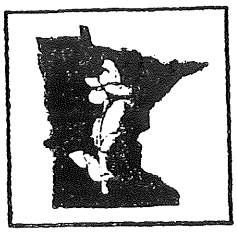
Hemlock Ravine
Scientific and Natural Area
1984 Resource Inventory

Portions of SE 1/4, Section 3
Township 48, Range 16W
Esko Quadrangle - L20a
Carlton County
Minnesota

Prepared by
The Scientific and Natural Area Program
and
The Minnesota Natural Heritage Program
Division of Fish and Wildlife
Minnesota Department of Natural Resources
June 1984



Scientific and Natural Areas

Scientific and Natural Areas serve:

Education - elementary through high school groups use such areas as outdoor classrooms.

Nature Observation - the public uses these areas to observe Minnesota's most unique or rare natural resources.

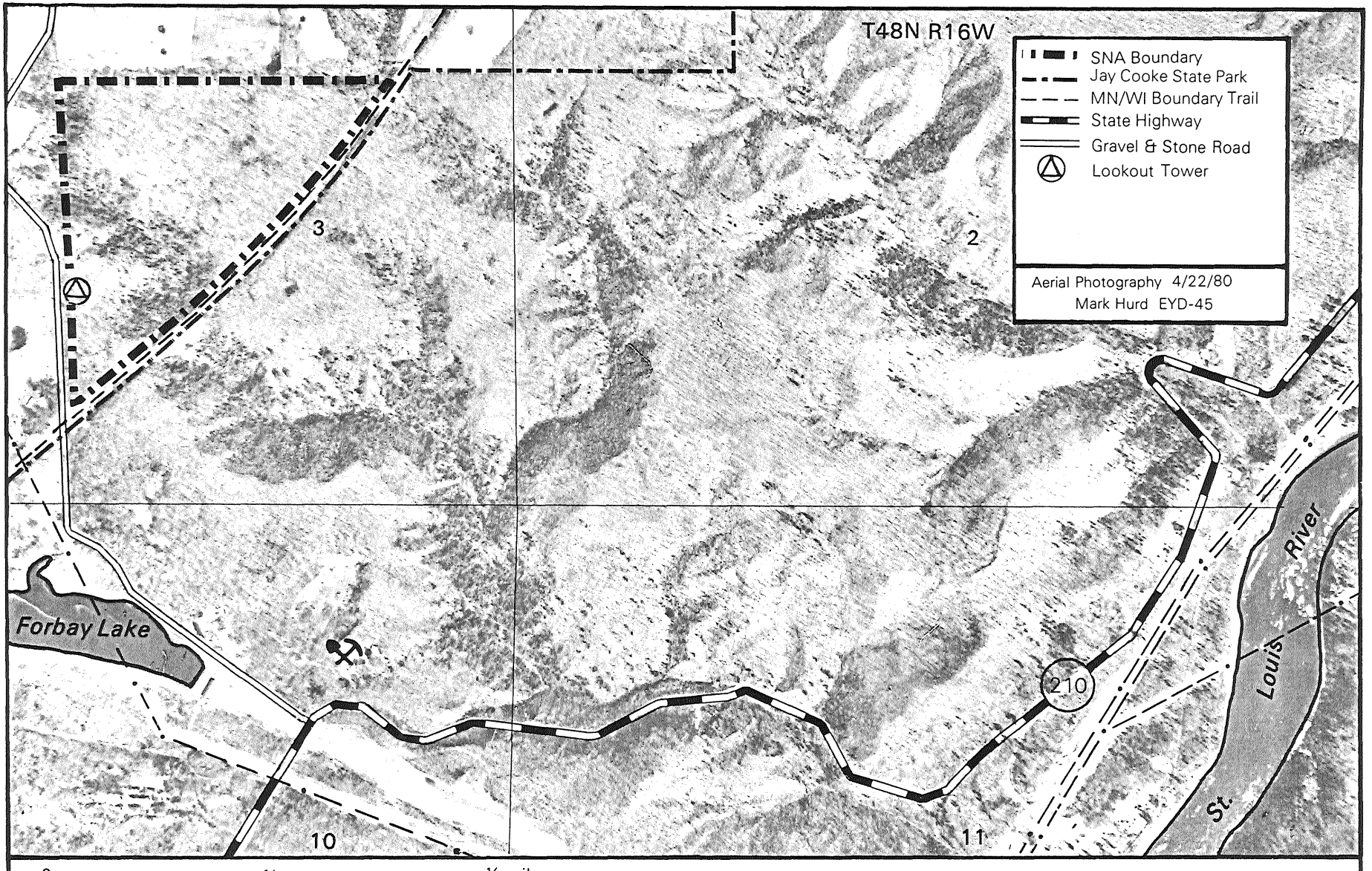
Protection Functions - Minnesota's rarest species or most unique features are protected for the citizens of today and tomorrow.

Recreation - the public uses such areas for informal, dispersed recreation.

Research - colleges are able to establish long term research projects secure in knowing the area will not be influenced by other management activities.

Genetic Storehouse - potentially valuable plants and animals are retained thereby offering potential for new medicines, resistance to plant diseases, and other unknown secrets.

Currently there are **34** Scientific and Natural Areas protecting undisturbed remnants of Minnesota's plant communities and plant and animal species. These areas encompass maple basswood forests, virgin prairies, orchid bogs, heron rookeries, sand dunes, and virgin pine stands, as well as many rare plant and animal species.



HEMLOCK RAVINE SNA

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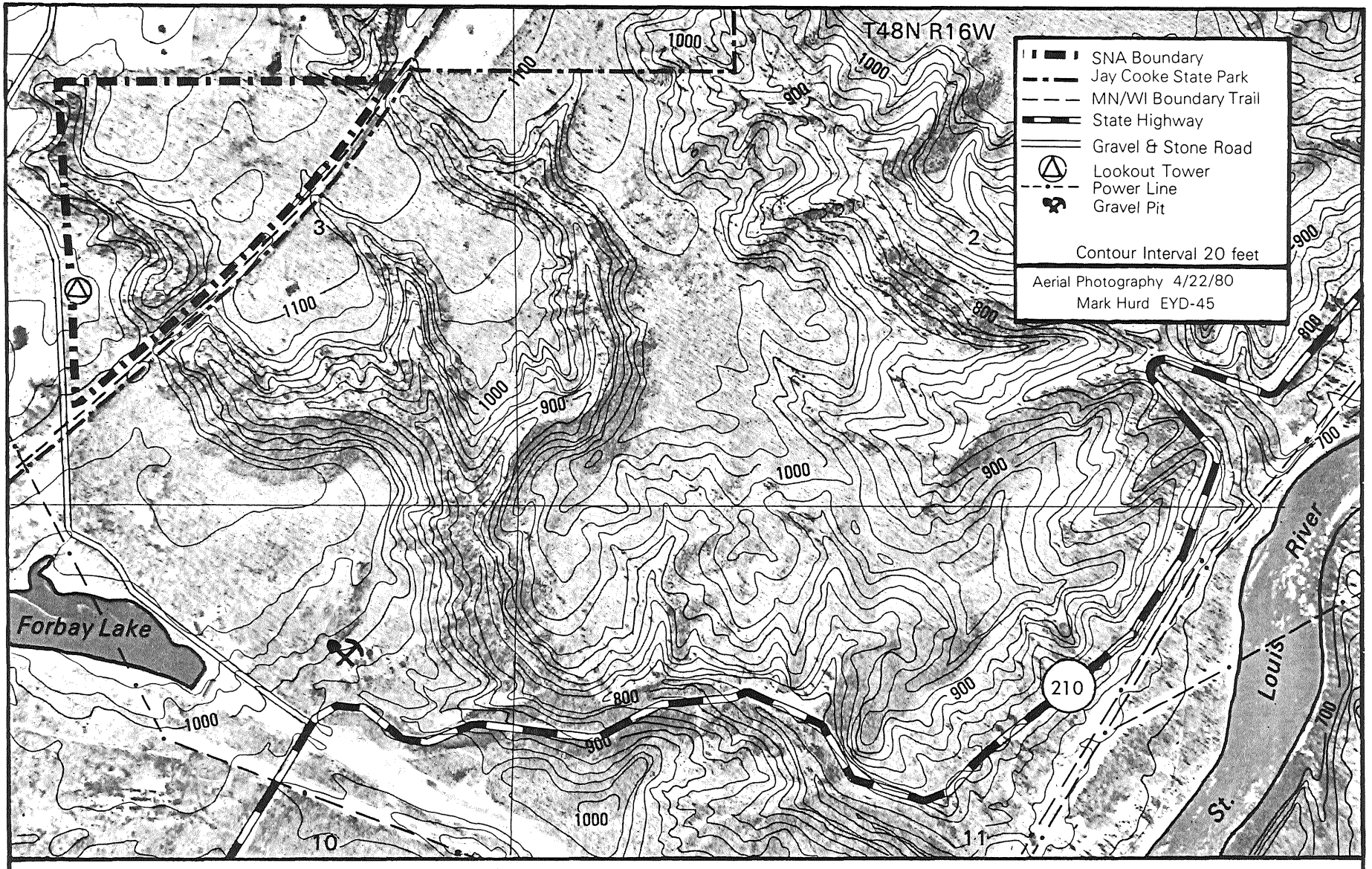

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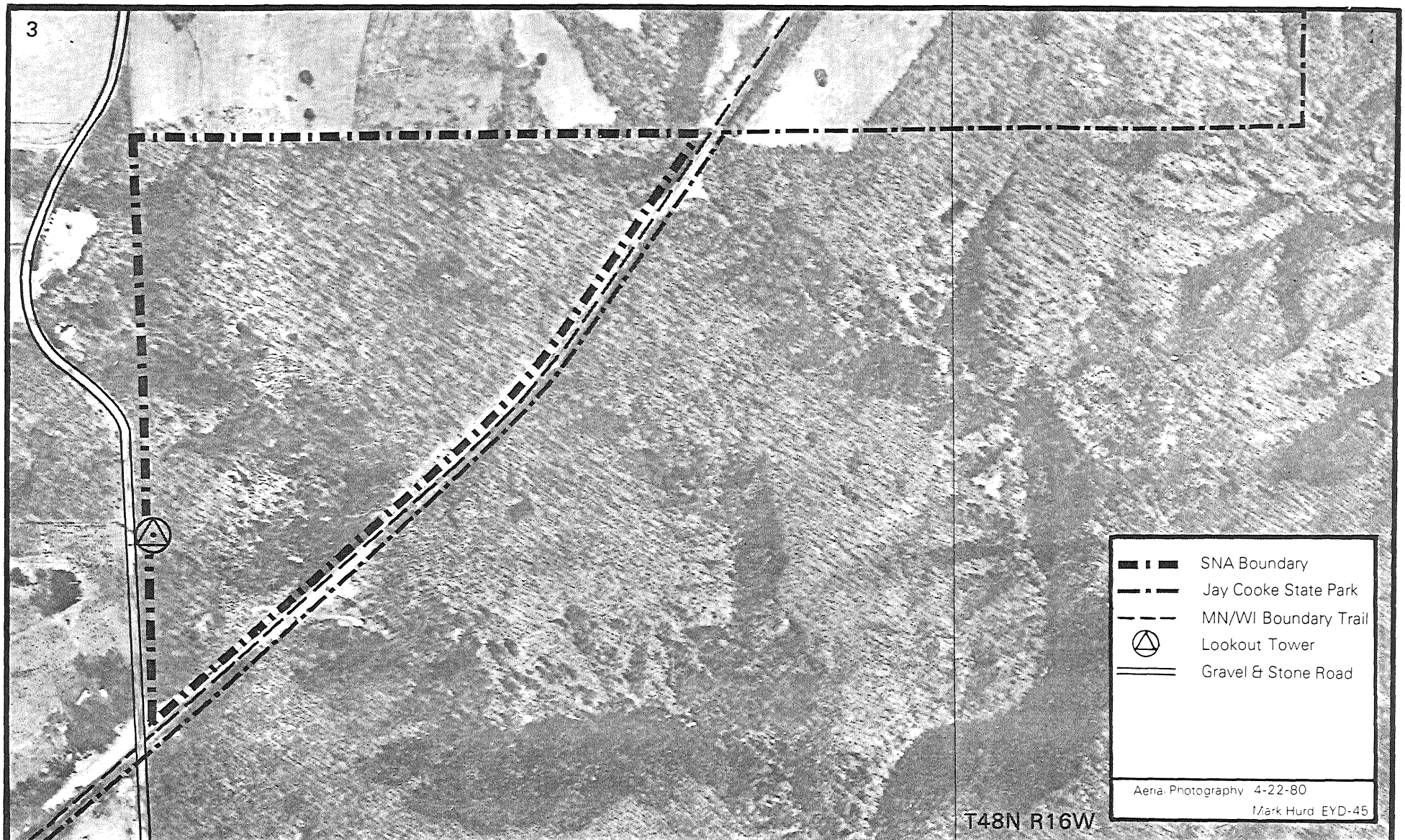

HEMLOCK RAVINE SNA

SITE

Preface

This report documents information collected during a 1984 inventory of the Hemlock Ravine Scientific and Natural Area. The inventory includes information on the physical and biological resources of the site and its land-use history. The land-use history was investigated in an attempt to document prior conditions and events which may have altered SNA resources. This report will serve as an aid to individuals responsible for managing the SNR, as well as users of the area, including scientists, educators, naturalists and the general public.

