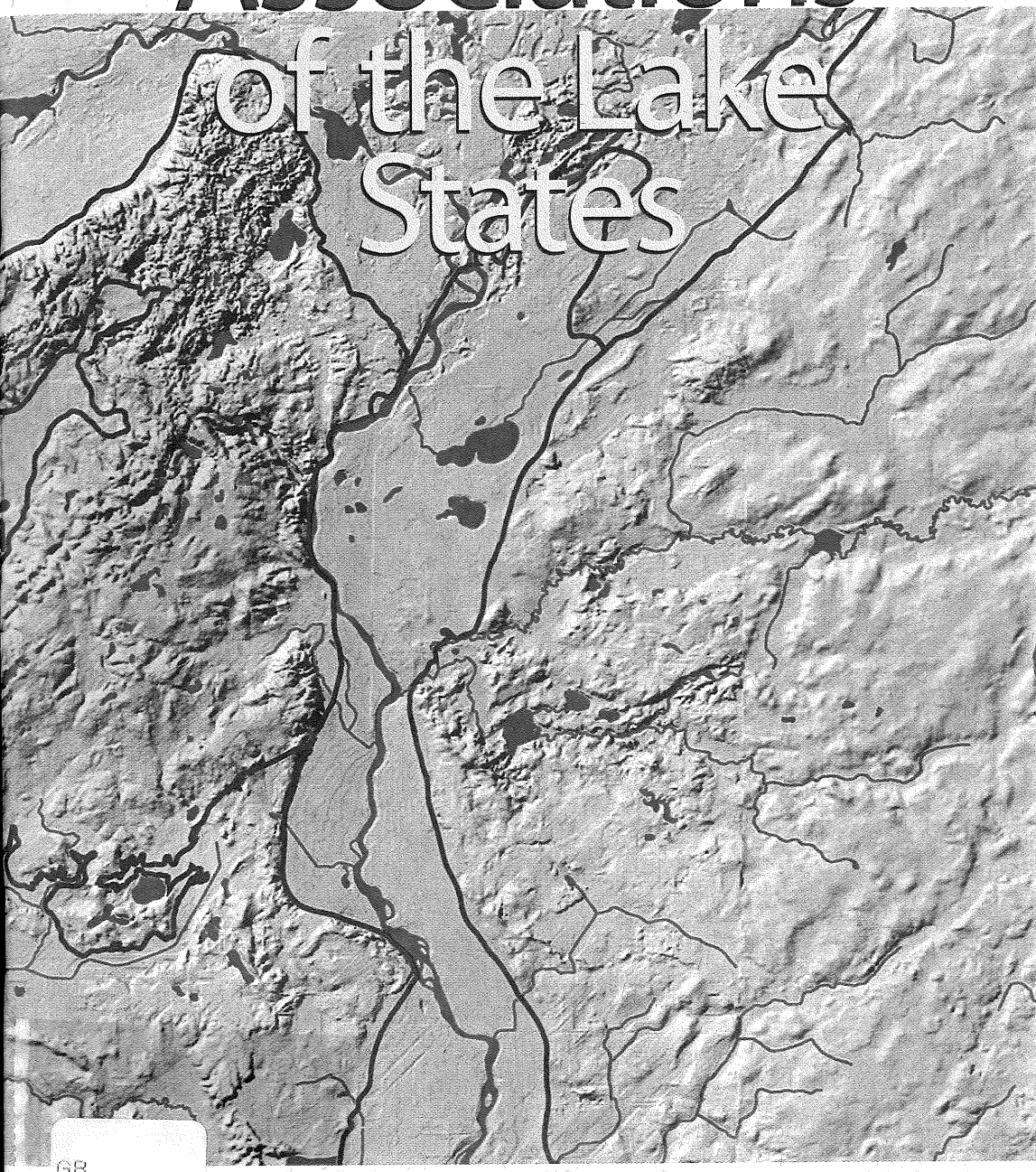
Landtype Associations of the Lake States



Great Lakes Ecological Assessment

Michigan Natural Features Inventory

Publication was created for the Lake States LTA Coordinating Committee

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Landscapes and Landtype Associations (LTAs)

Landscapes are broadly defined as portions of land, including all of the objects they contain, that the eye can comprehend in a single view. Landtype Associations (LTAs) are landscapes thousands to hundreds of thousands of acres in size that are defined using multiple biological and physical features. LTAs are part of a national system that allows scientists to formally define the broad concept of landscapes. This provides land managers with a tool to accurately communicate ideas, observations, and concerns about the use of natural resources.

See pages 6 and 7

LTAs Are Part of a National System

LTAs are part of the national framework of ecological map units initially developed by the U.S. Forest Service. These map units comprise eight different scales that allow resource managers to consider ecological patterns at any scale. The framework is hierarchical and perfectly nested, meaning that the smaller map units are created by subdividing the next larger units. Michigan, Minnesota, Wisconsin, and many other state agencies in the U.S. have adopted this national system.

See pages 8 and 9

Making LTA Maps

LTAs are made using a combination of many single-theme maps such as glacial landforms and topography. LTA concepts emphasize the interrelationships of biological and physical features. Interrelationships are discovered by overlaying many single-theme maps and observing where patterns coincide. The feature with the sharpest transition between adjacent LTAs is selected for delineation.

See pages 10 and 11

LTA Map for Michigan, Minnesota, and Wisconsin

See pages 12 and 13

LTAs and Resource Management

LTAs provide a practical tool for landscape-scale assessments and planning. LTAs are increasingly being recognized as the scale where broad management directions or goals can be applied for field operations. This is because people on the ground can often see and relate to the differences among LTA units. In addition, LTAs explain much of the variation in the distribution and abundance of many traditional resources.

