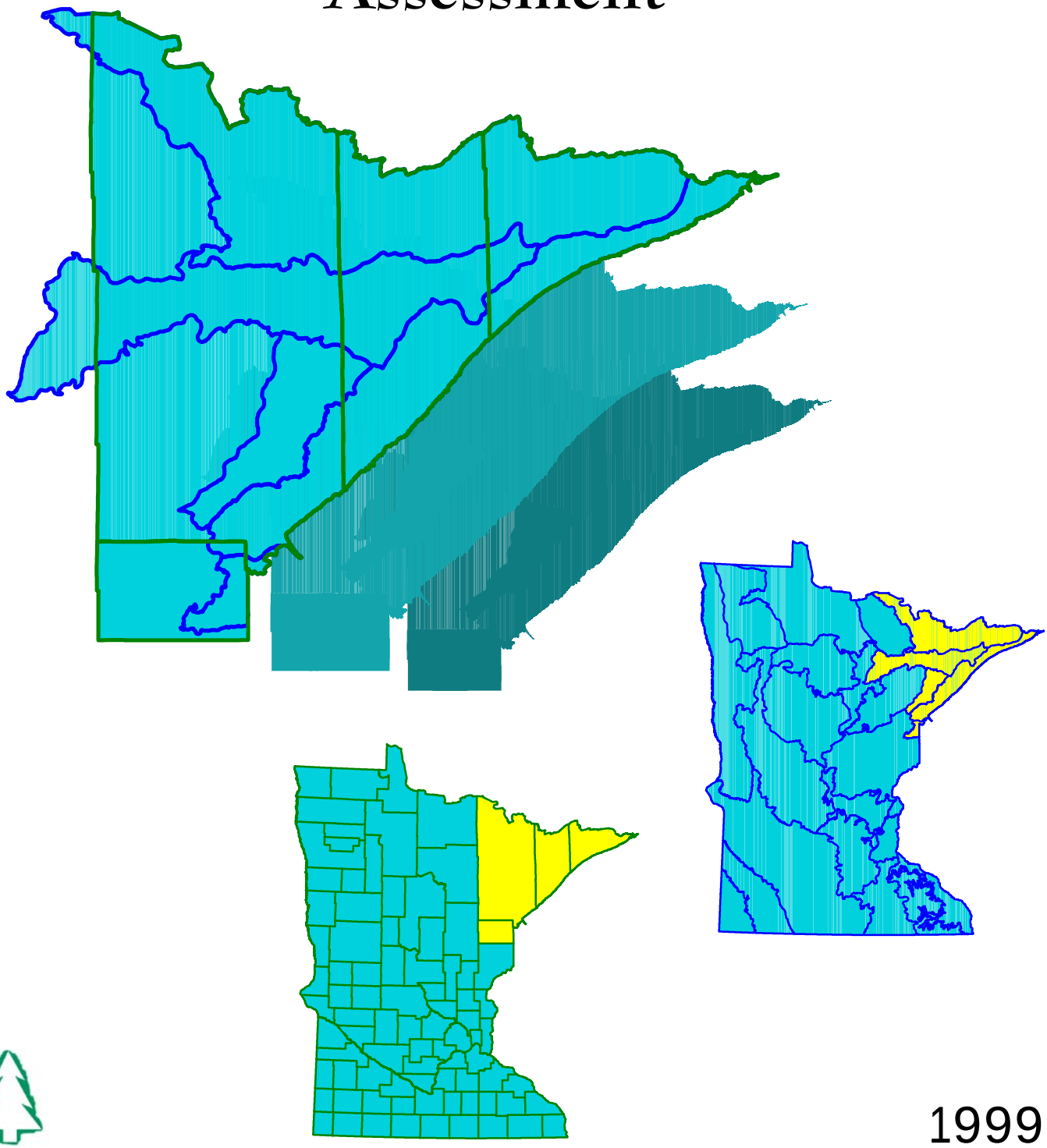
Minnesota Northeast Regional Landscape

Current Conditions and Trends Assessment



1999

Minnesota Forest Resources Council Document # LT-0799

Printed July 1999

Information on the Minnesota Forest Resources Council can be found at **www.frc.state.mn.us**. More detailed information on the Landscape program is located at that Internet site and also at the Interagency Information Cooperative's Internet site, **www.iic.state.mn.us**.

Acknowledgments

The Northeast Regional Landscape Current Conditions and Trends Assessment was prepared by Northeast Regional Landscape Monitoring and Assessment working group based on the objectives of the Minnesota Forest Resources Council's (MFRC) Landscape Program.

Project Direction

Dave Miller, Landscape Coordinator, MFRC

Northeast Regional Landscape Monitoring and Assessment Working Group

Jeff Kern (Chair), Bill Peterson, Mike Houser, James Hane, Keith Anderson, Denny Bone, Lynn Rogers, Bob Stine, Philip Cook, Nancy Odden, Chel Anderson, Jim Hall, Tim O'Hara, Forrest Johnson, Tom Duffus, Bob Berrisford, Jim Hart, and Clyde Hanson.

Staff

Chris Edgar, Forest Resource Modeler, MFRC

Tami Glassel, Desktop Publishing, Department of Natural Resources (DNR) Division of Forestry

Chad Skally, GIS Specialist, MFRC, Interagency Information Cooperative (IIC)

Contractors

Alaina Davis, Sara Litke, Mike Sowers, Robert Vogal

Other Persons and Agencies That Contributed

IIC, DNR, United States Forest Service (USFS), Natural Resources Research Institute, Minnesota Forest Industries, University of Minnesota, St. Louis County, Carlton County, Lake County, Cook County, Minnesota Department of Trade and Economic Development, Minnesota Pollution Control Agency (MPCA), Jan Green, Mike Vasievich (USFS), Brian Kernoham, Kara Dunning, Dan Hanson (DNR), John Almendinger (DNR), Jim Manolis (DNR), Sara Eliason (MFRC), Chung M. Chen (DNR), John Krantz (DNR), and countless others.

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Executive Summary

Current Conditions and Trends Assessment

Northeast Landscape Region

Introduction

Subdivision 2 of Minnesota's 1995 Sustainable Forest Resources Act (SFRA) provided authorization for establishing regional landscape committees: *"to foster landscape-based forest resource planning."*

Regional committees provide an opportunity to involve private citizens, forestry professionals and members of various interest groups in implementing landscape-level planning that will 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.

The following is the general planning process the regional forest resource committees will use to gather, share and communicate information:

- 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 landscape planning and coordination among multiple landowners and interests. The assessment information provides a scientific base for the collaborative decision making process as well as points out gaps where more information is needed.

The current conditions and trends assessment report gives as accurate a picture of the Northeast Regional Landscape as possible given the limitations of available information and resources. It also points to areas where more specific assessments are needed to resolve the primary issue of sustainablility in the landscape over time**. This assessment report is only the starting point for addressing forest sustainability in northeastern Minnesota, not the end result.**

Findings & Recommendations

To guide the regional forest resource committees as they carry out landscape-level planning and coordination, the Forest Resources Council established four broad goals that reflect the strategies for sustaining forests. The FRC used the "Generic Environmental Impact Statement on Timber Harvesting and Forest Management in Minnesota" to develop these goals. The Northeast assessment is structured around these four goals.

The goals are stated below with the findings, recommendations and additional data needs concerning that goal. The data used in the assessment follows in the next sections (pages 5 to 94) which is also organized by each of the goals.

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

Findings

- There was no net loss of forestland between pre-settlement (late 1800s) and 1990.
- There is a lack of timely and current data that prevents looking at changes from 1990 to the present.
- Information in the assessment does not predict future trends of forest gain or loss.

Recommendations

- Continue monitoring inventory data relative to forest cover as it becomes available.

Additional Data Needs

- We need improved FIA data collection in future.

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

Findings

- There is a variety of ownerships serving a variety of interests in both the public and private sector.
- The ratio of public forestland to private forestland changed little between 1977 and 1990 (ratio of pubic to private in 1977 was 2.79; in 1990 it was 2.76).
- Approximately 17% of the Northeast forestlands are reserved; nearly all reserved forestlands are in public ownership.
- The largest changes in ownership between 1977 and 1990 occurred on the non-industrial private ownerships; forestland owned by farmers decreased by 65% while other private individuals increased their forestland holdings by 59%; the amount of forestland owned by forest industry decreased 17% due to several large corporations leaving the region.
- Parcelization of private forestland, especially along lakeshores, has increased over the last 20 years but the extent of the trend is not known.

Recommendations

- Examine the impacts of public vs. private ownership as it relates to how the land is used and valued.

Additional Data Needs

- New FIA data to show trends.
- Parcelization of private lands; quantify trends.

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.

Findings

- The goal is vague and operationally difficult to understand and measure.
- Existing vegetation inventory systems are primarily focused on collecting timber (commercial species) management data, not ecologically based data; does not serve the purpose of an ecological assessment.
- There has been a large change in timber age class and species composition over time, but don't know what this means for sustainability.

- High deer density may cause forest regeneration to be more difficult for many species.
- Trend data is too short a time period to show much about sustainability.
- The question of whether the sustainability of increased timber harvesting over the last 10 years is sustainable is not resolved by the information in the assessment.

Recommendations

- Implement the mitigation alternatives described in the 1992 GEIS technical paper on Biodiversity especially #5.2. *"Comprehensive Inventory: A coordinated statewide biodiversity survey on forestlands should be undertaken as soon as possible. This survey should be an expansion of the MnDNR county biological survey. The same level of detail should be attained on commercial and reserved forestlands."*
- Adopt a variation of Boise Cascade's ecological matrix system to summarize vegetative information across all ownerships for the purpose of establishing landscape goals that account for the range of natural variation for Northeast ecosystems (see Appendix C).
- Research on how changes in cover type and age classes impact the functioning of aquatic and riparian ecosystems.
- Research on the historic range of natural variability as it applies to ecosystems.

Additional Data Needs

- Spatial data and patterns for vegetation.
- Wildlife species that are rare, not monitored, or dependent on a particular habitat (habitat specialist).
- Additional information on species that affect most ecosystem processes and functions (invertebrates, fungi, lichens, bacteria, bryophytes).
- Land potential and vegetative structure data relating to comprehensive inventory and ecosystems diversity matrix.
- Monitoring of water quality and what impacts aquatic systems.
- Soil data.

Goal 4: 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.

Findings

- The economic base is more diverse and resilient than in the past.
- Tourism is a substantial and growing component of the economy of the region.
- Information does not make linkages between economic and environmental quality, social satisfaction and community well-being.

Recommendations

- Examine how the change in forest conditions impacts both economical and ecological outcomes.

Additional Data Needs

- More economic data, including "non-labor income" data in counties of Northeast landscape.

Current Trends and Conditions

The Northeast region of the state consists of Carlton, St. Louis, Lake, and Cook counties and includes the ecological classifications of the Northern and Southern Superior Uplands. (See Appendix A for a historical perspective on the landscape.)

The data in this assessment come from several managing agencies that collect and aggregate their data across different geographical areas. (See Appendix B for a summary of data sources.) Because of these differences, data for Carlton, Cook, Lake, and St. Louis counties could not always be isolated for presentation in this report. Following are the geographic areas to which the data most often refer:

The Northeast's socioeconomic assessment area or **Northeast Landscape Region**: the area covered by Carlton, Cook, Lake, and St. Louis counties.

The Northeast's ecological assessment area: the Border Lakes, Glacial Lake Superior Plain, Laurentian Highlands, Naswauk Uplands, and North Shore Highlands subsections as defined by the ecological classification system.

The Aspen-birch Forest Inventory and Analysis (FIA) unit: the U.S. Forest Service unit that includes the four counties of the Northeast Landscape Region plus Koochiching County;

DNR Region 2: the MN Department of Natural Resources (DNR) administrative unit that includes the four counties of the Northeast Landscape Region plus Koochiching, Itasca, and part of Cass County.

The area represented is indicated in the title or footnotes of each table or figure and is displayed on a small accompanying map. If no known source of regional data exists, statewide conditions and trends are presented.

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 Region cover approximately 6.7 million acres. The data in this section shows the extent of forestlands across the region at present and in recent decades.

1.1. The extent of forestland in recent decades

The Northeast is heavily forested (see Figure 1.1.). In 1990, forestland spread across more than 5.6303 million of the Northeast's 6.6902 million acres (84.1%) (see Table 1.1.). Estimates of forestland for 1977 conditions range from 82.6% to 85.6% of total land area. Comparing 1977 conditions (reprocessed data) with 1990 conditions suggests that forestland area increased 2.7% (5480.6 to 5630.3 thousand acres) during the period 1977 to 1990. Non-forestland area decreased 7.9 percent (1151.5 to 1059.9 million acres). Total land area increased less than 1% (6.6321 to 6.6902 million acres). In 1990 there were 5.31 acres of forest for every non-forest acre in the Northeast. Estimates for 1977 range from 4.76 to 5.95 (see Table 1.2.).

Table 1.1. Extent of forestland in the Northeast's socioeconomic assessment area, 1977–1990.

Land use	1977 area thousands of acres[A]	1977 area (reprocessed) thousands of acres[B]	1990 area thousands of acres[C]
Forestland[D]	5,677.5	5,480.6	5,630.3
Non-forestland	954.6	1,151.5	1,059.9
Total land area	6,632.1	6,632.1	6,690.2

[A] Source: Spencer et al., 1979.

[B] Source: Miles et al., 1995 and unpublished USFS documents. Data from 1977 were reprocessed using 1990 inventory procedures in an effort to make data between inventories more comparable.

[C] Source: 1990 Forest Inventory and Analysis database.

[D] Forestland is land with at least 16.7% stocking by forest trees or land formerly having such cover and not currently in a non-forestland use (Miles et al., 1995). Forestland includes timberland, reserved forestland, and other forestland.

Note: Data in the table are based on a sample and are therefore subject to statistical error.

Table 1.2. Forestland/non-forestland ratio for the Northeast's socioeconomic assessment area, 1977–1990.

Ratio	1977[A]	1977 (reprocessed)[B]	1990[C]
Forestland/non-forestland	5.95	4.76	5.31

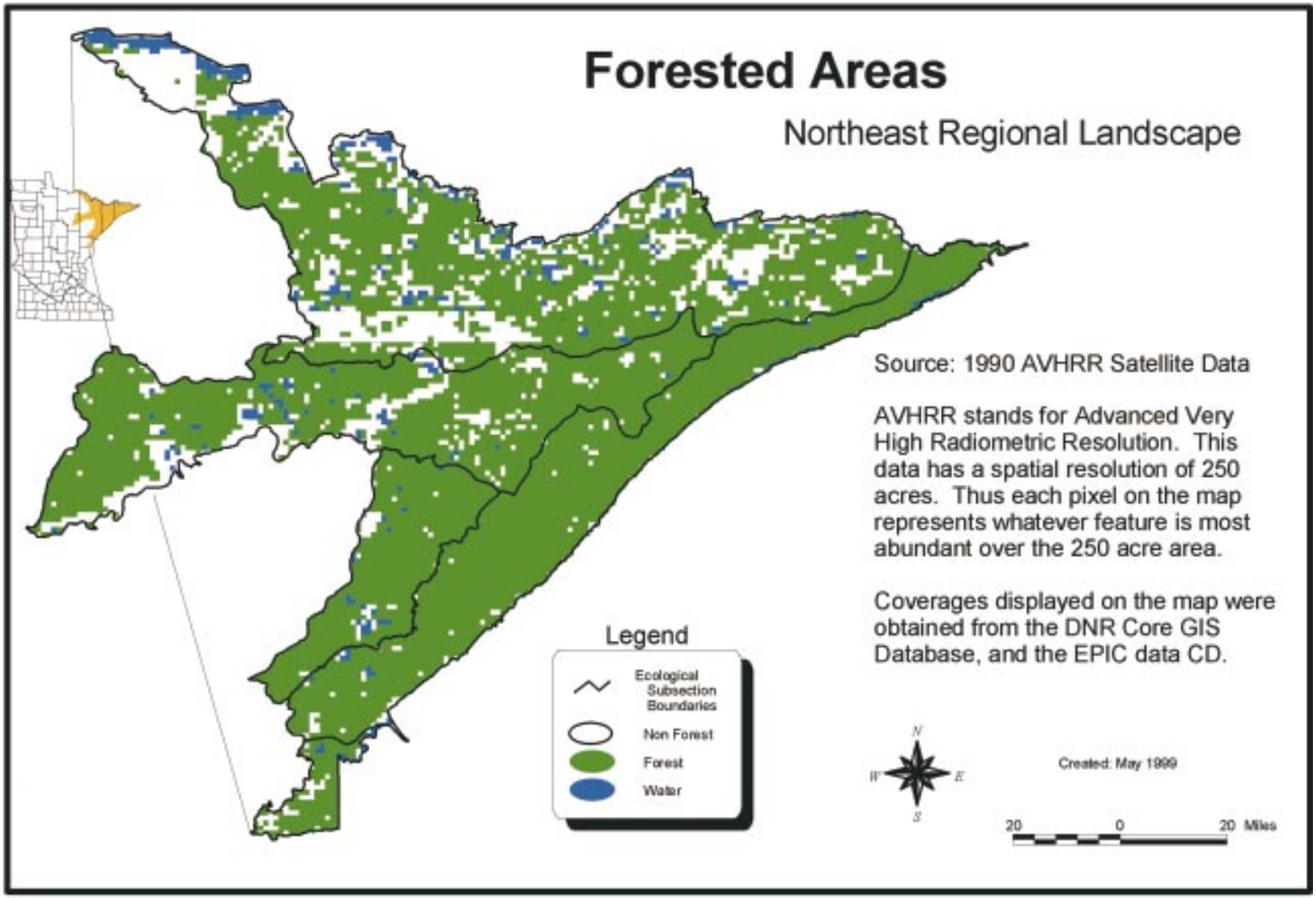
[A] Source: Spencer et al. 1979.

[B] Source: Miles et al. 1995 and unpublished USFS documents. Data from 1977 were reprocessed using 1990 inventory procedures in an effort to make data between inventories more comparable.

[C] Source: 1990 Forest Inventory and Analysis database.

Note: Data in the table are based on a sample and are therefore subject to statistical error.

Figure 1.1. Forested Areas, Northeast Regional Landscape, 1990.



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. Ownership of forestland

There are an estimated 5.6303 million acres of forestland in the Northeast's socioeconomic area, split among ownership classes as shown in Figure 2.1. and Table 2.1. (See Figure 2.6. for a map of ownership of all land (forested and non-forested) across the Northeast's ecological assessment area.) The three classes of forestlands are defined as follows:

- reserved forestlands—lands on which timber production is prohibited.
- timberlands—lands on which timber production is allowed and where industrial wood crops are able to grow at a sufficient rate. It is these lands on which timber harvesting occurs.
- other forestlands—lands not capable of producing industrial wood at a sufficient rate. Relatively little of the forestland in the Northeast (3.4%) is other forestland and most of this 3.4% is in state, county, or municipal ownerships.

Figure 2.1. Distribution of forestland in the Northeast's socioeconomic assessment area by owner, 1990.

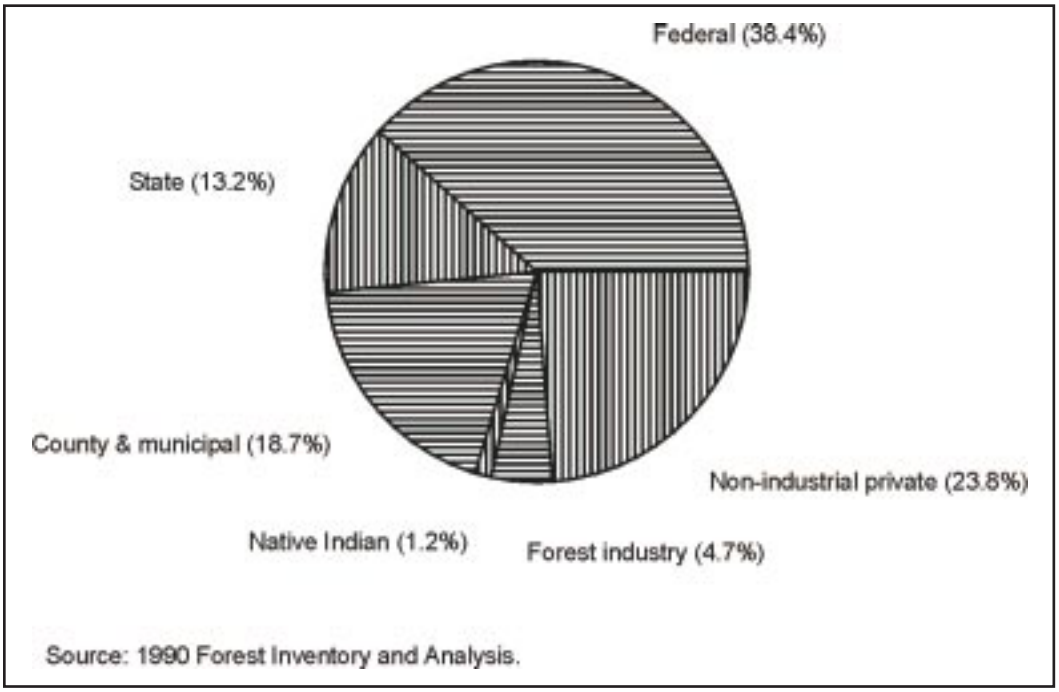


Table 2.1. Forestland ownership in the Northeast's socioeconomic assessment area, 1990. (Values are thousands of acres.)

Ownership group		Type of forestland		
		Timberland	Reserved forestland	Other forestland
Federal	2,162.0	1,269.8	874.5	17.7
State	741.0	596.9	81.6	62.5
County and municipal	1,054.5	955.6	19.3	79.6
Native Indian	69.4	67.1	1.3	1.0
Forest industry	262.1	259.2	1.8	1.1
Non-industrial private	1,341.3	1,306.2	4.7	30.4
Total	5,630.3	4,454.8	983.2	192.3

Source: 1990 Forest Inventory and Analysis database.

Trends in forest ownership were developed by comparing 1977 and 1990 forest inventory data (see Table 2.2.). Reporting of trend data is limited by the way information was reported in the 1977 publications. Data for 1977 were reported by county groups, with Carlton, Cook, Koochiching, Lake, and St. Louis composing one group. Data were also reported by ownership groups, with state, county, and municipal ownerships forming one group. For current purposes it would be best to separate Koochiching from the four counties of the Northeast's assessment area and to separate the state and county and municipal trends; however, the method of reporting the data in 1977 does not allow for these kinds of separations.

Table 2.2. Ownership of forestland in the Aspen-birch FIA Unit, 1977 and 1990. (Values are thousands of acres.)

Ownership	1977 forest-land area[A]	1990 forest-land area[B]	Percentage change
Federal and Native Indian	2,310.8	2,346.2	1.5%
State, county, and municipal	3,190.8	3,059.7	-4.1%
Forest industry[C]	565.6	470.2	-16.9%
Non-industrial private – farmer	599.5	208.7	-65.2%
Non-industrial private – other	805.1	1,278.3	58.8%
Total	7,471.8	7,363.1	-1.5%

[A] Source: Spencer et al. 1979.

[B] Source: 1990 Forest Inventory and Analysis database.

[C] The decrease in forest industry acreage was driven largely by sales of their Minnesota lands by Kimberly Clark, Consolidated Paper, and Champion International.

Note: Data in the table are based on a sample and are therefore subject to statistical error.

The ratio of public forestland to private forestland changed little between 1977 and 1990 for both the FIA aspen-birch unit and the state as a whole. For example, the Northeast had approximately 2.8 acres of public forestland for every acre of private forestland in both 1977 and 1990. The Northeast had greater concentrations of public lands compared to the state as a whole in both 1977 and 1990 (see Table 2.3.).

Table 2.3. Public forestland to private forestland ratio, 1977 and 1990.

Ratio	1977[A]	1990[B]
FIA aspen-birch unit	2.79	2.76
Statewide	1.50	1.46

[A] Source: Spencer et al. 1979 and Jakes 1980.
[B] Source: 1990 Forest Inventory and Analysis database.
Note: Data in the table are based on a sample and are therefore subject to statistical error.

2.2. Public land sales and exchanges

The following tables (2.4. to 2.8.) show the land purchases, disposals, and exchanges over recent years for the Superior National Forest, DNR, St. Louis County, and Carlton County.

Table 2.4. Superior National Forestland purchases, exchanges, and disposals, 1987–1997 (in acres).

Year	Purchases	Exchanges[A]	Disposals	Net gain	Net Gain % of Total
1987	0	1,036	0	1,036	5.4
1988	13	2,142	0	2,155	11.3
1989	300	4,282	3,391	1,191	6.2
1990	125	5,522	3,700	1,947	10.2
1991	100	7,112	6,611	601	3.1
1992	580	4,491	11,967	-6,896	-36
1993	2,483	7,318	6,751	3,050	15.9
1994	5,821	1,386	1,197	6,010	31.4
1995	4,572	0	3	4,569	23.9
1996	240	5,333	220	5,353	27.9
1997	122	1,442	1,426	138	0.7
Total	14,356	40,064	35,266	19,154	100

[A] Exchange acres are net acres gained in land exchanges.

Table 2.5. Summary of Superior National Forest major land exchanges, 1989–1997.

Fiscal year	Case	Acres	County
1989	Boise Cascade Corp.	3,125	St. Louis
1990	Lake County II	3,662	Lake
	MN Trust for Public Land	2,666	Cook
	MN Trust for Public Land	1,364	Cook
	State of MN	895	St. Louis
	Lake County	1,102	Lake
	Potlatch Corp.	1,327	Lake & St. Louis
1992	MN Trust for Public Land	1,932	Cook
	Cook County (airport)	1,421	Cook
1993	Potlatch Corp.	3,067	St. Louis
	MN Trust for Public Land	818	Cook
	MN Trust for Public Land	2,116	Cook
1994	Boise Cascade Corp.	1,279	St. Louis
1996	LTV Steel Mining Co.	4,975	St. Louis
1997	St. Louis County	1,441	St. Louis

Source: Superior National Forest staff.

Approximately 3,200 of the acres acquired by the DNR in Lake County were acquired from the Nature Conservancy (see Table 2.6.). The land was formerly owned by 3M and falls within Tettegouche State Park. In Cook County, approximately 3,280 acres were acquired from the Nature Conservancy. The land was formerly owned by Champion International and is now the Swamp River Wildlife Management Area. Nearly 500 acres in Cook County were acquired from the Trust for Public Land and now form a scientific and natural area.

The vast majority of the 23,000 acres acquired in St. Louis County were purchased with legislated funding to fulfill the St. Louis River Plan. The plan was developed by a joint powers board including St. Louis, Carlton, and Lake Counties and the townships bordering the river. Most of the land was acquired from Minnesota Power.

Table 2.6. DNR land acquisition and disposal history for 1993 to 1997.[1]

County	Acquired acres	Finalized sold acres	Land exchange relinquished acres	Net gain in acres	Net Gain % of Total
Cook	4,321	88	238	3,995	13.9
Lake	4,066	233	240	3,593	12.5
St. Louis	23,163	607	1,487	21,069	73.5
Total	31,550	928	1,965	28,657	99.9

[1] Data for Carlton County could not be obtained.
Source: DNR Real Estate Management, March 1999.

Table 2.7. St. Louis County: acres forfeit and sold, 1987–1997.

Year	Acres forfeit	Acres sold	Net gain
1987	4,049	937	3,112
1988	5,901	1,471	4,430
1989	8,574	832	7,742
1990	2,296	670	1,626
1991	2,360	816	1,544
1992	3,829	2,581	1,248
1993	2,593	2,102	491
1994	2,584	1,789	795
1995	2,374	2,165	209
1996	2,075	1,038	1,037
1997	1,400	2,082	-682
Net gain, 1987–1997			21,552

Source: St. Louis County Land Department.

Table 2.8. Carlton County: total forfeit acres and net annual change, FY 1988–1998.

Year	Acres[1]	Net change[1]
1988	73,002	–
1989	72,919	-82
1990	72,967	+48
1991	73,132	+165
1992	73,734	+602
1993	73,917	+183
1994	73,481	-436
1995	73,448	-33
1996	73,261	-187
1997	73,042	-219
1998	72,848	-194
Net change 1988–1998		-153

[1] Values rounded to nearest acre.
Source: Annual PILT reports filed by Carlton County Auditor.

Data from Lake County have not yet been received.

2.3. Reserved forestlands

Figure 2.2. and Table 2.9. show the acreage of state and federal areas in which timber harvesting is prohibited or highly restricted.

Table 2.9. Acres of reserved lands within the Northeast socioeconomic and ecological assessment areas. (Data represent areas within statutory boundaries.)

	1951	1960	1970	1999
State Parks[1]	9,140	11,152	25,744	44,016
Minnesota Scientific and Natural Areas[2, 4]	(A)	(A)	(A)	13,990
Voyageurs National Park[2]	(A)	(A)	(A)	218,054
Boundary Waters Canoe Area[3]	(A)	1,061,973	1,084,105	1,098,057
Federal Research Natural Areas[4]	(A)	(A)	1,973	2,733
Total	9,140	1,073,125	1,111,822	1,378,849

(A) denotes that either a designation did not exist or data were not available for a given time period.
[1]Source: Minnesota Legislative reports for the following years: 1951, 1959–60, 1969–70.
[2]Source: MnDNR GIS core library.
[3]Source: Superior National Forest staff. **Note**: Total acres of the BWCAW have not changed since the 1978 Act. Acre discrepancies are due to changes in the methods of accounting for surface water areas.
[4] Because MSNAs may lie within state parks and FRNAs may lie within the BWCA, some acres may be double counted.

2.4. Land use

Figure 2.3. displays the 1990 GIS land use data for northeastern Minnesota. GIS data for 1969 land uses are also available; however, due to the resolution and classification differences between the 1969 and 1990 data sets, the data cannot be compared directly (see Appendix B for information on the data sets). Table 2.10. summarizes the data for the land use classes that may be generally compared between the two data sets. Even in these classes, however, acreage values cannot be directly compared. The generalizations that can be made based on the data are that 1) the extent of cultivated land has decreased, 2) the extent of mining/extractive land has increased, and 3) the extent of grasslands has stayed roughly the same.

Table 2.10. 1969 and 1990 land use data for the Northeast's ecological assessment area.[A] (Values are in acres.) (See Appendix B for information on 1969 and 1990 land use data sets.)

Class	1969	1990
Cultivated land	16,524	1,230
Hay, pasture, grassland	92,665	97,524
Mining	50,399	80,162

[A] GIS data obtained from the DNR Management Information Systems Bureau.

2.5. Ownership fragmentation

2.5.1. Parcel sizes of non-industrial private forest lands

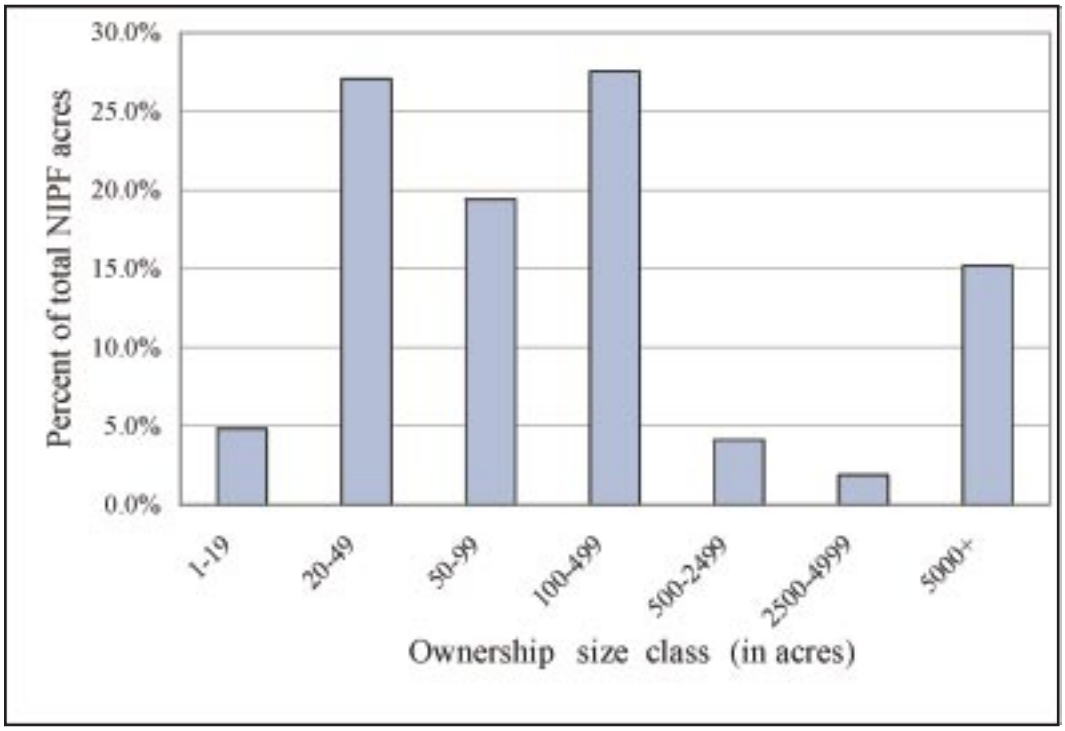
Data on the parcel sizes of non-industrial private forest (NIPF) land is readily available only for the year 1990 (see Table 2.11.). In 1990, total NIPF acreage was 1,306,200, or approximately 29% of total timberland and 24% of total forest land. The majority (68.1%) of NIPF land is held in parcel sizes of at least 50 acres; 48.7% is held in parcel sizes of 100 acres or larger (see Figure 2.4.). Figure 2.5. shows ownership size class data for NIPF lands statewide.

Table 2.11. Area of NIPF timberland in the Northeast Landscape Region by ownership size class, 1990. (Values are thousands of acres.)

Ownership size class (in acres)	1–19	20–49	50–99	100–499	500–2499	2500–4999	5000 +	Total
Area of timberland (in thousands of acres)	63.0	353.5	253.5	359.7	53.6	24.6	198.3	1,306.2
% of total	4.8%	27.1 %	19.4 %	27.5%	4.1%	1.9%	15.2%	100.0 %

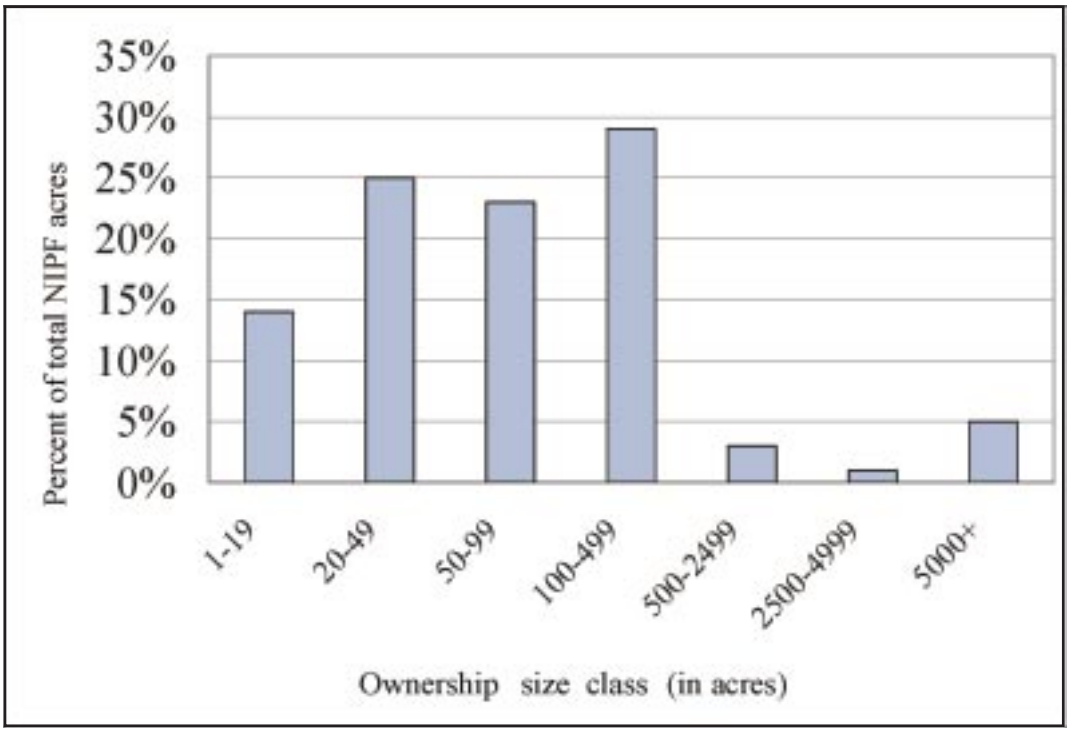
Source: 1990 Forest Inventory and Analysis database.

Figure 2.4. Distribution of NIPF acres by ownership class size in the Northeast, 1990.



Source: 1990 Forest Inventory and Analysis database.

Figure 2.5. Distribution of NIPF acres by ownership class size statewide, 1990.



Source: 1990 Forest Inventory and Analysis database.

2.5.2. Parcel sizes of all private lands

St. Louis and Cook Counties were contacted for data on parcel sizes of all private lands. Neither county has data readily available on how private land is divided among owners or on trends of average parcel size. St. Louis County is working toward a project that would determine this information for one township within the county but expects that the information for the entire county will not be available for many years.

