From Rural to Suburban in Less Than a Century: Changes in Housing Density in North Carolina From 1940 – 2030

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INTRODUCTION

North Carolina is known for its natural splendor – its majestic Blue Ridge Mountains, rolling farms and quiet rivers of the Piedmont, and tidal marshes and pounding surf of the coast. These natural assets are what make our state such a great place to live and work, and why more and more people are calling North Carolina home. Because of this population influx, North Carolina is changing fast, with far-reaching consequences for its citizens' quality of life. The state's population is expected to increase 50% by 2030, and recently North Carolina passed New Jersey to become the nation's tenth most populous state.

New maps displaying trends in North Carolina's housing density from 1940 to 2030 provide a striking visual depiction of what this booming population growth means for our state's farms, forests, rivers, and wildlife. The maps show that in less than a century, North Carolina has gone from being a predominantly rural state to one that will be highly sprawling and suburbanized, with less and less undeveloped open space. If current growth trends continue, with a few exceptions, North Carolina's farms, forests, and other natural lands will be small islands in a sea of suburban and exurban development by 2030. **The maps underscore how crucially important it is for the state to provide substantial new funding for land and water conservation programs, to protect critical streams, farms, forests, and wetlands before they are developed.**

The maps, produced by scientists at the University of Wisconsin-Madison and funded by the U.S. Department of Agriculture Forest Service North Central Research Station, use a gradation of color from green to orange, red and purple to show increasing housing density. The state appears predominantly green in 1940, with very low housing density throughout almost all of the state. The orange, red, and purple blotches increase with each passing decade until by 2030 the state is projected to appear mostly orange and red. In the real world, it's more than just colors changing on a map. Housing has rapidly spread over what were once family farms, intact forests, and healthy river banks.

The maps reinforce disturbing trends we have already seen. In 2005, the state lost 1000 farms, and between 2002 and 2005 North Carolina lost roughly 6,000 farms and more than 300,000 acres of farmland. Already, over 3,300 miles of streams, roughly the distance from Wilmington to Los Angeles, do not meet water quality standards. Polluted runoff, often caused by development along waterways, is the chief culprit. Childhood asthma is on the rise, at least in part due to air pollution. Habitat for wildlife is vanishing fast; already 18% of the state's plant and animal species are threatened or endangered. Natural areas for recreation are dwindling as forests, farms, and stream banks are converted to housing and shopping centers.

Rapid development is driving these trends, as farms and forests are disappearing under the bulldozer. Why does that matter? Thriving agriculture and forests are key to the state's future quality of life. Forests often contain the headwaters of our streams and rivers. When stream banks are forested, they prevent polluted runoff from entering streams, but when they are denuded, sediment and chemical contaminants pour into

streams, threatening drinking water quality downstream. Forests also provide abundant habitat for hundreds of plant and animal species in North Carolina. In addition, forests provide clean air and sequester carbon from the atmosphere, helping to limit global warming. Farms obviously provide food for North Carolinians, but also help to contribute to clean water. Perhaps equally important, thriving farms represent a culture and rural way of life that all North Carolinians respect and treasure.

Together, agriculture and forestry constitute the state's number one industry, and if we fail to preserve these critical lands, our economy's foundation will be undermined. We simply cannot afford to continue losing forests and farms to development. **It is critical that the North Carolina General Assembly enact legislation to place before voters a $1 billion Land and Water Conservation bond referendum** for preservation of land, water, historic resources, and communities, as recommended by the Land for Tomorrow coalition.

The General Assembly should also approve funding of at least $6 million in the 2007-08 budget for the Agricultural Development and Farmland Preservation Trust Fund, so that farmers who want to preserve their family farms can do so, and should pass reforms to tax laws to provide additional incentives to landowners who voluntarily conserve their land.

FINDINGS

The maps clearly show that low housing density areas (colored green), which in 1940 covered almost all of the state, have been overtaken by population growth and development such that by 2030, roughly half the state will be settled at a density equivalent to being urban, suburban, or sprawling exurban. By 2030, the green areas are overrun by new housing so that very few areas of the state are projected to maintain the lowest rural housing density. **The maps show that housing and other development is not limited to urban areas or suburbs. Indeed, increased development is occurring in most rural counties, the places where some of our state's most treasured natural areas are located.**

Let us be clear – the maps do not indicate that North Carolina is about to become another Manhattan. But they do show that we'll have fewer family farms, and therefore a less steady local supply of food and fiber; that forests and wildlife habitat will be severely fragmented, putting at risk not only the survival of threatened and endangered species but also currently thriving plants and animals; and increased water pollution from contaminated runoff caused by development, threatening our drinking water supplies, or at least necessitating greater expenditures to provide safe drinking water.

Table 1	Growth in Number of Housing Units		
Year	Number of Housing Units Statewide	Numeric Gain	Percentage Gain
1940	820,888		
1950	1,058,367	237,479	28.93%
1960	1,322,957	264,590	25.00%
1970	1,642,015	319,058	24.12%
1980	2,274,196	632,181	38.50%
1990	2,818,193	543,997	23.92%
2000	3,523,944	705,751	25.04%
2010	4,152,147	628,203	17.83%
2020	4,716,944	564,797	13.60%
2030	5,202,512	485,568	10.29%

The table above shows that from 1940 to 2030, there is expected to be a gain of 4,381,624 housing units, and an average gain of 486,847 units each decade. The average percentage increase per decade is estimated to be 23.03%. The overall percentage increase in housing units from 1940 to 2030 is projected to be 533.77%. For 2000-2030 only, the projected gain in housing units is 1,678,568, a 47.63% increase.

The color scheme in the maps is as follows: dark green equates to more than 100 acres per housing unit on average within a partial Census block group (more on that in Methods section); light green is 30 to 100 average acres per housing unit; yellow is 15 to 30 acres per housing unit; orange is 1 to 15 acres per housing unit (considered "exurban"); red is 0.33 to 1 acre per housing unit (roughly "suburban"), and purple is less than 0.33 acres per housing unit (urban).

It is important to emphasize that these housing density figures do not equate to average lot size. With any level of housing density, there is other associated development such as roads, schools, and office, commercial, and industrial areas. What this means is that the footprint of total development would provide an even worse picture than these maps, which focus only on housing. It is difficult to quantify the ratio of housing density to overall development acreage because it varies at different housing density levels. What we do know is that more than 100,000 acres of forests, farms and other natural areas are developed each year.