See pages 14 and 15

Management Applications

- LTAs and Rare Species—*Red-shouldered hawk* habitat in Michigan and Minnesota.
- LTAs as a Silvicultural Tool—*White pine* priority landscapes for restoration and blister rust considerations in Minnesota.
- LTAs as a Planning Tool—*Community and old-growth restoration* in the Northern Highland-American Legion State Forest in Wisconsin.

See pages 16–21

For More Information

- Personal contacts in Michigan, Minnesota, and Wisconsin.
- Web sites with information on National Hierarchical Framework of Ecological Units.

See page 22

Organizations that Participated in LTA Mapping

See page 23

Landscapes and Landtype Associations (LTAs)

The word *landscapes* has many meanings. Webster's dictionary defines landscapes as portions of land, including all of the objects they contain, which the eye can comprehend in a single view. *Landscapes* often refer to large areas of land such as those viewed from an airplane or satellite. In the sphere of land management and scientific research, the concept of landscapes must be clearly defined so we can accurately communicate our ideas, observations, and concerns about our use of natural resources. The definition should include the criteria and scale used to identify landscapes.

Landtype Associations are landscapes thousands to hundreds of thousands of acres in size. They are defined using important biological and physical features. The effort to map Landtype Associations in the Lake States was an outgrowth of the need to understand and communicate about landscapes. An interdisciplinary group of scientists from many different agencies developed the LTA approach to precisely describe landscapes.

LTAs more narrowly define landscapes because:

- The biological and physical features most important to resource management are used to define landscapes *documenting the factors used and data sources.*

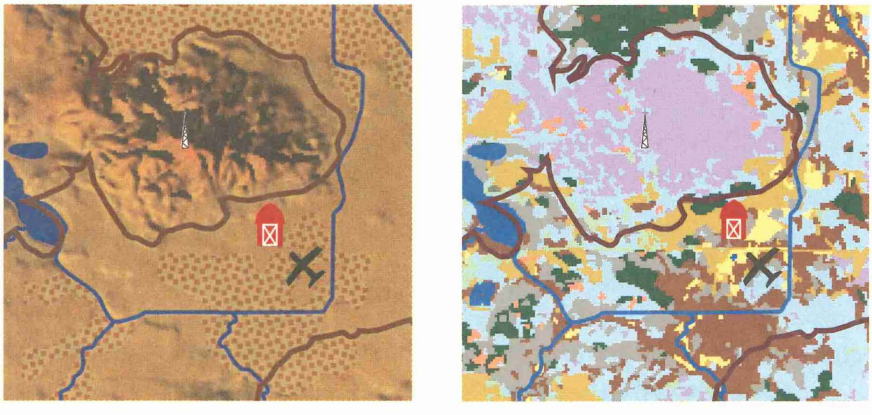
- The interrelationship of the defining features is emphasized *resulting in maps that enhance interdisciplinary communication.*

- Maps spatially define landscape boundaries *providing a basis for landscape-scale planning and evaluating the cumulative effects of management decisions.*

Thus, LTAs represent a formal way of defining the broad, fuzzy concept of landscapes. The LTA approach is a scientific platform that can be built and rebuilt through peer review and hypothesis testing as we continue to learn more about how natural resources function at a landscape scale.

DNR Photo

A low oblique aerial photograph of a "landscape" as defined in Webster's dictionary. A natural resource manager may see several different landscapes in this photograph based on differences in features observed such as cover types and topography.



Two maps with LTAs (dark brown lines) of the general area in the photograph above. To the left is a shaded relief map. To the right is cover types (violet = northern hardwoods, light blue = aspen/birch, tan = hay fields, brown = lowland shrubs, green = lowland conifers, and gray = lowland ash). LTAs are landscapes thousands to hundreds of thousands of acres in size with unique patterns of biological and physical features. Because of this, people working in the field commonly see and relate to the differences among LTA units. Orientation to the photograph is shown by the icons: plane, farm buildings, and tower.

LTAs Are Part of a National System

LTAs are designed to represent landscapes in a national framework of ecological map units. The framework comprises eight different scales of mapping: Domain, Division, Province, Section, Subsection, LTA, Landtype, and Landtype Phase. This enables resource managers to consider ecological patterns for areas as large as North America or as small as a single timber stand. Each mapping scale identifies areas with similar management opportunities and constraints relative to that scale.

The framework is hierarchical and nested, meaning that the smaller map units are created by subdividing the next larger units. For example, LTAs were constructed by subdividing each Subsection. Each Subsection has its own unique set of LTAs and LTA boundaries do not cross Subsection boundaries.

This national framework was initially developed by the U.S. Forest Service beginning in the late 1970s. Since that time other management agencies have contributed greatly to refining the conceptual framework and extending the mapping beyond the national forests. In 1995, after nearly 20 years of collaboration, the initial mapping of Domains, Divisions, Provinces, Sections, and Subsections was completed for the eastern United States and published as the National Hierarchical Framework of Ecological Units (NHFEU). Revisions to the mapping occur periodically.

Many state natural-resource management agencies in the United States have adopted the NHFEU, including those in Michigan, Minnesota, and Wisconsin. Since 1995, Lake States' managers and scientists from federal, state, and county agencies; tribal organizations; timber industries; environmental groups; and universities have worked to complete LTA mapping with two goals in mind:

- to consistently construct LTAs by using similar sets of defining criteria, and
- to match LTA boundaries across different ownerships and state boundaries.

The first version of LTA mapping has been completed in Minnesota, Wisconsin, the upper peninsula of Michigan, and the northern half of lower Michigan (pages 12 and 13).

