

3. Extent of forest land conversion, fragmentation and parcelization

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Fragmentation is a term used to describe certain kinds of landscape structures. Common measures of fragmentation are patch size, isolation (distance between patches), and edge (cumulative length of patch edges). “Permanent fragmentation” refers to long-term conversion of forest to urban, residential, agricultural, or other non-forest uses. Roads and utility corridors can also create permanent fragmentation. Permanent fragmentation is a permanent loss of habitat and alters some ecological processes. Permanent fragmentation therefore has the greatest negative impact on forest biodiversity.

“Habitat fragmentation” is defined as a disruption of habitat continuity caused by human or natural disturbance, which creates a mosaic of successional and developmental stages within a forested tract. At a landscape scale, aggregated continuing human disturbance may result in relatively high levels of habitat fragmentation with negative impacts. Dispersal can be affected if species or their propagules cannot cross a disturbed area, find suitable habitat within it, or successfully compete with disturbance adapted species.

Parcelization is the subdivision of a single forest ownership into two or more ownerships. The forest land itself may not change immediately when broken up into separate tracts, but it becomes more susceptible to fragmentation (e.g. some tracts may be sold for development). With multiple landowners, coordinated landscape scale management becomes increasingly difficult to implement due to landowners with diverse objectives. Parcelization can be a barrier to the successful conservation of biodiversity.

3.1 Forest land developed

3.2 Net change in forest land

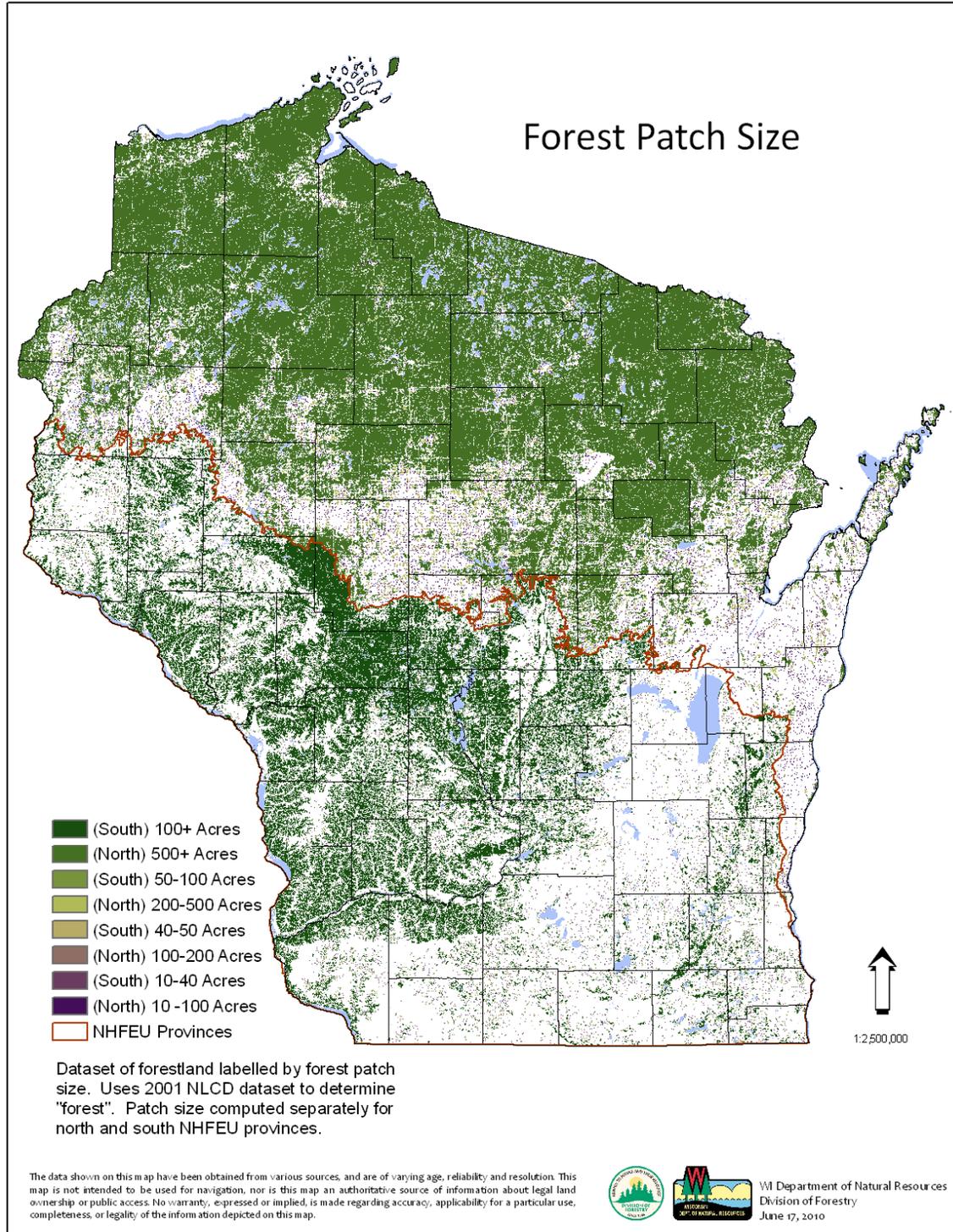
3.3 Additions to and conversions from forest land

