Chapter 1: Data Collection and Reporting Standards

Flora, Fungi and Plant Communities

Lichens and Bryophytes

Data Collection and Recording Guidelines

A qualified lichenologist or specially trained technician must do lichen and bryophyte data collection.

BIODIVERSITY STUDIES

Refer to Will-Wolf (*in press*) for an overview of field methods for biodiversity studies. The crucial factor in moving discussions from general methods to specific field practices is to recognize the importance of microhabitat in lichen and bryophyte ecology. Sampling procedures must be designed with all possible microhabitats in mind, and in a complete survey every potential substrate must be considered, as well as variation in environmental factors (i.e. light levels) that may generate additional microhabitats. (For example, substrate A under high light vs. low light conditions.) If data from the survey are to be used to compare between sites, or to compare the diversity at the same site at different times, the same array of microhabitats must be addressed, with the same thoroughness, and this must be well-documented. To a large degree the specific microhabitats included in the study area will dictate sampling methods.

Data generated by survey studies includes (1) species data, (2) site data, and (3) methods data.

Species Data:

- Species lists
  - Identification experts
  - Taxonomic authorities
  - Taxonomic checklist used
- Abundance Measures, may be included in the species data, either as percent cover (using percent or cover classes) or as thallus counts (using counts or class codes);
- Voucher List: a list of voucher specimens sent to the herbarium, including both collection number and species when field identifications are possible

Site Data* - The following data should be included for all surveys*:

- Date
- Location
- Size of survey area
- Weather conditions
- Site conditions (wet/dry)
- Total collecting time
- Vegetation and/or community type(s)
- Substrates and microhabitats examined
- Field personnel and identification experts
- Taxonomic authorities used including keys and checklists

Data for specific survey methods:

Methods and Data Elements

Walk Through
- Site data (above)

Complete Search
- Study area size and description
- Microhabitat descriptions
- Total time spent

Transects
- Placement criteria
- Number
- Spacing
- Length
- Width
- Orientation
- Time spent per transect

Subplots
- Placement criteria
- Distribution
- Size
- Number
- Time spent per subplot

Quadrats
- Placement criteria
- Number
- Size
- Time spent per quadrat

Other
- Method description and reference

POLLUTION STUDIES

Many species of lichens and bryophytes are used in pollution studies either as biological accumulators, or as biological indicators of pollution levels. The document "Lichens as Bioindicators of Air Quality" (Stolte et al., 1993) provides methodologies for a number of types of pollution studies. This document was produced by the Forest Service to provide uniformity between research projects undertaken by different researchers, in different National Forests. The following sections can be used to provide the general methodology for air pollution studies.

Accumulation Studies:

- Collection and Chemical Analysis of Lichens for Biomonitoring (Section 7. Larry Jackson, Jesse Ford, and David Schwartzman). This type of study involves the collecting of naturally occurring lichen or moss samples from an area or areas of interest. The samples are analyzed to determine the pollutant concentrations in the tissues. These concentrations can then be used for comparisons between sites, over time at the same site, and/or with published levels.
- Active Monitoring refers to transplant studies (Section 6. Lorentz Pearson). These can be done when an area of interest lacks naturally occurring species suitable for accumulation studies. In this case, organisms can be moved from a source location, to one or more study sites, exposed for a given period and then removed and tested for tissue pollutant levels.
- Transplant studies should always include control transplants; i.e. organisms that are collected and then "transplanted" to the source area using the same transplant techniques used at other sites. Control transplants are then analyzed using the same procedures as all other transplant samples.

Biological Indicator Studies:

The following methods are discussed in Section 4. Species and Communities, by Cliff Smith, Linda Geiser, Larry Gough, Bruce McCune, Bruce Ryan, and Ray Showman (pp 41-61).

- General Lichen Surveys provide a relatively quick, non-quantitative method for studying pollution levels around a point source. These studies often target specific subsets of lichen microhabitats which are easily repeatable across study sites. For example, a common choice for indicator studies is lichens and bryophytes on trees and shrubs in wooded sites. The data obtained consist of species lists at various sites at given distances from the point source. Analysis generally consists of distribution maps of different pollution tolerant and intolerant species, as well as measures of species richness. For an example of this type of study in Wisconsin see Will-Wolf (1980).
- Indicator species approaches require background knowledge of the pollution sensitivities of various lichen species that are known to occur in the area of interest. This approach is more quantitative than the previous one. Changes (or differences) in the abundance, distribution or vigor of indicator species are used to assess changes in pollution levels or differences in pollution levels across space. At this time, the necessary background information is not generally available for many Wisconsin

species. In the future this approach may be more practical as this information becomes more available.

- Quantitative community analysis is the quantitative study of entire communities, rather than merely a survey of species or a quantitative study of particular indicator species. This is the most involved of the three methods and generates the most information, including information on potential indicator species that can be useful in future indicator species studies. Methods are similar to those involved in any plant community study, adapted to the difficulties posed when sampling microhabitats on substrates such as trees, logs, soil, rocks, and so on. In addition to consulting the Forest Service document, the researcher should be familiar with the appropriate references cited in the Species and Communities section (pp 41-61) before completing their research design.

Vouchering And Sample Collection Guidelines

VOUCHERING

When:

- Always

Destination:

- When appropriate, the UW-Madison Lichen Herbarium, or other reputable repository

Data Requirements:

- Date
- Location
- Collector
- Collection number
- When available: species and identification expert

Bryophyte specimens must be fertile

COLLECTING

- Know which taxa are locally or nationally rare or protected. Find out and follow all necessary legal procedures for collecting. Contact the state's natural resource agency and the Office of Endangered Species, USFWS, Washington, D.C. 20240.