	Ecological Unit & Mapping Status	Key Biological & Physical Features	Extent of Map-Units
USA	**Domain** first version completed 1994	• global climate regimes • annual precipitation • evapotranspiration	1,000,000s of square miles
	Division first version completed 1994	• vegetation biomes • water deficits • winter temperatures	100,000s of square miles
	Province first version completed 1994	• climate subzones • historic vegetation • soil order	10,000s of square miles
	Section first version completed 1994	• glacial origin • historic vegetation • topography	1,000s of square miles
	Subsection first version (eastern US) completed 1995	• lithology • historic vegetation • topography	10s to 1,000s of square miles
Lake States	**Landtype Association** in progress	• glacial geology • surface water features • topographic roughness • soils • historic vegetation • potential vegetation	1,000s to 100,000s of acres
	Landtype in progress on national forests	• topographic roughness • plant communities • soil types	100s to 1,000s of acres
	Landtype Phase in progress on national forests	• indicator plants • soil types • topography	<100 acres

The Landtype Association level (highlighted) is one of eight scales of mapping in the National Hierarchical Framework of Ecological Units. Concepts and maps of ecological units are developed by observing the interrelationships among key biological and physical features. LTAs utilize features that show patterns at a landscape-scale. Initial LTA mapping in Minnesota, Wisconsin, and the upper peninsula and the northern half of lower Michigan is shown on pages 12 and 13.

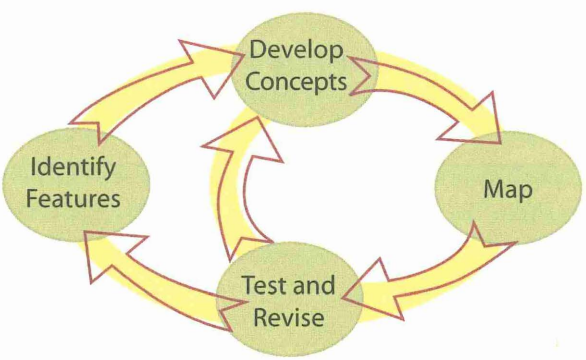
Making LTA Maps

LTAs are made using a combination of many single-theme maps. Hundreds of single-theme maps that show the distribution and abundance of biological and physical features could be considered as important landscape components. In the Lake States' glacial geology, bedrock geology, lakes, streams, peatlands, presettlement vegetation, historic disturbance regimes, potential natural vegetation, regional climate, soil characteristics, and topographic roughness are the single-theme maps commonly assembled to develop LTA concepts and ultimately to map LTAs.

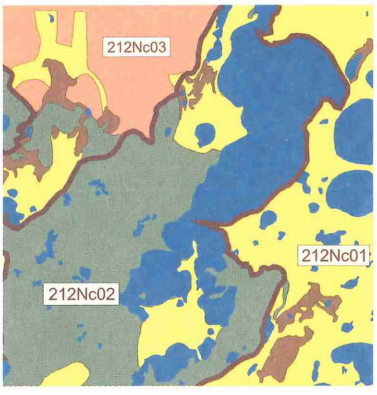
LTA concepts emphasize the interrelationships of biological and physical features that are discovered by overlaying single-theme maps and observing how patterns coincide. For example, a common LTA concept in the Lake States is the coincident pattern of the jack pine cover type, flat outwash plains, dry sandy soils, a deep water table, and a history of crown fires. Landform maps integrate many of these individual features that show coincident pattern, and are often a starting point for LTA mapping in the Lake States.

Because LTAs are defined using multiple features, the feature(s) with the sharpest transition between adjacent LTAs are selected as the basis for delineation. Thus, as one traces the periphery of a given LTA, the feature used to draw the boundary may change where it abuts different LTAs.

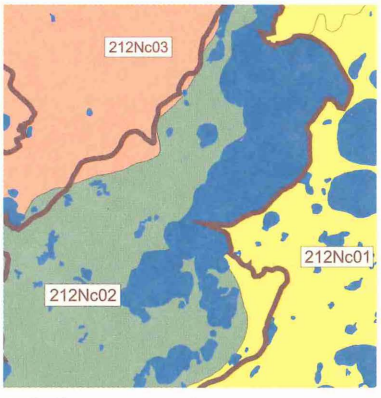
The current LTA maps should be considered as the *first version* that will be periodically updated, like computer software. Improvements in mapping technology, availability of new single-theme maps, feedback from field people, and changes in our understanding of the interrelationships of biological and physical features will ultimately lead to revisions of LTA concepts and map units.