Figure 2.6. shows ownerships of all lands in the Northeast's socioeconomic and ecological assessment areas.

2.5.3. Building trends on lake shoreline property[1]

In northeast Minnesota (Carlton, Cook, Koochiching, Lake, and St. Louis counties), about 65% of lake shoreline is publicly owned. About half of the public shoreline is within the BWCA. Outside the BWCA, lakeshore is split evenly between private and public ownership (see Table 2.12.).

Table 2.12. Ownership of lake shoreline.

Private	34.9%
Public	30.9% inside BWCA
	34.2% outside BWCA
Total	100%

Source: Kelly, T., and J. Stinchfield, 1998.

When last surveyed in 1982, 10.5% of the private shoreline in the Northeast was developed at a density of more than 20 units per mile (see Table 2.13.). This 10.5% of shoreline contained 65.0% of all housing units.

Table 2.13. 1982 Development density on privately owned lake lots in Northeast Minnesota (Carlton, Cook, Koochiching, Lake, and St. Louis counties).

Development density class (1982 housing units per mile of private shoreline on lake lots)	Private shoremiles (percent)	Housing units (percent)
2.5 or less	61.0	1.5
2.6 to 5.0	11.8	6.3
5.1 to 10.0	8.0	8.6
10.1 to 20	8.7	18.6
More than 20	10.5	65.0
Total percent	100.0	100.0
Total miles or units	2,259	14,743

Source: Kelly, T., and J. Stinchfield, 1998.

In the absence of a more recent lake home census, the DNR estimates in a report prepared in 1998 that lakeshore development growth rates have fallen since 1982, but are not negligible (see Table 2.14.). The estimate is based on U.S. Census data and county assessor records. Many factors likely contributed to this trend of slowing growth. Of these factors, only population growth has been projected into the future in quantitative terms. Population growth in the northeastern counties is projected to slow over the next decades and reach zero growth around 2030. Therefore, population growth, as an isolated

Source: Minnesota DNR.

1 All information in this section is summarized from the report "Lakeshore Development Patterns in Northeast Minnesota: Status and Trends," prepared by Tim Kelly and Joe Stinchfield of the MnDNR, July 1998.

factor, "should slow, rather than accelerate, the rate of lakeshore development" (Kelly & Stinchfield, 1998). (See Atlas, 1998 - map of seasonal home distribution.)

Table 2.14. Seasonal/Vacation home growth, 1970 to 1990.

	1970 to 1980 increase (percent)	1980 to 1990 increase (percent)
Minnesota	48.0	7.5
NE Minnesota	57.7	19.5

Note: The 1990 housing figure is "seasonal/recreational/occasional use," which in 1980 was reported as "seasonal or migratory" and "held for occasional use." The 1970 housing figure is "seasonal or migratory," which was reported the same way in 1980. In 1980, the "held for occasional use" category was 17% the size of the "seasonal or migratory" category.
Source: Kelly & Stinchfield, 1998.

2.5.4. Road density

Road density in Northern Minnesota varies among geographic regions (see Figure 2.7.). In the Glacial Lake Superior ecological subsection, where part of the city of Duluth is located, density is almost two miles of road per one square mile. In contrast, in the Border Lakes subsection, which includes the Boundary Waters Canoe Area and Voyageurs National Park, the road density is less than 0.5 miles of road per square mile and reflects the lower population density of the subsection.

Figure 2.7. Density of roads in Northeast Minnesota by ecological subsection.

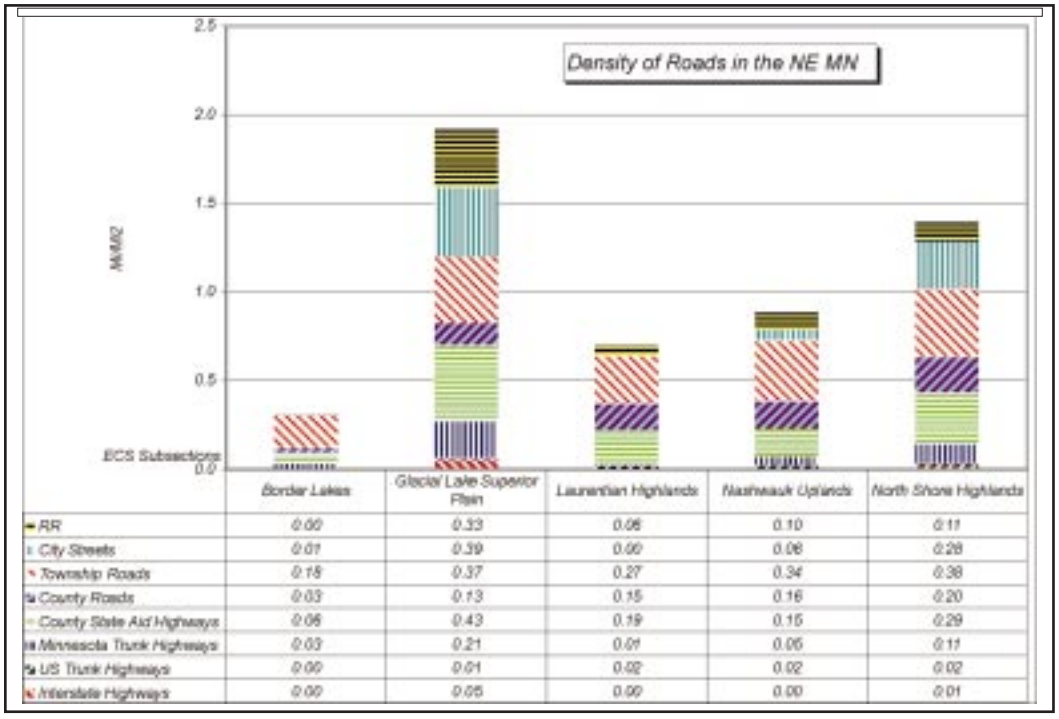
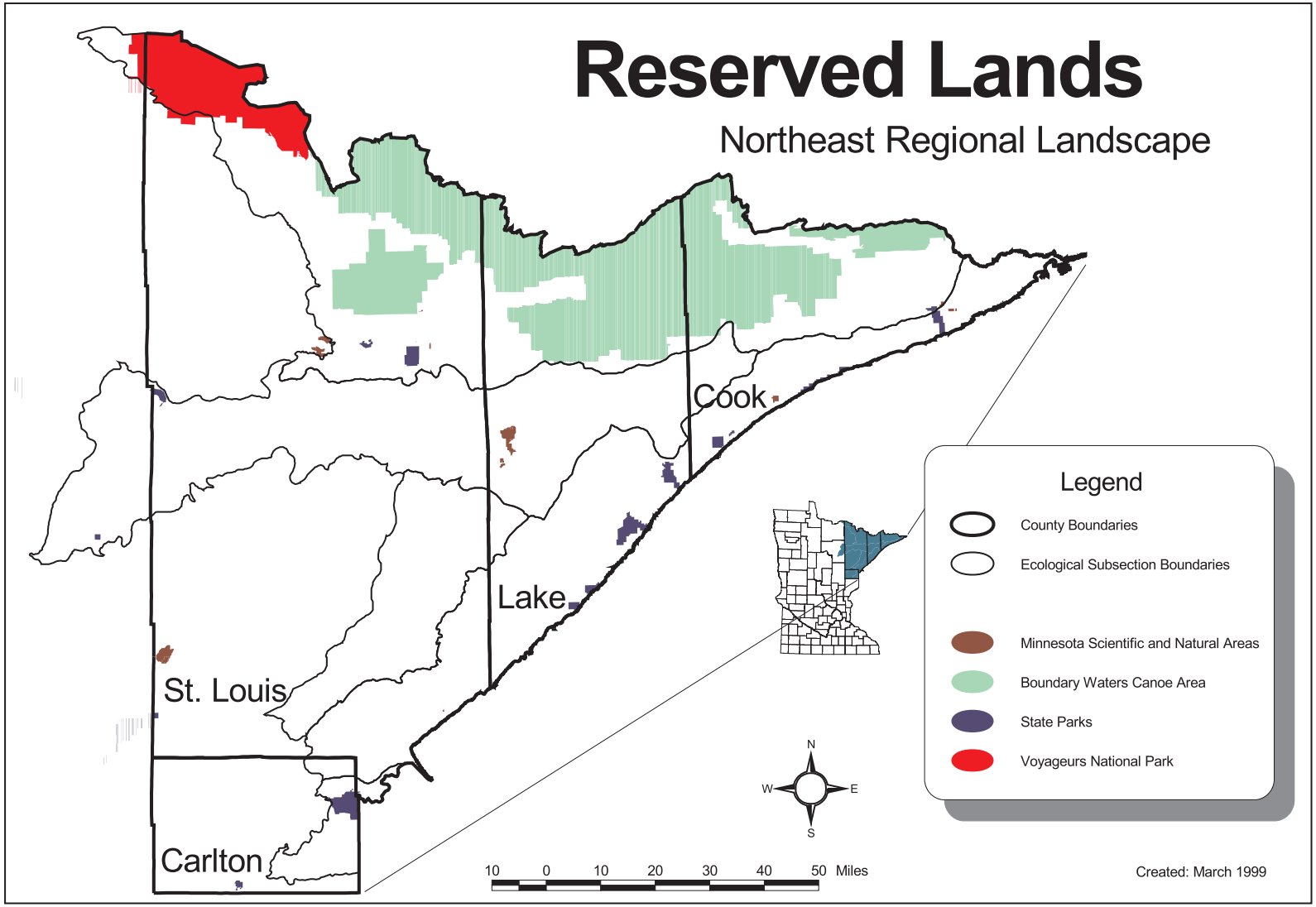
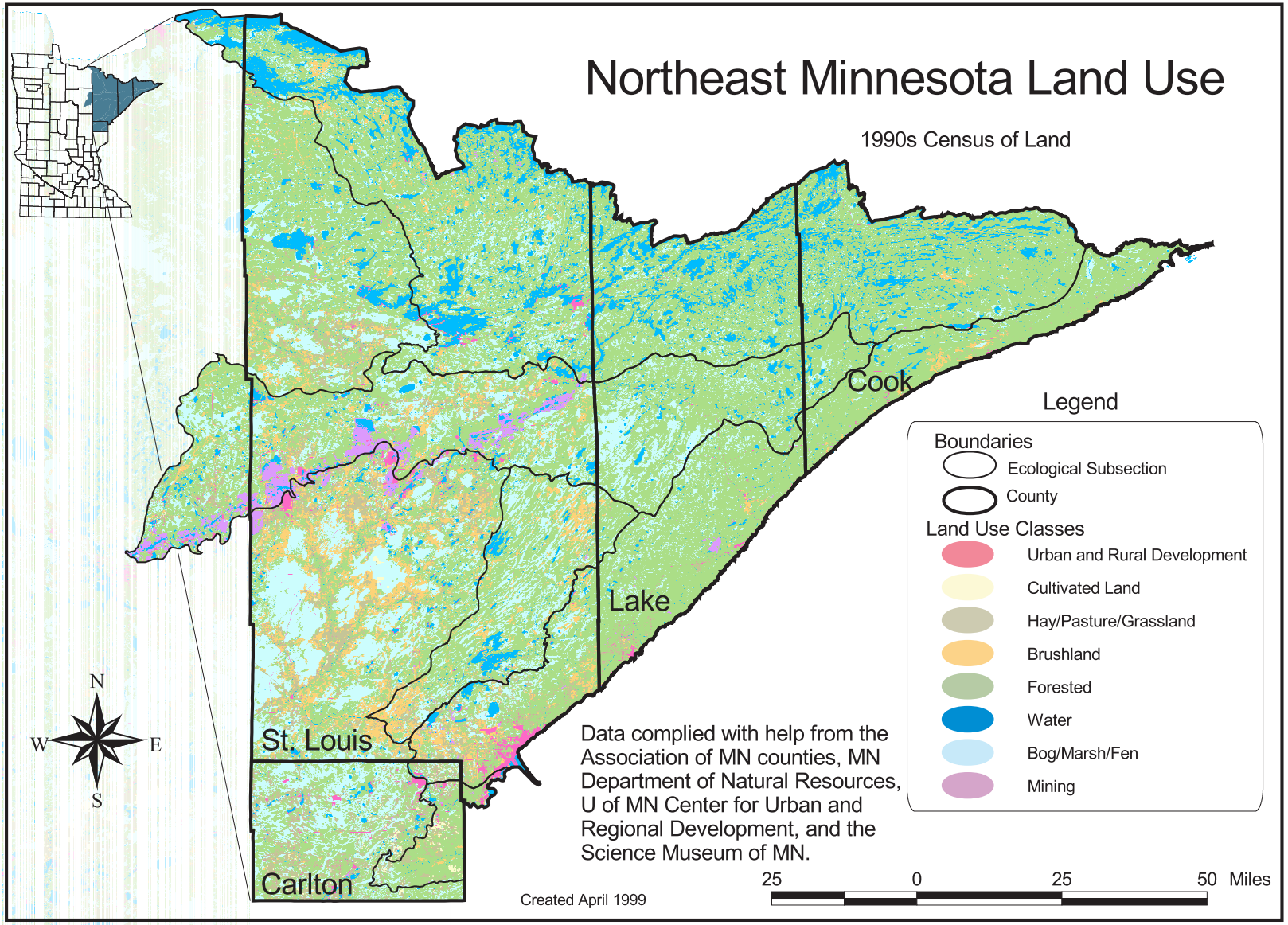


Figure 2.2. Locations of reserved state and federal lands.



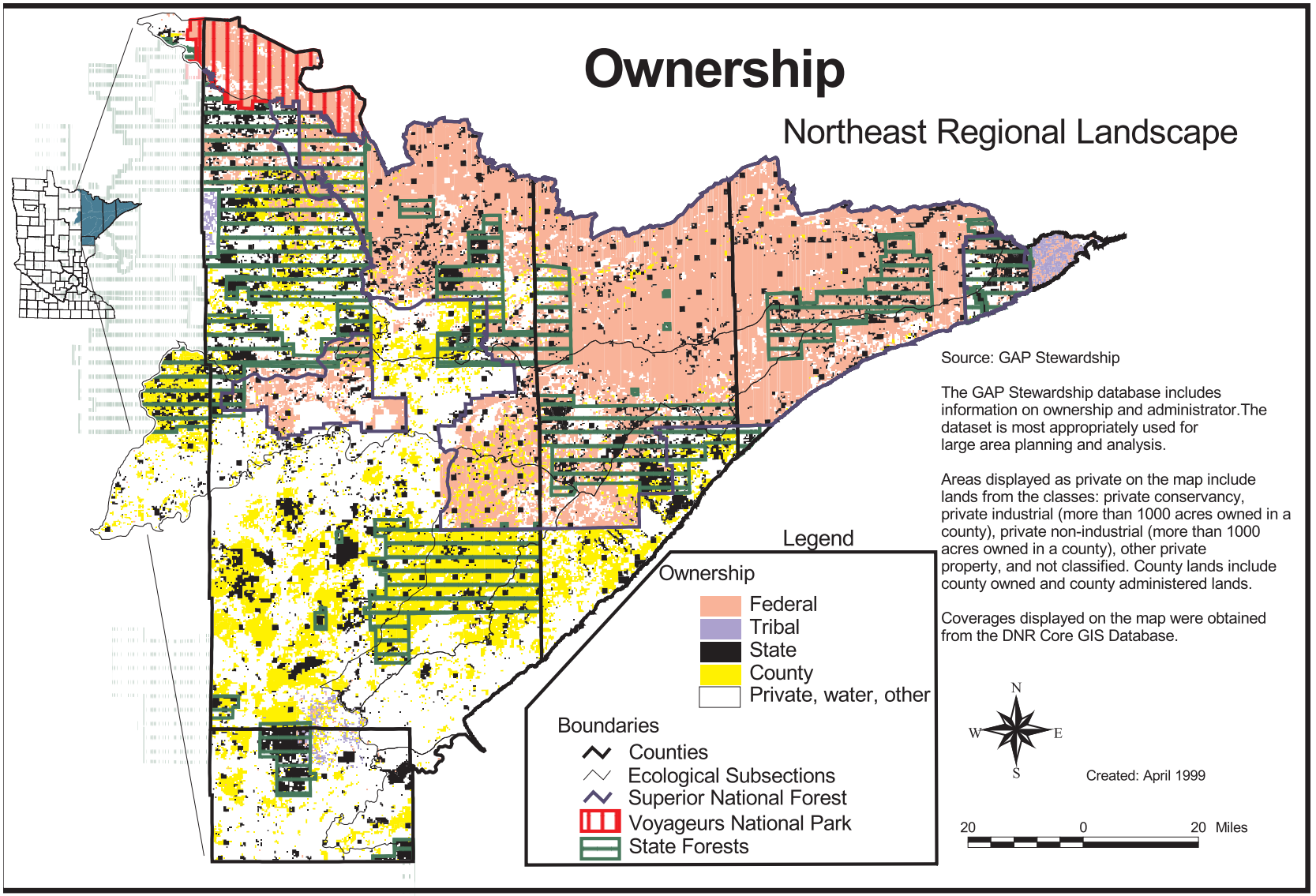
Source: MnDNR Core GIS database.

Figure 2.3. Northeast Minnesota land use and cover, 1990.



Source: Landsat images between 1991 and 1996, classified by Manitoba Remote Sensing Centre (see Appendix B).

Figure 2.6. Ownership of land in Northeast MN, based on 1995 GAP GIS data (see Appendix B for more information on data source).



Source: MnDNR GIS core library.

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; tree species; forest composition and age structure; growth and removals on timberland; silvicultural and harvesting practices; vascular plant and vertebrate species at risk; wildlife furbearer and game species; and lake and stream water quality. The only detailed forest cover type data available across all ownerships in the Northeast are Forest Inventory and Analysis (FIA). Satellite data are available for recent years but are generally not at the level of detail necessary to conduct a thorough analysis. The information that exists on other taxonomic groups (e.g., insects, lichens, and mosses) consists primarily of lists of species that have been found in the region. Little information on species abundance or population trends is available. The County Biological Survey is just beginning in the region and will not be completed for at least another three years. Table 3.1. summarizes the ecological data needs and limitations.

Table 3.1. Data needs for the assessment of ecological conditions.

Data needed	Availability	Remarks
Existing vegetation structure • Overstory density • Size class • Shade tolerance	FIA on all ownerships	1990 most recent data
	CSA on public ownerships	Gaps in coverage
	Satellite on all ownerships	Limited level of detail
Land potential (Appendix C) • Understory species comp. • Soils	Limited	DNR, Blandin, & Boise working on crosswalk of what to use
Historic range of natural variability	Marshner's map Bearing tree data	No agreement on what to use; group working on now
County biological survey • Plants • Other taxa	Limited	County Biological Survey to start on North Shore in 1999

3.1. Data needs

(See Table 3.1.)

3.1.1. Range of natural variation

Scientists from the Minnesota Department of Natural Resources, the University of Minnesota, the United States Forest Service, private industry, and other institutions are working together to develop a process that would define the range of natural variation for forested communities of northern Minnesota. The purpose is to develop an understanding of the types of forests (extent, composition, and spatial distribution) that resulted from natural processes that once existed exclusively on the landscape. The range of natural variation recognizes the dynamic nature of historical forests. The process being developed by the group of scientist is one of 1) defining native plant communities, 2) determining disturbance regimes for native plant communities, and 3) quantifying the extent and spatial distribution of native plant communities and seral stages that formerly existed on the landscape.

3.1.2. Minnesota County Biological Survey (MCBS)

Excerpt from the MCBS web page located at **http://www.dnr.state.mn.us/fish_and_wildlife/mcbs.html**, July 1999:

> "The MCBS began in 1987 as a systematic survey of rare biological features. The goal of the Survey 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.
>
> The Survey 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. Data are entered into the Department of Natural Resources' Natural Heritage Information System, which includes the mapping capabilities of an ARC/INFO Geographic Information System.
>
> To date, the Survey has been completed in 35 counties, is underway in 16, and proposed for all or portions of 13 counties. Ecological Units define targeted areas in parts of western and northeastern Minnesota (Red River Prairie and North Shore subsections)."

3.2. A visual comparison of pre-settlement vegetation to current vegetation

Figure 3.1 shows two representations of vegetation cover for Northeast Minnesota. The data source for the Marschner map is a vegetation survey analysis done in the 1930s of 19th century information; the data source for the Landsat map is a satellite image classified with the assistance of computer technology in 1997. The two sources differ considerably in resolution levels and vegetation classification systems (see below and Appendix B.). Because of these differences, direct quantitative comparisons between the

maps should not be made. The general observations that may be made are stated in the Executive Summary of this report.

The main difference between these data sources is their resolution. The satellite imagery has a very high resolution of 30 meters by 30 meters, while the Marschner map has a very low resolution of 10s of miles. This difference can be seen in the sizes of the unique vegetation stands in the two maps. In the Marschner map there are no small lakes represented and the size of the vegetation stands are fairly large, from 20,000 acres to 3,000,000 acres. Conversely, the satellite image has few to no vegetation stands that represent an area greater than 40,000 acres and presents much greater detail and representation of smaller features.

A second difference between these data sources is their classification systems. Marschner classified aspen-birch stands as either aspen-birch trending towards hardwoods or aspen-birch trending towards conifer. In the satellite data, again due to its higher spatial resolution capability, the classified aspen-birch stands are pure stands of aspen-birch, and any small conifer or hardwood stands are classified as such. The Marschner map is a "remarkably good generalization of actual conditions" (Heinselman, 1974).

3.3. A quantitative comparison of pre-settlement to today

The Public Land Survey (PLS) system was started in the late 1800s. 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 (Almendinger, 1996). John Almendinger, with the Minnesota Department of Natural Resources, has analyzed the bearing tree data and compared them 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, contact John Almendinger directly at the DNR Division of Forestry, Resource Assessment Office.

Table 3.2. summarizes the results of the analysis for the Northeast's ecological assessment area. 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. The final column shows the proportional difference for each species. For example, 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.

Table 3.2. Relative abundance of tree species as estimated from Public Land Survey bearing tree database (late 1800s) and the 1990 FIA point data for the Northeast's ecological assessment area.[A]

Tree species	Abundance - Bearing Tree	Abundance - FIA	Difference	Proportional difference
Ash	0.97%	3.90%	2.93%	4.01
Aspen/Cottonwood	9.4%	26.23%	16.83%	2.79
Balm-of-Gilead	0.24%	2.98%	2.73%	12.19
Birch	16.94%	15.57%	-1.36%	-1.09
Black Oak	0.01%	0.04%	0.03%	3.34
Cherry	0.02%	0.06%	0.04%	3.58
Elm	0.21%	0.27%	0.06%	1.28
Fir	10.52%	14.20%	3.68%	1.35
Ironwood	0.02%	0.02%	0.00%	1.09
Jack Pine	8.98%	3.21%	-5.77%	-2.80
Linden or Basswood	0.28%	0.62%	0.34%	2.20
Maple	0.84%	2.83%	1.99%	3.37
Mountain Ash	0.00%	0.03%	0.03%	6.82
Red/Black Oak	0.05%	0.23%	0.18%	4.92
Red Pine or Yellow Pine	2.94%	2.41%	-0.52%	-1.22
Spruce	19.77%	12.53%	-7.23%	-1.58
Sugar Maple	0.75%	3.61%	2.86%	4.79
Tamarack	11.44%	1.65%	-9.79%	-6.93
White Cedar	5.96%	7.08%	1.12%	1.19
Willow	0.10%	0.02%	-0.09%	-6.27
White Pine	7.49%	1.84%	-5.65%	-4.06
Yellow Birch	1.08%	0.66%	-0.42%	-1.63

[A] See Appendix B for details on the data used.

Source: DNR Division of Forestry, Resource Assessment.

3.4. Forests of the Boundary Waters Canoe Area Wilderness

A report on age class structure, old growth, and succession in the BWCAW is being prepared under contract and will be completed by June 30, 1999.

3.5. Riparian areas

The following are excerpts from *Best Management Practices for Water Quality, Evaluating BMP Compliance on Forest Lands in Minnesota: A Three-Year Study,* by Michael J. Phillips, Richard Rossman, and Rick Dahlman, Minnesota Department of Natural Resources, Division of Forestry, 1994.

> Best management practices (BMPs) serve as the cornerstone for the forestry water quality protection program in Minnesota. The use of BMPs has been actively promoted in Minnesota since 1988 in response to mandates contained in the 1987 Amendments to the Clean Water Act (PL 100-4)….annual field auditing program in 1991 designed to evaluate BMP compliance on state, federal, and county lands; private industrial lands; American Indian lands; and nonindustrial private forest lands.…
>
> The field audits were conducted by interdisciplinary teams.…
>
> The major findings for the field audits from 1991 to 1993 are summarized below:
>
> - Compliance with BMP recommendations averaged 84% across all forest landowners. The rate of compliance was highest on county and private industrial lands (90%) and lowest on nonindustrial private forest (77%) and American Indian (75%) lands. State and U.S. Forest Service lands had compliance levels of 85% and 87%, respectively.
> - The majority of departures from BMP recommendations (77%) were minor. Minor departures were small in magnitude and localized with a small potential to impact water quality.
> - Where BMPs were properly applied, adequate protection to the water resource was found 99% of the time. Even with minor departures from recommended practices, adequate protection was provided 60% of the time. The magnitude of the impact to water quality increased to the extent to which the BMP recommendations were ignored or not followed.
> - Departures from BMP recommendations were more frequent in southeastern Minnesota compared to the northern half of the state. The lower compliance level for southeastern Minnesota reflected the steeper and more difficult operating terrain common to that region of the state.
> - Major departures and gross neglects were found for less than 4% of total practices rated, with the highest proportion found on American Indian and nonindustrial private forest lands. These departures were more frequently found in southeastern Minnesota compared to the northern forested areas of the state.

- Compliance with filter strip BMP recommendations across all forest landownerships averaged 91%, indicating that operators, resource managers, and landowners are generally cautious when operating near water.
- Departures from BMP recommendations were common for water diversion devices and drainage structures on roads and skid trails. These practices are important because they influence the volume, velocity, and direction of surface flow. Other groups of practices where departures were frequent were those related to rehabilitation and maintenance, water crossings, and the depositing of slash and logging debris into open water and wetlands. These practices accounted for 15% of total practices rates, but represented 45% of all departures identified. However, 75% of the departures for these practices were minor.
- Minnesota compliance rates are consistent with results reported nationally.

3.6. Forest type groups

Forest Inventory and Analysis (FIA) is a periodic survey of the state's forestland. 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.

Forestlands are classified into types based on the predominant tree species in a stand. 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 forest types aspen, birch, and balsam poplar.

Figures 3.2. and 3.3. show the distribution of forest type groups in the Northeast (including Koochiching County) in 1977 and 1990, according to FIA data. Total forestland was an estimated 7.471 million acres in 1977 and 7.363 million acres in 1990. The aspen-birch, black spruce, and white spruce-balsam fir forest type groups collectively accounted for more than 70% of total forestlands in both 1977 and 1990.

Figure 3.2. Extent of forest type groups for the Aspen-birch FIA unit, 1977.

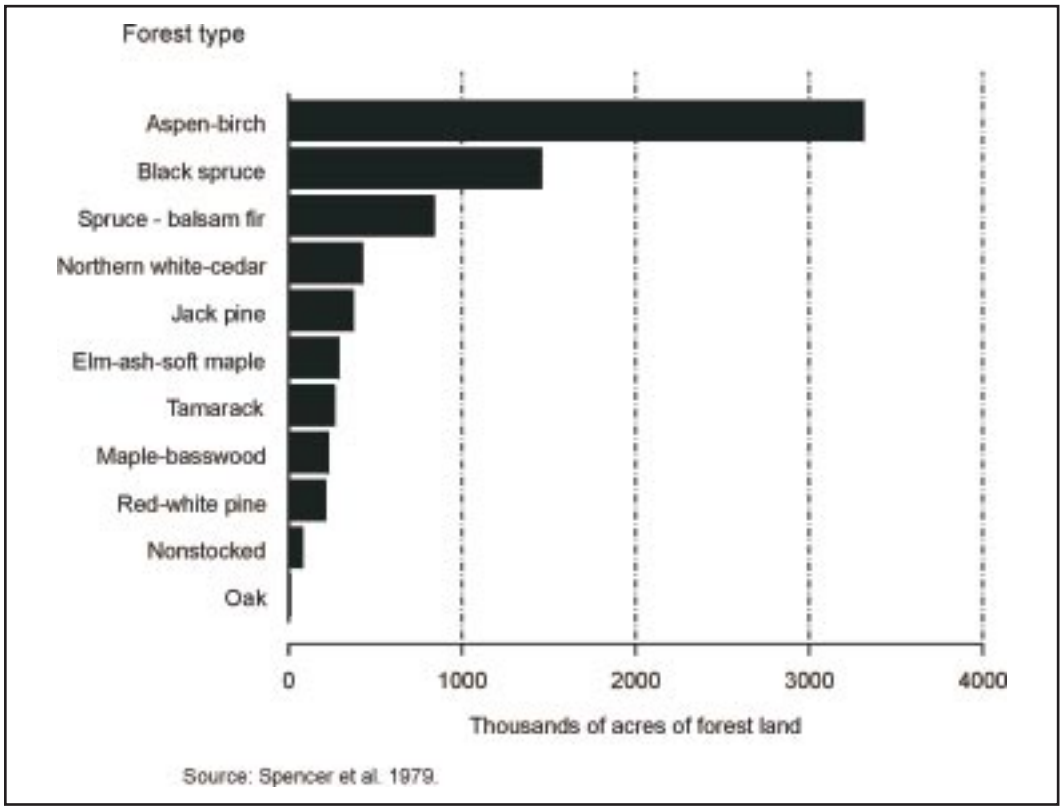
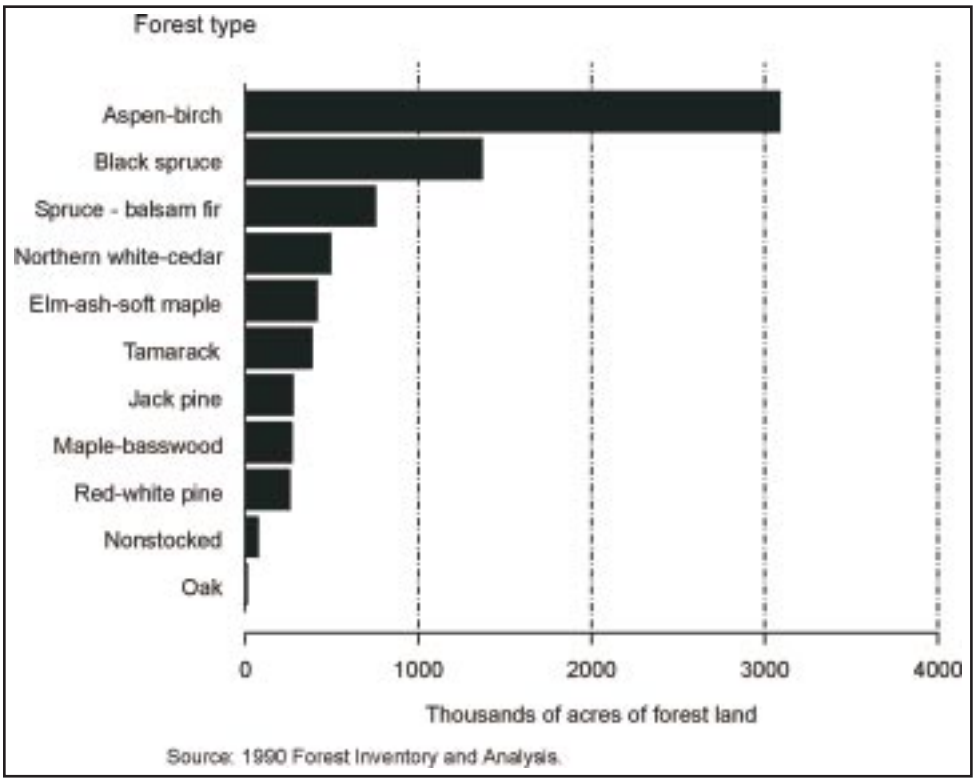
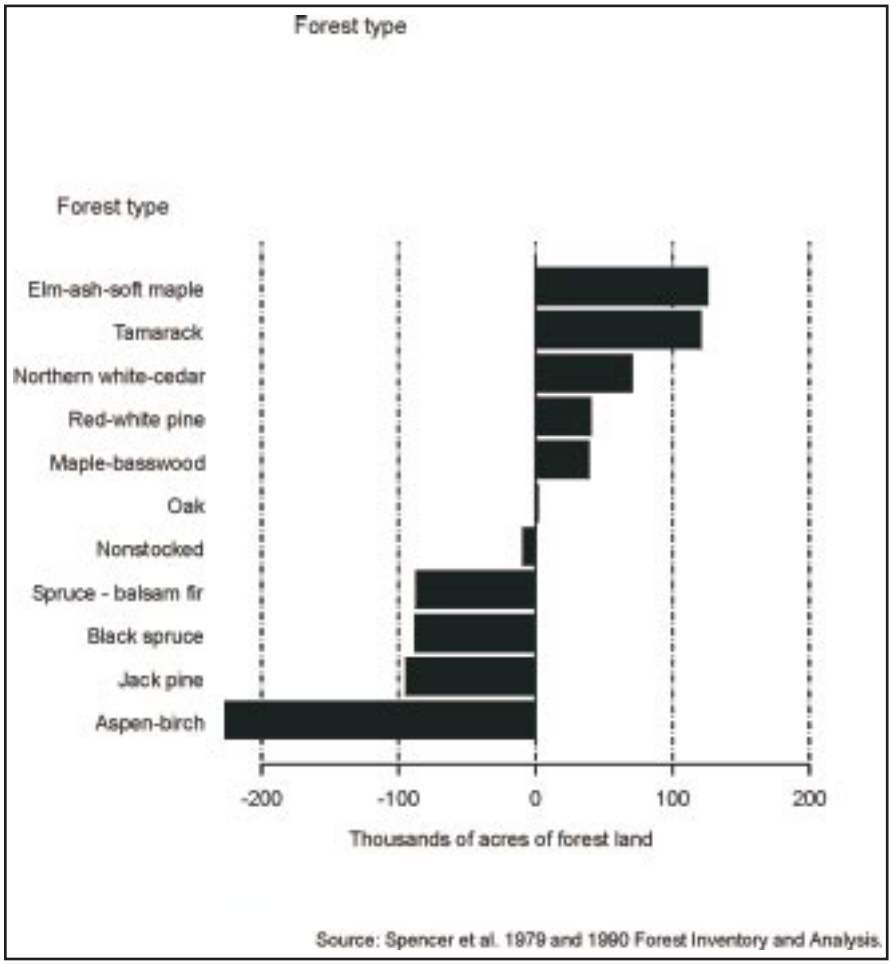


Figure 3.3. Extent of forest type groups for the Aspen-birch FIA unit, 1990.



Between 1977 and 1990 the aspen-birch, jack pine, black spruce, and spruce-balsam fir forest type groups experienced reductions in acreage (see Figure 3.4.). The aspen-birch type group was reduced by 226.2 thousand acres (6.8%) between 1977 and 1990. Jack pine experienced a reduction of 25%, from 368.9 thousand to 274.6 thousand acres. Increases in forestland area were observed for the elm-ash-soft maple, tamarack, northern white-cedar, red-white pine, and maple-basswood type groups.

Figure 3.4. Change in forest type group acreage for the Aspen-birch FIA unit, 1977–1990.



3.7. Age class structure of timberland

A balanced age class is one with equal amounts of acreage in each age class. Balanced age classes are desirable from both an economic production and a 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.

Figures 3.5. and 3.6. show the age class structures of timberlands in the Northeast (including Koochiching County) in 1977 and 1990, according to FIA data. The age class structure for 1977 shows and abundance of timberland in the 41–60 age classes. The imbalance in age classes in 1977 was somewhat reduced by 1990. Compared to 1977, the 1990 age class structure shows increased acreage in the 0–40 classes and reduced acreage in the 41–60 classes. Older age classes (81+ years) were not represented as well as younger age classes in either 1977 or 1990.

Figure 3.5. Age class structure of timberland in the Aspen-birch FIA unit, 1977.