- Obtain needed permits for scientific collecting on public lands. On private lands, obtain the permission of the landowner before collecting.

- Do not collect indiscriminately, even in large populations. Collect only the minimum amount of material necessary for documentation or research purposes. When collecting, take into account the cumulative effect of all collecting at the site.

- If you encounter a lichen or bryophyte with which you are unfamiliar, assume it is rare. Never collect the only specimen at a site. Never collect an entire individual or clone if it is the only one you see in the vicinity. Leave at least one-half of the specimen, clone, or colony.

- When collecting multiple specimens for exchange with other herbaria or for population studies or other purposes, make sure there is a clear need for the number of specimens you wish to collect. Be sure the lichen or bryophyte is abundant enough to justify the collection of multiple specimens. Collect population samples only as part of a scientifically designed sampling plan for a specific scientific purpose.

- Collect discreetly so as not to encourage others to collect indiscriminately, Be prepared to explain what you are doing and why. Avoid unnecessary damage to the site and its aesthetic values.

- Care properly for the specimens you collect. Deposit herbarium specimens in an appropriate, recognized, publicly accessible collection. Follow standard methods such as the guidelines of the chosen herbarium. An agreement must be made prior to collecting with a reputable repository for the storage and maintenance of collected voucher specimens.

Taxonomy

LICHENS

Species nomenclature should be consistent with the most recently published version of the "Checklist of the lichen-forming, lichenicolous, and allied fungi of the continental United States and Canada," which is published in *The Bryologist* (as of April 2000 the most recent version is the sixth checklist: [Esslinger and Egan, 1995]), or referenced to a specific monographic work more recently published than the latest checklist. Esslinger maintains an updated checklist at:

http://www.ndsu.nodak.edu/instruct/esslinge/chcklst/chcklst7.htm.

Name changes listed there usually have literature citations provided. (The web site checklist itself is not considered a published reference.)

BRYOPHYTES

Species nomenclature should be consistent with the following references, or a specific reference to a more recent monographic work should be provided. The liverwort list is somewhat out of date. In case of questions, the Missouri Botanical Garden moss database website can be used to check the validity of the current name:

http://mobot.mobot.org/Pick/Search/most.html

Here a name can be submitted and a button for "1 accepted name" will provide the accepted name as well as the citations.

Sphagnum: Anderson, 1990
Mosses: Anderson et al., 1990
Liverworts including hornworts: Stotler and Crandall-Stotler, 1977

FUNGI AND STRAMENOPILA

Note: Lichenized fungi are addressed in the section "Lichens and Bryophytes."

Data Collection and Recording Guidelines

A ballpark estimate of the number of fungi whose rhizomes reside in Wisconsin is 50 to 100 thousand species (Andrea Gargas, personal communication). This includes a fantastic diversity of forms and life cycles, and potentially a significant number of new species. (This estimate is based on the same type of extrapolations used to provide a global species estimate. This is discussed in Hawksworth et al. (1995, p. 315) under the entry for Numbers of fungi. A generally accepted figure for the global estimate is 1.5 million species. Also, a proposal for an all taxa survey in a Costa Rican Conservation Area is expected to produce a total list of 40 to 50,000 species (Rossman et al. 1998). This Conservation Area is less than 1% the size of Wisconsin.) Given the tremendous number of fungi species likely to be found in Wisconsin, and our present, very limited state of knowledge concerning these organisms, it is extremely important that researchers be encouraged to include their data in the Aquatic and Terrestrial Resource Inventory (ATRI).

BIODIVERSITY STUDIES

There are several types of biodiversity studies. All Taxa Surveys focus on a given area and search for and identify as many fungi species (or groups) as possible, on all substrates available. Alternatively, "restricted surveys" may focus on one or more specific functional types of fungi, or specific taxonomic group(s), or those associated with a particular substrate, and attempt to locate and identify as many of these as possible in the area of study. An example of this would be a "mushroom survey" in which any species of this general type would be surveyed in the area of interest. The methods and strategies of these approaches will vary greatly. In the first case, an All Taxa Survey will use methods appropriate for sampling all of the various substrates in the study area. In the latter case, the restricted survey will be organized around the specific fungi types or taxa of interest, and the sampling protocols selected will be those most appropriate for those specific organisms. *Measuring and Monitoring Biological Diversity: Standard Methods for Fungi* (Mueller et al., In Press), provides methodologies for many fungus groups.

All Taxa Survey protocols should follow those provided in Rossman et al. (1998). This is a comprehensive system of protocols designed to provide a complete survey of all potential fungus substrates. These have been broken down into the following categories: 1) living plants; 2) wood; 3) other terrestrial plant substrates, soil (including plant litter), water, rocks; and 4) animals and animal products. References to some habitat types in this text are not applicable (i.e. rainforest), but the protocols are organized around the substrate types, and these are universal. Methods include both direct methods, in which some stage of the organisms life cycle is visible in the field and provides material for collection and identification, and indirect methods, in which samples are collected for culturing purposes. Many fungus species must be grown in cultures to provide the fruiting structures or life cycle stages necessary for identification.