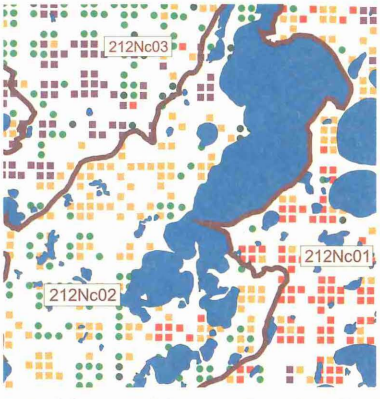
1. Topography and Water



2. Landforms



3. Soils



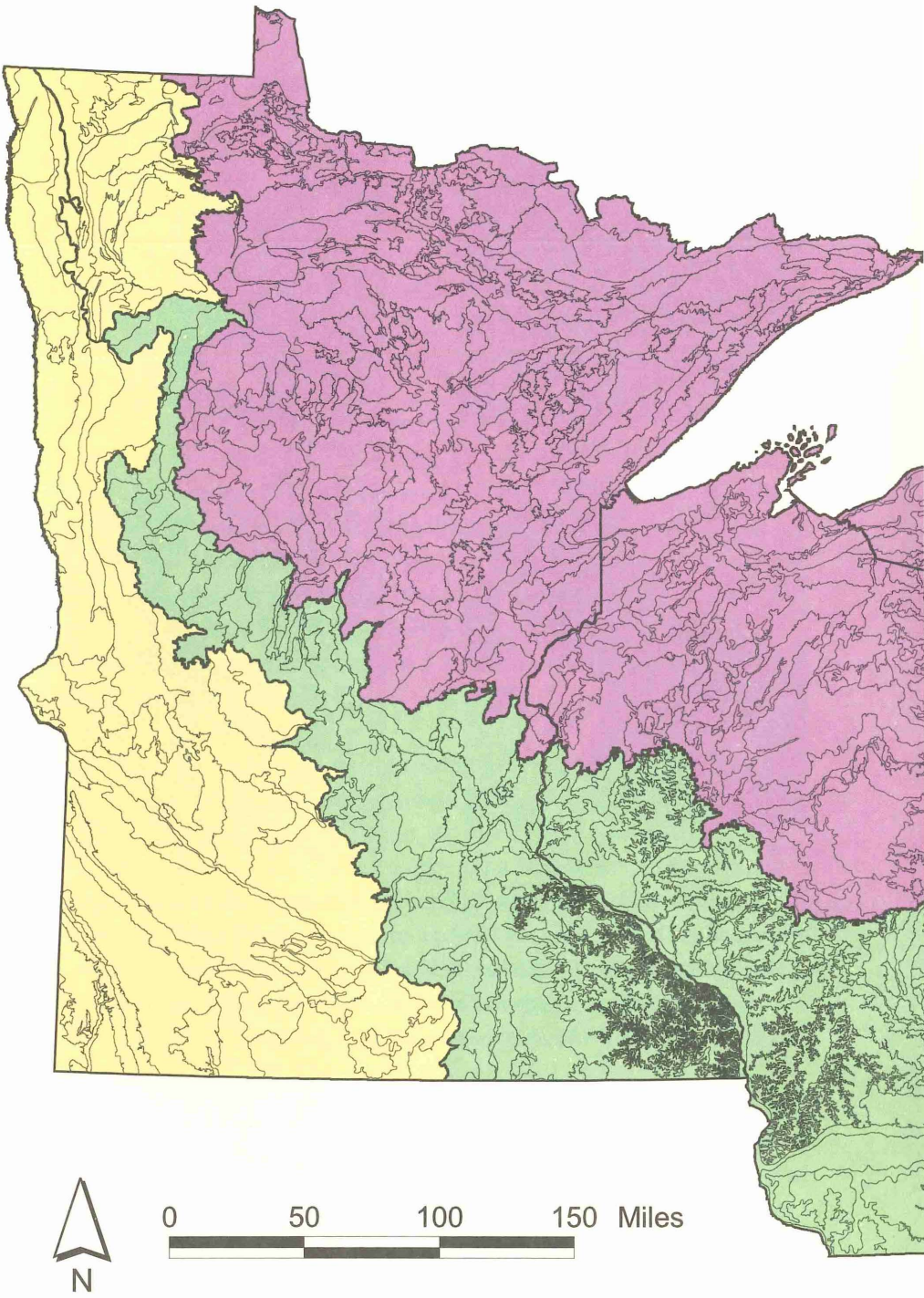
4. Public Land Survey Bearing Trees

LTAs (shown with thick brown lines and labels) are developed using many single-theme maps of biological and physical features such as: 1. topograhy and surface water, 2. landforms, 3. soils, 4. public land survey bearing trees. Interrelationships are discovered by overlaying several maps and observing how patterns coincide.

LTA 212Nc01—level topography, outwash plain landform (yellow), dry sandy soils (yellow), dry to dry-mesic coniferous bearing trees—jack pine (■) and red or white pine (■).

LTA 212Nc02—steep hilly topography, end moraine landform (green), mixture of dry sandy and moist loamy soils (green), a mixture of dry-mesic coniferous and deciduous bearing trees—oak, aspen, birch (●) and red or white pine (■).

