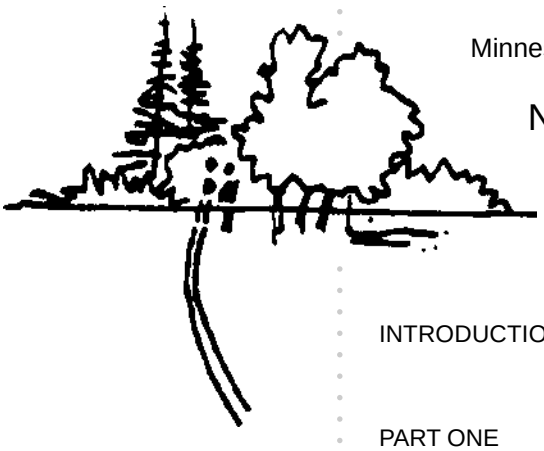


Minnesota School Nature Areas:

NOTES ON

BENEFITING THE BIOMES

by *Matt Nielsen and the School Nature Area Project*

Produced Spring of 1996, Reprinted in Spring, 1999

The School Nature Area Project (SNAP), a program of St. Olaf College, assists schools in establishing and using outdoor learning sites for environmental education. If you would like more information on this publication, the School Nature Area Project, and grants that may be available for schools to plan and fund school nature area projects, please contact SNAP at 1520 St. Olaf Avenue, Northfield, MN, 55057, by phone at 507-646-3599, or visit our World Wide Web site at http://www.stolaf. edu/other/snap

SNAP wishes to thank the following for their assistance and generous contributions in the production of this booklet: Minnesota Department of Natural Resources, the Minneapolis Star Tribune, Dean Savola, University of Minnesota Press, St. Olaf College, the Trygg Land Office of Ely, Wild River State Park, Maria Thompson, The Cannon River Watershed Partnership, Beth Holmes of Holmes Art and Design, the U.S. Environmental Protection Agency, the C.K. Blandin Foundation, and the Legislative Commission on Minnesota Resources of the Minnesota State Legislature.

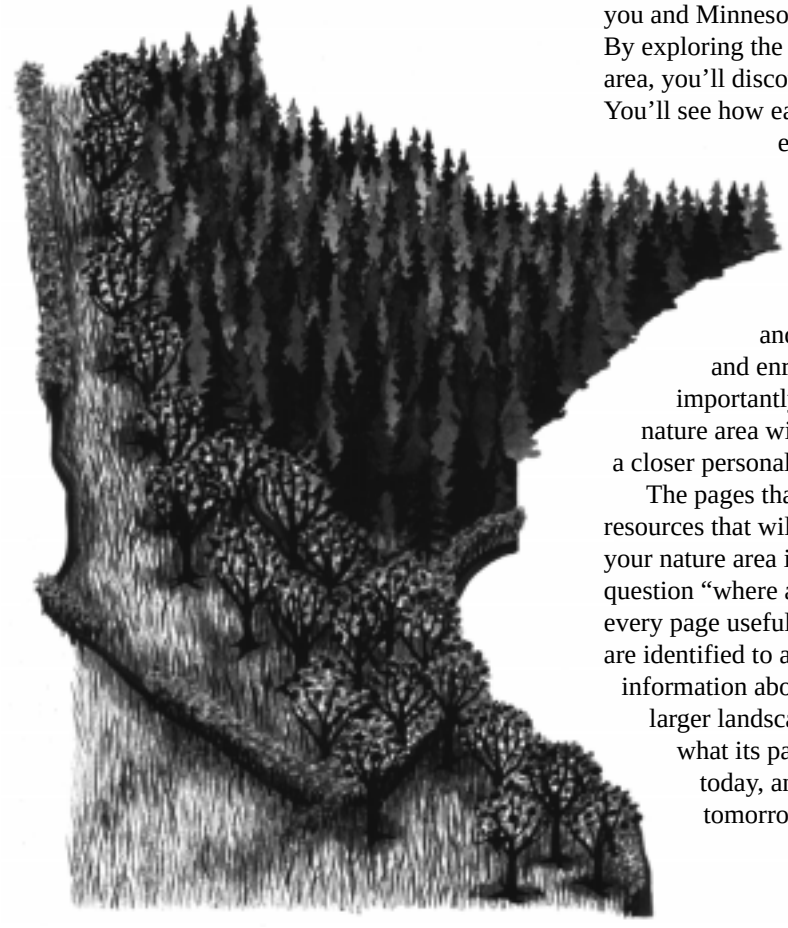
INTRODUCTION

Where Are You?

Simply— you are here. But where is here?

Put your finger on the map of Minnesota where you and your home and your nature area are. Imagine flying high above your nature area. Looking far beneath you, what do you see?

Perhaps you would describe winding roads cutting through forests, or bridges across lakes and wetlands. Perhaps you'd describe a complex "checker-board" of fields, forests, and city blocks surrounding your nature area. Each of these is certainly a part of where you are. But your nature area is much more. From towering blufflands, rolling prairies, wetlands teeming with life, ancient bogs, dark forests and rocky shores, to fence-rows, farm fields, mown lawns and city blocks, you are surrounded by nature. If you look closely, you'll discover that where you are is an amazing natural community of living things. People, green plants and brilliant flowers, browsing animals and darting birds, insects and spiders and tiny bacteria each have a place where you are.



This booklet was produced by the School Nature Area Project (SNAP) to help you discover your school nature area's place in a world of living things. It will assist you in planning a nature area that is beneficial to you and Minnesota native plants and animals. By exploring the landscape of your nature area, you'll discover just how natural it is. You'll see how each animal and every plant, each person past and present, has connections to the landscape where you are. Through this connection, you may address real environmental problems and discover ways to protect and enrich your nature area. Most importantly, involvement in your nature area will provide an opportunity for a closer personal connection with nature.

The pages that follow are filled with resources that will aid your effort to look at your nature area in Minnesota and answer the question "where are you?" With the turn of every page useful publications and programs are identified to assist you in finding more information about your nature area and the larger landscape of which it is a part — what its past was like, what it's like today, and what it might be like tomorrow.

How to Use This Booklet

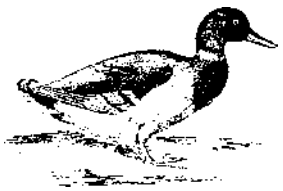
Whether you are beginning a new school nature area, or enhancing an established natural area, this booklet will assist you. The four sections take you from learning about Minnesota's ecological regions to incorporating this information into a project plan of your own.

Part 1 will familiarize you with the **Biomes of Minnesota** from 10,000 years before present to the time when European settlement was just beginning. This section illustrates three main ecological regions of the state, how they came to be and the plant and animal communities that are unique to them. It will help you locate your nature area within them.

Part 2 is about the **Bounding of the Biomes** and illustrates the pace of change within the biomes in the years following European settlement. It explains the system used to identify the biomes' resources and how the biomes' plant and animal communities have fared. Part Two also provides a list of organizations that protect the best examples of Minnesota's woodlands, wetlands, and prairies.

Part 3 is a **Checklist for a Natural Area.** It suggests the general qualities of ecologically healthy nature areas.

Part 4 is a **Step by Step Guide** to creating school nature area projects. It explains how to document the existing features of your nature area and how to use this information in a project plan of your own.



PART ONE

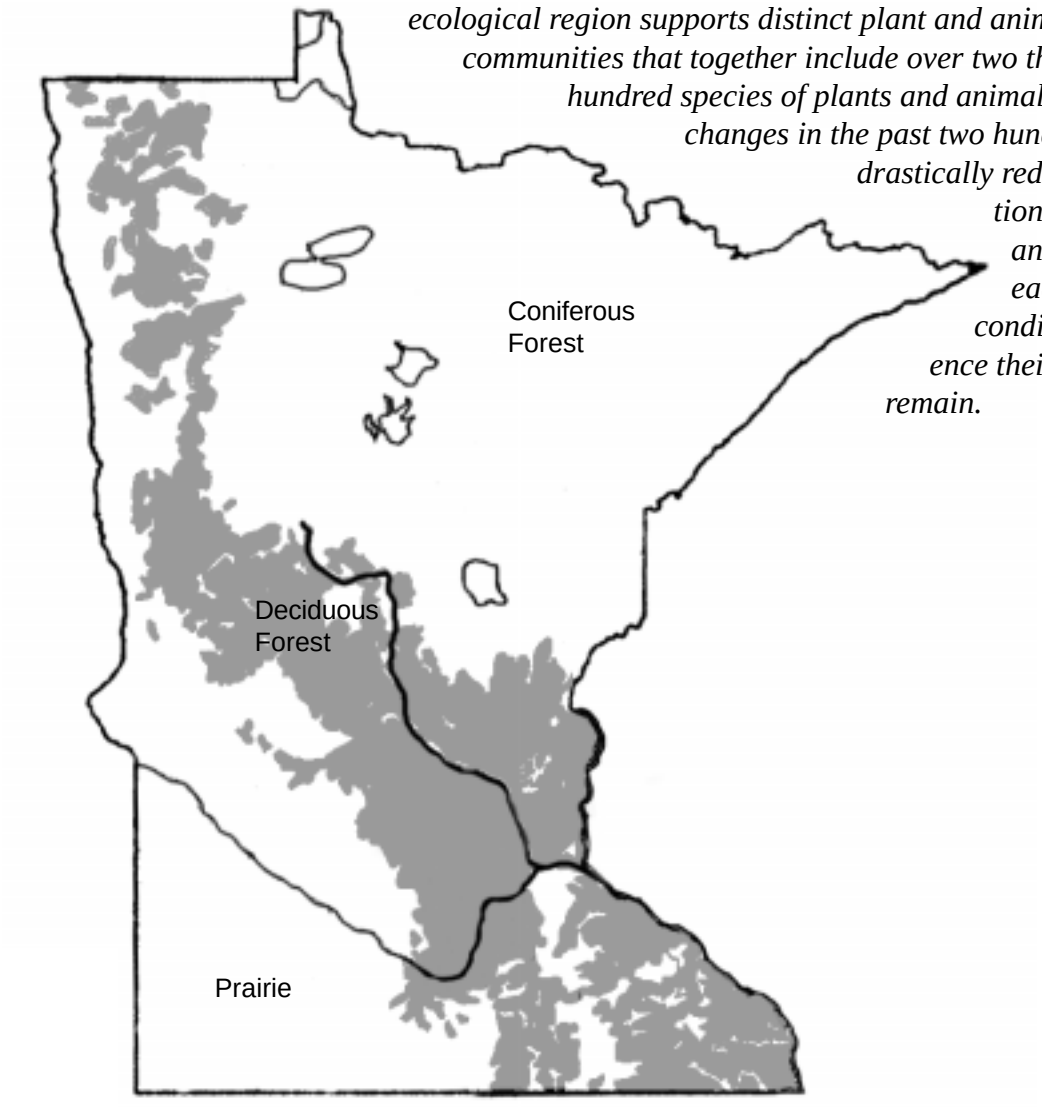
BIOME BASICS

BIOME BASICS:
Climate, Landform and Vegetation Patterns

Minnesota: Touched By Three Biomes

Your nature area in Minnesota is a part of one, two or even three large ecological regions, or biomes, that cover over 84,000 square miles of land and inland waters in Minnesota.

A biome is a major type of ecosystem with distinctive organisms determined by climate, soil, and landform. Minnesota's location on the North American continent at the merging of the northern coniferous (or Boreal) forest, eastern deciduous forest, and the prairie resulted in tremendous diversity. Each ecological region supports distinct plant and animal communities that together include over two thousand five-hundred species of plants and animals. Although the changes in the past two hundred years have drastically reduced the populations of plants and animals distinct to each biome, the conditions that influence their distribution remain.



North American Prairie

Minnesota is on the northeastern edge of the North America Prairie. The mountain ranges of North America block a large amount of the moisture that moves across the continent from the west. This rain shadow creates a dry, arid climate on the downwind side of the ranges, providing conditions favorable for a mixture of prairie grasses and *forbs* – or prairie wildflowers. In the west, where there is little moisture, a short grass prairie thrives. As moisture increases toward the east, and the prairie is able to grow taller, a mixed-grass prairie results. Minnesota is in the tallgrass prairie region characterized by vegetation reaching six feet or more.

Deciduous Forest

The North American Deciduous Forest is an ecological region of trees, shrubs and herbaceous plants that are characterized by the loss of leaves in the winter. Minnesota is on its northwestern edge. In Minnesota deciduous forests are found primarily on glaciated soils where there is adequate rainfall and moderate temperature variation. In Minnesota, this biome forms a boundary between the grasslands to the west and the coniferous forests to the northeast.

Coniferous Forest

Minnesota is touched by the southern edge of the Northern Coniferous (or Boreal) Forest. Pines, spruce and fir are typical in this ecological region where the growing season is short, the winters severe and the soils shallow from repeated glaciation.

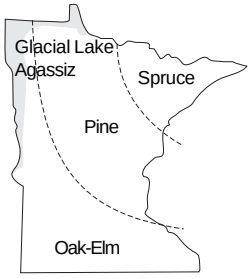
Minnesota's Natural Heritage: an Ecological Perspective
John Tester. 1995. $29.95
The Univ. of Minnesota Press
11030 S. Langely Avenue
Chicago, IL 60628
1-773-1550
1-800-621-8476 (fax)
www.upress.umn.edu

Unfolding chapter after chapter are the stories of Minnesota's familiar ecosystems - lakes, rivers, forests, prairies, and wetlands. The books informative text and many engaging maps, diagrams, and photographs illustrate the ecological processes and relationships happening in our own backyards.

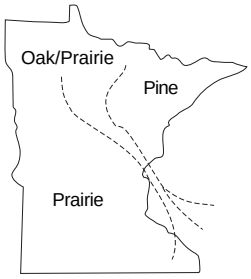
Minnesota Volunteer Magazine
Minnesota Volunteer
Circulation, MN - DNR
500 Lafayette Rd
St. Paul MN 55155
800-766-6000 (toll free)
651-296-6157
www.dnr.state.mn.us
Minnesota residents may request a free subscription to this attractive and informative magazine that presents timely articles and stories about issues affecting Minnesota's ecological regions. It includes a feature called "Young Naturalists."

Vegetation Sequence: 11,000 Years Before Present

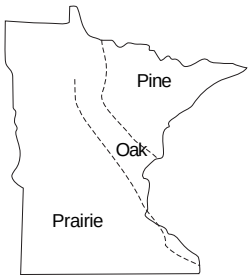
11,000 Years Ago



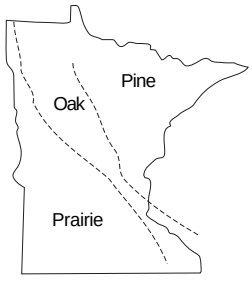
9,000 Years Ago



7,000 Years Ago



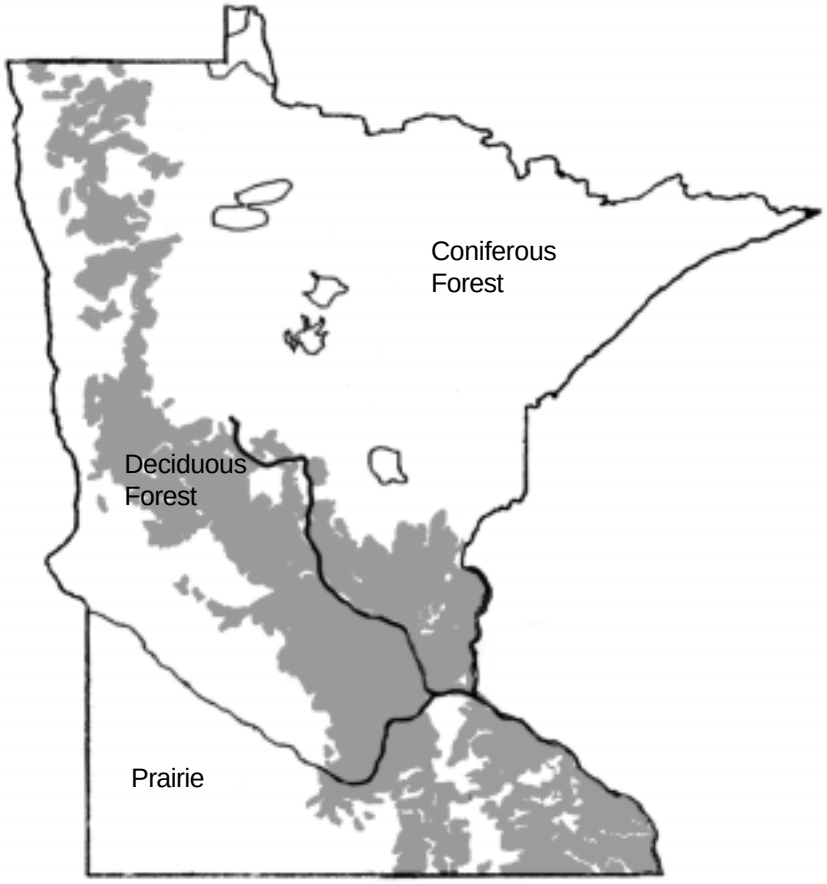
5,000 Years Ago



3,000 Years Ago

Climate:

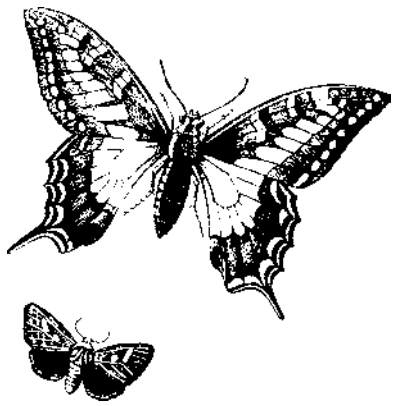
Precipitation and Temperature in Minnesota



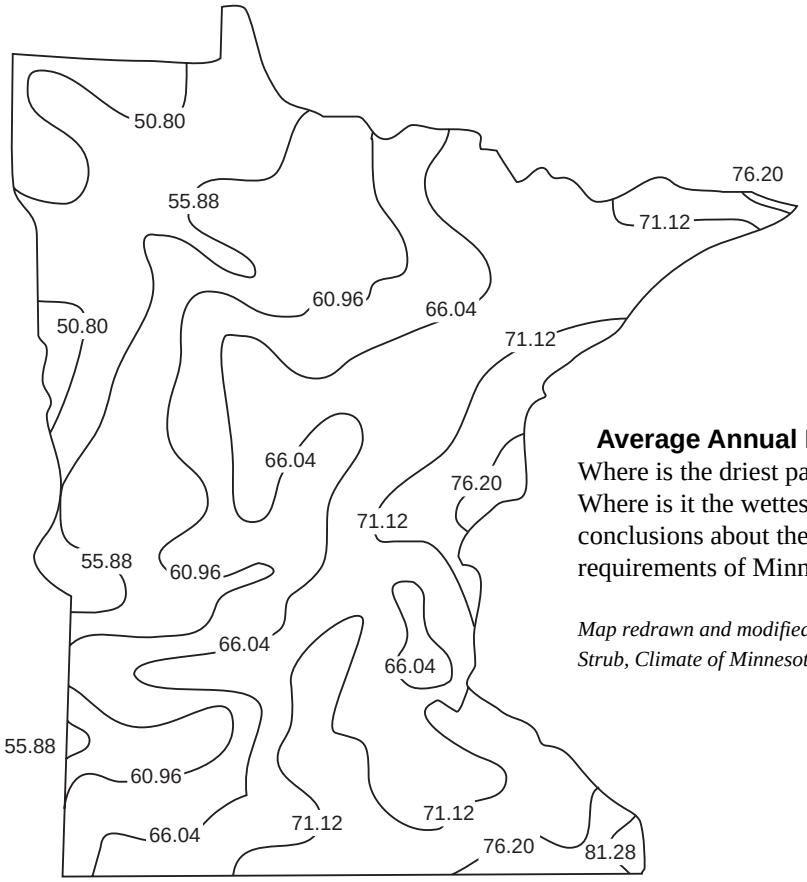
Present

Minnesota ecological regions were not always where they are today.

This sequence of illustrations shows the shifts in the biomes as temperature and moisture levels changed during the past 11,000 years. Generally, a cooler climate favored the spruce and pine forests; a warmer, drier climate favored grasslands and prairie species. Deciduous forests formed the transition between the coniferous and prairie communities. Have pine trees ever grown where you are now? Have prairies? List the ecological regions that have been a part of your place and when they occurred.



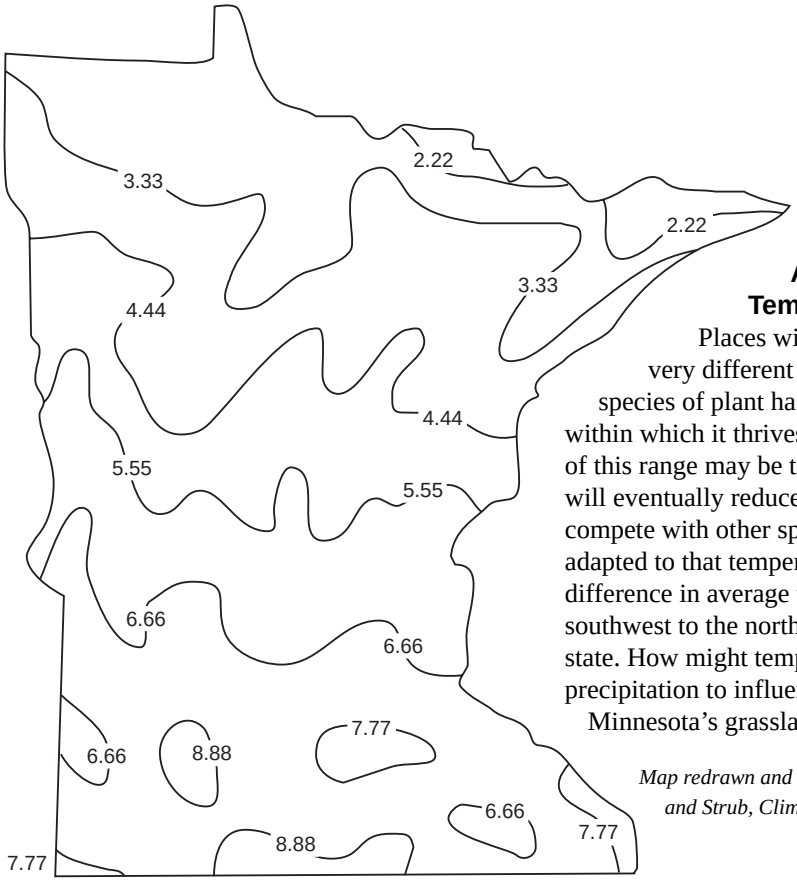
Maps adapted from H.E. Wright Jr. et al., 1992. The Patterned Peatlands of Minnesota. University of Minnesota Press, Minneapolis.