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DESCRIPTION OF STUDY AREA

Hemlock Ravine SNA is located adjacent to Jay Cooke State Park in the northeast corner of Carlton County. The site is less than 10 miles from Duluth and accessible from Trunk Hwy 210. The Minnesota/Wisconsin Boundary Trail forms the southeast boundary of the SNA.

This 50 acre tract of land is predominantly mature northern hardwoods. It is situated on the crest of a deeply dissected escarpment leading down to the rocky gorge of the St. Louis River. Vistas from the SNA overlook the Nemadji River Basin, the North Shore Highlands, and out to Lake Superior.

Hobbs and Goeble (1982) map the SNA as ground Moraine of the Nickerson Moraine Association. This includes loam to clay loam till, some of which may be related to the Cloquet Moraine Association. Both of these deposits are associated with glacial ice from the Superior Lobe of the late Wisconsin, Pleistocene period. The Cloquet Moraine was formed during the split rock phase (approx. 16,000 yrs. b.p.) and the Nickerson moraine was formed during the Nickerson phase (11,000-12,000 yrs. b.p.).

The major soils in the SNA are mapped as Duluth very fine, sandy loam, and Udorentus-very steep, loam to clayey soils.

A steep ravine cuts through the western portion of the SNA. This ravine harbors the state's largest population of hemlock trees. The uplands surrounding the SNA are primarily pasture, hayfields, woodlands, and scattered residential development.

LAND-USE HISTORY

Introduction

Hemlock Ravine designated a Scientific and Natural Area in August 1982, was originally purchased as part of Jay Cooke State Park in 1916. Previously it had been owned by various railroad companies (1865-1889), and then by several private parties (1889-1916). Aspects of the area's land-use history were reconstructed by investigating features of man's activities in the field and from aerial photos. This research was supplemented with county and historical records and interviews with adjacent landowners. The primary land-use activity that affected the SNA was logging. Agricultural practices, such as plowing and grazing, did not occur.

Logging

Logging began on a small scale in Carlton County in the 1850's and the 1860's in areas immediately adjacent to Duluth. In 1870 the first railroad line reached Duluth, enabling lumber from the north to reach the market in Minneapolis. At that time, a number of sawmills began production in the area around Carleton (then called North Pacific Junction) and Thomson. These included the James M. Paine Mill, which started production in Carleton in 1869; the A.M. Miller Mill which produced lumber, lath, and shingles in Thomson starting in 1870; and the Levois Shingle Mill, which opened in Thomson in 1873. The woods operations for these and a number of other mills was in Thomson Township and much of what later became Jay Cooke State Park.

The A.M. Miller mill had four logging camps cutting in Thomson Township, and its oxen pasture is now the location for the park headquarters. The Levois Shingle mill woods operations were along the St. Louis River in Thomson Township.

These early logging operations limited their cutting to white pine and cedar. Neither species occurred on the North Shore in large unbroken belts but were always found in strips and bunches. Originally, woods operations occurred close to the sawmills, and logs were hauled directly to mill by ox teams. By 1880 the A.M. Miller sawmill woods operations moved farther from the mill and began driving logs on the Midway River. By 1890 most of the virgin pine had been removed from the Townships of Thomson and Midway, and most of the sawmills in the Carleton and Thomson area had closed. By 1905 nearly all of the big pine in Pine, St. Louis, Carlton and Lake Counties had been cut and/or burned except for scattered tracts that were less accessible or poorer in quality. Pine stumps are found throughout the SNA, evidence that the area was logged sometime during the 1870-1890 lumber period.

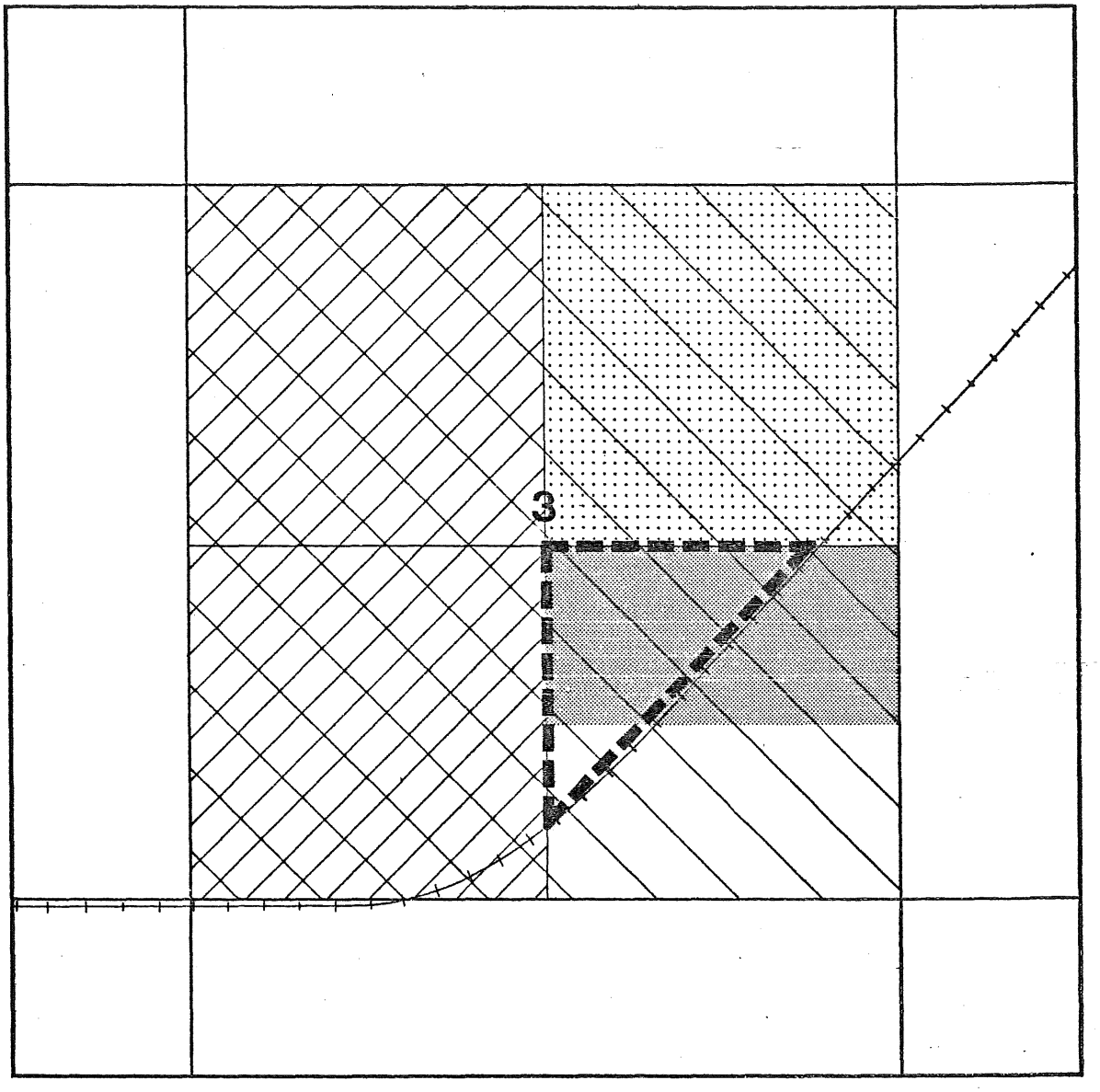
Around 1890 ownership of Hemlock Ravine went from the railroad to private lands. In 1890, with the passage of the Stone & Timber Act, that investment in standing timber began to boom. That same year mills began cutting Norway Pine. From 1894 to 1898, papermills began and rapidly increased their cutting of spruce for pulpwood. In 1904 the papermills started cutting balsam and tamarack along with the spruce. In 1906 mixed species were included with pine at state lumber sales. By 1907 mills were producing treated birch ties. Finally, by 1918, the end of the lumber industry on the North Shore was in sight.

During the time the study area was owned by the railroads, several leases were let for timber rights in section 3. The first was a 6 year (1871-1877) lease to Miller and Wynkoop for pine stumpage in all of section 3. In 1876 the W 1/2 of section 3 was re-leased to A.M. Miller from Duluth, again for pine stumpage. In 1877 the N 1/2 of the SE 1/4 was re-leased to C.O. Lovejoy for pine timber, estimated at 150 thousand board feet. The NE 1/4 of section 3 was re-leased in 1877 to A.M. Miller for 280 thousand board feet of pine timber (see Fig. 1).

The releasing of timber rights in section 3 suggests that this section was probably not logged during the initial lease period (1871-1877). There are no further lease records beyond those listed above. Logging probably took place in 1877 or soon after in the N 1/2 of the SE 1/4 of section 3. The south half of the SNA was never re-leased.

White pine and cedar were the only species being cut during the period the SNA was leased to timber companies. Logging activity in the Thompson area had virtually ceased before the industry began using hardwood species. It would not appear likely, therefore, that any additional cutting for hardwoods took place on the SNA before state ownership in 1916. No cutting occurred after that time.

The SW corner of the SNA, west of the ravine and south of the fire tower, appears on the 1938 aerial photos and in the field to be a younger age class. Whether this is the result of an undocumented cut or some other disturbance (i.e., railroad or road construction, fire) is unknown.



EXPLANATION

1871–1877, all of Sec. 3--pine stumpage

1876–1880, W½ Sec. 3--pine stumpage

1877–1881, NE¼ Sec. 3--280 M Bd. ft. pine timber

1877–?, N½SE¼ Sec. 3--150 M Bd. ft. pine timber

SNA boundary

R. R. tracks

NOTE: SNA boundary and R. R. tracks added for reference only, not present during the logging period

Figure 1. Timber leases let in Section 3 T48N R16W

A fire tower was built by CCC crews in 1937 on the west boundary of the present SNA. It was actively maned from 1937-1970, but between 1970-1980 was used only periodically. The tower has not been used by Forestry since 1980.

Fire History

Logging on the North Shore was frequently followed by either slash fires or accidental fires. Charred tree stumps present in Hemlock Ravine are evidence that fire passed through the area at least once. A date for this fire, or fires, can only be estimated. While two famous fires burned much of the region close to Hemlock Ravine, they did not burn the SNA itself. The Hinckley fire of 1894 burned a large area southwest of the SNA, and the Cloquet-Moose Lake fire of 1918 burned areas north and west of the ravine There have been no fires in the area since it was incorporated with Jay Cooke State Park in 1916.

The presence of charred stumps indicate that at least one fire burned the area after it was logged (after 1870). A major drought occurred in 1910 accompanied by extensive fires along the north shore. It is not known whether the SNA burned during that period.

Roads and Trails

Grand Portage Trail

Hemlock Ravine is situated along a number of historically important travel routes in Carlton County. The Grand Portage Trail (Fig.**2**) from Fond du Lac to Cloquet passes the ravine about 3/4 of a mile to the north and was used extensively by Indians, explorers, and fur traders. Explorers' accounts of the Grand Portage Trail have provided important insight into the area's presettlement vegetation. In winter the Fond du Lac to Cloquet Reservation Trail was used instead of the Grand Portage, and along the western 1/2 these trails coincide (Fig. 2).

The Grand Portage Trail was only a portion on a larger route from Lake Superior to either the Upper Mississippi River region, or Lake Vermillion and the Border Lakes Region. The first map of the trail was made by a Jesuit missionary in 1670. Voyageurs began using the route around 1680. It was used extensively from the early 1750's until the early 1760's by traders travelling between the trading post at La Pointe, Madelaine Island, operated by Joseph LaVerendrye, and his wintering house on the Upper Mississippi River. After the French-English war of 1763, the British took over the fur trade in the area and reopened the trading post at La Pointe in 1765. The Grand Portage Trail was also the route used by independent traders like Jean Baptiste Perrault (1784) and Jean Baptiste Cadotte (1792).

In the 1800's the trail was used by explorers searching for the Headwaters of the Mississippi, including the Cass Expedition of 1820 and the successful Schoolcraft Expedition of 1832. The journals from members of the Cass expedition provide particularly useful desciptions of the area's former vegetation.

