

Northeast Landscape Conditions & Trends Report

**A support document to the 2nd Generation MFRC
Northeast Landscape Plan**

January 2014



Minnesota Forest Resources Council (MFRC)

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Executive Summary

The Minnesota Forest Resources Council was established in 1995 by the Minnesota Legislature to provide advice to public and private organizations on forest sustainability issues through the Sustainable Forest Resources Act (SFRA). This legislation provided authorization for establishing regional landscape committees to foster landscape-based forest resource planning and coordination. These regional committees provide an opportunity to involve private citizens, forestry professionals and members of various interest groups in developing and implementing landscape-level plans that promote forest sustainability. SFRA defines landscape-level planning as *“long-term or broad based efforts that may require extensive analysis or planning over large areas that may involve or require extensive coordination across all ownerships.”* It charges the regional committees to: 1) include representative interests, 2) serve as a forum to discuss issues, 3) identify and implement an open and public process whereby landscape-level strategic planning can occur, 4) identify sustainable forest resource goals for the landscape and strategies to achieve those goals, and 5) provide a regional perspective on forest sustainability to the council.

From 1998 to 2005, landscape plans were prepared for each of the six forested regions in the state following the general planning process of:

- Prepare an assessment of current conditions and trends in the landscape;
- Determine vision, goals, and issues that address existing and potential conditions considered desirable for the region;
- Develop strategies for implementing the vision, goals and/or resolve issues in the region;
- Encourage voluntary implementation of the strategies by coordination between landowners; and
- Conduct an evaluation to determine how well the strategies accomplish the vision and goals and resolve issues.

The purpose of the first part in the general planning process – conducting a landscape assessment – is to provide a common understanding of ecological and socioeconomic conditions in order to further planning and coordination among multiple landowners and interests. This assessment information provides a scientific base for the collaborative decision making and goal development process. The Conditions and Trends Report gives as accurate a picture of the Northeast Landscape as possible given the limitations of available information and resources. This report is a starting point for addressing forest sustainability in northeastern Minnesota, not the end result.

To guide the regional forest resource committees as they carry out landscape-level planning and coordination, the Minnesota Forest Resources Council established four broad goals that reflect the strategies for sustaining forests. The MFRC used the Generic Environmental Impact Statement on Timber Harvesting and Forest Management in Minnesota to develop these goals. The Northeast Conditions and Trends report is structured around these four goals. The goals are stated below with the findings, recommendations and additional data needs concerning that goal.

Goal 1: Forestland Cover. Land area covered by forests within a region's landscape will be the same or larger.

Key Findings

- **Forests are the dominant land cover.** Roughly 85% of the Northeast Landscape is forested.
- **Forest cover is constant or increasing.** There was an estimated 5.5% net gain of forestland between 1977 and 2012 estimates.
- **Historic loss of upland forests.** The region has lost over 200,000 acres of upland forests to land development and agricultural uses since European settlement.
- **Increasing development.** Developed land estimates increased from 1.6 to 2.5% of the Northeast Landscape; 4,850 acres per year from 1992 to 2006.

Goal 2: Land Ownership. Forests within a region's landscape will be in a variety of ownerships, serving both public and private interests.

Key Findings

- **Abundant public land.** Approximately 65% of the total land and 71% of the forest land is publicly owned.
- **Maintained ownership patterns.** There is a variety of ownerships serving multiple interests in both the public and private sector and the estimated ratio of public forestland to private forestland has changed little between 1977 and 2012. Within private forestland there has been a shift from industrial ownership to non-industrial private landowners.
- **Uneven distribution of public lands.** The estimated ratio of public forestland to private forestland ranges greatly across the landscape from 0.57:1 in Carlton County in the southwestern portion of the region to 5.54:1 in Cook County, the northeastern corner of the region.
- **Reserved forest lands.** Timber harvest is prohibited by statute or administrative regulation on approximately 18.5% of the northeast forestlands.
- **Less than 10% under Stewardship Plans.** Less than 10% of non-industrial private forestland is managed under forest stewardship plans in the region.
- **Aging private woodland owners.** Most family forest lands have been owned for more than 25 years, and are owned by individuals greater than 55 years of age.
- **Large undivided private forestland parcels.** Most family forest lands with the exception of waterfront property are owned in parcels greater than 50 acres.
- **High proportion of public land increases the importance of payment in lieu of tax revenues.** Property tax revenues vary across the region depending on the amount of private land. Payment in lieu of tax payments are made in some regions to account for the high amount of public land.
- **School Trust Lands.** There are nearly 800,000 acres of school trust land in the Northeast region.

Goal 3: Healthy Forests. Within forested landscapes, healthy, resilient, and functioning ecosystems will be maintained within appropriate mixes of forest cover types and age classes to promote timber production, biological diversity, and viable forest dependent fish and wildlife habitats.

Key Findings

- **Forest age and composition has changed since European settlement.** Available data indicates species composition and age structure has changed since the mid to late-1800s.
- **Aging forests.** Northeast forests are aging with a shift in the most common age class from 41-60 years to 61-80 years. In addition all age classes greater than 61 have increased from 1977 to 2012 for timberlands as a whole and the aspen forest type in particular.
- **Low productive forests.** Fifty-five percent of Northeast Minnesota timberland is classified as low productivity.
- **Mortality exceeds removals.** Approximately 1.7% of the total growing stock volume is removed annually and approximately 2.0% of the total growing stock volume dies from natural processes annually.
- **Aging aspen stands have high mortality and low marketability.** Quaking aspen annual mortality is estimated at 30 million cubic feet (3.4% of the growing stock volume); 43% of which is occurring in the 61-80 year age class.
- **Recent decrease in balsam fir and red pine forest types.** Forest type changes from 1977 to 2012 show decreases in the balsam fir and red pine forest types and increases in other forest types.
- **Imbalance in age class distribution.** There is a lot of old aspen but also a significant amount of young aspen, whereas there is very little young birch.
- **Climate change vulnerability.** Regional Wet Forest, Forested Rich Peatland, and Acid Peatland plant communities are projected to see the greatest declines under future climate scenarios.
- **Regional forests serve as a large biomass and carbon reserve.** Northeast Landscape timberland has 111 million tons (not including foliage) of aboveground woody biomass. Northeast Landscape forest lands sequester 652 million short tons of carbon.
- **Healthy forest bird populations.** Eighty-five percent of Minnesota's forest associated bird species use Northeast Landscape forests and population trends appear stable.
- **High seasonal local deer densities.** Historically deer were very rare to absent in this region. While the area still has some of the lowest deer densities in the state, local deer densities in certain locations can greatly increase during late winter which has limited forest regeneration.
- **Declining moose herd.** Many forest wildlife species populations appear stable or increasing, but the Northeast Minnesota moose herd has declined by 52% from 2010 to 2013.
- **Increasing threat of invasive species.** Invasive species pose a significant threat to northeastern forests including emerald ash borer and gypsy moth.
- **High quality water resources.** The Northeast Landscape contains world class water resources with water flowing into the Hudson's Bay, Atlantic Ocean, and Gulf of Mexico drainages. Forest cover helps to maintain these outstanding water resources.

Goal 4: Economic and Social Values. Forests within a region’s landscape will be providing a full range of products, services, and values, including timber products, wildlife and tourism, which are major contributors to economic stability, environmental quality, social satisfaction, and community well-being.

Key Findings

- **Forest products are an important regional employer.** Forest products manufacturing and related sectors directly support an estimated 2,400 jobs within the four county Northeast Landscape and other major forestry employers are located near the Landscape’s border.
- **Northeast is a major player in statewide timber harvest.** The Northeast Landscape forests account for 31% of the total statewide harvest.
- **Local forest products demand.** Mills in the Northeast Landscape, and those with procurement areas within the four county area report consumption of nearly 2 million cords annually (approximately 75% of statewide total harvest).
- **Healthy tourism sector.** Tourism and recreation is a substantial and growing component of the regional economy with total output in the Northeast Landscape exceeding \$825 million and supporting nearly 15,000 full-time equivalent jobs in 2011.
- **Seasonal, recreational, and retirement homeowners.** The scenery and natural resources of this of this region attracts many seasonal and recreational homeowners, particularly along Lake Superior and inland lakes with 45% of the homes in Cook County utilized seasonally. Many of these homes transition from seasonal vacation use to retirement residencies leading to an aging but wealthy population in some regions of the Northeast Landscape.
- **Increasing mining economy.** In 2010 mining accounted for over 4,000 jobs in Minnesota, however, ferrous and non-ferrous (copper-nickel) mining expansion could add an additional 5,600 jobs to the region.
- **Diverse transportation network.** The Northeast Landscape has a wide range of transportation infrastructure which includes Great Lakes shipping and an extensive railroad and roadway network, including Interstate 35, US Highways 2, 53, and 169 in addition to state and county highways systems.
- **Tribal rights.** Native Americans are the largest minority race in the region. There are three Bands of Lake Superior Chippewa in the region which retain treaty rights both on and off reservation.



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Goal 1 – Forest Land Cover

MFRC Goal 1: Land area covered by forests within a region’s landscape will be the same or larger.

The four counties of the Northeast Landscape cover approximately 7.36 million acres, of which over 6.78 million acres are terrestrial. The data in this section shows the extent of forestlands across the region at present and in recent decades.

1.1. Land Cover Data Sources

Presettlement Vegetation of Minnesota: is based on Francis J. Marschner's original analysis done in the 1930's of 19th century of Public Land Survey notes. Marschner compiled his results in map format which has been subsequently captured in digital format.

1990 Census Land Use and Cover: integrates six different source data sets to provide a simplified 8-category view of Minnesota's land use / cover in 30 meter grid cells.

1992 GAP Analysis Project: created land cover datasets as part of its mission to identify habitats that need further protection. This dataset is based on similar satellite imagery to the National Land Cover Database; however it provides a more detailed classification system than the NLCD and places special emphasis on natural plant communities.

2001 and 2006 National Land Cover Database (NLCD): is a 16-class land cover classification scheme that has been applied consistently across the conterminous United States at a spatial resolution of 30 meters. NLCD is based primarily on Landsat satellite data and a variety of supporting information.

Forest Inventory Analysis (FIA): is the systematic collection of data and forest information by the U.S. Forest Service for assessment or analysis to assess America's forests. This continuous forest census reports on status and trends in forest area and location; in the species, size, and health of trees; in total tree growth, mortality, and removals by harvest; in wood production and utilization rates by various products; and in forest land ownership. This data is not meant to be represented spatially.

1.2. 1990 Land Cover

Table 1.1 displays the 1990 census land use and cover for the Northeast Landscape. Using this analysis, approximately 4.4 million acres of the Northeast Landscape were forested when the data was collected.

Figure 1.1 illustrates the spatial distribution of these land cover classifications and shows the majority of the bog/marsh/fen habitat existing in the western portion of the Northeast Landscape with forested land use across the northern and eastern portions of the landscape. Agriculture is a relatively minor component of this landscape. Although mining is only 1.1% of the Landscape Region's land cover, it is concentrated in the Mesabi Range portion of the landscape and represents a major land use locally.

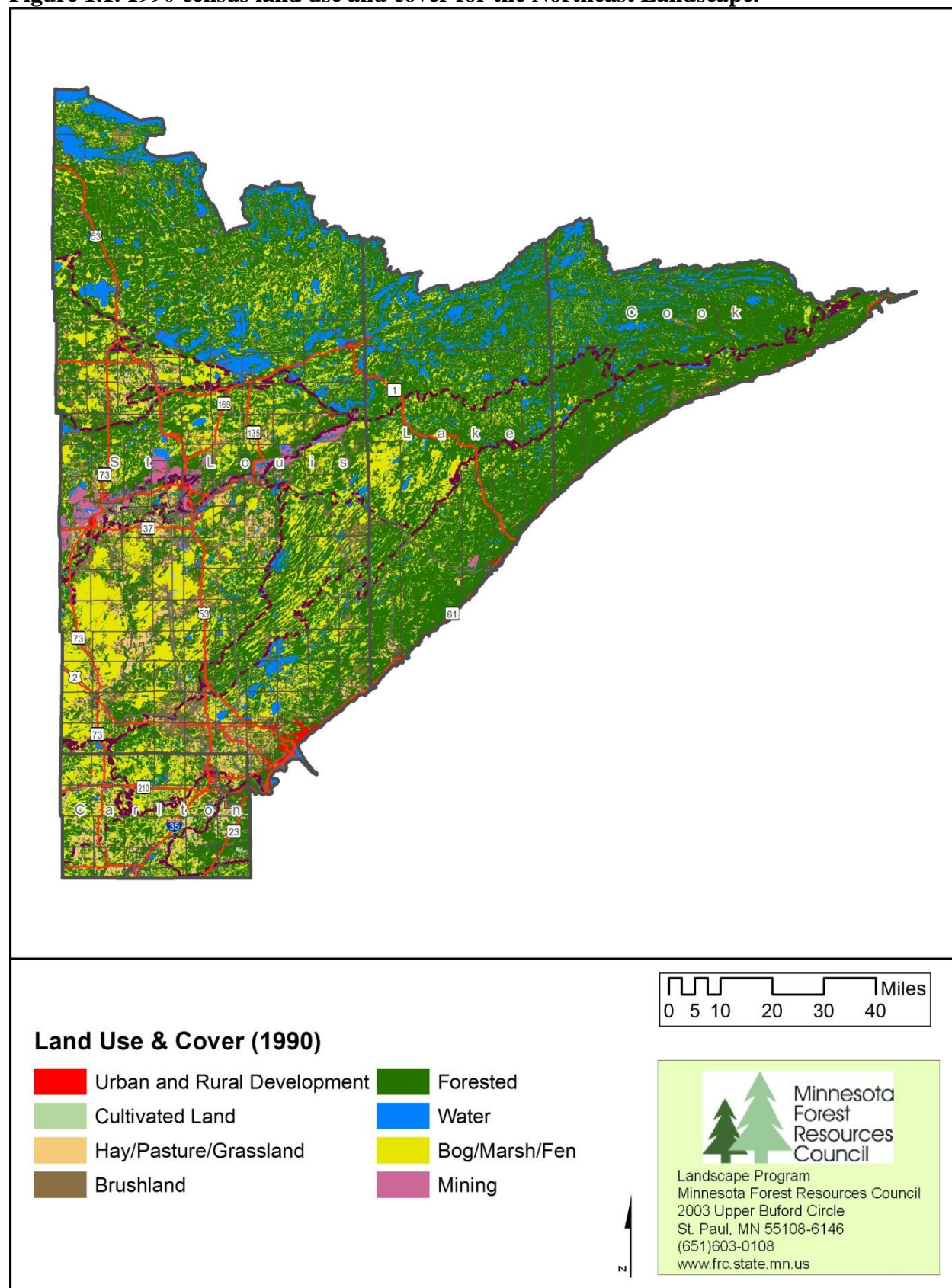
It is important to note, this analysis often placed lowland forests in the 'Bog/Marsh/Fen' category and therefore the combination of this category and 'Forested' of 5.8 million acres might provide a more accurate estimate.

Table 1.1. 1990 census land use and cover for the Northeast Landscape.

Land Use & Cover	Acres	% of Total
Urban and Rural Development	79,126	1.1
Cultivated Land	13,371	0.2
Hay/Pasture/Grassland	335,643	4.6
Brushland	408,349	5.5
Forested	4,427,905	60.1
Water	627,064	8.5
Bog/Marsh/Fen	1,385,809	18.8
Mining	84,325	1.1
Totals	7,361,593	100.0

Source: Minnesota DNR GIS Data Deli.

Figure 1.1. 1990 census land use and cover for the Northeast Landscape.



Source: Minnesota DNR GIS Data Deli.

1.3. Spatial Forestland Cover Analysis (Presettlement, GAP, & NLCD)

Table 1.2 provides an inventory of land cover for four time periods: Presettlement (approximately 150 years ago), 1992, 2001, and 2006.

Figure 1.2 and Figure 1.3 illustrate land cover patterns across the Northeast Landscape prior to European settlement and in 2006. As portrayed on the 2006 figure, the Northeast continues to be heavily forested. In 2006, more than 3.43 million acres of the Northeast Landscape were predicted to be upland forestland (Table 1.2).

It is important to consider sampling scale when comparing modern data sets with presettlement land cover and use caution when drawing conclusions from direct comparisons. With that caveat, estimated upland forestland area decreased by 22.3% (4.43 to 3.44 million acres) and lowland vegetation (includes forested lowlands, shrub lowlands, and emergent herbaceous wetlands) increased by 35.2% (1.81 to 2.44 million acres) from presettlement to 2006. This change has been less pronounced over recent years with estimated upland forest area decreasing by only 1.2% from 2001 to 2006 (3.48 to 3.44 million acres) and lowland vegetation increasing by 0.7% (2.42 to 2.44 million acres).

Due to challenges in differentiating forested lowlands, shrub lowlands, and emergent herbaceous wetlands using remote sensing, it is difficult to assess the true extent of lowland forests in the 2001 and 2006 National Land Cover Database (NLCD) data sets.

In 1992, developed lands covered approximately 116,000 acres or 1.6% of the region. In 2006, developed land estimates increased by almost 68,000 acres to an area over 183,000 acres (2.5%) of the region. The average annual consumption of rural lands into developed lands from 1992 to 2006 was approximately 4,850 acres per year.

Agricultural land estimates in contrast have decreased from 106,000 acres (1.4%) in 1992 to under 15,000 acres (0.2%) in 2006.

Upland grasslands have also seen a substantial decrease from presettlement (9.4% of total) to 2006 estimates (2.5% of total). Despite this general declining trend, upland grassland estimates have actually increased recently from 166,443 acres in 2001 to 186,589 acres in 2006.

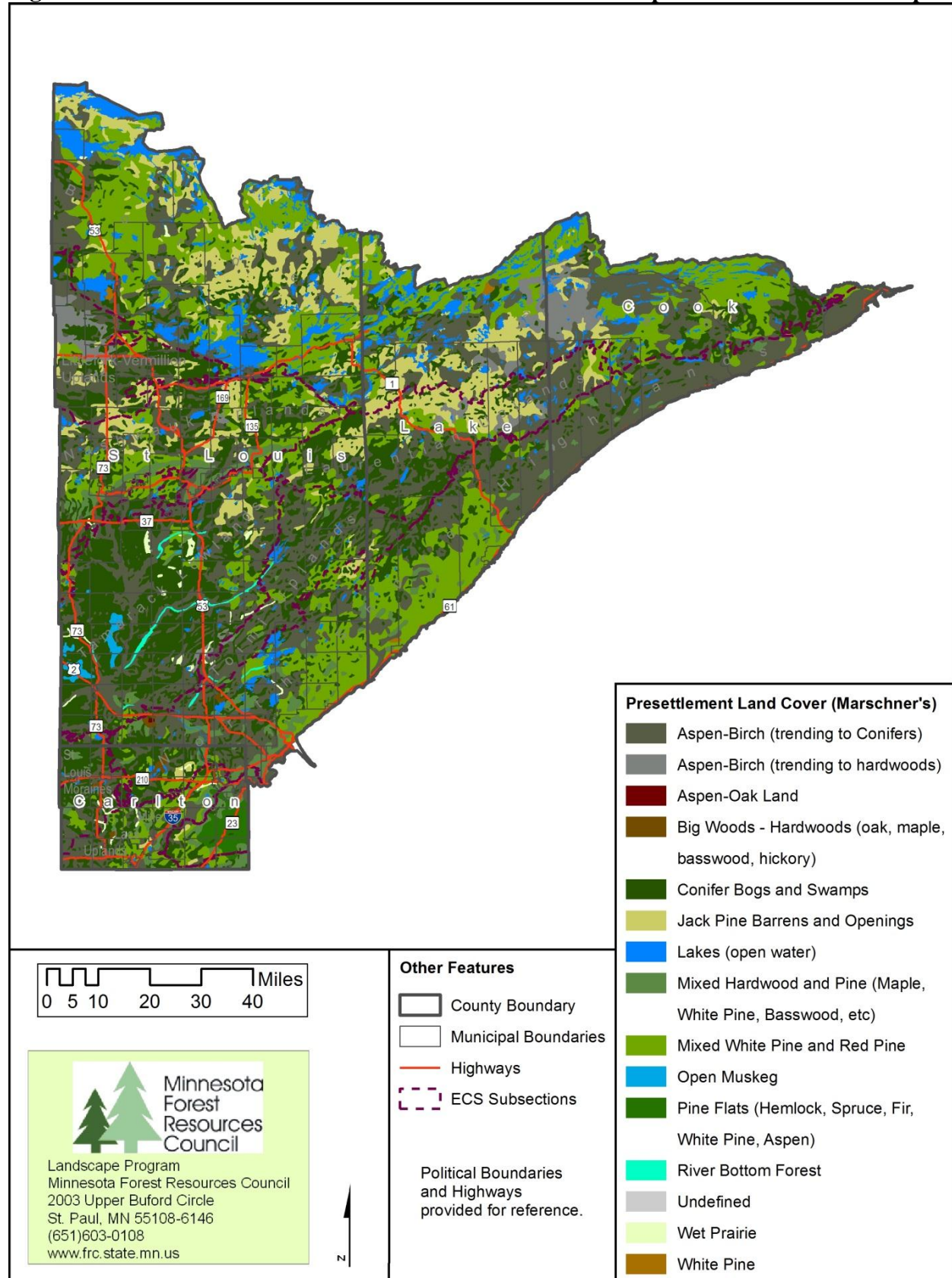
Table 1.2. Land cover change in the Northeast Landscape, Presettlement to 2006.

Cover Type	Presettlement					GAP 1992 (compared to Presettlement)			
	Acres	% of Total	Acres Change	% Change		Acres	% of Total	Acres Change	% Change
Upland Forest	4,428,714	60.1	-	-		3,928,833	53.4	-499,881	-11.3
Upland Shrub	0	0.0	-	-		427,374	5.8	427,374	n/a
Upland Grass	688,738	9.4	-	-		292,368	4.0	-396,371	-57.6
Lowland Vegetation	1,805,454	24.5	-	-		1,878,267	25.5	72,813	4.0
Agriculture	0	0.0	-	-		106,289	1.4	106,289	n/a
Developed	0	0.0	-	-		115,799	1.6	115,799	n/a
Barren	0	0.0	-	-		37,402	0.5	37,402	n/a
Open Water	425,582	5.8	-	-		576,353	7.8	150,771	35.4
Unclassified	15,156	0.2	-	-		960	0.0	-14,196	-93.7
Totals	7,363,644	100.0	-	-		7,363,644	100.0	-	-
Cover Type	NLCD 2001 (compared to GAP 1992)					NLCD 2006 (compared to NLCD 2001)			
	Acres	% of Total	Acres Change	% Change		Acres	% of Total	Acres Change	% Change
Upland Forest	3,480,330	47.3	-448,503	-11.4		3,439,594	46.7	-40,736	-1.2
Upland Shrub	472,971	6.4	45,598	10.7		473,577	6.4	605	0.1
Upland Grass	166,443	2.3	-125,925	-43.1		186,589	2.5	20,146	12.1
Lowland Vegetation	2,424,108	32.9	545,841	29.1		2,440,580	33.1	16,472	0.7
Agriculture	14,534	0.2	-91,755	-86.3		14,843	0.2	309	2.1
Developed	182,030	2.5	66,231	57.2		183,665	2.5	1,635	0.9
Barren	40,963	0.6	3,561	9.5		46,510	0.6	5,548	13.5
Open Water	581,902	7.9	5,549	1.0		577,923	7.8	-3,979	-0.7
Unclassified	363	0.0	-597	-62.2		363	0.0	0	0.0
Totals	7,363,644	100.0	-	-		7,363,644	100.0	-	-

Source: Minnesota DNR GIS Data Deli.

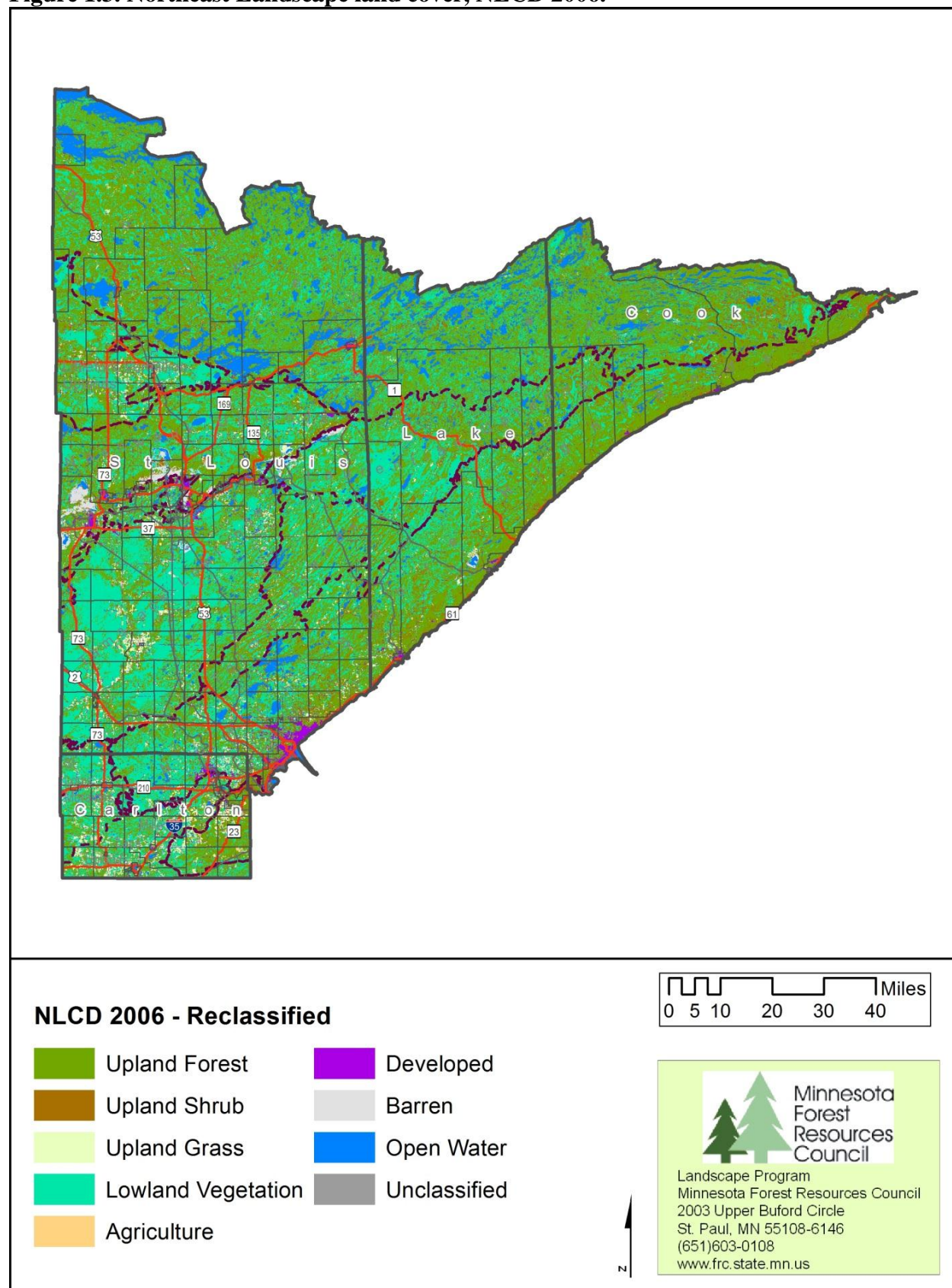
Note: Some changes in areas of cover types from one dataset to another may be due to changes in scale and/or classification methodologies used in creation of each dataset. However, the NLCD 2001 and 2006 datasets are directly comparable.

Figure 1.2. Presettlement land cover in the Northeast Landscape from Marschner's Map.



Source: Minnesota DNR GIS Data Deli.

Figure 1.3. Northeast Landscape land cover, NLCD 2006.



Source: Minnesota DNR GIS Data Deli.

1.4. The Extent of Forestland in Recent Decades

The Northeast Landscape is heavily forested (Figure 1.3). In 2012 estimates, forestland encompassed nearly 5.8 million (85.3%) of the Northeast Landscape's 6.8 million acres of terrestrial habitat (Table 1.3). This is an increase from estimates of forestland for 1977, 1990, and 2003 which ranged from 80.8% to 83.0% of the total land area. Comparing 1977 conditions with 2012 conditions suggests that forestland area increased 4.5% (5.5 to 5.8 million acres) during the 35 year period.

Table 1.3. Estimated extent of forestland in the Northeast Landscape, 1977-2012.

Land Cover	1977 acres	1990 acres	2003 acres	2012 acres
Forestland ^A	5,483,205	5,630,435	5,484,718	5,787,419
Non-forestland ^B	1,302,516	1,155,286	1,301,003	998,302
Percent Forestland	80.8%	83.0%	80.8%	85.3%

Source: Forest Inventory and Analysis estimate.

^A FIA defines forestland as: Land that is at least 10 percent stocked by forest trees of any size, or land formerly having such tree cover, and not currently developed for a non-forest use. The minimum area for classification as forest land is one acre. Roadside, stream-side, and shelterbelt strips of timber must be at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams and other bodies of water, or natural clearings in forested areas are classified as forest, if less than 120 feet in width or one acre in size. Grazed woodlands, reverting fields, and pastures that are not actively maintained are included if the above qualifications are satisfied. Forest land includes three sub-categories: timberland, reserved forestland, and other forestland.

^B All terrestrial acres not designated as forestland.

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.



Goal 2 – Land Ownership

MFRC Goal 2: Forests within a region’s landscape will be in a variety of ownerships, serving both public and private interests.

Data presented in this section show recent trends in forestland ownership and reserved forest acreage.

2.1. Land Ownership Data Sources

GAP Stewardship 2008: created land ownership information for the entire state of Minnesota. These data were created specifically to support the GAP Analysis Project. The base cartography is derived from mathematically subdivided PLS quarter-quarter sections and the 40 acre polygons have been dissolved on the ownership values in the attribute table. Ownership reflects surface features only. Ownership is only as current as the source information and should not be considered comprehensive for the entire state. Land interest is expressed only when some organization owns or administers more than 50 percent of a forty except where sub-forty accuracy stewardship polygons were created.

Forest Inventory Analysis (FIA): is the systematic collection of data and forest information by the U.S. Forest Service for assessment or analysis to assess America's forests. This continuous forest census reports on status and trends in forest area and location; in the species, size, and health of trees; in total tree growth, mortality, and removals by harvest; in wood production and utilization rates by various products; and in forest land ownership. This data is not meant to be represented spatially but breaks forestland and timberland estimates down by ownership class.

County Parcel Data: Carlton, Cook, Lake, and St. Louis counties have each developed GIS parcel data layers which contain a variety of information including ownership and parcel size. These data are not available to the public without purchase but some of the data is available for government use.

National Woodland Owner Survey (NWOS): is the official census of forest owners in the United States. On an annual basis, the NWOS contacts forest-land owners from across the county to ask them questions about: The forest land they own, their reasons for owning it, how they use it, if and how they manage it, sources of information about their forests, their concerns and issues related to their forests, their intentions for the future of their forests, and their demographics.

2.2 Land Ownership – Administration.

Ownership in the Northeast Landscape is split between many different public and private entities. Table 2.1 and Figure 2.1 were developed using GAP Stewardship 2008 data. This area is dominated by public lands with 64.2% of the total land area in public ownership, of which 97.5% is owned by the State of Minnesota or the US Forest Service. There is just less than 2.6 million acres of private land in the Northeast Landscape.

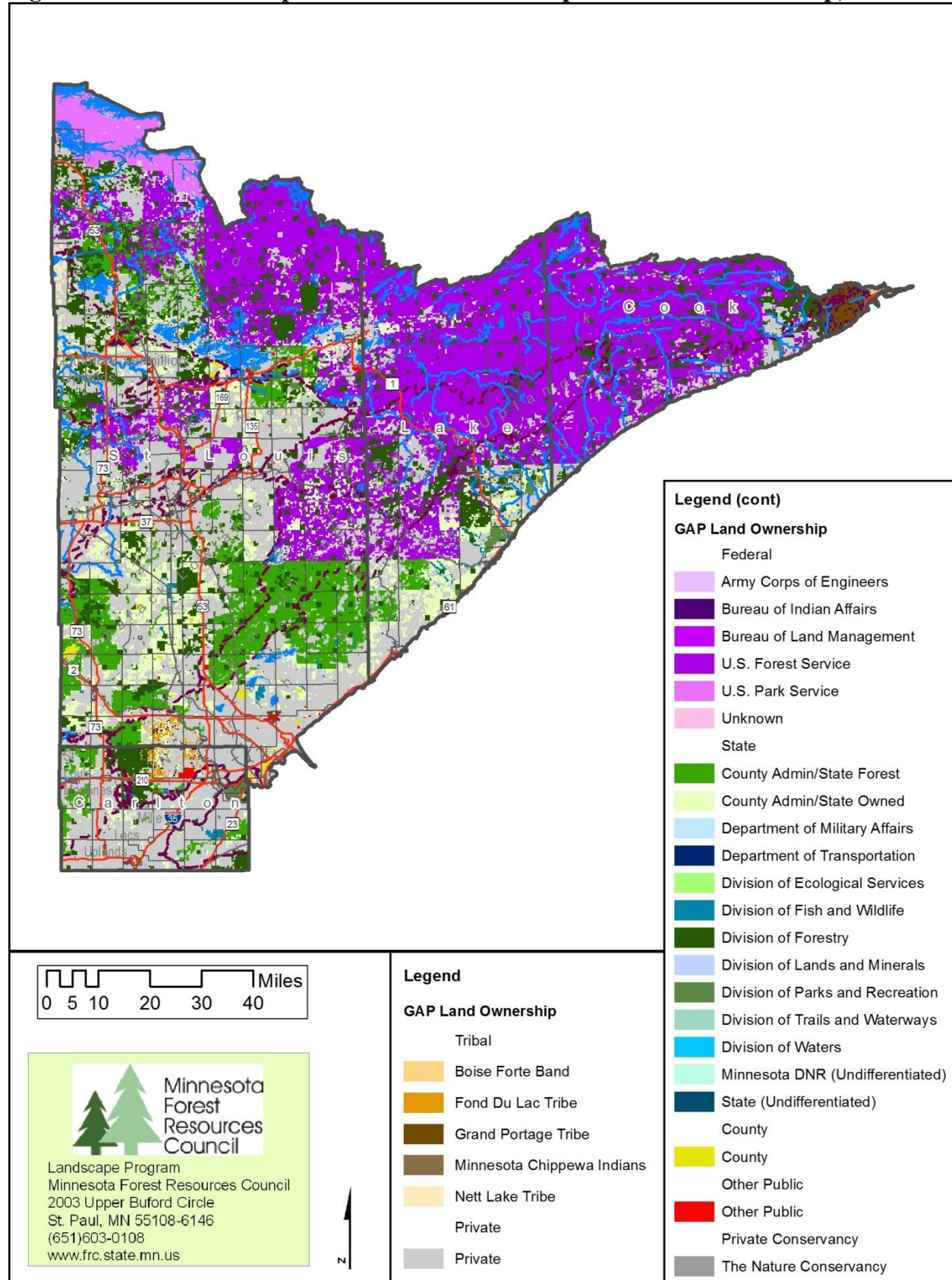
In many cases land ownership and management or administration are the same; however there are several situations where this distinction can make a dramatic difference in understanding trends on the landscape. For instance ‘County Administered State Owned’ tax forfeit land is owned by the State of Minnesota, however, it is managed by the counties changing the relative importance of counties in the Northeast Landscape from 0.4% to 16.0% of the total land area (Figure 2.2 and Table 2.2).

Table 2.1. Land ownership in the Northeast Landscape from GAP Stewardship, 2008.

Owner Description	GAP Public Ownership	Acres	% of Total
Federal	Army Corps of Engineers	34	0.0
	Bureau of Indian Affairs	16,772	0.2
	Bureau of Land Management	1,518	0.0
	U.S. Forest Service	2,334,185	31.7
	U.S. Park Service	180,810	2.5
	Unknown	11,692	0.2
Total Federal		2,545,011	34.6
State	County Admin/State Forest	612,819	8.3
	County Admin/State Owned	539,532	7.3
	Department of Military Affairs	42	0.0
	Department of Transportation	1,493	0.0
	Division of Ecological Services	2,872	0.0
	Division of Fish and Wildlife	27,949	0.4
	Division of Forestry	897,874	12.2
	Division of Lands and Minerals	1,989	0.0
	Division of Parks and Recreation	42,191	0.6
	Division of Trails and Waterways	3,351	0.0
	Division of Waters	253	0.0
	Minnesota DNR (Undifferentiated)	152	0.0
	State (Undifferentiated)	2,609	0.0
Total State		2,133,125	29.0
County	County	31,960	0.4
Total County		31,960	0.4
Other Public	Other Public	16,235	0.2
Total Other Public		16,235	0.2
Total Public Ownership		4,726,330	64.2
Tribal	Boise Forte Band	652	0.0
	Fond Du Lac Tribe	18,440	0.3
	Grand Portage Tribe	32,409	0.4
	Minnesota Chippewa Indians	678	0.0
	Nett Lake Tribe	9,513	0.1
Total Tribal		61,693	0.8
Private Conservancy	The Nature Conservancy	9,962	0.1
Private	Private	2,565,659	34.8
Total Private Ownership		2,575,621	35.0
Total Project Area		7,363,644	100.0

Source: Minnesota DNR GIS Data Deli

Figure 2.1. Land ownership in the Northeast Landscape from GAP Stewardship, 2008.



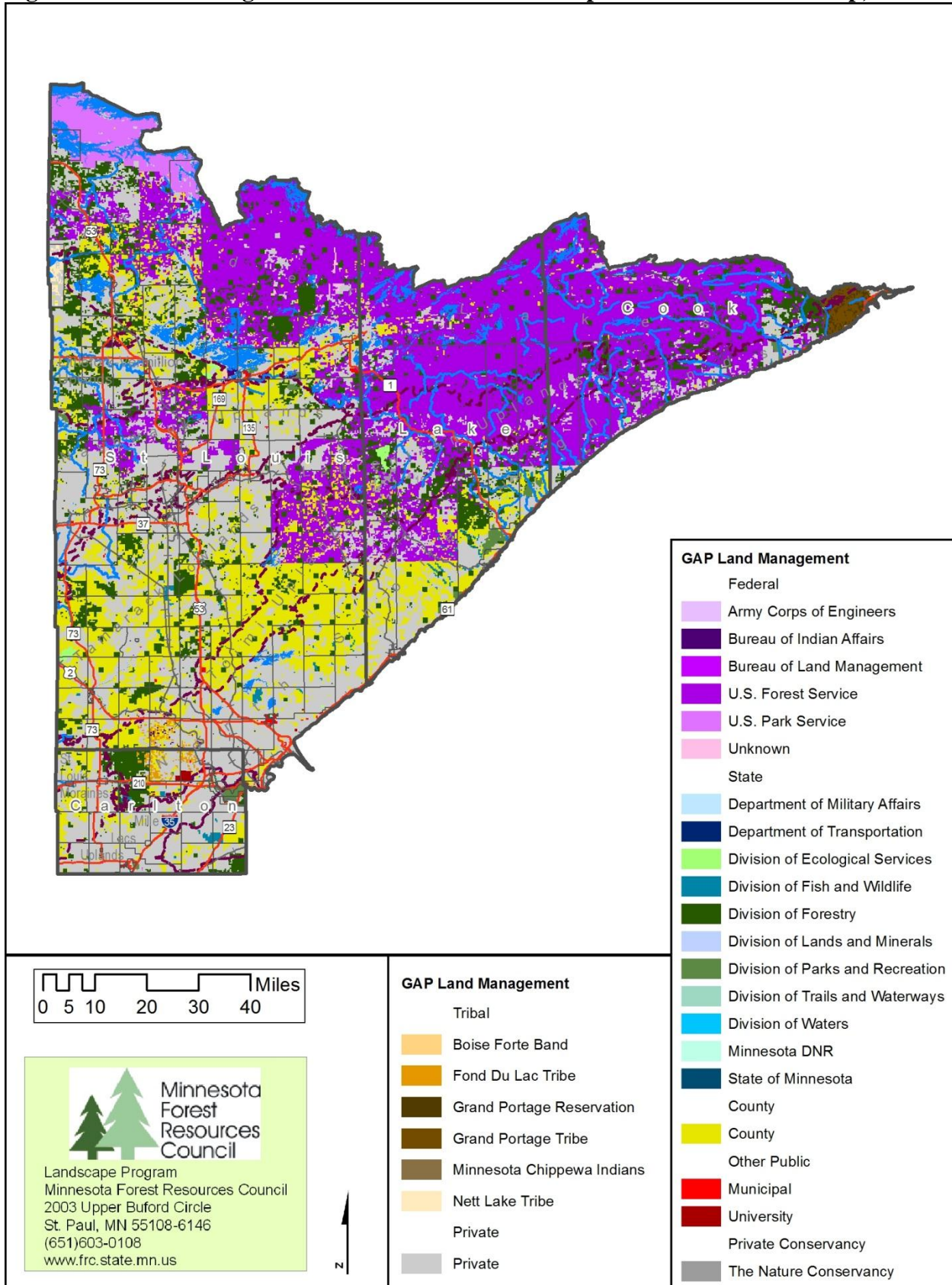
Source: Minnesota DNR GIS Data Deli

Table 2.2. Land management in the Northeast Landscape from GAP Stewardship 2008.

Management Type	Land Management	Acres	% of Total
Federal	Army Corps of Engineers	34	0.0
	Bureau of Indian Affairs	3,416	0.0
	Bureau of Land Management	1,518	0.0
	U.S. Forest Service	2,334,010	31.7
	U.S. Park Service	180,810	2.5
	Unknown	11,692	0.2
Total Federal		2,531,480	34.4
State	Department of Military Affairs	42	0.0
	Department of Transportation	1,493	0.0
	Division of Ecological Services	13,828	0.2
	Division of Fish and Wildlife	27,949	0.4
	Division of Forestry	893,074	12.1
	Division of Lands and Minerals	1,989	0.0
	Division of Parks and Recreation	42,141	0.6
	Division of Trails and Waterways	3,351	0.0
	Division of Waters	253	0.0
	Minnesota DNR	152	0.0
	State of Minnesota	2,609	0.0
Total State		986,881	13.4
County	Carlton County	74,574	1.0
	Cook County	4,642	0.1
	Lake County	152,340	2.1
	St Louis County	946,821	12.9
Total County		1,178,378	16.0
Other Public	Municipal	12,257	0.2
	University	3,978	0.1
Total Other Public		16,235	0.2
Total Public		4,712,974	64.0
Tribal	Boise Forte Band	652	0.0
	Fond Du Lac Tribe	20,681	0.3
	Grand Portage Reservation	11,116	0.2
	Grand Portage Tribe	32,409	0.4
	Minnesota Chippewa Indians	678	0.0
	Nett Lake Tribe	9,513	0.1
Total Tribal		75,049	1.0
Private Conservancy	The Nature Conservancy	9,962	0.1
Private	Private	2,601,369	35.3
Total Private		2,611,331	35.5
Total Project Area		7,363,644	100.0

Source: Minnesota DNR GIS Data Deli

Figure 2.2. Land management in the Northeast Landscape from GAP Stewardship, 2008.



Source: Minnesota DNR GIS Data Deli

2.2.1. School Trust Lands

When Minnesota became a state in 1858, sections 16 and 36 of every township were granted to Minnesota from the federal government to support schools. Alternative sections, referred to as Indemnity Lands, were granted when sections 16 and 36 had already been claimed, were reserved for an Indian reservation, or were under water. The grant ultimately resulted in 2.9 million acres being given to the state for the use of the public schools and the Minnesota Constitution established the Permanent School Fund (PSF) to ensure long-term funding would be generated from accumulated revenues from the land for public education. As a result, these lands are owned by the state in trust for all public schools of Minnesota, they are not owned by the local school district. Also included in school trust lands today are remaining lands from two other federal land grants: the Swampland grant of about 4.7 million acres in 1860, and the Internal Improvement grant of 500,000 acres in 1866.

By 1900, much of this land had been sold to support public schools. Today roughly 2.4 million acres (31% of the original 8.1 million acres) of school trust lands and an additional 1 million acres of mineral rights remain and are managed by the DNR. The vast majority of these lands are located in the northern forested portion of the state with nearly 800,000 (33%) acres found in the Northeast Landscape, accounting for almost 11% of the regional land cover (Table 2.3 and Figure 2.3).

In 2013, the Minnesota Legislature established the 12 member Legislative Permanent School Fund Commission to advise the Department of Natural Resources and the school trust lands director on the management of permanent school fund land and review legislation affecting permanent school fund land. The commission is required to review statutes and recommend any changes necessary for provident utilization of school trust lands, and to report annually to the legislature with recommendations for management of school trust fund lands to secure long-term economic return for the permanent school fund. The impact of this new commission on management of school trust lands in Northeast Minnesota is unknown but there may be changes in ownership and/or management of these lands in the near future.

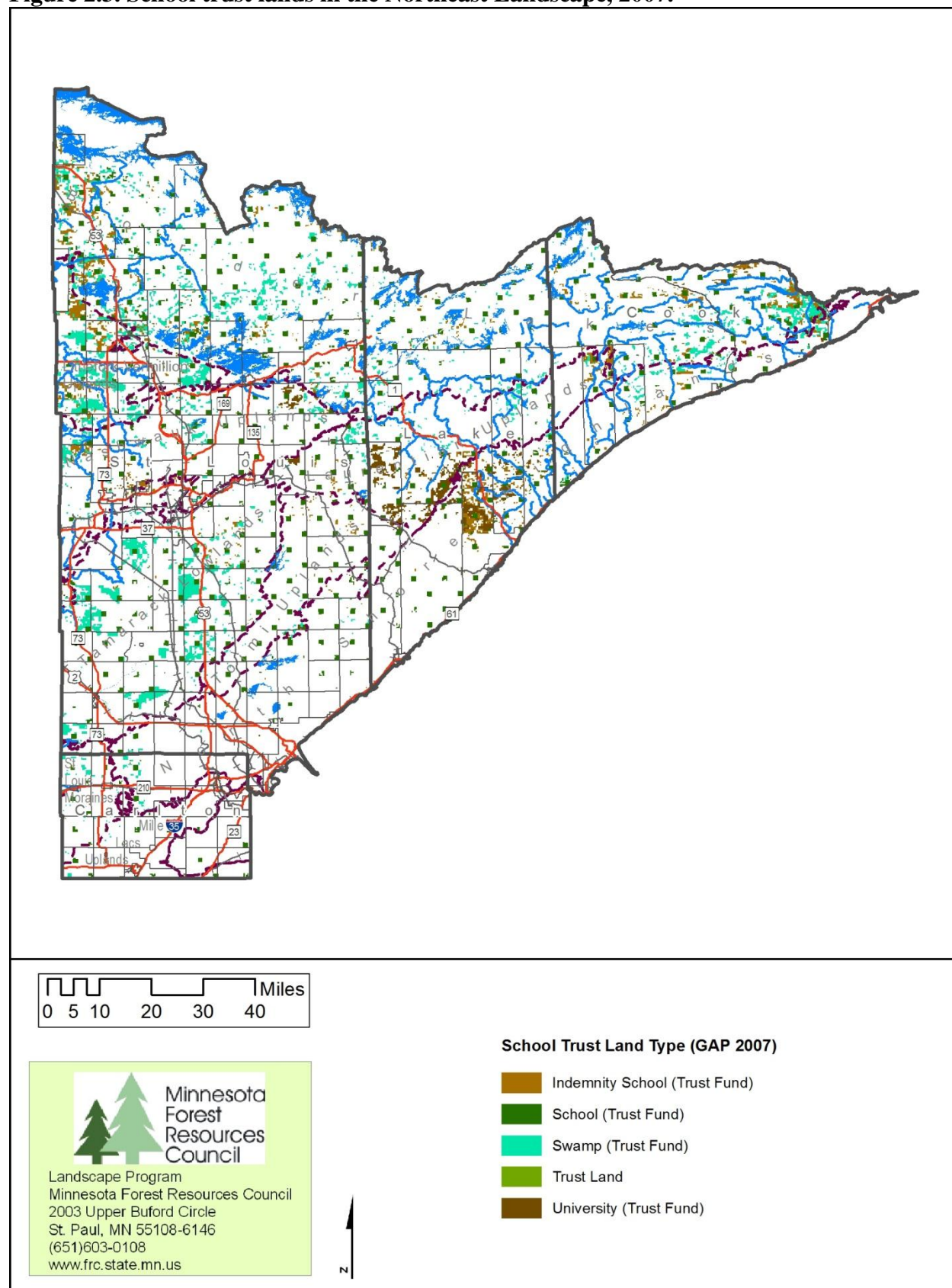
For more information visit: www.dnr.state.mn.us/aboutdnr/school_land/index.html

Table 2.3. School trust lands in the Northeast Landscape.

School Trust Land Type (GAP Land Ownership 2007)	Northeast Landscape		Minnesota	
	Acres	% of Total	Acres	% of Total
Indemnity School (Trust Fund)	146,339	2.0	286,344	0.5
Internal Imp (Trust Fund)	--	--	6,093	0.0
School (Trust Fund)	270,259	3.7	641,892	1.2
Swamp (Trust Fund)	315,432	4.3	1,376,894	2.5
Trans. School (Trust Fund)	--	--	80	0.0
Trust Land	73	0.0	73	0.0
University (Trust Fund)	67,413	0.9	80,772	0.1
Total Trust Lands	799,515	10.9	2,392,148	4.4
Total Region	7,363,644	-	53,997,289	-

Source: Minnesota DNR GIS Data Deli

Figure 2.3. School trust lands in the Northeast Landscape, 2007.



Source: Minnesota DNR GIS Data Deli

2.3. Forestland Management/Administration

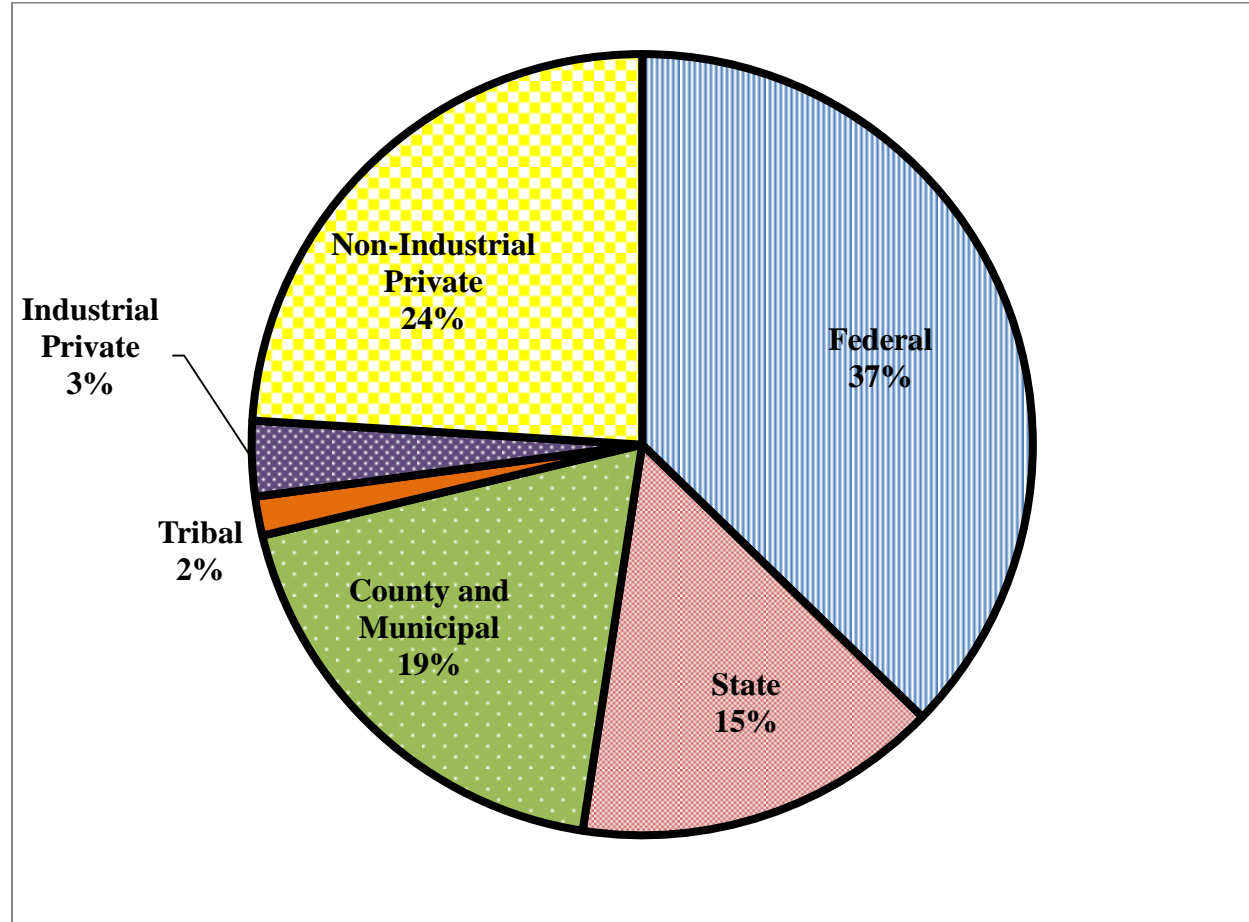
The Forest Inventory Analysis (FIA) reports ownership-administration on forestland whereas the GAP Stewardship 2008 data reports on all lands. There are an estimated 5.79 million acres of forestland in the Northeast Landscape, split among administration classes as shown in Figure 2.4 and Table 2.4. The three classes of forestlands are defined as follows:

- Reserved forestlands – Lands on which timber production is prohibited by statute or administrative regulation. See Figure 2.5 for a map of reserved timberlands in the Northeast Landscape.
- Timberlands – Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as timberland are capable of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included.)
- Other forestlands – Lands not capable of producing industrial wood at a sufficient rate. Relatively little of the forestland in the Northeast Landscape (3.6%) is ‘other forestland’.

The Northeast Landscape has gained an estimated 5.5% forestland from 1977 to 2012 (Table 2.5) and has a greater proportion of public lands compared to the state as a whole (Table 2.6). The ratio of public forestland to private forestland had changed little between 1977 and 2012 for the counties, Northeast Landscape, and the state of Minnesota. There is a distinct difference between counties with Carlton County averaging approximately 0.57 acres of public land for every acre of private land up to Cook County with approximately 5.54 acres of public for every acre of private land. Across the landscape there has been an average of approximately 2.40 acres of public land for every acre of private land in the Northeast Landscape.

Figure 2.5 and Table 2.7 show the acreage of state and federal areas in which timber harvesting is prohibited or highly restricted. These reserved lands account for an estimated 1.36 million acres or 18.5% of the Northeast Landscape. Most of the reserved land (1,285,560 or 94%) lies along the Canadian border in the Boundary Waters Canoe Area Wilderness () and Voyageurs National Park. Note that the total acres of the BWCAW have not changed since the 1978 Act and acre discrepancies are due to changes in the methods of accounting for surface water areas. Discrepancy in Voyageur National Park acreage resulted from the removal of the Koochiching County portion of the park in the most recent analysis.

Figure 2.4. Distribution of forestland in the Northeast Landscape by owner/administrator, 2012.



Source: 2012 Forest Inventory Analysis estimate.

Table 2.4. Estimated forestland ownership in the Northeast Landscape, 2012. (Values are acres.)

Ownership Group	Forestland	Type of forestland		
		Timberland	Reserved forestland	Other forestland
Federal	2,157,372	1,273,640	846,170	37,562
State	877,436	778,516	49,841	49,079
County and Municipal	1,089,188	1,025,180	6,279	57,729
Private	1,663,421	1,601,873	0	61,548
Native American	93,327	93,327	0	0
Forest Industry	180,299	177,136	0	3,163
Non-industrial private	1,389,795	1,331,410	0	58,385
Total	5,787,417	4,679,209	902,290	205,918

Source: Forest Inventory Analysis estimate.

Note: The FIA database combines Native American, Forest Industry, and Non-industrial Private as 'Private'. For some analysis these categories cannot be separated due to disclosure laws.

Table 2.5. Estimated ownership of forestland in the Northeast Landscape and percent change from 1977 to 2012. (Values are millions of acres.)

Ownership	1977 forestland acres	1990 forestland acres	2003 forestland acres	2012 forestland acres	Ownership % change from 1977 to 2012
Federal	1,992,662	2,159,331	2,039,180	2,157,372	8.3
State	783,577	740,987	866,134	877,438	12.0
County and Municipal	1,060,939	1,054,566	974,420	1,089,188	2.7
Private	1,646,026	1,675,551	1,604,984	1,663,421	1.1
Native American	N/A	N/A	48,464	93,327	N/A
Forest Industry	N/A	N/A	273,411	180,299	N/A
Non-industrial private	N/A	N/A	1,283,109	1,389,795	N/A
Total	5,483,204	5,630,435	5,484,718	5,787,419	5.5

Source: Forest Inventory and Analysis estimate.

Note: The FIA database combines Native American, Forest Industry, and Non-industrial Private as ‘Private’. For some analysis these categories cannot be separated due to disclosure laws (Labeled N/A when data is not available).

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

Table 2.6. Estimated public to private forestland ratio, 1977, 1990, 2003, and 2012.

Ratio	1977	1990	2003	2012
Carlton County	0.58	0.57	0.59	0.57
Cook County	5.21	5.86	5.94	5.17
Lake County	3.72	4.55	4.20	4.45
St. Louis County	1.98	1.91	1.95	2.07
Northeast Landscape	2.33	2.36	2.42	2.48
Statewide	1.27	1.29	1.30	1.24

Source: Forest Inventory and Analysis estimate.

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

Table 2.7. Acres of reserved lands within the Northeast Landscape. (Data represent areas within statutory boundaries.)

