

Minnesota North Central Landscape
**Current Conditions and
Trends Assessment**



Minnesota Forest Resources Council Document #LT-0500

©Copyright 2000, Minnesota Forest Resources Council

Printed May 2000

This document is on the Internet at www.iic.state.mn.us/finfo/landscape/4/nc/html.

Information about the Minnesota Forest Resources Council and the Landscape Program can be found at www.frc.state.mn.us. Information on the Landscape Program also is located at the Interagency Information Cooperative Internet site, www.iic.state.mn.us.

Equal opportunity to participate in and benefit from Minnesota Forest Resources Council programs is available to all individuals regardless of race, color, creed, religion, national origin, sex, marital status, status with regard to public assistance, age, sexual orientation, or disability. Discrimination inquiries should be sent to the Minnesota Forest Resources Council, 2003 Upper Buford Circle, St. Paul, MN 55108; or the Equal Opportunity Office, Department of the Interior, Washington, D.C. 20240.

This information is available in an alternative format upon request.

Table of Contents

Table of Contents	1
List of Tables	3
List of Figures	5
References	7
Introduction	8
Background	8
Findings	9
Preliminary Issues	10
Fragmentation of Landscape by Development	10
Development of Riparian Corridors	10
Ecosystem Sustainability	10
Harvest-level Sustainability	11
Historical Conditions and Trends	12
Geographic Description of the North Central Landscape	12
A visual comparison of pre-settlement vegetation to current vegetation	13
A quantitative comparison of pre-settlement to today	13
Natural Resources and Ecological Conditions and Trends	18
Matrix	18
The extent of forestlands in recent decades	18
Forest type groups	20
Age-class structure of forestlands in recent decades	23
Productivity of the North Central’s timberland	27
Annual growth, mortality, and removals of growing stock on timberland	28
Silvicultural and harvesting practices	30
Forest Health	33
Vascular plants	33

Table of Contents (continued)

Forest-dependent vertebrates at risk.....	36
Trends in wildlife species populations	39
Climate.....	42
Riparian areas	45
Minnesota County Biological Survey.....	48
Social and Economic Conditions and Trends	49
Ownership of Forestland	49
Reserved lands.....	51
Land Use	52
Ownership	53
Demographics	56
Observations	63
Employment.....	64
Observations	73
Economic Production and Financial Data	74
Stumpage Prices	82
Observations	84
Recreation and Tourism: Trails.....	86
Recreation and Tourism: Roads.....	87
Harvest volume trends	88
Exports and imports of pulpwood.....	90
Appendix A. Metadata - General Information of Data	91
Appendix B. Summary of FIA Sampling and Estimation Procedures	94
Appendix C. Summary of Forest Health Conditions from the US Forest Service	98
Appendix D. Pollution Control Agency Upper Mississippi River Basin Assessment of Stream Water Quality	106

List of Tables

Table 1. Relative difference in abundance of tree species estimated from the public land survey of the late 1800s and the 1990 Forest Inventory and Analysis for the North Central ecological landscape.	16
Table 2. Extent of forestland in the North Central landscape, 1977 and 1990.	19
Table 3. Ratio of forestland to nonforestland for the North Central landscape, 1977 and 1990.	19
Table 4. Forest type age-class structure of timberland in the North Central ecological landscape, 1990.	26
Table 5. Distribution of timberland by owner and site productivity class for the North Central ecological landscape.	27
Table 6. Average annual growth, mortality, and removals of growing stock on timberland in the Northern Pine Forest Inventory and Analysis Unit, 1977-1989.	28
Table 7. Richness of vascular plants in Owenby and Morley (1991) by MFRC landscape.	34
Table 8. Numbers of vascular plants in Owenby and Morley (1991) with recorded occurrence limited to a particular MFRC landscape.	35
Table 9. Richness of forest-associated mammals, amphibians and reptiles, and breeding birds in Minnesota.	36
Table 10. Status of Minnesota’s forest associated endangered, threatened, and special concern vertebrate wildlife, 1984.	37
Table 11. Status of Minnesota’s forest associated endangered, threatened, and special concern vertebrate wildlife, 1996.	38
Table 12. Density of waterways, by ecological subsection, in the North Central ecological landscape.	45
Table 13. Riparian areas classified by the National Wetlands Inventory (NWI), summarized by ecological subsection in the North Central ecological landscape.	46
Table 14. Forestland ownership in the North Central landscape, 1990.	49
Table 15. Forestland ownership in the Northern Pine Forest Inventory and Analysis Unit, 1977 and 1990.	49

List of Tables (continued)

Table 16. Ratio of public forestland to private forestland for the Northern Pine Forest Inventory and Analysis Unit, 1977 and 1990.	50
Table 17. Ownership of land in the North Central ecological landscape.	55
Table 18. Population of Minnesota and counties in the North Central landscape, 1970s and 1990s.	57
Table 19. Population projections for Minnesota and the North Central landscape, 1995-2025.	59
Table 20. Population projection by age group for Minnesota and the North Central landscape, 1995-2025.	60
Table 21. Persons with incomes below the poverty level, 1990.	61
Table 22. Per capita personal income for Minnesota and counties in the North Central landscape, 1990-1996.	62
Table 23. Number of employees by major industry in the North Central landscape, 1995.	68
Table 24. Projected employment by major industry, Northeast Projection Area, 1994-2005.	69
Table 25. Projected employment by major industry, Northwest Projection Area, 1994-2005.	70
Table 26. Percent unemployed for Minnesota and counties in the North Central landscape, 1990-1998.	71
Table 27. Minnesota Logger Education Program membership by county, 1998.	72
Table 28. Earnings by major industry for the North Central landscape, 1995.	77
Table 29. Economic impact of domestic travel to the North Central landscape, 1994 and 1995.	78
Table 30. Payments in lieu of taxes for public land in the North Central landscape, 1987-1997.	84
Table 31. Taconite production in Minnesota, 1990-1999.	85
Table 32. Minnesota pulpwood production, exports, and imports, 1993-1997.	90

List of Figures

Figure 1. Forest Change 1800s to 1990s.	14
Figure 2. Extent of forest type groups for the Northern Pine Forest Inventory and Analysis Unit, 1977.	20
Figure 3. Extent of forest type groups for the Northern Pine Forest Inventory and Analysis Unit, 1990.	21
Figure 4. Change in forest type group acreage for the Northern Pine Forest Inventory and Analysis Unit, 1977-1990.	22
Figure 5. Age-class structure of timberland in the Northern Pine Forest Inventory and Analysis Unit, 1977.	23
Figure 6. Age-class structure of timberland in the Northern Pine Forest Inventory and Analysis Unit, 1990.	24
Figure 7. Timberland age class structure changes in the Northern Pine Forest Inventory and Analysis Unit, 1977-1990.	25
Figure 8. Type and extent of silvicultural practices used on Minnesota's timberland, 1991-1996.	30
Figure 9. Extent of silvicultural systems used on Minnesota's timberland, 1991-1996.	31
Figure 10. Type and relative extent of regeneration activities on Minnesota's timberland, 1991-1996.	32
Figure 11. Rangewide spring (pre-birth) population estimates of otter, fisher, and marten, 1977-1997.	39
Figure 12. Rangewide spring (pre-birth) population estimates of bobcat, 1977-1997.	40
Figure 13. Moose population estimates for northern Minnesota, 1982-1998.	41
Figure 14. Leech Lake Dam precipitation 1887-1987.	42
Figure 15. Leech Lake Dam July temperatures (high and low) 1897-1996.	43
Figure 16. Leech Lake Dam January temperatures (high and low) 1897-1996.	44
Figure 17. Waterways in North Central Minnesota.	47
Figure 18. Reserved lands and forests in the North Central ecological landscape.	51
Figure 19. Land use from satellite data, 1990.	52
Figure 20. Distribution of non-industrial private forestland (NIPF) acres statewide by ownership class size, 1990.	53
Figure 21. GAP ownership in the North Central ecological landscape.	54

List of Figures (continued)

Figure 22. Population projections for counties in the North Central landscape, 1995-2025.	58
Figure 23. Number of employees by major industry for Minnesota, 1970-1995.	65
Figure 24. Number of employees by major industry for the North Central landscape, 1970-1995.	66
Figure 25. Projected employment by major industry for Minnesota, 1998-2045.	67
Figure 26. Earnings by major industry for Minnesota, 1970-1995.	74
Figure 27. Earnings by major industry for the North Central landscape, 1970-1995.	75
Figure 28. Projected earnings by major industry for Minnesota, 1998-2045.	76
Figure 29. Economic impact of domestic travel in Minnesota, 1988-1995.	79
Figure 30. Estimated taxes from seasonal/recreational residential uses, North Central landscape, 1980-1998.	80
Figure 31. Estimated taxes from seasonal/recreational commercial uses, North Central landscape, 1980-1998.	81
Figure 32. Average stumpage prices received by public agencies for sawtimber, 1987-1997.	82
Figure 33. Average stumpage prices received by public agencies for pulpwood, 1987-1997.	83
Figure 34. Trail mileage statewide in Minnesota, 1984-1996.	86
Figure 35. Road Mileage statewide in Minnesota, 1989-1999.	87
Figure 36. Trends in hardwood and softwood harvesting statewide in Minnesota, 1980-1997.	89
Figure 37. Estimated annual harvest volume from timberland in Minnesota by ownership class, 1989-1997.	89

References

- Almendinger, J. C. Minnesota's Bearing Tree Database. Minnesota Department of Natural Resources. St. Paul, MN, 1996.
- Almendinger, J. C., and Hanson, D. S. Ecological Land Classification Handbook for the Northern Minnesota Drift & Lake Plains and Chippewa National Forest. Minnesota Department of Natural Resources. St. Paul, MN, 1998.
- Dexter, M. H., compiler. Status of wildlife populations, fall 1998. Unpub. Rep., Section of Wildlife, MN Dept. of Natural Resources, St. Paul, MN, 1998.
- Generic Environmental Impact Statement (GEIS) Study on timber Harvesting and Forest Management in Minnesota.* Minnesota Environmental Quality Board. 1994.
- Green, J. C. "Birds and Forests: A Management and Conservation Guide." MN Dept. of Natural Resources. St. Paul, MN, 1995.
- Jakes, P. The fourth Minnesota forest inventory: area. Resource Bull. NC-54. USDA Forest Service, North Central Forest Experiment Station. St. Paul, MN, 1980.
- Heinselmann, M. L. "Interpretation of Francis J. Marschner's Map of the Original Vegetation of Minnesota." USDA Forest Service North Central Forest Experiment Station. St. Paul, MN, 1974.
- Murray, P. Forest Statistics for Minnesota's Northern Pine Unit, 1990. USDA Forest Service, North Central Forest Experiment Station. St. Paul, MN, 1991.
- Miles, P. D., C. M. Chen, & E. C. Leatherberry. Minnesota Forest Statistics, 1990, Revised. USDA Forest Service North Central Forest Experiment Station. St. Paul, MN, 1995.
- Minnesota Department of Natural Resources. "Checklist of Endangered and Threatened Animal and Plant Species of Minnesota." St. Paul, MN, 1984.
- Minnesota Department of Natural Resources. "Minnesota's List of Endangered, Threatened and Special Concern Species." St. Paul, MN, 1996.
- Minnesota Department of Natural Resources, Division of Forestry. Minnesota Primary Forest Products Directory. St. Paul, MN, 1999.
- Minnesota Department of Natural Resources, Trails and Waterways Unit. Minnesota Registry of Public Recreational Trail Mileages. St. Paul, MN, 1996.
- Minnesota Forest Resources Council. Status of Minnesota Timber Harvesting and Silvicultural Practice in 1996. St. Paul, MN, 1996.
- Owenby, G. B. and T. Morley. Vascular Plants of Minnesota: A Checklist and Atlas. Minneapolis: U of MN Press, 1991.
- Tester, J. R. Minnesota's Natural Heritage. St. Paul: U of MN Press, 1995.

Introduction

The process for conducting assessments of landscape conditions and trends for Minnesota's North Central (NC) landscape region is explained in the background section below. At the time of this printing the following sections of the assessment are completed:

- Historical Conditions (Range of Natural Variability)
- General Resources Trends and Conditions
- Social and Economic Trends and Conditions
- Preliminary Findings
- Preliminary Issues

This information will serve as the starting point for establishing a regional forest resource committee in the North Central landscape, which includes all of Aitkin, Becker, Beltrami, Cass, Clearwater, Crow Wing, Hubbard, Itasca, Mahnomon, and Polk counties. As additional ecological and social/economic data becomes available, it will be analyzed and presented to the regional committee for its consideration in determining desired future conditions, goals, and strategies for the landscape.

Background

Subdivision 2 of Minnesota's 1995 Sustainable Forest Resources Act (SFRA) authorizes the

Minnesota Forest Resources Council to establish citizen-based regional forest resource committees to foster landscape-based forest resource planning.

The SFRA defines landscape-level planning as long-term, broad-based efforts that may require extensive analysis and planning over large areas and that may require extensive coordination among all landowners in a region. Regional committees provide the opportunity to involve private citizens, forestry professionals, and members of various interest groups in implementing landscape-level planning that will promote forest sustainability. The SFRA charges the regional committees to:

- include representative interests;
- serve as a forum to discuss issues;
- identify and implement an open and public process whereby landscape-level strategic planning can occur;
- identify sustainable forest resource goals for the landscape and strategies to achieve those goals; and
- provide a regional perspective on forest sustainability to the MFRC.

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 (ecological, social, and economic) 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 and goals, and resolve issues in the region;
- encourage voluntary implementation of the strategies by coordination among landowners; and
- conduct an evaluation to determine how well the strategies accomplish the vision and goals and resolve issues.

This Current Trends and Conditions Assessment for the North Central landscape represents the first step in the general planning process for north central Minnesota. The assessment was accomplished by working with the Resource Management Partnership (ReMAP), a group of landowners and managers previously established in the North Central landscape to coordinate forest management activities. Although this assessment is a work in progress, it contains enough information to get the regional committee started on the steps in the general planning process.

Findings

Members of ReMAP, as well as resource managers from the MFRC, Department of Natural Resources (DNR), U.S. Forest Service, and county land departments, completed a preliminary analysis of the information in the Current Trends and Conditions Assessment and prepared their findings. The intent is to give the North Central regional forest resource committee some suggestions as to what the information means. Ultimately, however, the regional committee must draw its own conclusions from the assessment information. The findings of the assessment include the following:

- The landscape is still largely forested; current nonforestland is primarily agricultural in the southwest part of the landscape and urban/residential around the three population centers of Brainerd, Grand Rapids, and Bemidji.
- Forest cover types, age-class structure, and disturbance regimes have been greatly altered from presettlement conditions.
- Upland riparian areas are under pressure from residential development and should be given special consideration in future management.
- Forest mortality is roughly equal to removals by harvest; mortality and harvest together exceed

- growth for the period in consideration.
- Expected population increases are directly tied to the presence of lakes and the desire of people to relocate in places with trees and water.
 - Dramatic increases in population aged 65 and older, combined with their increased purchasing power, will augment the demand for recreational activities and influence the way the land is managed across the landscape.

Preliminary Issues

Based on the assessment information and preliminary findings, the MFRC landscape program staff defined the following issues to give the North Central regional forest resource committee some focal points as it begins its work:

Issue: Fragmentation of Landscape by Development

Issue Involves:

- Residential and summer home development
- Recreational development (golf courses, etc.)
- Size of development
- Increasing population and wealth
- Cumulative effects of development
- Amount of forestland and nonforestland

Information Needed:

- Quantifiable data on the extent of development

- over the last five to ten years
- Satellite imagery on size and extent of development
- Projections of development into the future
- Analysis of cumulative effects (loss of forestland, impacts on forestland, etc.)

Issue: Development of Riparian Corridors

Issue Involves:

- Residential and summer home development along lakes and streams
- Impacts on water quality
- Erosion and sedimentation
- Increasing population and wealth

Information Needed:

- Quantifiable data on the extent of development over the last five to ten years
- Projections of development into the future
- Wetland Functional Models to give predictions of an area's suitability for development

Issue: Ecosystem Sustainability

Issue Involves:

- Flora and fauna composition and distribution
- Noninventoried species
- Old growth, Research and Natural Areas (RNA), reserved acres, etc.

-
- Range of Natural Variability of species in landscape
 - Social and economic analysis

Information Needed:

- Completed assessment of ecological and economic conditions in the North Central landscape

Issue: Harvest Level Sustainability

Issue Involves:

- Mortality and harvest vs. growth
- Species composition
- Species age class and spatial distribution
- Patch size of harvest units/fragmentation
- Maximum regional harvest level from Generic Environmental Impact Statement (GEIS)
- Cumulative effects of harvesting

Information Needed:

- Change analysis using Landstat imagery from the last 10 years
- Cumulative-effects analysis of changes

Historical Conditions and Trends

Geographic Description of the North Central Regional Landscape

(Northern Minnesota Drift and Lake Plain Ecological Section—as defined by the Department of Natural Resources Ecological Classification System)

The following summary was taken out of the “Ecological Land Classification Handbook for the Northern Minnesota Drift and Lake Plains and the Chippewa National Forest” (Almendinger and Hanson, 1998):

The Northern Minnesota Drift & Lake Plain ... contains entirely Hubbard and Cass counties and portions of Clearwater, Beltrami, Koochiching, Itasca, St. Louis, Carlton, Aitkin, Crow Wing, Morrison, Todd, Wadena, Otter Tail, Becker, Mahnomen, and Polk counties. The central theme for this Section is that of extremely variable deposits of deep glacial drift, with numerous lakes and wetlands, and forest types that broadly include deciduous forests, coniferous forests, mixtures of these two types, and large areas of conifer swamp forests. Agriculture is not widespread. The surface water patterns and forest types are correlated with

glacial landforms including: outwash plains, lake plains, till plains, narrow outwash channels, moraine ridges, and drumlin fields. The total annual precipitation averages 24-28 inches (60-70 cm). About 40% of the precipitation occurs during the growing season. Snowfall ranges from 44-64 inches (110-160 cm). Temperature averages 37-43° F (3-5° C). Extreme winter temperatures can reach -41° C or F, which is the minimum tolerated by many deciduous trees, including sugar maple. The growing season lasts for 111 to 131 days.

Elevation ranges from 1,100-1,850 feet (330-560 m). Local relief ranges from virtually none on the large lake plains, to 50-165 feet (15-50 m) on other landforms. About 200 feet (60 m) of glacial drift covers the underlying bedrock in most areas, but the drift can be as thick as 600 feet (180 m) in some localities. The upland soils tend to be medium- to coarse-textured, and they are moderately well to somewhat excessively drained. Lowlands are extensive, poorly drained, and usually have organic soils over clayey parent material.

White pine, red pine, mixed pine-

hardwood, and northern hardwood cover-types tend to occur on the stagnation moraines within the Section. Jack pine and aspen-birch cover-types occupy the areas of flat outwash. Aspen-birch, mixed hardwood-conifer, and spruce-fir cover-types occur on the till plains. Conifer swamps and black ash swamps occur in the wetlands. The occurrence of these trees, their relationships to plant communities, and their distribution with regard to major landforms is covered extensively in this handbook.

A visual comparison of pre-settlement vegetation to current vegetation

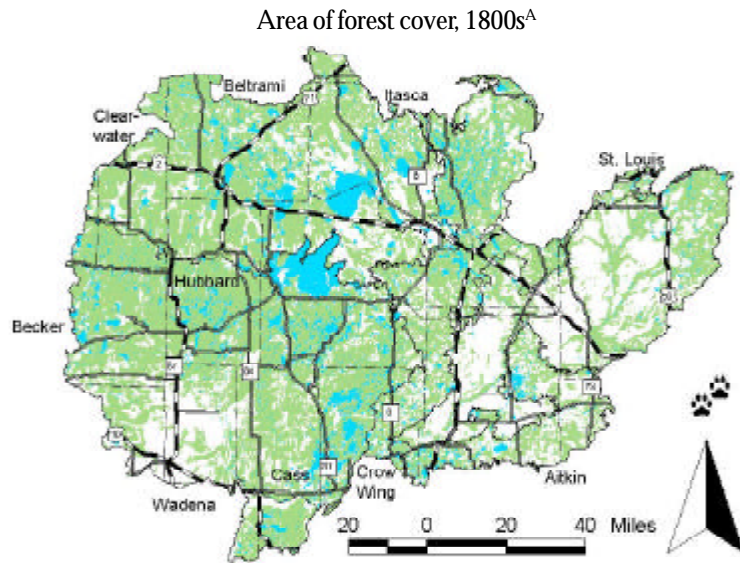
Figure 1 shows two representations of vegetation cover for north central Minnesota. The data source for the map of forest cover in the late 1800s (Marschner map) is a vegetation survey analysis done in the 1930s of 19th century information (Heinselmann, 1974). The data for the map of current vegetation (1990s) is from remotely sensed information. The two sources differ considerably in resolution and vegetation classification systems (see Appendix A). Because of these differences, direct quantitative comparisons between the geographic

information systems (GIS) data are not accurate. One general observation is the decrease of vegetation in the southeast portion of the North Central landscape.

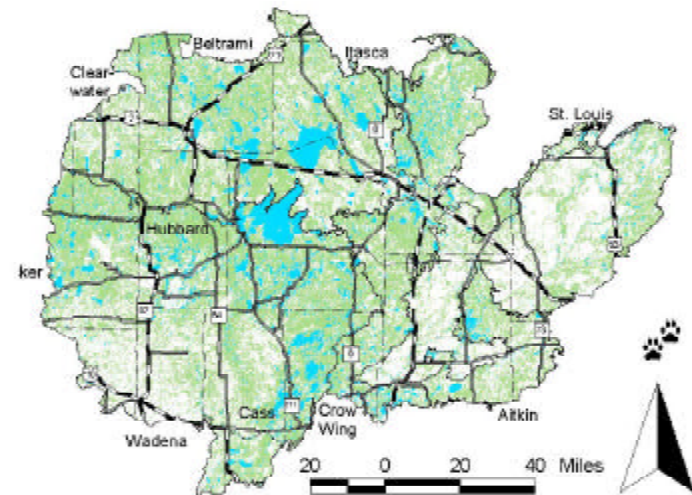
A quantitative comparison of pre-settlement vegetation to current vegetation

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 (DNR), has analyzed the bearing tree data and compared them to plot-level data from the 1990 Forest Inventory and Analysis (FIA) (see Appendix B for an explanation of the FIA program). Tree records were selected from the 1990 FIA plot data to reproduce as closely 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

Figure 1. Forest Change: 1800s to 1900s. (See Appendix A for more information on the data.)



Area of forest cover, 1990s^B



Source:

^AMarschner data based on public land survey records, 1930 (marsh forests not included).

^BRemotely sensed data, 1988-1996 (marsh forest not included).

Forestry, Resource Assessment Office.)

Table 1 summarizes the results of Almendinger's analysis for the North Central region's ecological assessment area. The table compares abundance of bearing trees to abundance of FIA possible bearing trees. The "difference" column shows the percentage point difference between the bearing tree abundance values and the FIA values. The final column shows the proportional difference for each species. For example, ash was 15 times more abundant among the selected FIA trees than among the bearing trees. In general there is a high increase in aspen and a significant decrease in tamarack from the bearing tree data to the FIA data.