There are currently 16.4 million acres of forest land in Wisconsin, up from 14.7 million acres in 1983 (Table 1.a). Based on estimations of vegetation type and cover in the mid-1800’s, forest area ranged from 22 to 26 million acres (not including barrens or savannas).

Each year some forest land is converted to non-forest land uses (developed), and some non-forest land is regenerated to forest. Criterion 6, Metric 16; and Criterion 7, Metric 19 provide additional assessments regarding land ownership, land use, management designations and limitations, and legal and institutional frameworks. More specifically, Metrics 3.4, 16.2, and 19.3 provide discussions of ownership trends and parcelization.

Metric 1.2, Map 1.a provides a statewide depiction of the density of forest canopy cover (National Land Cover Data 2001). Spatial models to evaluate forest fragmentation are being developed and refined to improve accuracy. Map 3.a showing forest patch size is such a GIS product, more of which will be available as this type of research progresses.

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Map 3.a: Fragmentation: forest patch size

Source: U.S. Forest Service, Rachel Riemann

Criterion 1: Conservation of biological diversity

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3.4 Forest Parcel Size

Parcelization is occurring in Wisconsin as evidenced by the increased number of landowners and smaller average parcel sizes. Most forest land (66%) in Wisconsin is privately owned. The average parcel size owned by a private landowner is 30 acres, a decrease from 41 acres in 1997 (Table 3.a). During this same period, the number of landowners increased from 263,000 to 362,000 (Table 3.b and Metric 16.2). The number of large scale forest owners (owning 200 acres or more) has remained stable since 1997, but the acreage of parcels owned by these large scale forest owners has decreased. The most dramatic change in acreage occurred with owners of parcels 5,000 acres and greater. Most likely these lands have been sold off in smaller parcels resulting in the increase in owners of less than 100 acres. Large forest landholdings in amenity rich areas are particularly at risk of being split as landowners can sell smaller parcels at a higher price.

In a study on what factors contribute to forest parcelization, Mehmood and Zhang (2001) found urbanization, income, regulation uncertainty, death, and financial assistance for landowners to have significant impacts on the change in average parcel size. The proximity of urban development and higher densities are correlated with reduced rates of timber harvest on private forests (Barlow et al, 1998). As forest parcels decrease, loggers may find the small sale sizes too small to bid on (Kittredge et al, 1996) and therefore more difficult for landowners to manage economically.

Ownership Category	Average Parcel Size (acres)	
	1997	2006
Private Forest Ownership	41	30
Non-Industrial Private Forest (NIPF) Ownership	37	28

(USDA, FIA, NWOS, 2006)

Ownership Parcel Size Class	# Owners (thousands)			# Acres (thousands)		
	1997	2006	Change from 1997 to 2006	1997	2006	Change from 1997 to 2006
1-9	92	176	84	339	529	190
10-19	40	46	6	518	575	57