Fig. 2

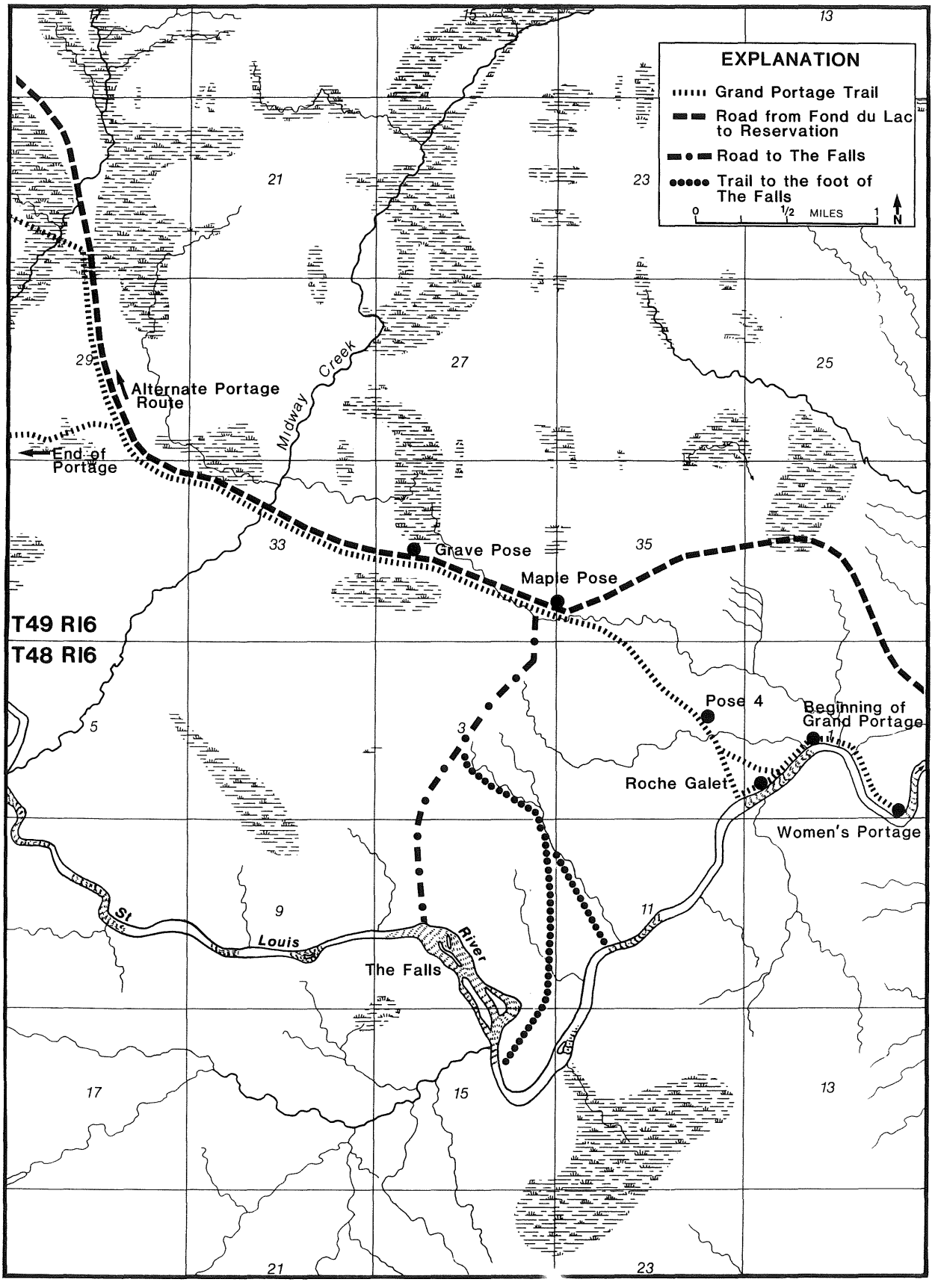


Figure 2. Early trails and roads in or near Hemlock Ravine SNA

From 1857-1859 the people of Fond du Lac improved the Fond du Lac to Cloquet Reservation Trail for ox cart travel as far as the Roxussain Homestead (Fig. 2). The Grand Portage Trail was abandoned entirely, even for summer travel. Eventually the trail was improved as far as Cloquet and became known as the Military or Government Road. In turn, this road was abandoned in 1907.

Two additional trails near our area are a) the Road to the Falls which lead from the Grand Portage to the falls of the St. Louis River, and b) a spur trail from the Road to the Falls leading to the foot of the falls (Fig. 2). Less is known historically concerning these trails. The 'Road to the Falls' appears on the 1858 Original Surveyors' Map and was still in use as late as 1888, but there is no trace of it by 1920, when a Jay Cooke State Park Map was made. Since it appears on the 1858 map, well before the lumber boom, local historians suggest it was probably used by the Fond du Lac Indians for hunting, fishing and making sugar, or as an Indian portage trail over the roughest of rapids. The spur trail from the Road to the Falls leading to the foot of the falls does not appear on the original surveyors map. This trail was retraced by a former state park custodian and reported in an unpublished report by John Fritzen on "Portages and Old Trails in and Adjacent Jay Cooke Park." A portion of this trail still exists, running from the fire tower southwest through the SNA to the railroad grade.

County Road

The most recent road is County Road 151, also known as the Park Road, which provides the SNA western boundary. This was constructed in two parts; the north half mile was built in 1922 and the south half in 1935. Before 1935, the south half was an unimproved cartway.

The Railroad

The railroad is an important land feature of Hemlock Ravine. The complication of the Lake Superior and Mississippi Railroad line from St. Paul to Duluth in 1870 marked the beginning of the lumber boom in northeastern Minnesota. The original railroad line did not pass adjacent to the SNA but paralleled the north bank of the St. Louis River (Fig. 3) from Thomson to Fond du Lac. This portion of the track was known as the "Skally Line". The big trestles necessary to cross the deep ravines were hard to maintain, in constant threat of fire, and experienced mud slides in the spring. All this caused the St. Paul & Duluth R.R. (formerly the Lake Superior & Mississippi River R.R.) to build the 'Short Line' from Thomson to Duluth in 1868 (Fig. 3). This line forms the southern boundary of Hemlock Ravine. In 1897 the largest trestle on the Skally Line burned, and all traffic took the 'Short Line'.

The entire line from St. Paul to Duluth became part of the Northern Pacific R.R. in 1900; The Burlington Northern acquired title in 1970. In 1976 The Burlington Northern abandoned the line from Duluth as far south as Hinckley and took up the tracks. In 1980 the state bought the line for use as a trail--the Minnesota/Wisconsin Boundary Trail. In 1985 this trail will be paved from Jay Cooke State Park to Duluth to provide for year round multiple use.

Fig. 3.

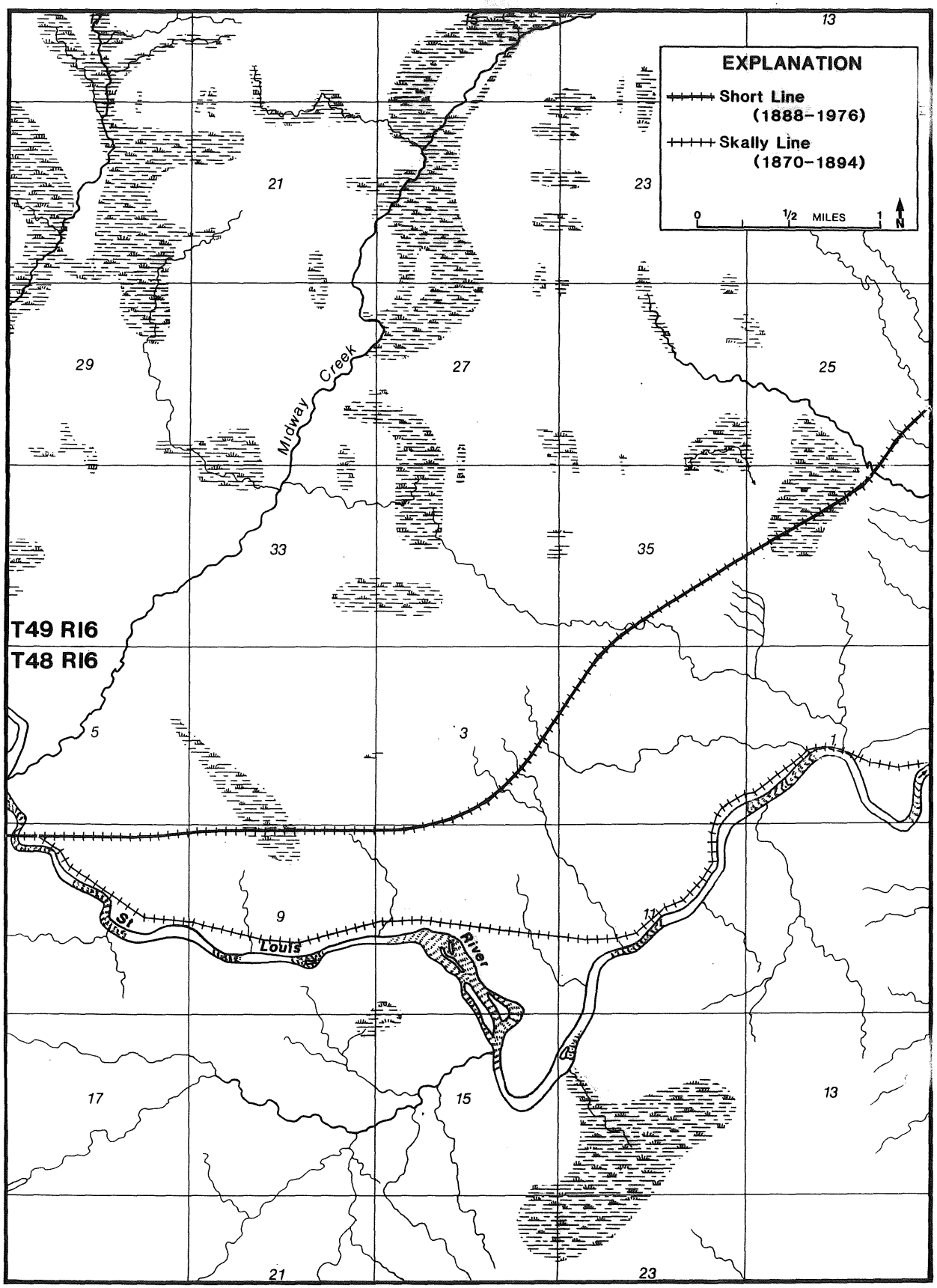


Figure 3. Former railways adjacent to or near Hemlock Ravine SNA

VEGETATION HISTORY

The present vegetation of Hemlock Ravine is a reflection of both natural climatic modifications since glacial times and human modifications since the area was originally settled. In order to understand the magnitude of the human impact, it is important to know how the vegetation appeared prior to settlement.

When the Superior Lobe was still advancing and retreating in northeastern Minnesota, most of southern Minnesota was marked by boreal spruce forest which spread northward with the retreat of the ice mass about 11,500 years ago (BP). The spruce forest itself could not survive the continued trend toward a warmer, drier climate and was replaced by pine forests about 10,000 BP, followed by deciduous forest 8,000-7,500 BP. Reversal of the climatic trend about 7,000 BP led to gradual advance of coniferous forest into deciduous (Wright 1972).

Tools for reconstructing the state's vegetation at the time of settlement are available in records of the General Land Survey Office. Those records constitute the field notes of the men who originally surveyed Minnesota during the late 1800's.

As the men surveyed each township, they walked along the section lines, marking the mile and half mile intervals by recording tree species, diameter at breast height (dbh), and distance from the survey corner to the nearest tree. Theoretically, the only criteria for selecting these bearing trees was a minimum dbh of five inches. As the surveyors travelled through the townships, they also recorded the location of uplands, swamps, prairies, marshes, groves, and windfalls, as well as all streams, rivers, lakes, and roads. Houses, cabins, fields and other 'improvements' were noted with less regularity, depending on the surveyor and the year the survey was done. Although there are several problems in the use of survey notes for determining past vegetation, including fraud, bias, and species name duplication, the records remain a valuable source of information regarding the nature of the vegetation prior to settlement by European-man.

The townships surrounding Hemlock Ravine SNA were surveyed in 1858. In the township north of Hemlock Ravine SNA (Thompson Twp), birch, fir, and white pine were the most frequently recorded bearing trees, with cedar and tamarack common in the lowlands. Less frequently reported species were aspen, spruce, and yellow pine (presumably Pinus resinosa). In the southern and eastern portions of the township, yellow birch and sugar maple are reported in the line descriptions.

South of the SNA the topography breaks into a steeply dissected escarpment leading down to the St. Louis River valley. Here yellow birch, sugar maple, and lynn (basswood) are frequently used as bearing trees, along with white pine, birch, and fir. Aspen, spruce, ironwood, elm, and cedar are also occasionally recorded.