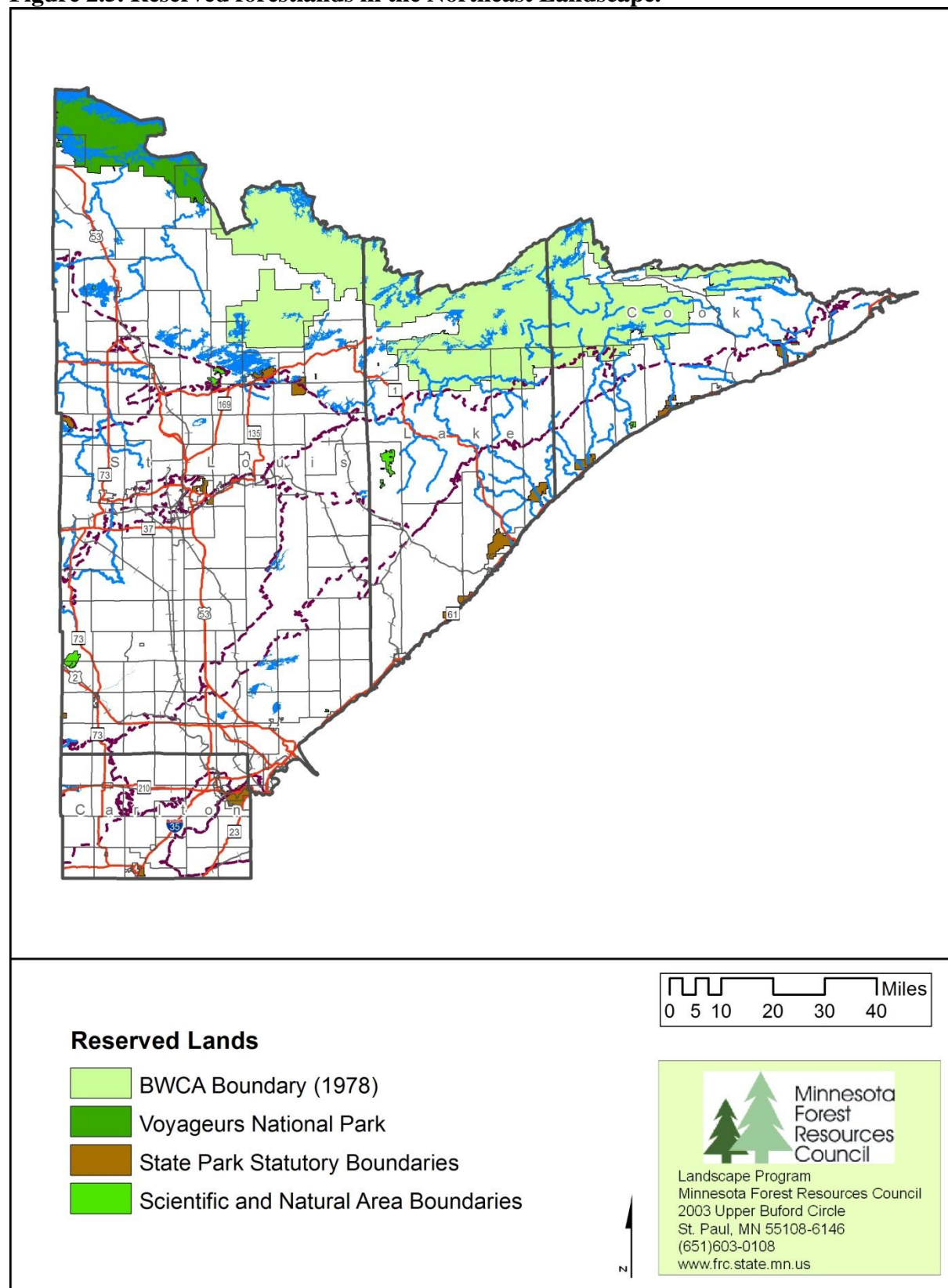
	1951 ¹	1960 ¹	1970 ¹	1999 ¹	2013 ²	% of NE Landscape
State Parks & Waysides	9,140	11,152	25,744	44,016	62,151	0.8
Scientific & Natural Areas	N/A	N/A	N/A	13,990	15,230	0.2
Voyageurs National Park	N/A	N/A	N/A	218,054	189,619	2.6
Boundary Waters Canoe Area	N/A	1,061,973	1,084,105	1,098,057	1,095,941	14.9
Reserved Lands Total	9,140	1,073,125	1,111,822	1,378,849	1,362,941	18.5

¹Source: 1999 Minnesota Northeast Regional Landscape ‘Current Conditions and Trends Assessment’.

²Source: Minnesota DNR GIS library – data clipped to the boarder of the four NE counties.

N/A denotes that either a designation did not exist or data were not available for a given time period.

Figure 2.5. Reserved forestlands in the Northeast Landscape.



Source: Minnesota DNR GIS Data Deli

2.4. Public land sales and exchanges

The following tables (2.6 to 2.11) show the land purchases, disposals, and exchanges over recent years for the Superior National Forest, DNR, St. Louis County, and Lake County.

The Superior National Forest (SNF) has experienced a net gain of approximately 22,000 acres from 1987 to 2012 (Table 2.8). Annual change in the SNF has been relatively small but has been positive for nearly the entire time period. The SNF experienced a net loss only during the 1992 and 2012 fiscal years.

The Minnesota Department of Natural Resources experienced a net gain of 67,956 acres from 1993 to 2013. Eighty one percent of this land was in Lake and St. Louis counties and only 4.5% of the net gained acres were in Carlton County (Table 2.10).

Data was not available on annual land exchanges in Carlton County at the time of publication.

Cook County does not currently have data on annual land exchanges. As of January 2013, Cook County had 4,224 acres of tax forfeit land which is only 0.44% of their total land area. Only 9.22% of Cook County's 949,781 acres are currently taxable. Cook County is currently in the process of exchanging their remaining BWCA Wilderness lands with the US Forest Service for lands which can be used for tower installation and gravel development.

Lake County experienced a net gain of just over 1,000 acres between 1997 and 2012 (Table 2.11). The majority of this gain came when the DNR conveyed 2,740 acres to Lake County by the DNR in 2000.

Saint Louis County experienced a net gain of 20,316 acres between 1987 and 2012. The majority of this net gain came in the late 1980's and early 1990's. In fact, from 1998 onward St. Louis County has experienced a net loss of 8,927 acres (Table 2.12).

Table 2.8. Superior National Forestland purchases, exchanges, and disposals, 1987-2012 (in acres).

Year	Purchases	Exchanges^A	Disposals	Net gain
1987	0	1,036	0	1,036
1988	13	2,142	0	2,155
1989	300	4,282	3,391	1,191
1990	125	5,522	3,700	1,947
1991	100	7,112	6,611	601
1992	580	4,491	11,967	-6,896
1993	2,483	7,318	6,751	3,050
1994	5,821	1,386	1,197	6,010
1995	4,572	0	3	4,569
1996	240	5,333	220	5,353
1997	122	1,442	1,426	138
1998	0	0	0	0
1999	0	0	0	0
2000	70.57	31.9	0	102.5
2001	200 (160 of which was a Donation)	518.4	0	718.3
2002	73.6 (.1 of which was a Donation)	281.3	0	354.9
2003	662.12	16.4	0	678.5
2004	322.7 (40 of which was Donation)	311.0	0	633.7
2005	42.5 (1.75 of which was Donation)	100	0	142.5
2006	47.8 (4.3 of which was Donation)	0	16.2	31.6
2007	47.7	40	3.1	84.6
2008	22.3	0	0.5	21.8
2009	33.5	0	0	33.5
2010	30.2	788.2	0	818.4
2011	0	0	0	0
2012	12.4 (4.2 of which was Donation)	-764.6	0	-752.2
Total	15,921.4	41,386.5	35,285.7	22,022.2

^A Exchange acres are net acres gained in land exchanges.

Table 2.9. Summary of Superior National Forest land donations, purchases, and exchanges, 2000-2012.

Fiscal year	Case	Acres	County
2000	The Trust for Public Lands (Hilliard) – Purchase	3.4	Lake
	The Trust for Public Lands (Nundahl) – Purchase	67.2	Cook
	Boundary Waters land & Timber Ltd. (Acquired) – Exchange	191.9	St. Louis
	Boundary Waters land & Timber Ltd. (Conveyed) – Exchange	160.0	St. Louis
2001	County of Lake (Acquired) – Exchange	527.3	Lake
	County of Lake (Conveyed) – Exchange	40.9	Lake
	Priscilla Evans – Purchase	40.0	Lake
	Martin Radtke – (Donation)	160.0	Lake
2002	Bradely Gerlach – Donation	0.1	Cook
	The Trust for Public Lands (Nundahl P-2) - Purchase	33.8	Cook
	County of St. Louis (Acquired) – Exchange	221.4	St. Louis
	County of St. Louis (Conveyed) – Exchange	44.7	St. Louis
	County of St. Louis P2 (Acquired) – Exchange	127.0	St. Louis
	County of St. Louis P2 (Conveyed) – Exchange	22.4	St. Louis
	The Trust for Public Lands (Krekelberg) - Purchase	39.8	St. Louis
2003	The Trust for Public Lands (Adams) - Purchase	5.5	Cook
	The Trust for Public Lands (Brandenburg) - Purchase	560.0	Lake
	The Trust for Public Lands (Fisher) - Purchase	64.6	St. Louis
	The Trust for Public Lands (Johnson) - Purchase	32.1	St. Louis
	Ojibway Summer Home Group (Acquired) – Exchange	88.8	St. Louis
	Ojibway Summer Home Group (Conveyed) – Exchange	72.3	Lake
2004	Cook County (Acquired) – Exchange	316.5	Cook
	Cook County (Conveyed) – Exchange	5.5	Cook
	William & Barbara Jean Rom	40.0	Lake
	The Trust for Public Lands - Purchase	280.0	Lake
	Donald & Valerie Beland – Purchase	2.5	Lake
	Martin & Donna Radtke – Donation	40.0	Lake
2005	Tracy Klein – Purchase	40.0	St. Louis
	John Swenson – Purchase	0.7	Lake
	Lake Superior Land Co. –Purchase	8.4	St. Louis
	LeRoy & Ruth Brown – Donation	1.8	Lake
	Greg & Jeanie Wright (Acquired) – Exchange	160.0	Cook
	Greg & Jeanie Wright (Conveyed) – Exchange	60.0	Cook

Table 2.7. Continued.

Fiscal year	Case	Acres	County
2006	Trappers Landing Lot 2 (Aho/Smith) – Conveyed	1.5	Lake
	Trappers Landing Lot 3 (Marietta) – Conveyed	2.5	Lake
	Trappers Landing Lot 4 (Senger) – Conveyed	1.4	Lake
	Trappers Landing Lot 6 (Shervheim) – Conveyed	2.5	Lake
	Trappers Landing Lot 8 (Shervheim) – Conveyed	1.3	Lake
	Okstad – Conveyed	0.7	Lake
	Berdusco – Purchase	43.5	Cook
	D Anderson – Donation	4.3	Lake
	Trappers Landing Lot 9 (Shervheim) – Conveyed	2.1	Lake
	Trappers Landing Assoc. Outlot A & B – Conveyed	4.2	Lake
2007	Timothy Shaw – Conveyed	1.2	Lake
	Thomas Savre – Conveyed	1.9	Lake
	Randy Correll (Acquired) – Exchange	760.0	Lake
	Randy Correll (Conveyed) – Exchange	720.0	Lake
	The Trust for Public Lands (Long Island S-1) - Purchase	12.5	St. Louis
	The Trust for Public Lands (Clarke) - Purchase	35.2	St. Louis
2008	Hubert Nelson – Conveyed	0.2	Cook
	Jon Buccheit – Conveyed	0.2	Cook
	The Trust for Public Lands (Long Island S-2) - Purchase	22.3	St. Louis
2009	Robin Twite – Conveyed	0.4	St. Louis
	Trappers Landing Lot 5 (Isabella) – Conveyed	1.0	Lake
	The Trust for Public Lands (Long Island N) - Purchase	21.3	St. Louis
	The Trust for Public Lands (Chainsaw Sisters) - Purchase	33.5	St. Louis
2010	The Trust for Public Lands (Domine Wolf Island P-1) - Purchase	30.2	St. Louis
	South Kawishiwi Cabin Group (Acquired) – Exchange	197.2	Lake
	South Kawishiwi Cabin Group (Acquired) – Exchange	1,015.6	St. Louis
	South Kawishiwi Cabin Group (Conveyed) – Exchange	424.6	Lake
2012	Rom – Donation	4.2	Lake
	Rom – Purchase	8.2	Lake
	Lake County Rifle Lake (Acquired) – Exchange	2,854.3	Lake
	Lake County Rifle Lake (Conveyed) – Exchange	3,619.0	Lake

Source: Superior National Forest staff.

Table 2.10. DNR land acquisition and disposal history for 1993 to 2013^A

County	Acquired acres	Finalized sold acres	Land exchange relinquished acres	Net gain in acres
Carlton	3,803.4	541.3	143.0	3,119.1
Cook	11,777.8	345.1	1,947.8	9,484.9
Lake	38,199.1	1,083.3	7,913.4	29,202.4
St. Louis	31,942.3	2,817.8	2,974.3	26,150.2
Total	85,722.5	4,787.5	12,978.4	67,956.6

Source: DNR Division of Lands and Minerals.

^A This data only includes “finalized” transactions where the deed has been recorded and filed, as such some transactions from the last 2-3 years maybe not be included as they have not completed the finalization process.

Table 2.11. Acres forfeit, sold, exchanged, or repurchased and sold in Lake County, 1997 to 2012.

Year	Acres forfeit, exchanged, or repurchased	Acres sold
1997	4	143
1998	189	319
1999	95	54
2000	2,740	1
2001	372	578
2002	40	217
2003	381	362
2004	673	607
2005	1,508	1,780
2006	272	545
2007	165	214
2008	30	114
2009	112	43
2010	333	663
2011	1	82
2012	171	266
Total	7,087	5,988

Source: Lake County Land Department

Compiled from “Certification for Payment in Lieu of Tax” reports submitted annually to the DNR.

Note: The report uses figures from July 1 – June 30. (i.e. 2012 is the acreage from July 1, 2011 – June 30, 2012)

Note: 2,740 acres were conveyed to Lake County by the DNR in 2000.

Table 2.12. St. Louis County: acres forfeit and sold, 1987 to 2012.

Year	Acres forfeit	Acres sold	Net gain
1987	1,582	937	645
1988	2,643	1,471	1,172
1989	9,734	832	8,902
1990	3,060	670	2,390
1991	14,743	816	13,927
1992	2,414	2,581	-167
1993	3,585	2,102	483
1994	1,376	1,789	-413
1995	2,231	2,165	66
1996	1,151	1,038	113
1997	4,207	2,082	2,125
1998	1,065	2,663	-1,598
1999	864	1,767	-903
2000	926	2,121	-1,195
2001	774	1,398	-624
2002	1,339	1,315	24
2003	2,009	1,333	676
2004	146	391	-245
2005	1,316	1,653	-337
2006	90	2,005	-1,915
2007	616	1,715	-1,099
2008	280	977	-697
2009	379	1,046	-667
2010	585	743	-158
2011	447	652	-205
2012	781	765	16
Net change 1987 to 2012			20,316

Source: St. Louis County Land and Minerals Department.

2.5. Ownership fragmentation

2.5.1. Parcel sizes of non-industrial private family forest lands

Data on parcel size of family forestland was collected by the USDA Forest Service in 1990 and 2006 (publish year) through the National Woodland Owner Survey (Table 2.13).

For this survey, the US Forest Service defined '*Family Forestland*' as: families, individuals, trusts, estates, family partnerships, and other unincorporated groups of individuals that own forest land; where forest land is defined as land at least 10 percent stocked by forest trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. The minimum area for classification of forest land was 1 acre. More information on the NWOS can be found at: www.fia.fs.fed.us/nwos/

In 1990, total family forestland acreage was estimated at 1,306,200 acres, or approximately 29% of total timberland and 24% of total forestland. By 2006, the estimated total family forestland acreage had decreased to 1,141,800 acres in Northeastern Minnesota (includes Koochiching County). Survey respondents indicated the majority (1990, 68.1%; 2006, 66.9%) of this family forestland is held in parcel sizes of at least 50 acres (Figure 2.6). Figure 2.7 shows ownership size class data for family forestland acreage in the Northeast and statewide.

Figure 2.8 shows the estimated distribution of family forestland owners by ownership size class statewide and in Northeastern Minnesota from National Woodland Owner Survey respondents. Nearly half (49.5%) of all family forestland owner respondents in the state of Minnesota have properties less than nine acres. In Northeastern Minnesota, approximately half (48.7%) of all family forestland landowner respondents have properties between 10 and 49 acres.

Table 2.13. Estimated area of family forestland acres by ownership size class in Northeastern Minnesota^A, in 1990 and 2006. (Values are thousands of acres.)

	Ownership size class (in acres)							Total
	1-9	10-49	50-99	100-499	500-999	1000-4999	5000+	
1990 NE MN area of timberland (thousands of acres)	63.0	353.5	253.5	359.7	53.6	24.6	198.3	1306.2
1990 % of total	4.8	27.1	19.4	27.5	4.1	1.9	15.2	100.0
2006 NE MN area of timberland (thousands of acres)	28.0	350.2	273.2	420.3	49.0	21.0	0.0	1141.8
2006 % of total	2.5	30.7	23.9	36.8	4.3	1.8	0.0	100.0

Source: National Woodland Owner Survey conducted in 1990 and from 2002 to 2006 – USFS Forest Inventory and Analysis database.

^A Koochiching County was included in Northeast Minnesota for the National Woodland Owner Survey and could not be removed for this analysis.

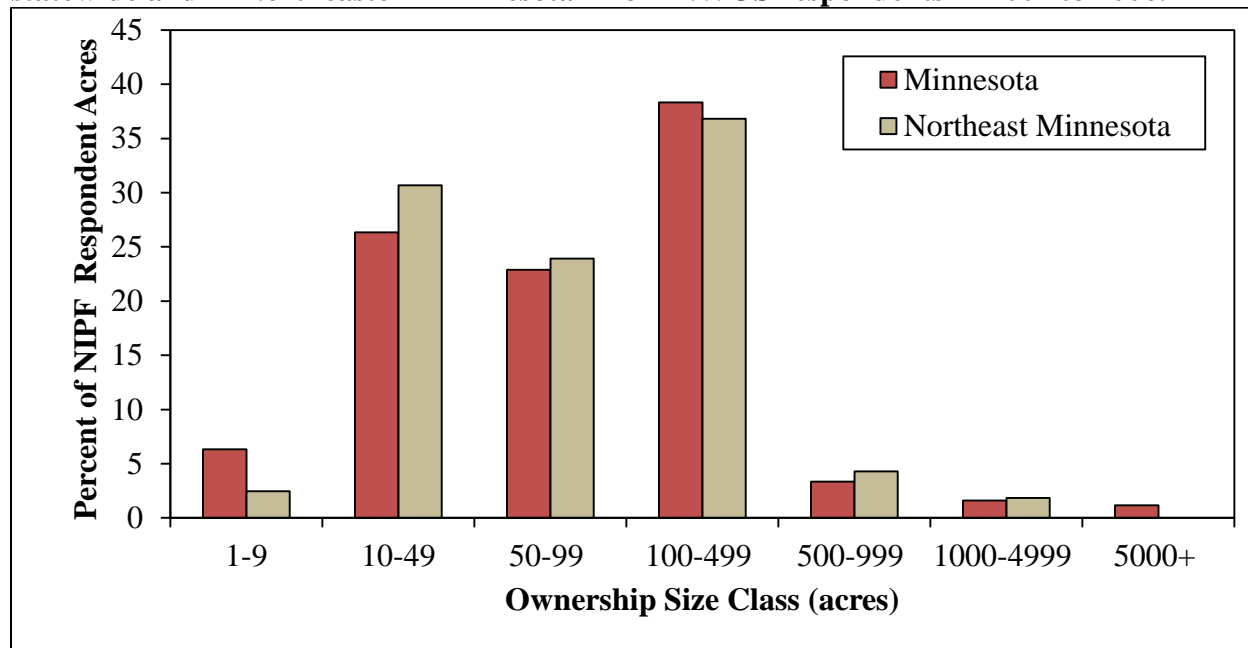
Figure 2.6. Estimated distribution of family forestland acres by ownership size class in Northeastern Minnesota^A from NWOS respondents in 1990 and 2006.



Source: National Woodland Owner Survey conducted in 1990 and from 2002 to 2006 – USFS Forest Inventory and Analysis database.

^A Koochiching County was included in Northeast Minnesota for the National Woodland Owner Survey and could not be removed for this analysis.

Figure 2.7. Estimated distribution of family forestland acres by ownership size class statewide and in Northeastern Minnesota^A from NWOS respondents in 2002 to 2006.



Source: National Woodland Owner Survey conducted from 2002 to 2006 – USFS Forest Inventory and Analysis database.

^A Koochiching County was included in Northeast Minnesota for the National Woodland Owner Survey and could not be removed for this analysis.

Figure 2.8. Estimated distribution of family forestland owners by ownership size class statewide and in Northeast Minnesota^A from NWOS respondents in 2002 to 2006.

Source: National Woodland Owner Survey conducted from 2002 to 2006 – USFS Forest Inventory and Analysis database.

^A Koochiching County was included in Northeast Minnesota for the National Woodland Owner Survey and could not be removed for this analysis.

2.5.2. Parcel sizes of all private lands

Data on parcel size of family forests in Section 2.5.1 indicated that 48.7% of family forestland landowner survey respondents have properties between 10 and 49 acres. Using County GIS parcel data for the four northeast counties which includes all private ownership (residential, commercial, rural, forestland, etc.) Table 2.14 shows 98.2% of all private parcels in the Northeast Landscape are less than 50 acres with 64.6% less than five acres. Note this data includes both rural and urban parcels.

Table 2.14. Number of private parcels in the Northeast Landscape by size class, 2013.

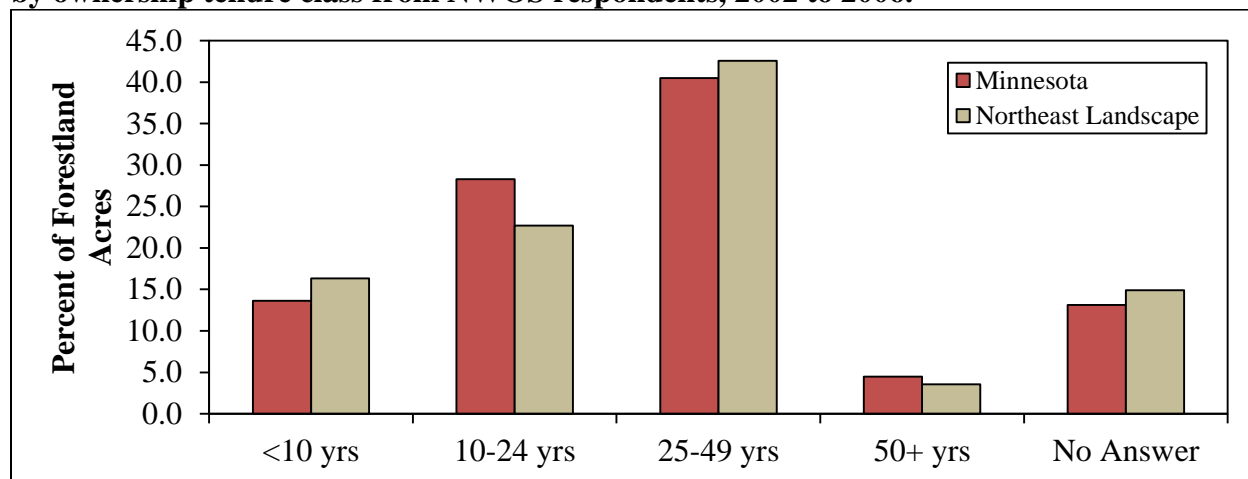
Ownership size class (in acres)	<5	5-19	20-49	50-99	100-499	500-2499	2500-4999	5000+	Total
Carlton County	14,155	3,709	8,576	175	28	0	0	0	26,643
Cook County	5,049	1,540	1,418	157	49	0	0	0	8,213
Lake County	9,054	2,237	5,646	48	31	1	0	0	17,017
St. Louis County	105,437	16,769	29,596	2,337	944	36	0	0	155,119
Northeast Landscape	133,695	24,255	45,236	2,717	1,052	37	0	0	206,992
% of parcels in Northeast Landscape	64.6	11.7	21.9	1.3	0.5	0.0	--	--	

Source: Carlton, Cook, Lake, and St. Louis County GIS department's parcel shapefile.

2.5.3. Private land ownership tenure.

Data on private family forestland ownership tenure in Northeastern Minnesota (includes Koochiching County) was collected by the USDA Forest Service in 2006 (publish year) through the National Woodland Owner Survey (Figure 2.9 and Figure 2.10). Based on survey response in 2006, approximately 43% of family forestland acres had been owned by the same owner for 25-49 years, while 16.3% of the total family forestland acres were owned for less than 10 years. Figure 2.10 shows a little more than 40% of the family forestland owner respondents have held the property for 25-49 years.

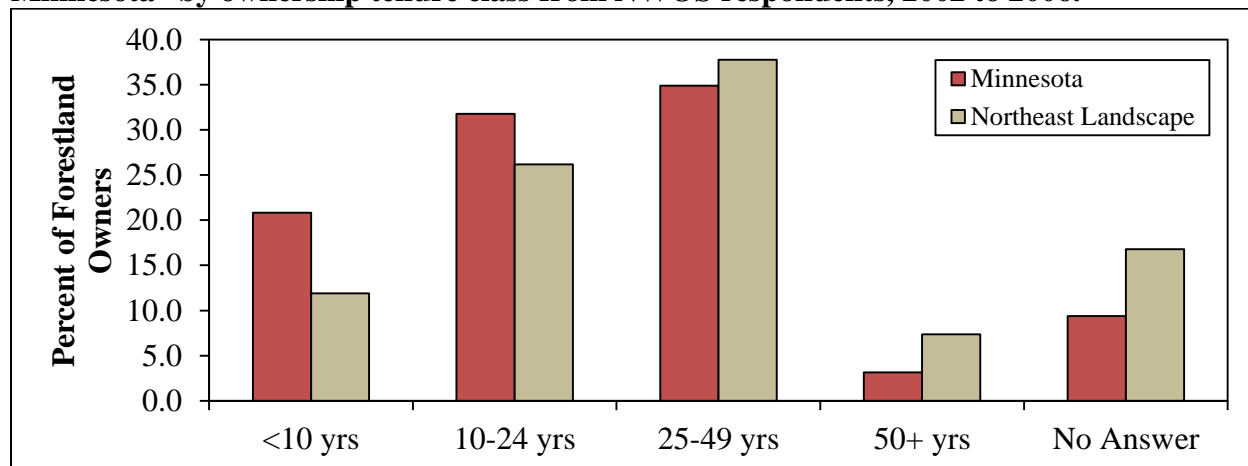
Figure 2.9. Estimated distribution of family forestland acres in Northeastern Minnesota^A by ownership tenure class from NWOS respondents, 2002 to 2006.



Source: National Woodland Owner Survey conducted from 2002 to 2006 – USFS Forest Inventory and Analysis database.

^A Koochiching County was included in Northeast Minnesota for the National Woodland Owner Survey and could not be removed for this analysis.

Figure 2.10. Estimated distribution of family forestland owners in Northeastern Minnesota^A by ownership tenure class from NWOS respondents, 2002 to 2006.



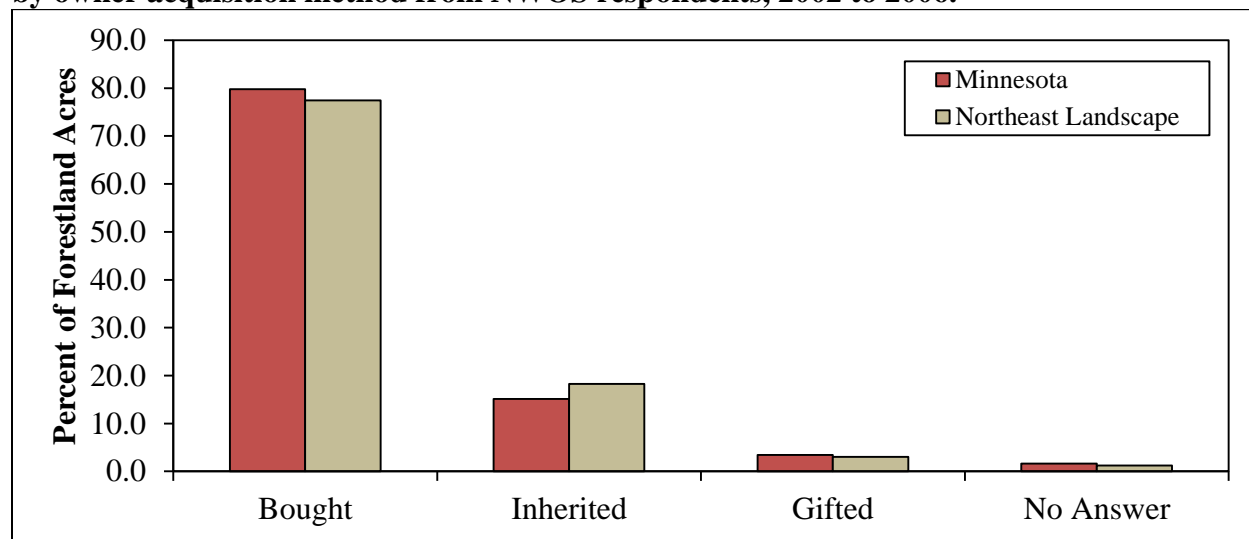
Source: National Woodland Owner Survey conducted from 2002 to 2006 – USFS Forest Inventory and Analysis database.

^A Koochiching County was included in Northeast Minnesota for the National Woodland Owner Survey and could not be removed for this analysis.

2.5.4. Private land acquisition method.

Data on family forest land acquisition method in Northeastern Minnesota (includes Koochiching County) was collected by the USDA Forest Service in 2006 (publish year) through the National Woodland Owner Survey (Figure 2.11 and Figure 2.12). Just under 80% of family forestland acreage and properties were acquired via purchase based on NWOS response.

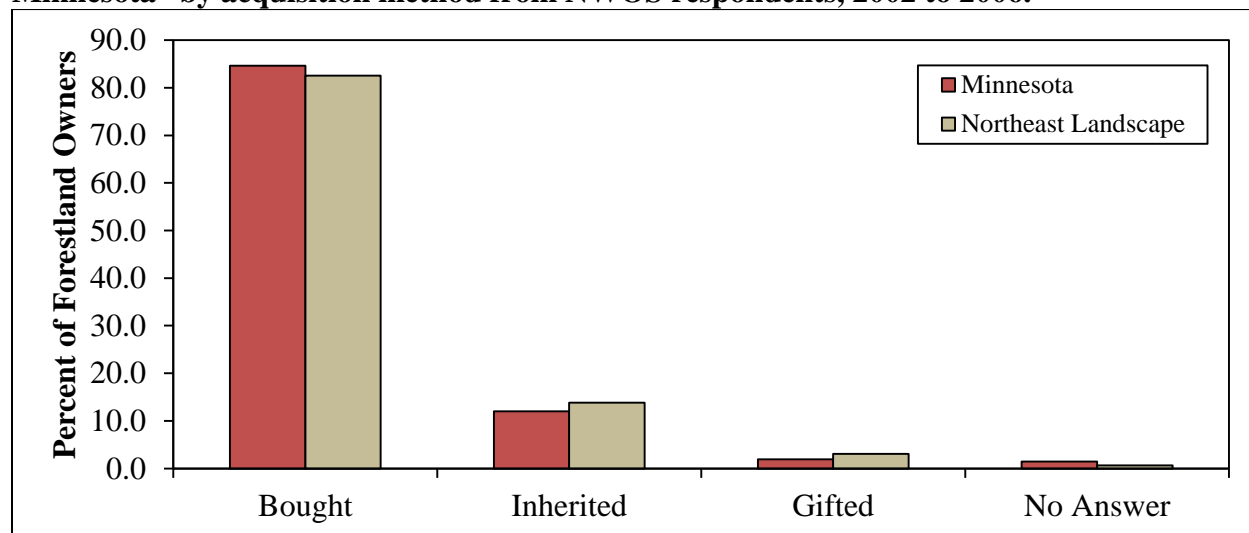
Figure 2.11. Estimated distribution of family forestland acres in Northeastern Minnesota^A by owner acquisition method from NWOS respondents, 2002 to 2006.



Source: National Woodland Owner Survey conducted from 2002 to 2006 – USFS Forest Inventory and Analysis database.

^A Koochiching County was included in Northeast Minnesota for the National Woodland Owner Survey and could not be removed for this analysis.

Figure 2.12. Estimated distribution of family forestland owners in Northeastern Minnesota^A by acquisition method from NWOS respondents, 2002 to 2006.



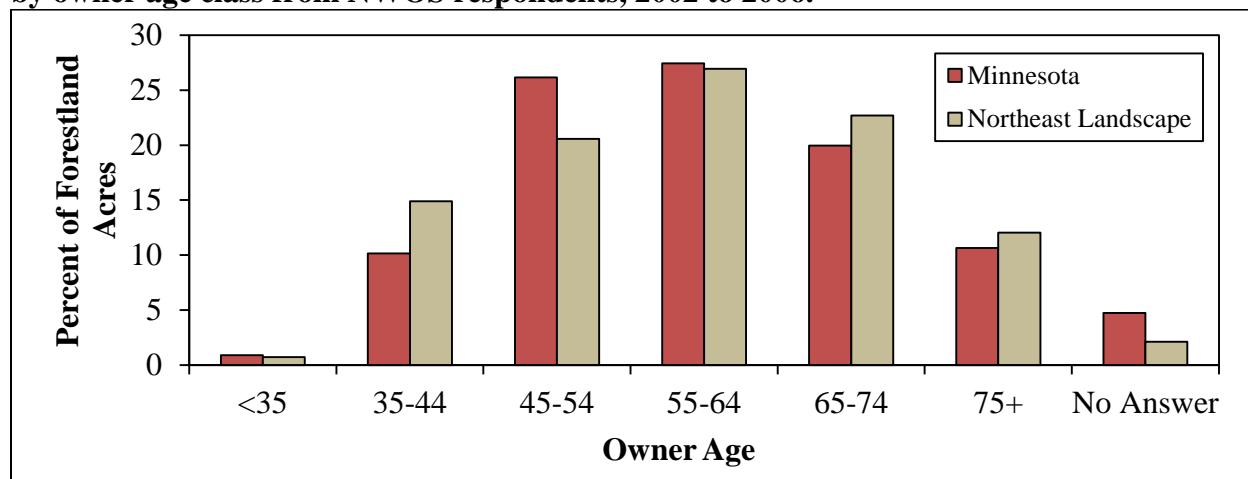
Source: National Woodland Owner Survey conducted from 2002 to 2006 – USFS Forest Inventory and Analysis database.

^A Koochiching County was included in Northeast Minnesota for the National Woodland Owner Survey and could not be removed for this analysis.

2.5.5. Private landowner age.

Data on family forest landowner age in Northeastern Minnesota (includes Koochiching County) was collected by the USDA Forest Service in 2006 (publish year) through the National Woodland Owner Survey (Figure 2.13 and Figure 2.14). Based on survey response in 2006, approximately 34% of all family forestland by acreage and owners was owned by people greater than 65. This is in stark contrast to the less than one percent of private land owned by individuals less than 35 years of age. Owners in the Northeast Landscape tend to be older than those across the state of Minnesota.

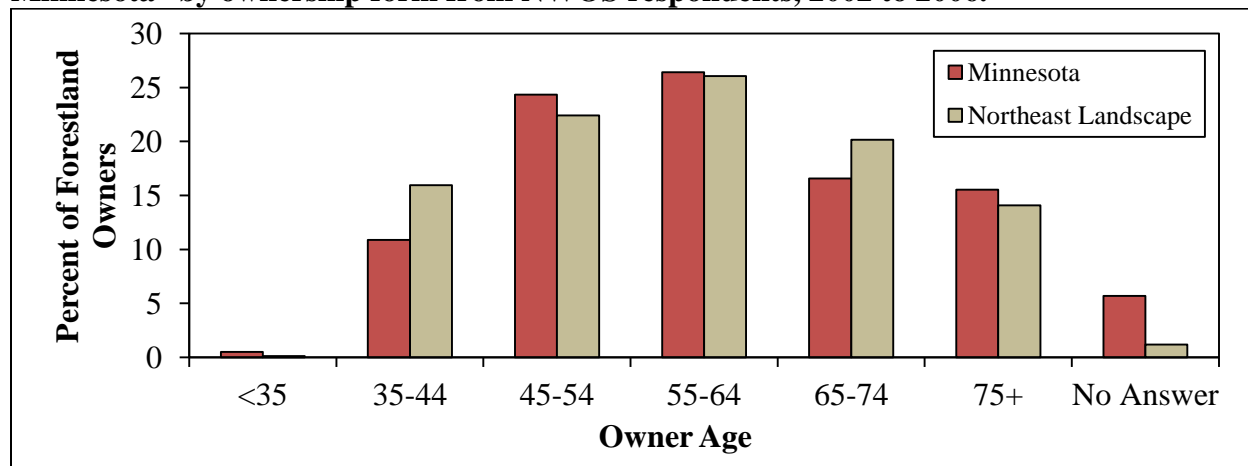
Figure 2.13. Estimated distribution of private forestland acres in Northeastern Minnesota^A by owner age class from NWOS respondents, 2002 to 2006.



Source: National Woodland Owner Survey conducted from 2002 to 2006 – USFS Forest Inventory and Analysis database.

^A Koochiching County was included in Northeast Minnesota for the National Woodland Owner Survey and could not be removed for this analysis.

Figure 2.14. Estimated distribution of private forestland owners in Northeastern Minnesota^A by ownership form from NWOS respondents, 2002 to 2006.



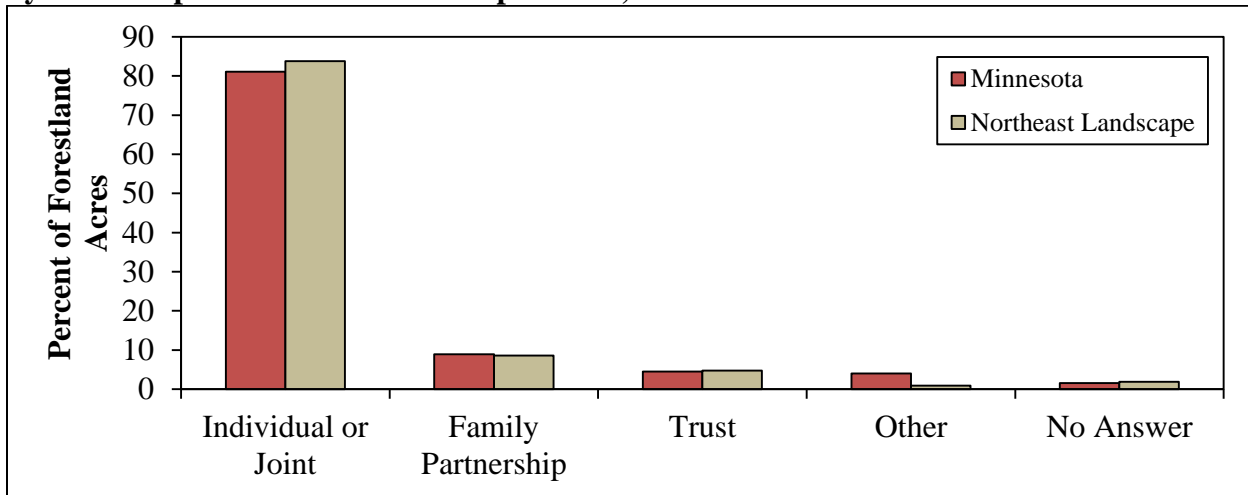
Source: National Woodland Owner Survey conducted from 2002 to 2006 – USFS Forest Inventory and Analysis database.

^A Koochiching County was included in Northeast Minnesota for the National Woodland Owner Survey and could not be removed for this analysis.

2.5.6. Private land ownership form.

Data on family forestland ownership form in Northeastern Minnesota (includes Koochiching County) was collected by the USDA Forest Service in 2006 (publish year) through the National Woodland Owner Survey (Figure 2.15 and Figure 2.16). Based on survey response in 2006, approximately 84% of all family forestland was owned individually or jointly. This trend was even higher for forestland owners where nearly 94% of the forestland owners were individual or joint.

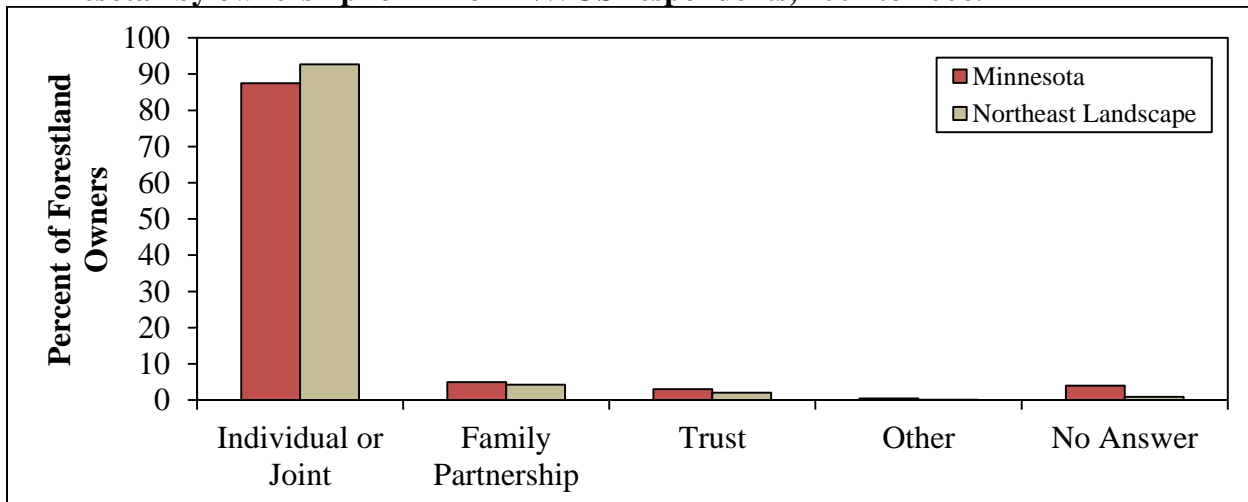
Figure 2.15. Estimated distribution of private forestland acres in Northeastern Minnesota^A by ownership form from NWOS respondents, 2002 to 2006.



Source: National Woodland Owner Survey conducted from 2002 to 2006 – USFS Forest Inventory and Analysis database.

^A Koochiching County was included in Northeast Minnesota for the National Woodland Owner Survey and could not be removed for this analysis.

Figure 2.16. Estimated distribution of private forestland owners in Northeastern Minnesota^A by ownership form from NWOS respondents, 2002 to 2006.



Source: National Woodland Owner Survey conducted from 2002 to 2006 – USFS Forest Inventory and Analysis database.

^A Koochiching County was included in Northeast Minnesota for the National Woodland Owner Survey and could not be removed for this analysis.

2.6. Forest Stewardship Plans

According to the Minnesota Department of Natural Resources' Forest Stewardship Program, *"The DNR Forest Stewardship Program provides technical advice and long-range forest management planning to interested landowners. All aspects of the program are voluntary. Plans are designed to meet landowner goals while maintaining the sustainability of the land. The entire property except active farming areas, is covered by the plan."* (FSP 2013)

It should be noted that not all private forest land is eligible for a Forest Stewardship Plan; for example, a landowner must have at least 20 eligible acres to enroll. Non-forested land that meets certain criteria is eligible for the program as well; examples include agricultural land that will be converted to forest and non-forested wetlands (Arends et al. 2009).

The Spatial Analysis Project (SAP) was conducted by the Minnesota DNR Forestry Private Lands Program in 2006. The purpose of the SAP was to create "a GIS layer representing the level of "benefit" gained from potential forest stewardship work." Several factors that were determined to "contribute to the overall benefits gained by active forest stewardship" were mapped, overlaid, and scored, and then scores were weighted by the importance of the factor. The resulting scores were then classified into low, medium and high potential benefit gained by active forest stewardship. Similar to Forest Stewardship Plan eligibility, the SAP process considered other factors in addition to areas of existing forest; therefore non-forested areas may have also been identified as gaining potential benefit from forest stewardship. More information on this process can be found at <http://www.fs.fed.us/na/sap/products/mn.shtml>. (USFS 2009).

To quantify Forest Stewardship Plan accomplishments, the USFS asked the states to designate Important Forest Resource Areas (IFRA). Accomplishments would then be based on how much of those areas are covered by current forest stewardship plans (plans are current for 10 years in Minnesota). For the IFRA's in Minnesota, the medium and high areas delineated in the SAP were used.

Forest stewardship plan areas in Minnesota were compared against the IFRA's. Table 2.15 lists the accomplishments for Minnesota state-wide and within the Northeast Landscape for forest stewardship plans current as of the end of the Federal Fiscal Year (Sept. 30, 2013). IFRA's across the State were at 4.2% coverage. In the Northeast Landscape, IFRA's were at 5.0% coverage (Figure 2.17).

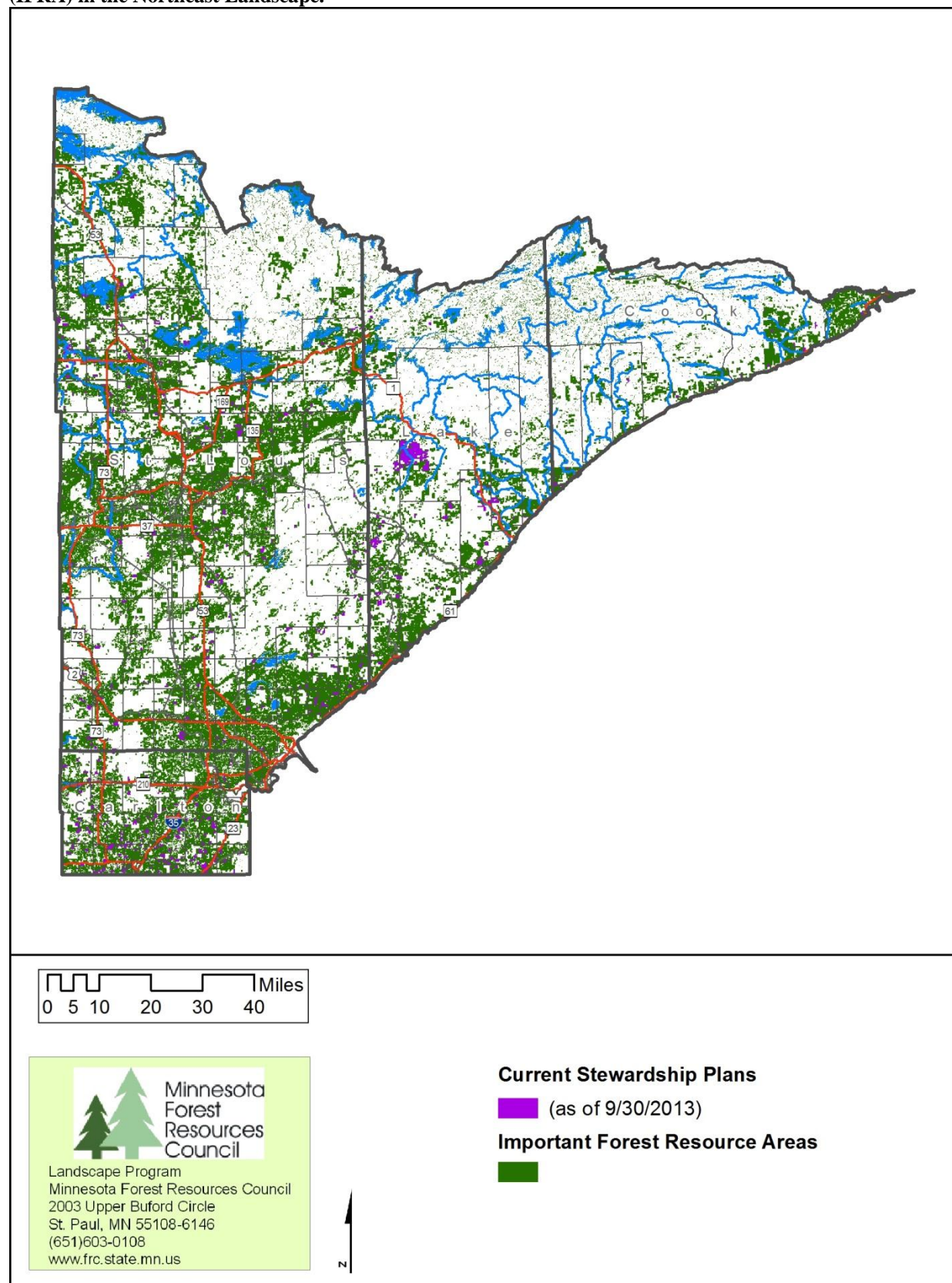
Table 2.15. Areas covered by Forest Stewardship Plans compared to Important Forest Resource Areas (IFRA) in the Northeast Landscape.

Study Area	Metric	Acres
Northeast	Acres covered by current forest stewardship plans	106,835
	Acres of Important Forest Resource Areas	1,815,382
	Acres in Important Forest Resource Areas covered by current Forest Stewardship Plans	80,817
Minnesota	Acres covered by current forest stewardship plans	618,682
	Acres of Important Forest Resource Areas	9,898,192
	Acres in Important Forest Resource Areas covered by current Forest Stewardship Plans	415,893

Source: Spatial Analysis Project (SAP), Minnesota DNR Forestry Community and Private Lands Program (2006). For further information on this data, contact the MN DNR Private Forest Management Program.

Notes: The SAP that created the IFRA used GAP Land Cover (1992) data to determine forested acres. IFRA acres exceed 1992 forested acres because the SAP process considered areas of potential forest gain and areas that could have significant effect on forests as well. Acres covered by forest stewardship plans only include forest stewardship plans submitted to the DNR; other plans may exist that were not submitted to the DNR.

Figure 2.17. Areas covered by Forest Stewardship Plans compared to Important Forest Resource Areas (IFRA) in the Northeast Landscape.



Source: Spatial Analysis Project (SAP), Minnesota DNR Forestry Community and Private Lands Program (2006)

2.7. Taxes

Property taxes in the Northeast Landscape exceeded \$313 million in 2013 (Table 2.16). Only 0.1% (\$335,759) of the total property tax dollars was from Managed Forest Land in the Northeast Landscape. This was true across the counties with the highest percentage of total dollars from Managed Forest Land was in Lake County with 0.5%. Cook County was the only county with more property tax dollars coming from Seasonal Recreational Residential than Residential although it is nearly equal in Lake County (Table 2.16). Nearly 77% of the total property tax dollars were from St. Louis County with Carlton County coming in second at 13.9% (Table 2.16).

Annual gross sales in the northeast landscape exceed \$9.2 billion with total sales and use tax of nearly \$200 million (Table 2.17). St. Louis County accounts for over 83% of the total sales and use tax. St. Louis has the fifth highest total sales and use tax for counties in Minnesota (Table 2.18).

‘Payments in Lieu of Taxes’ (PILT) are payments to local governments that help offset losses in property taxes due to non-taxable public lands within their boundaries. PILT payments help local governments carry out services such as firefighting and police protection, construction of public schools and roads, and search-and-rescue operations. The formula used to compute the payments is contained in the PILT Act and is based on population, receipt sharing payments, and the amount of public land within an affected county. PILT payments in the northeast Landscape by the Minnesota DNR have doubled in the last ten years (Table 2.19) PILT payments by the US Forest Service for Superior National Forest lands were just over \$750,000 in 2012 which was down from a peak of \$1,793,846 paid in 2009 (Table 2.20).

Table 2.16. Total net property tax and estimated distribution among selected use classes in the Northeast Landscape, 2013. (Values are dollars.)

	Carlton	Cook	Lake	St. Louis	Northeast Landscape
Farm	\$3,922,707	\$915,325	\$2,293,751	\$12,982,874	\$20,114,657
Timber/Managed Forest Land	\$105,186	\$13,559	\$85,704	\$131,310	\$335,759
Seasonal Recreational Residential	\$1,958,679	\$6,024,965	\$5,082,880	\$22,048,454	\$35,114,978
Residential (Homestead and Non-)	\$20,583,579	\$2,651,746	\$5,411,526	\$113,735,782	\$142,382,633
Total	\$43,573,042	\$11,913,165	\$17,465,642	\$240,762,815	\$313,714,664

Source: MN Department of Revenue.

Note: There are classes besides those listed; however, the ‘Total’ includes all property types.

Table 2.17. Sales and uses taxes in the Northeast Landscape, 2011. (Values are millions of dollars.)

County	Gross Sales	Taxable Sales	Sales Tax	Use Tax	Total Tax	Number of Businesses
Carlton	\$903.59	\$195.05	\$13.83	\$1.52	\$15.35	824
Cook	\$186.66	\$92.12	\$6.48	\$0.10	\$6.58	390
Lake	\$259.67	\$78.97	\$5.58	\$5.06	\$10.64	396
St. Louis	\$7,876.41	\$2,093.83	\$146.98	\$19.49	\$166.47	5,281
Northeast Landscape	\$9,226.32	\$2,459.98	\$172.88	\$26.17	\$199.05	6,891

Source: Minnesota Department of Revenue Tax Research Division.

Table 2.18. Sales and uses taxes in the Northeast Landscape by Minnesota County rank, 2011.

County	Gross Sales	Taxable Sales	Sales Tax	Use Tax	Total Tax	Number of Businesses
Carlton	39	35	35	20	34	34
Cook	80	54	54	75	58	65
Lake	76	59	59	9	40	64
St. Louis	7	5	5	4	5	5

Source: Minnesota Department of Revenue Tax Research Division.

Note: There are 87 counties in Minnesota.

Table 2.19. Minnesota DNR payments to counties in lieu of taxes for public land in the Northeast Landscape, 2002-2012. (Values are dollars.)

	MN DNR
2002	\$1,969,536
2003	\$2,006,007
2004	\$2,063,532
2005	\$2,129,605
2006	\$2,748,064
2007	\$2,864,025
2008	\$2,975,578
2009	\$3,117,118
2010	\$3,097,719
2011	\$4,074,220
2012	\$4,079,407

Source: Minnesota Department of Revenue Tax Research Division.

Table 2.20. Payments to counties in lieu of taxes for Superior National Forest land in the Northeast Landscape, 1977-2012. (Values are dollars.)

Fiscal Year	Cook	Lake	St. Louis	Total
1977	\$66,586	\$284,335	\$495,218	\$846,139
1978	\$173,893	\$394,164	\$614,783	\$1,182,840
1979	\$96,027	\$267,328	\$514,730	\$878,085
1980	\$104,502	\$290,036	\$586,423	\$980,961
1981	\$62,878	\$95,745	\$493,207	\$651,830
1982	\$58,849	\$73,456	\$439,870	\$572,175
1983	\$60,516	\$72,075	\$435,559	\$568,150
1984	\$61,521	\$70,928	\$415,498	\$547,947
1985	\$62,511	\$71,991	\$420,530	\$555,032
1986	\$61,649	\$70,837	\$403,651	\$536,137
1987	\$63,594	\$73,741	\$403,651	\$540,986
1988	\$63,916	\$74,055	\$428,442	\$566,413
1989	\$63,830	\$74,111	\$395,371	\$533,312
1990	\$63,617	\$74,601	\$407,335	\$545,553
1991	\$63,581	\$74,601	\$328,834	\$467,016
1992	\$62,926	\$73,455	\$262,095	\$398,476
1993	\$63,044	\$72,751	\$259,091	\$394,886
1994	\$63,384	\$73,245	\$247,748	\$384,377
1995	\$69,908	\$67,514	\$286,093	\$423,515
1996	\$69,908	\$79,457	\$388,506	\$537,871
1997	\$61,379	\$69,663	\$377,428	\$508,470
1998	\$64,169	\$72,827	\$397,883	\$534,879
1999	\$63,163	\$107,947	\$454,560	\$625,670
2000	\$67,418	\$109,671	\$467,752	\$644,841
2001	\$97,772	\$110,991	\$504,723	\$713,486
2003	\$116,258	\$132,108	\$709,126	\$957,492
2004	\$121,257	\$137,865	\$739,044	\$998,166
2005	\$126,512	\$143,913	\$750,084	\$1,020,509
2006	\$129,401	\$147,181	\$758,547	\$1,035,129
2007	\$128,274	\$145,887	\$767,575	\$1,041,736
2008	\$127,358	\$144,852	\$796,140	\$1,068,350
2009	\$208,736	\$237,409	\$1,347,701	\$1,793,846
2010	\$210,829	\$239,788	\$1,073,923	\$1,524,540
2011	\$210,814	\$239,697	\$279,324	\$729,835
2012	\$217,213	\$246,972	\$287,769	\$751,954

Source: US Forest Service, Superior National Forest



Goal 3 – Healthy Forests

MFRC Goal 3: Within forested landscapes, healthy, resilient, and functioning ecosystems will be maintained within appropriate mixes of forest cover types and age classes to promote timber production, biological diversity, and viable forest dependent fish and wildlife habitats.

This report includes the best ecological data available at this time. It includes data on pre-settlement forest patterns; climate change; tree species; forest composition and age structure; growth and removals on timberland; silvicultural and harvesting practices; species at risk; wildlife furbearer and game species; invasive species; and lake and stream water quality.

3.1. Healthy Forest Data Sources

Minnesota Ecological Classification System (ECS): The Minnesota Department of Natural Resources and the U.S. Forest Service developed an Ecological Classification System for ecological mapping and landscape classification in Minnesota following the National Hierarchical Framework of Ecological Units (ECOMAP 1993). For more information on this system see Section 3.2.

Native Plant Communities (NPC): This is a classification system of the native vegetation of Minnesota developed by the Minnesota DNR. This system is intended to provide a framework and common language for improving vegetation management, surveys of natural areas, identifying research needs, and promoting the study and appreciation of native vegetation in Minnesota. For more information on this system see Section 3.3.

Minnesota Biological Survey (MBS): The MBS is a systematic survey of rare biological features. The goal of the MBS is to identify significant natural areas and to collect and interpret data on the distribution and ecology of rare plants, rare animals, and natural communities. More information on this system can be found in Section 3.4.

Presettlement Vegetation of Minnesota: The Public Land Survey of Minnesota started in 1847 and by 1908 the entire state of Minnesota had been surveyed. As an essential part of the survey process, surveyors notched or blazed bearing trees to facilitate the relocation of survey corners. They also noted the species, diameter, and distance and azimuth from the corner for each bearing tree. This data has been used to estimate tree species abundance across the state prior to European settlement.

Forest Inventory Analysis (FIA): The FIA is a systematic collection of data and forest information by the U.S. Forest Service for assessment or analysis to assess America's forests. This continuous forest census is designed to provide reliable estimates on the type, extent, growth, mortality, and removals of forestland. This data is not meant to be represented spatially but breaks forestland and timberland estimates down by ownership class.

Current Status and Long-term Trends of Silvicultural Practices in Minnesota: This was developed by Anthony W. D’Amato, Nicholas W. Bolton, Charles R. Blinn, and Alan R. Ek of the University of Minnesota, Department of Forest Resources in 2008. This technical report characterized the status of silvicultural practices within Minnesota in 2008 and used results from past surveys (1991 and 1996) to describe general trends in Silviculture across ownerships and over time. More information on this data source can be found in Section 3.14.

MN DNR Rare Plants and Animals: Data available through the MN DNR Division of Ecological and Water Resources and the Minnesota Natural Heritage System.

MNTaxa: A list of vascular plant species that reflect vouchered specimens present in herbarium collections at the University of Minnesota and University of Minnesota Duluth herbariums.

MN DNR Forest Wildlife Populations and Research Group: Develops annual summaries of forest wildlife populations.