Average Annual Precipitation (cm)

Where is the driest part of Minnesota? Where is it the wettest? Can you draw any conclusions about the different moisture requirements of Minnesota's biomes?

Map redrawn and modified to metric from Baker and Strub, Climate of Minnesota, 1965.



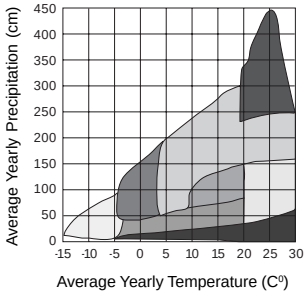
Average Annual Temperature (C°)

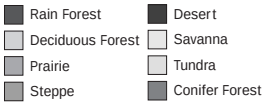
Places within Minnesota have very different temperatures. Every species of plant has a temperature range within which it thrives; temperatures outside of this range may be tolerated for a time, but will eventually reduce the plant's ability to compete with other species that are better adapted to that temperature. Notice the difference in average temperature from the southwest to the northeast corners of the state. How might temperature interact with precipitation to influence the distribution of Minnesota's grasslands and forests?

Map redrawn and modified to metric from Baker and Strub, Climate of Minnesota, 1965.

Climograph of World's Major Biomes

The world's biomes, including those in Minnesota, are formed in part by the interaction of temperature and moisture. Where there is low moisture and high temperature, deserts are found. Where there is high moisture and high temperatures, tropical rainforests are found. What would a climograph for Minnesota's prairie, deciduous woodlands, and coniferous forests look like?





Climate Resources

Minnesota Weather
Keen, Richard A.
American & World Geographic Publishing
P.O. Box 5630
Helena, MT 59604
406-443-2842
$14.95 + S&H
www.montanamagazine.com

Interesting stories combined with maps, bar graphs and tables provide data on Minnesota's diverse weather patterns.

Weather Station Equipment
Down to Earth
Rt. 1, Box 135A
Gordon, WI 54838

Supplier of weather related resources including observation notebooks, cloud charts, weather curriculum, barometers, and psychrometers.

Landform:

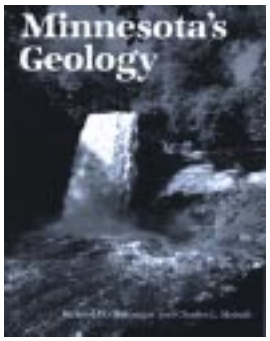
Minnesota's Topographic Features

Can you identify any of the landscape formations that have given shape to your nature area?

The vegetation of Minnesota's terrestrial biomes is also influenced by complex landforms. Between two million and twelve thousand years ago glaciers scoured most of Minnesota. Grinding as they moved across the earth's surface, the ice lobes contained billions of tons of rock, gravel, and sand. With the final retreat of the ice around 10,000 years ago, all of Minnesota – except the extreme southeast and southwest – was covered with landforms created by the glaciers. The typical landforms include terminal moraines, sandy outwash plains, ground moraines, and broad glacial lake plains. Covering most of central and southern portions of the state, terminal moraines and outwash plains are familiar to Minnesotans today as hilly lake country and flat agricultural fields.

The other major land form types – lake plains, glacially scoured bedrock, and stream – dissected lands – also relate to the state's glacial history. They provide variability from the predominantly flat till plains and moraines of Minnesota's core. Located in the four corners of the state, these landform types enrich the state's diversity with areas of vast wetlands, sharp topographic relief, and bedrock devoid of glacial debris.

Map and descriptions adapted with permission, Minnesota's Endangered Flora and Fauna. © 1988, University of Minnesota Press.

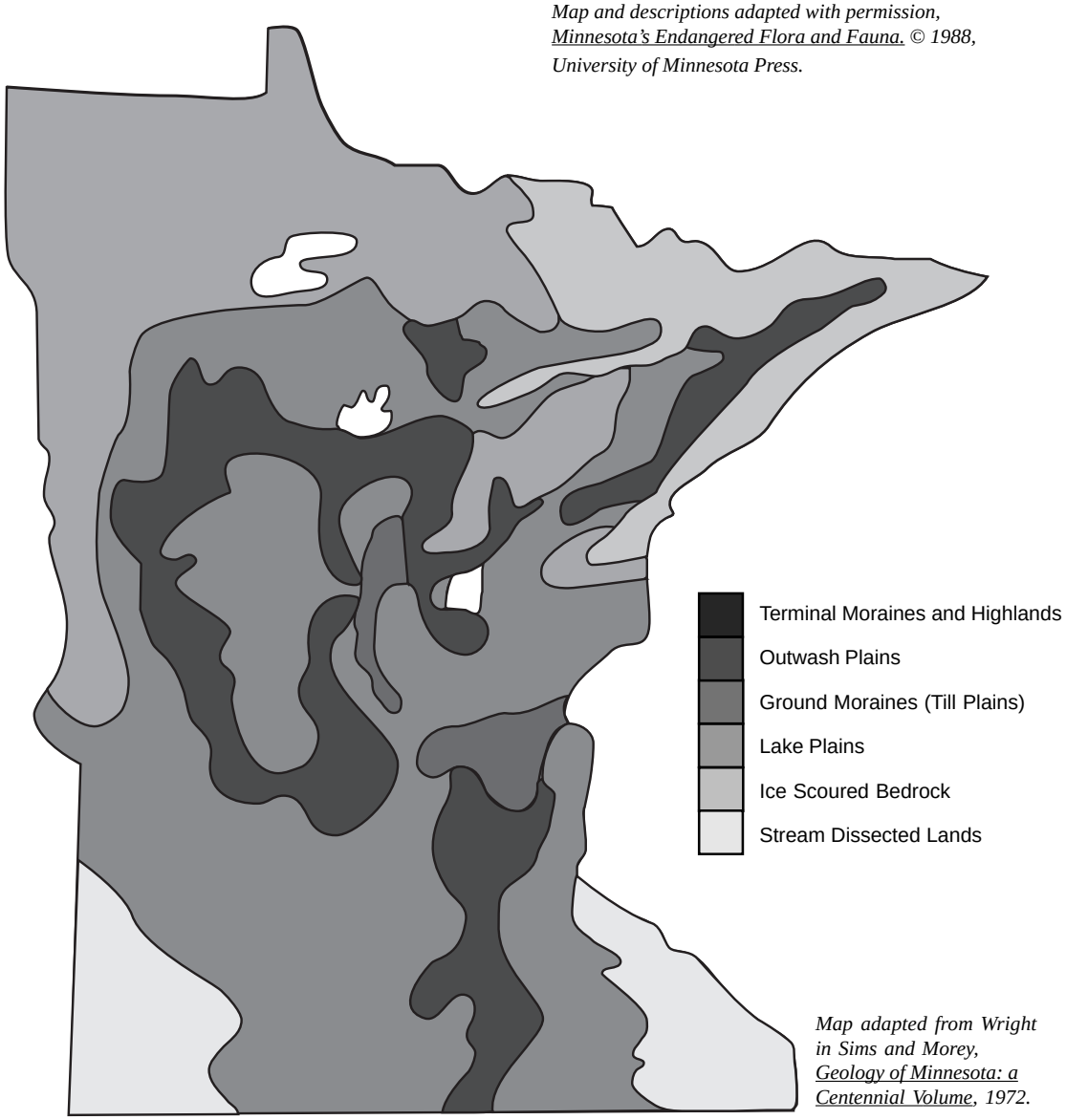


For more information on the origin of Minnesota's landforms, read:

Minnesota's Geology
Ojakangas, Richard W.; Matsch, Charles L.

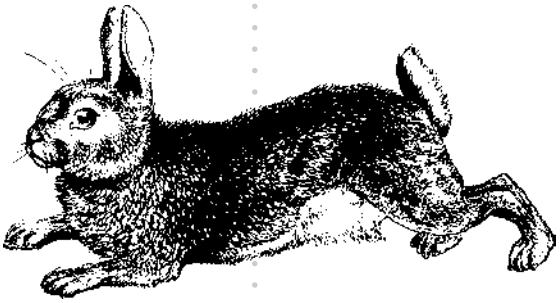
(out of print)

Contents include Minnesota's place in geologic history. Examines Minnesota's mineral resources and explores the state's regional geology through landmarks found throughout the state.



Map adapted from Wright in Sims and Morey, Geology of Minnesota: a Centennial Volume, 1972.

Minnesota Landforms Fall Into Six General Categories



Terminal Moraine

This glacial feature, common to the Minnesota landscape, is formed of glacial debris deposited at the edge of an active ice sheet. Hilly, high and often studded with lakes, these moraines form dramatic relief compared with the extensive flat plains of ground moraine. For example, the rugged terrain of the Alexandria Moraine reaches 500 meters above sea level, the highest elevation in western Minnesota. The moraine's varying topography has had interesting implications for the development of vegetation, due in part to its effect on wild fire patterns. Since the location of the prairie/forest border is determined largely by fire, the topographic relief of moraines has played an important role in determining the patterns of distribution of prairie species from the west and deciduous forest species from the east.

Outwash Plain

Formed by glacial melt-waters carrying a suspended load of rock flour, pebbles, and cobbles, an outwash plain is a topographic feature characterized by its sandy soils and flat relief. The Anoka Sand Plain just north of the Twin Cities metropolitan area, the largest sand dune area in the state, is an example of this landform type. Sand dunes, created by wind action after glacial outwash streams ceased to exist, provide habitat for pioneer species adapted to disturbance. The community that develops on these dunes is characterized by species tolerant of the drought conditions and the relative infertility of the shifting sandy soils.

Ground Moraine

During times of rapid glacial retreat, broad plains of glacial till were deposited, forming level to gently rolling topography known as ground moraine. This feature explains the generally flat topography throughout much of the state. In south-central Minnesota, rich prairie soils have developed on such broad till plains. This highly fertile land has undergone extensive alteration because of its value as agricultural land.

Lake Plain

In the northwestern corner of Minnesota, old beach lines and lake sediments covering glacial till provide evidence of ancient Lake Agassiz, which once extended far into central Canada as the largest freshwater lake on the continent. This lake gradually receded as ice-dammed outlets to the north and east of Minnesota were opened. Lake deposits of considerable depth and abandoned beach lines of former lake-shores remain as evidence of this former lake. Today waters in this part of the state flow north through the Red River to their eventual outlet in Hudson Bay.

In the saturated soils of the poorly drained, gently sloping lake bed, extensive peatlands developed. A peatland is a waterlogged terrestrial ecosystem in which a layer of organic matter (peat) accumulates to a thickness of at least 30 cm. (12 inches) because of perennial saturation with water. They exhibit extensive patterns when viewed from above, and are recognized worldwide as a unique landscape feature. These peatlands, a composite of bog and fen habitats, formed as a result of a complex interaction between topography, surface and groundwater hydrology, and vegetation.

Glacial Scoured Bedrock

The bedrock of the Border Lakes and the Northshore regions in the northeastern corner of the state forms a rugged, almost mountainous terrain compared with that of the rest of the state. Elevations in Minnesota reach their lowest level (183 meters above sea level on the shore of Lake Superior) and highest level (701 meters above sea level at Eagle Mountain in Cook County) in this region, all within a distance of a few kilometers. Here, repeated glacial scour exposed resistant Precambrian rocks. Water action from stream flow and wave action continued the modification of the bedrock surface. Because the history of this area is one of glacial erosion rather than of glacial deposition, little if any glacial drift covers the rock.

Stream-Dissected Land

The stream-dissected lands of southeastern and southwestern Minnesota are also intimately related to the glacial history of Minnesota. Although today both areas exhibit a landscape formed by stream erosion, the evolution of these landforms is quite distinct. The southeastern corner of the state, commonly referred to as the "driftless area" is more accurately identified as the Paleozoic Plateau. This area is underlain by flat-lying limestone rocks and is covered in varying thickness with glacial debris dating from earlier glacial advances, as well as by windblown silt (loess) from the outwash plains of the last glaciation. Visually, the most remarkable features are the steep ravines and valleys that have been cut 100 to 200 meters through glacial cover exposing the limestone beneath. Although this region was not directly impacted by all glacial advances, large volumes of glacial melt-water from adjacent lands dissected the gently rolling uplands, leaving behind steep valleys that wind their way to the Mississippi.

The stream-dissected landscape of southwestern Minnesota is dominated by a plateau known as the Prairie Coteau. This highland rises 200–275 meters above neighboring till plains to the northeast. Its prominence relates primarily to a thick cover of glacial drift on a bedrock upland. The crest of the plateau is formed by the Bemis Moraine, which is an important drainage divide. Streams flowing to the northeast are tributaries of the Minnesota River. Streams flowing to the south and southwest lead into the Des Moines and Big Sioux rivers, all a part of the Missouri drainage. These streams flow through channels obviously cut in a time of much greater water-flow. Stream erosion, both past and present, has dissected the topography and in certain areas exposed the pink quartzite bedrock.

As its name suggests, the Prairie Coteau's thick mantle of drift once supported a rich prairie ecosystem much like the one that covered the broad till plains to the north and east. With the exception of a few preserves specifically established to protect remnants of this once diverse and extensive system, all has been transformed by agriculture. Although not directly affected by agricultural development, other habitats in the region are indirectly impacted by erosion, siltation, or grazing.

Illustration by Maria Thompson

Vegetation:

Minnesota's Plant Communities

Broadly influenced by landform and climate, Minnesota's biomes contained diverse plant communities. Influenced by localized factors such as soil type, the vegetation in each community was continually modified by natural disturbances such as fire, windstorms, insects, and disease. Throughout the state fire was the most important agent affecting vegetation patterns before European settlement. The complex interaction of fire with climate, soils, and topography created a dynamic landscape characterized by a constantly shifting mosaic of vegetation types.

The following pages describe and locate the most common vegetation types in Minnesota at the time of the Public Land Survey from 1854-1907. Knowing the type of vegetation that existed in your nature area in the past provides clues to the plants and animals best suited to your site today.

In limited areas across the state, very specialized communities occur where particular or adverse local environmental conditions restrict typical vegetation development. These sites range from loose sand to bare rock and are characterized by little or no true soil development. Three classes of these primary communities are recognized in Minnesota: cliff, rock, and lakeshore. Although uncommon in distribution, they harbor a large number of the states endangered species.

Maps and descriptions of vegetation types reproduced with permission, The Natural Vegetation of Minnesota at the Time of the Public Land Survey. © 1988, State of Minnesota, Department of Natural Resources.

About Fire

Historically fire was an integral and necessary part of Minnesota's forests and prairies. In the absence of towns and cities a natural fire could burn unchecked across a tremendous area until rain, humid woodlands, or a natural barrier stopped its progress. Without periodic fires sweeping through them, the grasslands of the prairie and savanna quickly became woodland, and the northern pine forests could not regenerate.

Minnesota's prairies frequently burned. Occasionally lightning strikes set the vast grasslands on fire. In addition, Native Americans set fires to herd animals or create corridors for movement. Seemingly destructive, fire benefited the prairie. Burns increased productivity by removing the dead plant material. Removing the litter increased the soil temperature in the early spring, allowing prairie species to emerge sooner. In addition, the burn removed small woody plants and brush, keeping the burned area open and unshaded. The burned vegetation increased microbial activity in the soil which, in turn, released more nutrients earlier in the growing season.

While a prairie plant may project several feet above the surface, much of the plant is safe below ground. Prairie grasses and forbs have root systems that may extend as deeply as 15 feet, and many also possess underground stems, or rhizomes. Grasses and many forbs also grow "rosettes" for much of the growing season, sending up tall leaves, but keeping the vulnerable shoot tip close to the ground until the stem elongates at flowering time. When fire (or grazing animals, or lawn mowers) destroys the aboveground parts of the plant, the plant regrows from the protected shoot tip, or from buds on the buried rhizome.

Fire was also common in Minnesota's forests. It sometimes burned the forest canopy; sometimes, the ground layer beneath the canopy; sometimes, both. Fire opened pockets within the forest allowing for a continuum of forest types and ages important for wildlife and biodiversity. In addition, some species require fire to release seeds. The pine cones of the Jack Pine, for instance, remain tightly closed until the heat of a forest fire opens them. The seeds fall onto newly burned mineral soil in sunny openings created by fire.

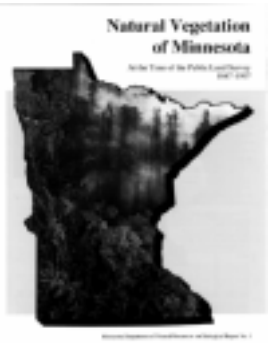
Today, in natural areas, fire is used as a management tool only under tightly controlled conditions. Periodic controlled burns are used to manage examples of Minnesota's prairies, savannas, and woodlands. Burns are usually scheduled in early spring or late fall. Weather is the key to a successful burn. Relative humidity, temperature and wind are particularly important. Generally the best day for a controlled burn is one with a relative humidity between 45 and 60 percent, an air temperature between 40°F and 60°F, and a wind speed less than 10 miles per hour.

In many communities, burn permits are required and fires must be supervised by local fire officials. If burning becomes important to your school nature area be sure to remember the following:

1. Secure appropriate permits.
2. Involve local fire safety officials in burn planning and execution.
3. Have students inform neighbors about the importance of burning and what to expect.

Nature's Heartland: Native Plant Communities of the Great Plains
(out of print)
Bill Boon and Harlen Groe
(1990)
Iowa State University Press,
2121 South State Avenue
Ames, IA, 50014
www.isupress.edu

Contents include descriptions of native plant communities of the Midwest including those found in Minnesota including: dry prairie, marsh-pothole prairie, wet prairie, oak savanna, maple-basswood, woodland flower, pine-fir-birch, and floodplain forest. 1,400 color photographs of native plants and plant communities in all seasons. Not all species listed are native to Minnesota.



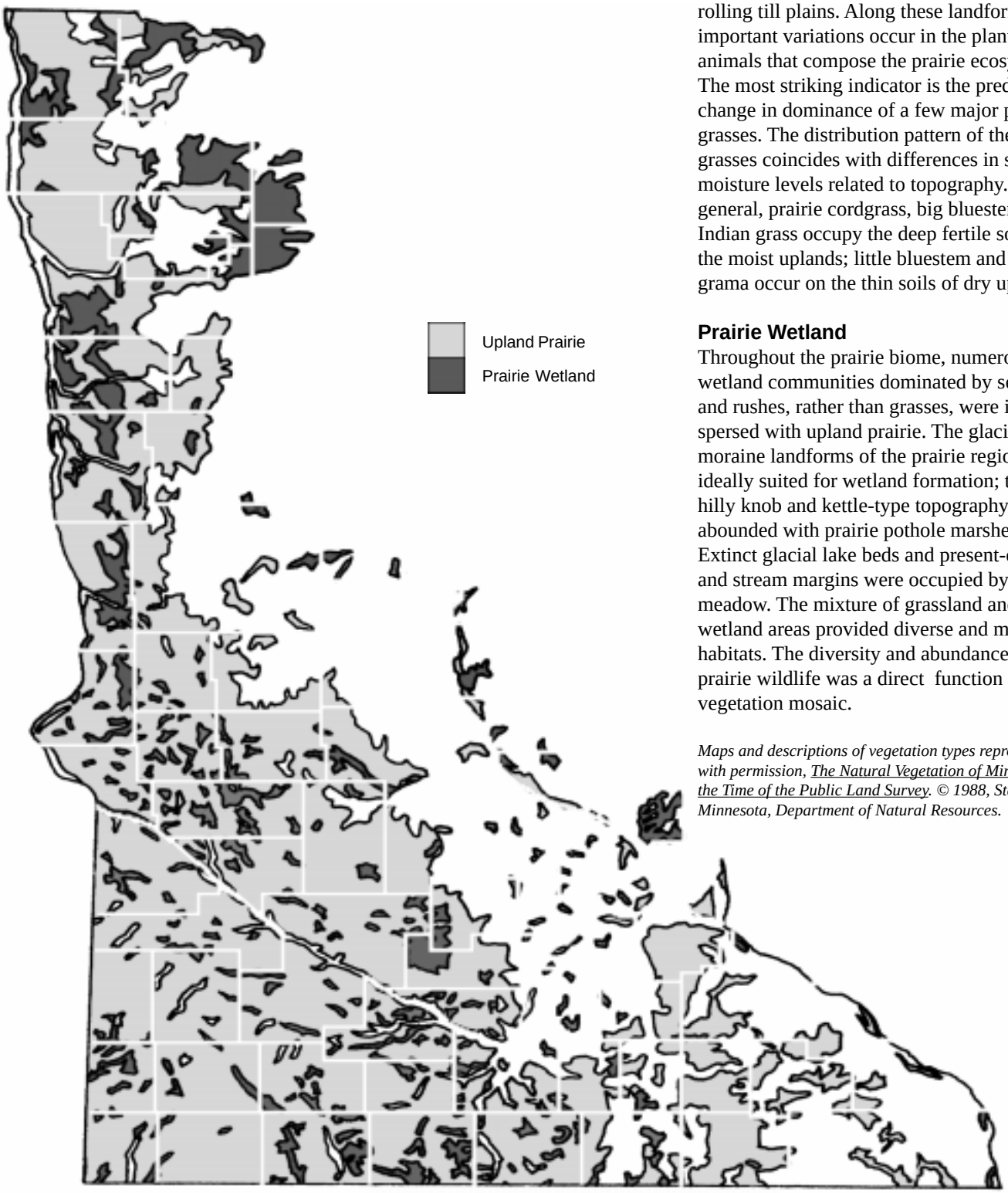
The Natural Vegetation of Minnesota at the Time of the Public Land Survey

Wendt, Keith and Barbara Coffin
Minnesota's Bookstore
117 University Ave.
St. Paul, MN 55155
1-651-297-3000
$2.00
www.comm.media.state.mn.us

This six page color pamphlet describes Minnesota's natural communities and maps their occurrence throughout Minnesota at the time of the public land survey from 1847-1907. Map includes county line references.