Fig. 4A

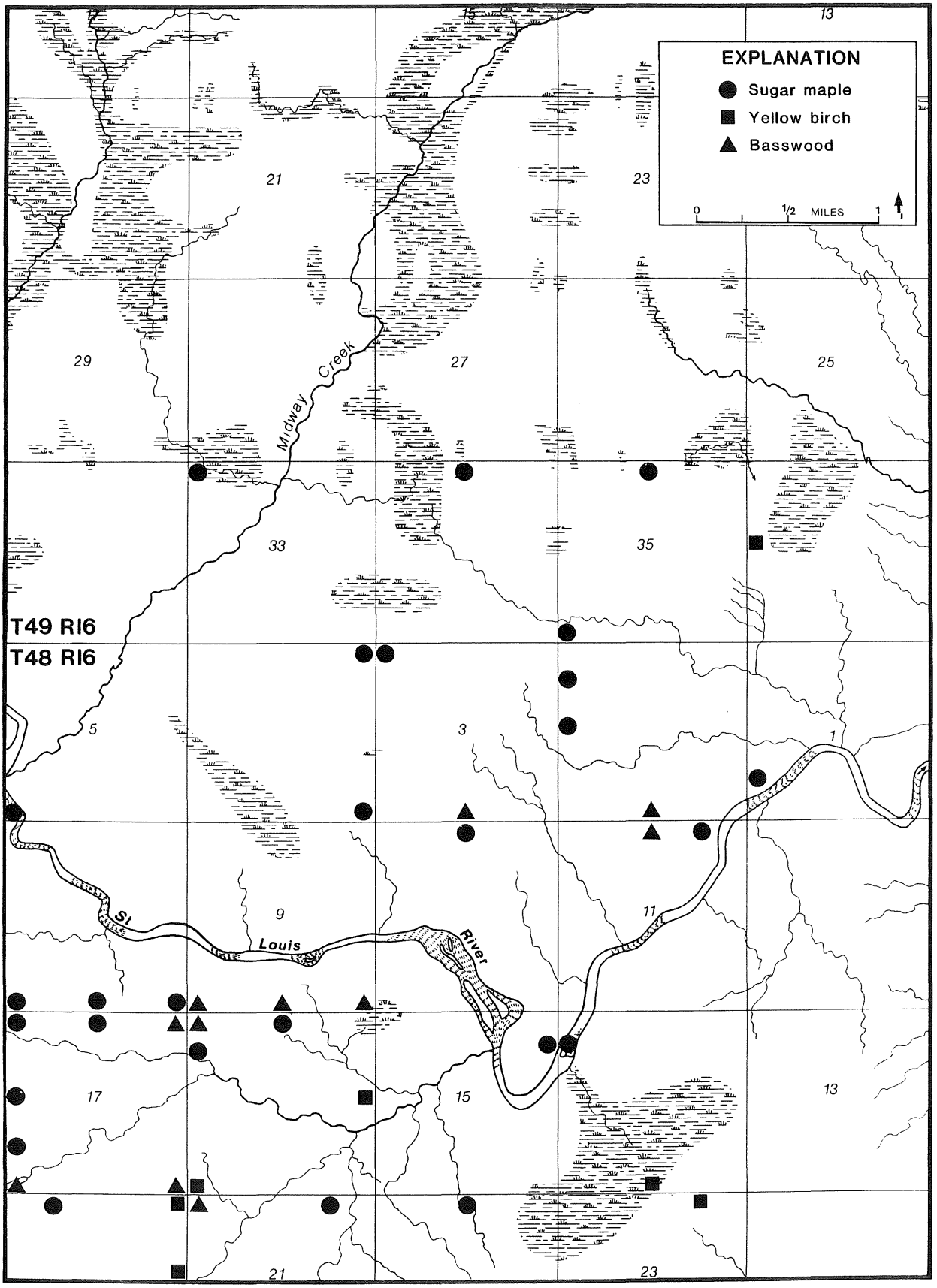


Figure 4A. Distribution of presettlement tree species (sugar maple, yellow birch, basswood)

Fig 4B

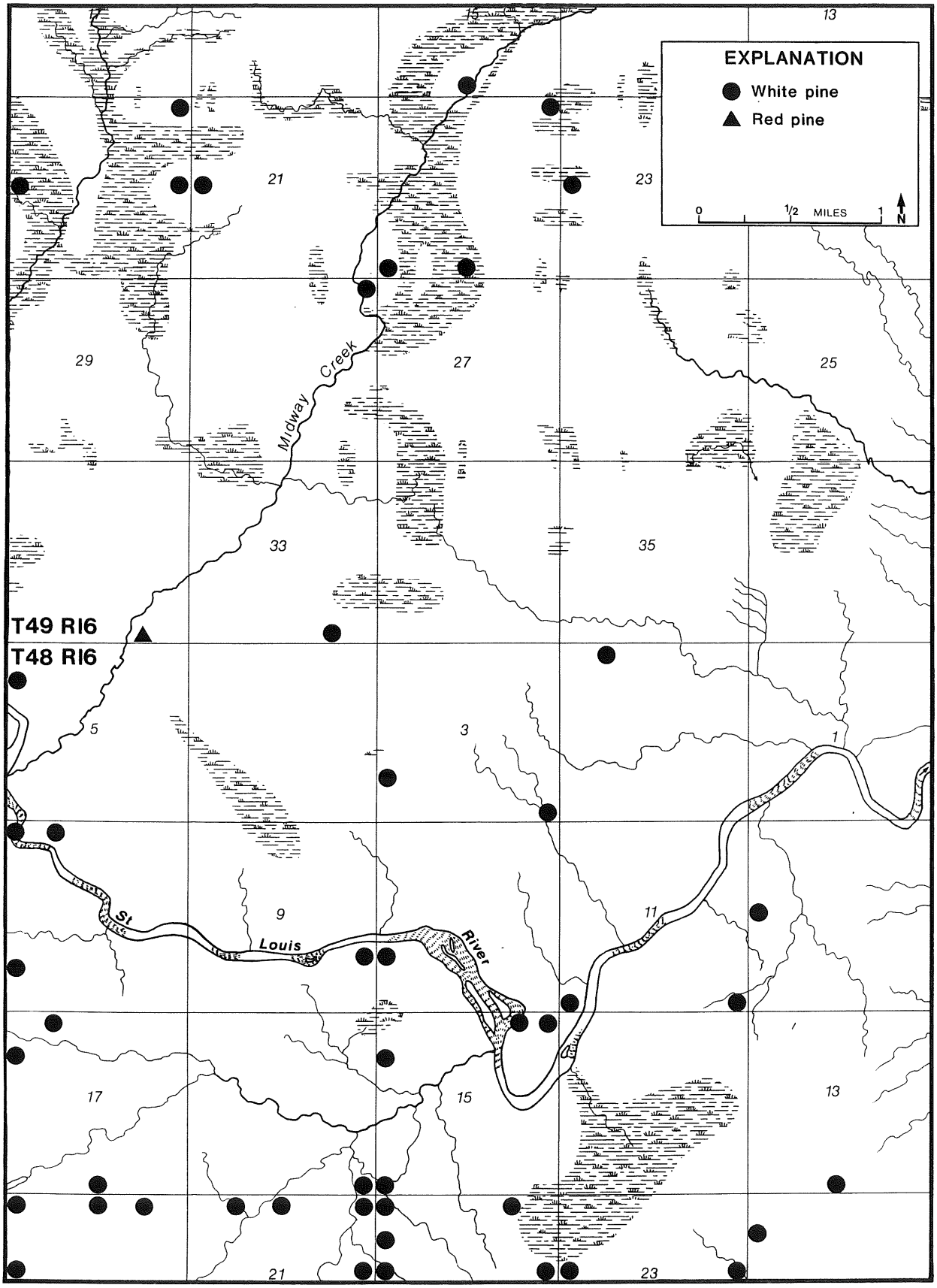


Figure 4B. Distribution of presettlement tree species (white pine, red pine)

FIG 4C

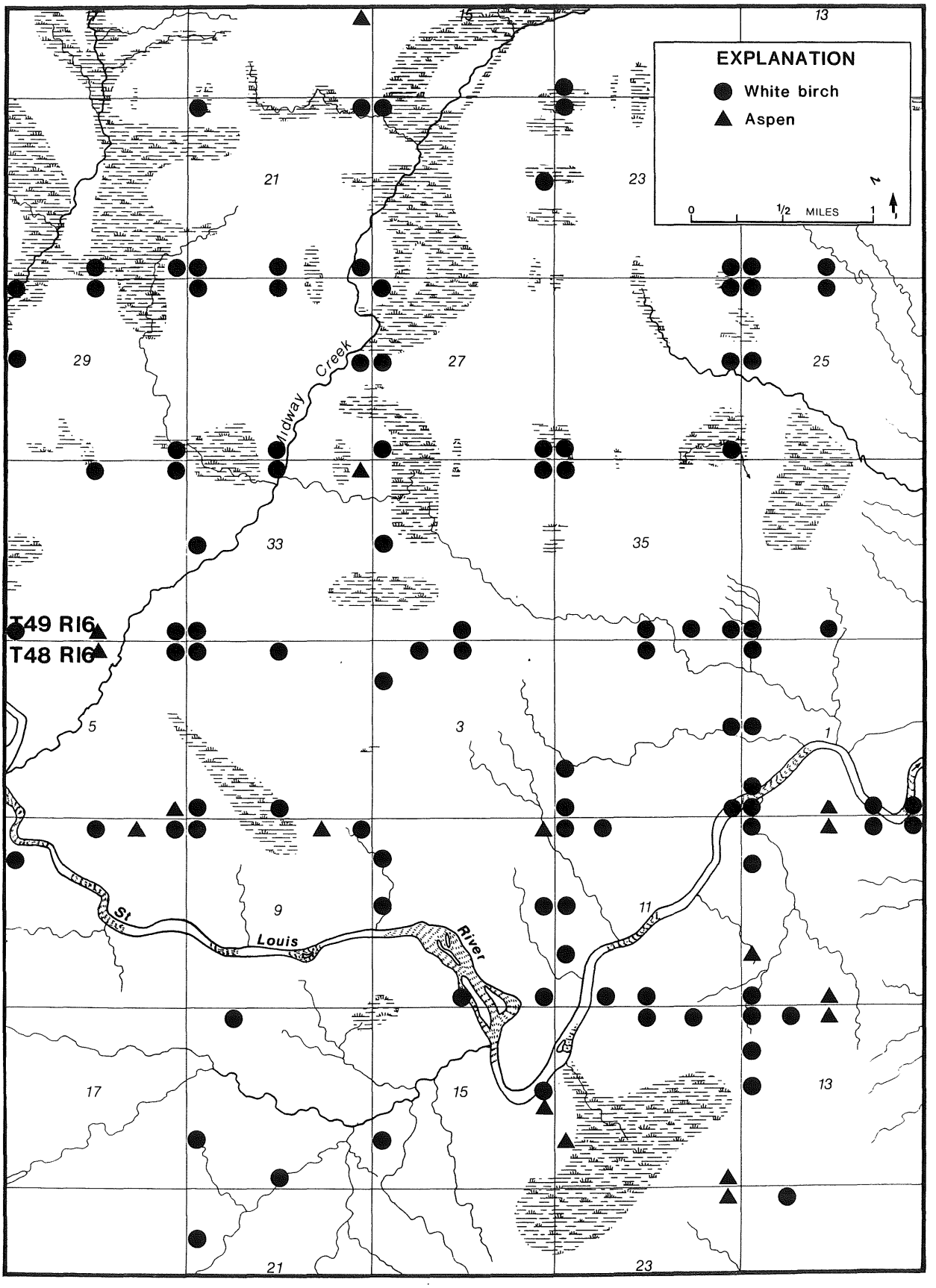


Figure 4C. Distribution of presettlement tree species (white birch, aspen)

Fig 4D

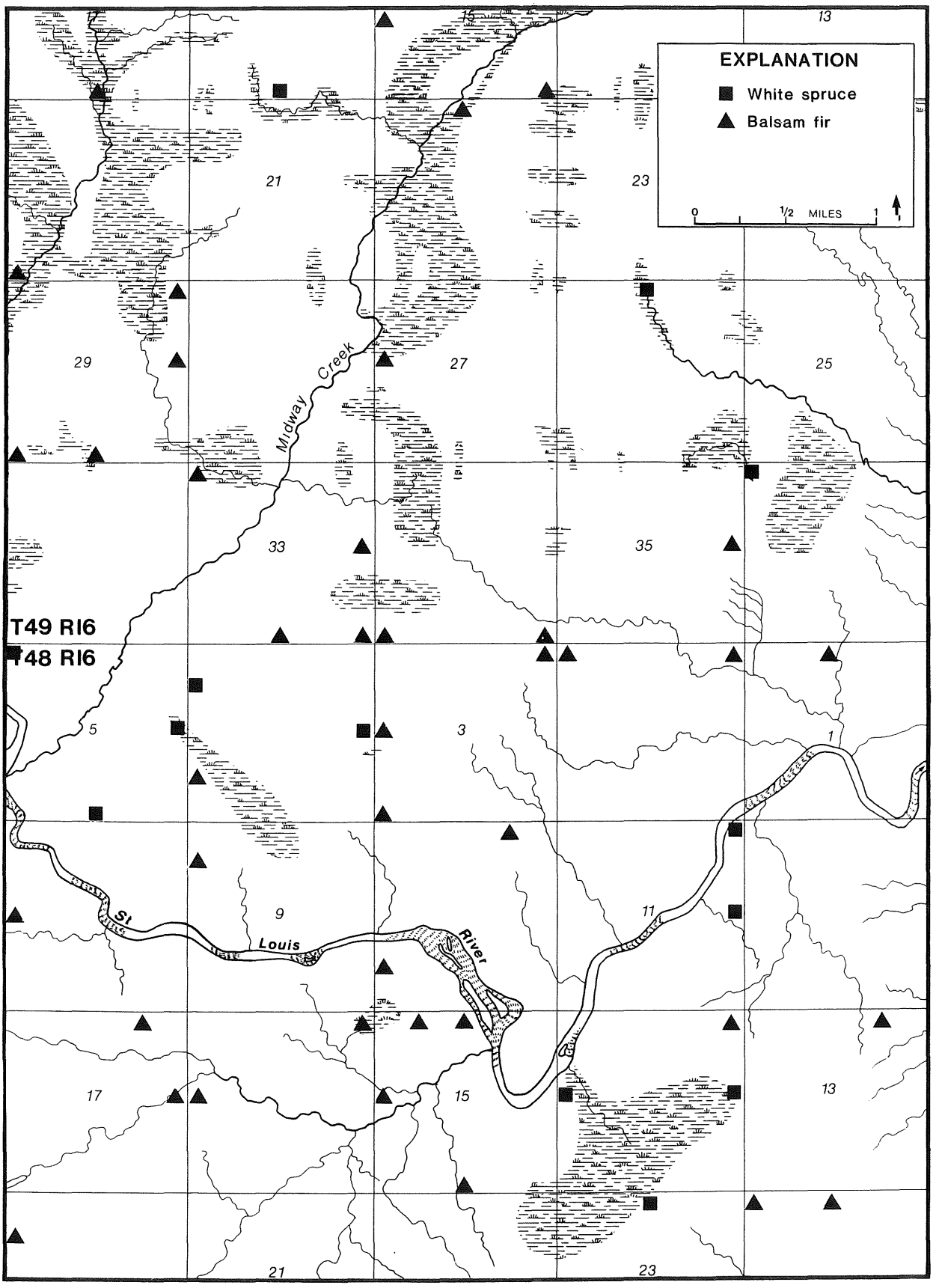


Figure 4D. Distribution of presettlement tree species (white spruce, balsam fir)

