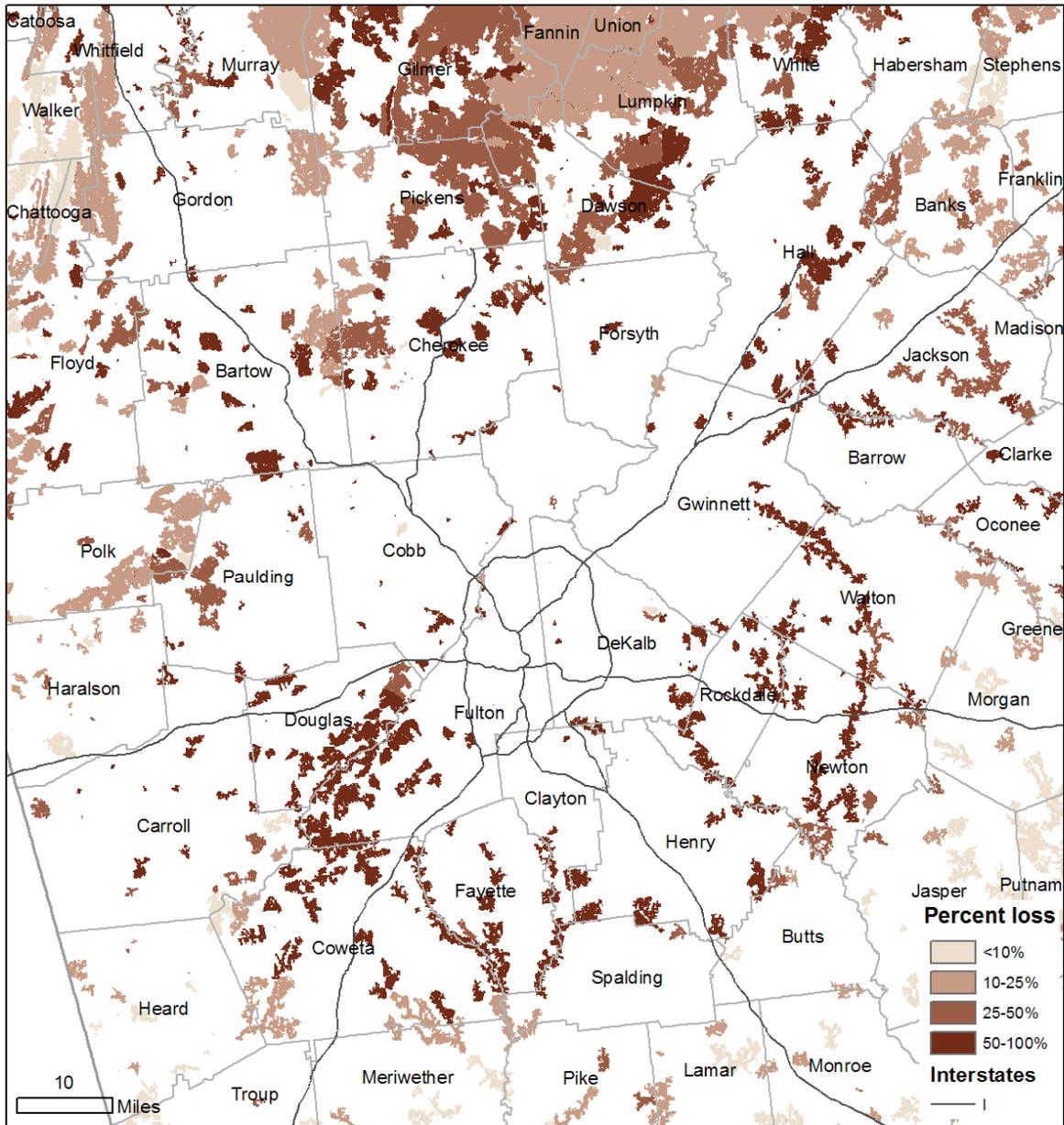
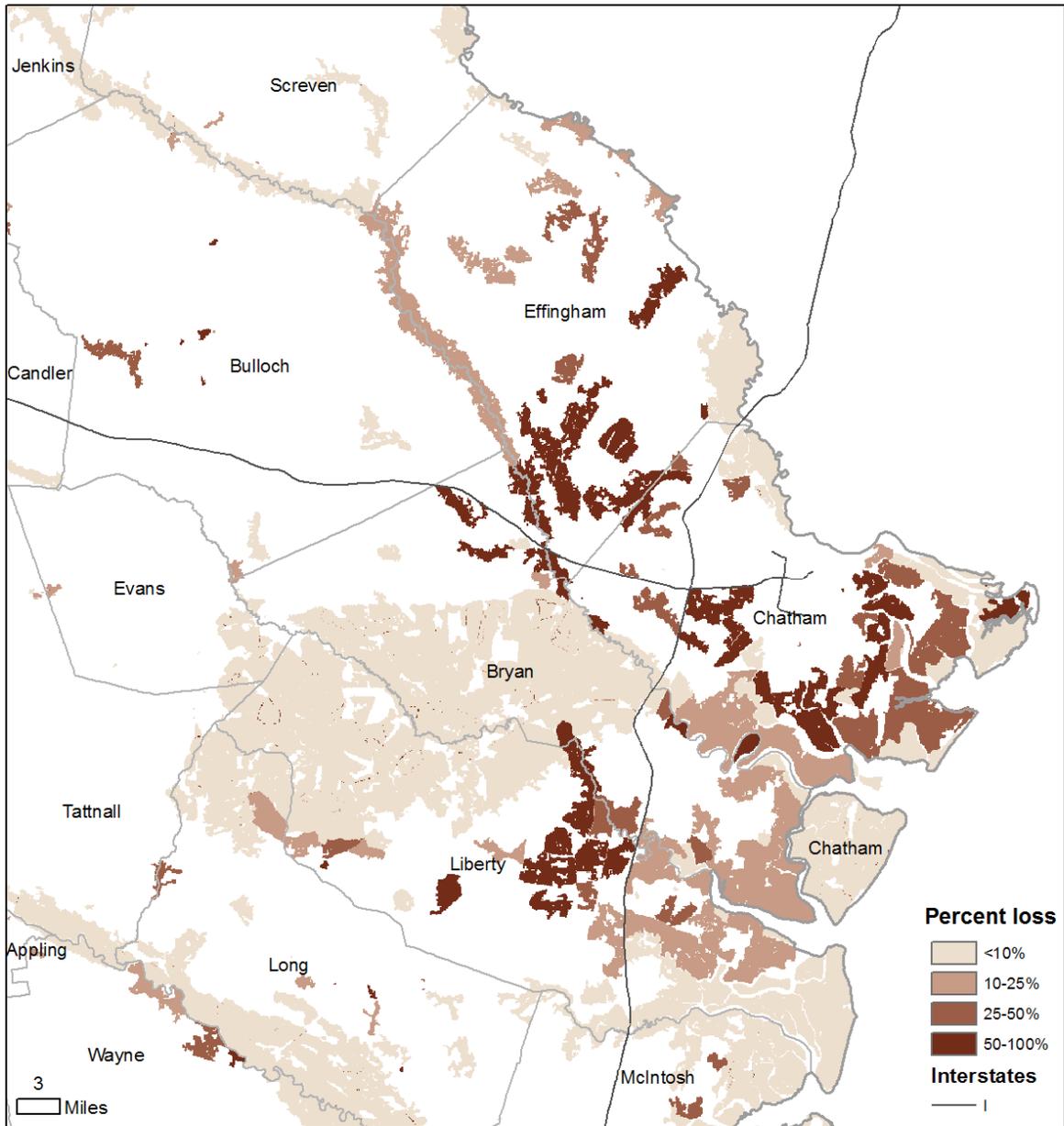


Figure A2.9. Focal areas lost from 2000 to 2050 in the Savannah, Georgia metropolitan area.



3. Missouri

Approximately 29 percent (53,144 km²) of Missouri was included in the state’s 207 conservation opportunity areas. Focal area loss in the state will likely increase from 9.0 to 11.9 percent between 2000 and 2050. The spatial distribution of development pressure from 2000 to 2050 is depicted in Figures A3.1- A3.7. A few specific focal areas are likely to exhibit substantial loss of habitat, particularly around the St. Louis metro area (Figure A3.8) and the corridor from Springfield to Branson (Figure A3.9)

Table A3.1. The proportion of focal areas lost through human modification due to residential development over time in Missouri. “Proportion lost to development (cover, %)” refers to the percentage of each focal area lost to residential development alone. “Proportion lost to development (functional, %)” refers to that lost due to residential development and its related indirect effects (i.e., footprint of development and human activities).

Proportion lost to development (cover, %)						Proportion lost to development (functional, %)					
2000	2010	2020	2030	2040	2050	2000	2010	2020	2030	2040	2050
1.5%	1.6%	1.7%	1.8%	1.9%	2.0%	9.0%	10.4%	11.1%	11.7%	11.9%	11.9%

Figure A3.1. Loss of focal areas in Missouri from estimated human modification due to development in 2000.

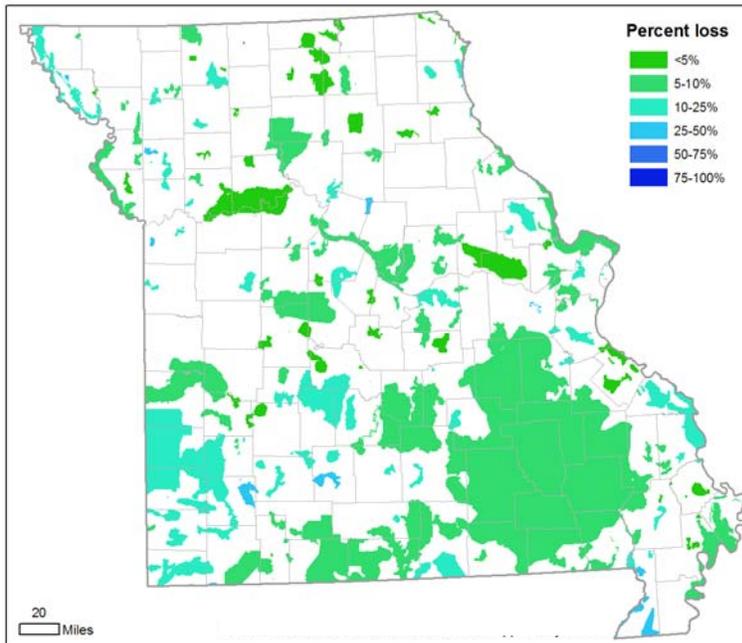


Figure A3.2. Loss of focal areas in Missouri from estimated human modification due to development in 2010.

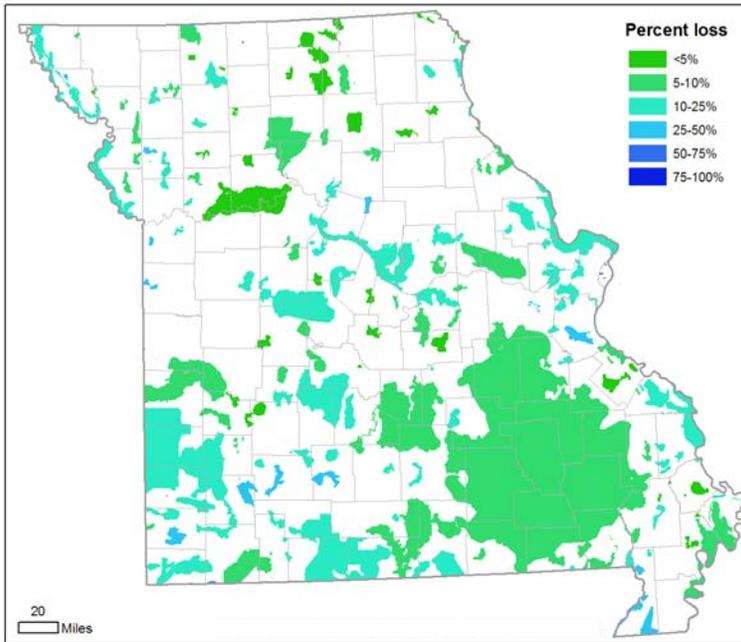


Figure A3.3. Loss of focal areas in Missouri from estimated human modification due to development in 2020.

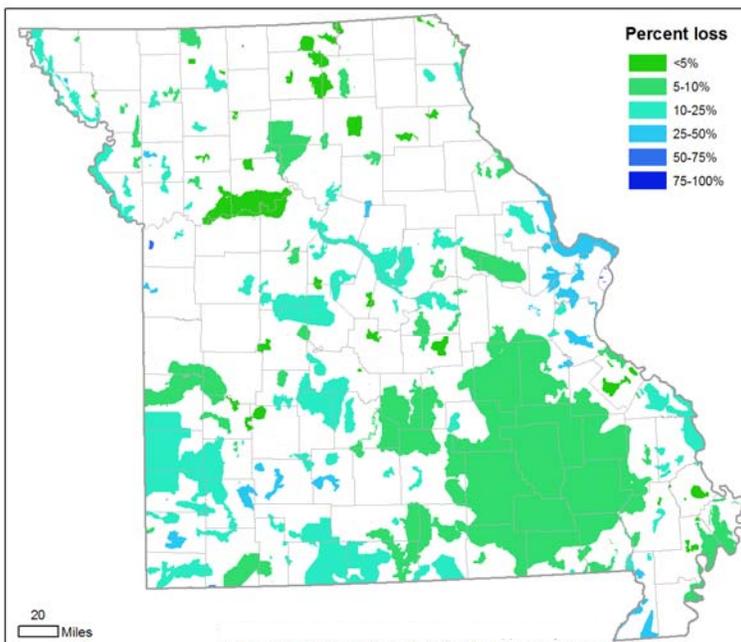


Figure A3.4. Loss of focal areas in Missouri from estimated human modification due to development in 2030.

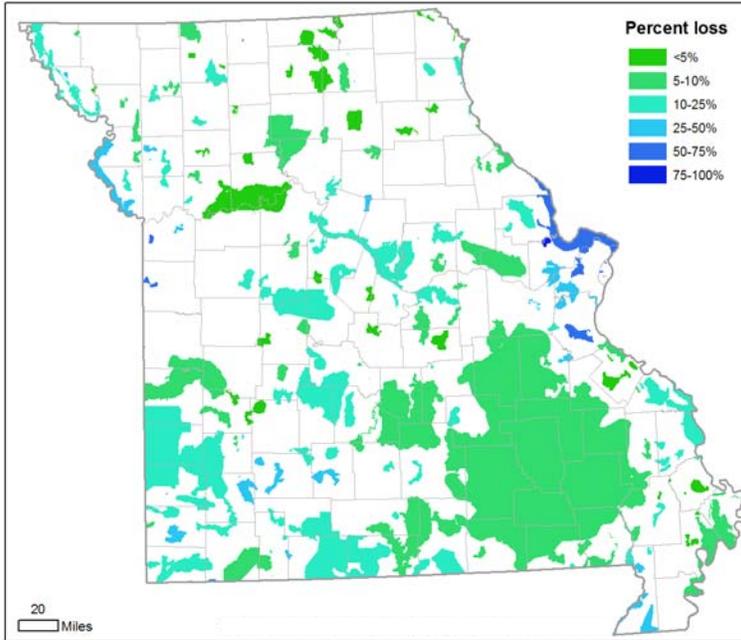


Figure A3.5. Loss of focal areas in Missouri from estimated human modification due to development in 2040.