The maps provide additional data to a growing mountain of evidence that our state is developing at a hectic pace, with potentially dire consequences. In April, Environment North Carolina issued a report, "*Losing our Natural Heritage: Development and Open Space Loss in North Carolina*," which found that the state lost 2.37 million acres of cropland and forest land, or an estimated 325 acres every day, to development during the last twenty years. Based on these trends, North Carolina can expect to lose another two million acres of farms and forests over the next 20 years, roughly 100,000 acres per year.

The Environment North Carolina report also stated that the rate of increase in developed acres is even higher than the state's population growth. Over the last 20 years, the state's population grew by 40%, but the number of developed acres increased by 65%. For the next 20 years, the state's population is expected to increase by 30%, but again, the increase in developed acres is expected to be higher – 38%.

North Carolina's future quality of life is plainly put at risk by these development trends. Frequently, homes are built near rivers, creeks and streams; the more this happens, the more polluted runoff is created because impervious services like driveways and rooftops are unable to filter contaminants as a naturally forested stream does. In addition, as more and more roads are built to service new housing, air pollution worsens as vehicular travel increases. Development also obviously destroys the forests, marshes and farms that provide wildlife habitat; increasingly the state's plants and animals are losing the scale of areas they need to maintain healthy populations. Developing more land limits the natural areas where our families can go for recreation as well. Finally, the conversion of farms by development limits the state's ability to provide sufficient food and fiber for its population, which is likely to become more important as energy and transportation costs continue to rise. **The very nature of our state, how we think of North Carolina – beautiful, rural, plentiful and natural – is in peril.**

METHODS

Housing density in these maps is measured as housing units per square kilometer. A housing unit is defined as a free-standing single-family home, one-half of a duplex, an apartment, or a house trailer. Second (vacation) homes are included in the data. Mapping units are "partial block groups", intermediate between Census blocks and Census block groups. Block groups are aggregates of Census blocks that generally contain approximately 600 to 3,000 people and vary widely in size. A block group is not a political unit, but a geographic unit invented for the purposes of collecting information in the U.S. Decennial Census of Population and Housing. "Block groups" are loosely based on population but are also generally bounded by geographic features like roads and waterways; blocks vary in size from about 300 to 3,000 people. "Partial block groups" are portions of a block group that may be split by a political boundary (city, congressional district, township, etc.)

The map shows each partial block group as a single color based on average housing density across that entire geographic unit; it does not display individual house locations. The maps use 2000 data, and pivot backward for historical density estimates, and forward for future projections. For historic housing units, since Census block and block group boundaries change from one Census to the next, the study could not simply use housing units reported by the Census for each decade. Instead, the researchers used the 2000 Census boundaries and the age of housing present during that year to estimate the number of units in previous years. Respondents to the Census long-form survey (about 1 in 7 households) report the year their house was built. The researchers adjusted for the fact that some older houses were destroyed before 2000 and hence no longer appear in the

Census. The adjustment was based on the number of houses actually present in a historic Census year county-wide (because county boundaries are usually consistent from one Census to the next), compared with the houses of that vintage still present at the 2000 Census.

Projections of housing units for 2010, 2020 and 2030 for each partial block group assume that past growth rates will continue for the next thirty years. The study derived rates of growth of housing units from 1990 to 2000, then applied those growth rates in each of the following three decades.

POLICY RECOMMENDATIONS

1) The Legislature Should Pass the Land and Water Conservation Bond Act
The single most important step the General Assembly can take to address the growing loss of farms, forests, and wildlife habitat is to approve legislation that would place before voters a bond referendum for $1 billion for preservation of critical lands and historic places. The funds would be spent over five years, and most would be placed in existing successful programs at the state's natural resource trust funds. The Clean Water Management Trust Fund, Parks and Recreation Trust Fund, Natural Heritage Trust Fund, and Agricultural Development and Farmland Preservation Trust Fund all have proven records of effectively and efficiently using state dollars to preserve lands with high conservation values. The trust funds' work has resulted in cleaner water, numerous new state parks, additional game lands, protected farms, and conserved wildlife species. The Land and Water Conservation Bond Act also includes an innovative program called "Landing Jobs" that calls for a portion of the funding to be used to implement an approach to conservation that invests in rural and low-income communities to both protect their natural resources and help local economies thrive.

A majority of senators and representatives has cosponsored bills (Land and Water Conservation Bond Act, H 990 and S 1522) to place the $1 billion bond on the ballot. **Given that the maps in this report plainly show that forests and farmland are being developed at a rapid pace, it is important to note that the proposed legislation would provide $40 million per year for five years to preserve working farms and forests, and keep them in productivity.**

The legislation remains on the table as both houses work to determine how to fund important long-term infrastructure needs. The Land and Water Conservation bond is one of the elements of the recently formed Partnership for North Carolina's Future. The Partnership, which includes the Land for Tomorrow coalition of over 250 organizations, is urging the legislature to invest in North Carolina's quality of life by providing bonds and other funding for schools, water and sewer, transportation, affordable housing, and land conservation.

2) The Legislature Should Increase Farmland Preservation Funding

Even if the Land and Water Conservation bond is placed on the ballot and subsequently passed by North Carolina voters, there is a critical immediate need for the General Assembly to provide funding for the state's Agricultural Development and Farmland Preservation Trust Fund (ADFPTF). This program has received spotty funding, with a total of roughly $2.6 million over the last decade, but it has leveraged almost ten times that to enable farmers to place voluntary conservation easements on their farms. These agreements have allowed them to maintain ownership of their land, continue to farm it, and invest in their farm's operations.

It is critical that the state invest in farmland preservation because North Carolina holds the dubious distinction of being tied for first among states in the number of farms lost per year. Yet agriculture (and related agribusiness) is the state's largest industry, contributing more than $68 billion to the state's economy annually and nearly one in every five jobs. These impressive numbers cannot be maintained if we continue to lose farms so rapidly.