Invasive Species: Minnesota DNR invasive species information on the GIS Data Deli

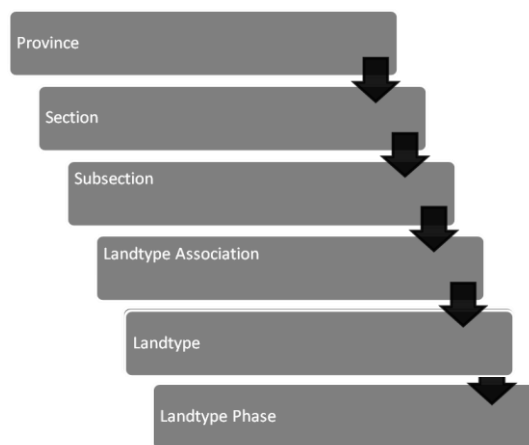
Water Health data: Minnesota DNR water quality data on the GIS Data Deli

Forest Ecosystem Vulnerability Assessment and Synthesis (FEVAS): A climate change vulnerability assessment for forest ecosystems in northern Minnesota developed by forest managers and researchers from across the State of Minnesota and Great Lakes Region.

3.2. Minnesota Ecological Classification System (ECS)

The Minnesota Department of Natural Resources and the U.S. Forest Service have developed an Ecological Classification System (ECS) for ecological mapping and landscape classification in Minnesota following the [National Hierarchical Framework of Ecological Units](#) (ECOMAP 1993).

Ecological land classifications are used to identify, describe, and map progressively smaller areas of land with increasingly uniform ecological features. The system uses associations of biotic and environmental factors including: 1) climate, 2) geology, 3) topography, 4) soils, 5) hydrology, and 6) vegetation. There are eight levels of ECS units in the United States. Map units for six of these levels occur in Minnesota: Provinces, Sections, Subsections, Land Type Associations, Land Types, and Land Type Phases. The first three levels are described below:



- **Provinces** are units of land defined using major climate zones, native vegetation, and biomes such as prairies, deciduous forests, or boreal forests. There are four ecological provinces in Minnesota.

- **Sections** are units within Provinces that are defined by origin of glacial deposits, regional elevation, distribution of plants, and regional climate. Minnesota has ten ecological sections.
- **Subsections** are units within Sections that are defined using glacial deposition processes, surface bedrock formations, local climate, topographic relief, and the distribution of plants, especially trees. Minnesota has 26 ecological subsections.
- **Land Type Associations (LTAs)** are divisions within Subsections that are delineated using glacial landforms, bedrock types, topographic roughness, lake and stream distributions, wetland patterns, depths to groundwater table, soil parent material and pre-European settlement vegetation. There are 291 LTAs in the state, 160 of which occur in the Laurentian Province.

Source: Field Guide to Native Plant Communities of Minnesota, MN DNR 2003. More information is available at: www.dnr.state.mn.us/ecs/index.html

3.2.1. ECS Geography of the Northeast Landscape

The Northeast Landscape is located entirely within the Laurentian Mixed Forest Province. There are five ecological sections that cover the region and a total of ten subsections within those sections (Figure 3.1 and Figure 3.2). Table 3.1 summarizes the acreages of ECS Sections with the Northeast Landscape. The maps below illustrate the hierarchical or scaled nature of the various ECS geographic units as they relate to the state and the Northeast Landscape.

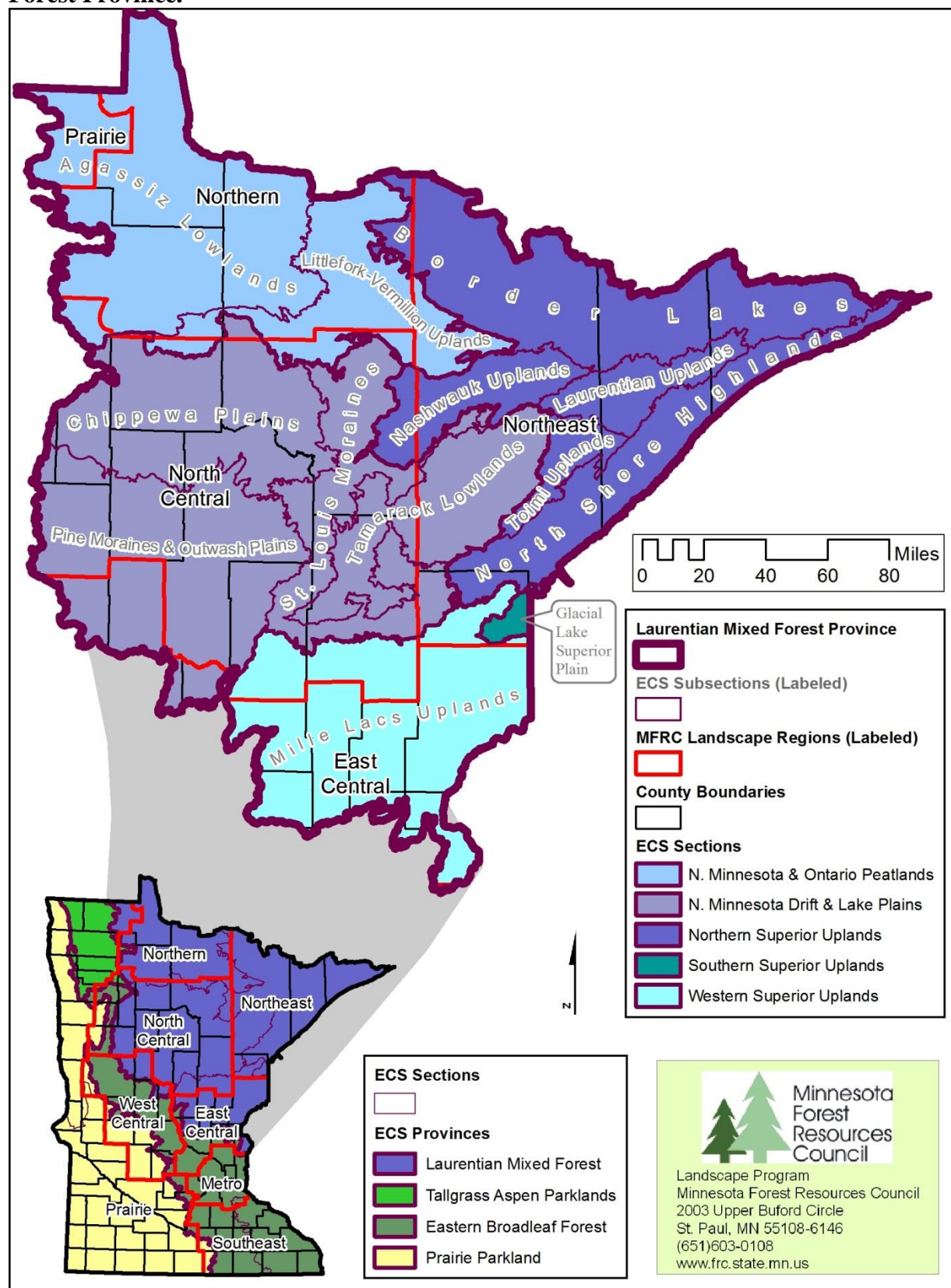
Within the ten subsections, there are 68 LTAs. The average area of a land type association across the region is approximately 145,000 acres. Table 3.2 summarizes the areas of each subsection and provides the number of LTAs in each section and subsection.

Table 3.1. Ecological Classification System Section (ESC) Areas in the Northeast Landscape.

ECS Section	Code	Acres	% of Total
Northern Superior Uplands	NSU	5,609,755	76.2
N. Minnesota Drift & Lake Plains	DLP	1,132,137	15.4
N. Minnesota & Ontario Peatlands	NMOP	303,575	4.1
Western Superior Uplands	WSU	206,662	2.8
Southern Superior Uplands	SSU	109,676	1.5
Total		7,361,805	100.0

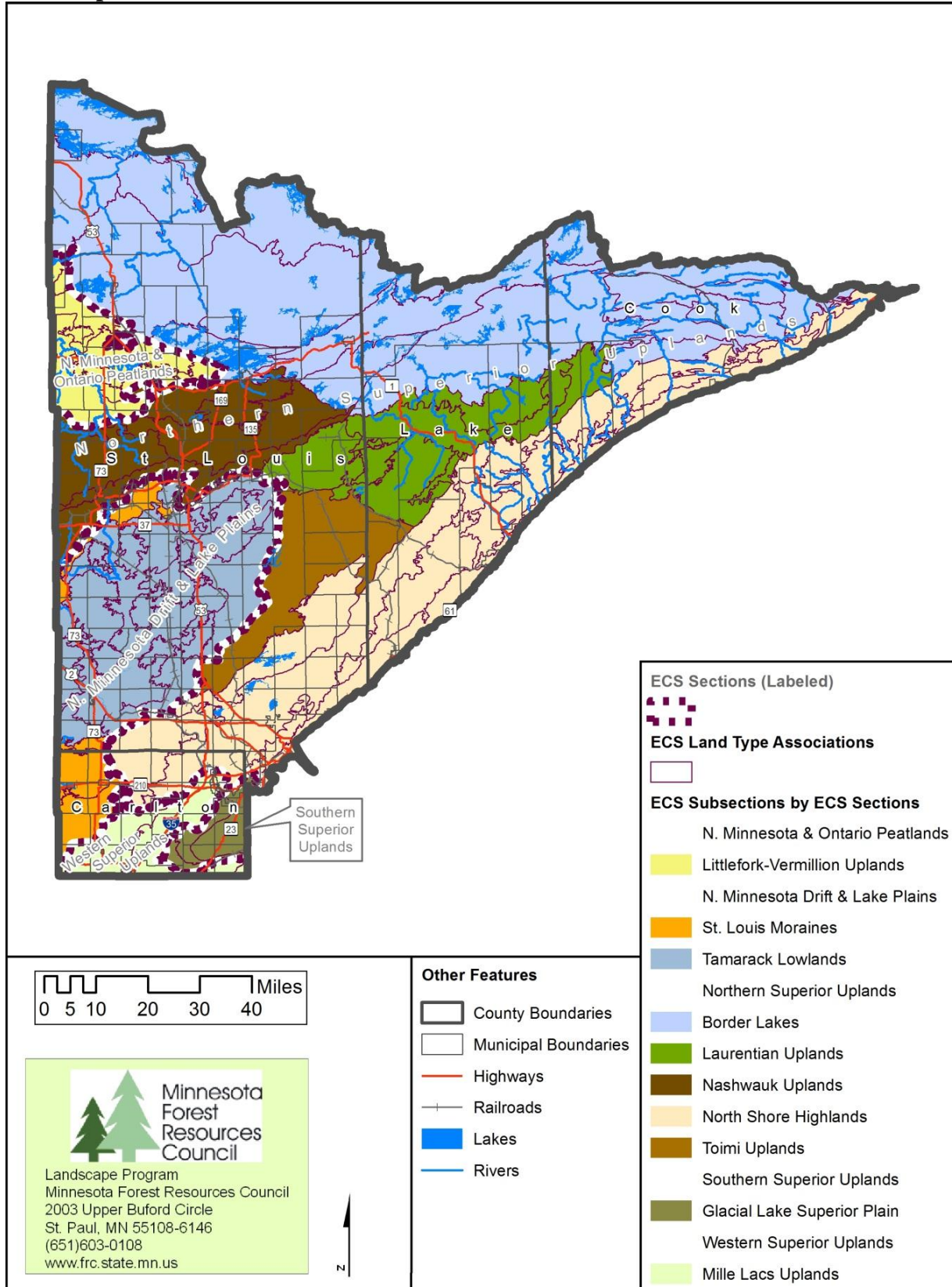
Source: MN DNR Data Deli

Figure 3.1. Ecological Classification System (ESC) Section areas in the Laurentian Mixed Forest Province.



Source: MN DNR Data Deli

Figure 3.2. Ecological Classification System (ESC) Subsection areas in the Northeast Landscape.



Source: MN DNR Data Deli

Table 3.2. Ecological Classification System (ECS) Subsection Areas in the Northeast Landscape.

ECS Sections	ECS Subsections	Acres	% of Total	# of Land Type Associations
N. Minnesota & Ontario Peatlands	Littlefork-Vermillion Uplands	303,575	4.1	7
Total (Subsection)		303,575	4.1	7
N. Minnesota Drift & Lake Plains	St. Louis Moraines	191,251	2.6	6
	Tamarack Lowlands	940,886	12.8	5
Total (Subsection)		1,132,137	15.4	11
Northern Superior Uplands	Border Lakes	2,623,704	35.6	17
	Laurentian Uplands	567,293	7.7	8
	Nashwauk Uplands	598,124	8.1	6
	North Shore Highlands	1,481,342	20.1	10
	Toimi Uplands	339,292	4.6	1
Total (Subsection)		5,609,755	76.2	42
Southern Superior Uplands	Glacial Lake Superior Plain	109,676	1.5	3
Total (Subsection)		109,676	1.5	3
Western Superior Uplands	Mille Lacs Uplands	206,662	2.8	5
Total (Subsection)		206,662	2.8	5
Total Project Area		7,361,805	100.0	68

Source: MN DNR Data Deli

3.3. Native Plant Communities (NPC)

A **native plant community** is a group of native plants that interact with each other and with their environment in ways not greatly altered by modern human activity or by introduced organisms. These groups of native plant species form recognizable units, such as hardwood forests, pine forests, or marshes, that tend to repeat over space and time. Native plant communities are classified and described by considering 1) vegetation, 2) hydrology, 3) landforms, 4) soils, and 5) natural disturbance regimes. Examples of natural disturbances include: wildfires, severe droughts, windstorms, and floods.

Sometimes referred to as native habitats or natural communities, native plant communities are named for the characteristic plant species within them or for characteristic environmental features. Examples of native plant communities in the Northeast Landscape include Northern Mesic Mixed Forest, Northern Poor Dry-Mesic Mixed Woodland, Northern Mesic Hardwood Forest, and Northern Rick Spruce Swamp. There are many kinds of vegetated areas that are not native plant communities. These include places where native species have largely been replaced by exotic or invasive species such as smooth brome grass, buckthorn, and purple loosestrife, and planted areas such as orchards, pine plantations, golf courses, and lawns. Other areas not considered to be native plant communities include areas where modern human activities such as

farming, overgrazing, non-sustainable logging, and development have destroyed or greatly altered the vegetation.

More information on NPC Classes can be found in the '*Field Guide to the Native Plant Communities of Minnesota*' or at www.dnr.state.mn.us/npc/classification.html

3.3.1. Native Plant Community Classification

In 2003, researchers in the Minnesota Department of Natural Resources (DNR) completed a new classification of the native vegetation of Minnesota, Minnesota's Native Plant Community Classification (Version 2.0). The DNR's new classification is intended to provide a framework and common language for improving our ability to manage vegetation, to survey natural areas for biodiversity conservation, to identify research needs, and to promote study and appreciation of native vegetation in Minnesota. Version 2.0 of the DNR's native plant community classification is based strongly on plant species composition and was developed through analysis of extensive field data collected from [sample plots](#) in forests, prairies, wetlands, and other habitats. The classification is hierarchical, with vegetation units described at levels ranging from broad landscape-level ecological systems to local communities (Table 3.3). One of the most important features of the new classification is the inclusion of ecological processes as an organizing principle.

The NPC classification has six levels (Table 3.3). **System Groups**, the highest level, were created to allow development of manageable field keys for lower levels of the classification. System Groups were formed by combining lower levels of the classification along major physiognomic and hydrologic splits in vegetation. **Ecological Systems** are groups of native plant communities that are unified by strong influence from a major ecological process or set of processes, especially nutrient cycling and natural disturbances. **Floristic Regions** are divisions within Ecological Systems that reflect the distribution of Minnesota's plant species into characteristically northern, northwestern, central, and southern groups, or floras. The important influences on these species distributions appear to be climate and paleohistory. **Native Plant Community Classes** are units of vegetation that generally have uniform soil texture, soil moisture, soil nutrients, topography, and disturbance regimes. For wooded vegetation, Native Plant Community Classes were developed by emphasizing understory vegetation more than canopy trees, under the hypothesis that in much of Minnesota understory plants are often more strongly tied to specific habitat conditions (such as levels of nutrients and moisture) than are canopy trees. **Native Plant Community Types** are defined by dominant canopy trees, variation in substrate, or fine-scale differences in environmental factors such as moisture or nutrients. Type distinctions were also made to describe geographic patterns within a Class. **Native Plant Community Subtypes** are based on finer distinctions in canopy composition, substrates, or other environmental factors. In some instances, Subtypes represent apparent trends within a Type for which more study and collection of data are needed. In other instances Subtypes are well-documented, fine-scale units of vegetation that are useful for work such as rare plant habitat surveys.

Table 3.3. Native Plant Community (NPC) classification hierarchy.

Classification Level	Dominant Factors	Example
System Group	Vegetation structure & geology	Upland Forest & Woodland Systems
Ecological System	Ecological processes	Fire-Dependent Forest/Woodland
Floristic Region	Climate & paleohistory	Central
NPC Class	Local environmental conditions	Central Dry Pine Woodland
NPC Type	Canopy dominants, substrate, or finer environmental conditions	Jack Pine-(Yarrow) Woodland
NPC Subtype	Finer distinctions in canopy dominants, substrate, or environmental conditions	Ericaceous Shrub

Source: Field Guide to the Native Plant Communities of Minnesota www.dnr.state.mn.us/npc/classification.html

3.3.2. NPC Systems in the Northeast Landscape

Upland/Lowland Characteristics

The Northeast Landscape Region covers over 7.3 million acres. Within this region there are five forested NPC systems (Table 3.5); three of which are generally represented in lowland areas and two systems that are in upland terrain areas. Upland systems cover almost two-thirds of the region. The Natural Resources Research Institute has integrated soil series, plant relevee, geomorphic, topographic, and other relevant geospatial data layers to create native plant community maps of the Drift and Lake Plains and Western Superior Uplands ecological sections to estimate acreages of native plant communities at the system and class level by ownership. These NPC system area estimates are listed below in Table 3.4 and Table 3.5.

Upland Systems

- Fire Dependent
- Mesic Hardwood

Lowland Systems

- Acid Rich Peatland
- Forest Rich Peatland
- Wet Forest

Table 3.4. Native Plant Community (NPC) System area estimates by lowland and upland systems

NPC Systems	Acres	Percent
Upland NPC Systems	4,629,640	62.9
Lowland NPC Systems	2,725,125	37.1
Total	7,354,765	100.0

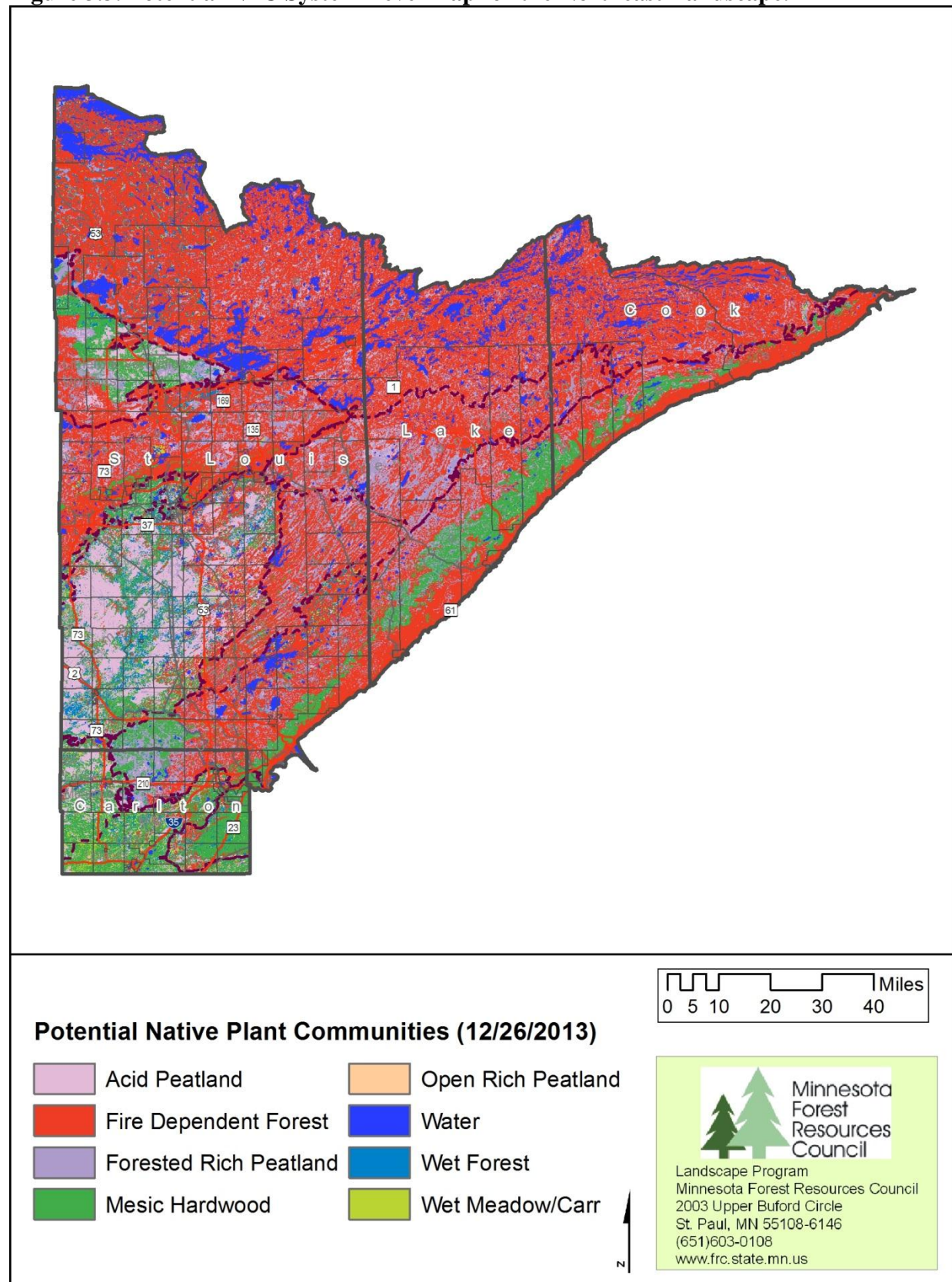
Source: George Host, Natural Resources Research Institute

Table 3.5. Northeast Landscape Native Plant Community (NPC) system area estimates.

Code	NPC System	Acres	Percent
FD	Fire Dependent	3,810,476	82.3
MH	Mesic Hardwoods	819,164	17.7
	Subtotal - Upland Systems	4,629,640	100.0
AP	Acid Peatland	496,419	18.2
FP	Forested Peatland	1,188,855	43.6
WF	Wet Forest	401,837	14.7
WM	Wet Meadow	43,509	1.6
Water	Water	594,505	21.9
	Subtotal - Lowland Systems	2,725,125	100.0
	Total	7,354,765	--

Source: George Host, Natural Resources Research Institute

Figure 3.3. Potential NPC System Level map for the Northeast Landscape.



Source: George Host, Natural Resources Research Institute

3.3.3. NPC Landownership Characteristics

Land ownership varies greatly across the five NPC systems. Table 3.6 illustrates the diverse ownership patterns by NPC system. Individual private landowners are the largest ownership block of forests classified in the Mesic Hardwood NPC system. The federal government is the largest owner of lands classified as fire dependent as well as the forested peatlands systems.

Land ownership also varies greatly across the Northeast Landscape at the NPC class level. Table 3.7 summarizes the NPC classes by the landownership categories.

Table 3.6. NPC System area estimates by land ownership

Code	NPC Systems	Federal	State	County	Tribal	Industrial	Private	Other	Total
Upland Systems									
FD	Fire Dependent	1,664,401	930,114	9,886	33,055	275,398	887,518	10,104	3,810,476
MH	Mesic Hardwoods	58,798	247,655	6,838	10,339	53,662	440,240	1,633	819,164
	Subtotal	1,723,199	1,177,769	16,724	43,394	329,060	1,327,758	11,737	4,629,640
Lowland Systems									
AP	Acid Peatland	1,084	334,364	6,960	92	28,942	124,611	367	496,419
FP	Forested Peatland	419,452	426,762	5,931	15,545	78,070	240,208	2,886	1,188,855
WF	Wet Forest	43,656	140,774	1,674	944	29,027	185,005	757	401,837
WM	Wet Meadow	4,099	8,876	107	32	5,207	25,035	154	43,509
W	Water	351,467	42,452	461	1,387	33,674	164,781	282	594,505
	Subtotal	819,758	953,228	15,133	18,000	174,920	739,640	4,446	2,725,125
	Total	2,542,957	2,130,997	31,857	61,394	503,980	2,067,398	16,183	7,354,765

Source: George Host, Natural Resources Research Institute

Table 3.7. NPC class level area estimates by land ownership in the Northeast Landscape.

Code	NPC Class	Federal	State	County	Tribal	Industrial	Private	Other	Total
FDc23	Central Dry Pine Woodland	0	1	0	0	0	46	0	47
FDc34	Central Dry-Mesic Pine-Hardwood Forest	0	0	0	0	0	183	0	183
FDc24	Central Rich Dry Pine Woodland	1	71	10	19	29	655	20	805
MHc47	Central Wet-Mesic Hardwood Forest	0	98	0	0	4	507	0	609
FDn33	Northern Dry-Mesic Mixed Woodland	4,096	17,811	506	66	11,732	60,660	551	95,422
FDn12	Northern Dry-Sand Pine Woodland	0	388	0	0	79	2,980	0	3,447
MHn45	Northern Mesic Hardwood (Cedar) Forest	35,257	65,698	1,754	5,544	9,438	57,095	249	175,036
MDn35	Northern Mesic Hardwood Forest	17,062	55,344	1,663	2,495	10,244	141,535	439	228,781
FDn43	Northern Mesic Mixed Forest	807,827	768,800	8,385	32,828	231,158	727,637	7,863	2,584,498
FDn32	Northern Poor Dry-Mesic Mixed Woodland	852,478	143,043	985	143	32,399	95,356	1,670	1,126,074
MHn47	Northern Rich Mesic Hardwood Forest	0	0	0	0	0	2	0	2
MHn44	No. Wet-Mesic Boreal Hdwd-Conifer Forest	6,474	125,431	3,417	2,065	33,069	237,998	934	409,389
MHn46	Northern Wet-Mesic Hardwood Forest	5	1,084	3	235	907	3,102	10	5,347
	Upland Total	1,723,199	1,177,769	16,724	43,394	329,060	1,327,758	11,737	4,629,640
AP	Acid Peatland	1,084	334,364	6,960	92	28,942	124,611	367	496,419
FP	Forested Peatland	417,557	379,301	3,473	10,608	75,833	225,932	2,821	1,115,524
FPn63	Northern Cedar Swamp	0	2,477	2	65	360	2,617	0	5,522
FPn71	Northern Rich Spruce Swamp (Water Track)	1,740	20,427	466	642	1,282	10,475	66	35,096
FPn81	No Rich Tamarack Swamp (Water Track)	156	24,557	1,991	4,231	594	1,185	0	32,712
WFn64	Northern Very Wet Ash Swamp	0	4,112	72	184	1,787	2,564	0	8,720
WFn63	Northern Wet Cedar Forest	0	273		112	47	1	0	433
WF	Wet Forest	43,656	136,388	1,602	648	27,193	182,440	757	392,684
WM	Wet Meadow	4,099	8,876	107	32	5,207	25,035	154	43,509
Water	Water	351,467	42,452	461	1,387	33,674	164,781	282	594,505
	Lowland Total	819,758	953,228	15,134	18,001	174,919	739,640	4,446	2,725,125
	Grand Total	2,542,957	2,130,997	31,858	61,395	503,979	2,067,398	16,182	7,354,765

Source: George Host, Natural Resources Research Institute

Note: More information on NPC Classes can be found in the 'Field Guide to the Native Plant Communities of Minnesota' or at:

www.dnr.state.mn.us/npc/classification.html

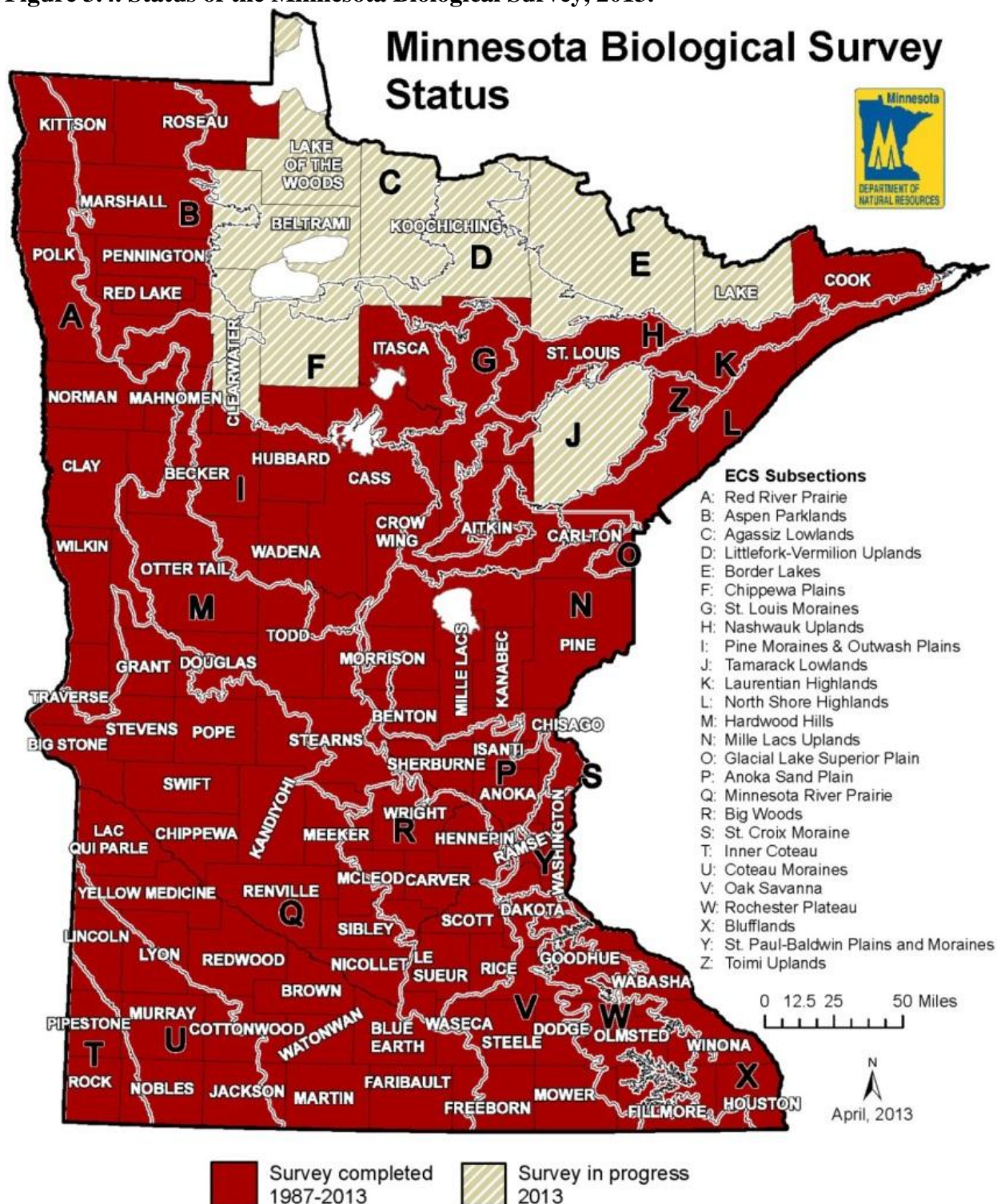
3.4. Minnesota County Biological Survey (MCBS)

The Minnesota Biological Survey (MBS) began in 1987 as a systematic survey of rare biological features. The goal of the MBS is to identify significant natural areas and to collect and interpret data on the distribution and ecology of rare plants, rare animals, and natural communities. To accomplish this goal the MBS uses a multi-level procedure, beginning with evaluation of existing inventory data and followed by an assessment of the quality and condition of selected areas using air photos, classified satellite imagery, and ground survey. This is supplemented by specialized field surveys of selected rare species or groups of species. Through this process the MBS systematically collects, interprets, and delivers baseline data on the distribution and ecology of rare plants, rare animals, native plant communities, and functional landscapes needed to guide decision making. To date MBS has completed survey work in 81 of Minnesota's 87 counties, with surveys underway in 6 other counties (Figure 3.4). The Tamarack Lowlands, Border Lakes, and Littlefork-Vermilion Uplands ECS units are currently being surveyed in Lake and St. Louis counties.

In the completed survey area, the MBS has added over 15,000 new records of rare plants and animals to the DNR's Natural Heritage Information System (NHIS), added over 8,800 vegetation plots to the Relevé Database, recorded 20 native plant species and 3 native amphibians not previously documented in Minnesota, conducted aquatic plant surveys in over 1,500 lakes, produced printed and digital maps of native plant communities and rare species for 38 counties, and digital maps for an additional 18 counties and 3 Ecological subsections.

In the completed portion of the Northeast Landscape the Biological Survey has identified 612,337 acres as areas of biological significance (Figure 3.5 and Table 3.8). These areas of biological significance are distributed between several Native Plant Community classes.

Figure 3.4. Status of the Minnesota Biological Survey, 2013.



Source: MN DNR Division of Ecological and Water Resources

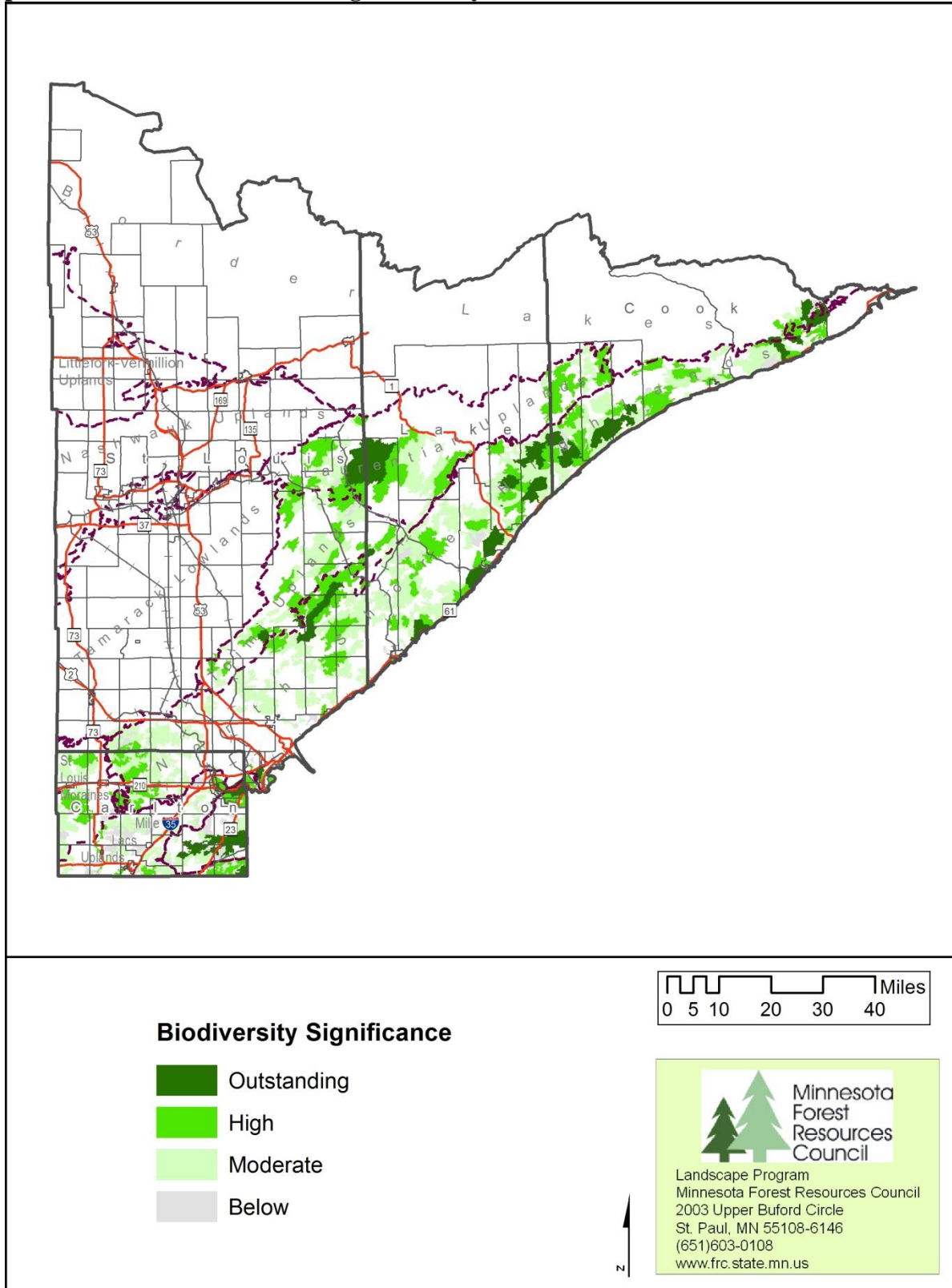
Table 3.8. Areas of biological significance in the Northeast Landscape by NPC class.

Native Plant Community Systems	Acres	% of NE Landscape	No. Polygons
Fire-Dependent Forest/Woodland	187,971	2.6	4,421
Mesic Hardwood Forest	136,119	1.8	2,754
Other	96,031	1.3	3,905
Acid Peatland	70,762	1	3,021
Forested Rich Peatland	69,097	0.9	3,806
Wet Forest	34,521	0.5	2,206
Wet Meadow/Carr	8,843	0.1	859
Open Rich Peatland	5,064	0.1	418
Floodplain Forest	1,278	0	125
Rock Outcrop	1,024	0	402
Cliff/Talus	545	0	366
Lake Shore	424	0	361
Marsh	357	0	54
River Shore	303	0	108
Total Native Plant Communities	612,339	8.3	22,806
Total Project Area	7,363,644	-	-

Source: MN DNR Data Deli

Note: The Biological Survey has not been completed for all of the Northeast Landscape (Figure 3.4); however the percentages listed represent the percent of the total area and not the completed area. Once the survey is complete these numbers are likely to increase.

Figure 3.5. Areas of biological significance in the Northeast Landscape from the completed portions of the Minnesota Biological Survey.



Source: Minnesota Biological Survey, MN DNR Data Deli

3.5. Comparison of pre-settlement vegetation to current vegetation

The Northeast Landscape was heavily forested prior to European settlement and continues to be today. A quantitative comparison of cover type change from presettlement to 2006 is provided in Section 1.3 using data from Francis J. Marschner's analysis of 19th century of Public Land Survey notes and the 2006 National Land Cover Database.

The Public Land Survey of Minnesota started in 1847 and by 1908 the entire state of Minnesota had been mapped. As an essential part of the survey process, surveyors notched or blazed bearing trees to facilitate the relocation of survey corners. They also noted the species, diameter, and distance and azimuth from the corner for each bearing tree. The Minnesota Department of Natural Resources Ecological Classification System Program analyzed bearing tree data and compared it to FIA 1990 plot-level data. Tree records were selected from the 1990 FIA plot data to reproduce as nearly as possible the procedure that the surveyors used to select bearing trees. For a more detailed description of the methodology used, see “Minnesota’s Bearing Tree Database” (<http://files.dnr.state.mn.us/eco/nhnrp/brgtree.pdf>).

Table 3.9 summarizes the results of the analysis for the Northeast Landscape. Values in the “Abundance - Bearing Tree” column show the percent of all bearing trees that were of a given species. For example, about 17% of the bearing trees were birch trees. The “Abundance – FIA” column shows corresponding values for selected FIA trees records. The fourth column shows the percentage point difference between the bearing tree values and the FIA values. Ash was four times more abundant among the selected FIA trees than among the bearing trees, while tamarack was seven times more abundant among the bearing trees than among the FIA trees.

The MN DNR Division of Forestry, Resource Assessment program has also done comparisons between pre-settlement (ca. 1846-1908) and modern (ca. 1990) NPC communities. Table 3.10 shows a significant decline old growth stage (>115 year) forests in the FDn43 forest community; a system which accounts for nearly 2.6 million acres in the Northeast Landscape. Table 3.11 shows changes in the relative abundance of different species in different growth stages between pre-settlement and modern forests. Aspen was a relatively abundant species in young forests prior to European settlement; however, its relative abundance has greatly increased in the mature and old forest classes. White pine and white spruce have greatly declined in relative abundance in FDn43 old growth forest communities. More information can be found at:

www.dnr.state.mn.us/forestry/ecs_silv/npcTables_Figures.html

More information on the comparison of pre-settlement and current vegetation can be found in the following resources:

- Friedman, S. K., and Reich, P.B. (2005). "Regional legacies of logging: departure from presettlement forest conditions in northeastern." *Ecological Applications* **15**: 726-744. (This essentially covers the Northeast Landscape and summarizes change for % density and basal area by subsection.)
- Schulte, L. A., D. J. Mladenoff, et al. (2007). "Homogenization of northern U.S. Great Lakes forests due to land use." *Landscape Ecology* **22**(7): 1089-1103. (This includes northern MN and shows changes in species composition as well as tree size.)

- White, M. A. and G. E. Host (2008). "Forest disturbance frequency and patch structure from pre-European settlement to present in the Mixed Forest Province of Minnesota, USA." Canadian Journal of Forest Research **38**(8): 2212-2226.

Table 3.9. Relative abundance of tree species estimated from Public Land Survey bearing tree database (late 1800s) and the 1990 FIA point data for the Northeast Landscape.

Tree species	Abundance - Bearing Tree	Abundance – 1990 FIA	Difference
Ash	1.0%	3.9%	2.9%
Aspen/Cottonwood	9.4%	26.2%	16.8%
Balm-of-Gilead	0.2%	3.0%	2.7%
Birch	16.9%	15.6%	-1.4%
Black Oak	0.0%	0.0%	0.0%
Cherry	0.0%	0.1%	0.0%
Elm	0.2%	0.3%	0.1%
Fir	10.5%	14.2%	3.7%
Ironwood	0.0%	0.0%	0.0%
Jack Pine	9.0%	3.2%	-5.8%
Linden or Basswood	0.3%	0.6%	0.3%
Maple	0.8%	2.8%	2.0%
Mountain Ash	0.0%	0.0%	0.0%
Red/Black Oak	0.1%	0.2%	0.2%
Red Pine or Yellow Pine	2.9%	2.4%	-0.5%
Spruce	19.8%	12.5%	-7.2%
Sugar Maple	0.8%	3.6%	2.9%
Tamarack	11.4%	1.7%	-9.8%
White Cedar	6.0%	7.1%	1.1%
Willow	0.1%	0.0%	-0.1%
White Pine	7.5%	1.8%	-5.7%
Yellow Birch	1.1%	0.7%	-0.4%

Source: DNR Division of Forestry, Resource Assessment.

Table 3.10. Balance of growth-stages in pre-settlement and modern FDn43 forests.

Growth Stage (Years)	Pre-settlement (ca. 1846-1908)	Modern (ca. 1990)
Young (0-35)	17%	20%
Transition (35 - 55)	30%	26%
Mature (55-95)	31%	48%
2nd Transition (95 - 115)	6%	3%
Old (> 115)	16%	2%

Source: DNR Division of Forestry, Resource Assessment.

<http://files.dnr.state.mn.us/forestry/ecssilviculture/plantcommunities/FDn43.pdf>

Note: Values based on 11,725 Public Land Survey corners and 10,785 FIA subplots modeled to represent the FDn43 community and estimated to fall within the young, mature, and old growth-stages.

Table 3.11. Relative abundance (%) of tree species in young, mature, and old growth-stages in pre-settlement and modern FDn43 forests.

Dominant Trees	Forest Growth Stages in Years					
	Young (0-35)		Mature (55-95)		Old (> 115)	
	Pre-settlement	Modern	Pre-settlement	Modern	Pre-settlement	Modern
Quaking Aspen	60%	76%	12%	52%	5%	23%
Jack Pine	19%	0%	3%	0%	3%	0%
Red Pine	3%	0%	9%	1%	5%	1%
Paper Birch	15%	5%	31%	20%	18%	18%
Balsam Fir	1%	7%	10%	13%	13%	25%
White Pine	2%	0%	24%	1%	28%	3%
White Spruce	–	1%	4%	2%	28%	2%
White Cedar	–	0%	3%	0%	2%	14%
Red Maple	–	3%	1%	4%	–	1%
Black Spruce	0%	0%	0%	1%	0%	6%
Balsam Poplar	–	4%	–	2%	–	2%
Miscellaneous	0%	4%	3%	4%	0%	5%

Source: DNR Division of Forestry, Resource Assessment.

<http://files.dnr.state.mn.us/forestry/ecssilviculture/plantcommunities/FDn43.pdf>

Note: Values based on 11,725 Public Land Survey corners and 10,785 FIA subplots modeled to represent the FDn43 community and estimated to fall within the young, mature, and old growth-stages.

Pre-settlement landscape (ca. 1846-1908) and Modern (ca. 1990)

3.6. Forests in a changing climate

Future forest management discussions need to consider climate change considerations in addition to the pre-settlement conditions. Forest managers and researchers from across the State of Minnesota and Great Lakes Region developed a climate change vulnerability assessment for the forest ecosystems of the Laurentian Mixed Forest Province in northern Minnesota (Handler et al. 2013). Contributors to the assessment included private forestry companies; academic institutions; and federal, state, and tribal agencies. This collaboration led to the development of the Forest Ecosystem Vulnerability Assessment and Synthesis (FEVAS) which pulls together information about the current condition of forests and land-use in northern Minnesota, observed and projected climate trends, ecosystem modeling results, and published scientific literature to describe the potential impacts of climate change. The assessment included a deliberate process to incorporate local knowledge and manager experience before reaching conclusions about the vulnerability of different forest systems. This assessment serves as an information baseline for managers to consider and refine based on local information. The particular climate change risks for a specific location will be influenced by variety of factors, including site conditions, forest health, and past management.

The FEVAS summarizes major drivers and stressors related to climate change (Table 3.12) and vulnerability determinations for all six forested Native Plant Community Systems, in addition to two key managed forest systems. Overall vulnerability determinations ranged from low-moderate (Floodplain Forests) to high (Wet Forests, Forested Rich Peatlands, and Acid Peatlands) (Table 3.13). These vulnerability determinations were made by a group of local forest managers and researchers, after considering the full array of information described above. For more complete information on climate change in Northeastern Minnesota, please refer to the full FEVAS document. This document should be available in the near future; refer to www.nrs.fs.fed.us/niacs/ for updates.

Table 3.12. Summary of current major drivers and stressors for each forest system analyzed in the Forest Ecosystem Vulnerability Assessment and Synthesis.

Community Type	Major Drivers	Major Stressors
Fire-Dependent Forest	Coarse-textured soils or shallow soils over bedrock, fire return intervals 20 to 150 yrs.	Fire suppression, insect pests and diseases, understory hazel competition, deer herbivory
Mesic Hardwood Forest	Mesic soils or deep impermeable layers, consistent moisture and nutrients, gap-phase disturbances with stand-replacing events every 400 to 2000 yrs.	Exotic earthworms, invasive plants, insect pests, diseases, freeze-thaw cycles, drought, deer herbivory
Floodplain Forest	Alluvial soils, annual or occasional floods, connectivity to river and water table	Changes to flood regime, buckthorn and reed canarygrass, drought, deer herbivory
Wet Forest	Wet-mesic soils, saturated in spring and dry in summer, periodic flooding	Changes to soil moisture regime, ongoing ash decline, invasive species, insect pests, drought
Forested Rich Peatland	Peat soils, saturated throughout growing season, moisture through precipitation and groundwater, pH greater than 5.5	Changes to water table, roads and beaver dams, insect pests and diseases, winterburn, drought, deer herbivory
Acid Peatland	Peat soils, saturated throughout growing season, moisture through only precipitation, pH less than 5.5, nutrient-poor environments	Changes to water table, roads and beaver dams, insect pests and diseases, winterburn, drought
Managed Aspen	Gradient of soil types and landforms, frequent disturbance, even-aged management on 35 to 60 yr. rotation	Forest tent caterpillar and gypsy moth, drought, deer herbivory, hypoxylon canker, exotic earthworms
Managed Red Pine	Sandy to mesic soils, limited by high summer temperatures, dependent on planting for regeneration, even-aged management on 60 to 120 yr. rotation	Armillaria, red pine shoot blight, understory hazel competition, deer herbivory, bark beetles, drought stress in dense stands

Source: Handler et al. 2013; Forest Ecosystem Vulnerability Assessment and Synthesis (FEVAS)

For more information on native plant communities: www.dnr.state.mn.us/npc/classification.html

Table 3.13. Vulnerability determination summaries for the forest systems analyzed in the Forest Ecosystem Vulnerability Assessment and Synthesis.

Forest System	Potential Impacts	Adaptive Capacity	Vulnerability	Evidence	Agreement
Fire-Dependent Forest	Negative	Moderate-High	Moderate	Medium	Medium
Mesic Hardwood Forest	Moderate	Moderate-High	Moderate	Medium	Medium
Floodplain Forest	Moderate-Positive	Moderate	Low-Moderate	Limited-Medium	Medium
Wet Forest	Negative	Low	High	Limited-Medium	Medium
Forested Rich Peatland	Negative	Low	High	Medium	Medium-High
Acid Peatland	Negative	Low	High	Medium	Medium-High
Managed Aspen	Moderate-Negative	Moderate	Moderate-High	Medium	High
Managed Red Pine	Moderate-Negative	Moderate-Low	Moderate-High	Medium	Medium

Source: Handler et al. 2013; Forest Ecosystem Vulnerability Assessment and Synthesis (FEVAS)

Note: More information on native plant communities can be found at: www.dnr.state.mn.us/npc/classification.html

3.7. Forest type groups

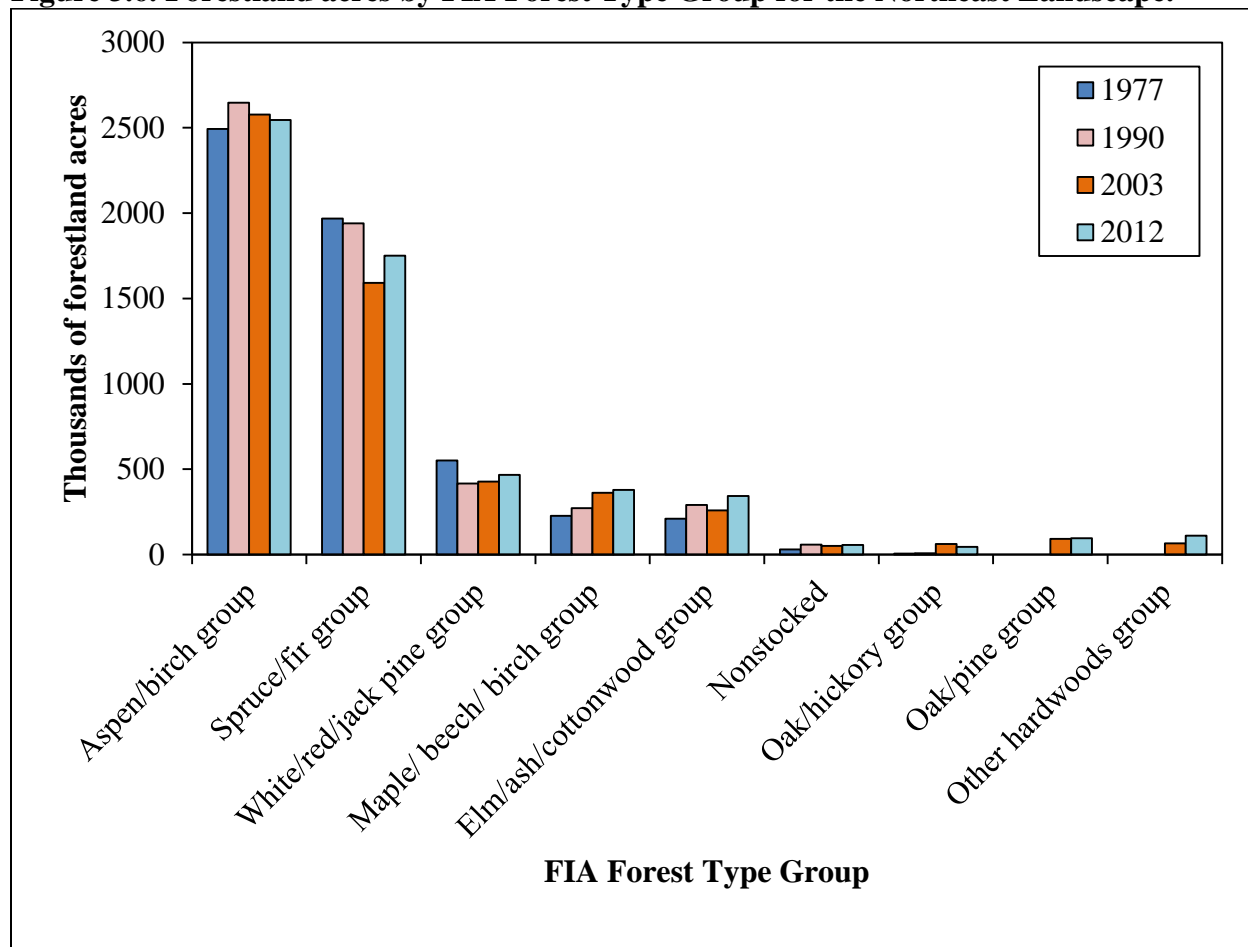
Forest Inventory and Analysis (FIA) is a periodic survey of the state's forestland coordinated by the US Forest Service. Survey procedures are designed to provide reliable estimates on the type, extent, growth, mortality, and removals of forestland. FIA was not conceived or designed to provide information on ecological potential, plant diversity, forest fragmentation, or any number of other variables that may be necessary to fully assess the diversity of our forests. FIA alone provides an incomplete picture of forest diversity.

FIA classifies forestlands into types based on the predominant tree species in a stand (Figure 3.6). Forest types exhibit broad ranges of species composition and structure. For example, the aspen forest type will include areas of pure aspen and also areas with multiple species such as aspen, birch and fir. Forest type groups are collections of one or more forest types. For example, the aspen-birch group includes aspen, birch, and balsam poplar forest types. Figure 3.6 shows the FIA estimated distribution of forest type groups in the Northeast Landscape in 1977, 1990, 2003, and 2012. The aspen-birch and spruce-fir forest type groups collectively account for more than 74% of total forestlands (44.0% and 30.2 % respectively) in 2012.

The Minnesota DNR classifies forestlands using the Cooperative Stand Assessment (Figure 3.7). This system is similar to FIA forest type grouping and combines stands in groups that are uniform enough in composition to be managed together. The grouping names assigned are general descriptive terms for the overall contents of stands and should not be confused with species designations, which refer to individual trees. This system has more categories than the FIA system. Figure 3.7 shows the FIA estimated distribution of forest type groups in the

Northeast Landscape in 1977, 1990, 2003, and 2012 using the Cooperative Stand Assessment forest typing system. Aspen was the dominant forest type in each of the sample years ranging from an estimated 32 to 35% of the total forestland acres. In 1977 balsam fir was the second largest area but this was bypassed by black spruce and birch in 1990, 2003, and 2012 sample years.

Figure 3.6. Forestland acres by FIA Forest Type Group for the Northeast Landscape.

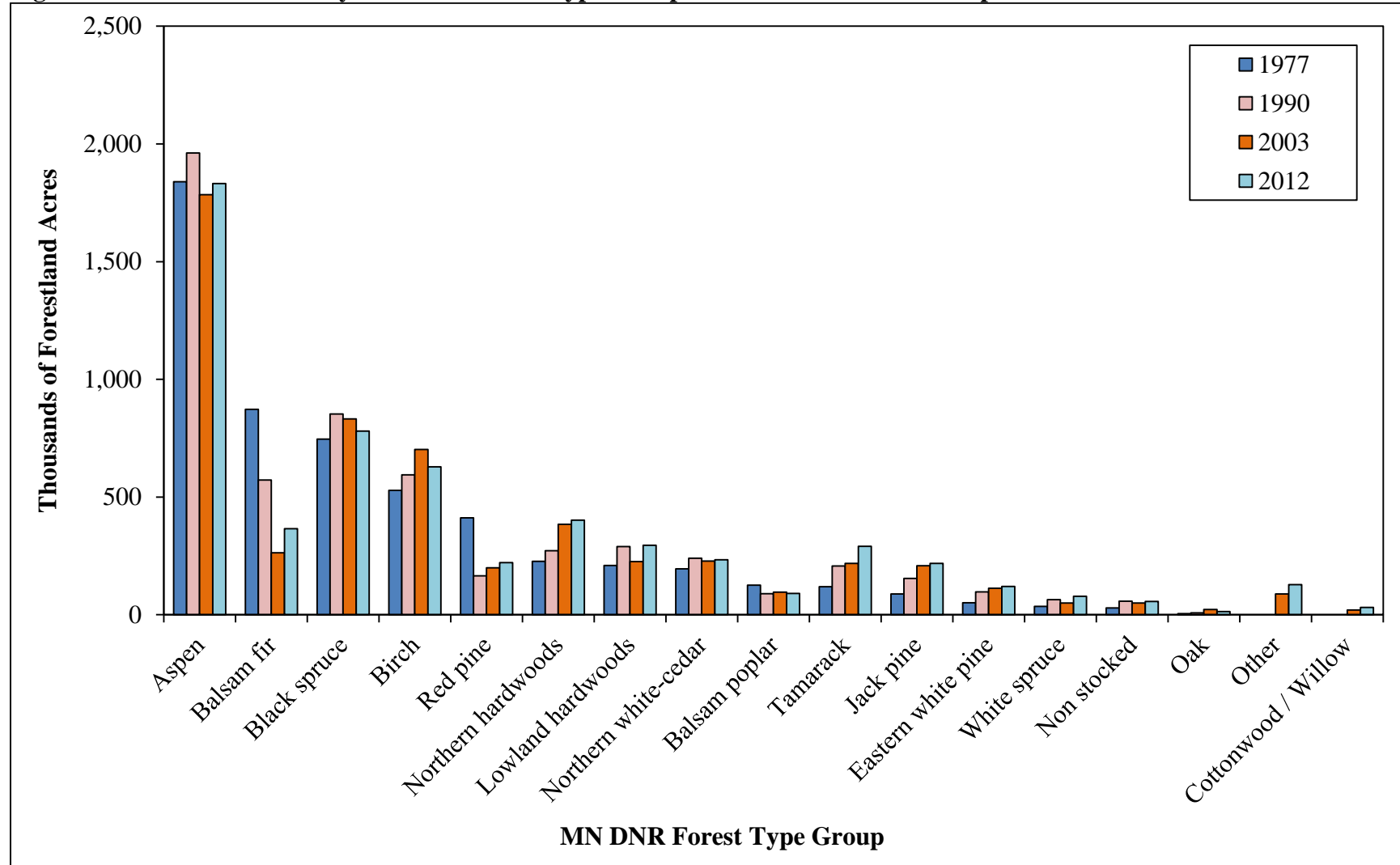


Source: Forest Inventory and Analysis estimate

Note: Oak/pine and Other Hardwoods group data not available for 1977 and 1990 records

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

Figure 3.7. Forestland acres by MN DNR Forest Type Group for the Northeast Landscape.