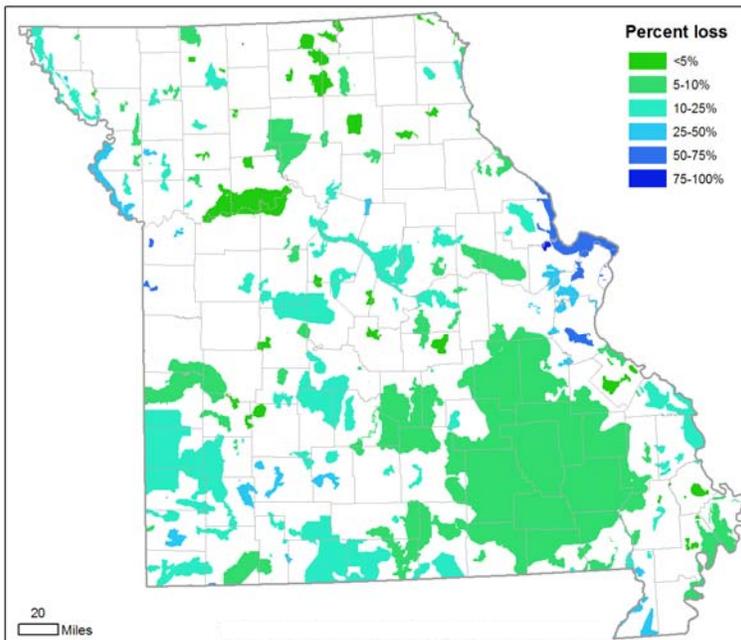


Figure A3.6. Loss of focal areas in Missouri from estimated human modification due to development in 2050.

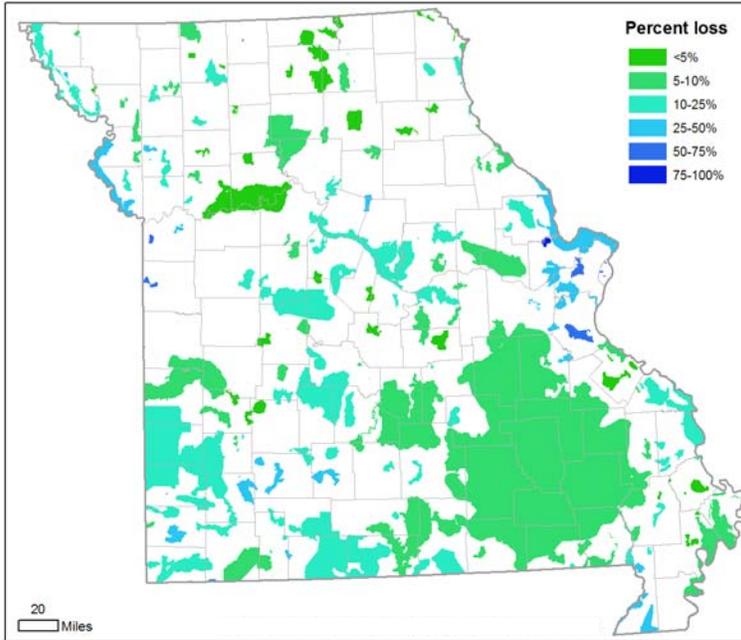


Figure A3.7. A comparison of the loss of focal areas in Missouri from estimated human modification due to development between 2000 and 2050.

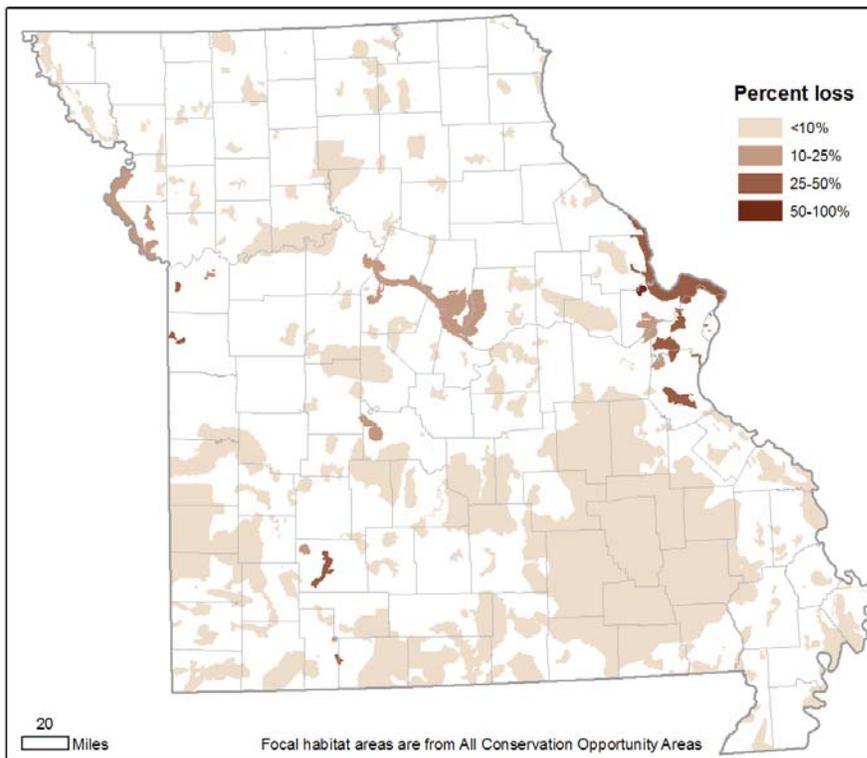


Figure A3.8. Focal area loss from 2000 to 2050 in the St. Louis, Missouri metropolitan area.

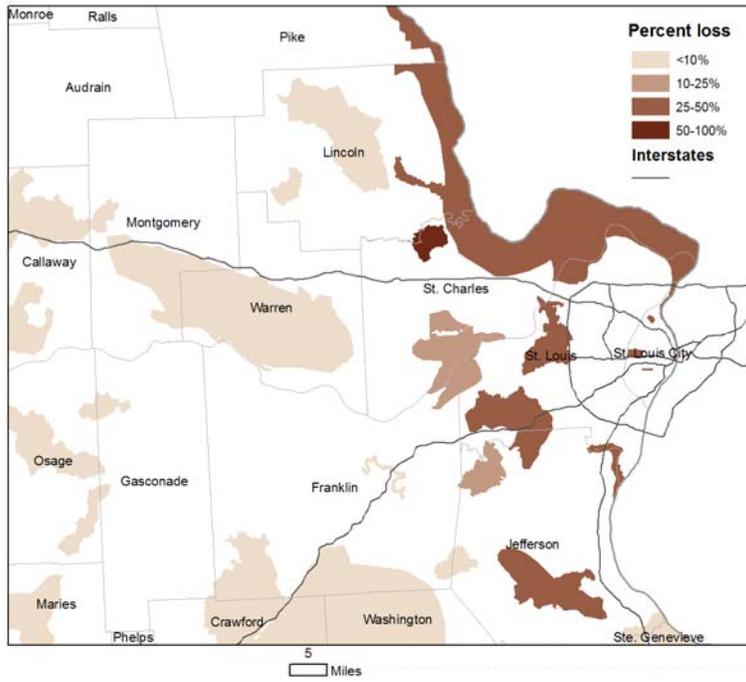
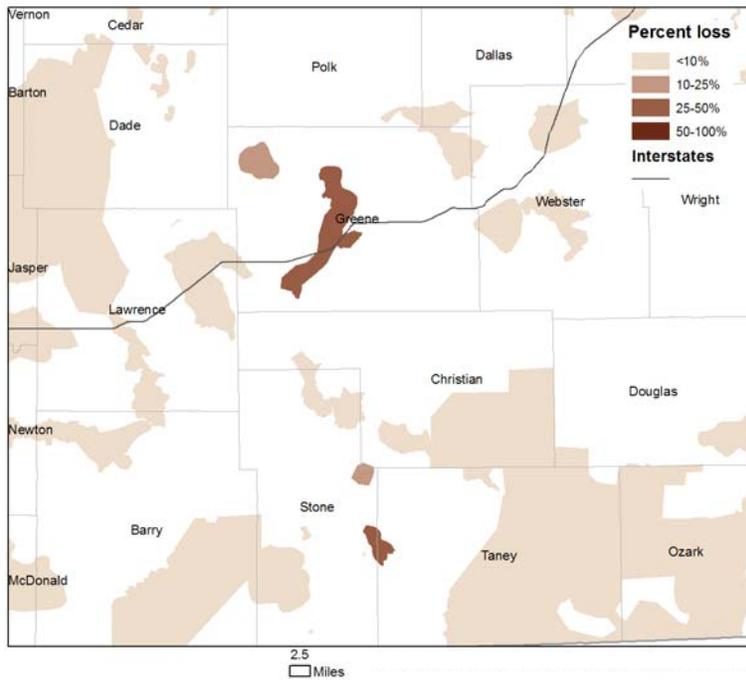


Figure A3.9. Focal area loss from 2000 to 2050 in the Springfield (north in Greene County) to Branson (south, in Stone County) corridor of Missouri.



4. Montana

Approximately 6 percent (22,707 km²) of Montana was included in the state's 19 Terrestrial Focus Areas. We found relatively little estimated loss of focal area due to residential development between 2000-2050 (i.e., averaged less than 1 percent statewide and no focal areas exceeded 1.9 percent loss). These focal areas pre-date the more recent "crucial areas assessment" activities.

Figure A4.1. Loss of focal areas in Montana from estimated human modification due to development in focal areas in 2050. Note that there is very little increase in habitat loss from 2000.

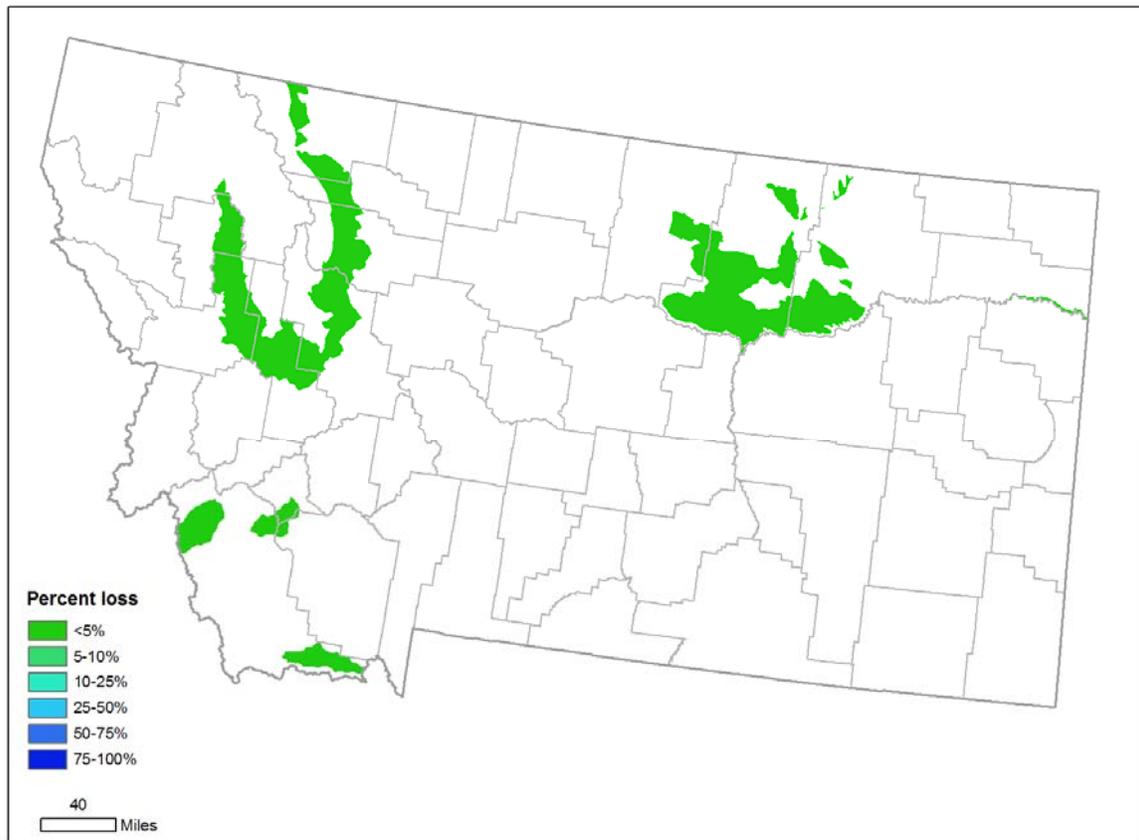


Table A4.1. The proportion of focal areas lost through human modification due to residential development over time in Montana. The focal areas are those identified in Figure 3.27. “Proportion lost to development (cover, %)” refers to the percentage of each focal area lost to residential development alone. “Proportion lost to development (functional, %)” refers to that lost due to residential development and its related indirect effects (i.e., footprint of development and human activities).

Focal area	Area (km ²)	Proportion lost to development (cover, %)						Proportion lost to development (functional, %)					
		2000	2010	2020	2030	2040	2050	2000	2010	2020	2030	2040	2050
1	608.3	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.8%	1.0%	1.0%	1.0%	1.0%	1.0%
2	1.6	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%
3	121.3	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%
4	10,211.0	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	1.4%	1.6%	1.6%	1.6%	1.6%	1.6%
5	384.1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%
6	34.1	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
7	3.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.3%	0.3%	0.3%	0.3%
8	8,130.9	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%
9	292.5	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%
10	53.6	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
11	0.6	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
12	4.4	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	1.6%	1.9%	1.9%	1.9%	1.9%	1.9%
13	21.9	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
14	29.8	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
15	44.6	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.3%	0.3%	0.3%	0.3%	0.3%
16	26.8	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	0.6%	0.6%	0.6%	0.6%	0.6%
17	717.7	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
18	1,151.3	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%
19	870.6	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%

5. New Hampshire

Approximately 63 percent (15,211 km²) of New Hampshire was included in their mapping of focal areas (Highest Ranking Habitat). New Hampshire will likely lose from 22 to 25 percent the habitat in their focal areas by 2050. However, roughly 2/3 of that estimated loss had already occurred by 2000. The spatial distribution of development pressure from 2000 to 2050 can be seen in Figures A5.1- A5.3. Focal area loss has occurred most substantially in southern New Hampshire, particularly surrounding Portsmouth (Figure A5.4).

Table A5.1. The proportion of focal areas lost through human modification due to residential development over time in New Hampshire. “Proportion lost to development (cover, %)” refers to the percentage of each focal area lost to residential development alone. “Proportion lost to development (functional, %)” refers to that lost due to residential development and its related indirect effects (i.e., footprint of development and human activities).

Tier	Extent (km ²)	Proportion lost to development (cover, %)						Proportion lost to development (functional, %)					
		2000	2010	2020	2030	2040	2050	2000	2010	2020	2030	2040	2050
Highest (by condition)	5,944	2.5	2.8	2.9	3.1	3.2	3.2	16.4	19.1	19.9	20.9	21.4	21.6
Highest (in region)	2,703	2.3	2.5	2.7	2.8	3.0	3.0	16.8	19.0	20.6	21.7	22.2	22.3
Supporting landscapes	6,564	2.5	2.8	3.0	3.2	3.4	3.5	18.3	20.7	22.7	24.1	24.7	25.0

Figure A5.1. Loss of focal areas in New Hampshire from estimated human modification due to development in 2000 and 2010.