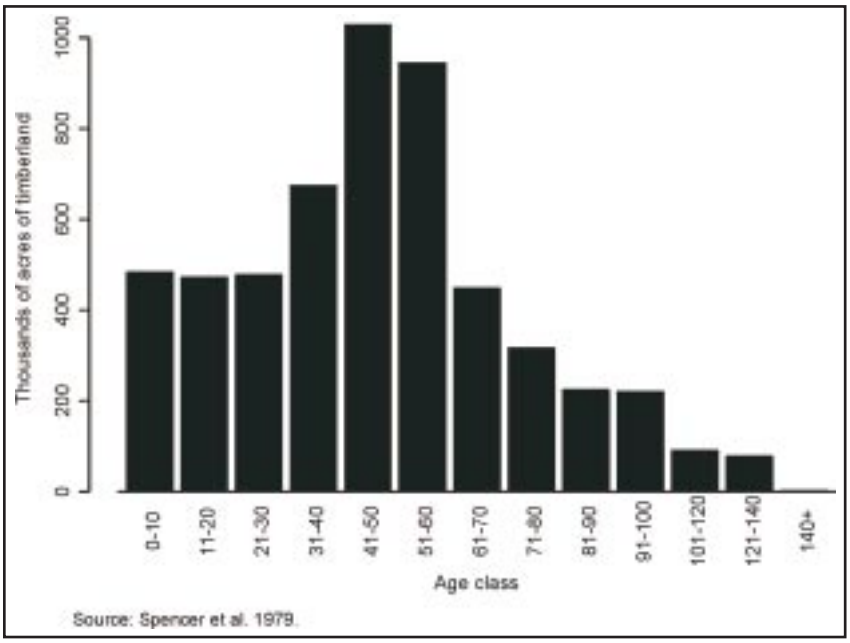
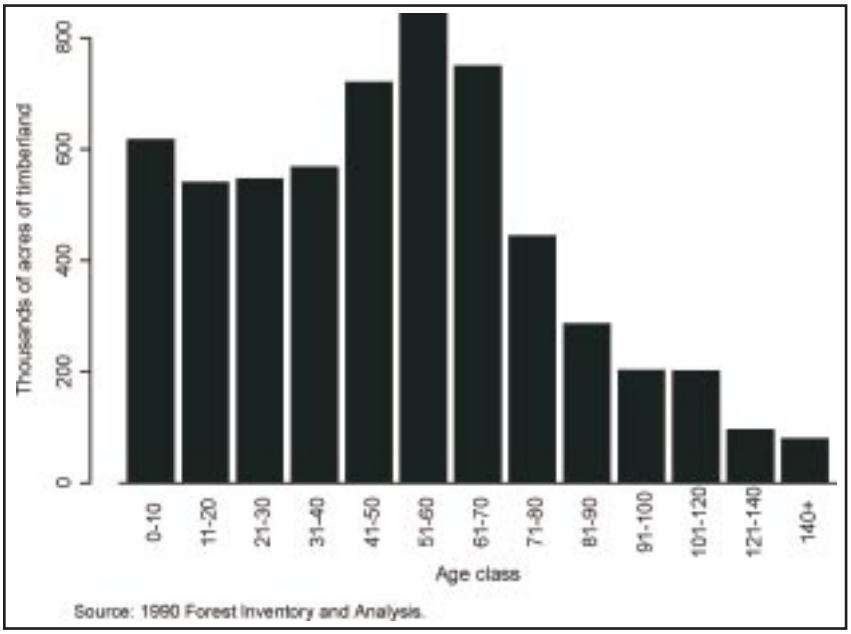


Figure 3.6. Age class structure of timberland in the Aspen-birch FIA unit, 1990.



The amount of timberland in the 31–60 age classes was reduced between 1977 and 1990 (see Figure 3.7.). Gains were observed in the younger (<30 years) and older (61+ years) age classes.

Figure 3.7. Timberland age class structure changes in the Aspen-birch FIA unit, 1977–1990.

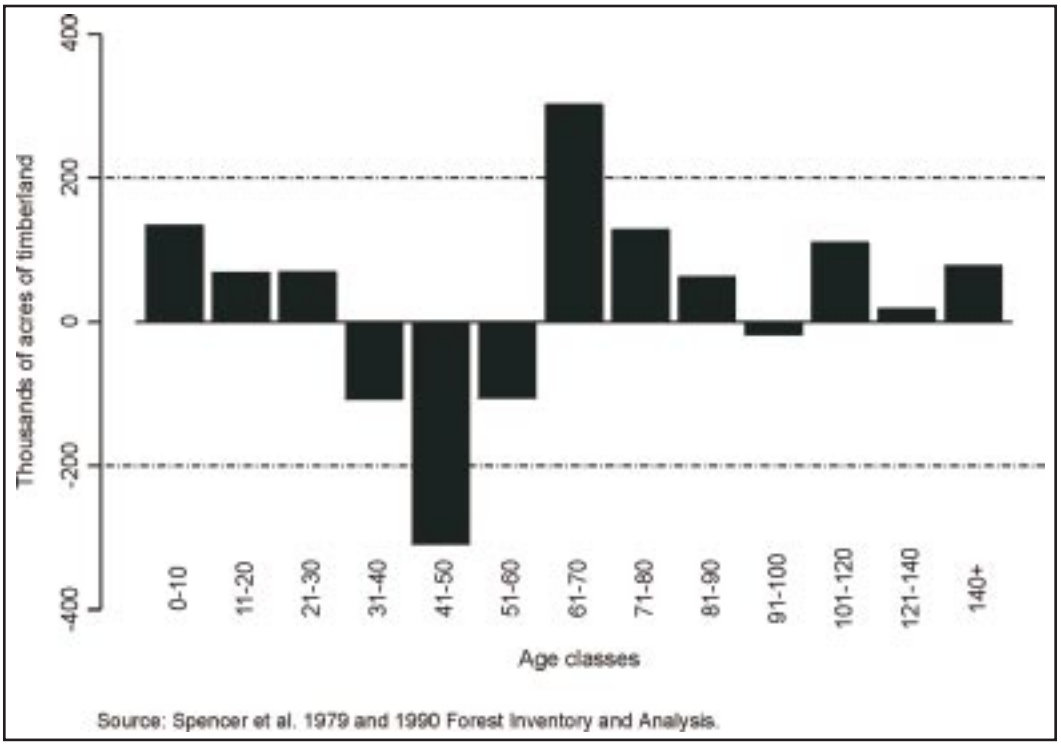


Table 3.3. and Figure 3.8. summarize the forest age structure data.

The DNR and St. Louis County currently have formal policies for designating old growth on lands they administer in the Northeast. The status of policy implementation is as follows:

- The DNR is inventorying and identifying stands by ECS subsections to be managed for old growth. To date they have completed the Vermillion-Littlefork subsection and are starting on the Border Lakes subsection.
- St. Louis County's policy was approved by the county board this spring. The county is now deciding how to implement the policy. Their old-growth inventory is based on the "Biophysical Inventory."

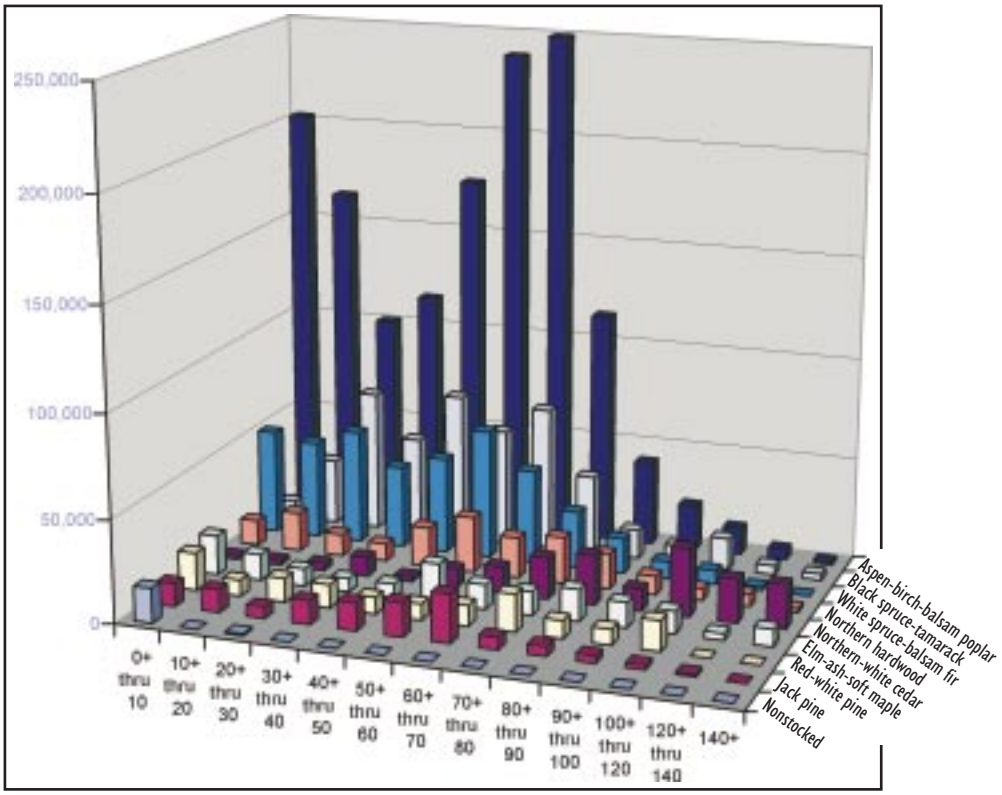
For the Superior National Forest, the USFS will identify old growth in each of the alternatives presented in the forest plan revision process. A different amount of old growth will be designated in each alternative depending on the emphasis of the alternative.

Table 3.3. Forest type – age class structure of timberland in the Northeast's ecological assessment area, 1990. Values are thousands of acres of timberland.

Forest type	Age class													Total
	0–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	91–100	101–120	121–140	140+	
Jack pine	11.2	11.1	5.6	11.7	13.4	16.5	23.4	6.0	4.8	3.5	2.2	1.1	0.0	110.5
Red pine	16.5	7.9	11.7	10.8	8.2	6.8	7.4	12.6	5.6	4.0	4.5	0.0	0.0	96.0
White pine	1.9	0.0	0.0	0.6	0.0	1.1	2.7	5.8	3.1	3.7	10.3	0.0	0.0	29.2
Balsam fir	42.3	41.5	45.6	33.4	42.3	57.0	36.9	26.5	17.3	6.5	7.0	1.0	0.0	357.3
Black spruce	4.7	26.0	56.9	44.9	64.0	49.7	55.5	38.7	14.2	7.5	15.3	3.5	3.1	384.0
Northern white cedar	1.8	2.3	3.4	9.4	2.4	9.0	12.8	20.3	24.3	10.7	33.0	21.2	21.4	172.0
Tamarack	3.4	6.1	12.2	3.0	8.1	7.2	14.6	0.0	0.0	1.3	0.0	0.9	0.0	56.8
White spruce	8.9	6.4	10.2	6.9	4.9	6.4	9.1	1.4	0.0	2.0	0.0	0.7	0.0	56.9
Oak-hickory	1.2	3.9	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0
Elm-ash-soft maple	19.6	12.9	8.6	6.6	6.7	19.4	12.2	11.7	15.6	12.2	11.1	3.3	8.3	148.2
Maple-basswood	11.2	15.0	10.7	8.7	19.5	25.4	19.9	22.7	17.4	9.2	5.9	6.1	1.9	173.6
Aspen	177.3	142.3	76.9	93.8	132.2	149.5	144.5	68.3	22.8	12.6	7.9	1.1	1.5	1,030.7
Paper birch	16.9	13.1	17.1	20.0	39.9	83.9	100.7	41.9	15.3	7.9	3.3	3.9	0.0	363.9
Balsam poplar	8.3	8.5	6.7	0.9	3.0	5.5	4.1	3.3	3.4	1.4	1.9	0.0	0.0	47.0
Nonstocked	16.8	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.7
Total	342.0	297.0	266.5	250.7	344.6	439.3	443.8	259.2	143.8	82.5	102.4	42.8	36.2	3,050.8

Source: 1990 Forest Inventory and Analysis. **Note**: Data in table are based on a sample and therefore subject to statistical error.

Figure 3.8. Forest type – age class structure of timberland in the Northeast's ecological assessment area, 1990. (Values are acres of timberland.)

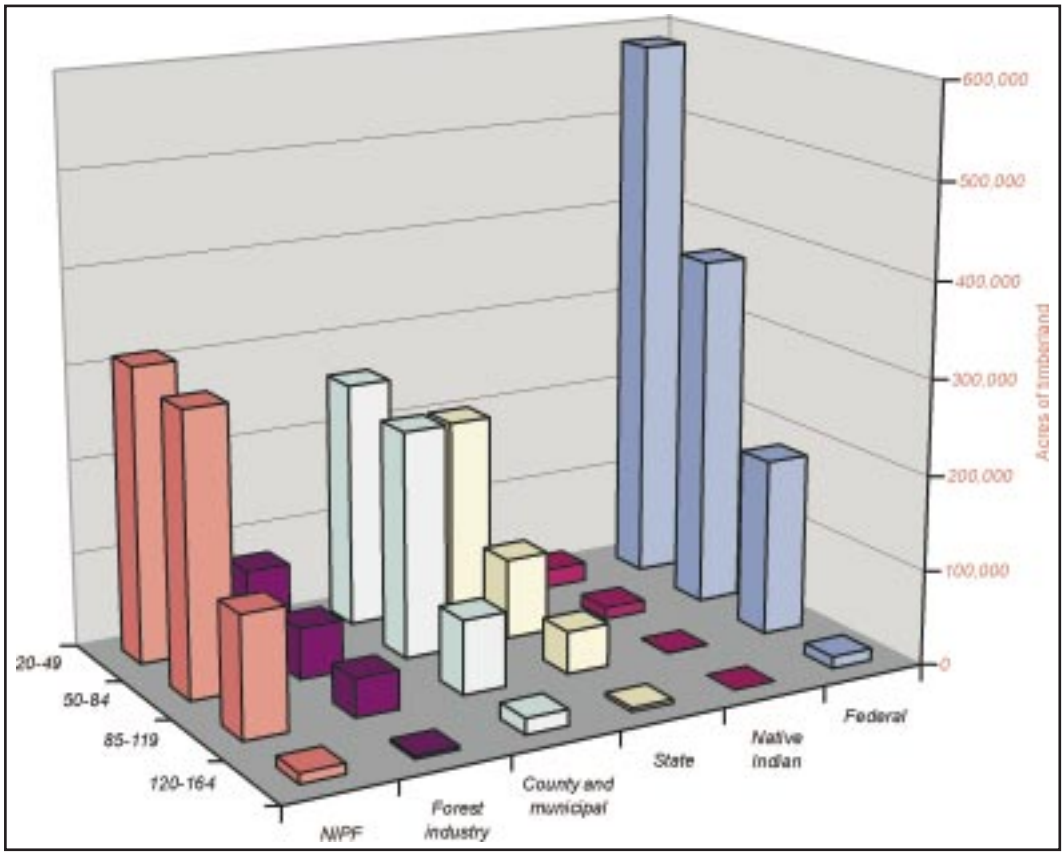


Source: 1990 Forest Inventory Analysis.

3.8. Productivity of the Northeast's timberland

Stand productivity is measured by the amount of timber volume produced per acre per year. About 48% (1.46 million acres) of timberlands across the Northeast's socioeconomic assessment area are classed as low productivity (20–49 cubic feet per acre per year). Less than 2% of the timberland area in the landscape is in the highest productivity class (120–164 cubic feet per acre year). The remainder is in the middle productivity classes of 50–119 cubic feet per acre per year. The distribution of timberland by owner and site productivity class is displayed in Figure 3.9. Low productivity timberlands are the dominant productivity class for each landowner group.

Figure 3.9. Distribution of timberland by owner and site productivity class for the Northeast's ecological assessment area, 1990.



Source: 1990 Forest Inventory and Analysis.

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

Current annual growth, mortality, and removals are defined by the Forest Service as follows (Miles, et al., 1995):

- Current annual growth of growing stock – The annual change in volume of sound wood in live sawtimber and poletimber trees and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes.
- Current annual removals from growing stock – The current net growing stock volume in growing-stock trees removed annually for roundwood forest products, in addition to the volume in logging residues and the volume in other removals.
- Current annual mortality of growing stock – The current growing stock volume in growing stock trees that died in a year due to insects, disease, fire, animals, weather, and other factors.

There was 5.6 billion cubic feet of growing stock volume on timberland in the Aspen-birch FIA Unit in 1990 (see Table 3.4.). Net growth in 1989 was 149.32 million cubic feet (2.7% of total growing stock volume). Removals for 1988 were 102.35 million cubic feet (1.8% of total growing stock volume).

The largest net growth rates (% of total growing stock volume basis) for species groups with more than 100 million cubic feet total growing stock volume were observed for hard maple and soft maple. The low removal rates for the species suggests a substantial increase in the extent of these species over time, assuming 1988–1989 conditions continue.

Extended periods where removals exceed net growth cannot be sustained. Based on the 1988–1989 data, removals exceeded net growth for aspen, jack pine, and elm species groups. For example, net growth of aspen in 1989 was 3.2% of total 1990 growing stock volume. Removals for 1988 were 3.6% of total 1990 growing stock volume.

Table 3.4. Current annual growth and removals of growing stock on timberland for the Aspen-birch FIA unit.

Species group	Growing stock				
	1990 volume	1989 net growth		1988 removals	
	Thousand cubic feet	Thousand cubic feet	Percentage	Thousand cubic feet	Percentage
Aspen	1,546,931	49,332	3.2	55,134	3.6
Spruce	764,560	19,333	2.5	10,986	1.4
Paper birch	706,773	12,936	1.8	7,631	1.1
Balsam fir	620,953	13,365	2.2	8,989	1.4
Cedar	480,103	11,320	2.4	801	0.2
Ash	267,016	7,929	3.0	1,175	0.4
Balsam poplar	243,221	4,326	1.8	2,690	1.1
Red pine	180,592	6,883	3.8	4,282	2.4
Tamarack	177,955	5,128	2.9	766	0.4
Jack pine	166,927	1,664	1.0	6,236	3.7
White pine	127,846	4,499	3.5	2,192	1.7
Hard maple	116,152	5,090	4.4	321	0.3
Soft maple	102,150	5,075	5.0	517	0.5
Basswood	49,600	1,472	3.0	85	0.2
Elm	18,768	-17	-0.1	178	0.9
Yellow birch	14,240	94	0.7		0.0
Red oak	12,501	410	3.3	242	1.9
White oak	9,785	306	3.1	127	1.3
Other hardwoods	1,349	152	11.3		0.0
Cottonwood	765	12	1.6		0.0
Other softwoods	84	14	16.7		0.0

Species group	Growing stock				
	1990 volume	1989 net growth		1988 removals	
	Thousand cubic feet	Thousand cubic feet	Percentage	Thousand cubic feet	Percentage
Total	5,608,271	149,323	2.7	102,352	1.8

Source: Kingsley, 1991.
Note: Data in the table are based on a sample and are therefore subject to statistical error.

Table 3.4. Continued

Because removals and net growth can fluctuate widely between years depending on demand, disturbance, and other factors, data averaged over several years often provide more useful information. For the period 1977–1989, average annual removals exceeded average annual growth for four species: jack pine, black spruce, elm, and balsam poplar (see Table 3.5.). For the most abundant species, quaking aspen, average annual growth exceeded average annual removals by 14 million cubic feet.

Table 3.5. Average annual growth and removals of growing stock on timberland in the Aspen-birch FIA unit, 1977–1989.

Species	Growing stock				
	1990 volume	Average annual growth 1977–1989		Average annual removals 1977–1989	
	Thousand cubic feet	Thousand cubic feet	Percentage	Thousand cubic feet	Percentage
Quaking aspen	1,503,590	44,585	3.0	30,509	2.0
Paper birch	706,773	11,019	1.6	10,929	1.5
Balsam fir	620,953	10,079	1.6	7,681	1.2
Black spruce	560,642	8,777	1.6	9,434	1.7
Northern white-cedar	479,828	9,494	2.0	1,722	0.4
Black ash	258,115	6,367	2.5	1,970	0.8
Balsam poplar	243,221	3,316	1.4	3,851	1.6
White spruce	203,918	9,228	4.5	3,321	1.6
Red pine	180,592	6,772	3.7	2,876	1.6
Tamarack	177,955	5,239	2.9	576	0.3
Jack pine	166,927	2,109	1.3	3,222	1.9
White pine	127,846	4,041	3.2	2,820	2.2
Hard maple	116,152	4,364	3.8	692	0.6
Soft maple	102,150	4,784	4.7	503	0.5
Basswood	49,600	1,272	2.6	461	0.9
Bigtooth aspen	43,341	1,279	3.0	1,203	2.8

Table 3.5. Continued

Species	Growing stock				
	1990 volume	Average annual growth 1977–1989		Average annual removals 1977–1989	
	Thousand cubic feet	Thousand cubic feet	Percentage	Thousand cubic feet	Percentage
Elm	18,768	-1,837	-9.8	698	3.7
Yellow birch	14,240	124	0.9		0.0
Select red oak	12,373	384	3.1	53	0.4
White oak	9,785	281	2.9	65	0.7
White and green ash	8,901	323	3.6	120	1.3
Other hardwoods	861	29	3.4		0.0
Cottonwood	765	22	2.9		0.0
Black cherry	314	34	10.8		0.0
Eastern red cedar	275	14	5.1		0.0
Willow	174	14	8.0		0.0
Other red oak	128	6	4.7		0.0
Other softwoods	84	1	1.2		0.0
Total	5,608,271	132,120	2.4	82,706	1.5

Source: Kingsley, 1991.
Note: Data in the table are based on a sample and are therefore subject to statistical error.

Mortality plays a major role in changing the composition of the region's forests (see Table 3.6.). In 1976, 55,496 cubic feet of growing stock volume in the Aspen-Birch FIA unit died (1.2 percent of the 4.52 billion cubic feet of total growing stock volume). Disease, weather, and insects were leading causes of observed mortality. The extent of mortality in 1989 increased to 83,846 cubic feet (1.5 percent of the 5.6 billion cubic feet of total growing stock volume).

Table 3.6. Mortality of growing stock on timberland in the Aspen-birch FIA unit, 1977–1989.

Species	Growing stock				
	1990 volume	Average annual mortality 1977–1989		Current annual mortality 1989	
	Thousand cubic feet	Thousand cubic feet	Percentage	Thousand cubic feet	Percentage
Aspen	1,546,931	22,770	1.5	25,908	1.7
Spruce	764,560	11,402	1.5	12,220	1.6
Paper birch	706,773	8,817	1.2	9,068	1.3

Table 3.6. Continued

Species	Growing stock				
	1990 volume	Average annual mortality 1977–1989		Current annual mortality 1989	
	Thousand cubic feet	Thousand cubic feet	Percentage	Thousand cubic feet	Percentage
Balsam fir	620,953	21,627	3.5	19,185	3.1
Cedar	480,103	1,258	0.3	763	0.2
Ash	267,016	1,501	0.6	1,950	0.7
Balsam poplar	243,221	5,749	2.4	6,073	2.5
Red pine	180,592	54	0.0	13	0.0
Tamarack	177,955	1,251	0.7	1,750	1.0
Jack pine	166,927	3,600	2.2	4,057	2.4
White pine	127,846	405	0.3	94	0.1
Hard maple	116,152	238	0.2	202	0.2
Soft maple	102,150	859	0.8	1,409	1.4
Basswood	49,600	258	0.5	303	0.6
Elm	18,768	2,747	14.6	535	2.9
Yellow birch	14,240	172	1.2	219	1.5
Red oak	12,501	43	0.3	63	0.5
White oak	9,785	2	0.0	0	0.0
Other hardwoods	1,349	37	2.7	27	2.0
Cottonwood	765	1	0.1	7	0.9
Other softwoods	84	0	0.0	–	0.0
Total	5,608,271	82791	1.5	83,846	1.5

3.10. Silvicultural and harvesting practices

Trends in the extent and type of silvicultural practices were based on landowner surveys of practices in 1991 and 1996. Data presented in this section are representative of practices on public, forest industry, and Native Indian lands. Non-industrial private landowners were not surveyed. The data presented are for the entire state. In 1996, respondents to the survey owned approximately half of the state's 14.7 million acres of timberland.

Silvicultural practices are the ways in which forests are managed. The total amount of timberland on which silvicultural practices are carried out is small (see Figure 3.10.). For example, in 1996, less than 1.3% of the respondents' timberland area was harvested. Noticeable trends between 1991 and 1996 were increases in harvesting (1.15% to 1.29%

of respondents' timberland area) and regeneration activity (1.08% to 1.14%) and a decrease in stand improvement activities (0.32% to 0.20%). Site preparation activities were conducted on 0.18% of the respondents timberland area in both 1991 and 1996.

Managers used clearcutting more than any other silvicultural system in both 1991 and 1996 (see Figure 3.11.). Data for 1996 suggest that managers planned less clearcutting than in 1991. The percentage of clearcuts with residual trees (remaining trees left for purposes other than regeneration) left on site sharply increased between 1991 and 1996, from 39% to 65.2% of total harvested area. The number of residual trees varies widely among owners and site conditions. On average, 14 trees per acre were left in clearcuts with residuals in 1996. Seed tree, shelterwood cutting, and thinning were used more than in the past. Strip and patch clearcutting and selective logging were less common in 1996 than in 1991.

Figure 3.10. Type and extent of silvicultural practices on Minnesota's timberland, 1991–1996.

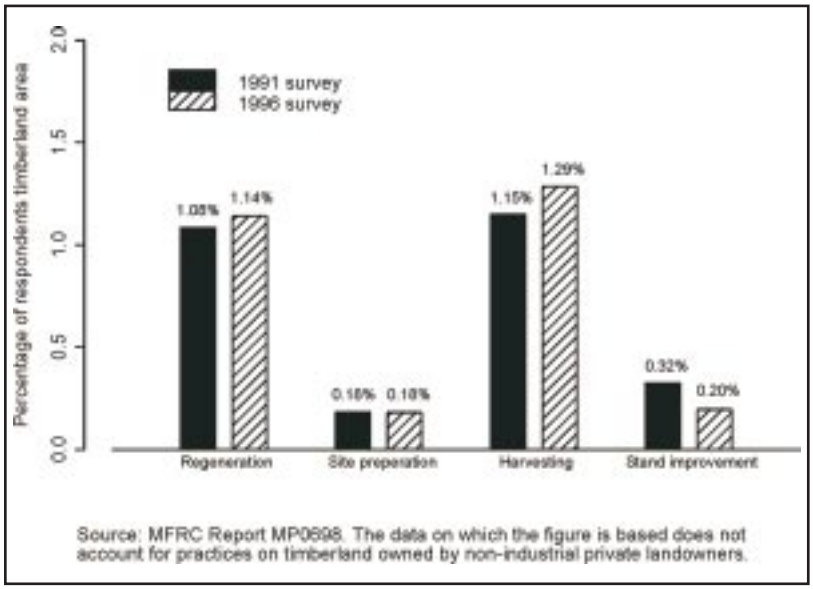
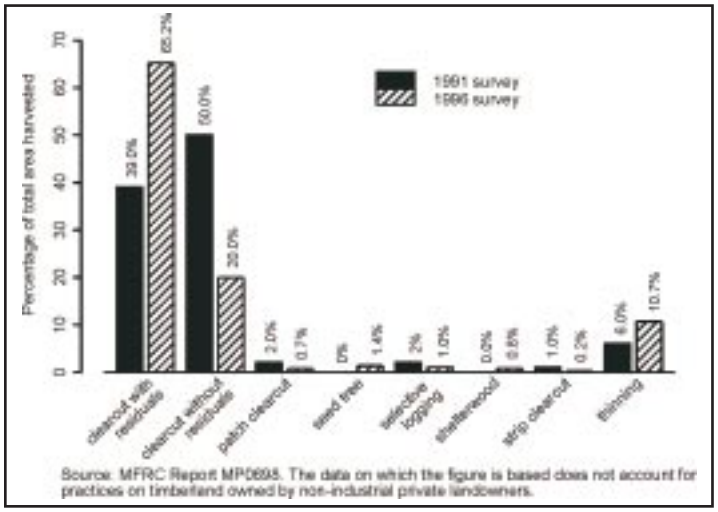
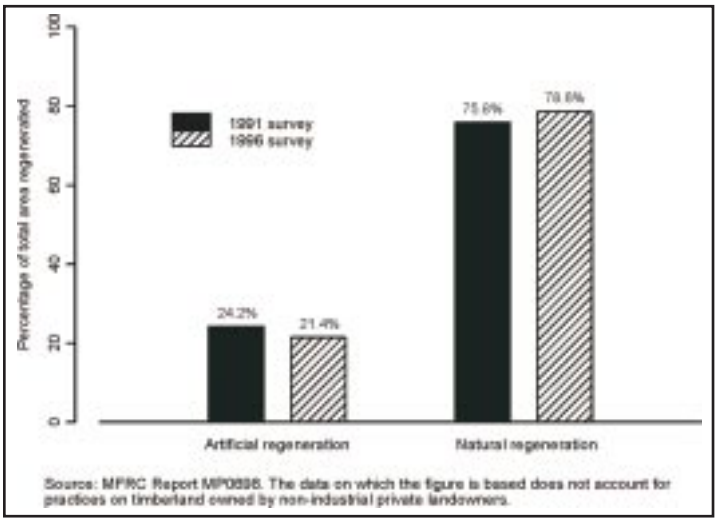


Figure 3.11. Extent of silvicultural systems on Minnesota's timberland, 1991–1996.



Managers use natural regeneration more often than artificial regeneration (see Figure 3.12.). 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 78.6% of total regenerated area, while use of artificial regeneration declined correspondingly from 24.2% to 21.4%.

Figure 3.12. Type and relative extent of regeneration activities on Minnesota's timberland, 1991–1996.



Source: MFRC Report MP0886. The data on which the figure is based does not account for practices on timberland owned by non-industrial private landowners.

3.11. Vascular plants

Information on vascular plants was obtained from *Vascular Plants of Minnesota: A Checklist and Atlas* (Owenby and Morley, 1991). The atlas displays the geographic origins of specimens (97,000 at the time of publication) in the University of Minnesota Herbarium. The 1,881 maps in the atlas show specimen locations at time of collection for 1,887 species. *Vascular Plant of Minnesota* is not a comprehensive inventory of the state's vascular plant resources; no such inventory for the state exists at this time.

The richness of vascular plants in Minnesota is in excess of 2,010 species (Owenby and Morley, 1991). Approximately 1,201 of the 1,887 species in Owenby and Morley's atlas had recorded occurrences in the Northeast's ecological assessment area (see Table 3.7.). Note that the number of species with recorded occurrences in a given landscape reflects the U of MN Herbarium's collection and not necessarily the richness of the landscape. For example, landscapes with significant amounts of remote areas may not be as well represented in the database as those landscapes with considerable access.

Table 3.7. Richness of vascular plants in Owenby and Morley (1991) by MFRC regional landscape.

State list				
Regional landscapes	Number of species[A]	Endangered[B]	Threatened[B]	Special concern[B]
Northeast	1,201	16	19	50
Northern	1,014	1	8	30
West Central	1,066	2	4	19
North Central	1,186	3	11	29
East Central	1,356	12	10	38
Southeast	1,395	21	34	51
Metro	1,088	11	6	19
Prairie	1,199	12	13	45
Statewide	1,887	55	64	125

[A] Owenby and Morley, 1991.
[B] Minnesota DNR, 1996.

Also of interest is the number of species with occurrences limited to a given landscape. Of the species in the atlas, 82 had recorded occurrences in the Northeast and no other landscape (see Table 3.8.). The majority of these (60%) are on the state's endangered/threatened/special concern list. The other northern landscapes (Northern, West Central, East Central, and North Central) collectively had only 30 species limited to a specific landscape.

Table 3.8. Numbers of vascular plants in Owenby and Morley (1991) with recorded occurrence limited to a particular regional landscape.

State list				
Regional landscapes	Number of species[A]	Endangered[B]	Threatened[B]	Special concern[B]
Northeast	82	14	12	23
Northern	3	0	1	1
West Central	6	1	0	0
North Central	7	1	3	0
East Central	14	2	2	2
Southeast	82	11	20	15
Metro	9	2	0	0
Prairie	56	8	6	15

[A] Owenby and Morley, 1991.
[B] Minnesota DNR, 1996.

3.12. Forest-dependent vertebrate species at risk

The Northeast's forests provide habitat for many of the state's mammals, amphibians, reptiles, breeding birds, and fishes. Statewide there are 65 mammals associated with forest habitat (see Table 3.9.). Fifty-seven of these occur in the Northeast's ecological assessment area. All of the state's 19 amphibians and reptiles that are forest associates occur in the Northeast. Slightly more than 70% of the state's forest associated breeding birds are known to occur in the Northeast.

Table 3.9. Richness of forest associated mammals, amphibians and reptiles, breeding birds, and fishes in the Northeast's ecological assessment area.

	All habitats		Forest associated	
	Statewide	Northeast	Statewide	Northeast
Mammals[A]	80	61	65	57
Amphibians and reptiles[A]	49	19	43	19
Breeding birds[B]	245	177	151	125
Fishes[C]	163	89	-	-

[A] Tester, 1995.
[B] Green, 1995.
[C] DNR Division of Fish and Wildlife, 1998.

Of the 201 forest associate vertebrate species in the Northeast, none is listed as endangered, two are listed as threatened (Blanding's turtle and wood turtle), and eight are listed as special concern (gray wolf, bald eagle, northern myotis, heather vole, mountain lion, snapping turtle, smokey shrew, and least weasel) (see Tables 3.10. and 3.12.).

Table 3.10. Numbers of endangered, threatened, special concern forest associate vertebrate species in the Northeast's ecological assessment area.

Vertebrate group	Forest associate richness	Endangered	Threatened	Special concern
Mammals	57	0	0	6 (10.5%)
Amphibians and reptiles	19	0	2 (10.5%)	1 (5.3%)
Breeding birds	125	0	0	1 (0.8%)
Total	201	0	2 (1%)	8 (4%)

Source: DNR, 1996.

The status of forest associated vertebrate species in the Northeast at the time of the 1984 listing and the 1996 listing are displayed in Tables 3.11. and 3.12. The status of six species were unchanged between 1984 and 1996 (Blanding's turtle, wood turtle, northern myotis, heather vole, mountain lion, and snapping turtle). Seven species were downgraded between 1984 and 1996. The gray wolf and bald eagle were downgraded from threatened in 1984 to special concern in 1996. Rock vole, wolverine, martin, caribou, and osprey were removed from the list altogether. Two species, smokey shrew and least weasel, were added to the list for the first time in 1996.

Table 3.11. Status of Minnesota's forest associated[1] endangered, threatened, special concern vertebrate wildlife, 1984[1].

Note: Species known to occur in the Northeast's ecological assessment area are indicated by **bold** highlighting.

Endangered	Threatened	Special concern
Mammals	**Mammals**	**Mammals**
	1. Gray wolf	1. Least shrew **2. Mountain lion** **3. Wolverine** **4. Marten** **5. Rock vole** 6. Woodland vole **7. Northern myotis** **8. Heather vole** 9. Eastern pipistrelle **10. Caribou** 11. Eastern spotted skunk 12. Northern bog lemming
Birds	**Birds**	**Birds**
	1. Bald eagle 2. Loggerhead shrike	1. Red-shouldered hawk **2. Osprey** 3. Louisiana waterthrush
Amphibians and reptiles	**Amphibians and reptiles**	**Amphibians and reptiles**
1. Five-lined skink	**1. Wood turtle** **2. Blanding's turtle**	1. Northern cricket frog **2. Snapping turtle** 3. Racer 4. Timber rattle snake 5. Rat snake 6. Fox snake 7. Western hognose snake 8. Eastern hognose snake 9. Milk snake 10. Massasauga 11. Bullfrog 12. Pickerel frog

[1]Source: Tester, 1995 and Green, 1995.
[2]Source: DNR, 1984.

Table 3.12. Status of Minnesota's forest associated[1] endangered, threatened, special concern vertebrate wildlife, 1996[2].

Note: Species known to occur in the Northeast's ecological assessment area are indicated by **bold** highlighting.

Endangered	Threatened	Special concern
Mammals	**Mammals**	**Mammals**
	1. Eastern spotted skunk	**1. Gray wolf** 2. Least shrew **3. Mountain lion** 4. Woodland vole **5. Least weasel** **6. Northern myotis** **7. Heather vole** 8. Eastern pipistrelle **9. Smokey shrew** 10. Northern bog lemming
Birds	**Birds**	**Birds**
	1. Loggerhead shrike	1. Red-shouldered hawk 2. Cerulean warbler 3. Acadian flycatcher **4. Bald eagle** 5. Louisiana waterthrush 6. Hooded warbler
Amphibians and reptiles	**Amphibians and reptiles**	**Amphibians and reptiles**
1. Northern cricket frog 2. Massasauga	**1. Wood turtle** 2. Timber rattle snake **3. Blanding's turtle**	1. Smooth softshell **2. Snapping turtle** 3. Racer 4. Rat snake 5. Five-lined skink 6. Western hognose snake 7. Four-toed salamander

[1]Source: Tester, 1995 and Green, 1995.
[2]Source: DNR, 1996.

Another species that has special legal standing is the lynx. The following excerpts are taken from *Fact Sheet: Management of the Lynx* (Felis lynx) *in Minnesota,* prepared by Michael W. DonCarlos, April 19, 1994.

> Lynx are a protected species (Minn. Stat. 97B.625) in Minnesota. Under the law, the Commissioner of the Minnesota Department of Natural Resources has the authority to set an open season, based on population estimates. Currently, under Minn. Rules, Ch. 6234.1500, the taking of lynx is prohibited statewide.

Historical Legal Status

1951: Bounty on lynx established.

1965: Bounty on lynx eliminated.

1976: Lynx protected by state law; seasons established.

1984–1992: Lynx season closed by Commissioner's orders.

1993: Lynx season closed by Minn. Rule Ch. 6234.1500.

[1999: Is being considered by U.S. Fish & Wildlife Service for listing]….