Source: Forest Inventory and Analysis estimate

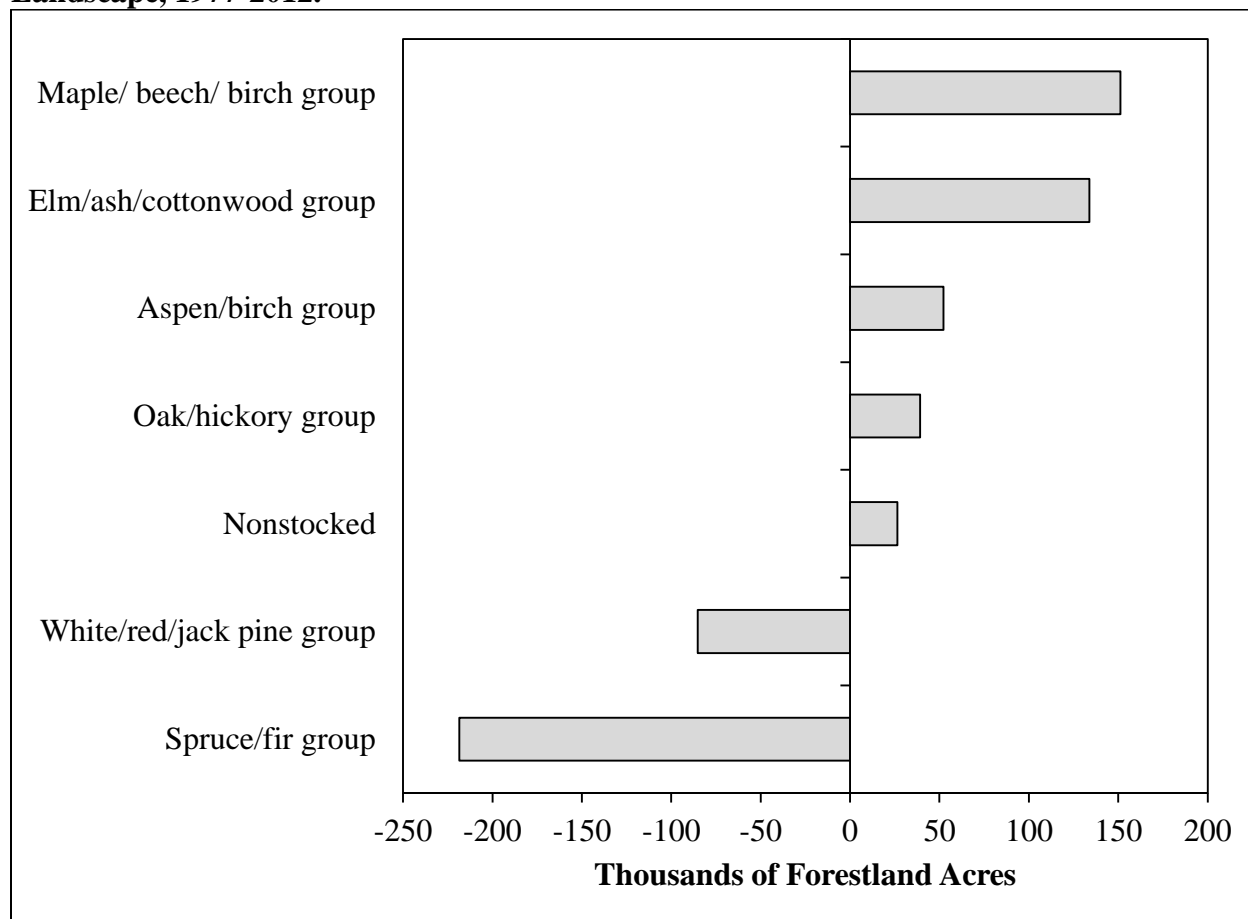
Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

3.8. Change in forest type group area

Between 1977 and 2012 FIA estimates of the spruce-fir and white-red-jack pine forest type group acreages declined (Figure 3.8). The spruce-fir type group estimate was reduced by 218,500 acres (11.1%) between 1977 and 2012. White-red-jack pine experienced a reduction of 15.5%, from 551,100 to 465,800 acres. Increases in forestland area were estimated for the maple-beech-birch, elm-ash-cottonwood, aspen-birch, oak-hickory, and non-stocked type groups.

Figure 3.9 shows change in estimated MN DNR forest type group acreage for the Northeast Landscape from 1977 to 2012. Balsam fir saw the largest decline of the MN DNR forest type groups, dropping from 872,300 to 366,100 acres (58.0% decline). Red pine also saw a significant decline from 411,300 to 221,300 acres (46.2% decline). The largest increases were estimated in the northern hardwoods (226,700 to 401,700 acres, 59.0% increase) and tamarack (119,200 to 290,900 acres, 43.6% increase).

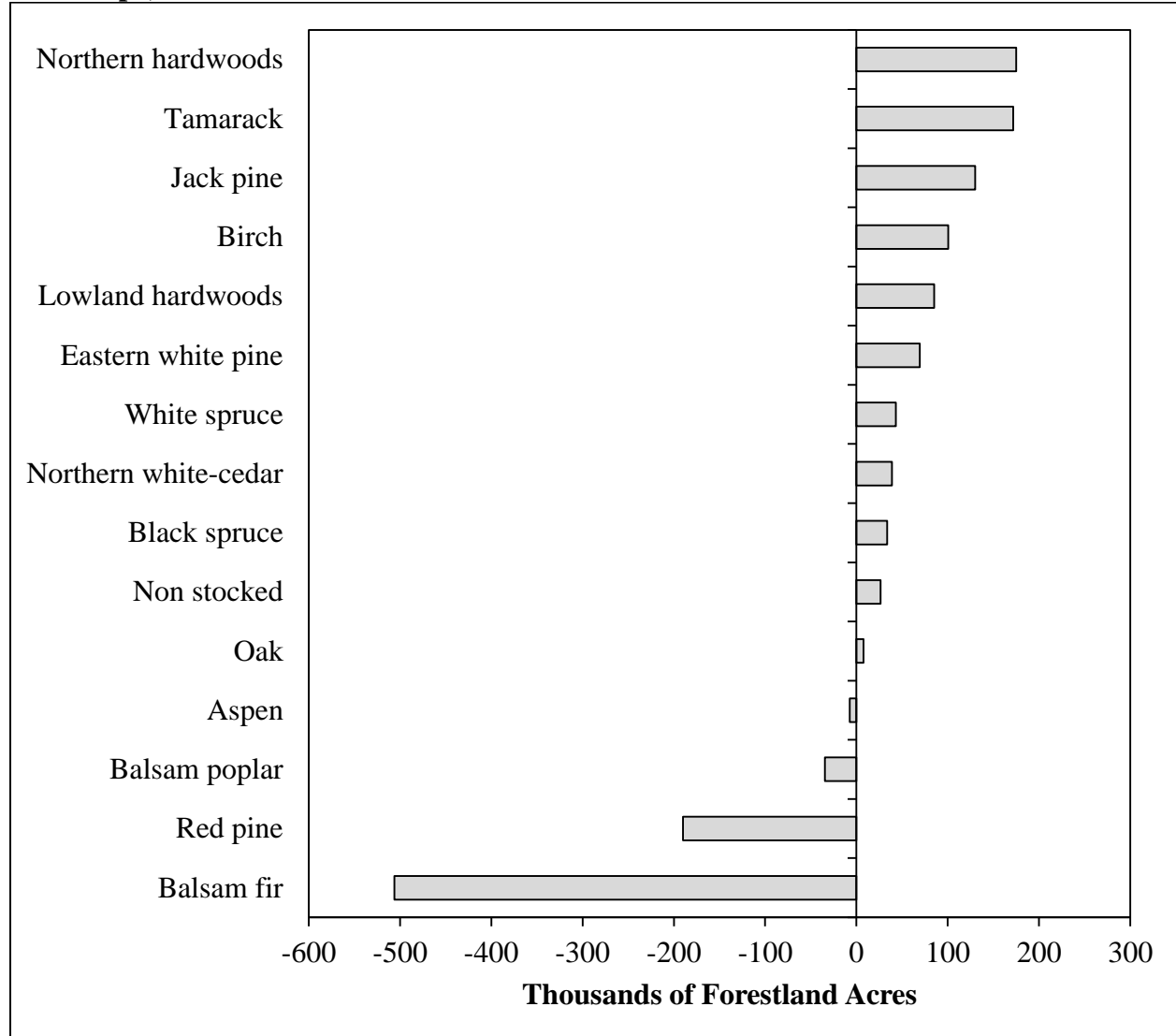
Figure 3.8. Estimated change in FIA Forest Type Group acreage for the Northeast Landscape, 1977-2012.



Source: Forest Inventory and Analysis estimate

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

Figure 3.9. Estimated change in MN DNR Forest Type Group acreage for the Northeast Landscape, 1977-2012.



Source: Forest Inventory and Analysis estimate

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

3.9. Age class structure of timberland

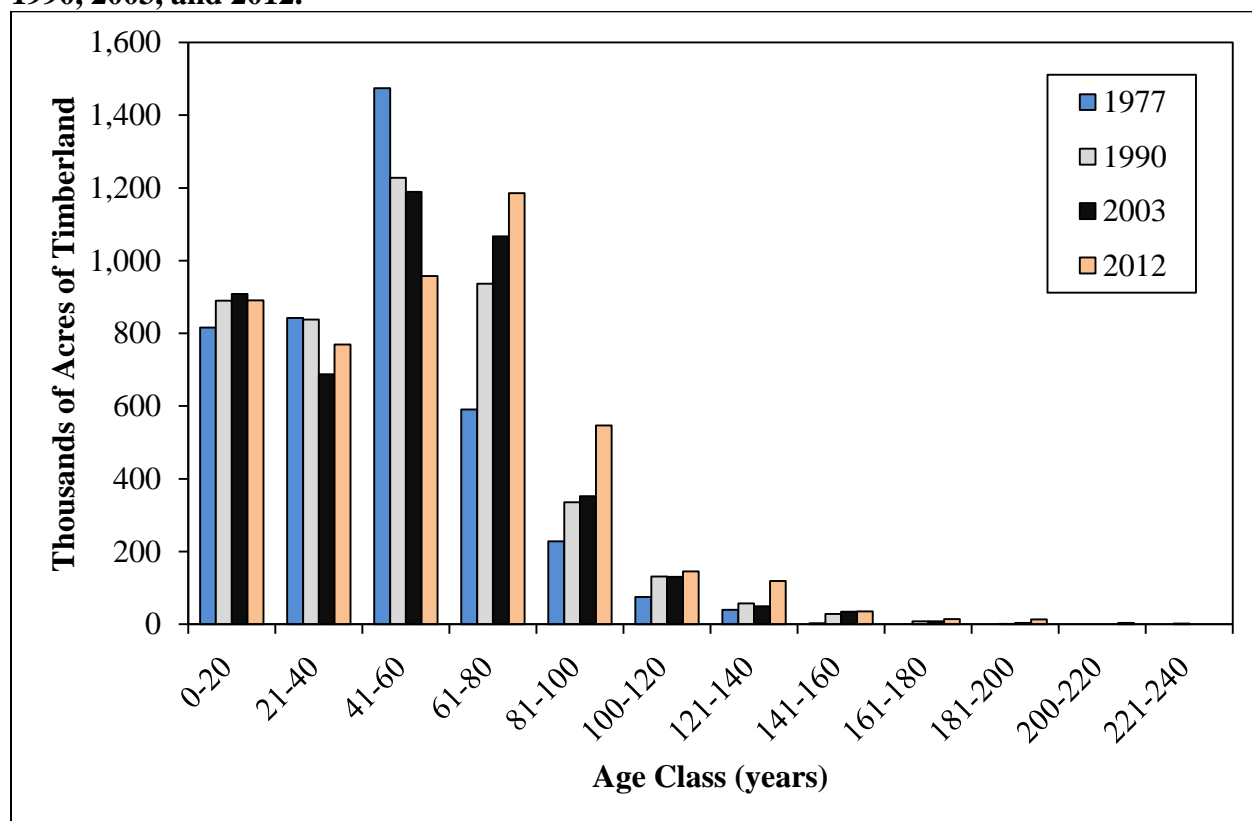
A balanced age class is one with equal amounts of acreage in each age class. Table 3.10 highlighted the changes in growth stage distribution between modern and pre-European settlement forests in NE Minnesota. Recent forest management practices have targeted this discrepancy in an effort to create a more diversified age class structure which can be desirable from both an economic and biological diversity perspective. Balanced age classes are in accordance with the forest management principles of sustained yield and even-flow. With a variety of stand ages comes a variety of stand compositions and structures, each providing habitat that may not be found in other age classes.

Figure 3.10 shows the FIA estimated age class structure of timberlands in the Northeast Landscape in 1977, 1990, 2003, and 2012 FIA datasets. The FIA estimated age class structure for 1977 shows an abundance of timberland in the 41 to 60 year age class (1.47 million acres; 36.2% of all timberland). The imbalance in estimated age classes in 1977 was somewhat reduced by 1990 (1.23 million acres; 27.6% of total) but this age class remained the most abundant until 2012 when 61 to 80 years became the most abundant size class. In 2012, 11.7% of the total forestland acres were 81 to 100 acres however the older age classes (101+ years) were not represented as well as younger age classes in any year (2.9, 5.1, 5.1, 7.1% respectively).

The FIA estimated amount of timberland in the 21 to 40 and 41 to 60 year age classes was reduced between 1977 and 2012 (Figure 3.11). Gains were observed in the younger (<20 years) and older (61+ years) age classes with the greatest increase (594,100 acres) occurring in the 61 to 80 year class. A similar pattern is seen with the aspen forest type acres declining in 41-60 year class and increasing in the 61-80 year age class (Figure 3.12).

Table 3.14 through Table 3.17 summarize FIA estimates of forest age structure data for 1977, 1990, 2003, and 2012. This analysis shows the highest total acreage (1,185,085 acres) in 2012 was in the 61-80 year age class but also shows variation between forest types (Table 3.15). For example the majority of white spruce stands are 80 years or less whereas eastern white cedar stands are spread relatively uniformly from zero to over 180 years.

Figure 3.10. Estimated age class structure of timberland in the Northeast Landscape, 1977, 1990, 2003, and 2012.



Source: Forest Inventory and Analysis estimate

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

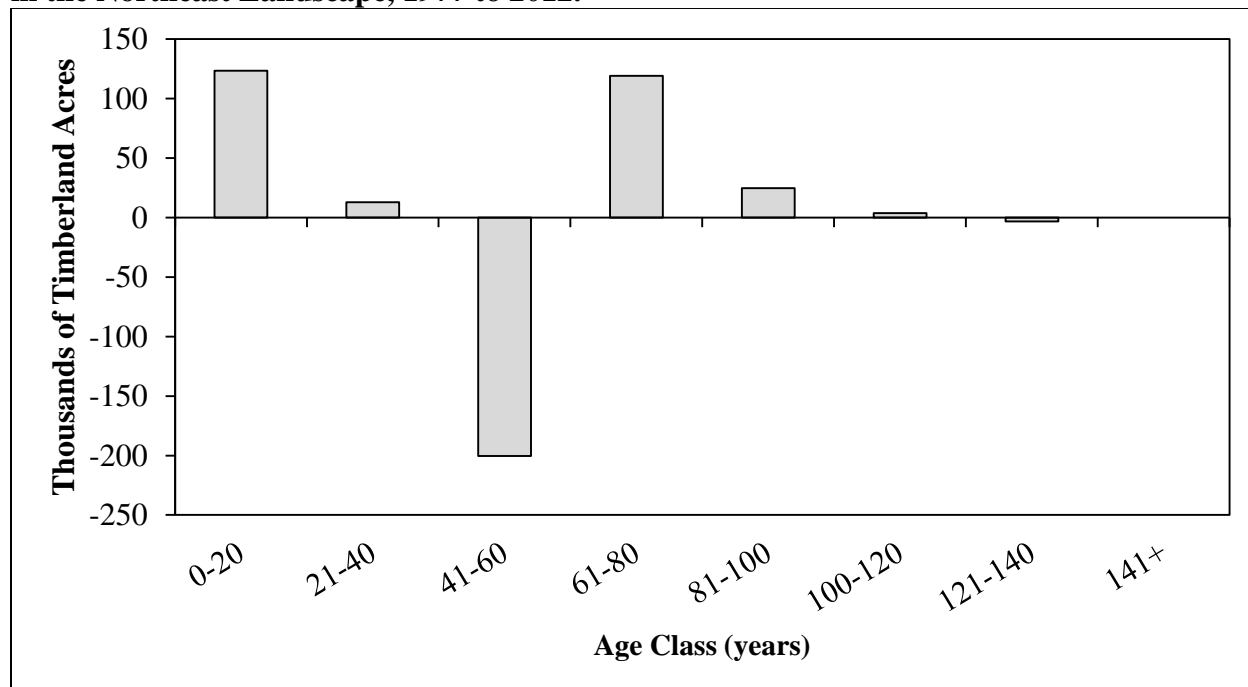
Figure 3.11. Estimated change in age class structure on timberland in the Northeast Landscape, 1977 to 2012.



Source: Forest Inventory and Analysis estimate

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

Figure 3.12. Estimated change in age class structure of the aspen forest type on timberland in the Northeast Landscape, 1977 to 2012.



Source: Forest Inventory and Analysis estimate

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

Table 3.14. Estimated age class structure of timberland in the Northeast Landscape (acres) by MN DNR Forest Type, 1977.

MnDNR Forest Type	Age Class										Total
	0-20	21-40	41-60	61-80	81-100	100-120	121-140	141-160	161-180	181+	
Aspen	387,379	367,762	535,745	168,035	45,299	1,400	5,999	-	-	-	1,511,619
Birch	77,160	80,797	246,576	98,967	21,402	1,400	-	-	-	-	526,302
Balsam fir	94,998	94,761	247,499	43,494	13,899	1,200	-	-	-	-	495,851
Black spruce	69,495	154,282	125,592	77,291	22,698	1,500	1,400	-	-	-	452,258
Northern hardwoods	33,121	21,997	68,750	61,597	27,063	6,799	4199	-	-	-	223,526
Lowland hardwoods	30,299	12,899	74,593	32,796	28,498	8,599	5,299	-	-	-	192,983
Northern white-cedar	8,032	13,399	28,897	39,399	21,797	40,294	21,297	2,500	-	-	175,615
Balsam poplar	48,060	20,197	46,194	5,599	5,599	-	-	-	-	-	125,649
Tamarack	17,999	33,796	24,498	9,299	2,600	1,200	1,101	-	-	-	90,493
Jack pine	24,003	10,499	34,199	12,500	4,500	2,700	-	-	-	-	88,401
Red pine	-	22,797	24,300	26,884	8,599	1,300	-	-	-	-	83,880
Eastern white pine	2,800	-	2,600	10,901	25,763	7,299	-	-	-	-	49,363
White spruce	10,699	7,899	11,698	4,199	-	1101	-	-	-	-	35,596
Oak	-	1200	2,700	-	-	-	-	-	-	-	3,900
Cottonwood / Willow	-	-	-	-	-	-	-	-	-	-	-
Non stocked	-	-	-	-	-	-	-	-	-	-	-
Other	11581	-	-	-	-	-	-	-	-	-	11,581
Total	815,626	842,285	1,473,841	590,961	227,717	74,792	39,295	2,500	-	-	4,067,017

Source: Forest Inventory and Analysis estimate

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

Table 3.15. Estimated age class structure of timberland in the Northeast Landscape (acres) by MN DNR Forest Type, 1990.

MnDNR Forest Type	Age Class										Total
	0-20	21-40	41-60	61-80	81-100	100-120	121-140	141-160	161-180	181+	
Aspen	448,544	314,470	463,916	315,175	50,401	8,900	1,100	-	-	1500	1,604,006
Black spruce	42,798	176,543	192,321	130,896	42,192	19,102	3,500	3,100	-	-	610,452
Balsam fir	90,603	108,876	140,490	79,213	26,603	7,000	1,000	-	-	-	453,785
Birch	35,399	43,898	154,905	159,011	24,700	5,401	3,900	-	-	-	427,214
Lowland hardwoods	52,717	35,490	42,499	50,001	46,504	18,502	6,900	4,800	-	1100	258,513
Northern hardwoods	38,899	29,200	66,599	49,099	39,499	10,211	6111	1900	-	-	241,518
Northern white-cedar	4,202	11,401	17,599	47,100	49,304	37,518	27,202	16,803	8,001	-	219,130
Tamarack	28,298	44,298	44,499	20,804	14,299	2,300	3,300	1,500	-	-	159,298
Jack pine	29,498	14,100	35,100	29,999	10,499	5,400	1,100	-	-	-	125,696
Red pine	28,398	24,999	22,103	22,501	13,000	4,500	1,200	-	-	-	116,701
Balsam poplar	24,600	14,800	29,508	14,200	5,100	1900	-	-	-	-	90,108
White spruce	12,300	18,006	15,600	9,111	5201	-	701	-	-	-	60,919
Eastern white pine	1,901	600	1,100	9,702	6,801	10,301	1,200	-	-	-	31,605
Oak	4700	-	1,700	-	1,600	-	-	-	-	-	8,000
Cottonwood / Willow	-	-	-	-	-	-	-	-	-	-	-
Non stocked	47,090	900	-	-	-	-	-	-	-	-	47,990
Other	-	-	-	-	-	-	-	-	-	-	-
Total	889,947	837,581	1,227,939	936,812	335,703	131,035	57,214	28,103	8,001	2,600	4,454,935

Source: Forest Inventory and Analysis estimate

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

Table 3.16. Estimated age class structure of timberland in the Northeast Landscape (acres) by MN DNR Forest Type, 2003.

MnDNR Forest Type	Age Class										Total
	0-20	21-40	41-60	61-80	81-100	100-120	121-140	141-160	161-180	181+	
Aspen	484,061	320,075	398,429	298,697	44,182	3,214	-	-	-	-	1,548,658
Black spruce	44,447	74,892	181,395	180,845	103,600	35,649	15,176	6,606	3,576	-	646,186
Birch	62,148	28,497	169,443	222,868	44,357	7,046	-	-	-	-	534,359
Northern hardwoods	57,122	41,550	91,441	131,374	25,762	2,506	804	3214	-	848	354,621
Balsam fir	53,107	46,758	72,419	23,084	14,829	-	3,214	-	997	-	214,408
Lowland hardwoods	15,928	16,001	50,773	66,114	19,736	11,372	10,889	-	-	-	190,813
Northern white-cedar	3,214	4,670	46,074	17,523	46,686	32,754	7,348	21,912	3,195	2,544	185,920
Tamarack	23,109	30,438	54,741	42,134	12,680	9,020	6,428	2,411	-	-	180,961
Red pine	33,240	46,509	40,658	13,847	16,786	4,821	235	-	-	-	156,096
Jack pine	22,230	36,558	13,014	24,576	9,288	4,100	-	-	-	-	109,766
Balsam poplar	27,088	10,370	28,428	15,742	3,214	-	-	-	-	-	84,842
Eastern white pine	3,998	3,484	3,392	15,557	3,263	19,727	3,392	-	-	-	52,813
White spruce	10,508	8,771	12,005	804	1,273	-	-	-	-	-	33,361
Cottonwood / Willow	13,224	-	1,707	1,788	-	-	-	-	-	-	16,719
Oak	410	3,576	10,567	-	-	-	-	-	-	-	14,553
Non stocked	34,883	-	-	-	-	-	-	-	-	-	34,883
Other	19,713	15,077	14,155	11,324	6,280	-	1696	-	-	-	68,245
Total	908,430	687,226	1,188,641	1,066,277	351,936	130,209	49,182	34,143	7,768	3,392	4,427,204

Source: Forest Inventory and Analysis estimate

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

Table 3.17. Estimated age class structure of timberland in the Northeast Landscape (acres) by MN DNR Forest Type, 2012.

MnDNR Forest Type	Age Class										Total
	0-20	21-40	41-60	61-80	81-100	100-120	121-140	141-160	161-180	181+	
Aspen	510,849	380,624	335,279	287,175	70,103	5,168	2,604	-	-	-	1,591,802
Black spruce	18,674	41,469	136,482	198,969	118,206	46,793	43,123	4,025	4,132	3,281	615,154
Birch	61,534	23,620	83,153	204,465	83,973	3,805	10,458	-	1,468	-	472,476
Northern hardwoods	55,700	35,333	64,566	144,868	51,935	7,202	-	-	-	3,304	362,908
Balsam fir	41,202	63,312	67,816	53,365	15,590	2,975	2,231	-	-	1,631	248,122
Lowland hardwoods	18,024	23,690	45,063	78,435	54,816	14,560	7,103	3,304	-	-	244,995
Tamarack	17,154	28,993	63,248	76,495	48,317	-	9,087	1,577	-	-	244,871
Northern white-cedar	2,018	7,038	14,661	41,870	41,526	31,258	26,190	26,603	8,465	8,769	208,398
Red pine	31,535	55,248	46,930	29,897	12,019	13,445	2,478	-	-	-	191,552
Jack pine	9,986	43,931	26,500	11,137	23,227	-	2,936	-	-	-	117,717
Balsam poplar	27,281	13,683	24,172	16,639	2,993	-	-	-	-	-	84,768
White spruce	10,109	31,117	18,946	7,929	-	-	-	-	-	-	68,101
Eastern white pine	9,522	5,501	4,879	10,188	4,778	14,196	12,333	-	-	-	61,397
Cottonwood / Willow	6,502	3,251	7,511	10,345	-	2,478	-	-	-	-	30,087
Oak	734	-	3,281	5,996	3,163	-	-	-	-	-	13,174
Non stocked	35,631	-	-	-	-	-	-	-	-	-	35,631
Other	34,650	12,485	14,792	7,312	15,650	3,163	-	-	-	-	88,052
Total	891,105	769,295	957,279	1,185,085	546,296	145,043	118,543	35,509	14,065	16,985	4,679,205

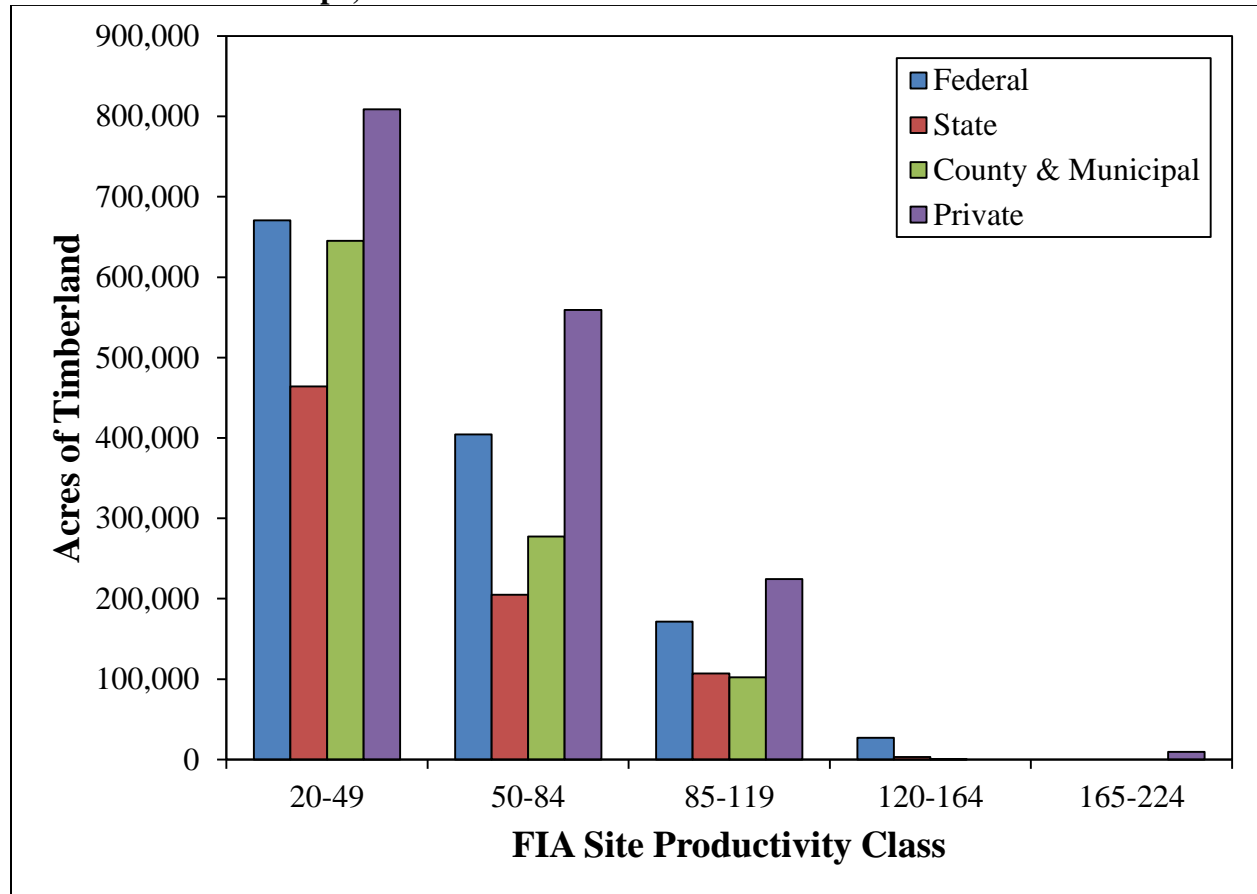
Source: Forest Inventory and Analysis estimate

Note: Area estimates are based on FIA samples and affected by stratification of the sample into categories and by non-sampled rates leading to some artificial variability in area estimates from survey to survey.

3.10. Productivity of the Northeast's timberland

The site productivity class in the Forest Inventory and Analysis (FIA) database is a classification of forest land in terms of inherent capacity to grow crops of industrial wood. This class identifies the potential growth in cubic feet/acre/year and is based on the culmination of mean annual increment of fully stocked natural stands. About 55% (2.59 million acres) of timberlands across the Northeast Landscape area are classed as low productivity (20-49 cubic feet per acre per year). Less than 1% of the timberland area in the landscape has estimated site productivity over 120 cubic feet per acre per year. The remainder is in the middle productivity classes of 50-119 cubic feet per acre per year. The estimated distribution of timberland by owner and site productivity class is displayed in Figure 3.13. Low productivity timberlands are the dominant productivity class for each landowner group.

Figure 3.13. Estimated distribution of timberland by owner and site productivity class for the Northeast Landscape, 2006.



Source: Forest Inventory and Analysis estimate.

Note: 'Private' includes forest industry, non-industrial private, and Native American lands due to data disclosure laws.

3.11. Timberland biomass

Forest biomass is an estimate of the total dry weight of live trees (at least 1 inch d.b.h.) on the landscape including bark but excluding foliage. Biomass has five components for most tree species (bole, tops and limbs, saplings, stump, and belowground).

- Bole - Biomass of a tree at least 5 inches d.b.h. from 1 foot above the ground to a 4-inch top outside bark or to a point where the central stem breaks into limbs.
- Tops and limbs - Total biomass of a tree at least 5 inches d.b.h. from a 1-foot stump minus the bole.
- Saplings - Total aboveground biomass of a tree from 1 to 5 inches in d.b.h.
- Stump - Biomass of a tree 5 inches d.b.h. and larger from the ground to a height of 1 foot.
- Belowground biomass - Biomass of coarse roots with a root diameter ≥ 0.1 inch. This is a modeled estimate, calculated on live trees with a diameter of ≥ 1 inch and dead trees with a diameter ≥ 5 inches.

The Northeast Landscape timberlands have an estimated total biomass of 135.6 million short tons (one short ton equals 2,000 lbs.) with aboveground biomass accounting for over 111 million short tons (Table 3.18). Twenty four percent of this aboveground biomass is aspen and 22% is spruce and balsam fir. These estimates do not include dead trees, foliage, or trees on non-timberlands but highlight the volume of chemical resources sequestered in the woody species of Northeastern Minnesota's forests.

Table 3.18. Estimated biomass in dry weight (short tons) of live trees on timberland in the Northeast Landscape, 2012.

Species Group	Merchantable bole	Tops and limbs	Saplings	Stumps	Total aboveground biomass	Belowground biomass	Total biomass
Eastern white and red pine	7,153,262	1,244,404	253,932	353,027	9,004,624	2,057,340	11,061,964
Jack pine	2,034,481	364,760	174,957	120,237	2,694,435	622,454	3,316,889
Spruce and balsam fir	13,268,884	2,482,710	7,615,574	896,593	24,263,761	5,794,408	30,058,169
Other softwoods	7,755,320	1,291,085	1,056,097	542,936	10,645,438	2,467,845	13,113,283
Maple	7,401,437	2,316,471	2,426,689	475,953	12,620,551	2,517,430	15,137,981
Ash	4,119,622	1,307,145	1,351,245	310,147	7,088,158	1,414,043	8,502,201
Aspen	14,937,038	4,629,775	6,697,475	780,597	27,044,885	5,407,882	32,452,767
Other hardwoods	10,829,244	3,307,516	2,478,304	654,791	17,269,857	3,415,378	20,685,235
Eastern noncommercial hardwoods	45,189	17,901	985,293	4,730	1,053,113	246,520	1,299,633
Total	67,544,477	16,961,767	23,039,566	4,139,011	111,684,822	23,943,300	135,628,122

Source: Forest Inventory and Analysis estimate

3.12. Forestland carbon stock

Interest in terrestrial carbon sequestration has increased in an effort to explore opportunities for climate change mitigation. Carbon sequestration is the process by which atmospheric carbon dioxide is taken up by trees, grasses, and other plants through photosynthesis and stored as carbon in biomass (trunks, branches, foliage, and roots) and soils. The sink of carbon sequestration in forests and wood products helps to offset sources of carbon dioxide to the atmosphere, such as deforestation, forest fires, and fossil fuel emissions.

Sustainable forestry practices can increase the ability of forests to sequester atmospheric carbon while enhancing other ecosystem services, such as improved soil and water quality. Planting new trees and improving forest health through thinning and prescribed burning are some of the ways to increase forest carbon in the long run. Harvesting and regenerating forests can also result in net carbon sequestration in wood products and new forest growth.

In response to government, business, and individual commitments to reduce carbon dioxide emissions, carbon is now a priced environmental commodity in the global marketplace. The United States carbon market is in its formative stages. States and regions are developing climate change strategies and policy for reducing carbon dioxide emissions, and mandatory markets are forming at the regional and state levels. The Voluntary Reporting of Greenhouse Gases Program, established by Section 1605(b) of the Energy Policy Act of 1992, provides a means for organizations and individuals - including forest landowners and other land managers - to record their baseline emissions and emission reductions. More information on carbon sequestration can be found at: www.fs.fed.us/ecosystemservices/carbon.shtml

The Forest Inventory Analysis estimates forests of the Northeast Landscape currently sequester 652 million short tons of carbon (Table 3.19). Seventy five percent of this carbon is sequestered in the organic soil (defined as the fine organic material below the soil surface to a depth of 1 meter). Nearly 53% of the non-organic soil carbon storage is in live trees at least 1 inch d.b.h..

Table 3.19. Estimated carbon storage in Northeast Landscape forestland, 2012 (Values are millions of short tons).

	Carlton	Cook	Lake	St. Louis	Northeast Landscape
Aboveground in live trees*	4.9	11.7	15.7	35.0	67.4
Belowground in live trees*	1.0	2.5	3.4	7.6	14.5
Above and belowground standing-dead trees*	0.7	1.7	2.4	5.3	10.1
Above and belowground live seedlings, shrubs, and bushes	0.3	0.8	1.1	2.8	5.0
Stumps, coarse roots, and coarse woody debris	0.8	2.1	2.7	6.2	11.7
Litter	2.2	6.9	11.3	25.4	45.8
Organic soil	26.0	71.0	106.2	258.3	461.5
Total carbon	36.0	96.7	142.7	340.6	615.9

Source: Forest Inventory and Analysis estimate

* At least 1 inch d.b.h./d.r.c

3.13. Annual growth, mortality, and removals of growing stock on timberland

Forest Inventory and Analysis Definitions:

- Growing stock. All live trees of commercial species that meet minimum merchantability standards (at least 5 inches d.b.h.). In general, these trees have at least one solid 8-foot section, are reasonably free from defect on the merchantable bole, and at least 34% or more of the volume is merchantable. Excludes rough or rotten cull trees.
- Net cubic-foot volume. For timber species, this is the net volume of wood in the central stem of a sample tree ≥ 5.0 inches in diameter, from a 1-foot stump to a minimum 4-inch top diameter, or to where the central stem breaks into limbs all of which are <4.0 inches in diameter.
- Average annual net growth. The average annual change in the volume of trees during the period between inventories. Components include the change in volume of trees that have met the minimum size requirements over the inventory period, plus the volume of trees reaching the minimum size (≥ 5.0 inches dbh) during the period (ingrowth), minus the volume of trees that died during the period, minus the volume of cull during the period. Mortality removals (trees killed in the harvesting process and left on site) and diversion removals (trees removed from the forest-land base due to a change from forest to non-forest land) are not included.
- Average annual removals of growing stock. Trees that were growing-stock trees on timberland at the time of the previous inventory and were removed from timberland by the time of the current inventory. Removals are cut and utilized trees, trees killed as a result of harvest operations but not utilized and live trees associated with land-use reclassifications.
- Average annual mortality of growing stock. Volume of growing stock trees that were alive at the time of the previous inventory and are dead in the current inventory. Tree death associated with insects, disease, fire, animals, weather, and other factors are included.
- Sampling error percent. Equals 100 multiplied by the square root of the variance divided by the sample estimate. Since sampling error is given in percent of the estimate, a large sampling error indicates that there is considerable uncertainty associated with the estimate.

There were 4.08 billion cubic feet (31.9 million cords) of growing stock on timberland in the Northeast Landscape in the 2012 FIA survey dataset (Table 3.20). Average annual net growth in this dataset was 86.5 million cubic feet (2.1% of total growing stock volume). Red pine and white spruce had the highest net growth rates (as % of total growing stock volume) for species with more than 100 million cubic feet of total growing stock volume.

Table 3.21 shows net volume, average annual net growth, average annual net removals, and average annual net mortality of growing stock on timberland for the Northeast Landscape for the 2003 FIA dataset. Comparison between these estimates shows a decrease in net volume and annual net mortality and an increase in annual net growth and annual net removals from 2003 to 2012. Annual net mortality of quaking aspen has increased by nearly 4 million cubic feet from 2003 to 2012.

Average annual removals were 69.5 million cubic feet (1.7% of total growing stock volume). Annual removal rates (as % of total growing stock volume) for species with more than 100 million cubic feet of total growing stock volume were highest for quaking aspen and jack pine (2.7 and 2.6% annual removal of volume, respectively). Average annual removal estimates were highest on forestlands managed by counties in the Northeast Landscape (Table 3.22).

Mortality strongly influences the region's forests. On average, 2% of all growing stock (82.6 million cubic feet) died each year in the Northeast Landscape. Annual mortality rates (% of total growing stock volume) were highest for balsam fir, paper birch, and quaking aspen. Annual net mortality of quaking aspen increased by nearly 4 million cubic feet from 2003 to 2012. Overall mortality increased from 1.0% of total volume in 1977 to 2.0% in 2012 (Table 3.23) with higher rates in quaking aspen and paper birch. Estimated paper birch mortality increased 12 fold from 1977 to 2012 and estimated mortality in quaking aspen increased by 70% over this period. Data collection methods changed significantly over this period. We do not know how much those changes may have influenced the estimates.

Mortality rates are strongly related to age class structure. The forest overall is older than it was in the 1990s. As expected mortality rates are higher in older age classes than in younger age classes of aspen (Table 3.24). Mortality rates were lower in private timberlands than public lands (Table 3.25).

More recent trends can be detected by comparing FIA data from 2005 to 2012. The volume of trees that died increased between 2005 and 2012 for aspen, paper birch, and other hardwoods, decreased for spruce and balsam fir, and did not change for pine, maple, white cedar, and tamarack (Figure 3.14).

Table 3.20. Estimated current net volume, average annual net growth, average annual net removals, and average annual net mortality of growing stock on timberland for the Northeast Landscape, 2012.

Species	Growing stock										
	Net Volume		Average annual net growth			Average annual removals			Average annual mortality		
	Cubic feet	Sampling error percent	Cubic feet	Sampling error percent	Percent of volume	Cubic feet	Sampling error percent	Percent of volume	Cubic feet	Sampling error percent	Percent of volume
Quaking aspen	917,073,085	5.0	18,119,718	15.2	2.0	24,367,550	16.2	2.7	31,312,620	7.5	3.4
Black spruce	452,067,341	7.2	10,667,137	10.8	2.4	5,855,153	26.0	1.3	5,771,029	10.4	1.3
Paper birch	395,232,637	6.2	-2,754,205	-49.0	-0.7	9,085,529	22.4	2.3	14,146,833	9.6	3.6
Balsam fir	341,489,243	4.8	11,123,498	11.6	3.3	6,076,961	20.6	1.8	13,336,791	7.9	3.9
Red pine	332,876,919	13.5	13,482,124	14.3	4.1	3,168,952	42.9	1.0	387,538	58.2	0.1
Northern white-cedar	331,303,666	10.5	6,570,743	15.9	2.0	469,499	52.9	0.1	979,712	36.5	0.3
White spruce	207,282,173	9.6	8,423,609	11.6	4.1	2,136,976	33.2	1.0	1,362,787	23.1	0.7
Black ash	201,566,784	9.4	2,555,995	48.6	1.3	1,507,521	33.9	0.7	3,204,481	31.3	1.6
Eastern white pine	169,597,341	13.5	4,616,285	21.5	2.7	3,865,773	78.4	2.3	1,292,057	41.5	0.8
Tamarack	153,750,423	11.6	5,638,427	12.2	3.7	815,252	45.0	0.5	908,233	29.7	0.6
Sugar maple	141,738,681	14.7	2,029,593	28.4	1.4	3,156,444	55.2	2.2	926,955	28.9	0.7
Jack pine	133,768,084	11.9	4,650,389	19.8	3.5	3,498,428	35.0	2.6	1,215,542	26.7	0.9
Red maple	102,058,175	8.2	3,163,007	16.6	3.1	2,439,121	29.9	2.4	1,491,326	20.2	1.5
Balsam poplar	68,573,871	13.1	-1,132,010	-94.4	-1.7	1,273,796	41.1	1.9	4,174,394	24.1	6.1
American basswood	43,843,901	20.4	613,363	32.6	1.4	677,904	85.7	1.5	230,583	48.4	0.5
Big-tooth aspen	26,708,292	19.0	1,086,784	50.6	4.1	579,834	85.7	2.2	673,797	32.4	2.5
Yellow birch	22,093,481	24.8	508,145	151.2	2.3	123,719	77.8	0.6	507,562	52.4	2.3
Northern red oak	13,742,487	33.9	280,597	46.4	2.0	--	--	--	118,093	76.4	0.9

Table 3.20 continued.

Species	Growing stock										
	Net Volume		Average annual net growth			Average annual removals			Average annual mortality		
	Cubic feet	Sampling error percent	Cubic feet	Sampling error percent	Percent of volume	Cubic feet	Sampling error percent	Percent of volume	Cubic feet	Sampling error percent	Percent of volume
Green ash	9,714,453	26.6	436,797	41.4	4.5	44,644	97.3	0.5	55,546	82.1	0.6
Bur oak	8,208,525	39.2	148,825	67.3	1.8	--	--	--	19,681	104.0	0.2
American elm	3,723,856	29.6	332,049	32.2	8.9	--	--	--	--	--	--
Scotch pine	1,399,710	70.0	176,494	85.2	12.6	--	--	--	--	--	--
Silver maple	1,163,132	84.4	-315,100	-125.4	-27.1	--	--	--	424,851	98.3	36.5
Boxelder	893,072	73.1	66,670	70.4	7.5	--	--	--	18,563	98.7	2.1
Northern pin oak	34,939	103.9	7,218	104.0	20.7	--	--	--	--	--	--
Black cherry	34,556	101.7	-14,048	-158.4	-40.7	--	--	--	22,793	104.0	66.0
Black locust	--	--	-7,577	-96.9	--	--	--	--	--	--	--
Black willow	--	--	--	--	--	--	--	--	--	--	--
Other	--	--	-4,016,337	-17.2	--	366,207	60.1	-	--	--	--
Total	4,079,938,828	2.6	86,458,190	6.3	2.1	69,509,260	11.8	1.7	82,581,769	4.6	2.0

Source: Forest Inventory and Analysis estimates.

Sampling error percent equals 100 multiplied by the square root of the variance divided by the sample estimate.

Table 3.21. Estimated net volume, average annual net growth, average annual net removals, and average annual net mortality of growing stock on timberland for the Northeast Landscape, 2003.

Species	Growing stock										
	Net Volume		Average annual net growth			Average annual removals			Average annual mortality		
	Cubic feet	Sampling error percent	Cubic feet	Sampling error percent	Percent of volume	Cubic feet	Sampling error percent	Percent of volume	Cubic feet	Sampling error percent	Percent of volume
Quaking aspen	1,076,305,524	4.9	20,004,433	16.7	1.9	29,717,777	13.2	2.8	27,455,314	8.6	2.6
Paper birch	552,457,450	5.9	-149,660	1177.1	0.0	8,054,737	18.1	1.5	17,084,078	9.3	3.1
Black spruce	417,774,982	7.2	7,222,649	21.7	1.7	3,732,954	29.9	0.9	8,630,858	13.9	2.1
Northern white-cedar	333,703,715	10.6	5,013,916	24.0	1.5	2,065,279	54.7	0.6	2,353,887	38.1	0.7
Balsam fir	320,612,511	5.2	-1,745,366	107.0	-0.5	6,008,780	19.0	1.9	21,993,998	9.2	6.9
Red pine	210,446,402	15.9	8,130,402	25.0	3.9	1,678,605	33.4	0.8	442,728	49.3	0.2
Black ash	187,826,945	10.2	4,136,117	17.4	2.2	676,648	60.0	0.4	1,280,700	28.2	0.7
Sugar maple	173,952,832	13.8	3,287,728	33.1	1.9	360,550	59.8	0.2	742,631	41.0	0.4
White spruce	159,285,356	10.7	1,928,848	46.1	1.2	2,360,315	34.3	1.5	3,333,562	19.5	2.1
Eastern white pine	143,834,194	15.2	2,502,369	25.0	1.7	1,253,967	39.0	0.9	1,455,011	42.7	1.0
Red maple	130,290,578	8.3	6,457,362	17.3	5.0	1,294,602	26.3	1.0	1,993,503	22.2	1.5
Jack pine	124,257,871	12.7	2,953,320	30.5	2.4	2,575,029	45.1	2.1	1,835,825	24.2	1.5
Tamarack	120,013,597	12.9	3,818,018	19.2	3.2	529,008	44.9	0.4	591,261	40.3	0.5
Balsam poplar	89,072,179	15.8	-1,208,133	79.1	-1.4	2,431,748	36.8	2.7	4,428,758	22.4	5.0
American basswood	40,396,120	23.1	442,768	52.0	1.1	105,941	99.8	0.3	227,929	76.5	0.6
Big-tooth aspen	35,501,665	31.5	733,709	77.5	2.1	1,295,217	45.7	3.6	1,201,473	40.5	3.4
Yellow birch	33,410,832	20.9	355,088	91.0	1.1	--	--	--	246,986	52.9	0.7
Northern red oak	15,462,994	32.1	218,367	50.1	1.4	153,683	101.3	1.0	--	--	--

Table 3.21 continued.

Species	Growing stock										
	Net Volume		Average annual net growth			Average annual removals			Average annual mortality		
	Cubic feet	Sampling error percent	Cubic feet	Sampling error percent	Percent of volume	Cubic feet	Sampling error percent	Percent of volume	Cubic feet	Sampling error percent	Percent of volume
Bur oak	13,338,293	35.6	365,642	47.1	2.7	51,587	114.9	0.4	45,140	114.9	0.3
Green ash	10,442,369	27.9	-9,666	526.7	-0.1	--	--	--	54,206	99.8	0.5
American elm	1,235,484	35.8	-63,869	106.8	-5.2	--	--	--	89,780	79.5	7.3
Boxelder	1,114,140	64.0	-26,996	100.5	-2.4	--	--	--	30,940	100.5	2.8
Silver maple	723,389	99.1	--	--	--	--	--	--	--	--	--
Eastern cottonwood	487,699	99.6	--	--	--	--	--	--	--	--	--
Black willow	444,014	101.2	--	--	--	--	--	--	--	--	--
Black cherry	98,201	101.0	--	--	--	--	--	--	--	--	--
Slippery elm	86,449	99.1	--	--	--	--	--	--	--	--	--
Eastern redcedar	77,029	101.0	--	--	--	--	--	--	--	--	--
Siberian elm	64,467	101.0	--	--	--	--	--	--	--	--	--
Totals:	4,192,717,283	2.5	64,367,047	9.6	1.5	64,346,427	9.9	1.5	95,518,569	5.1	2.3

Source: Forest Inventory and Analysis estimates.

Sampling error percent equals 100 multiplied by the square root of the variance divided by the sample estimate.

Table 3.22. Annual growing stock removal estimate as a percent of timberland volume by ownership in the Northeast Landscape, 2012.

	Federal			State		
	Volume (ft ³)	Removal (ft ³)	% of Volume	Volume (ft ³)	Removal (ft ³)	% of Volume
Quaking aspen	266,266,210	2,313,872	0.9%	117,614,767	4,572,425	3.9%
Black spruce	174,855,268	1,516,966	0.9%	88,325,129	742,136	0.8%
Paper birch	152,677,053	1,594,236	1.0%	40,706,171	1,658,257	4.1%
Red pine	143,599,870	1,591,835	1.1%	81,673,560	1,004,076	1.2%
Balsam fir	97,939,320	638,969	0.7%	39,165,619	543,042	1.4%
White spruce	97,422,039	459,270	0.5%	17,570,695	255,763	1.5%
Jack pine	85,337,264	2,791,732	3.3%	14,490,622	429,993	3.0%
Northern white-cedar	84,346,564	153,421	0.2%	73,927,532	122,181	0.2%
Eastern white pine	59,727,073	3,809,316	6.4%	29,104,283	-	-
Sugar maple	46,776,464	19,163	0.0%	15,134,342	246,389	1.6%
Red maple	24,115,416	125,896	0.5%	9,450,167	259,760	2.7%
Tamarack	23,547,945	0	0.0%	40,834,831	42,933	0.1%
Black ash	20,663,607	250,510	1.2%	24,586,285	153,660	0.6%
Balsam poplar	11,248,723	29,993	0.3%	10,192,934	667,954	6.6%
Big-tooth aspen	10,247,463	0	0.0%	2,573,709	499,254	19.4%
Total	1,308,655,566	15,661,384	1.2%	617,732,767	11,247,610	1.8%
	County and Municipal			Private		
Quaking aspen	173,414,156	7,694,347	4.4%	359,777,951	9,786,906	2.7%
Black spruce	84,496,644	1,371,551	1.6%	104,390,301	2,224,500	2.1%
Paper birch	79,083,944	2,688,067	3.4%	122,765,469	3,144,969	2.6%
Red pine	33,006,599	-	-	74,596,889	573,041	0.8%
Balsam fir	63,463,315	2,347,714	3.7%	140,920,988	2,547,237	1.8%
White spruce	31,812,013	515,740	1.6%	60,477,425	906,203	1.5%
Jack pine	6,563,686	134,525	2.0%	27,376,512	142,178	0.5%
Northern white-cedar	78,910,457	142,086	0.2%	94,119,112	51,811	0.1%
Eastern white pine	32,714,644	-	-	48,051,341	56,457	0.1%
Sugar maple	40,410,380	347,594	0.9%	39,417,495	2,543,298	6.5%
Red maple	25,846,013	1,384,977	5.4%	42,646,579	668,488	1.6%
Tamarack	40,843,439	236,267	0.6%	48,524,208	536,053	1.1%
Black ash	60,770,027	446,648	0.7%	95,546,865	656,703	0.7%
Balsam poplar	20,242,816	126,983	0.6%	26,889,399	448,866	1.7%
Big-tooth aspen	6,856,728	80,580	1.2%	7,030,392	-	-
Total	802,603,428	18,106,376	2.3%	1,350,947,067	24,493,891	1.8%

Source: Forest Inventory and Analysis.

Note: Total removal was estimated at 1.7% of Northeast Landscape timberland volume.

Table 3.23. Estimated annual growing stock mortality as a percent of timberland volume in the Northeast Landscape, 1977, 1990, 2003, & 2012.

Tree species	1977*	1990*	2003	2012
Quaking aspen	2.0%	1.5%	2.6%	3.4%
Paper birch	0.3%	1.2%	3.1%	3.6%
Maple	0.4%	0.5%	0.9%	1.2%
Other Hardwoods	1.3%	1.6%	1.8%	2.2%
Red pine	0.0%	0.0%	0.2%	0.1%
Eastern white pine	0.2%	0.3%	1.0%	0.8%
Jack pine	0.8%	2.2%	1.5%	0.9%
White spruce	0.5%	0.7%	2.1%	0.7%
Black spruce	0.6%	1.8%	2.1%	1.3%
Tamarack	2.4%	0.7%	0.5%	0.6%
Balsam fir	0.8%	3.5%	6.9%	3.9%
Northern white-cedar	0.3%	0.3%	0.7%	0.3%
Total	1.0%	1.5%	2.3%	2.0%

Source: Forest Inventory and Analysis.

Note: Data collection procedures and plot design have changed over the course of the Forest Inventory Analysis program history which may lead to issues comparing between years. FIA data collected in 1977 and 1990 (*) were collected as a periodic survey while 2003 and 2012 are part of the annual survey (5 year running average). Comparisons between similarly collected survey data are stronger than between the two methods.

Table 3.24. Estimated annual growing stock mortality estimate of quaking aspen (*Populus tremuloides*) as a ratio of volume (ft³) on timberland in the Northeast Landscape, 2012.

Stand age class	Mortality Estimate	Volume Estimate	Ratio estimate (Mortality/Volume)	Sampling error	Variance
0-20 years	800,547	33,202,096	0.024	111.15	0.00072
21-40 years	3,941,733	192,240,663	0.021	51.95	0.00011
41-60 years	8,511,470	298,786,267	0.029	31.87	0.00008
61-80 years	13,267,998	312,996,312	0.042	30.11	0.00016
81-100 years	3,423,117	62,370,953	0.055	66.41	0.00133
100+ years	665,659	9,603,622	0.069	112.73	0.00611
Total	30,610,525	909,199,913	0.034	17.48	0.00003

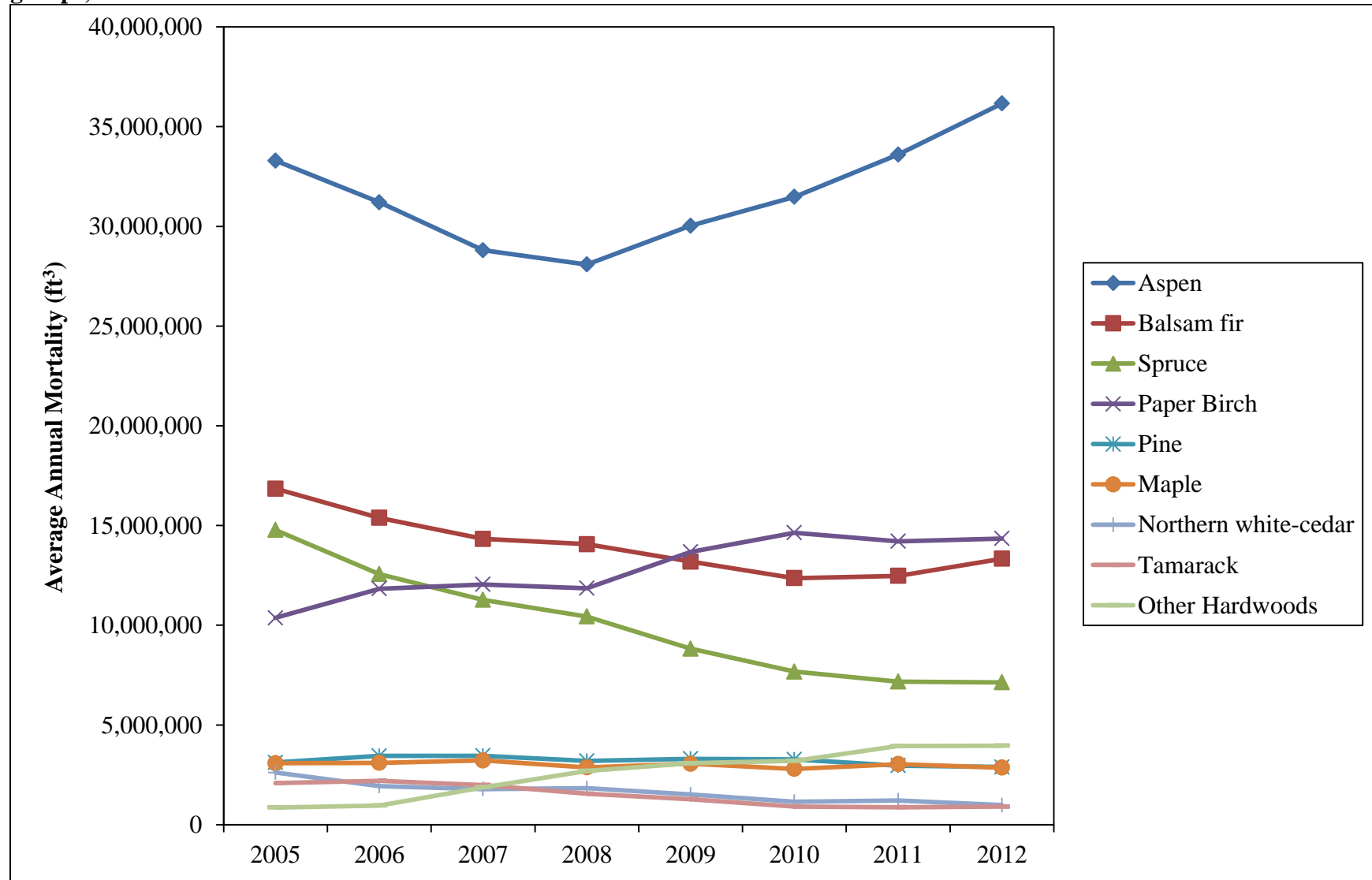
Source: Forest Inventory and Analysis.

Table 3.25. Annual growing stock mortality estimate as a percent of timberland volume by ownership in the Northeast Landscape, 2012.