Range of Natural Variability

Scientists from the Minnesota DNR, the University of Minnesota, the U.S. 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 on the landscape. The range of natural variation recognizes the dynamic nature of historical forests. The process being developed by the scientists 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. This analysis should be completed by late summer 2000.

Table 1. Relative difference in abundance of tree species estimated from the public land survey of the late 1800s^A and the 1990 Forest Inventory and Analysis^B for the North Central ecological landscape.



Tree Species (from bearing tree metadata)	Tree code	Difference	Proportional difference
Ash— <i>Fraxinus nigra</i> , <i>F. pennsylvanica</i> , <i>F. americana</i>	AH	17.35	15.14
Aspen— <i>Populus tremuloides</i> , <i>P. grandidentata</i> , <i>P. balsamifera</i> (in lesser part)	AS	67.36	9.54
Balm-of-Gilead— <i>Populus balsamifera</i> (in greater part)	BG	12.65	54.27
Birch— <i>Betula papyrifera</i> , <i>B. cordifolia</i>	BI	0.14	0.49
Bur Oak— <i>Quercus macrocarpa</i>	BO	7.86	13.26
Butternut— <i>Juglans cinerea</i>	BU	0.03	2.53
Box-Elder— <i>Acer negundo</i>	BX	0.24	9.44
Cherry— <i>Prunus serotina</i> , <i>P. pennsylvanica</i>	CH	0.24	27.3
Cottonwood— <i>Populus deltoides</i>	CO	-0.27	-13.54
Elm— <i>Ulmus americana</i> , <i>U. rubra</i> , <i>U. thomasii</i>	EL	3.96	6.53
Fir— <i>Abies balsamea</i>	FI	14.23	8.34
Ironwood— <i>Ostrya virginiana</i>	IR	-0.76	-9.57
Jack Oak— <i>Quercus ellipsoidalis</i>	JO	0.25	2.02
Jack Pine— <i>Pinus banksiana</i>	JP	-13.35	-1.21

Table 1 continued on next page.

Source:

^APublic Land Survey Bearing Tree Data, late 1800s.

^BUnited States Forest Service Forest Inventory and Analysis, 1990.

Table 1. Relative difference in abundance of tree species estimated from the public land survey of the late 1800s^A and the 1990 Forest Inventory and Analysis^B for the North Central ecological landscape (continued).

Tree Species (from bearing tree metadata)	Tree code	Difference	Proportional difference
Linden or Basswood— <i>Tilia americana</i>	LI	8.89	13.13
Maple— <i>Acer rubrum</i> , <i>A. saccharum</i> , <i>A. saccharinum</i>	MA	3.39	3.01
Oak— <i>Quercus rubra</i> , <i>Q. macrocarpa</i> , <i>Q. ellipsoidalis</i> , <i>Q. velutina</i> , <i>Q. alba</i> , <i>Q. bicolor</i>	OA	-6.51	0
Pine— <i>Pinus strobus</i> , <i>P. resinosa</i> , <i>P. banksiana</i>	PI	-9.51	0
Red Elm— <i>Ulmus rubra</i>	RE	0.1	-1.29
Red Oak— <i>Quercus rubra</i> , <i>Q. ellipsoidalis</i> (in part or as hybrid)	RO	13.86	30.41
Red, Norway, or Yellow Pine— <i>Pinus resinosa</i>	RP	-15.57	-7.98
Spruce— <i>Picea mariana</i> , <i>P. glauca</i>	SP	-15.14	-7.34
Sugar Maple— <i>Acer saccharum</i>	SU	6.16	9.94
Tamarack— <i>Larix laricina</i>	TA	-69.92	-21.67
White Cedar— <i>Thuja occidentalis</i>	WC	-3.3	-2.39
Willow— <i>Salix</i> spp.	WI	-0.62	-30.86
White Pine— <i>Pinus strobus</i>	WP	-21.41	-25.52
Yellow Birch— <i>Betula alleghaniensis</i>	YB	-0.21	-6.35



Source:
^APublic Land Survey Bearing Tree Data, late 1800s.
^BUnited States Forest Service Forest Inventory and Analysis, 1990.

Natural Resources and Ecological Conditions and Trends

This section includes data on 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 fur bearer and game species, climate, and stream water quality. The only detailed forest cover-type data available across all ownerships (public and private) in the North Central landscape is Forest Inventory and Analysis (FIA). (See Appendix B for an explanation of the FIA program.) 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.

Matrix

Being developed, expected to be ready by summer 2000.

The extent of forestlands in recent decades

(see Tables 2 and 3)

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

Table 2. Extent of forestland in the North Central landscape, 1977 and 1990.

Land Use	1977 area thousands of acres ^A	1990 area thousands of acres ^B
Nonforestland	3,231.0	3372.2
Forestland ^C	5,569.8	5491.3
Total	8800.8	8863.5

Tables 2 & 3



Table 3. Ratio of forestland to nonforestland for the North Central landscape, 1977 and 1990.

Ratio: forestland to nonforestland	1977 ^A	1990 ^B
North Central landscape	1.72	1.63

Source:

^AJakes and Raile, 1980.

^BMurray, 1991.

Note:

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

Forest type groups

Figures 2, 3, and 4 describe the extent of several forest-type groups in north central Minnesota. They are based on data collected in 1977 and 1990 in the Northern Pine Forest Inventory and Analysis Unit.

Figure 2. Extent of forest-type groups for the Northern Pine Forest Inventory and Analysis Unit, 1977.



Source:
Jakes and Raile, 1980.

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

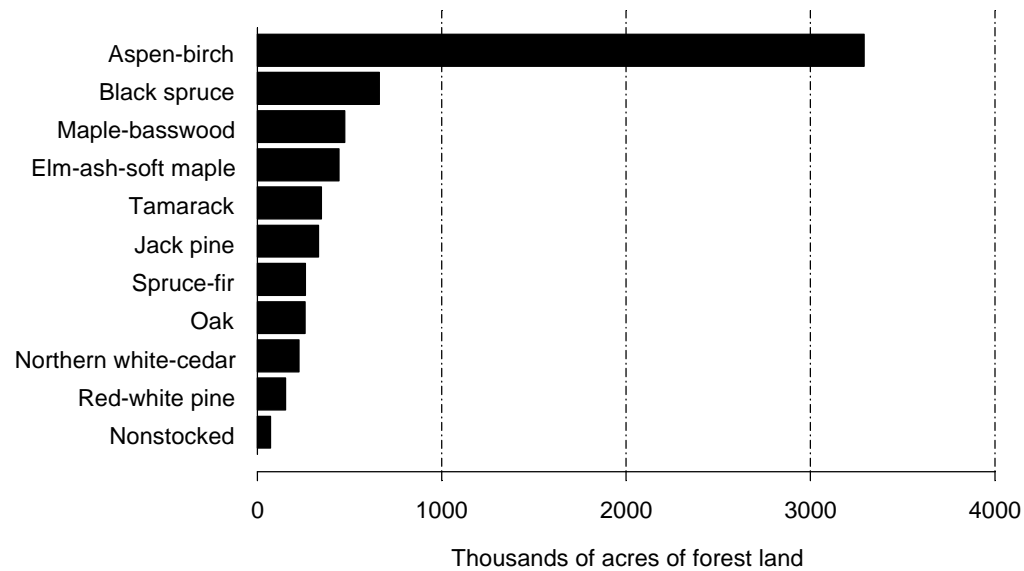
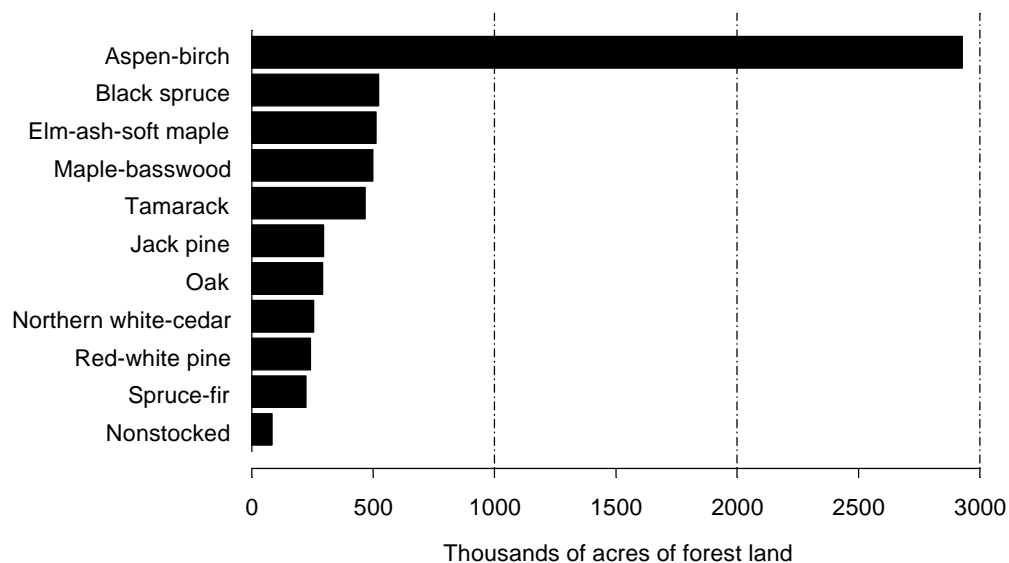


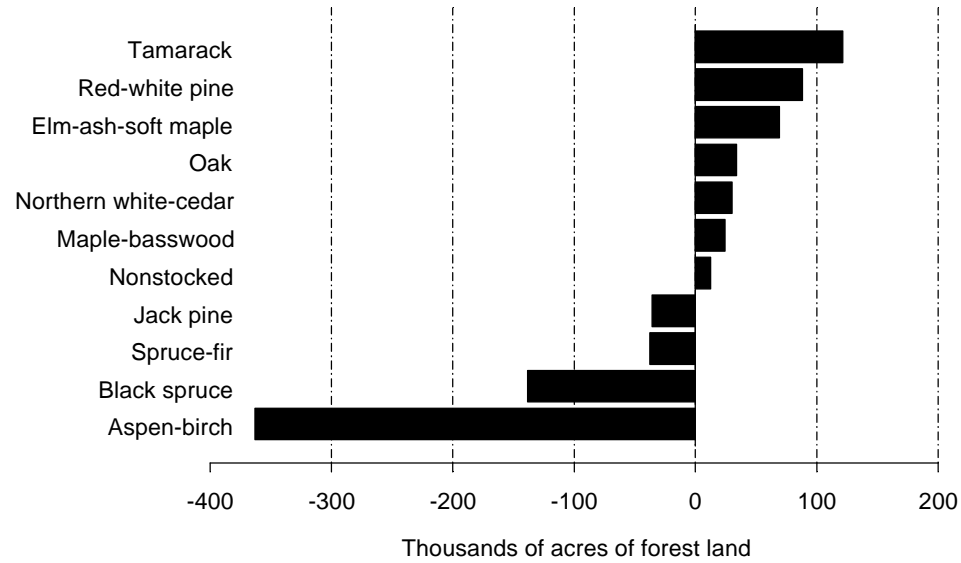
Figure 3. Extent of forest-type groups for the Northern Pine Forest Inventory and Analysis Unit, 1990.



Source:
United States Forest
Service Forest Inventory
and Analysis, 1990.

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

Figure 4. Change in forest-type group acreage for the Northern Pine Forest Inventory and Analysis Unit, 1977-1990.



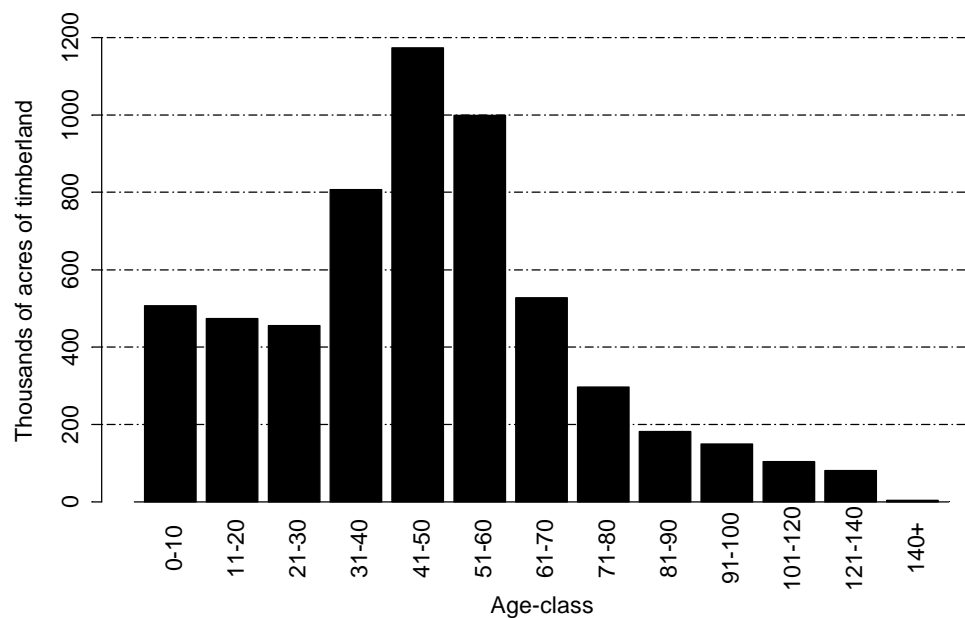
Source:
 Jakes and Raile, 1980;
 United States Forest Service
 Forest Inventory and
 Analysis, 1990.

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

Age-class structure of timberland

Figures 5 to 7 and Table 4.

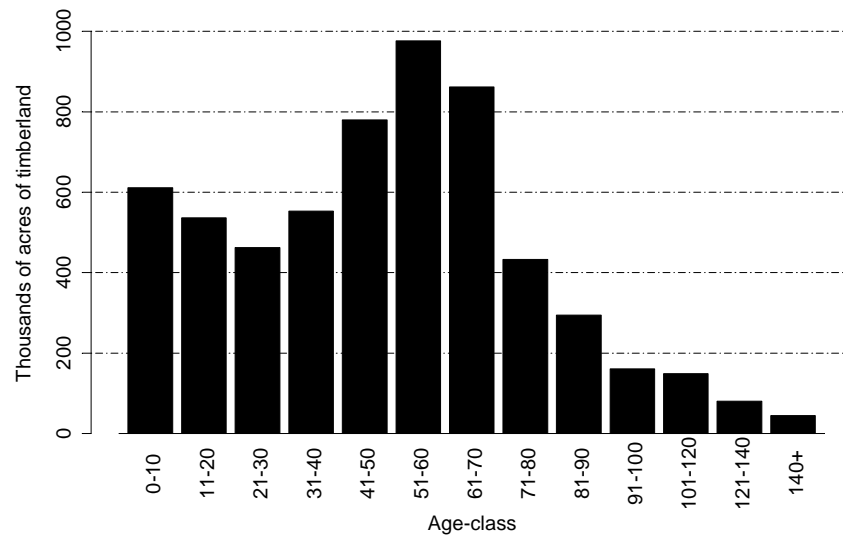
Figure 5. Age-class structure of timberland in the Northern Pine Forest Inventory and Analysis Unit, 1977.



Source:
Jakes and Raile, 1980.

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

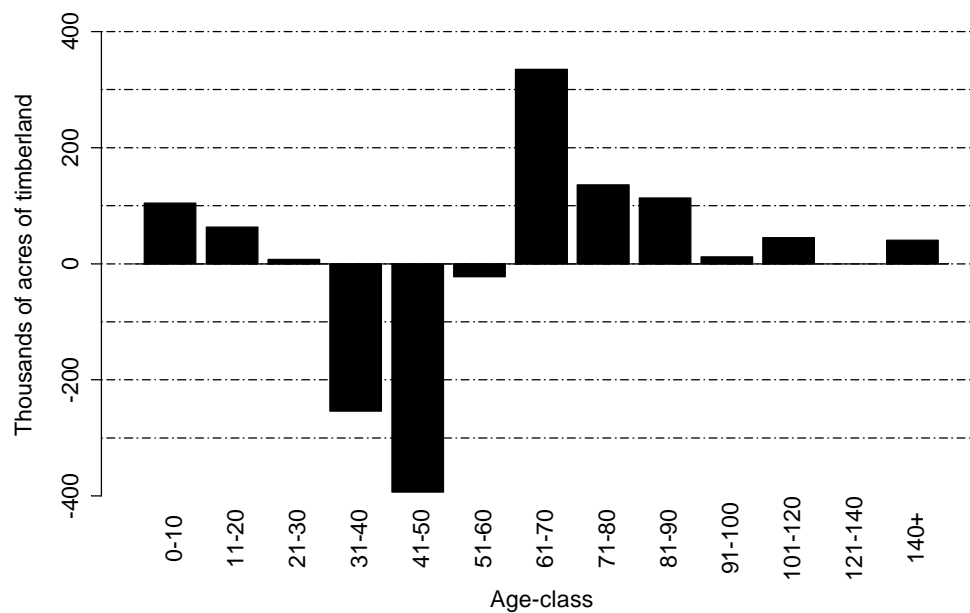
Figure 6. Age-class structure of timberland in the Northern Pine Forest Inventory and Analysis Unit, 1990.



Source:
United States Forest
Service Forest Inventory
and Analysis, 1990.

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

Figure 7. Timberland age-class structure changes in the Northern Pine Forest Inventory and Analysis Unit, 1977-1990.



Source:
 Jakes and Raile, 1980;
 United States Forest
 Service Forest Inventory
 and Analysis, 1990.

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

Table 4. Forest type age-class structure of timberland in the North Central ecological landscape, 1990.
(Values are in thousands of acres.)



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	141+	
Jack pine	17.0	17.7	16.1	34.9	55.9	58.7	31.9	10.9	7.6	0.0	0.0	0.0	0.0	250.7
Red pine	47.2	33.3	23.0	12.2	12.8	20.8	13.2	12.7	11.8	3.1	10.2	2.2	0.0	202.5
White pine	0.0	1.2	2.3	0.0	3.3	4.1	5.6	4.5	1.4	0.0	2.0	0.8	0.0	25.2
Scotch pine	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Balsam fir	3.6	12.3	23.8	35.0	26.2	41.0	35.7	10.5	2.3	4.2	0.0	0.0	0.0	194.6
Black spruce	4.4	24.6	46.2	54.7	56.6	48.4	26.3	19.9	15.3	5.3	3.6	3.8	0.0	309.1
Northern white-cedar	1.4	2.5	3.4	2.4	8.4	10.3	23.3	17.6	20.7	17.2	27.4	8.5	12.6	155.7
Tamarack	20.3	26.6	45.2	47.7	31.5	31.2	27.1	22.9	23.4	20.8	12.0	8.9	4.2	321.8
White spruce	13.2	3.9	2.4	3.1	1.7	0.0	2.7	2.5	0.0	1.5	0.0	0.0	0.0	31.0
Oak	11.7	5.3	7.2	9.8	34.1	56.3	52.5	30.9	24.8	3.2	4.2	2.8	0.0	242.8
Elm - ash - soft maple	29.9	32.0	17.5	33.4	27.4	44.6	63.5	49.7	32.5	26.9	22.2	8.1	2.4	390.1
Maple - basswood	13.8	10.1	14.7	17.6	53.5	65.2	73.5	43.0	44.8	17.3	20.6	4.6	0.0	378.7
Aspen	285.7	221.9	157.1	200.0	295.0	351.0	283.2	83.4	32.7	13.8	10.0	1.3	0.0	1,935.1
Paper birch	9.7	12.1	13.1	18.9	58.0	65.9	65.3	37.3	10.1	4.0	2.2	3.4	0.0	300.0
Balsam poplar	15.7	20.4	14.6	9.8	13.7	15.9	13.7	4.2	9.0	2.5	0.0	0.0	0.0	119.5
Nonstocked	30.8	4.2	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.1
Total	504.4	428.6	387.7	479.5	678.1	813.4	717.5	350.0	236.4	119.8	114.4	44.4	19.2	4,893.4

Source:
United States Forest
Service Forest Inventory
and Analysis, 1990.

Productivity of timberland in Minnesota's North Central landscape

Table 5. Distribution of timberland by owner and site-productivity class for the North Central ecological landscape. (Values are in thousands of acres.)

Productivity class (cubic feet/acre/year)	Owner		
	Private	Public	All
20-49	715.5	979.4	1694.9
50-84	858.6	965.6	1824.2
85-119	551.5	688.5	1240.0
120-164	50.1	81.1	131.2
165-224	1.6	1.5	3.1
All classes	2177.3	2716.1	4893.4



Source:
United States Forest
Service Forest Inventory
and Analysis, 1990.

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

Table 6. Average annual growth, mortality, and removals of growing stock on timberland in the Northern Pine Forest Inventory and Analysis Unit, 1977-1989.



Species group	Growing stock						
	1990 volume	Average annual growth 1977-1989		Average annual mortality 1977-1989		Average annual removals 1977-1989	
	Thousand cubic feet	Thousand cubic feet	Percent	Thousand cubic feet	Percent	Thousand cubic feet	Percent
Quaking aspen	1,814,162	54,593	3.0	33,602	1.9	43,019	2.4
Paper birch	621,468	10,794	1.7	8,705	1.4	7,389	1.2
Jack pine	369,013	8,775	2.4	6,240	1.7	8,156	2.2
Basswood	360,881	9,749	2.7	1,383	0.4	1,699	0.5
Red pine	355,600	14,263	4.0	330	0.1	2,009	0.6
Black ash	342,998	9,414	2.7	1,858	0.5	1,934	0.6
Balsam fir	326,440	6,469	2.0	10,344	3.2	5,837	1.8
Balsam poplar	303,463	4,610	1.5	8,080	2.7	3,400	1.1
Select red oak	302,179	7,564	2.5	1,979	0.7	2,979	1.0
Northern white-cedar	263,737	5,209	2.0	573	0.2	684	0.3
Tamarack	257,928	6,029	2.3	3,015	1.2	1,244	0.5
White oak	223,700	7,122	3.2	406	0.2	1,427	0.6
Hard maple	183,183	5,689	3.1	537	0.3	924	0.5
Black spruce	174,799	2,456	1.4	3,734	2.1	521	0.3
Bigtooth aspen	167,202	4,844	2.9	1,413	0.8	1,779	1.1
Soft maple	135,302	5,984	4.4	947	0.7	679	0.5

Source:
Murray, 1990.

Table 6 continued on next page.