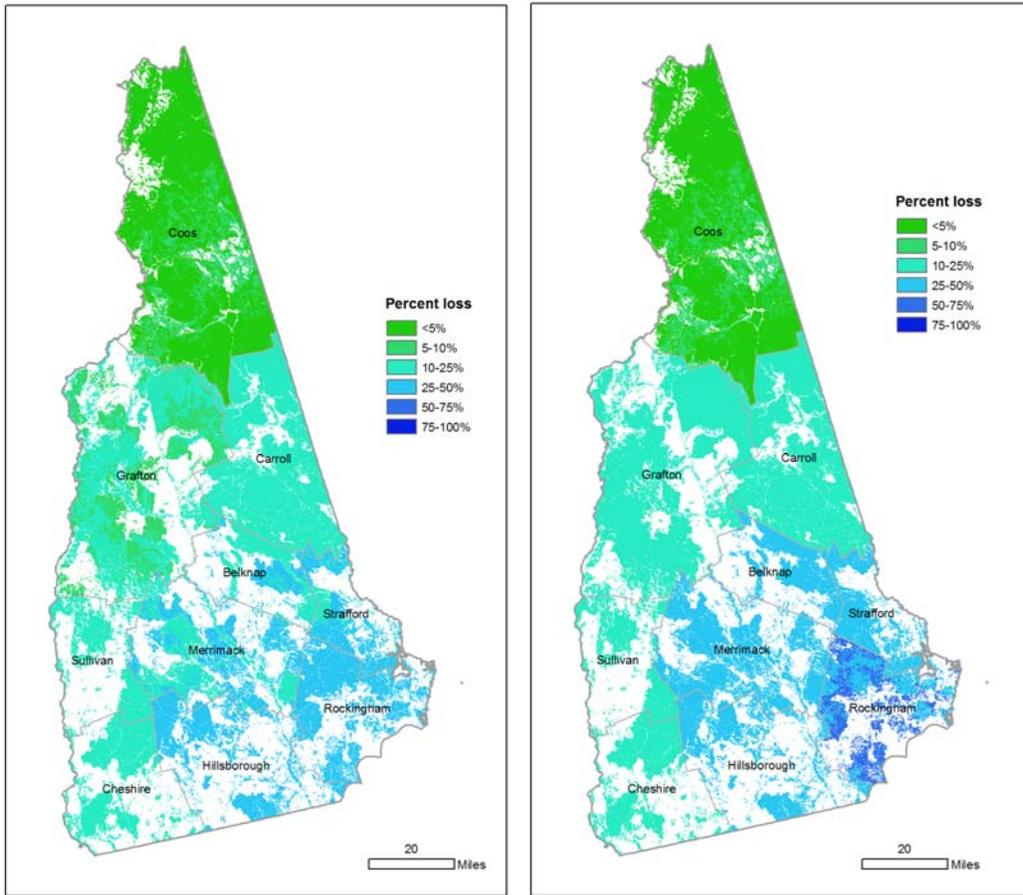


Figure A5.2. Loss of focal areas in New Hampshire from estimated human modification due to development in 2020 and 2030.

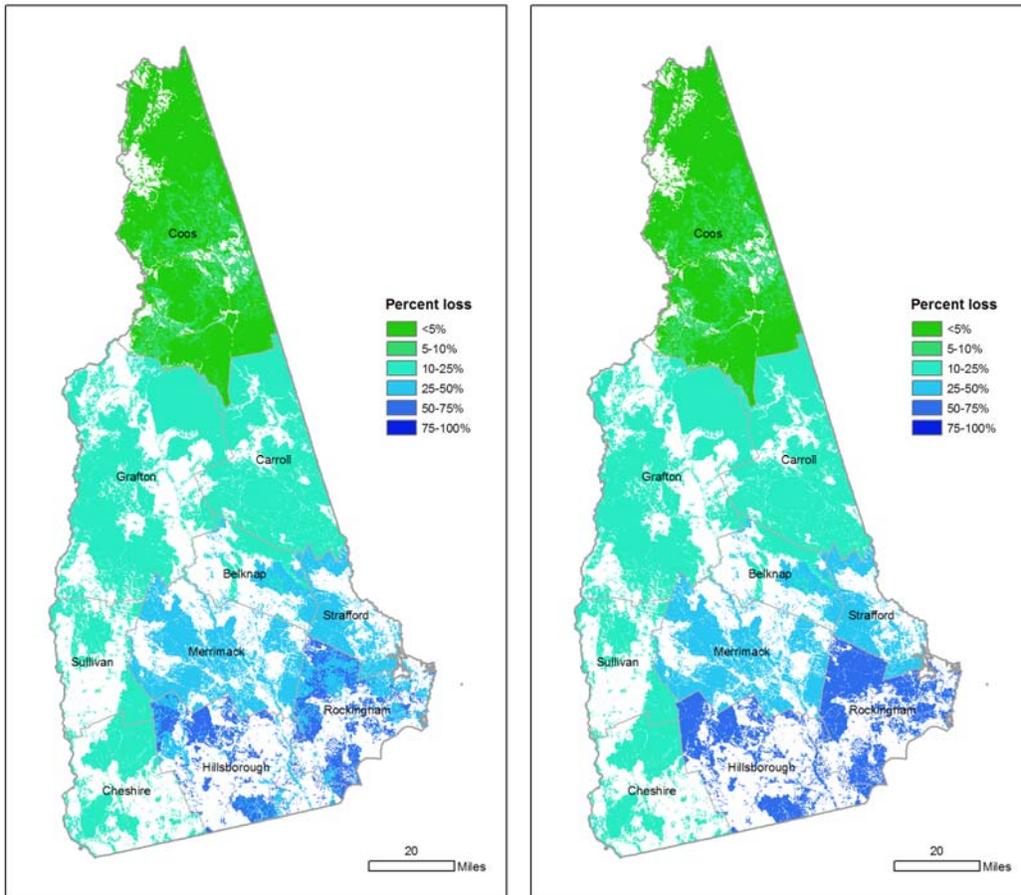


Figure A5.3. Loss of focal areas in New Hampshire from estimated human modification due to development in 2040 and 2050.

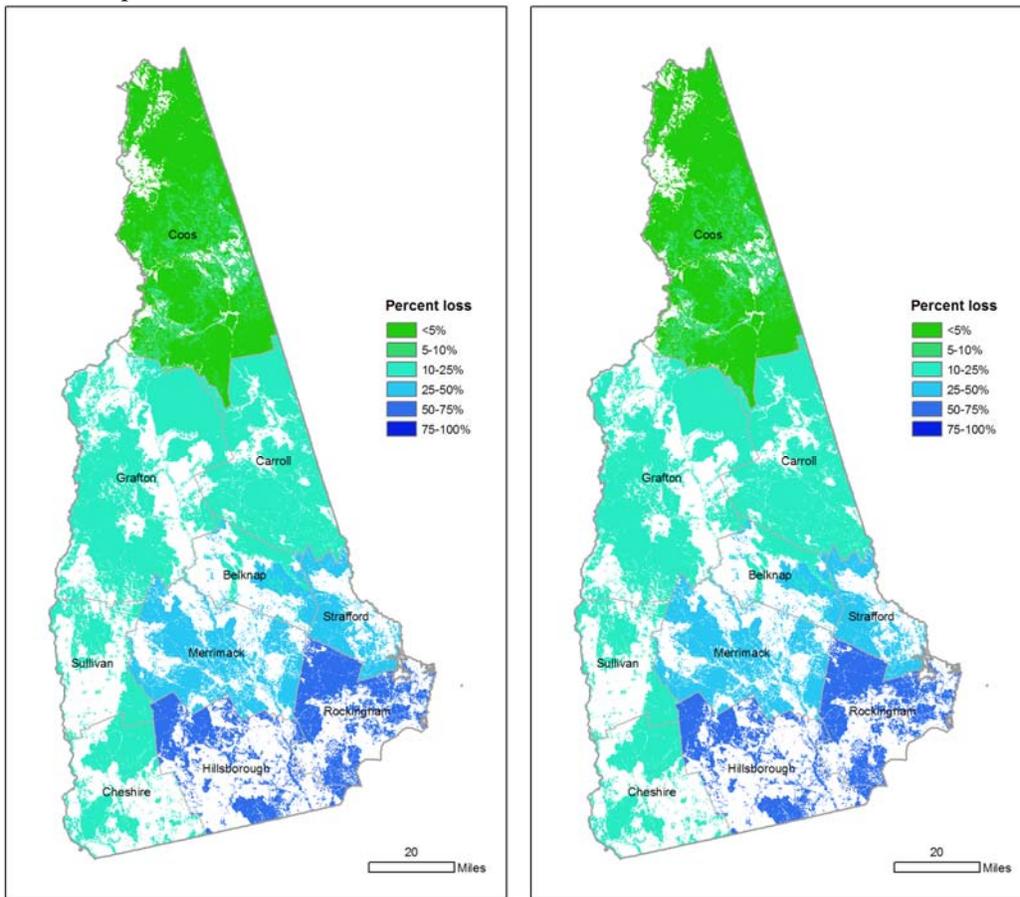
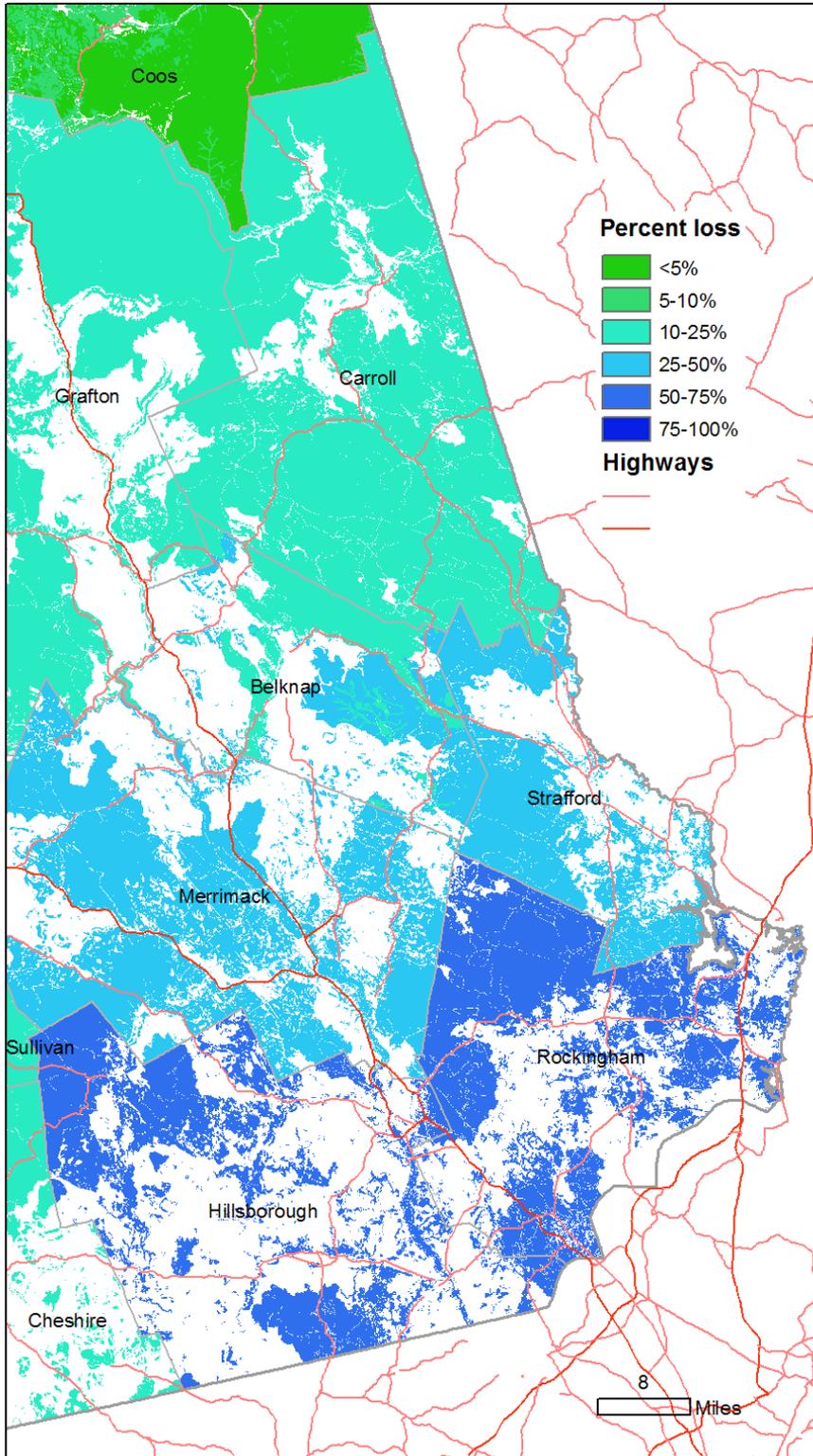


Figure A5.4. Focal area loss in 2050 near Portsmouth in southeast New Hampshire.



6. Tennessee

Approximately 21 percent (23,915 km²) of Tennessee was included in one of the 653 patches (at least 1 km² in size) that make up the state’s Priority Terrestrial Habitat Areas. In 2000, roughly 4.13 percent of the focal areas had already been lost to development. This loss is projected to increase slightly to 4.19 percent by 2050 for the entire state (Figure A6.1- A6.7). Nearly all of the impacts due to development occur on areas identified as “medium” priorities. However, there are a number of smaller patches of focal areas, particularly around the Nashville and Chattanooga (Hamilton County) metropolitan areas (Figure A6.8) that are likely to experience substantial habitat loss.

Table A.6.1. The proportion of focal areas lost through human modification due to residential development over time in Tennessee. “Proportion lost to development (functional, %)” refers to that lost due to residential development and its related indirect effects (i.e., footprint of development and human activities).

Priority	Proportion lost to development (functional, %)					
	2000	2010	2020	2030	2040	2050
Low	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
Medium	4.13%	4.17%	4.17%	4.18%	4.18%	4.19%
High	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
Very high	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%

Figure A6.1. Loss of focal areas in Tennessee from estimated human modification due to development in Tennessee in 2000.

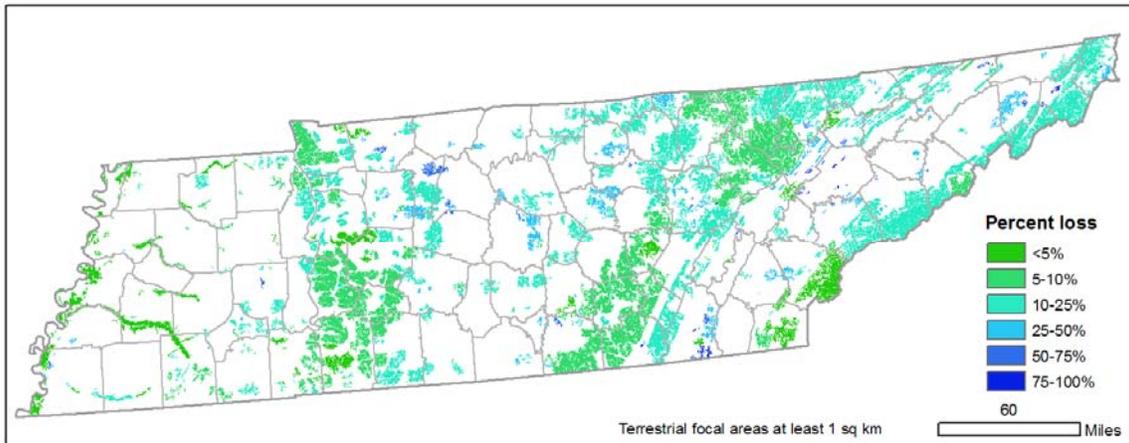


Figure A6.2. Loss of focal areas in Tennessee from estimated human modification due to development in Tennessee in 2010.