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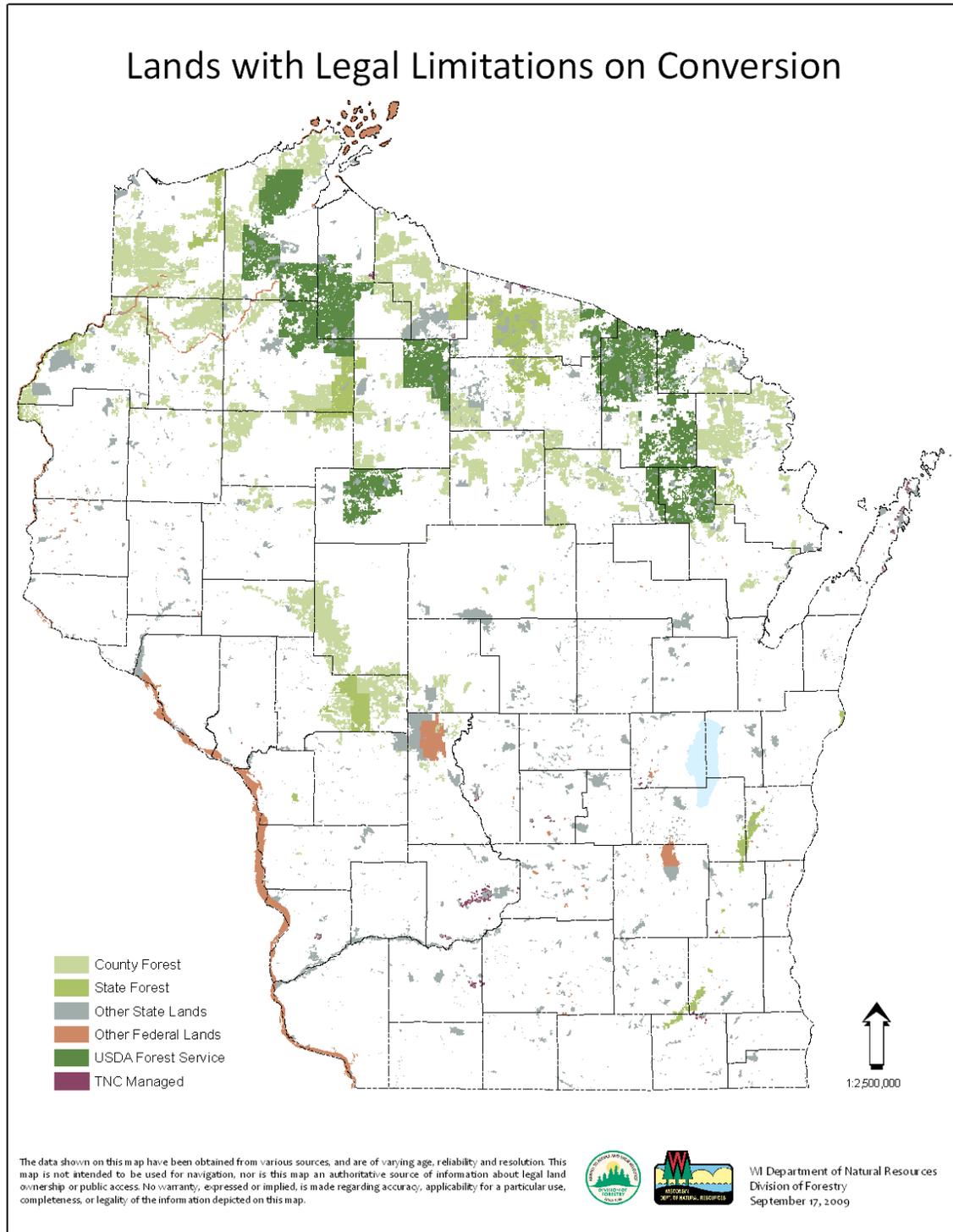
20-49	69	77	8	2157	2204	47
50-99	37	36	-1	2290	2411	121
100-199	17	19	2	2111	1996	-115
200-499	7	7	0	1569	1496	-73
500-999	1	1	0	435	423	-12
1000-4999	<1	<1	0	316	304	-12
≥5000	<1	<1	0	1077	810	-267
Total	263	362	99	10,812	10,479	-64
(USDA, FIA, NWOS, 2006)						

3.5 Lands with Various Legal Limitations on Conversion

Maintaining forest land contributes to the conservation of forest biodiversity. One method is public ownership. The vast majority of public land occurs in northern and west-central Wisconsin (Map 3.b). Public and tribal forest land ownership is slowly increasing and represents about 34% of Wisconsin forest land (Table 3.c). About 66% of forest land is privately owned, in large part as non-industrial private forests (NIPF). On private forest lands, conservation easements may help ensure long-term retention of forested conditions. In Wisconsin, statutory incentives like the Managed Forest Law (MFL) and regulations like county zoning ordinances are additional methods to encourage maintenance of private forested lands. Criterion 6, Metric 16; and Criterion 7, Metric 19 provide related information about land ownership, land use, management designations and limitations, and legal and institutional frameworks.