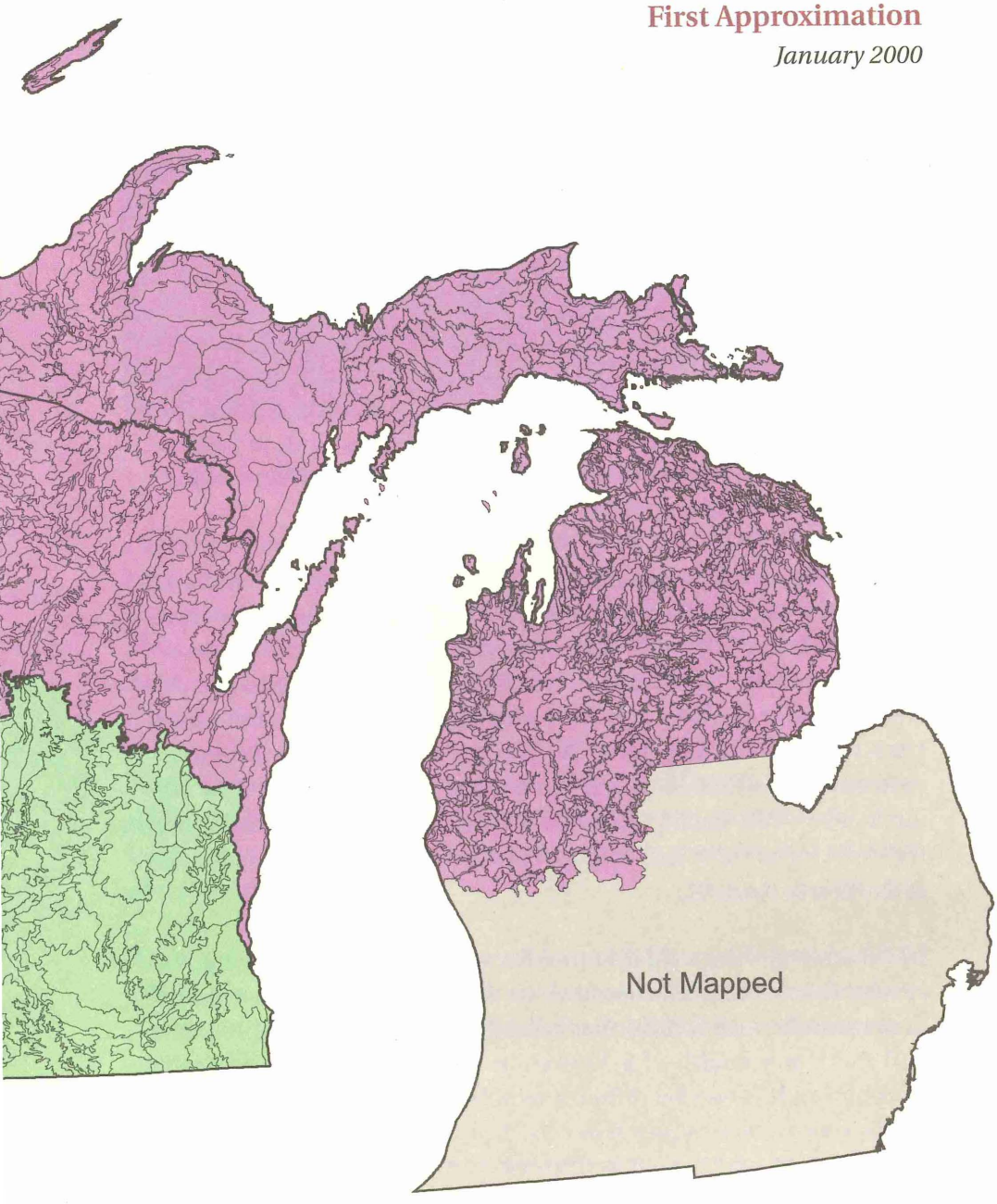
LTA 212Nc03—rolling topography, till plain landform (orange), uniform moist loamy soils (orange), dry-mesic and mesic deciduous bearing trees—oak, aspen, birch (●) and lowland coniferous bearing trees—tamarack or black spruce (■).


N
0
50
100
150 Miles
Laurentian Mixed Forest Province - 766 LTAs
Prairie Parkland Province - 66 LTAs
Eastern Broadleaf Forest Province - 172 LTAs

LTA Map for Michigan, Minnesota, and Wisconsin by Province

First Approximation

January 2000



This map is a compilation of LTA mapping from each state or portions of a state. The stage of completion in each state varies from initial review draft to published products.

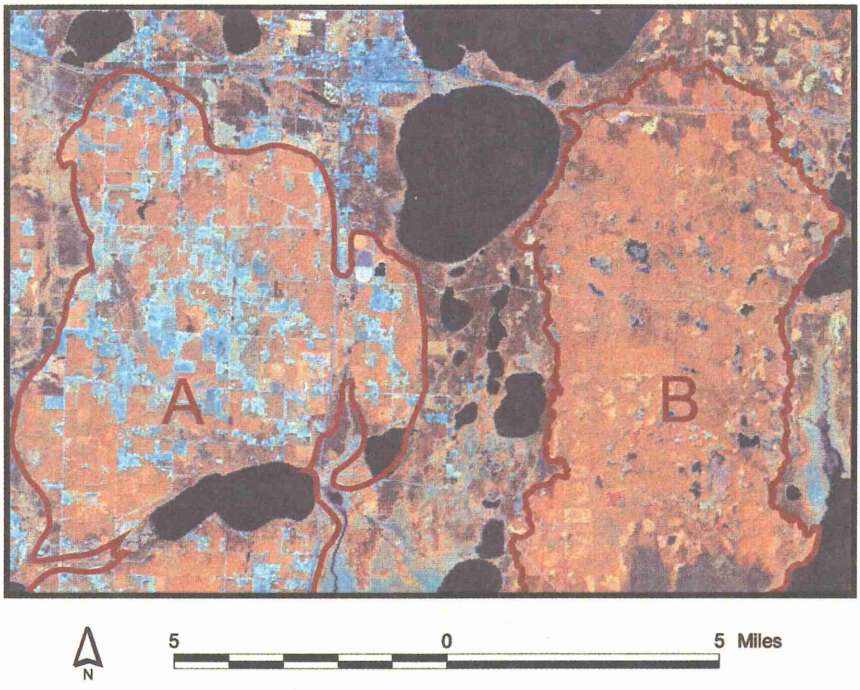
LTAs and Resource Management

LTAs are an important management consideration because many ecological processes operate at the landscape scale. Some animals migrate and range over large areas; both groundwater and surface water move through large watersheds; soil-forming processes are correlated with extensive geologic formations; the history and current pattern of plant communities are related to large landforms.

Natural resources can have distributions that relate to any scale of the national hierarchy, but LTAs explain much of the variation in the distribution and abundance of many traditional resources. There are two reasons for this. First, human land-use patterns are well-correlated with LTAs, especially agricultural potential. Farms are abundant on LTAs that are well-drained, flat, stoneless, and with soils that hold water. Second, forest types are correlated with LTAs because landscape features historically controlled the probability of fire. Forest types and the interspersion of forests with farmland are two important landscape features that affect populations of game species.