Vegetation Types of the

Prairie



Upland Prairie

Tallgrass prairie, at the time of the public land survey, covered one-third of the state. It occupied a wide variety of landforms, including beach ridges and swales, glacial lake beds, morainic hills, steep bluffs, and rolling till plains. Along these landforms, important variations occur in the plants and animals that compose the prairie ecosystem. The most striking indicator is the predictable change in dominance of a few major prairie grasses. The distribution pattern of these grasses coincides with differences in soil moisture levels related to topography. In general, prairie cordgrass, big bluestem and Indian grass occupy the deep fertile soils of the moist uplands; little bluestem and sideoats grama occur on the thin soils of dry uplands.

Prairie Wetland

Throughout the prairie biome, numerous wetland communities dominated by sedges and rushes, rather than grasses, were interspersed with upland prairie. The glacial moraine landforms of the prairie region were ideally suited for wetland formation; their hilly knob and kettle-type topography abounded with prairie pothole marshes. Extinct glacial lake beds and present-day lake and stream margins were occupied by sedge meadow. The mixture of grassland and wetland areas provided diverse and mingling habitats. The diversity and abundance of prairie wildlife was a direct function of this vegetation mosaic.

Maps and descriptions of vegetation types reproduced with permission, The Natural Vegetation of Minnesota at the Time of the Public Land Survey. © 1988, State of Minnesota, Department of Natural Resources.

Prairie Resources

Prairie Restoration for Schools: A Guide to Restoration from Site Analysis to Management.
Murray, Molly Fifield (1996 ed.)
University of Wisconsin-
Madison Arboretum
1207 Seminole Hwy
Madison, WI 53711
608-263-7888
608-262-5209 (fax)
$21.10 + S&H
www.wisc.edu/arboretum

Shows how the process of ecological restoration enables people to learn about the cultural and natural history of the prairie and to forge a positive relationship with it. Clearly outlines the process of involving students in small scale restoration projects. Plant propagation, curriculum, species list, appendices of resources and references are useful.

The Prairie World

(out of print)
David Costello. (1975)
University of Minnesota Press
11030 S. Langley Avenue
1-773-568-1550
fax: 800-621-8476
$9.95 + S&H
www.upress.umn.edu

Describes in detail the history, ecology, plants, and animals of the mid-continental prairie. 244 pages.

How to Manage Small Prairie Fires
Pauly, Wayne R. (1985)
Dane County Parks
4318 Robertson Road
Madison, WI. 53714
608-246-3896; 608-246-3898 (fax)
$4.00
www.co.dane.wi.us/parks/parkhome.htm

This booklet answers common questions about fire as a tool for maintaining prairie landscapes. Describes common fire tools and their uses, how to gauge proper weather conditions for a burn, constructing fire breaks, burn procedures and dealing with hazards.

The Prairie Garden: 70 Native Plants You Can Grow in Town or Country
Smith, Robert J. and Beatrice S. (1980)
Order Department
University of Wisconsin Press
c/o Chicago Distribution Center
11030 S. Langley Avenue
Chicago, IL 60628
1-773-568-1550 (fax): 800-621-8476
$12.95 + S&H
www.wisc.edu/wisconsinpress/

Descriptions of prairie plant habitat needs, common names, height, flower color, flowering time, seed collection dates, seed propagation, and companion plants.

Where the Sky Began: Land of the Tallgrass Prairie
Madson, John (1985)
Iowa State University Press
2121 South State Avenue
Ames, IA 50014
www.isu.press.edu
$21.95 + S&H
1-800-862-6657

Engaging literature that blends history with natural science to give a sense of the prairie experience.

Prairie Communities
Robison, Roy and Donald White (1995 ed.)
Minnesota Extension Service
Distribution Center
3 Coffey Hall
1420 Eckles Ave.
St. Paul, MN 55108-6064
1-800-876-8636; 612-625-8173
www.extension.edu
(U of MN No. 280 AG-FO-3238-GO)
$1.50 + S&H

Lists plants commonly found in Midwest prairie landscapes. Provides detailed information about each species: height, form, flower color, growing requirements, propagation techniques and the authors' remarks. Some species listed are not naturally found in Minnesota.

Restoring the Tallgrass Prairie: An Illustrated Manual for Iowa and the Upper Midwest
Shirley, Shirley
Order Department
University of Iowa Press
c/o Chicago Distribution Center
11030 Langley Avenue
Chicago, IL 60628
773-568-1550
16.95 + 3.50 shipping

Describes site planning considerations including soil and moisture require-ments, as well as seed collection, propagation, and site preparation. Descriptions of individual grass and forb species includes seed handling, germination, and identification information. Appendices include illustrated glossary of plant parts, bloom time, butterfly habitats, plant family characteristics, and sources of equipment and seeds.

Project Bluestem: A Curriculum on Prairies and Savannas
Neal Smith National Wildlife Refuge
9981 Pacific Street, PO 399
Prairie City, Iowa 50228
www.tallgrass.org
515-994-3400
$27.50 to Friends of Walnut Creek

Nearly 350 pages – 75 new or adapted environmental education activities – developed by a team of classroom teachers, naturalists, and school administrators for use at school and in the field. Multi-disciplinary activities organized for elementary, middle and secondary school students through 6 themes: prairie soils, prairie plants, prairie wildlife, human/prairie interactions and prairie ecosystem. Pre- and post-visit activities, materials, references, and teachers' background included.

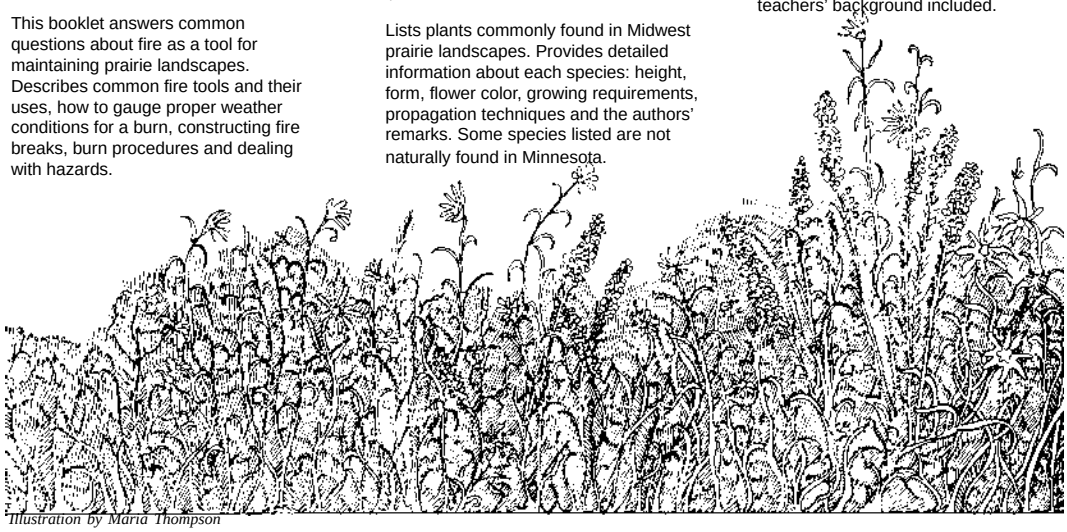
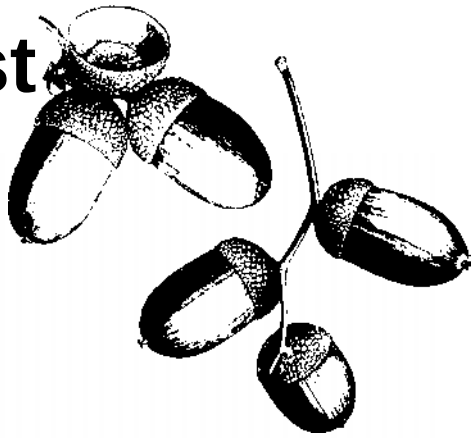


Illustration by Maria Thompson

Vegetation Types of the

Deciduous Forest



Aspen Parkland

Aspen parkland formed a transition between the prairie and coniferous forest of extreme northwest Minnesota and adjacent Canada. It covered vast acreage within the poorly drained flatlands left by Glacial Lake Agassiz. Sometimes referred to as brush prairie, the aspen parkland was a fire-maintained mosaic of wet prairie, sedge meadow, shrub thicket, and aspen groves. Extensive areas of this vegetation type still remain today.

Oak Woodland and Brushland

Oak woodland and brushland was a common ecotonal type between the prairie and deciduous forest. Fire, more than landform type or climate, was the significant factor influencing the position and extent of this community.

The oak woodland and brushland vegetation type has often been referred to as savanna. However, in Minnesota the image of a tallgrass prairie dotted with trees to create an orchard-like appearance is more myth than fact. Careful study of the original pubic land survey records has led to a new interpretation. The oak woodland and brushland ranged from small groves of trees intermixed with open prairie to a chaparral-like community of scrub forest and dense shrub thicket. The structure of the community was largely determined by soil conditions and fire frequency. Oaks, especially bur oak and northern pin oak, were the dominant trees. In the southeast, white oak and black oak were also common.

Floodplain Forest

Floodplain forests line major and minor watercourses throughout the state. They are especially well developed in the valleys of the Mississippi, Minnesota, and Red rivers. The lowland sites occupied by these forests are subjected to periodic flood and drought. Spring floodwaters enrich the soil as they deposit silt over the forest floor. Silver maple, American elm, green ash, black willow, and cottonwood are the dominant trees, and poison ivy and stinging nettle the characteristic understory plants.

In southeast Minnesota along the Mississippi River Valley, a number of southern species reach their northern limits, such as swamp white oak, river birch, and button birch, a state special concern species. The floodplain forests of this region are also critical habitat to two of Minnesota's rare reptiles - the wood turtle and the massasauga (a species of rattlesnake). In northwestern Minnesota, the floodplain forest reaches its northern limit. The narrow bands of forest occurring along prairie streams here are often called gallery forests. Their species richness is reduced, compared to southern stands, and bur oak and boxelder are dominant trees.

Maple-Basswood Forest

Minnesota's maple-basswood forest, dominated by elm, basswood, sugar maple, and red oak, occurs at the western edge of the deciduous forest biome of eastern North America. The largest continuous area of maple-basswood forest in Minnesota at the time of the original public land survey covered over 3,000 square miles in the south-central part of the state. The early settlers called this area the "Big Woods." Smaller areas of maple-basswood occurred in the rugged, stream-dissected lands of southeastern Minnesota and in the west-central part of the state. The boundaries of this forest were in a large part controlled by the frequency of fire. The dominant trees are highly fire-sensitive and were restricted to areas where natural firebreaks such as rivers, lakes and rough topography prevented the spread of fire from the adjacent prairie lands.

Maps and descriptions of vegetation types reproduced with permission, The Natural Vegetation of Minnesota at the Time of the Public Land Survey. © 1988, State of Minnesota, Department of Natural Resources.

Department of Natural Resources

Division of Forestry Programs
500 Lafayette Road, St. Paul MN 55155
651-296-4491, 1-800-766-6000

"Where Are All the Trees: A Minnesota Primer and Discovery Guide?"
Written for K-9 students and educators, topics include information and activities on tree growth, importance for wildlife, forest history, cultural uses, and forest management for wood products.

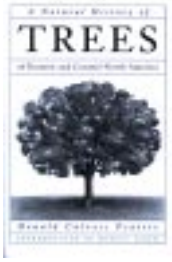
Project Learning Tree
Supplemental environmental education curriculum on trees, forestry, and forest ecosystems. Curriculum is only distributed through workshops.

School Forest Program
Schools in Minnesota can register their school nature areas as official school forests. School forests receive "Dialogs" a monthly newsletter detailing the events and activities of over 70 school forests throughout the state.

Minnesota ReLeaf
A statewide campaign to encourage local governments, citizens, and businesses to plant trees and shrubs. The program is part of the international Global ReLeaf campaign headed by the American Forestry Association. It is an effort aimed at reducing carbon dioxide buildup in the earth's atmosphere. Grants are available to fund tree planting projects.

Minnesota's Native Big Tree Registry
A DNR program to locate and identify Minnesota's largest native trees. Trees are measured and awarded points according to circumference, height, and crown size. A champion tree has amassed the most points.

Forest Publications and Programs



A Natural History of Trees of Eastern and Central North America
Random House Distribution Center
400 Hahn Road
Wesminster, MD 21157
800-726-0600; 617-351-5000
$19.95
ISBN: 0395-581-745

Succinct, non-technical description of each species: leaves, flowers, fruit and geographic range: followed by an essay on each tree's place in historic and contemporary culture.

Trees of Minnesota
MN DNR - Forestry
Minnesota's Bookstore
117 University Ave.
St. Paul, MN 55155
1-651-297-3000
$5.95 + S&H

Provides information on 50 tree species that grow in Minnesota including identification notes and drawings, range maps and forest product uses.

Managing Landscapes in the Big Woods Ecosystem
Mature Conservancy of Minnesota
Southeast Minnesota Office
PO Box 106
Wabasha, MN 55981-0106
651-565-4011
nfalkum@tnc.org

A 23 page booklet on the history, management and future of the Big Woods. Diagrams and graphics illustrate changing land use patterns and ecological concepts.

The Great Lakes Forest: An Environmental and Social History
(out of print)
Flader, Susan L., editor. 1983
University of MN Press
2037 University Ave SE
Minneapolis, MN 55455
1-800-388-3863;
$34.95 + S&H

A multi-disciplinary approach to the history of the forest region of northern Minnesota and adjacent states. Published with the Forest History Society. 337 page, 8 page photo essay, maps.

(Forest resources continued)

More Forest Publications and Programs

Tree Trust
6300 Walker Street
St. Louis Park, MN 55303
(612) 920-9326
willow.ncfes.umn.edu/treetrust/ttrust2.htm
treetrust@willow.ncfes.umn.edu

Through Tree Trust's *Time for Trees* program, communities and schools are able to organize and implement planting projects in their neighborhoods and on their school grounds. The school program provides students and teachers with classroom education and the opportunity to develop outdoor environmental learning areas. Tree Trust provides schools with Green Team coordinators, classroom presenters, plant materials, manuals, Project Learning Tree training and some funding.

Vegetation Types of the

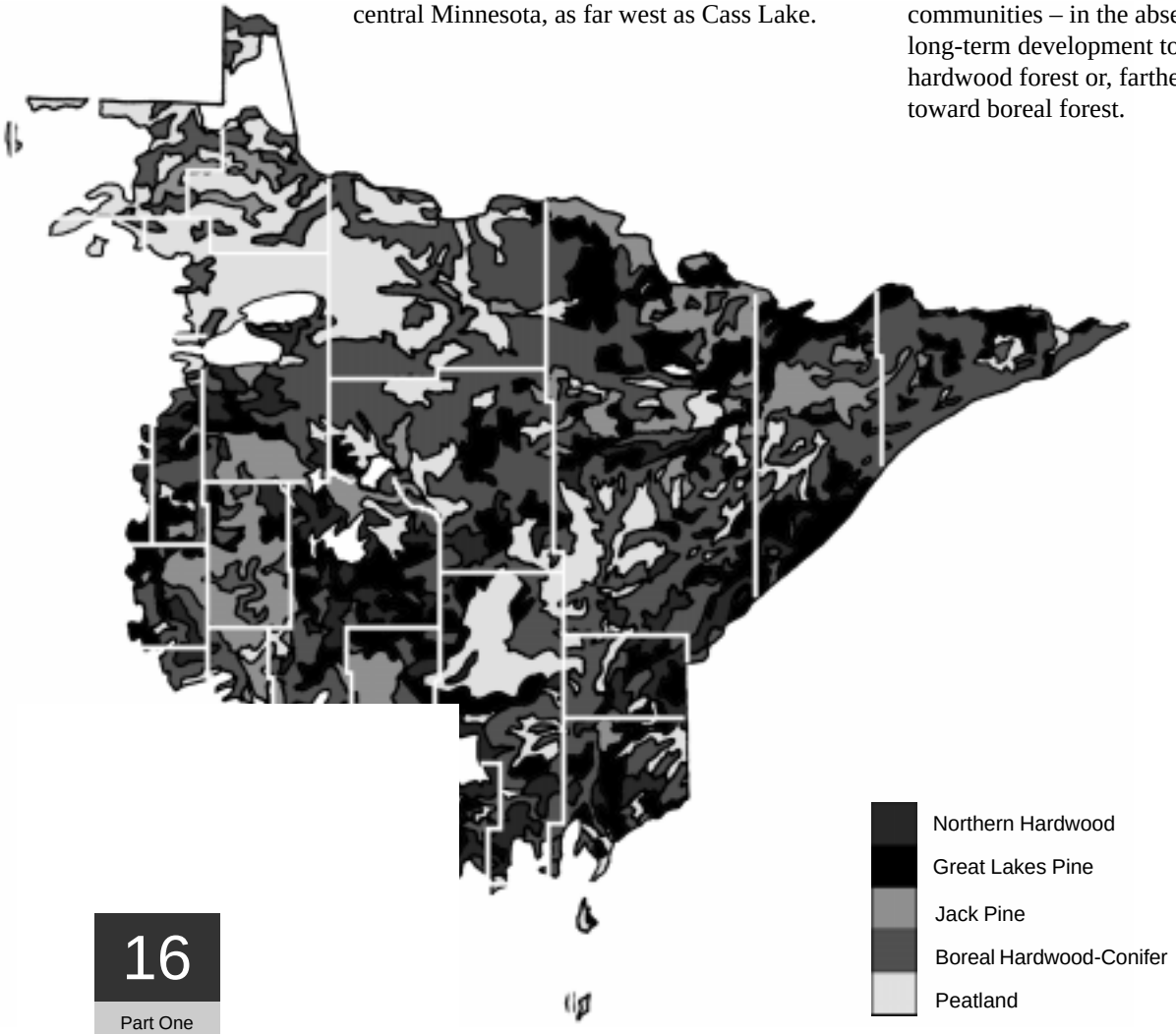
Coniferous Forest

Northern Hardwood Forest

The northern hardwood forest in Minnesota represents the western-most expression of this forest type, which extends from northern Minnesota through the Upper Great Lakes region and eastward along the Canadian border to New England. In Minnesota, the northern hardwood forest is dominated by sugar maple, basswood, yellow birch, and red oak. Conifers, particularly white pine, northern white cedar, and balsam fir are often found scattered through the forest. Due to the fire sensitivity of the dominant trees, this forest association was relatively rare in the state. It was generally restricted to rich, morainic soils where fire frequencies were low. The most conspicuous area of northern hardwoods was the narrow belt along the North Shore Highlands that stretched from Duluth to the Canadian border. It was also found in fire-protected pockets across north-central Minnesota, as far west as Cass Lake.

Great Lakes Pine Forest

The Great Lakes pine forest occurs in Minnesota principally on glacial till over bedrock in the Canadian-Minnesota border lakes area and in the gravel moraines and sandy outwash plains in the north-central part of the state. This forest is defined by its characteristic trees – eastern white pine and red pine. Historically, tree composition and age structure of the pine forest were largely determined by natural fire cycles. Fires of varying frequency and intensity created a dynamic ecosystem composed of early post-fire stands of jack pine and red pine and mature old-growth stands of white pine. In general, red pine was more abundant than white pine and occurred on coarsely-textured, dry sites prone to fires. White pine stands occurred on the mesic sites of lake margins and lower slopes less subject to fires. The general successional trend for the pine forest communities – in the absence of fire – was long-term development toward northern hardwood forest or, farther to the north, toward boreal forest.



Jack Pine Forest

This forest community occurs on the driest, least fertile soils of the pine region. It is especially prevalent on sandy outwash plains in north-central Minnesota and on bedrock outcrops north of Lake Superior. Jack pine grows in pure stands or in mixtures with aspen, northern red oak, and red pine. Most natural stands originate following fire. Fire opens the habitat to direct sunlight and exposes a mineral soil seedbed-both requirements for jack pine reproduction. The dry, open conditions under the jack pine canopy allow for a variety of understory plants. Acid-tolerant shrubs such as wintergreen and blueberry are especially common. On deeper soils, hazel may form impenetrable thickets, whereas on rocky soils, a dense blanket of feather mosses may be the only understory.

Boreal Hardwood-Conifer Forest

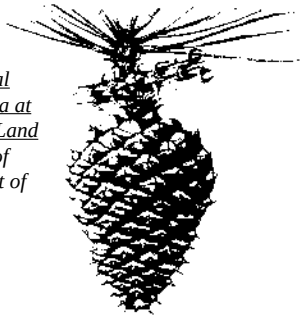
The boreal hardwood-conifer forest in Minnesota is a southern extension of the large Boreal Forest region of Canada. This forest type occupies much of northeastern Minnesota—a region characterized by a short, moist growing season and deep snow. The dominant tree species are balsam fir, white spruce, black spruce, trembling aspen, and white birch. They occur in pure or mixed stands. Species composition varies considerably in response to differences in site conditions and natural fire cycles. Balsam fir, owing to its great shade tolerance, tends to form extensive stands in the absence of frequent fires. Natural disturbances, including fire, wind, and spruce budworm epidemics often result in extensive areas of even-aged stands of spruce-fir or aspen-birch forest. Far less extensive on upland sites, and found mainly in extreme northeastern Minnesota, old-growth white cedar forests occur on fire-protected lower slopes. Northern white cedar typically grows in dense pure stands or was mixed with lesser amounts of balsam fir, mountain ash and white spruce. In the absence of disturbance by fire or wind-storm, upland white cedar forests are long-lived communities and have the potential to dominate large areas of the landscape.

Peatland

Extensive peatlands blanket the nearly flat landscape left when the waters drained from the ancient glacial lakes of north-central Minnesota. Scattered throughout northern Minnesota, smaller peatlands occur in the basins of glacial moraines. Although there were several attempts-mostly unsuccessful-to drain the largest peatlands, the vegetation mosaic of these areas is relatively unchanged since pre-European settlement.