Distribution

Lynx distribution in Minnesota is unclear. Harvest distribution (data) may be misleading because it is dominated by wandering immigrants from Canada, and so does not reflect continuously occupied habitat. Nevertheless, there is habitat in Minnesota that is capable of maintaining lynx.…

…There are currently no mechanisms for monitoring or modeling lynx populations in Minnesota….

The following excerpts are taken from Commissioner Rodney W. Sando's (DNR) letter dated September 25, 1998, to Mr. Kemper McMaster, Field Supervisor, U.S. Fish and Wildlife Service.

…Lynx habitat and forestry management in Minnesota

There is no evidence that habitat and forest management are limiting lynx or hares in Minnesota.…Although lynx may use older forests for denning, their primary (actually, obligate) prey is the snowshoe hare, which inhabits younger, successional forests. Consequently, lynx require a habitat mosaic to meet their seasonal and variable habitat needs.…

This study [GEIS] did not find significant statewide impacts to lynx populations (if any were present) over the next 50 years based on the three projected levels of timber harvest in the state,….

3.13. Trends in wildlife species populations

Trends in wildlife populations were obtained from the DNR-Section of Wildlife. The following figures (3.13. to 3.17.) depict population estimates for otter, martin, fisher, bobcat, moose, and deer. Population indexes are reported for grouse.

Figure 3.13. Rangewide spring (pre-birth) population estimates of otter, fisher, and marten, 1977–1997.

Figure 3.14. Rangewide spring (pre-birth) population estimates of bobcat, 1977–1997.

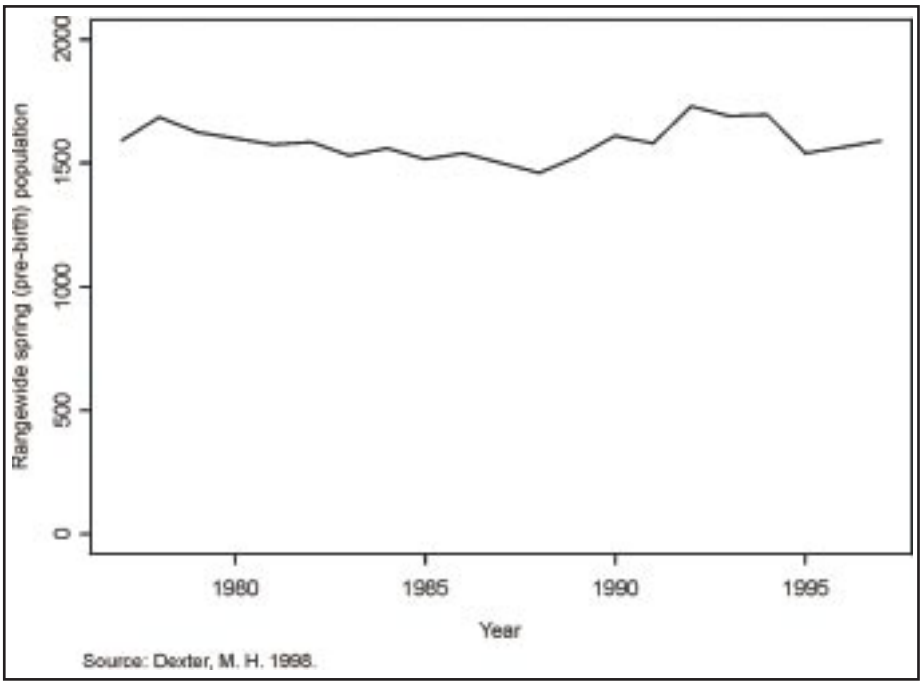
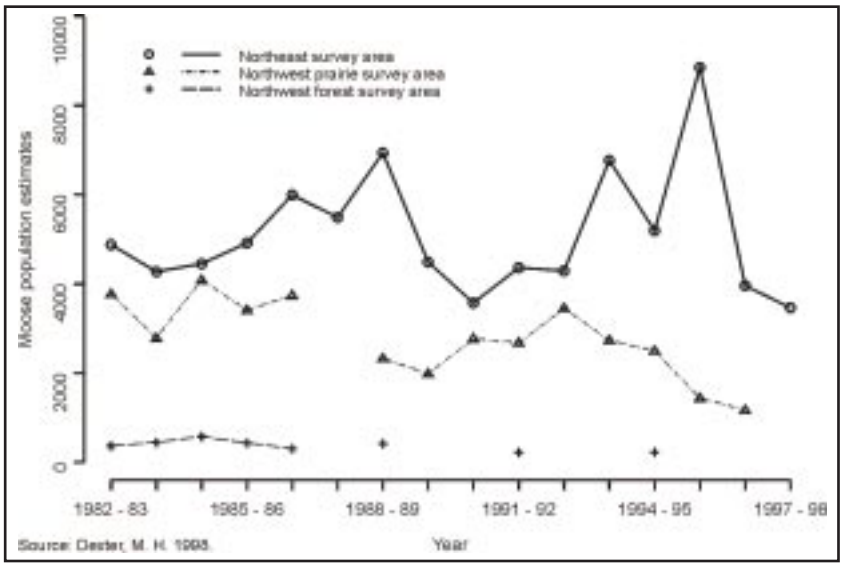


Figure 3.15. Moose population estimates for northern Minnesota, 1982–1998.



The DNR Section of Wildlife publishes spring white-tailed deer densities annually. Estimates for permit areas in the Northeast's ecological assessment area (see Figure 3.16.) are displayed in Table 3.13. In 1998, deer densities were highest in permit areas 119–121 with a density of 16 deer per square mile. Permit area 126, 128–129 had the lowest densities in 1998 at four deer per square mile. In all areas of the Northeast, deer densities are lower today than 10 years ago.

Table 3.13. Estimated deer population trends, 1988–1998.

Permit area	Deer per square mile										
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
169	24	17	19	21	22	20	18	18	11	11	14
170	14	12	14	15	16	14	13	13	9	8	11
175–179	10	9	10	10	10	10	10	10	7	6	8
180–184, 199	11	11	12	13	12	12	11	12	8	8	10
107–109, 195	9	9	10	10	10	10	10	10	6	5	7
119–121	18	16	19	19	20	19	17	19	13	12	16
122–125	8	8	9	9	8	7	6	7	5	5	6
126, 128–129	6	4	5	5	4	4	4	4	3	3	4

Source: DNR Section of Wildlife.

Figure 3.16. DNR deer permit areas.

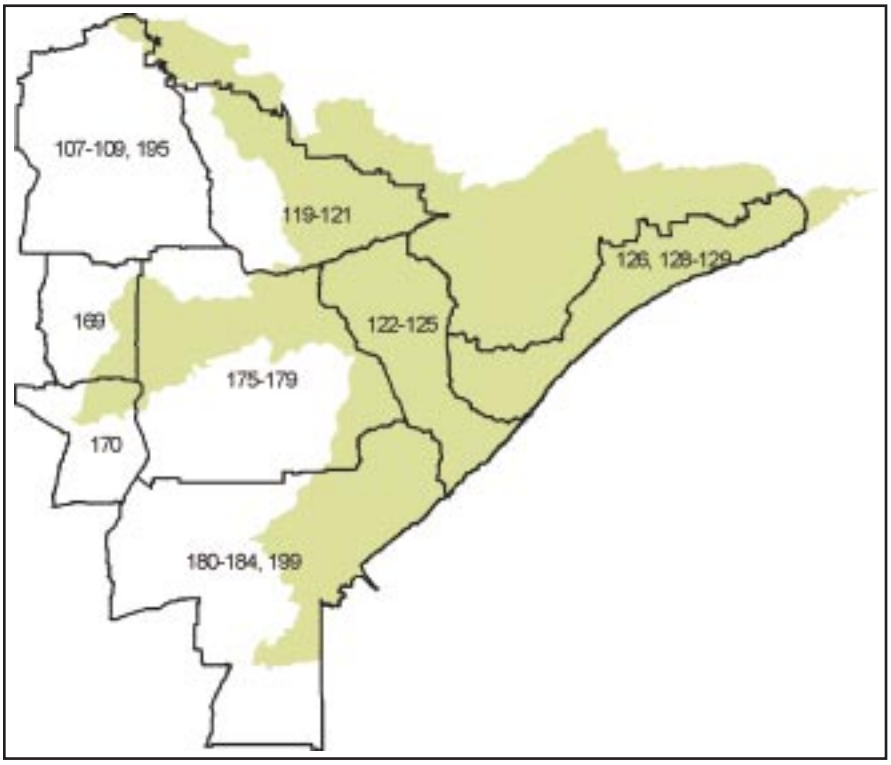
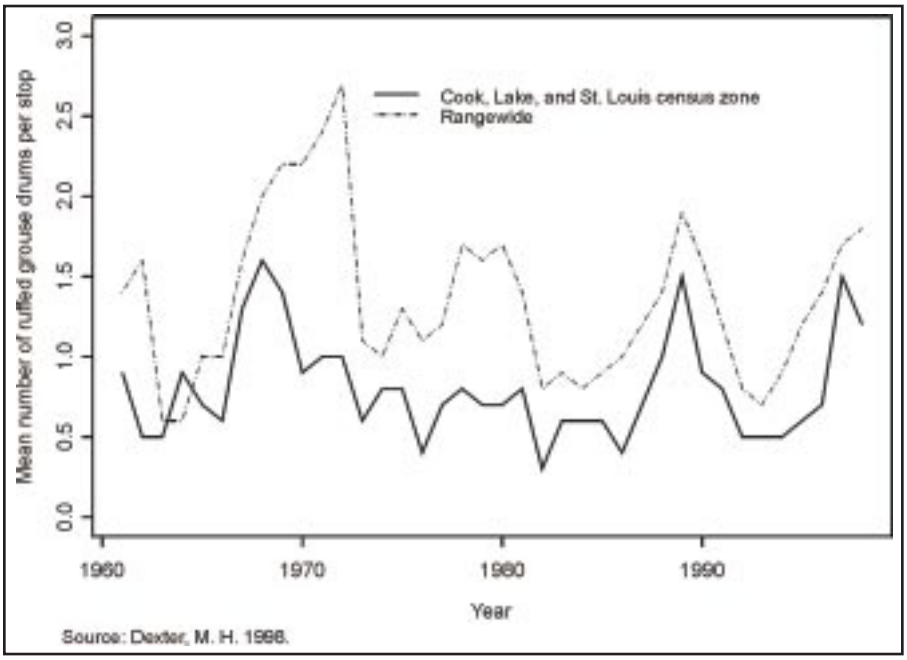


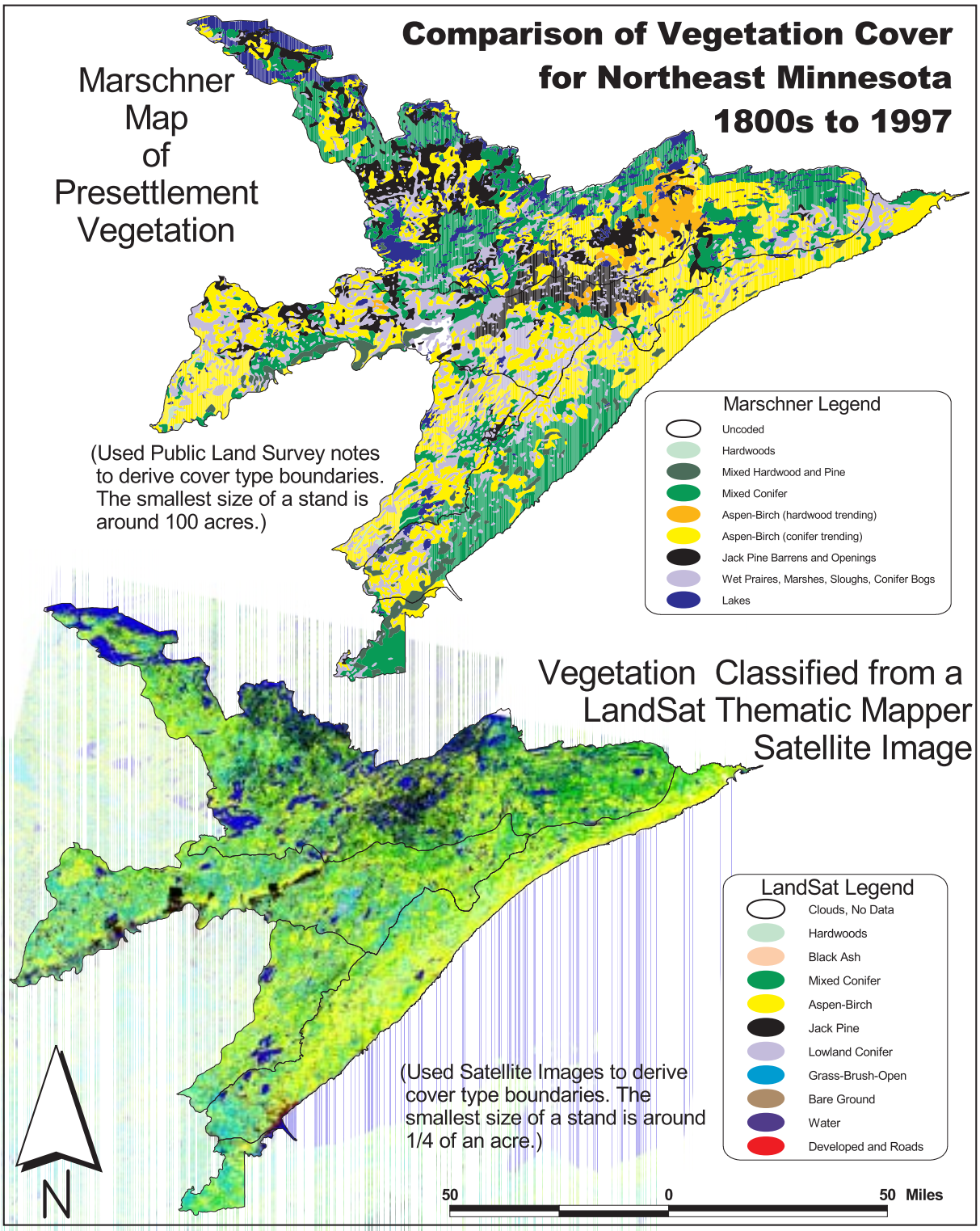
Figure 3.17. Ruffed grouse trends for Cook, Lake, and St. Louis counties, 1961–1998.



3.14. Water quality in lakes and streams

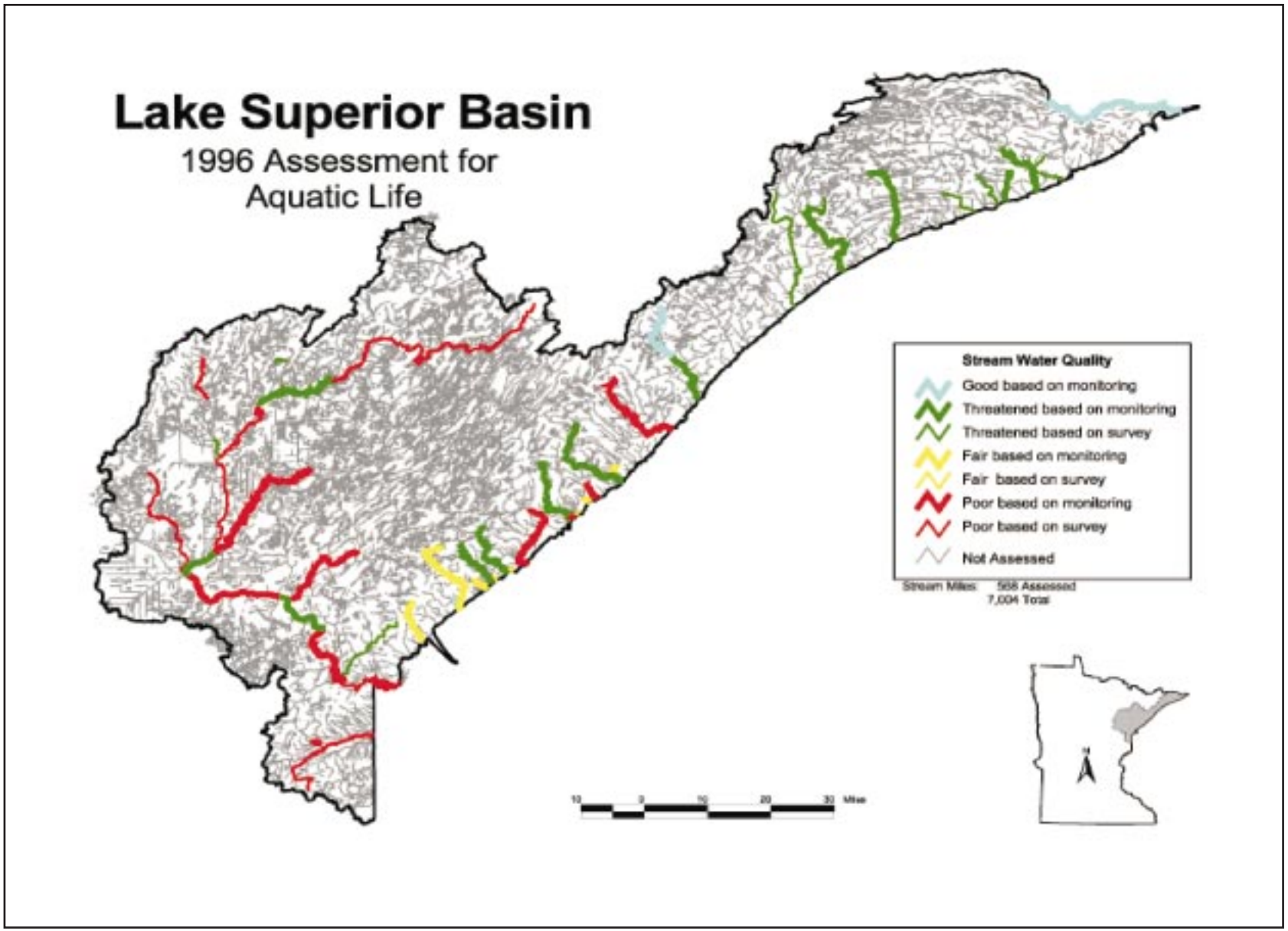
Figures 3.18. through 3.20. summarize water quality information for lakes and streams in the Lake Superior Basin. The data are collected and reported by the Minnesota Pollution Control Agency (PCA) as directed by Congress in the Clean Water Act. Appendix D provides a summary of the assessment methods used by the PCA and contains more complete, tabular data. The areas of the Northeast Landscape Region that do not lie within the Lake Superior Basin lie within the Rainy River Basin.

Figure 3.1. Comparison of vegetation cover for NE Minnesota, 1800s to 1997.



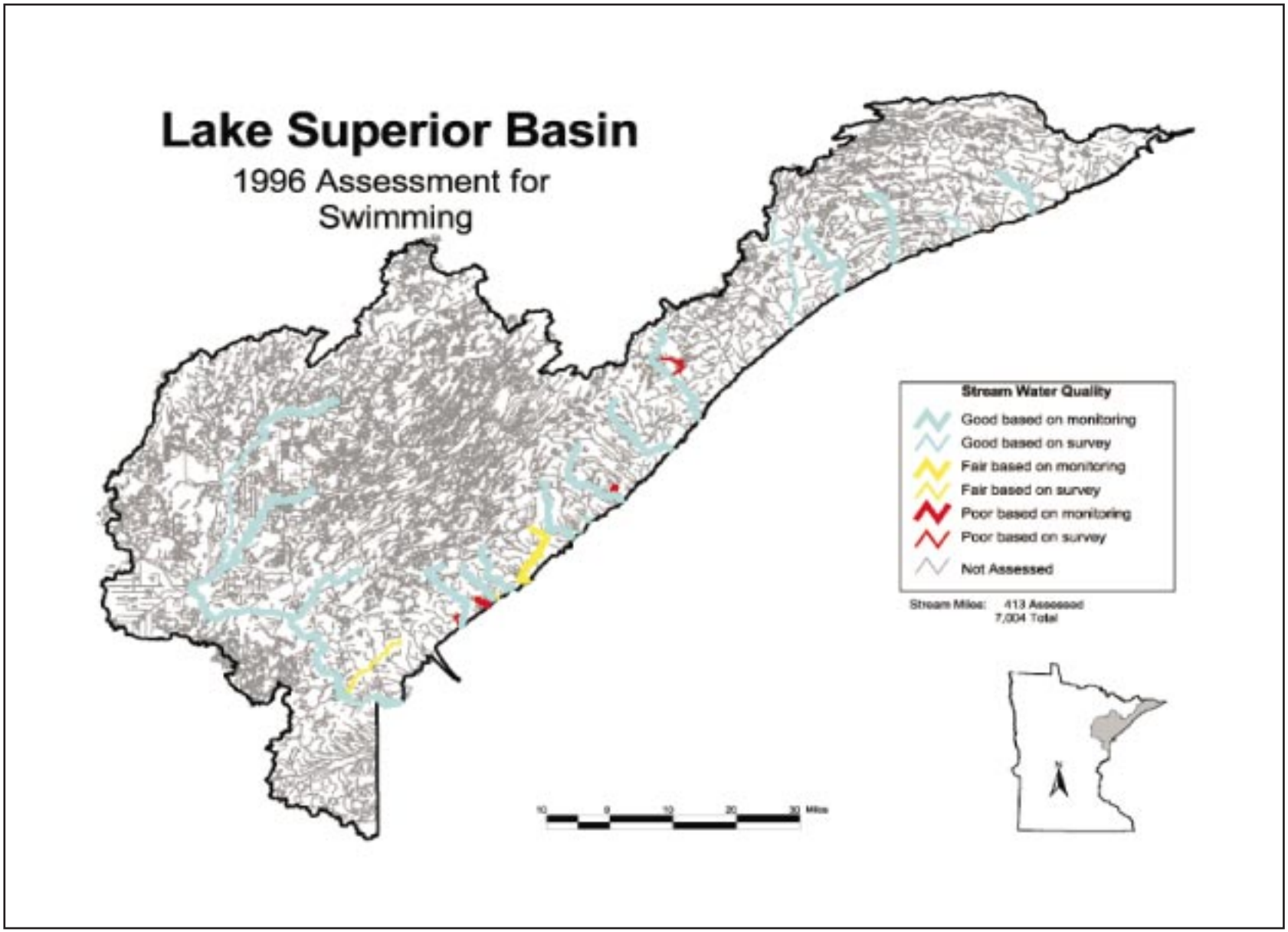
Sources: Marschner data was obtained from MnDNR, Classified Landsat TM data from peter Wolter, et al., 1997 (See Appendix B for details about the data mapped above).

Figure 3.18. Water quality of streams in the Lake Superior Basin as assessed for aquatic life, 1996.



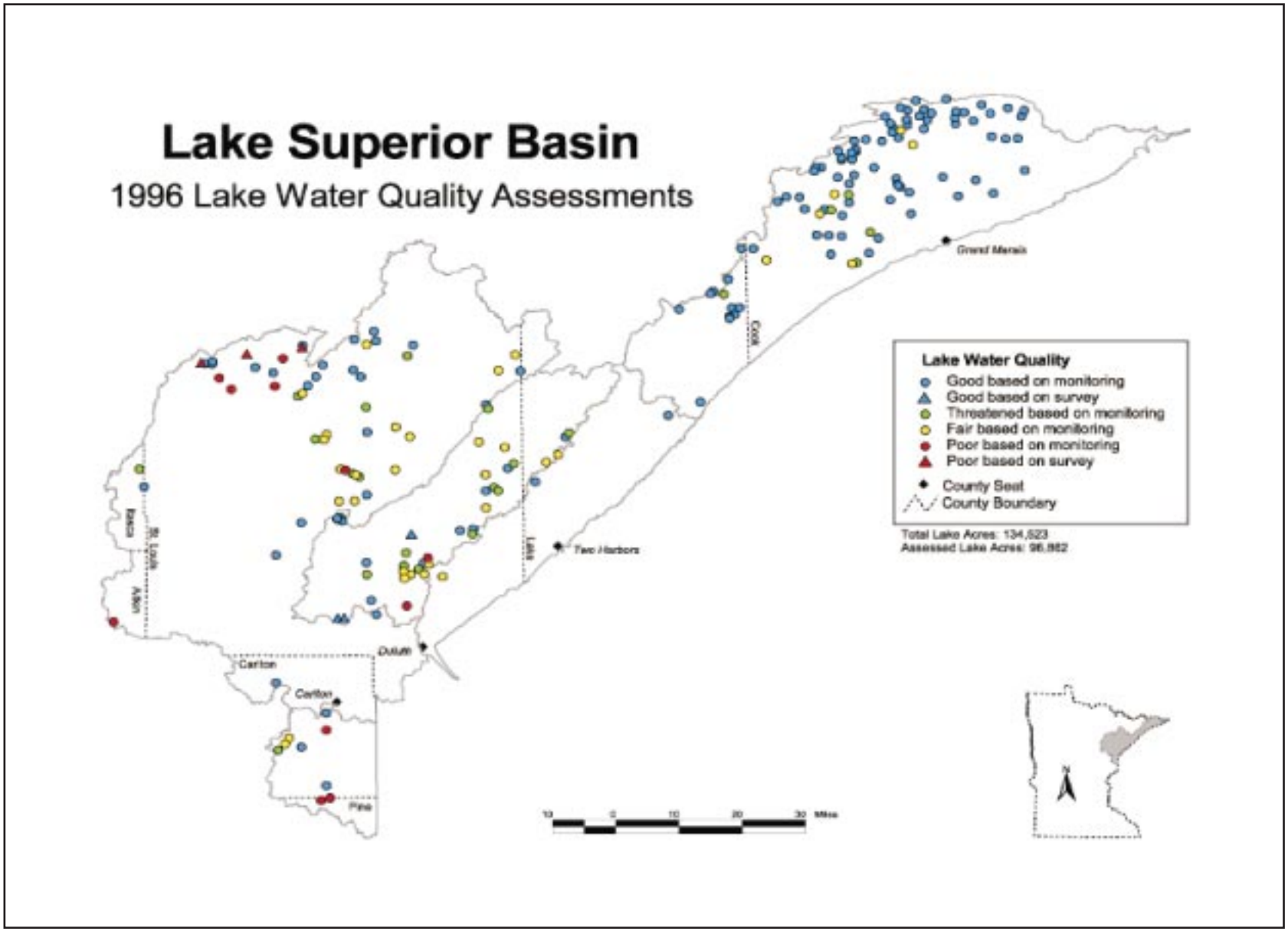
Source: MPCA (see Appendix D for more information).

Figure 3.19. Water quality of streams in the Lake Superior Basin as assessed for swimming, 1996.



Source: MPCA (see Appendix D for more information).

Figure 3.20. Water quality of lakes in the Lake Superior Basin as assessed for swimming, 1996.



Source: MPCA (see Appendix D for more information).

Goal 4: 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.

To help evaluate the Northeast's landscape region in regard to Goal 4, data are presented on the population and economies of the region. Information on the condition and trends of recreation, tourism, and the forest products sector is also presented.

4.1 Demographics

The "1990 Population Density by Minor Civil Division (MCD)" map clearly shows that the MCDs with the highest population densities are located around the cities of Duluth, Virginia, and Cloquet (Northeast Regional Landscape Atlas, 1998). In Lake and Cook Counties, densities of less than 10 people per square mile occur outside the cities of Silver Bay, Two Harbors, and Grand Marais. According to 1990 U.S. Census Bureau data, the four-county Northeast region had an overall population density of 22.7 people per square mile, while the state of Minnesota's population density was 55 people per square mile. Although the average population density of the Northeast region is relatively low in comparison to the state average, population density varies widely among the four counties of the region. Densities range from 2.7 people per square mile (Cook County) and 5.0 people per square mile (Lake County) to 31.8 people per square mile (St. Louis County) and 34.0 people per square mile (Carlton County).

The "1990 Total Population by Minor Civil Division (MCD)" map shows a fairly even spatial distribution of population across much of the Northeast region (Atlas, 1998). MCDs with the largest total population are concentrated near the cities of Duluth, Hibbing, Virginia, and Cloquet. Table 4.1. shows the population data for Minnesota and the counties within the Northeast region for 1970–1997. Between 1980 and 1990, the total population of the four-county region fell by 10.2%, while Minnesota's total population increased by 7.3%. During this time period, total population decreased in all four counties in the region. Carlton County experienced the smallest decrease in population (2.3%) while Lake County lost over 20% of its total population between 1980 and 1990. However, between 1990 and 1997, this trend was reversed and the Northeast region experienced a small (1.6%) increase in total population. For individual counties in the region, population growth ranged from a modest 0.6% (St. Louis) to a rather vigorous 14.7% (Cook).

Table 4.1. Population of Minnesota and counties in the Northeast Landscape Region.

	1970	1980	1990	1980–1990 % change	1997*	1990–1997 % change
Minnesota	3,806,103	4,075,970	4,375,099	7.34	4,735,830	8.25
Northeast	265,539	269,300	241,755	-10.23	245,560	1.57
Carlton	28,072	29,936	29,259	-2.26	30,974	5.86
Cook	3,423	4,092	3,868	-5.47	4,437	14.71
Lake	13,351	13,043	10,415	-20.15	10,695	2.69
St. Louis	220,693	222,229	198,213	-10.81	199,454	0.63

Source: 1990 U.S. Census Bureau.
* Minnesota State Demographic Center.

Table 4.2. shows population projection data for Minnesota and counties in the Northeast region for 1995–2025. Minnesota is expected to experience a 14.2% gain in total population by 2025, while the Northeast region is expected to lose 6.6% of its total population. The projections also indicate that Carlton County will lose less than 1.0% of its total population, while Lake County is expected to lose over 10% of its total population. Note that while the four-county region is projected to lose population, Cook County is expected to experience a 6.8% increase in total population.

Table 4.2. Population projections for Minnesota and counties in the Northeast Landscape Region.

	1995*	2000	2005	2010	2015	2020	2025	1995–2025 % Change
Minnesota	4,626,514	4,806,020	4,948,730	5,066,540	5,167,870	5,243,620	5,282,840	14.19
Northeast	244,077	245,390	243,490	239,890	235,890	231,980	228,010	-6.58
Carlton	30,559	31,070	31,160	31,020	30,960	30,720	30,260	-0.98
Cook	4,166	4,340	4,360	4,410	4,430	4,480	4,450	6.82
Lake	10,473	10,540	10,440	10,270	10,010	9,700	9,360	-10.63
St. Louis	198,879	199,440	197,530	194,190	190,490	187,080	183,940	-7.51

Source: Minnesota State Demographic Center.
* The 1995 data is a U.S. Census Bureau estimate that was used to create the population projections through 2025.

Table 4.3. shows population projections by age group for Minnesota and the Northeast Region. Ages are grouped to show trends in the economically productive (25 to 64 years) and senior retiree (65+ years) age ranges. The data show that in 1995, 51.2% of the Minnesota population was in the economically productive age range of 25 to 64 years. By the year 2025, 51.8% of Minnesota's population will be in this age range. The situation is somewhat different for the Northeast. In 1995, 49.6% of the region's population was in the 25- to 64-year-age range, and projections indicate that by the year 2025, only 45.7% of the population will be in this age range. The percentage of the population that is at

least 65 years old is an important indication of the potential economic productivity of the population. In 1995, the 65+ age group constituted 12.5% of Minnesota's population and 16.9% of the Northeast's population. The projections show that by the year 2025, 19.7% of Minnesota's population will be at least 65 years old, while 26.4% of the population in the Northeast will be at least 65 years old.

Table 4.3. Population projection by age group for Minnesota and the Northeast Landscape Region.

	Minnesota			Northeast Region		
Age Group	1995*	2025	1995–2025 % Change	1995*	2025	1995–2025 % Change
0–24	1,678,036	1,506,390	-10.2	81,848	63,700	-22.2
25–64	2,369,249	2,735,390	15.5	120,947	104,110	-13.9
65+	579,229	1,041,060	79.7	41,282	60,200	45.8
Total	4,626,514	5,282,840	14.2	244,077	228,010	-6.58

* The 1995 data is a U.S. Census Bureau estimate that was used to create the population projections through 2025.

The "Persons with Incomes Below Poverty Level" map shows that the percentage of people with incomes below the poverty level varies considerably across the Northeast region (Atlas, 1998). St. Louis County experienced the highest overall levels of poverty in the Northeast region. Many areas of northern St. Louis, Lake, and Cook Counties show high levels of poverty. In 1990, 10.2% of Minnesota's population was below the poverty level, while the Northeast region experienced a 13.7% rate of poverty. For individual counties in the region, the poverty rates were 9.5% in Lake, 10.9% in Cook, 12.3% in Carlton, and 14.2% in St. Louis.

Although the poverty rates are slightly higher in the four-county region than in the state, some progress has been made with regard to growth of per capita personal income (see Table 4.4.). All of the counties in the Northeast region had per capita personal income levels below the Minnesota average for the entire time period. However, during the 1990–1996 time period, all four counties in the Northeast region experienced income growth rates greater than 30%. The rates for Carlton, Lake, and St. Louis Counties were higher than the Minnesota growth rate of 32.7%, while Cook County's rate of growth (30.8%) was slightly less than Minnesota's.

Table 4.4.1. shows percent of total income broken down by sources for Minnesota. Non-labor income is the highest source at 30 percent.

Table 4.4. Per capita personal income for Minnesota and counties in the Northeast Landscape Region, 1990–1996 (dollars).

	1990	1995	1996	% Growth 1995–1996	% Growth 1990–1996
Minnesota	19,373	24,097	25,699	6.7	32.7
Carlton	13,807	17,689	18,435	4.2	33.5
Cook	17,091	21,664	22,347	3.2	30.8
Lake	13,641	17,685	18,780	6.2	37.7
St. Louis	16,252	20,536	21,687	5.6	33.4

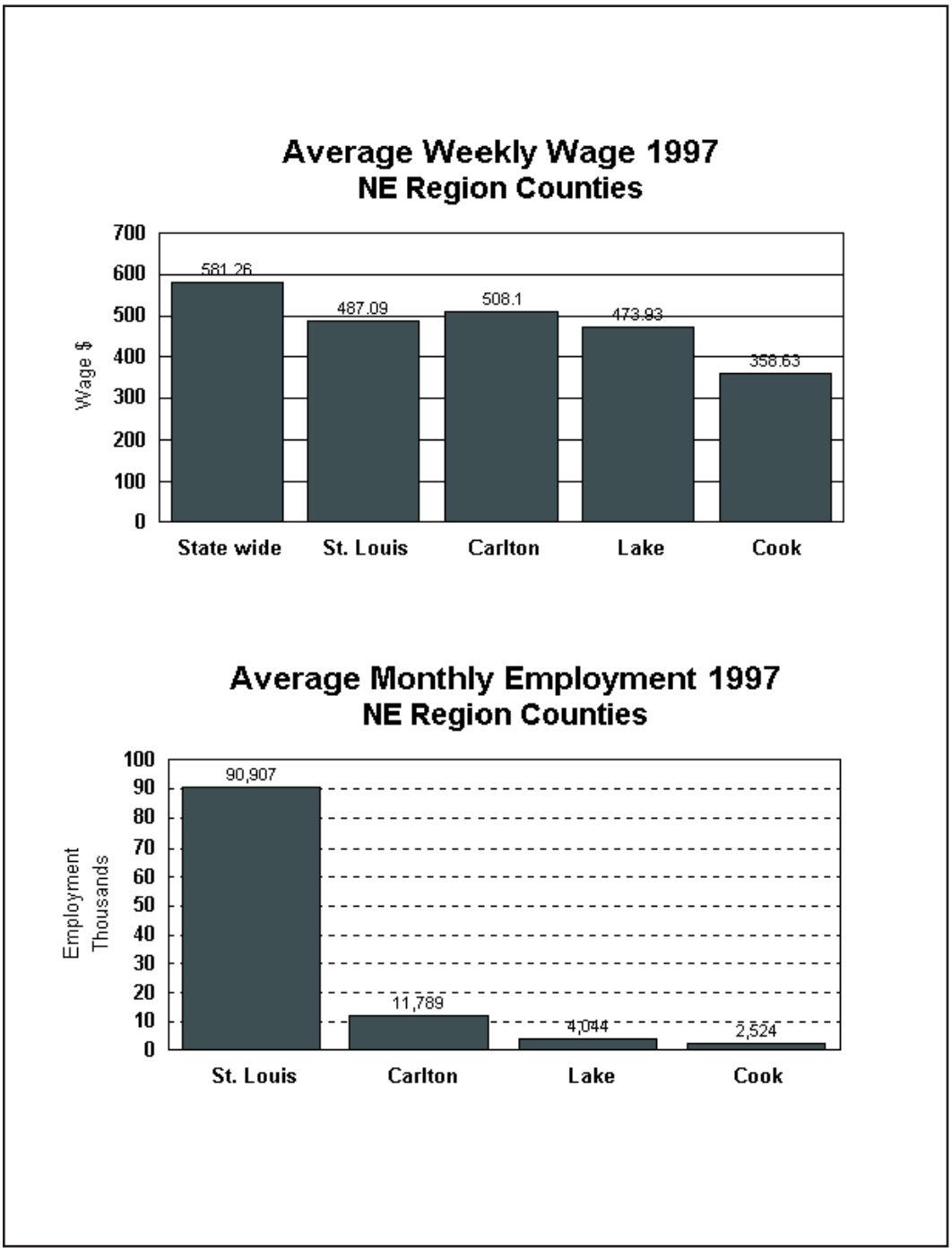
Source: Minnesota State Demographic Center.