LTAs provide a practical analytic tool for summarizing landscape characteristics and assessing the condition of resources such as the cumulative effects of managing small tracts of land. Most management prescriptions in the Lake States are applied to tracts smaller than 40 acres for a variety of practical and administrative reasons. The potential consequence of independently managing small areas is to fragment the landscape and alter landscape-scale ecological processes. Evaluating individual small tracts as a part of a larger landscape, such as LTAs, provides an appropriate context.

LTAs can also be a valuable tool for evaluating and applying results from research. Research in the fields of forestry, wildlife management, and ecology has been going on for nearly 100 years, and there is a wealth of information that managers might apply to their land. It can be difficult to select the most applicable management techniques from the hundreds of papers that are published. In addition, it is difficult to know how to extrapolate the results from a geographically limited study to a broad landscape. Matching LTA properties with study areas can help with both of these problems.



The effects of different management regimes on two patches (A and B) of the Guthrie Till Plain LTA are very evident in this satellite image. This LTA has rolling topography and rich, loamy soils. The patches, A and B, are separated by sandy plains with poor soils (Bemidji Sand Plain LTA). Both patches of the Guthrie Till Plain LTA share the same ecological potentials despite striking differences in current land use.

Patch B, which is mostly public land, is nearly continuous forest. Mesic sugar maple-basswood communities (the tan areas) dominate the landscape as they did historically. The light blue-green areas in island B are clearcuts.

Patch A, which is predominantly private land, has a wide variety of land cover including agricultural fields (cyan areas). This patch is highly fragmented in comparison to patch B; the result of independent management of small tracks of land.

Management Applications

LTAs and Rare Species—*Red-Shouldered Hawk*

Photo: Cornell University

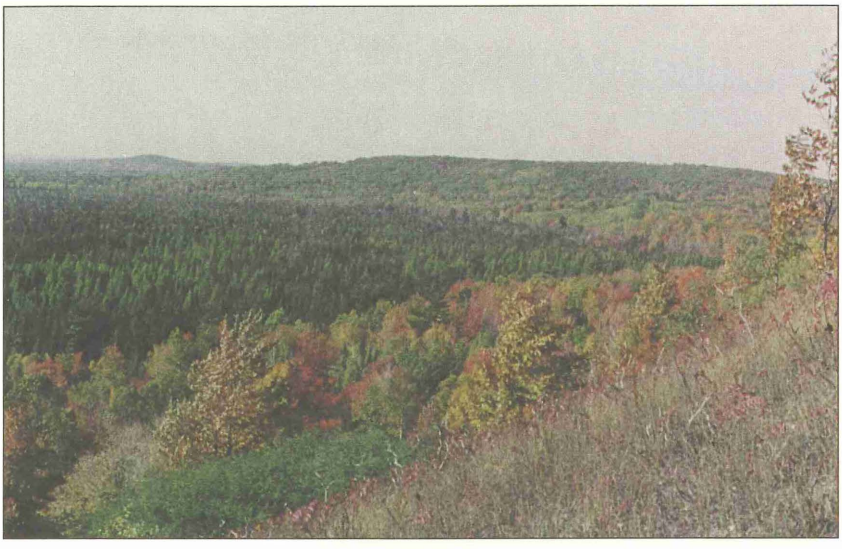
The red-shouldered hawk *(Buteo lineatus)* was once a common raptor in the Lake States, but now this species is rare. Red-shouldered hawks are being displaced by the larger and more aggressive red-tailed hawk *(Buteo jamaicensis)* where large forests have been fragmented into small, discontinuous stands. Its protection status is *threatened* in Michigan and Wisconsin, and it is listed as a species of *special concern* in Minnesota.

In Michigan, researchers have noticed that the habitat required by red-shouldered hawks is correlated with particular LTAs. These LTAs are typically end moraines with mature stands of northern hardwoods and wetland inclusions. The hawks nest in the hardwoods and hunt along the edges of the wetlands.

In central Minnesota, surveys done by the Minnesota County Biological Survey and Nongame Wildlife Program have also demonstrated strong correlation of red-shouldered hawks with end-moraine LTAs similar to those used by the hawks in Michigan. The Minnesota survey is interesting because it also demonstrated that the hawks do not commonly use LTAs that lack end-moraine characteristics.

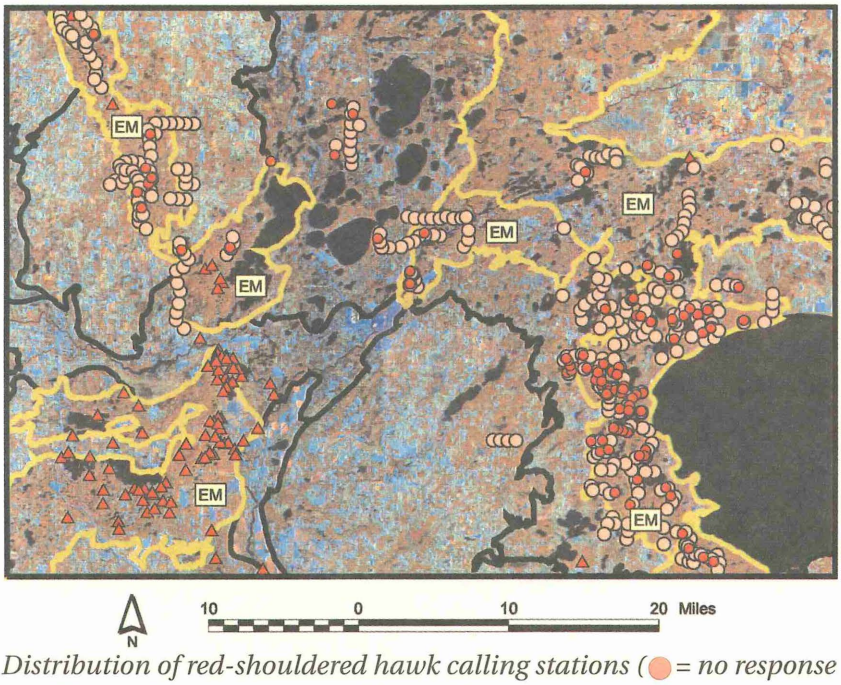
Research by the University of Minnesota has shown that stand-scale habitat properties are also important. These hawks prefer mixed stands of aspen, paper birch, red oak, and sugar maple with diameters over 15 inches. These properties of red-shouldered hawk habitat are captured by ecological map units subordinate to LTAs and by traditional stand-inventory data.