The extensive peatlands that developed in ancient glacial lake plains exhibit the full range of vegetation associations typical of bogs, fens, and swamps. Bogs developed on nutrient-poor acid peat and receive their water supply only from precipitation. They are isolated from groundwater influence. Bogs may be forested, with stands of black spruce or tamarack, or they may be open – dominated by sphagnum mosses, sedges, and low acid-tolerant shrubs. In contrast, fens develop on mildly acid to highly alkaline peat deposits. Fens receive their water supply from mineral-rich groundwater as well as from precipitation, and thus maintain a relatively rich flora compared with that of bogs. Fens are dominated by grasses and sedges. Fens occur in the prairie region of Minnesota as well, but these wetlands are very small compared to the vast acreage of the peatland region fens. These communities are characterized by a distinct assemblage of plants specifically adapted to areas where groundwater rich in calcium and magnesium bicarbonate is discharged. Many of these plants, called calciphiles (or calcium loving), are rare in Minnesota, such as three state-threatened species – whirled nut-rush, sterile sedge, and beaked spike-rush. Swamps are also mineral-rich wetlands, but they are dominated by woody plants and are associated with springs or seepage streams and may consist of either coniferous trees (e.g., northern white cedar) or deciduous trees (e.g., black ash).

Maps and descriptions of vegetation types reproduced with permission, The Natural Vegetation of Minnesota at the Time of the Public Land Survey. © 1988, State of Minnesota, Department of Natural Resources.



More Forest Publications and Programs

Northwoods Wildlife
Benyus, Janine M. (1989)
Creative Publishing International
5900 Green Oak Drive
Minnetonka, MN 55343
800-328-0590
www.howtobookstore.com
$19.95 + S&H

This publication explores the uniqueness of the northwoods: its habitats and accompanying wildlife. Includes descriptions for a variety of habitats, tips for wildlife watching hot spots, and a wildlife event calendar.

Minnesota Extension Service Publications

Distribution Center
University of Minnesota
20 Coffey Hall
1420 Eckles Ave
St. Paul, MN 55108
612-625-8173; 800-876-8636
(fax) 612-625-6281
www.extension.umn.edu

The Minnesota Extension Service publishes information on many forest topics. Call or write for a catalog.

Woodland Stewardship: A Practical Guide for Midwestern Landowners
Melvin Baughman, Alvin Alm et.al (1993)
$14.95 + S&H
Publication #MI-5901-GO.

Contains information on improving timber stands, creating wildlife habitat, marketing and harvesting timber, or enhancing woodland beauty. Maps of the North American distribution of species found in Minnesota are included as well as steps to take to learn about a forest's age, structure, resource value, and wildlife.

A Beginners Guide to Minnesota Trees
David Rathke (1996)
$1.00 + S&H
Publication #BU-6593-GO

Casual nature observers and elementary and secondary youth may prefer this inexpensive 20 page guide. It identifies 35 tree species commonly found in MN.

Minnesota Trees
David Rathke (1995)
$9.50 + S&H
Publication #BU-0486-GO

Key to common Minnesota woody plants. Identification information and line drawings are useful. Contains youth project section and species checklist.

Watershed Address
You live in the watershed of the waterbody into which your land drains. This water body may flow into a larger one, which flows into a larger one and eventually into an ocean.

Every time it rains, water carries materials from your school's grass, sidewalks, and driveways into nearby lakes, streams, or wetlands. Fertilizers, soaps, sediment, and other materials often contained in the water have put watersheds under considerable stress. Over time the effects of these materials could be harmful to water quality. Please learn where your water goes and what you can do to protect it.

Using topographic maps trace the path of a drop of water from the time it hits the ground near your school until it reaches a wetland, stream, river, lake, maybe even an ocean. How far could it travel?

A. Locate your place on a topographic map. If the map is old, your house, or school may not be shown. Map resources are listed in Part 4 of this booklet.

B. Numbers on the maps tell how many feet above the sea the land is located. They are located on "contour lines." Contour lines close together indicate steep slopes. Contour lines far apart indicate flat land.

C. Examine the elevation contours to see the topography of the land and find examples of different landscape types: hill, valley, wetland. How does the map illustrate the differences?

D. Water will flow toward the lower numbers. A drop of water flowing off your land will flow across the contour lines toward lower numbers to the nearest stream, lake, ditch or wetland.

Where does your water flow, and how can it be protected?

Adapted with permission from The Cannon River Watershed Partnership, Faribault.

Aquatic Communities:

Lakes, Streams and Rivers in Minnesota

A review of the communities that form a significant component of Minnesota's biological diversity would be incomplete without a discussion of the state's aquatic communities. Water covers more than four million acres of our state. This 8% of Minnesota's landscape is composed of more than 15,000 lakes and over 22,000 kilometers of streams and rivers. In this discussion, aquatic communities refers to the great diversity of Minnesota's lakes, streams and rivers. Aquatic areas dominated by floating, emergent or standing vegetation are considered to be wetland types and have been described in sections on bog, fen, swamp, and prairie wetland. As would be expected, variability in the aquatic systems is closely related to differences in landform and climate. A general classification of Minnesota's lake, stream, and river types provides a framework for understanding the occurrence and distribution of Minnesota's aquatic organisms. However, the history of regional land-use patterns and the human manipulation of these systems is in many cases the most important factor influencing the current status of rare and endangered aquatic communities and their plants and animals.

Lakes

In Minnesota, lake types typically correlate with geologic and climatic trends on a line from the northeast to the southwest. Along this gradient the chemical composition of the glacial till and bedrock is a major influence on the level of dissolved minerals and nutrients available to lakes from surface runoff and groundwater. Climatic factors – precipitation, temperature and evapotranspiration – also have an important influence on lake environments. These differences are reflected in the abundance and kinds of organisms that occur in lakes.

Lakes in northeastern Minnesota occur on glacially scoured landscapes. Their waters usually have very low levels of dissolved minerals. Many of these lakes are very deep, and most are connected with swift-flowing streams. Precipitation in this part of the state exceeds evaporation, so that outlets are active throughout the year. The waters, although clear and aesthetically pleasing, are biologically unproductive. Forms of algae and other aquatic plants that depend on moderate to high nutrient concentrations find these lakes inhospitable. They are unproductive for fish as well. However, certain species such as lake and brook trout are specifically adapted to them. The relatively low biologically productivity typical of these lakes is a reflection of their cold temperatures and nutrient-poor status.

Lakes in central Minnesota occur in shallow to moderately deep basins in calcareous drift. The waters are much richer in dissolved minerals, and organisms are correspondingly more abundant. In this region of the state, the rate of evaporation balances with that of precipitation so that water flow through the lakes decrease seasonally and outlets are frequently inactive. These lakes are generally intermediate in nutrient levels and productivity. They are best known for their walleye and bass populations.

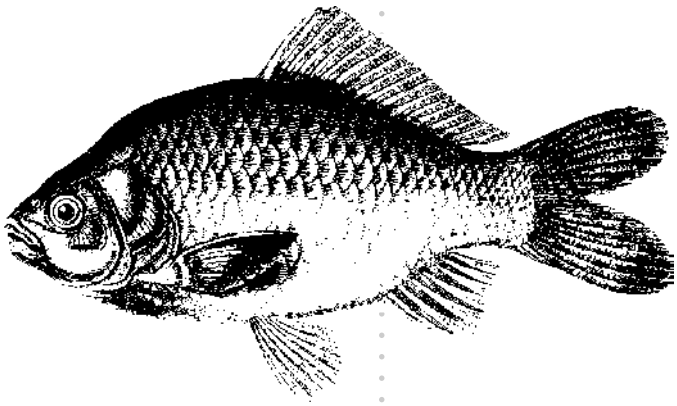
Lake chemistry strongly reflects the change from precipitation surplus in northeastern Minnesota to the negative water balance in the southwestern lakes. Hot dry summers in the region elevate evaporation rates, causing lakes to have high concentrations of dissolved minerals. This phenomenon is so pronounced that in some cases crusts of white salts are deposited on the mud flats of lake margins when the water level drops during the summer season. These prairie lakes are shallow, fertile, and turbid. Of all Minnesota lakes, these have suffered the greatest alteration by humans. Agricultural drainage and runoff has greatly altered the biological composition and water quality of many of them.

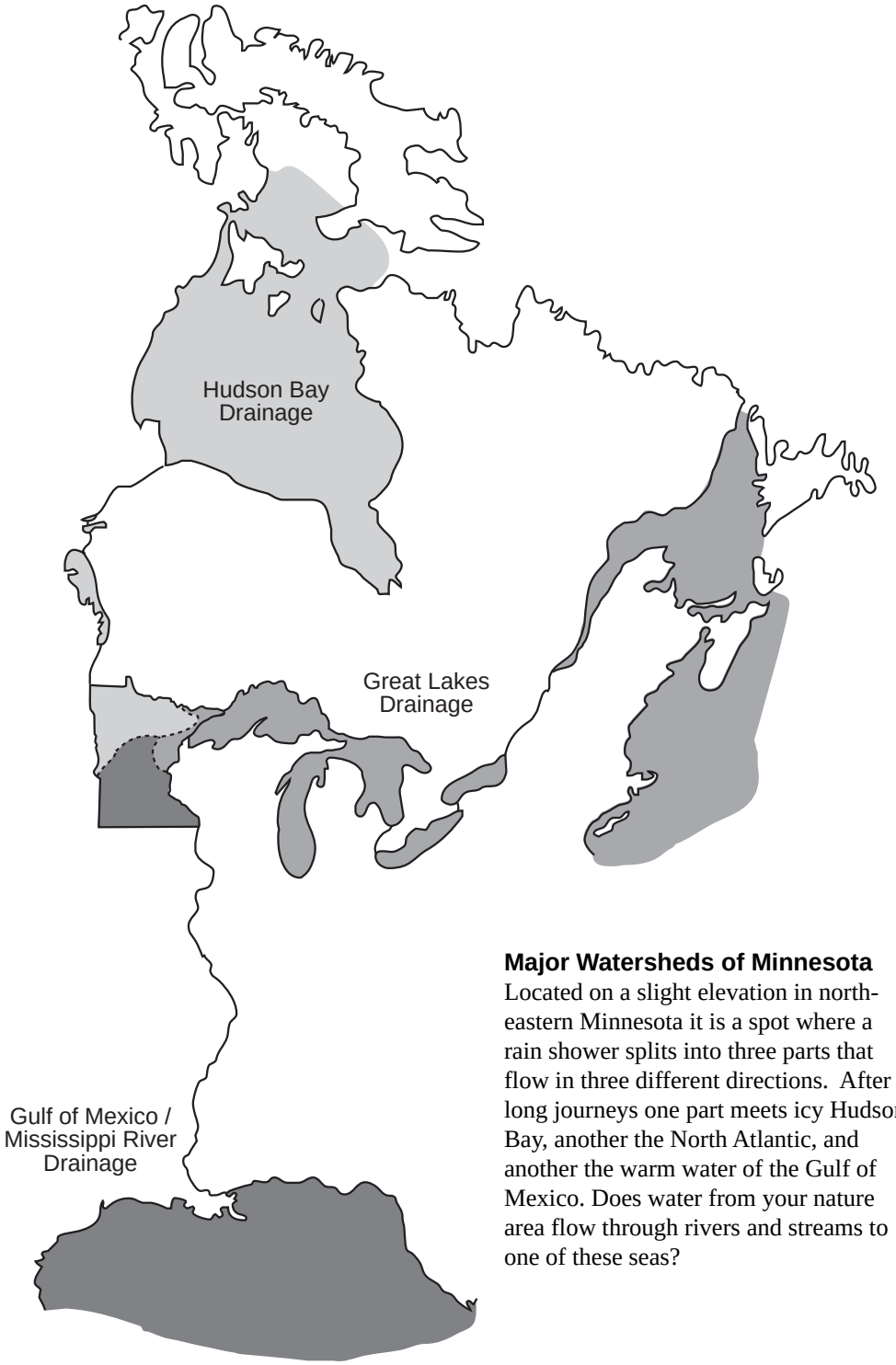
Streams and Rivers

Just as the changes in geology, topography and climate across the state influence lakes, so do they similarly affect streams and rivers. The rivers of northeastern Minnesota are clear, fast-flowing and cold, with low biological productivity. The rivers of southwestern Minnesota are turbid, sluggish, and warm with relatively higher biological productivity. Nevertheless, within each region of the state there is considerable variability that cannot be detailed by such broad generalizations. For the purposes of

describing the distribution of river organisms, two factors, habitat requirements and watershed boundary, are most informative. On a local scale, habitat conditions (e.g. stream gradient, water clarity and temperature, and substrate) are important variables controlling the abundance of river species.

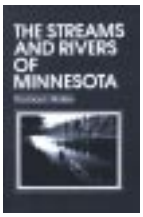
Descriptions reproduced with permission, Minnesota's Endangered Flora and Fauna. © 1988 University of Minnesota Press.





Major Watersheds of Minnesota
Located on a slight elevation in northeastern Minnesota it is a spot where a rain shower splits into three parts that flow in three different directions. After long journeys one part meets icy Hudson Bay, another the North Atlantic, and another the warm water of the Gulf of Mexico. Does water from your nature area flow through rivers and streams to one of these seas?

Aquatic Publications and Programs



Minnesota Wetlands: A Primer on Their Nature and Function
National Audubon Society (1993)
26 E. Exchange St., Suite 207
Saint Paul, MN. 55101
651- 225-1830
$2.50, first copy free

This Primer describes Minnesota's wetland communities, what wetlands are and how wetlands work. The common plants and animals, value, location and status of different wetland types such as marshes, swamps, bogs, and fens are included.

Wetland Plants and Plant Communities of Minnesota and Wisconsin
Eggers, Steve D. and Reed, Donald M.
US Army Corps of Engineers
Attention - Library Sales
190 Fifth St. East
St. Paul, MN 55101-1638
651-290-5680
$11.00 + S&H

Provides keys and descriptions to Minnesota's aquatic communities and associated plant life. Descriptions of plants are included for marshes, wet meadows, bogs, shrub swamps, wooded swamps, floodplain forests, and seasonally flooded basins.

A Guide to Aquatic Plants: Identification and Management
Minnesota DNR Fisheries
500 Lafayette Rd
St. Paul MN 55155
1-800-766-6000 (toll free)
651-296-6157
-free to public-

The guide uses drawings to identify 25 common aquatic plants. It discusses the need to protect valuable plants and control harmful species, summarizes state regulations and explains the DNR Aquatic Plant Management Program.

Project WET
DNR Waters
500 Lafayette Road
St. Paul, MN 55155-4044
1-800-766-6000 (toll free)
612-296-6157

Environmental education curriculum on wetland plants, habitats and ecosystems. Curriculum is only distributed through workshops.

WOW: The Wonders of Wetlands, An Educator's Guide
Slattery, Britt Eckhardt
Environmental Concern
210 West Chew Ave., PO Box P
St. Michaels, MD 21663
410-745-9620 (fax: 410-745-3517)
$15.95 + $4.50 S&H
www.wetland.org

Reader-friendly wetland education. Includes activities to discover what a wetland is, its unique soils, plants and animals. It explores the role of wetlands and provides recommendations for applying knowledge and skills to the task of wetland restoration and protection.

Streams and Rivers of Minnesota
Waters, Thomas F. (1980).
University of MN Press
c/o Chicago Distribution Center
11030 South Langley Avenue
Chicago, IL 60628
773-568-1550 (fax: 800-621-8476)
www.upress.umn.edu
$13.95 + S&H

Describes the physical characteristics, history, biology, and recreational use of the principal rivers of Minnesota and their tributaries. 361 pages, maps, drawings.

Wetlands: Investigating Swamps, Bogs, Fens and Marshes
Hickman, Pamela. 1993.
Available from: Acorn Naturalists
17300 E. 17th St. #J-236
Tustin CA 92780
1-800-422-8886 (fax: 800-452-2802)
www.acornnaturalist.com
$10.95

Wetland education for elementary students (K-8) that focuses on wetland plants, animals, and ecology. Includes both activities and discussions of wetlands as natural filters, fish nurseries, and wildlife homes. Perfect introduction to aquatic environments.

Wetland Trunk
US Fish and Wildlife Service
Minnesota Valley National Wildlife Refuge
4101 East 80th Street
Bloomington, MN 55425-1600
612-854-5900

A trunk containing many wetland educational materials is available for checkout from the USFWS. Trunk contains wetland resources including: videos, posters, articles, magazines, activities and resource directory.

The Patterned Peatlands of Minnesota.
Wright, H.E., Barbara Coffin and Norman Aaseng. (1992).
University of MN Press
11030 South Langley Avenue
Chicago, IL 60628
773-568-1550 (fax: 800-621-8476)
www.upress.umn.edu
$44.95 + S&H

Explores the ecosystem of the peatlands of Minnesota, which exhibit one of the most remarkable displays of complex adjustment of living organisms to their environment. 544 pages, line drawings, photographs.

Fabulous Wetlands
DNR - Film Library
500 Lafayette Rd
St. Paul MN 55155
1-888-646-6367 (toll free)
651-296-6157

An entertaining video on the uses and values of wetlands. One of many films available from the DNR film library: free loan of films, videos, and slide shows. Borrower pays insured return postage. Schools obtain a user number.

Mississippi Headwaters River Watch Program
Cass County Court House
PO Box 3000
Walker, MN 56484
218-547-3300 (fax: 218-547-7376)
www.mhriverwatch.dst.mn.us
0999mhb@InforMNs.k12.mn.us

Mississippi Headwaters River Watch is a scientific ambient water quality collection and monitoring program, that involves middle school and high school volunteers in the collection of water quality data.

A monitoring plan, field procedures and reporting sheets have been developed by qualified biologists, chemists and limnologists. These professionals then train volunteers, who have the responsibility of implementing the monitoring plan, under the direction of the River Watch Coordinator, a trained limnologist.

All results collected by River Watch volunteers will be recorded by the state pollution control agency and entered into the national water quality data bank. These results will identify trends in water quality and help government officials make decisions about future river protection programs.

PART TWO

BOUNDING THE BIOMES

Through centuries of slowly shifting climates and localized disturbances of fire and storm, Minnesota's plant and animal communities were constantly changing. However, during the nearly 200 years of European settlement the pace and scale of change increased dramatically.

The location and features of Minnesota's woodlands, wetlands and prairies were systematically recorded when Minnesota was surveyed for settlement. Between 1847-1907 nearly two-hundred government-appointed land surveyors, with the aid of hardy assistants, walked every mile of the state. They determined the lay of the land, divided the state into a rectangular grid of artificial boundaries and provided settlers with the opportunity to buy land from the federal government. Their records describe Minnesota as settlement of the Upper Midwest was just beginning.

Today, after more than a century of settlement, very few remnants of the native woodlands, wetlands and prairies described by the surveyors remain. The location and condition of these remaining scattered areas is once again being documented. The Minnesota County Biological Survey and other state, federal, and private agencies and individuals are working to protect remnants of Minnesota's native landscapes.

1847 – 1907

Surveying the United States: 209 Years, A Billion Plus Acres and Still Going

The following article, reprinted with the permission of the Star Tribune, Minneapolis-St. Paul, "Surveying the US: 209 Years, a Billion Plus Acres and Still Going." Dean Rebuffoni. 1/2/94.

Since the First Continental Congress created the Public Land Survey in 1785, its employees have surveyed more than 1 billion acres of the United States, including all of Minnesota.

Any piece of land that is bought and sold today in that vast expanse is just a small piece of the large rectangular squares — the original townships — laid out by the surveyors. The only areas not surveyed by the rectangular system are Hawaii, parts of the South, and the states that constitute the original thirteen colonies.

And the work goes on: Alaska has not been fully surveyed, nor have some national forests and parks in the western states. But while laying a straight line through the outback still can be hard work, it's not the task that the early surveyors faced.

"If you were to walk in the woods today, you probably would take the path of least resistance," said Rob Nurre, a private biologist in Stevens Point, Wisconsin. "But the surveyors had to walk prescribed lines, and that often meant hacking their way through some very rugged unsettled country."

Land Survey Resources

Trygg Land Maps
Trygg Land Office
PO Box 628, Ely MN 55731
218-365-5177, $4.00

Maps compiled from original land survey data and other documentary sources. Twenty three maps describe Minnesota's vegetation at the time the land survey was completed (1847-1907) as well as notable landscape or cultural features: settlements, cleared fields, mill sites, roads and trails. These resources provide an interesting and easy to use picture of the past.

The Field Notes of the Public Land Survey
Minnesota History Center
345 Kellogg Ave W.,
St. Paul, MN 55102-1906
651-296-2143

Although originally federal property, the field notes of the Public Land Survey are now owned by the state. There are more than 300,000 pages of notes covering all of Minnesota, and they are contained in more than 1400 leather bound volumes. Because of their value and fragility, access to the volumes is restricted, although their contents have been reproduced on microfilm and optical discs and are available for research. A site's township name, range number, tier number, and legal description is necessary to access information.

He emphasized that interpreting the old, sometimes cryptic survey notebooks "requires that we also understand the mind set of the surveyors and what they were expected to do."

Their employer, the General Land Office, expected them to survey the land into townships, each 6 miles square, with lines running due north and south and others crossing at right angles. They were to clearly mark these lines and their corners by inscribing trees, the so-called bearing trees and, on the prairie, with earthen mounds and wooden posts. These artificial boundaries were to be recorded in the surveyors' field notes.

They were also expected to record significant natural features such as soils, plants, topography, waterways, lakes, hills, caves, and mineral deposits. And they were to record artificial features — Indian villages and mounds, for example, and European settlements, fields, trails, and roads.

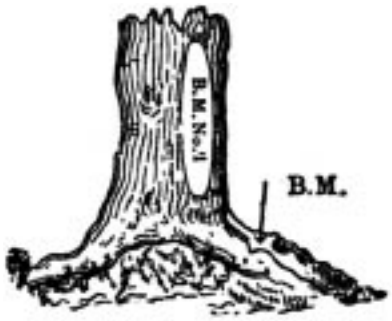
For doing all that, the deputy surveyor, the man in charge of the survey crew, was paid $2 to $4 for each surveyed mile during the mid-1800's, In turn, he had to provide transportation and provisions and pay the other crew members. They each got about $1 a day.