Table 6. Average annual growth, mortality, and removals of growing stock on timberland in the Northern Pine Forest Inventory and Analysis Unit, 1977-1989. (continued)

Species group	Growing stock						
	1990 volume	Average annual growth 1977-1989		Average annual mortality 1977-1989		Average annual removals 1977-1989	
	Thousand cubic feet	Thousand cubic feet	Percent	Thousand cubic feet	Percent	Thousand cubic feet	Percent
Elm	121,041	-2,977	-2.5	8,988	7.4	1,288	1.1
White pine	110,473	3,908	3.5	364	0.3	1,595	1.4
White spruce	85,755	3,312	3.9	729	0.9	1,154	1.3
White and green ash	44,421	1,775	4.0	137	0.3	47	0.1
Yellow birch	7,125	-21	-0.3	92	1.3	22	0.3
Other red oak	5,716	-15	-0.3	152	2.7	73	1.3
Other hardwoods	4,904	120	2.4	86	1.8	—	0.0
Butternut	1,721	6	0.3	25	1.5	28	1.6
Black cherry	1,553	18	1.2	45	2.9	—	0.0
Hickory	620	15	2.4	14	2.3	—	0.0
Eastern red cedar	421	14	3.3	—	0.0	—	0.0
Other softwoods	215	37	17.2	—	0.0	—	0.0
Willow	173	30	17.3	14	8.1	—	0.0
Cottonwood	156	-4	-2.6	8	5.1	—	0.0
Total	6,586,349	169,782	2.6	93,800	1.4	87,887	1.3



Source:
Murray, 1990.

Silvicultural and harvesting practices

Trends in the extent and type of silvicultural practices were based on surveys conducted in 1991 and 1996. Data presented in this section are representative of practices on public, forest industry,

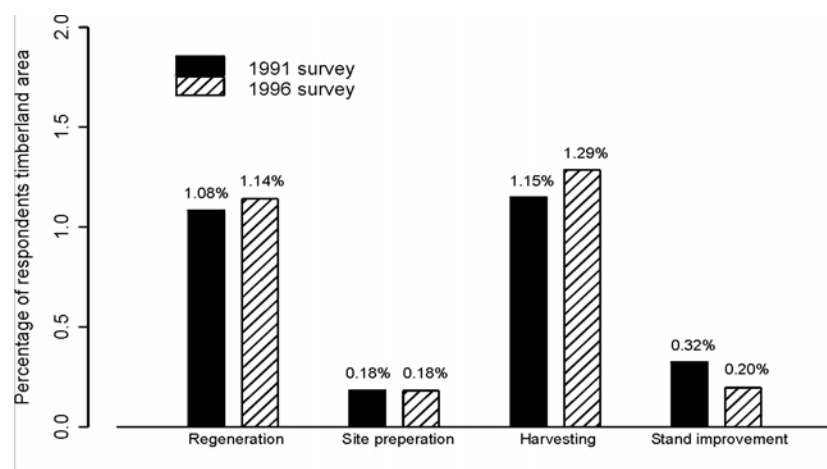
and American Indian lands; nonindustrial private forestland owners were not surveyed (Minnesota Forest Resources Council 1996). The data presented are for the entire state. In 1996, respondents to the survey owned approximately

Figure 8. Type and extent of silvicultural practices used on Minnesota's timberland, 1991-1996.



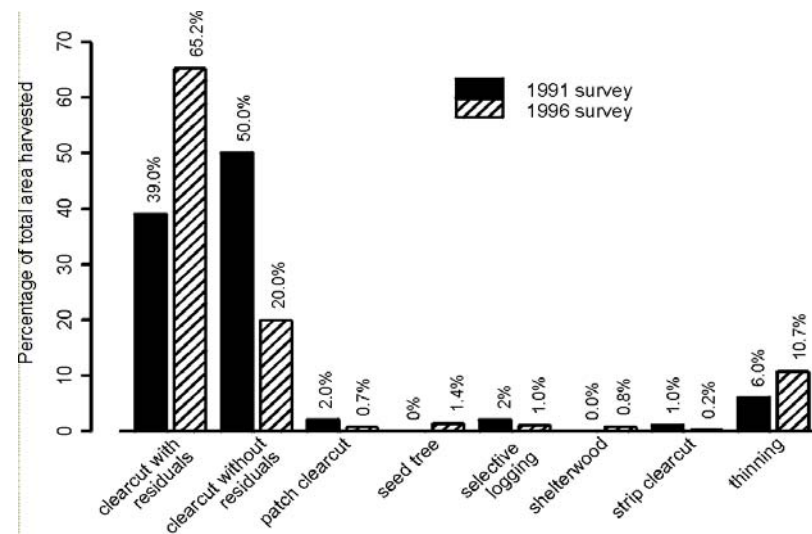
Source:
MFRC Report MP0698.

Note:
The data on which the figure is based does not account for practices on timberland owned by nonindustrial private forest landowners.



half of the state's 14.7 million acres of timberland.
 Silvicultural practices are the ways in which forests are managed.

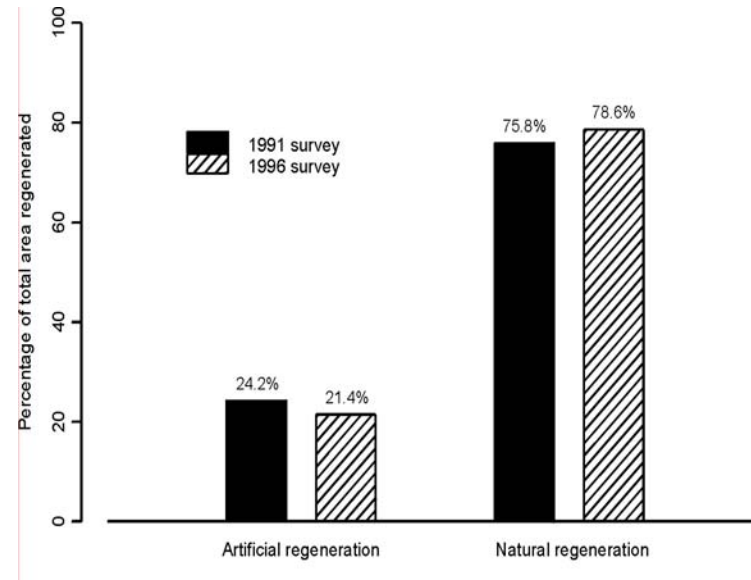
Figure 9. Extent of silvicultural systems used on Minnesota's timberland, 1991-1996.



Source:
 MFRC Report MP0698.

Note:
 The data on which the figure is based does not account for practices on timberland owned by nonindustrial private forest landowners.

Figure 10. Type and relative extent of regeneration activities on Minnesota's timberland, 1991-1996.



Source:
MFRC Report MP0698.

Note:
The data on which the figure is based does not account for practices on timberland owned by nonindustrial private forest landowners.

Forest Health

In the North Central regional landscape there are 2 insects that greatly affect the forest: tent caterpillar and spruce budworm. Tent caterpillar cycles every 10 years and attacks mostly aspen; the most recent cycle was in the early 1990s. Spruce budworm affects both balsam fir and white spruce. See Appendix C, “Summary of Forest Health Conditions from the US Forest Service,” for more information on forest health in Minnesota.

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 in the University of Minnesota Herbarium (97,000 at the time of publication). The 1,881 maps in the atlas show specimen locations at time of collection for 1,887 species. “Vascular Plants 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 1,186 of the 1,887 species in Owenby and Morley’s atlas had recorded occurrences in the North Central’s ecological assessment area (Table 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 in which significant amounts of land are remote and tough to access may not be as well represented in the database as those landscapes where access to most areas is easy.

Also of interest is the number of species with occurrences limited to a given landscape. Of the species in Owenby and Morley’s atlas, seven had recorded occurrences only in the North Central landscape (Table 8). The majority of these (57%) are on the state’s endangered/threatened/special concern list.

Table 7. Richness of vascular plants in Owenby and Morley (1991) by MFRC landscape.



MFRC Regional Landscape	Number of species ^A	1996 State List of Endangered, Threatened, and Special Concern Species ^B		
		Endangered	Threatened	Special Concern
North East	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

Source:

^AOwenby and Morley, 1991.

^BMinnesota Department of Natural Resources, 1996.

Table 8. Numbers of vascular plants in Owenby and Morley (1991) with recorded occurrence limited to a particular MFRC landscape.

MFRC Regional Landscape	Number of species ^A	1996 State List of Endangered, Threatened, and Special Concern Species ^B		
		Endangered	Threatened	Special Concern
North East	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



Source:

^AOwenby and Morley, 1991.

^BMinnesota Department of Natural Resources, 1996.

Forest-dependent vertebrates at risk

Table 9. Richness of forest-associated mammals, amphibians and reptiles, and breeding birds in Minnesota.



	All habitats Statewide	Forest associated Statewide
Mammals ^A	80	65
Amphibians and reptiles ^A	49	43
Breeding birds ^B	245	151

Source:

^AJ. R. Tester, 1995.

^BJ. C. Green, 1995.

Table 10. Status of Minnesota's forest-associated endangered, threatened, and special concern vertebrate wildlife, 1984.

Endangered	Threatened	Special concern	
Mammals —	Mammals 1. Gray wolf	Mammals 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	Amphibians and Reptiles 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
Birds —	Birds 1. Bald eagle 2. Loggerhead shrike	Birds 1. Red-shouldered hawk 2. Osprey 3. Louisiana waterthrush	
Amphibians and reptiles 1. Five-lined skink	Amphibians and reptiles 1. Wood turtle 2. Blanding's turtle		



Table 11. Status of MN's forest-associated endangered, threatened and special concern vertebrate wildlife, 1996.

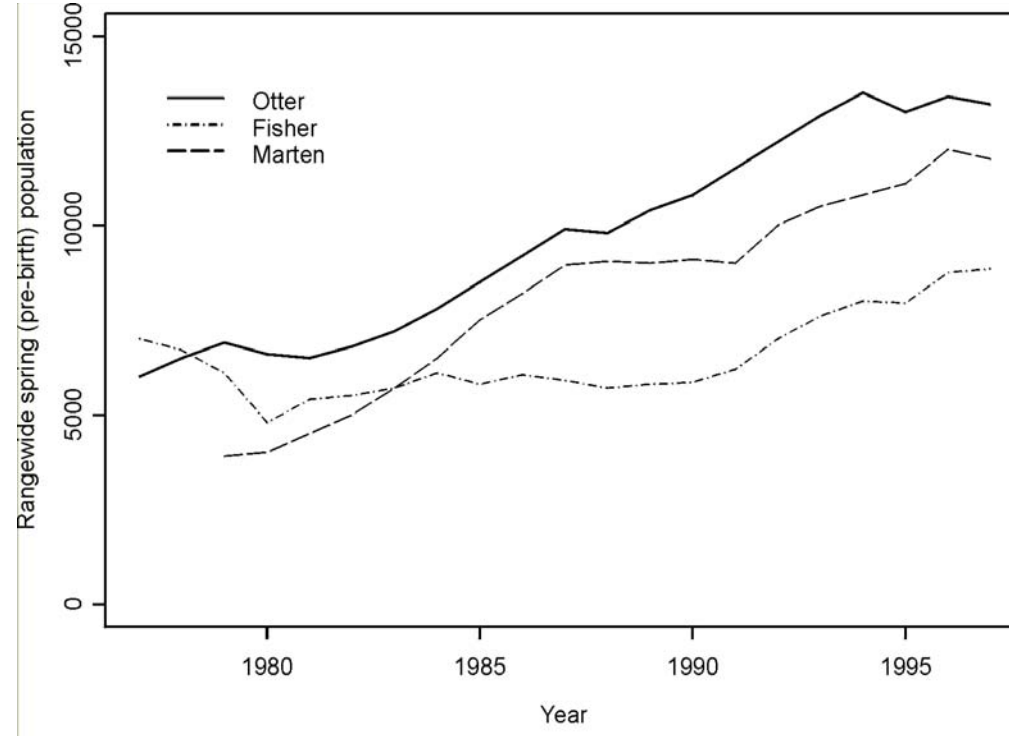


Endangered	Threatened	Special concern	
Mammals —	Mammals 1. Eastern spotted skunk	Mammals 1. Gray wolf 2. Least shrew 3. Mountain lion 4. Woodland vole 5. Least weasel 6. Northern myotis 7. Heather vole 8. Eastern pipistrelle 9. Smokey shrew 10. Northern bog lemming	Birds 1. Red-shouldered hawk 2. Cerulean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

Trends in wildlife species populations

Trends in wildlife populations were obtained from the Minnesota Department of Natural Resources Section of Wildlife. Figures 11 to 13 depict population estimates for otter, martin, fisher, bobcat, and moose.

Figure 11. Rangewide spring (pre-birth) population estimates of otter, fisher, and marten, 1977-1997.



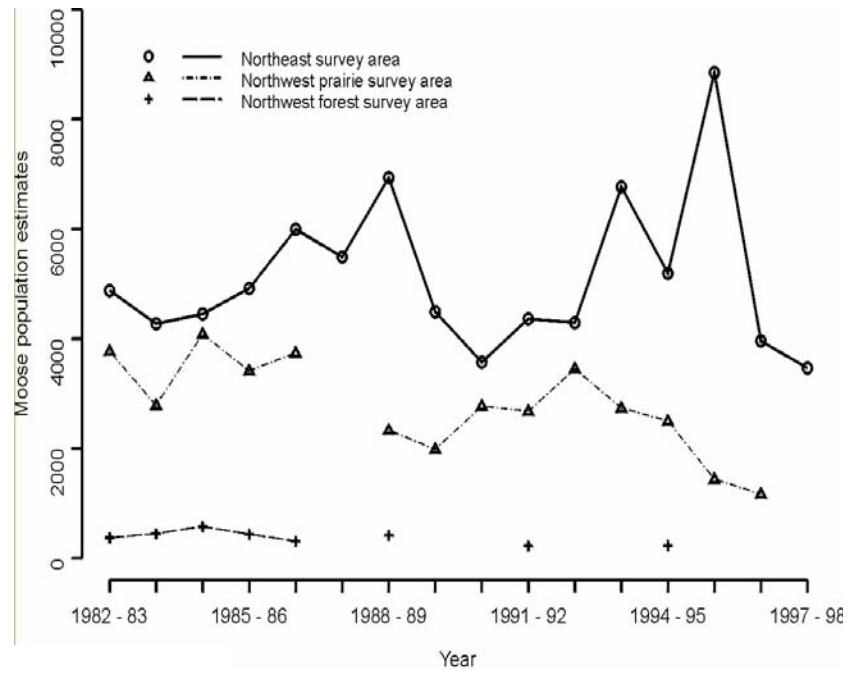
Source:
M.H. Dexter, 1998.

Figure 12. Rangewide spring (pre-birth) population estimates of bobcat, 1977-1997.



Source:
M.H. Dexter, 1998.

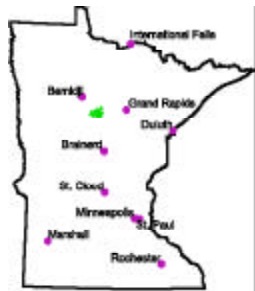
Figure 13. Moose population estimates for northern Minnesota, 1982-1998.



Source:
M.H. Dexter, 1998.

Climate

Figure 14. Leech Lake Dam precipitation, 1887-1987.



Source:
National Climate Data
Center
(www.ncdc.noaa.com).

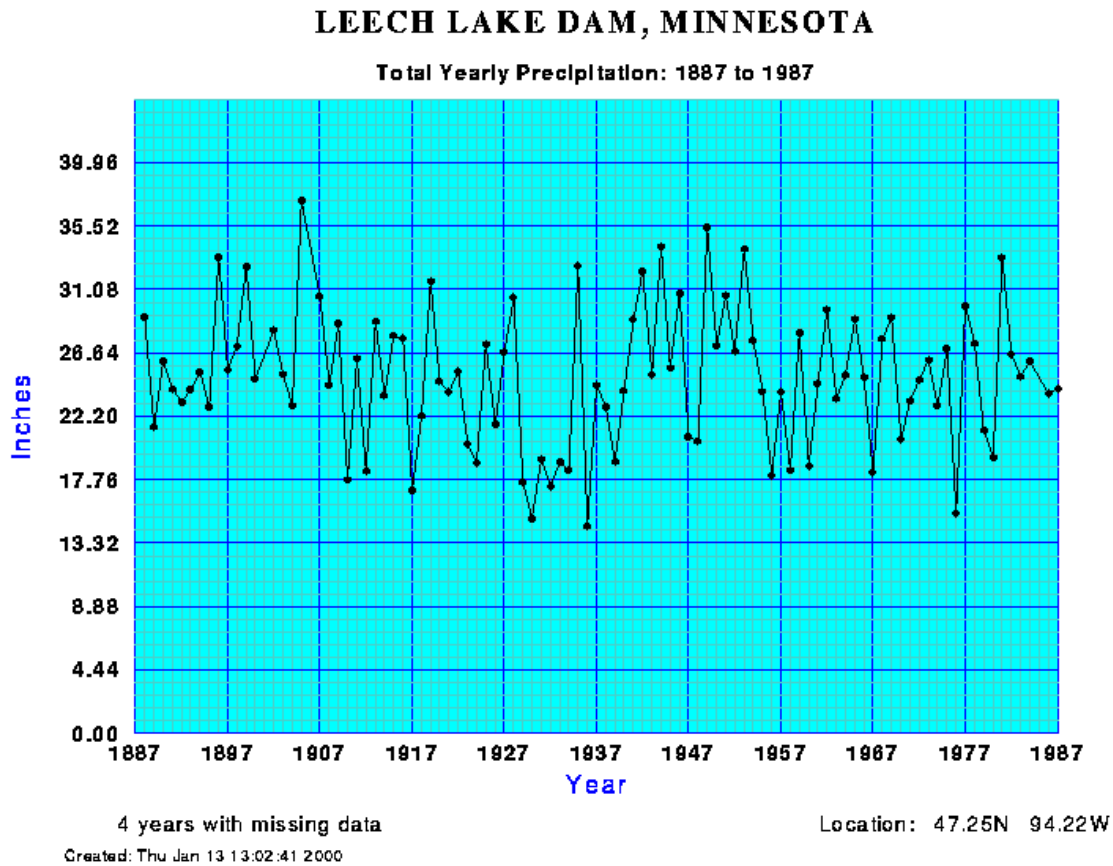
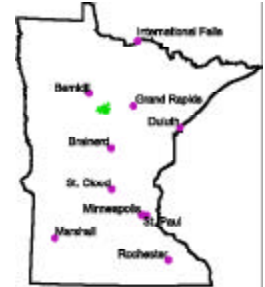
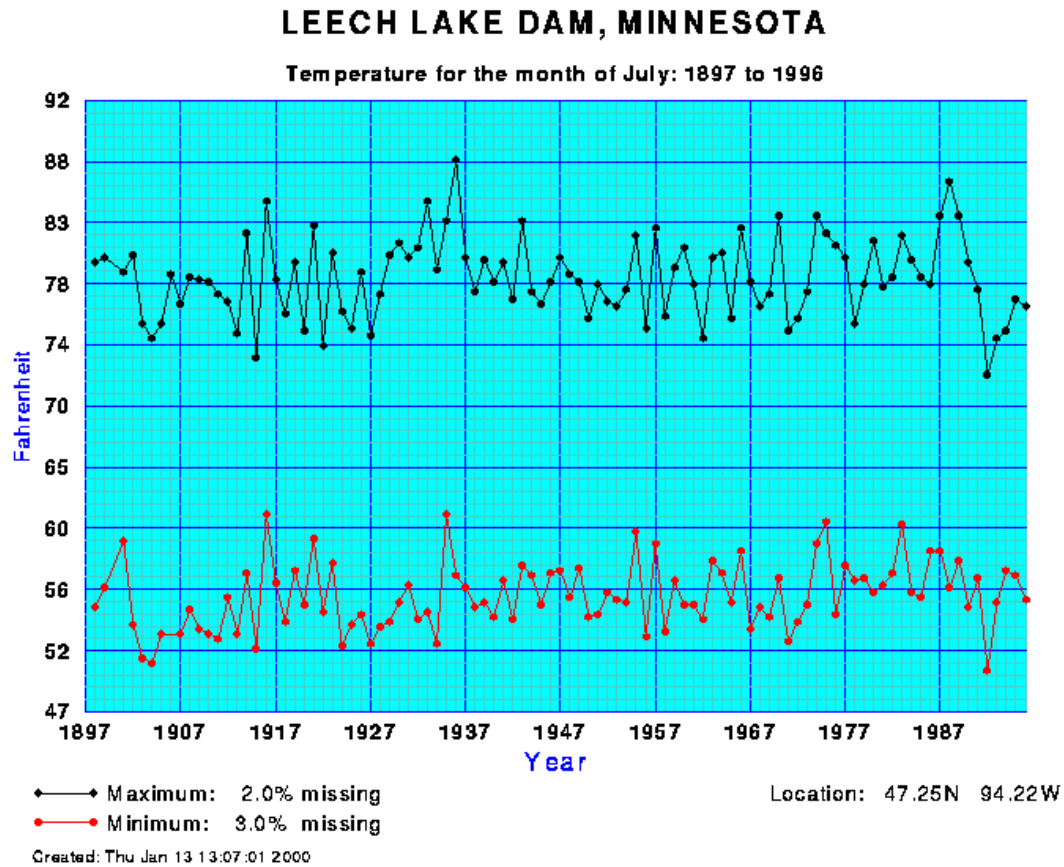
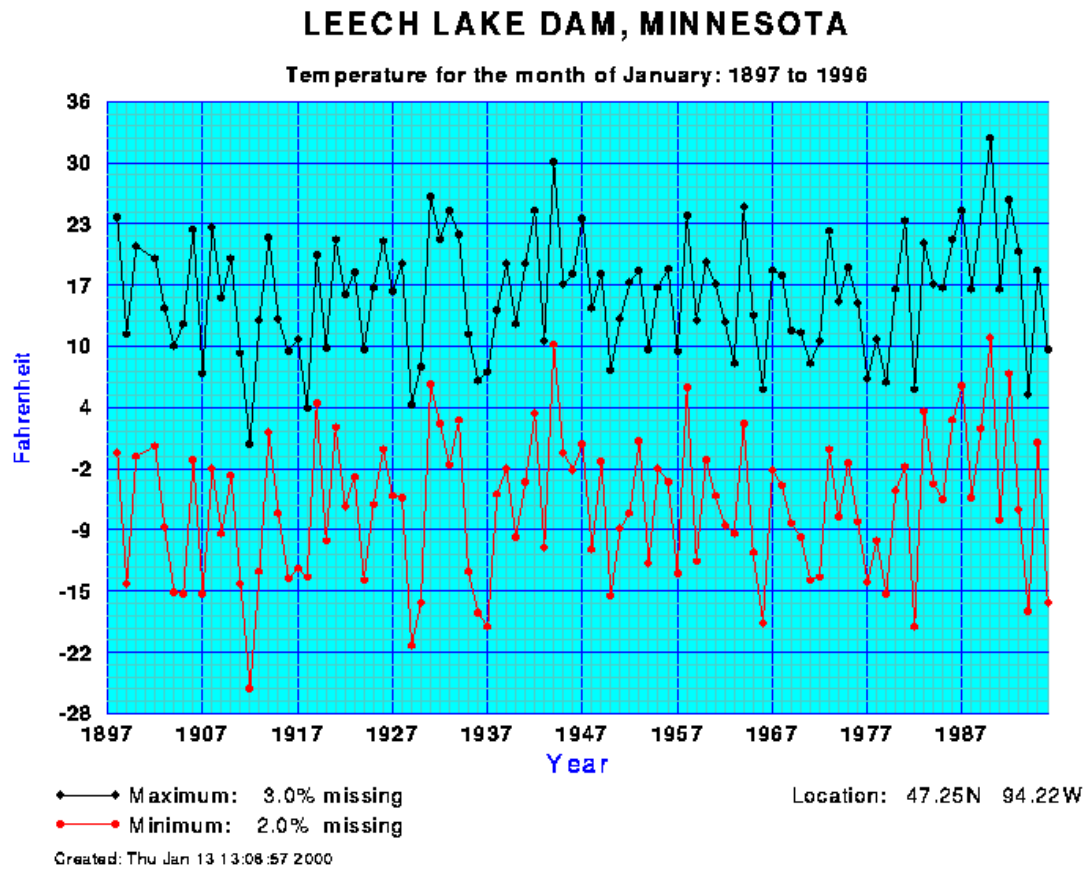
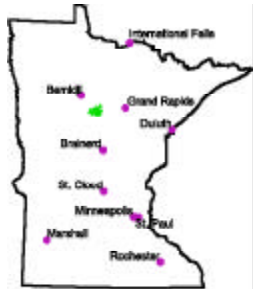


Figure 15. Leech Lake Dam July temperatures (high and low), 1897-1996.