The observations in Michigan and Minnesota suggest that this is a case where a species perceives suitable habitat at the scale of an LTA. Thus, LTAs and subordinate ecological map units are an important tool for focusing management activities designed to enhance populations of red-shouldered hawks.



MI DNR Photo

In the northern Lake States, red-shouldered hawks require contiguous stands of hardwood forests interspersed with wetlands. These conditions often occur on specific LTAs with hilly terrain such as this in Michigan.



Distribution of red-shouldered hawk calling stations (● = no response and ● = positive response) and known locations from the Minnesota Natural Heritage data base (▲) by LTA in central Minnesota. Note the concentration of positive responses and known locations on end moraine LTAs (shown with yellow boundaries and "EM" labels). Also note the predominance of forest cover (tan tones) in end moraine LTAs versus open areas (light blue tones) in adjacent LTAs.

LTAs as a Silvicultural Tool—*White Pine*

Although white pines were just 5 percent to 8 percent of the trees in the primeval Lake States forests, no other tree is so romantically associated with the Lake States wilderness. White pine populations were devastated in these early days not so much by logging, but by the intense wildfires that followed on logged-over land. Throughout the northern forested regions of these states, the large and charred white pine stumps give testimony to what the land produced and might produce again. There is broad support, from commercial interests to environmental groups, for restoring white pine in the Lake States. Where do you start?

In Minnesota, there is a strong relationship between the historic distribution of white pine and LTA map units. White pine was most abundant on topographically rough landforms with loamy soil textures. Because of this relationship, LTAs were used to summarize the change in white pine populations from the late 1800s to 1990.

The current presence or absence of white pine in all canopy levels (seedlings, saplings, subcanopy, and canopy) was summarized by LTAs to determine where white pine is recovering on its own and to estimate the need for silvicultural intervention. When LTAs were grouped using landform and soil drainage, significant differences were observed.

In the Lake States, the natural recovery of white pine has been hindered by the introduction of a blister-rust fungus. Gooseberries are the alternate host of this fungus and their populations also show relationships with LTA map units. Gooseberries are abundant on somewhat poorly drained soils on till plains and lake plains, where there is little evidence of natural recovery of white pine. White pine is showing signs of natural recovery on end moraines, its preferred habitat. End moraines also have low populations of gooseberries.

LTAs, because of their design, spatially link four separate considerations for restoration: where white pine once occurred, topography, advanced regeneration trends, and distribution of gooseberries. By establishing criteria that considers these factors, managers can assign restoration priorities to areas where white pine is ecologically appropriate, cost effective, and with lower risk of blister-rust.

Opportunities for White Pine Restoration in the Northern Minnesota Drift and Lake Plain Section

Soil Drainage Class	LTAs Grouped by Landform			
	Lake Plains	Till Plains	End Moraines	Outwash Plains
Excessive or Somewhat Excessive	No Data	No Data	Best	Not Suited
Well or Moderately Well	Not Suited	Fair	Good	Best
Somewhat Poor or Poor	Not Suited	Fair	Fair	Not Suited

LTAs grouped by landform type and soil drainage classes can be used to identify where the greatest opportunities occur for white pine restoration. Ratings in this example were based on the historic abundance of white pine, the occurrence of side slopes or hill tops (the preferred micro-sites for reducing blister rust infections), and the abundance of gooseberries

Green: best opportunities for restoration: high abundance historically, lowest abundance of gooseberries, and an abundance of preferred micro-sites. In addition, little or no silvicultural assistance appears to be needed because when a seed source exists, white pine appears to be recovering on its own. In fact, on well-drained outwash plains it is replacing jack pine.

Yellow: good opportunities for restoration: highest abundance historically, slightly higher abundance of gooseberries than green, and an abundance of preferred micro-sites. Silvicultural practices will be needed to improve white pine regeneration and recruitment into the canopy because of shrub competition.

Orange: fair opportunities for restoration: moderate abundance historically, high abundance of gooseberries, and moderate abundance of preferred micro-sites. Intensive silvicultural practices will be needed.