Legal limitations on conversion help to reduce permanent fragmentation. However, they do not address habitat fragmentation. If legal limitations on conversion incorporate forestry practices guidelines, then some aspects of habitat fragmentation could be addressed.

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Map 3.b: Lands with legal limitations on conversion (this map does not include private conservation easements other than The Nature Conservancy) Source: DNR, 2009

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Table 3.c: Area of forest land in Wisconsin by ownership category

Ownership Category	1968 Thousand acres	1983 Thousand acres	1996 Thousand acres	2006 Thousand acres
Total Private	10,216	10,426	10,812	10,749
NIPF	8,816	9,252	9,710	10,070
Forest Industry	1,400	1,174	1,102	679
Tribal	157	358	347	368
Total Public	4,573	4,568	4,745	5,157
Federal	1,485	1,621	1,629	1,576
State	723	707	823	1,075
Local	2,366	2,240	2,293	2,506
Total	14,945	15,351	15,904	16,274

(USDA, FIA, NWOS, 2006)

3.6 Road Density

3.7 Housing density

Roads are a vital component of our society and the management of forests. They provide access for housing, recreational activities, hunting and fishing, research, fire control, forest improvement activities, timber harvesting, and other uses. Roads also have well-documented, short and long-term effects on the environment and can be highly controversial as society balances the benefits of biodiversity including human social and economic needs. One size road may have a significant effect in one location and not in another. Road density and housing density are related. Roads fragment landscapes and facilitate the development of housing; as road and housing density increases, forest landscapes become increasingly fragmented and interior forest patch sizes become smaller. An effective synthesis of roads and related housing issues draws people together to thoroughly evaluate access benefits, problems and risks, and to inform managers about what roads may be needed, for how long, for what purposes, and at what benefits and costs (Gucinski, 2001).

In general, increased road and housing density threaten the conservation of biodiversity by:

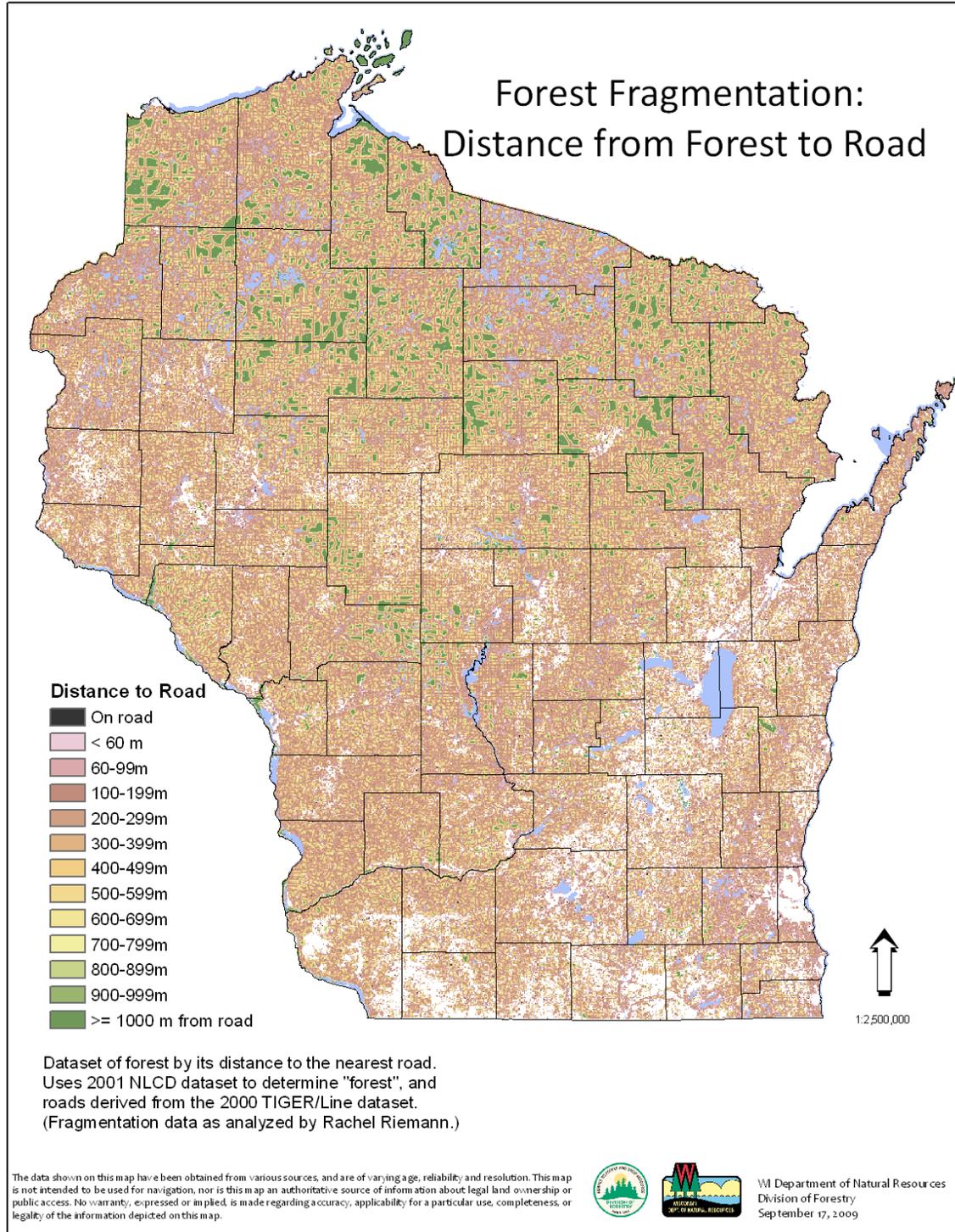
- Altering composition, structure, and function of adjacent ecosystems
- Changing land use through development (removing habitat)
- Increasing edge and decreasing interior forest
- Providing avenues and sources of invasion for exotic species
- Causing air and water pollution
- Altering hydrological networks
- Increasing ecosystem disturbance through increased human access and activity; impacts are both direct (e.g. road kills, potential overhunting) and indirect (e.g. habitat alteration, wildlife behavioral changes)
- Limiting management alternatives

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Many of these impacts can be mitigated by techniques such as road design, routing to avoid critical habitats, warning signs, seasonal road closures, fencing, vegetative buffers, etc. Housing impacts may also be regulated through appropriate zoning and land use planning. All such measures, however, involve tradeoffs balancing social and economic benefits with diversity critical for sensitive species.

Road densities for the state represented in Map 3.c were calculated using TIGER data (US Census Bureau). In Province 212, the mean road density was 1.3 km² with a maximum of 19.5 km². In Province 222, the mean road density was 1.6 km² and the maximum 20.8 km².

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Map 3.c: Fragmentation: distance from forest to road