	Federal			State		
	Volume (ft ³)	Mortality (ft ³)	% of Volume	Volume (ft ³)	Mortality (ft ³)	% of Volume
Quaking aspen	266,266,210	9,258,668	3.5%	117,614,767	3,821,619	3.2%
Black spruce	174,855,268	2,525,224	1.4%	88,325,129	944,420	1.1%
Paper birch	152,677,053	5,432,261	3.6%	40,706,171	870,451	2.1%
Red pine	143,599,870	28,153	0.0%	81,673,560	200,388	0.2%
Balsam fir	97,939,320	3,514,335	3.6%	39,165,619	1,287,704	3.3%
White spruce	97,422,039	583,578	0.6%	17,570,695	103,073	0.6%
Jack pine	85,337,264	727,798	0.9%	14,490,622	165,986	1.1%
Northern white-cedar	84,346,564	561,759	0.7%	73,927,532	173,524	0.2%
Eastern white pine	59,727,073	337,653	0.6%	29,104,283	349,078	1.2%
Sugar maple	46,776,464	217,560	0.5%	15,134,342	60,335	0.4%
Red maple	24,115,416	200,904	0.8%	9,450,167	179,573	1.9%
Tamarack	23,547,945	437,910	1.9%	40,834,831	157,816	0.4%
Black ash	20,663,607	270,030	1.3%	24,586,285	85,205	0.3%
Balsam poplar	11,248,723	1,643,364	14.6%	10,192,934	826,286	8.1%
Big-tooth aspen	10,247,463	209,918	2.0%	2,573,709	19,334	0.8%
Total	1,308,655,566	25,958,390	2.0%	617,732,767	9,622,340	1.6%
	County and Municipal			Private		
Quaking aspen	173,414,156	6,549,162	3.8%	359,777,951	11,683,171	3.2%
Black spruce	84,496,644	1,061,203	1.3%	104,390,301	1,240,182	1.2%
Paper birch	79,083,944	2,679,196	3.4%	122,765,469	5,164,924	4.2%
Red pine	33,006,599	-	-	74,596,889	158,997	0.2%
Balsam fir	63,463,315	2,918,403	4.6%	140,920,988	5,616,349	4.0%
White spruce	31,812,013	119,793	0.4%	60,477,425	556,342	0.9%
Jack pine	6,563,686	80,928	1.2%	27,376,512	240,829	0.9%
Northern white-cedar	78,910,457	62,462	0.1%	94,119,112	181,966	0.2%
Eastern white pine	32,714,644	58,093	0.2%	48,051,341	547,234	1.1%
Sugar maple	40,410,380	370,046	0.9%	39,417,495	279,015	0.7%
Red maple	25,846,013	421,914	1.6%	42,646,579	688,936	1.6%
Tamarack	40,843,439	259,168	0.6%	48,524,208	53,339	0.1%
Black ash	60,770,027	804,162	1.3%	95,546,865	2,045,085	2.1%
Balsam poplar	20,242,816	707,863	3.5%	26,889,399	996,880	3.7%
Big-tooth aspen	6,856,728	288,970	4.2%	7,030,392	155,575	2.2%
Total	802,603,428	16,952,292	2.1%	1,350,947,067	30,048,747	2.2%

Source: Forest Inventory and Analysis.

Figure 3.14. Estimated annual growing stock mortality volume (ft³) of timberland in the Northeast Landscape by species groups, 2005 to 2012.



Source: Forest Inventory Analysis

3.14. Silvicultural and harvesting practices

In 2008 Anthony W. D’Amato, Nicholas W. Bolton, Charles R. Blinn, and Alan R. Ek of the University of Minnesota Department of Forest Resources published a Technical Report looking at silvicultural practices in the state of Minnesota titled: “*Current Status and Long-term Trends of Silvicultural Practices in Minnesota: A 2008 Assessment*” The following text and tables are summarized from this document. The full report can be found at:

http://iic.umn.edu/prod/groups/cfans/@pub/@cfans/@forestry/documents/asset/cfans_asset_184742.pdf

This study characterized the status of silvicultural practices within Minnesota in 2008 and used results from past surveys (1991 and 1996) to describe general trends in Silviculture across ownerships and over time. A questionnaire regarding silvicultural practices applied in fiscal year 2008 was administered to all state, county, federal, industry, and Native American ownerships. Non-industrial private landowners were not surveyed. The data presented are for the entire state. Surveys included questions on silvicultural and harvesting practices such as regeneration practices used, extent and type of biofuels harvesting, use of site-level guidelines, and approaches to insect and disease issues. In addition, open-ended responses were collected on questions relating to general constraints most affecting the implementation of silvicultural practices.

Twenty-six respondents completed the survey with the respondent pool including 2 state, 2 federal, 14 county, 3 industrial, and 5 Native American ownerships. In addition, one non-governmental organization involved with forest management also completed the survey. Collectively, the respondent pool ownerships covered 64% of the timberland in the state (9,865,694 out of 15,414,200 acres) and accounted for 67% of the estimated 2008 statewide harvest (1.97 million out of 2.92 million cords). The respondent harvest levels were similar to those reported during the 1996 survey; however, the statewide harvest levels were less than in 1996 (3.81 million cords). In addition, the harvest volume removed per acre of timberland in 2008 (0.20 cords) was lower than the harvest volumes in 1996 (0.25 cords).

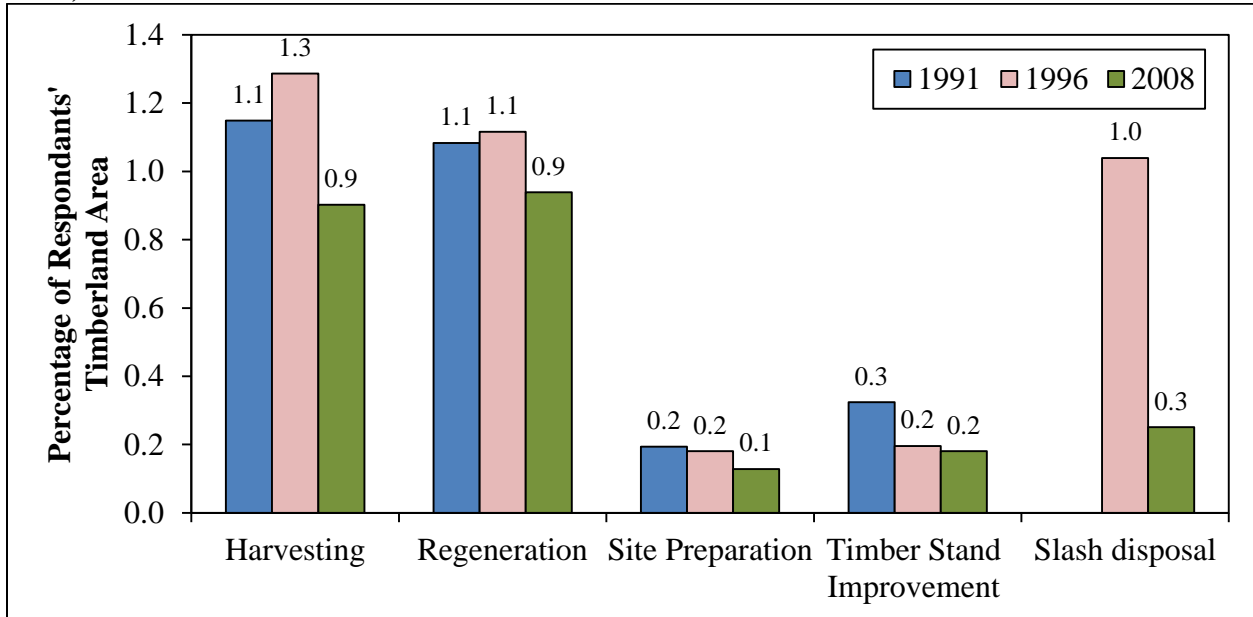
Silvicultural practices are the ways in which forests are managed. The total amount of timberland on which silvicultural practices are carried out is small (Figure 3.15). For example, in 1996, less than 1.3% of the respondents’ timberland area was harvested. Timberstand improvement and site preparation both decreased from 1996 to 2008.

Managers used clearcutting more than any other silvicultural system in 1991, 1996, and 2008 (Figure 3.16), however, the data suggest managers planned less clearcutting between each sampling interval. Patch clearcut, selection, seed tree, shelterwood cutting, and thinning were each used more in 2008 than in 1991 or 1996. Strip clearcutting was less common in 2008 than 1996.

Managers use natural regeneration more often than artificial regeneration (Figure 3.17). This fact is not unexpected, since aspen and many other Minnesota forest species regenerate well on their own. Use of natural regeneration increased between 1991 and 1996 from 75.8% to 80.7% of total regenerated area, while use of artificial regeneration declined correspondingly from 24.2% to 19.3%. This trend was reversed in 2008 when natural regeneration dropped to 60.9% and

artificial regeneration acres nearly doubled to 39.1%. Most natural regeneration was of vegetative origin (sprouts or root suckers), whereas artificial regeneration was primarily conifer species that were containerized planting stock.

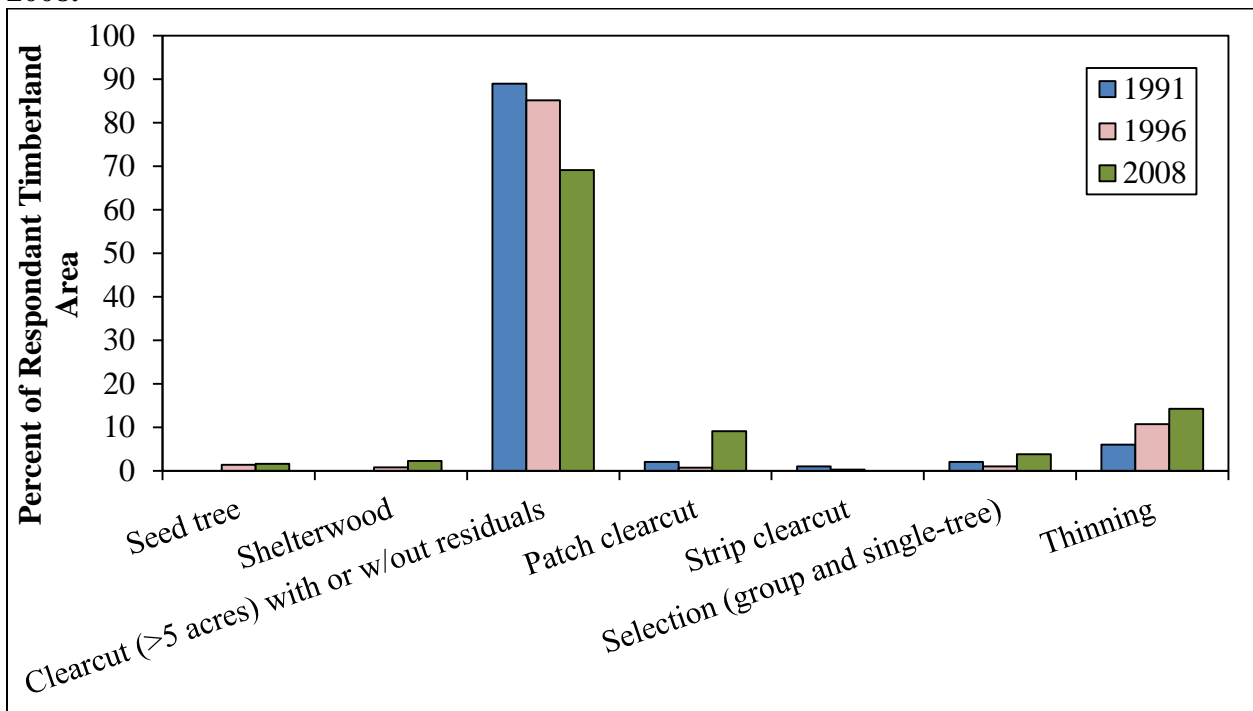
Figure 3.15. Type and extent of silvicultural practices on Minnesota’s timberland, 1991, 1996, and 2008.



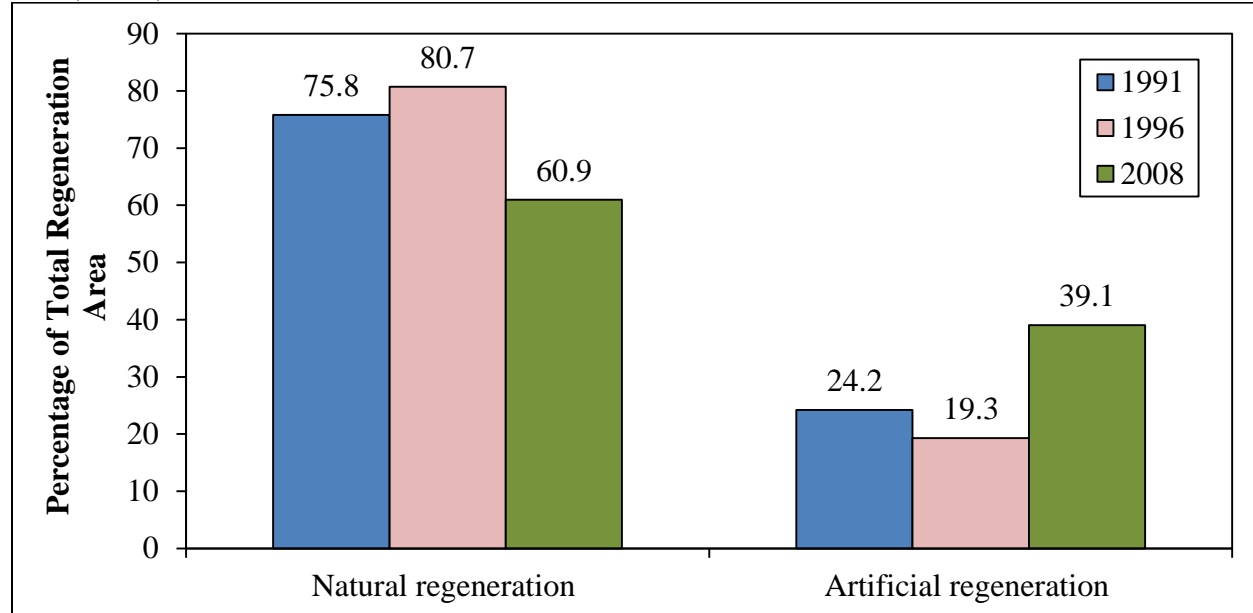
Source: D'Amato et al., 2009

Note: Slash disposal was not a category for the 1991 survey.

Figure 3.16. Extent of silvicultural systems on Minnesota’s timberland, 1991, 1996, and 2008.



Source: D'Amato et al., 2009

Figure 3.17. Type and relative extent of regeneration activities on Minnesota’s timberland, 1991, 1996, and 2008.

Source: D'Amato et al., 2009

3.15. Northeast vascular plants

The Minnesota DNR maintains a list of vascular plant species that reflect vouchered specimens present in herbarium collections at the University of Minnesota Herbarium, a division of the Bell Museum of Natural History on the St. Paul campus, and select plant families (Cyperaceae, Orchidaceae, and ferns) from the Olga Lakela Herbarium at University of Minnesota Duluth. This database provides the species full scientific name, including family, genus, species, and variety or subspecies (when applicable). Other attributes available include: whether the species is introduced to Minnesota; current status according to Minnesota's Endangered Species Statute and associated Rules; physiognomy; and the counties and subcounties where it has been documented. For further information on this data set visit: www.dnr.state.mn.us/eco/mcbs/plant_lists.html

According to this dataset total vascular plant species richness in Minnesota is 2,250 with 1,273 documented in the Northeast Landscape (Table 3.26). Eighty five percent of these 1,273 species are native to the region and 80 of the species are found only in the Northeast Landscape; 19 of which are found only in Cook County.

Table 3.26. Vascular plant species richness in the Northeast Landscape

	Carlton	Cook	Lake	St. Louis	Northeast Landscape	Minnesota
Native	660	763	835	986	1,079	1,874
Introduced	66	102	113	178	191	362
Unknown	2	2	3	3	3	14
Species	728	867	951	1,167	1,273	2,250
Endemic	1	19	1	5	80	--

Note: The number of species with recorded occurrences in a given landscape reflect herbarium records and not necessarily the richness of the landscape. Regions like the NE with significant amounts of remote areas may not be as well represented as those landscapes with easier access.

3.16. Northeast forest associated vertebrate species

The Northeast Landscape provides habitat for many of the state's amphibians, reptiles, birds, and mammals. Comprehensive data on the range of individual species is hard to develop. The best available data on species richness in the state of Minnesota was compiled in 2003 by the MN DNR Wildlife Resource Assessment Program from various species distribution sources following consultation with species group experts. The data was collected as part of Minnesota's contribution to the national GAP data system and has more validity than most single sources due to the variety of sources it considered as well as the use of expert panel reviewers at the time. Species distributions are based on the state's ECS subsections and report 31 of the state's 50 amphibian and reptile and 63 of the 78 mammal species occur in ECS subsections completely or partial within the Northeast Landscape (Table 3.27).

Birds are the most taxonomically rich vertebrate group in the region and can often be used as indicator species on the health of forested systems and associated ecological functions. The DNR's 2003 GAP data indicates 264 of 315 bird species occur in ECS subsections completely or partial within the Northeast Landscape. This data reports all species observed in a region, including species moving through on migration. Ensuring healthy forests for migrating birds is important but perhaps more pertinent is data relating to species which breed in Minnesota. The Minnesota Breeding Bird Atlas (MNBBA) is a five year project (2009 through 2013), that uses volunteers and project partners to report evidence of breeding bird behavior to develop: 1) a list of species that currently breed in the state; and 2) where in the state each species breeds. This study found nearly 75% (177/237) of the state's breeding birds and nearly 85% (127/150) of the state's forest associated breeding birds occur in the four-county Northeast Landscape. Additionally, 127 of the region's 177 breeding bird species (72%) are forest associated species. Breeding bird estimates include species that had either confirmed or probable breeding evidence during the 5 year MNBBA (more information at www.mnbba.org).

Since 1995, the Natural Resources Research Institute at the University of Minnesota Duluth has monitored the populations of forest-breeding birds in the Superior National Forest. In general, this study found population trends appear stable or increasing with 6 species showing significant declines, 22 species showing significant increases, and 35 species showing stable trends over the 1995-2013 period. This study selected forest stands in a stratified-random manner based on dominant tree species and suggest the positive results correlate to changes in forest age-class structure and sivilcultural practices observed over the last 35 years. Study results indicate older forests, especially those with diverse structural elements, support a broad range of species including species that normally use early-successional forests. Aspen forests provide an excellent example of how this structural diversity develops; stands >60 years old have 2-3 times higher natural mortality than those that are 41-60 years old, thus providing a variety of habitat elements from snags that increase nest-cavities to tree-fall gaps that endorse the shrubby growth utilized by many species. Still, several species including the Connecticut Warbler, Swainson's Thrush, and Yellow-bellied Flycatcher have shown consistent declines in the Superior NF. These species breed in lowland conifer forests and hypotheses for their declines generally do not identify management practices. Further information can be found in:

Zlonis, E.J., G.J. Niemi, A. Grinde, J. Bednar. 2013. Summary of breeding bird trends in the Chippewa and Superior National Forests of Minnesota – 1995-2013. NRRI technical report NRRI/TR-2012/39, University of Minnesota Duluth.

Table 3.27. Richness of amphibians, reptiles, birds, and mammals in Northeastern Minnesota, 2003.

MN DNR Subsection	Amphibian	Reptile	Bird	Mammal
Mille Lacs Uplands	15	14	196	53
Glacial Lake Superior Plain	11	6	200	50
St. Louis Moraine	12	4	200	50
Tamarack Lowlands	12	5	201	49
North Shore Highlands	13	7	225	58
Toimi Uplands	12	5	176	42
Laurentian Uplands	12	4	177	41
Nashwauk Uplands	12	4	176	40
Littlefork-Vermillion Uplands	12	4	180	39
Border Lakes	12	4	165	39
Total Northeast Subsections	16	15	264	63
Minnesota	21	29	315	78

Source: 2003 National GAP Analysis Program – from MN DNR Wildlife Resource Assessment Program.

3.17. Species at risk

Minnesota law requires the Department of Natural Resources to maintain a list of species that are at risk of disappearing from the state. Listed species are placed into one of three categories: endangered, threatened and special concern. The list is based on scientific field studies, such as those conducted by the Minnesota Biological Survey. The state's List of Endangered, Threatened and Special Concern Species was first established in 1984, updated in 1996, and updated again in 2013 (Table 3.28). Additional information on species at risk and the process of developing the list can be found at: www.dnr.state.mn.us/ets/index.html

Minnesota designates species as:

- Endangered, if the species is threatened with extinction throughout all or a significant portion of its range
- Threatened, if the species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range
- Species of Special Concern, if although the species is not endangered or threatened, it is extremely uncommon in this state, or has unique or highly specific habitat requirements and deserves careful monitoring of its status. Species on the periphery of their range that are not listed as threatened may be included in this category along with those species that were once threatened or endangered but now have increasing or protected, stable populations

Table 3.29 displays the taxonomic break down of the 2013 changes to the 1996 Endangered, Threatened and Special Concern List for Minnesota and the DNR Northeast Region. In the Northeast Region (not the Northeast Landscape), the DNR added 88 new species, removed 16 species, increased the designation for 18 species, and decreased the designation for 11 species. Most of the species that were proposed for addition to the Endangered, Threatened and Special

Concern List have not been the target of previous surveys, so data on their distribution in the Rare Features Database (www.dnr.state.mn.us/eco/nhnrp/nhis.html) is incomplete for these species.

Table 3.28. Numbers of endangered, threatened, and special concern species for Minnesota, 2013.

	Endangered	Threatened	Special Concern	Total
Mammals	0	2	19	21
Birds	9	2	21	32
Amphibians and Reptiles	2	4	10	16
Fish	4	5	25	34
Mollusks	13	11	9	33
Jumping Spiders	0	1	9	10
Leafhoppers	0	0	3	3
Dragonflies	0	1	7	8
Butterflies and Moths	8	1	10	19
Caddisflies	5	11	8	24
Tiger Beetles	3	2	4	9
Vascular Plants	86	93	130	309
Fungi	3	0	5	8
Lichens	7	9	21	37
Mosses and Liverworts	3	7	17	27
Total	143	149	298	590

Source: Minnesota's List of Endangered, Threatened, and Special Concern Species, 2013. MN DNR Division of Ecological and Water Resources

Table 3.29. Changes to the endangered, threatened and special concern list for the state of Minnesota and the MN DNR Northeast Region between the 1996 and 2013 listing.

	Minnesota				DNR Northeast Region			
	Add	Remove	Status increase	Status decrease	Add	Remove	Status increase	Status decrease
Mammals	7	1	1	0	4	1	0	0
Breeding birds	5	1	2	2	3	1	0	2
Amphibians and reptiles	3	1	1	0	1	1	0	0
Fishes	13	0	8	0	4	0	0	0
Mollusks	8	5	8	2	3	0	0	0
Spiders and Insects	30	6	9	2	7	4	3	2
Vascular Plants	66	13	42	12	30	7	15	7
Lichens	21	1	0	1	19	1	0	0
Mosses and Liverworts	25	1	1	0	15	1	0	0
Fungi	2	0	0	0	2	0	0	0
Total	180	29	72	19	88	16	18	11

Source: MN DNR Division of Ecological and Water Resources

3.18. Trends in wildlife species populations

The Northeast Landscape is well known for its wildlife populations and the following figures show population trends for ruffed grouse, otter, martin, fisher, bobcat, moose, white-tailed deer, and timber wolves.

Minnesota frequently is the nation's top ruffed grouse producer. On average, 115,000 hunters harvest 545,000 ruffed grouse in the state each year, making it the state's most popular game bird. During the peak years of 1971 and 1989, hunters harvested more than 1 million ruffed grouse. One reason for the Minnesota's status as a top grouse producer is an abundance of aspen and other ruffed grouse habitat, much of it located on county, state, and national forests where public hunting is allowed. An estimated 11.5 million of the state's 16.3 million acres of forest are grouse habitat (MN DNR – Division of Wildlife). For the past 64 years, DNR biologists have monitored ruffed grouse populations using a drum count index. Ruffed grouse drum count index values in the Laurentian Mixed Forest Province (Figure 3.18) highlight the roughly ten year cycle ruffed grouse populations follow in Northeastern Minnesota.

The Minnesota DNR Forest Wildlife Research Group annually monitors furbearer populations using a variety of indices. The statewide bobcat spring (pre-birth) population estimate has increased to a mean of approximately 5,000 in the last 15 years from an average of just under 2,000 individuals from 1977 to 1997 (Figure 3.19). Statewide fisher spring population estimates

have decreased from approximately 10,000 individuals in the mid 1990's to just under 6,000 in 2013 (Figure 3.20). American marten population estimates have similarly decreased recently from peak estimates in excess of 14,000 in the early 2000's to an estimate of just under 9,000 in 2013 (Figure 3.21). Otter population estimates in Minnesota increased from 1977 to the mid 1990's and have remained relatively steady around 12,000 individuals since then (Figure 3.22).

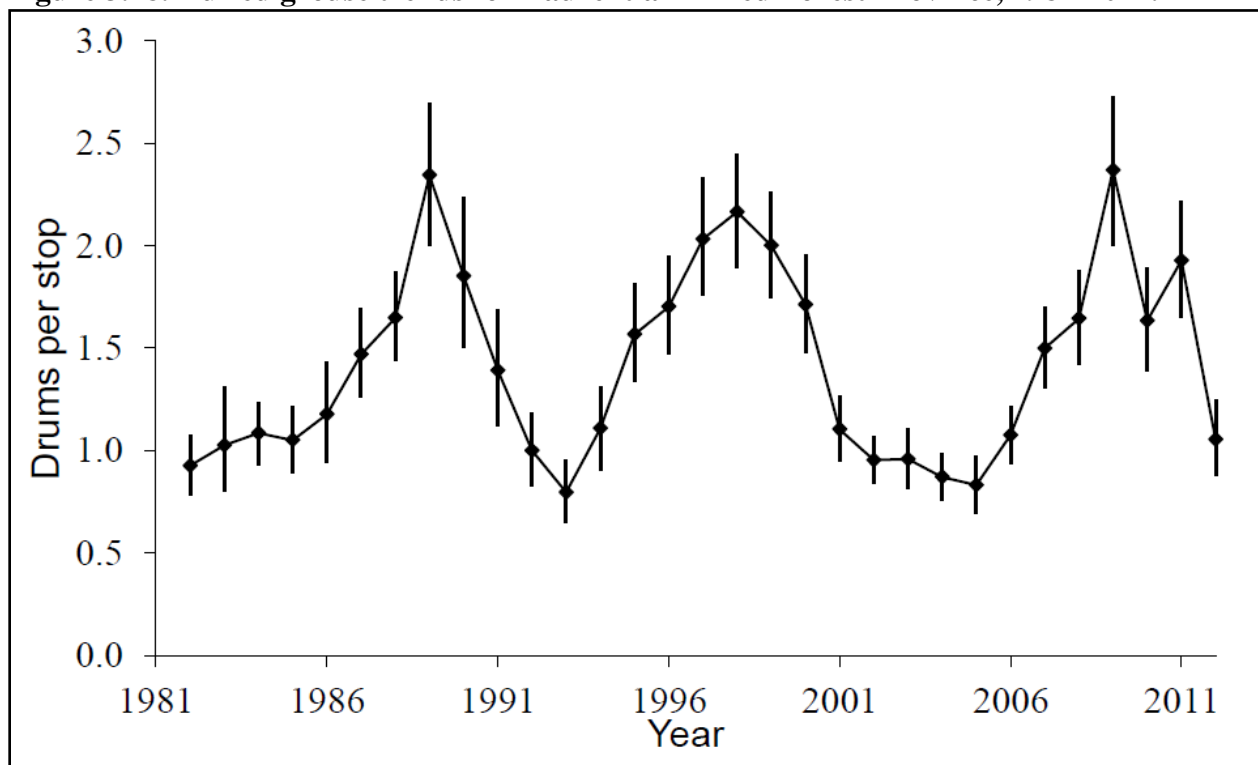
The northeastern moose population declined from an estimated 8,840 individuals in 2006 to an estimated 2,760 during the annual aerial survey (moose range Figure 3.23; population Figure 3.24). This population decline of 35 percent from 2012 to 2013 and a 52 percent drop since 2010 prompted DNR to not open the 2013 season. The 'Minnesota Moose Research and Management Plan' established biological and management thresholds for closing the moose season (http://files.dnr.state.mn.us/fish_wildlife/wildlife/moose/management/mooseplan-final.pdf).

While those thresholds have not all been met, DNR wildlife managers did not anticipate such an alarming decline in the overall moose population when the thresholds were established. The Minnesota DNR will not consider opening future seasons unless the moose population recovers and is working with other moose experts to develop thresholds that would determine when the hunting season could be reopened. The exact causes of moose mortality are not well understood. Utilizing the latest technology, DNR wildlife, university, and tribal researchers are conducting multiple research projects to learn more about moose mortality. More information is available at www.mndnr.gov/moose.

The DNR Section of Wildlife publishes spring white-tailed deer densities annually. Deer densities are stated as an average yearly density across the permit area, and portions of some permit areas may have local and/or seasonal densities higher or lower than the average. Estimates for permit areas existing mostly or entirely within the Northeast Landscape (Figure 3.23) are displayed in Table 3.30. In 2011, deer densities were highest in permit areas 177 (City of Cook, MN area) and 156, 183 (Carlton County, MN) with densities of 28, 22, and 23 deer per square mile respectively. Permit areas 126 (Isabella, MN area) and 127 (Grand Marais, MN area) had the lowest densities in 2011 at two to five deer per square mile. Due to the lakeshore microclimate and deer migration to this area, deer densities along the North Shore of Lake Superior can greatly exceed reported densities in late winter.

The Minnesota DNR monitors the mid-winter timber wolf population before the pups are born using a combination of visual, track, scat, and other methods. The winter of 2012-13 survey results estimate that within Minnesota's wolf range there were 438 packs and 2,211 wolves (Table 3.31). More information about wolves in Minnesota can be found at the DNR website: www.mndnr.gov/wolves

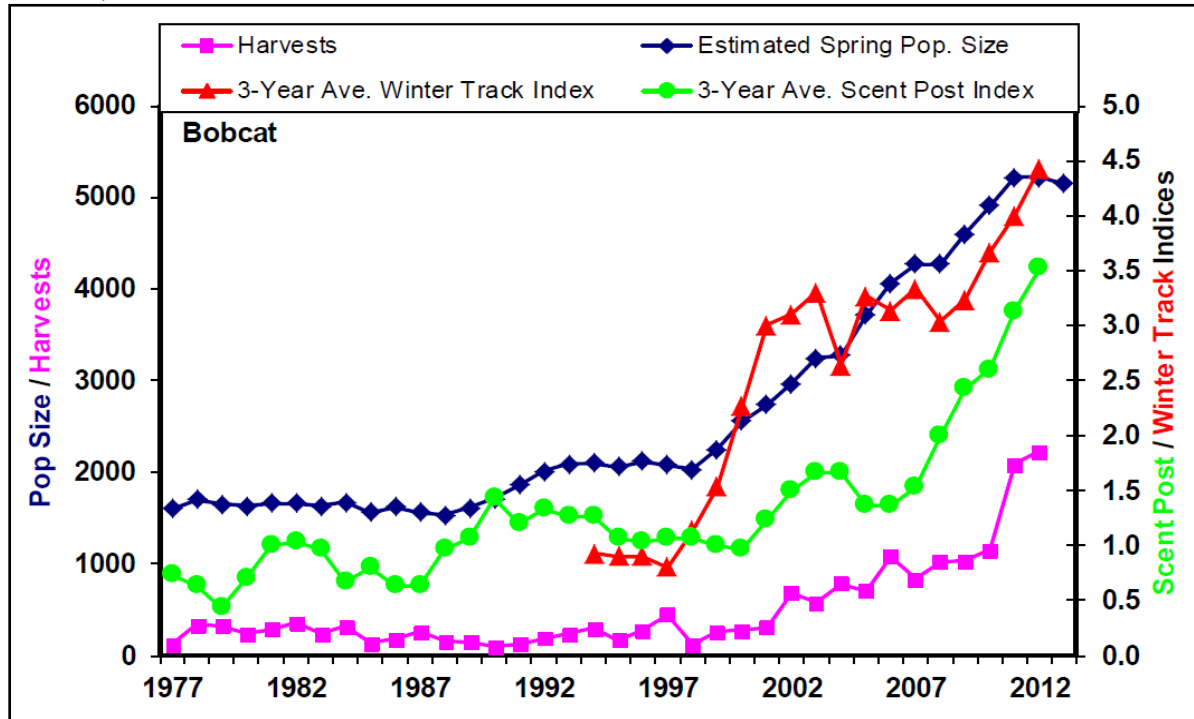
Figure 3.18. Ruffed grouse trends for Laurentian Mixed Forest Province, 1982-2012.



Source: MN DNR Forest Wildlife Populations and Research Group.

Note: Vertical error bars represent 95% confidence intervals based on bootstrap samples.

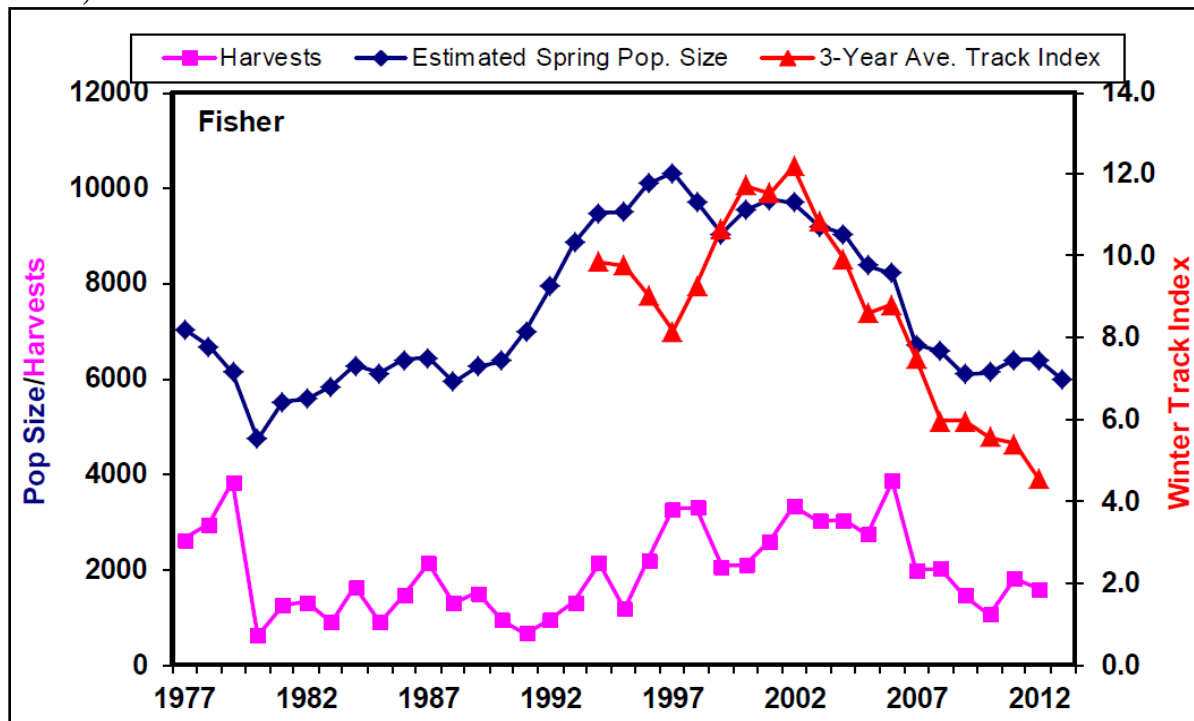
Figure 3.19. Minnesota bobcat spring (pre-birth) population estimate, harvest, and survey indices, 1977-2013.



Source: MN DNR Forest Wildlife Populations and Research Group.

Note: Harvests include an estimate of non-reported take.

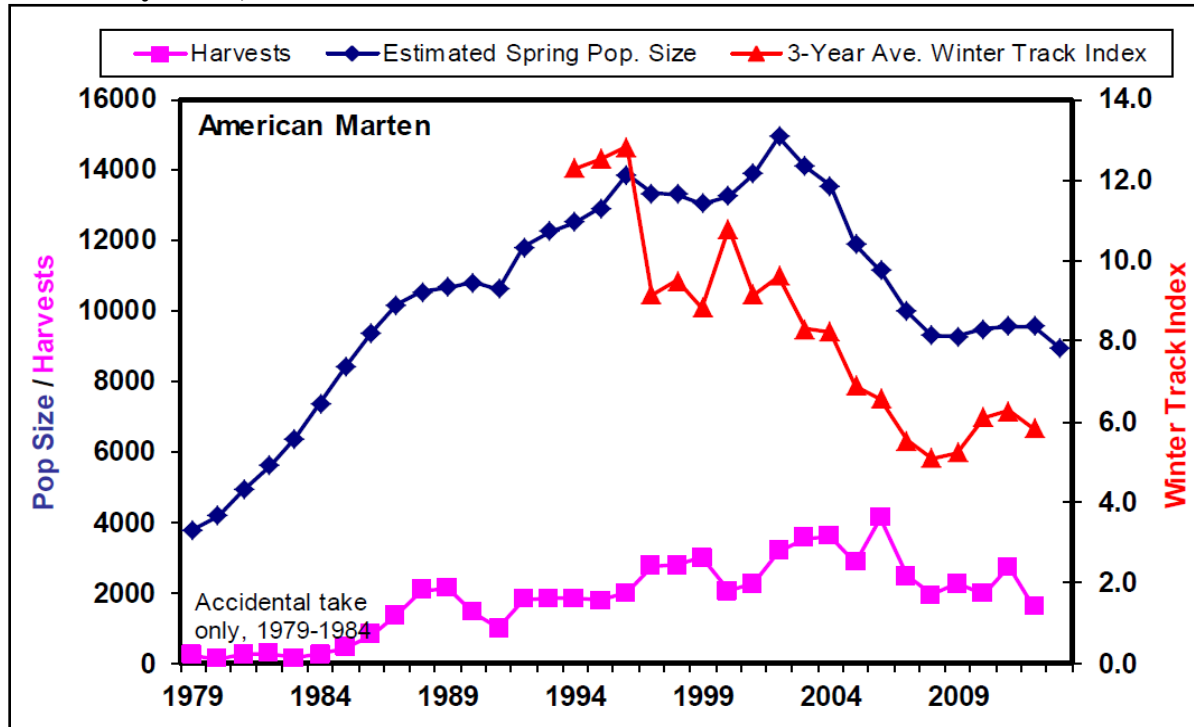
Figure 3.20. Minnesota fisher spring (pre-birth) population estimate, harvest, and survey index, 1977-2013.



Source: MN DNR Forest Wildlife Populations and Research Group.

Note: Harvests include an estimate of non-reported take.

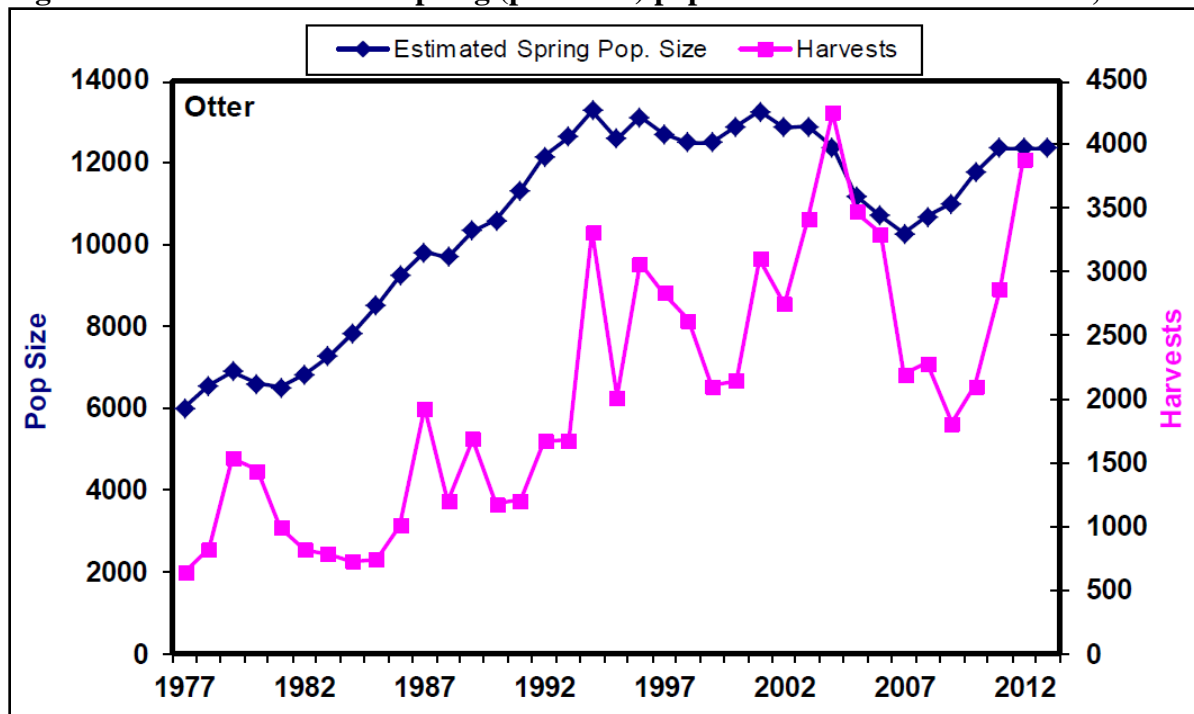
Figure 3.21. Minnesota American marten spring (pre-birth) population estimate, harvest, and survey index, 1977-2013.



Source: MN DNR Forest Wildlife Populations and Research Group.

Note: Harvests include an estimate of non-reported take.

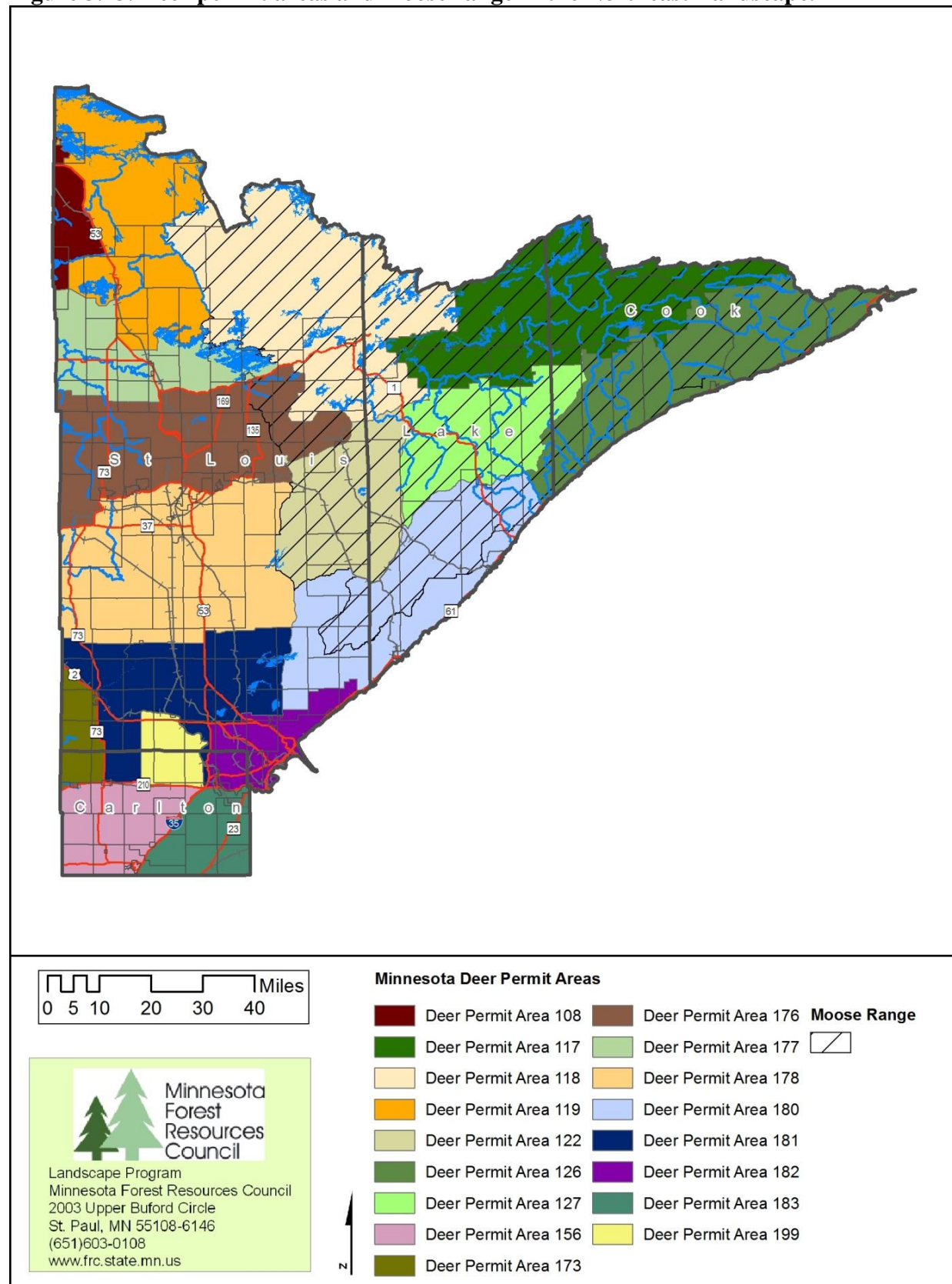
Figure 3.22. Minnesota otter spring (pre-birth) population estimate and harvest, 1977-2013.



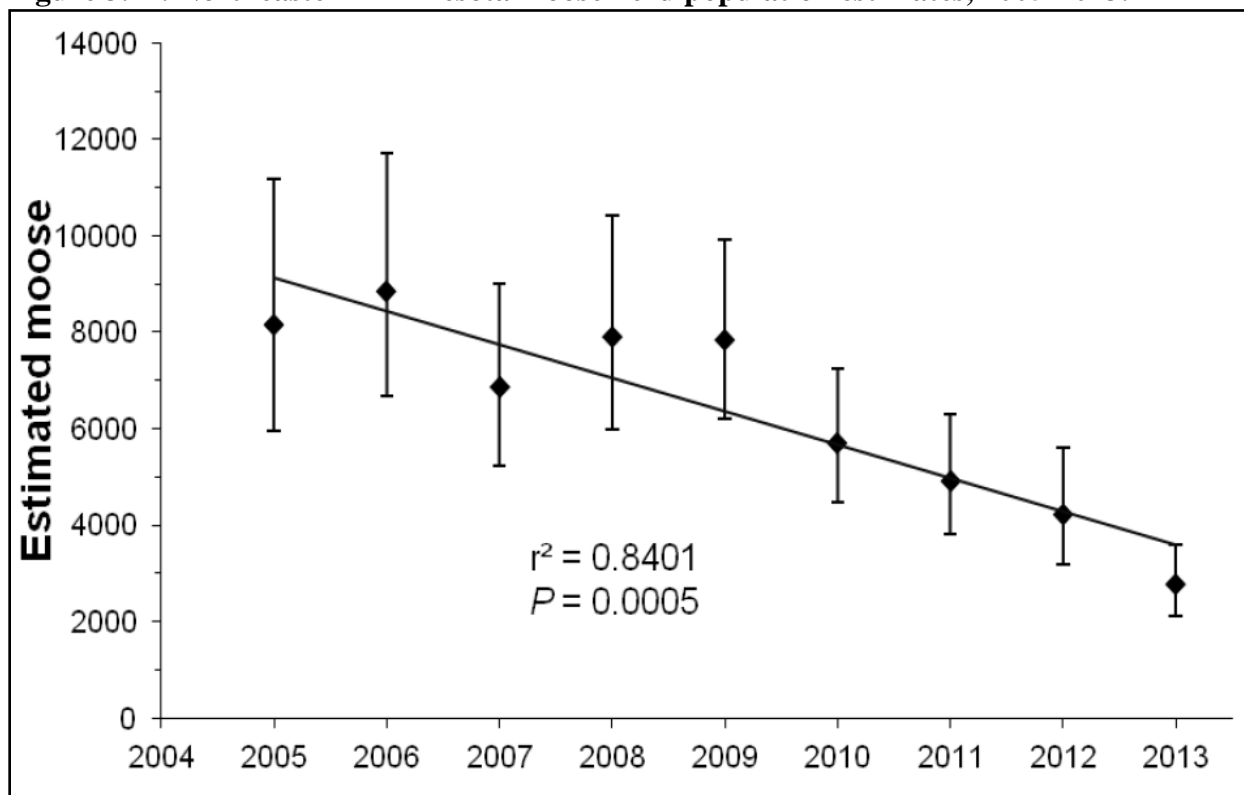
Source: MN DNR Forest Wildlife Populations and Research Group.

Note: Harvests include an estimate of non-reported take.

Figure 3.23. Deer permit areas and moose range in the Northeast Landscape.



Source: Minnesota DNR Data Deli

Figure 3.24. Northeastern Minnesota moose herd population estimates, 2005-2013.

Source: MN DNR Forest Wildlife Populations and Research Group.

Note: Data only reported back to 2005 due to a change in survey methodology starting in that year. Error bars represent 90% Confidence Intervals.

Table 3.30. Estimated deer population trends in northeastern deer permit areas, 2001-2011.

Permit area	Area (mi ³)	Deer per square mile										
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
118*	1,202	8	9	9	8	7	8	8	7	6	7	6
119*	799	13	14	15	14	12	13	13	13	10	11	10
122*	600	5	6	6	6	7	7	7	7	7	7	7
126	941	5	5	6	6	6	6	7	6	5	5	5
127	587	2	2	2	2	2	2	3	2	2	2	2
156	826	19	21	23	23	23	24	24	23	23	23	22
173*	592	14	15	16	15	14	14	15	14	13	14	15
176*	1,099	10	11	12	11	10	10	11	11	9	11	9
177*	504	38	42	45	41	36	37	39	37	30	32	28
178*	1,278	19	22	24	25	24	25	26	26	23	24	21
180	982	13	15	16	16	15	15	15	15	14	14	14
183	663	25	26	28	27	25	25	24	23	22	23	23

Source: MN DNR Forest Wildlife Populations and Research Group.

Permit areas listed exist mostly or entirely within the Northeast Landscape. Units 117 (BWCA), 199 (Fon du lac Reservation), and 182 (Duluth) also lie with in the Northeast Landscape but were not modeled.

* Some permit area boundaries were changed in 2010.

Table 3.31. Winter timber wolf population trends, 1988-2013.

	Winter Wolf Survey Year				
	1988/89	1997/98	2003/04	2007/08	2012/13
Total # observations	1,244	3,659	1,719	2,710	2,898
Total Wolf Range (km ²)	60,229	88,325	88,325	88,325	95,098
Occupied Range (km ²)	53,100	73,920	67,852	71,514	70,579
% Occupied Range confirmed by pack detection in township	55	84	54	68	70
% occupied area with pack detection that exceeds human/road density thresholds ^a	11	17	19	20	31
# Radio-Marked Packs	108 ^b	36	24	32	36
Average mid-winter pack size	5.55	5.4	5.3	4.9	4.3
Average Territory Size ^c (km ²)	227	192	140	142	161
Estimated # packs	233	385	485	503	438
Population Estimate (90% CI)	1521 (1,338, 1,762)	2445 (1,995, 2,905)	3020 (2,301, 3,708)	2921 (2,192, 3,525)	2211 (1,652, 2,641)
Population Density (wolves/100 km ²)	2.86	3.31	4.45	4.08	3.13
Questionnaire: % respondents that perceive that the local wolf population (increased, stable, decreased) since last survey	-	(71, 29, 0)	(40, 42, 18)	(40, 58, 2)	(28, 56, 16)

Source: MN DNR Forest Wildlife Populations and Research Group.

^a Thresholds from Fuller et al. (1992)^b Included packs marked in years prior to the survey^c Adjusted using scaling factors to account for interstitial spaces/territory underestimation

3.19. Invasive Species

Non-native invasive species pose a significant threat to Minnesota's forests, lakes, and associated economies. Figure 3.25 shows the distribution of invasive plants listed on Minnesota's Prohibited Noxious Weeds List. The Department of Agriculture is responsible for maintaining and updating this list which includes annual, biennial, or perennial plants that are designated as having the potential or are known to be detrimental to human or animal health, the environment, public roads, crops, livestock or other property. Plants on this list designated as:

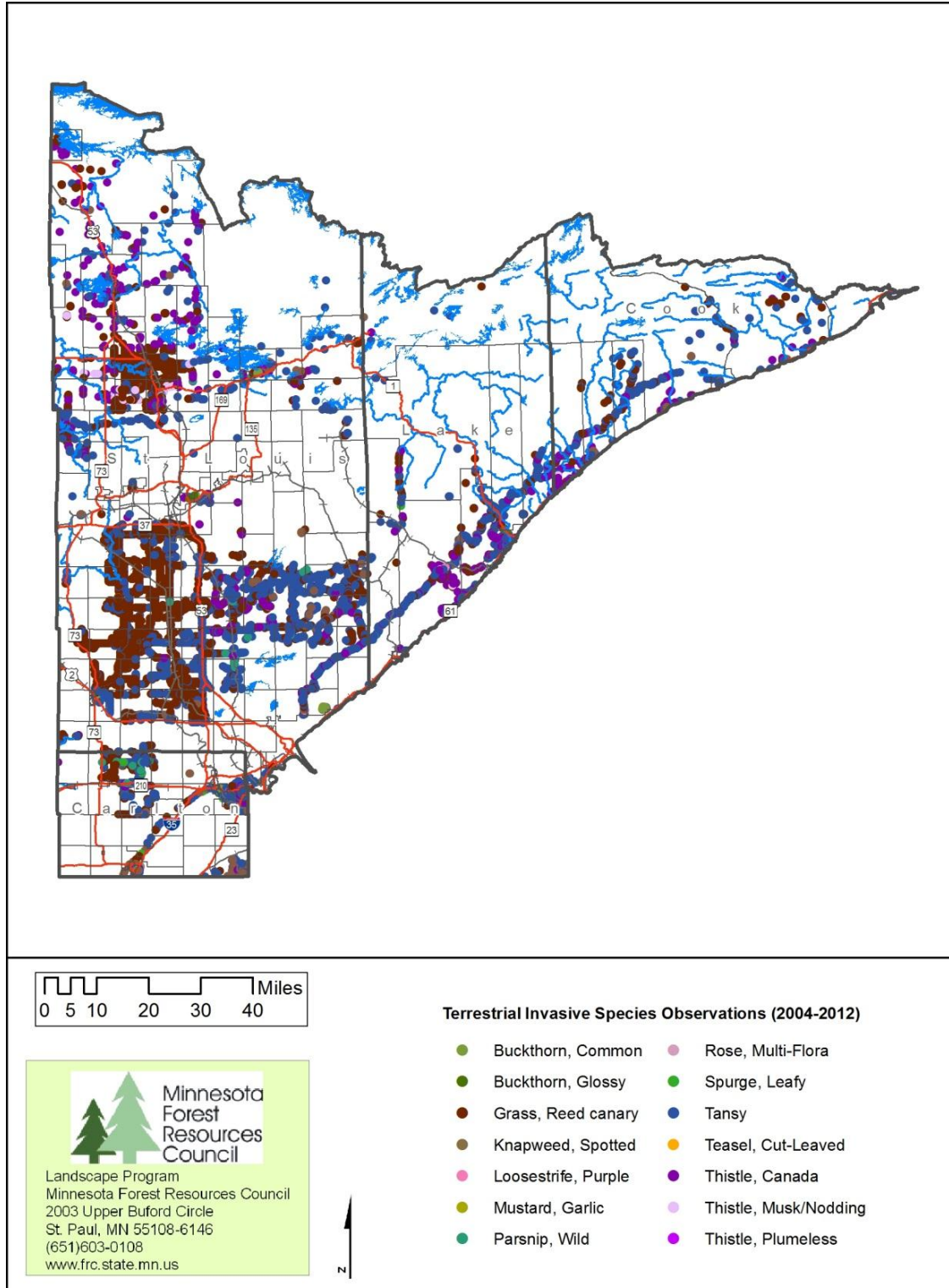
1. Eradicate List: plants that are not currently known to be present in Minnesota or are not widely established. These species must be eradicated, meaning all of the above and below ground parts of the plant must be destroyed, as required by Minnesota Statutes, Section 18.78. Additionally, no transportation, propagation, or sale of these plants is allowed. Measures must also be taken to prevent and exclude these species from being introduced into Minnesota.
2. Control List: plants established throughout Minnesota or regions of the state. Species on this list must be controlled, meaning efforts must be made to prevent the spread, maturation and dispersal of any propagating parts, thereby reducing established populations and preventing reproduction and spread as required by Minnesota Statutes, Section 18.78. Additionally, transportation, propagation, or sale of these plants is prohibited.
3. Restricted Noxious Weeds: plants that are widely distributed in Minnesota and are detrimental to human or animal health, the environment, public roads, crops, livestock or other property, but whose only feasible means of control is to prevent their spread by prohibiting the importation, sale, and transportation of their propagating parts in the state except as allowed by Minnesota Statutes, Section 18.82. Plants designated as Restricted Noxious Weeds may be reclassified if effective means of control are developed.

More information on terrestrial invasive plants in Minnesota can be found at www.mda.state.mn.us/plants/badplants/noxiouslist.aspx or www.dnr.state.mn.us/invasives/terrestrial/index.html

Emerald ash borer (EAB) is a nonnative invasive insect that kills ash trees. EAB has currently been identified in the Twin Cities Metro and Southeastern regions of the state and quarantine has been placed on Ramsey, Hennepin, Houston, and Winona counties to help slow the spread of EAB. The closest confirmed EAB site to the Northeast Landscape was identified in Superior, WI in August 2013. EAB poses a significant threat to the black ash communities in the Northeast Landscape. Figure 3.26 shows the areas of the Northeast Landscape with the highest introduction risk.

Figure 3.27 shows the distribution of lakes and rivers containing aquatic invasive species in the Northeast Landscape. More information on aquatic invasive species in Minnesota can be found at www.dnr.state.mn.us/invasives/index_aquatic.html and the complete list of infested waters can be found at http://files.dnr.state.mn.us/eco/invasives/infested_waters.pdf.

Figure 3.25. MN DNR terrestrial invasive species observations in the Northeast Landscape, 2004 to 2012.



Source: Minnesota DNR Data Deli

Note: Species represented in this figure are those designated by the MN Department of Agriculture as 'Noxious Weeds' and therefore falling under the Noxious Weed Law (www.mda.state.mn.us/plants/badplants/noxiouslist.aspx). Other non-native species, not on the noxious weed list, are present in the region.

Figure 3.26. Emerald ash borer introduction risk in the Northeast Landscape.