However, a buck went a long way then. For example, an acre of surveyed land could be bought for $1.50 from the General Land Office.

The size of the survey crew depended on how much work it was expected to do, but often there were five men: the deputy surveyor, two ax-men, a cook, and a couple of chain-men.

The surveyor handled the compass, the ax-men cleared a path through the woods and the cook handled the food and other camp work. The chain-men, of course, handled the metal measuring chain. It was 66 feet long and weighed from 4 to 10 pounds.

"To survey a township, including its 36 sections, meant laying out and walking 72 miles of measured chain, but it frequently



meant walking 120 to 130 miles through the wilderness, and a good day's work would be perhaps 10 measured miles."

The work generally was easiest on the treeless prairie, tougher in the woods, and downright miserable in the bogs, marshes and other wetlands that then covered so much land. And while they frequently traveled through areas teeming with fish and game, the surveyors didn't spend much time angling and hunting.

"It just wasn't time efficient. They carried their food supplies, and often it was salt pork and hardtack (hard biscuits)."

They were afield in all types of weather, usually far from the nearest pioneer settlements. Sickness was common, and Indians sometimes hindered the work.

"The European settlers usually didn't show up until after the surveyors," Nurre said. "For the native Americans, seeing the surveyors do their work, seeing the survey stakes pounded into the land, was the first tangible evidence that the treaties they had signed were, indeed, to come to pass.

"Those survey stakes became the harbingers of change to the landscape."

Formula's of landscape division:

Surveyor's Chain	=	66 feet
One Mile	=	5,280 feet or 80 chains
One Section	=	1 square mile or 640 acres
640 Acres	=	divided into multiple acreage based on the quartering of sections
One Acre	=	43,560 square feet

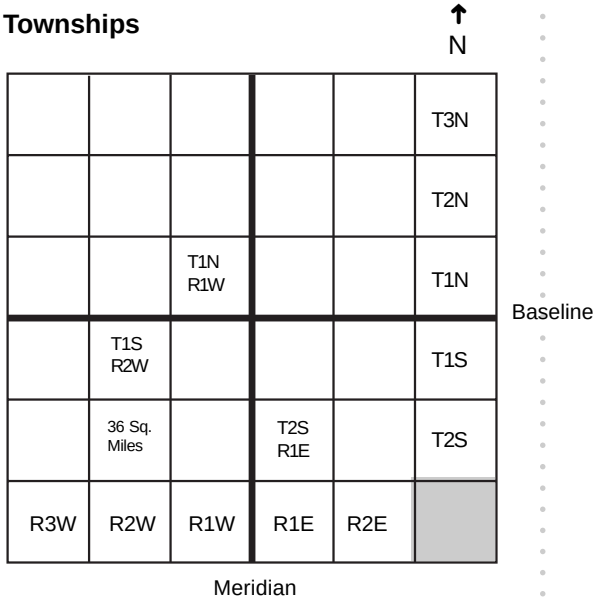
Organizing the Landscape for Buying and Selling

Every piece of land that is bought or sold in Minnesota and most of the United States is part of a grid system of land division that overlays natural communities and systems.

First the surveyors divided the landscape into *townships* that were numbered north and south from a baseline into *Tiers* and numbered east and west from the principal meridians into *Ranges*.

Township

Townships



Then the surveyors divided each township into 36 sections. Each section was one square mile or 640 acres. Note the numbering system used to designate the sections.

Township

1 Section in a township

36 Sections in a Township

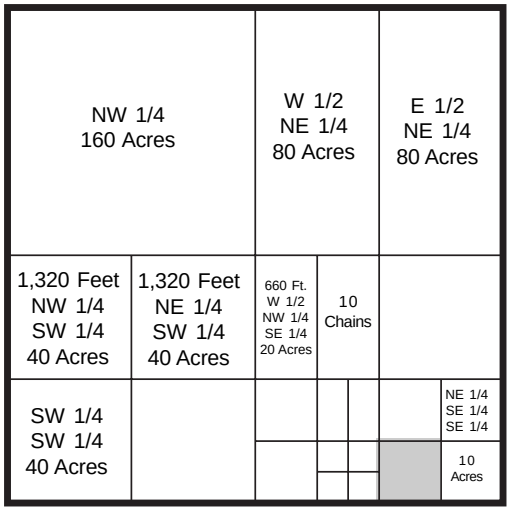
36	31	32	33	34	35	36	31
1	6	5	4	3	2	1	6
12	7	8	9	10	11	12	7
13	18	17	16	15	14	13	18
28	19	20	21	22	23	24	19
25	30	29	28	27	26	25	30
36	31	32	33	34	35	36	31
1	6	5	4	3	2	1	6

Finally each section was broken down into parcels of land or acreages. Each acre contains 43,560 square feet.

A Section, 640 acres, 1 square mile

10 Acres

Acreages



"Eyewitnesses to Wilderness"

Reprinted with the permission of the Star Tribune, Minneapolis-St. Paul. Eyewitnesses to Wilderness 1/2/94

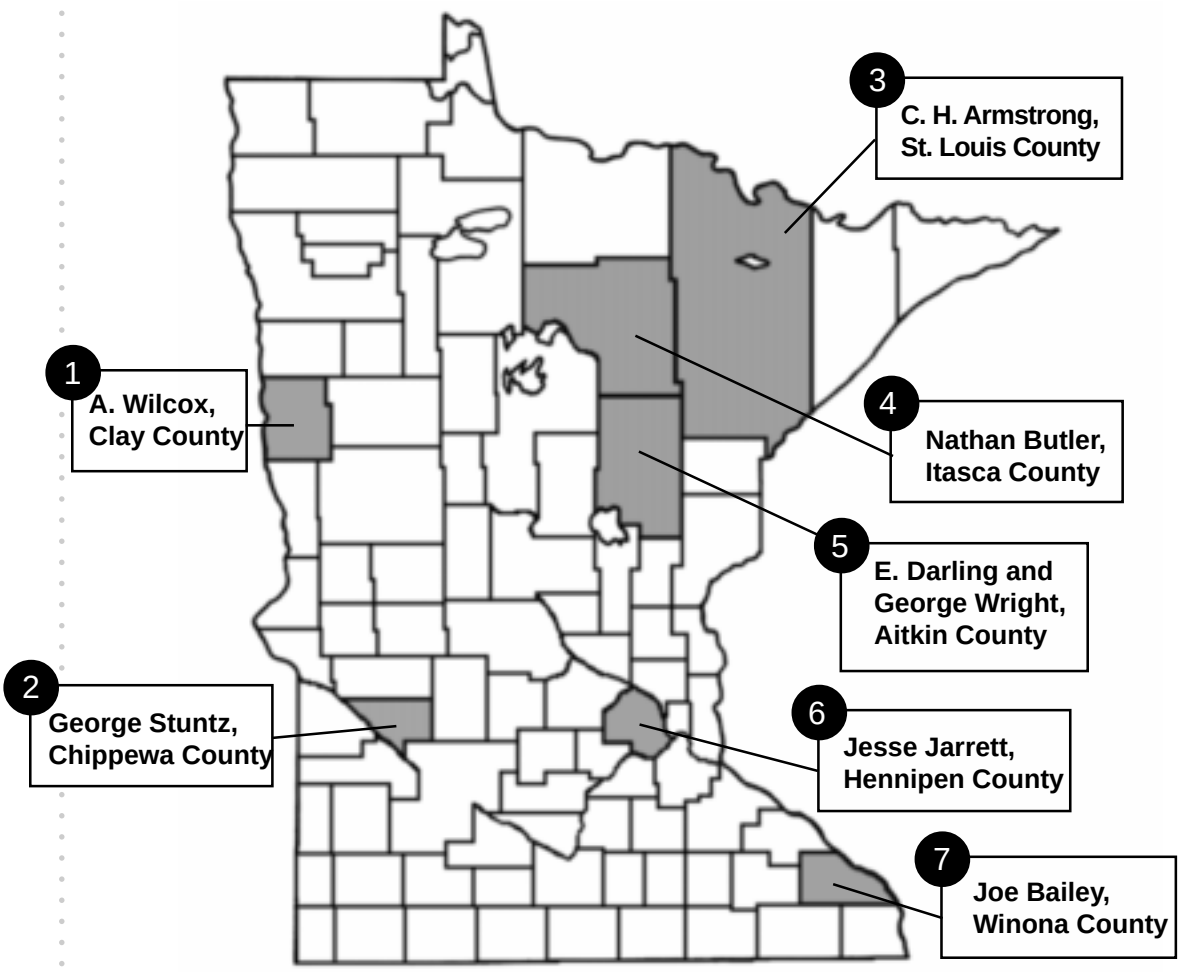
Field notes written by the original land surveyors are largely businesslike and professional, but sometimes they show flashes of humor and insightful predictions. They also reveal the tough conditions that surveyors often endured in the wilderness that now is Minnesota. And sometimes the pristine land moved them to lyricism.

When the surveyors were afoot, Minnesota's wetlands were still vast and undrained. That created problems because the surveyors had to mark section corners, either by blazing trees, building earthen mounds or driving long, wooden stakes into the soil.

1 A. Wilcox, who surveyed Clay County in 1870, wryly described the woes he encountered: "It being impossible to build a mound at this point I stuck [a section post] into the marsh. But when last seen, it was fast going down out of sight."

2 When he surveyed Chippewa County in 1871, **George Stuntz** found rich soil and flat terrain - sure bets to attract farmers. But he also encountered a form of wildlife that later would plague county farmers: *"Millions of grasshoppers. Sun clouded with grasshoppers in the middle of the day. All flying to the SE"*

3 Surveying could be exceedingly hard work, as is revealed in **C. H. Armstrong's** field notes from the wild of St. Louis County: *"This township was surveyed during the coldest weather I have ever experienced, it being often thirty degrees below zero and seldom reaching minus ten degrees [and] the snow being an average of two or more feet. I have striven to hold my instruments at proper adjustment but I feel positive that no instrument … is now or ever will be manufactured that will give a perfect meridian while subjected to such intense cold, and the proper handling of a sensitive instrument is a physical impossibility."*



4 **Nathan Butler** spent the winter of 1872-73 surveying in northern Minnesota, in what is now Itasca County. In one area, the magnetic needle in his compass acted so erratic that he had to switch to a solar compass to get an accurate bearing. Butler later wrote, *"There were millions of dollars of the best kind of iron ore under my feet, and I did not know it."* He had been atop what now is the Mesabi Iron Range.

5 Surveyor **E. Darling** didn't especially like what he found in part of Aitkin County in 1860. He described "*wet & boggy"* swamps, *"ridges of poor soil"* and "*no timber is worth cutting."* But another surveyor, **George Wright,** was awed by what he saw in another part of Aitkin County, along the Mississippi River: *"The river … is perhaps not excelled for beauty by any streams in the world; with a perfectly uniform width ... handsomely rounded banks of ten to twenty feet high and a current at two to three miles per hour, it sweeps away in those graceful curves which never fail to delight the eye … it can only be appreciated through an … acquaintance therewith. It must be seen and felt."*

6 **Jesse Jarrett** summed up a six square mile tract of land that he visited on Aug. 17, 1853. At the time, the land was at the edge of the frontier; today, it's a big chunk of Minneapolis, including the city's chain of lakes. *"This township contains a number of lakes of clear deep water, also a number of small lakes. There are also a considerable number of marshes generally suitable for meadows. The soil of this township is good second rate, sandy, well adapted for farming in this country where the summers are short."*

7 **Joe Bailey,** while roughing it across Winona County in 1854, predicted that the area could someday provide its settlers with an abundance of fattening food, the sort of diet then believed to cause gout, or "rich man's disease." The county, he wrote: *"… is well adapted to the culture of the gout, but will doubtless be, for many years to come, the peaceful abode of the large Yellow Rattlesnake, some twelve of which were killed by (his surveying crew) during our short but painful sojourn."*

Bailey and his crew also encountered stinging weeds, troublesome brush and one family of settlers: *"… the valleys are narrow and fertile, but generally wet and thickly coated with bull nettles and undergrowth of various kinds. One family had just pitched their tent … but their protracted stay was exceedingly doubtful."*

The Surveyor's Instructions: What They Were Looking For

The instructions to the land surveyors were as follows: "Your field notes are to form a full and perfect history of your operations in the field. You are to enter in their proper places in the field notes of your survey, a particular description and the exact location of the following objects."

1. The length and variation of every line you run.
2. The name and diameter of all bearing trees, with the course and distance of the same from their corners.
3. The name and material from which you construct mounds, with the course and distance to the pits.
4. The name, diameter and exact distance to all those trees which your lines intersect.
5. At what distance you enter, or at what distance you leave every river, creek or "bottom," prairie, swamp, marsh, grove, or windfall, with the course of the same at both points of intersection.
6. The surface whether level, rolling, broken, or hilly.
7. The soil, whether first, second, or third rate.
8. The several kinds of timber and undergrowth, naming the timber in order of its prevalence.
9. All rivers, creeks and smaller streams of water, with their actual or right angled widths, course, banks, current, and bed, at the points where your lines cross.
10. A description of all bottom lands — whether wet or dry, and if subject to inundation, state to what depth.
11. All springs of water, and whether fresh, saline, or mineral, with the course and width of the stream flowing.
12. All lakes and ponds, describing their banks and the depth and quality of water.
13. All coal banks, precipice, caves, sinkholes, quarries and ledges with the character and quality of the same.
14. All waterfalls and mill sites.
15. All towns and villages, houses, cabins, fields and sugar camps, factories, furnaces and other improvements.
16. All minerals or ores, and all diggings thereof, with particular descriptions of both that may come to your knowledge, whether intersected by your lines or not.
17. All roads and trails with the courses they bear.
18. All offsets or calculations by which you obtain the length of such parts of your lines as cannot be measured with the chain.
19. The precise course and distance of all witness corners from the true corners which they represent.

Provided by the Trygg Land Office, Ely, Minnesota.

Biome Remnants: Protected Sites in Minnesota

If you wish to see an example of one of Minnesota's natural communities or you are considering restoring an area to prairie, woodland, or wetland, you may want to visit an existing remnant site. Remnants and restorations of natural areas can be found throughout the state on private and public land and can serve as a model for what your place could be like. Be sure to get permission before venturing into a preserved area. Many of the areas are protected in order to preserve their unique characteristics, and may have special restrictions on their use.

The Nature Conservancy
1313 5th St. SE
Suite 320
Minneapolis, MN 55414-1588
www.tnc.org
612-331-0750

The Nature Conservancy is an international conservation organization that works to preserve the best examples of plants, animals, and natural communities that represent the diversity of life on earth by protecting the lands and waters they need to survive. The Minnesota Chapter owns and manages 52 Preserves which include native prairie, woodland, and wetland communities. Some Preserves can be visited; A Guide to the Nature Conservancy Preserves in Minnesota is available for $16.00.

Minnesota's Natural Resource Conservation Programs
Minnesota Extension Service
Distribution Center
University of Minnesota
20 Coffey Hall
1420 Eckles Ave
St. Paul, MN 55108-6064
800-876-8638; 612-625-8173
fax: 612-625-6281
www.extension.umn.edu

This free booklet lists land conservation grants and programs available to Minnesota land owners including programs in soil protection practices, forest land management, water conservation, and wildlife, wetland, and prairie management. The publication number is NR-FO-5946-S.

Today: Protecting What Remains

As the original land survey in Minnesota was completed, the pace and scale of settlement increased dramatically. In 1850 there were less than 7,000 settlers living in Minnesota. In a decade the number jumped to over 172,000. By 1900 there were almost 2 million people in all regions of the state.

By 1950 Minnesota's population increased to nearly 3 million, and only fragments of native vegetation remained. As prairie, woodland, and wetland acres were eliminated, diversity suffered. Habitat was lost. The complexity of the landscape was simplified.

As the 20th century draws to a close 4.5 million Minnesotans live in a landscape that holds few clues to the places of two centuries ago. Only isolated remnants of Minnesota's natural communities remain. Scattered pockets of prairie persist along railroad corridors, on the edges of pioneer cemeteries and in a few places left untouched by plows or graders. Fragments of forests line rivers and stand like ancient islands scattered through the state.

The Minnesota County Biological Survey of the Minnesota DNR, using 20th-century tools of aerial photography, computers, and sophisticated mapping techniques, are once again surveying the landscape. Initiated in 1987, and operated by the Natural Heritage and Nongame Wildlife programs, the survey systematically gathers, county-by-county, information on Minnesota's biotic communities and the plants and animals they shelter. It also documents the existence of rare plants and animals in each county, producing a map of significant natural features that can be used in local land-use planning.

Minnesota County Biological Survey
MN DNR
500 Lafayette Rd, Box 7
St. Paul, MN 55155
888-646-6367 toll free
651-296-6157 metro

Comprehensive data on the distribution and status of intact biotic communities is now being compiled by the Minnesota County Biological Survey. Maps for the counties that have been completed detail plant communities prior to settlement and remaining tracts of significant plant communities.

Vegetation Today Within The Biomes

Descriptions of vegetation types reproduced with permission, Minnesota's Endangered Flora and Fauna. © 1988, University of Minnesota Press.

The Prairie Today …

Large scale habitat destruction and alteration in the prairie biome has been more complete than in any other area of the state. Shortly after 1850, when agriculture became an important factor in the state's economy, the entire native prairie landscape had all but disappeared under the plow. Now less than 1% of the original prairie remains, usually along railroad rights-of-way, on steep slopes, and in other difficult-to-farm areas. With the destruction of the continuous tallgrass prairie came large reductions in population and geographic distribution of many native prairie species. By the early 1900's the herds of bison and elk had vanished from the prairie biome. Prairie birds such as the long-billed curlew and McCown's longspur were extirpated, and the greater prairie-chicken was pushed out of the southern part of the state. Today 105 vascular plant and animal species associated with the prairie biome have been identified as endangered, threatened, or of special concern in the state. The isolated remnants of native prairie are the last stronghold for many of Minnesota's rarest species.

The Aspen Parkland Today …

The continuous nature of the aspen parkland is rapidly disappearing because agricultural clearing continues in the region. The suppression of natural fires is also altering the character of the ecosystem. Groves of aspen-oak forest have spread in some areas to form a nearly uniform, continuous cover. Because of these changes, some species that inhabit this ecosystem – sandhill cranes, sharp-tailed sparrows, and western fringed prairie orchid – are rarer today.

The Oak Woodland and Brushland Today …

Agricultural activities and fire suppression have severely degraded and diminished this once widespread community type. Today remnant examples of this community are restricted to the sandy soils of dunes and sand plains unsuitable to cultivation. Both plants and animals typical of this community have declined: the loggerhead shrike and the kitten-tail plant are examples.

The Floodplain Forests Today …

Owing to the low agricultural and development value of the floodplain community, the original distribution of this forest type has not been greatly impacted. Intact floodplain forests are often the only large pieces of native habitat remaining in heavily agricultural areas.

The Maple-Basswood Forest Today …

Since settlement in the mid 1800's, the original maple-basswood forest has been profoundly altered by agricultural development and urban growth. The Big Woods itself has been virtually eliminated through land clearing. Much of the former deciduous forest is now Minnesota's dairy region. Today, remnant stands occur only as small, isolated fragments surrounded by cropland. Within the topographically rugged "driftless area," the maple-basswood forests are restricted to sites of steep, north–and east–facing slopes which were less vulnerable to cultivation efforts. A number of rare woodland plants occur in this habitat, including golden-seal, twin leaf, squirrel-corn, trillium, ginseng, and the federally listed Minnesota dwarf trout lily.

The Northern Hardwood Forest Today …

The northern hardwood forest has experienced profound alteration from its condition at the time of settlement. Clear-cutting and subsequent conversion to other forest types has eliminated much of the northern hardwoods. In addition, high-grading of the forest by selective removal of yellow birch and conifers has resulted in a change of forest composition toward the increased dominance of sugar maple and basswood. Forests that have remained undisturbed are characterized by a closed over-story canopy of old-growth trees (150 plus years). These sites are especially important habitat for species of lichens that require mature forests. The state threatened lichen *Lobaria quercizans* is found only on mature trees within the northern hardwood and forested swamp communities. The eastern hemlock, a tree species that is common in eastern North America, occurs in Minnesota exclusively in the northern hardwood forest.

The Great Lakes Pine Forest Today …

The red pine and white pine forests were the most thoroughly exploited natural communities in the Upper Midwest. Lumbering, beginning in the 1840's, virtually eliminated the large groves of original pine forest from the landscape. Subsequent land-clearing activities destroyed chances for pine regeneration and resulted in their replacement by stands of aspen and birch, now the most common forest type in northern Minnesota. Large stands of virgin pine are now restricted to the Border Lakes region within the BWCA and Voyageurs National Park. The essentially undisturbed character of this area allows the pine forest ecosystem to function much as it did on the pre-European-settlement landscape. Pine stands in these large pristine areas and smaller remnant stands scattered throughout north-central Minnesota provide important nesting habitat for osprey and the threatened bald eagle.

Minnesota State Park System
Minnesota DNR
500 Layfayette Road
St. Paul, MN 55155
651-296-6157 metro
888-646-6367 (MN toll free)
www.dnr.state.mn.us

Many of the state parks have interpretive information and management projects that attempt to restore the natural communities that were historically a part of the park's landscape. Also at the parks, you'll find information on the Junior Park Naturalist Program. The program invites children ages 7-14 to observe and learn about the natural community of the park environment. The program includes three booklets representing Minnesota's major biomes: prairies, hardwoods, and conifer forests. Each booklet offers three achievement levels to motivate participants. Junior Park Naturalist materials are free and available exclusively at Minnesota state parks.