Restricted Surveys must be designed to use the procedures that will most effectively sample the type of fungi of interest. When possible, methods should be based on those provided in Mueller et al. (In press). Otherwise, surveys should be based on current methods that are well-documented in the literature. References for methods should be provided as supporting documentation with every database submitted to ATRI.

Vouchering and Sample Collection Guidelines

BIODIVERSITY STUDIES

Voucher specimens should be collected for all species encountered in a biodiversity study. In most cases, organisms must be collected as they are discovered in order to be identified, and these specimens then serve as voucher specimens. However, voucher specimens should also be collected for easily identified species. In an extensive, long-term study it may be useful to develop stop rules in order to avoid collecting unnecessary vouchers (as well as potential overcollecting of rare species). Stop rules indicate under what conditions field personnel can stop collecting specimens and switch to simply recording data in the field on the appropriate data forms. This may occur in situations when field personnel have become sufficiently familiar with some species or taxonomic groups such that they can be accurately identified at sight. If sufficient voucher specimens exist, and the field personnel have the requisite expertise, no further specimens should be collected. Stop rules will depend on the level of expertise of the field personnel, the organisms included in the survey, the duration of the survey, and so on, and hence must be tailor-made for the individual survey. In any survey which may include rare organisms, stop rules should be discussed prior to any collecting, and all field personnel should be aware at all times of the collecting status (yes/no) of those organisms.

GENERAL COLLECTING

- Obtain needed permits for scientific collecting on public lands. On private lands, obtain the permission of the landowner before collecting.

- Do not collect indiscriminately, even in large populations. Collect only the minimum amount of material necessary for documentation or research purposes. When collecting, take into account the cumulative effect of all collecting at the site.

- Collect discreetly so as not to encourage others to collect indiscriminately, Be prepared to explain what you are doing and why. Avoid unnecessary damage to the site and its aesthetic values.

- Care properly for the specimens you collect. Deposit herbarium specimens in an appropriate, recognized, publicly accessible collection. Follow standard methods such as the guidelines of the chosen herbarium. An agreement must be made prior to collecting with a reputable repository for the storage and maintenance of collected voucher specimens. The choice of a repository will depend on the type of survey and/or type of fungi collected. Several potential repsitories include: the Chicago Field Museum of Natural History, the New York Botanical Gardens, USFS Forest Products Lab Herbarium, and others.

Taxonomy

Beyond the phylum level for the Fungi and Stramenopila Kingdoms (Alexopoulos, et al., 1996; p 62) no specific taxonomic system is recommended here. The researcher should use a currently accepted taxonomic system and provide a recent literature reference. An overview of current systems is provided in Ainsworth & Bisby's Dictionary of the Fungi (Hawksworth et al. 1995). In particular see the entries under: fungi, kingdoms of fungi, classification, phylogeny, and the entries for each phylum.

Kingdom Fungi
- Phylum Chytridiomycota
- Phylum Ascomycota
- Phylum Basidiomycota
- Phylum Zygomycota

Kingdom Stramenopila
- Phylum Oomycota
- Phylum Hyphochytriomycota
- Phylum Labyrinthulomycota

VASCULAR PLANTS

Data Collection Methods

Wisconsin DNR/Bureau of Endangered Resources uses the guidelines set by the Nature Conservancy, the Natural Heritage Inventory, and the Association for Biological Diversity in the following manual of national standards (The Nature Conservancy, 1982):

Vouchering and Sample Collection Guidelines

The Plant Conservation Roundtable's "Conservation Guidelines" (adopted June 13, 1986, Washington, D.C.) are followed to collect native plants for use as herbarium specimens. Specimens or photographs should be submitted to the Wisconsin State Herbarium, Madison, Wisconsin.

1. Know which taxa are locally or nationally rare or protected. Find out and follow all necessary legal procedures for collecting. Contact the state's natural resource agency and the Office of Endangered Species, USFWS, Washington, D.C. 20240.

2. Obtain needed permits for scientific collecting on public lands. On private lands, obtain the permission of the landowner before collecting. Report any illegal collecting that you encounter to the appropriate authorities.

3. Do not collect indiscriminately, even in large populations. Collect only the minimum amount of plant material necessary for documentation or research purposes. When feasible, use photography or other methods of documentation. When collecting, take into account the cumulative effect of all collecting at the site.

4. Avoid collecting from a population of fewer than 100 plants. When essential to verify a possible new record for the area, or to obtain a scientific voucher, collect only a single specimen. Do not collect whole plants when plant parts are sufficient. Do not collect samples so large as to affect adversely the population's reproduction and survival. For voucher specimens, take only a small part if this would be adequate for positive identification. Never collect the only plant at a site.

5. If you encounter a plant with which you are unfamiliar, assume it is rare and exercise one of the following options:
    a. Small population; possible to return. Photograph the plant for identification and return for collecting only if the collection would add significantly to scientific knowledge.
    b. Small population; difficult to return. Collect at most a single specimen.
    c. Large population. Follow these Guidelines.

6. When collecting multiple specimens for exchange with other herbaria or for population studies or other purposes, make sure there is a clear need for the number of specimens you wish to collect. Be sure the plant is abundant enough to justify the collection of multiple specimens. Collect population samples only as part of a scientifically designed sampling plan for a specific scientific purpose. Collect no more than 5 percent of the plants visible in any population.

7. Collect discreetly so as not to encourage others to collect indiscriminately, Be prepared to explain what you are doing and why. Avoid unnecessary damage to the site and its aesthetic values.

8. If you discover a new plant record, notify an appropriate conservation official or land manager. Be cautious in providing site locations of rare plants to others.