Source:
National Climate Data
Center
(www.ncdc.noaa.com).

Figure 16. Leech Lake Dam January temperatures (high and low), 1897-1996.



Source:
National Climate Data
Center
(www.ncdc.noaa.com).

Riparian areas

Table 12. Density of waterways, by ecological subsection, in the North Central ecological landscape.

Type of Waterway	Chippewa Plains	St. Louis Moraines	Tamarack Lowlands	Pine Moraines & Outwash Plains
Perennial Stream	0.31	0.35	0.43	0.24
Intermittent Stream	0.22	0.15	0.18	0.23
Ditch	0.05	0.03	0.43	0.12
All	0.59	0.53	1.03	0.58



Source:
Minnesota Department
of Natural Resources GIS
data derived from 1980
USGS quadrangle maps.

Note:
Density equals miles of
waterway divided by
square miles of subsection

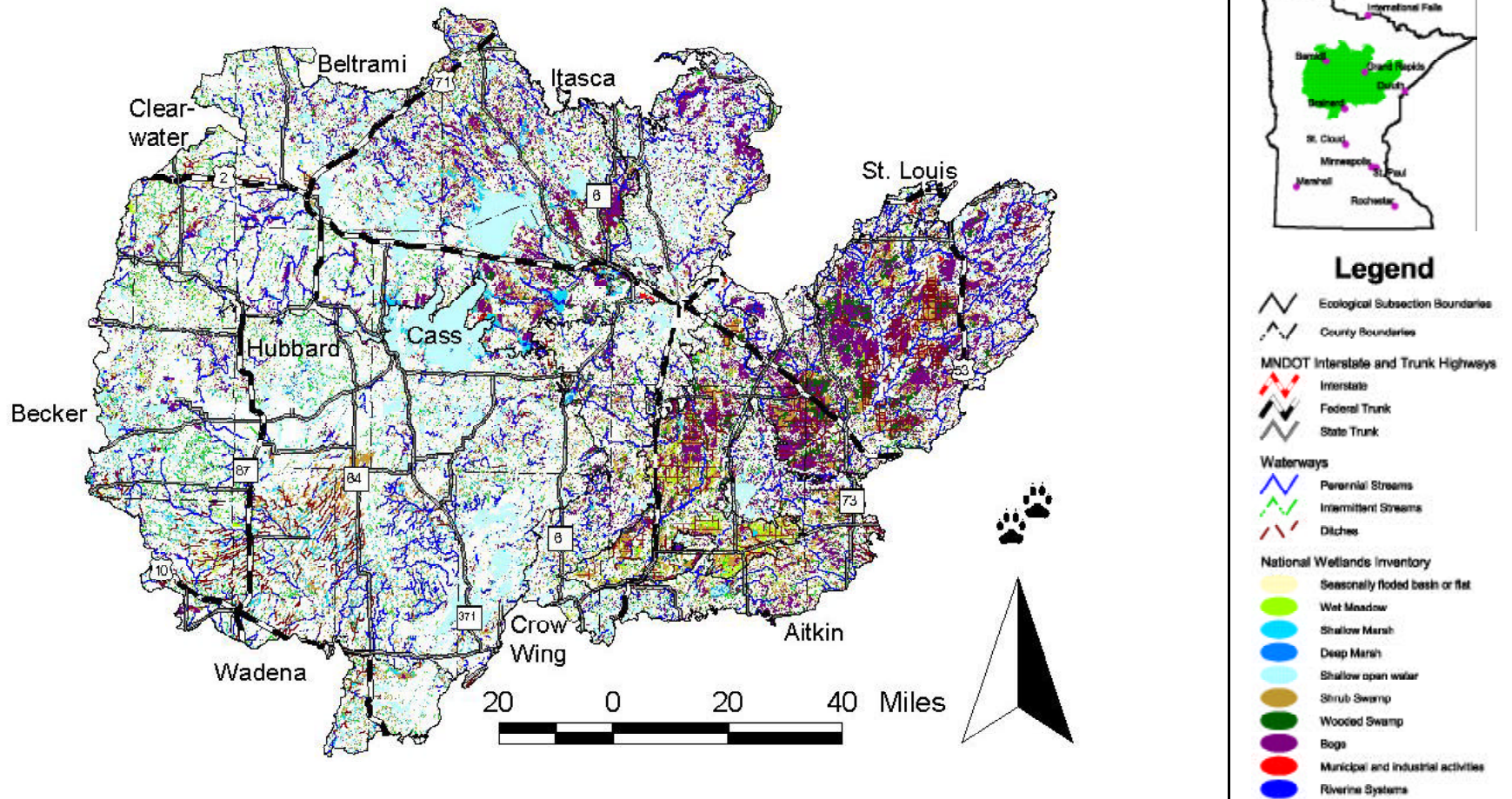
Table 13. Riparian areas classified by the National Wetlands Inventory (NWI), summarized by ecological subsections in the North Central ecological landscape.



Riparian area types	Chippewa Plains	St. Louis Moraines	Tamarack Lowlands	Pine Moraines & Outwash Plains
Seasonally flooded basin or flat	0.4%	0.1%	0.1%	0.1%
Wet meadow	1.6%	1.7%	4.0%	0.9%
Shallow marsh	4.6%	1.3%	0.6%	5.1%
Deep marsh	0.4%	0.4%	0.1%	0.4%
Shallow open water	9.9%	8.1%	1.4%	11.1%
Shrub swamp	7.5%	7.9%	14.9%	6.3%
Wooded swamps	2.4%	4.7%	9.4%	1.1%
Bogs	9.6%	11.1%	21.9%	2.7%
Municipal and industrial activities, water regime	0.1%	0.1%	0.1%	0.0%
Riverine systems, system	0.5%	0.3%	0.9%	0.5%
Uplands, system	63.0%	64.3%	46.7%	71.7%
Area outside Minnesota, system	0.0%	0.0%	0.0%	0.0%

Source:
Department of Natural Resources GIS data derived from aerial photographs taken between 1979 and 1988.

Figure 17. Waterways in North Central Minnesota.



Source:
Aerial photography, 1979-
1988, and USGS
quadrangle maps.

Minnesota County Biological Survey (MCBS)

The County Biological Survey is just beginning in the North Central landscape. It has been completed for Cass County, and will be done for Crow Wing, Aitkin, and Itasca counties by 2001. The following is an excerpt from the MCBS web page located at http://www.dnr.state.mn.us/fish_and_wildlife/mcbs.html:

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 northeast Minnesota (Red River Prairie and North Shore subsections).

Social and Economic Conditions and Trends

Ownership of Forestland

Table 14. Forestland ownership in the North Central landscape.

(Values are in thousands of acres.)



Owner	All forestland	Type of forestland		
		Timberland	Reserved forestland	Other forestland
Private ^A	2,131.0	2,113.1	2.1	15.8
Public ^B	3,345.6	3,103.1	33.4	209.1
Total	5,476.6	5,216.2	35.5	224.9

Source (Table 14):
United States Forest Service Forest Inventory and Analysis, 1990.

Source (Table 15):
^CJakes and Raile 1980
^DUnited States Forest Service Forest Inventory and Analysis, 1990.

Table 15. Forestland ownership in the Northern Pine Forest Inventory and Analysis Unit, 1977 and 1990. (Values are in thousands of acres.)



Ownership	1977 forestland area ^C	1990 forestland area ^D	Percent change 1977 to 1990
Private ^A	2,479.9	2,387.6	-3.7
Public ^B	4,032.3	3,929.5	-2.5%
Total	6,512.2	6,317.1	-3.0%

Note (Tables 14 & 15):
^APublic includes state, county, federal, and American Indian owners.
^Bincludes forest industry and nonindustrial private forest landowners.

Table 16. Ratio of public forestland to private forestland for the Northern Pine Forest Inventory and Analysis Unit, 1977 and 1990.



Ratio public to private forestland	1977 ^A	1990 ^B
Northern Pine FIA Unit	1.63	1.65
Statewide	1.5	1.46

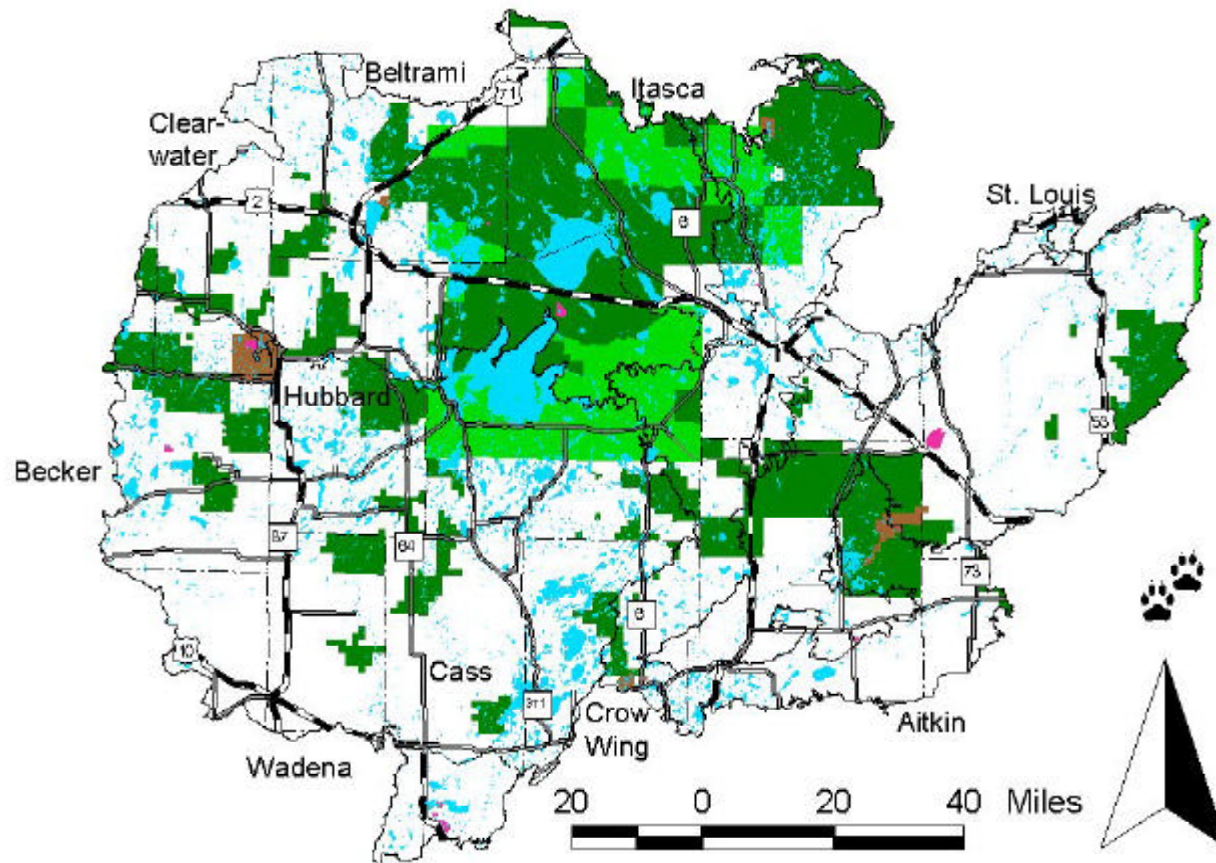
Source:

^AJakes and Raile 1980.

^BUnited States Forest Service Forest Inventory and Analysis, 1990.

Reserved lands

Figure 18. Reserved lands and forests in the North Central ecological landscape.



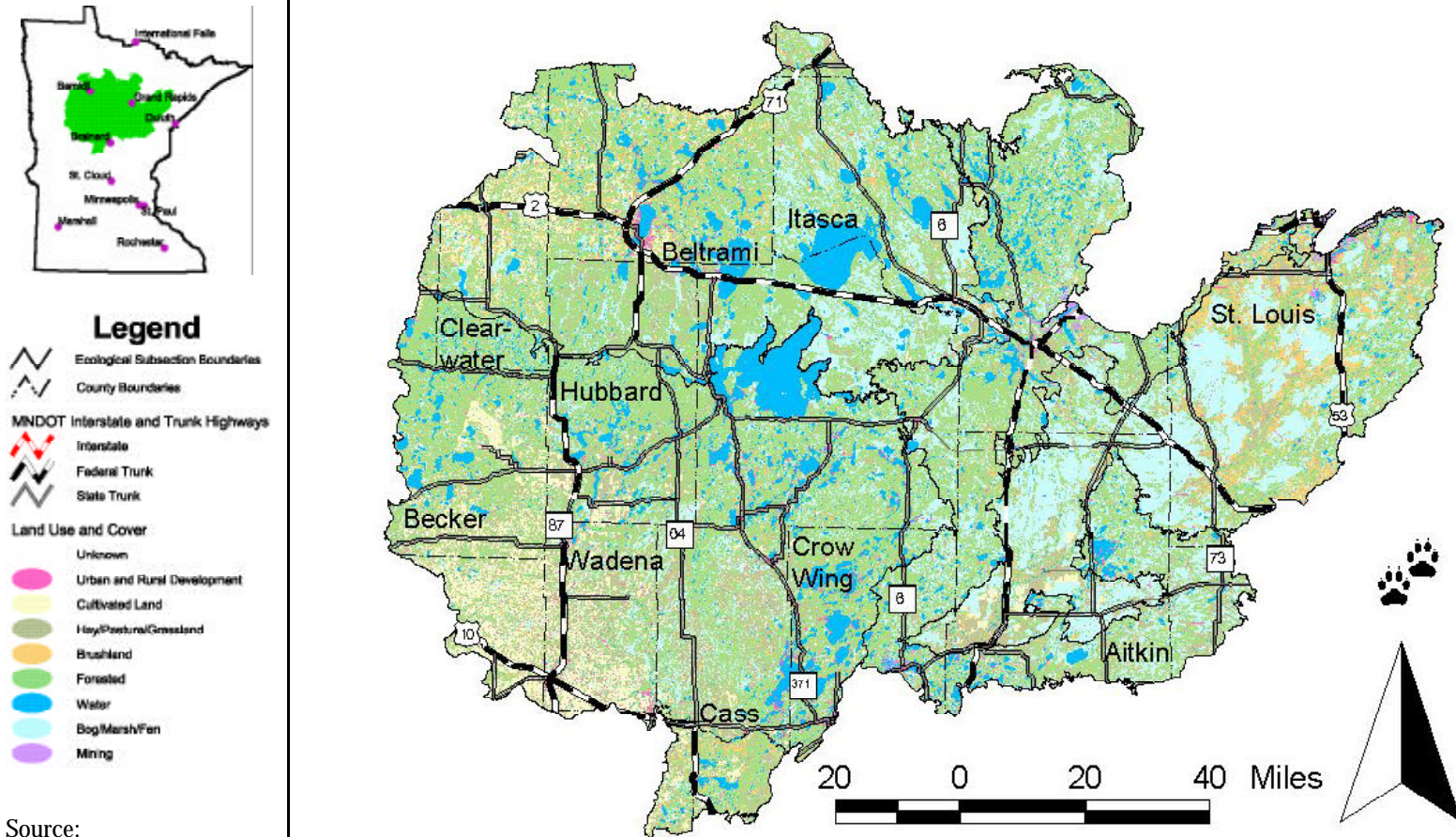
Legend

- Ecological Subsection Boundaries
- County Boundaries
- MNDOT** Interstate and Trunk Highways
 - Interstate
 - Federal Trunk
 - State Trunk
- Lakes
- Scientific and Natural Areas
- State Parks
- State Forests
- National Forests

Source:
DNR and Forest Service
management boundaries.

Land Use

Figure 19. Land use from satellite data, 1990. (See Appendix A for more information on the data.)



Ownership

Figure 20. Distribution of nonindustrial private forestland (NIPF) acres statewide by ownership class size, 1990.

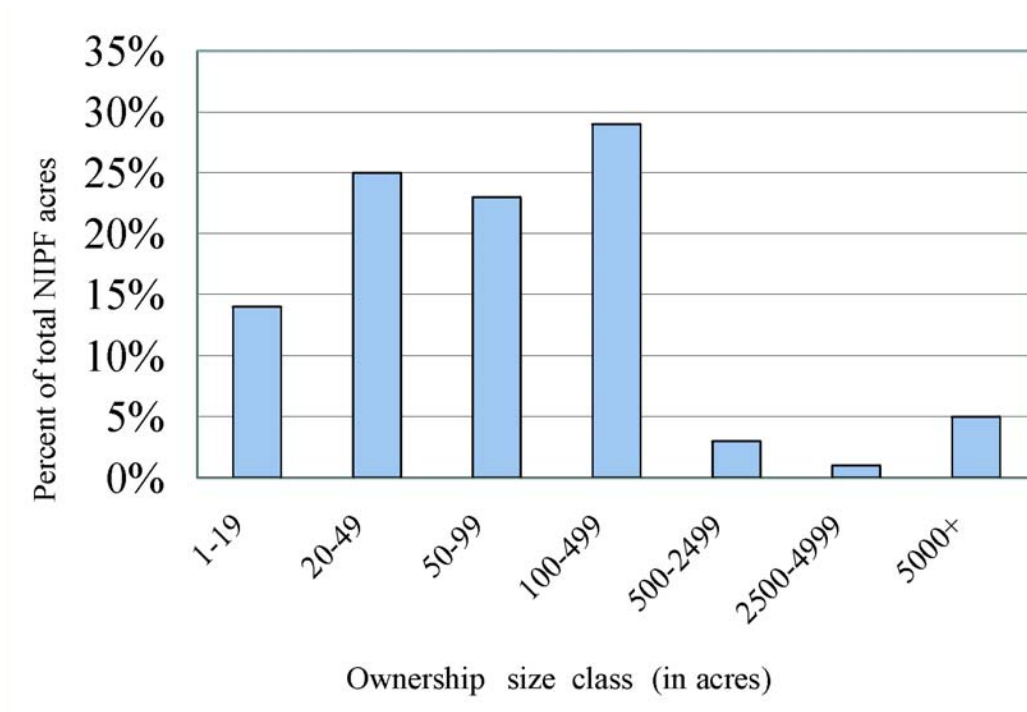
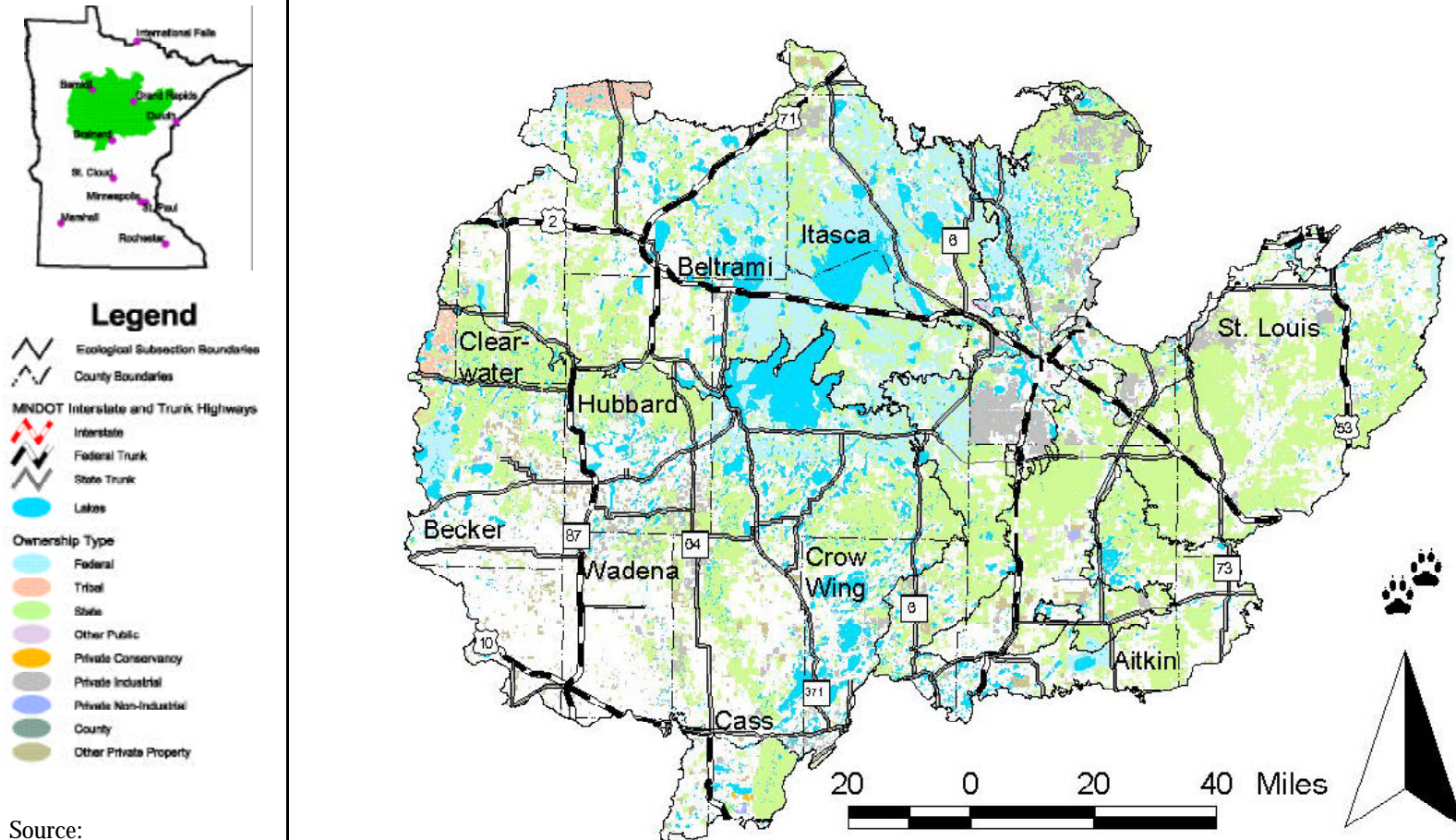


Figure 21. GAP ownership in the North Central ecological landscape.
 (See Appendix A for more information on the data.)