Table 4.4.1. Total personal income - Minnesota, 1996.

Source	Percent of Total Income
Farming and ag. services	1.7
Mining	0.4
Timber-related	2.5
Construction	4
Manufacturing (non-wood)	12.6
Transportation & public utilities	4.5
Wholesale trace	5.6
Retail trade	6.3
Finance, insurance, and real estate	5.8
Services	18.1
Government	9.2
Non-labor income[A]	30
Total	100.7

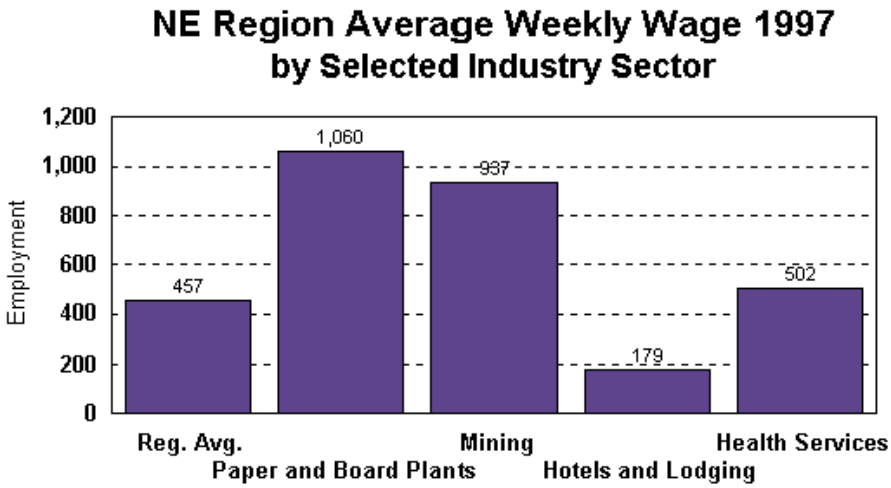
[A]This "non-labor income" includes dividends, interest and rent from investments, Social Security, pension and retirement funds, money from home equity gains, and other payments.
Source: U.S. Bureat of Economic Analysis, 1998

Figure 4.1. General employment data, 1997, by NE Regional Counties.



Source: Minnesota Department of Economic Trade and Development.

Figure 4.2. General employment data, 1997, by selected industry sector.



- Manufacturing and mining industries are the economic base of the region. These industries provide for 14 percent of total employment and account for 21 percent of the wages paid. Average weekly wages for the mining and pulp, paper and board plan industry's were more than 2 times greater than the average weekly wage for the region.
- The service industry accounts for 29 percent of the employment and 25 percent of wages.
- Paper and board plants account for 22 percent of the manufacturing employment and pay the highest weekly wage of $1,060.
- Health services account for 38 percent of the service industry jobs and pay an average weekly wage of $502.
- Hotels and lodging account for 12 percent of the service industry emplyment and pay an average wage of $179.

Source: Minnesota Department of Economic Trade and Development.

4.2. Employment

The Bureau of Economic Analysis defines employment as employment covered by social security. Also, data are reported by place of work rather than by employee's place of residence as the Census data are. All employment and earnings data are reported for industries classified by Standard Industrial Classification (SIC) codes. The SIC codes are used in the Regional Economic Information System (REIS) to provide a detailed accounting of employment and earnings by industry at the county, state, and national level. Since only social security data are used, individual businesses that opt out of the social security system (such as independent loggers) are not included. Also, transportation and agriculture industries tend to be undercounted because employees have their own retirement systems.

The REIS tends to emphasize manufacturing and heavy industry data rather than service industry data. Tourism is captured indirectly through codes for eating and drinking places, hotels and lodging places, and automobile dealers and service stations under the service industry category.

Data disclosure laws are a problem frequently found in county-level data. These laws prevent the release of data that would make it possible to identify a specific business within a geographic area. Lack of disclosure results in incomplete or absent data for many industry categories. Because of the limitations of SIC codes and data availability, data in this assessment are presented only by major industry categories. Selected sectors of the economy are included in the major industry categories as follows:

- Agricultural Services, Forestry, and Fishing
- Construction
- Farming
- Government - local, state, military, and federal, including U.S. Forest Service employees
- Manufacturing - includes lumber and wood products; furniture and fixtures; and paper and allied products
- Mining - includes metal, coal, oil and gas extraction; and nonmetallic minerals
- Trade - includes wholesale trade; retail trade; and finance, insurance, and real estate
- Services - includes hotels and lodging places
- Transportation

The "Number of Employees by Major Industry" graph for Minnesota shows the dramatic increase in employment in the trade and services sectors of the economy during this time period (Atlas, 1998). The effects of the recession of the early 1980s are not discernible in this graph; however, the effects of the recession between 1980 and 1985 are evident in the "Number of Employees by Major Industry" graph for the Northeast region (Atlas, 1998). Between 1980 and 1985 most sectors of the region's economy experienced a loss of jobs. The most dramatic job losses occurred in the mining, trade, and manufacturing sectors. Service industry employment increased dramatically between 1970 and 1990, and then steadily between 1990 and 1995. In addition, employment in the trade sector of the economy rebounded from the recession and grew at a fairly steady pace between 1980 and 1995. Employment in the mining industries experienced a large drop in the early 1980s as a result of the recession, but has remained at a constant level since. Agricultural services employment, which includes forestry, has remained fairly constant throughout the 25-year time period.

In 1995 the dominant employment sectors in the Northeast region were services, retail trade, and government, while farm employment accounted for only 1.2% of total regional

employment and the agricultural services, forestry, and fishing sector accounted for less than 1% of the total regional employment (see Table 4.5.). This division of employment among sectors is generally unchanged from that in 1970 (see Table 4.6.).

Table 4.5. Number of employees by major industry in the Northeast Region, 1995.

	Number of employees	Percent of total
1. Services	39,418	29.4
2. Retail trade	26,928	20.1
3. Government	23,888	17.8
4. Manufacturing	10,911	8.2
5. Construction	6,319	4.7
6. Transportation and public utilities	6,201	4.6
7. Finance, insurance, and real estate	6,055	4.5
8. Mining	5,211	3.9
9. Wholesale trade	4,361	3.3
10. Farm employment	1,569	1.2
11. Agricultural services, forestry, fishing	970	0.7
Unclassified	2,093	1.6
Total	133,924	100

Source: Regional Economic Information System, Table CA25, Bureau of Economic Analysis.

Table 4.6. Number of employees by major industry in the Northeast Region, 1970.

	Number of employees	Percent of total
1. Government	21,796	20.7
2. Services	19,554	18.6
3. Retail trade	16,270	15.4
4. Manufacturing	15,070	14.3
5. Mining	9,768	9.3
6. Transportation and public utilities	6,189	5.9
7. Finance, insurance, and real estate	4,812	4.6
8. Construction	4,711	4.5

	Number of employees	Percent of total
9. Wholesale trade	3,950	3.7
10. Farm employment	1,160	1.1
11. Agricultural services, forestry, fishing	372	0.4
Unclassified	1,676	1.5
Total	105,328	100

Table 4.6. Continued

Source: Regional Economic Information System, Table CA25, Bureau of Economic Analysis.

The "Projected Jobs" graph shows that, at the state level, the service industry will continue to expand and increase its number of employees (see Atlas, page III-13.). Employment in agricultural services and mining is expected to remain constant during this time period. Table 4.7. shows the projected employment by major industry for the Northeast region. The projections show that the dominant employment sectors will be services, retail trade, government, and manufacturing.

Table 4.7. Projected employment by major industry for the region including Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, and St. Louis Counties, 1994–2005.

Industry	1994 Estimate employment	2005 Projected employment	1994–2005 Percent change	1994–2005 Numeric change
Total - all industries	140,600	156,850	12	16,250
Agriculture, forestry, fishing	1,540	1,540	0	0
Mining	5,810	6,200	7	390
Construction	4,440	4,870	10	430
Manufacturing	13,720	14,370	5	650
Transportation	6,650	6,710	1	60
Wholesale trade	4,540	4,440	-2	-100
Retail trade	27,070	29,780	10	2,710
Eating and drinking places	9,070	10,760	19	1,690
Other retail trade	18,000	19,020	6	1,020
Finance, insurance, real estate	4,360	4,600	6	240
Services	48,150	57,940	20	9,790
Business services	2,310	4,610	100	2,300
Health services[1]	15,410	17,880	16	2,470
Educational services[2]	12,080	13,010	8	930
Social services	3,740	5,840	56	2,100

Table 4.7. Continued

Industry	1994 Estimate employment	2005 Projected employment	1994–2005 Percent change	1994–2005 Numeric change
Other services	14,610	16,600	14	1,990
Government	13,270	14,460	9	1,190
Federal government	2,150	2,660	24	510
State & local government[3]	11,120	11,800	6	680
Self-employed/unpaid family	11,060	11,950	8	890

Source: Minnesota Department of Economic Security.
[1] State and local government hospital employment included.
[2] State and local government non-library educational employment included.
[3] State and local government hospital and educational employment excluded.

During the recession of the 1980s, counties in the Northeast region experienced double-digit unemployment. At one point, the unemployment rate for Lake County reached 33%, the third highest in the United States. Unemployment rates have improved significantly since then as a result of limited call backs in the mining industry, expansions in the wood products industry, and new business startups. [1]Although unemployment rates remained high in the region relative to the Minnesota rates during the early 1990s, the county rates have continued to fall during the decade to rates near or below the national rate for 1998 (see Table 4.8.).

Table 4.8. Percent unemployed for Minnesota and counties in the Northeast Region.

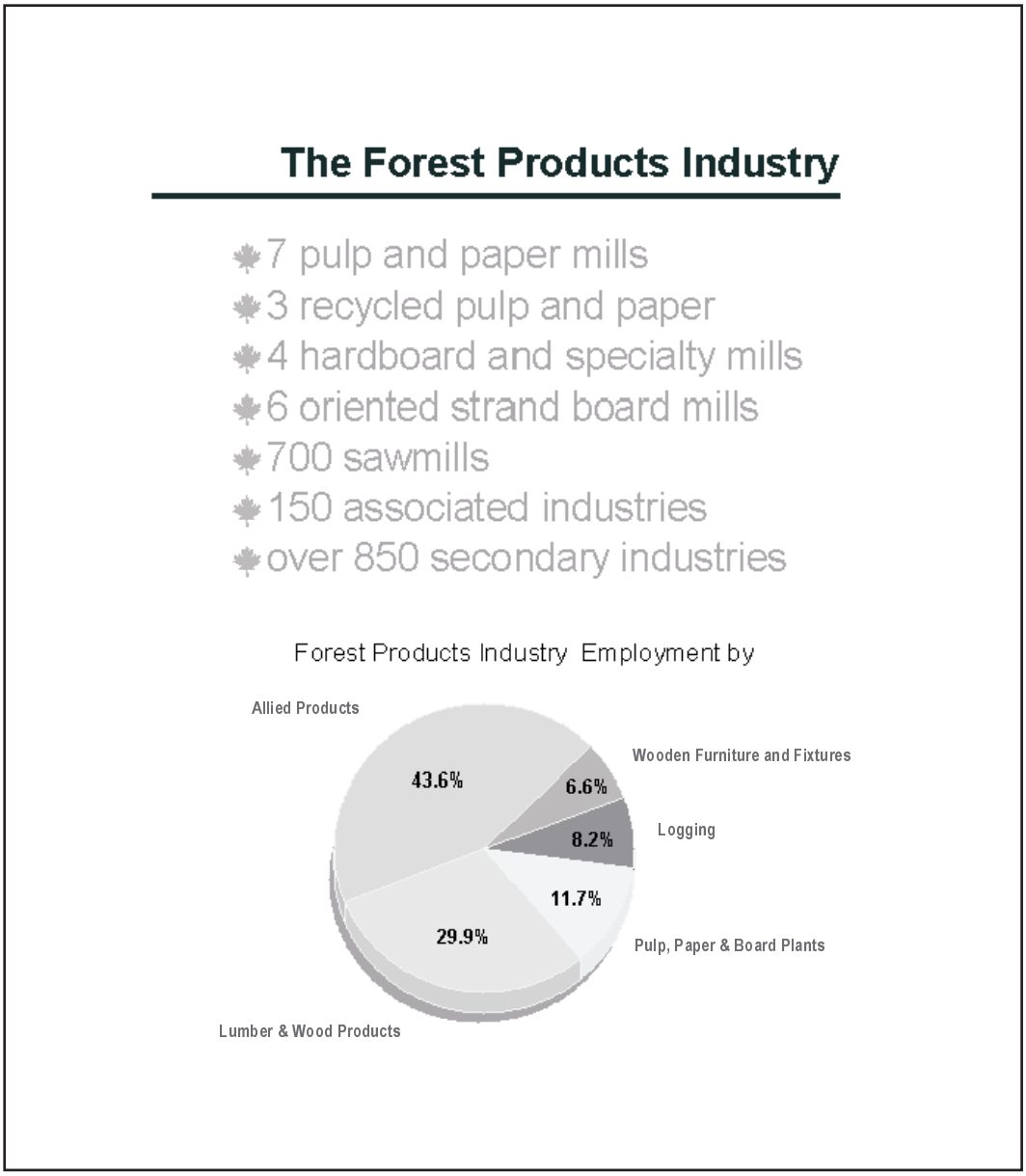
	1990	1991	1992	1993	1994	1995	1996	1997	1998
U.S.	5.5	6.7	7.4	6.8	6.1	5.6	5.4	4.9	4.5
Minnesota	4.9	5.1	5.2	5.1	4.0	3.7	4.0	3.3	2.5
Carlton	7.6	8.1	8.8	8.4	7.7	6.9	7.2	6.2	4.6
Cook	9.1	6.8	6.5	5.8	5.6	5.7	5.5	4.7	3.8
Lake	6.8	8.8	9.9	8.2	6.1	5.2	5.8	5.2	4.0
St. Louis	6.6	7.0	7.7	7.8	6.4	5.7	5.7	4.9	3.8

Source: Minnesota Department of Economic Security.

1 Source: *Overall Economic Development Program for the Arrowhead Region,* 1993 Update, Arrowhead Regional Development Commission.

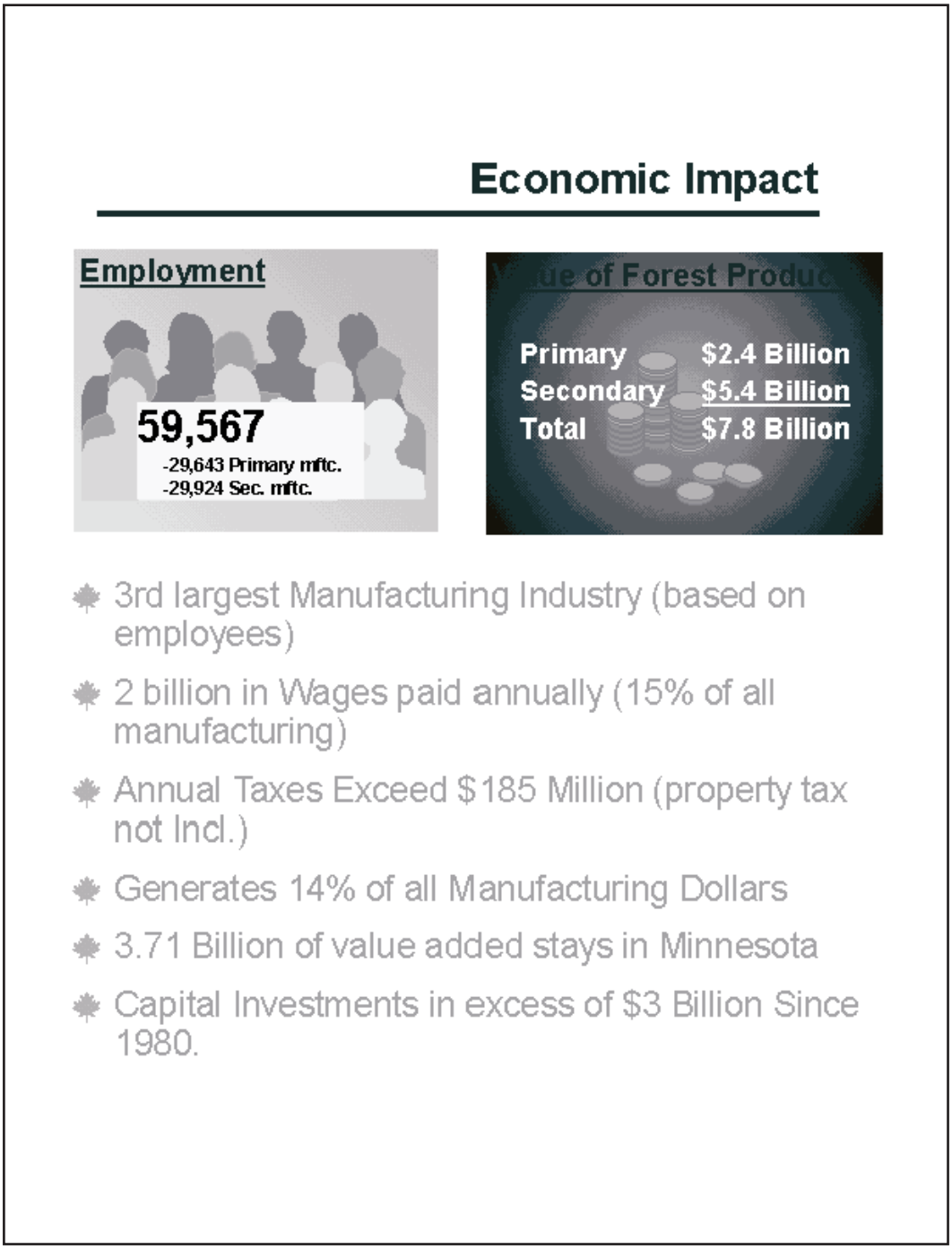
4.2.1. Forest products industry

Figure 4.3. The Minnesota forest products industry.



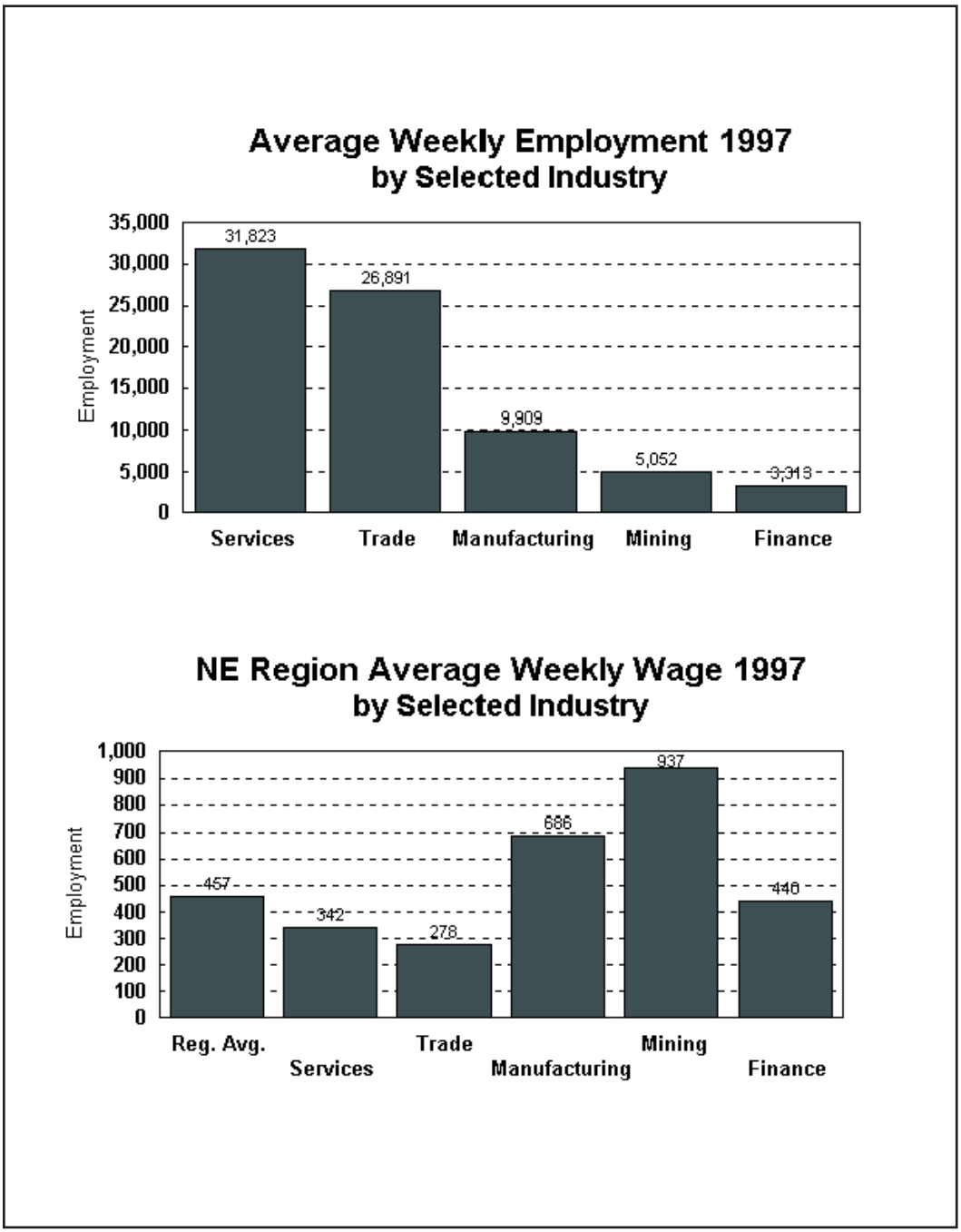
Source: Minnesota Forest Industries.

Figure 4.4. Minnesota economic impact.



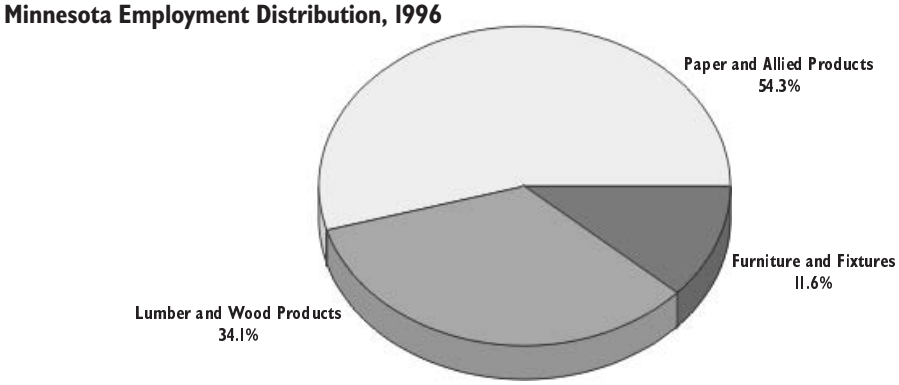
Source: Minnesota Department of Economic Trade and Development.

Figure 4.5. General employment data, 1997, by selected industry.



Source: Minnesota Department of Economic Trade and Development.

Figure 4.6. Forest products industry, 1996.



SIC Code	Industry	MN Employment 1996	Employment Growth 1988–1996		MN Location Quotient 1996	MN Manufacturing Value Added 1996 (Millions)
			Minnesota	United States		
	All Private Sector Industries	2,038,017	21.7%	13.4%	1.00	34,716
	Forest and Forestry Products	57,800	4.3	-1.0	1.44	3,770
24	**Lumber and Wood Products**	**19,698**	**16.2**	**0.9**	**1.23**	**1,436**
241	Logging	749	38.2	-8.0	0.45	44
242	Sawmills	1,292	25.2	-12.3	0.35	211
243	Millwork	12,377	6.8	5.0	2.10	890
244	Containers	1,000	61.6	19.6	0.93	d
245	Buildings	1,372	53.1	30.2	0.75	80
249	Misc. Wood Products	2,909	27.8	-3.9	1.60	180
25	**Furniture and Fixtures**	**6,705**	**21.3**	**-4.5**	**0.65**	**378**
251	Household	1,446	0.6	-11.0	0.25	54
252	Office	1,006	84.9	-13.3	0.80	d
253	Public Building & Related	431	-39.1	33.4	0.49	d
254	Partitions	3,077	28.2	8.3	1.78	158
259	Misc. Furniture & Fixtures	745	71.7	7.5	0.95	d
26	**Paper and Allied Products**	**31,397**	**-4.6**	**-0.8**	**2.24**	**1,956**
261	Pulp Mills	d	n/a	-15.2	0.95	d
262	Paper Mills	5,254	8.4	-8.7	1.59	749
263	Paperboard Mills	d	n/a	-6.0	1.59	d
265	Paperboard Containers & Boxes	4,913	n/a	6.2	1.09	d
267	Misc. Converted Paper Products	21,089	-12.2	1.0	4.28	743

Note: n/a = Not available; d = non-disclosed data.
Source: Unpublished data, 1998, U.S. Department of Labor, Bureau of Labor Statistics.

- The state's forest products industries accounted for 13.5 percent of total manufacturing employment in Minnesota in 1996 and 10.9 percent of total manufacturing value added by all Minnesota industries in 1996.
- Besides the SIC code industry breakdown, Minnesota's forest products industries can be divided into two sectors—primary and secondary. The primary sector includes those industries which use logs or chips from logs, such as sawmills and pulp and paper manufacturers. Secondary processors include manufacturers of finished wood products such as cabinets, windows, and moldings.
- Potlatch Corporation, Andersen Corporation, Marvin Lumber and Cedar Company, and Boise Cascade each had more than 1,000 Minnesota employees in 1997, according to *Corporate Report Fact Book, 1998 Edition*.
- Overall employment in Minnesota's forest products industries increased by 4.3 percent between 1988 and 1996 compared to an average decrease of 1.0 percent nationally.
- Minnesota had more employees in miscellaneous converted paper products (SIC 267) in 1996 than any other state, despite a decrease in employment of over 12 percent from 1988 to 1996.

Source: Minnesota Department of Trade and Development.

4.3. Earnings and production

The "Earnings by Major Industry" graph for Minnesota shows that the trade sectors (other) of the economy have experienced the highest earnings and the largest rate of increase since 1970, followed closely by the service and manufacturing industries (Atlas, 1998). Mining joins agriculture and forestry with low but constant earnings during the 25-year-period. The Earnings graph for the Northeast region shows that the services, trade (other), and government industries had the highest earnings and the largest rate of growth (Atlas, 1998). The mining sector experienced a major decrease in earnings from 1980–1985 as a result of the recession. Although mining earnings have increased at a modest and steady rate since the recession, this sector has never fully recovered from the recession. Agricultural services and forestry earnings have remained fairly constant during the 25-year time period. The "Projected Earnings by Industry" graph shows that the service industry is expected to increase significantly in the future (Atlas, 1998). The agricultural services and mining industries are expected to remain constant during the next 45 years. No decrease of earnings is expected in any of the industrial sectors.

The data in Table 4.9. show the earnings by major industry for the Northeast region for 1995. The services, government, and manufacturing sectors together accounted for 58.4% of the total economic production on the Northeast region in 1995. In 1995, farm earnings showed a loss of $4.1 million. In 1990, farming activity did result in regional earnings of $4.7 million, but was only 0.2% of the total regional economic production. The agricultural services, forestry, and fishing sector had earnings of $10.3 million in 1995, which accounted for only 0.3% of the total regional economic production.

Table 4.9. Earnings by major industry for the Northeast Region, 1995.

	Thousands of dollars	Percent of total earnings
1. Services	837,536	25.3
2. Government	671,213	20.2
3. Manufacturing	426,335	12.9
Lumber and wood products	129,324	3.9
Furniture and fixtures	506	0.02
Paper and allied products	*	*
4. Retail trade	356,406	10.7
5. Mining	287,793	8.7
6. Transportation	237,136	7.1
7. Construction	192,327	5.8
8. Wholesale trade	137,222	4.1
9. Finance, insurance, and real estate	105,338	3.2
10. Agricultural services, forestry, fishing	10,326	0.3
11. Farm earnings	-4,117	0.0
Unclassified	57,953	1.7
Total	3,315,468	100.0

Source: Regional Economic Information System, Table CA05, Bureau of Economic Analysis.

* Data not disclosed for St. Louis and Carlton Counties. There were no earnings for Cook and Lake Counties.

Table 4.10. shows total taconite production during the 1990s for the seven taconite plants of the Iron Range. During the recession, taconite production fell from 54.3 million tons in 1979 to 23.2 million tons in 1982. Production rebounded to 42.5 million tons in 1990 and has remained fairly stable during the 1990s.

Table 4.10. Taconite production, 1990–1999. (Values are millions of tons.)

1990	1991	1992	1993	1994	1995	1996	1997	1998*	1999*
42.5	39.9	38.8	39.8	41.7	45.0	43.9	44.8	46.3	46.4

Source: Minnesota Department of Revenue's "Minnesota Mining Tax Guide."
* Estimates from the Iron Range taconite plants.

4.4. Property taxes

Table 4.11. Total net property tax and estimated distribution among selected use classes in Carlton County, 1993–1998. (Values are dollars.)

	1993	1994	1995	1996	1997	1998
Total net tax on real property	16,374,880	17,162,465	19,181,654	19,052,140	20,693,697	20,658,218
Farm	976,085	965,300	921,794	973,874	1,063,537	1,112,122
Timber	268,730	253,949	285,572	282,615	290,645	290,688
Seasonal/Recreation Residential	692,414	700,620	735,472	794,125	744,083	665,764
Residential (year-round)	5,710,598	6,428,699	7,430,078	7,851,998	9,156,037	9,168,418

Source: MN Department of Revenue.

Table 4.12. Total net property tax and estimated distribution among selected use classes in Cook County, 1993–1998. (Values are dollars.)

	1993	1994	1995	1996	1997	1998
Total net tax on real property	4,492,098	5,038,382	5,491,526	6,007,275	6,490,579	6,725,011
Farm	6,974	6,504	6,788	7,492	9,596	10,141
Timber	50,482	46,172	41,444	42,849	45,944	51,280
Seasonal/Recreation Residential	2,794,458	3,124,475	3,345,954	3,658,436	3,774,313	3,889,014
Residential (year-round)	809,793	946,796	1,094,632	1,193,014	1,512,789	1,674,587

Source: MN Department of Revenue.

Table 4.13. Total net property tax and estimated distribution among selected use classes in Lake County, 1993–1998. (Values are dollars.)

	1993	1994	1995	1996	1997	1998
Total net tax on real property	6,086,393	6,478,363	7,118,571	6,653,213	7,137,234	7,200,343
Farm	6,487	6,514	7,725	6,108	6,777	6,609
Timber	510,837	532,171	603,140	545,645	632,718	695,397
Seasonal/Recreation Residential	1,505,511	1,589,350	1,843,655	1,798,208	1,798,367	1,749,992
Residential (year-round)	2,158,871	2,431,993	2,756,461	2,427,741	2,688,507	2,752,540

Source: MN Department of Revenue.

Table 4.14. Total net property tax and estimated distribution among selected use classes in St. Louis County, 1993–1998. (Values are dollars.)

	1993	1994	1995	1996	1997	1998
Total net tax on real property	104,931,834	108,950,993	113,486,068	116,863,231	121,870,982	118,176,011
Farm	526,595	514,660	512,495	508,962	538,208	552,018
Timber	1,893,251	1,749,827	1,734,392	1,622,230	1,623,879	1,570,405
Seasonal/Recreation Residential	9,284,538	9,473,207	10,116,902	10,508,827	10,070,101	9,823,474
Residential (year-round)	44,402,963	48,018,896	50,471,810	53,140,317	56,622,840	56,125,887

Source: MN Department of Revenue.

Table 4.15. Total net property tax and estimated distribution among selected use classes in the Northeast Regional Landscape, 1993–1998. (Values are dollars.)

	1993	1994	1995	1996	1997	1998
Total net tax on real property	131,885,205	137,630,203	145,277,819	148,575,859	156,192,492	152,759,583
Farm	1,516,141	1,492,978	1,448,802	1,496,436	1,618,118	1,680,890
Timber	2,723,300	2,582,119	2,664,548	2,493,339	2,593,186	2,607,770
Seasonal/Recreation Residential	14,276,921	14,887,750	16,041,983	16,759,596	16,386,864	16,128,659
Residential (year-round)	53,082,225	57,826,384	61,752,981	64,613,070	69,980,173	69,721,432

Source: MN Department of Revenue.

Table 4.16. shows payments made to the county governments by the Superior National Forest and the DNR.

Table 4.16. Payments in lieu of taxes for public land in the Northeast Region, 1987–1997. (Values are dollars.)

Year	SNF[1]	DNR[2]	Total
1987	1,686,182	1,248,868	2,935,050
1988	1,569,993	1,259,046	2,829,039
1989	2,154,705	1,238,499	3,393,204
1990	2,189,098	1,247,027	3,436,125
1991	2,078,402	1,221,392	3,299,794
1992	2,118,459	1,271,404	3,389,863
1993	2,236,492	1,325,948	3,562,440
1994	2,251,214	1,334,268	3,585,482
1995	2,456,634	1,384,076	3,840,710
1996	2,701,995	1,390,423	4,092,418
1997	2,470,466	1,428,259	3,898,725

[1] Source: Superior National Forest.
[2] Source: Minnesota Department of Natural Resources, Bureau of Real Estate Management.

4.5. Recreation and tourism

4.5.1. Supply and demand

4.5.1.1. Roads

Table 4.17. shows the total mileage of roads in Minnesota from 1989–1999. The following route systems are included in the mileage total: interstate trunk, U.S. trunk, Minnesota trunk, county state aid, municipal state aid, county, township, unorganized township, municipal streets, national forest development, Indian reservation, state forest, state park, military, national wildlife refuge, state game preserve, and airport roads. Historic road mileage summaries were not available by county.

An average of 140 miles per year were added to Minnesota roads over the last 10 years for an overall increase of 1.24%, or 1,640 miles.

Table 4.17. Minnesota statewide road mileage, 1989–1999.

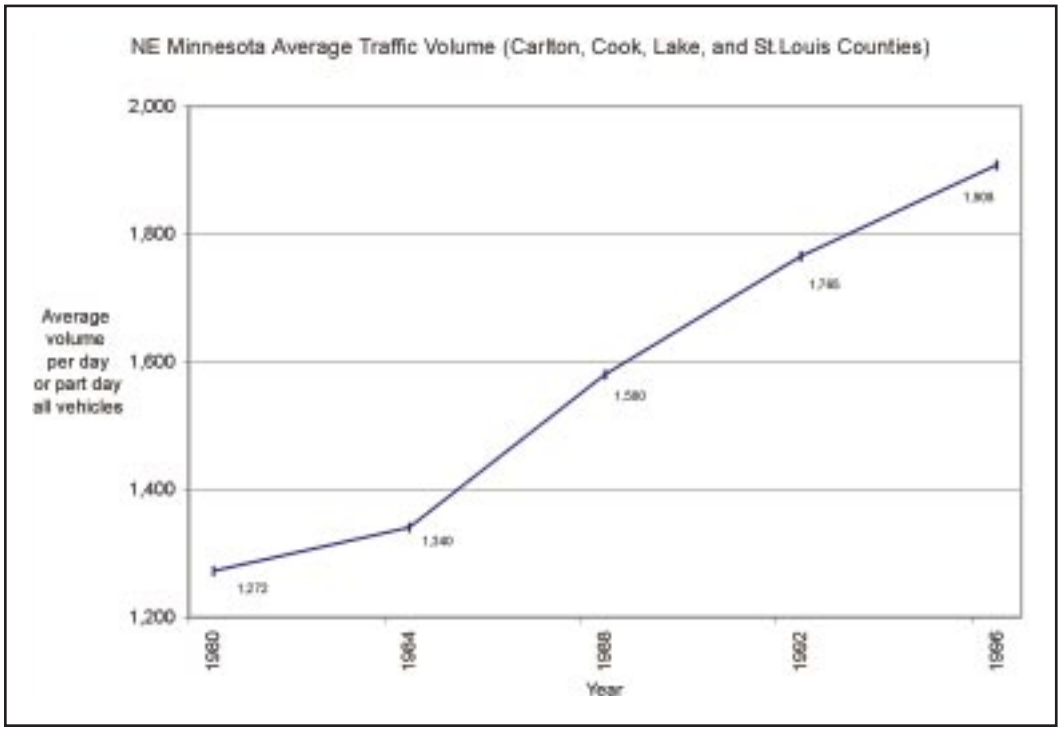
Year	Mileage
1999	134,337
1998	134,184
1997	133,987
1995	133,710
1994	133,590
1993	133,194
1992	133,060
1991	132,875
1990	132,848
1989	132,697

Source: Minnesota Department of Transportation.

Figure 4.7. represents the average volume per day or part day for all vehicles for the combination of Carlton, Cook, Lake, and St. Louis counties. These data are collected only on interstate trunk, U.S. trunk, Minnesota trunk, and county state aid road systems.

Average traffic volume per day or part day for all vehicles increased by 636 vehicles, or 50%, between 1980 and 1996 across the Northeast's socioeconomic assessment area.