The current state budget contains only nominal ADFPTF funding, and there is growing demand among farmers and the agricultural community to provide substantially more funding to purchase easements so that farmers have the financial option of keeping their farms rather than selling to a developer. Local land trusts have identified more than 200 agricultural landowners who would be willing to conserve their land through conservation easements. Their lands total approximately 25,000 acres. Governor Easley's proposed budget included $6 million for the ADFPTF, and the House budget contained $8 million, but the Senate's version had no funding. Budget negotiators have not yet reached a final compromise. It is imperative that budget conferees include at least $6 million for this fund, to provide farmers with more options to own, preserve, and farm their land.

3) The Legislature Should Approve Expanded Conservation Tax Incentives
It is also important for the General Assembly to enact expanded income and property tax incentives for voluntary land conservation on privately owned lands. Many landowners would like to be able to preserve their land, yet they need additional incentives to be able to make it a financially sound decision. A House bill (H 1889, with 78 cosponsors), would establish a new Present Use Value (PUV) category for lands being managed under a wildlife management plan approved by the Wildlife Resources Commission or a federal wildlife program. The bill also would clarify the amount of easement value required to be donated for land placed under a conservation easement to continue to be enrolled in the PUV program, even if the PUV program's income/production requirements can no longer be met due to the easement. The bill requires that at least 25% of the easement value be donated. The conservation community also supports a bill in the Senate, S 1203, which is similar to H 1889 except for two differences. S 1203 also contains a provision to reduce the minimum acreage eligible for PUV agricultural land from ten to five acres, and sets the required donated value for continued PUV eligibility under an easement at 50%, not 25% as proposed in the House version.

APPENDIX: METHODS AND DATA

The maps of housing density by decade, 1940-2030, for the northeast and southeast regions, distributed as power-point slides in files titled "NE Series 1940-2030" and "SO Series 1940-2030", are very powerful tools to illustrate the impacts of housing development on forests in the eastern U.S. These maps were produced by R.B. Hammer and V.C. Radeloff at the University of Wisconsin – Madison, with funding from the USDA Forest Service North Central Research Station. The lead author is Volker Radeloff, U. Wisconsin-Madison, Forest Ecology and Management, 1630 Linden Drive, Madison, WI 53706, phone: 608-263-4349, fax: 608-262-9922, radeloff@wisc.edu.

Users of these maps should understand the underlying data and some of its limitations. The paragraphs below summarize the techniques used. For more details on methodology, see these papers available at http://silvis.forest.wisc.edu/pubs.asp.

Radeloff, V. C., R. B. Hammer, and S. I. Stewart. 2005. Sprawl and forest fragmentation in the U.S. Midwest from 1940 to 2000. Conservation Biology 19: 793-805.

Hammer, R. B. S. I. Stewart, R. Winkler, V. C. Radeloff, and P. R. Voss. 2004. Characterizing spatial and temporal residential density patterns across the U.S. Midwest, 1940-1990. Landscape and Urban Planning, 69(2-3):183-199.

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Housing units and geographies: Housing density in these maps is measured as housing units per square kilometer. A housing unit, as defined in the U.S. Census of Population and Housing (source of the data) might be a free-standing single-family home, one-half of a duplex, an apartment, a house trailer, or even a boat or camper if that serves as a permanent residence. Housing units include both year-round primary residences and "vacant" homes (a category which includes seasonal homes that are not the primary residence, even if they are occupied for much of the year). Since the growth of second-homes may cause significant forest fragmentation, it is appropriate to include the "vacant" units in the density measure.

Mapping units are "partial block groups", intermediate between Census blocks and block groups. Census blocks are delineated by physical features and may be as small as a city block or may contain many acres in sparsely populated areas. Because of their small size, confidentiality concerns and sampling errors dictate that the Census not report details like the year a house was built at the Census block level. For this reason, the study could not use Census blocks as the basic geographic unit. Block groups are aggregates of Census blocks that generally contain approximately 600 to 3,000 people and vary widely in size. The partial block group provides better spatial resolution than the block group, while also making key housing data available.