Source:
 Land records, 1983-1995
 (data mapped to whoever
 owns more than 50
 percent of a forty, private
 ownership of less than
 1000 acres not mapped).

Table 17. Ownership of land in the North Central ecological landscape.

Ownership Class	Acres
County	6,680
Federal	773,611
Other private property	115,163
Other Public	4,922
Private Conservancy	1,301
Private Industrial, more than 1000 acres owned within affected county	327,527
Private Non-Industrial Business or Trust, more than 1000 acres owned within affected county	6,939
State, including tax-forfeited lands under county stewardship	2,775,672
Tribal	63,552



Source:
Department of Natural Resources GIS data derived from land records predominately between 1983 and 1985.

Note:
Land interest is expressed only when some organization owns or administers more than 50 percent of a forty (acres).

Demographics

Table 18 shows the population data for Minnesota and the counties within the North Central landscape for 1970-1997. Between 1980 and 1990, the total population of the ten-county region fell by 0.2%, while Minnesota's total population increased by 7.3%. Some counties lost population while others experienced population growth. Mahnommen County experienced the largest decrease in population (-8.9%), while Beltrami County's population increased by almost 11%. Between 1990 and 1997, the North Central region experienced an 8.4% increase in total population, while Minnesota's population increased by 8.3%. All ten counties in the region experienced an increase in population, with

Aitkin, Cass, Crow Wing, and Hubbard Counties experiencing double digit increases. For individual counties in the region, population growth ranged from a modest 1% (Polk) to a rather vigorous 14.3% (Crow Wing).

According to 1990 U.S. Census Bureau data, the ten-county North Central region had a population density of 15.4 people per square mile, while the state of Minnesota's population density was 55 people per square mile. Although, the average 1990 population density of the North Central landscape is relatively sparse in comparison to the state average, it is important to keep in mind that this regional average combines the data from ten counties with varying population densities.

Table 18. Population of Minnesota and counties in the North Central landscape, 1970s to 1990s.^A

	1970	1980	1990	1980-1990 % Change	1997 ^A	1990-1997 % Change	1990 Population Density (people/mi ²)
Minnesota	3,806,103	4,075,970	4,375,099	7.34	4,735,830	8.25	55.0
North Central	208,496	242,801	242,383	-0.17	262,618	8.35	15.4
Aitkin	11,403	13,404	12,425	-7.30	13,949	12.27	6.8
Becker	24,372	29,336	27,881	-4.96	29,394	5.43	21.3
Beltrami	26,373	30,982	34,384	10.98	37,615	9.40	13.7
Cass	17,323	21,050	21,791	3.52	24,531	12.57	10.8
Clearwater	8,013	8,761	8,309	-5.16	8,467	1.90	8.4
Crow Wing	34,826	41,722	44,249	6.06	50,578	14.30	44.4
Hubbard	10,583	14,098	14,939	5.97	16,717	11.90	16.2
Itasca	35,530	43,069	40,863	-5.12	43,337	6.05	15.3
Mahnomen	5,638	5,535	5,044	-8.87	5,222	3.53	9.1
Polk	34,435	34,844	32,498	-6.73	32,808	0.95	16.5

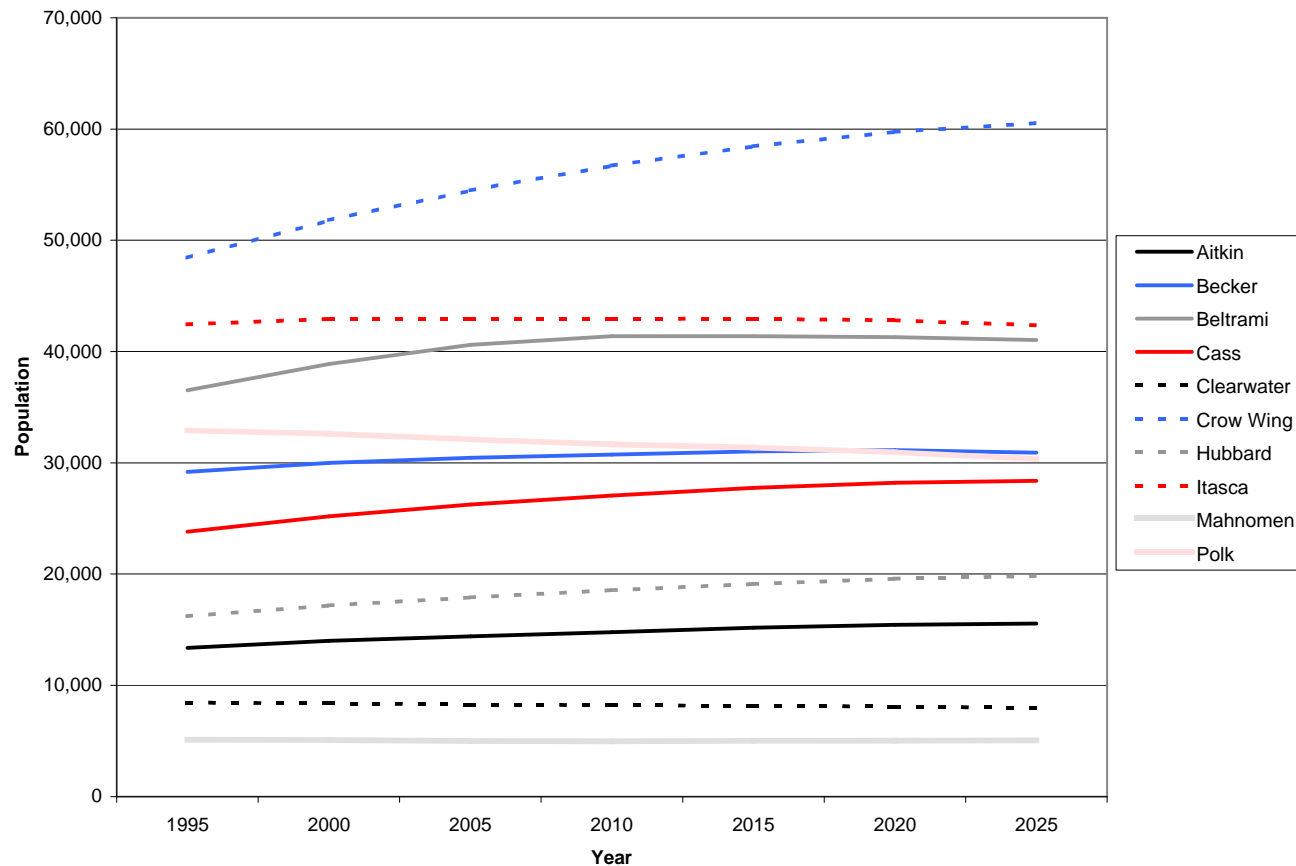


Source:
^AUnited States Census Bureau 1990.
^BMinnesota State Demographic Center.

Figure 22 shows population projections for the ten counties in the North Central landscape. The projections show that Aitkin, Becker, Beltrami, Cass, Crow Wing, and Hubbard Counties will experience

an increase in total population between 1995 and 2025. The other counties are projected to lose population during this time period.

Figure 22. Population projections for counties in the North Central landscape, 1995-2025.



Source:
Minnesota State
Demographic Center.

Note:
The 1995 data is a
United States Census
Bureau estimate that was
used to create the
population projections
through 2025.

Table 19 shows population projection data for Minnesota and counties in the North Central landscape for 1995-2025. Minnesota is expected to experience a 14.2% gain in total population by 2025, while the North Central landscape is expected to

experience a 10% gain in total population. Aitkin, Beltrami, Cass, Crow Wing, and Hubbard Counties are expected to experience double-digit increases in total population.

Table 19. Population projections for Minnesota and the North Central landscape , 1995-2025.

	1995 ^A	2025	1995-2025 % Change
Minnesota	4,626,514	5,282,840	14.19
North Central	256,429	282,000	9.97
Aitkin	13,366	15,550	16.34
Becker	29,163	30,920	6.02
Beltrami	36,508	41,050	12.44
Cass	23,801	28,380	19.24
Clearwater	8,452	7,990	-5.47
Crow Wing	48,437	60,530	24.97
Hubbard	16,225	19,830	22.22
Itasca	42,446	42,360	-0.20
Mahnomen	5,127	5,060	-1.31
Polk	32,904	30,330	-7.82



Source:
Minnesota State
Demographic Center.

Note:
^AThe 1995 data is a
United States Census
Bureau estimate that
was used to create the
population projections
through 2025.

Table 20 shows population projections by age group for Minnesota and the North Central landscape. 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 North Central



Table 20. Population projection by age group for Minnesota and the North Central landscape, 1995-2025.

Age Group	Minnesota			North Central Region		
	1995 ^A	2025	1995-2025 % Change	1995 ^A	2025	1995-2025 % Change
0-24	1,678,036	1,506,390	-10.2	90,515	79,960	-11.7
25-64	2,369,249	2,735,390	15.5	122,250	128,970	5.5
65-85+	579,229	1,041,060	79.7	43,664	73,070	67.3
Total	4,626,514	5,282,840	14.2	256,429	282,000	10.0

Source:
Minnesota State
Demographic Center.

Note:
^AThe 1995 data is a U.S.
Census Bureau estimate
that was used to create
the population
projections through
2025.

region, where 47.7% of the region's population was in this age range in 1995, and by the year 2025, only 45.7% of the population will be in the 25 to 64 year 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, it was 12.5% in Minnesota and 17% in the North Central region. The population projections show that by the year 2025, 19.7% of Minnesota's population will be at least 65 years old, while 25.9% of the population in the North Central will be at least 65 years old.

The significantly higher percentages in the North Central region may be an indication of a combination of the aging of the resident population and the in-migration of retirees from areas outside the region. A significantly older population may put a strain on the social services sector of the North Central region's economy. However, an aging resident population and in-migration of retirees may actually lead to opportunities for economic development, perhaps in the construction, social services, health services, retail trade, and government sectors of the economy.

Table 21 shows the poverty rates for Minnesota and the ten counties in the North Central region for 1990. The North Central region had an overall poverty rate of 18%, while Minnesota's poverty rate was 10.2%. In 1990, all ten counties in

Table 21. Persons with incomes below the poverty level, 1990.

Region	% of Population Below Poverty Level
Minnesota	10.2
North Central	18.0
Aitkin	18.7
Becker	17.8
Beltrami	24.0
Cass	21.8
Clearwater	22.7
Crow Wing	15.0
Hubbard	17.2
Itasca	15.8
Mahnomen	26.0
Polk	14.4



Source:
United States Census
Bureau, 1990.

the region had significantly high levels of poverty, ranging from a low of 14.4% in Polk County to a high of 26% in Mahnomen County. Four of the ten counties had poverty rates over 20%.

Although the poverty rates are significantly higher in the ten-county region, there has been some progress with regard to the growth of per capita

personal income (See Table 22). All ten counties in the North Central region had per capita personal income levels below the Minnesota average for the entire time period. However, during the 1990-1996 time period, most of the counties in the North Central region experienced income growth rates of at least 30%.

Table 22. Per capita personal income for Minnesota and counties in the North Central landscape, 1990-1996.



Source:
Minnesota State
Demographic Center.

	1990	1995	1996	% Growth 1995-1996	% Growth 1990-1996
Minnesota	19,373	24,097	25,699	6.7	32.7
Aitkin	12,840	16,341	17,032	4.2	32.7
Becker	13,723	16,595	18,161	9.4	32.3
Beltrami	13,002	16,165	17,025	5.3	30.9
Cass	13,243	16,393	17,083	4.2	29.0
Clearwater	11,542	14,367	15,643	8.9	35.5
Crow Wing	15,094	18,836	19,776	5.0	31.0
Hubbard	12,701	16,082	16,919	5.2	33.2
Itasca	13,665	16,837	17,530	4.1	28.3
Mahnomen	12,385	13,747	16,568	20.5	33.8
Polk	15,507	17,354	19,309	11.3	24.5

Observations

- Between 1990 and 1997, the total population in the North Central region increased by 8.4%. Aitkin (12.3%), Cass (12.6%), Crow Wing (14.3%), and Hubbard (11.9%) Counties experienced a double-digit increase in total population.
- Between 1995 and 2025, the North Central region is projected to experience a 10% increase in total population. Aitkin (16.3%), Beltrami (12.4%), Cass (19.2%), Crow Wing (25%), and Hubbard (22.2%) Counties are expected to experience a double-digit increase in total population.
- Population projections show an aging resident population and in-migration of retirees from outside the region. The projections indicate an increase in the percentage of the population over the age of 65. In 1995, it was 17%, and by the year 2025, 25.9% of the population in the North Central region will be at least 65 years old.
- A significantly older population may put a strain on the social services sector of the Northeast's economy. However, an aging resident population and in-migration of retirees from elsewhere may actually lead to opportunities for economic development, perhaps in the construction, social services, health services, retail trade, and government sectors of the economy.
- According to 1990 U.S. Census Bureau data, the North Central region had a relatively high level of poverty.

Employment

Employment data is defined as employment covered by social security and reported by place of work (as opposed to place of residence data used in the census). 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 is used, individual businesses opting 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 encountered in gathering county-level data. These laws prevent data from being released that would

make it possible to identify a specific business within a geographic area. This results in incomplete or absent data for many industry categories.

Because of the limitations of SIC codes and data availability, only major industry categories were included in this assessment. These industries include the following:

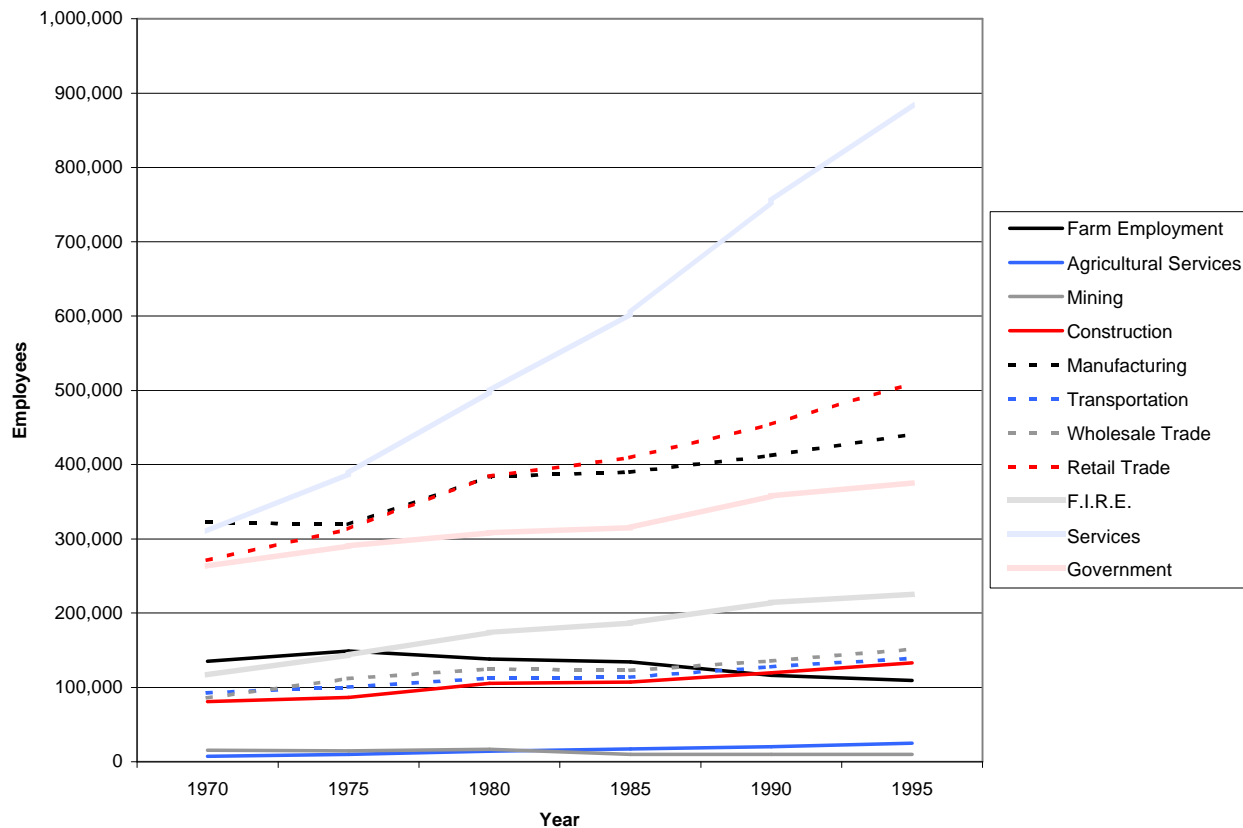
- Agricultural Services, Forestry, and Fishing
- Construction
- Farming
- Finance, Insurance, and Real Estate (F.I.R.E.)
- Government (state, local, military, and federal including USFS employees)
- Manufacturing (includes lumber and wood products; furniture and fixtures; and paper and allied products)
- Mining (includes metal, coal, oil and gas extraction; and nonmetallic minerals)
- Retail Trade
- Services (includes hotels and lodging places)
- Transportation and Public Utilities
- Wholesale Trade

Figure 23 shows the number of employees by major industry for Minnesota. This graph clearly shows the dramatic increase in employment in the services sector between 1970 and 1995. There also has been a significant increase in employment in the retail trade and manufacturing sectors. Farm

employment has steadily fallen from almost 150,000 in 1975 to just under 110,000 in 1995. Employment in the agricultural services and mining industries has remained fairly constant during this time period.

Figure 24 shows the number of employees by major industry for the North Central region. This

Figure 23. Number of employees by major industry for Minnesota, 1970-1995.



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

graph shows that there were significant gains in employment in the services, retail trade, and government sectors of the economy. Agricultural services employment, which includes forestry, made modest gains during the 25-year time period. Farm employment fell steadily between 1980 and 1995.

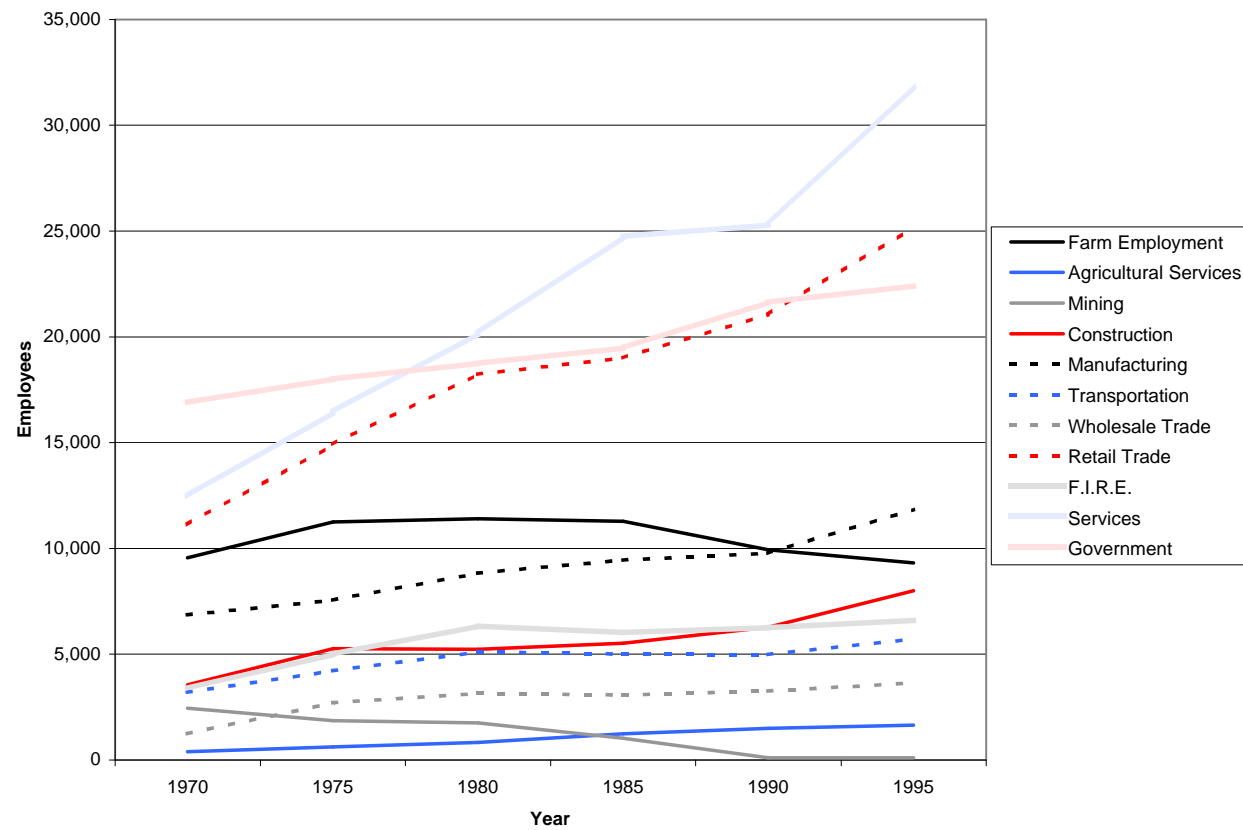
Overall, most industrial sectors in the North Central region experienced an increase in employment between 1970 and 1995.

Although Figure 24 shows that the mining industry experienced a major decrease in employment between 1970 and 1995, REIS data

Figure 24. Number of employees by major industry for the North Central landscape, 1970-1995.