The Minnesota Naturalist Association (MNA)
P.O. Box 23435
Richfield, MN 55423

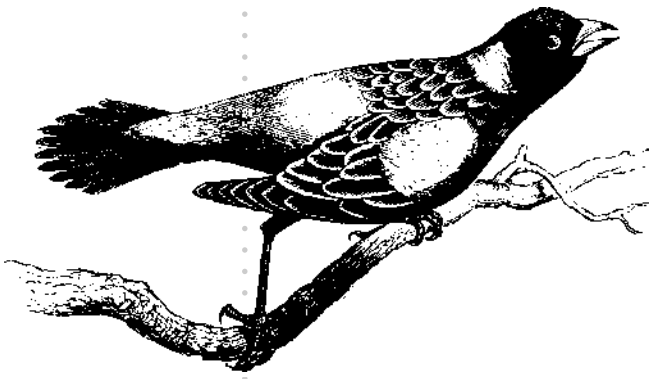
The MNA produces a list of Minnesota's environmental education facilities. Contact facilities near you for descriptions of their natural features and management activities.

Scientific and Natural Areas Program
Box 7 Minnesota DNR
500 Layfayette Road
St. Paul, MN 55155
651-296-6157 metro
888-646-6367
www.dnr.state.mn.us

This program has established a system of public natural areas that include the rarest and most precious of Minnesota's natural features. The select lands and waters that qualify are protected through fee acquisitions, gifts, easements, or leases. Special permission is required to use SNA's. For more information contact the program.

Educator's Guide to Using Environmental Learning Centers
RELC Green Print Council Office
Minnesota DNR
Box 46
500 Lafayette Road
St. Paul, MN 55155
651-282-5788

Describes each of Minnesota's environmental learning centers, their mission and services, and everything a teacher needs to know to bring a class to them.



The Jack Pine Forests Today …

Following the early logging of the Great Lakes pine forest and resultant fires, jack pine forest increased in extent across Minnesota. Current fire-protection policies, however favor the replacement of jack pine forest by the more shade-tolerant trees of the Great Lakes pine forests and the boreal hardwood-conifer forest. Open jack pine stands, maintained by periodic fires, are important habitat for one of Minnesota's rarest plant species, the endangered Ram's-head lady's slipper, as well as a threatened species of tiger beetle. The marten, an animal of special concern, is also an inhabitant of mature jack pine forest and other coniferous forest types in northeastern Minnesota. Once common, this species was pushed to near extirpation by hunting and removal of forest cover. It is now making a limited comeback.

The Boreal Hardwood-Conifer Forest Today …

Relatively natural stands of boreal hardwood-conifer forest are still fairly common in northern Minnesota. Within the BWCA, a vast expanse of this forest type, interspersed with wetlands and lakes, supports the last large population of federally-threatened gray wolf in the contiguous United States.

The Peatlands Today …

The vast continuous peatlands of northern Minnesota are the state's last remaining intact ecosystem. Despite drainage efforts of early settlers, this system, unlike any other ecosystem in Minnesota, retains a large enough area to provide viable habitat for the full range of plants and animals native to these lands. In particular, the shrub bogs of the peatlands provide specialized habitat for the northern bog lemming, and the mineral rich fens provide specialized habitat for the rare and intriguing linear-leaved sundew and a moss (*Cinclidium stygium*), which is an indicator of rich fen habitat.

The Primary Communities Today …

The extreme conditions (cliff, sand, etc.) found in primary communities afford few opportunities for development, hence, unlike most natural communities in the state, their distribution today is probably similar to their pre-settlement range.

The Lakes Today …

Minnesota's lakes, notably those in the southwest, have been extensively altered by humans. Agricultural drainage and polluted runoff has greatly altered the biological composition and water quality of many of them. Much is yet to be known about the distribution of aquatic organisms as a reflection of the health of the environment. There is little information on the distribution and habitat preference of aquatic plants, most aquatic invertebrates, and fish other than game species.

The Rivers and Streams Today …

Several of the state's endangered fish and mollusks clearly illustrate both the importance of undisturbed habitat and the impact of drainage divides. The shovelnose sturgeon and the paddlefish were once much more common in the Mississippi River drainage, but the construction of navigational dams has altered habitat and interfered with spawning migrations. The siltation of once clear upland streams due to intensive agricultural practices is another significant factor in the increasing rarity of fish species. In all cases, the fact that watershed boundaries restrict and limit species migration and dispersal means that the short-term impact of habitat degradation may mean the long term extirpation of a species. Many river organisms are restricted to their particular drainage system and have no mechanism for moving to suitable habitat in other watersheds when habitat is destroyed in its native waters. Conservation of river and stream habitats must occur throughout Minnesota if we are to protect the full biological diversity of our waterways.

PART THREE

SITE CHECKLIST:

Guidelines for Planning School Nature Areas

Preservation is the most important action you can take to benefit any nature area that has not been significantly altered. Once a native landscape is gone, the area will never support the population of plants and animals that it once did. Landscapes that have been significantly altered – where few original plant and animal residents remain – can be patiently redirected (but never fully recreated) through restoration. In either case, management requires seeing nature areas as a part of a larger system whose plants, animals, land, water and human components are interconnected.

Whether preserving, restoring, or managing a particular site, some common themes should guide your nature area planning.

☐ **Diversity**
Conserve the full range of natural habitats that occur on your site and are appropriate to your biome to help assure survival of all plants and animal species that comprise the region's biodiversity.

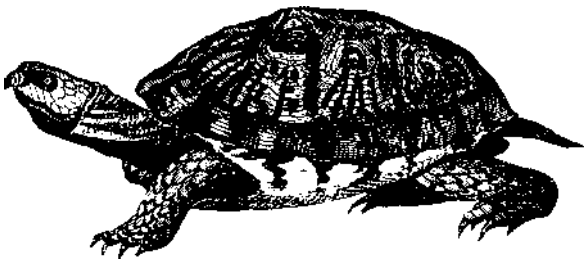
☐ **Limited Fragmentation**
Develop and maintain connected habitat areas, allowing for safe, effective movement of plant and animal populations.

☐ **Native Plants**
Utilize native plants because they are adapted to the conditions of your site, have natural "checks and balances," and do not require as much maintenance. Remove species that are aggressive or threaten native plants.

☐ **Rare Species**
Begin a program to identify and protect the plant and animal species that are threatened or endangered in your area.

☐ **Reasonable Access**
Accommodate human use and educational opportunities. Monitor your impact.

☐ **Wildlife**
Provide indigenous wildlife with food, water, cover and sufficient safe space.



☐ Diversity

Test Your Biodiversity Knowledge

Which of these communities have the most biodiversity?

1. a) A farm pasture
   b) A native prairie

2. a) A wildflower garden
   b) A mowed lawn

3. a) A group of wild lupine seedlings grown from seeds from one adult plant
   b) A group of wild lupine seedlings grown from seeds from several adult plants

4. a) An area with wild huskies, poodles, and Chihuahuas living in it
   b) An area with wolves, coyotes, and foxes living in it

5. a) An old-growth forest
   b) A second-growth forest that grew where an old forest was logged

6. a) Ten separate 1,000 acre old-growth forests
   b) One ten-thousand acre old-growth forest

Answers:
1. b: Greater number of species
2. a: Greater number of plant species and the animal species they attract
3. b: Greater genetic diversity
4. b: Domestic dogs are all the same species. Wolves, coyotes and foxes are each separate species
5. a: Disturbance eliminates many species.
6. b: Fragmentation eliminates edge-sensitive species like wolves, moose, Cooper's hawks, etc.

Biodiversity (short for biological diversity) has three parts:

Ecosystem diversity – a variety of habitats within an ecosystem.

Species diversity – a variety of species within a habitat.

Genetic diversity – a variety of genetically different individuals within a species.

Without **ecosystem diversity**, every place on Earth would be the same, and the habitat needed to support many different types of plants and animals wouldn't exist. Without **species diversity**, the complex relationships among species that keep life running smoothly on Earth wouldn't exist. Without **genetic diversity**, a species would not have the ability to adapt to changes in its environment.

Without diversity, life on Earth would be in trouble. For example, there is a moth species in England that has both a dark-colored and a light-colored form. When air pollution began to increase at the time of the Industrial Revolution, the resulting soot darkened the bark of trees. Light-colored moths stood out against the dark background and were eaten by birds, but the dark-colored ones survived. What would have happened to the species if there were only light-colored individuals? This is an example of the importance of **genetic diversity**. A wide variety of individuals helps a species survive changes in its environment.

What about **species diversity**? No species lives by itself. Every species depends on others for what it needs to survive. For example, many flowers need bees to pollinate them so they can produce seeds. Some flowers need a very specific kind of bee. If that one species of bee is eliminated, it doesn't matter how many other species of bees there are in the area, the flower will be eliminated too.

What happens to an ecosystem in which habitats become less diverse? Here's an example: If you eliminate wetland habitat, you lose all the species that depend on wetlands, like cattails, wild rice, ducks, muskrats, and so on. You also lose both flood control and drought protection. Wetlands absorb excess rainwater and let it soak into the ground, where deep-rooted plants can use it during droughts. Without wetlands, excess rainfall runs off into rivers, washing away valuable soil as it goes, and may fill the rivers to flood stage. Water doesn't get a chance to soak into the ground, so when droughts occur there is less water in the soil for plants to use, and many plants (and the animals that depend on them) die. **Ecosystem diversity** is part of what makes our planet healthy, just like species diversity and genetic diversity.

Adapted with permission from Wild River State Park, Center City, Minnesota. Written by Park Naturalist Dave Crawford, 1993.

☐ Fragmentation

Limited Fragmentation

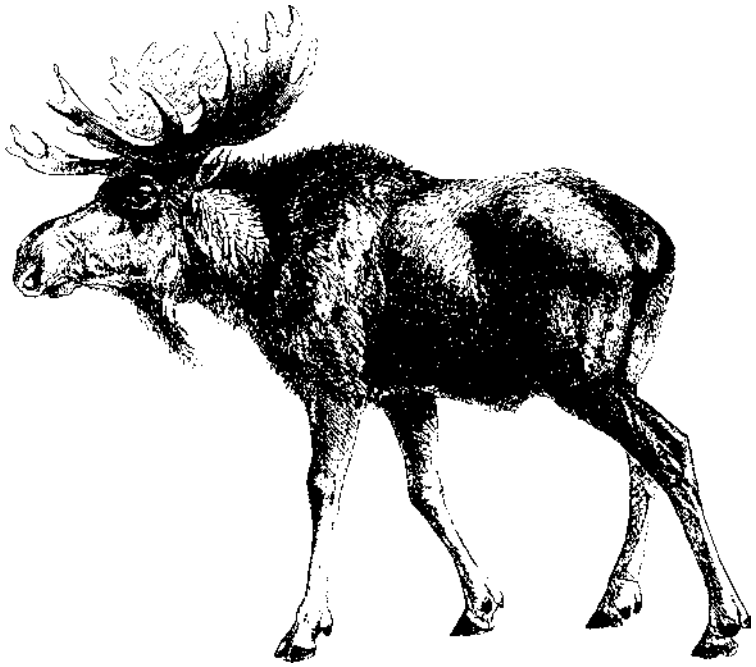
Scientists who are concerned about the loss of many species (over 550 animal species have become extinct in North America since the Pilgrims landed at Plymouth Rock) have found that certain plant and animal species need undisturbed habitat to survive. Suppose a particular species of hawk needs 100 acres of forest in which to establish a nesting territory. If someone builds a road through the forest, splitting it in half, the hawk will give up trying to nest and move somewhere else because the area has been fragmented. But will it be able to find another suitable territory?

Suppose your house were split up into 200 rooms, each the size of a telephone booth? You'd still have the same floor space as in a normal house, but split up into tiny pieces. It wouldn't bother your pet hamster, but what about you? Would you be able to live in it?

Some species actually do better in fragmented habitats. White-tailed deer, raccoons, and cowbirds all increase in numbers when they are provided with habitat that is split up into alternating patches of woods and open areas. These species are called opportunists – they can take advantage of habitat that has been disturbed. If you garden you know all about opportunists, except you probably call them "weeds". While fragmentation may cause an increase in these few species, there may be fifty species – habitat specialists – that are eliminated when a habitat is fragmented. What happens to overall species diversity then?

Fragmentation also affects genetic diversity. Suppose someone builds a shopping center on top of a prairie, leaving only two prairie fragments on the east and west edges with the shopping center and its parking lots in between. A moth-pollinated wildflower, blue lupine, is found in both fragments. But the small moths that pollinate the flowers can't survive the flight over the acres-wide, black-topped "desert" in between. So the east-fragment lupines interbreed with each other, and the west-fragment lupines interbreed with each other. With no genetic exchange between fragments, both populations become less diverse genetically and less able to survive.

Adapted with permission from Wild River State Park, Center City, Minnesota. Written by Park Naturalist Dave Crawford, 1993.



Fragmentation Resources

Reconstruction of Fragmented Ecosystems: Global and Regional Perspectives
Saunders, D. and Paul Ehrlich, editors. (1993).
(out of print)

Discusses the role of ecologists and conservation biologists in ecosystem reconstruction. 466 pages, color photographs, graphs and tables.

The Ecology of Greenways: Design and Function of Linear Conservation Areas
Smith, Daniel and Paul Hellmund. 1993.
University of MN Press
c/o Chicago Distribution Center
11030 Langley Avenue
Chicago, IL 60628
773-568-1550
fax: 800-621-8476
www.upress.umn.edu
ISBN: 0816621578
$39.95 + S&H

Reference book and practical guide. Includes discussions of landscape ecology, conservation biology, water resource management, ecological planning, and recreation design. 222 pages, line drawings, black and white photographs.

The Role of Corridors
Saunders, D. and R. Hobbs, editors. 1993
(out of print)

Brings together new data on the importance of corridors for biological management.

The Role of Remnants of Native Vegetation
Saunders, D. and G. Arnold. 1993
(out of print)

Integrated research on management of remnants of native vegetation.

☐ Native Plants

Native Verses Exotic Species

Consider these four reasons for choosing native species over ornamentals.

1. Native plants are **adapted** to the soil, rainfall, and sunlight conditions of your region, so they are apt to thrive once established. Native plants have a home court advantage.

2. Native plants form the **food base** that native wildlife species adapted to your area depend on. Their presence in your natural area supports the species that live there.

3. Because natives have evolved adaptations to local conditions they require less **maintenance** and resources.

4. Non-native plants often lack the **natural controls** that help keep their populations in check. As they proliferate, they choke out the native plant species.

The plants you want in your natural area are natives, or those that grow naturally in your region. Ornamentals, or exotics, are plants that are imported from another place.

Plants and animals brought to this continent from other parts of the world do not have the same "checks and balances" that our native species do. Non-native species are called alien or exotic species. Some exotic species, like purple loosestrife and Eurasian water milfoil, are spreading across North America choking out native species. These invading aliens reproduce rapidly, spread easily, and have no natural enemies on this continent to control them. When an entire marsh - home to dozens of plant species that are used for food and shelter by dozens of animal species - is replaced by a dense growth of purple loosestrife, which native animals can't eat or hide in, what happens to species diversity?

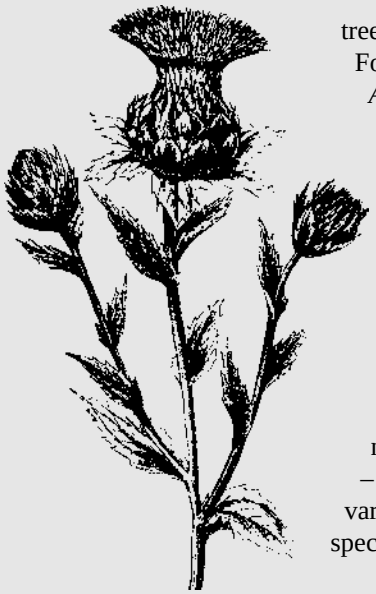
Our common house cat is another exotic species. We brought it to this continent because we like the company and because "working cats" on farms help control mice and other small mammals that damage crops. But what happens when one of these cats goes off on its own? A study done in Wisconsin estimated that free-roaming cats in that state kill 137 million birds every year, especially birds that nest on the ground. What effect does this have on species diversity?

Adapted with permission from Wild River State Park, Center City, Minnesota. Written by Park Naturalist Dave Crawford, 1993.

What's in a Name? The Problem With Cultivars

The next time you visit a plant nursery or a greenhouse look at the names of the plants. You will soon discover that plants often have more than one name. Many plants have both common names and scientific names.

For example, the native red maple's common name is "red maple" but its scientific name is *Acer rubrum. Acer* is Latin for maple and defines all of the plants in the world that have maple characteristics: similar fruit, flowers, roots, leaves, stem, etc.. *Rubrum* is its species name and describes a particular kind of maple with a defining characteristic that is distinct through generations — meaning a characteristic that a parent will always pass on to children and grandchildren and so on.



Sometimes a scientific name for a particular kind of tree will also have a cultivar name after its species name. For example there is a red maple tree that is known as *Acer rubrum* 'Northwoods.' This means that a particular tree was selected and propagated for its unique characteristics.

Cultivars are often made for special characteristics: fall color, flower structure, short stature, all kinds of reasons. But cultivars – because they are plants propagated from a single set of parents – do not have the opportunity to go through the natural process of random pollination. Therefore there is much less genetic diversity in a forest of cultivated 'Northwoods' red maples than would be found in a naturally occurring forest of red maples. Native plants – not cultivars – are important because without a wide variety of genetically different individuals, the ability of a species to survive changes in its environment is threatened.

Native Plant Resources

Minnesota Native Plant Society
220 Biological Science Center
1445 Gortner Ave
St. Paul, MN 55108
$12.00 membership
www.stolaf.edu/depts/biology/mnps

Membership in the Minnesota Native Plant Society provides a forum for the exchange of information about native plant species and native plant suppliers. Monthly speakers, the Plant Press newsletter, field trip opportunities included in the membership.

Vascular Plants of Minnesota: a Checklist and Atlas
Ownbey, Gerald B. and Morley, Thomas . (1993)
University of MN Press c/o
Chicago Distribution Center
11030 South Langley Avenue
Chicago, IL 60628
773-568-1550; (fax: 800-621-8476)
www.upress.umn.edu
$29.95 + S&H
ISBN: 0816623546

This resource is the definitive reference to the 2010 vascular plant species (ferns, conifers, and flowering plants) currently found in Minnesota. Maps show the geographic distribution of each plant. The Checklist section provides both an authoritative summary of the nomenclature of Minnesota plants and extensive references to taxonomic literature. As such it is the most complete list ever prepared for the entire state.

Northland Wildflowers: A Guide for the Minnesota Region
Moyle, John B. & Evelyn W. 1977
University of MN Press
Chicago Distribution Center
11030 South Langley Avenue
Chicago, IL 60628
773-568-1550; (fax: 800-621-8476)
www.upress.umn.edu
$18.95 paperback + S&H
ISBN: 0816613559

Primarily a field guide of 300+ flowering plants found in woodland, wetland, prairie, and disturbed communities in Minnesota. Plants are arranged by family. Common and Latin names are used. Stunning color photographs of each species make this a very useful reference.

Trees of Minnesota
MN DNR - Forestry
Minnesota's Bookstore
117 University Ave.
St. Paul, MN 55155
1-800-657-3757
$5.00 + S&H

Provides information on 50 tree species that grow in Minnesota including identification notes and drawings, range maps and forest product uses.

Wildflowers and Weeds: A Field Guide in Full Color
Booth, Courtenay
Simon and Schuster. 1978
(out of print)

Color photographs and information about native and non-native herbaceous plants found in Minnesota's woodlands, wetlands, and prairies. Plants are arranged by easy to use family groups. Key to the plant families and diagrams are useful.

Nature Study Pocket Guides
Nature Study Guild
Box 972
Berkeley, CA 94701
$2.00 each + S&H

Easy to use illustrated pocket keys to the features common in Minnesota's nature areas. Field guide topics include: Flower Finder, Tree Finder, Winter Tree Finder, Fern Finder, Track Finder, Berry Finder, and Winter Weed Finder.

The Ferns of Minnesota
Tryon, Rolla. 1980.
University of MN Press
Chicago Distribution Center
11030 South Langley Avenue
Chicago, IL 60628
773-568-1550; (fax: 800-621-8476)
www.upress.umn.edu
$12.95 + S&H
ISBN: 0816609357

This revised edition of the 1954 publication is a comprehensive guide for the identification of ferns in the state. 176 pages, 201 drawings, 13 color photographs.

Minnesota Native Plant Nurseries

SNAP does not necessarily endorse the products or services of these vendors

Nurseries are increasing their native plant offerings every year. Before ordering plants it is important to research the origin of the seed. Choose seeds or plants that originate as near as possible to where they will be planted. Seeds from Nebraska, for instance, don't carry with them the genetic information and variability necessary to survive in Minnesota's unique climate and soils. Also be certain that plants are not taken from the wild to be sold. Each nursery will have information on the installation and proper management of the plants that they sell. Be sure to follow their recommendations carefully to insure the success of your planting projects.

Country Wetlands Nursery and Consulting Ltd
Box 126
Muskego WI 53150
414-679-6866
Specializes in wetland consultation, design and management for gardens and restorations.

Feder's Prairie Seed Co.
12871 380th Avenue
Blue Earth MN 56013
507-526-3509
feder@bevcomm.net
Native Minnesota grass and wildflower seeds. Wayne Feder is a former HS Ecology teacher and is available to talk to school groups.

Kaste Inc.
RR #2, Box 153
Fertile MN 56540
218-945-6303
kastein@means.net
Native grass and wildflower seed

Landscape Alternatives, Inc.
1705 Alban St
Roseville, MN 55113-6554
651-488-3142
Offers 120 species of prairie, wetland, and woodland seedlings.

Mark E. Gullickson
RR #2, Box 150A
Fertile, MN 56540
218-945-6894
Native grass seed

Minnesota DNR Tree Sales
Forestry Box 95
Willow River, MN 55795
218-372-3183; (fax:218-372-3091)
The DNR state nurseries sell tree and shrub seedlings for projects throughout the state (minimum order of 500 trees).For availability, cost, order forms, and a List of the tree and shrub seedlings available call or write for updated information.

Mohn Seed Co.
3560 265th Avenue
Cottonwood MN 56229
507-423-6482
www.mohnseed.com
Specializes in native grass and wildflower seed and seedlings in woodland, wetland, and prairie mixes. Consultation and installation available. Some native shrubs and trees also available. Call for additional information.