Fig. 4E

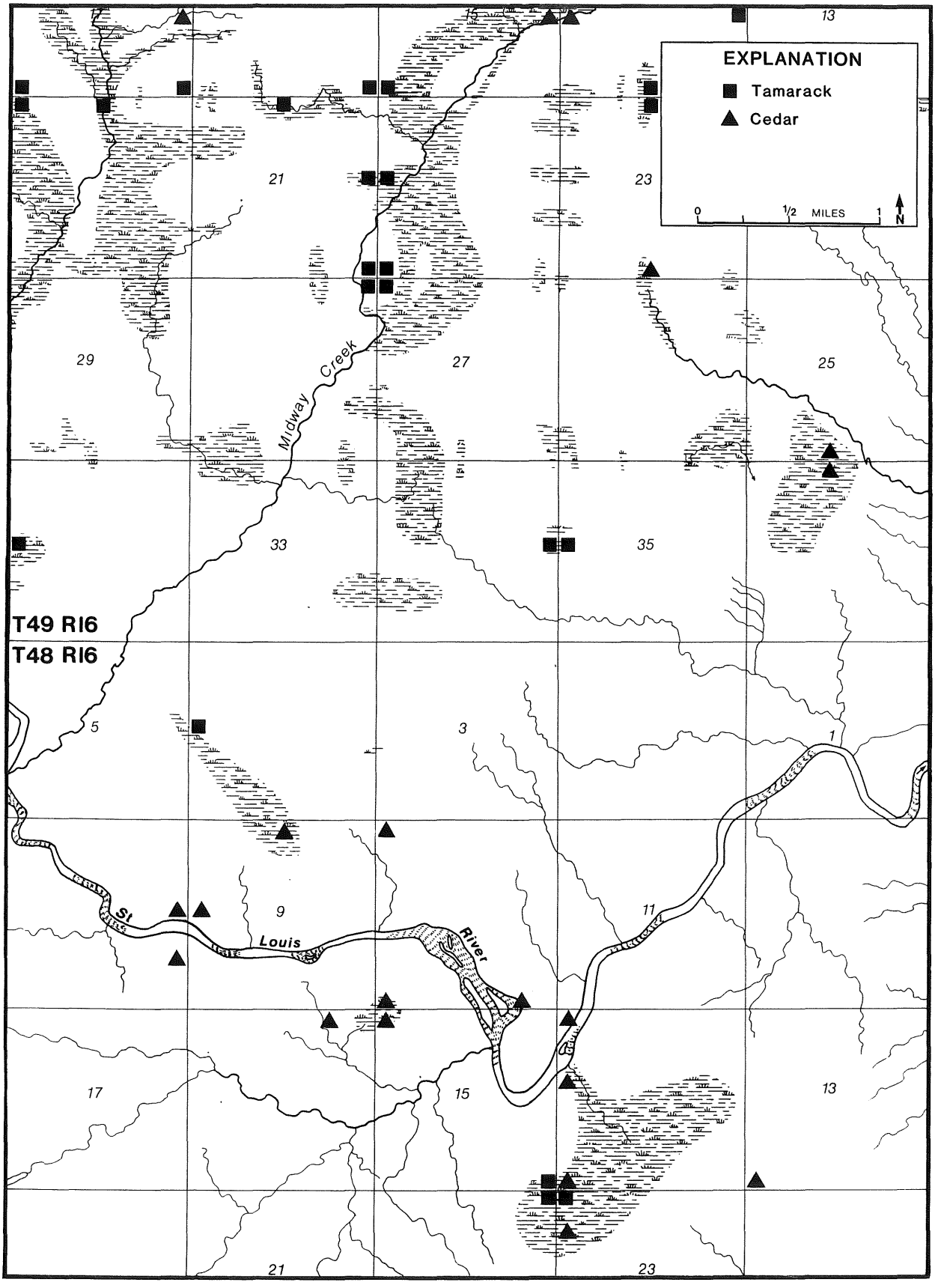


Figure 4E. Distribution of presettlement tree species (tamarack, cedar)

Additional descriptions of the presettlement vegetation comes from explorers' journals as they traveled over the Grand Portage Trail. The journals of two members of Governer Cass' expedition in 1820, David Bates Douglass, a Captain in the army and Henry Rave Schoolcraft, the geologist of the expedition, provide a few descriptions of the vegetation.

Douglass' best description of the vegetation along the Grand Portage Trail is from the end of the portage:

> July 8
>
> ...Botanized here...The forest growth is white and yellow pine, fir, cruciform spruce - called by the voyageurs white spruce - common spruce, tamarack, birch of two kinds, poplar of two kinds, maple of two kinds, mountain ash and some elm - with occasionally an undergrowth of alders, hazel, willow and thorn (white).

Douglass made no mention of hemlock along the portage.

Further up the St. Louis River, Douglass makes two interesting entries:

> July 10
>
> [approximately 10 miles upstream from Portage]...The river is then very gentle for 6 miles to Isle an Pins where there is another rapid. In the course of this distance observed large forests of pine trees on the left killed by the fire and afterwards observed the same thing in several other places.
>
> July 11
>
> [upstream from the present town of Brookston]...the appearance of the shore indicates a richer soil than any we have passed hitherto. There are here the aspen, the lind... the bass, soft and sugar maple, elm, white and swamp ash, birch and some oaks, the first I have seen and occasionally spruce, hemlock, and white pine, and finally a luxuriant undergrowth of willow, alder, hazel, chokeberry, white-thorn, gooseberry, and rose... .

This description of hemlock east of Brookston is substantiated by several later reports of hemlock in this vicinity.

Schoolcraft, in his journal, gives additional accounts of the local vegetation. On the difficult second day of the portage, passing just north of the SNA, Schoolcraft notes:

July 7

...Everything around us wears a wild and sterile aspect, and the extreme ruggedness of the country-the succession of swampy grounds and rocky precipices-the dark forest of hemlock and pines which overshadow the soil... .

At the end of the portage Schoolcraft gives a general description of the landscape they crossed:

July 8

...The growth of trees is pine, hemlock, spruce, birch, oak and maple, the former predominating... Where depressions exist in the surface of the soil, so that it remains wet and marshy, the tamarack is found, and the white cedar is seen overhanging the cliffs on the banks of the river... .

A short distance upstream from the Grand Portage, the Cass expedition split up. Schoolcraft accompanied the group taking an overland route to Sandy Lake. During this 4 day trip through boggy, swampy country Schoolcraft makes several interesting entries relating to hemlocks:

July 10th

Our guides taking their course by the sun, immediately struck into a close matted forest of pine and hemlock, through which we urged our way with some difficulty...This terminated in a thick forest of hemlock and spruce, of a young growth, which continued two miles and brought us to the banks of a small lake, with clear water and pebbly shore.

July 11th

The dreadful storms which prevail here at certain seasons, are indicated by the prostration of entire forests, and the up-rooting of the firmest trees. These lie invariably pointing towards the southeast, indicating the strongest winds to prevail from the opposite point. It is one of the most fatiguing labours of the route, to cross these immense windfalls, - the trees are chiefly tamarack, spruce, cedar, ash, white birch, and hemlock.

Schoolcraft's relatively frequent description of hemlock associated with lowland trees (i.e., tamarack, spruce) does not match well with hemlock's more typical association with upland, northern hardwood sites. He may have confused hemlock with balsam fir, which is more ubiquitous in its habitat associations.

PRESENT VEGETATION

Introduction

The Hemlock Ravine SNA contains a fine example of an old-growth Northern Hardwood-Coniferous Forest, a community type considered threatened in Minnesota (see element abstract, Appendix 3). Minnesota's Northern Hardwood-Conifer Forest represents the westernmost expression of the Upper Great Lakes hardwood forests (Society of American Foresters cover type maple-beech-yellow birch and hemlock-yellow birch). In Minnesota, however, hemlock (Tsuga canadensis) is limited to a few stands near Duluth, beech (Fagus grandifolia) is absent, and yellow birch (Betula lutea) assumes a significant role. The Northern Hardwoods-Conifer Stand at Hemlock Ravine SNA is a particularly significant example of this community type because it is one of the very few stands remaining in Minnesota where hemlock is a component of the forest.

As is the case with almost all known remnants of old-growth Northern Hardwood-Conifer Forest, the areas has experienced some land-use activities which have altered the original vegetation. Stumps from selective pine removal in the late 1800's are still evident today. Subsequent slash fires, although there is no historical documentation for fires in this specific area, probably explain the birch dominated area in the eastern portion of the SNA, the younger forest in the SW corner, and the occurrence of charred stumps. However, a Yellow Birch dated at approximately 164 years old indicates that fires, in at least the last 164 years, have either been small and spotty or not severe enough to kill a major portion of the canopy trees.

Deer browsing is another factor that may be impacting natural vegetation development. Deer historically did not occur in the high numbers currently present in the area. Deer browsing may be supressing hemlock regeneration and affecting other species as well.

Methods

The vegetation communities on the Hemlock Ravine SNA are mapped and described in the following section. The vegetation for this site is grouped into four types - Northern Hardwoods-Conifer Forest (Upland), Northern Hardwoods-Conifer Forest (Ravine Slope), Black Ash Wetland, and Paper Birch Forest. This classification is based on dominance of canopy layer species and overall floristic composition. In addition, the vegetation community types that are considered elements* by the Minnesota Natural Heritage Program were ranked according to their quality (i.e., how close they resemble presettlement conditions). Four element occurrence ranks are given: Grade A = excellent, Grade B = good, Grade C = marginal, Grade D = poor. Definitions of the above ranks are provided in the element abstracts for the Northern Hardwood-Conifer Forest (Appendix 3). This assessment was done in order to document the significance of the Northern Hardwood community types at the Hemlock Ravine SNA. The rankings are also useful for management consideration as they reflect the degree to which the original vegetation has been altered and the propensity of the vegetation to return to more natural conditions.

The boundaries of the vegetation types on the cover type map (Fig. 5) were identified with the use of aerial photographs, soil maps, and on-site field evaluations. Boundaries of vegetation types are always more definitive when mapped than they appear in the field. Sharp changes between vegetation types are rare; instead, they grade on a continuum and from one type to another. Vegetation data describing in more detail the composition of the Northern Hardwoods-Conifer Forest at the Hemlock Ravine SNA are available from the Northern Hardwoods-Conifer Forest Study conducted by Natural Heritage Program staff in 1982 and 1983. For this study releves (a semi-quantitative vegetation sampling method) were conducted within the Northern Hardwood-Conifer Forest type. The location of the releve plots are indicated in Fig 5. Species presence/absence, relative abundance and community structure were documented (see Appendix 3).

* An element is a natural feature of particular importance because it is exemplary, unique, threatened or endangered on a national or statewide basis.