Figure 4.7. Northeast Minnesota average traffic volume (Carlton, Cook, Lake, and St. Louis Counties) 1980–1996.

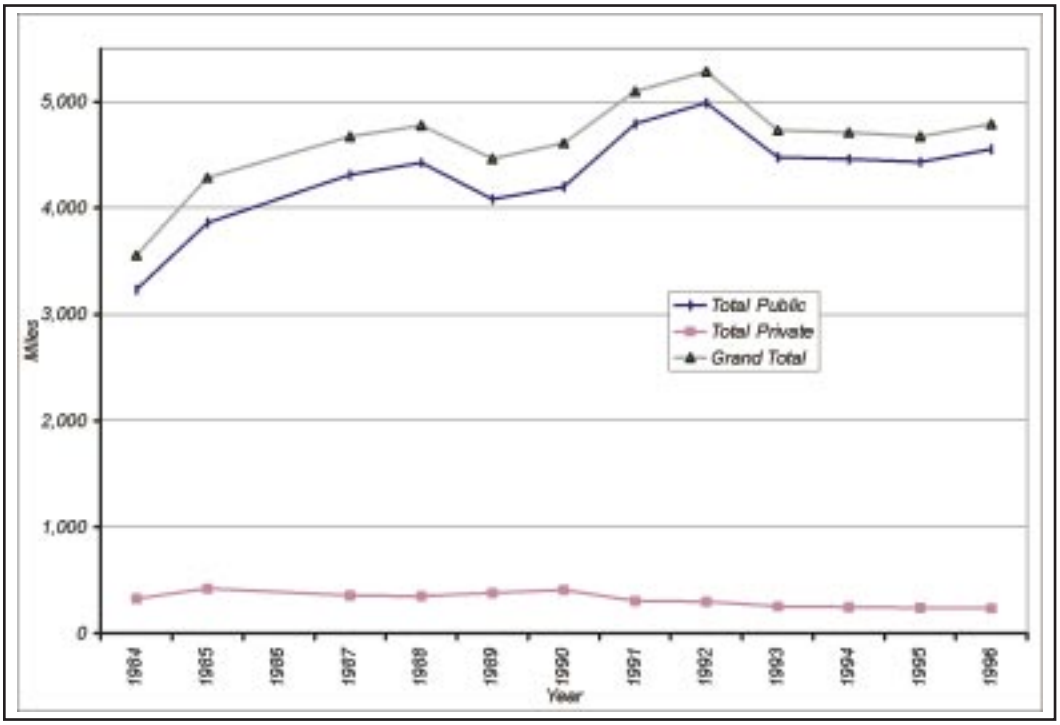


Source: Minnesota Department of Transportation.

4.5.1.2. Trails

Figure 4.8. and Tables 4.18. and 4.19. represent the recreational trail mileage for DNR Region 2 and the state. Public trails include those provided by the following agencies and programs: U.S. Forest Service, U.S. Fish and Wildlife Service, National Park Service, U.S. Corps of Engineers, MnDNR, MN Historical Society, MN Department of Transportation, the University of Minnesota, county administrations and grant-in-aid, city and township non-grant-in-aid and grant-in-aid, and public school districts. Five categories of trails are included in the data: hiking, skiing, horseback riding, biking, and snowmobiling. Because the DNR state trails are the only mileages that are updated frequently in "The Minnesota Registry of Public Recreational Trail Mileages," the increase in public trails shown by the data here are primarily increases in DNR state trail miles.

Figure 4.8. Length of trails in DNR Region 2, 1984–1996.[A]



[A] Source: "Minnesota Registry of Public Recreational Trail Mileages" for the years of 1984 to 1996, DNR Division of Trails and Waters.
Note: Only DNR state trail mileages were updated frequently in the registries. Also, the data may include overlaps of trail miles among different uses and therefore overestimate total mileage.

Table 4.18. Statewide trail mileage, 1984–1996.[A]

	1984	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Total Public	11,693	13,167	14,580	15,604	15,461	15,924	17,819	18,683	18,938	19,164	19,516	19,920
Total Private	1,558	1,824	1,639	1,584	1,548	1,558	1,423	1,383	1,374	1,369	1,340	1,293

[A] Source: DNR Division of Trails and Waters.

Table 4.19. DNR Region 2[A] public and private trail mileage by classification, 1984–1996.[BA] DNR Region 2 consists of the following counties: Carlton, Cook, Itasca, Koochiching, Lake, St. Louis, and part of Cass.

Class	1984	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Public												
Hike	1,020	952	1,012	1,033	1,106	1,093	1,260	1,263	1,257	1,253	1,253	1,262
Ski	865	980	1,018	1,073	1,128	1,119	1,132	1,145	1,132	1,125	1,131	1,085
Horse	33	26	30	35	369	369	369	369	369	369	369	369
Bike	7	7	10	24	26	26	31	31	31	31	37	37
Snowmobile	2,153	2,646	2,997	3,042	2,651	2,771	3,221	3,427	2,915	2,898	2,889	2,980
Total	3,233	3,862	4,315	4,425	4,082	4,201	4,793	4,988	4,479	4,463	4,435	4,554
Private												
Hike	252	269	268	251	247	239	237	229	195	195	189	185
Ski	11	168	136	147	133	130	68	73	60	55	46	46
Horse	55	35	35	33	33	28	28	27	12	12	7	7
Bike	44	33	32	29	29	23	23	22	14	14	14	13
Snowmobile	118	69	61	39	39	67	25	10	10	10	10	10
Total	324	423	358	351	382	409	305	297	253	248	239	235
Combined Total	3,557	4,285	4,673	4,776	4,464	4,610	5,098	5,285	4,732	4,711	4,675	4,790

[B] Source: DNR Division of Trails.

4.5.1.3. Public campgrounds

Table 4.20. Superior National Forest capacity and use.

Developed campgrounds	
Capacity for season	425,000 PAOT[1] days
Campground use	324,000 recreation visitor days[2]
Average use of campgrounds	55% of theoretical capacity
BWCAW	
Capacity for season	455,000 PAOT[1] days
BWCAW use	1,500,000 recreation visitor days[2]

[1] Persons at one time.

[2] A recreation visitor day is one person per 12 hours.

Source: Superior National Forest staff.

The Superior National Forest Plan currently is being revised. During the revision process, the 1986 Plan remains in effect and is the best source of resource allocations and outputs. At this time, there are no projections on resource allocations and outputs that may result from the revised Forest Plan.

Table 4.21. Voyageurs National Park visitation.

Year	Visitors
1997	223,418
1998	231,958

Source: VNP staff.

No fees are charged for use of Voyageurs National Park. The park is currently in the process of preparing several major planning documents including a General Management Plan/Visitor Use and Facilities Plan/Environmental Impact Statement. The document will provide a management framework for the next 20 years. Also, funding is being pursued to develop a framework to address carrying capacity questions in regard to visitor impacts on resources and impacts to the quality of visitor experiences.

Table 4.22. Current state park capacity and use in the Northeast Landscape.

Camping capacity	
Drive-in sites	483
Other sites[1]	95
Cabins	1 at 10-person capacity 4 at 20-person capacity
Use of parks, 1998	
Total visitors	2,244,217
Overnight visitors	181,159
Campsites occupied	54,163
Lodge units occupied	812

[1] Includes cart in, walk in, boat in, and backpack sites.
Source: DNR Division of Parks.

The DNR does not limit the number of people per campsite in the state parks; therefore, park capacity is not figured in terms of person-days. State park campsites are open all year. Full services are provided generally mid-May through mid-October, though the season varies each year and for each park. Use of campsites is highest during the full-service season.

4.5.1.4. Indoor lodging capacity

Tables 4.23. and 4.24. show current lodging capacity and trends in lodging establishments. Data differ between the tables because of reporting requirements. Data in Table 4.24. include all lodging establishments that filed at least one sales tax record

during the given year. Data in Table 4.23. include any properties whose owners have chosen to register them with the Office of Tourism since August 1996.

Table 4.23. Indoor lodging capacity.[1]

	Carlton	Cook	Lake	St. Louis	Total
Properties	**13**	**80**	**70**	**211**	**374**
Properties open in winter	12	58	39	135	277
All units	**415**	**1,475**	**922**	**4,948**	**60**
All units - winter	394	1,231	524	4,070	6,219
Lodge units	5	134	77	117	333
Lodge units - winter	5	125	58	95	283
Cabins	20	338	420	1,093	1,871
Cabins - winter	6	170	119	298	593
Condo units	0	36	54	58	475
Condo units - winter	0	3,363	53	36	452
Hotel/Motel units	390	61	351	3,598	4,950
Hotel/Motel units - winter	383	1,544	276	3,559	4,762
Bed & breakfast units	0	29	20	82	131
Bed & breakfast units - winter	0	29	18	82	129

[1] This table was compiled 3/15/99 based on Minnesota Office of Tourism Accommodations database. The database consists of information provided by the properties, and includes only properties that have submitted information since August 1, 1996.

Table 4.24. Hotels, motels, and other lodging establishments.

	1989	1990	1991	1992	1993	1994	1995
Carlton	25	23	24	23	25	24	21
Cook	63	64	69	68	74	69	68
Lake	61	60	61	54	56	53	45
St. Louis	214	219	221	224	229	231	221
Total	363	366	375	369	384	377	355

Source: Tax Research Division, Minnesota Department of Revenue.

4.5.2. Economic impact

4.5.2.1. Public recreation receipts

Table 4.25. Superior National Forest receipts, 1998.

Developed campgrounds total receipts	$289,513.00
BWCAW entry fee receipts	$1,001,642.00
Total	$1,291,155.00

Source: Superior National Forest staff.

Table 4.26. State park receipts in the Northeast Landscape Region, July 1997–August 1998.

Daily vehicle permits	$173,963.56
Annual vehicle permits	$315,898.69
Camping permits	$619,263.82
Total	$1,109,126.07

Source: DNR Division of Parks.

Table 4.27. State hunting, fishing, and harvesting licenses, April 1997–March 1998.

Region	Number	Receipts
Carlton	21,886	$332,251.36
Cook	22,399	$302,790.06
Lake	14,696	$215,987.46
St. Louis	157,420	$2,462,793.42
Region Total	216,401	$3,313,822.30

Source: Minnesota DNR License Bureau.

4.5.2.2. Tax revenues

The data for the "Seasonal/Recreational Commercial Homes Tax" and "Seasonal/Recreational Residential Homes Tax" graphs are taken from property taxes levied in Minnesota between 1974–1996 (Atlas, 1998). The data have not been adjusted for inflation during the time period. Seasonal commercial taxes have increased sporadically since 1974 in the northeast region. St. Louis County had the highest increase in commercial taxes, but experienced a slight decline between 1987–1990 and 1994–1997. Seasonal commercial taxes generally increased in Cook County, which experienced a large increase between 1996 and 1997. The data for the seasonal residential taxes show a general trend of increasing tax income for the Northeast region with St. Louis County experiencing the largest increase in taxes.

4.5.2.3. Tourism industry[2]

The economic impact of travel and tourism is difficult to measure directly. Travel expenditures fall across many industries, but account for only a portion of sales in each industry. Travel and tourism also create "indirect" and "induced" economic impacts beyond direct expenditures (see Figure 4.9.). Because of these complexities, the impact of travel and tourism must be estimated rather than measured directly. In 1997, the Minnesota Office of Tourism estimated the economic impact of domestic travel in Minnesota using the REMI (Regional Economic Models, Inc.) model (see Table 4.28.). The model incorporates industry data and traveler survey information to provide economic impact information at the statewide level. County estimates were made based on the assumption that visitor-days in a county were directly proportional to gross sales in lodging in the county.

Figure 4.9. Minnesota's tourism industry.

Minnesota's Tourism Industry

	1996 Total	1995–1996 Growth
Jobs	170,300	4.5%
Gross business receipts	$9.1 billion	4.6%

- There were a total of 25.9 million person-trips to and through Minnesota in 1996 of which 79 percent were pleasure travelers, 17 percent were business travelers, and 4 percent were international travelers.
- Travel and tourism pump $25 million into Minnesota's economy every day.
- Minnesota lodging sales grew by 31 percent from 1991 to 1995, outpacing inflation by more than 4 percent a year.

Source: Travel and Tourism Passport, Minnesota Office of Tourism, Minnesota Department of Revenue, TravelScope.

Table 4.28. Estimated economic impact of domestic travel to the Northeast.

County	1994			1995		
	Employ-ment	Wages/ Salaries (billion $)	Gross Receipts (billion $)	Employ-ment	Wages/ Salaries (billion $)	Gross Receipts (billion $)
Carlton	203	0.004	0.011	329	0.007	0.017
Cook	2,441	0.050	0.127	2,907	0.068	0.159
Lake	638	0.013	0.033	708	0.015	0.037
St. Louis	6,770	0.137	0.352	7,333	0.161	0.393
Total	10,052	0.204	0.523	11,277	0.251	0.606

Source: Minnesota Office of Tourism, 1997.

2 Information in this section is summarized from the report *"Economic Impacts Estimates: Domestic Travel in Minnesota,"* produced by the Minnesota Office of Tourism, Research Division, February 1997.

Table 4.29. shows annual gross sales for resorts in the Northeast as reported to the Minnesota Department of Revenue. Table 4.30. shows annual gross sales for all lodging establishments, including hotels, resorts and campgrounds. In both tables the data include all reported sales at the establishments, such as room rental, equipment rental fees, gift shop sales, and, in some cases, restaurant sales. Table 4.31. shows revenues from lodging taxes levied by communities in the Northeast Landscape Region.

Table 4.29. Northeast resorts: annual gross sales, 1989–1995. (Values in thousands of dollars.)

County	1989	1990	1991	1992	1993	1994	1995
Carlton	44	276	(ND)	(ND)	(ND)	(ND)	(ND)
Cook	6,676	6,915	7,625	8,583	9,243	9,784	9,810
Lake	2,816	3,416	2,827	1,537	1,572	1,336	1,451
St. Louis	9,012	12,738	14,339	14,853	15,777	15,691	15,946
Approximate total:[1]	20,537	25,335	24,791[1]	24,973[1]	26,592[1]	26,811[1]	27,207[1]

ND: Data not disclosed.

[1] Totals for 1991–1995 do not include data for Carlton County and are therefore an underestimation.

Note: Figures include all reported sales at the establishments, such as room rental, equipment rental fees, and in some cases, restaurant and gift shop sales.

Source: MN Department of Revenue, Tax Research Division.

Table 4.30. Northeast lodging establishments: annual gross sales, 1989–1995. (Values in thousands of dollars.)

County	1989	1990	1991	1992	1993	1994	1995
Carlton	1,169	1,657	1,943	2,051	1,823	1,437	2,296
Cook	8,803	9,052	12,941	14,299	15,616	17,258	18,935
Lake	5,750	6,401	5,850	4,259	3,959	4,511	4,942
St. Louis	43,145	46,716	48,363	48,018	46,328	47,857	49,720
Total	58,867	63,826	69,097	68,627	67,726	71,063	75,893

Note: Figures include all reported sales at the establishments, such as room rental, equipment rental fees, and in some cases, restaurant and gift shop sales.

Source: MN Department of Revenue, Tax Research Division.

Table 4.31. Lodging tax revenues for communities in Northeast Minnesota, 1990–1998. (Values are dollars.)[A]Includes Eveleth, Virginia, Hibbing, Chisolm, and Mt. Iron.

Year	Duluth	Ely area	Iron Range[A]	Grand Marais	Gunflint Trail	North Shore[B]	North St. Louis[C]	Two Harbors	Total
1990	591,566	67,282	134,581	35,174	–	121,630	–	–	950,233
1991	635,712	76,333	134,117	54,971	–	201,135	11,690	–	1,113,958
1992	661,866	82,493	147,703	66,564	2,677	214,010	68,113	–	1,113,958
1993	677,939	93,212	151,266	71,722	43,677	250,141	73,362	–	1,363,319
1994	721,173	97,886	168,125	84,490	46,106	281,931	79,413	20,035	1,499,159
1995	770,770	118,653	183,547	95,331	50,191	321,545	98,261	26,892	1,665,190
1996	804,762	143,786	183,265	92,181	52,156	343,197	107,491	26,999	1,753,840
1997	833,721	142,840	203,350	92,551	56,735	368,053	105,940	39,142	1,842,332
1998	892,407	156,222	203,332	105,092	83,540	398,200	113,444	44,439	1,996,676

[B]Includes Lutsen, Tofte, and Schroeder.
[C]Includes Orr and Ash Rivers, Crane Lake, and Kabetogama.
Source: MN Office of Tourism.

Table 4.32. shows wages and salaries and gross receipts from tourism in the years 1994 and 1995.

Table 4.32. Gross receipts from tourism in Northeast Minnesota.

County	1994			1995		
	Jobs	Wages & salaries	Gross receipts	Jobs	Wages & salaries	Gross receipts
Cook	2,441	50,000,000	127,000,000	2,907	68,000,000	159,000,000
Lake	638	13,000,000	33,000,000	708	15,000,000	37,000,000
St. Louis	2,790	57,000,000	145,000,000	3,021	66,000,000	162,000,000
Carlton	ND	ND	ND	ND	ND	ND
Total	5,869	120,000,000	305,000,000	6,636	149,000,000	358,000,000

ND: Data not disclosed.
Source: Northern Lights Tourism Alliance, IRRB.
Note: The data was gathered for the taconite tax relief area of Northeastern Minnesota.

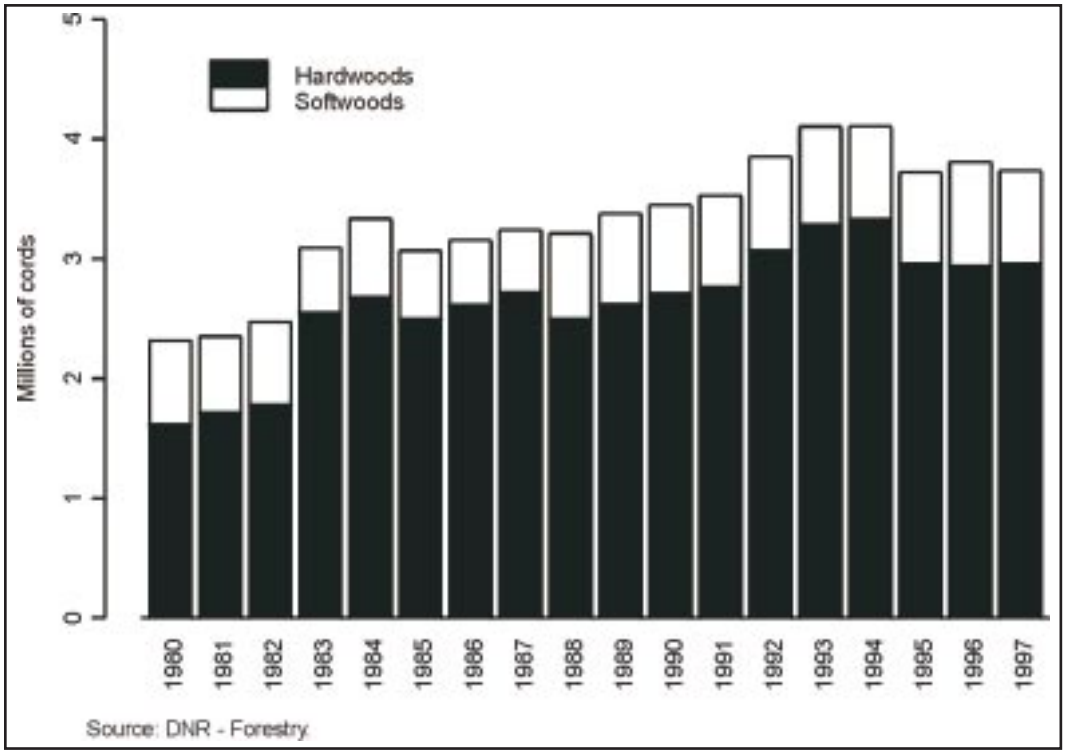
4.6. Forest products sector

4.6.1. Harvesting trends

The data in Figure 4.10. are based on periodic surveys of primary wood users (sawtimber and pulpwood manufacturers) and households (fuelwood). The decrease in harvest level between 1994 and 1995 is attributed partially to an update of fuelwood consumption numbers from a 1995–1996 survey.

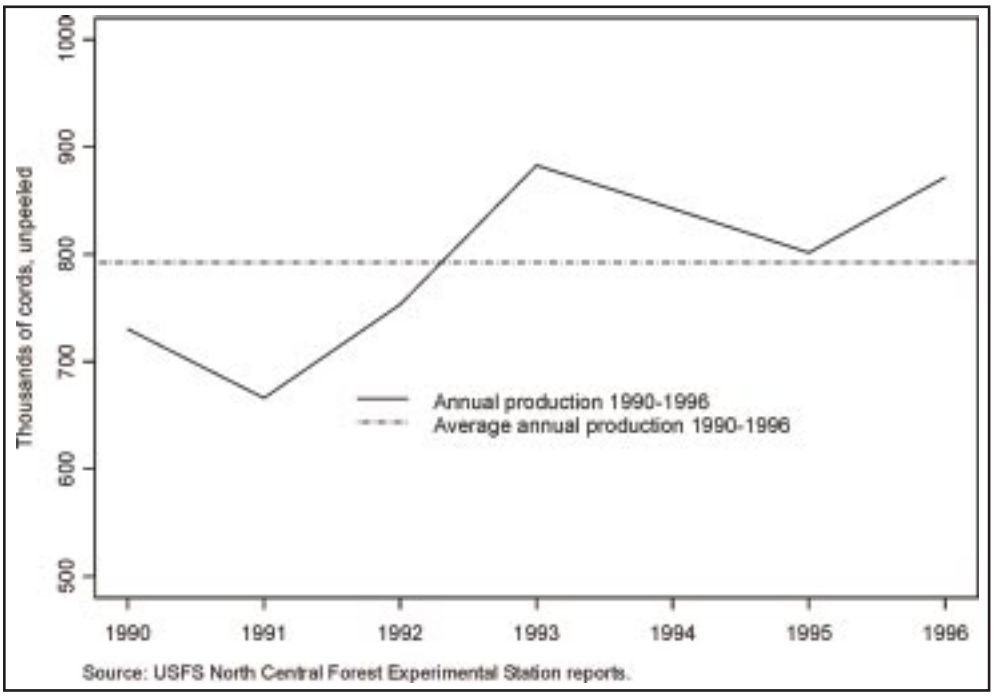
The DNR Division of Forestry projects a statewide annual harvest level of 4.34 million cords for 2001.

Figure 4.10. Statewide trends of hardwood and softwood harvesting, 1980–1997.



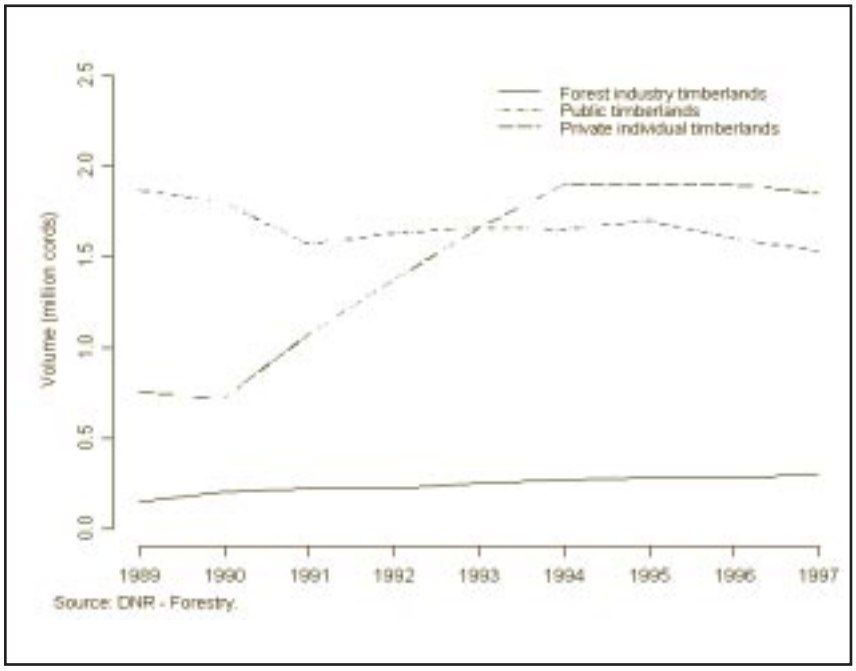
Pulpwood production in the Northeast is higher today than in 1990 (see Figure 4.11.). Production for 1996 was 10% higher than the average production level for the period 1990 to 1996.

Figure 4.11. Pulpwood production of the Northeast Regional Landscape, 1990–1996.



Prior to 1993 public timberlands were the primary supplier to Minnesota's wood industries (see Figure 4.12.). In 1994, private individuals became the primary supplier and have remained so through 1997.

Figure 4.12. Estimated annual harvest volume from timberland in Minnesota by ownership class, 1989–1997.



Note: Harvest levels on public land are based on the volume of timber sold in each year.

Table 4.33. Harvesting of public lands in the Northeast. (Values are acres.)

	1990	1991	1992	1993	1994	1995	1996	1997	1998
DNR[1]	(NA)	8,020	(NA)	(NA)	(NA)	(NA)	12,039	8,551	8,974
Superior National Forest[2]	9,058	9,060	9,843	3,998	8,194	9,484	8,938	5,108	6,281
St. Louis County[3]	4,726	5,978	5,077	7,578	6,912	7,772	5,022	4,706	7,669
Lake County[4]	3,034	1,969	1,971	1,619	1,166	2,135	1,295	1,748	N/A

NA: Data not received or not available.

[1] Source: DNR Division of Forestry. **Note**: DNR acreages are timber sold acres. Prior to 1996 the DNR was not required to compile and report data on harvested acreages. The acreage for 1991 is an estimate prepared for the GEIS.

[2] Source: SNF staff.

[3] Source: St. Louis County Land Department staff.

[4] Source: Lake County Land Department staff. Data was converted from cords, assuming 15 cords per acre.

4.6.2. Exports and imports

Table 4.34. Minnesota pulpwood production, exports and imports, 1993–1997. (Values are in thousand cords, unpeeled. Includes mill residues used for pulp.)

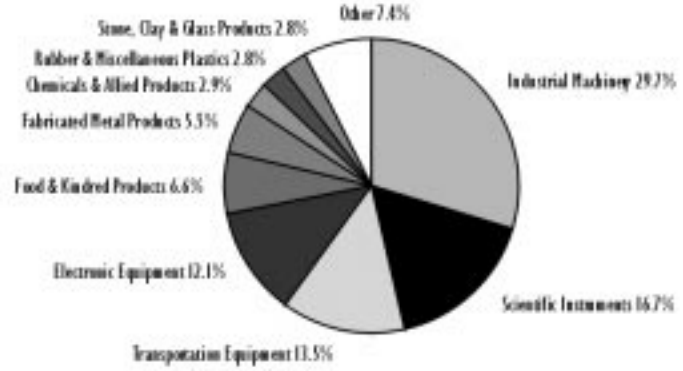
Year	Total production	Exports	Imports from MI and WI	Imports from Canada
1993	2,969	185	66	71
1994	3,029	216	72	114
1995	2,971	232	98	142
1996	3,065	390	73	136
1997[A]	2,980	326	46	102

[A]1997 data are preliminary and subject to revision.
Source: USDA Forest Service, North Central Forest Experiment Station.

Figure 4.13. Total manufactured exports, 1997.

Total Manufactured Exports

Minnesota's Manufactured Exports by Industry



Code	Industry	1994	1995	1996	Percent Change 1994 to 1996 Minnesota	Percent Change 1994 to 1996 U.S.	Percent 1996 Distribution Minnesota	Percent 1996 Distribution U.S.	Minnesota as Percent of the U.S. in 1996
		(thousands of dollars)							
20	Food & Kindred Products	$ 574,087	$ 568,854	$ 584,749	1.9%	17.2%	6.6%	5.0%	2.1%
22	Textile Mill Products	19,660	20,835	21,530	9.5	20.1	0.2	1.2	0.3
23	Apparel	20,026	11,698	17,388	-13.2	31.4	0.2	1.5	0.2
24	Lumber & Wood Products	52,483	67,585	86,983	65.7	1.3	1.0	1.4	1.1
25	Furniture & Fixtures	25,531	28,025	31,099	21.8	3.8	0.3	0.6	0.9
26	Paper & Allied Products	144,021	116,300	140,351	-2.5	27.9	1.6	2.6	0.9
27	Printing & Publishing	64,103	69,257	64,262	0.2	10.9	0.7	0.8	1.3
28	Chemicals & Allied Products	211,161	212,490	259,893	23.1	20.2	2.9	10.8	0.4
29	Petroleum Refining	7,293	11,159	14,135	93.8	30.3	0.2	1.3	0.2
30	Rubber & Miscellaneous Plastics	209,195	228,548	250,547	19.8	21.7	2.8	2.3	1.9
31	Leather & Leather Products	40,523	41,241	38,623	-4.7	44.4	0.4	0.4	1.5
32	Stone, Clay & Glass Products	200,530	298,181	247,541	23.4	17.7	2.8	1.0	4.6
33	Primary Metal Products	77,406	96,966	99,768	28.9	31.2	1.1	4.0	0.4
34	Fabricated Metal Products	322,998	452,648	493,227	52.7	23.3	5.5	3.1	2.8
35	Industrial Machinery	2,140,562	2,366,898	2,643,903	23.5	26.3	29.7	20.3	2.3
36	Electronic Equipment	942,096	1,044,238	1,076,872	14.3	28.1	12.1	17.1	1.1
37	Transportation Equipment	1,088,678	1,217,401	1,205,053	10.7	9.8	13.5	17.4	1.2
38	Scientific Instruments	1,052,137	1,226,777	1,490,984	41.7	23.4	16.7	6.3	4.2
39	Miscellaneous Manufacturing	107,139	147,524	141,407	32.0	17.8	1.6	1.9	1.3
	TOTAL	$7,299,551	$8,218,568	$8,908,366	22.0%	21.0%	100.0%	100.0%	1.6%

Source: U.S. Department of Commerce, University of Massachusetts at Amherst, MISER.

HIGHLIGHTS

- Minnesota manufactured exports totaled $8.9 billion in 1996, which is 1.6 percent of total U.S. manufactured exports.
- Four percent or more of the nation's exports of scientific instruments and stone, clay and glass products originate in Minnesota.
- Industrial machinery, Minnesota's largest export sector, accounts for 29.7 percent of total Minnesota manufactured exports.
- Minnesota's total manufactured exports grew at a rate of 22 percent, slightly above the national rate of 21 percent, between 1994 and 1996.
- The high technology industries of industrial machinery, electronic equipment and scientific instruments account for 58.5 percent of total exports.
- Other exports in the top five are transportation equipment and food and kindred products.

Source: Minnesota Department of Economic Security

4.6.3. Mill consumption capacities

Table 4.35. Mill consumption capacities, 1997. (Values are cords/year.)

	Current capacity	Anticipated increase
Diamond Brands, Inc. - Cloquet	18,000	
Georgia-Pacific Corporation - Duluth	85,000	
Lake Superior Paper Industry - Duluth	150,000	
Louisiana-Pacific Corporation - Two Harbors	130,000	
Potlatch Corporation - Cloquet	330,000	350,000
Potlatch Corporation - Cook	180,000	100,000

Source: "1999 Minnesota Primary Forest Products Directory," MnDNR, Division of Forestry.

4.6.4. Stumpage prices

Figures 4.14. and 4.15. show a general rise in stumpage prices received by public agencies since 1988. Note, however, 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 over time.

Figure 4.14. Average stumpage prices received by public agencies for sawtimber, 1988–1998.

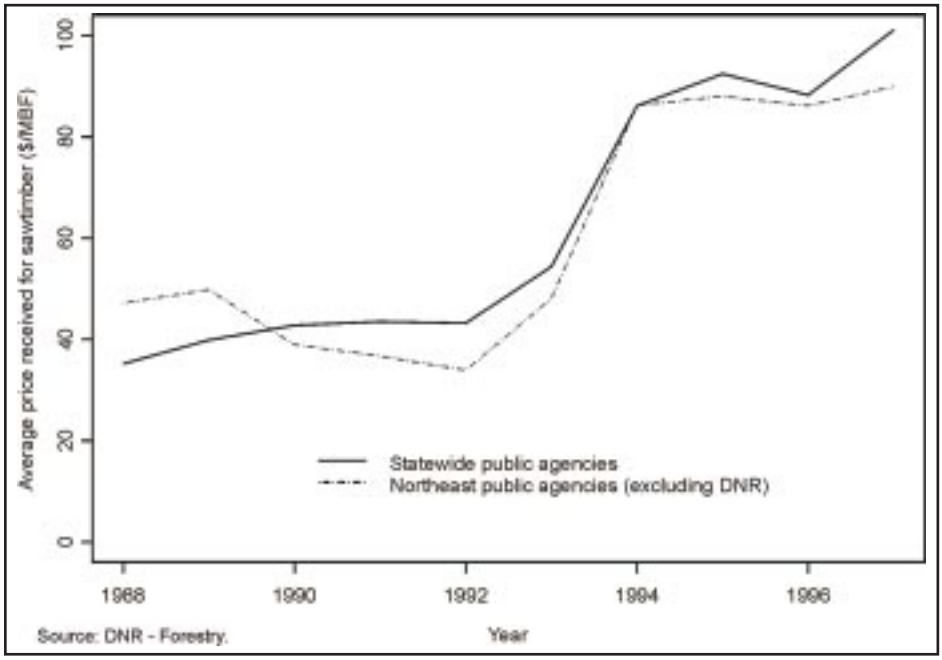
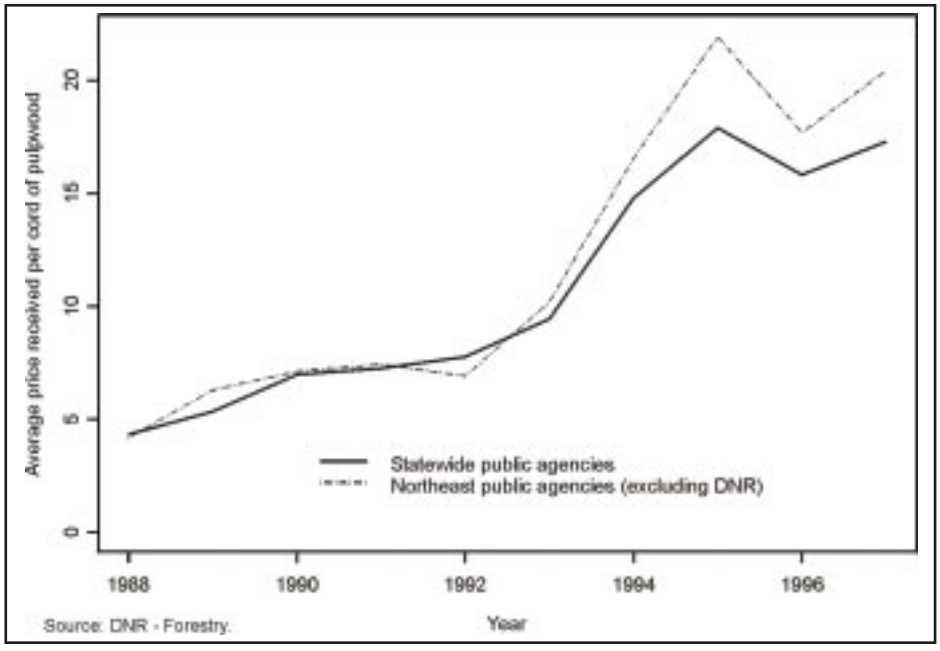


Figure 4.15. Average stumpage prices received by public agencies for pulpwood, 1988–1998.