Morning Sky Greenery
RR #1, Box 137
HancockMN 56244-9654
612-795-2436
Wildflower and grass seedlings

Oscar Carlson
Box 157
Lake Bronson MN 56734
218-754-4475
Wildflower and grass seed

Outback Nursery
15280 110th St. S.
Hastings MN 55033
612-438-2771; (fax: 612-438-3816)
Large selection of container grown native shrubs and trees. Informative catalog.

Ox Cart Seed Co.
RR #3, Box 226
Hawley MN 56549
Native grass seed

Prairie Hill Wildflowers
RR #1, Box 191-A
Ellendale MN 56026
507-451-7791
Wildflower and grass seeds. Consultation and installation available. Call or write for further information and price lists.

Prairie Moon Nursery
Route 3, Box 163
Winona MN 55987
507-452-1362
Seeds and plants of 216 native prairie, wetland, and woodland plants from the southeast Minnesota. Nursery also stocks native shrubs and vines. Catalog is a useful guide on how to establish and maintain your plantings.

Prairie Nursery
PO Box 306
Westfield WI 53964
608-296-3679
Seeds and plants for 75 prairie species. Informative full color catalog details species as well as consulting services: site evaluation, planting design, site preparation, planting, and post planting management for sites of all sizes.

Prairie Restorations, Inc.
PO Box 327
Princeton MN 55371
612-389-4342
Specializes in restoration and maintenance of prairies. Retail sales of seed and plants is done through mail order or at the nursery.

Schumacher's Berry Farm and Wholesale Nursery Grower
RR 2 Box 10
Heron Lake, MN 56137
507-793-2288; (fax: 507-793-0025)
Available to schools and retail nurseries only. Minimum order $150.00. Sells multiple varieties and sizes of Minnesota's native shrubs and trees. Call or write for wholesale price list.

Shooting Star Native Seed
Hwy 11 West & County Road 33
PO Box 648
Spring Grove MN 55974
507-498-3953
Wildflower and grass seed; general seeding contractor

Wildlife Habitat
5114 NE 46th St
Owatonna MN 55060
507-451-6771
Native grass seeds. Consultation and installation available. Specializes in "warm season" prairei grass. Orders only accepted for 5+acres. Call or write for price lists.

☐ Rare Species

Rare Species Management

Species become rare primarily through habitat loss or degradation, exploitation, and over-harvesting. All species, whether rare or common, contribute to the biological diversity of a region, but "endangered," "threatened," or "species of special concern" – legal designations – are in imminent danger of disappearing. Species that are extirpated from their normal range are said to be extirpated. Species that are eliminated entirely are said to be extinct. Both extirpation and extinction have negative consequences for species, genetic, and habitat diversity.

Rare species are typically found where land and vegetation have not been altered by plowing, grazing, heavy logging, or draining. You can play an important role in protecting rare species in Minnesota by knowing what species are endangered or threatened in your area, knowing why they are in danger, and helping to protect the places where they occur.

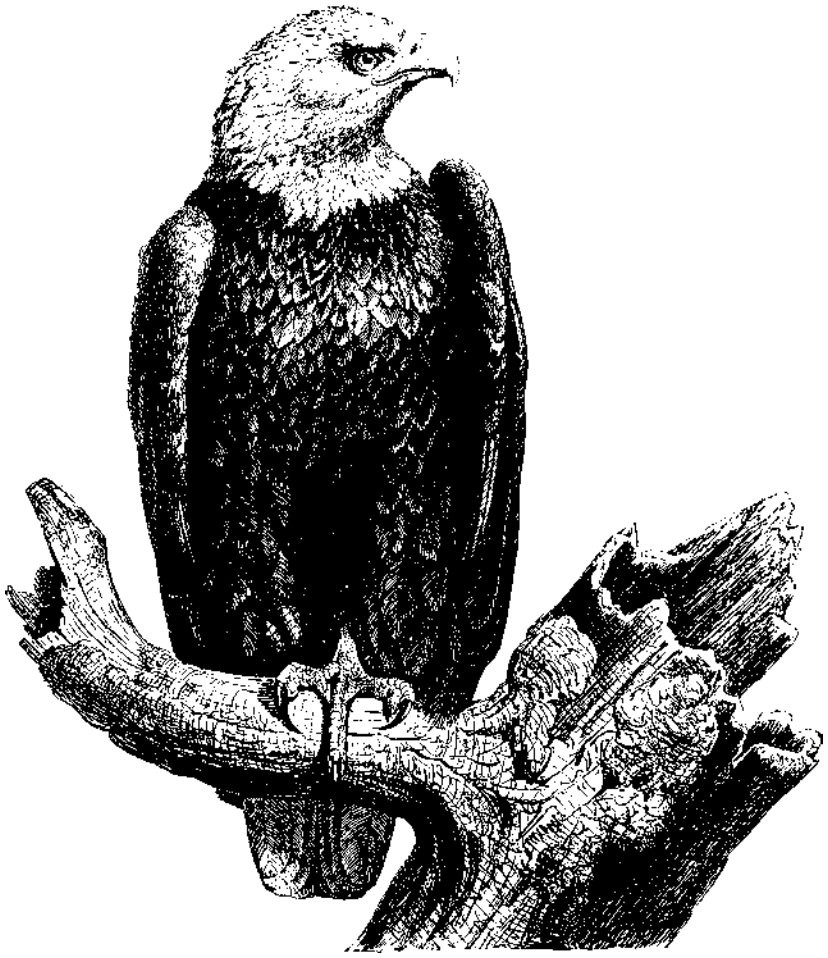
Rare Species Resources

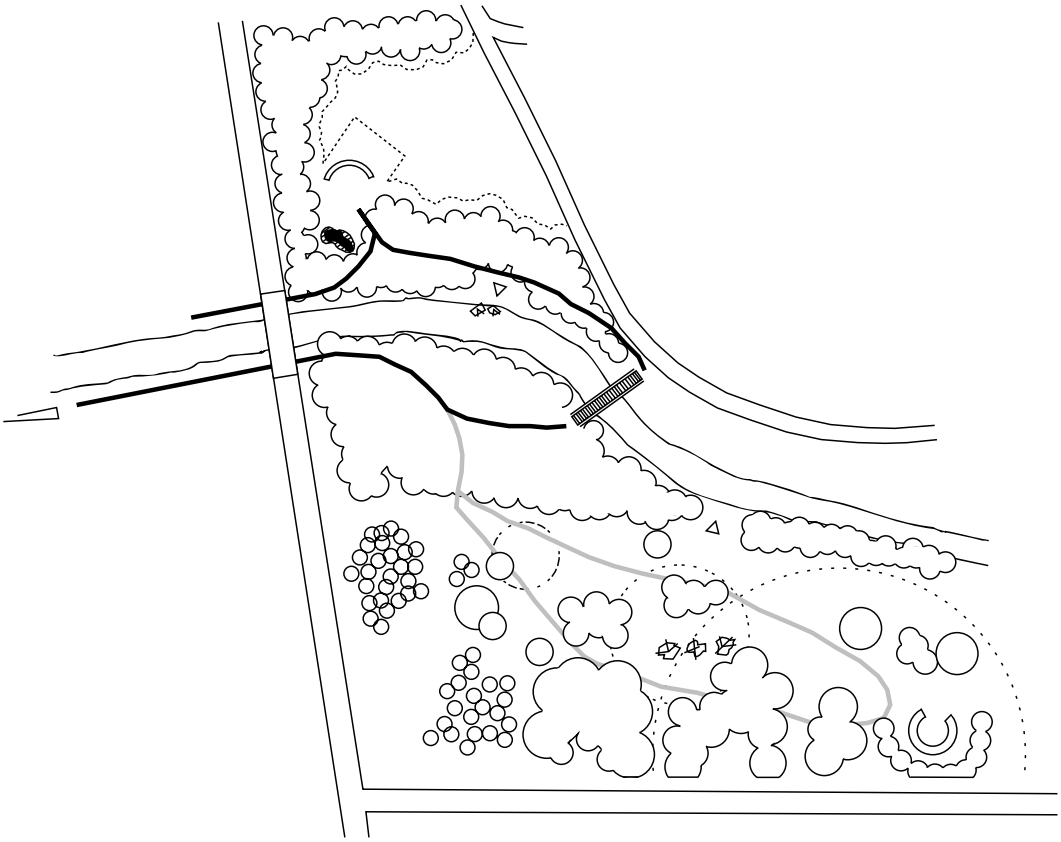
Minnesota Natural Heritage Information System
MN DNR Nongame Wildlife
500 Lafayette Rd.
St. Paul, MN 55155-4007
651-296-3344

The Minnesota Natural Heritage Information System provides information on Minnesota's rare plants, animals, natural communities, and geologic features. This information assists Minnesotans in managing the state's biological diversity. There is a fee for database searches.

Minnesota's Endangered Flora and Fauna
Coffin, Barbara and Pfannmuller, Lee, 1988
University of MN Press
Chicago Distribution Center
11030 South Langley Avenue
Chicago, IL 60628
773-568-1550; (fax: 800-621-8476)
www.upress.umn.edu
ISBN: 0816616892
$19.95 paperback + S&H

This comprehensive resource provides a list of over 300 plant and animal species that are threatened or endangered within the state. Species descriptions include identification information, common, Latin, and family names. The official protection status of the species as well as distribution maps for both the country and the state are given. 374 maps, 234 line drawings, 474 pages.





☐ Reasonable Access

Trails and other features to accommodate human use are often desired within school nature areas. While these features facilitate easy movement and access to interesting, beautiful, and instructional sites, they are not without their consequences. Trails and roads contribute to fragmentation, loss of diversity, and displacement of wildlife. They often provide an opportunity for non-native species to gain a foothold in your nature area.

Before building a trail, consider the impact the trail will have on your school nature area. Site it to have minimal impact and be aware of the changes that may be occurring in the area because of the trail.

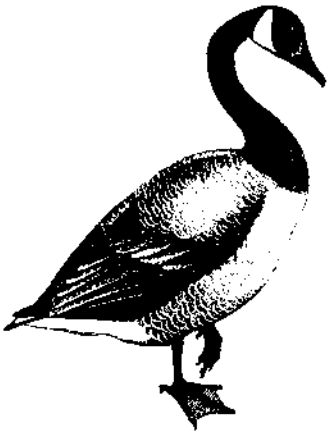
Trails and Access Resources

Recreational Trail Design and Construction
Rathke, David M. and Melvin Baughman, 1994.
MN Extension Service
Distribution Center
20 Coffey Hall
1420 Eckles Ave
St. Paul, MN 55108-6069
800-876-8636; 612-625-8173
(fax: 612-625-6281)
$3.00 + S&H

Guide to trail design and construction techniques. Graphic illustrations of common designs are useful. Order publication # BU-6371-S.

Signs, Trails and Wayside Exhibits: Connecting People to Places
Trapp, Suzanne, Michael Gross and Ron Zimmerman. 1992.
Available from: Acorn Naturalists
17300 E. 17th St. #J-236
Tustin CA 926780
800-422-8886; (fax: 800-452-2802)
www.acornnaturalists.com
$19.95 + S&H

This “how to” guide suggests ways to build signs and exhibits that effectively translate both the content and the spirit of a place to its visitors. Chapters on design basics, exhibits, the message, sign fabrication, trail construction and maintenance, and trail interpretation are included. Photographs and line drawings demonstrate creative solutions that will give your nature area high visibility. Order Publication #BIN-1102.



Wildlife

Wildlife Habitat

A crucial step in attracting and keeping wildlife in your natural area is understanding the needs of the wildlife that you want to attract. To survive, all animals need food, water, shelter and a certain amount and quality of space. The combination of these elements comprise a species' habitat.

Each species has its own habitat needs. Many migrating songbirds seek heavily vegetated areas in Minnesota for stopover, resting and feeding sites. The ovenbird needs the protection of the contiguous tree canopy of the trees and shrubs of the "Big Woods" for protection from the cowbird, its competitor. The cowbird prefers to live at the edge of the forest. Therefore the oven bird's survival depends on its ability to find mature forest cover away from the cowbird. By understanding the habitat elements present in your natural area, and the requirements of particular animals, you can best support the animals that are already present and perhaps attract new ones.

For many species of wildlife, plants are the fundamental source of food and cover and are, therefore, a critical feature in wildlife habitat. Because of the key role that native plants play, they are essential elements of habitat in your nature area.

Wildlife Requirements

Food Sources. Wildlife diversity is supported by diverse food sources. An animal's diet changes throughout the year as different foods become available and its needs change. Different plant sizes and ages, such as seedlings, saplings and mature trees, that create both an understory and a canopy, also contribute to diversity. For this reason it is important to include a variety of plants.

Cover. Most wildlife will not spend a lot of time where they are exposed and vulnerable to their predators. Including and arranging plants and other structures to provide cover, especially near food and water sources, is important in creating habitat in your nature area.

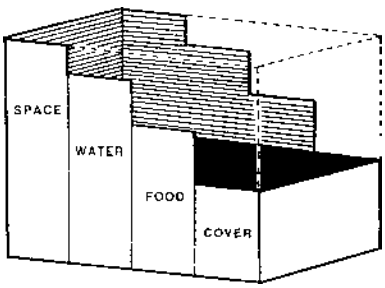
Water. Water is necessary for most wildlife to drink. In addition, some animals require bodies of water during certain phases of their life cycle. For example, frogs, toads, and salamanders need water for the development of their eggs and young.

Space. An animal's living space, or home range, is the area within which the needs for food, water, and cover can be met. The size of the living space depends on an animal's body size and eating habits. Consequently, certain wildlife need more space than others. A field mouse needs less space than a moose. In the context of your schoolyard, space will be limited to the number of acres you plan to enhance. Many species require large areas and may exceed the boundaries of your site.

There is a limit to how many animals can be sustained on an area of land over time. That limit is called the habitat's **carrying capacity**, and is determined by the quality and quantity of food, water, cover and space. An increase or decrease of one requirement can influence the limit. If the population of wildlife exceeds the carrying capacity, the excess animals will die or leave. Carrying capacity fluctuates in response to environmental influences. These may be naturally occurring, such as trees taking over a open field, or human-induced, such as building a housing development in the field. Carrying capacity varies from year to year and from season to season. Nature area projects that provide food, water, cover, and space influence carrying capacity.

The need that is in shortest supply, and therefore prevents the wildlife population from getting any larger, is called the **limiting factor**. For example, your site may include a wetland that offers food, water, and space for wood ducks, but without cavity trees for cover, wood ducks will not nest there. The limiting factor – in this case cover – determines the habitat's carrying capacity. Limiting factors are very important for wildlife management. If you want to increase a population, you have to determine what is holding it down. If it is lack of cover, providing more food won't help. You can influence habitat to compensate for limiting factors

Limiting Factor Graph



Wildlife Resources


Landscaping For Wildlife
Henderson, Carrol L., 1987
DNR Nongame Wildlife Program
Minnesota's Bookstore
117 University Avenue
St. Paul, MN 55155
(612) 297-3000
1-800-657-3757
$10.95 + S&H

Describes the benefits, the principles, and habitat components of landscaping for wildlife. Reference tables of plant species and their requirements are included. Feeder construction, animal space and habitat requirements. Lists sources of seeds, plants and garden catalogs.

The Mammals of Minnesota
Hazard, Evan B., 1982
University of MN Press
Chicago Distribution Center
11030 South Langley Avenue
Chicago, IL 60628
773-568-1550; (fax: 800-621-8476)
www.upress.umn.edu
ISBN: 0816609527
$16.95 paperback + S&H

A handbook of classification, identification, distribution and ecology of 81 species of mammals now or once found in Minnesota's woodlands, wetlands, and prairies. Each mammal is described in terms of size, color, and behavior. Anatomical drawings and distribution maps, along with a glossary, subspecies lists, and extensive bibliography make this resource especially valuable. 272 pages.

US Fish and Wildlife Service Resource Catalog
3815 East 80th St.
Bloomington, MN 55425
(612)854-5900

The catalog lists audiovisual materials offered by the USFWS. Materials are free, but you pay for return postage.

Basic Projects in Wildlife Watching
Fadala, Sam
Stackpole Books
Cameron and Kelker Streets
P.O. Box 1831
Harrisburg PA 17105
1-800-READ NOW
$16.95 + S&H

Procedures for projects that attract wildlife: watering holes, blinds, woodpiles, calling stations, scent posts etc.

Woodworking for Wildlife: Homes For Birds and Mammals
Henderson, Carrol L. 1987.
MN DNR Nongame Wildlife Program
Minnesota's Bookstore
117 University Avenue
St. Paul, MN. 55155
651-297-3000
800-657-3757
$9.95

Contains general bird house, nest boxes and platforms information for a variety of species, and woodworking plans.

Wild about Birds: The DNR Bird Feeding Guide
Carrol L. Henderson. 1995.
MN DNR Nongame Wildlife Program
Minnesota's Bookstore
117 University Avenue
St. Paul, MN. 55155
651-297-3000
800-657-3757
$19.95

Contains color photographs and descriptions of the habitat and feeding requirements for birds throughout Minnesota including Minnesota's permanent residents and migrants according to range. Discusses problem animals at feeders, feeder design, food types, and appendices of valuable bird and plant information.

Minnesota Zoo Discovery Programs & "Exploring Minnesota" instructional units
Minnesota Zoo
13000 Zoo Boulevard
Apple Valley, MN 55124-8199
612-431-9200; 800-366-7811
www.mnzoo.com

The Minnesota Zoo offers in-services for educators and adults to discover Minnesota's wildlife and their habitats. Topics have included wetlands, birds and bats, animal homes and families. "Exploring Minnesota" instructional units include learner outcomes, instructional activities, field trip ideas, vocabulary lists and bibliographies for K-3, 4-6, and 7-12. Topics include phenology, the interdependence of an ecological system, animal adaptations to seasonal change, vertebrate animals, and food chains.

Bell Museum of Natural History — Learning Kits
University of Minnesota
10 Church Street SE
Minneapolis MN 55455
(612) 626-2299
$25 per week + shipping
www.umn.edu/bellmuse/mnideals

The Bell Museum offers rental Learning Kits that contain touch and see samples of natural history objects, lesson plans, books, activity ideas, and a bibliography. Fourteen kits are available on topics such as amphibians and reptiles, habitats of Minnesota, and migration and flight. Bell Museum wildlife information phone line can answer wildlife questions. Please call during afternoon business hours at (612) 624-1374.

Homes For Wildlife: A Planning Guide for Habitat Enhancement on School Grounds
Marilyn Wyzga. 1995.
Developed by the New Hampshire Fish and Game Department.
Revised for Minnesota by the School Nature Area Project
1520 St. Olaf Avenue
Northfield, MN 55057
507-646-3599
$10

The guide provides a step by step procedure for assessing and mapping the schoolyard property, developing a plan for implementing enhancement projects geared to provide wildlife habitat.

American Wildlife and Plants: A Guide to Wildlife Food Habits
Martin, Alexander et al. (1985).
Dover Press. New York 1951.
available at amazon.com- $8.76

Lists the primary food sources month by month for many North American birds and Mammals.

Nongame Wildlife Program
DNR Nongame Wildlife Program
BOX 7 500 Lafayette Road
St. Paul MN 55155
651-296-4966

The DNR Nongame Wildlife Program is funded by taxpayers through a check-off on state tax forms. The program provides funds and expertise for projects that have helped preserve and protect the state's nongame species and their habitat requirements.

Roadsides for Wildlife Program (RWP)
MN DNR - Roadsides for Wildlife Program
261 Highway 15 S
New Ulm, MN 56073-8915
507-359-6018; (fax: 507-359-6018)
www.dnr.state.mn.us/fish_and_wildlife/roadsides

Provides technical advice, and in some cases materials and equipment, to county road officials, conservation groups, and landowners to improve the quality of roadsides and other grassland sites for the benefit of nesting wildlife.

Partner's for Wildlife Program - US Fish and Wildlife Service
Partners for Wildlife Coordinator
Federal Building-Fort Snelling
Twin Cities, MN 55111

If you need help solving a land-management problem, the US Fish and Wildlife Service can provide information on a variety of issues including: wetland restoration, nest structures or nesting islands, food and shelter for fish and wildlife, soil and water quality improvements, native plant restoration, water level management, and environmental education and outreach.

MN Waterfowl Association
5701 Normandale Road
Minneapolis, MN 55424
612-922-2832; (fax: 612-922-2983)

A nonprofit organization involved in the improvement and protection of waterfowl and its habitat. The Association's Habitat Development Program provides cost-sharing to landowners for restoration or creation of shallow wetlands and funds other wildlife habitat development projects. All project proposals are reviewed by the Association and by the DNR Wildlife Section.

Illustration by Maria Thompson

PART FOUR

A STEP BY STEP GUIDE FOR CREATING SCHOOL NATURE AREAS

In Parts One, Two, and Three of this booklet you located your nature area within a biome and have become familiar with the qualities of Minnesota's landscape regions. Utilizing that information it is possible to make plans for projects that will benefit your nature area.

Before You Begin

Obtain a Base Map

Before you begin to gather information about your site you need to have a place to record it. Obtain or make a scaled map of your site. The margins of this section list where base maps of your school nature area can be obtained. Use your base map to record information.

Identify The Stakeholders To Form a Site Team

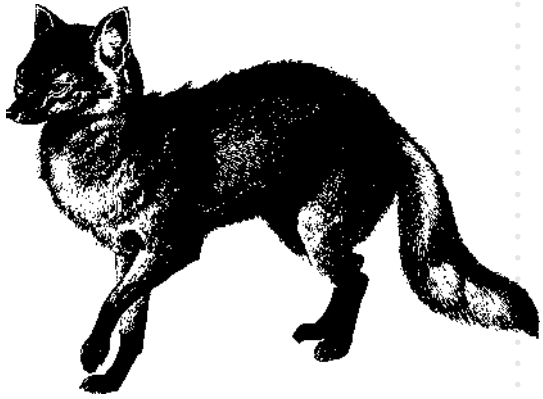
A stakeholder is an individual or group that is interested in the nature area use and development. The success of school nature area projects is dependent on the development of a common set of shared ideas and attitudes about environmental education, the value of school nature area sites, teacher education, curriculum, and community connections. This booklet is created to assist the site team in shaping a vision of the nature area site consistent with the environmental benefits of native landscapes.