9. If you learn that rare or protected taxa or their habitats may be destroyed, notify your state conservation agency or The Nature Conservancy, 1800 North Kent Street, Arlington, VA 22209.

10. Conduct salvage (rescue) projects only in sites that are scheduled for imminent destruction and only in conjunction with appropriate state agencies or conservation organizations. Obtain prior permission of the landowner. Do not collect from portions of the site that will remain in a natural state. Use salvaged plants only for such purposes as relocation, public education, botanical research or documentation, or as propagation stock, and not for sale to the public.

11. Care properly for the specimens you collect. Deposit herbarium specimens in an appropriate, recognized, publicly accessible collection. Follow standard methods such as the guidelines issued by the Association of Systematics Collections for labeling the specimens.

12. If you plan to maintain living plants, collect in a manner to ensure the survival of the individual plants.

13. Do not purchase wild-collected plants (or plant parts) of rare or protected taxa even for research, teaching, or herbarium specimens.

14. When choosing live plant material to use for scientific research, if possible use plants or plant parts from existing collections or from propagated sources. If you must collect living plants from the wild for scientific research, collect in a manner least likely to damage the wild population. In order of general preference, collect (1) seeds (if abundant), (2) cuttings or other plant parts, (3) whole plants. Leave behind some reproductive or regenerative parts such as fruits, roots, or rhizomes.

15. When discussing your research results, describe conservation considerations underlying your collecting techniques.

16. Teach your students about proper and careful collecting. When taking students into the field, visit only non-sensitive areas, taking care not to trample the site. Avoid frequent visits to the same natural site. For classroom use, collect only those plants both common in the region and locally abundant at the site. Generally, collect only the portions of a plant necessary for identification, such as leaf, flower, or fruit.

Data Recording Guidelines

For general guidelines, refer to NHPOM, referenced above in Data Collection Methods. Recommended data on rare plant populations would consist of the following items found in the "Special Plant Survey Form" and the "Wisconsin Rare Plant Reporting Form" (developed in

1991 by Thomas A. Meyer) designed for Bureau of Endangered Resources field personnel and educated laypersons, respectively:

	Special Plant Survey Form	Wisconsin Rare Plant Reporting Form
General Information	♦ Site name ♦ Date ♦ Quad name ♦ Quad code ♦ County(ies)/state ♦ Field quad margin # ♦ Full extent of Element Occurrence (EO) known and mapped (y/n) ♦ Precise location(s) mapped on base map (y/n)	♦ Scientific name ♦ Common name ♦ Observer ♦ Phone ♦ Date of observation ♦ Site name (if known) ♦ County ♦ Township/range/section ♦ Directions to site and location of plant population (include map) ♦ Landowner (if known)

	Special Plant Survey Form	Wisconsin Rare Plant Reporting Form
Biology	♦ Element name ♦ Element code ♦ Occ. # ♦ Phenology ♦ Population size ♦ Population area ♦ Age structure ♦ Vigor ♦ Evidence of reproduction (y/n) ♦ Type of reproduction ♦ Symbiotic or parasitic relationships ♦ Evidence of disease, predation, or injury ♦ Success of each stage of life cycle (good/fair/poor/none/uncertain) ♦ Reproduction ♦ Dispersal ♦ Establishment ♦ Maintenance	♦ Estimated population size (number of individuals) ♦ Character of "individual" ♦ (stem, clump, clone, etc) ♦ Percentage of Population * In flower/bud * In fruit * Mature, non-flowering seedlings

Habitat	♦ Aspect ♦ Slope ♦ Light ♦ Topographic Position ♦ Moisture ♦ Elevation range ♦ Cross Section of topography ♦ Associated natural community/plant community ♦ Natural community form completed (y/n) ♦ Associated plant species ♦ Soil name(s)/Substrate ♦ Estimated acres of potential habitat in area	♦ Associated plant species and/or plant community ♦ Slope ♦ Light ♦ Aspect ♦ Light ♦ Soil moisture ♦ Soil type

Identification	♦ Photograph taken (y/n) ♦ Specimen taken (yes – give collector, collection #, and repository/no) ♦ Other genus members co-occurring at site ♦ List ♦ Hybridization (y/n) ♦ Identification problems	♦ Photograph taken (y/n) ♦ Specimen taken (y/n) ♦ Repository

Conservation	♦ Owner aware of EO (y/n) ♦ Owner protecting EO (y/n) ♦ Evidence of disturbance ♦ Threats to EO ♦ Conservation/management needs ♦ Research needs ♦ Data Security	♦ Evidence of disturbance including predation, grazing, logging, natural succession, etc. ♦ Compare condition to last visit if seen before

	Special Plant Survey Form	**Wisconsin Rare Plant Reporting Form**
Summary	♦ EO Quality ♦ EO Condition ♦ EO Viability (Excellent/Good/Marginal/Poor) ♦ EO Defensibility ♦ EO Overall Rank	♦ Other comments concerning special conditions at site, current land use, management/conservation recommendations, ownership info, etc.

High-quality data is stored in the Biological Conservation Database (BCD), but it also accommodates lower-quality data. For example, rock-bottom, absolute minimum data (as from old herbarium collections) with mere location, even to township level, is enough for inclusion in the BCD. Even modern collections with scanty data are useful, should be, and are included in the BCD because it documents changing conditions such as landscapes.

Decision Item – ATRI will need to be able to accommodate "minimum data records" and not just for historical sites.