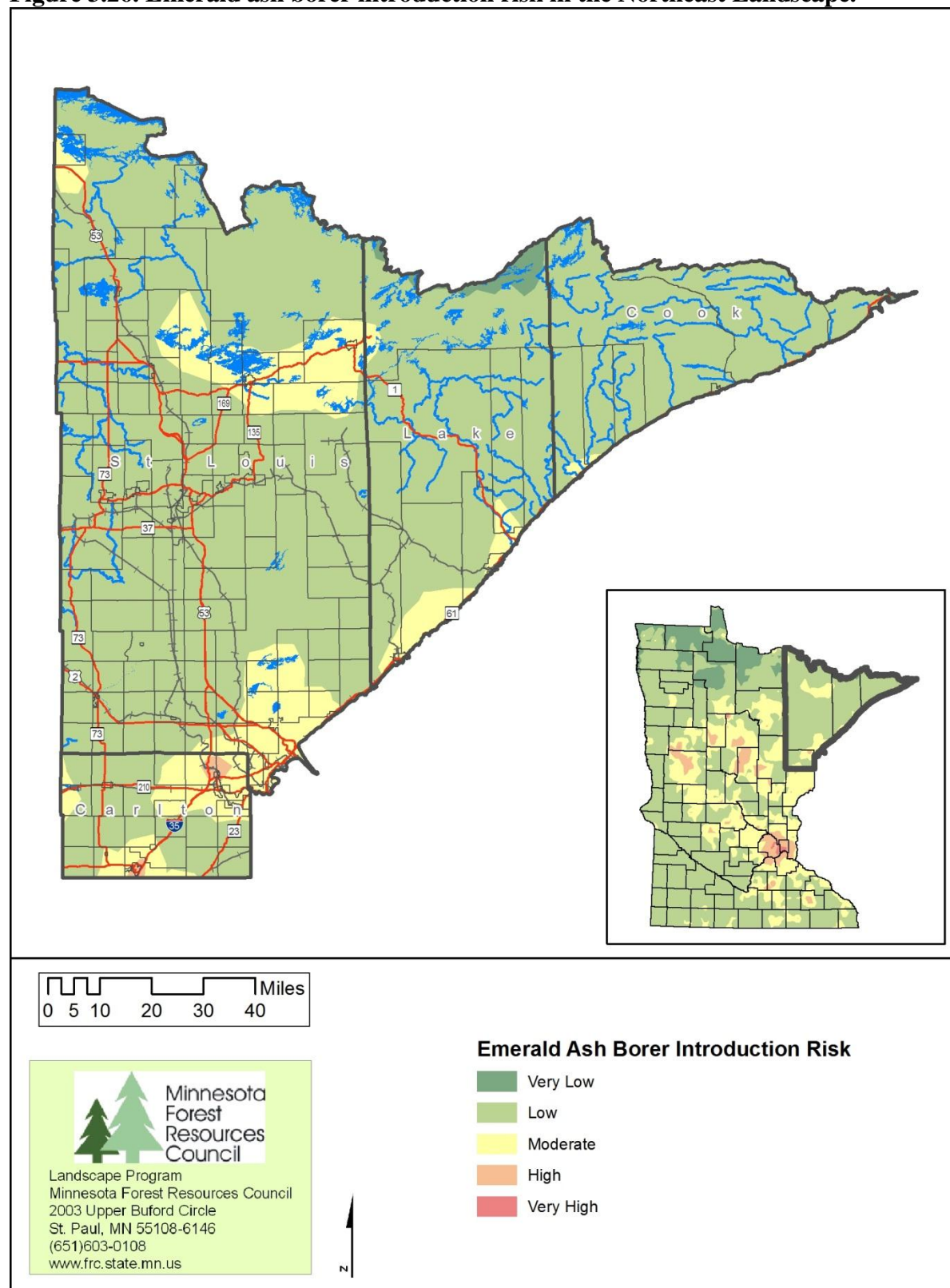
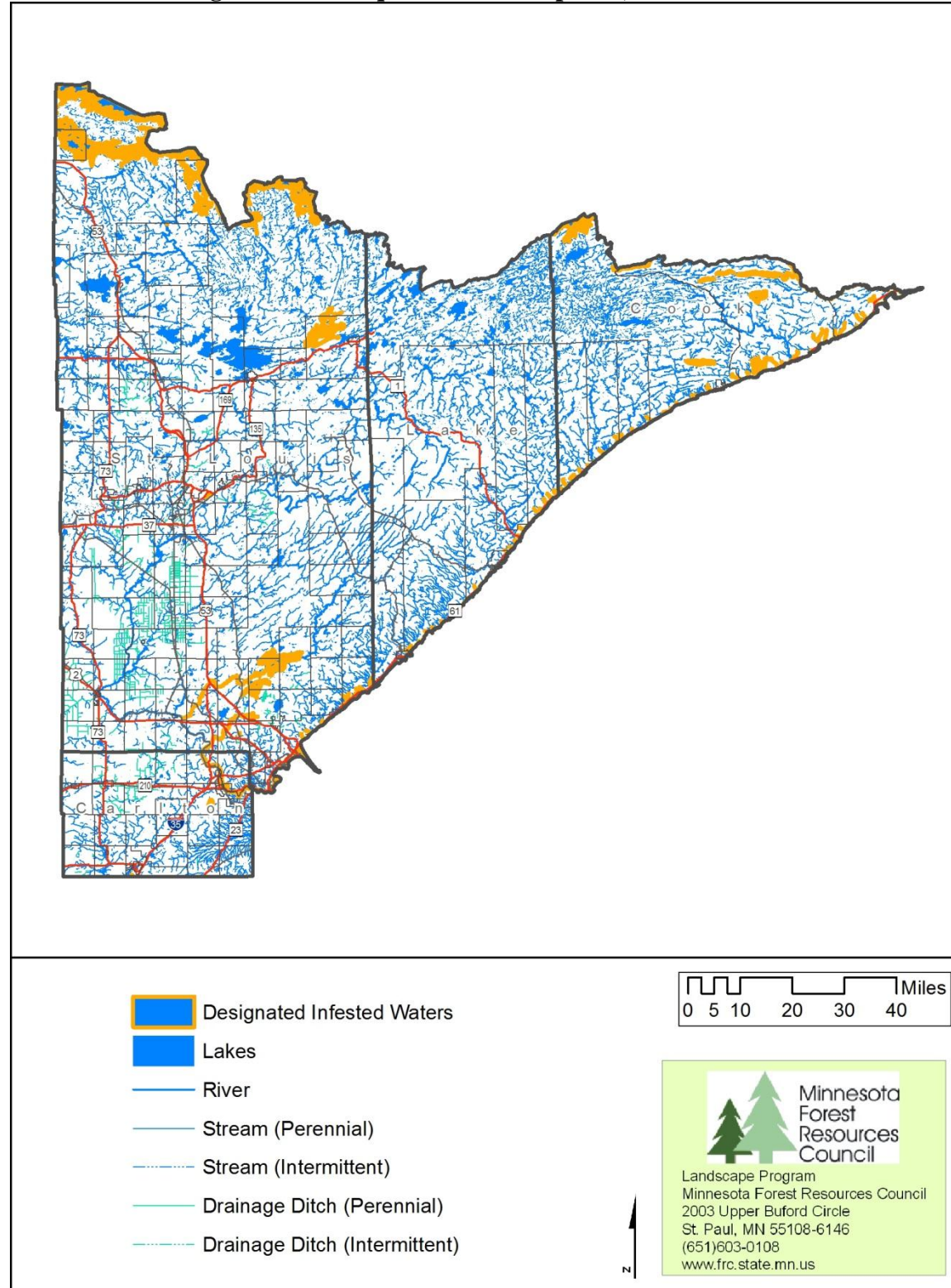


Figure 3.27. Lakes and streams in the Northeast Landscape designated by the Minnesota DNR as containing non-native aquatic invasive species, 2013.



Source: Minnesota DNR Data Deli

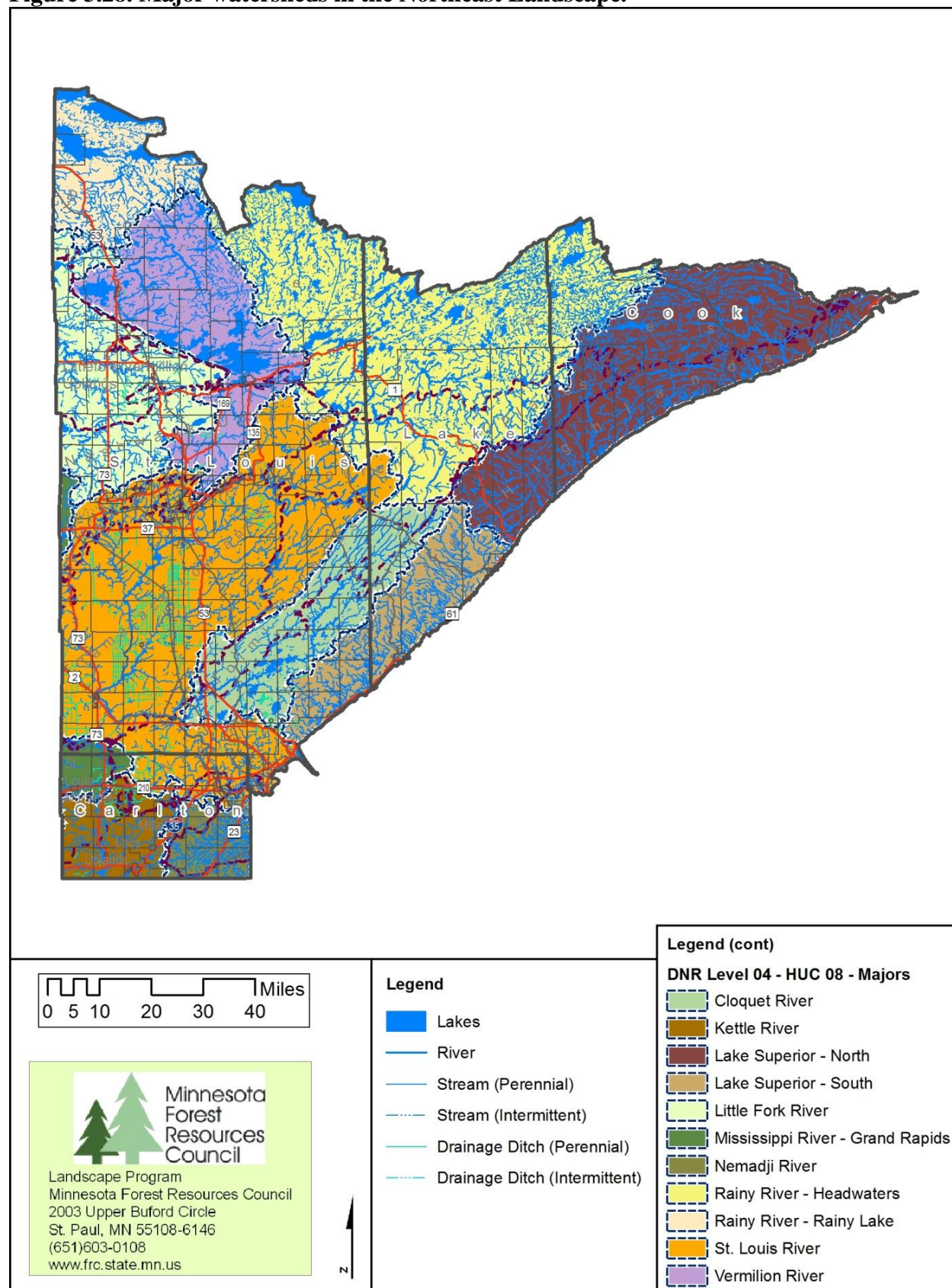
3.20. Water quality in lakes and streams

The Northeast Landscape is an area of rich water resources. Water in this region flows north through the Rainy River to Hudson's Bay, east through the Great Lakes to the Atlantic Ocean, and south through the Mississippi River to the Gulf of Mexico (Figure 3.28). These are three of the most important water basins in North America and forestry practices within them can directly affect stream and lake health.

The Minnesota DNR developed the Watershed Health Assessment Framework (WHAF) to provide a comprehensive overview of the ecological health of Minnesota's watersheds. By applying a consistent statewide approach, the WHAF expands understanding of processes and interactions that create healthy and unhealthy responses in Minnesota's watersheds. Health scores are used to provide a baseline for exploring patterns and relationships in emerging health trends. The Saint Louis River watershed scored lower than the other watersheds in the region (Figure 3.29).

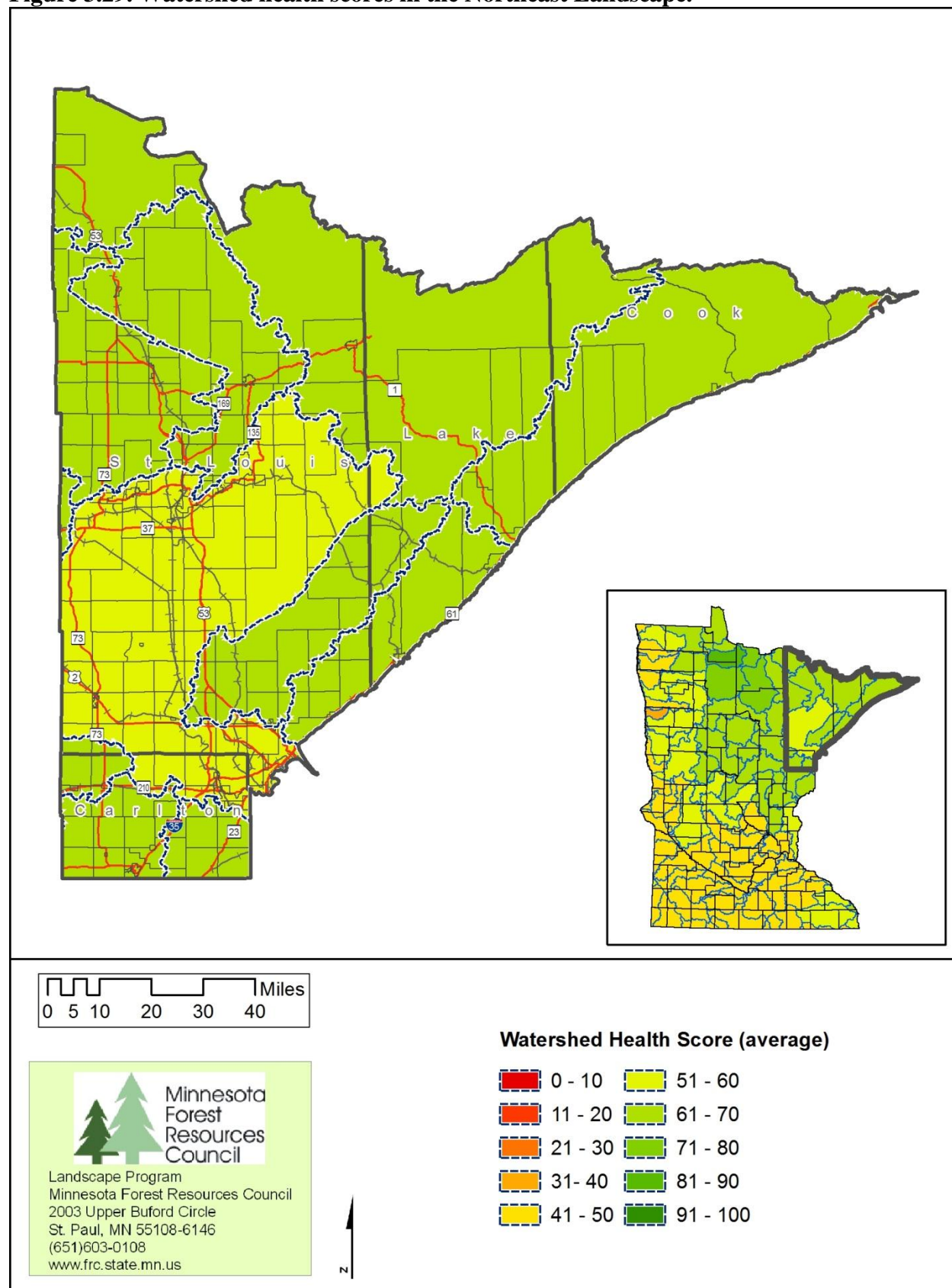
The Minnesota Pollution Control Agency (MPCA) is the state agency responsible for protecting Minnesota's water quality. Water quality standards are fundamental tools that help protect Minnesota's abundant and valuable water resources from pollution. "*Beneficial uses*" are the uses that water resources and their associated aquatic communities provide. Under the federal Clean Water Act, states are required to monitor and assess their waters to determine if they meet water quality standards and thereby support the beneficial uses they are intended to provide. Waters that do not meet their designated uses because of water quality standard violations are impaired. States are then required to develop a list of impaired waters that require Total Maximum Daily Loads (TMDL) studies, and to submit an updated list to the U.S. Environmental Protection Agency every even-numbered year for approval. These studies identify both point and nonpoint sources of each pollutant that fails to meet water quality standards and define how much of the pollutant can be in the surface and/or ground water while still allowing the waterbody to meet its designated uses, such as drinking water, fishing, swimming, irrigation or industrial purposes. Rivers and streams may have several TMDLs, each one determining the limit for a different pollutant. Most of the impaired lakes and streams in the Northeast Landscape result of mercury in fish tissue (Table 3.32). More information about impaired waters in Minnesota can be found at www.pca.state.mn.us/index.php/water/water-types-and-programs/minnesotas-impaired-waters-and-tmdls/minnesotas-impaired-waters-and-total-maximum-daily-loads-tmdls.html.

Figure 3.28. Major watersheds in the Northeast Landscape.



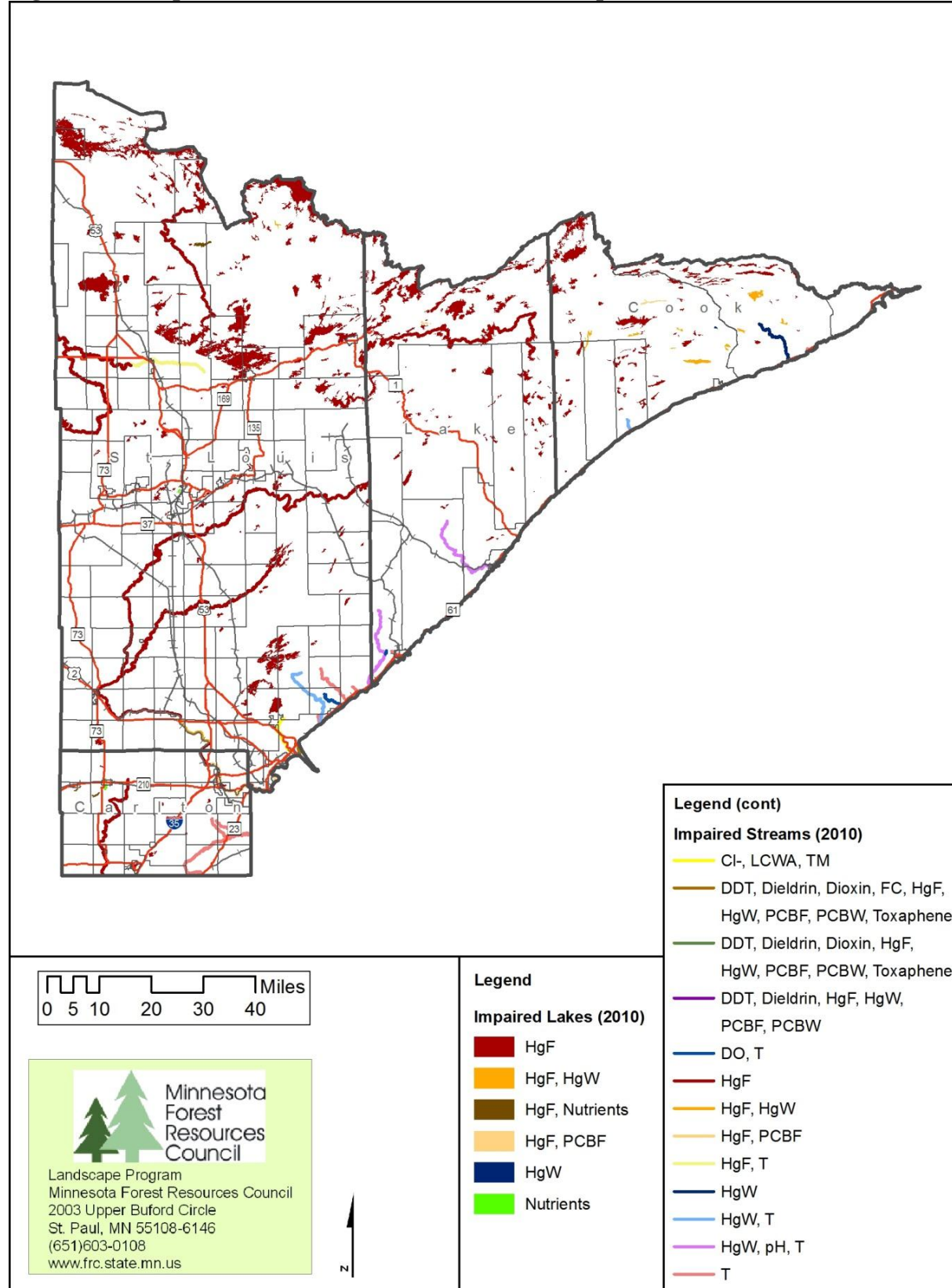
Source: Minnesota DNR Data Deli

Figure 3.29. Watershed health scores in the Northeast Landscape.



Source: Minnesota DNR Data Deli

Figure 3.30. Impaired waters in the Northeast Landscape, 2010.



Source: Minnesota DNR Data Deli

Table 3.32. Area of lakes and length of rivers and streams in the Northeast Landscape by affected use and impairment, 2010.

Impairment		Affected Use	Area or Length (Miles)
Mercury in fish tissue (HgF)		AQC	350,372
HgF, Mercury in water column (HgW)		AQC	7,010
HgF, Nutrients		AQC, AQR	1,740
HgF, PCB in fish tissue (PCBF)		AQC	1,260
HgW		AQC	131
Nutrients		AQR	629
Total Lake Area			361,142
HgF		AQC	506.2
Turbidity (T)		AQL	64
HgW, pH, T		AQC, AQL	47.2
HgF, T		AQC, AQL	25.7
HgW, T		AQC, AQL	23
HgF, PCBF		AQC	16.2
HgW		AQC	13.2
Chloride (Cl-), Lack of a coldwater assemblage (LCWA), Temperature (TM)		AQL	9.6
HgF, HgW		AQC	9.5
Dissolved oxygen (DO), T		AQL	7
DDT, Dieldrin, HgF, HgW, PCBF, PCBW		AQC	5.5
DDT, Dieldrin, Dioxin, Fecal coliform (FC), HgF, HgW, PCBF, PCBW, Toxaphene		AQC, AQR	2.4
DDT, Dieldrin, Dioxin, HgF, HgW, PCBF, PCBW, Toxaphene		AQC	2
Total Stream and River Length			731.6
Abbreviation	Impairment	Abbreviation	Impairment
AQC	Aquatic consumption	HgW	Mercury in water column
AQL	Aquatic life	LCWA	Lack of a coldwater assemblage
AQR	Aquatic recreation	PCBF	PCB in fish tissue
Cl-	Chloride	PCBW	PCB in water column
DO	Dissolved oxygen	T	Turbidity
FC	Fecal coliform	TM	Temperature
HgF	Mercury in fish tissue		

Source: Minnesota DNR Data Deli; Minnesota Pollution Control Agency

3.20.1. Forest cover and water quality

Forestlands can be a great storm filter and are a key component in sustaining high quality water and hydrology. Forests buffer pounding rains and hold soil in place which allows moisture to seep into the ground water and therefore reduce erosion and unwanted runoff. Beyond just having forested cover, the age distribution of forests within a watershed, can have an impact on water quality through effects on peak flows, loss of base flow, sedimentation and erosion, turbidity, nutrient levels, and water temperatures. These effects in turn can impact the health and distribution of fish and invertebrates within the watershed.

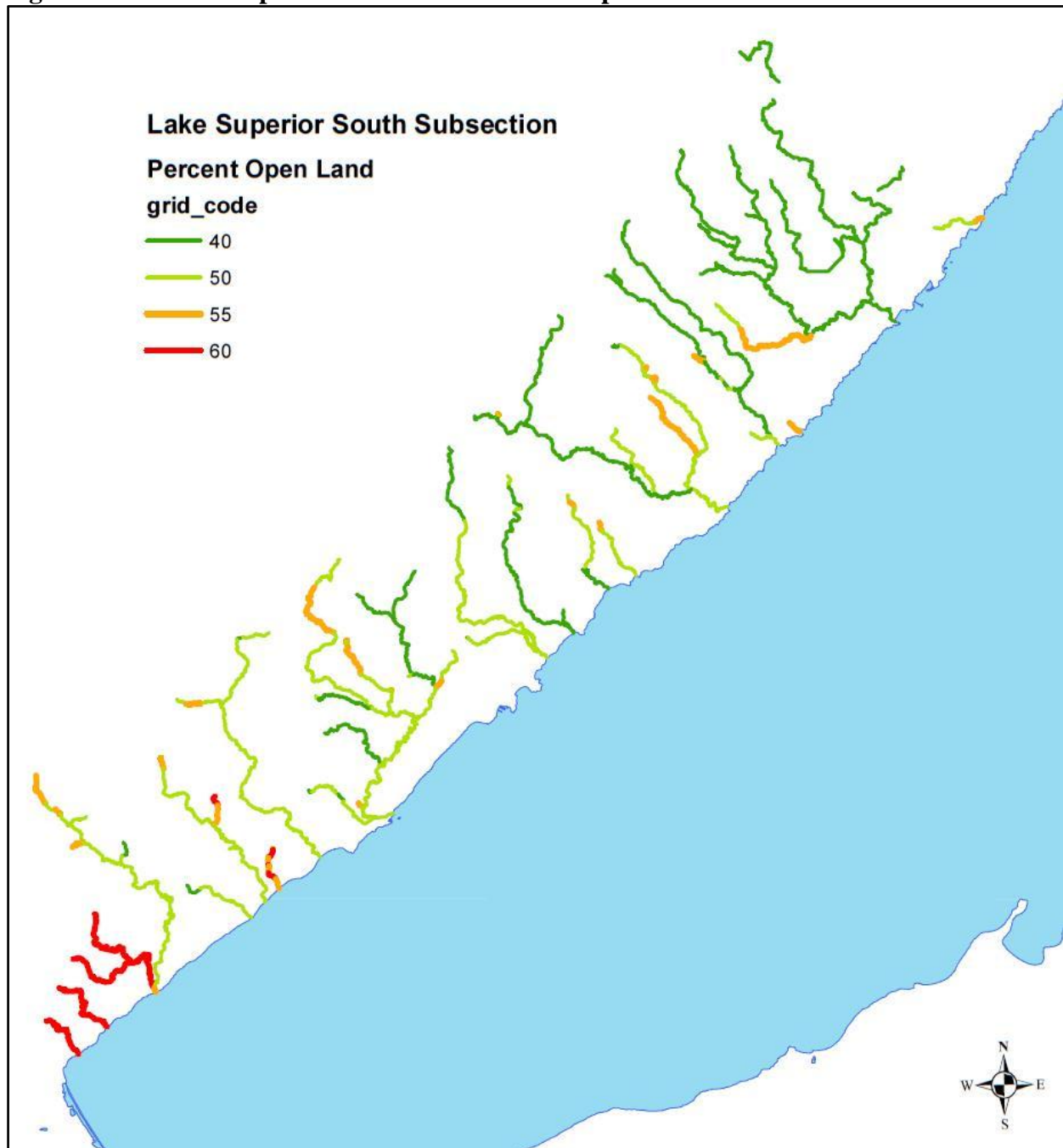
Changes in vegetation cover from forestland to farmland or young forest can cause snow to melt faster and allow rainfall to reach streams faster. These changes may not have an impact on peak flows during large flood events, but they do impact smaller peak flow events as well as annual peak flows. These impacts begin to appear as the percentage of open land or young forest within a watershed rises above 60% (Verry, 2000; *Land Fragmentation and Impacts to Streams and Fish in the Central and Upper Midwest*; Society of American Foresters).

Minnesota DNR Fisheries and Ecological & Water Resources and the EPA's Mid-Continent Ecology Division in Duluth have initiated work to identify points within watersheds in the southern portion of the Lake Superior basin that may be at risk due to impacts related to the amount of open land/young forest within the watershed (Figure 3.31). This work will inform forest management decisions within potentially impacted watersheds and possible outcomes of this use may include reforestation efforts in locations where such work can reduce the percentage of open land/young forest below the impact threshold, and coordination of timber sale activity across land ownerships to avoid increasing the amount of young forests at points within watersheds known to be at or above the impact threshold.

Following appropriate management practices in these riparian areas as outlined in the MFRC Voluntary Site-Level Forest Management Guidelines will contribute to keeping Northeast Minnesota's lakes, rivers, wetlands and fisheries healthy. These healthy forests maintain high quality aquatic systems such as cold water trout streams through shading and water temperature maintenance, erosion and nutrient loading reduction, and providing coarse woody debris and structural cover. The Northeast Landscape contains 2,153 miles of designated trout streams and an additional 1,270 protected tributaries to designated trout streams (Figure 3.32).

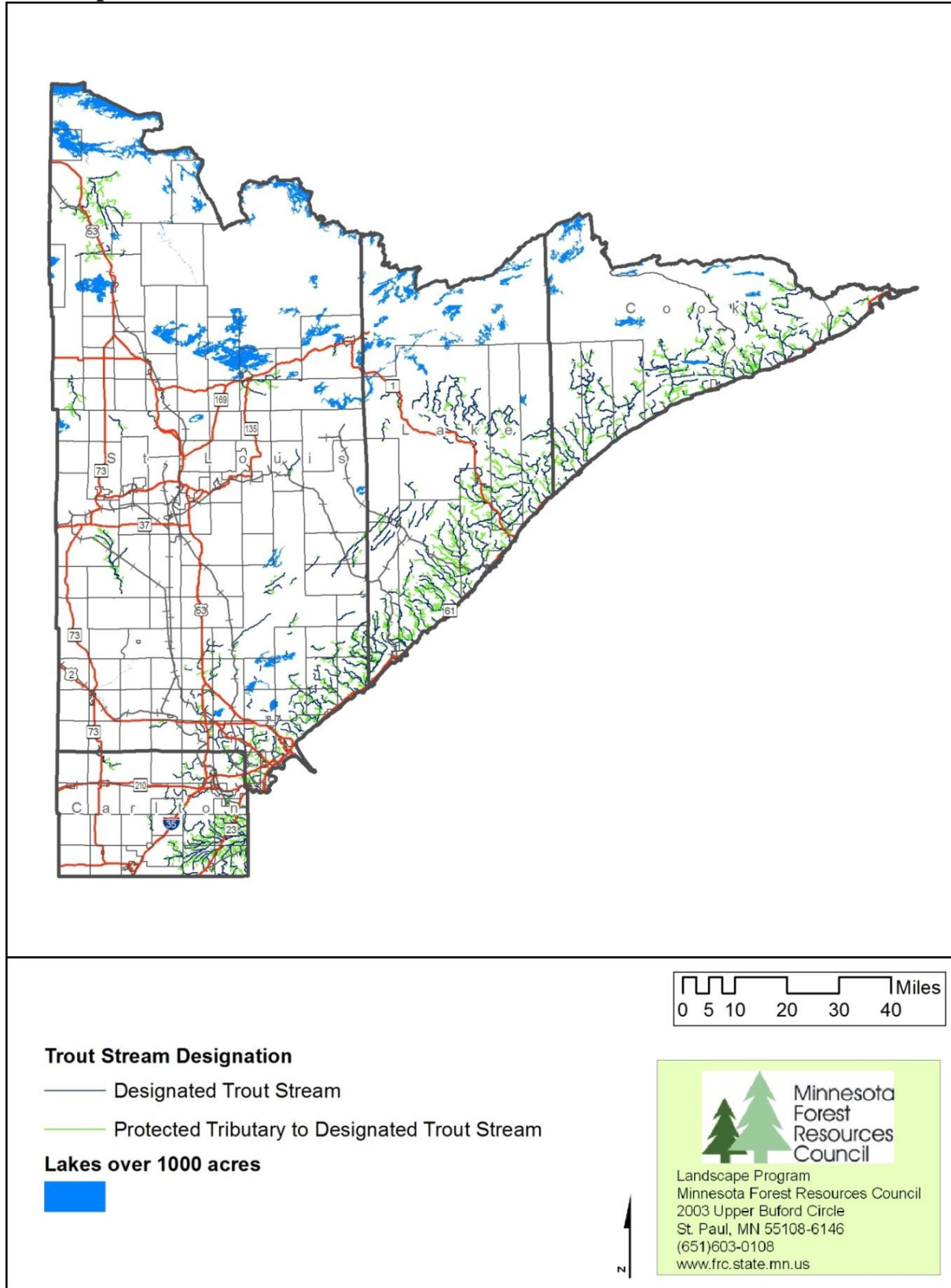
MFRC Voluntary Site-Level Forest Management Guidelines are available at:
www.frc.state.mn.us/documents/council/site-level/MFRC_FMG&Biomass_2007-12-17.pdf

Figure 3.31. Percent open land in southern Lake Superior watersheds.



Source: Minnesota DNR-Fisheries and the EPA's Mid-Continent Ecology Division

Figure 3.32. Designated trout streams and protected tributaries in the Northeast Landscape.



Source: Minnesota DNR Data Deli



Goal 4 – Economic and Social Values

MFRC Goal 4: Economic and Social Values. Forests within a region’s landscape will be providing a full range of products, services, and values, including timber products, wildlife, and tourism that are major contributors to economic stability, environmental quality, social satisfaction, and community well-being.

In general Goal 4 refers to both economic and social issues. This report includes the best economic data available at this time. It focuses on the regional forest products industry, tourism, mining, and transportation. Social components relating to recreation and tourism are found in this report; for a review of regional demographic trends and projections relating to population, households, employment, earnings and income see the “NE Landscape Demographic Data Report” at http://mn.gov/frc/initiatives_llm_committees_northeast.html.

4.1. Economic and Social Value Data Sources

Minnesota DNR: The MN DNR Division of Forestry updates a series of annual and semi-annual forest products industry documents. These were referred to in the development of the following document. Some data was collected directly from MN DNR staff while other data was extracted from Division of Forestry documents. Many of these documents can be found at: www.dnr.state.mn.us/publications/forestry/index.html The MN DNR Division of Parks and Trails provided data on recreational infrastructure in the region and use data directly from their database.

US Forest Service: The USFS Northern Research Station updates a series of annual and semi-annual forest products industry documents. These were referred to in the development of the following document. Some data was collected directly from USFS staff while other data was extracted from USFS documents. Many of these documents can be found at: www.nrs.fs.fed.us/pubs/ Additional data on forestry, wilderness, and recreation trends was collected directly from USFS Superior National Forest Staff.

Explore Minnesota: Compiles and shares data on trends in regional tourism. More information on this Minnesota state agency can be found at: www.exploreminnesota.com/index.aspx

Minnesota Department of Revenue: Compiles and shares data on trends in the regional economy. More information can be found at: www.revenue.state.mn.us/Pages/default.aspx

US Department of Commerce: Compiles and shares data on trends in the regional economy. More information can be found at: www.commerce.gov/

Additional Resource Documents:

“*Northeast Minnesota Forestry Analysis*”; 2012; James Skurla (Labovitz School of Business and Economics, University of Minnesota – Duluth) provides an excellent overview of forest products and tourism industry in the Northeast Landscape. Available at: http://mn.gov/frc/initiatives_llm_committees_northeast.html

“Northeast Minnesota Forestry Analysis, 10 year projections”; 2013; James Skurla (Labovitz School of Business and Economics, University of Minnesota – Duluth) provides several forest products projection scenarios for the Northeast Landscape. Available at:

http://mn.gov/frc/initiatives_llm_committees_northeast.html

“Economic Contribution of Minnesota’s Forest Products Industry – 2011 edition” by Donald Deckard (MN Forestry) and James Skurla (University of Minnesota – Duluth) provides an excellent overview of the forest products industry in Minnesota.

<http://files.dnr.state.mn.us/forestry/um/economiccontributionMNforestproductsindustry2011.pdf>

“Status of the Minnesota Logging Sector in 2011”; in preparation; C. Blinn, T. O’Hara, D. Chura, and M. Russell. This document had not been completed but provides information on the logging industry in Minnesota.

“Current Status and Long-term Trends of Silvicultural Practices in Minnesota”; 2008; A. D’Amato, N. Bolton, C. Blinn, and A. Ek - University of Minnesota, Department of Forest Resources.

“The Economic Impact of Ferrous and Non-Ferrous Mining on the State of Minnesota, the Arrowhead Region, including Douglas County, WI”; November 2012; James Skurla (Labovitz School of Business and Economics, University of Minnesota – Duluth).

<https://lsbe.d.umn.edu/uploads/FINAL%20Mining%202012%20Report.pdf>

4.2. Forest products industry

This section summarizes historical and current trends in the forest products industry from statewide to management agency level. The first section provides an overview of the forest products industry, and the following sections detail harvesting, imports-exports, mill consumptions, stumpage prices, and logging operation trends. Data in this section is often presented as primary and secondary forest products. Primary forest products manufacturers procure and utilize wood fiber directly from the forest while secondary forest products manufacturers purchase and utilize primary forest products in their manufacturing process.

Forest products manufacturing and related sectors is a significant economic driver in Minnesota, directly contributing \$9.7 billion in industry output and \$3 billion in value added while employing about 40,370 people with a \$1.8 billion payroll (Table 4.1). Including direct, indirect, and induced economic effects, Minnesota’s forestry-related sectors have a total economic impact of \$17.1 billion in industry output, \$6.9 billion in value added (contribution to gross state product), and support 86,775 jobs (Table 4.1).

Minnesota is the 8th ranked state in forest industry gross state product per capita, with 66% coming from pulp and paper and the remaining 33% from wood products (Figure 4.1). Within the state, forest products manufacturing is the fifth largest manufacturing sector by employment in Minnesota (Figure 4.2), contributing approximately \$3 billion or 10 percent of the state’s total manufacturing value added sector and 1.7 percent of gross state product. Based on IMPLAN modeling results, the total economic impact of forest products manufacturing is \$6.9 billion in value added including direct, indirect, and induced effects.

The highest density of forest products jobs are in the Minneapolis-St. Paul metro area with others spread throughout the state (Figure 4.3). Of the estimated 40,370 forest products jobs, more than 2,400 are within the four county Northeast Landscape with other major employers located near the Landscape border (Table 4.2). This industry has seen declines in recent years highlighted by the closure of two major facilities (Table 4.3) and the remaining forest industry and its related infrastructure have survived some extremely tough times. Remaining regional forest products employers include: SAPPI Fine Papers and Jarden Home Brands, Inc. in Carlton County, Hedstrom Lumber in Cook County, UPM Blandin in Itasca County, Packaging Corp of America (formerly Boise, Inc.) in Koochiching County, Louisiana-Pacific Corp. in Lake County and NewPage in St. Louis County.

In addition to direct employment, primary and secondary forest products manufacturing supports jobs in related sectors including: wholesale trade (4,214 total jobs), food services and drinking places (3,934 total jobs), commercial logging (2,417 total jobs), real estate establishments (1,977 total jobs), and transport by truck (1,558 total jobs) (Table 4.4).

Based on IMPLAN modeling results, Minnesota’s forestry-related sectors generate state and local tax receipts of \$493 million in sales, property, and income taxes with a total state and local tax impact of \$621 million (Table 4.5). Note that IMPLAN tax impact estimates are much higher than direct tax impacts because they include sales taxes generated from spending labor income as well as direct and indirect effects generated from business and occupations tax revenue.

Most of the information in this section comes from “Economic Contribution of Minnesota’s Forest Products Industry – 2011 edition” by Donald Deckard (MN Forestry) and James Skurla (University of Minnesota – Duluth). This document can be found at the following website and should be used to get further information on the general status of the forest products industry in Minnesota.

<http://files.dnr.state.mn.us/forestry/um/economiccontributionMNforestproductsindustry2011.pdf>

Table 4.1. Direct contribution and total economic impact of Minnesota forest products manufacturing and related sectors.

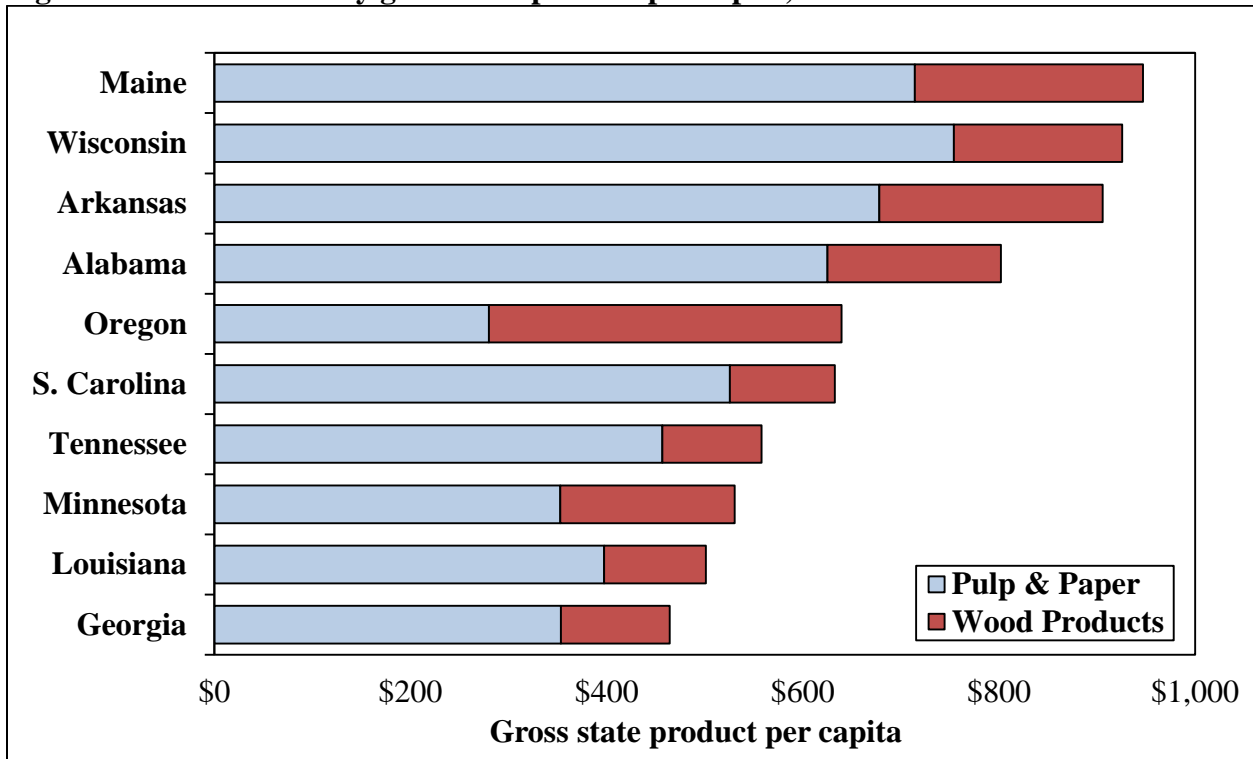
IMPLAN¹ Sector	Employment		Output (Billion \$)		Value Added (Billion \$)	
	Direct Contribution	Total Impact	Direct Contribution	Total Impact	Direct Contribution	Total Impact
Primary Forest Products Mfg.	5,353	19,153	\$2.90	\$5.20	\$0.80	\$1.90
Secondary Forest Products Mfg.	31,743	68,541	\$6.80	\$12.40	\$2.20	\$5.20
Forestry and Logging	3,273	6,231	\$0.70	\$1.10	\$0.20	\$0.40
Totals²	40,369	86,775	\$9.70	\$17.10	\$3.00	\$6.90

Source: Deckard and Skurla 2011.

¹ IMPLAN – (IMpact analysis for PLANning) software and data combines classic economic input-output analysis with regional specific social accounting matrices and multiplier models.

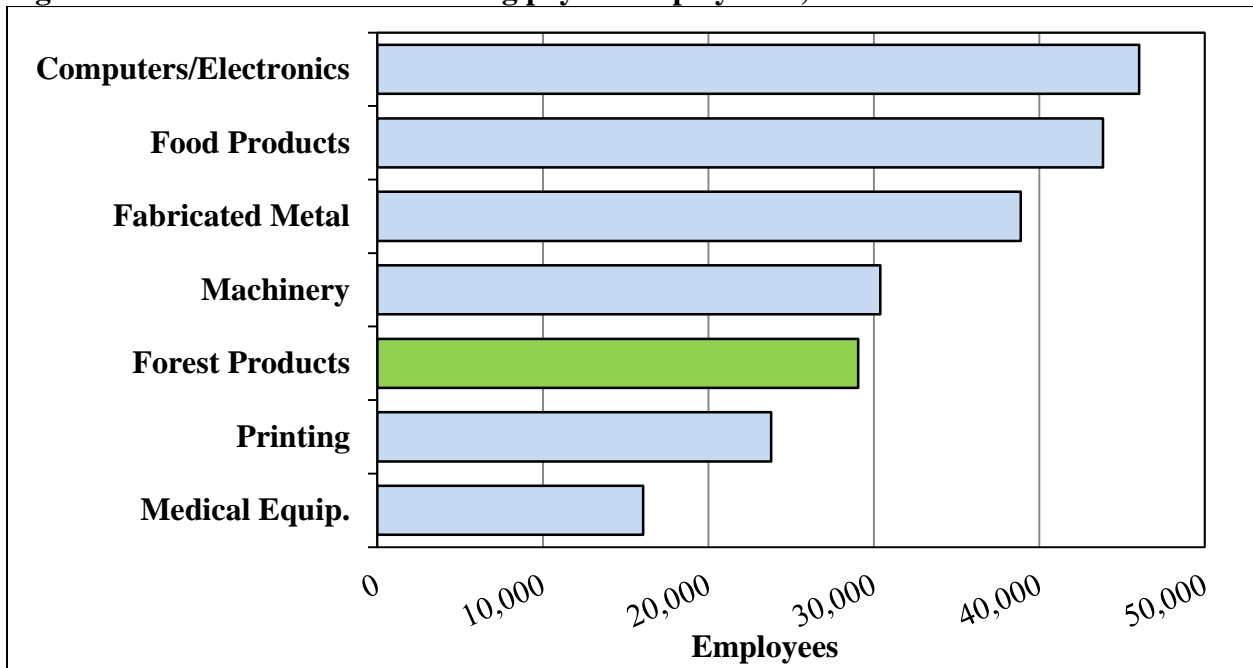
² To avoid the appearance of double counting, forestry and logging were discounted from primary manufacturing estimates of output and value added.

Figure 4.1. Forest industry gross state product per capita, 2010.



Source: Don Deckard, Minnesota DNR, Division of Forestry.

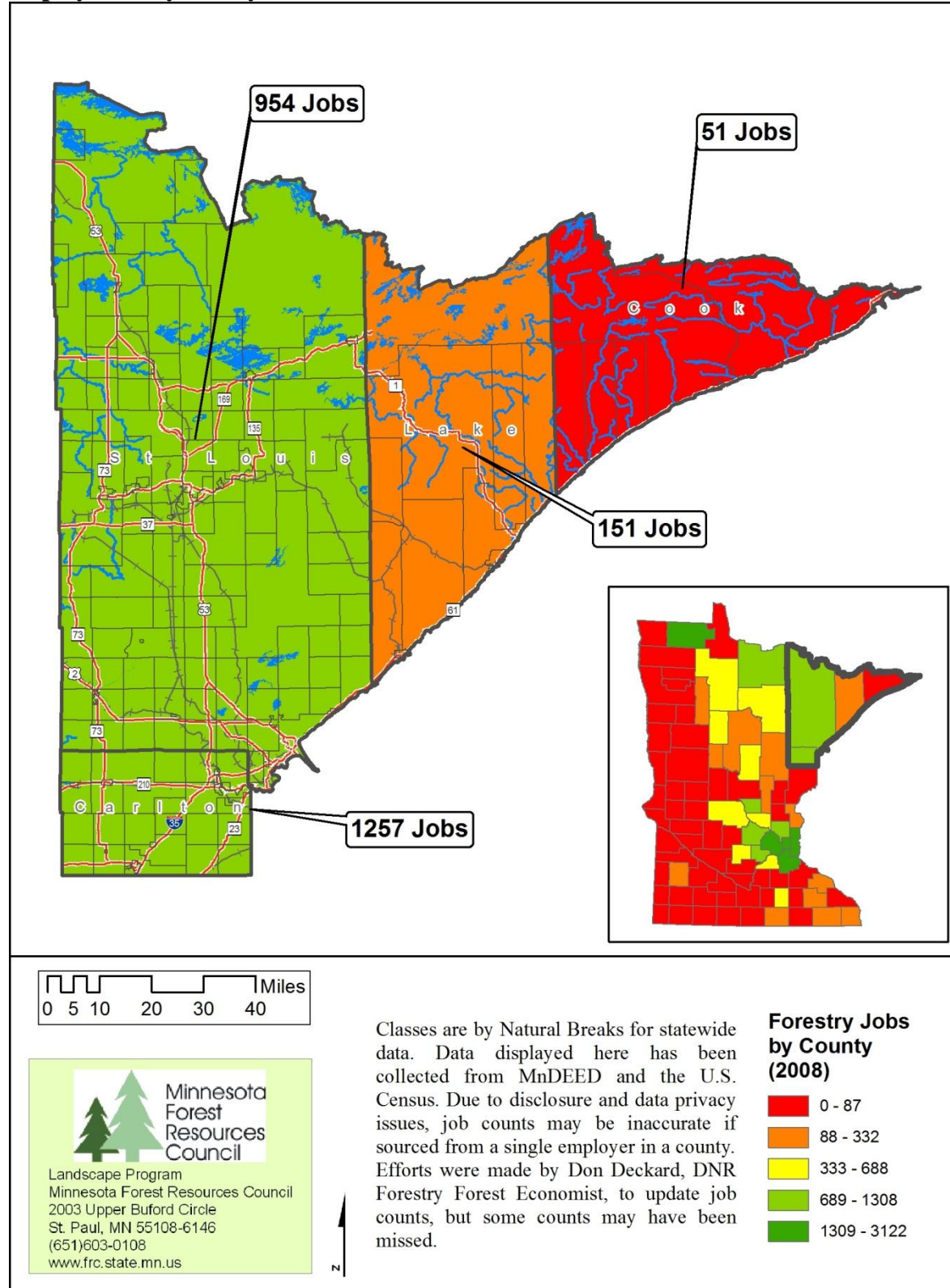
Figure 4.2. Minnesota manufacturing payroll employment, 2011.



Source: Don Deckard, Minnesota DNR, Division of Forestry.

Note: Forest products employment value includes Forestry and Logging (Industry Code; 113), Support Activities for Forestry (Industry Code; 1153), Wood Product Manufacturing (Industry Code; 321), Paper Manufacturing (Industry Code; 322), 50% of Furniture and Related Product Manufacturing total (Industry Code; 337), and Forest Products Non-employer values.

Figure 4.3. Estimated forest products manufacturing and related sectors direct employment by county.



Source: Minnesota Department of Employment and Economic Development 2008 county employment data and U.S. Census Economic Census 2007, Geographic Series: Non-Employer Statistics data. Originally compiled for Deckard and Skurla 2011.

Table 4.2. Forestry related jobs by Minnesota County, 2008.

State Rank	County	Jobs
1	Washington	3,122
2	Roseau	2,614
3	Ramsey	2,294
4	Dakota	2,291
5	Hennepin	2,149
6	Anoka	1,308
7	Carlton	1,257
8	Wright	1,151
9	Koochiching	1,089
10	Benton	1,079
11	St. Louis	954
29	Lake	151
40	Cook	51

Source: Deckard and Skurla 2011.

Table 4.3. Forest industry related facilities in Minnesota.

Manufacturing & Energy Facilities 2012	
Pulp & Paper Mills	4 (Verso, Sartell shutdown 8/12)
Recycled Pulp & Paper Mills	3
Hardboard & Specialty Plants	1 (G-P, Duluth shutdown 8/12)
Oriented Strand Board / Structural Panel Plants	2
Sawmills	500+
Specialty Businesses	150
Secondary Manufacturers	800+
Renewable Energy ¹	14

Source: Don Deckard, Minnesota DNR, Division of Forestry

¹Includes: electricity generation, combined heat & power (CHP), and fuel pellet manufacturing facilities with >10,000 cord annual consumption.

Table 4.4. Top 25 sectors which primary and secondary forestry industry and related employment supports in Minnesota.

IMPLAN¹ Industry Sector	Direct	Indirect	Induced	Total
Wood windows, doors, and millwork mfg	9,427	--	--	9,427
Wood kitchen cabinet and countertops	6,963	--	--	6,963
Paperboard container mfg	4,320	--	--	4,320
Wholesale trade businesses	0	3,351	863	4,214
Food services and drinking places	0	989	2,945	3,934
Paper mills	3,128	--	--	3,128
Commercial logging	0	2,415	2	2,417
Real estate establishments	0	727	1,250	1,977
Transport by truck	0	1,326	232	1,558
Wood container and pallet manufacturing	1,328	--	--	1,328
Custom architectural woodwork and millwork manufacturing	1,423	--	--	1,423
Coated and laminated paper, packaging paper and plastics film manufacturing	1,369	--	--	1,369
Engineered wood member and truss mfg	1,365	--	--	1,365
Private hospitals	0	0	1,343	1,343
Offices of physicians, dentists, and other health practitioners	0	0	1,322	1,322
Employment services	0	748	528	1,276
Stationery product manufacturing	1,270	--	--	1,270
Reconstituted wood product mfg	1,089	--	--	1,089
Services to buildings and dwellings	0	866	310	1,177
Sawmills and wood preservation	752	--	--	752
All other paper bag and coated and treated paper manufacturing	1,135	--	--	1,135
Showcase, partition, shelving, and locker manufacturing	1,091	--	--	1,091
Nursing and residential care facilities	0	0	1,091	1,091
Management of companies and enterprises	0	946	128	1,074
Retail Stores - General merchandise	0	64	968	1,032
Additional jobs in another 362 sectors of the economy . . .				29,700
Total	37,096	21,752	27,928	86,775

Source: Deckard and Skurla 2011.

¹ IMPLAN – (IMpact analysis for PLANning) software and data combines classic economic input-output analysis with regional specific social accounting matrices and multiplier models.

Table 4.5. State and local taxes generated by forestry-related sectors in Minnesota.

IMPLAN Description	Employee Compensation	Indirect Business Tax	Households	Corporations
Dividends				\$37,398,390
Soc Ins Tax- Employee Contribution	\$1,974,716			
Soc Ins Tax- Employer Contribution	\$8,495,870			
Indirect Bus Tax: Sales Tax		\$202,151,383		
Indirect Bus Tax: Property Tax		\$136,247,661		
Indirect Bus Tax: Motor Vehicle Lic		\$5,466,657		
Indirect Bus Tax: Severance Tax		\$1,449,264		
Indirect Bus Tax: Other Taxes		\$24,804,628		
Indirect Bus Tax: S/L Non-Taxes		\$25,258,558		
Corporate Profits Tax				\$23,103,363
Personal Tax: Income Tax			\$128,709,352	
Personal Tax: (Fines- Fees)			\$13,822,303	
Personal Tax: Vehicle License			\$6,477,967	
Personal Tax: Property Taxes			\$1,535,282	
Personal Tax: (Fish/Hunt)			\$4,177,554	
Total State and Local Tax	\$10,470,586	\$395,378,147	\$154,722,456	\$60,501,753

Source: Deckard and Skurla 2011.

Note: Estimated total state and local tax impact from all sources equally \$621 million.

¹ IMPLAN – (IMpact analysis for PLANning) software and data combines classic economic input-output analysis with regional specific social accounting matrices and multiplier models.

4.2.1. Harvesting trends

Minnesota's all-ownership annual timber harvest volume last peaked in 2005 at 3.7 million cords (Figure 4.4). As a result of recession induced mill closures, harvest volume declined to about 2.6 million cords in 2012. This is largely due to the significant decline in harvest of private and tribal forests. Since 2005, harvest volume from private and tribal ownership decreased from 55% of total all-ownership harvest volume to 34% of total all-ownership harvest volume in 2012. Meanwhile the volume of timber harvested from public land has stayed relatively constant over this time period but has increased from 45% to 66% of total all-ownership harvest volume (Figure 4.5). Data averaged from 2008-2010 indicates the statewide public land harvest is broken down roughly 47% state, 43% county, and 10% federal ownership (Table 4.6). There has also been a trend toward a higher percentage of wood being harvested during winter (December, January, February) and less in summer (June, July, August) when loggers have indicated most excess capacity is available.

Approximately 2.7 million cords are harvested annually in the state of Minnesota with 72% being used as pulp wood and the remaining 28% being used for sawlogs, specialty products, and fuel wood (Table 4.7). In 2008, St. Louis County accounted for almost 1.7 times more cords harvested than any other county in the state. The other three counties in the Northeast Landscape rank 9th, 10th, and 15th in the state for harvested cords and the four counties combined account for 823,432 cords or 31% of the roughly 3 million cord statewide all-ownership timber harvest (Table 4.8, Figure 4.6).

Annual public land timber sales in the Northeast Landscape have totaled approximately 450,000 cords over the last five years (Figure 4.7). Aspen accounts for 45% these annual public land timber sales with other key species being spruce (16 %), birch (11 %), and pine (9%).

Pulpwood harvest in the Northeast Landscape peaked at nearly 965,000 cords in 2005 and has dropped to 621,000 following the recession and regional mill closures (Figure 4.8). Roughly 70% of this total comes from St. Louis County with Lake and Carlton counties accounting for 10-15% and Cook County less than 5%. Despite the change in pulpwood harvest from 2005 to 2010, the percent of the statewide pulpwood harvest coming from the Northeast Landscape has remained relatively steady at approximately 30%.