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

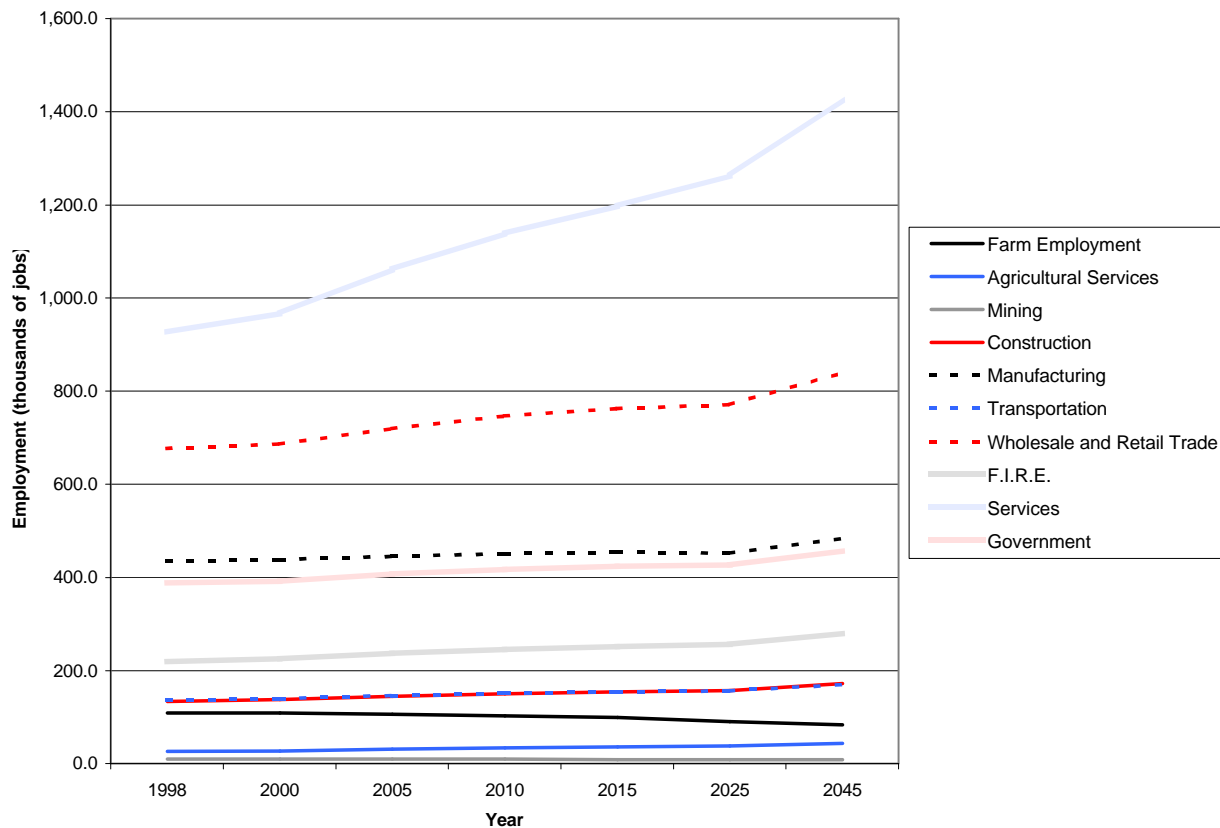


for mining was not disclosed for Itasca County for 1990 and 1995. This is significant because Itasca County has consistently led the region in mining employment. For example, the total mining employment for the North Central region was 2,437 in 1970, of which 2,355 were employed in Itasca

County alone. Itasca County’s mining employment fell from 2,355 in 1970 to 915 in 1985, but no employment data were disclosed for 1990 and 1995.

Figure 25 shows projected employment for 1998 to 2045 by major industry in Minnesota. This graph shows that, at the state level, the service

Figure 25. Projected employment by major industry for Minnesota, 1998-2045.



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

industry will continue to dramatically expand and increase its number of employees. Employment in agricultural services and mining is expected to remain constant, while farm employment is projected to steadily decrease during this time period.

The data in Table 23 indicate that in 1995, the dominant employment sectors in the North Central region were services, retail trade, and government, which together accounted for almost 60% of total employment in the region.

Table 23. Number of employees by major industry in the North Central landscape, 1995.



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

Industry	Number of Employees	Percent of Total
1. Services	31,867	23.8
2. Retail Trade	25,188	18.8
3. Government	22,404	16.7
4. Manufacturing	11,844	8.8
5. Farm Employment	9,320	7.0
6. Construction	7,999	6.0
7. Finance, Insurance, and Real Estate	6,596	4.9
8. Transportation and Public Utilities	5,714	4.3
9. Wholesale Trade	3,628	2.7
10. Agricultural Services, Forestry, Fishing	1,632	1.2
11. Mining	108	0.1
Unclassified	7675	5.7
Total	133,975	100.0

Table 24 shows the projected employment by major industry for the Minnesota Department of Economic Security (MDES) Northeast Projection Area (which includes Aitkin and Itasca counties of

the North Central regional landscape). The projections show that the dominant employment sectors will be services, retail trade, government, and manufacturing.

Table 24. Projected employment by major industry, Northeast Projection Area^A, 1994-2005.

Industry	1994 Estimated Employment	2005 Projected Employment	1994-2005 Percent Change	1994-2005 Numeric Change	Region's % of 1994 State Employment
Total – All Industries	140,600	156,850	12	16,250	6
Agriculture, Forestry, Fishing	1,540	1,540	0	0	2
Mining	5,810	6,200	7	390	77
Construction	4,440	4,870	10	430	5
Manufacturing	13,720	14,370	5	650	3
Transportation	6,650	6,710	1	60	6
Wholesale Trade	4,540	4,440	-2	-100	3
Retail Trade	27,070	29,780	10	2,710	6
Finance, Insurance, Real Estate	4,360	4,600	6	240	3
Services	48,150	57,940	20	9,790	6
Government	13,270	14,460	9	1,190	8
Self-Employed/Unpaid Family	11,060	11,950	8	890	7



Source:
Minnesota Department
of Economic Security.

Note:
^AThe Minnesota
Department of
Economic Security
Northeast Projection
Area includes the
following counties
(those underlined are in
the MFRC North
Central landscape
region): Aitkin,
Carlton, Cook, Itasca,
Koochiching, Lake, and
St. Louis.



Table 25 shows the projected employment by major industry for the MDES Northwest Projection Area (which includes Becker, Beltrami, Cass, Clearwater, Crow Wing, Hubbard, Mahnomen and

Polk counties of the North Central regional landscape). These projections show that the dominant employment sectors will be services, retail trade, and manufacturing.

Table 25. Projected employment by major industry, Northwest Projection Area^A, 1994-2005.

Source:
Minnesota Department
of Economic Security.

Note:
^AThe Minnesota
Department of
Economic Security
Northwest Projection
Area includes the
following counties
(those underlined are in
the MFRC North
Central landscape
region): Becker,
Beltrami, Cass, Clay,
Clearwater, Crow Wing,
Douglas, Grant,
Hubbard, Kittson, Lake
of the Woods,
Mahnomen, Marshall,
Morrison, Norman,
Otter Tail, Pennington,
Polk, Pope, Red Lake,
Roseau, Stevens, Todd,
Traverse, Wadena, and
Wilkin.

Industry	1994 Estimated Employment	2005 Projected Employment	1994-2005 Percent Change	1994-2005 Numeric Change	Region's % of 1994 State Employment
Total - All Industries	216,620	241,040	11	24,420	9
Agriculture, Forestry, Fishing	18,460	17,020	-8	-1,440	23
Mining	250	230	-8	-20	3
Construction	6,980	7,420	6	440	9
Manufacturing	27,020	32,320	20	5,300	7
Transportation, Public Utilities	7,250	6,790	-6	-460	6
Wholesale Trade	8,250	8,360	1	110	6
Retail Trade	36,940	41,390	12	4,450	9
Finance, Insurance, Real Estate	6,020	6,410	6	390	4
Services	66,870	78,880	18	12,010	8
Government	17,060	18,550	9	1,490	11
Self-Employed/Unpaid Family	21,520	23,680	10	2,160	13

Table 26 shows the unemployment rates for the United States, Minnesota, and counties in the North Central region. These data indicate that, although there has been a steady improvement in the

unemployment rates between 1990 and 1998 in most counties in north central Minnesota; the rates are still relatively high for several counties, in particular Clearwater, Mahnomen, and Aitkin.

Table 26. Percent unemployed for Minnesota and counties in the North Central landscape, 1990-1998.

Region/ County	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
Aitkin	10.8	11.2	12.1	12.4	10.3	9.4	9.7	8.4	7.5
Becker	7.6	7.6	11.4	11.3	7.9	7.6	8.1	7.4	5.6
Beltrami	7.7	7.9	8.0	7.8	6.6	6.5	7.3	6.2	4.5
Cass	10.0	9.5	10.2	10.3	8.4	8.2	9.1	7.4	5.6
Clearwater	16.9	17.4	18.2	18.8	14.9	15.0	15.1	13.0	10.8
Crow Wing	7.3	7.2	8.0	8.1	6.6	6.2	6.8	5.8	4.5
Hubbard	9.5	9.0	9.6	9.4	7.8	6.8	8.3	6.6	4.9
Itasca	10.7	10.1	11.7	12.6	11.6	9.5	9.7	8.6	6.4
Mahnomen	11.8	11.5	8.8	9.8	7.8	7.0	9.5	9.7	8.5
Polk	7.3	6.0	6.1	5.9	5.6	5.0	5.8	5.6	3.5



Source:
Minnesota Department
of Economic Security.

Table 27 shows the county breakdown of MN Logger Education Program (MLEP) membership as of December 31, 1997. These data indicate the county where the logging businesses are located, not the county that they've indicated for their directory

listing. Over 50% of MLEP's members are in the North Central region (177 of 346 members or 51.2%).

Table 27. Minnesota Logger Education Program membership by county, 1998.

County	Number of MLEP Members
Aitkin	18
Becker	2
Beltrami	44
Benton	1
Carlton	19
Cass	19
Clearwater	12
Crow Wing	12
Fillmore	2
Goodhue	1
Hubbard	21
Itasca	48
Kanabec	1
Koochiching	38

County	Number of MLEP Members
Lake	8
Lake of the Woods	7
Marshall	1
Mille Lacs	7
Morrison	4
Olmsted	1
Pine	8
Polk	1
Roseau	3
St. Louis	59
Todd	1
Wadena	6
Douglas County, Wisconsin	2
Total	346

Source:
Minnesota Logger
Education Program
Logging Professional
Membership Directory,
1998.

Observations

- In 1995, the dominant employment sectors in the North Central region were services, retail trade, and government, which together accounted for almost 60% of total employment in the region.
- Employment projections show that by the year 2005, the dominant employment sectors will be services, retail trade, government, and manufacturing.
- In 1998, Aitkin (7.5%), Clearwater (10.8%), and Mahnommen (8.5%) Counties still had relatively high unemployment rates.

Economic Production and Financial Data

Figure 26 shows statewide earnings by major industry for the 1970-1995 time period. These data show that the services and manufacturing sectors of the economy have experienced the most significant

earnings and the largest rate of increase since 1970. Mining joins agricultural services with low but constant earnings during the 25-year period, while the farm sector shows a significant decrease in earnings between 1990 and 1995.

Figure 26. Earnings by major industry for Minnesota, 1970-1995.



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

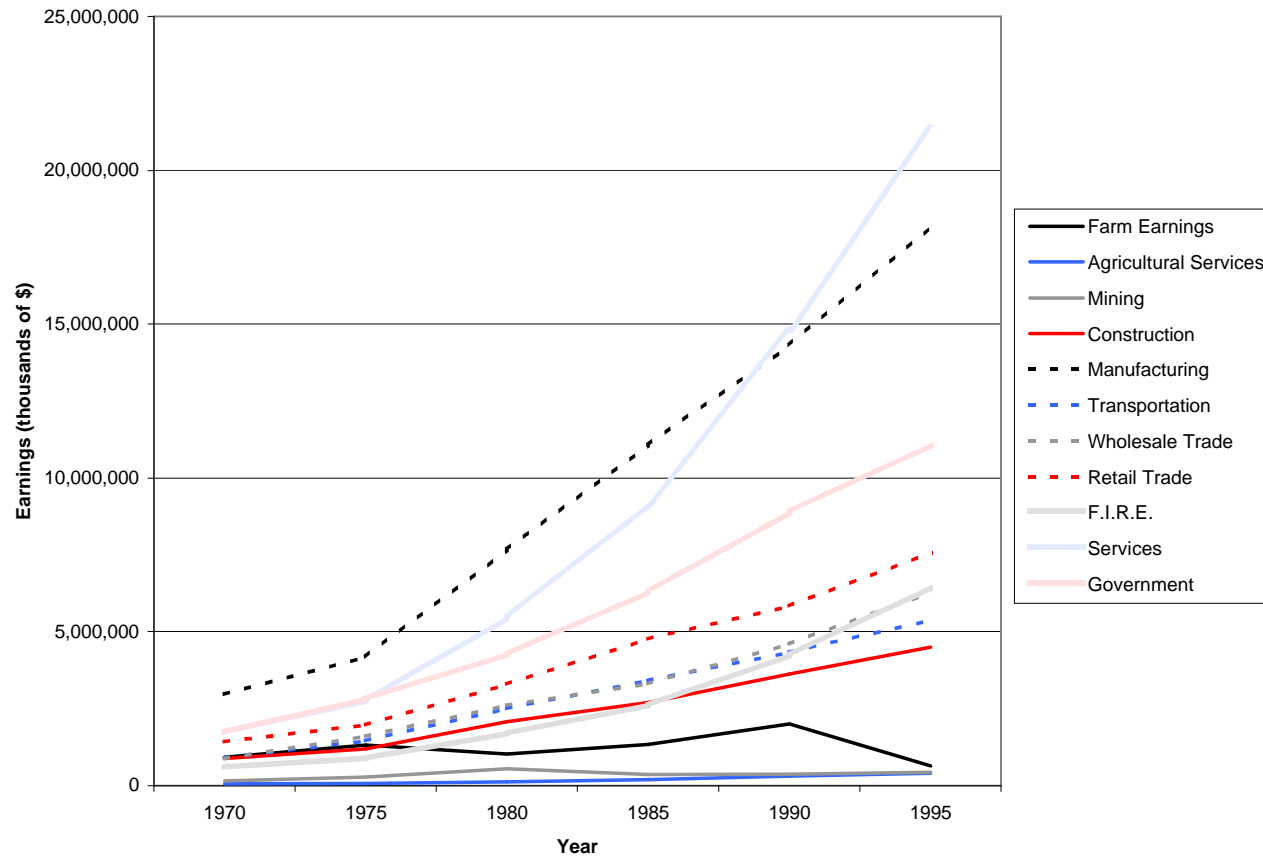
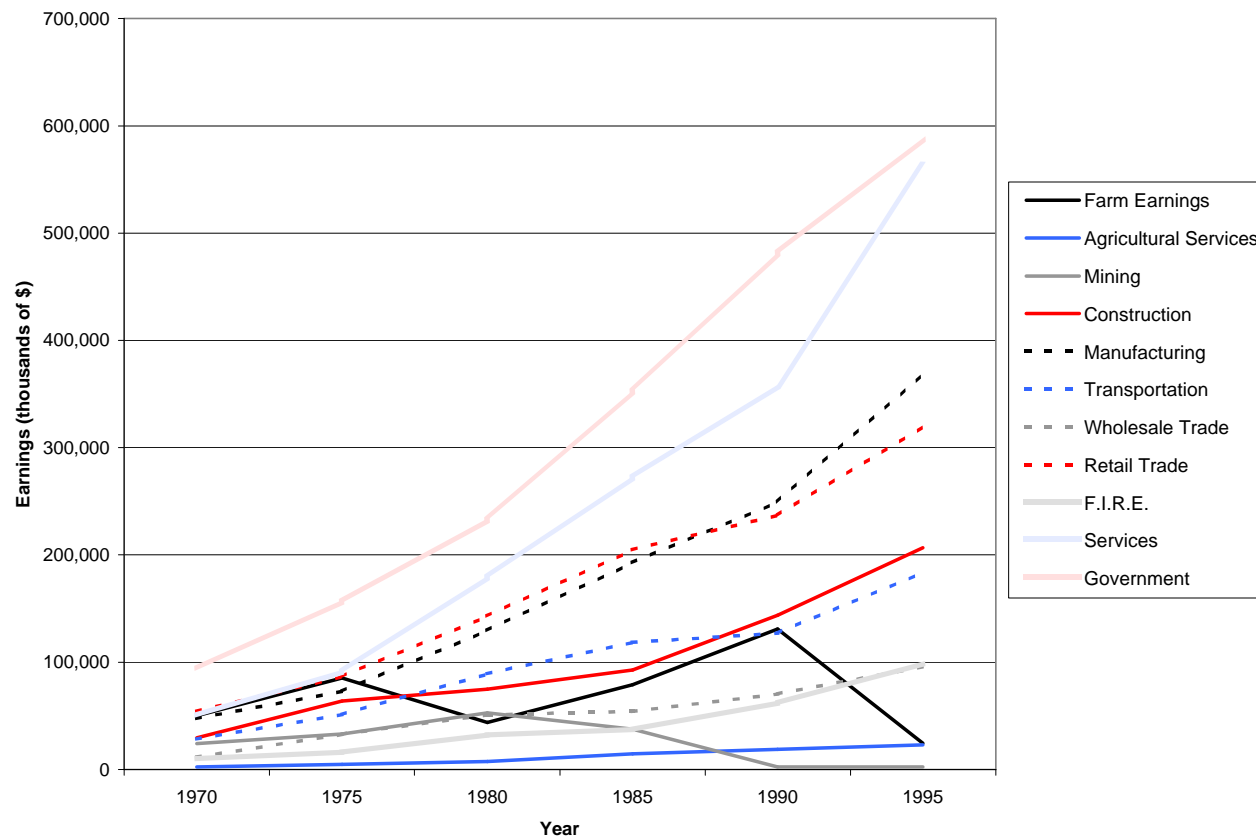


Figure 27 shows the earnings by major industry for the North Central region from 1970 to 1995. These data show that the government and services sectors of the economy experienced the greatest earnings and the largest rate of growth during this 25-year period. Farm earnings in the region have varied

greatly between 1970 and 1995, reaching a high of \$130.8 million in 1990 and then falling to \$24.5 million in 1995. Agricultural services earnings have remained fairly constant during the 25-year period. Although Figure 27 shows that the mining industry experienced a major decrease in earnings

Figure 27. Earnings by major industry for the North Central landscape, 1970-1995.



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

between 1980 and 1990, Regional Economic Information System (REIS) earnings data for mining were not disclosed for Itasca County for 1990 and 1995. This is significant because Itasca County has consistently led the region in mining earnings. For example, the total mining earnings for the North

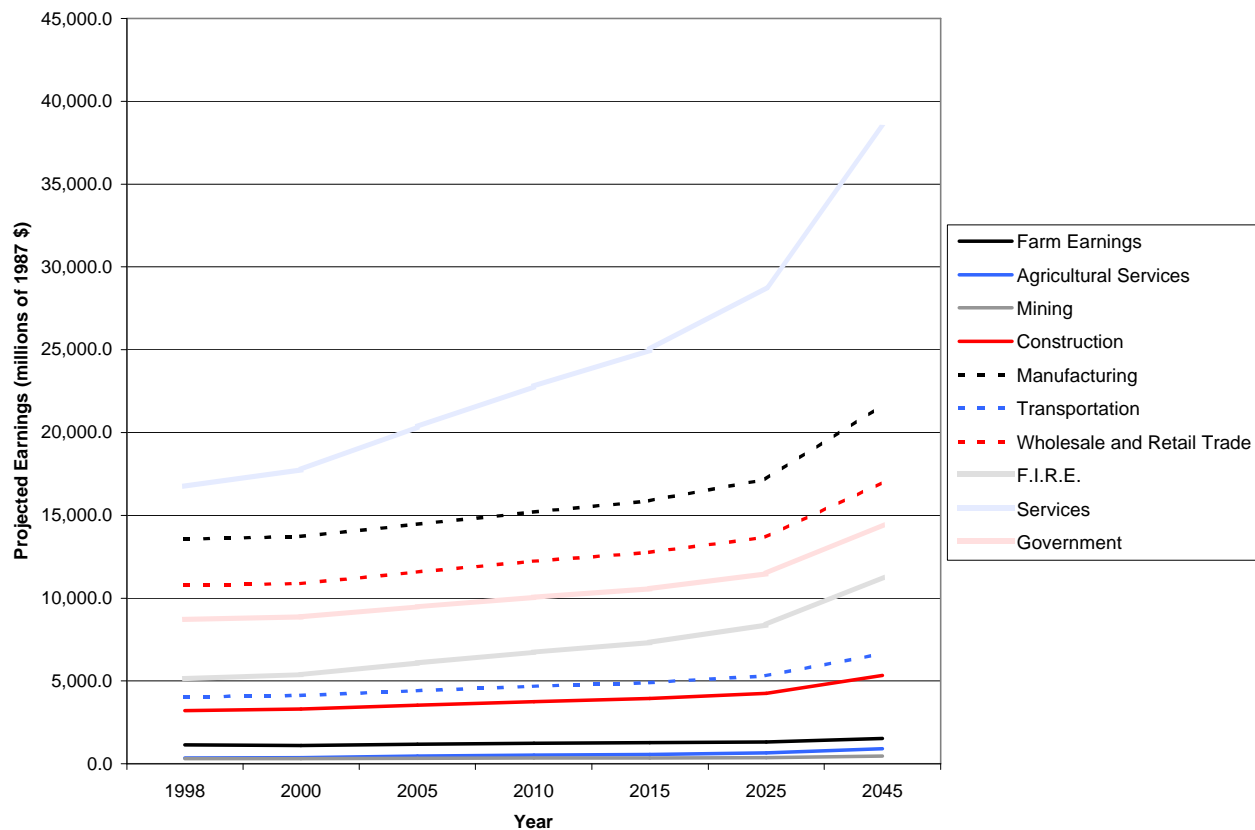
Central region were \$52.9 million in 1980, of which almost \$50.8 million were earned in Itasca County alone. Itasca County's mining earnings did fall to \$33.4 million in 1985, but no data were disclosed for 1990 and 1995.

Figure 28 shows the projected earnings for

Figure 28. Projected earnings by major industry for Minnesota, 1998-2045.



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



1998 to 2045 by major industry for Minnesota. This graph clearly shows that service industry earnings are expected to increase significantly in the future. Earnings in the farm, agricultural services and mining industries are expected to remain fairly constant during the next 45 years. No decrease in earnings is

expected in any of the industrial sectors.

The data in Table 28 shows the earnings by major industry for the North Central region for 1995. The government, services, and manufacturing sectors together accounted for 58% of the total economic production in the North Central region in 1995.

Table 28. Earnings by major industry for the North Central landscape, 1995.