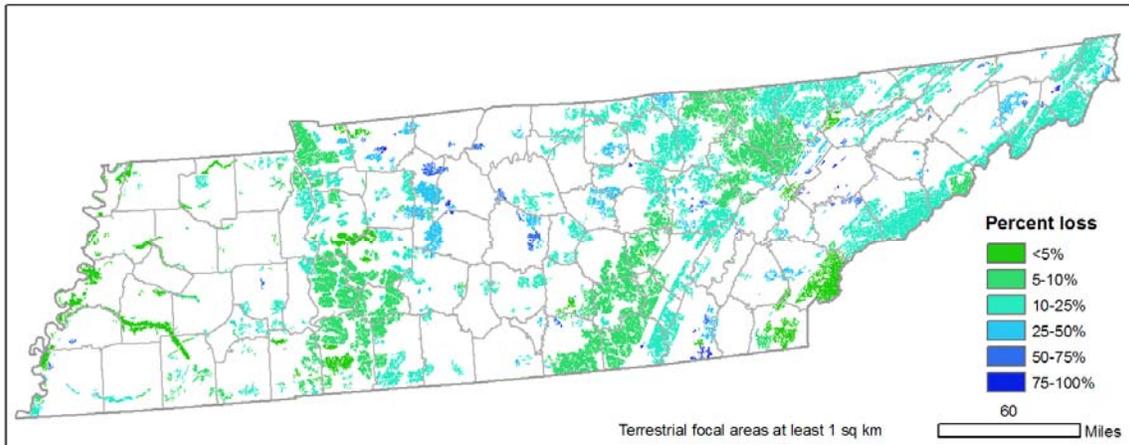


Figure A6.3. Loss of focal areas in Tennessee from estimated human modification due to development in Tennessee in 2020.

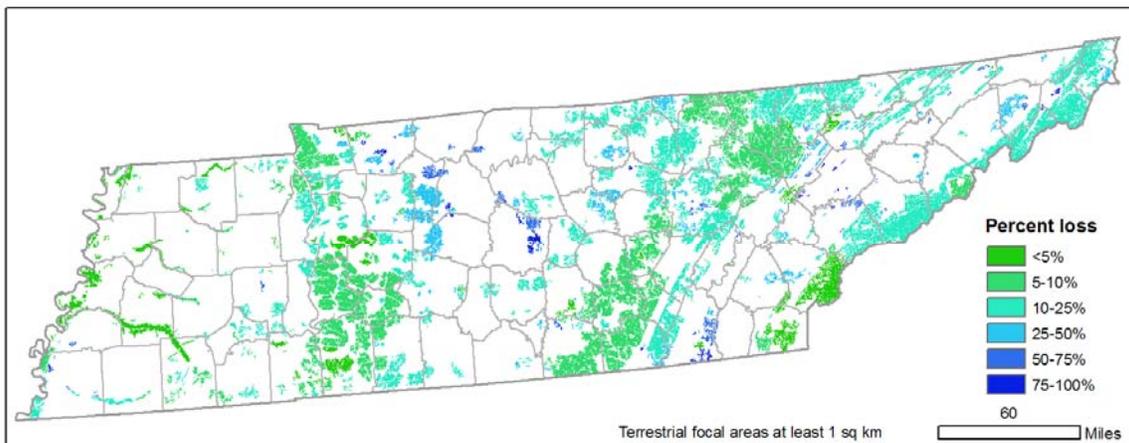


Figure A6.4. Loss of focal areas in Tennessee from estimated human modification due to development in 2030.

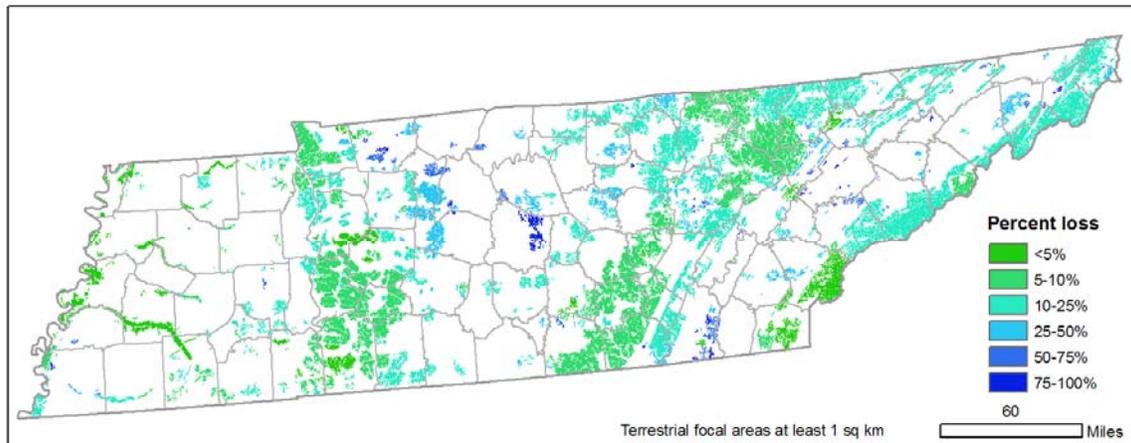


Figure A6.5. Loss of focal areas in Tennessee from estimated human modification due to development in 2040.

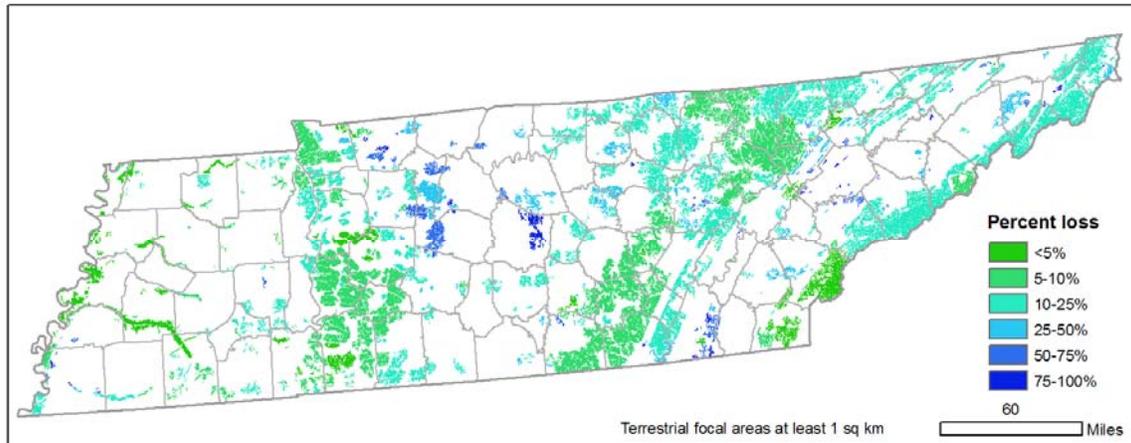


Figure A6.6. Loss of focal areas in Tennessee from estimated human modification due to development in 2050.

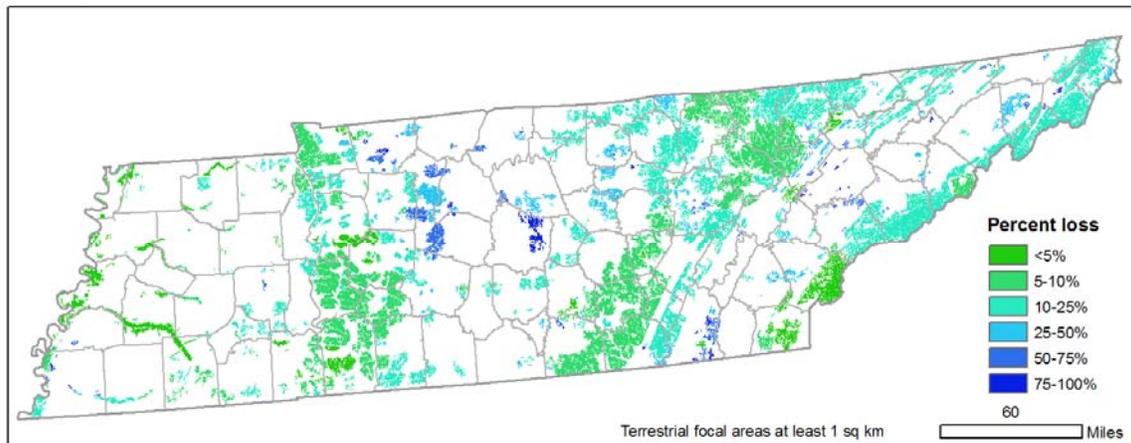


Figure A6.7. Loss focal areas in Tennessee estimated human modification due to development from 2000 to 2050.

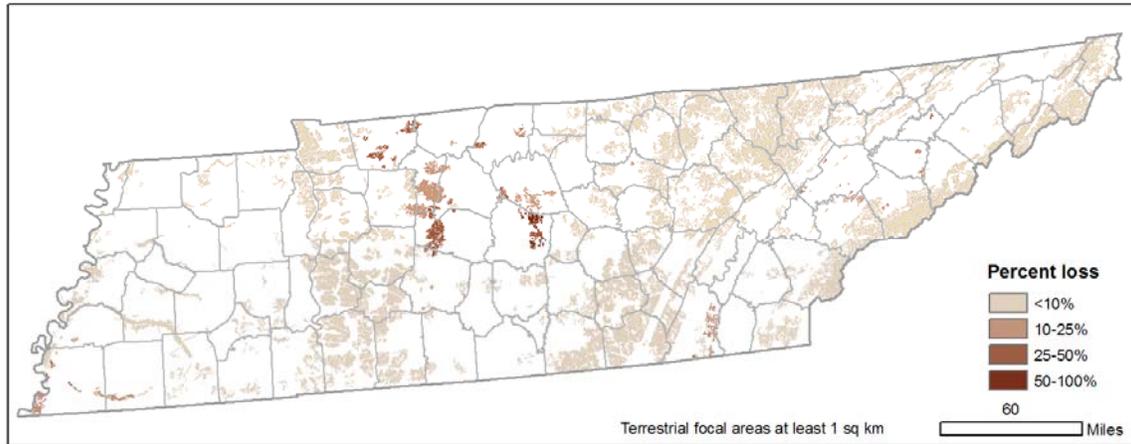
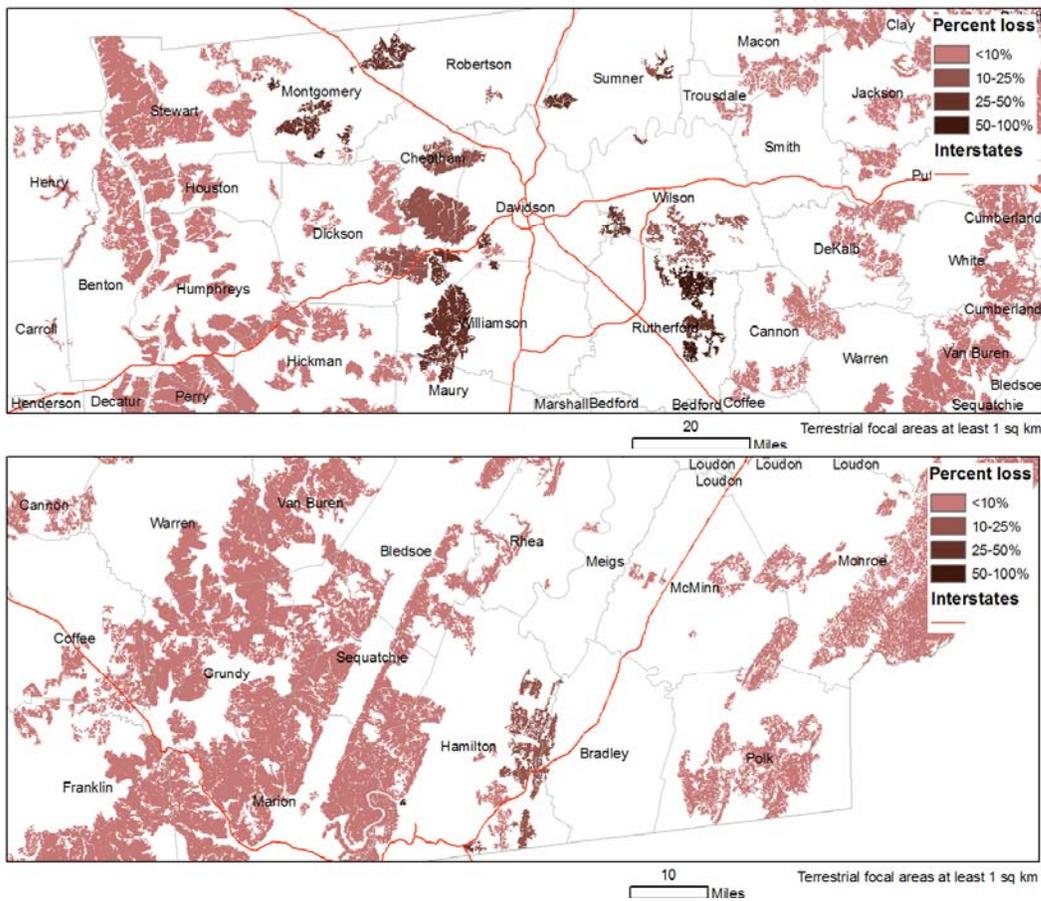


Figure A6.8. Loss of focal areas in Tennessee from 2000 to 2050 around Nashville (top) and Chattanooga (bottom).



APPENDIX B: Summary of Interviews with State & Local Planners

- 1. Colorado**
- 2. Georgia**
- 3. Missouri**
- 4. Montana**
- 5. New Hampshire**
- 6. Tennessee**

1. Colorado

A. Population Projections

The State Demography Office, Division of Local Government offers population forecasts in 5 and 1 year increments from 2000-2035, which are available in Excel format (on file with author).

B. Comprehensive Vision Plan or Land Use Plan

Colorado does not have a statewide land use plan. Local governments control land use planning regulations. As far as the role of the state, the Office of Smart Growth is the clearinghouse for best practices; and provides grants for consulting as well as training—the tools and toolkits—on growth management.³⁰

C. Regional Growth Plans

Colorado has 14 regional councils of government. While some growth is occurring in the mid-size cities (e.g. Fort Collins, Pueblo), it is mostly happening in the Denver front-range region.³¹

D. Transportation

While desired capacity improvements are included in the Long Range Transportation Plan, there is not much mapping for future expansions because there is no money for expansion.³²

Indeed, there is not much ongoing expansion work. With the cash crunch, there is a hiring freeze as well as no money to maintain or create/expand transportation system.³³

Roadway data typically displays quarterly projections but does not have future projections.³⁴ Some limited projection-data exists: shape files for new project around the Pikes Peak TPR (on file with author).

E. Statewide Datasets on parcels/Zoning

BLM's Land and Resource Information System, a cadastral survey, will soon be available in ARC/View. Land records are currently in paper format.³⁵

CoMap.³⁶

F. Lot Size for Septic Systems

The state sets the floor, but there is much variation: some regions have fractured granite that allows grey water to move easily through the soil and subsequently have much higher standards.³⁷ Colorado has no

GIS coverage of septic leach fields and does not have an adequate GIS clearinghouse; septic facilities that are less than 2000 gallons/day are administered by the county.³⁸

G. Statewide Subdivision Law

The state has had guidance for counties since 1974, found at CRS 30-28-133. This statute establishes the 35 acre ranchette break point of exemption from the subdivision process.³⁹

H. Enabling Legislation for Cluster/Conservation Subdivision

Yes, for nearly ten years.

CRS 30-28-403 Cluster Development states that “[n]o rural land use process as authorized by this section shall approve a cluster development that would exceed one residential unit for each seventeen and one-half acre increment. As a condition of approving a cluster development, a rural land use process shall require that the cluster development plan to set aside land to preserve open space or to protect wildlife habitat or critical areas not permit development of such land for at least forty years from the date the plan is approved.”