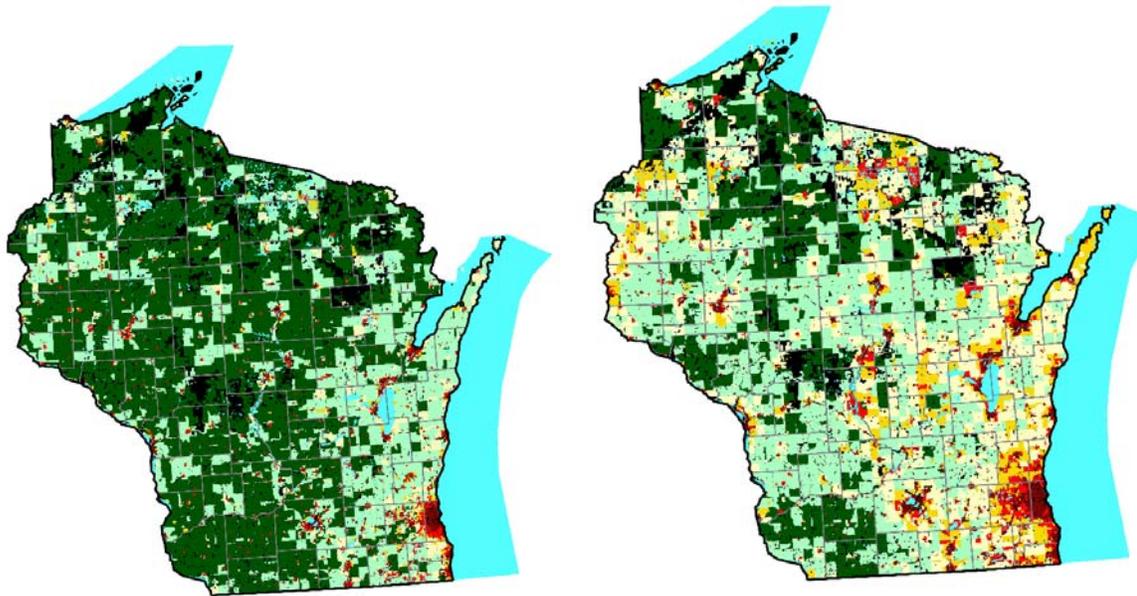
Source: US Forest Service, Rachel Riemann

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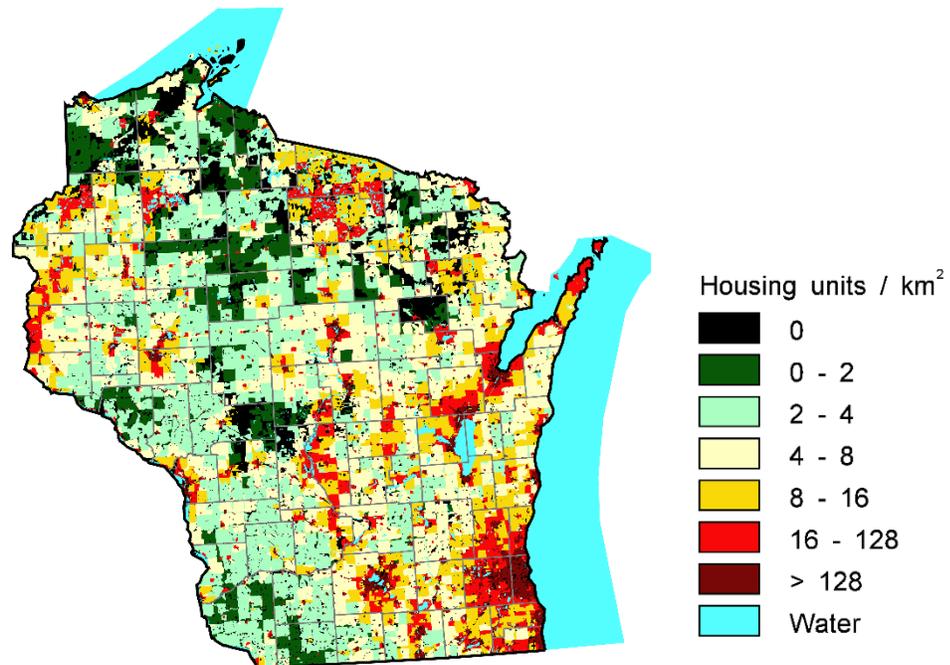
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In a study of three ecoregions in northern Wisconsin, there was a substantial increase in road density and landscape fragmentation from 1937 to 1999 (Hawbaker et al. 2006). Road density more than doubled from 1.7 to 3.5 km/km². Roads were mapped from aerial photographs and any linear feature that was clearly visible in the photo and connected to another road or building was considered a road. Typical roadless patch size was greatly reduced. (See Hawbaker and Radeloff, 2004 for a discussion on road density and landscape pattern.)

Housing density is increasing across most forested regions within Wisconsin (Map 3.d). In northern Wisconsin, there was a 6% increase in population and a 113% increase in the number of housing units between 1940 and 1990; much of this housing development was concentrated along lakeshores (Hawbaker et al. 2006). The majority of forests either contains or is near housing (Radeloff 2005). Few large, remote interior forest patches remain in Wisconsin.



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Map 3.d: Housing density changes 1940, 1990, 2030
Source: Hammer, Radeloff, 2007