Taxonomy

RECOGNIZED SYSTEMS

There is a single, internationally accepted set of rules for naming scientific names of vascular plants – the International Code of Botanical Nomenclature (ICBN), which is updated by the International Association for Plant Taxonomy at an international congress every six years. The latest ICBN is referred to as the St. Louis code (Greuter et al., 2000). This "Code", however, does not mean that all botanists have to use the same name for the same plant species!

Some may choose to "lump" or "split" species according to their own "species concept", and this implies the use of different names, as instructed by the rules of ICBN. For example, some botanists name the common spring wildflower "hepatica" as *Hepatica americana,* while others use the name *Anemone americana*. Both names are correct under the ICBN; it's a matter of individual professional opinion which genus the plant belong in. There is no hard and fast rule at either state, national, or international levels; rather, it's a matter of consensus.

So there are many "recognized systems"; for example, the state floristic atlases for Minnesota, Wisconsin, Michigan, and Illinois all use names, which, while over 90% congruent, contain some differences such as the hepatica example mentioned above.

Common names are even less systematized than scientific names. In the systems discussed below, there are often from one to several common names given for a particular species – no common name is right, and the user is invited to take their pick. An exception is the TNC/ABI-WDNR/BER common names, where only one common name is used and therefore can be considered as "semi-official".

ACCEPTABLE SYSTEMS FOR WISCONSIN

All of the systems mentioned in the previous paragraph are considered "acceptable" by botanists, as long as the names these use conform to the rules of the ICBN.

In practice, there are several vascular plant nomenclatural systems that are in common usage in Wisconsin:

1. The U.S. Department of Agriculture (USDA) nomenclatural system (also known as the John Kartesz system; he and the staff of the Biota of North America Program spent years straightening out the nomenclature of U.S. plants). The names used in this system are all easily accessible online at http://plants.usda.gov. It should be cited as:

   > USDA, NRCS 2001. The PLANTS Database, Version 3.1 (http://plants.usda.gov/). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

2. The Wisconsin State Herbarium nomenclatural system, used at the University of Wisconsin-Madison Botany Department and available online on the Wisconsin Vascular Plants (WVP) website at http://wiscinfo.doit.wisc.edu/herbarium. This system follows the USDA system quite closely, although there are a few differences.

3. The Natural Heritage Inventory nomenclatural system followed by The Nature Conservancy (TNC; http://www.tnc.org) and its newly established partner the Association for Biodiversity Information (ABI; http://www.abi.org). This is the system that the WDNR Bureau of Endangered Resources (BER) uses for the scientific names of plants on its "working list". Note that each species also has one and only one common name associated with it. Each species also has a distinctive element code (ELCODE), for example *Aster furcatus* is PDAST0T170, where "P" signifies vascular plant, "D" dicot, "AST" the first three letters of the family name (Asteraceae), and the final five letters/digits a unique combination assigned by the TNC/ABI national office. There are approximately 290 vascular plants currently on the WDNR/BER working list (Wisconsin Natural Heritage Program). About 90% have names that are exactly congruent with those used in the USDA and WVP systems.

4. NatureServe (http://www.natureserve.org/explorer) is a non-profit organization working in partnership with the Nature Conservancy that offers direct access to online information on more than 50,000 species and ecological communities in the United States and Canada.

TAXONOMIC CROSS-WALKS

Given that the TNC/ABI system is the one that WDNR/BER Natural Heritage Inventory uses, it is the system to which the USDA and WVP systems should be cross-walked.

LEVEL OF TAXONOMIC RESOLUTION

The level of taxonomic resolution (identification to genus, species, subspecies, variety) varies with the system employed. In general, the USDA and WVP recognize more infraspecific taxa (subspecies, varieties) than does the TNC/ABI-WDNR/BER system. Of the approximately 290 vascular plant species on the WDNR/BER working list, 20 are recognized at the varietal level and 6 at the subspecies level; the rest are recognized at the species level.

FOREST TYPES AND TREES

Data Collection and Recording Guidelines

FIA INVENTORY

Wisconsin DNR/Division of Forestry uses forestland data collected by qualified inventory foresters under guidelines established by the USDA Forest Service Forest Inventory and Analysis (FIA) Unit. The database includes data on all forestland ownerships in the state. FIA inventory methods have been used for standardized periodic forest inventories since 1936 in Wisconsin. Beginning in 2000, inventories will be done on an annual basis on a 5-year cycle using standard inventory methods and terminology defined in the FIA field manual (USDA, 1999). Fixed radius plot sampling is the standard sampling method

Level of detail:

- Plot level data
- Condition class
- Subplot information
- Tree and sapling data
- Seedling data
- Site tree information
- Nonforest plots

DNR FORESTRY DATA COLLECTION

DNR field foresters collect data using DNR Forest Tax Law and Forest Reconnaissance guidelines established by DNR Forestry staff. DNR Forest Tax Law data only includes forestland in the Tax Law program owned by industrial and non-industrial private landowners. Forest Reconnaissance data includes some, but not all, state and county-owned forestland. Historical data in electronic format is not available. Standard methods and terminology are defined in the Wisconsin DNR Manual Code 8625.2, Forest Tax Law Handbook, and Public Forest Lands Handbook. Variable plot radius is the standard sampling method

Level of detail:

- Heading information
- Stand information
- Management prescriptions
- Aesthetic prescriptions
- Wildlife prescriptions
- Forestry BMPs for water quality prescriptions
- Endangered resources (active/passive management) prescriptions

FOREST TYPES

FIA and DNR Forestry forest type definitions are different and generally not compatible. FIA identifies forest types by species plurality of stems/acre of all live trees over 1-inch diameter. DNR Forestry identifies forest types by species volume/acre of growing stock trees (commercial species $\geq$ 5-inch diameter) for trees 5-inch diameter or larger and by species majority of trees/acre for trees less than 5-inch diameter. For forest type classes and descriptions, see the Taxonomy section.