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Future housing units: Projections of housing units for 2010, 2020 and 2030 for each partial block group assume that past growth rates will continue for the next thirty years. The study derived rates of growth of housing units from 1990 to 2000, then applied those growth rates in each of the following three decades. This is a fairly simplistic forecast, and researchers are currently working on a more sophisticated model to predict future housing growth.
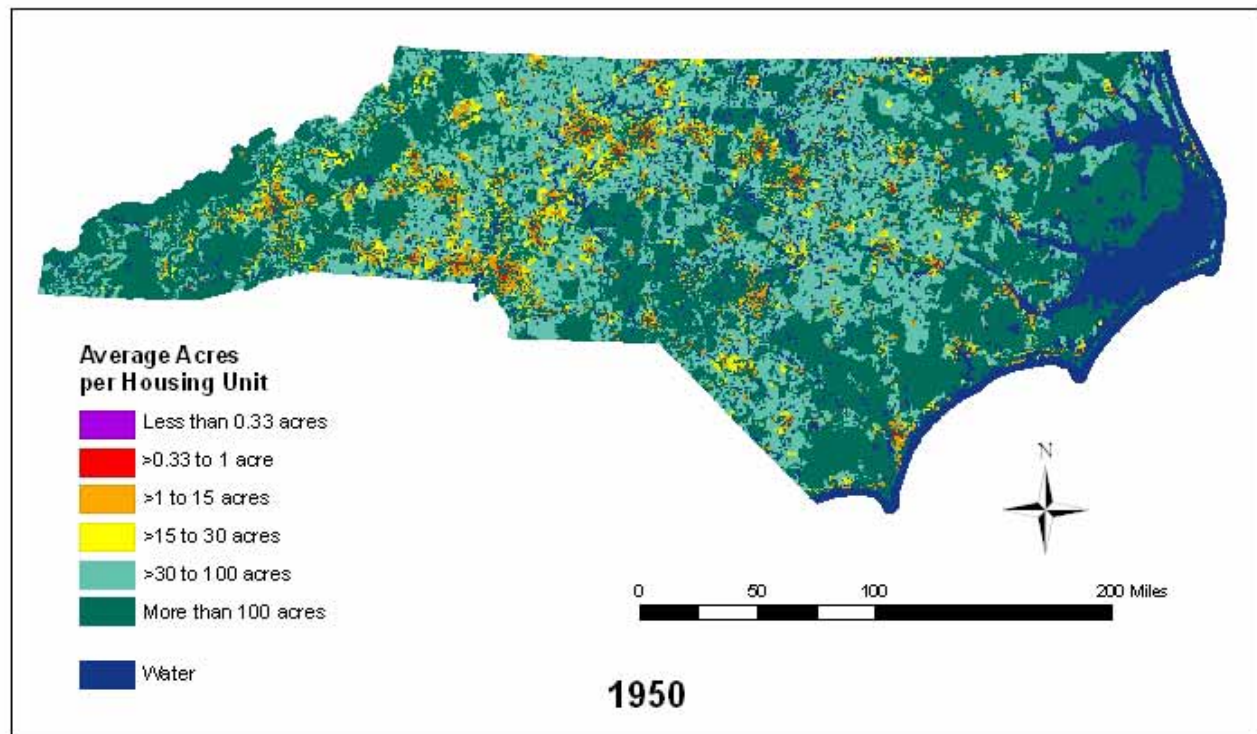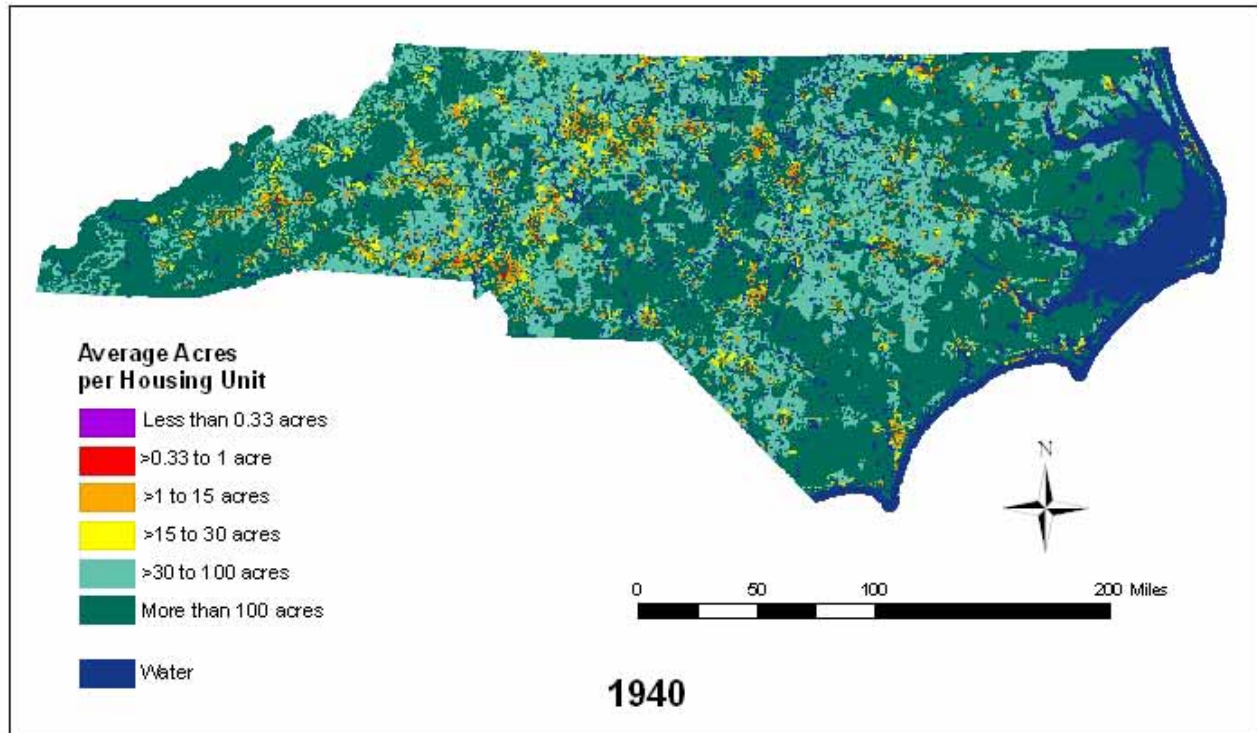
ACKNOWLEDGMENTS

The Wilderness Society for her assistance in manipulating the maps and explaining their meaning.

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Housing Density, 1940 and 1950, North Carolina

Average Acres per Housing Unit
- Less than 0.33 acres
- >0.33 to 1 acre
- >1 to 15 acres
- >15 to 30 acres
- >30 to 100 acres
- More than 100 acres
- Water

0   50   100   200 Miles

1940

Average Acres per Housing Unit
- Less than 0.33 acres
- >0.33 to 1 acre
- >1 to 15 acres
- >15 to 30 acres
- >30 to 100 acres
- More than 100 acres
- Water

0   50   100   200 Miles

1950

Housing Density, 1960 and 1970, North Carolina

Average Acres per Housing Unit

- Less than 0.33 acres
- >0.33 to 1 acre
- >1 to 15 acres
- >15 to 30 acres
- >30 to 100 acres
- More than 100 acres
- Water

1960

Average Acres per Housing Unit

- Less than 0.33 acres
- >0.33 to 1 acre
- >1 to 15 acres
- >15 to 30 acres
- >30 to 100 acres
- More than 100 acres
- Water