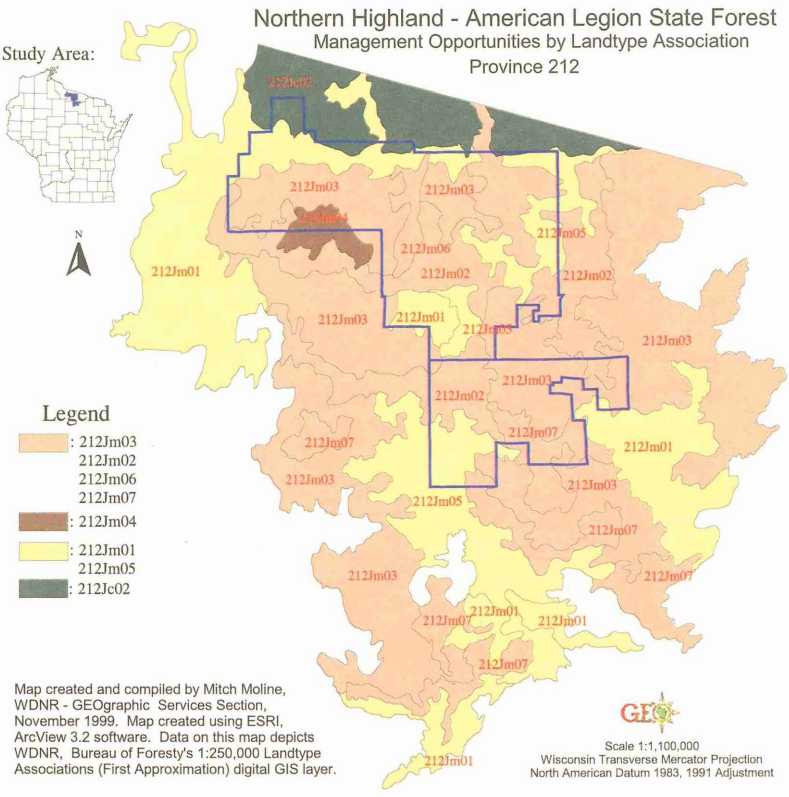
White: generally not suited for white pine restoration: low historic abundance, high incidence of gooseberries, general lack of preferred micro-sites.

LTAs as an Assessment and Planning Tool–*Community and Old-Growth Restoration*

In preparation for the development of a master plan for the Northern Highland–American Legion State Forest in north-central Wisconsin, a variety of ecological and socioeconomic assessments are being developed. Two of the ecological assessments utilize the National Hierarchical Framework of Ecological Units as a basic structure to organize, analyze, interpret, and present landscape information. The Regional Ecological Assessment employs the Province, Section, and Subsection levels, while the Community Restoration and Old-Growth Assessment applies LTAs.

Within the Community Restoration and Old-Growth Assessment, LTAs provide an ecological framework to characterize and analyze the property and surrounding landscape. Descriptive data layers organized by LTA include: area, glacial geology, topography, soils, hydrography, habitat types, presettlement vegetation, disturbance regimes, current vegetation, natural heritage inventory, and land ownership. These features tend to be relatively homogeneous within LTAs, while more variable among LTAs. The patterns of ecological features within and between LTAs can help define opportunities for management.

Ecological potentials and management opportunities to restore a variety of plant communities and developmental stages are being analyzed within the LTA framework. For example, both ecological assessments have assigned high priorities to white pine, red pine, and hemlock-hardwood community restoration and old growth development on this state forest. The predominant LTAs offer excellent potentials to restore white and red pine communities with old-growth representation. In contrast, potentials for hemlock-hardwood restoration and old-growth development are limited to several relatively minor LTAs and to some specific landscape positions within the predominant LTAs. Within LTAs, the identification and ranking of potential old-growth sites require finer scale analysis, applying tools such as forest inventory, natural heritage inventory, habitat types, and local ownership. Actual implementation of selected management opportunities will depend on socioeconomic and institutional issues.



LTAs are being used to assess where ecological potential and management opportunities exist to restore a variety of plant communities including red pine, white pine, and hemlock for the Northern Highlands–American Legion State Forest in northern Wisconsin.

Orange: LTAs Jm03, Jm02, Jm06, Jm07
High potentials and excellent to good management opportunities for white pine and red pine communities.
Minor opportunities along some swamps, lake shores, and streams for hemlock communities.

Brown: LTA Jm04
A large wetland with minor opportunities for red and white pine communities.

Yellow: LTAs Jm01, Jm05
Heterogeneous LTAs with some good potentials and opportunities for all three species.

Green: LTA Jc02
High potential and good management opportunities for hemlock–hardwood communities because of abundant woody competition.

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Web Sites

LTA maps, descriptions, and databases are not currently available on any web sites. However, several are being planned.

General information about the Minnesota DNR Ecological Land Classification can be found at:

www.iic.state.mn.us www.dnr.state.mn.us

The *Great Lakes Ecological Assessment* web site is a collection of new and existing environmental, biological, and socioeconomic information; some of which is summarized by LTA. This information is created to provide a scientific basis for resource planning and management in the Northern Lake States.

http://econ.usfs.msu.edu/gla/index.htm

Organizations that Participated in LTA Mapping in Michigan, Minnesota, and Wisconsin

Beltrami County
Blandin Paper Company
Champion Paper Company
Koochiching County
Mead Corporation
Michigan Coastal Management Program
Michigan Department of Natural Resources
Michigan Natural Features Inventory
Michigan Technical University
Minnesota Center for Environmental Advocacy
Minnesota Department of Agriculture
Minnesota Department of Natural Resources
Menominee Tribal Enterprises
Natural Resources Conservation Service
Northern Michigan University
Potlatch Corporation
University of Wisconsin - Madison
University of Wisconsin - Stevens Point
USDA Forest Service - Great Lakes Assessment
USDA Forest Service - National Forests
USDA Forest Service - State and Private Forestry
USDI Bureau of Land Management
U.S. Fish and Wildlife Service
Wisconsin County Forest Association
Wisconsin Department of Natural Resources
Wisconsin Geological and Natural History Survey