I. Best Source of Data on Protected Areas

Parks and recreation areas (on file with author); State Wildlife Areas (on file with author); DRCOG Urban Growth Boundary (on file with author)

Recommended Sources:

Coalition of Land Trusts, Jill Ozarski (303-271-1577)

COMap v. 7

J. Local Context

The Denver Regional Council of Governments Metro Vision (governments banded together to create an urban boundary to contain sprawl - *saved*) and Fort Carson (army base that is planning substantial growth in housing for soldiers and doing much work on sustainability) are two areas on which Bergman suggests we focus. He also emphasized the critical need for regional (i.e. city and county) cooperation, as they need to coordinate the work on the urban fringe.⁴⁰

i. DOT

Finch notes on two occasions that capacity improvement is not exclusively highway, but includes transit as well—which works well in densely populated areas in the Front Range.

We should consider not only growth in capacity/infrastructure, but also growth in traffic. Some areas like the SW portion of Colorado and rural areas have corridors that are/were underutilized and are now facing increased volume of traffic; with this comes an increase in vehicle-wildlife collisions and other adverse environmental effects; DOT is trying to address specific species and habitats to protect the wildlife corridors and reduce these incidences.⁴¹

DOT is also involved in an FHWA-sponsored Ecological project “applying a Regional Ecosystem Framework (REF) to the I-70 Corridor in Colorado from Denver to Glenwood Springs traversing portions of the Clear Creek, Blue River, and Gore Creek watersheds. The REF incorporates an ecosystem based approach to development of transportation infrastructure through protection and restoration of aquatic and terrestrial wildlife connectivity. The REF also strives to improve predictability in the environmental

review process and provides an enhanced forum for public involvement over the current planning process.”⁴²

ii. Coalition of Land Trusts (CLT)

CLT, which represents not only land trusts but local governments, focuses on private lands and how to ensure that the expected population growth and development is done in a manner that does not destroy open spaces, vistas, and other natural resources. Ozarski discusses two main programs for conserving open spaces in Colorado: Great Outdoors Colorado (GOCO), which provides tens of millions of dollars of competitive benefits for a range of areas, from ball fields to working ranches; and the State Conservation Easement Income Tax Credit.⁴³

Two million acres of land are protected across the state—conservation funding sources at the local level and sales taxes have been important in purchasing much of this land.

The applicability of our study becomes a challenge because, while wildlife habitat is important, there are many other important areas too. Ozarski discussed the difficulties of private land conservation – need landowners’ willingness and cheap land. Our figures would not capture this.⁴⁴

Ozarski brings to my attention a relevant federal effort, *The Forest Service Open Space Conservation Strategy: Cooperating across boundaries to sustain working and natural landscapes* – this effort looks at population growth and management of forests and grasslands. “The strategy charts a path forward for the Forest Service to work in partnership with states, local governments, landowners, and non-profit organizations to address the loss of open space threat. The strategy provides a framework to strengthen and focus existing and new Forest Service conservation actions across the agency.”⁴⁵

K. SWAP

i. *Linking Land Use and Conservation Planning – Defenders of Wildlife*

“Ironically, the majority of research documenting development impacts on wildlife has occurred in Colorado (see Appendix A), which did not prioritize or emphasize development as a threat in their State Wildlife Action Plan.” (8)

In Colorado: “Current research (Bock et. al) indicates that livestock grazing had more detrimental effects than development on rodents in several habitat types; “Exurban development had no obvious effects on rodent variety or abundance. Results suggest southwestern exurban developments can sustain a rich assemblage of grassland and savanna rodents if housing densities are low and houses are embedded in a matrix of natural vegetation with little grazing.” (47)⁴⁶

ii. Analysis

The Colorado SWAP is extremely focused on fulfilling the requirements of the State Wildlife Grant program and consists primarily of charts. Therefore it generally eschews any sort of general strategic discussion linking human population trends with environmental pressures. The introduction briefly mentions “infrastructure and other resource demands from a growing Colorado population” as a major threat to wildlife (viii), but the population issue is never revisited in any depth. The habitat destruction resulting from development is seen as a major strategic theme (43), and a key issue impacting all wildlife in the state (46). In the case of some specific threatened species, the preferred solution to habitat pressures is given as “planning and zoning” (328) and in the case of certain river habitats “growth management” is recommended to alleviate pressure (53) - however no details are given on what exactly these solutions entail. The need to “improve ability to predict threats to vulnerable species including such variables as areas of future human disturbance” is included in a long list of research priorities, but given no special prominence or explanation.

2. Georgia

A. Population Projections

The Office of Planning and Budget is in the process of working with UGA on these projections. This data will not be publicly available until March 31, 2009. UGA is currently working with UT-San Antonio and will be submitting a draft to communities in December for review/challenge/etc. They do not have GIS datasets on growth either.⁴⁷

B. Comprehensive Vision Plan or Land Use Plan

No.⁴⁸ The Planning Act of 1989 provided for the Department of Community Affairs (DCA) to produce a comprehensive plan, but since no governor has ever asked for one, there is no comprehensive plan.⁴⁹

C. Regional Growth Plans

Yes, the state has 16 regional development centers, each of which has a regional plan.⁵⁰

D. Transportation

G-DOT has GIS data for “locations of all roadway projects on existing highways under construction and in the preconstruction (design) phase. It does not contain locations of projects that would be completely new or local government grant projects (Transportation Enhancement, State Aid, Local Area Roadway Assistance Program, etc.). At this time we do not have a way to map these locations, but it is a work in progress.”⁵¹ (*saved: GDOT_projects.zip*)

E. Statewide Datasets on parcels/Zoning

There is no statewide parcel dataset. There is, however, some individual county parcel data available on the Clearinghouse website (on file with author). Some cities and towns charge for their parcel data.⁵²

F. Lot Size for Septic Systems

County Boards of Health are authorized by Georgia statute in OCGA 31-3-5(b) (2) to establish minimum lot sizes. The Georgia Department of Human Services, Division of Public Health provides counties technical guidance “for the siting, design, permitting, inspecting, and trouble-shooting of on-site sewage management systems.”⁵³

G. Statewide Subdivision Law

No.⁵⁴

H. Enabling Legislation for Cluster/Conservation Subdivision

Clusters and conservation subdivisions do exist in the state, but Frederick was not sure if there is actual enabling legislation.⁵⁵ Frederick added that with home rule, counties and local governments can do what they want.

In much of Georgia, “state conservation subdivisions are not allowed. Or, to be more accurate, the zoning and subdivision codes of most local governments do not provide the flexibility to build anything other than conventional subdivisions, making it either impossible or difficult and time-consuming (and therefore expensive) for developers to have a conservation subdivision design approved.” Some counties have passed conservation subdivision ordinances to reduce the barriers to non-conventional development with varied success.⁵⁶

The state has enabling legislation that authorizes local jurisdictions to implement transferable development rights programs in their communities.⁵⁷ It also has as a land conservation tax credit.⁵⁸

I. Best Source of Data on Protected Areas

Conserved and protected lands (**on file with author**).

Georgia GIS Clearinghouse, see <https://gis1.state.ga.us/index.asp>
Terry Jackson, GISCC Chair, Georgia Department of Community Affairs

J. Local Context

Planning is done at the local level due to the structure of the Georgia Planning Act of 1989. A mandated consideration of natural resources promulgated by the Dept. of Natural Resources exists. These “Environmental Planning Criteria” protect river corridors, wetlands, mountain areas, and some other areas.⁵⁹

All of Georgia's 692 cities and counties are required to adopt local regulations protecting wetlands, water supply watersheds, aquifer recharge areas, protected river segments and protected mountains that occur within their jurisdictions. So far about 250 governments have adopted the required regulations" [as of 2001]...A number of implementation challenges have been identified. Two critical local issues are how to address the local need for occasional variances and how to insure enforcement of local regulations in jurisdictions lacking sufficient administrative capacity.⁶⁰

While planning is typically done at the local level, the governor asked for a specific study to be done on the Georgia coast. Along with local officials of the five coastal counties, DCA developed a Coastal Regional Plan. To date, Jackson affirms, this is DCA's largest planning effort.⁶¹

DCA is currently engaged in water planning – setting up regional water planning councils to look at planning and water demand. These councils will prepare regional water development and conservation plans (WDCPs), which the Dept. of Natural Resources will use in issuing groundwater permits.⁶² This endeavor will require strong population projections (UGA is currently developing these).

The sixteen regional development centers (RDCs) are semi-autonomous entities that exist under the auspices of the 1989 Planning Act. Most of their funding is from local constituents, but they also receive state & federal support. Currently, RDCs are being reorganized: there will be 12 instead of 16 centers and they will receive more state funding [for water studies]. This reorganization has been preceded by a decade of planning efforts to consolidate planning regions of the Dept. of Humna Resources, DOT, and DCA, all of which have their own paradigm. The reorganization should be done by summer of 2009 and should improve services, help with inter-agency coordinating, and make efforts more cost-effective.⁶³

Our [WHPRP] study could be useful if the results are made available/distributed to the RDCs for integrating into their comprehensive plans. Additionally, its relevance would be greatly enhanced if we include the environmental criteria and/or the population projections (these will not be available for several months).

DCA provides planning data to local governments. They are currently building a "data appendix generator" to provide information to local governments for developing their comprehensive plans. Their data will overlay environmental criteria and development to illustrate potential conflicts.

The weakest part of the planning process is that, while local governments are required under the Georgia Planning Act of 1989 and the Mountain and River Corridor Protection Act (O.C.G.A. 12-2-8) to pass local ordinances to protect natural resources, not all of them have done this. A lack of state oversight impedes ensuring that local governments enforce local laws to protect the environment ("Designed to fail"). Jackson is not sure when the state will become more serious with making stringent laws to protect the environment.

K. SWAP

i. Linking Conservation and Land Use Planning – Defenders of Wildlife

Georgia: "Georgia Land Conservation Partnership Plan: This report also addressed the need for tax relief to protect rural properties from the impacts of residential and commercial sprawl and mentioned other relatively new approaches such as transferable development rights and carbon sequestration credits" (Sec 5, pp. 187) (DOW -27)

ii. Conservation Across the Landscape

"Georgia's plan provides another excellent model of conservation actions in its Appendix L (GA DNR 2005). Each high priority conservation action is tied to a goal, a target species/habitat, a geographic

region, funding source, and lead and cooperating partners. Georgia’s analysis answers the question of who is supposed to do what where, with which resources, and toward what end.” (17)

Defenders of Wildlife consider this one of a dozen “state wildlife action plans that exhibit the best quality in most areas and emerge as [a] good model[] for the future evolution of these documents (21).⁶⁴

iii. SWAP Analysis:

The Georgia SWAP throughout demonstrates an understanding that population growth and development pose a significant threat to wildlife and wildlife habitats and also describes a real effort to use population and land use trends and projections to inform conservation decisions on all geographic scales. The Executive Summary declares “The trend of increasing fragmentation and degradation of natural habitats is likely to continue in the coming decades, driven by local, national, and global economic and demographic factors. Many scientists believe that the next fifty years will be a critical period in the struggle to protect our remaining biological resources.” (xi) Later the SWAP expresses an interest in “historic, current, and potential impacts of various sources of stress” (24). In terms of historic impact, a 1987 study on population growth and land use changes is particularly cited, but there is an acknowledgement that “urban sprawl has increased dramatically” since that study (46), and a set of satellite images reflecting changes between 1974 and 1998 are also repeatedly used in the document to elucidate ongoing development patterns (53). The SWAP divides Georgia into five ecoregions, and describes not only the overall rate of development in these regions but the specific towns, cities, and highways where development and urban sprawl pose a particular threat to wildlife (57). In four of the five ecoregions, development is the first listed problem affecting wildlife diversity.

The SWAP expresses some uncertainty concerning the ability of past population and land use trends to accurately project the future, noting that understanding of Georgia’s conservation needs is likely to change with the emergence of new trends (x). Nevertheless a statewide conservation initiative given highest priority is to not only track land use changes in Georgia as they effect critical species and habitats but also to “develop projections of future land use trends and resulting impacts on ecological systems.” (172)

3. Missouri

A. Population Projections

Yes, from Office of Administration Website (on file with author).

In addition to state projections, also East West Gateway Council (on file with author)

B. Comprehensive Vision Plan or Land Use Plan

No.⁶⁵ Nor is there is a state-level entity or parent organization for planning and growth. Local entities will often give DOT the heads up about growth so they will be able to anticipate the additional demand on roads – but this cooperation is not required.⁶⁶

C. Regional Growth Plans

All nineteen of the regional planning commissions and councils of government have growth plans, but not necessarily comprehensive plans. Due to enabling legislation, each of these plans is done in a different context and often addresses a specific area (e.g., hazard mitigation, transportation).

D. Transportation

Missouri has lots of ongoing new and expansion transportation projects, unlike most of the other states in which we are interested. This level of expansion is a major concern – not only for the costs of maintenance and construction, but also the dealing with public expectations.⁶⁷

MACOG works with the regional planning commissions—planning, coordinating, and facilitating between these groups—and also with DOT on their planning framework.

While there is lots of ongoing construction, the biggest and most contentious is the work on I-70, which goes across the state; the road bed is failing and stopgap resurfacing only works for a year or two each time.⁶⁸

[On a state-level] GIS is only created for transportation projects as the infrastructure is built.⁶⁹

Transportation data for East-West Gateway Council (on file with author)

Each of the ten districts at DOT does its own coordinating and planning. Due to the decentralized structure, Bernskoetter was not sure how the general headquarters could have each of these districts incorporate our study into their planning.⁷⁰

Regarding transportation GIS, the East-West Council of Governments has a mapping component in its Transportation Improvement Project (TIP); long-range plan; and its unfunded wish list. Not all COGs have a mapping component in their TIP.⁷¹

E. Statewide Datasets on parcels/Zoning

No. As zoning is all done on the local level, it is also maintained at a local level.⁷²

F. Lot Size for Septic Systems

The minimum lot size, which is established by the State Department of Health, is 3 acres.⁷³

G. Statewide Subdivision Law

No.⁷⁴

H. Enabling Legislation for Cluster/Conservation Subdivision

There is enabling legislation that gives the authority to local jurisdictions. The legislation is very generic and does not explicitly address clusters, conservation, or other innovative approaches. It is modeled on the standard enabling statute (Standard State Zoning Enabling Act) from the 1920s Department of Commerce, and has undergone some tweaks/modifications over the years. That said, it does not preclude any of these things. Local governments can implement any of these standards should they choose to do so.⁷⁵

MACOG, the Missouri Chapter of APA, the Missouri Association of Counties, and others are working to develop and propose modernization of enabling legislation at the county-level: the legislation would grant counties the authority to address conservation, open spaces, etc. in zoning and subdivision. For the past three years, legislation has been submitted to the state legislature. It has been pre-filed and will be introduced again. Once the legislation is passed, Hermes hopes this would lead to enabling legislation for municipalities. MACOG is being inclusive with who they include in their partnerships – special interest groups, planners, etc.