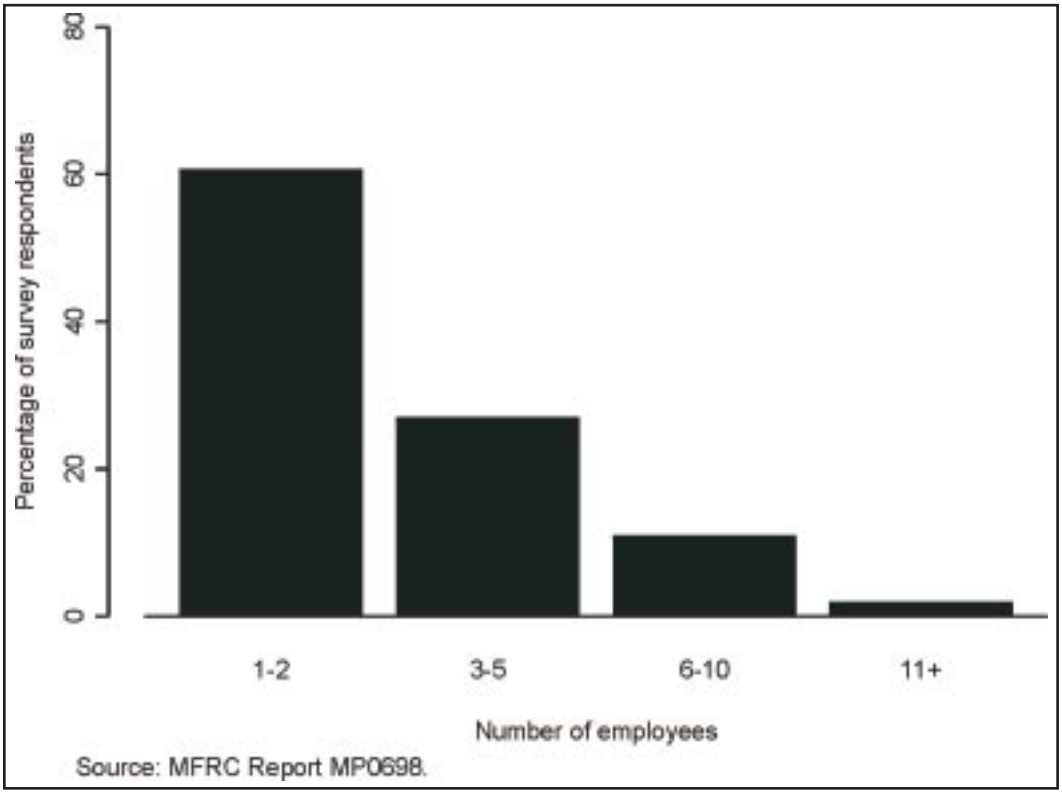


4.6.5. Logging operators

No detailed, accurate source of regional logger employment data could be found. Statewide information on logging operator size is available for 1996 (MFRC Report MP0698). Data are based on surveys sent to 1,562 individuals who were listed in the Minnesota Logger Education Program (MLEP) database. Of the original 1,562 surveys, 390 were completed to a sufficient degree to be included in the analysis. Of these, approximately 20% lived within the Northeast regional landscape.

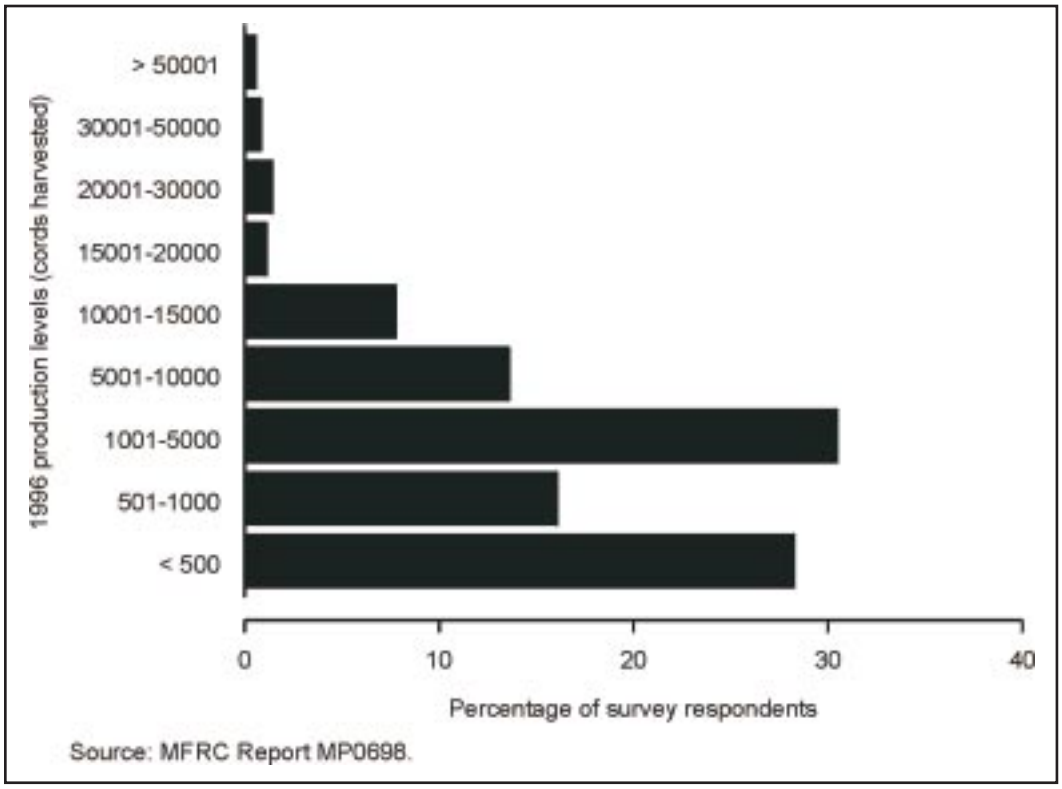
Respondents reported a total of 1,254 employees for an average of 3.23 persons per firm. The majority of respondents (61%) had 1–2 employees (see Figure 4.9.). Average length of ownership of the logging business was 17.6 years.

Figure 4.16. Statewide survey of logger operators: number of employees, 1996.



Annual production levels are a second measure of logging operation size (see Figure 4.17.). The majority of survey respondents (75%) reported annual production levels of 5,000 cords or less. Ten survey respondents exceeded production levels of 20,000 cords in 1996. These ten logging operations harvested 27% of the total harvest reported by survey respondents.

Figure 4.17. Statewide survey of logger operators: annual production, 1996.



Additional information on types of harvesting, season of harvest, age and value of harvesting equipment, and stumpage source are provided in MFRC Report MP0698.

Appendix A

Human Impacts on the Ecology of Northeastern Minnesota

Human Impacts on the Ecology of Northeastern Minnesota

This essay is a brief, once over lightly overview of the cultural ecology of northeastern Minnesota, with special reference to the Northern and Southern Superior Uplands. Its purpose is to trace, in broad outline, the most important themes and trends in landscape change since the last ice age. Although humans have been a force for landscape change for more than 10,000 years, the focus here is on the last three centuries, the so-called *historic* period, for which there are written records as well as archeological and oral history data. The general approach is rooted in the concepts of historical geography, the branch of human geography concerned with processes and sequences of landscape change. Because it is an overview, what has been written unavoidably reflects the personal interests (and disinterests) of the author; as a consequence, some themes may appear to have been slighted; others overemphasized. A selective bibliography has been included to direct readers to the wide range of published works bearing on the subject.

The Pre-settlement Landscape

Prior to European contact, Native Americans had lived in northeastern Minnesota for thousands of years and through several successive cultural traditions. Archeological sites document an ancient Native American presence in the Superior Uplands region beginning near the end of the last ice age, about 9,500 B.C., and continuing down through the *prehistoric* period. Postglacial environmental history was characterized by major shifts in climate, flora, and fauna, but as there were probably never more than a few thousand prehistoric Native Americans in the region at any one time, their impact on ecosystems was limited.

When the French reconnaissance of the Great Lakes reached Lake Superior in the seventeenth century, northeastern Minnesota was on the periphery of the hunting and fishing territories controlled by the most important tribal societies in the region, the linguistically related Eastern Dakota or Sioux, Assiniboine, and Cree. Unfortunately, very little is known about the distribution of native peoples in Minnesota during what has been termed the *protohistoric* period, that is, the 140-year timespan between Giovanni Verazzano's discovery of New France in 1524 and the establishment of the Jesuit mission at Chequamegon Bay in 1665. Taken at face value, the accounts left by the earliest explorers suggest that the Superior Uplands were virtually uninhabited at the time of initial European contact.

The first great wave of historic immigration to northeastern Minnesota was triggered by events hundreds of kilometers to the east. In 1641 war broke out between the Five Nations of the Iroquois and the Algonquian-speaking Huron. This conflict eventually involved most of the important tribes in the Great Lakes region and radically altered the human geography of northeastern North America. Iroquois expansion, aided and abetted by British fur trade interests, resulted in the annihilation of the Huron nation and the displacement of several other Algonquian groups, including the Ottawa and the Ojibwa, who were driven out of their traditional homelands around Sault Ste. Marie into the western Lake Superior basin. By 1701, Ojibwa bands had established permanent villages around Fond du Lac and Madeline Island and were expanding west and south into the interior, so that by the time of the French and Indian War, Ojibwa hegemony had been extended over much of northern Minnesota and adjacent parts of Wisconsin and Ontario.

Early French attempts at colonizing *Nouvelle France* (Canada) failed but in 1608 a permanent settlement was established on the St. Lawrence River under the leadership of Samuel de Champlain. From his base at Quebec, Champlain undertook to discover a waterway to the *Mer de l'ouest* (Western Sea) through the Great Lakes. While the quest for a Northwest Passage was unsuccessful, by 1634 the French had penetrated as far west as *Lac Superieur* and had acquired detailed knowledge of the territory that came to be known as *les pays d'en haut* (the upper country).

This laid the groundwork for Canada's fur trade empire, the driving force shaping land use patterns in the region for the next two centuries. As early as 1654, freelance fur traders, the famous *coureurs de bois*, were active in northeastern Minnesota and by 1731 trading forts had been established at the Grand Portage of the Pigeon River and at Fond du Lac at the mouth of the St. Louis River. Over the next 125 years, a complex network of fur trading posts, canoe routes, and portage paths evolved, linking the peltry hinterland with Mackinac, Montreal, Albany, and European markets.

France's claim to northeastern Minnesota was upheld until the French and Indian War. In 1763, France ceded its Canadian empire to Great Britain, with the result that the Great Lakes fur trade passed into the control of British merchant adventurers, principally the North West Company of Montreal and the London-based Hudson's Bay Company. In 1783, in boundary settlements at the end of the Revolutionary War, the Superior Highlands became part of the United States, although, despite the abandonment of the North West Company fort at Grand Portage in 1803, British control of the fur trade was not broken until after the War of 1812, when John Jacob Astor's American Fur Company appeared on the scene. The trade in beaver and other high-grade peltry from the Superior Highlands peaked in the 1820s but declined rapidly in the 1850s, although small-scale trade in pelts between trappers and local merchants continued well into the twentieth century.

Two geographic factors controlled the fur trade: the location of prime habitat for fur-bearing animals and access to markets for the furs. The Superior Uplands was a rich source of furs with many natural routes between the interior and Lake Superior, the great avenue of the fur trade. French and Anglo American fur traders operated out of widely spaced posts located at strategic points determined by topography and drainage patterns. Most of the beaver, muskrat, fox, wolverine, and bear peltry was harvested by Native Americans, sold to individual white or mixed blood traders by native middlemen, and then transported to Montreal or Albany in birchbark canoes paddled by French-speaking *voyageurs*. The fur trade had a profound impact on native peoples through acculturation but had important biological consequences as well. Lacking acquired immunities to common Old World diseases, Ojibwe bands were periodically decimated by a broad spectrum of diseases including smallpox, measles, whooping cough, scarlet fever and diphtheria. Large-scale epidemics swept through northeastern Minnesota in 1781–83, 1801, and 1869–70. The fur trade also led directly to the depletion of the region's fur bearing animals, in particular the beaver, which was nearly extirpated in some districts by 1820.

Euro-American Settlers and Settlements

Native American sovereignty over northeastern Minnesota was extinguished by a series of treaties between the United States and tribal leaders, beginning with an 1826 agreement allowing mineral exploration and culminating with the Treaty of La Pointe, signed in September 1854. The Ojibwa still controlled all of their lands in the region when Congress established Minnesota Territory in 1849 and no part of the Superior Highlands was open to white settlement until after the Treaty of La Pointe was ratified in early June 1855. Treaties concluded in 1863, 1864, and 1866 created Ojibwa reservations at Fond du Lac, Nett Lake, and Grand Portage. Nevertheless, large numbers of Ojibwa continued to follow the traditional hunting, fishing, foraging lifeway of their ancestors and contemporary maps, such as those drawn by the government land surveyors, show the region dotted with villages, cemeteries, and portages, as well as seasonal camps for fishing, wild ricing, and maple sugaring.

At the time of the Treaty of La Pointe, the entire Arrowhead region was part of Itasca County, one of Minnesota's nine original counties, from which were created St. Louis County (originally named Superior County), organized in 1855; Lake County, set off from St. Louis in 1856; and Cook County, separated from Lake in 1874 but not organized until 1882. Settlement was slow: the first adventurers, prospectors and lumbermen began to arrive in the 1850s, but it wasn't until the white pine logging and iron ore mining booms in the 1880s that significant numbers of Euro-American immigrants settled in Minnesota's

Arrowhead region. Population growth was nearly static until after 1870, but by 1890 the trickle of immigrants had become a torrent, filling up large areas of what had heretofore been vacant wilderness. Local population increases of 100% or more were not uncommon between 1900 and 1920, although growth generally slowed after 1915. Widespread rural population loss characterized the period between the two world wars, a trend which continued down though the 1950s and 1960s, except in the townships adjoining urban centers.

The basic pattern of rural settlement in the Lake Superior Highlands was derived chiefly from New England and the Old Northwest. In contrast to the prairie and deciduous woodland regions, the dominant settlement pattern in the northeastern part of the state was characterized by dispersed single family homesteads and transient work camps, rather than closely knit agrarian communities. More importantly, those who came to the Superior Highlands were employed primarily as industrial workers engaged in the production and processing of lumber, pulpwood, fish, furs, and minerals. The region held few attractions for farmers because of its dense forest cover and generally poor soils, and it appears that pioneers scarcely grew enough foodstuffs to meet local needs anywhere until the last decade of the nineteenth century. Nevertheless, there was a widespread movement toward developing commercial agriculture in the cut-over pine lands, and the 1925 census of agriculture presents a picture of what might be termed the "golden age" of northeastern Minnesota agriculture. At that time, much of the farmland was in hay or potatoes, with small acreages of wheat, oats, and corn. Livestock raising was an important enterprise, dominated by dairying. However, except in isolated pockets, farming in northeastern Minnesota was most often a part-time occupation because of the brief growing season and generally poor soils. Isolated farmers in remote areas were also at a disadvantage because of high transportation costs. Since World War II, commercial farming has been almost entirely confined to dairying within the Duluth and Iron Range "milksheds" and to specialty crops, such as strawberries.

In general, the Lake Superior Highlands region is not well endowed physically for large-scale urban development because of its relative isolation and rugged topography. Concentrations of people tended to occur at the decisive breaks in the physical landscape, especially where the mode of transportation had to be altered: at safe harbors along Lake Superior, at the mouths of rivers, at rapids and falls, and later along railroads and trunk highways. The first villages were established along the North Shore of Lake Superior during the middle decades of the nineteenth century, but most were little more than outposts on the leading edge of the Great Lakes maritime frontier. Many were in fact nothing more than "paper towns" platted as speculative devices: between 1852 and 1914, literally hundreds of townsites were platted, promoted, occupied and then abandoned in repeated cycles of boom and bust, creating a landscape full of ghost towns. The land sharks' feeding frenzy at the head of Lake Superior during the Territorial period is illustrated by the platting no fewer than four cities between 1852 and 1856, all of which disappeared in the aftermath of the Panic of 1857. Duluth, first settled in 1852 but not incorporated as a city until 1870, was built upon the skeletons of the extinct towns of Clifton, Buchanan, Rice's Point, and Portland; until 1884, it was the only town-like place on the North Shore, excepting the fishing hamlets of Beaver Bay, Grand Marais, and Grand Portage. Successive bursts of town-building produced Aurora, Biwabik, Chisholm, Eveleth, Hibbing, Two Harbors, and Virginia, all of which were founded before the turn of the century. Whether on the North Shore or the Range, the built environment reflected the pattern of architecture and urban design common to company towns and industrial centers in the Northeast and Middle West.

A fundamental yet often neglected aspect of the environment in northeastern Minnesota is the imprint of the township and range system of subdividing land. The rectangular survey was extended into northeastern Minnesota in the 1850s but the subdivision of the public domain into townships was not completed until the 1890s. The survey imposed a grid of six-mile square townships and one-mile square sections, thereby creating a checkerboard of land ownership and use. Although the effect was not so pronounced as in agricultural districts, the functional impact of the rectangular survey is still visible in the form of county and township boundaries, land and timber

sales, local roads, and in place names. From an economic perspective, the government survey in the Superior Uplands was used primarily to facilitate logging and mining rather than settlement. Very little public land was alienated into private ownership before the start of the white pine logging boom in the 1870s and by the 1900s county platbooks are dotted with small private landholdings, villages, post offices, rural schools, and stores. By 1940, however, this trend had been almost everywhere reversed.

The Industrial Landscape: Lumbering and Mining

The transformation of the ecology of northeastern Minnesota was a direct consequence of the industrial revolution. As the region was integrated into the capitalist economy, its natural ecosystem was changed in response to the new world order. Two industries were most important in shaping both the physical and the cultural landscape of the Superior Uplands: lumbering and mining.

Two native forest types merge west of Lake Superior: the eastern pine forest, dominated by white and red pine, white spruce, balsam fir, poplar and birch; and the boreal forest, dominated by spruce, fir and birch, with black spruce, tamarack and white cedar in low-lying areas. Timber was frequently mentioned by early visitors as northeastern Minnesota's greatest natural resource and a sawmill was built near the mouth of the St. Louis River as early as 1855, but until the 1870s the forests of the Superior Uplands remained virtually untouched. Much of the timberland bordering the North Shore was judged to be of inferior quality, so the first large-scale logging operations were conducted in the St. Louis River valley. However, by 1880 the best pine had been cut and loggers began seeking North Shore and Border Lakes sources of old-growth white pine. A great public timberland sale took place at Duluth in 1882, with pine lands in the Superior Uplands auctioned off for between $2.50 and $5 an acre.

The development of the white pine logging industry north of Duluth was nothing short of spectacular. The eastern pine forest attracted the earliest attention of loggers because of the burgeoning demand for soft pine lumber for house framing and siding. The rule was "cut and get out" and operations were carried on at a frenzied pace. Literally overnight, lumber companies moved into the virgin forest and built camps, company towns, houses, hotels, saloons, schools, mills, dams, railroads, docks, and watercraft. But the average lifespan of a northwoods logging camp probably averaged less than five years, that of a company town less than 20. Pine timber production peaked around 1905 and declined rapidly thereafter. In 1909, 4.3 million board feet of logs were floated into Duluth, but by 1920 Cook County had been stripped of most of its pine sawtimber.

After the exhaustion of the most merchantable white pine stands, commercial logging slowly shifted to pulpwood. Rag paper began to fall out of general use after the Civil War and by 1900 wood pulp was being used for boxes and containers as well as paper. The pulp paper industry in the Great Lakes dates from the turn of the century and was the dominant force in northeastern Minnesota logging by World War II, by which time several large pulp and paper mills had been built. Pulpwood loggers went into the Superior Uplands seeking old growth spruce and jack pine as well as the second-growth aspen and balsam growing on cut-over pine lands. Logging practices were rapidly modernized so that by 1950 the old-time lumberjack working with ax, crosscut saw and ox team had faded into history, replaced by mechanically skilled workers equipped with chainsaws, power skidders, bulldozers, and mechanical loaders. Trucks replaced railroads in hauling logs out of the woods and the last logging railroads were abandoned, although water transport, both river driving and lake rafting, continued into the 1960s.

One of the most important human impacts of logging in the northern coniferous forest was fire. As early as 1879, the state geologist observed that ten times as much pine was burnt than cut. (Indeed, most forest ecologists believe that the mixed hardwood and softwood forest that covers much of the Superior Uplands is an "accidental forest" created by fire.) Destructive forest fires were numerous and widespread, causing staggering losses in timber, wildlife habitat, human life and property, while substantially altering forest

composition. Catastrophic wildfires burned out huge areas around Chisholm in 1908, Baudette in 1910, Cloquet in 1918, and in the Superior National Forest during the droughty 1930s. Despite the heroic efforts of pioneer foresters, effective fire control in the region was practically nonexistent until the organization of the Civilian Conservation Corps (CCC) in 1933.

As with industrial lumbering, the search for minerals played an important part in the early exploration of northeastern Minnesota but did not become an important factor in regional economic development until the final decades of the nineteenth century. The purported discovery of gold near Lake Vermillion in 1865 triggered a wave of prospecting throughout the Arrowhead and rumors of precious metals led to the building of roads and the publication of the first detailed maps of the region. The Vermillion iron range was independently discovered by George R. Stuntz and H. H. Eames in 1865, but the first shipment of iron ore from Soudan was not made until 1884. Exploratory diggings along the eastern Mesabi range began in the 1870s and in 1891, the Merrit family was successful in developing the rich hematite deposits of the Mountain Iron mine. By 1940 the Mesabi range was the source of more than half of the iron ore mined in the United States. Taconite, which was discovered in 1892 by state geologist N. H. Winchell, was not mined commercially until 1922, but it eventually replaced hematite as the most important ore mined in the region. Duluth and Two Harbors quickly emerged as the principal terminals for rail and ship transport of ore to Eastern industrial centers. Duluth also developed important iron and steel manufacturing works, with blast furnaces opened in 1916. After World War II, the Reserve and Erie Mining companies constructed the first taconite processing and shipping facilities.

Because of its remoteness and rugged topography, most of northeastern Minnesota was not served by railroads until comparatively late. Regional settlement was profoundly influenced by the completion in 1870 of the Lake Superior & Mississippi Railroad between St. Paul and Duluth, but it was iron mining that provided the chief stimulus to railroad building. In 1884 the Duluth & Iron Range Railroad (forerunner of the Duluth, Mesabi & Iron Range) was founded and by 1890 it had extended its main line from Two Harbors as far as Ely. Several railroad projects existed only on paper, such as the Grand Marais & Northwestern, incorporated in 1913 to build a line from Duluth up the North Shore to the Canadian border. Industrial logging was also dependent upon railroads, and several short-lived narrow gauge logging railways were constructed, including the famous Alger Smith Co. “gunnysack line” that operated in Lake and Cook counties between 1889 and 1917. However, since 1920 most of northeastern Minnesota’s railroad network has been abandoned.

The Postindustrial Landscape: Conservation and Tourism

After the end of the pine logging boom, and before the development of the pulpwood logging industry, most of the region outside the iron ranges was sub-marginal in terms of economic development. As soon as the pine was exhausted, logging camps and sawmills closed, workers moved away, towns declined. The physical character of the northwoods implied several different and distinctive modes of subsistence, where the typical forest-dweller who stayed supported his family through intermittent commercial fishing, small-scale logging, and hunting, in some cases augmented by subsistence farming but most often by temporary work for wages. During the Great Depression of 1929–33, a large segment of the population suffered extreme economic hardship, which was alleviated to some extent by the Federal Relief work projects and antipoverty programs.

Increasing numbers of Arrowhead residents found employment in tourism and outdoor recreation. Sport fishing and hunting were the first recreational attractions along the North Shore and by the turn of the century several entrepreneurs had gone into the business of providing basic amenities to visiting sportsmen. Hotels, resorts and vacation cottages followed. Canoe camping, hiking and nature study were also popular Victorian era pastimes that carried over into the twentieth century. With the advent of the automobile, campgrounds and waysides were developed for public use, as the Superior Uplands garnered

national attention as a premier outdoor recreation destination. By the 1960s many of the outstanding scenic and natural areas in the region had been included in the growing park system, the core of which had been developed as CCC camps or, in the case of the Boundary Waters Canoe Area, as public forest reserves.

Not surprisingly, conflicts over land use between industrial and conservancy interests began in the late nineteenth century and have intensified ever since. A natural resources conservation movement emerged in the 1890s, partly as a reaction against the wasteful exploitation of soil, water and trees. In Minnesota, the idea of forest conservation was promoted most ardently by Gen. C. C. Andrews, who served as the state's fire warden and forestry commissioner from 1895 until 1914. Early efforts by Andrews, Bernard E. Fernow, Gifford Pinchot and others to create national forests were hampered by a lack of legislative interest and the opposition of lumbering and mining interests. Nevertheless, in 1891 Congress gave the president power to establish forest reserves from the public domain and in 1909 President Theodore Roosevelt used this authority to create the Superior National Forest. The first state forests were created under an amendment to the state constitution passed in 1914. Congressional action was carried forward on a groundswell of public interest in conservation: the Weeks Act of 1911 authorized the federal government to purchase privately owned lands to protect watersheds and the Clarke-McNary Act of 1924 broadened the federal program to include purchase of privately owned timberlands. By executive order, President Calvin Coolidge withdrew all of the public domain outside the national forest in northeastern Minnesota from public sale, leading to the establishment of the Chippewa National Forest in 1928 and setting the stage for the acquisition of Voyageurs National Park, established in 1971. Together, these actions effectively reversed the trend toward private ownership of northeastern Minnesota forestlands and within a generation government agencies had become the largest landowners in the northeastern Minnesota. In some parts of the Superior Uplands private landholdings had completely disappeared by the 1930s.

The legislation creating the national forests emphasized the two guiding principles of modern forestry: multiple use and sustained yield. While a few remote uncut areas were placed off-limits to loggers, and a large area of rugged backcountry adjoining the Canadian border (the Boundary Waters Canoe Area) was set aside for recreational use, timber production had priority over other land uses. Timber was customarily sold or leased to loggers in relatively small offerings, and by law a portion of the receipts were passed through to state and local government. Logging methods used in the Superior Uplands, an area dominated by second-growth trees on cut-over lands, emphasized timber stand improvement and regeneration after harvest. Since the 1930s, nursery grown seedlings have been planted to keep the forest well stocked with commercial timber. A system of logging roads, canoe trails, and fire lookout towers was also developed under the supervision of the U.S. Forest Service.

Automobiles changed the face of northeastern Minnesota forever. Natural routes for overland travel exist throughout the Superior Uplands, mostly along watershed divides. Portage paths were observed throughout the region was early explorers and the government surveyors carefully mapped hundreds of canoe routes and trails. Nevertheless, long-distance overland commerce hardly existed in before the mining era. The first public roads for wheeled traffic were built in the 1860s but most were in execrably bad condition and poorly maintained. There were also dogsled routes and ice roads for sledges. The revolution in motorized transport after 1914 triggered a widespread movement for improved highways and bridges that quickly spread to northeastern Minnesota. After World War I, a system of interstate and local roads was developed with federal aid. One of the first large highway projects in the region was the realignment and reconstruction of the North Shore Road, redesignated Highway 1 (present-day Highway 61), in 1924–25. By 1940, all-weather trunk highways linked all of the major cities in the region with Duluth and Grand Rapids.

Changes on the Land: The Last Hundred Years

A century ago, northeastern Minnesota had about 90,000 inhabitants. There was only one real urban area, Duluth, and most people lived in the country or in small company towns. There were thousands of permanent inhabitants in what are now the national forests and over a hundred logging and mining boom towns had not yet become ghost towns. Agriculture was widespread in the cut-over pine lands, although there were few townships with more than a fraction of the land area under cultivation, and wheat was seen as a viable cash crop in the eyes of agricultural extension agents. Although the region had become industrially important as a source of raw materials, a sizable portion of the population still subsisted off nature's bounty by trapping, hunting, foraging, and fishing. Yet while the region exported millions of dollars worth of sawlogs and iron ore, lumber and steel milling were not nearly as important as they became later. In 1890, pulpwood and taconite were unheard of as northern Minnesota products.

As we have seen, Native Americans were the first humans to appear in the Superior Uplands and lived here for thousands of years before Europeans appeared. The Ojibwa, the earliest historic period immigrants, had possession of the region for almost two centuries before the first settlers arrived to stay and the reservation communities remain an integral part of the cultural landscape to this day. The effects of Native American hunting and gathering practices on the ecology of the region have been subtle in both prehistoric and historic times. The European fur trade developed a distinctive cultural landscape, introduced alien pathogens that decimated native populations, and drove several species of fur-bearing animals to near extinction, but the trade's long-term effects on the land were so slight that 150 years later, we are hardly aware of their presence.

From an ecological standpoint, the growth of industrial logging and mining since the late nineteenth century has been a mixed blessing. The history of deforestation and loss of biodiversity, soil and water pollution, urban sprawl and neighborhood decay, and conflicts over industrial versus conservancy land use are among the more unpleasant (but by no means uninteresting) aspects of regional heritage. At the same time, the steamroller of "progress" has by no means obliterated northeastern Minnesota's unique cultural and geographical attributes. However much the past may be obscured, present and future generations will do well by seeking out the imprint of cultural forces in the landscape of the Superior Uplands.

ROBERT C. VOGEL
New Brighton, MN
June, 1998

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Appendix B

—Metadata—
General Information on Data

Appendix B. Metadata - General Information of Data[A]

Data	Date(s)	Source	Size of Data Area	Spatial Resolution	Summary	Pros (+) / Cons (-)
Advanced Very High Radiometer Resolution (AVHRR)[B]	1990 to 1996 biweek	Satellite images	Earth	250 acres	AVHRR Satellites initially used for weather purposes, but found to be useful in regional / global vegetation analysis.	+ High temporal resolution. - Poor spatial resolution.
Breeding Birds[A]	1999	J. C. Green	Minnesota and NE Minnesota	None	Listing of birds in the state and northeast.	+ Complete species list for the state and NE Minnesota. - No abundance list.
Cooperative Stand Assessment (CSA)[B]	1998	Aerial photos and ground surveys	Minnesota, Stand Level, Public Forestlands	1 to 3 acres	Public agencies responsible for forest management use this data as their main inventory source.	+ Detailed forest stand information. - Only land managed by public agencies for forest management represented.
Demographic	1990; 1995	U.S. Census Bureau	U.S., states, counties, cities, census tracts, and block groups	None	Survey of all individuals. Demographic data on population, income, housing, and employment by geographic region (place of residence).	+ Complete universe of individuals. + Fine level of geographic detail. - Updated only every 10 years.
Employment and Earnings	1969 to 1996	Bureau of Economic Analysis	States and counties	None	Employment and income estimates for over 3,100 U.S. counties, 330 metropolitan areas, and 172 BEA economic areas; gross state product estimates for 1997–94 and regional projections to 2045.	+ Detailed employment and earnings data for major industrial sectors at the county, state, and national level. - Since only social security data are used, individual businesses opting out of the social security system are not included. - Data disclosure laws prevent data from being released that would make it possible to identify a specific business within a geographic area.
Forest Inventory and Analysis (FIA)[A, B, C]	1977; 1990	Aerial photos and ground surveys	Minnesota, Plot Level	1,225 acres represented per plot	A federally funded inventory of the state's forest resources: their type, extent, growth, mortality, and removals.	+ Detailed forest stand information. + Represents public and private lands. - Poor spatial resolution.

Data	Date(s)	Source	Size of Data Area	Spatial Resolution	Summary	Pros (+) / Cons (-)
GAP Stewardship[B]	1995	Land records	Minnesota	40 acres	Provides ownership and administration information for each Public Land Survey (PLS) quarter-quarter section.	+ Provides ownership information for the entire state. - Source data is mostly from 1983–85. - Poor spatial resolution.
Land Use[B]	1969	Air photos	Minnesota	40 acres	Shows land use in Minnesota broken into several different categories.	+ Historical representation. - Poor spatial resolution.
Land Use[B]	1990	Aerial photos and satellite images	Minnesota	¼ acre	Shows land use in Minnesota broken into several different categories.	+ High spatial resolution. - Different classifications used than in the 1969 land use data.
Mammals, Amphibians, Reptiles	1995	J. R. Tester and J. C. Green	Minnesota and NE Minnesota	None	Listing of mammals, amphibians, and reptiles in the state and northeast.	+ Complete species list for the state and NE Minnesota. - No abundance data.
Marschner Presettlement Vegetation[B]	1930	1847–1908 PLS	Minnesota	100s acres	Maps out basic boundaries of forest stands using data from the PLS.	+ Historical representation. + Good generalization. - Very poor spatial resolution. - General cover type classes.
Minnesota Legislative Reports (State Lands)	1950–1970	DNR reports	Minnesota	None	Gives information on statutory acreages in different state land areas (parks and forests).	+ Good historical information. - Is based on statutory boundaries.
MN DNR Trails	1984–1996	DNR reports	Minnesota	None	Yearly summaries from 1984 to 1996 on the trail mileages in Minnesota, including both private and public trails.	+ High temporal resolution. + Distinctive trail classes. - Only DNR trail mileages frequently updated. - Overlap in trail mileage counts for multi-use trails.
National Resources Inventory[B]	1982, 1987, 1992	Aerial photos and ground surveys	U.S. non-federal lands	1,875 acres represented per plot	A statistically based sample of land use and natural resources' conditions and trends on U.S. nonfederal land.	+ Includes private land. - Does not include federal lands. - Main focus is on agricultural land.
Public Land Survey Bearing Tree Data[B]	1847–1908	Ground surveys	Minnesota	Quarter section	A field survey conducted in the late 1800s and early 1900s to ascertain and dispose of lands in the Western Territory.	+ Represents Minnesota before major European settlement and harvesting. - Survey was completed over a long period of time.

Data	Date(s)	Source	Size of Data Area	Spatial Resolution	Summary	Pros (+) / Cons (-)
Silvicultural Practices	1996	MFRC	Minnesota	None	Type and event of silviculture and harvesting practices in the state.	+ Shows trends for 1991–96. - No spatial breakdown. - Does not account for practices on non-industrial private forest (NIPF) lands.
Vascular Plants[A]	1991	Herbarium collections	Minnesota FRC Landscapes	None	Original locations of specimens in the University of Minnesota herbarium.	+ Complete species list for the state and the FRC landscapes. - Not a systematic inventory.
Vegetation (Landsat)[B]	1997	Satellite images	NE Minnesota	¼ acre	A Landsat satellite images classified into vegetation types.	+ Detailed cover type classes. + High spatial resolution. - Only done for the NE Minnesota image. - Only has information on cover type.

[A]The Reference Section lists many good additional resources. Also, libraries and numerous Internet sites contain additional information on the data.

[B]Detailed metadata can be found at the Interagency Information Cooperative's web site at **www.iic.state.mn.us**.

[C]The following Internet site contains information on the FIA program: **srsfia.usfs.msstate.edu/tables.htm**.

Appendix C

A Process for Conducting Landscape Assessments

A Process for Conducting Landscape Assessments

Minnesota Forest Resources Council Landscape Coordination Program

Background

In November 1997 the Minnesota Forest Resources Council (MFRC) approved a policy statement on the process for establishing regional committees. Concurrent with the establishment of a pilot committee, a team of technical information specialists from a variety of agencies and industry were organized to compile existing landscape information and to outline an assessment process. This brief describes a process for conducting landscape assessments that has been accepted in both the Northeast and North Central Landscape Regions.

The purpose of a landscape assessment is to quantify existing ecological complexity, understand socioeconomic conditions and trends, and to identify historical conditions across entire landscapes in order to provide a scientifically-based decision making process that can be used in a multi-landowner, collaborative planning environment. Without defining such a process MFRC is subjecting itself to committees that will potentially operate on perceptions rather than science.

Process

Landscape assessments should be unique to each regional landscape as defined by MFRC and should consider ecological, historical, and socioeconomic processes (Figure 1). A useful process should identify a means of assessing existing ecological conditions in terms of both current vegetation composition and structure (i.e., seral conditions) and land potential (e.g., habitat types). Following identification of existing conditions, the historical conditions of the landscape should be assessed in comparable terms to the existing conditions. Through analysis of the historical landscape, thresholds of ecological conditions, minimum requirements necessary to sustain viable populations of all native flora/fauna, must be determined. Appropriate thresholds may be defined as maintenance of a percentage of historical conditions. Concurrent with an ecological assessment of the landscape should be comparable assessments focused on bringing together the social and economic states of the landscape. "Historical" analysis of social and economic data should be in the form of long-term trend analyses. This process will ultimately lead to issue identification based on fact, not perception. Social, economic, and ecological objectives can then be formulated into desired future conditions through partnership efforts similar in structure to MFRC's regional committees. Monitoring in an adaptive management format should then be used to implement and adjust management practices to address issues or attain desired future conditions.

Ecological and Historical Components

In any landscape assessment, the ecological conditions become the cornerstone of analysis for two reasons. First, it is the physical environment that is ultimately impacted with any land management strategy whether it be active (e.g., fertilization) or passive (e.g., fire suppression). Although socioeconomic values may provide a reason to manage, it is the physical act of management that impacts the natural resource base. Second, the ecological considerations are often complex and available data are poor. Lack of data and complexity often times cause concern with many audiences.

There are two primary classification systems that must be married during the assessment process, existing vegetation structure and land potential (Figure 2). Existing vegetation structure describes the composition and structure (e.g., overstory density and size class, shade-tolerance) of forest communities and provides a measure of succession. Forest communities and their structure change over time (i.e., temporal variation). Land potential describes what a forest community has the potential to look like (i.e., succeed to). Because forest communities change over time, it is important to have some means of determining how they will change. Every forest community has processes and functions that existed historically. Land potential is a classification system that describes forest communities in these terms, usually through inspection of understory species composition and soils. When both of these classification systems (i.e., vegetation structure and land potential) are combined, the unit described is an ecological type (Figure 3). Ecological types therefore are unique with respect to existing vegetation and the ability of that vegetation or community to succeed.

An ecosystem diversity matrix (EDM) (Haufler et al. 1994) can be used to represent ecological types across entire landscapes and thus serve as the backbone of a landscape assessment (Haufler et al. 1998). An EDM combines vegetation structure (Y-axis) and land potential (X-axis) into a two-dimensional matrix of ecological types (Figure 4). By filling in each cell (i.e., ecological type) of the matrix with the amount of land across the landscape of that type, the EDM can become a very powerful tool. The EDM can be used to quantify landscape complexity, establish partnerships, and compare existing conditions to historical conditions. Landscape complexity can be described quantitatively by comparing gross acreage in various ecological types or it can be described spatially by distributing the ecological type acreage on a map. Partnerships can be built in order to have each participant classify their own lands using the matrix and then fill in appropriate cells. Finally, if existing and historical conditions are described using the EDM, direct comparison of ecological types can be made between those two time frames.