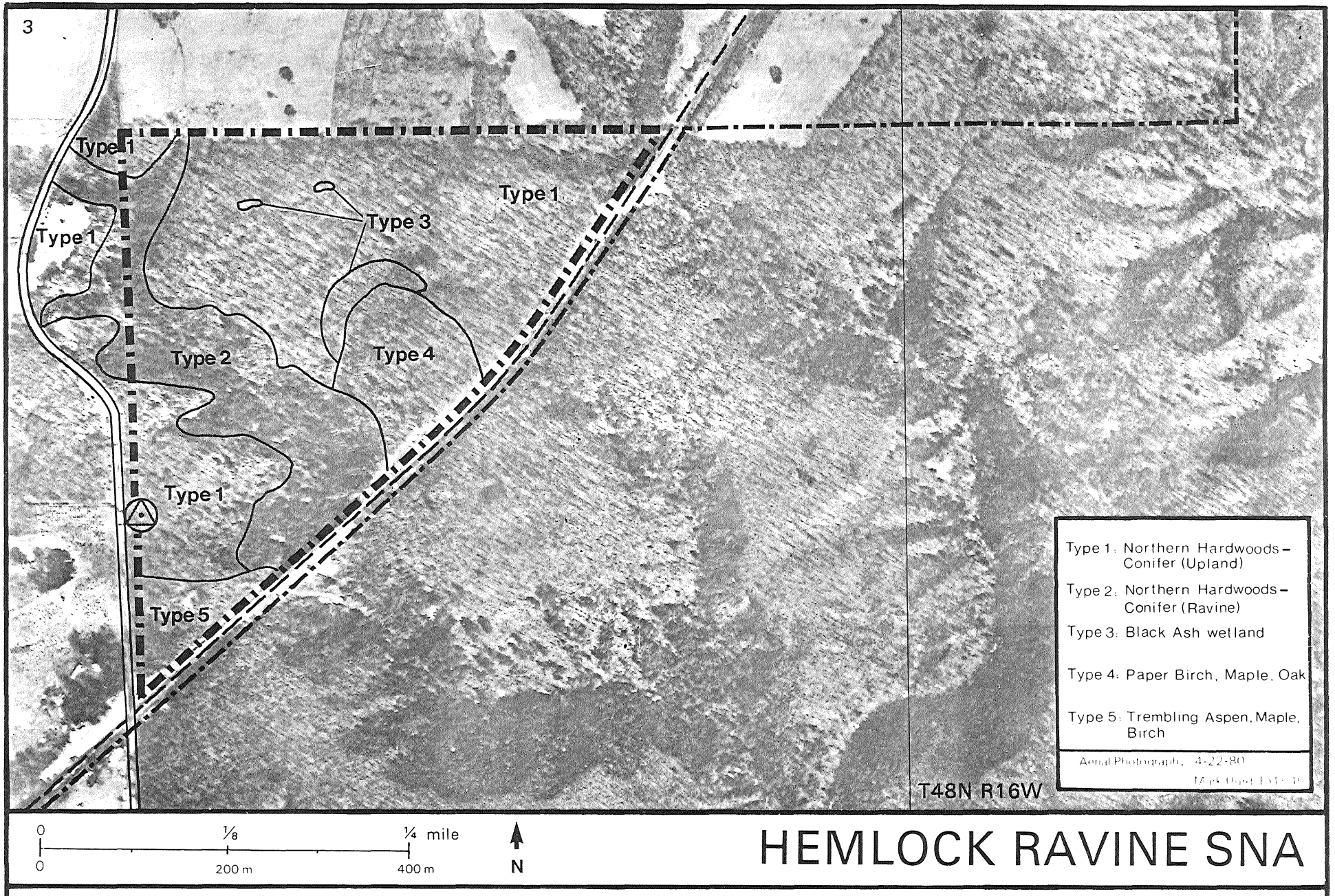


Figure 5. Vegetation Types

SITE

Community Descriptions

Northern Hardwood-Conifer Forest: (Type 1 - Forest type occuring on slopes of ravine) Element Occurrence rank = AB

This community type occurs on the steep slopes of the ravine that cuts through the SNA. The abundance and distribution of species is different on these steep slopes when compared to the adjacent upland northern hardwoods. On the slopes, the community is dominated by sugar maple (Acer saccharum) and paper birch (Betula papyrifera) with a scattered supercanopy of white pine (Pinus strobus). Associated species that occur with less frequency include white spruce (Picea glauca), balsam fir (Abies balsamea), northern white cedar (Thuja occidentalis), and hemlock (Tsuga canadensis). The ground layer is sparsely vegetated. Soil formation in ravines in this part of Carlton County (Udorthents - 25 to 60% slope - type 1020) are typically restricted by the steep slopes to the upper 10 or 12 inches of the clayey and loamy material. There is considerable sliding and creeping downslope, making erosion a chief management concern (SCS, Soil Interpretation Record Type 1020). The occurrence of hemlock in this community is particularly significant.

Northern Hardwood-Conifer Forest: (Type 2 - Forest type occurring on upland) Element Occurrence = B

This community type forests most of the SNA. The canopy is dominated by old-growth sugar maple (Acer saccharum), yellow birch (Betula lutea) and basswood (Tilia americana). Pine stumps dating from logging in the late 1800's are scattered throughout. The shrub layer includes species such as mountain maple (Acer spicatum), sugar maple. basswood, and ironwood (Ostrya virginiana). The understory varies from large areas dominated by Carex pensylvanica a sedge species, to areas where herb diversity is greater, including species typical of deciduous hardwoods - dwarf ginseng (Panax trifolius), (Anemone quinquefolia), wild sarsaparilla (Aralia nudicaulis), and Jack-in-the-pulpit (Arisaema triphyllum). One rare plant element white baneberry (Actaea pachypoda), occurs in this community type. Soils, classified in the Duluth Series (type 504), are considered to be fine sandy loams occurring on well to moderately well-drained soils formed on glacial till. Two releves were conducted in this community see locations on Map and data on species presence and abundance in Appendix .

Black Ash Wetland (Type 3)

Scattered wet depressions occur throughout the northern portion of the SNA on poorly drained soils formed in the glacial till (soil type-502: Dusler series). These areas are ringed by black ash (Fraxinus nigra). The center of these wet areas (only one area actually had standing water when visited in late June 1984) are open, dominated by low herbaceous species such as marsh marigold (Caltha palustris), jewelweed (Impatiens capensis), sensitive fern (Onoclea sensibilis), iris (Iris versicolor) and several sedge species.

Paper Birch, Sugar Maple, Red Oak Community (Type 4)

A knoll and surrounding area on the east-central boundary of the Hemlock Ravine SNA has a distinctly different composition than the majority of the SNA. Dominant in the canopy of this area are young to mid-age paper birch (Betula papyrifera). Associated species in the canopy are sugar maple and northern red oak (Quercus borealis). The understory, like areas within Type 2, has large "grassy" patches dominated by the sedge, Carex pensylvanica. In other areas where the sedge mat does not dominate the understory, wild sarsaparilla and sugar maple are the most prevalent species. This area, a drier and younger site than most of the SNA, may be the result of fire.

Trembling Aspen, Sugar Maple, Paper Birch Community (Type 5)

A forest community dominated by trembling aspen occurs in the very southwestern corner of the SNA. The origin of this stand of aspen, that appears to be fairly young (dbh of aspen are 7-10 cm.), is of unknown origin. Scattered throughout the canopy are paper birch, sugar maple, northern red oak and white spruce. The shrub layer of the stand is open with a dense understory of sugar maple.

Plant Species List

The following list contains 82 species of vascular plants which have been collected at Hemlock Ravine SNA. This list is not comprehensive and is based on only two visits to the site. Additional collecting will probably result in 50 to 75 species being added to the list. Some ubiquitous species, such as Aster macrophyllus, are assumed to occur commonly at Hemlock Ravine but have not been collected yet. Other species which are rare in Minnesota, such as Adoxa moschatellina and Claytonia caroliniana, may also occur at the site and should be searched for. All vouchered specimens are on deposit in the herbarium of the University of Minnesota at St. Paul.

Abies balsamea (L.) Mill.
Acer saccharum Marsh.
Acer spicatum Lam.
Actaea pachypoda Ell.
Actaea rubra (ait.) Willd.
Allium tricoccum Ait.
Anemone riparia Fern.
Aralia nudicaulis L.
Aralia racemosa L.
Arisaema triphyllum (L.) Schott
Athyrium filix-femina (L.) Roth var michauxis (Spreng.) Farwell
Betula lutea Michx. f.
Botrychium virginianium (L.) Sw.
Bromus ciliatus L.
Caltha palustris L.
Carex arctata Bootl.
Carex brunnescens (Pers.) Poir.
Carex crinita Lam.
Carex deweyana Schwein.
Carex pensylvanica Lam.
Carex stipata Willd.
Caulophyllum thalictroides (L.) Michx.
Cicuta maculata L.
Cinna latifolia (Trev.) Griseb.
Circaea alpina L.
Cornus alternifolia L.f.
Cornus canadensis L.
Corylus cornuta Marsh.
Diervilla lonicera Mill.
Dryopteris spinulosa (O.F. Mull.) watt
Equisetum pratense Ehrh
Equisetum scirpoides Michx.
Erigeron philadelphicus L.
Galiopsis tetrahit L.
Galiums asprellum Michx.
Galium triflorum Michx.
Glyceria striata (Lam.) Hitchc.
Gymnocarpium dryopteris (L.) Newm.

Hieracium canadense Michx.
Impatiens capensis Meerb.
Laportea canadensis (L.) Wedd.
Lathyrus ochroleucus Hook.
Linnaea borealis L.
Lonicera canadensis Bartr.
Luzula acuminata Raf.
Lycopodium annotinum L.
Lycopodium clavatum L.
Lycopodium dendroideum Michx.
Maianthemum canadense Desf.
Matteucia struthiopteris (L.) Tod.
Miluim effusum L.
Mitella nuda L.
Monesis uniflora (L.) Gray
Oryzopsis asperifolia Michx.
Osmorhiza longistylis (Torr.) DC.
Osmunda claytoniana L.
Panax trifolium L.
Phalaris arundinacia L.
Picea glauca (Moench) Voss
Populus balsamifera L.
Populus tremuloides Michx.
Polypodium virginianum L.
Prenanthes alba L.
Pteridium aquilinum (L.) kuhn.
Quercus borealis Michx. f.
Ranunculus acris L.
Ranunuculus hispidus Michx. var caricetorum (Greene) T. Duncan
Rubus parviflorus Nutt.
Sanguinaria canadensis L.
Saxifraga pensylvanica L.
Scrophularia lanceolata Pursh
Solanum dulcamara L.
Streptopus amplexifolius (L.) DC.
Thelypteris phegopteris (L.) Slosson
Thuja occidentalis L.
Tilia americana L.
Trientalis borealis Raf.
Trillium cernuum L.
Tsuga canadensis (L.) Carr.
Vaccinium myrtilloides Michx.
Viola pubescens Ait.
Viola selkirkii Pursh

Rare Plants

Two species of plants occur on the SNA which are considered rare in Minnesota: Hemlock (Tsuga canadensis) and white baneberry (Actea pacypoda). A status sheet for each of the species is included in the Appendix.

A field survey for hemlock was conducted in the SNA on November 3, 1983 after leaffall. Results of the survey are presented in table 1. Ten pole-sized trees (dbh >6") and 3 saplings (dbh <3") were found. The trees occurred in 6 different locations (see Fig. 6), five on the west side of the ravine and one on the east. Each site is separated from the next by at least a major gully. Hemlock seedlings were numerous in 4 of the sites and only consisted of a few individuals in the other two locations.

All but one of the hemlocks were located on the slopes of the steep ravine in the western portion of the SNA. One tree was situated a few hundred feet west of the edge of the ravine. In general, the groundcover in the hemlock sites is predominantly litter, baresoil, and moss, with less than 50% herbaceous cover (grasses and sedges). Associated canopy species include yellow birch, white cedar, white spruce, paper birch, and white pine; and to a lesser degree basswood, balsam fir, red oak, sugar maple, and balm of Gilead.

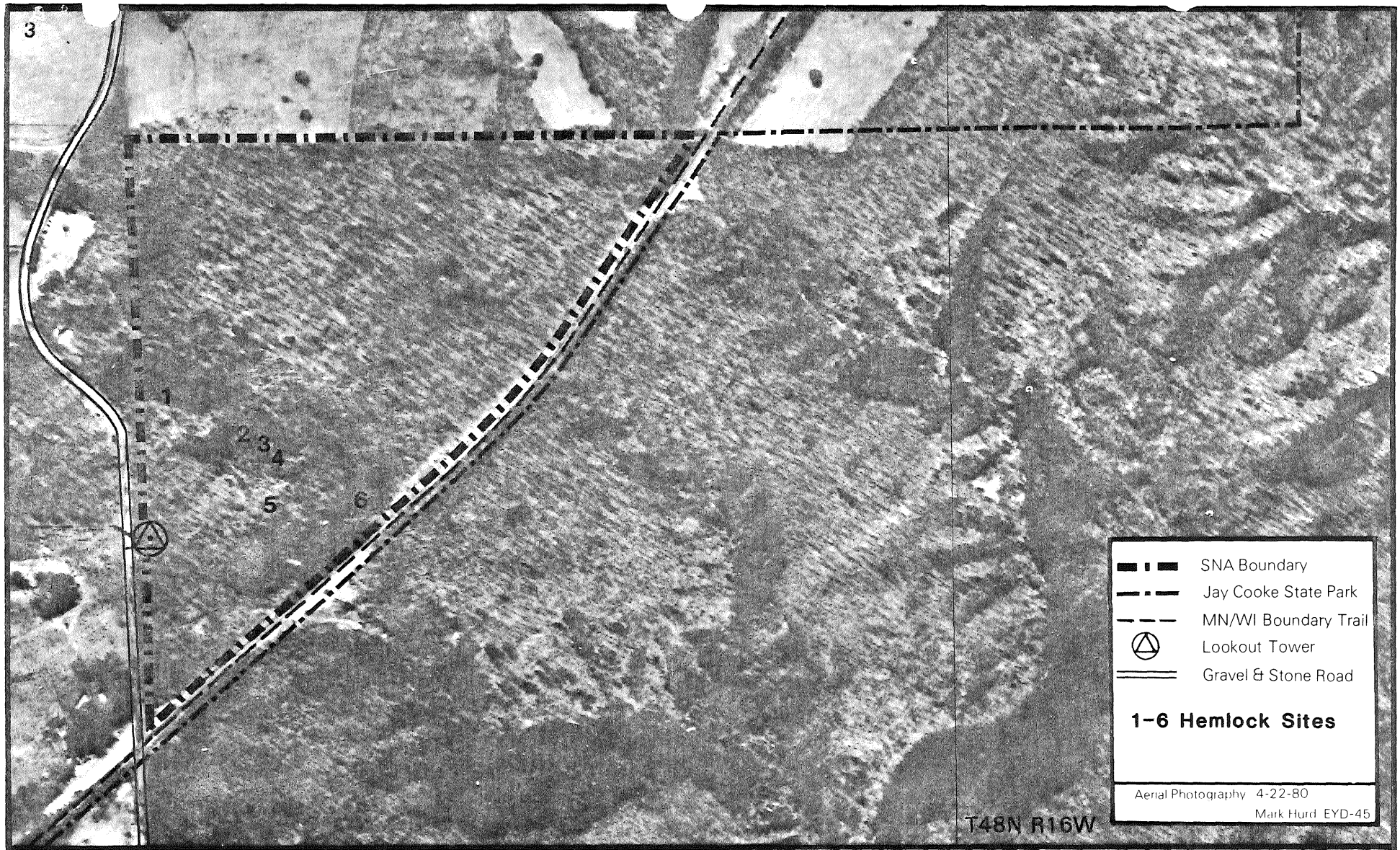


FIG. 6 Distribution of Hemlock Trees

SITE

Table 1. Hemlock Survey 11-3-83.