MINIMUM DATA REQUIREMENTS

All studies use commonly accepted forestry sampling and volume estimation methods. Minimum data requirements are as follows:

Plot level data

- Date
- Location

Stand level/condition class data

- Ownership
- Forest type
- Primary and secondary stand size classes
- Year of origin
- Habitat type
- Tree density (basal area)
- Soil type

Tree/seedling level data

- Species
- Diameter at breast height
- Merchantable height (all sampled trees)
- Total height (dominant species sample)

OTHER FOREST MONITORING PROGRAMS

The national Forest Health Monitoring program (FHM) is designed to determine the status, changes, and trends in indicators of forest condition on an annual basis. For more information about their biotic and abiotic data sources and analytical approaches to address forest health issues see:

http://www.na.fs.fed.us/spfo/fhm/

Vouchering and Sample Collection Guidelines

A qualified professional forester or forestry technician must do forestry data collection. Vouchering is not applicable.

Taxonomy

TREE SPECIES

FIA (Little, 1981)

SOFTWOODS

- Balsam fir ..... *Abies balsamea*
- Eastern red cedar ..... *Juniperus virginiana*
- Tamarack ..... *Larix laricina*
- White spruce ..... *Picea glauca*
- Black spruce ..... *Picea mariana*
- Eastern white pine ..... *Pinus strobus*
- Red pine ..... *Pinus resinosa*
- Jack pine ..... *Pinus banksiana*
- Northern white cedar ..... *Thuja occidentalis*
- Eastern hemlock ..... *Tsuga canadensis*
- Other softwoods
  - European larch ..... *Larix decidua*
  - Norway spruce ..... *Picea abies*
  - Colorado (blue) spruce ..... *Picea pungens*
  - Scotch pine ..... *Pinus sylvestris*

HARDWOODS

- Hard maples
  - Black maple ..... *Acer nigrum*
  - Sugar maple ..... *Acer saccharum*
- Soft maples
  - Red maple ..... *Acer rubrum*
  - Silver maple ..... *Acer saccharinum*
- Birches
  - Yellow birch ..... *Betula alleghaniensis*
  - River birch ..... *Betula nigra*
  - Paper birch ..... *Betula papyrifera*
  - Select hickories
    - Shagbark hickory ..... *Carya ovata*
  - Other hickories
    - Bitternut hickory ..... *Carya cordiformis*
  - Hackberry ..... *Celtis occidentalis*
  - American beech ..... *Fagus grandifolia*
  - Ashes
    - White ash ..... *Fraxinus americana*
    - Black ash ..... *Fraxinus nigra*
    - Green ash ..... *Fraxinus pennsylvanica*
  - Butternut ..... *Juglans cinerea*
  - Black walnut ..... *Juglans nigra*
  - Balsam poplar ..... *Populus balsamifera*

- Eastern cottonwood ..... *Populus deltoides*
- Aspens
  - Bigtooth aspen ..... *Populus grandidentata*
  - Quaking aspen ..... *Populus tremuloides*
- Black cherry ..... *Prunus serotina*
- Select white oaks
  - White oak ..... *Quercus alba*
  - Swamp white oak ..... *Quercus bicolor*
  - Burr oak ..... *Quercus macrocarpa*
  - Chinkapin oak ..... *Quercus muehlenbegii*
- Select red oak
  - Northern red oak ..... *Quercus rubra*
- Other red oaks
  - Northern pin oak ..... *Quercus ellipsoidalis*
  - Black oak ..... *Quercus velutina*
- Black willow ..... *Salix nigra*
- American basswood ..... *Tilia americana*
- Elms
  - American elm ..... *Ulmus americana*
  - Siberian elm ..... *Ulmus pumila*
  - Slippery elm ..... *Ulmus rubra*
  - Rock elm ..... *Ulmus thomasii*
- Other hardwoods
  - Boxelder ..... *Acer negundo*
  - Northern catalpa ..... *Catalpa speciosa*
- Honeylocust ..... *Gleditsia triacanthos*
- Red mulberry ..... *Morus rubra*
- Black tupelo ..... *Nyssa sylvatica, Var. sylvtica*
- White poplar ..... *Populus alba*
- Black locust ..... *Robinia pseudoacacia*
- Non-commercial species
  - Striped maple ..... *Acer pensylvanicum*
  - Mountain maple ..... *Acer spicatum*
  - Ailanthus ..... *Ailanthus altissima*
  - American hornbeam ..... *Capinus caroliniana*
  - Flowering dogwood ..... *Cornus florida*
  - Hawthorn ..... *Crataegus spp.*
  - Osage-orange ..... *Maclura pomifera*
  - Apple ..... *Malus spp.*
  - Eastern hophornbeam ..... *Ostrya virginiana*
  - Pincherry ..... *Prunus pennsylvanica*
  - Wild plum ..... *Prunus spp.*
  - Chokecherry ..... *Prunus virginiana*
  - Peachleaf willow ..... *Salix amygdaloides*
  - Diamond willow ..... *Salix bebbiana*
  - American mountain ash ..... *Sorbus americana*

FOREST TYPES

1). USDA Forest Service, Forest Inventory and Analysis (FIA) classifies forest types based on the species forming a plurality of live tree (all live trees over 1-inch diameter) stocking (Schmidt, 1997).