It is generally agreed upon by ecologists that in order to maintain ecosystem integrity and biological diversity, some reference should be made to historical conditions that biodiversity evolved with. It is also agreed that a range of historical conditions is more important and revealing than is a "snapshot" of historic conditions. The representative range should be between 200 and 400 years ago. By understanding the historical range of variability (HRV), discussions can be held to determine what percent of HRV is needed today in order to maintain viable populations of all native species. This important question, *"how much of each ecological type is enough?"* is difficult yet necessary to answer in order to successfully assess landscapes. Once an understanding of ecological thresholds has been established, a process of issue identification can be used to identify actual issues that may exist across the landscape (Figure 1).

Social and Economic Components

As aforementioned, social and economic conditions and trends are important components to landscape assessments. An important part of the issue identification process is to carefully consider economic and social objectives. Economic considerations include the needs of natural resource-based economics and employment opportunities. Social considerations include diverse demands for natural resource-based recreation and aesthetics, cultural and archeological values, and other concerns unique to the landscape. Critical to the assessment process is development of a link between social and economic criteria and ecological objectives or thresholds. Such a linkage would allow for assessment of social and economic change due to land management. By filtering social and economic needs/values through a comprehensive evaluation of ecological thresholds, tradeoffs can be made between objectives and desired future conditions set (Figure 5).

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Haufler, J. B., C. M. Mehl, and G. J. Roloff. 1998. Conserving biological diversity using a coarse-filter approach with a species assessment. Pages 107–125 in R. K. Baydack, H. Campa III, and J. B. Haufler, eds. Practical approaches to the conservation of biological diversity. Island Press, Washington D.C. 313 pp.

Figure 1. Landscape assessment process.

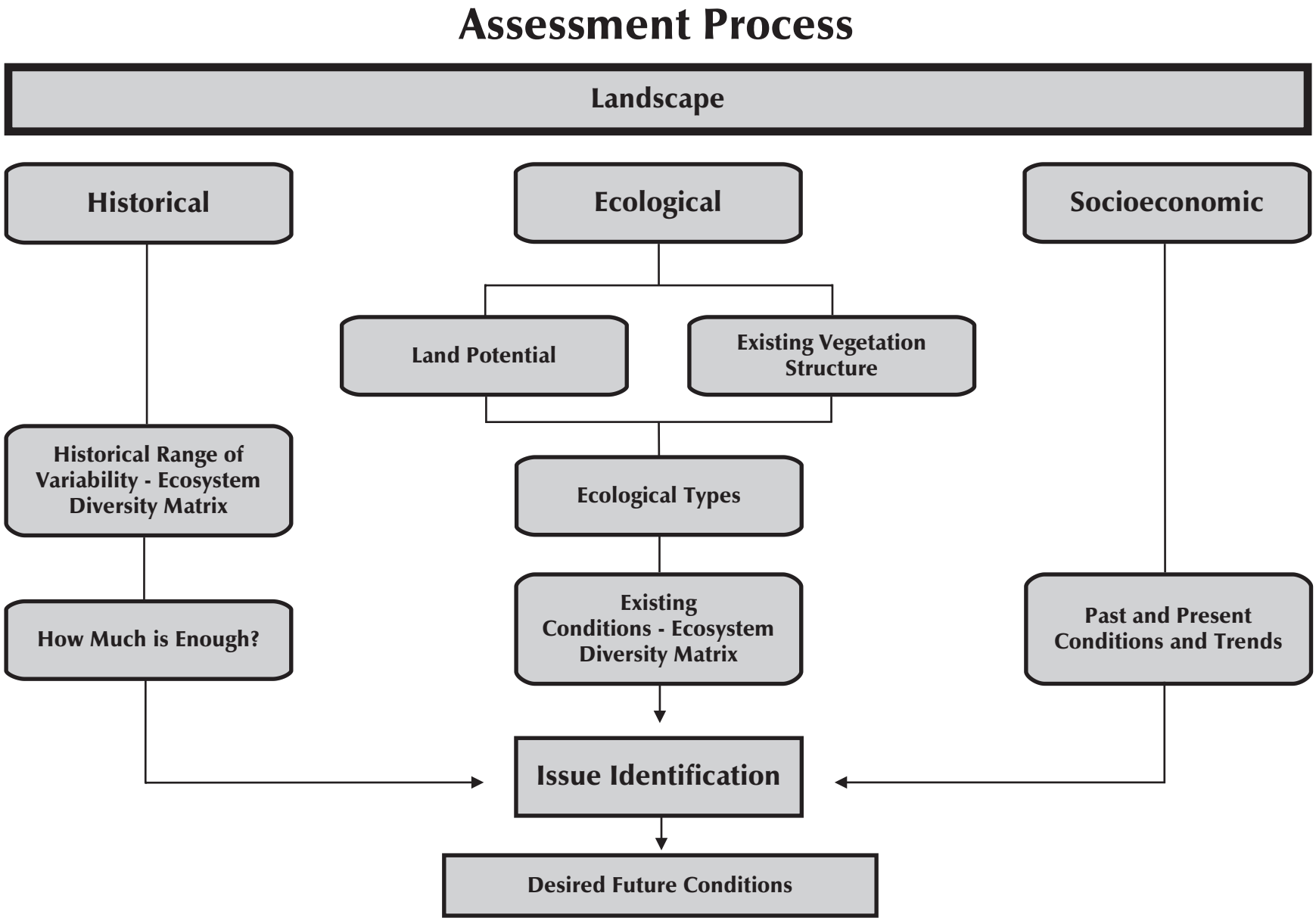
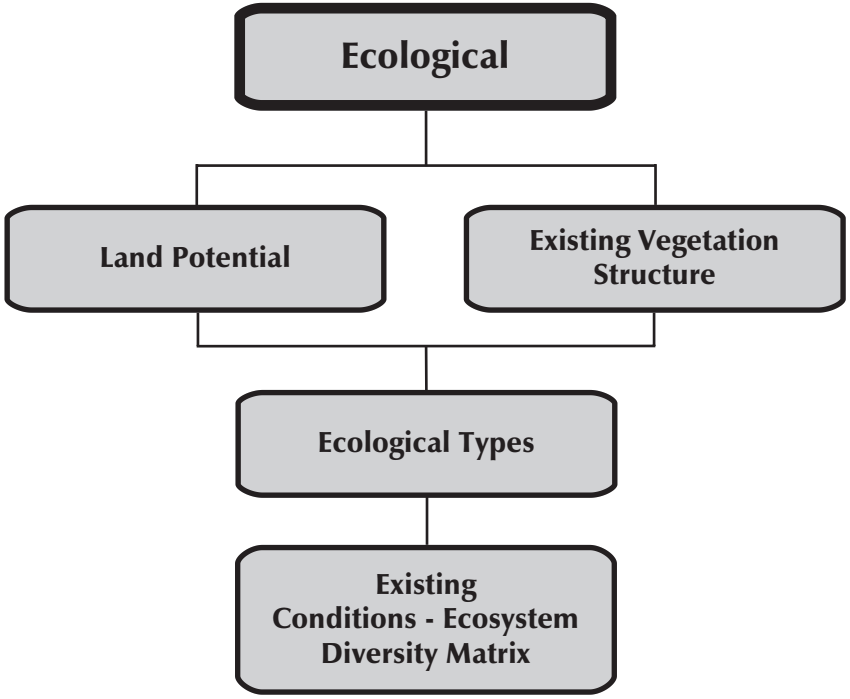


Figure 2. Ecological components of a landscape assessment.

Ecological Considerations



Vegetation Structure

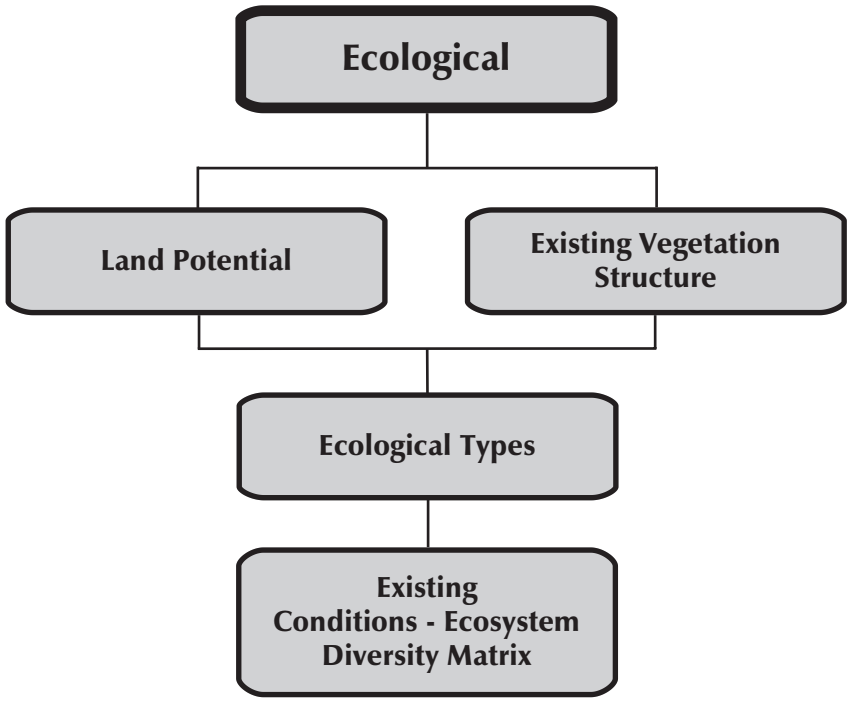
- Existing stage in succession
- *"What the forest looks like today"*
- Often defined by:
  - Size class, shade-tolerance, and density

Land Potential

- Capability of forest communities to succeed
- *"What the forest has the potential to look like"*
- Often defined by:
  - Understory plants and soils

Figure 3. Ecological types as defined by vegetation structure and land potential.

Ecological Considerations



Ecological Type

- For a site:
  the combination of:
  - land potential, and
  - existing vegetation structure
- Effectively becomes a management unit

Figure 4. An example ecosystem diversity matrix.

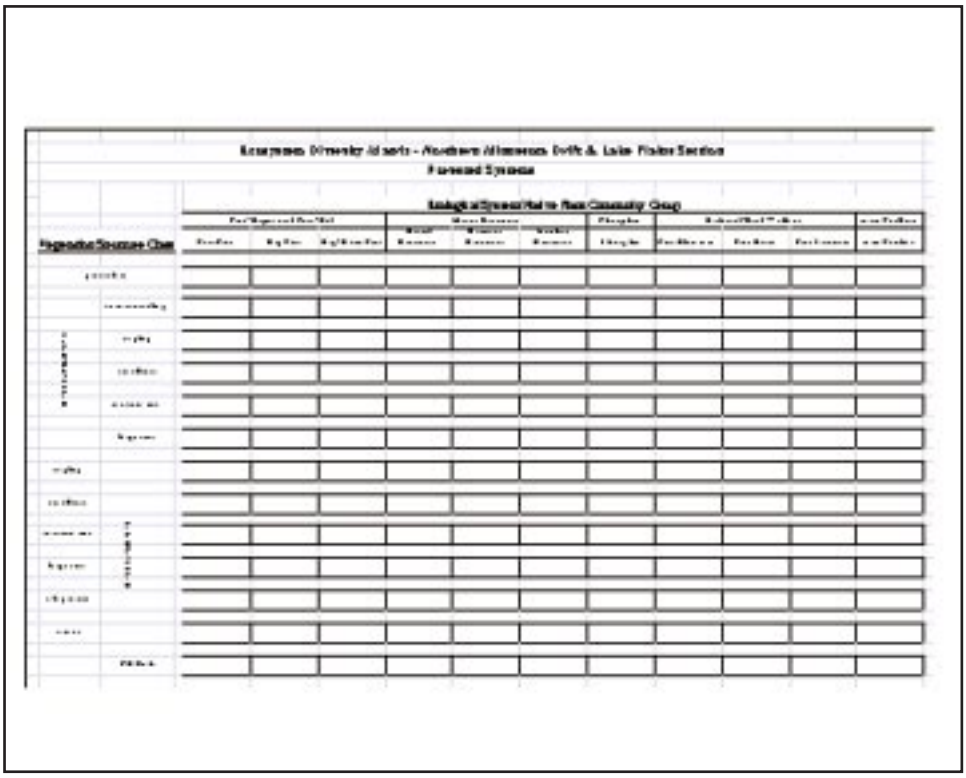
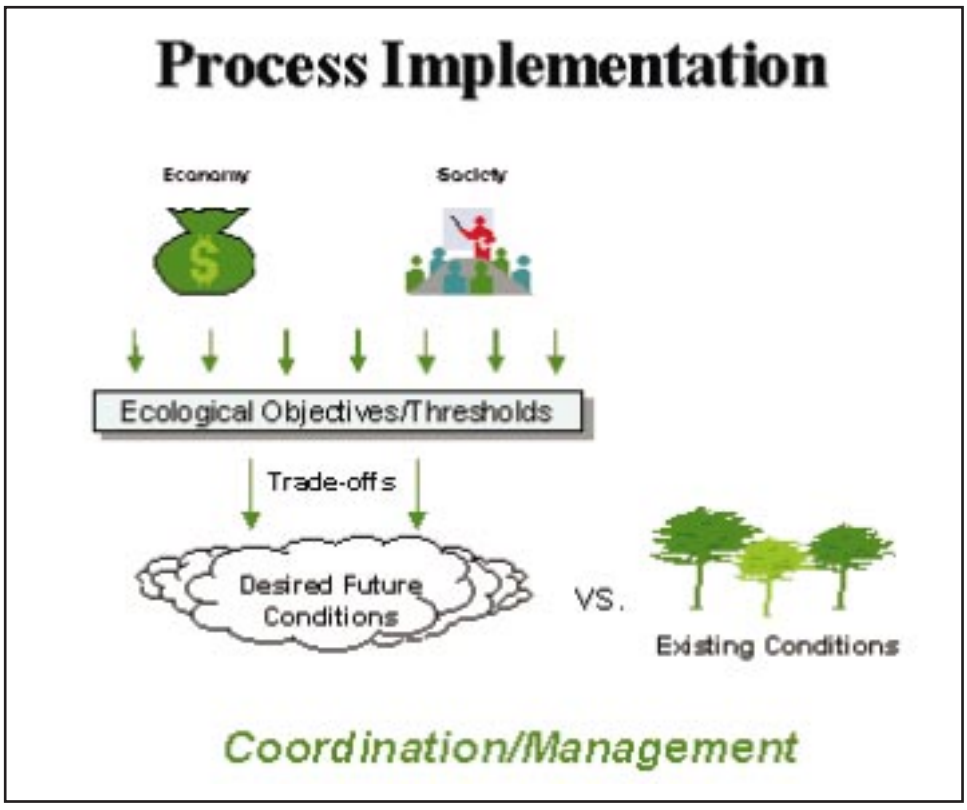


Figure 5. Schematic of landscape assessment implementation.



Appendix D

Water Quality Data

Appendix D

Contents:

- **Summary of stream assessment methodology**
- **Summary of stream water quality criteria and key for stream tables**
- **Table of Lake Superior Basin stream water quality data, 1996**
- **Table of Rainy River Basin stream water quality data, 1994**

A Summary of lake assessment process and methods may be viewed at:

http://www.pca.state.mn.us/water/basins/305blake.html

Minnesota Pollution Control Agency
Stream Assessments

The Minnesota Pollution Control Agency prepares lake and stream assessments for Congress under Section 305(b) of the Clean Water Act, to understand the extent to which Minnesota waterbodies meet the goals of the Clean Water Act and attain state water quality standards; and to share the information with planners, citizens, and other partners in basin planning and watershed management activities. These assessments area fundamental part of our state water quality management program.

Two major goals of the Clean Water Act, "Fishable and Swimmable" waters are assessed here in terms of Aquatic Life Use Support and Swimming - Recreation Use Support.

Rivers and Streams
Use Support
Assessment Methodology

How do we measure "Water Quality"? One way is to look at standards or expectations.

Water quality standards consist of two parts: beneficial uses for a waterbody and water quality criteria to protect and support those uses.

Beneficial uses are the desirable uses that water quality should support, legally defined in Minnesota Rules, Chapter 7050, to include domestic consumption, aquatic life, recreation (swimming), agriculture and wildlife, industrial consumption, and aesthetics. The level of *use support* describes the quality of the waterbody with respect to its designated uses. A *use impairment* occurs when a waterbody cannot support its designated uses fully. Existing and threatened use impairments are considered water quality problems and may require corrective or preventive action.

Numeric water quality criteria establish the minimum chemical and physical parameters required to support a beneficial use. Physical and chemical numeric criteria may set maximum concentrations of pollutants, acceptable ranges of physical parameters, and minimum concentrations of parameters such as dissolved oxygen.

What is it, exactly, that we are assessing?

Waterbody Delineation

Assessments of use support in Minnesota are made on individual waterbodies. The waterbody unit used for river system assessments is the river reach. Minnesota uses the USEPA Reach File 1 (RF1) river reach numbering system, augmenting it to include reaches not in RF1. A river reach is typically less than 20 miles in length and extends from one tributary river to another. RF1 reaches may be divided further when there is a change in the use classification (as defined in Minn. R. Ch. 7050) within a reach or when there is a significant morphological feature within the reach, such as a dam. Each waterbody is identified by a unique code (WBID), comprised of the USGS 8-digit Hydrologic Unit Code, plus the 3-digit RF1or MPCA segment number. It is for these specific reaches that the data are evaluated, as described below.

Aquatic Life Use Support

Assessments of aquatic life use support are conducted to determine if the waters are of a quality to support the aquatic life that would be found in the stream under the most natural conditions. Three types of data are used in the assessments: water chemistry data, biological and habitat information, and a survey of local resource managers.

The following guidelines are used to evaluate each of the data sources for a reach, and to combine them when more than one type of information is available.

Water Chemistry Data

To evaluate chemical and physical parameters of water quality, the Minnesota Pollution Control Agency (MPCA) uses data and sampling site

information that are stored in the US Environmental Protection Agency STORET data system by the MPCA and others. Ten years of data are used where available, based on water year, believing that the time period is sufficient in most cases to pick up impairments under a variety of climatic and flow conditions.

Samples are evaluated against water quality standards set forth in Minnesota Rules Ch. 7050, as minimum requirements needed to support aquatic life. Determinations of use support are based on the "frequency of exceedance" of the chronic standards applicable for a given water class.

Conventional parameters include dissolved oxygen (DO), pH, and turbidity. At least 10 samples from a reach are needed during a 10-year time frame for a parameter to be evaluated. For each parameter evaluated, levels of support are then defined as:

- **Fully Supporting** - Fewer than 10% of samples exceed the standard
- **Partially Supporting** - 10% to 25% of the samples exceed the standard
- **Not Supporting** - More than 25% of samples exceed the standard.

Toxics include unionized ammonia, chloride, arsenic, cadmium, chromium, copper, lead, nickel, selenium, and zinc. At least five samples are needed for a given toxicant to be evaluated. For each toxicant evaluated, levels of support are then defined, according to EPA guidance, as:

- **Fully Supporting** - Not more than 2.8% of samples exceed the standard (not more than one violation in threes years of monthly sampling)
- **Not Supporting** - More than 2.8% of observations exceed the standard.

Nonpoint Source Indicators

Total phosphorous (TP), nitrate/nitrite, total suspended solids (TSS), and biochemical oxygen demand (BOD) are evaluated as indicators of nonpoint sources of pollution. In contrast to the support parameters described above, Minnesota has not established legal standards for the indicators. However, the MPCA has developed ecoregion expectations for them from data collected at a small set of least impacted sites. At least 10 observations are needed for an indicator to be evaluated, and a reach is considered to be "threatened" if more than 10% of the observations of an indicator exceed the ecoregion expectation.

Preliminary assessment based on physical/chemical parameters of water quality:

For each reach, the evaluations described above are combined into a preliminary assessment of the waterbody's ability to support aquatic life. The level of support is assumed to be no greater than the support provided by the weakest of the elements measured. Therefore, the preliminary assessments are defined as follows:

- **Not Supporting** - At least one of the conventional or toxics parameters indicates nonsupport
- **Partially Supporting** - The worst parameter indicates partial support
- **Supporting but Threatened** - Conventional and toxics show full support, but threat indicated by nonpoint sources of pollution
- **Fully Supporting** - all measures show full support.

Biological/Habitat Data

The MPCA conducted fish community assessments for rivers and streams in the St. Croix, Red River, and Minnesota River basins. The Index of Biotic Integrity (IBI) and a regional reference site approach were used to evaluate fish communities and develop biological criteria. Field investigations and IBI metric development were conducted in cooperation with numerous federal and state agencies.

The typical time frame or index period for sampling fish communities was during normal to low flows in the summer (mid-June through September) and fall. A collection was only used to assess that portion of the reach that has similar physical/chemical characteristics.

The IBI is a composite index, evaluating 10–12 characteristics of a fish community, with a total possible score of 12 to 60 points. IBI classes were determined in relation to the best sites in the basin or ecoregion. "Fair" (30) was considered to be the lowest acceptable condition in terms of meeting an

aquatic life or biological criteria. Therefore the use support levels were defined as:

- **Fully Supporting** - IBI score 30 or above
- **Not Supporting** - IBI score below 30
- **Partially Supporting** - IBI scores disparate between two portions of a larger reach.

Nonpoint Source Survey (NPSS) of Local Resource Managers

The Minnesota Pollution control Agency has conducted surveys of local resource managers to obtain the judgment of these professionals as to the quality of lakes and streams in their area. The respondents were asked in general terms to identify local resources that were threatened or impaired by nonpoint sources of pollution. For the purpose of the survey, "Impaired" waterbodies showed definite signs of degradation, while "Threatened" waterbodies do no show signs of degradation, but watershed conditions are likely to cause problems that will impair the waterbody in the future. The local managers were also asked to identify the cause of the impact (low dissolved oxygen, habitat, toxics, etc.) and its probable sources (erosion, animal wastes, etc.).

How the survey was applied to the 305(b) assessments:

- **Supporting but Threatened** - One or more respondents (a majority) indicated that the waterbody was "Threatened by nonpoint sources of pollution.
- **Not Supporting** - A majority of respondents said that the waterbody was "Impaired" by nonpoint sources of pollution
- **Partially Supporting** - An equal number of responses for Threatened vs. Impaired.

Aquatic Life Use Support

How We Combine The Information Sources

Some waterbodies had more than one category of data available for assessing use support. When this occurred, the judgment was based on the strongest information possible, according to the following simple hierarchy:

Biology was considered to be the strongest indicator of a waterbody's ability to support aquatic life, therefore, IBI evaluations took precedence over any other preliminary assessments for a reach.

In the absence of biological measures, support levels were based on physical and chemical parameters of water quality, where available, with one exception: Where local resource managers believe that a reach is impaired due to habitat degradation, the reach was judged to be "Not Supporting" of aquatic life, even if the chemistry data indicate "Full Support." The rationale for this decision is that, although monitoring is generally considered more reliable than survey information, routine water column sampling may miss problems that are nonchemical in nature.

Swimming Use Support

Assessments for swimming use support are conducted to determine if the waters are of a quality to support primary body contact. Swimmable use was determined based on two types of information: 1) instream monitoring of fecal coliform bacteria; and 2) a survey of local resource managers.

Instream Monitoring

In Minnesota, water quality standards for primary body contact apply from March 1 to October 31. The MPCA uses data collected according to USEPA guidelines for fecal coliform monitoring using the membrane filter technique.

Ten years of data are used, where available, based on water year. At least 10 samples are needed for the data to be evaluated. To approximate the requirements of the fecal coliform standard as written in Minnesota rules, at least five observations for a month (all years combined) are needed to determine a geometric mean for that month. All data and site information are stored in the USEPA's STORET data system. Use support categories are defined as follows:

- **Fully Supporting** - The geometric mean for each month (all years combined) did not exceed 200 orgs/100ml, *and* fewer than 10% of all observations for the 10-year period exceeded 2,000 orgs/100ml.
- **Partially Supporting** - The geometric mean for one or two months (all years combined) exceeded 200 orgs/100ml, *or* 10–25% of all observations for the 10-year period exceeded 2,000 orgs/100ml.
- **Not Supporting** - the geometric mean for three or more months (all years combined) exceeded 200 orgs/100ml, *or* more than 25% of all observations for the 10-year period exceeded 2,000 orgs/100ml.

Survey of Local Resource Managers

As part of a survey conducted of local resource managers in 1991, the question was posed whether the waters in their area were considered to be poor or good for swimming. If the respondents to the survey answered that the actual swimming use of a river reach was poor, the reach was considered not supporting of swimming. If the reach was considered good for swimming, then the reach was considered to fully support swimming use. Where there was more than one respondent and a difference of opinion regarding this condition, then the majority opinion and the number of respondents was equal.

Swimming Use Support
How We Combine
The Information Sources

If a reach had both monitoring information and survey results, it was the monitoring data that determined the use support for swimming.

Minnesota Pollution Control Agency

Water Quality Criteria - Aquatic Life Use Support in Rivers and Streams

Index of Biotic Integrity (IBI)	
Aquatic Life Use Support	Criteria (evaluated against regional expectations).
Fully Supporting (S)	The biological community is in fair or better condition, not significantly altered from what would be expected for the region under natural conditions. IBI score of 30 or above.
Not Supporting (NS)	Indications of a poor or very poor biological community, severely modified from what would be expected under natural conditions. IBI score less than 30.
Partially Supporting (PS)	Disparate levels of support between different portions of a larger reach.
Nonpoint Source Survey of Local Resource Managers (NPSS)	
Aquatic Life Use Support	Criteria (evaluative).
Threatened (t)	One or more respondents to the survey (majority) indicated that the waterbody was threatened by nonpoint sources of pollution.
Not Supporting (ns)	One or more respondents to the survey (majority) indicated that the waterbody was impaired by nonpoint sources of pollution.
Partially Supporting (ps)	Equal number of surveys identify the waterbody as Threatened vs. Impaired.
Determination of Use Support, Based on Hierarchy of Data Sources	
Aquatic Life Use Support	Criteria for each waterbody (river reach).
Full Support	IBI shows support for aquatic life. If no IBI, physical/chemical parameters are fully supporting (FS).
Supporting but Threatened	IBI shows support for aquatic life, but reach is considered by professional judgment to be threatened (ST). No IBI. Physical/chemical parameters are fully supporting, but threat indicated by NPS indicators or by the survey of local resource managers (ST).
Threatened	Threat indicated by limited monitoring of NPS indicators only (T). No monitoring; reach identified as threatened on the NPSS of resource managers (t).
Partially Supporting	Partial support based on mixed IBI findings (PS). Partial support based on physical/chemical parameters (PS). Partial support based on the survey of local resource managers only (ps).
Not Supporting	IBI shows nonsupport (NS). If no IBI, physical/chemical parameters show nonsupport (NS). No IBI. Physical/chemical parameters show support, but survey of local resource managers indicates nonsupport due to habitat problems (NS). No monitoring; reach identified as impaired on the NPSS of resource managers (ns)

Lake Superior Basin - Assessment of Stream Water Quality

(Based on the 1998 MN 305(b) Report to Congress of the United States

HUC-Segment		River Reach	Location	Uses			Indicators of Impairment													Suspected Pollution Sources											
				Reach Length (Miles)	Aquatic Life	Swimming	Biology	Oxygen Depletion	Turbidity	Un-Ionized Ammonia	Metals	Chloride	Habitat Alteration	Sedimentation	Bacteria	Total Phosphorus	Nitrite/Nitrate	Oxygen Demand (BOD)	Suspended Solids	Municipal	Industrial	Nonpoint	Agriculture	Forestry	Construction	Urban Runoff	Resource Extraction	Land Disposal	Hydro Modification	Atmospheric Mercury	
Lake Superior (MN North)																														
04010101-012		Pigeon R		23.3	FS					FS																				
04010101-014		Flute Reed Cr		12.9	t				t					t	t									F				L		
04010101-015	*	Brule R	Greenwood R to Lake Superior	11.4	ST	FS			PS						FS		T					Y							L		*
04010101-109		Kadunce Cr		8.5	T												T													
04010101-021		Kimball Cr		7.8	t																								L		
04010101-022		Devil Track R	Devil Track Lk to Lake Superior	7.6	t	fs		t							fs										C					
04010101-027		Cascade R		16.5	ST	FS								t	FS		T					Y		F						
04010101-037		Poplar R	Source to Rice Lk	22.3	ST				ns				ns	ns										F	C					
04010101-034		Poplar R	(Rice Lk)	1.2	ST				ns				ns	ns										F	C					
04010101-033		Poplar R	Rice Lk to Mistletoe Cr	10.1	ST	FS			PS				ns	ns	FS									F	C					
04010101-030	*	Poplar R	Mistletoe Cr to Lake Superior	7.4	ST	FS			PS				ns	ns	FS		T					Y		F	C					*
04010101-043		Temperance R	Source to Plouff Cr	9.1	t	fs								t	fs									F						
04010101-039		Temperance R	Plouff Cr to Lake Superior	17.7	t	fs								t	fs									F				L		
04010101-051		Baptism R. E BR	Source to Baptism R. W BR	11.8		ns									ns							Y						L		
04010101-052		Baptism R. W BR	Source to Baptism R. E BR	12.3	FS	FS									FS															
04010101-050		Baptism R	Baptism R.W BR. to Lake Superior	7.7	ST	FS			FS						FS		T					Y								
Lake Superior (MN South)																														
04010102-009	*	Beaver R		20.0	NS	FS		ok	NS	ok	NS	ok			FS	T	T		T			Y								*
04010102-110		Skunk Cr	(Tributary to Gooseberry R)	2.3	PS	NA			PS						NA			T				Y								
04010102-010		Gooseberry R		7.1	ST	FS									FS		T		T			Y								
04010102-406		Crow Cr		3.7	NS				NS		NS											Y								
04010102-306		Encampment R		1.4	PS	FS			PS						FS							Y								
04010102-206		Silver Cr		0.3	PS	FS			PS						FS							Y								
04010102-106		Pete's Cr		0.9	NS					ok	NS	ok										Y								

Full Support (FS, S); Supporting but Threatened (ST, T); Partial Support (PS); Not Supporting (NS); Not Attainable (NT). Lower case denotes assessment based on 1992 survey of local resource managers. *USEPA 303(d) listed waterbody. p. 1

HUC-Segment		River Reach	Location	Uses			Indicators of Impairment												Suspected Pollution Sources										
				Reach Length (Miles)	Aquatic Life	Swimming	Biology	Oxygen Depletion	Turbidity	Un-Ionized Ammonia	Metals	Chloride	Habitat Alteration	Sedimentation	Bacteria	Total Phosphorus	Nitrite/Nitrate	Oxygen Demand (BOD)	Suspended Solids	Municipal	Industrial	Nonpoint	Agriculture	Forestry	Construction	Urban Runoff	Resource Extraction	Land Disposal	Hydro Modification	Atmospheric Mercury
04010102-011		Stewart R		14.3	ST	FS									FS														
04010102-012	*	Knife R		13.3	NS	FS			NS		NS		t		FS		T		T			Y		F				H	*
04010102-104		Little Sucker R		0.7	PS	FS			PS						FS							Y							
04010102-013		Sucker R		16.8	ST	FS									FS		T					Y							
04010102-203		Schmidt Cr	Above trout stream portion	0.3	PS	NA			PS						NA							Y							
04010102-103		Schmidt Cr	Trout stream portion (mouth)	0.7	PS	NA			PS						NA							Y							
04010102-014		French R		8.0	ST	FS									FS	T	T	T				Y							
04010102-102	*	Talmadge R		3.2	PS	NA		PS							NA							Y							
04010102-015	*	Lester R		16.7	PS	FS			PS				t		FS	T	T					Y				U			*
04010102-115		Amity Cr	(Tributary to Lester R)	3.1	FS	NA									NA														
St Louis River																													
04010201-033		St Louis R	Source to Partridge R	27.8	ns				ns													Y						L	H	
04010201-032		St Louis R	Partridge R to Embarrass R	16.9	ns				ns													Y		F				L	H	
04010201-031		St Louis R	Embarrass R to Two R	15.7	ST	FS			ns						FS	T	T		T			Y		F				L	H	
04010201-631		Elbow Cr	Class 7 waters	1.8	NT																									
04010201-531		Elbow Cr	From Class 7 to Elbow Lk	3.6	T									t		T	T													
04010201-637		Manganika Cr	Class 7 waters	1.5	NT																									
04010201-030		St Louis R	Two R to Swan R	17.1	NS	fs			ns						fs							Y		F				L	H	
04010201-240		Barber Cr (E Swan R)	Class 7 waters	2.7	NT				ns											M								L		
04010201-140		Barber Cr (E Swan R)	From Class 7 to W Swan R	14.5	ns				ns											M		Y						L		
04010201-039		Swan R	W Swan R to St Louis R	3.9	t				t				t		t													L		
04010201-029		St Louis R	Swan R to Whiteface R	18.9	ns	fs			ns						fs							Y		F				L	H	
04010201-120		Trib to Whiteface R	Class 7 waters	1.0	NT																									
04010201-020		Whiteface R	Paleface R to St Louis R	28.6	NS	NA					NS				NA	T	T		T			Y								
04010201-019		St Louis R	Whiteface R to Floodwood R	5.9	ST	FS			ns						FS									F				L	H	
04010201-042		Floodwood R		12.8	ns	fs		ns	ns				ns	ns	fs							Y	A						H	
04010201-018		St Louis R	Floodwood R to E Savanna R	1.8	ST	FS			ns						FS									F				L	H	
04010201-017		St Louis R	E Savanna R to Stoney BK	19.2	NS	FS			ns		NS				FS	T		T	T			Y		F				L	H	

Full Support (FS, S); Supporting but Threatened (ST, T); Partial Support (PS); Not Supporting (NS); Not Attainable (NT). Lower case denotes assessment based on 1992 survey of local resource managers. *USEPA 303(d) listed waterbody. p. 2

HUC-Segment		River Reach	Location	Uses			Indicators of Impairment													Suspected Pollution Sources										
				Reach Length (Miles)	Aquatic Life	Swimming	Biology	Oxygen Depletion	Turbidity	Un-Ionized Ammonia	Metals	Chloride	Habitat Alteration	Sedimentation	Bacteria	Total Phosphorus	Nitrite/Nitrate	Oxygen Demand (BOD)	Suspended Solids	Municipal	Industrial	Nonpoint	Agriculture	Forestry	Construction	Urban Runoff	Resource Extraction	Land Disposal	Hydro Modification	Atmospheric Mercury
04010201-016		St Louis R	Stoney BK to Artichoke R	0.2	ST	FS			ns						FS								F					H	
04010201-014		St Louis R	Artichoke R to Cloquet R	1.5	ST	FS			ns						FS								F					H	
04010201-013	*	St Louis R	Cloquet R to Pine R	9.5	ST	FS			ns						FS	T	T	T	T			Y		F				L	H	*
04010201-511		St Louis R	Pine R to Knife Dam	6.2	NS	FS					NS				FS	T		T	T			Y								
04010201-411		St Louis R	Knife Dam to Potlatch Dam	1.1	ns	fs									fs							Y								
04010201-311		St Louis R	Potlatch Dam to Scanlon Dam	1.4	NS	FS					NS				FS	T		T	T			Y								
04010201-211		St Louis R	Scanlon Dam to Thomson Reservoir	3.2	NS	FS					NS				FS	T		T	T			Y								
04010201-111		St Louis R	Thomson Reservoir (09-0001)	0.6	NS	FS					NS				FS	T		T	T			Y								
04010201-010		Midway R		18.6	t	ps		t					t	t	ps							Y	A		C	U				
04010201-209		St Louis R	Midway R to Fond du Lac Dam	7.8	ns	fs			ns					ns	fs							Y								
04010201-109	*	St Louis R	Fond du Lac Dam to Mission Cr	4.5	NS	FS			ns		NS				FS	T	T	T	T			Y								*
04010201-006		St Louis R	Mission Cr to Pokegama R	5.4	NS	FS			ps		NS		ps	ps	FS	T		T	T			Y		F		U		L	H	
04010201-103		Miller Cr		8.6	PS		PS															Y								
04010201-003	*	St Louis R	Pokegama R to Lake Superior	6.0	NS	FS			ps		NS		ps	ps	FS	T	T	T	T	M		Y		F		U		L	H	*
Cloquet River																														
04010202-001		Cloquet R	US-Kab-Wan-Ka R to St Louis R	7.2	NS	FS			FS		NS				FS			T				Y								
Nemadji River																														
04010301-215		Skunk Cr	(Tributary to Nemadji R)	1.9	NS						NS					T		T	T			Y								
04010301-015		Nemadji R	Source to Net R	22.1	ns				ns					na								Y							H	
			-End of Basin -																											

Full Support (FS, S); Supporting but Threatened (ST, T); Partial Support (PS); Not Supporting (NS); Not Attainable (NT). Lower case denotes assessment based on 1992 survey of local resource managers. *USEPA 303(d) listed waterbody. p. 3