1970
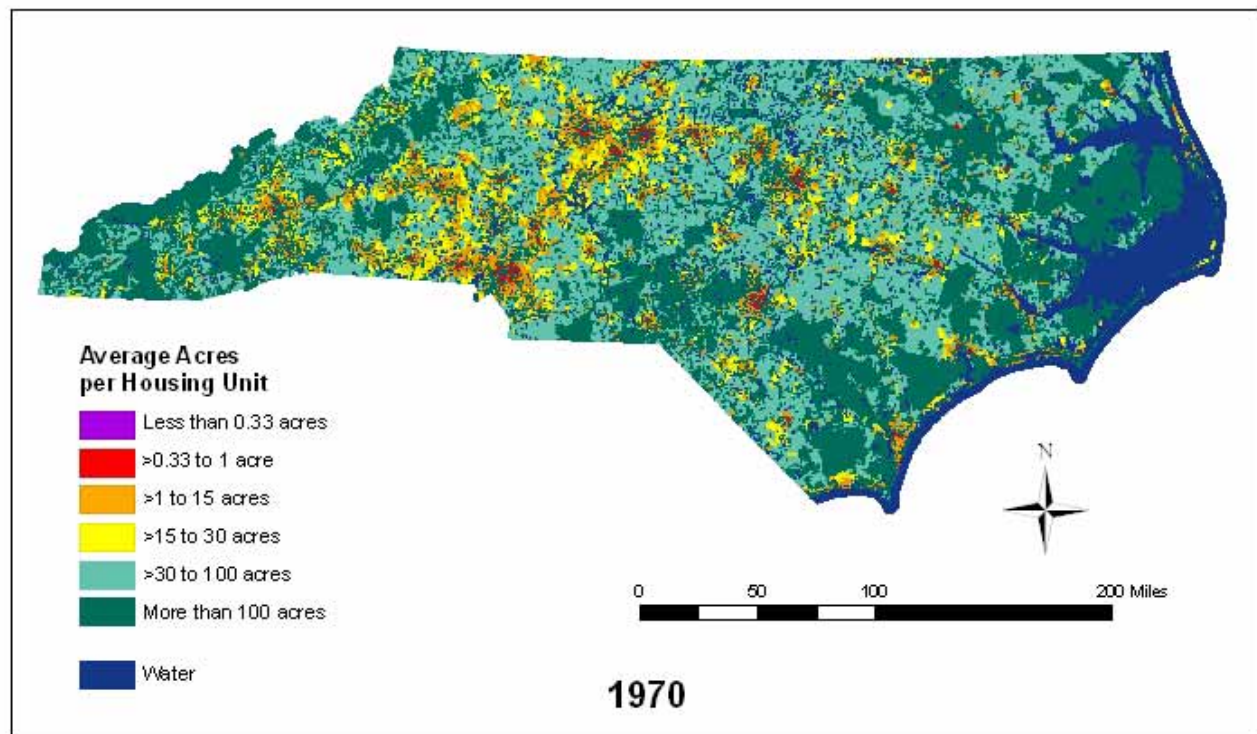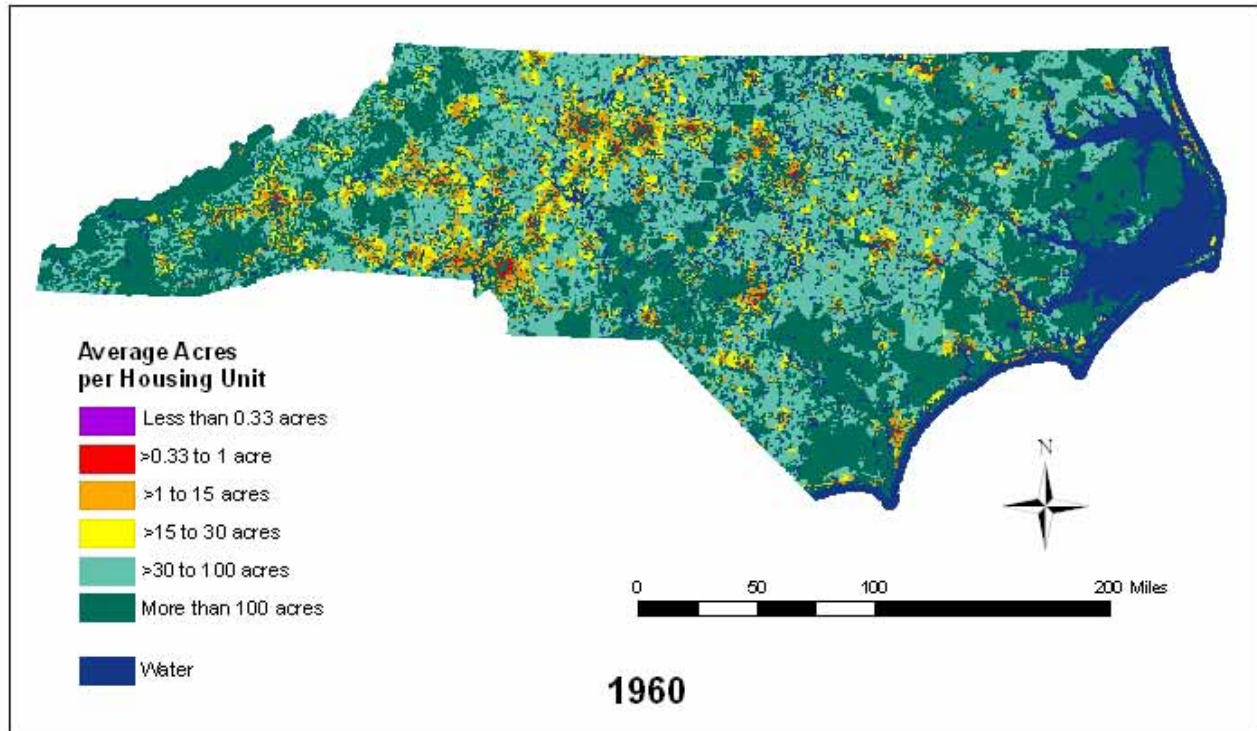
Housing Density, 1980 and 1990, North Carolina

Average Acres
per Housing Unit

- Less than 0.33 acres
- >0.33 to 1 acre
- >1 to 15 acres
- >15 to 30 acres
- >30 to 100 acres
- More than 100 acres

Water

1980

Average Acres
per Housing Unit

- Less than 0.33 acres
- >0.33 to 1 acre
- >1 to 15 acres
- >15 to 30 acres
- >30 to 100 acres
- More than 100 acres