Site	Tree#	Dbh(in)	height(ft)	canopy(c) position	slope(%)	slope position	aspect	top forked-f, entire-le	damage(1)	seedlings(2)	comments
A	1	11.8	57	main c.	100	mid	N	e	s (h)	numerous	
B	2	12.2	53	super c.	100	mid	N	e	s (1), F		3 saplings
	3	2	14	sub c.	100	mid	N	e	D	numerous	close to
	4	2	13	sub c.	100	mid	N	e	-		each other
	5	1	11	sub c.	100	mid	N	e	B		in a row
C	6	10.5	55	main c.	150	top	N	e	-	numerous	
D	7	9.2	64	main c.	150	top	N	e	-	few	sunnier, drier, site
E	8	14"	53	main c.	90	upland	SW	e	s (h), F	few	short distance back from crest of ravine, continuous sedge ground layer
F	9	13.2	63	main c.	55	mid	E	f	s (m)		in gully
	10	8.0	41	sub c.	40	bottom	SE	f	-		oriented
	11	11.5	60	main c.	65	mid	W	e	s (m)	numerous	approx
	12	6	37	sub c.	80	top	SW	e	s (1)		NE-SW, on
	13	15.9	53	super c.	90	top	W	f	s.(h), F		E. side of ravine. All other trees on W. side. Most seedlings top slope.

1. damage: s-sapsucker, F-frostcracks, B-browsed, D-Deer rub
   degree: h-heavy, m-moderate, l-light.

2. Seedlings: 10 or more-numerous, 1 to 2-few.

APPENDIX

1. Status Sheet: Tsuga canadensis
2. Status Sheet: Actea pacypoda
3. Element Abstract: Northern Hardwoods - Conifer Forest
4. Releve's

STATUS SHEET

NAME: Tsuga canadensis (L.) Carr. (Eastern Hemlock)

FEDERAL STATUS: None

STATE STATUS: Special Concern

BASIS FOR STATUS CLASSIFICATION: Hemlock reaches the extreme western edge of its range in Minnesota and has always been uncommon in the state. Since the time of settlement, however, hemlock has experienced a drastic decline in numbers and is in danger of extirpation from the state.

OCCURRENCES IN MINNESOTA: There are several reports of hemlock occurring in Minnesota. Many of these reports, however, are not substantiated by voucher specimens or by accurate descriptions. In spite of this, there are 16 records (historical and recent) which we can assume to be authentic. The most significant of these records is from St. Louis County near Paupores (Lawson 1942). The site was first reported in 1915 and was reported to occur on a 280 acre tract and contain nearly 5,000 trees. The effects of logging followed by a fire in 1918 apparently destroyed all the hemlocks. A search in 1930 failed to locate a single surviving tree. There is, remarkably, an unconfirmed report of hemlock being cut in this area around 1970 (on the north side of the St. Louis River between Brookston and Floodwood). This raises the hope that a few trees may still persist in this area (Zumbahlen, pers. comm.).

Three hemlock trees were discovered in Mille Lacs County near the village of Isle in 1935 by U.S. Forest Service employee E.I. Roe. The site was confirmed by C.O. Rosendahl two years later and is apparently the site of a Bakuzis-Waring study. This site was revisited in 1981 by DNR employee Ray Neuman, who reported the three trees still surviving.

There is a documented record of hemlock from Pine County near Findlayson dated 1936 (Kanta), and three reliable sight records of individual trees from in and near the Nemadji State Forest. All of these records are quite old, and we currently know of no extant native hemlock in Pine County.

Four hemlock trees were discovered by foresters near Togo in Itasca County in 1932. Two of the trees were left standing but soon died from exposure when the surrounding forest was cleared (Heinselman, pers. comm.). It appears that hemlock is now extinct in Itasca County.

Approximately 10 native hemlock trees are known to occur in Magney and Snively Parks in Duluth, and a single tree has been located near the Lestar River just east of Duluth. A short distance southwest of Duluth, in Jay Cooke State Park, a single hemlock survives as a remnant of a stand which was first reported 90 years ago. There are

three other reports of hemlock occurring in Carlton County (the largest with 9 trees), but all are believed to have been destroyed.

The population at Hemlock Ravine SNA (Carlton County) contains 13 trees and more than 100 seedlings. This population is the largest currently known to exist in Minnesota and is the only one adequately protected.

PREFERRED HABITAT: In Minnesota, hemlock occurs in a variety of forest habitats, but appears to prefer protected rocky slopes and ravines. It favors moist, acidic soil containing considerable organic matter. Dry autumns may limit the occurrence of hemlock on less protected droughty soils.

THREATS TO SPECIES: Because of the critically low number of hemlocks occurring at each known site, the greatest threat to their survival appears to be reproductive failure. This threat may be exacerbated by the harsh environmental conditions experienced by these outlier populations in Minnesota. The cold, dry climate may hinder the survival rate of young trees. Also, the foliage of this species is especially favored by deer, and young trees often suffer severely from browse damage.

Other threats include fire, logging, and conversion of habitat to agricultural and residential uses.

REFERENCES: Heinselman, M.L. Adjunct Professor, Depart. of Ecology and Behavioral Biology, Univ. of Minn., Minneapolis.

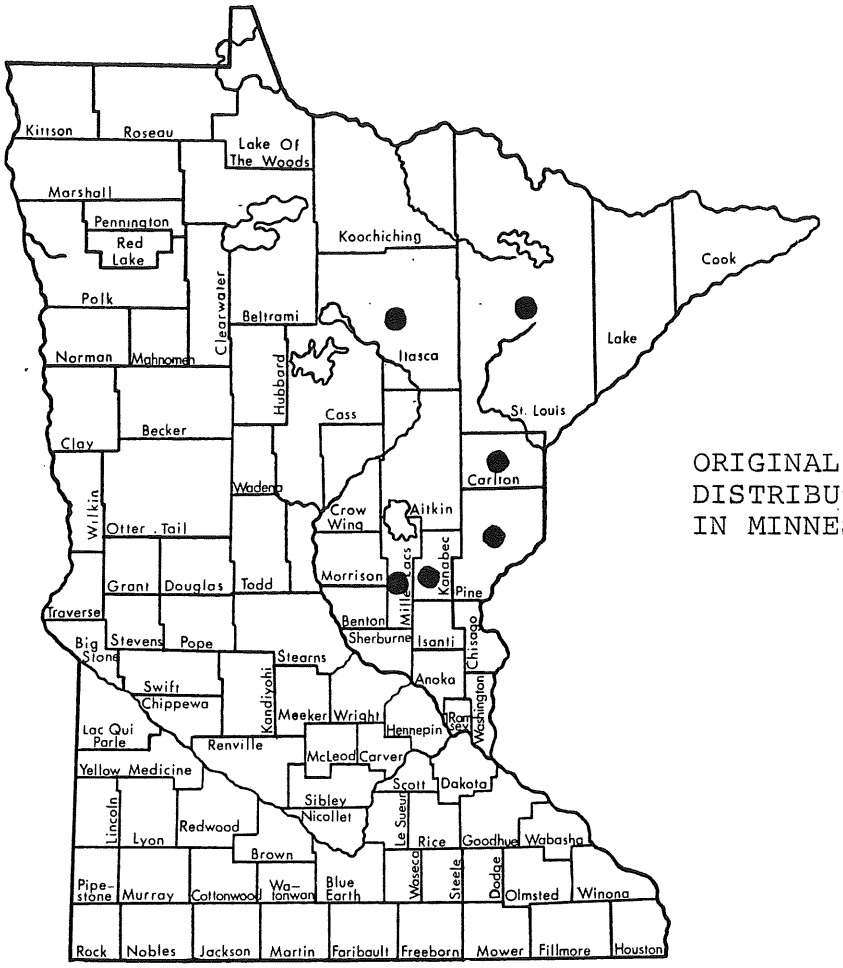
Kanta, Hjalmar. Herbarium specimen on deposit in the Department of Botany, Univ. of Minn., St. Paul.

Lawson, E.L. 1942. What happened to the hemlock? Minnesota Volunteer, 3(16):64-66.

Little, E.L. 1971. Atlas of United States trees. Vol. 1. Conifers and important hardwoods. U.S. Dept. of Agric., Misc. Pub. No. 1146.

Neuman, R. Region II Resource Coordinator, Div. of Parks and Recreation, Dept. of Nat. Resour., Grand Rapids, Minn.

ZumBahlen, Bruce. Supervisor, State Forest Management and Policy, Dept. of Nat. Resour., St. Paul, Minn.



ORIGINAL COUNTY DISTRIBUTION OF HEMLOCK IN MINNESOTA

NATIONAL DISTRIBUTION OF HEMLOCK

STATUS SHEET

NAME: Actaea pachypoda Ell.

FAMILY: Ranunculaceae

COMMON NAME: White Baneberry

FEDERAL STATUS: None

STATE STATUS: Unofficial "Watch" Category

BASIS FOR MINNESOTA STATUS: The majority of extant populations of this species in Minnesota occur in mature northern hardwood forests along the north shore of Lake Superior. Many of these sites are managed by the U.S. Forest Service, who routinely clear the native vegetation and plant the site to conifers. As this process continues and more habitat is lost, the indiginous population of A. pachypoda will likely suffer a significant decline.

PREFERRED HABITAT IN MINNESOTA: This species is apparently restricted to remnants of the original hardwood forests in eastern Minnesota.

NORTHERN HARDWOODS CONIFER FOREST
ELEMENT ABSTRACT

NATURAL COMMUNITY
ELEMENT NAME: Northern Hardwoods Conifer Forest

PLANT COMMUNITY
COVER TYPES: Acer saccharum-Tilia americana-Betula lutea cover type (A2.A00)
Acer saccharum-Tilia americana-Betula papyrifera cover type (A2.B00)
Acer saccharum-Betula lutea (A2.C00)
Acer saccharum (A2.D00)

BASIS FOR CONCERN: High-grading of the Northern Hardwood-Conifer Forest throughout its range in Minnesota by selective removal of Yellow Birch and conifers has resulted in a change in forest composition toward increased dominance of Sugar Maple and Basswood. Mesic Stands containing Yellow Birch and conifers, as conspicuous components of the forest, are rare. A survey conducted by the Natural Heritage Program, during the summers of 1982 and 1983, of old-growth (100 years or older) northern hardwood-conifer forest stands, occurring in the Duluth area north to the Canadian border, further confirmed that this type of stand is found today in only isolated, remnant tracts.

DESCRIPTION AND DISTRIBUTION: Minnesota's northern hardwood forests are the westernmost expressions of the Upper Great Lakes hardwood forests (SAF cover types sugar maple-beech-yellow birch and hemlock-yellow birch) (Eyre, 1980). In Minnesota, however, hemlock (Tsuga canadensis) is limited to a few stands near Duluth, beech (Fagus grandifolia) is absent, and yellow birch (Betula lutea) assumes a significant role.

The Northern Hardwood-Conifer Forest of Minnesota occurs on mesic loamy sites and is dominated by hardwoods or a mixture of hardwoods and conifers. Sugar maple (Acer saccharum), yellow birch (Betula lutea), and basswood (Tilia americana) are the dominate hardwoods. The subdominant conifers, including white spruce (Picea glauca), balsam fir (Abies balsamea), white cedar (Thuja occidentalis), and white pine (Pinus strobus) are frequent associates. Forest composition varies by geographic range grading on north-to-south and east-to-west clines as the relative dominance of each species shifts along climatic gradients (Flaccus and Ohman 1964). Basswood and Ironwood (Ostrya virginiana), for example, are absent from the most

northerly stands but are major components of hardwood forests west of Duluth, whereas Yellow birch becomes infrequent to the west.