Counties near urban areas are more likely to have conservation subdivision, clusters, etc. Not many rural counties have planning and zoning (re fighting words). Their interest is in minimal oversight and property rights. In terms of innovation, these communities have by and large not gotten into these sorts of planning approaches.⁷⁶

Hermes is currently working with Johnson County, which is experiencing pressure from the expanding Kansas City-area to develop minimum development standards so that landowners have a manner by which to evaluate development. They recognize the balance of property rights versus the impacts of free unregulated property rights, especially the fiscal impact: they won't be able to construct, maintain, etc. the county roads to support all of this development; they simply don't have the money or staff.⁷⁷

I. Best Source of Data on Protected Areas

Conserved and protected lands (on file with author)

Missouri Spatial Data Information Service (*see* <http://msdis.missouri.edu/>)

Missouri Resource Assessment Partnership (MoRAP, *see* <http://www.cerc.usgs.gov/morap/>)

Missouri Natural Heritage Database

University of Illinois at Urbana-Champaign LEAM Model

Two Regional Councils of Government (EWCOG, MARC)

MoRAP has developed an urban land demand projection, which relies on distance from roads & from urban areas, as well as the population trends from the past 10 years. Completed in 2005, this is a very simple project that does not actually address where the road might go; and had to include agricultural land demand, which is very hard to predict—especially with the recent price increase for corn, bio-fuel development, etc. The dataset covers Missouri, Kansas, and Nebraska.

MoRAP is also working with the East-West Gateway Council of Governments (EWCOG) to create an overlay of the environmentally significant layer and areas that will be threatened. For the past year, they have been modeling the EWCOG area – including a dataset with a 1-2 meter scale of environmentally important areas. They are in the midst of developing a land use model that will forecast growth at a 30x30 meter resolution.⁷⁸

Univ. of Illinois has a Land-use Evolution and impact Assessment Model (LEAM) that takes into account the “leap-frog effect,” whereby developers will select parcels away from urban centers for the cheaper land.⁷⁹

LEAM is “a comprehensive urban planning support system in a regional scale. LEAM incorporates ecological, geographic, and environmental theories into a single hierarchical framework, yet it is designed as an open architecture...A land-use decision support system for St. Louis metropolitan region using LEAM approach has been developed.”⁸⁰ It is a probability-based model looking at environmental stresses on important habitats and uses large tracts of property and projected growth.⁸¹

Finally, the Mid-America Regional Council (MARC) has a natural resources inventory and dataset on land cover. The natural resources data is used as a baseline dataset for transportation planning as well as for growth.⁸² They also are working on infrastructure growth to predict future development through the seven-county area in the next 30-40 years by decade. The future distribution of people, houses, and jobs will help them in allocating their transportation funding.⁸³

The surrounding Kansas City region has very little wild spaces (most of the habitat has been converted to agriculture, pastureland, and housing). There is some habitat along streams and floodplains, in which they have focused; but there is little upland habitat and no megafauna on which to base their planning.⁸⁴

Since they are not too far in the Eco-logical⁸⁵ work, our study could be useful – especially our methods for approaching the problem.⁸⁶

J. Local Context

i. Missouri Association of Councils of Government (MACOG)

The significant planning issues are conceptualized as either physical infrastructure (e.g., transportation) or natural resources infrastructure (e.g., water). In the northwest part of the state, water resources quantity is a major issue – not only for new developments, but existing populations and communities.

Transportation infrastructure is another major concern—not only the maintenance and construction, but the public expectation (*see* Sect. 3D).

The Department of Conservation (DOC) recently was awarded a federal grant to provide training and education that focuses on local planning in connection with conservation, forestry, open spaces, natural resources, etc. MACOG was awarded the project from DOC to carry out the program, called “**Forestry Training and Publication Development.**” They will hold workshops to train local governments and regional councils of government to incorporate natural resources into their planning efforts.

MACOG will provide information for these entities to implement conservation strategies into their local decision making beyond zoning – in their regulatory and non-regulatory frameworks. In some areas, they will do some in broad terms – bring conservation into existing programs to avoid formal zoning.⁸⁷ This project will strengthen the connection of transportation, hazard mitigation, homeland security, water quality, and natural resources planning; and will show local governments how to do so without formal zoning.

In a related discussion, Hermes notes that the authority for planning, zoning, and subdivision is done at a local and county level. This is also the case for floodplain management. Local authorities can adopt floodplain standards without formal zoning adoptions (which require a constituent vote). Most counties are participants in NFIP, which has an element of land use control. For some, however, this crosses the sensitive boundary of property rights and land use planning.

ii. East-West Gateway Council of Governments (EWCOG)

The EWCOG covers five counties in Missouri and three in Illinois.

The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) “give[es] State and local transportation decision makers more flexibility for solving transportation problems in their communities.”⁸⁸ EWCOG is in the midst of developing a regional ecosystem-level of mitigation. This shifting from site-specific mitigation to regional mitigation requires meeting and working with state and national conservation/natural resource groups. In doing so, they anticipate reducing their expenditures and getting more bang-for-their-buck.

A study like ours could help put everyone on the same page as to their development/ conservation priorities, how things overlap, and where they can have the minimum impact. This mitigation planning entails applying the LEAM forecasting tool in planning; it is a very forward-looking project with a 20-30 year horizon.

Sharing what's going on around the country—best practices, strategies to reduce impact, and how to resolve conflicts—would be especially useful. In Missouri, “Land use control” and “land management” are fighting words. As there is no statutory authority, entities like EWGCOG face the challenge of planning at the regional scale.

More data from our study could lead to more progress and avoidance of adverse impacts. People would rather hear about wildlife and other issues than land use control/management/etc.⁸⁹

iii. Mid-America Regional Council in Kansas City

The Mid-America Regional Council in Kansas City is working on a green infrastructure plan and faces a number of challenges like geography (in both Kansas and Missouri—for which planning and transportation districts do not exactly overlap).⁹⁰

They are in the process of putting together an Action Plan that, through the FHWA Eco-logical Grant Program, focuses on integrating/better linking environmental and transportation in planning efforts (on file with author). They are currently at the policy and process level—not quite at the data level yet. Our study could be of use here as well.

They are also looking at opportunities for restoration in their “how we do business” approach. It is not stated officially as a policy, but is one of their considerations (that we should take into consideration for applicability of our study). Some past decisions resulted in significant environmental damage, and now, for example, they are going back through corridors to see not only what preventative measures they could take, but how to restore some of the streams and corridors.

K. SWAP:

i. Linking Land Use and Conservation Planning – Defenders of Wildlife

Missouri is not mentioned in Linking Landscapes.

ii. Conservation Across the Landscape

Missouri is one of several states that uses stakeholders and ranking information to select the most important areas (15). It is one of the few to have set up a formal steering committee for their plan to move things forward (26).⁹¹

iii. Analysis:

The Missouri SWAP is presented in a collection of power-point presentations and heavily illustrated documents much more tailored to a lay audience of environmental actors than the products of most states. This SWAP is very much a snapshot of particular areas immediately conducive to productive action, with far more attention paid to historical landscape conditions that it would be desirable to recreate than to developing threats. However there are some exceptions to this present-and-past centric attitude. “Population change and possibility of future extractive use” possible criterion for assessing priority regions, and the issue of “How long do we have?” is also mentioned in such a context. The SWAP states as a general rule that urban regions need more immediate action than equivalent rural sites. Discussions of individual conservation opportunity areas only occasionally mention developing problems due to expanded human involvement, but again such notation is not entirely absent. In regard to LeBarque creek, the SWAP highlights the possibility that “the rapid rate of development in St. Louis County could affect stream quality.” Additionally “change because of habitat loss and degradation” is named as a reason for future review of the Action Plan.

4. Montana

A. Population Projections

Population projections are available (*saved: MTPopproj_2030.xls*). Fischer reflects her concern that **seasonal residents** are generally overlooked in population projections, land use, and growth; she also discussed Larry Swenson, an economist at the Center for Rocky Mountain West, who has done extensive demographic analyses and believes that the population projections and projected growth outside cities are overestimated (basically, as the population is aging and as fuel prices remain high, people will stay in the cities).

B. Comprehensive Vision Plan or Land Use Plan

There is no statewide comprehensive vision plan or land use plan – this planning is done at the county level and the instrument is referred to as a “growth policy.” There is some regional planning done on a watershed scale, but this is not very common.⁹²

C. Regional Growth Plans

See Sect. 4B.

D. Transportation

At any given time, MT-DOT has between 500 – 600 projects underway, but most of the transportation plans are for safety/preservation (e.g., overlay of existing surfaces, straitening of curves); some highway re-construction is tentatively planned. Montana-DOT has a Tentative Construction Program Map, which they update once a year (and are in the process of updating); this statewide map of major projects (including overlays) has a five-year horizon (*saved shape files: TCP_2008*).⁹³

Major highway projects are indicated in the Statewide Transportation Implementation Project.⁹⁴

E. Statewide Datasets on parcels/Zoning

The state has a Natural Resources Information System (NRIS) that provides the public with an array of layers, including land use/cover, critical infrastructure, and the Cadastral Mapping Program (<http://gis.mt.gov/>) - “a framework of property boundaries along with associated land ownership information (who owns what and where).”

F. Lot Size for Septic Systems

Sanitation in Subdivision Act: Condominiums, mobile home parks, recreational vehicle parks and divisions of land that create a parcel of less than 20 acres are subject to sanitary review.

Under ARM 17.36.101 *et seq.*, the Department of Environmental Quality sets standards and procedures relating to size of lots, topography, geology, hydrology, type of facilities proposed and other factors affecting public health and the quality of water for uses relating to agriculture, industry, recreation and wildlife. For proposed subsurface wastewater treatment systems (ARM 17.36.340), “the minimum lot size must be one acre for each living unit and one acre for up to 700 gallons per day of design wastewater flow for commercial and other non-residential uses.”

G. Statewide Subdivision Law

The state has a 160-acre subdivision threshold; anything less than 160 acres has to go through the subdivisions review.⁹⁵ The Montana Subdivision and Platting Act (Mont. Code Ann. § 76(3)), covers aspects of development—roads, flood plains, zoning, clusters, etc.—and is administered at the local level by county commissioners.

Montana has 57 counties and, according to Killbreath, there is not a single state-wide subdivision model; rather, there are 15-20 different sets. After a preliminary plat is approved by the board of county commissioners, DEQ reviews the plat for water, wastewater, and storm drainage via the Sanitation and Subdivision Act (Mont. Code Ann. § 76(4)).

H. Enabling Legislation for Cluster/Conservation Subdivision

Montana has an enabling statute (Mont. Code Ann. § 76 (3-509)) for conservation clusters. Some believe that this statute is problematic, as open space *must be* maintained by a conservation easement in perpetuity; usually easements are voluntary, but here they are the only option for clustering.⁹⁶

I. Best Source of Data on Protected Areas

NRIS (see 1.E) is a great resource for public and private protected areas (on file with author). The Montana Fish, Wildlife, and Parks (FWP) has information on state parks (on file with author) available on its website, and is in the midst of a very relevant project: *Crucial Areas and Crucial Corridors Initiative*—pulling together information on roadless areas, open spaces, wilderness, etc. to develop a set of information tools—hope to have a draft by next spring. This initiative takes into consideration two things that the SWAP did not: adds a recreational standpoint and specifically considers big game.⁹⁷ This analysis, as of October 2008, is in the early stages, but will overlay growth models, wildlife linkages, transportation data, and other information.⁹⁸ The CACC Initiative aims to “develop and conduct a process to ‘identify key wildlife migration corridors and crucial wildlife habitats in the West and make recommendations on needed policy options and tools for preserving those landscapes.’”⁹⁹

J. Local Context

Montana DOT is working with MT Fish, Wildlife, and Parks (FWP) to provide them with better data to enhance their work. While DOT has lots of shape files, in terms of GIS they are still organizing as a department. In fact, the department recently did an inventory – some is out of date, some not organized properly, etc.¹⁰⁰

Some of the major state concerns include: oil and gas development in eastern Montana; wind transmission line corridors and residential development, which is sprawling into sensitive areas and along watercourses/riparian areas in Western & Central Montana; transportation infrastructure that impedes animal dispersal. FWP is looking closely at hot-spot locations and crossing structures, corridors, etc.

There are serious issues with timber companies, like Plum Creek, which methodically are selling off real estate for development (including winter range and corridors), which results, among other things, with a subsequent loss of public access for hunting. Other issues of concern include development at the wild-urban interface (due to the loss/degradation of wildlife habitat as well as the costs of structure protection and managing wildfires).¹⁰¹

K. SWAP

i. Linking Land Use and Conservation Planning – Defenders of Wildlife

Linking Conservation and Land Use Planning

Montana: “Increasingly, the high and flat benches [of Shrub Grassland] that traditionally provided grazing lands for wildlife and livestock are prized for residential development because of their easy access with 100-mile views” (SWAP pp. 134) (DOW-12)

ii. Analysis:

The Montana SWAP opens with a fairly involved history, but a history that does not concern the overall relationship between human beings and the land of Montana, instead chronicling all institutional and legislative developments with direct application to the protection of Montana wildlife. The SWAP is not greatly interested in categorizing and analyzing the distribution of threats to habitats and species, but rather focuses on pinpointing the specific species and areas of greatest conservation need. High concentrations of human population (by Montana standards) are identified as sources of concern at an ecoregion level (CWCS, 37), although population growth is not mentioned and there is no real sign of a temporal perspective. On an area level however, charts cataloguing conservation concerns repeatedly feature “Habitat loss, degradation, and fragmentation, especially as a result of human population growth/development and the expansion of the transportation network.” (CWCS, 54) Population growth is also explicitly mentioned as a concern at an ecological community level. The actual Action Plan identifies particular courses of action most subject to immediate progress, and recommends steps in mountain stream areas “to address impacts resulting from human population growth and development.” (AP, 11)

5. New Hampshire

A. Population Projections

Annual population projections are available from the State Data Center (on file with author). The Center also provides information for population estimates, growth trends, and housing and household data.¹⁰²

B. Comprehensive Vision Plan or Land Use Plan

The state has a comprehensive development plan that “establishes state policy on development related issues and...shall provide a basis for identifying critical issues facing the state, determining state priorities, allocating limited state resources, and taking into account the plans of various state, regional, and local governmental units” (State Development Plan - RSA 9A). Smart Growth Policies can be found at N.H. Rev. Stat. Ann. 9B, which sets the background for the state-development plan; while this is still under review (no firm deadlines for completion), drafts of the plan are available on the Office of Energy and Planning (OEP) website.¹⁰³

C. Regional Growth Plans

All 9 regional planning commissions (<http://www.nharpc.org/>) have a regional plan; these are updated every five years and can be found on the regional planning commissions’ websites.