Water

1990
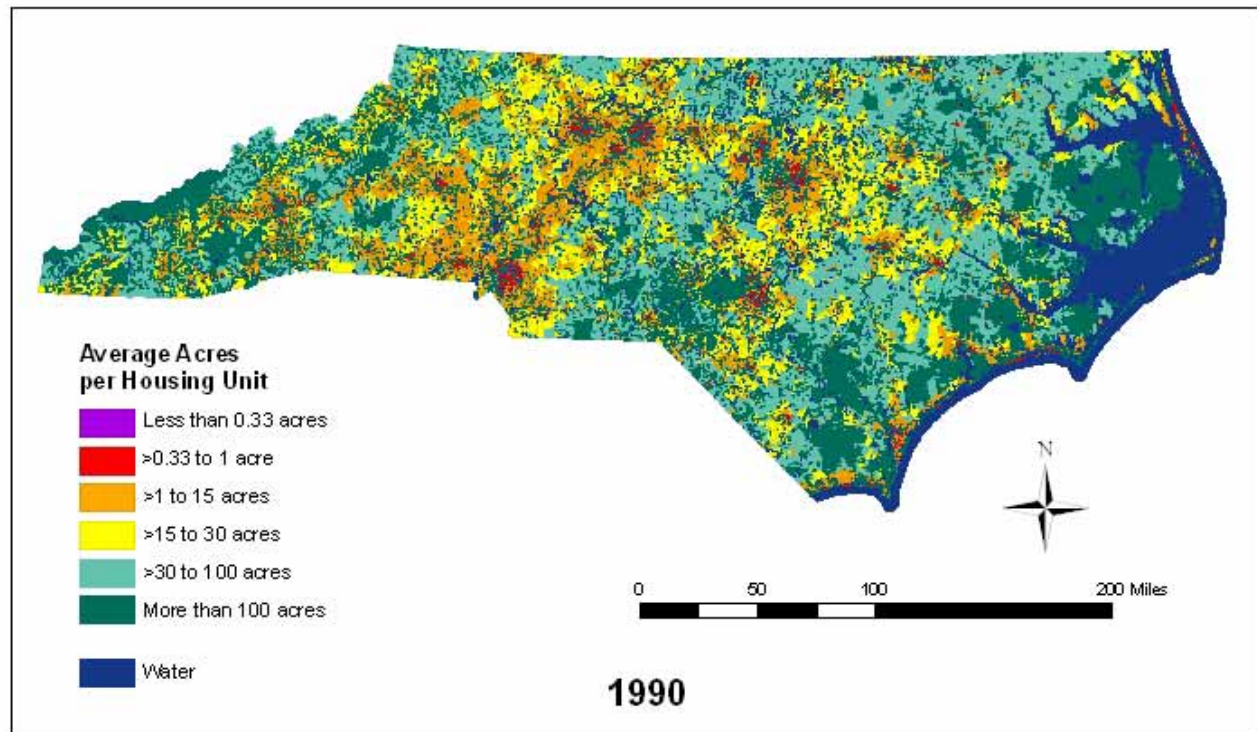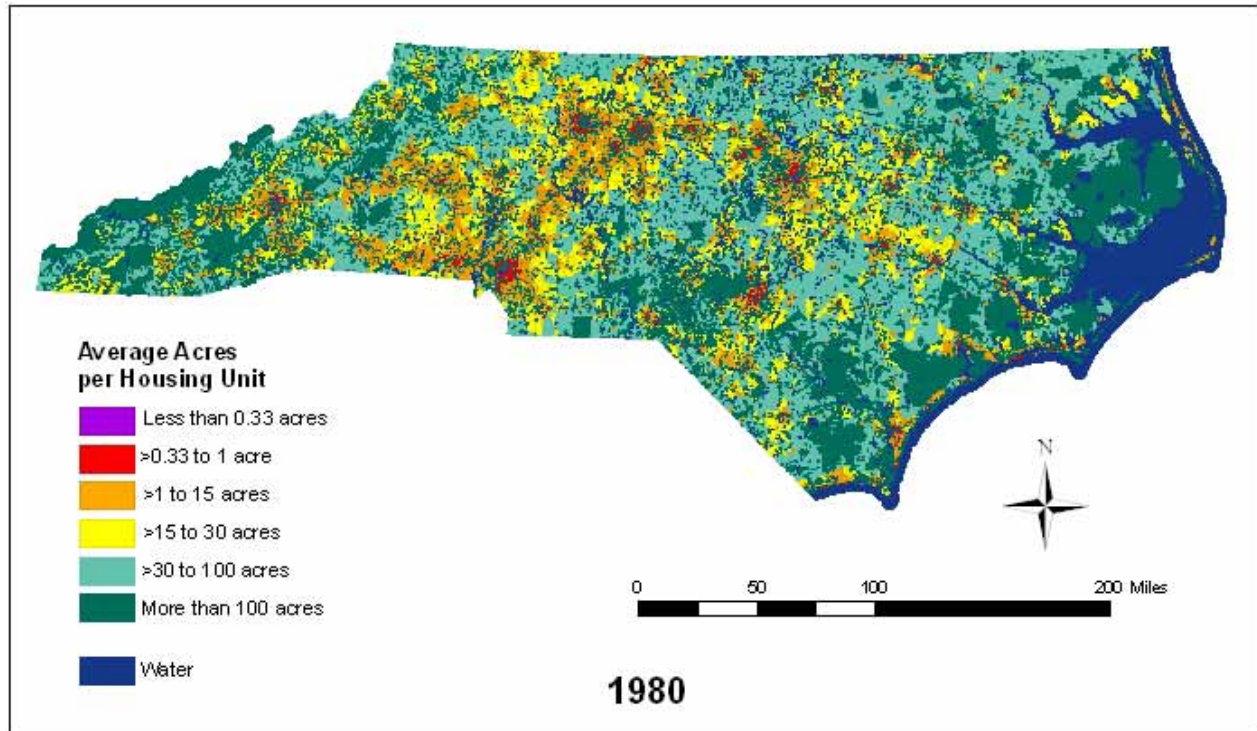
Housing Density, 2000 and Projected 2010, North Carolina

Average Acres
per Housing Unit

- Less than 0.33 acres
- >0.33 to 1 acre
- >1 to 15 acres
- >15 to 30 acres
- >30 to 100 acres
- More than 100 acres

- Water

0   50   100   200 Miles

2000

Average Acres
per Housing Unit

- Less than 0.33 acres
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0   50   100   200 Miles