Industry	Earning (thousands of dollars)	Percent of Total Earnings
1. Government	587,968	22.4
2. Services	563,827	21.5
3. Manufacturing (Lumber and Wood Products)	369,139 (77,675)	14.1 (3.0)
4. Retail Trade	319,846	12.2
5. Construction	206,876	7.9
6. Transportation and Public Utilities	183,910	7.0
7. Finance, Insurance, and Real Estate	98,636	3.7
8. Wholesale Trade	95,914	3.6
9. Farm Earnings	24,517	0.9
10. Agricultural Services, Forestry, Fishing	22,899	0.9
11. Mining	2,536	0.1
Unclassified	150,390	5.7
Total	2,626,458	100.0



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

The economic impact of domestic 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. Because of these

complexities, the impact of travel and tourism can only be estimated, not measured directly. In 1997, the MN Office of Tourism estimated the economic impact of domestic travel in Minnesota using the REMI (Regional Economic Models, Inc.) model. (See Table 29 and Figure 29). The model

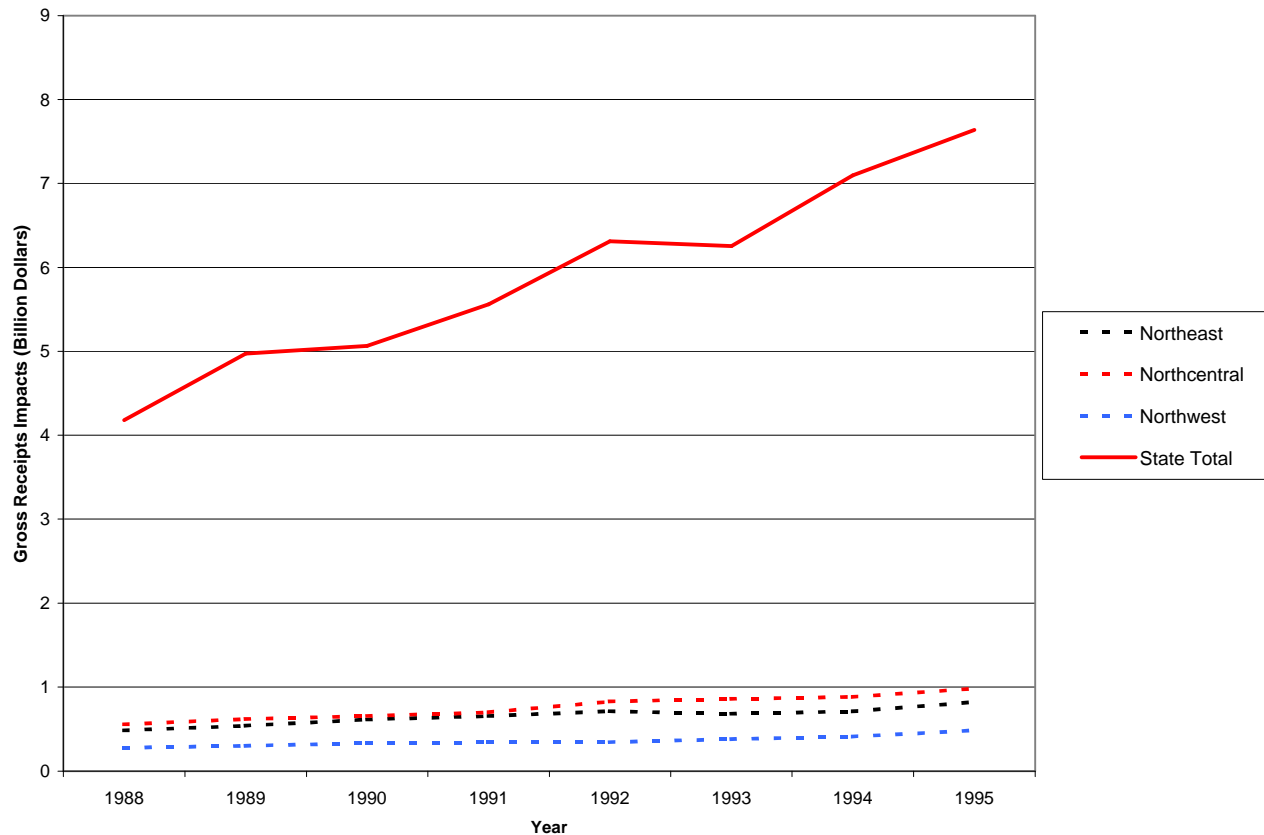
Table 29. Economic impact of domestic travel to the North Central landscape, 1994 and 1995.



Source:
Minnesota Department
of Trade and Economic
Development, MN
Office of Tourism, 1997.

County	1994			1995		
	Employment	Wages/ Salaries (billions of \$)	Gross Receipts (billions of \$)	Employment	Wages/ Salaries (billions of \$)	Gross Receipts (billions of \$)
Aitkin	304	0.006	0.016	257	0.005	0.014
Becker	2,546	0.052	0.133	3,419	0.079	0.186
Beltrami	1,126	0.023	0.059	1,207	0.025	0.064
Cass	2,072	0.042	0.108	2,169	0.045	0.114
Clearwater	47	0.001	0.002	45	0.001	0.002
Crow Wing	7,326	0.149	0.381	8,049	0.177	0.431
Hubbard	1,063	0.022	0.055	1,003	0.021	0.053
Itasca	1,566	0.032	0.082	1,727	0.036	0.091
Mahnomen	183	0.004	0.010	228	0.005	0.012
Polk	403	0.008	0.021	362	0.008	0.019
Total	16,636	0.339	0.867	18,466	0.402	0.986

Figure 29. Economic impact of domestic travel in Minnesota, 1988-1995.



Source:
Minnesota Department
of Trade and Economic
Development, Minnesota
Office of Tourism

Note:
The Minnesota Office of
Tourism regions include the
following counties (counties
underlined indicate those in
the MFRC North Central
landscape):

Northeast:
Aitkin, Carlton, Cook Isanti,
Itasca, Kanabec, Koochiching,
Lake, Pine, and St. Louis.
North Central:
Beltrami, Benton, **Cass**, Crow
Wing, Hubbard, Lake of the

Woods, Mille Lacs, Morrison,
Roseau, Sherburne, Stearns,
and Todd.
Northwest:
Becker, Clay, Clearwater,
Douglas, Grant, Kittson,
Mahnomen, Marshall, Norman,

Otter Tail, Pennington, Polk,
Pope, Red Lake, Stevens,
Wadena, and Witkin.

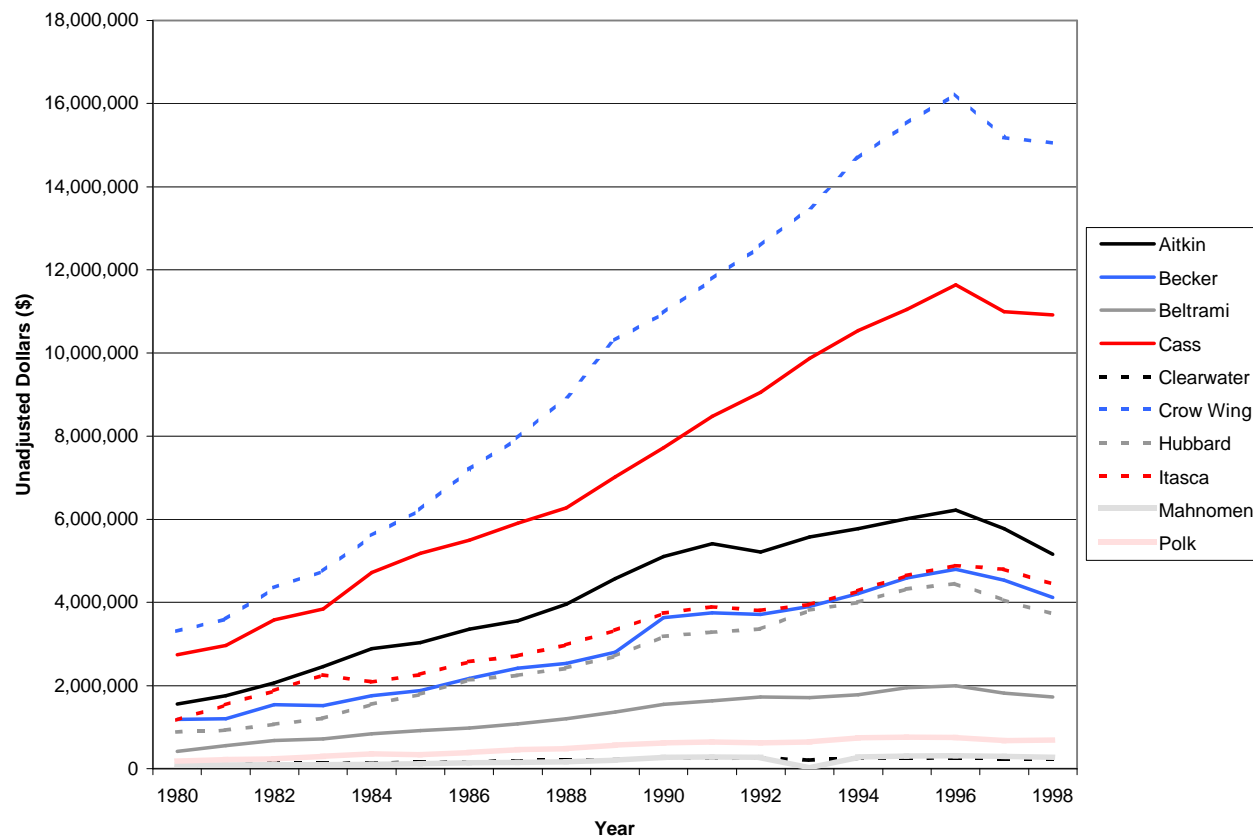
incorporates industry data and traveler survey information to provide economic impact information at the statewide level. County estimates were made based on the assumption that visitor-days in a county were directly proportional to gross sales in lodging in the county.

The data for the seasonal/recreational-residential and the seasonal/recreational-commercial tax graphs are taken from property taxes levied in Minnesota between 1980-1996. The data has not been adjusted for inflation during the time period. Figure 30 shows the

Figure 30. Estimated taxes from seasonal/recreational residential uses, North Central landscape, 1980-1998.



Source:
Minnesota Department
of Revenue, Property Tax
Division.

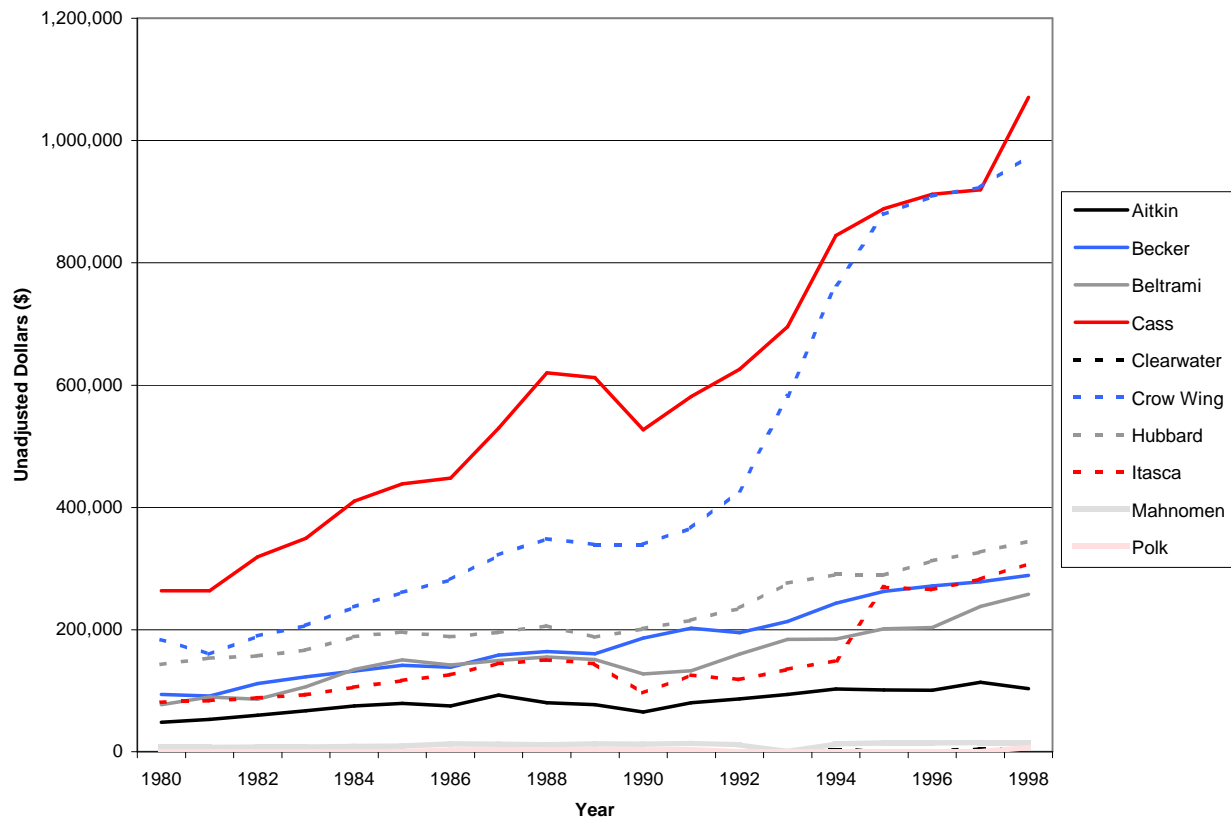


estimated taxes from seasonal/recreational residential uses. The data in this graph show a general trend of increasing tax income for the North Central region with Crow Wing and Cass Counties experiencing the largest increase in taxes.

seasonal/recreational-commercial taxes. The data show that commercial tax income has increased sporadically since 1980 in the North Central region. Cass and Crow Wing Counties had the highest increase in commercial taxes during this time period.

Figure 31 shows the estimated taxes from

Figure 31. Estimated taxes from seasonal/recreational commercial uses, North Central landscape, 1980-1998.



Source:
Minnesota Department
of Revenue, Property Tax
Division.

Stumpage Prices

Figures 32 and 33 show a general rise in stumpage prices received by public agencies since 1987. 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 32. Average stumpage prices received by public agencies for sawtimber, 1987-1997.



Source:
Department of Natural
Resources, Division of
Forestry.

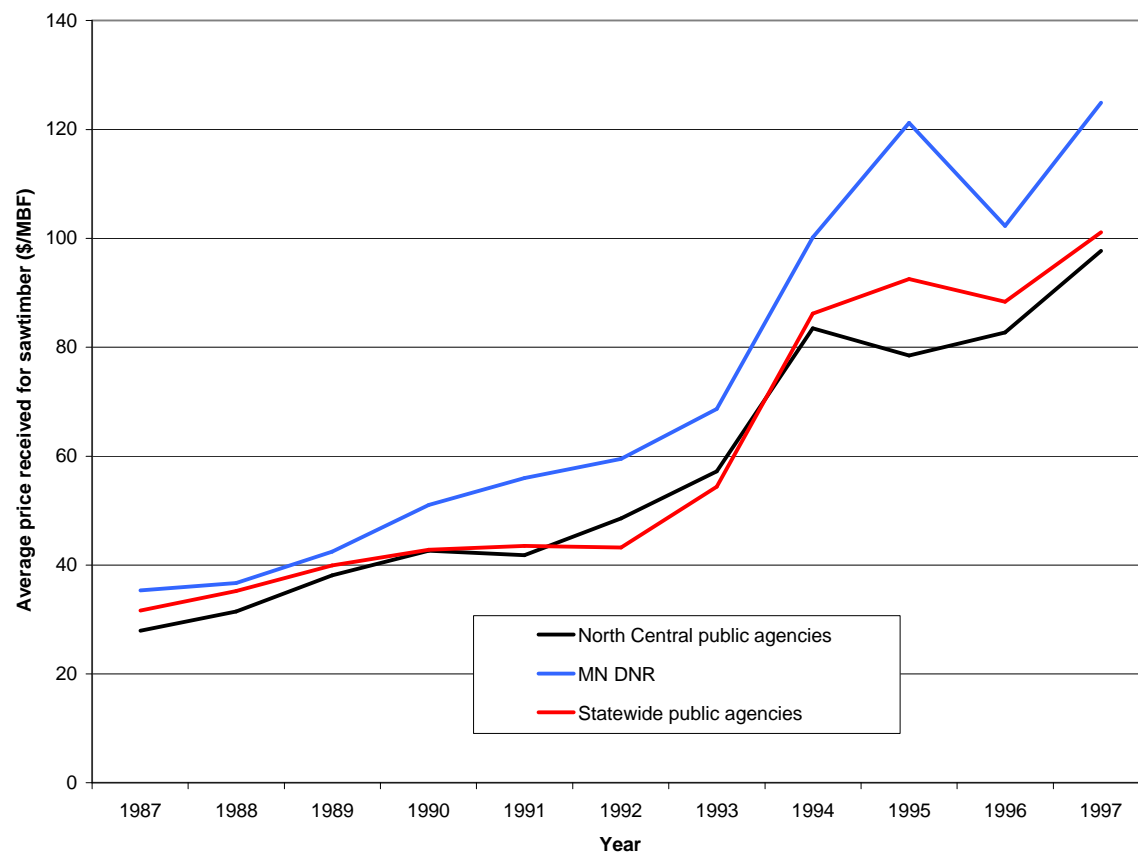
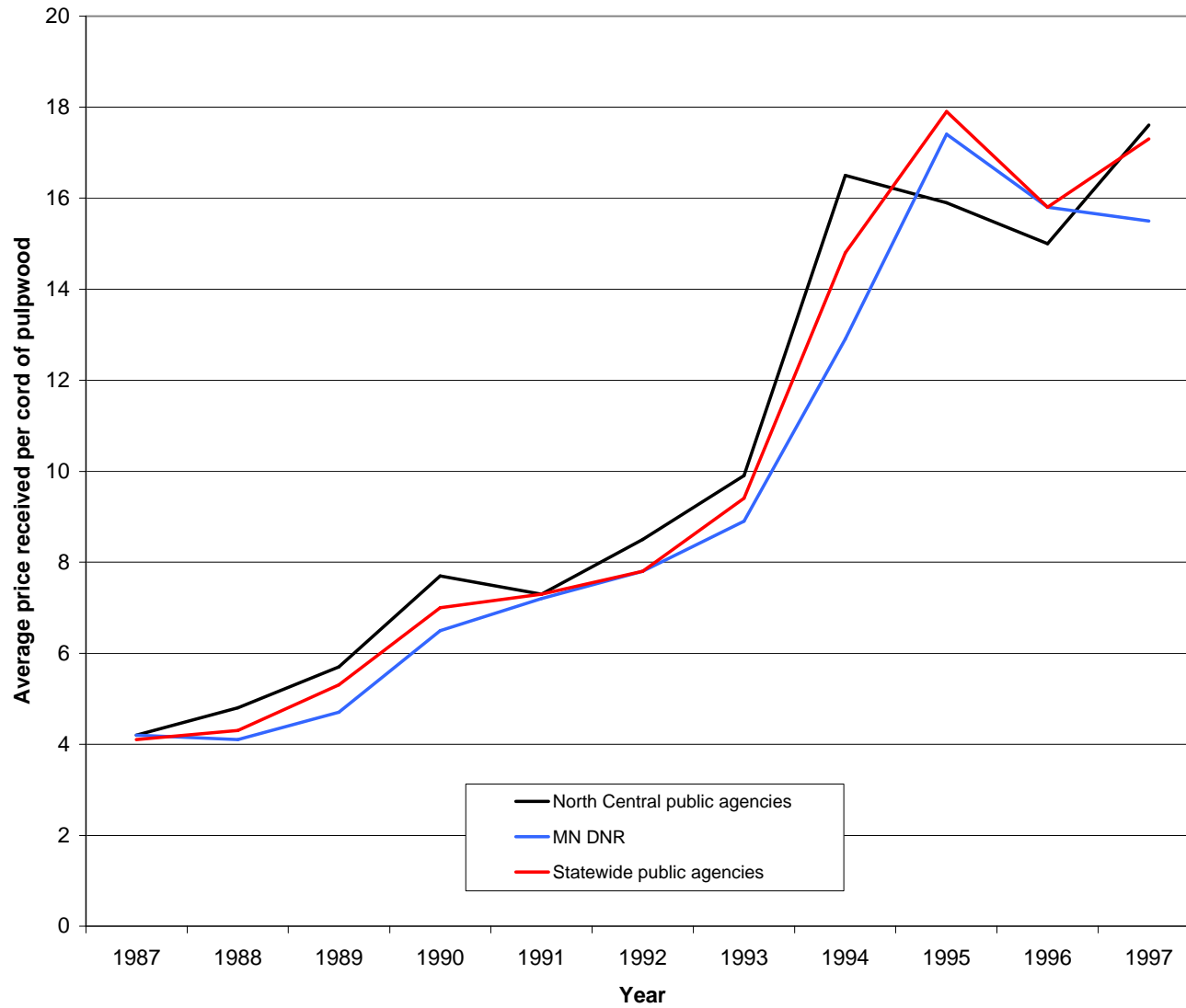


Figure 33. Average stumpage prices received by public agencies for pulpwood, 1987-1997.



Source:
Department of Natural
Resources, Division of
Forestry.

The data in Table 31 show total taconite production during the 1990s for the Iron Range's seven taconite plants. During the recession of the early 1980s, taconite production fell from 54.3 million tons in 1979 to 23.2 million tons in 1982,

and later rebounded to 42.5 million tons in 1990. Taconite production has remained fairly stable during the 1990s.

Table 30. Payments in lieu of taxes for public land in the North Central landscape, 1987-1997



Agency	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Chippewa National Forest ^A	.7	.5	.7	.9	.8	1.0	1.1	1.1	1.1	1.2	1.2
DNR ^B	1.7	1.8	1.8	1.7	1.7	1.7	1.9	1.9	1.9	1.9	1.9
Total	2.4	2.3	2.5	2.6	2.5	2.7	3.0	3.0	3.0	3.1	3.1

Source:

^AUnited States Forest Service, Chippewa National Forest

^BMinnesota Department of Natural Resources, Bureau of Estate Management

Observations

- In 1995, the government, services, and manufacturing sectors accounted for 58% of total regional earnings.
- Lumber and wood products manufacturing accounted for 3% of total regional earnings but accounted for 21% of total manufacturing earnings.
- Between 1994 and 1995, employment, salaries, and gross receipts in tourism all exhibited

upward trends.

- Between 1980 and 1998, there has been a general trend of increasing tax income from seasonal/recreational residential and commercial uses in the North Central region. Crow Wing and Cass Counties experienced the largest rate of increase and the greatest total tax income during this time period.

Table 31. Taconite production in Minnesota, 1990-1999.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998*	1999*
Total Production (millions of tons)	42.5	39.9	38.8	39.8	41.7	45.0	43.9	44.8	46.3	46.4



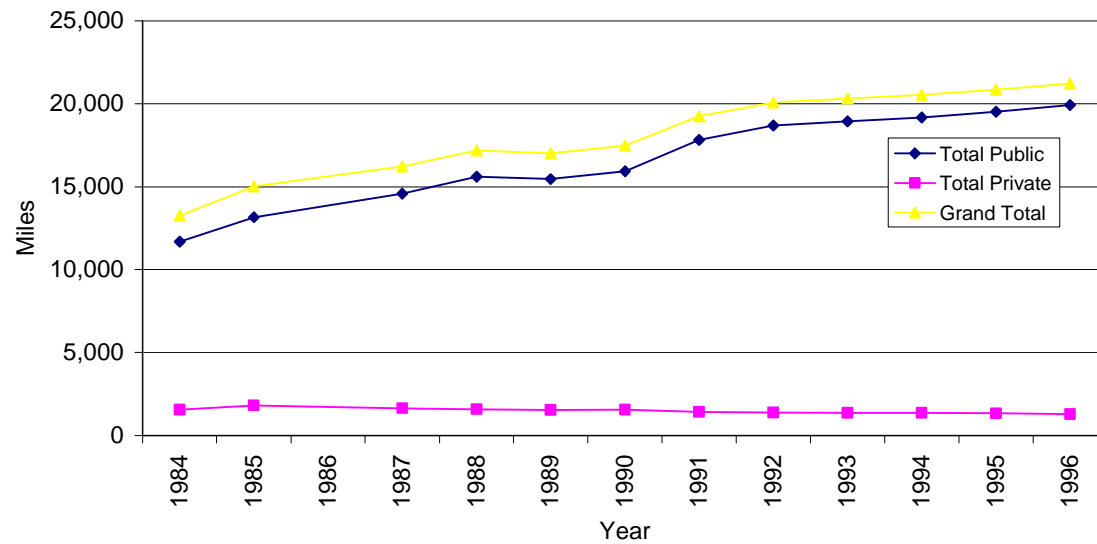
Source:
Minnesota Department
of Revenue.