Stakeholders in school nature areas may include: teachers, students, grounds staff, administrators, parents, community leaders, park and recreation department staff, government agency staff, business leaders, etc.

Once you have assembled the stakeholders and have a base map, there are six steps the group should consider when planning a nature area project.

The Six Step Process

1. Gather Site Information
2. Analyze Objectives
3. Plan Projects
4. Create a Site Plan
5. Implementation
6. Evaluation



Minnesota Maps: Where to Get Them

School files
Many times when real estate is bought or sold, built or remodeled, maps are created to document the site, its size, or a buildings' relationship to its boundaries. Refer to school files for a map that documents your site.

Minnesota Catalog of **Topographical and Other Published Maps**

US Geological Survey (USGS)
USGS Information Services
Map Distribution
Box 25286
Mailstop 306
Denver CO 80225
303-202-4700
fax: 303-202-4693
www.usgs.gov

"Minnesota Catalog of Topographic and other Published Maps" contains detailed ordering information for topographic maps, county maps, township maps and maps of particular regions in Minnesota. Catalog also indicates stores and map libraries where Minnesota maps are available. Costs of the maps will vary. Ordering directly from the USGS is the least expensive.

Aerial Photographs
Minnesota DNR - Resource Assessment Office
2002 Airport Road
Grand Rapids, MN 55744
218-327-4449

Minnesota DNR has aerial photographs for sites in many Minnesota counties. Un-enlarged scale is 4" = 1 mile. Enlargements are available. Call or write for updated list of available counties and detailed ordering information and costs.

continued on next page

Platt Maps
Your County's Recorders Office

Platt Maps illustrate the legal boundaries of your property, and neighboring properties.

County Soils Survey Maps
Your county Soil and Water Conservation District (SWCD)

For more information contact: Minnesota Association of Soil and Water Conservation Districts
790 Cleveland Ave. S.
Suite 216
St. Paul, MN 55116
651-690-9028
fax: 651-690-9065

SWCD offices have records of soil types found in your area. Maps can be provided detailing the soil types, their characteristics, uses, and land use capacity. Useful for determining soil erodibility, water holding capacity, etc. Keep in mind that descriptions are often focused on agricultural uses. Also, if you have slopes or erodible bare ground your local SWCD office will provide recommendations on how to stabilize them with native vegetation to hold and protect the soil.

Step 1:

Gather Information About Your Site

The tools you will need to plan the best projects for your nature area begin with your own knowledge and observations. Students are great at gathering this information and make strong contributions to planning a nature area. Always use their efforts. Utilizing information and resources found in Parts One, Two, and Three of this booklet, record the following information on individual base maps for later use.

Site Information Gathering Tasks

1. Property Lines and Neighbors.
Draw on your map shared property lines and the names of your neighbors.

2. Service Utilities.
Draw on your map utilities (overhead and buried) that service your area. Contact your local utility companies for guidance in locating underground utilities, or call Gopher State One Call at 1-800-252-1166.

3. Structures.
Draw on your map all built structures (buildings, roads, lots) and their access points. Label their function.

4. Needed Open Space.
Label all areas of the school campus that are used for sports, play, playgrounds, outdoor storage and snow piling. Label them.

5. Site Size.
Use a measuring tool to determine the area of your school campus. Convert the area into acres (43, 560 sq. ft. / acre). Create a scale for the base map.

6. Micro-climate.
Draw on your map the sunniest and warmest parts of your site, draw on your map the shadiest and coolest.

7. Topography and Drainage.
Draw on your map the general lay of the land. If your site has slope, draw arrows on your map in the directions of slope. Draw any stream, pond, lake, irrigation canal, spring, even the location of any down-spouts from your roof on your map. Using topographic maps, trace the path of a drop of water from the time it hits the ground until it reaches a wetland, stream, river, lake, or maybe even an ocean. Answer the question, where does your water go?

8. Soils.
Observe your site's soils. Dig a hole in a few different areas on your campus that appear to be distinct from each other. Dig one on a high place, another in a low place. Dig one in a woodland, another where only plants without woody stems grow. Observe each hole and the soils they contain. Are the grains rough and gritty, and large textured? This would indicate a sandy soil. Are they fairly small and shiny and do they stick together when you squeeze them? This would indicate that the soil is a clay soil. Are the soils at different places different colors or do they smell differently? Make a chart for each of the holes that you dig noting its moisture, soil texture, smells, and anything else you think makes that hole's soil unique. Note the soil hole locations on your map, then contact your local county Soil and Water Conservation District and obtain a soils map for your site. Using the soil information, compare it to your field observations.

9. Fragmentation.
Identify existing stands of vegetation that could be connected with new planting projects. Use aerial photographs and your observations of surrounding land to decide if planting projects on your site could benefit a nearby natural area.

10. Vegetation Cover Type Units.
Look for areas that have similar characteristics: similar trees, shrubs, and herbaceous plants (examples: include conifer tree area, old field, cattail marsh). Make up symbols for them and draw each area on the map. For each cover type you identify, look for the three most common plants and write down the plant species if you know it or make up a name that describes it. Make drawings or take photographs to document the cover type and its common plants.

11. Homes and Habitats.
Make a list of the animals you would expect to find in your natural area. Ask each student to draw a picture of where he or she lives. Ask them to include where they shop for food, sleep, play, work. Discuss what they drew and have students point out the things they need to live. Make a gallery of homes. Point out that everyone has a home and that home is more than a building. Decide the four most important things that all animals need (food, water, shelter, space). Look for those things on your school site and indicate on a map where they were found. "Animal" can include anything from an insect to a mammal. Use wildlife habitat references to make an area animal chart. List: what each animal eats, how much space it needs, how it drinks, where it may live, and if they are year-round or seasonal residents of your nature area. Then decide if that animal has everything that it needs to live in the nature area.

12. Diversity.
Locate the places in your nature area that have the most diversity, or abundance of differing species. Observe the diversity of a lawn, parking lot, edge of a forest, grassland, and a forest. Lay a hoop on the ground at the different places where you want to check diversity. Tally how many different plant species are within the hoop. You don't need to identify their names. Draw an example of each of the species you find. Make a map of the most diverse places in your nature area. The places where natural habitats meet, the edges, may have the most diversity. The least diversity will be found in landscapes that are simple and uniform — the parking lot and lawn.

13. The Life of the Site.
Locate and describe ten human-made and ten nature-made features that are presently or were historically on or near your site (e.g. the last time fire burned in your area, or previous residents). Interview, research, and document when features were added or taken away. Make a timeline of events in the life of the nature area.

14. Routes, Paths and Gathering Places.
Locate the places where people and animals have created paths or places to gather. Mark their locations on your map and label whether they are human-made or animal-made. Measure how long the paths are and draw them on your site map.

15. Endangered Plants and Animals. Use resources in Parts I, II, and III of this booklet to answer the question, "What plants and animals are missing or threatened in the nature area?" Make a chart that lists what the organism is, how it is recognized, why it might be missing, and what it would need to exist in the nature area.

For Your Information

Acorn Naturalists
Catalog of Resources for the Field and Classroom
17300 E. 17th St. #J-236
Tustin CA 92780
800-422-8886
fax: 800-452-2802
www.acornnaturalists.com

and

Common Ground Distributors
P.O. Box 25249
Asheville NC 28813
828-684-5779
www.comground.com

Both catalogs listed above are brimming with books and audiovisual resources that will help you find information about your site. Materials that can be ordered include: environmental education resources, science curriculum materials, observation and field equipment, animal tracking and calling supplies, natural history field guides, plant references, animal references, earth science topics, animal puppets, nature games, posters, and audiovisual material.

Adapted from:
Observation Cards
New Jersey School of Conservation, Montclair State College, Branchville, New Jersey.

Bioregional Quiz
Elmwood Institute for Ecoliteracy. 2522 San Pablo Ave., Berkeley CA 94702.

Step 2:

Analyze Information – How Can The Site Be A Better Nature Area?

Analyze the information you have collected and set your objectives by answering the following questions.

1. How can biodiversity in the nature area be increased?

2. How can fragmentation of habitat within our nature area be eliminated or reduced?

3. How can rare or threatened species that may be a part of or near to our nature area be protected?

4. How can wildlife habitat be protected or enhanced within the nature area?

5. How can native plants be used to benefit the nature area?

6. What areas of the school nature area are needed for trails and gathering places? How can these have the least impact on habitat?

7. How can your community be involved in the planning effort?

8. What areas on campus are not currently used? Can these be considered nature area land?

9. What existing features can become the starting point for nature area projects?

   Some examples might include:
   – An existing stand of native vegetation
   – large old shade trees
   – scattered trees and shrubs that could be connected into one large planting
   – presence of water and sufficient cover
   – presence of particular wildlife species
   – areas of diversity to be protected

Step 3:

Plan Projects – Discuss Concepts And Options

Once you have a good idea of what exists on your site and what your nature area objectives are, conceptualizing action projects may be the next step in the development of the area. It is important to consider and document all project ideas before you discard any of them. Brainstorm a list of options. Decide on the top three on which the site team can focus their initial efforts.

Project Concepts

Aquatic Environments

- Limit use of fertilizers, pesticides, and herbicides and apply them only to trouble spots.
- Do frequent water quality testing to monitor changes in water quality.
- Establish buffer zones of native vegetation around wetlands and watersheds.
- Identify the places that animals use for water and protect them.
- Adopt erosion control measures, especially on construction sites.
- Build earthen dikes to impound water.
- Plug drainage ditches and tiles to restore drained wetlands.

Forest Environments

- Do population counts of forest species and monitor how they change over time.
- Plant native tree species.
- Participate in the MN DNR Big Tree Registry and create a big tree registry for your community.
- Create a community brochure that describes the forests around your community.
- Work towards the reintroduction of a forest-dwelling species that is no longer a part of your site.

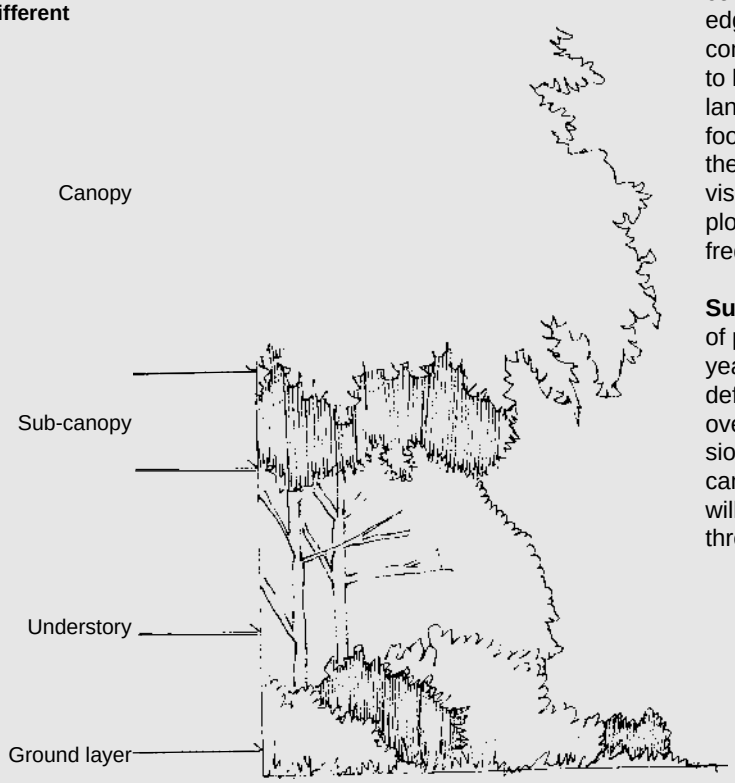
Prairie Projects

- Do population counts of prairie plant species.
- Diversify your prairie planting.
- Use drifts of native prairie grasses and forbs to enhance a walkway area.
- Burn or mow your prairie for greater diversity.
- Create an “electronic field guide” of prairie flowers, bloom times, and where they are observed.

Planting Projects

A good way to enhance a nature area is to increase the amount and diversity of vegetation on your site. Planting vegetation is a long-term investment that provides more for your area each year.

The layers of a forest edge. Does your planting project include different zones?



Things to consider in your plantings.

Layers. Include as many plants as possible and make habitat areas as large as possible. Different animal species require different plants but also different layers of vegetation. Provide a multitude of choices, for example: a diverse ground layer, varying shrub heights and canopy.

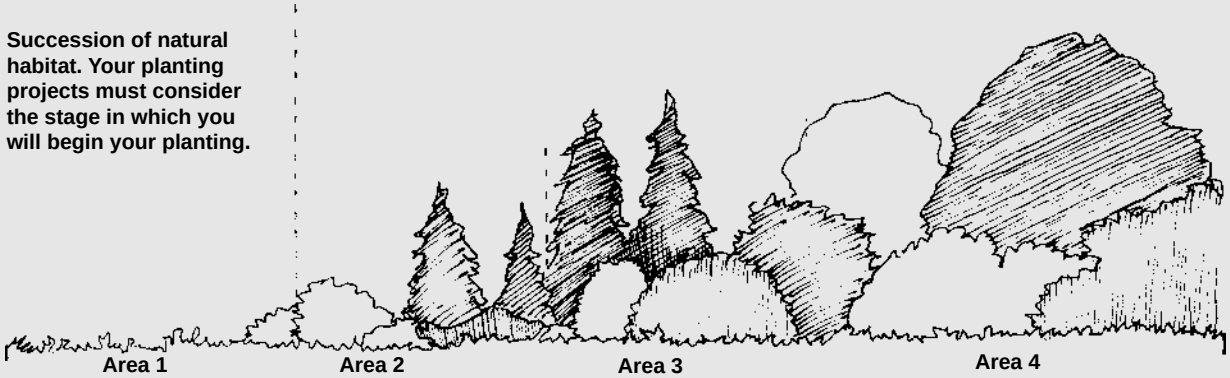
Arrangement. Clusters of trees (clumps) and dense bushes (thickets) provide maximum cover and an important edge for wildlife. The edge is the area where two types of plant communities meet. Rabbits, for example, like to hang out where brushland and meadowland meet because of the good selection of food and shelter found at that edge. Grouping the same plant species together provides visual order and can become an experimental plot for observing the wildlife species that frequent the planting.

Succession. Plant succession is the change of plant species in an area over a period of years. Every acre of soil and water has a definite sequence in plant cover that occurs over time. These changes, called "successional stages," occur in a cyclical pattern. We can usually predict the type of vegetation that will occur in each stage as an area proceeds through the cycle.

1. Bare ground
2. Annual forbs and/or grasses
3. Perennial forbs and grasses
4. Shrubs
5. Young woodland or trees
6. Mature woodland or trees

A single step in succession may take weeks, months, years, or even centuries, depending on natural and human-caused factors. If the land is disturbed at any time during this plant succession trend, succession begins again, and, depending on the disturbance, may even take a different direction.

Succession of natural habitat. Your planting projects must consider the stage in which you will begin your planting.



Area 1
Annual forbs
1 – 5 years

Area 2
Perennial grass, shrubs and young trees
3 – 20 years

Area 3
Older forest, young tree species underneath. Herbaceous ground cover
75 – 150 years

Area 4
Self replacing forest with distinct horizontal layers: Canopy, understory, ground cover
200+ years

Action Plan Project, School Nature Area

School Name_____

Project_____ **Date** _____

Coordinator_____ **Phone**_____

1. Project Description (additional details included on attached sheets)

2. Project Benefits (educational and/or environmental)

3. Project Timeline (approximate start date, finish date, dates for major steps

4. People Involved (community members, students, staff)

5. Resource People and Suppliers

6. Project Materials and Budget

7. Maintenance Plan (indicate who is responsible)

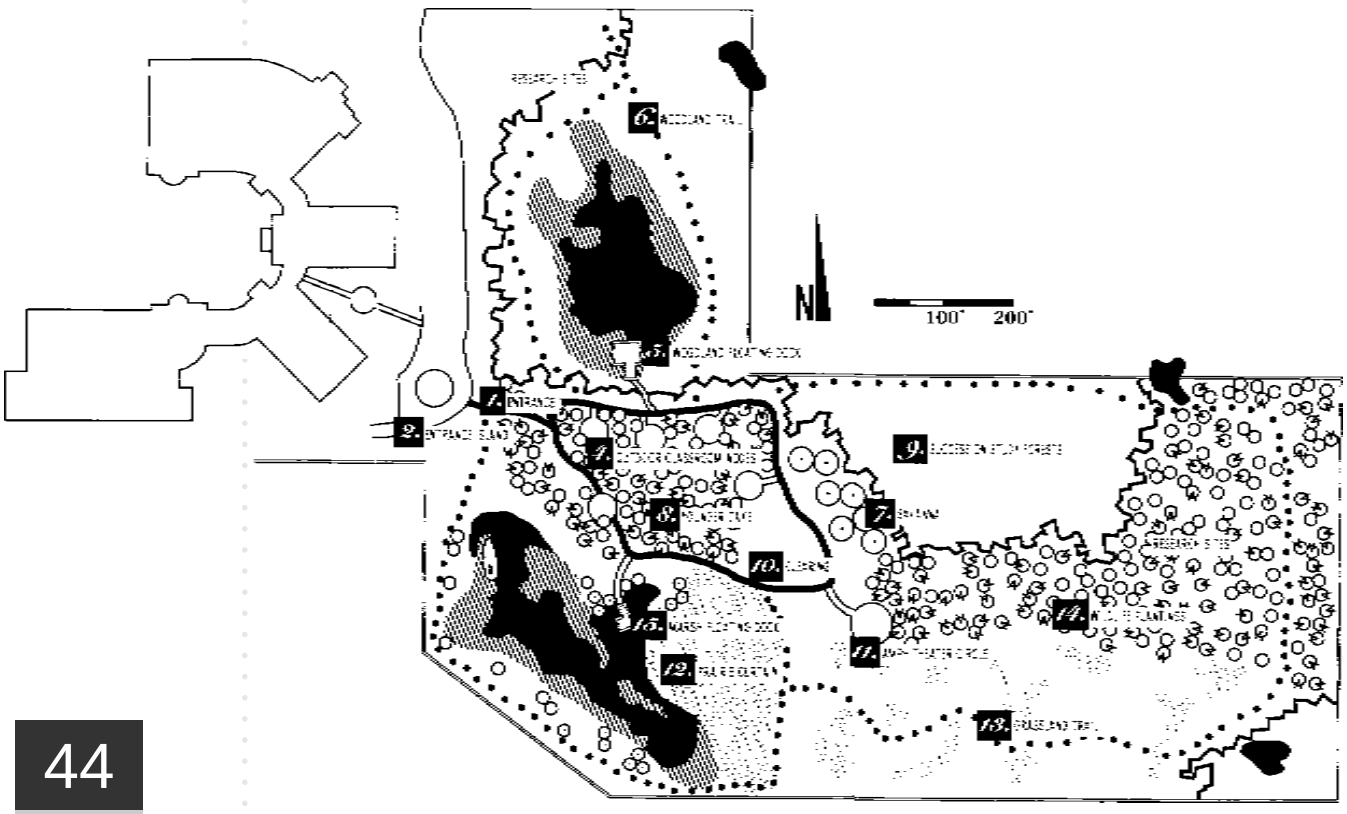
8. How Will You Evaluate Your Project Success or Failure?

Step 4:

Create An Action Plan – The Game Plan

Once you have a sense of the projects you wish to accomplish, an action plan is the next step. It addresses the details of each project: who will do the work, where will it occur, how much will it cost, who will pay for it, etc.. The following information is usually included in an action plan.

An action plan typically will include a drawing or concept plan illustrating where in the nature area the projects will occur. This example from the Stillwater Environmental Learning Center describes conceptualized projects and where they will be located.



Step 5:

Implementation – Doing The Work

Because school nature area projects are variable and truly unique, there are many ways in which they are accomplished. The most successful ones involve kids and community members, the project goals were clearly defined, all stakeholders had a common vision of the outcome, and projects were broken into manageable tasks.

Step 6:

Evaluation – How Will You Know If You Succeed Or Fail?

In planning your projects, devise a way to evaluate your successes and failures. The important thing to do is to define the project's goals, create a mechanism (before the project is underway) that will tell if the project succeeded or failed to meet its goals, and be able to suggest why. Some evaluation examples include: ongoing control plots for vegetation projects, water chemistry evaluation for water projects, ongoing wildlife observation, community surveys, etc.. Evaluation is an often-overlooked aspect of most projects, but including it in your planning will have rewards long after your first project is complete.

Students building bird houses.

Students monitoring bluebird houses.

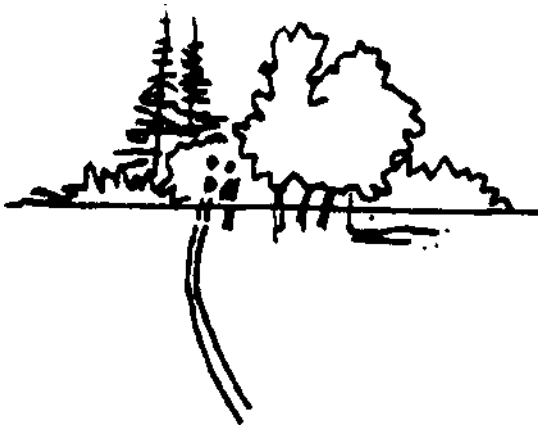
CONCLUSION

A Final Thought . . .

The woodlands, wetlands, and prairies that are a part of your place have a colorful past and a promising future. By paying attention to the conditions that created them, and the conditions that altered them, you will discover your own place's connection to larger natural communities.

Set a goal to develop or enhance your nature area to reflect its biome and plant and animal communities. Nature area projects provide habitat and homes for an amazing diversity of living things — people, green plants and brilliant flowers, browsing animals and darting birds, insects and spiders and tiny bacteria. Working with nature, you can benefit the biomes.

What will you do next?



The School Nature Area Project (SNAP)
St. Olaf College
1520 St. Olaf Avenue
Northfield, Minnesota 55057
(507) 646-3599

http://www.stolaf.edu/other/snap