2010
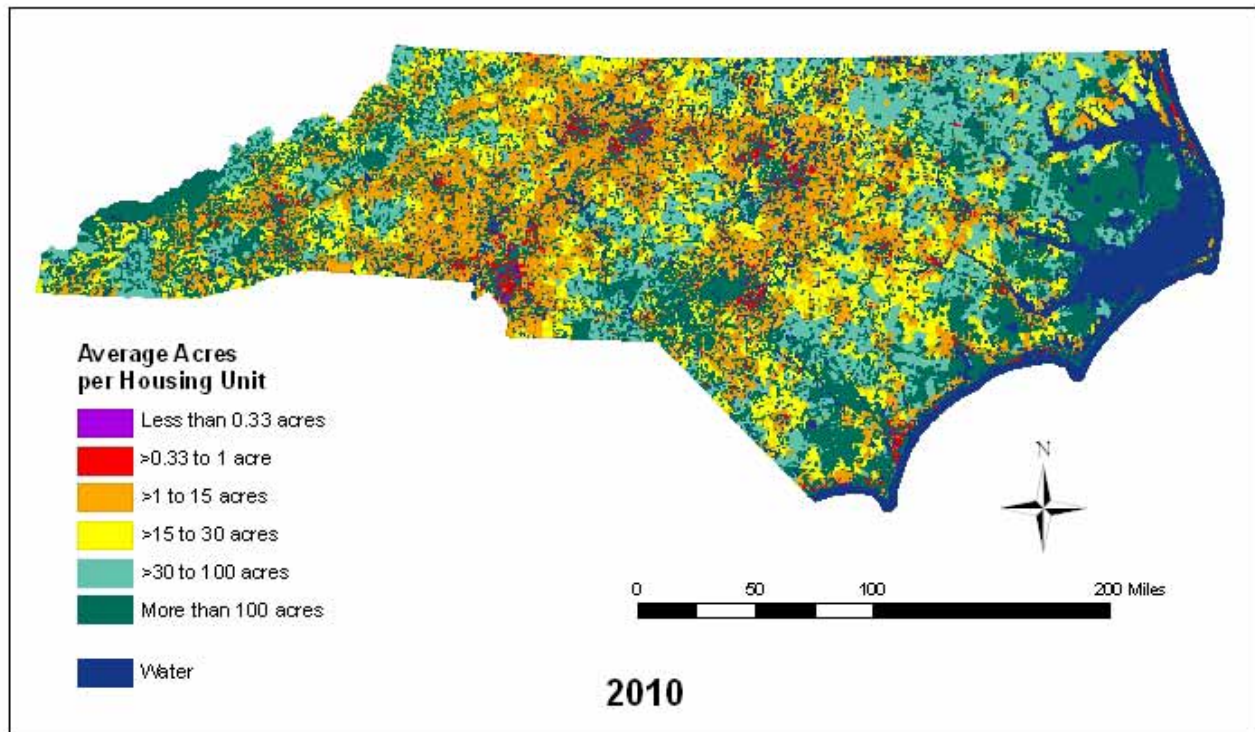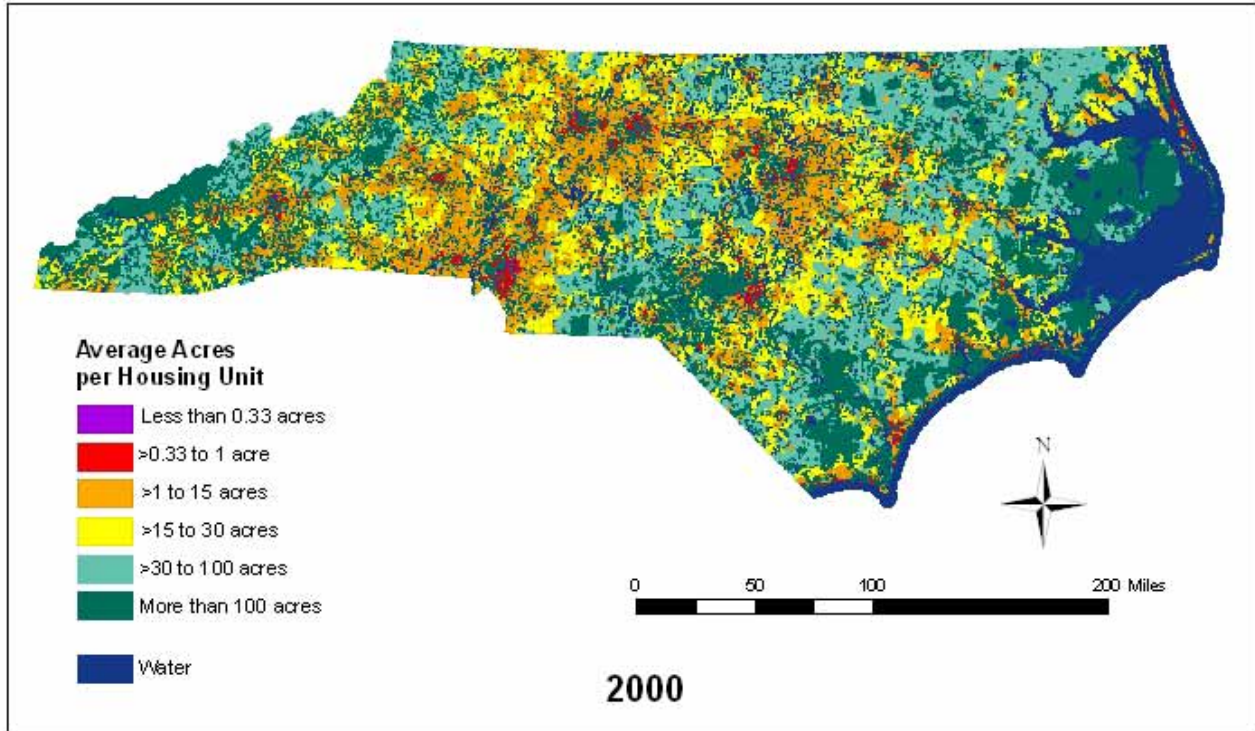
Housing Density, Projected 2020 and 2030, North Carolina

Average Acres per Housing Unit
- Less than 0.33 acres
- >0.33 to 1 acre
- >1 to 15 acres
- >15 to 30 acres
- >30 to 100 acres
- More than 100 acres
- Water