Recreation and Tourism: Trails

Figure 34. Trail mileage statewide in Minnesota, 1984-1996.



Source:
Minnesota Department
of Natural Resources
Division of Trails and
Waterways.



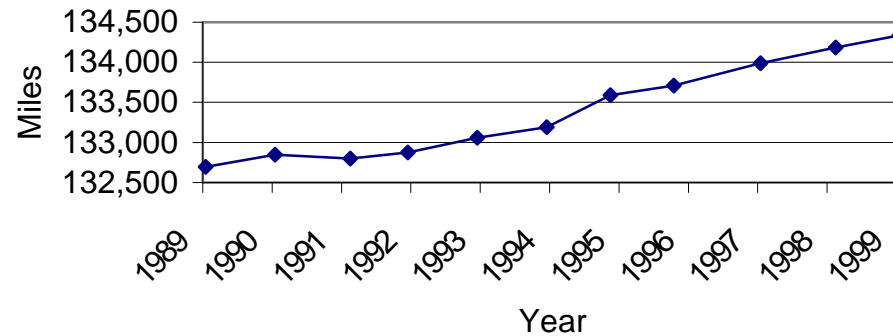
Recreation and Tourism: Roads

Figure 35 shows the total mileage of roads in Minnesota from 1989 to 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 10 years from 1989 to 1999, for an overall increase of 1.24% or 1,640 miles.

Figure 35. Road mileage statewide in Minnesota, 1989-1999.



Source:
Minnesota Department
of Transportation.

Harvest volume trends

Figure 36 shows statewide harvest levels in millions of cords. The figure is based on data from periodic surveys of primary wood users (saw timber and pulpwood manufacturers) and households (fuelwood). The decrease in harvest level between

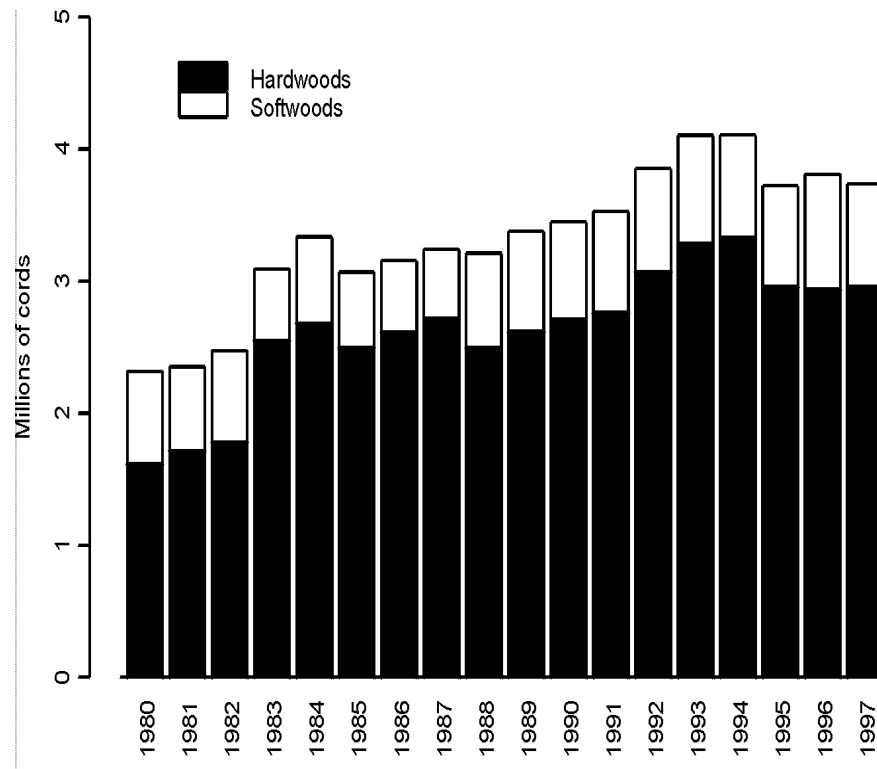
1994 and 1995 is attributed partly to an update of fuelwood consumption numbers from a 1995-1996 survey.

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

Figure 36. Trends in hardwood and softwood harvesting statewide in Minnesota, 1980-1997.

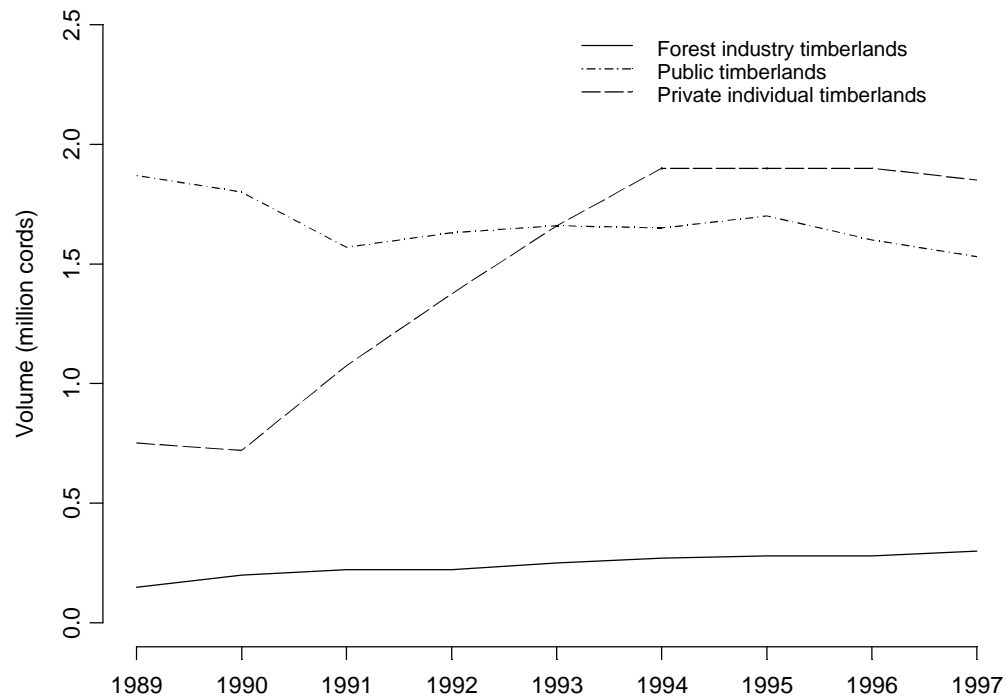


Source:
Minnesota Department
of Natural Resources
Division of Forestry.



Prior to 1993 public timberlands were the primary supplier to Minnesota's wood industries (Figure 37). In 1994, private individuals became the primary supplier and have remained so through 1997.

Figure 37. Estimated annual harvest volume from timberland in Minnesota by ownership class, 1989-1997.



Source:
Minnesota Department
of Natural Resources
Division of Forestry.

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

Exports and imports of pulpwood

Table 32. Minnesota pulpwood production, exports, and imports, 1993-1997.
(Values are in thousands of cords, unpeeled and include mill residues used for pulp.)



Year	Total production	Exports	Imports ^A	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 ^B	2,980	326	46	102

Source:
United States Forest
Service North Central
Forest Experiment
Station.

Note:
^A Data include imports
from Michigan and
Wisconsin.
^B 1997 data is preliminary
and subject to revision.

Appendix A. Metadata: General information about data in current conditions and trends assessment for the North Central landscape region.^A (continued)

Data	Date(s)	Source	Size of Data Area	Spatial Resolution	Summary	Pros (+) / Cons (-)
LandUse ^B	1969	air photos	Minnesota	40 acres	Shows land use in Minnesota broken into several different categories.	+ Historical representation - Poor spatial resolution
LandUse/Cover ^B	1990	Aerial photos and satellite images	Minnesota	1/4 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 North central Minnesota	none	Listing of mammals, amphibians, and reptiles in the state and North central.	+ Complete species list for the state and North central MN - No abundance data
Marschner Presettlement Vegetation ^B	1930	1847-1908 Public Land Survey (PLS)	Minnesota	100's 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)	1951 to 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 to 1996	DNR reports	Minnesota	none	Yearly summaries from 1984 to 1996 on the trail mileages in MN, 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. nonfederal lands	1875 acres represented per plot	A statistically based sample of land use and natural resources conditions and trends on U.S. non-federal land.	+ Includes private land - Does not include federal lands - Main focus is on agricultural land

Table continued on next page.

^ALibraries and numerous Internet sites contain additional information on the above data sources.

^BDetailed metadata can be found at the Interagency Information Cooperative's web site, www.iic.state.mn.us.

^CThe following Internet site contains information on the FIA program: srsfia.usfs.msstate.edu/tables.htm.

Appendix B. Summary of FIA Sampling and Estimation Procedures.

Chapter 2 from “The Eastwide Forest Inventory Data Base: Users Manual” (<http://www.srsfia.usfs.msstate.edu/ewman.htm>)

Users of the Eastwide Data Base need a basic understanding of FIA sampling and estimation procedures to understand the type of data available. Here, we present a general discussion of these procedures. Specific sampling methods differ among regions and even among States within a region. Publications cited in this manual give more detailed information about methods used by each region. If you need more information about sampling procedures for a specific State, contact the FIA project responsible for that State’s inventory.

Each State inventory begins with the interpretation of an aerial-photo sample that classifies the land by various photo classes. The total area of a sample comes from outside sources (usually Bureau of Census reports). The photo classes used are based on land use (pasture, cropland, urban, etc.). For forested land, more detailed classes are sometimes defined based on criteria such as forest type, volume per acre, stand size, stand density, ownership, and stand age. Then, ground plots are measured to adjust the aerial photo sample for changes since the date of

photography and misclassification and to obtain estimates that cannot be made from the aerial photography. The photo classification of these ground plots, together with the area estimates from the photo sample, is used to assign area expansion factors to all ground plots. These area expansion factors are used to expand values observed on the plot from a per acre basis to a population basis. An area expansion factor is basically the area (in acres) that the plot represents for estimation purposes. The sampling area, or level at which expansion factors are assigned, is different from State to State, as is the scheme used to assign photo-interpretation classes. For the details of how these expansion factors were assigned to the ground plots for a particular State, contact the appropriate FIA project.

FIA plots are designed to cover a 1-acre sample area; however, not all trees on the acre are measured. Various arrangements of fixed radius and variable radius (prism) sample points are used to select sample trees to be measured. Ground plots may be new plots that have never been measured, or remeasurement plots that were measured in the previous inventory. For all plots,

Appendix B. Summary of FIA Sampling and Estimation Procedures.

estimate of when they died.

The removals factor (REMOVFAC) is computed and used like MORTFAC. REMOVFAC is the number of trees per acre of annual removals that the sample tree represents. It is computed based on observations of trees cut on either new or remeasured plots, depending on the inventory design. None of the Eastern FIA projects use removals prediction equations to estimate removals.

The items in the plot record are either observations of a specific condition at the plot center or estimates of average conditions on the acre sampled by the plot. Ownership is an example of a specific condition recorded at plot center, rather than averaged over the plot. If a plot area overlaps more than one owner, the ownership at plot center determines the recorded ownership class. Basal area is an example of an item averaged over the entire plot. If the plot falls in two stands with different basal areas, the value recorded in BACUR will represent their average basal area. In some State inventories, plots falling on more than one stand are shifted into one stand. EWDB users concerned about field procedures should check with the FIA project for more information.

We have tried to make the data in the EWDB

as consistent as possible from one State to another. Therefore, although differences in field and estimation procedures do exist between States, the data in the EWDB for different States are compatible. The minor differences that do exist should have little or no impact on most uses of this data.

Accuracy Standards

Forest inventory plans are designed to meet sampling error standards for area, volume, growth, and removals provided in the Forest Service Handbook. These standards, along with other guidelines, are aimed at obtaining comprehensive and comparable information on timber resources for all parts of the country. In the East, FIA inventories are commonly designed to meet the specified sampling errors at the State level at the 67-percent confidence limit (one standard error). A 3-percent error per 1 million acres of timberland is the maximum allowable sampling error for area. A 5-percent error per 1 billion cubic feet of growing stock on timberland is the sampling error goal for volume, removals, and net annual growth.

Caution: FIA inventories are extensive inventories that provide reliable estimates for large sampling areas. As data are subdivided into smaller

Appendix C. Summary of Forest Health Conditions from the US Forest Service.

State with 100 thousand acres would have a 9.5 percent maximum allowable sampling error at the 67-percent level.

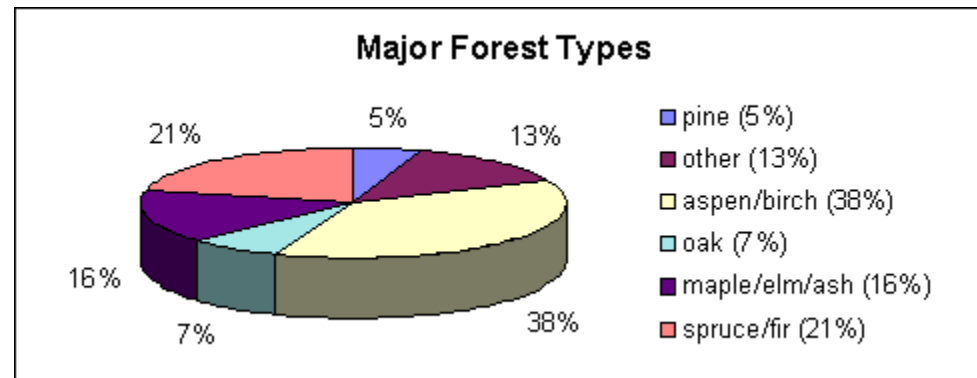
1999 Forest Health Highlights, Minnesota. Summary from the USDA Forest Service, North Central Experiment Station (http://willow.ncfes.umn.edu/fhh/fhh-99/mn/mn_99.htm)

The Resource

Minnesota's trees are a valuable resource. Forests account for 33% of Minnesota's land area, or about 16.7 million acres. The area of all forestland in the State has increased by 0.7 percent since 1977. Private land owners control 48.5% of the timberland; state, county, and municipal governments administer

37.8%, and the National Forest comprises 12.4%.

These forests are important to both the wood products and tourist industry. Forestry related industries and manufacturing employ about 60,000 people. The value of wood products annually exceeds \$8 billion. A total of 4 million cords of wood were cut in 1993, pulp and paper and oriented strand board accounts for 34% of the cut. Window frames make up 20% of all the value of products produced. Other products include saw logs, veneer, post and poles, wood chips for landscaping, and fuelwood, although wood for energy accounts for only 4% of the volume cut, down from 12% in 1990. The



They call the Wind “Awesome,” “Total Devastation,” “Unbelievable”

In 1999, wind events damaged timber on 465,000 acres. The most dramatic event occurred on July 4th when straight-line winds blew down timber over an area of almost 400,000 acres. There were at least 100,000 acres where nearly 100% of the trees were broken off or tipped over. In some of these areas the piled trees were over 20 feet high. Most of the damage occurred within the Boundary Waters Canoe Area (BWCA) on the Superior National Forest where over 380,000 acres were damaged. Fortunately there were no camper fatalities in this heavily used wilderness area, but there were many medical evacuations immediately after the storm. Campsite and portage trail clearing continued throughout the summer.

Some of the areas outside of the BWCA are being salvaged. Because there was a lot of pine involved in the blowdown, two fears are on everyone’s mind: fire and bark beetles. Fire hazard reduction is on going around private residences, and emergency fire plans are being developed. No salvage, however, is allowed within the BWCA. Bark beetle populations were being assessed during the summer. The concern is the amount of brood wood available

for populations to build up in next year. If conditions are dry during the summer of 2000, bark beetle populations will build up and standing pine may be attacked.

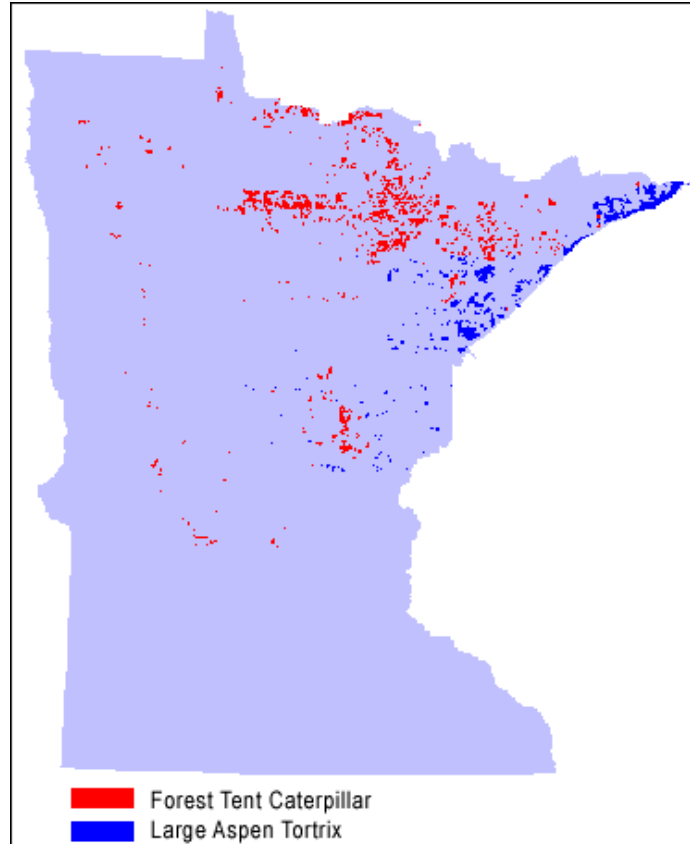
For more detail/maps: www.ra.dnr.state.mn.us/bwca

Gypsy Moth Ups and Downs

Over 18,000 pheromone traps were set in Minnesota in 1999. Statewide the trap catches were down when compared to 1998. 286 moths were caught in 1999 compared to 953 moths in 1998.

Two surprises were noted this year. In southeastern Minnesota and in the Twin Cities area, where the predominance of oak make both areas prime targets for gypsy moth and in the past have been traditional hot spots for catching gypsy moth, there was a decline in trap catches. In 1998 over 900 moths were caught; in 1999 only 156 were caught. It is theorized that the wet spring and early summer may have contributed to this decline. The same pattern was noted in southern Wisconsin.

The other surprise was the significant increase in trap catches along the “North Shore” area of Lake Superior. This area traditionally



Large Aspen Tortrix

Large aspen tortrix outbreaks often immediately precede forest tent caterpillar outbreaks. Since both defoliating insects feed on aspen, they compete for food, and the forest tent caterpillar often overwhelms the large aspen tortrix. In 1999, it was estimated there were 340,000 acres defoliated from the large aspen tortrix. Most of the defoliation occurred in the Arrowhead area of Minnesota.

Spruce Budworm

This is the 46th consecutive year in which spruce budworm caused defoliation in Minnesota. (See summary of defoliation by year.) Approximately 70,000 acres of balsam fir and white spruce were defoliated in 1999. Trees showing in excess of 50% defoliation occurred on nearly 5,000 acres. Most of the defoliation occurred in northeastern Minnesota in historic budworm outbreak areas. Declines in spruce budworm activity in northeastern Minnesota may have been due to the very wet summer. Most of this area received 150 to 175% of normal rainfall.

In central Minnesota where white spruce plantations have been defoliated by budworm since the early 1990's, populations have declined for the second straight year. Warm spring conditions in this

Appendix C. Summary of Forest Health Conditions from the US Forest Service.

Leaf Diseases

The wet spring was perfect for foliage diseases. The most common disease was anthracnose which produces spots on the leaves. The spots grow together and cause a general browning of the leaves, and the leaves are then shed. Anthracnose is caused by a particular group of fungi, and both oaks and ashes were infected.

By far, bur and white oaks were affected the most. Approximately 150,000 acres of oak across southeastern Minnesota showed symptoms of anthracnose. Trees infected generally outgrow the disease. As new leaves are produced and the weather turns dryer as the growing season progresses, disease symptoms tend to diminish. Outbreaks of this disease are so tied to weather conditions, outbreak predictions for the following year are nearly impossible to make.

Another spectacular foliage disease occurred on balsam poplar or balm of Gilead in central and northern Minnesota. This foliage disease was Septoria blight. This disease is similar to anthracnose in that foliage first shows brown spots which then grow together, and the entire leaf browns and drops. The disease is more prevalent on the lower parts of the tree, but if conditions remain wet throughout the

growing season, the disease will spread upward in the tree and the balsam poplars will become nearly bare of leaves by August.

Excerpts from "Forest Insect and Disease Conditions In the United States 1997" from USDA Forest Service Forest Health Protection (http://www.fs.fed.us/foresthealth/cy97_conditions_final.pdf)

Forest tent caterpillar

Malacosoma disstria

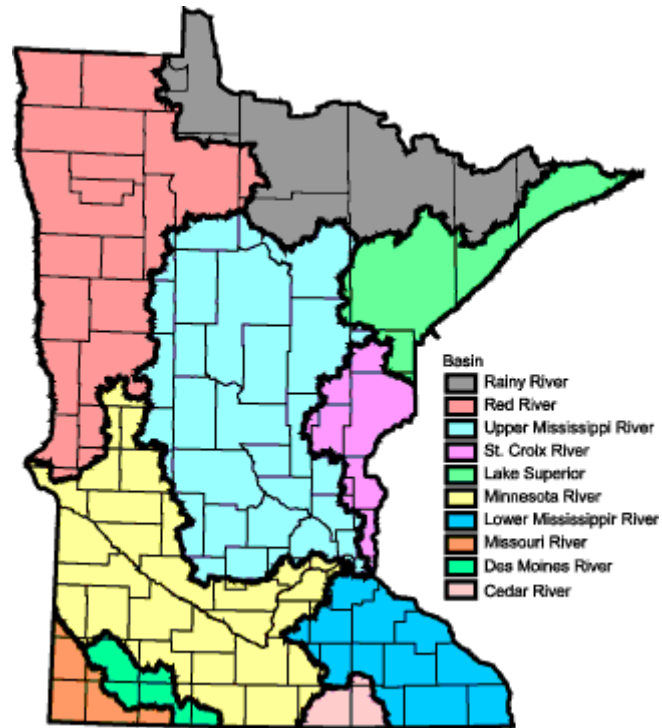
- Region 9/Northeastern Area: Illinois, Maryland, Minnesota, New Hampshire, Rhode Island, West Virginia.
- Host(s): Aspen, basswood, pin oak, sweetgum, other hardwoods.
- Small outbreaks totalling 1,364 acres were reported in 1997. The last large occurrence of forest tent caterpillar was in 1994.

Jackpine budworm

Choristoneura pinus

- Only 111 acres of defoliation occurred in Minnesota in 1997. Mortality from defoliation in previous years occurred over 33,000 acres of State and private land in Minnesota.

Appendix D. Pollution Control Agency Upper Mississippi River Basin Assessment of Stream Water Quality.



Minnesota river basins.

Source:
<http://www.pca.state.mn.us/water/basins/305briver.html#map>.

To get more information on water quality for specific streams and lakes, go to the Internet site www.pca.state.mn.us