D. Transportation

DOT has been advising OEP in a Long Range Transportation Plan, which has a thirty year horizon, and is very well crafted with a great vision statement.¹⁰⁴

The plan, which has not yet been released, focuses on preservation (maintaining the system that NH has today); there are no future plans for road creation, expansions, etc. (excluding local roads) other than the widening of a 20-mile segment of I-93¹⁰⁵ and a smaller turnpike/overpass to the Manchester Airport. No GIS data exists for either of these, though DOT hopes to have GIS for the former project by late winter.¹⁰⁶ DOT is also focusing on integrating the disparate state and town systems to meet local visions.¹⁰⁷

A third expansion project, the Conway Bypass, is included in the long range plan, but is not funded and may not be completed for decades. Local upgrades to modernize the roads have been proposed so that the roads can handle more daily traffic (those that handle 100-500 cars/day will be enhanced for 500-1000 cars/day). As DOT does not currently have the money to build new roads, as of December 2008, their planning approach currently focuses on addressing bridges and roads in the *worst* condition. Upgrading and maintaining rather than creating new infrastructure, they are working to use more resilient pavement materials—a greater initial investment that makes more sense in the long-term.¹⁰⁸

E. Statewide Datasets on parcels/Zoning

There is not a statewide parcel dataset,¹⁰⁹ but a recent survey of municipalities was conducted by the NH GRANIT at Complex Systems Research Center, University of New Hampshire, in collaboration with all nine regional planning commissions, “to better understand municipal tax parcel data holdings as well as related data sets.”¹¹⁰

The available (limited) data from local and regional entities can be found by contacting the Regional Planning Commissions or the State GIS Clearinghouse GRANIT Program; conservation lands data is available on the OEP website.¹¹¹

F. Lot Size for Septic Systems

This depends on soil and slope, and ranges from 30,000 square feet in good soils to two and three times that (N.H. Code Admin R. Ann. 1005.03).¹¹²

G. Statewide Subdivision Law

There is no minimum acreage lot size for subdivision; there is only the enabling legislation related to septic systems.¹¹³

H. Enabling Legislation for Cluster/Conservation Subdivision

N.H. Rev. Stat. Ann. §674:21 Innovative Land Use Controls Zoning Statute enables communities to adopt innovative zoning (includes TDRs, cluster developments, and environmental characteristics zoning).¹¹⁴

I. Best Source of Data on Protected Areas

The Forest Society (<http://www.spnhf.org/>), GRANIT Program (<http://www.granit.unh.edu/>), and NH Department of Environmental Services (<http://www2.des.state.nh.us/gis/onestop/>) (*saved: NH Conservation/Public Lands*)

J. Local Context

Regarding the safety/expansion/overlay/preservation transportation projects, local communities oppose these terms. They believe such projects signify a lot more than safety. These relatively minor projects on small, rural roads (which typically take from 4-6 years to ID the problem and then to complete) in NH provide economic vitality for local communities. DOT is doing a better job to recognize these concerns and to create a better dialogue with the nine regional planning councils. While DOT is strapped for cash, they now have an innovative (“out of the box”) commissioner who is working with local, state, and federal officials to develop revenue enhancements. Even if he does succeed, projects like the Conway Bypass will still take 8-10 years.¹¹⁵

The Community Technical Assistance Program (CTAP: <http://www.nhctap.com/>), developed through the OEP, focuses on how to share resources and helping communities in the I-93 region plan for future growth. CTAP and DOT are also evaluating potential corridor improvements to determine where they are most important, how to address them, etc.¹¹⁶

In the Ten Year Transportation Improvement Plan, DOT is in the process of trying to capture projects in GIS—not just future and current ones, but also completed projects—to create a record that replaces the old non-electronic project sheets system that they currently use.

K. SWAP

i. Linking Land Use and Conservation Planning – Defenders of Wildlife

New Hampshire is one of eight states and the only of our case-study states to identify development as the greatest threat to wildlife:

“Rapid urban development in many parts of the state was identified as the most potent risk to our wildlife, devastating the health of many terrestrial, wetland, and aquatic populations and irreversibly fragmenting their habitats” (Exec Summ, pp. x).

Of the 24 states that use or intend to use the permit review process to influence land use planning and reduce development impacts, New Hampshire is one of the few to address the limitations of permit review as a conservation tool:

New Hampshire: “401 Objective: Release Wildlife Maps to the Public. The state should make wildlife-related information accessible to developers and public, while also protecting sensitive information and landowner rights. If developers and consultants have access to information prior to planning their projects, they will know which agencies to contact for a full review or for help in developing project designs before investing large amounts of time and money in a project. This will also help to streamline the review process and reduce redundancy in review requests” (pp. 5-12).

ii. Analysis

Throughout the New Hampshire SWAP there is a focus on the risk to wildlife and wildlife habitats posed by development coupled with recognition that population growth greater than that of other New England states lies at the root of such development (4-23). A similar direct association between population growth and environmental risk is made concerning transportation infrastructure, while more vague connections are made with a slew of other environmental risks including light pollution, predation, and altered hydrology. A Wildlife Risk Assessment survey found that development was considered by experts to be by far the most significant risk to New Hampshire habitats, while transportation infrastructure also placed in the top five (3-5). Indeed development is identified in the SWAP as a critical threat to approximately half of New Hampshire’s habitats, covering a clear majority of the state’s land mass. Furthermore in the case of New Hampshire’s Northern Upland Watershed, while development is not considered as an immediate area of concern, the plan acknowledges it is likely to become a source of serious pressure in the future. This sort of predicted risk is not given great prominence in the document, but the instruction form sent out to participants in the Wildlife Risk Assessment clearly outlines the parameters of consideration given to future environmental problems by the New Hampshire Fish and Game Department (Appendix M). Interest is limited to a fifteen year timeframe and participants were asked to “limit potential risks to those with underlying causes that currently exist and are likely to increase with current human population patterns.” Clearly this reflects a belief that human population trends will define the environmental issues of the future. Human population patterns are also noted as a parameter used in the construction of computer models for assessing habitat fragmentation (3-5), eventually intended to inform land use decision making (5-8), and as a cause of rising land prices used as evidence in favor of tax breaks for private forest owners willing to maintain open space (5-22).

6. Tennessee

A. Population Projections

Population projections by county and city are available (*saved as “Population Projections”*).

B. Comprehensive Vision Plan or Land Use Plan

No.

C. Regional Growth Plans

While the state does not have a comprehensive vision plan, land use plan, or statewide guidelines on zoning, regional growth plans and zoning guidance at the local level do exist.¹¹⁷

D. Transportation

TDOT is currently developing a self-updating system¹¹⁸ that will create the new GIS layers for new and ongoing projects:

The T-DOT Program Project Resource Management (PPRM) scheduling tool “tracks project commitments throughout the project planning and development process. The goals of the commitment tracking through PPRM are to carry all project commitments through the lifecycle of the project development and to inform other divisions of commitments made for a project.”¹¹⁹

As of January 13, 2009, the PPRM Project Status Layer is not available to the public.¹²⁰

The State Long Range Transportation Plan indicates a number of new and expansion projects, but there does not presently seem to be GIS data for these projects.

The average time between when a transportation project gets funding in Tennessee and when we can drive on it is 12-15 years. Layers are created for planning reports for projects not yet funded.¹²¹

E. Statewide Datasets on parcels/Zoning

While not state-wide, the Office for Information Resources does possess parcel data for many of the counties (*request for data denied as we have no contract with a state agency*). A number of counties (approx. 50 of the 95) have data that is not managed by the Department of Finance & Administration.¹²² Their data may require a fee.

F. Lot Size for Septic Systems

This depends on soil types, ranges from a minimum of one acre to 2-5 acres, and requires the county health department’s approval.¹²³

G. Statewide Subdivision Law

No. The power to zone, as with the power to plan in general, is not mandatory. Communities are free to decline the grant of power and choose not to adopt zoning. While there is no statewide subdivision law, under the all-permissive Standard Planning Enabling Act (Title 13), counties and cities can but do not have to do adopt subdivision laws.¹²⁴

H. Enabling Legislation for Cluster/Conservation Subdivision

Tenn. Code Ann. 13-7-201 is an enabling statute that addresses special development districts, Transfer of Development Rights, and conditional zoning. There does not seem to be legislation that explicitly addresses conservation/cluster subdivision at the state level.

I. Best Source of Data on Protected Areas

TN Dept. of Environment and Conservation – Division of State Parks
Land Trust of Tennessee – conservation easements (on file with author)
Univ of the South Landscape Analysis Lab – Nick Hollingshad, nahollin@sewanee.edu
UT-Chattanooga School of Forestry - Don Hodges, 865-974-2706

J. Local Context

i. TACIR

Some of the exigent planning concerns for TACIR include: the effect of alternative sewage disposal systems on sprawl; problems of failing/corroding sewage systems; the perceived effects of > \$100 barrels of oil on the urban pattern; and the continued crisis of water shortages.

While some counties have done real long term planning, others have not employed such planning foresight (not looked at growth projections and water needs together) and are now experiencing shortages (i.e. some areas of the state are no longer supplied with water supplies from the TN or Cumberland rivers). TACIR is trying to get these counties to take long term steps.¹²⁵

As far as the enforcement and regulation concerns, this is all done on the local and county level: with so many different counties, there are also many different interests (95 counties), which vary extensively. Some cities and counties do great long range planning, while others rely on zoning/short-term measures. Some pockets of the country are experiencing no economic development and are desperate for growth; others are booming and requiring much more regulation/planning.¹²⁶ One of the fastest growing areas in the country is in the counties that surround Nashville. Here they are experiencing one of the fastest losses of agricultural land to sprawl.

Additionally, in the Cumberland Plateau, which spans twenty counties and is very rich in biodiversity, there are many coal deposits. There is also a serious concern about timber and paper companies, which own enormous tracts and are beginning to divest large tracts, selling them as second homes and other forms of development, leading to vast fragmentation. There is little regulation and nothing currently to slow this down.¹²⁷

ii. Dept. of Economic Development

Additionally, the conversion of agricultural lands to low-density developments is a major concern. As the planning legislation is enabling but not mandatory in Tennessee, most communities have a shell of planning, but few are very proactive—habitat conversion is still a foreign idea.

There has been some very recent focus on regional planning (e.g., Tennessee Valley Authority partnering with the EPA, state agencies, and some of the water commissions to look at conserving natural resources and quality growth that includes habitat protection/conservation in high-density areas; they are trying to bring together different planning and natural resource agencies with workshops, roundtables, etc.). These efforts are still in the early stages.¹²⁸

In addition to the lack of mandatory statutes, there is also the local economic pressure to push forward. For our study to be of use, we will need to focus on grassroots; looking at the regional outlook from the local level; spreading information from the bottom up. Since planning is done at the local level, we should have a focus on small, rural communities and break down the big responsibilities for local government.¹²⁹

iii. The University of the South

The University of the South has modeled housing and land use/cover change in the Southern Cumberland Plateau area over the past two decades to project future growth. *Water is the limiting factor*. Due to the concern for providing water to the burgeoning second homes and exurban growth in this part of the state, the University is working with utility groups to update their model to apply the water concern to simulate what will happen.

The University will also work with the Dept. of Environment and Conservation to examine acid drainage and sedimentation on a watershed-scale. With the anticipated housing growth, what will happen with tax rates, asks Professor Gottfried. It increases “economic growth,” but also leads to fragmentation and jeopardizes the state’s tourism and recreation (economic staples). The state is not dealing with this and neither are the counties (lack funding/capacity). Some highways (HW 111 and 2) are opening up formerly undeveloped land and leading to land booms. Also, Volkswagen is considering adding a facility near Chattanooga that would add new housing pressure. Gottfried also alludes to the issue of Georgia’s “water grab” from TN waters.

There is not much coordination across the state, no zoning in rural areas, and no capacity for enforcement. “Planning’ is a bad word in TN (re my land). Awareness is slowly rising, but not much regional planning – some counties don’t even have planning departments.¹³⁰

iv. Land Trust for Tennessee (LTT)

TN is pretty behind on state-wide wildlife planning. Only the SWAP does this, and it has a lot of gaps – for example, it may not even account for flora (i.e. rare plants), just fauna; and the SWAP is very static.

As a land trust, LTT is looking at other attributes in addition to the fauna. Not many counties in Tennessee have planning and zoning departments. Urban boundaries do not seem to be effective/well-constructed. Tennessee needs a state-wide assessment, and our (WHPRP) study could be a first step for them. As TN does not have a lot of legislation, LTT is always looking for tools like ours to help in planning/conservation.¹³¹

Rural parts of the state like the North East portion do not have sophisticated analysis; but they are starting to see some good things coming from that portion of the state – one county, for example, is completing its first comprehensive plan.

TN is three distinct parts: East (mountains); Middle (working farms, rivers, and streams); and West (flat, cotton land), each with its own concerns, priorities, etc.

v. Cumberland Region Tomorrow (CRT)

TWRA and Cumberland Region Tomorrow (a non-profit group) are working together to create a green print of middle Tennessee (map of conserved/protected areas around the Nashville area), which they hope will be expanded/replicated on a state-wide scale.¹³²

CRT has a regional growth planning encouragement program aimed at teaching, encouraging, and sharing resources in a non-confrontational, economic-based approach that advocates BMPs.

The Cumberland region spans ten counties and is one of the fastest growing areas in the state and South East. Planning and Zoning (or lack there of) have led to segregation and sprawl. The region lacks good

comprehensive plans, and the regulatory framework has perpetuated the sprawling development. *This region is rapidly growing and urbanizing with a rural set of rules: development is driving everything and commissions are trying to keep up with development, but they are out of sync.

CRT is trying to change this. They have partnered with TWRA to compile GIS resources into one useful Map Resource. The CRT *Greenprint Tools for Quality Growth* is an online resource utilizing web-based Global Information Systems (GIS) technology that uses four comprehensive data layers at the regional level: land, water, cultural, natural resources. Similar to our (WHPRP) study, they overlaid growth boundaries with SWAP priority Wildlife Habitats.

A regional visionary process and mechanism for community leaders to implement quality growth (a guide for training and assistance), *Greenprint* is the companion to the Quality Growth Toolbox – a comprehensive training and technical assistance resource that includes strategies, tools, incentives and resources that can be tailored to each community in the region. The toolbox supports better planning and decision making by looking at conserving natural resources, water, land, etc. to identify resources that we want to keep and how to integrate development.

Jones attributes their success to great partnerships with wildlife agency (TWRA) and expressed her enthusiasm/offered materials to be a case study for our work.¹³³

vi. Tennessee-TNC

TNC is doing very similar work looking at the intersection of priority wildlife habitats and growth. They have a state ownership overlay and conservation easement data that they are willing to share.

Easements are an underutilized tool in the state of Tennessee. In addition to a few conservation easements, the Tennessee Chapter of TNC owns several small preserves.¹³⁴

The population projections that they use include municipalities, not just county-level data. The break down of incorporated and unincorporated municipalities may be too fine a scale for our work, but can be elicited from TN Dept. of Economic and Community Development. TNC uses these as well as counties' urban growth plans to spatially delineate urban growth boundaries and potential areas of growth – where growth is and is not being steered.

As their study is on a state level, the scale is more refined. They just completed their growth model – “would have used Theobald’s work had we known about it.” The TNC work is 30m resolution, presumably a bit more detailed than our national-scale study.

The growth analysis is completed and they are now in the process of updating the SWAP model based on updated GAP data – using the growth analysis in an analysis of caves/karst. They are also looking at threats other than growth (forestry practices, agricultural impacts, etc.)

K. SWAP

i. Linking Land Use and Conservation Planning – Defenders of Wildlife

Tennessee is not mentioned.

ii. Analysis

Near the beginning of the Tennessee SWAP, changes in land use in Tennessee are placed in grand temporal perspective. The state acknowledges that compared to pre-1900 history, “human population and land use has exhibited a much more dramatic change in the last 100 years and will likely continue its

proliferation as we move into the 21st century and beyond.” (5) Moreover while the document praises population growth as necessary to “long-term development” it is also implicated as the source of “great challenges when it comes to conserving and protecting species of Greatest Conservation Need” (7). Such a perspective leads to the conclusion that the single highest priority action to be taken at a regional level to protect aquatic, terrestrial and subterranean species would be “participation in the review of county urban growth management plans” (148). The schema used by Tennessee to evaluate sources of environmental stress reflects the same sort of developed temporal perspective, dividing threats into “Historical-Continuing”, Current”, “Next 1-5 Years” and “Next 5-10 Years Groups.” A further sorting singles out sources of stress likely to bring forth other stresses in the future, such as road construction which encourages development (74). These categorizations are applied on a regional level, and text descriptions of each region in the report mention individual metropolitan areas particularly subject to population growth and thus urban sprawl and associated stresses. Unfortunately such conclusions are not applied in any formulaic way on a local level; the mapping system of the Tennessee SWAP describes which local habitats would be theoretically susceptible to individual sources of stress, rather than which local habitats are actually subject to such pressures. There is an acknowledgement that this is a major failing in the current SWAP, and an opportunity for future improvement (189).