2020

Average Acres per Housing Unit
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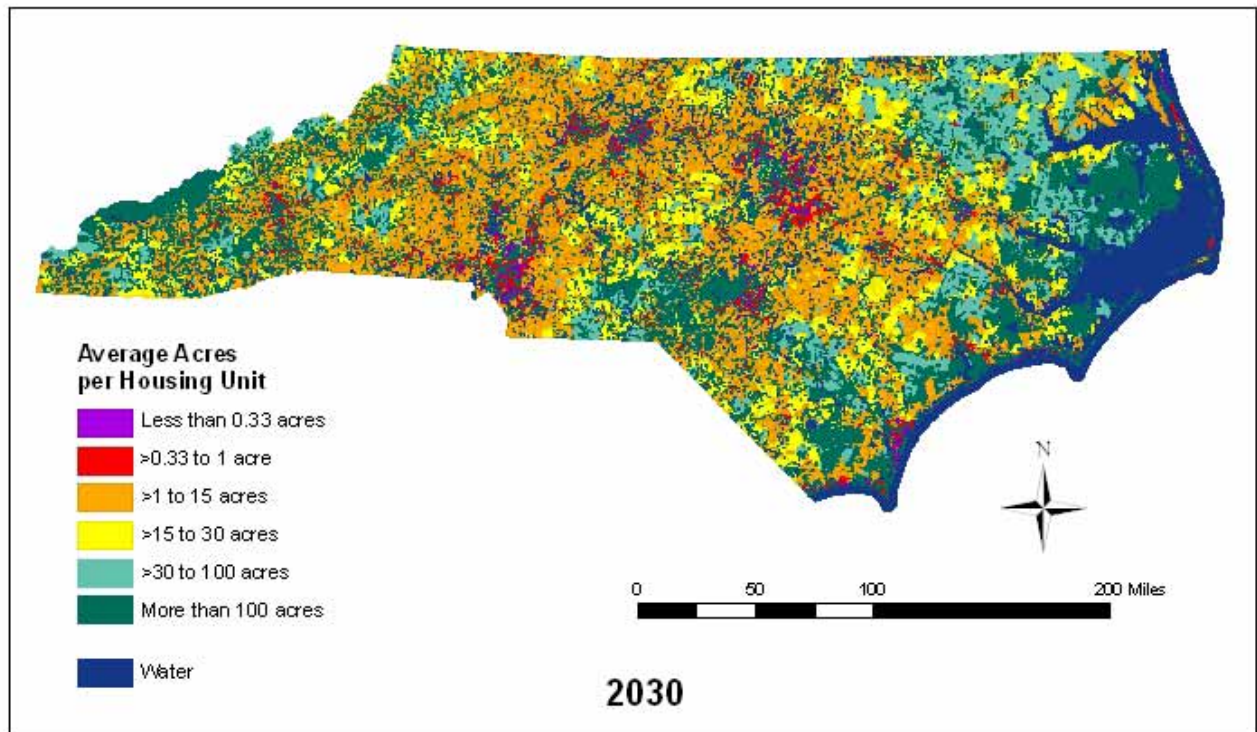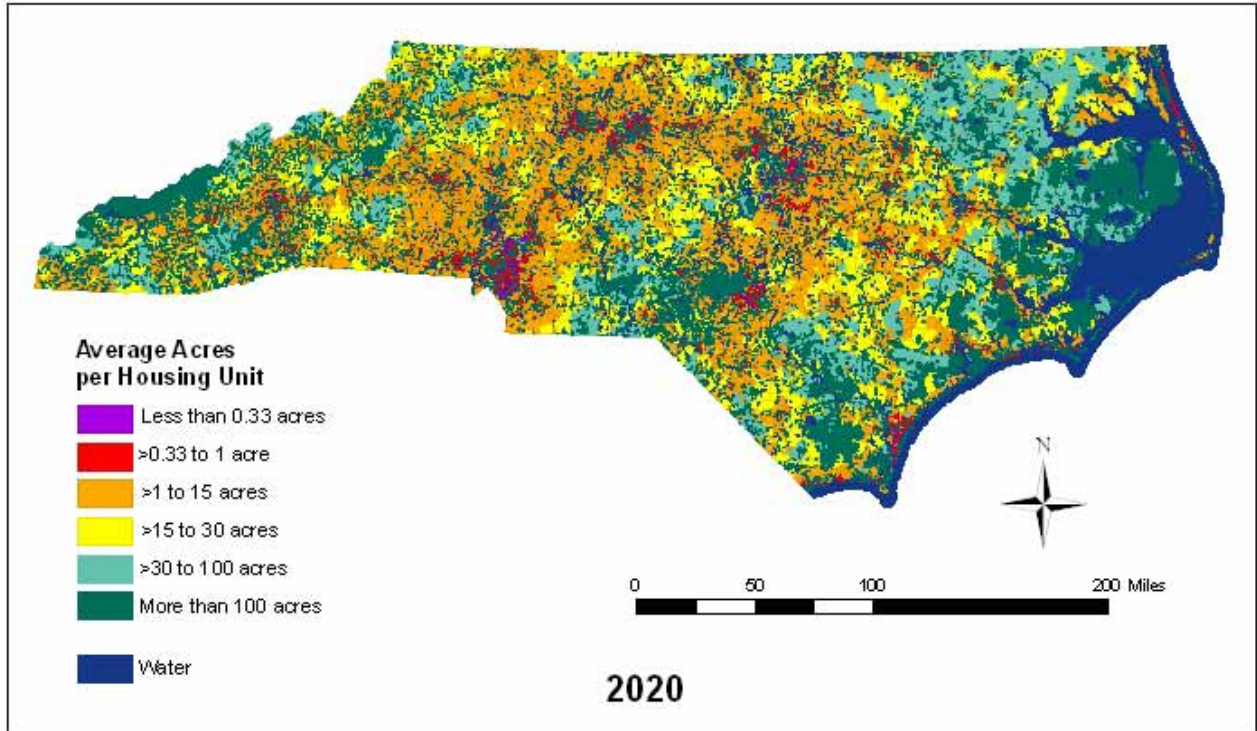
2030

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For questions about map displays, contact: Ann Ingerson, Research Associate, The Wilderness Society, ann_ingerson@tws.org or (802) 586-9625.

For questions about data methods, contact: Volker Radeloff, U. Wisconsin-Madison, Forest Ecology and Management, 1630 Linden Drive, Madison, WI 53706, radeloff@wisc.edu, 608-263-4349.