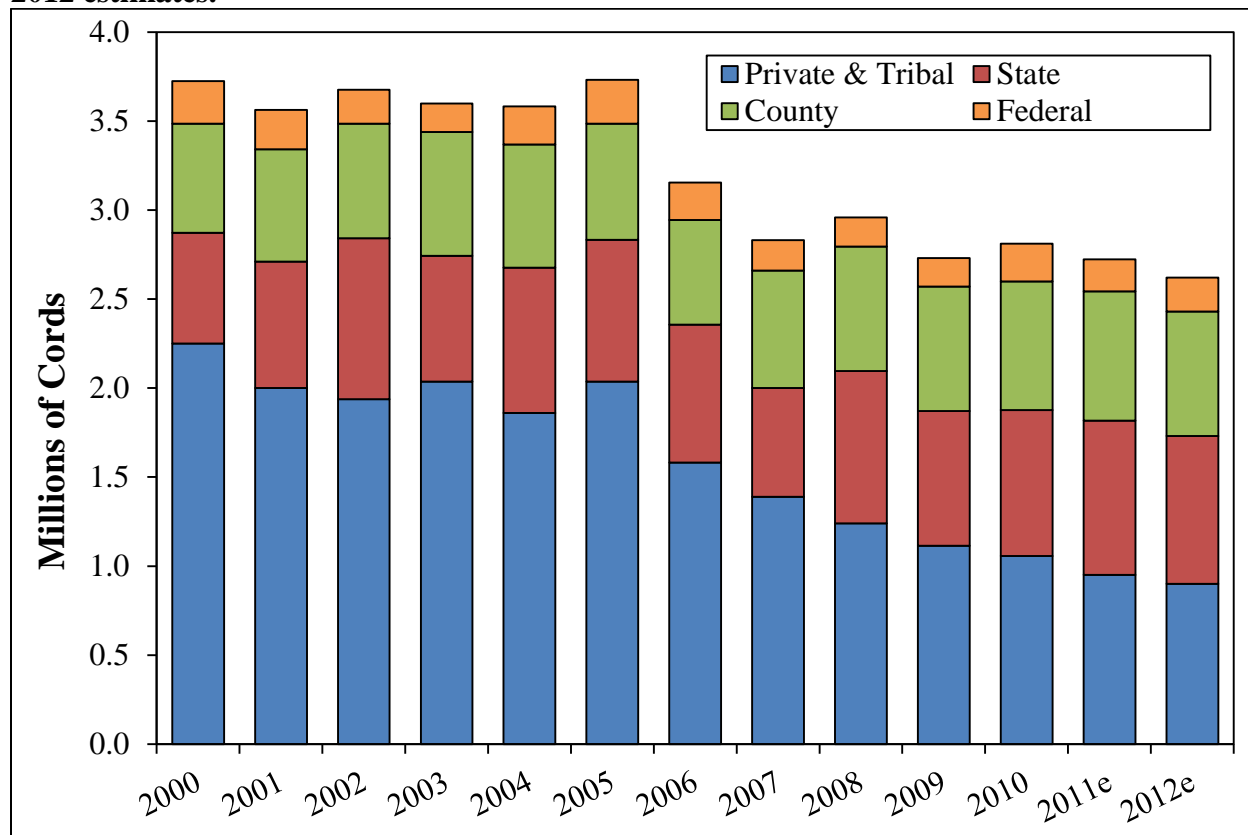
Sawtimber harvest in the Northeast Landscape has stayed relatively steady around 50 million board feet during each survey year from 1992 to 2010 (Figure 4.9). The percentage from individual counties varies by year, but recent trends show approximately 65% of the sawtimber coming from St. Louis County and the remaining 35% split among the other three counties.

Superior National Forest annual harvest volume has declined since it peaked in the early 1990's but has been rebounding since a low of 27,930 million board feet (mbf) in 2007 to 59,000 mbf in 2012 (Table 4.9 and Figure 4.10). The volume offered for sale has followed a similar pattern with a peak of 101,690 mbf available in 1990, dropping to 32,204 mbf in 2009, and climbing back up to 58,814 mbf in 2012 (Table 4.10); this table also gives a general sense of spatial differences in timber harvest within the region.

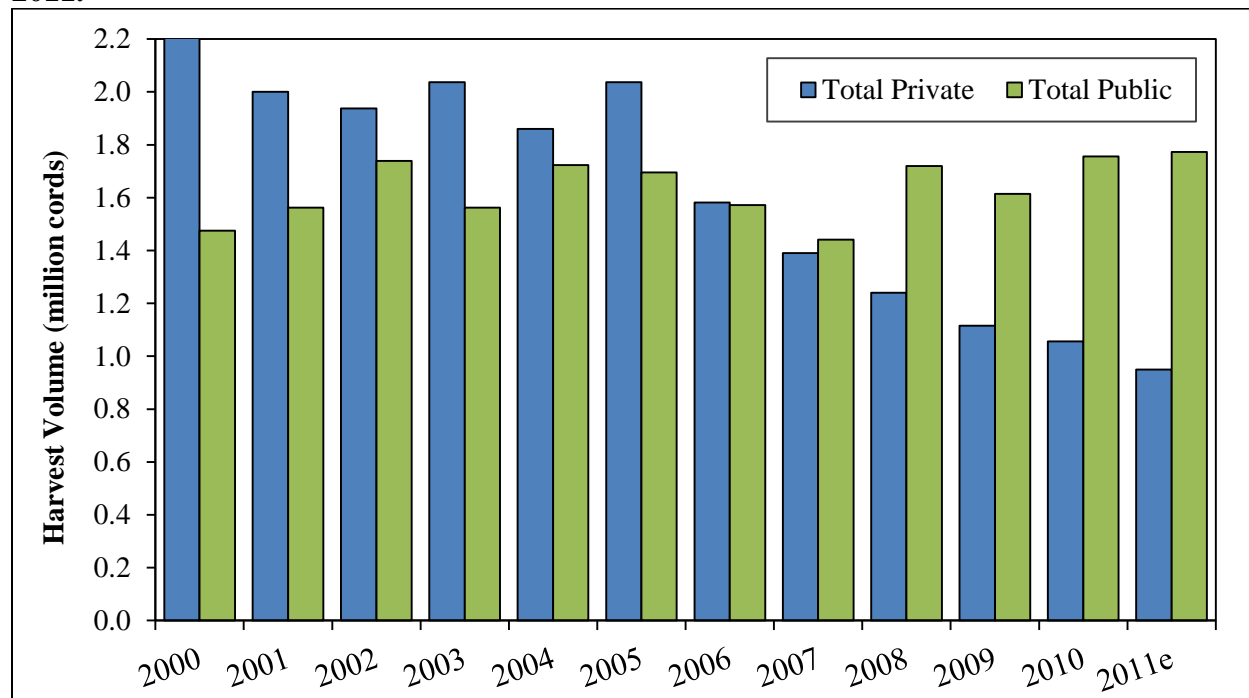
The use of woody biomass as a feedstock for bioenergy has emerged as a prominent issue in the Lake States. In the D’Amato et al., 2009 study a total of 7,642 acres were reportedly sold specifically as biofuels harvests in 2008, with the majority of that acreage on state and county lands and to a lesser extent on industry and Native American ownerships (Table 4.11). This acreage is likely an underestimate of the total amount of sales involving biofuels, as this information is not recorded separately on timber sale documents for all agencies. Biofuels harvests focused primarily on logging residues, although roundwood, sub-merchantable trees, and hard snags were harvested for biofuels on 20, 72, and 17% of biofuel sales, respectively (Table 4.11). Although logging residues were largely collected from piles at landings, 21% of biofuels harvests involved a second entry into the stand to collect harvest residues.

A number of cottage industries are supported in rural communities throughout Minnesota on non-timber forest products (NTFP). The economic impact of this NTFP’ can be substantial. For example, the Minnesota fir bough and wreath business exceeded \$23 million in 2007 (Deckard and Skurla 2011). NTFPs include: decorative products such as fir boughs, decorative spruce tops, cones, birch bark, and vines; specialty wood products, e.g., woven baskets and burls; edible products such as maple syrup, nuts, and mushrooms; and medicinal and herbal products such as ginseng. Harvest numbers are difficult to estimate for many of these industries.

Figure 4.4. Statewide trends in timber harvesting by ownership class, 2000-2010 and 2011-2012 estimates.



Source: Don Deckard, Minnesota DNR, Division of Forestry

Figure 4.5. Minnesota all-ownership trends in timber harvesting by calendar year, 2000-2011.

Source: Don Deckard, Minnesota DNR, Division of Forestry

Table 4.6. Minnesota annual industrial timber harvest volume and stumpage value by ownership.

Ownership	Harvest (Cords)	Market Share (% Cords)
Family and Tribal	1,000,000	33%
State DNR	775,000	26%
County and Local Govt.	720,000	24%
Industrial / Corporate	350,000	12%
Federal	160,000	5%
Total	3,005,000	100%

Source: Deckard and Skurla 2011.

Note: Three-year average harvest volumes do not include residential fuelwood at 200,000 cords per year. Stumpage values from Minnesota DNR, Public Stumpage Price Review.

Table 4.7. Minnesota timber harvest estimate, 2011.

Timber Harvest 2011 (est.)	Million cords ¹	% of total cords
Pulpwood	1.9	72%
Sawlogs & Specialty Products	0.5	18%
Fuel wood	0.3	10%
Total	2.7	100%

Source: Don Deckard, Minnesota DNR, Division of Forestry.

¹Cord = 80 cubic feet of solid wood.

Figure 4.6. Minnesota all-owner annual timber harvest volume by county, 2008.

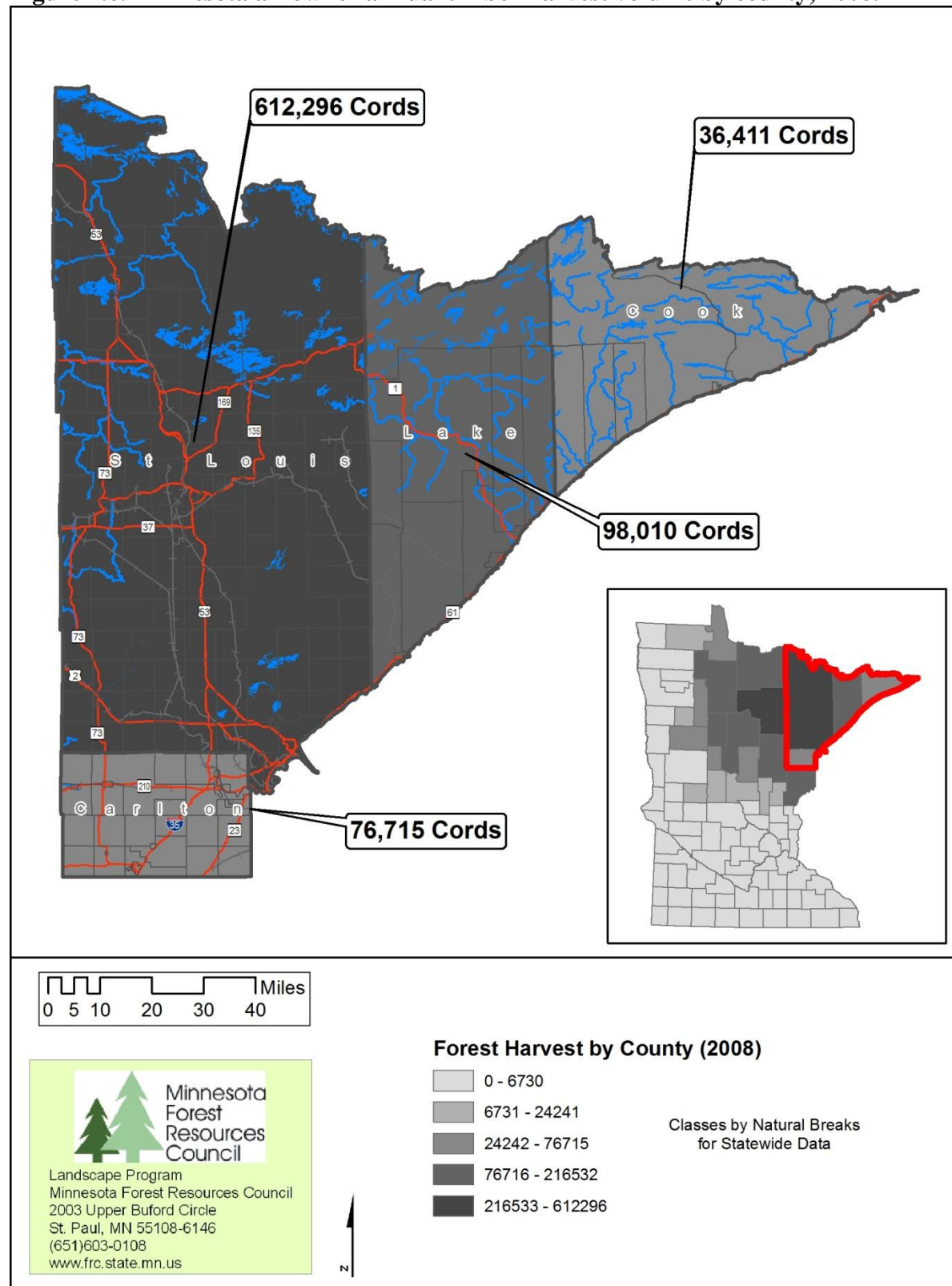
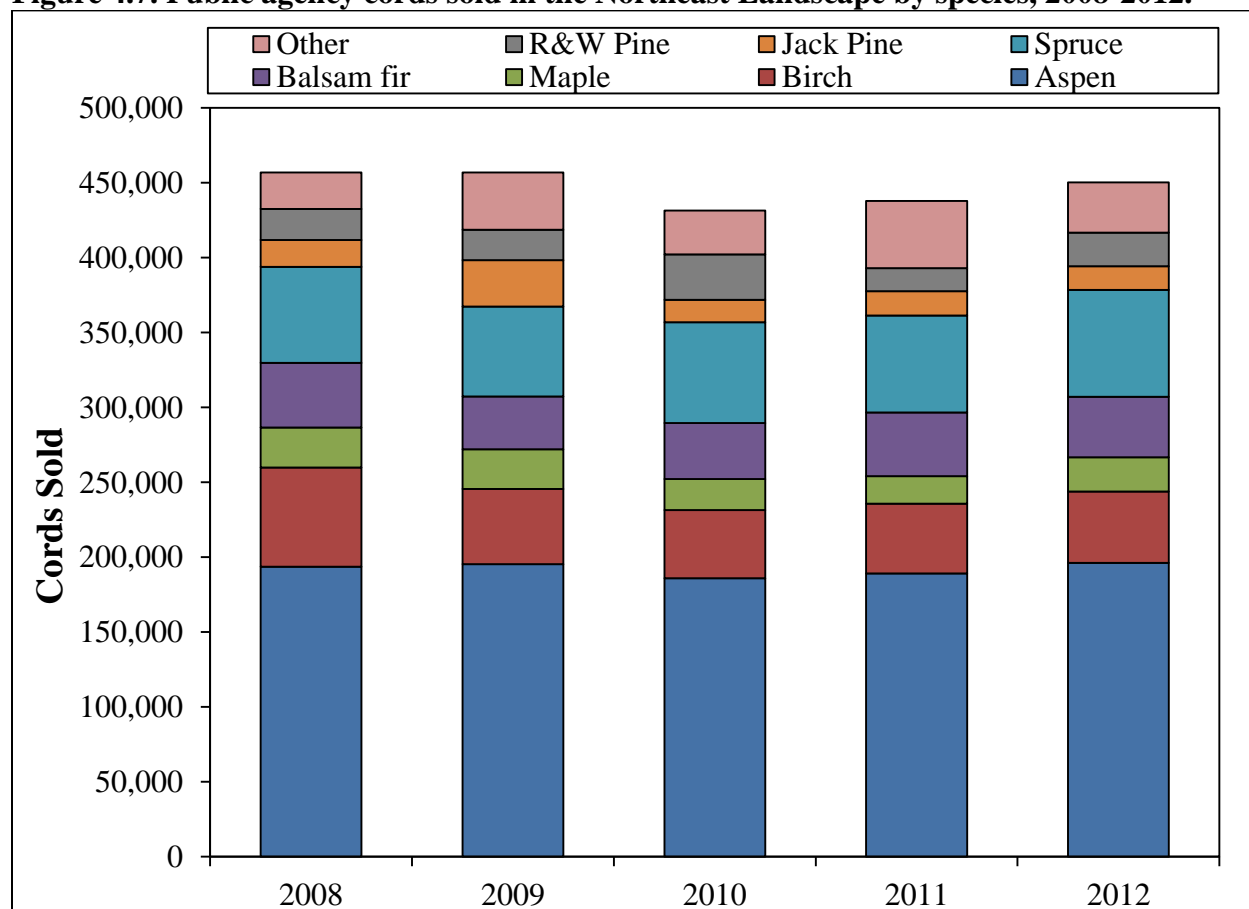


Table 4.8. Timber harvest by Minnesota County, 2008.

State Rank	County	Cords
1	St. Louis	612,296
2	Itasca	361,457
3	Koochiching	216,532
4	Beltrami	208,049
5	Cass	194,043
6	Aitkin	178,416
7	Pine	125,800
8	Hubbard	114,842
9	Lake	98,010
10	Carlton	76,715
15	Cook	36,411

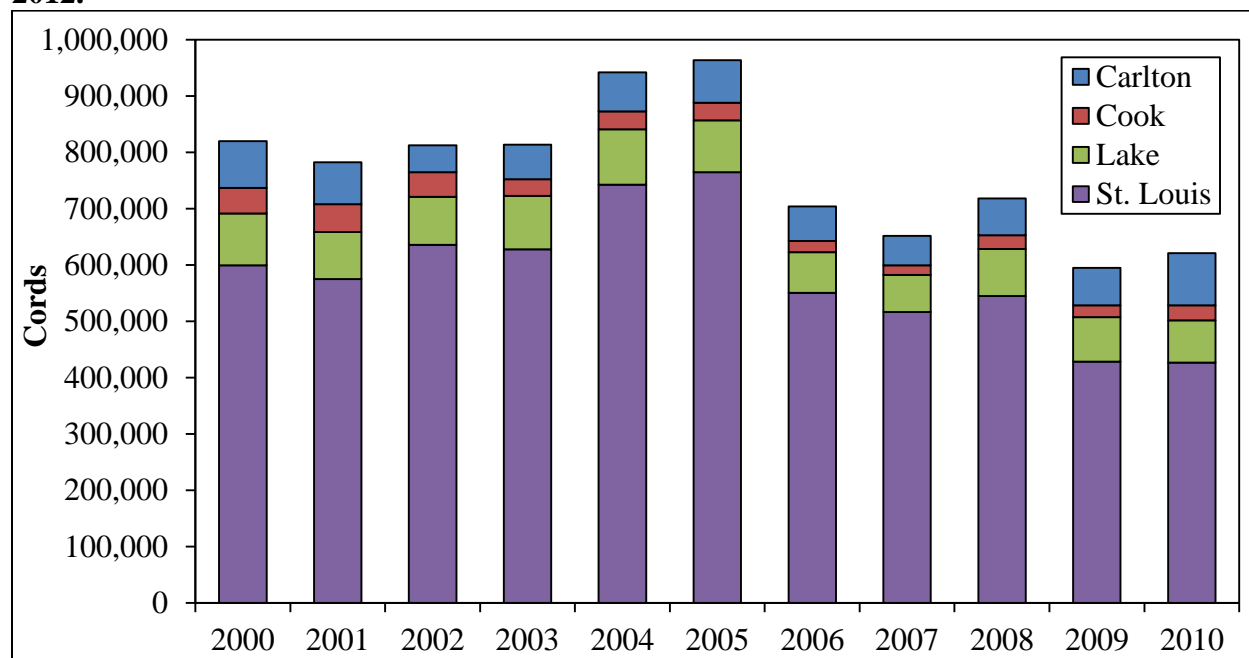
Source: Deckard and Skurla 2011.

Figure 4.7. Public agency cords sold in the Northeast Landscape by species, 2008-2012.



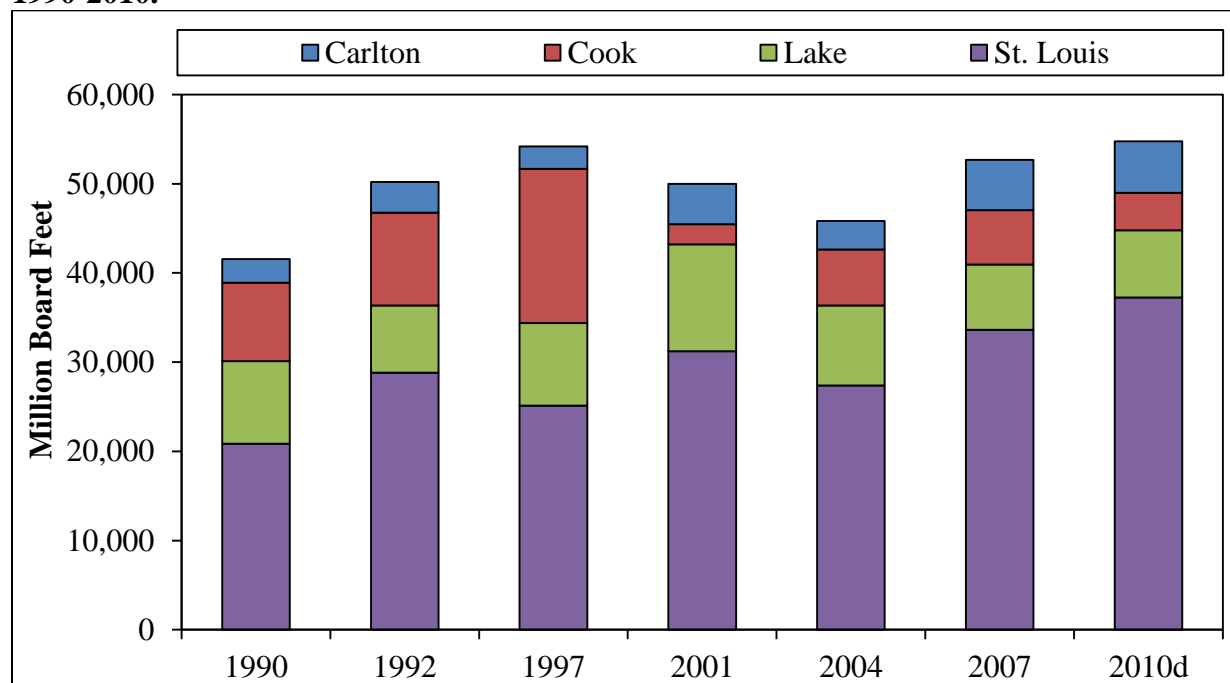
Source: Minnesota Public Agency Stumpage Price Review and MnDNR Timber Sales database. Compiled by Don Deckard, Minnesota DNR, Division of Forestry.

Figure 4.8. Northeast Landscape all-ownership pulpwood timber harvest by county, 2000-2012.



Source: US Forest Service Annual Pulp Mill Surveys; compiled by Don Deckard, Minnesota DNR, Division of Forestry.

Figure 4.9. Northeast Landscape all-ownership sawtimber and specialty harvest by county, 1990-2010.



Source: Minnesota DNR periodic sawmill & specialty surveys, International 1/4-inch rule; compiled by Don Deckard, Minnesota DNR, Division of Forestry.

Note: 1990, 1992, 1997, 2004, and 2007 data published by USFS; 2001 and 2010(draft) not published.

Table 4.9. Superior National Forest summary timber volume targets, offered (sold*) volume and acres, and harvested volume and acres, fiscal year 1997 to 2012.

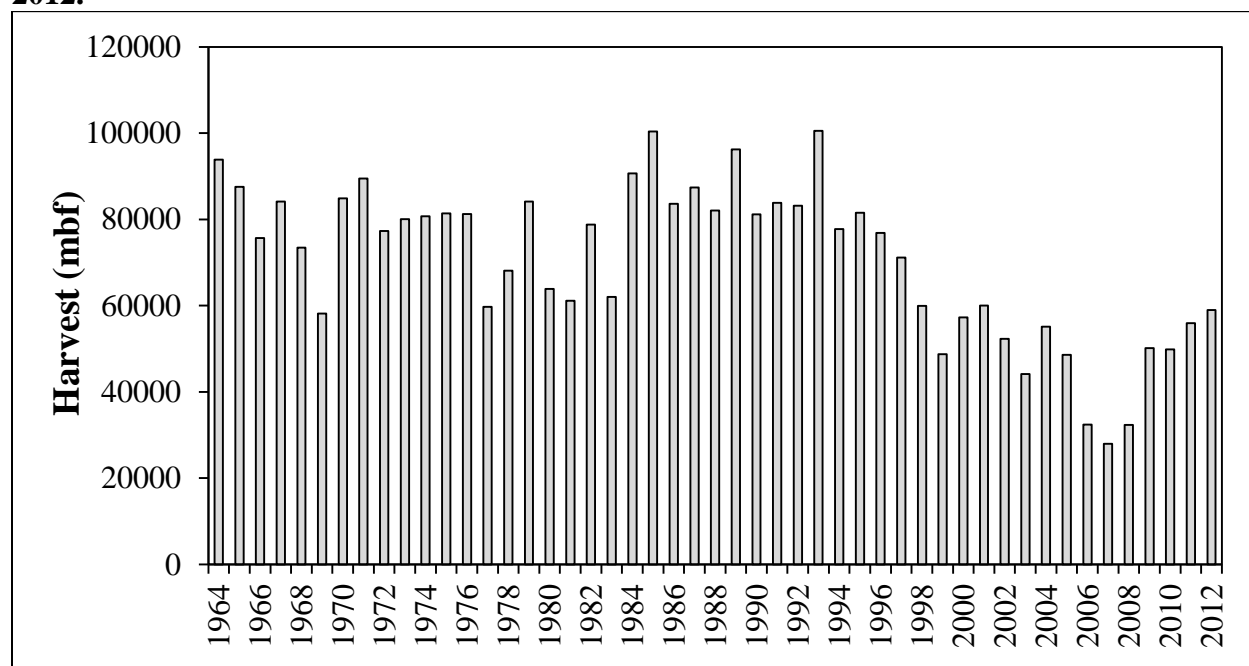
Fiscal Year	Target	Offered, Sold*		Harvested	
		MBF	Acres	MBF	Acres
1997	73,700	71,160	9,848	58,865	5,108
1998	74,000	59,964	6,835	57,208	6,281
1999	67,600	*48,736	4,257	55,764	3,768
2000	60,000	57,260	5,794	66,633	5,052
2001	62,000	59,998	8,527	71,408	5,366
2002	52,000	52,259	6,278	56,509	7,026
2003	46,000	**44,110	5,136	46,507	3,990
2004	50,000	50,111	3,665	55,147	3,919
2005	50,000	49,333	4,548	48,590	4,230
2006***	60,000	57,295	6,088	32,445	4,049
2007***	60,900	56,372	5,533	27,930	1,624
2008***	60,000	60,274	6,472	32,330	3,467
2009***	60,000	32,204	2,871	50,163	3,533
2010***	60,000	42,897	2,807	49,851	3,838
2011***	60,000	55,926	4,862	40,152	3,802
2012***	60,000	58,814	5,970	57,429	5,065

Source: US Forest Service, Superior National Forest

*17,000MBF was tied up in litigation and not offered in FY 1999

**2,800 MBF was tied up in litigation and not offered in FY 2003

*** Values from fiscal year 2006 onward represent what was actually sold. All preceding years represent value offered.

Figure 4.10. Superior National Forest annual harvest volume (million board feet), 1964 to 2012.

Source: US Forest Service, Superior National Forest

Table 4.10. Superior National Forest summary of offered (sold*) volume (million board feet), fiscal year 1978 to 2012.

FY	Laurentian	Gunflint	Isabella	Kawishiwi	LaCroix	Tofte	Two Harbors	Virginia	Total
1978	2,600	6,600	16,700	5,600	12,300	3,600	3,500	5,400	56,300
1979	7,739	9,092	13,468	1,611	9,141	5,071	1,354	10,210	57,686
1980	8,800	9,600	16,300	4,000	12,800	4,100	--	7,200	62,800
1981	8,800	13,100	15,800	700	10,100	3,700	--	9,400	61,600
1982	8,100	11,200	18,200	4,500	9,400	1,500	--	7,500	60,400
1983	8,400	8,200	14,800	500	6,700	2,000	--	2,300	42,900
1984	7,800	15,500	15,400	1,900	32,900	5,800	--	8,300	87,600
1985	9,100	14,900	14,100	3,500	17,400	5,000	--	9,700	73,700
1986	4,500	12,200	23,500	3,500	27,000	7,800	--	10,200	88,700
1987	8,100	16,000	19,400	3,900	18,300	6,900	--	10,700	83,300
1988	20,800	11,000	21,300	4,800	20,700	6,200	--	--	84,800
1989	21,459	15,265	18,782	4,316	31,132	7,419	--	--	98,373
1990	25,613	17,214	--	5,606	31,712	21,545	--	--	101,690
1991	21,418	13,848	--	6,308	28,530	13,690	--	--	83,794
1992	21,717	14,792	--	4,480	29,269	12,936	--	--	83,194
1993	23,128	20,706	--	7,735	33,685	15,253	--	--	100,507
1994	22,120	14,098	--	7,665	25,612	8,273	--	--	77,771
1995	24,010	10,551	--	6,252	23,846	16,877	--	--	81,536
1996	23,264	10,257	--	5,165	22,300	15,863	--	--	76,849
1997	17,212	13,706	--	9,990	20,718	9,534	--	--	71,160
1998	3,730	9,854	--	9,009	8,341	29,030	--	--	59,964
1999	768	13,132	--	2,525	20,068	12,243	--	--	48,736
2000	11,545	20,564	--	7,365	7,671	10,115	--	--	57,260
2001	11,556	10,733	--	5,685	20,686	11,338	--	--	59,998
2002	19,035	7,466	--	4,823	13,031	7,904	--	--	52,259
2003	326	748	--	5,097	30,216	7,724	--	--	44,110
2004	32,852	4,718	--	3,812	723	8,006	--	--	50,111
2005	26,468	4,705	--	6,422	451	11,287	--	--	49,333
2006*	20,426	3,486	--	6,016	1,125	26,242	--	--	57,295
2007*	17,984	13,329	--	17,990	123	6,946	--	--	56,372
2008*	31,025	12,763	--	3,849	839	11,798	--	--	60,274
2009*	6,263	727	--	180	22,399	2,635	--	--	32,204
2010*	843	355	--	8,923	24,320	8,456	--	--	42,897
2011*	9,134	10,980	--	5,958	15,101	14,612	--	--	55,785
2012*	11,251	3,584	--	12,645	15,059	16,275	--	--	58,814

Source: US Forest Service, Superior National Forest

Note: The Isabella, Two Harbors, and Virginia Ranger Stations were closed and consolidated with other ranger stations.

* Values from fiscal year 2006 onward represent what was actually sold. All preceding years represent million board feet offered.

Table 4.11. Summary of biofuels harvests reported within Minnesota in 2008. Percentages represent proportion of harvests.

Survey Variable	State	County	Federal	Forest Industry	Native American	Total
Number of respondents	1	7	2	1	4	15
Total acres of biofuel harvests	5,467	1,675	0	300	200	7,642
Percent of biofuels removed on second entry	25%	58%	-	0%	0%	21%
Percent of biofuel harvests where roundwood was sold as biofuel	25%	36%	-	10%	10%	20%
Percent of biofuel harvests for which:						
Sub-merchantable materials were harvested	75%	65%	-	75%	-	72%
Hard snags were harvested	15%	2%	-	50%	0%	17%

Source: D'Amato et al., 2009

Note: Harvest levels are likely an underestimate, as not all agencies recorded biofuels harvests separately from roundwood harvests.

4.2.2. Forest product exports and imports

No good information is available on imports and exports on the county level for northeastern Minnesota so the following section provides forest product import-export data on the state level.

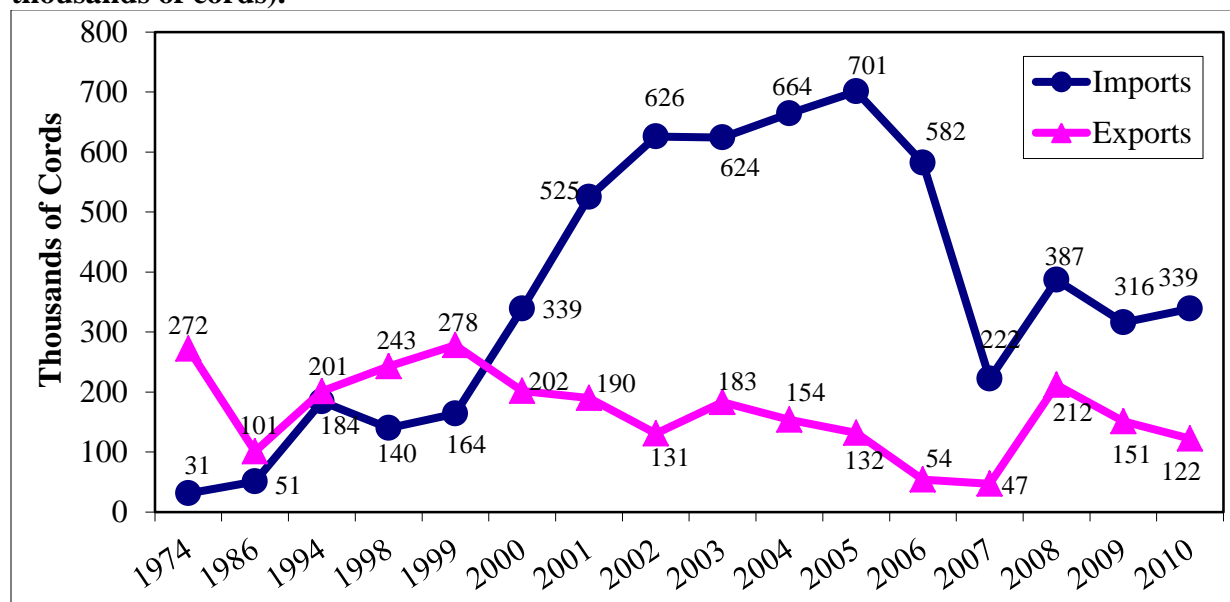
Minnesota has been a net importer of pulpwood since 2000; peaking at 701,000 cords in 2005. (Figure 4.11). As mill demand and stumpage prices increased in the mid-2000's, mills increasingly looked outside of Minnesota's borders in order to meet their raw material needs, especially for aspen and maple. Imports in 2008 were largely from Wisconsin (303,600 cords), with fair amounts from Canada and Michigan. Minnesota pulpwood exports are mainly to Canadian and Wisconsin mills and ranged from 278,000 to 47,000 cords between 1974 and 2010. While Minnesota remains a net importer of timber, imports remain substantially less than 2005 levels. The change has been due to several factors, most notably reduced demand due to mill closures and slowdowns.

Sixty-two percent of the \$47 million dollars of 'logs and other wood in the rough' transported in Minnesota has a final destination out of the state; most of this is sent to Wisconsin. Minnesota exports \$15.3 million in raw forestry products to other countries. China is the state's number one trade partner, importing \$5.1 million or 33% of all Minnesota raw forestry product exports to other countries (Figure 4.12).

Forty three percent (\$2.8 billion) of the \$6.6 billion of manufactured wood products shipments originating in Minnesota is utilized in-state and 57% (\$3.8 billion) is shipped to other states. Primary U.S. markets for Minnesota manufactured wood products include: Wisconsin, Illinois, Michigan, Iowa, and North Dakota (Figure 4.13). Minnesota also exports \$87.7 million worth of manufactured wood products to other countries. Canada is the state's number one trade partner in wood products, importing \$57 million or 65% of all Minnesota wood products exports to other countries (Figure 4.14).

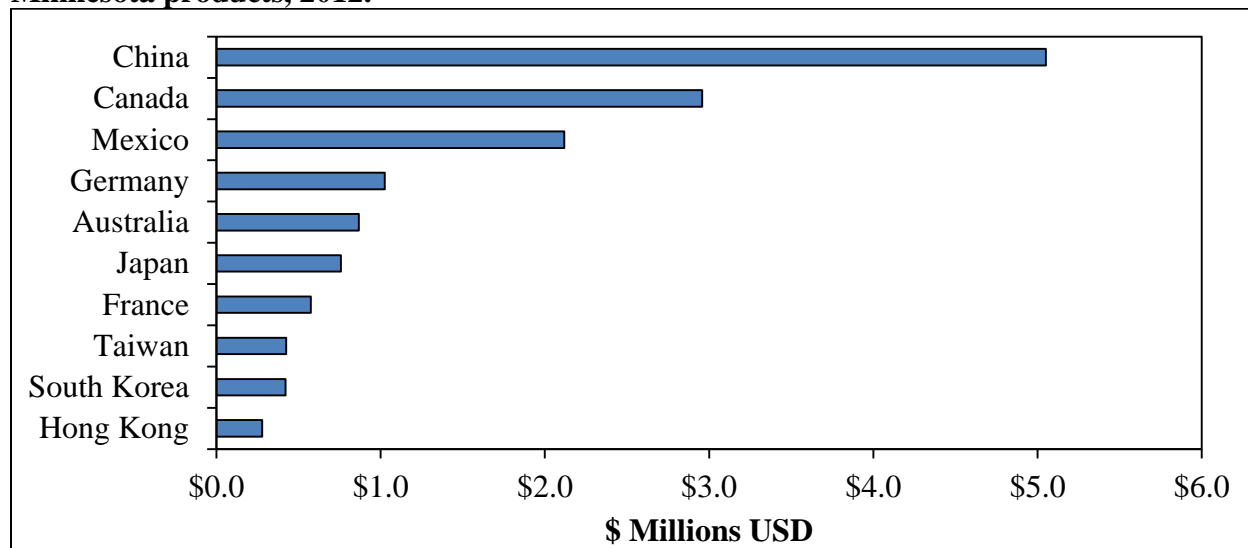
Approximately forty one percent of the \$4.9 billion in pulp, paper, and paperboard shipments originating in Minnesota is utilized in-state and 59% is shipped to other states including Wisconsin, Illinois, Iowa, Indiana, and California (Figure 4.15). Minnesota exports \$706 million in pulp, paper, and paperboard products to other countries. China and Canada are the state's top two trade partners in pulp, paper, and paperboard, importing about 22% and 18% respectively (Figure 4.16).

Figure 4.11. Minnesota imports and exports of roundwood pulpwood, 1974-2010 (Values thousands of cords).



Source: US Forest Service Mill Surveys

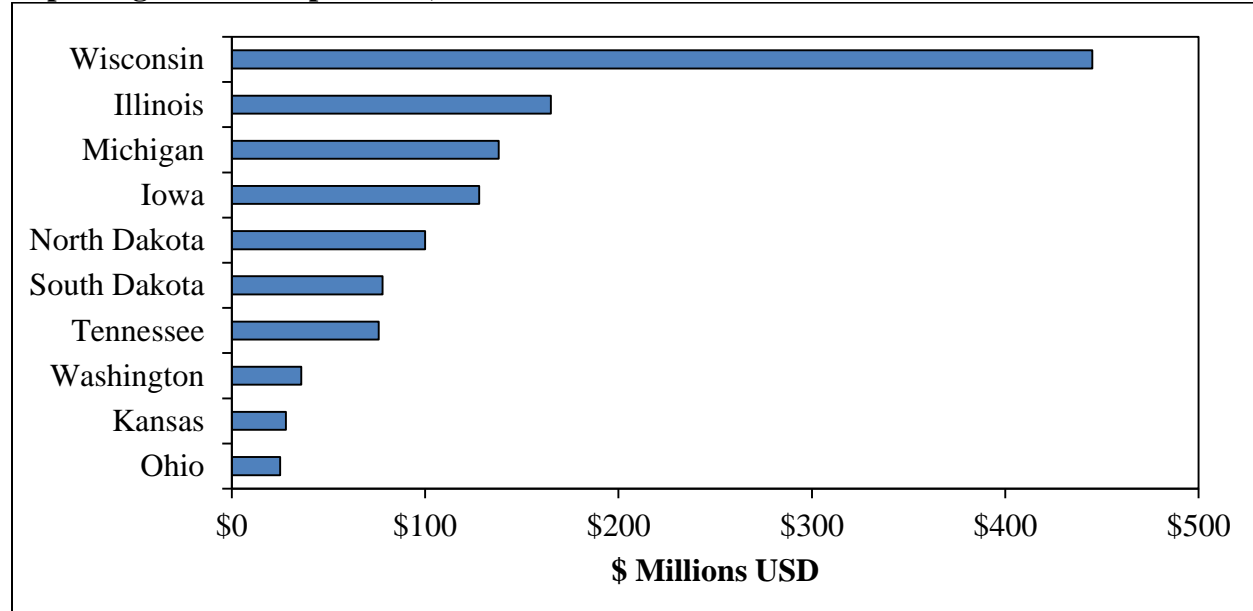
Figure 4.12. Minnesota forestry product exports (NAICS 113), top ten countries importing Minnesota products, 2012.



Source: Office of Trade and Industry Information, Manufacturing and Services, International Trade Administration, U.S. Department of Commerce. Trade Statistics Express Database.

Note: NAICS 113 "Forestry and Logging" is a non-manufactured goods sector which includes industries that grow and harvest timber on a long production cycle greater than 10 years and establishments gathering forest products, such as gums, barks, balsam needles, rhizomes, fibers Spanish moss, ginseng and truffles.

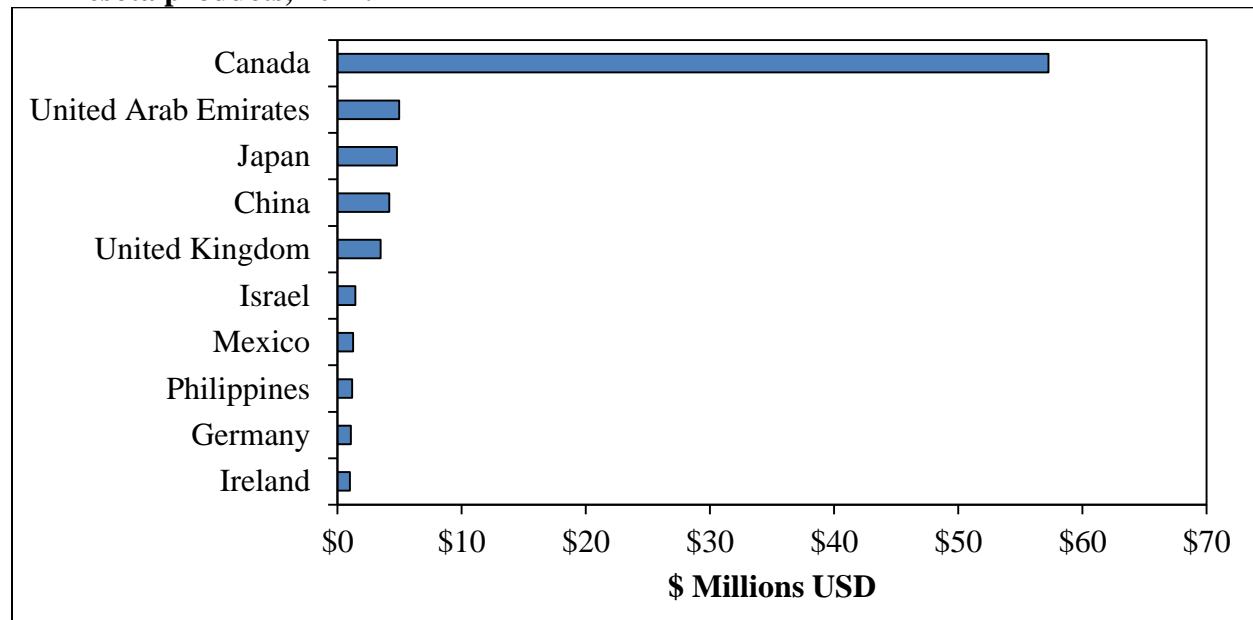
Figure 4.13. Minnesota ‘Wood Products - SCTG Code # 26’ exports, top ten states importing Minnesota products, 2007.



Source: U.S. Census Bureau, 2007 Commodity Flow Survey.

Note: Standard Classification of Transported Goods (SCTG) Code # 26 “Wood Products” includes: Wood chips or particles, lumber, plywood, veneer, laminated wood, shingles and shakes, particle board, fiberboard, windows, doors, frames and thresholds, wood packing containers, cable drums, pallets, skids, and cask and barrels, and other wood products, not elsewhere classified.

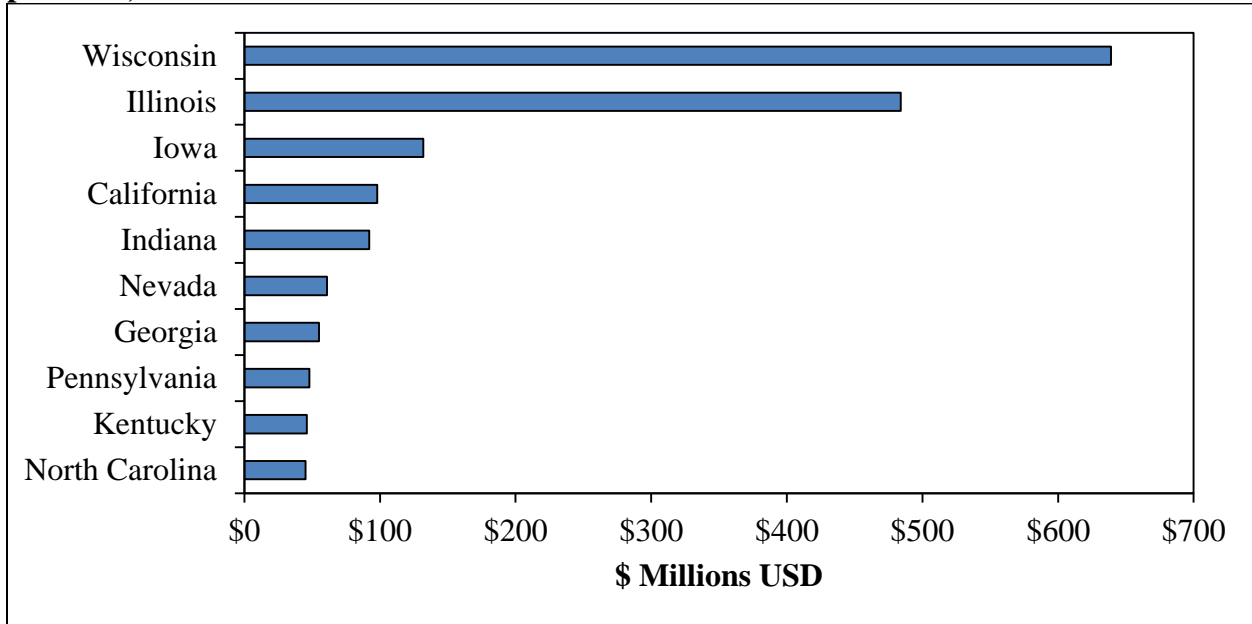
Figure 4.14. Minnesota wood product exports (NAICS 321), top ten countries importing Minnesota products, 2012.



Source: Office of Trade and Industry Information, Manufacturing and Services, International Trade Administration, U.S. Department of Commerce. Trade Statistics Express Database.

Note: NAICS 321 “Wood Products” is a manufactured goods sector which includes industries that manufacture wood products, such as lumber, plywood, veneers, wood containers, wood flooring, wood trusses, manufactured homes (i.e., mobile homes), and prefabricated wood buildings.

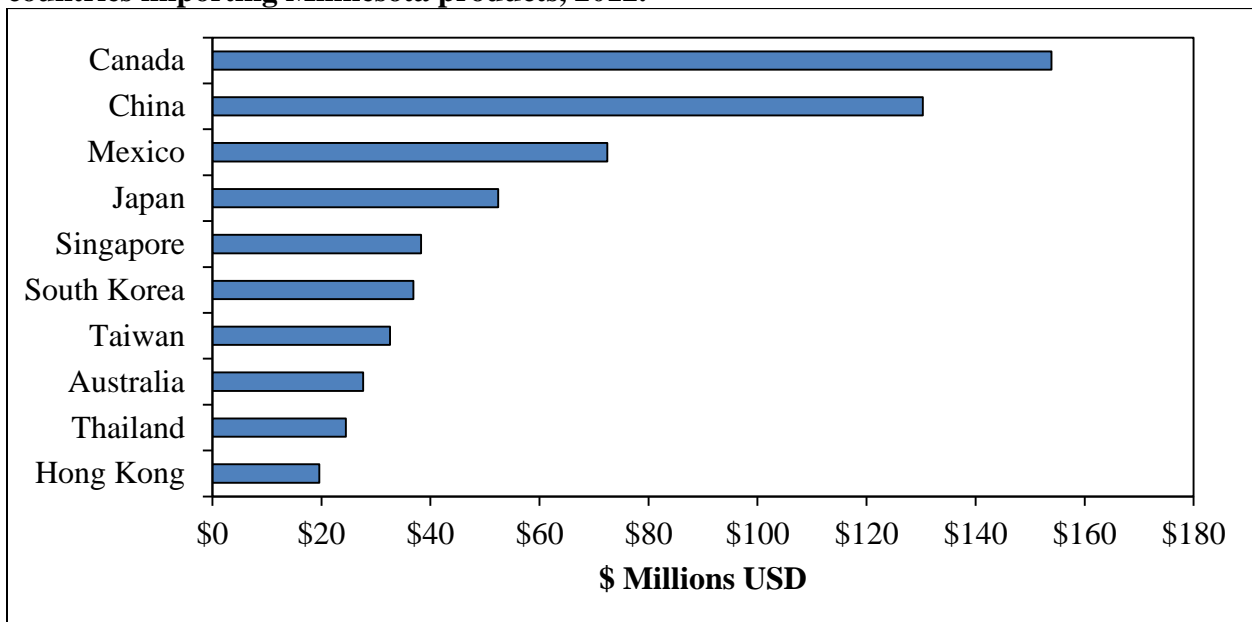
Figure 4.15. Minnesota ‘Pulp, Paper, and Paperboard - SCTG Code # 27’ and ‘Paper and Paperboard Articles - SCTG Code # 28’ exports, top ten states importing Minnesota products, 2007.



Source: U.S. Census Bureau, 2007 Commodity Flow Survey.

Note: Standard Classification of Transported Goods (SCTG) Code # 27 “Pulp, Paper, and Paperboard” includes: Pulp of fibrous cellulosic materials and paper and paperboard in largerolls or sheets. SCTG Code # 28 “Paper and Paperboard Articles” includes other paper and paperboard articles. See the following website for a full definition: [http://bhs.econ.census.gov/bhs/cfs/Commodity%20Code%20Manual%20\(CFS-1200\).pdf](http://bhs.econ.census.gov/bhs/cfs/Commodity%20Code%20Manual%20(CFS-1200).pdf)

Figure 4.16. Minnesota pulp, paper, and paperboard exports (NAICS 322), top ten countries importing Minnesota products, 2012.



Source: Office of Trade and Industry Information, Manufacturing and Services, International Trade Administration, U.S. Department of Commerce. Trade Statistics Express Database.

Note: NAICS 322 “Paper manufacturing” is a manufactured goods sector which make pulp, paper, or converted paper products.

4.2.3. Mill consumption capacities

Mills in the Northeast Landscape, and those with procurement areas within the four county area, report consumption of nearly 2 million cords annually (Table 4.12). These numbers have been affected by the closure of the Ainsworth and Georgia-Pacific plants and may underrepresent the true consumption in the region, as data for the Laurentian Energy Authority and Minnesota Power biomass energy plants was not available.

Table 4.12. Roundwood consumption capacities of mills in the Northeast Landscape and those with procurement areas within the four county area. (Values are cords)

Name	County	City	Product	2010 Reported Consumption*	2011 Reported Consumption*	2012 Reported Consumption*	Notes
Ainsworth	St. Louis	Cook	OSB	0	0	0	Closed Jan 2009
Boise Inc. (1)	Koochiching	International Falls	Paper	508,386	509,324	543,454	
Georgia-Pacific Superwood	St. Louis	Duluth	Hardboard	43,080	44,860	25,166	Closed Aug 2012
Hedstrom Lumber	Cook	Grand Marais	Lumber	28,288	27,571	29,019	
Jarden Home Brands, Inc.	Carlton	Cloquet	Matches	4,076	3,453	3,689	
Louisiana-Pacific Corp.	Lake	Two Harbors	OSB Siding	68,317	66,043	95,260	
NewPage	St. Louis	Duluth	Paper	132,454	144,189	140,601	
SAPPI	Carlton	Cloquet	Pulp & Paper	893,830	916,550	866,603	
Savanna Pallet (1)	Aitkin	McGregor	Pallets, Lumber	35,157	47,118	41,340	
UPM Blandin (1)	Itasca	Grand Rapids	Paper	213,954	214,796	200,247	
Column Totals				1,927,542	1,973,904	1,945,379	

Source: Minnesota Department of Labor and Industry – Compiled by Minnesota DNR

*Reporting required under Minn. Stat. § 176.130, Targeted Industry Fund - Loggers.

(1) Mill procurement area includes the four Northeast Landscape counties.

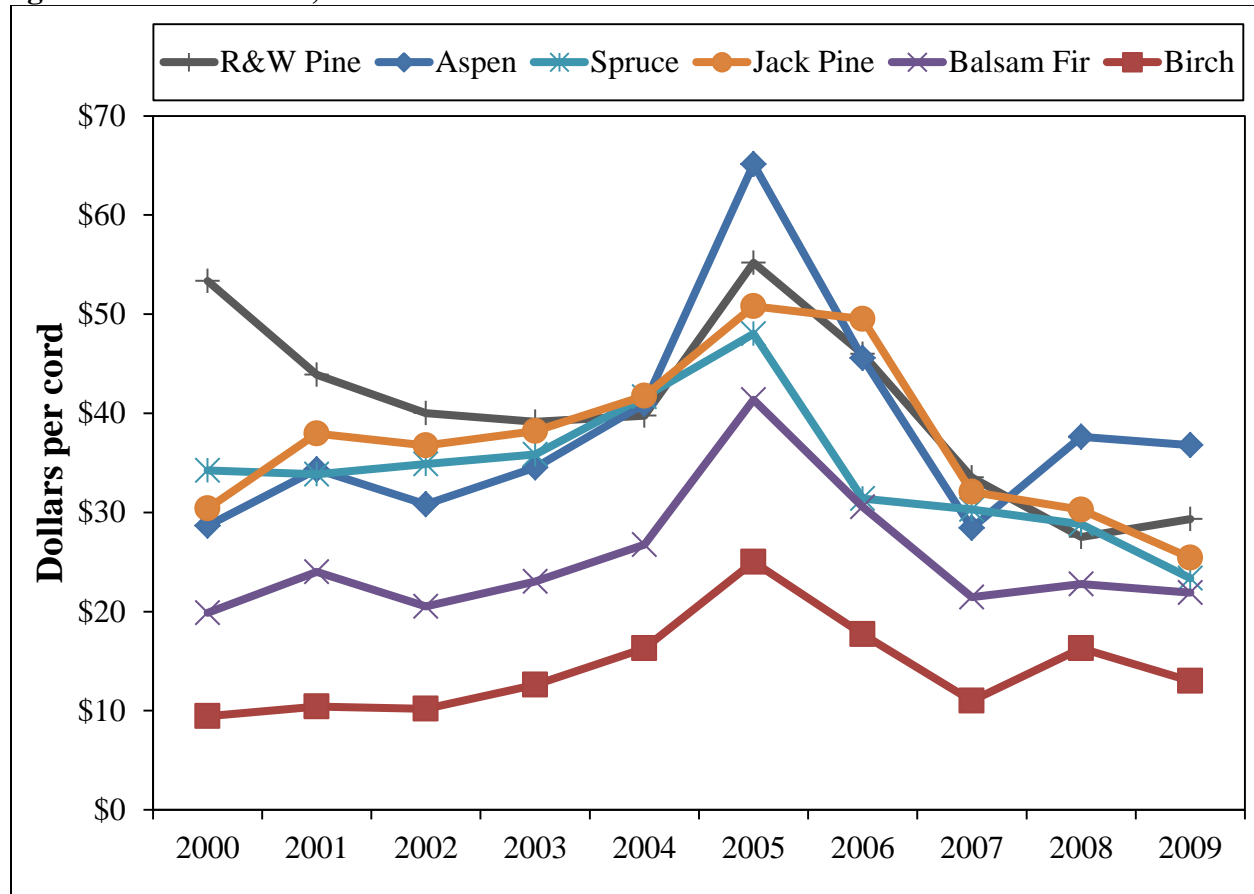
Note: Data represents roundwood consumption only and does not include residual chips purchased from sawmills.

4.2.4. Stumpage prices

Across the state there was a general rise in stumpage prices received by public agencies peaking in 2005 and then a decline following mill closures and the economic downturn (Figure 4.17). Note, that prices received on individual timber sales can vary significantly from the averages shown in the figures because of variability in economic and physical conditions of the harvest site and the quality of wood.

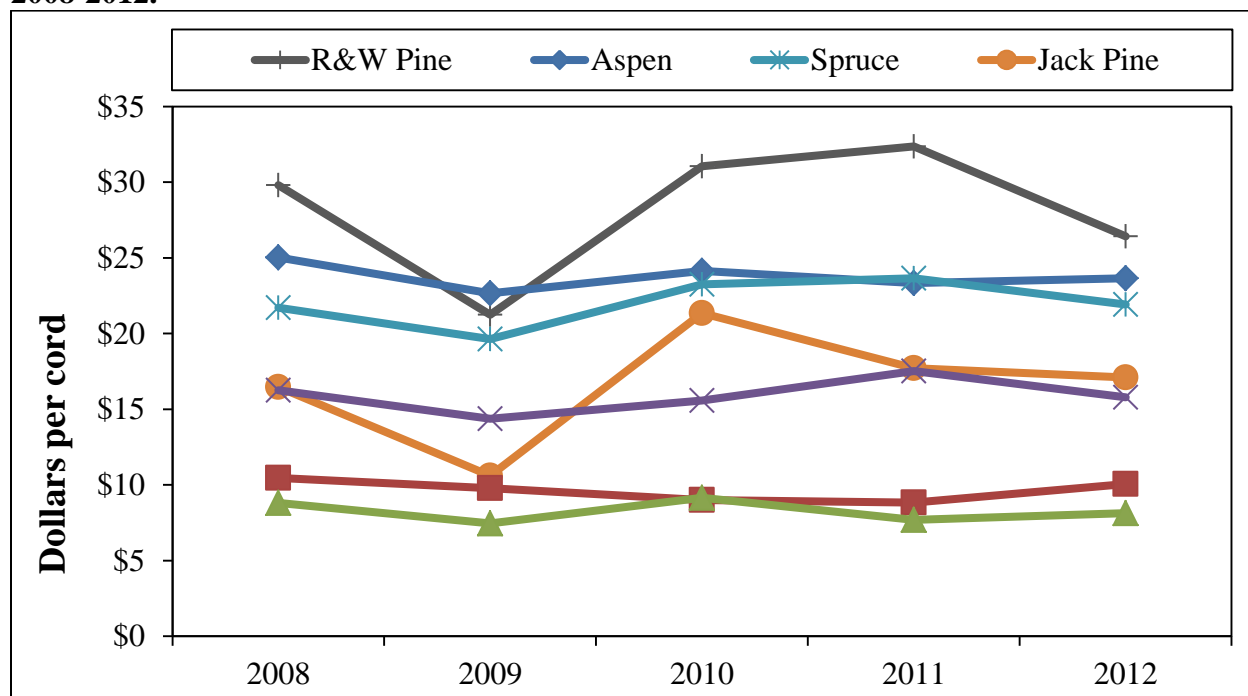
Prices received by public agencies in the Northeast Landscape tend to be similar or slightly below the statewide average (Figure 4.18). Aspen and spruce prices have remained relatively steady between \$20 and \$25 from 2008 to 2012, while the pine species saw a dip in 2009 and subsequent recovery.

Figure 4.17. Average prices received for stumpage per cord by species sold by public land agencies in Minnesota, 2000-2009.



Source: Minnesota DNR, Minnesota's Forest Resources 2010

Note: Data represents the Pulp & Bolts in Combination. A bolt is defined as a short log, usually 100" length, with a specific minimum top diameter, generally sawn for lumber.

Figure 4.18. Northeast Landscape public agency stumpage values per cord by species, 2008-2012.