Jack Pine – Forests in which jack pine comprises a plurality of the stocking. Species commonly associated with the jack pine forest type in Wisconsin include red pine, red oaks, aspen, and eastern white pine.

Red Pine – Forests in which red pine comprises a plurality of the stocking. Species commonly associated with the red pine forest type in Wisconsin include eastern white pine, jack pine, and aspen.

Eastern White Pine – Forests in which eastern white pine comprises a plurality of the stocking. Species commonly associated with the eastern white pine forest type in Wisconsin include red pine, aspen, red maple, paper birch, and red oak.

Balsam Fir – Forests in which balsam fir and white spruce comprise a plurality of stocking, with balsam fir the most common. Species commonly associated with the balsam fir forest type in Wisconsin include white spruce, aspen, northern white-cedar, tamarack, paper birch, red maple, black spruce and eastern white pine.

White Spruce – Forests in which white spruce and balsam fir comprise a plurality of the stocking, with white spruce the most common. Species commonly associated with the white spruce forest type in Wisconsin include aspen, paper birch, balsam fir, eastern white pine, red maple and northern white-cedar.

Black Spruce – Forests in which swamp conifers comprise a plurality of the stocking, with black spruce the most common. Species commonly associated with the black spruce forest type in Wisconsin include tamarack, balsam fir, eastern white pine, northern white-cedar, aspen, jack pine, and paper birch.

Northern White-Cedar – Forests in which swamp conifers comprise a plurality of the stocking, with northern white-cedar the most common. Species commonly associated with the northern white-cedar forest type in Wisconsin include balsam fir, paper birch, black spruce, tamarack, black ash, red maple, and aspen.

Tamarack – Forests in which swamp conifers comprise a plurality of the stocking, with tamarack the most common. Species commonly associated with the tamarack forest type in Wisconsin include northern white-cedar, black spruce, red maple, white pine, balsam fir, and paper birch.

Oak-Hickory – Forests in which northern red oak, white oak, bur oak, or hickories, singly or in combination, comprise a plurality of the stocking. Species commonly associated with the oak-hickory forest type in Wisconsin include red maple, aspen, and black cherry.

Elm-Ash-Soft Maple – Forests in which lowland elm, ash, red maple, silver maple, and cottonwood, singly or in combination, comprise a plurality of the stocking. Species commonly associated with the elm-ash-soft maple forest type in Wisconsin include northern white-cedar, aspen, cottonwood, and balsam fir.

Maple-Beech-Birch – Forests in which sugar maple, yellow birch, American elm, and red maple, singly or in combination, comprise a plurality of the stocking. Species commonly associated with the maple-beech-birch forest type in Wisconsin include basswood, eastern hemlock, green and white ash, aspen, black cherry and select red oaks.

Aspen – Forests in which quaking aspen or bigtooth aspen, singly or in combination, comprise a plurality of the stocking. Species commonly associated with the aspen forest type in Wisconsin include red maple, paper birch, balsam fir, and select red oaks.

Paper Birch – Forests in which paper birch comprises a plurality of the stocking. Species commonly associated with the paper birch forest type in Wisconsin include aspen, red maple, balsam fir, northern white-cedar, sugar maple, and balsam poplar.
Balsam Poplar – Forests in which balsam poplar comprises a plurality of the stocking. Species commonly associated with the balsam poplar forest type in Wisconsin include balsam fir, aspen, northern white-cedar, paper birch, black ash, and white spruce.

2). DNR Forestry classifies forest types based on commercial species $\geq$ 5-inch diameter forming the majority volume and/or commercial species $<$ 5-inch diameter forming the majority stocking (Wisconsin DNR, HB24315).

White pine

a. Stand Composition: More than 50 percent of the basal area in pine with white pine (*Pinus strobus*) predominant.

b. Associated Species:
   (1) Sandy soils: Red pine (*P. resinosa*), jack pine (*P. banksiana*), aspen (*Populus spp.*), red maple (*Acer rubrum*), white oak (*Quercus alba*), red oak (*Q. rubra*), and black oak (*Q. velutina*) pin oak (*Q. ellipsoidalis*), paper birch (*Betula papyrifera*), and balsam fir (*Abies balsamea*).

   (2) Loamy soils: Paper birch (*Betula papyrifera*), yellow birch (*B. allegheniensis*), sugar maple (*Acer saccharum*), black cherry (*Prunus serotina*), basswood (*Tilia americana*), balsam fir (*Abies balsamea*), hemlock (*Tsuga canadensis*), white spruce (*Picea glauca*), white ash (*Fraxinus glauca*), northern red oak (*Q. rubra*), white oak (*Q. alba*), red maple (*Acer rubrum*),and American beech (*Fagus grandifolia*).

Red pine

a. Stand Composition: More than 50 percent pine with red pine (*Pinus resinosa*) predominant.

b. Associated Species:
   (1) Sandy Soils: Jack pine (P. banksiana), white pine (P. strobus), quaking aspen (Populus tremuloides), bigtooth aspen (P. grandidentata), black oak (Quercus velutina), red oak (Q. rubra), white oak (Q. alba), paper birch (Betula papyrifera), and red maple (Acer rubrum).