The dense shade produced by the maple canopy results in a relatively open understory. Maple saplings are the most abundant component of the shrub layer with occasional occurrence of 1 Hazel (Corylus cornuta), ironwood, mountain maple (Acer spicatum), and (Prurus virginiana). The characteristic understory species are Clintonia borealis, Polygonatum pubescens, Streptopus roseus, Aralia nudicaulis, Mitella nuda, Claytonia caroliniana, and Lycopodium lucidulum.

The Northern Hardwood-Conifer Forest merges on the drier end of the moisture gradient with pine forest and on the wetter end with swamp forest. It grades into a "Big Woods" type of hardwood community beginning south of a line from Duluth to Itasca State Park. The fire intolerance of this community type has probably greatly restricted its potential extent in northern Minnesota, where fire has always been a significant factor in maintaining the vegetational mosaic. This community was originally restricted to a narrow zone bordering Lake Superior with scattered stands occurring inland as far as Cass lake. Today, very few intact stands larger than 15 acres are known to exist.

POTENTIAL THREATS: Northern Hardwood-Conifer Forests are vulnerable to logging and have been particularly affected by selective removal of yellow birch for use as veneer. In addition, old-growth stands are targeted as good areas for firewood cutting. Stands that are logged are often replanted with spruce or pine and managed so that natural regeneration of these areas to northern hardwoods-conifer type is restricted.

REPRESENTATIVE SITES: Jay Cooke State Park (Carlton Co.)
Lake Agnes Northern Hardwoods (Cook Co.)
Langley Hill Northern Hardwoods (Lake Co.)

NUMBER OF OCCURRENCES: Fifteen sites of natural area quality (Rank A or B), as of May 1984.

SELECTED REFERENCES:
Brown, R.T. and J.T. Curtis. 1952. The Upland Conifer-Hardwood Forests of northern Wisconsin. Ecological Monographs 22(3).

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Tubbs, C.H. 1974. Natural regeneration of northern hardwoods in the great lakes region. North Cent. For. Exp. Station. St. Paul, MN. Research Paper NC-150 USDA Forest Service, 20 p.

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ELEMENT OCCURRENCE RANKING - NORTHERN HARDWOOD-CONIFER FOREST

GRADE A--[Old growth (120 yr.+) forest tracts relatively undisturbed by man or recovered to an extent where community structure and composition is intact and reflects native presettlement conditions]

Grade A forests display the following ecological features: (1) closed overstory canopy of old growth mesophytic species, (2) presence of standing dead trees and numerous down trees, (3) heterogenous understory, patchy distribution of herbaceous layer, (4) uneven age stand, shade-tolerant mesophytic trees regularly distributed in all size classes, (5) abundance and richness of spring ephemerals and spring blooming herbs. Grade A forests may have been subjected to some light to moderate disturbance. Examples are tracts that have received limited selective removal of conifer species. These types of former land uses in a Grade A tract have done little damage; the major change has been an increase in the relative importance of the mesophytic species - sugar maple, yellow birch, basswood.

GRADE B--[Forest tracts due to slight to moderate man-induced disturbances or their small size are not considered of Grade A quality]

These tracts have been recently lightly disturbed or moderately disturbed in the past but have recovered much of their original composition and structure. Examples of Grade B forests are (1) old growth forests being selectively logged, (2) old second-growth (90-120 yr.) forests with an intact ground layer, and good tree size class distribution, (3) virgin old growth forest of small size (<40 acres). Grade B forests have the propensity to return to Grade A condition with protection and removal of disturbance.

GRADE C--[Mature second growth (50-90 yr.) forests or moderately disturbed communities where the original composition and structure has been altered and no longer reflects natural conditions]

Grade C forests are typically mid successional forests recovering after heavy logging. These tracts are characterized by an absence of larger tree size classes, presence of low branching and multiple-trunked trees, absence of dead falls, and relatively uniform understories, often characterized by a continuous cover of a few dominant species.

GRADE D--[Degraded forest communities]

Severe disturbances have profoundly altered the original structure and composition of the site. Grade D forests include young second growth stands (20-50 yr.) following recent clear cutting.

RF NO: BAC 002
DATE: 10 June 1982
SURVEYOR: Coffin, B. and Engstrom
LOCATION: Hemlock Ravine SNA, NW 1/4 SE 1/4 Sec. 3, T48N, R16W. Old-growth northern hardwoods with six Tsuga canadensis in deep ravine that cuts through site. SE-facing slope. Betula lutea cored and aged at approx. 164 yrs-70CM DBH.

TREE LAYER 07P

Betula lutea 2.1
Acer saccharum 2.1
Tilia americana 2.1

TREE LAYER 05R

Acer saccharum 2.1
Tilia americana +.1

SHRUB LAYER 04P

Acer saccharum 3.1
Acer spicatum 2.1
Tilia americana +.1

SHRUB LAYER 03P

Acer saccharum 3.1
Betula lutea +.1

HERB LAYER 02P

Acer saccharum 1.1
Acer spicatum 1.1
Lonicera canadensis 1.1

HERB LAYER H2P

Impatiens capensis 2.1
Aralia nudicaulis 2.1

HERB LAYER H2P (continued)

Dryopteris phegopteris 1.2
Allium tricoccum 1.2
Arisaema triphyllum 1.1
Viola selkirkii 1.1
Lycopodium lucidulum +.1
Lycopodium obscurum var. dendroideum +.1
Osmunda claytoniana +.1
Athyrium filix-femina +.1
Polygonatum pubescens +.1
Trillium cernuum var. macranthum +.1
Actaea pachypoda +.1
Anemone quinquefolia var. interior +.1
Viola pubescens +.1
Panax trifolius +.1
Osmorhiza claytoni +.1
Trientalis borealis +.1
Aster macrophyllus +.1
Taraxacum officinalis +.1

GRAMINOID LAYER G2B

Carex pensylvanica 1.2
Unknown R.1

REF. NO: BAC 001
DATE: 11 June 1982
SURVEYOR: Coffin, B. and Engstrom
LOCATION: Hemlock Ravine SNA, NW 1/4 SE 1/4 Sec. 3, T48N, R16W. Old-growth northern hardwoods with Hemlock (Tsuga canadensis) in deep ravine that cuts through site. SE-facing slope. Betula lutea aged at approx. 164 yrs- 70 CM DBH.

TREE LAYER 07I

Betula lutea 3.1
Acer saccharum 2.1
Tilia americana 2.1
Quercus borealis R.1

TREE LAYER 06R

Acer saccharum 2.1

SHRUB LAYER 04R

Acer saccharum 1.1
Betula lutea R.1
Tilia americana R.1

SHRUB LAYER 03P

Acer saccharum 4.1

FORB LAYER 02I

Acer saccharum 2.1
Betula lutea +.1
Prunus virginiana +.1
Sorbus +.1
Tilia americana +.1

FORB LAYER H2I

Aralia nudicaulis 2.1
Viola pubescens 1.2

FORB LAYER H2I (continued)

Arisaema triphyllum 1.1
Actaea pachypoda 1.1
Impatiens capensis 1.1
Osmorhiza claytoni 1.1
Allium tricoccum +.2
Aster macrophyllus +.2
Lycopodium obscurum var. dendroideum +.1
Botrychium virginianum +.1
Dryopteris spinulosa +.1
Gymnocarpium Dryopteris +.1
Maianthemum canadense +.1
Polygonatum pubescens +.1
Streptopus roseus var. longipes +.1
Trillium cernuum var. macranthum +.1
Actaea rubra +.1
Anemone quinquefolia var. interior +.1
Ranunculus cf. r. abortivus +.1
Ranunculus cf. r. acris +.1
Dicentra cucullaria +.1
Lathyrus ochroleucus +.1
Osmorhiza longistylis +.1
Solanum cf. s. dulcamara +.1
Taraxacum officinalis +.1
Athyrium filix-femina R.1

GRAMINOID LAYER G2R

Carex pensylvanica 2.3
Unknown +.2
Oryzopsis asperifolia +.1

REF

ID: BAC 002
DATE: 10 June 1982
SURVEYOR: Coffin, B. and Engstrom
LOCATION: Hemlock Ravine SNA, NW 1/4 SE 1/4 Sec. 3, T48N, R16W. Old-growth northern hardwoods with six Tsuga canadensis in deep ravine that cuts through site. SE-facing slope. Betula lutea cored and aged at approx. 164 yrs-70CM DBH.

TREE LAYER 07P

Betula lutea 2.1
Acer saccharum 2.1
Tilia americana 2.1

TREE LAYER 05R

Acer saccharum 2.1
Tilia americana +.1

SHRUB LAYER 04P

Acer saccharum 3.1
Acer spicatum 2.1
Tilia americana +.1

SHRUB LAYER 03P

Acer saccharum 3.1
Betula lutea +.1

HERB LAYER 02P

Acer saccharum 1.1
Acer spicatum 1.1
Lonicera canadensis 1.1

HERB LAYER H2P

Impatiens capensis 2.1
Aralia nudicaulis 2.1

HERB LAYER H2P (continued)

Dryopteris phegopteris 1.2
Allium tricoccum 1.2
Arisaema triphyllum 1.1
Viola selkirkii 1.1
Lycopodium lucidulum +.1
Lycopodium obscurum var. dendroideum +.1
Osmunda claytoniana +.1
Athyrium filix-femina +.1
Polygonatum pubescens +.1
Trillium cernuum var. macranthum +.1
Actaea pachypoda +.1
Anemone quinquefolia var. interior +.1
Viola pubescens +.1
Panax trifolius +.1
Osmorhiza claytoni +.1
Trientalis borealis +.1
Aster macrophyllus +.1
Taraxacum officinalis +.1

GRAMINOID LAYER G2B

Carex pensylvanica 1.2
Unknown R.1

SYMBOLS USED ON RELEVE DESCRIPTIONS

Height Class (Stratification)
8....>35 m
7.... 20-35 m
6.... 10-20 m
5.... 5-10 m
4.... 2-5 m
Graminoid & Forb layer.... ≤2 m

For each species within the height class 2 symbols are used (eg. Zizia aptera +.1):
the first is an estimate of cover-abundance,
the second is an index of sociability (dispersion of population)

Cover-abundance
r single occurrence
+ occasional, cover <5%
1 plentiful, cover <5%
2 very numerous, cover 5-25%
3 any number of individuals, cover 25-50%
4 any number of individuals, cover 50-75%
5 any number of individuals, cover 75-100%

Sociability
1 growing singly
2 grouped, few individuals
3 large group, many individuals
4 small colonies, extensive patches, broken mat
5 extensive mat

Additional symbols
r rare or endangered species
cf precise identification not possible although close resemblance exists to indicated taxon
i introduced species

REF. NO: BAC 001
DATE: 11 June 1982
SURVEYOR: Coffin, B. and Engstrom
LOCATION: Hemlock Ravine SNA, NW 1/4 SE 1/4 Sec. 3, T48N, R16W. Old-growth northern hardwoods with Hemlock (Tsuga canadensis) in deep ravine that cuts through site. SE-facing slope. Betula lutea aged at approx. 164 yrs- 70 CM DBH.

TREE LAYER 07I

Betula lutea 3.1
Acer saccharum 2.1
Tilia americana 2.1
Quercus borealis R.1

TREE LAYER 06R

Acer saccharum 2.1

SHRUB LAYER 04R

Acer saccharum 1.1
Betula lutea R.1
Tilia americana R.1

SHRUB LAYER 03P

Acer saccharum 4.1

FORB LAYER 02I

Acer saccharum 2.1
Betula lutea +.1
Prunus virginiana +.1
Sorbus +.1
Tilia americana +.1

FORB LAYER H2I

Aralia nudicaulis 2.1
Viola pubescens 1.2

FORB LAYER H2I (continued)

Arisaema triphyllum 1.1
Actaea pachypoda 1.1
Impatiens capensis 1.1
Osmorhiza claytoni 1.1
Allium tricoccum +.2
Aster macrophyllus +.2
Lycopodium obscurum var. dendroideum +.1
Botrychium virginianum +.1
Dryopteris spinulosa +.1
Gymnocarpium Dryopteris +.1
Maianthemum canadense +.1
Polygonatum pubescens +.1
Streptopus roseus var. longipes +.1
Trillium cernuum var. macranthum +.1
Actaea rubra +.1
Anemone quinquefolia var. interior +.1
Ranunculus cf. r. abortivus +.1
Ranunculus cf. r. acris +.1
Dicentra cucullaria +.1
Lathyrus ochroleucus +.1
Osmorhiza longistylis +.1
Solanum cf. s. dulcamara +.1
Taraxacum officinalis +.1
Athyrium filix-femina R.1

GRAMINOID LAYER G2R

Carex pensylvanica 2.3
Unknown +.2
Oryzopsis asperifolia +.1

SYMBOLS USED ON RELEVE DESCRIPTIONS

Height Class (Stratification)
8....>35 m
7.... 20-35 m
6.... 10-20 m
5.... 5-10 m
4.... 2-5 m
Graminoid & Forb layer.... <2 m

For each species within the height class 2 symbols are used (eg. Zizia aptera +.1):
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