APPENDIX C: Summary of Interviews with State Wildlife Action Plan Coordinators

State	Link to State Wildlife Action Plan	Location of Priority Habitat Data/Maps	Does Map Include Aquatic Habitat?	If No, Is a Separate Aquatic Habitat Map Available?	Location of Focal Area Map/Data	Does Map Include Aquatic Habitat?	If No, Is a Separate Aquatic Habitat Map Available?
Colorado	LINK	Habitats are listed in the main report, Appendix F (p. 315) and illustrated in Figure I-2 (Fig I-2 Key Habitats of Colorado) Narrative descriptions are found in Appendix C; Map can be found through link titled "Potential Conservation Opportunity Areas" at: http://georgiawildlife.dnr.state.ga.us/documentdetail.aspx?docid=89&pageid=14&category=conservation	No.	Yes. See Figure I-3 (Fig I-3 High priority Colorado Watersheds)	See Figure I-1 (Fig I-1 Colorado High Priority Habitats Private Land Focus)	Yes.	
Georgia	LINK	The wildlife agency conducted an "all wildlife strategy." They identified eight recognized primary habitat types. The priority habitats are not transparent to the public. All habitats are priorities.	Yes.		See Appendix K. http://www1.gadnr.org/wcs/PDF/Appendix_K.pdf	No.	Yes. Map of "High Priority Waters." The statewide shapefiles are at: http://georgiawildlife.dnr.state.ga.us/documentdetail.aspx?docid=89&pageid=13&category=conservation See: "High Priority Streams GIS Shape Files"
Missouri	LINK		No.	No.	The state identified over 100 Conservation Opportunity Areas. There were 33 that had a stakeholder team, now 36, all of which have profiles. GIS shape files were provided on DVD via mail.	Yes.	

Montana	LINK	See section "Component II: Communities," pgs. 157-187	Yes.	Yes. Separate maps of aquatic habitat are included in the section.	See section "Component I: Focus Areas" (pp. 35-156)	Yes.	Yes. Separate maps of aquatic habitat are included in the section.
New Hampshire	LINK	See " Statewide habitat map" at: http://www.wildlife.state.nh.us/Wildlife/Wildlife_Plan/using_maps.htm	Yes.		See " Highest Ranked Wildlife Habitat by Ecological Condition" at: http://www.wildlife.state.nh.us/Wildlife/Wildlife_Plan/using_maps.htm	Yes.	
Tennessee	LINK	They do not have a map associated with the plan that represents priority habitats.	No.	No.	See "Priority Terrestrial Habitat Areas" Chapter 3, pp. 100-102.	No.	Yes. See "Priority Aquatic Habitat Areas" Chapter 3, pp. 104-106.

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- ² Casey, F., A. McMurray, T. Kroeger, J. Michalak, and P. Manalo. 2008. *The Cost of a Comprehensive National Wildlife Habitat Conservation System*. Defenders of Wildlife. Based on a scenario of protecting 217.9 million acres (12% of U.S. acreage) over a 30-year period, the authors estimate that the "undiscounted least cost option...through land rentals/leases at an estimates \$219 billion. Fee-simple purchases with management costs would be nearly \$927 billion. Easements, including initial one-time transaction costs, would amount to about \$350 billion.
- ³ Lerner, Jeff, Janet Mackey, and Frank Casey. 2007. "What's in Noah's Wallet? Land Conservation Spending in the United States." *BioScience*. 57(5): 419-423.
- ⁴ Austin, J., L. Breggin, V. Buckingham, S. Kakade, J. McElfish, K. Mengerink, R. Thomas, J. Thompson, and J. Wilkinson. 2007. *Mitigation of Impacts to Fish and Wildlife Habitat: Estimating Costs and Identifying Opportunities*. Washington, DC: Environmental Law Institute.
- ⁵ Shaffer, Mark. February 2009. Presentation titled "Environment Program Habitat Conservation-Policy Grants."
- ⁶ Nelson, Arthur C. and Robert Lang. January 2007. "The Next 100 Million." *Planning*. Chicago, IL: American Planning Association.
- ⁷ Theobald, D.M. 2005. "Landscape Patterns of Exurban Growth in the USA from 1980 to 2020." *Ecology and Society*. 10(1): 32.
- ⁸ Pub. L. 106-553, codified at 16 U.S.C. § 669c; Association of Fish and Wildlife Agencies and U.S. Fish and Wildlife Service. 2006. *State Wildlife Grants: Five-Year Accomplishment Report*.
- ⁹ Association of Fish and Wildlife Agencies. "Teaming With Wildlife: Total Funding To Date." http://teaming.com/pdf/SWG_Allocations.pdf. (Last visited December 12, 2008.)
- ¹⁰ Similar definitions for "focal areas" and "priority habitat" are offered in: Lerner, Jeff, Bobby Cochran, and Julia Michalak. 2006. "Conservation Across The Landscape: A Review of the State Wildlife Action Plans." Washington, DC: Defenders of Wildlife.
- ¹¹ Theobald, D.M. 2003. Targeting conservation action through assessment of protection and exurban threats. *Conservation Biology* 17(6):1624-1637.
- ¹² Lerner, Jeff. January 2009. "Identified Conservation Opportunity Areas for the Lower 48 States." PowerPoint slide provided by author; Stein, B.A. and Gravuer, K. 2008. *Hidden in Plain Sight: The Role of Plants in State Wildlife Action Plans*. Arlington, Virginia: NatureServe. Appendix B.
- ¹³ Primary research conducted by David Theobald, Ph.D., Sophia Linn, and Matt Lineal. Colorado State University.
- ¹⁴ Primary research conducted by David Theobald, Ph.D. and Jessica Salo. Colorado State University.
- ¹⁵ U.S. Census Bureau, Population Projections Program. "State Population Projections (Based on 1990 Census released 1996)." <http://www.census.gov/population/www/projections/stproj1996.html>.
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- ¹⁷ Colorado Division of Wildlife. November 2006. *Colorado's Comprehensive Wildlife Conservation Strategy*. <http://wildlife.state.co.us/WildlifeSpecies/ColoradoWildlifeActionPlan/>. (Last visited May 29, 2009.)
- ¹⁸ Georgia Department of Natural Resources, Wildlife Resources Division. August 2005. "A Comprehensive Wildlife Conservation Strategy for Georgia." <http://www1.gadnr.org/cwcs/Documents/strategy.html>. (Last visited June 1, 2009.)
- ¹⁹ Georgia Department of Natural Resources, Wildlife Resources Division. August 2005. "A Comprehensive Wildlife Conservation Strategy for Georgia." http://www1.gadnr.org/cwcs/PDF/Appendix_K.pdf. (Last visited June 1, 2009.)
- ²⁰ Missouri Department of Conservation. August 2005. "Comprehensive Wildlife Conservation Strategy." http://www.fws.gov/midwest/FederalAid/state_plans.html. (Last visited June 1, 2009.)
- ²¹ Montana Fish, Wildlife & Parks. "Comprehensive Fish & Wildlife Conservation Strategy." <http://fwp.mt.gov/specieshabitat/strategy/fullplan.html>. (Last visited June 1, 2009.)
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- ²⁵ Tennessee Wildlife Resources Agency. September 2005. "Tennessee Comprehensive Wildlife Conservation Strategy." See "Priority Terrestrial Habitat Areas" Chapter 3, pp. 100-102.
- ²⁶ See: <http://www.natureserve.org/publications/usEcologicalsystems.jsp>.
- ²⁷ See: <http://www.landfire.gov/index.php>.
- ²⁸ For example, see: Odell, E. A., D. M. Theobald, and R. L. Knight. 2003. "Incorporating Ecology into Land-Use Planning—The Songbirds' Case for Clustered Development." *Journal of the American Planning Association* 69 (1): 72–82.
- ²⁹ Theobald, D.M., J.M. Miller and N.T. Hobbs. 1997. Estimating the cumulative effects of development on wildlife habitat. *Landscape and Urban Planning*. 39(1): 25-36; Hansen, A.J., R.L. Knight, J.M. Marzluff, S. Powell, K. Brown, P.H. Gude, and K. Jones. 2005. "Effects of exurban development on biodiversity; patterns, mechanisms, and research needs." *Ecological Applications*. 15(6): 1893-1905.
- ³⁰ Personal communication with Eric Bergman, Director of Office of Smart Growth: August 27, 2008.
- ³¹ Personal communication with Eric Bergman, Director of Office of Smart Growth: August 27, 2008.
- ³² Person communication with Jennifer Finch, Colorado-DOT: August 29, 2008.
- ³³ Personal communication with Matthew Tomaszewski, GIS Specialist, Colorado Department of Transportation, Division of Transportation Development: September 29, 2008.
- ³⁴ Personal communication with Marvin Koleis, Data Management Section Manager, DOT: September 9, 2008.
- ³⁵ Bureau of Land Management, Geographic Coordinate Data Base, *see* http://www.blm.gov/co/st/en/BLM_Programs/geographical_sciences/cadastral/gcdb.html
- ³⁶ Colorado Ownership Management and Protection, *see* <http://www.nrel.colostate.edu/projects/comap/samples.html>
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- ³⁸ Personal communication with Andrew Ross, Colorado Dept. of Public Health and Environment: September 10, 2008.
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- ⁴⁰ Personal communication with Eric Bergman, Director of Office of Smart Growth: August 27, 2008.
- ⁴¹ Person communication with Jennifer Finch, Colorado-DOT: August 29, 2008.
- ⁴² *See* http://www.environment.fhwa.dot.gov/ecological/eco_entry_cdot.asp. Missouri is the only other case-study state to receive funding for the Ecological program.
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- ⁴⁴ Personal communication with Jill Ozarski, Coalition of Land Trusts: September 29, 2008.
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- ⁴⁶ Defenders of Wildlife (2007). *Linking Conservation and Land Use Planning: Using the State Wildlife Action Plans to Protect Wildlife from Urbanization*.
- ⁴⁷ Personal communication with Eric McRae, University of Georgia, Information Technology Outreach Services: September 25, 2008.
- ⁴⁸ Personal communication with Jim Frederick, Director, Department of Community Affairs: August 27, 2008.
- ⁴⁹ Personal communication with Terry Jackson, GISCC Chair, Georgia Department of Community Affairs: October 10, 2008.
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- ⁵¹ Personal communication with Teague Buchanan, Enterprise GIS Manager, Georgia Department of Transportation: September 24, 2008.
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- ⁵⁷ 1998 Ga. Laws HB 1540, O.C.G.A. § 36-66A-2.
- ⁵⁸ 2006 Ga. Laws H.B. 1107.
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- ⁶¹ Coastal Comprehensive Master Development Plan, *see* <http://crd.dnr.state.ga.us/assets/documents/GCMP.pdf>
- ⁶² Georgia Comprehensive State-wide Water Management Plan (2008). *See* http://www.georgiawatercouncil.org/Files_PDF/water_plan_20080109.pdf
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- ⁶⁴ Defenders of Wildlife (2006). *Conservation Across the Landscape: A Review of the State Wildlife Action plans.*
- ⁶⁵ Personal communication with Doug Hermes, Statewide Planning Coordinator, MACOG: November 10, 2008.
- ⁶⁶ Personal communication with Matt Hesser, State Demographer, Missouri Office of Administration: September 26, 2008.
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- ⁷⁰ Personal communication with Eric Bernskoetter, Transportation Planning Specialist, General Headquarters, MoDOT: December 10, 2008.
- ⁷¹ Personal communication with Caroline Twenter, East-West Gateway Council of Governments: October 6, 2008.
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- ⁸¹ Personal communication with Caroline Twenter, East-West Gateway Council of Governments: October 6, 2008.
- ⁸² Personal communication with Mell Henderson, Director of Transportation, Mid-America Regional Council in Kansas City: October 14, 2008.
- ⁸³ Personal communication with Andrea Retinsky, Mid-America Regional Council in Kansas City, October 15, 2008.
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- ⁸⁵ FHWA’s *Eco-Logical* “puts forth the conceptual groundwork for integrating plans across agency boundaries, and endorses ecosystem-based mitigation - an innovative method of mitigating infrastructure impacts that cannot be avoided.” *See* http://www.environment.fhwa.dot.gov/ecological/eco_index.asp
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- ⁹² Personal communication with Doris Fischer, FWP Land Use Specialist: September 10, 2008.
- ⁹³ Personal communication with Dick Turner, Chief, Multimodal Planning Bureau, Montana DOT: December 8, 2008.
- ⁹⁴ *See* http://www.mdt.mt.gov/publications/docs/stip/2008stip_final.pdf.
- ⁹⁵ Personal communication with Steve Kilbreath, State Department of Environmental Quality, November 19, 2008.
- ⁹⁶ Personal communication with Doris Fischer, FWP Land Use Specialist: September 10, 2008.
- ⁹⁷ Personal communication with Doris Fischer, FWP Land Use Specialist: September 10, 2008.
- ⁹⁸ Personal communication with Deborah Wombach, Montana DOT: October 22, 2008.

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- ⁹⁹ Western Governors' Association, *see* <http://www.westgov.org/wga/initiatives/corridors/index.htm>.
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- ¹⁰¹ Personal communication with Doris Fischer, FWP Land Use Specialist: September 10, 2008.
- ¹⁰² *See* <http://www.nh.gov/oep/programs/DataCenter/library.htm>.
- ¹⁰³ Personal communication with Joanne Cassulo, New Hampshire Office of Energy and Planning: July 25, 2008.
- ¹⁰⁴ Personal communication with Joanne Cassulo, New Hampshire Office of Energy and Planning: July 25, 2008.
- ¹⁰⁵ Personal communication with Glenn Davison, New Hampshire DOT: August 26, 2008. Also, *see* <http://www.rebuildingi93.com/>.
- ¹⁰⁶ Personal communication with Peter Stamnas, Project Manager, NH DOT: November 7, 2008.
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- ¹⁰⁸ Personal communication with Bill Watson, NH DOT: December 8, 2008.
- ¹⁰⁹ Personal communication with Ken Gallager, NH OEP: August 18, 2008.
- ¹¹⁰ <http://www.granit.unh.edu/resourcelibrary/municipalresources/surveyresults.html>
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- ¹¹⁷ Personal communication with Bill Terry, Planning Consultant, TACIR: September 12, 2008.
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- ¹¹⁹ May 2007 Statewide Storm Water Management Plan – TDOT Environmental Division Environmental Procedures Manual: 4-3. *See* <http://www.tdot.state.tn.us/sswmp/pdfs/EnviroProcMan.pdf>.
- ¹²⁰ Personal communication with Van Colebank, DOT: January 13, 2009.
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- ¹²² Personal communication with Dennis Pederson, Office of Information Resources, GIS Services: October 13, 2008.
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- ¹²⁸ Personal communication with Tim Roach, Director of Local Planning, Dept. of Economic Development: October 13, 2008.
- ¹²⁹ Personal communication with Tim Roach, Director of Local Planning, Dept. of Economic Development: October 13, 2008.
- ¹³⁰ Personal communication with Dr. Robin Gottfried, Department of Economics, The University of the South: December 1, 2008.
- ¹³¹ Personal communication with Emily Burnett Parish, The Land Trust for Tennessee: November 17, 2008.
- ¹³² Personal communication with Emily Burnett Parish, The Land Trust for Tennessee: November 17, 2008.
- ¹³³ Personal communication with Dr. Bridget Jones, Executive Director, Cumberland Region Tomorrow: November 20, 2008.
- ¹³⁴ Personal communication with Gina Hancock and Joey Wisby of the Tennessee Chapter of TNC: December 16, 2008.