Source: Don Deckard, Minnesota DNR, Division of Forestry

Note: Data represents the Pulp & Bolts in Combination. A bolt is defined as a short log, usually 100" length, with a specific minimum top diameter, generally sawn for lumber.

4.2.5. Logging operators

Logging businesses are a crucial component in the wood supply chain. Although no regional data is available on the status of these businesses in the Northeast Landscape; Minnesota Forest Industries, Minnesota Logger Education Program, University of Minnesota Department of Forest Resources, University of Minnesota Extension, and the Minnesota Agricultural Experiment Station conducted a study regarding 2011 logging operations across the state (C. Blinn, T. O'Hara, D. Chura, and M. Russell – Status of the Minnesota Logging Sector in 2011 – in development). The objectives of this study were to (1) to update the understanding of Minnesota's logging sector as of 2011, (2) to compare those results to previous surveys where appropriate in Minnesota, Wisconsin, and Michigan, and (3) gain insight into what the current status of the logging industry and markets in Minnesota may mean for the future.

This data is based on surveys sent to 427 individuals who were listed in the Minnesota Logger Education Program (MLEP) database. Of the original 427 surveys, 226 (51%) were completed by firms producing 100 cords or more in 2011 and were used in data analysis. Approximately 26% of the respondents' logging businesses were located (although not necessarily where the timber was harvested) within the Northeast Landscape (58% were located in the DNR's NE Region). Statewide, respondents reported a total of 1,605.5 full- or part-time employees and subcontractors of which 57.1% are full-time employees, 22.0% are part-time employees and 20.9% are subcontractors (Table 4.13). The total combined number of employees and subcontractors for the 216 responding firms ranged from 1 to 62 with a median of 5 and an average of 7.43 (Figure 4.19). The average logging business had been in operation for 28.1 years

(median 29) in 2011 and approximately 70% of the responding businesses had been in operation for more than 20 years (Figure 4.20). Eighty two percent of the 2011 volume was harvested using conventional equipment, 16% by cut-to-length and 2% by chainsaw.

Survey respondents produced approximately 69-77% of the estimated 2011 statewide harvest and showed considerable range in production from 100 to 138,393 cords (mean 9,518; median 4,000) in 2011 (Table 4.14). Only 26% of the respondents produced 10,000 cords or more but they were responsible for 75.6% of the total volume harvested (Table 4.14). Similar to the agriculture industry, the percentage of larger business has increased over time. On average, 4.64 gallons of fuel were required to harvest and deliver each cord of wood produced.

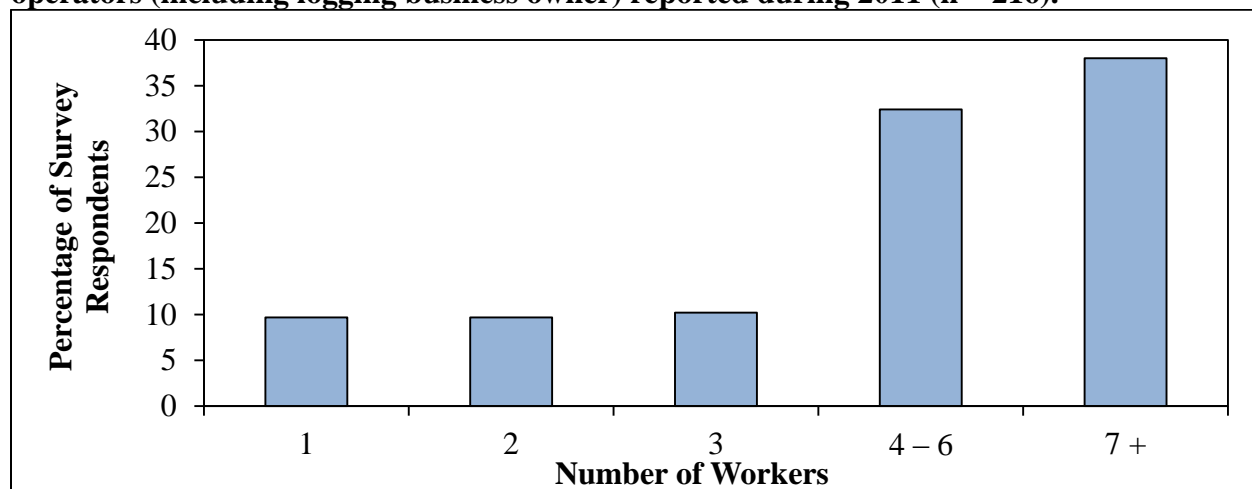
Additional information on types of harvesting, season of harvest, harvesting equipment, and stumpage source will be provided in C. Blinn, T. O'Hara, D. Chura, and M. Russell 'Status of the Minnesota Logging Sector in 2011' upon completion.

Table 4.13. Summary of number of full- and part-time workers and subcontractors employed by responding logging business owners during 2011 (n=216). The number of respondents for each type of worker is noted in parentheses.

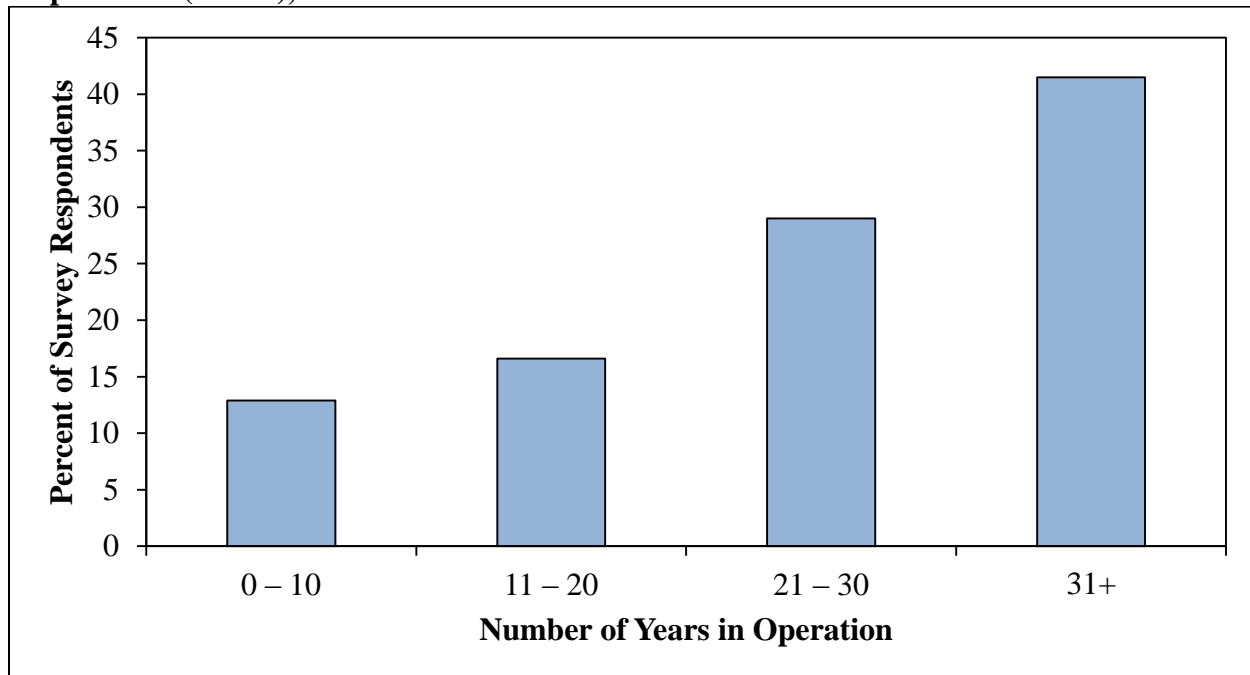
Type of worker	Employees Full-Time	Employees Part-time	Subcontractor	Total number of workers
Woods worker	484 (161)	155 (80)	63.5 (36)	702.5
Truck driver	250.5 (99)	98.5 (50)	236.5 (94)	585.5
Procurement/Forester/Landowner Assistance	25 (22)	9 (9)	9 (9)	43
Mechanic	47.5 (32)	39 (29)	21 (14)	107.5
Office/clerical	56.5 (44)	37 (35)	6 (6)	99.5
Supervisor/manager	53.5(48)	14 (13)	0 (0)	67.5
Total	917	352.5	336	1605.5

Source: C. Blinn, T. O'Hara, D. Chura, and M. Russell – Status of the Minnesota Logging Sector in 2011 – in development.

Figure 4.19. Summary of total number of workers from the statewide survey of logger operators (including logging business owner) reported during 2011 (n = 216).



Source: C. Blinn, T. O'Hara, D. Chura, and M. Russell – Status of the Minnesota Logging Sector in 2011 – in development.

Figure 4.20. Statewide summary of years in operation by the percent of logging business respondents (n=217), 2011.

Source: C. Blinn, T. O'Hara, D. Chura, and M. Russell – Status of the Minnesota Logging Sector in 2011 – in development.

Table 4.14. Statewide cords harvested by survey respondents (n = 209), 2011.

Volume harvested (cords)	Number of respondents	Percent of respondents	Percent of total volume
< 1,000	55	26.3	1.5
1,001 – 2,500	27	12.9	2.6
2,501 – 5,000	40	19.1	7.6
5,001 – 10,000	32	15.3	12.6
10, 001 – 15,000	17	8.1	11.1
15,001 – 20,000	8	3.8	7.6
20,001 – 30,000	20	9.6	24.3
30,001 – 40,000	4	1.9	6.7
40,001 – 50,000	1	0.5	2.3
> 50,000	5	2.4	23.6

Source: C. Blinn, T. O'Hara, D. Chura, and M. Russell – Status of the Minnesota Logging Sector in 2011 – in development.

Note: Percentages may not total 100 due to rounding error.

4.3. Recreation and tourism

Outdoor recreation and tourism is a significant portion of the Northeast Landscape’s economic base. Travelers come to experience the woods and waters of Northeast Minnesota which provide opportunities for hiking, biking, canoeing, kayaking, boating, camping, fishing, hunting, golfing and many more activities amid beautiful scenery. Winter sports range from snowboarding to snowshoeing. Tourism is a substantial and growing component of the regional economy with total traveler expenditures in the Northeast Landscape exceeding \$1 billion and supporting nearly 22,700 full-time equivalent jobs.

The following section outlines the regional recreation and tourism resources and their economic impact.

4.3.1. Trails

Northeast Minnesota has an extensive and diverse trail network that create a major tourism draw to the region during all seasons. There are numerous trails managed by other organizations throughout the Northeast Landscape, but the two main trail management agencies in the region are the US Forest Service and the Minnesota DNR. The US Forest service maintains trails throughout the Northeast Landscape for a wide range of uses including 55 miles of dogsled trails (Table 4.15). Fourteen percent of the MN DNR’s trail miles are found in the Northeast Landscape, including over one third of all horse and cross-country ski trails (Table 4.16). A feature trail in the region is the Superior Hiking Trail. The Superior Hiking Trail is a 296-mile footpath that follows the rocky ridgeline above Lake Superior on Minnesota’s North Shore from Duluth to the Canadian border. This trail is maintained by the Superior Hiking Trail Association and its volunteers.

Table 4.15. Length of US Forest Service recreational trails in the Superior National Forest.

Trail Type	Miles
Snowmobile	783
Bicycle (includes mountain bike)	162
Hiking	596
Dogsled	55
Portage	212
Cross-country ski	471
All-Terrain Vehicle (ATV) trails (category includes both Class 1 and Class 2 ATVs)	436
Roads open for public use	1,588

Source: US Forest Service, Superior National Forest

Note: Miles are by opportunity; therefore, some trails are open for more than one type of use. For instance, some hiking trails are also cross country ski trails.

Table 4.16. Length of MN DNR recreational trails in Minnesota and Northeast Landscape.

Trail Type	Minnesota miles	Northeast miles	% of State miles
Snowmobile	22,361	2,305	10.3%
Bicycle	698	85	12.2%
Mountain Bike	1,124	296	26.3%
Hiking	2,415	668	27.7%
Winter Hiking	142	13	9.2%
Horse	1,061	378	35.6%
Cross-country ski	993	337	33.9%
All-Terrain Vehicle (ATV) trails (category includes both Class 1 and Class 2 ATVs)	1,941	285	14.7%
Off-Highway Motorcycle (OHM) trails	1,496	179	12.0%
Off-Road Vehicle (ORV) trails	458	35	7.6%
Total	32,689	4,581	14.0%

Source: MN DNR Division of Parks and Trails

Note: The mileage value for each trail use was calculated from the subset of trail features that met the conditions of the associated query listed above; therefore each use category is NOT mutually exclusive, since many trails permit more than one use. Therefore, some dual use trail miles may be counted twice.

4.3.2. Public parks, campgrounds, and recreation areas

The Northeast Landscape is a very popular destination for camping and sightseeing. The twelve Minnesota State Parks within the Northeast Landscape which include: Bear Head Lake, Cascade River, George Crosby Manitou, Gooseberry Falls, Grand Portage, Jay Cooke, Judge C.R. Magney, McCarthy Beach, Moose Lake, Savanna Portage, Soudan Underground Mine, Split Rock Lighthouse, Temperance River, and Tettegouche. These parks contain 666 campsites and see and annual visitation in excess of 2.2 million (Table 4.17). State park campsites are open all year; however, full services are generally only provided mid-May through mid-October and use of campsites is highest during this full-service season. These twelve DNR State Parks brought in over \$1.6 million in total sales including nearly \$900,000 through camping fees (Table 4.18). These figures only count the State Park Stickers sold at the park itself and many of them may have been purchased elsewhere. In addition, some of these parks are also designated Minnesota Department of Transportation Rest Areas do not charge fees. Therefore the actual use of these parks is likely much greater than represented in permit sales.

The Northeast Landscape also contains nearly all of the Superior National Forest. This national forest estimated roughly 1.5 million site visits in 2011 which was down from the estimated 2.1 million visits in 2006 (Table 4.19). This decrease in visitation may have resulted from the recent economic downturn coupled with the 92,000 acre Pagami Creek Fire which led to the closure of portions of the Superior National Forest during peak fall colors in 2011. These issues may have also led to the decrease in percent of travelers coming from greater than 200 miles from 50.6% to 40.4% between 2006 and 2011 (Table 4.20).

The Superior National Forest has 23 developed campgrounds with 599 individual sites and 7 group sites. Maximum occupancy of individual sites is 9 but average use is 3.4 people per individual site and 15 per group site. The campground season is typically about 139 days from

May 5 to mid-September and use ranges from 11 percent occupancy to 75 percent occupancy, with a big range across the campgrounds. Most of these campgrounds are managed under a concession.

The Northeast Landscape is also home to the Superior National Forest's Boundary Waters Canoe Area Wilderness (BWCAW). There are a total of 280.5 overnight permits available for canoe camping every day of the managed season from May 1 through Sept 30, plus an overnight motor quota of 1,903 permits per season (maximum of 9 people per overnight canoe or motor permit). The wilderness is open to use outside these dates via a free self-issued permit. In 2011, the BWCA saw 110,972 overnight visitors based on permit data and is the most visited wilderness in the United States. Between Boundary Waters Canoe Area Wilderness entry fees and Superior National Forest campground receipts the forest reported more than \$1.5 million in revenue (Table 4.21).

Voyageurs National Park was established in 1975 and has roughly 225,000 visitors annually (Figure 4.21). The National Park Service maintains over 200 developed campsites which are dispersed throughout the park and accessible by boat only. Use of these campsites requires a free overnight permit but specific use estimates are not readily available. The historic Kettle Falls Hotel is also open for lodging inside the park from mid-May through September 30.

In addition to the camping areas listed here there are a number of private campgrounds and campsites managed by other organizations. One of these is the Superior Hiking Trail which features 92 backcountry campsites with no fees, reservations, or permits required.

Table 4.17. State park capacity, use, and receipts in the Northeast Landscape, 2012.

Camping capacity	
Drive-in sites	547
Other sites	119
Cabins (number – capacity)	1 - 2 person, 4 - 6 person, 11 - Camper cabins, 2 guest houses
Use of parks	
Total visitors	2,234,311
Overnight visitors	178,937
Campsites occupied	54,783
Lodge units (includes camper cabins) occupied	3,295
State park receipts	
Daily vehicle permits	\$196,698
Annual vehicle permits	\$548,162
Camping permits	\$886,403
Total	\$1,631,263

Source: Minnesota DNR Division of Parks and Trails, Recreation Dynamics Headquarters Manager.

Note: These numbers do not include any group centers that may be present in State Parks.

Table 4.18. State park camping receipts in the Northeast Landscape, 2012.

Park Name	Total Camping Revenue
Bear Head Lake State Park	\$130,805
Gooseberry Falls State Park	\$129,857
Jay Cooke State Park	\$115,138
Tettegouche State Park	\$106,176
Temperance River State Park	\$96,747
McCarthy Beach State Park	\$68,449
Cascade River State Park	\$64,645
Savanna Portage State Park	\$46,574
Moose Lake State Park	\$45,159
Split Rock Lighthouse State Park	\$36,129
Judge C.R. Magney State Park	\$34,413
George H. Crosby Manitou State Park	\$12,312
Total	\$886,403

Source: Minnesota DNR Division of Parks and Trails, Recreation Dynamics Headquarters Manager.

Table 4.19. Annual visitation estimate for the Superior National Forest, 2006 and 2011.

Visit Type	2006 Visits	2011 Visits
Day use developed site visits	364,000	260,000
Overnight use developed site visits	47,000	74,000
General forest area visits	1,422,000	1,040,000
Designated wilderness visits	279,000	174,000
Total estimated site visits	2,112,000	1,548,000

Source: Superior National Forest, 2006 and 2011 Visitor Use Reports

Note: A 'Site Visit' is the entry of one person onto a National Forest site or area to participate in recreation activities for an unspecified period of time.

Table 4.20. Percent of Superior National Forest visits by distance traveled, 2006 and 2011.

Miles from survey respondent's home to interview location	2006	2011
0 - 25	18.7%	37.6%
26 - 50	4.6%	4.3%
51 - 75	3.4%	2.8%
76 - 100	8.6%	3.1%
101 - 200	14.1%	11.8%
201 - 500	45.5%	31.3%
Over 500	5.1%	9.1%

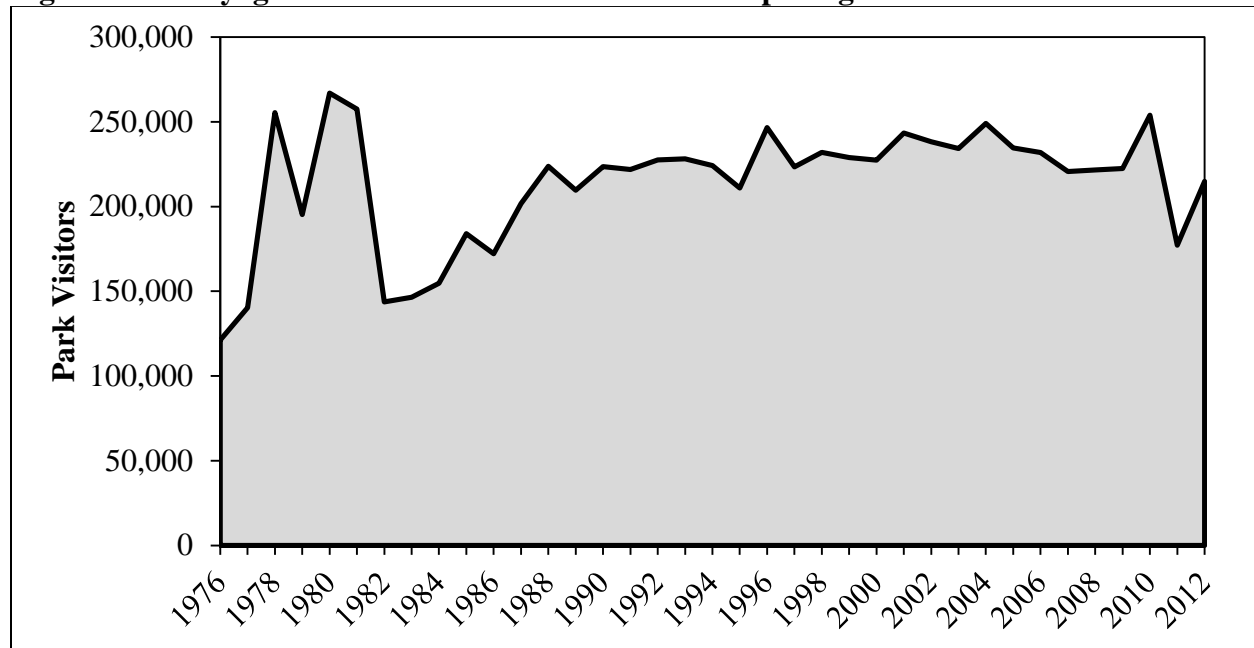
Source: Superior National Forest, 2006 and 2011 Visitor Use Reports

Note: National Forest visits are defined as the entry of one person upon a national forest to participate in recreation activities for an unspecified period of time. Travel distances were self-reported.

Table 4.21. Superior National Forest receipts, fiscal year 2012.

Superior National Forest	Total Revenue
Developed campgrounds total receipts	\$ 409,000
BWCAW entry fee receipts	\$ 1,026,818
Total	\$1,516,818

Source: US Forest Service, Superior National Forest

Figure 4.21. Voyageurs National Park visitation from opening in 1976 to 2012.

Source: National Park Service Visitor Use Statistics.

4.3.3. Indoor lodging capacity

Table 4.22, Table 4.23, and Table 4.24 show past and current lodging capacity in the Northeast Landscape. A total of 396 rental establishments representing 8,262 units were reported to Explore Minnesota as of July 2013 (Table 4.22). Approximately 84% of these units are open in the winter. Data in Table 4.22 differs from Table 4.23 and Table 4.24 because of reporting requirements. Submission of data to Explore Minnesota is voluntary whereas the data in Table 4.23 and Table 4.24 are collected by the Department of Revenue and include all lodging establishments that filed at least one sales tax record during the given year.

The Northeast Landscape has seen a net gain of 23 hotels, motels, and other lodging establishments from 1990 to 2010 (Table 4.23). Most of this increase occurred in Cook County with 21 new establishments. Carleton and Lake counties experienced a net loss over this time interval. Resorts have not fared as well as other forms of lodging over the last 25 years (Table 4.24). Minnesota has seen a net loss of 491 resorts from 1985 to 2010. The majority of this change has occurred in other parts of the state. The Northeast Landscape only accounted for nine of the net loss in resorts.

Table 4.22. Indoor lodging capacity, 1999 and 2013.

	Carlton		Cook		Lake		St. Louis		Total	
	1999	2013	1999	2013	1999	2013	1999	2013	1999	2013
Properties	13	18	80	86	70	72	211	220	374	396
Properties open in winter	12	8	58	59	39	41	135	122	244	230
Lodging Units	415	637	1,475	1,540	922	1,080	4,948	5,005	7,760	8,262
Lodging units open in winter	394	622	1,231	1,355	524	759	4,070	4,181	6,219	6,917
Cabins	20	19	338	366	420	403	1,093	969	1,871	1,757
Cabins - winter	6	4	170	224	119	180	298	237	593	645
Lodge units	5	0	134	170	77	116	117	258	333	544
Condo units	0	0	363	480	54	170	58	74	475	724
Hotel/Motel units	390	618	611	610	351	378	3,598	3,900	4,950	5,506
Bed & breakfast units	0	0	29	26	20	21	82	55	131	102

Compiled 3/15/99 and 7/29/13 from Explore Minnesota Tourism's Accommodations database. Note: Only includes lodging and camping properties that voluntarily submit information.

Note: Some units may be double counted as a lodge units and as hotel/motel units, but only once under "all units."

Table 4.23. Hotels, motels, and other lodging establishments, 1990 to 2010.

	1990	1995	2000	2005	2010	Change 1990 to 2010
Carlton	23	21	20	17	17	-6
Cook	64	68	79	81	85	21
Lake	60	45	42	50	56	-4
St. Louis	219	221	224	225	231	12
Northeast Landscape	366	355	365	373	389	23

Source: Minnesota Department of Revenue Tax Research Division.

Note: 1990, 1995, and 2000 from industry code 70 (Hotels and other lodging places) while the 2005 and 2010 data is from industry code 721 (Accommodations)

Table 4.24. Resorts in the Northeast Landscape, 1985-2010.

	1985	1990	1995	2000	2005	2010	Change 1985 to 2010
Carlton	ND	4	ND	ND	ND	ND	
Cook	42	38	43	38	33	41	-1
Lake	34	33	19	18	25	31	-3
St Louis	110	115	112	101	106	105	-5
Minnesota	1,378	1,285	1,248	1,122	955	887	-491

Source: Minnesota Department of Revenue Tax Research Division.

ND: to avoid disclosure for individual businesses, data is not reported for any county with less than four establishments.

4.3.4. Hunting, fishing, and harvesting

Hunting, fishing, and harvesting are important social and economic components of the Northeast Landscape for the Native American community as well as other residents and visitors. The economic impact of the activities is difficult to track but license sales can give a general picture of use in the region. Caution should be taken when interpreting these data because it is recorded based on location of purchase and not location of use but \$3.25 million worth of licenses were purchased in the Northeast Landscape (Table 4.25).

Table 4.25. State hunting, fishing, and harvesting licenses, 2012.

County	Residency	Transactions	Agent Fee	State Fee	Total Fee
Carlton	Resident	27,796	\$19,118	\$494,824	\$513,942
	Non Resident	108	\$73	\$3,239	\$3,312
	Combined	27,904	\$19,191	\$498,063	\$517,254
Cook	Resident	5,698	\$3,318	\$92,803	\$96,121
	Non Resident	71	\$44	\$2,633	\$2,677
	Combined	5,769	\$3,362	\$95,436	\$98,798
Lake	Resident	10,973	\$6,723	\$187,500	\$194,224
	Non Resident	35	\$25	\$916	\$940
	Combined	11,008	\$6,748	\$188,416	\$195,164
St. Louis	Resident	133,702	\$89,140	\$2,327,980	\$2,417,119
	Non Resident	752	\$540	\$23,274	\$23,815
	Combined	134,454	\$89,680	\$2,351,254	\$2,440,934
Northeast Landscape		179,135	\$118,981	\$3,133,169	\$3,252,150

Source: Minnesota DNR License Bureau.

Note: This data represents where the licenses are sold not where the hunting, fishing, and harvesting licenses are used. Many licenses used in the Northeast Landscape are not purchased there. In addition, 4% of all transactions statewide (139,615 of 2,906,692) are now sold on-line or over the phone.

4.3.5. Economic impact of tourism industry

Accurate estimates of the total economic impact of tourism on a region are difficult to measure directly; however, it is a major component of the total economy in the Northeast Landscape.

Travel expenditures fall across many industries, but account for only a portion of sales in each of these industries. Travel and tourism also create “indirect” and “induced” economic impacts beyond direct expenditures. Because of these complexities, the impact of travel and tourism must be estimated rather than measured directly. In 2011, Explore Minnesota Tourism estimated the economic impact of travel/tourism in Minnesota to be over \$11.9 billion in gross sales, account for almost 240,000 full- and part-time jobs, \$4.1 billion in wages, and \$769 million in state sales tax (17% of state total sales tax revenues). The tourism in the Northeast Landscape was estimated to account for just under \$600 million in gross sales, \$40 million in sales tax, and over 12,000 private sector jobs (Table 4.26).

Explore Minnesota Tourism also estimates the total economic impacts of expenditures by travelers in 2007-2008 (Table 4.27). This estimate includes all of the direct impacts in addition to the estimated indirect impacts. Indirect impacts are the additional jobs and wages supported during additional rounds of spending. As part of the 2007-2008 report Explore Minnesota Tourism also estimated traveler expenditures by season (Table 4.28). In the Northeast Landscape 45% of the total traveler expenditures are between June and August.

Another indicator of the economic impact of the tourism industry are lodging and resort sales and taxes. Table 4.29 shows gross lodging sales in the Northeast Landscape in excess of \$178 million with a total tax income of just under \$11.6 million. This is nearly triple the gross sales in 1990 (Table 4.30). The resort industry is strongest in Cook and St. Louis counties with gross sales in excess of \$26 million annually in each county (Table 4.31). Cook County has seen the greatest increase from 1990 to 2011 with a net increase of \$19.5 million in annual gross sales (Table 4.32).

Further information on the economic impact of tourism in the Northeast Landscape is available in: “Northern Minnesota Forestry Analysis, 2011” prepared by the Bureau of Business and Economic Research at the Labovitz School of Business and Economics – University of Minnesota Duluth and the revised 2012 report of the same name. These can be found on the MFRC NE Landscape website: http://mn.gov/frc/initiatives_llm_committees_northeast.html

Table 4.26. Leisure and hospitality industry in the Northeast Landscape, 2011.

	Gross Sales	Sales Tax	Private Sector Employment
Carlton	\$56,754,339	\$3,785,229	996
Cook	\$51,475,292	\$3,426,587	876
Lake	\$30,392,095	\$2,060,150	872
St. Louis	\$458,947,071	\$30,897,156	10,070
Total	\$597,568,797	\$40,169,122	12,814

Source: Explore Minnesota Tourism, an office of the State of Minnesota.

Table 4.27. Total economic impact of expenditures by travelers in the Northeast Landscape from June 2007 - May 2008.

	Traveler Expenditures	Full-time Equivalent Jobs	Resident Income \$	State Revenue	Local Revenue
Carlton	\$71,803,954	1,504	\$29,968,513	\$8,735,369	\$2,679,056
Cook	\$181,571,153	3,803	\$75,781,587	\$22,089,186	\$6,774,547
Lake	\$136,228,886	2,854	\$56,857,274	\$16,573,035	\$5,082,794
St. Louis	\$693,775,527	14,528	\$289,558,160	\$84,401,827	\$25,885,249
Total	\$1,083,379,520	22,689	\$452,165,534	\$131,799,417	\$40,421,646

Source: Explore Minnesota Tourism, an office of the State of Minnesota.

Table 4.28. Traveler expenditures (millions of dollars) by season in the Northeast Landscape June 2007 - May 2008.

	June - Aug.		Sept. - Nov.		Dec. - Mar.		Apr. - May		Total Expenditures
	Million \$	% of Total	Million \$	% of Total	Million \$	% of Total	Million \$	% of Total	
Carlton	\$30.5	42%	\$17.8	25%	\$13.8	19%	\$9.6	13%	\$71.8
Cook	\$87.5	48%	\$35.8	20%	\$39.9	22%	\$18.4	10%	\$181.6
Lake	\$65.1	48%	\$34.7	25%	\$24.0	18%	\$12.4	9%	\$136.2
St. Louis	\$304.6	44%	\$162.9	23%	\$143.4	21%	\$82.9	12%	\$693.8
Total	\$487.7	45%	\$251.3	23%	\$221.1	20%	\$123.3	11%	\$1,083.4

Source: Explore Minnesota Tourism, an office of the State of Minnesota.

Table 4.29. Lodging sales and use tax statistics for lodging sales in the Northeast Landscape, 2011.

	Gross Sales	Taxable Sales	Sales Tax	Use Tax	Total Tax	Number of Establishments
Carlton	\$8,951,032	\$7,933,916	\$547,218	\$168	\$547,386	15
Cook	\$28,233,380	\$26,491,261	\$1,854,247	\$3,936	\$1,858,183	84
Lake	\$17,026,230	\$16,579,797	\$1,156,180	\$6,506	\$1,162,686	52
St Louis	\$124,386,996	\$114,388,154	\$7,931,851	\$99,594	\$8,031,445	228
NE Landscape	\$178,597,638	\$165,393,128	\$11,489,496	\$110,204	\$11,599,700	379

Source: Minnesota Department of Revenue Tax Research Division.

Note: Includes all businesses in NAICS code 721

Table 4.30. Northeast lodging establishments: annual gross sales, 1990 to 2010. (Values in thousands of dollars.)

County	1990	1995	2000	2005	2010	Change 1990 to 2010
Carlton	\$1,657,000	\$2,296,000	\$6,297,004	\$6,340,493	\$8,943,646	\$7,286,646
Cook	\$9,052,000	\$18,935,000	\$25,097,144	\$27,083,514	\$30,016,956	\$20,964,956
Lake	\$6,401,000	\$4,942,000	\$10,125,172	\$13,988,124	\$17,357,906	\$10,956,906
St. Louis	\$46,716,000	\$49,720,000	\$80,456,091	\$95,326,109	\$115,395,038	\$68,679,038
Total	\$63,826,000	\$75,893,000	\$121,975,411	\$142,738,240	\$171,713,546	\$107,887,546

Source: Minnesota Department of Revenue Tax Research Division.

Note: 1990, 1995, and 2000 from industry code 70 (Hotels and other lodging places) while the 2005 and 2010 data is from industry code 721 (Accommodations)

Table 4.31. Annual Minnesota sales tax statistics for resorts in the Northeast Landscape, 2011.

	Establishments	Gross Sales	Taxable Sales	Sales Tax	Total Tax
Carlton	ND	ND	ND	ND	ND
Cook	40	\$26,417,498	\$25,485,025	\$1,782,960	\$1,788,316
Lake	30	\$9,542,399	\$9,196,182	\$647,559	\$651,072
St. Louis	101	\$27,499,427	\$23,947,097	\$1,697,769	\$1,711,717
Minnesota	858	\$251,528,701	\$216,123,957	\$15,279,048	\$15,348,196

Source: Minnesota Department of Revenue Tax Research Division.

ND: to avoid disclosure for individual businesses, data is not reported for any county with less than ten establishments.

Note: Sales tax statistics data are based on the year the sales took place. The difference between Total Tax and Sales Tax is Use Tax.

Table 4.32. Annual gross sales by Northeast Landscape resorts, 2004-2011. (Values in thousands of dollars.)

County	1990	1995	2004	2005	2006	2007	2008	2009	2010	2011	Change 1990-2011
Carlton	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Cook	6.9	9.8	21.8	21.7	22.4	22.8	25.4	22.9	24.9	26.4	19.5
Lake	3.4	1.5	7.4	7.9	8.9	9.5	10.2	9.4	9.4	9.5	6.1
St. Louis	12.7	15.9	26.0	26.5	27.5	27.8	27.1	25.7	26.3	27.5	14.8
Minnesota	-	-	227.8	232.9	242.7	257.6	247.8	230.8	244.0	251.5	-

Source: Minnesota Department of Revenue Tax Research Division.

ND: to avoid disclosure for individual businesses, data is not reported for any county with less than ten establishments.

4.4 Mining

Mining is a major economic driver in the Northeast Landscape and is the dominant economic engine in the communities of north central St. Louis County.

Minnesota is the largest producer of iron ore and taconite in the United States, and much of this is found in the Northeast Landscape. Even though nearly all of the high grade natural iron ore in Minnesota has already been mined, advances in technology have found a use for lower grade iron ore, called taconite. The taconite is crushed, processed into hard, marble-sized pellets, and shipped to steel mills. The taconite pellets are melted in blast furnaces and then blown with oxygen to make steel. Total taconite production for the seven operating Iron Range taconite plants has remained relatively steady around 38 million tons from 2000 to 2011 with the exception of 2009 when production dipped to 17.1 million tons.

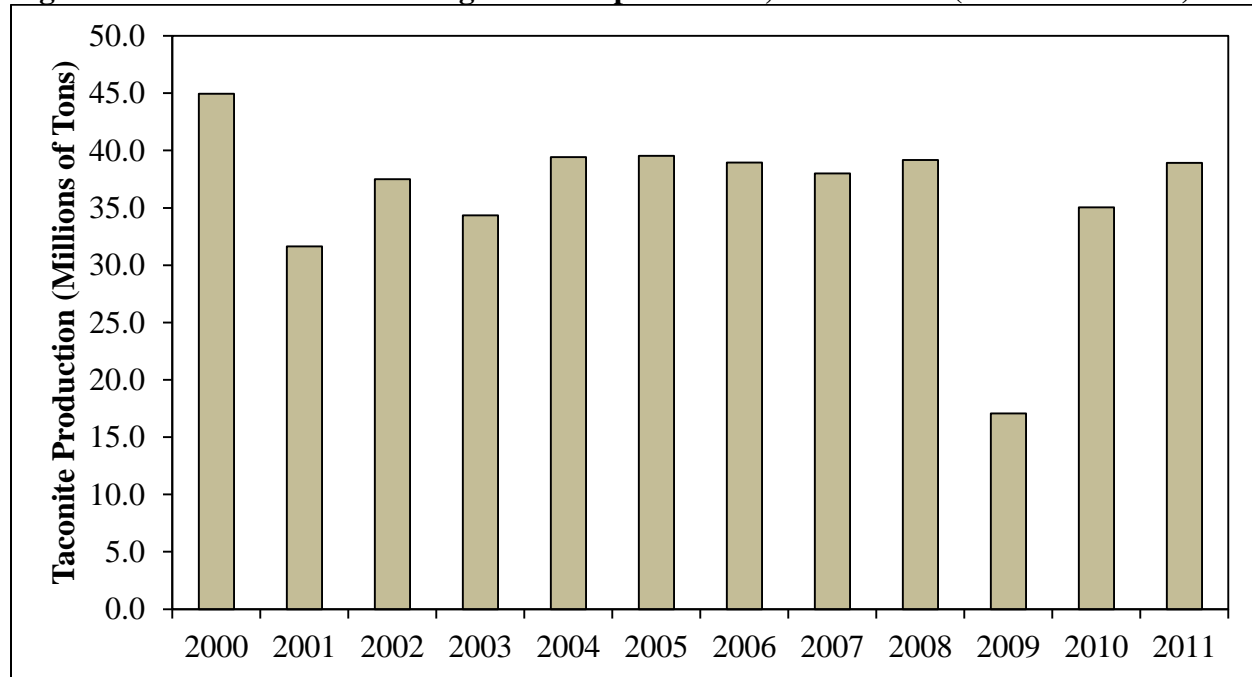
Copper-nickel mining exploration is also ongoing in the region. Copper-nickel mining is sometimes referred to as "sulfide mining," for the kind of ore in which the metals are found. Sulfur functions as a metal collector in nature and is responsible for concentrating the economic quantities of copper and nickel. However, to extract these metals, mining operations need to deal with the sulfur which has raised water quality concerns, since once sulfur is exposed to oxygen and water; a chemical reaction occurs that creates, among other things, sulfuric acid and potential for water pollution.

Table 4.33 shows current ferrous mining accounts for nearly 4,000 jobs in Minnesota, however, the total economic impacts, from the largest possible increase in ferrous and non-ferrous (copper-nickel) mining production could account for almost \$5 billion in value added, almost \$7.8 billion in output, and a total employment of 27,300.

Further information on the economic impact of mining in the Northeast Landscape is available in: "The Economic Impact of Ferrous and Non-Ferrous Mining on the State of Minnesota, the Arrowhead Region, including Douglas County, WI"; November 2012; prepared by the Bureau of Business and Economic Research at the Labovitz School of Business and Economics – University of Minnesota Duluth.

<https://lsbe.d.umn.edu/uploads/FINAL%20Mining%202012%20Report.pdf>

Figure 4.22. Minnesota Iron Range taconite production, 2000 - 2011. (Millions of tons.)



Source: Minnesota Department of Revenue; Mining Tax Guide

Table 4.33. Economic impact of ferrous and non-ferrous mining operations in Minnesota and future mining development projections.

	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Current Ferrous (2010 Baseline)				
Value Added (Million \$)	\$1,136.8	\$349.0	\$435.3	\$1,921.2
Output (Million \$)	\$1,711.9	\$602.9	\$708.1	\$3,022.9
Employment	3,975	2,273	4,978	11,226
Total Ferrous (Expansions, New Projects, and 2010 Baseline Operations)				
Value Added (Million \$)	\$2,765.6	\$849.1	\$1,059.1	\$4,673.8
Output (Million \$)	\$4,164.6	\$1,466.8	\$1,722.6	\$7,353.9
Employment	9,004	5,148	11,275	25,427
Current Non-Ferrous (2010 Baseline)				
Value Added (Million \$)	\$111.7	\$20.8	\$24.6	\$157.1
Output (Million \$)	\$136.4	\$33.7	\$40.0	\$210.1
Employment	175	144	232	551
Total Non-Ferrous (New Projects and 2010 Baseline Operations)				
Value Added (Million \$)	\$227.5	\$42.3	\$50.1	\$319.9
Output (Million \$)	\$277.8	\$68.6	\$81.5	\$427.9
Employment	602	496	798	1,896
Total Ferrous and Non-Ferrous (Expansions, New Projects, and 2010 Baseline Operations)				
Value Added (Million \$)	\$2,993.1	\$891.4	\$1,109.2	\$4,993.6
Output (Million \$)	\$4,442.4	\$1,535.4	\$1,804.1	\$7,781.8
Employment	9,606	5,644	12,073	27,323

Source: “The Economic Impact of Ferrous and Non-Ferrous Mining on the State of Minnesota, the Arrowhead Region, including Douglas County, WI”; November 2012; prepared by the Bureau of Business and Economic Research at the Labovitz School of Business and Economics – University of Minnesota Duluth

4.5. Transportation.

The Northeast Landscape has a wide range of transportation infrastructure which includes Great Lakes shipping and an extensive railroad and roadway network including Interstate 35, US Highways 2, 53, and 169 in addition to state and county highways systems. This region also features 265 miles of scenic byways on the North Shore Scenic Drive, the Gunflint Trail, and Superior National Forest Highway 11.

There are over 9,000 miles of roads in the Northeast Landscape and approximately 86 percent of them are designated collector or local roadways (Table 4.34). This network of roadways is important for accessing the region’s timber resources but many of these lower level roadways are subject to spring weight restrictions which limit access to logs in these regions (Figure 4.24). With increasingly early springs, transportation logistics required to insure logs harvested in the winter are able to be transported to the mills will become increasingly challenging.

‘Annual Average Daily Vehicle Miles Traveled’ is the number of vehicles that travel a section of road per day (averaged for 365 days in one year) multiplied by the length of the section of road (Figure 4.25). ‘Heavy Commercial Annual Average Daily Vehicle Miles Traveled’ is the same measure for trucks with at least 2 axles and 6 tires (Figure 4.26). Vehicle Miles Traveled provides a normalized comparison for traffic measurements whereas the ‘Annual Average Daily Traffic’ and ‘Heavy Commercial Annual Average Daily Traffic’ are the number of vehicles that travel a section of road per day (averaged for 365 days in one year). This measure can be skewed by the presence of multiple sections of a Route Type. MNDOT measures traffic for road sections every 2-4 years.

Table 4.35 and Table 4.36 report the average annual daily traffic and miles traveled in the northeast landscape. Use varies across the landscape and Figure 4.23 shows how traffic decreases as a motorist gets farther from Duluth on Minnesota Highway 61.

Table 4.34. Minnesota DOT roadway functional classes in the Northeast Landscape.

Road Functional Class	Miles
Principal Arterial - Interstate	96
Principal Arterial - Other Freeways & Expressways	6
Principal Arterial - Other	578
Minor Arterial	601
Total Arterial	1,282
Major Collector	1,365
Minor Collector	912
Total Collector	2,278
Local	5,551
Total Local	5,551
Total Northeast Region	9,111

Source: Minnesota Department of Transportation

www.fhwa.dot.gov/planning/processes/statewide/related/highway_functional_classifications/

Table 4.35. Average annual vehicle use of roadways in the Northeast Landscape.

Route Type	Length (miles)	Annual Average Daily Vehicle Miles Traveled	Annual Average Daily Traffic
Interstate	95.6	2,111,031	557,400
US Highway	321.1	2,491,478	695,640
MN Highway	626.7	2,103,212	755,765
County State Aid Highway	2081.9	1,932,121	1,276,660
Municipal State Aid Street	232.9	744,032	1,876,290
County Road	1962.9	207,634	135,735
Township Road	9.3	770	285
Municipal Street	0.5	1,311	7,750
Total	5330.8	9,591,588	5,305,525

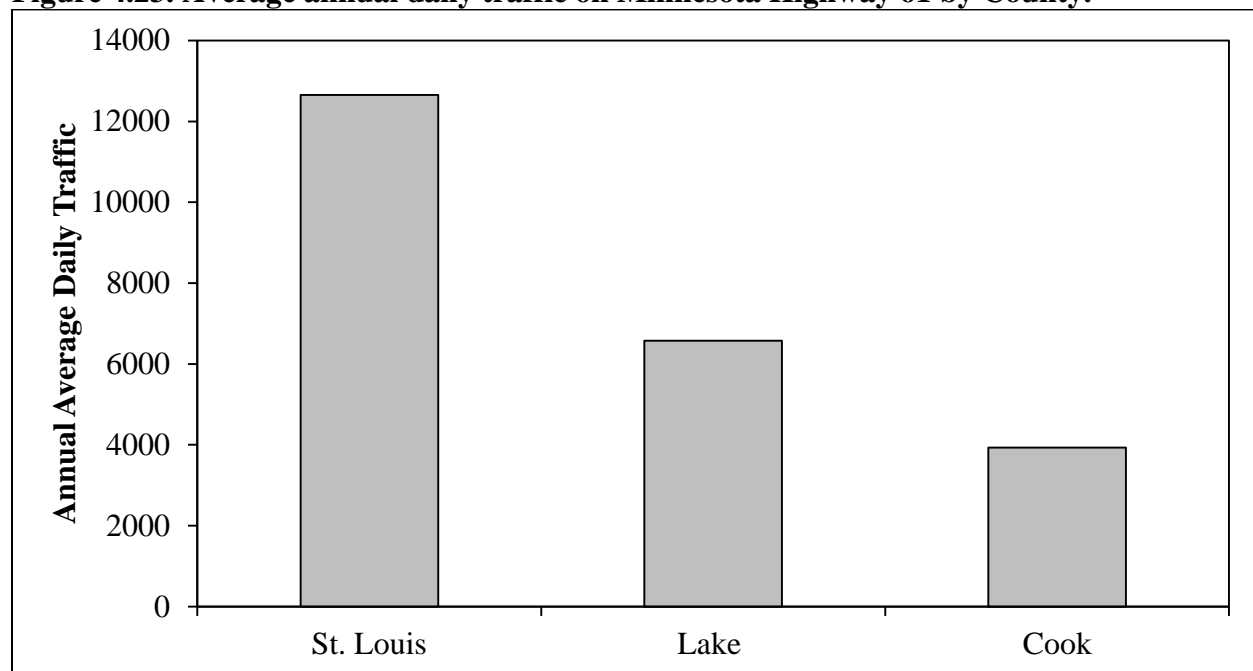
Source: Minnesota Department of Transportation www.dot.state.mn.us/tda/index.html

Table 4.36. Average annual heavy commercial vehicle use of roadways in the Northeast Landscape.

Route Type	Length (miles)	Heavy Commercial Annual Average Daily Vehicle Miles Traveled	Heavy Commercial Annual Average Daily Traffic
Interstate	95.6	122,602	31,080
US Highway	320.7	159,879	35,960
MN Highway	625.1	124,850	38,005
Total	1041.4	407,332	105,045

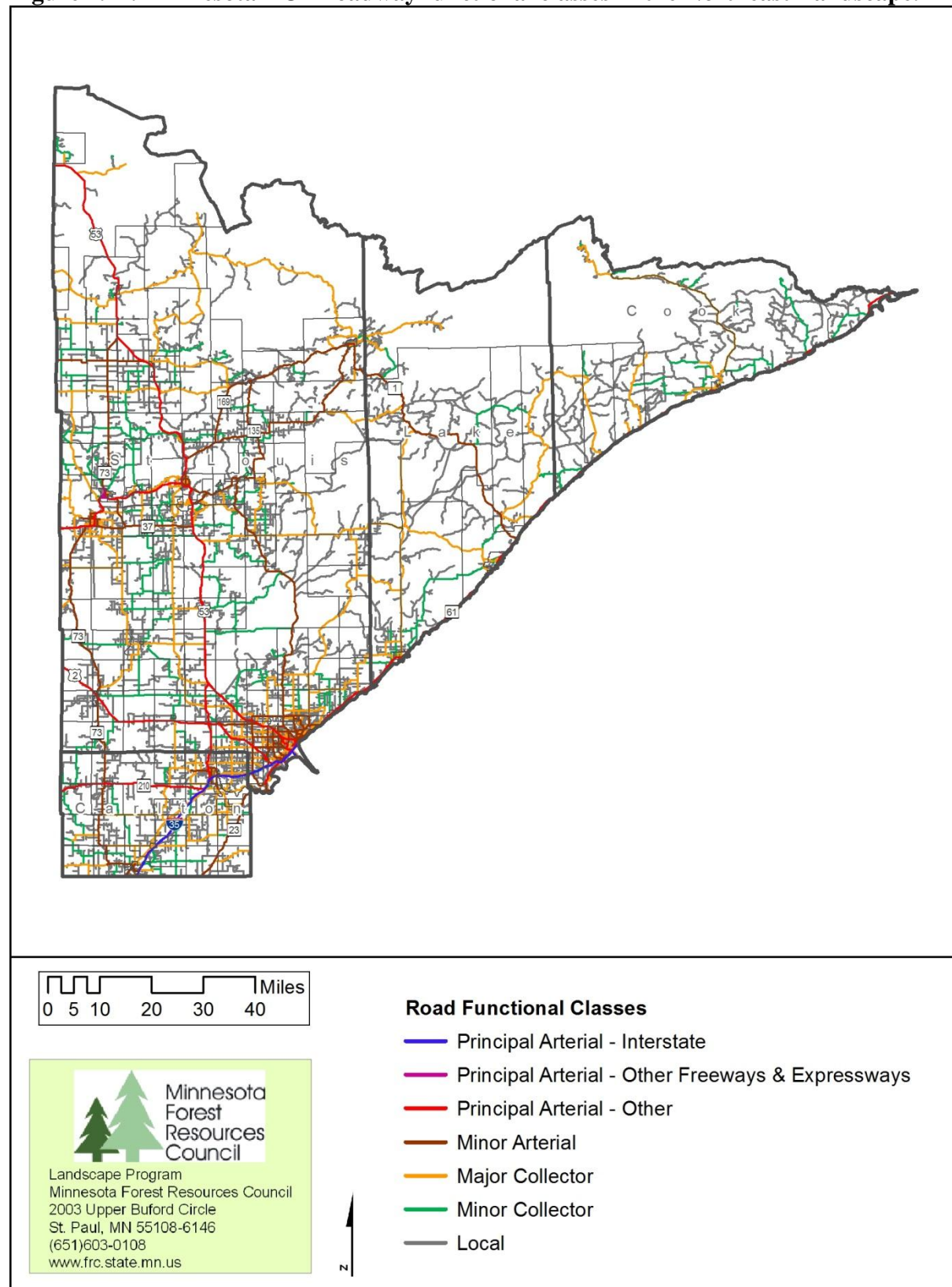
Source: Minnesota Department of Transportation www.dot.state.mn.us/tda/index.html

Figure 4.23. Average annual daily traffic on Minnesota Highway 61 by County.



Source: Minnesota Department of Transportation.

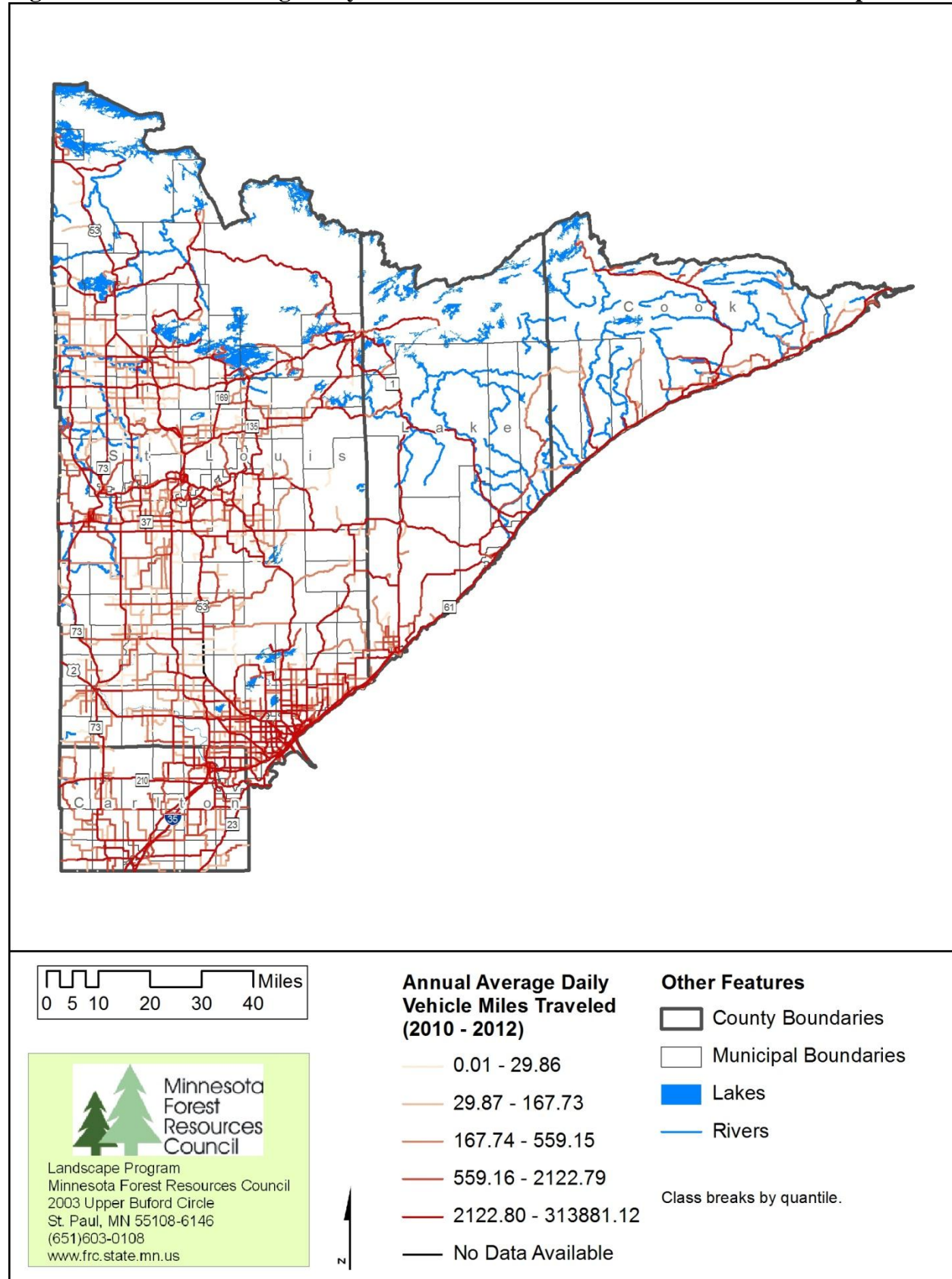
Figure 4.24. Minnesota DOT roadway functional classes in the Northeast Landscape.



Source: Minnesota Department of Transportation

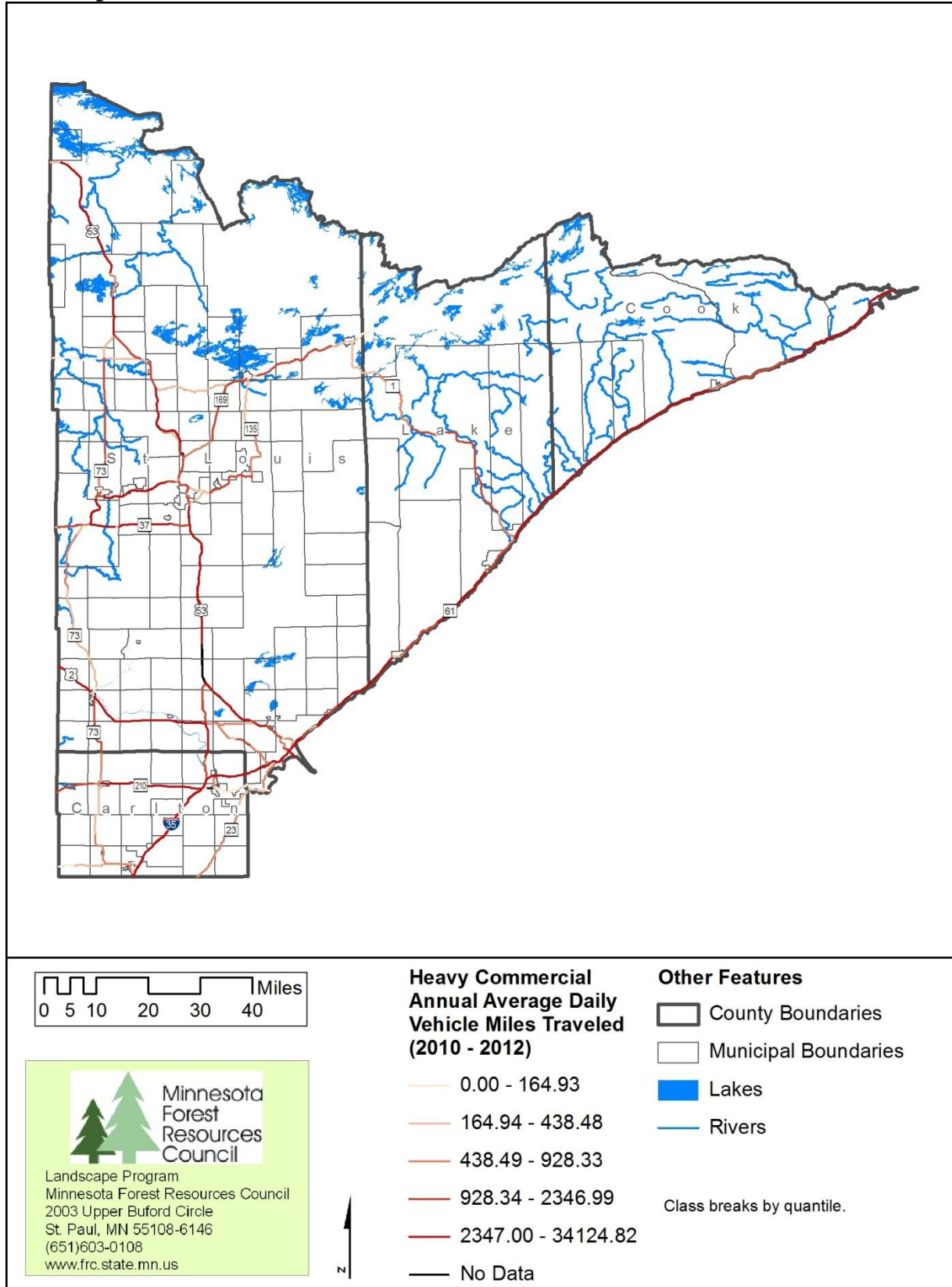
www.fhwa.dot.gov/planning/processes/statewide/related/highway_functional_classifications/

Figure 4.25. Annual average daily vehicle miles traveled in the Northeast Landscape.



Source: Minnesota Department of Transportation www.dot.state.mn.us/tda/index.html

Figure 4.26. Heavy commercial annual average daily vehicle miles traveled in the Northeast Landscape.



Source: Minnesota Department of Transportation www.dot.state.mn.us/tda/index.html