   (2) Loamy Soils: White pine, black cherry (*Prunus serotina*), balsam fir (*Abies balsamea*), sugar maple (*Acer saccharum*), basswood (*Tilia americana*), yellow birch (*B. allegheniensis*), white spruce (*Picea glauca*), and eastern hemlock (*Tsuga canadensis*). Natural red pine stands do not occur on these soils. These associates are found only in plantations.

Jack pine

a. Stand Composition: More than 50 percent pine with jack pine (*Pinus banksiana*) predominant.

b. Associated Species:
   (1) Common Associates: red pine, white pine, scrub oaks, aspen, white birch
   (2) Occasional Associates: red maple, black cherry, balsam fir, white spruce

Fir-Spruce

a. Stand Composition: More than 50 percent balsam fir (*Abies balsamea*) or white spruce (*Picea glauca*) or both.

b. Associated Species: Paper birch (*Betula papyrifera*), trembling aspen (*Populus tremuloides*), red maple (*Acer rubrum*), white cedar (*Thuja occidentalis*), black spruce (*Picea mariana*), hemlock (*Tsuga canadensis*), red pine (*Pinus resinosa*), white pine (*P. strobus*), jack pine (*P. banksiana*), and other species found among northern hardwoods and swamp hardwoods.

Swamp conifer type – Balsam fir

a. Stand Composition: More than 50 percent swamp conifers with balsam fir (*Abies balsamea*) predominant.

b. Associated Species: Northern white cedar (*Thuja occidentalis*), black spruce (*Picea mariana*), white spruce (*P. glauca*), tamarack (*Larix laricina*), hemlock (*Tsuga canadensis*), white pine (*Pinus strobus*), jack pine (*Pinus banksiana*), black ash (*Fraxinus nigra*), paper birch (*Betula papyrifera*), yellow birch (*B. allegheniensis*), red maple (*Acer rubrum*), quaking aspen (*Populus tremuloides*) and balsam poplar (*P. balsamifera*).

Black spruce

a. Stand Composition: More than 50 percent swamp conifers with black spruce (*Picea mariana*) predominant.

b. Associated Species:

(1) Common associates : tamarack (*Larix laricina*), northern white cedar (*Thuja occidentalis*) and balsam fir (*Abies balsamea*).

(2) Occasional associates : white spruce (*Picea glauca*), hemlock (*Tsuga canadensis*), white pine (*Pinus strobus*), jack pine (*P. banksiana*), balsam poplar (*Populus balsamifera*), quaking aspen (*P. tremuloides*), black ash (*Fraxinus nigra*), red maple (*Acer rubrum*), paper birch (*Betula papyrifera*) and yellow birch (*B. allegheniensis*).

Tamarack

a. Stand Composition: More than 50 percent swamp conifers with tamarack (*Larix laricina*) predominant.

b. Associated Species:

(1) Organic soils: Includes black spruce (*Picea mariana*), white spruce (*P. glauca*), and northern white cedar (*Thuja occidentalis*).

(2) Mineral soils: Includes quaking aspen (*Populus tremuloides*), paper birch (*Betula papyrifera*), red maple (*Acer rubrum*), and white pine (*Pinus strobus*).

(3) Tamarack is usually associated with lowland brush because it has a relatively thin crown that passes sufficient light to allow the brush layer to develop.

Cedar

a. Stand Composition: More than 50 percent swamp conifers with northern white cedar (*Thuja occidentalis*) predominant.

b. Associated Species: Includes black spruce (*Picea mariana*), white spruce (*P. glauca*), tamarack (*Larix laricina*), balsam fir (*Abies balsamea*), eastern hemlock (*Tsuga canadensis*), black ash (*Fraxinus nigra*), red maple (*Acer rubrum*), yellow birch (*Betula allegheniensis*),

paper birch (*B. papyrifera*), American elm (*Ulmus americana*), and quaking aspen (*Populus tremuloides*).

Hemlock Hardwood

a. Stand Composition: Mainly eastern hemlock (*Tsuga canadensis*), with yellow birch (*Betula allegheniensis*), eastern white pine (*Pinus strobus*), sugar maple (*Acer saccharum*), and in the eastern part of the state, American beech (*Fagus grandifolia*).

b. Associated Species: Northern red oak (*Quercus rubra*), red maple (*A. rubrum*), basswood (*Tilia americana*), white ash (*Fraxinus americana*), northern white cedar (*Thuja occidentalis*), paper birch (*B. papyrifera*), and balsam fir (*Abies balsamea*).

Northern hardwood

a. Stand Composition: Contains more than 50 percent hardwood species that are moderately to highly shade tolerant. Predominant species include sugar maple (*Acer saccharum*), basswood (*Tilia americana*), red maple (*A. rubrum*), white ash (*Fraxinus americana*), yellow birch (*Betula allegheniensis*), and in northeastern Wisconsin, American beech (*Fagus grandifolia*).

b. Associated Species: Black cherry (*Prunus serotina*), white pine (*Pinus strobus*), balsam fir (*Abies balsamea*), hemlock (*Tsuga canadensis*), white spruce (*Picea glauca*), and northern red oak (*Quercus rubra*).

Oak

a. Dry Southern Hardwoods: Includes dry upland sites where bur oak (*Quercus macrocarpa*), black oak (*Q. velutina*), northern pin oak (*Q. ellipsoidalis*), or white oak (*Q. alba*) are dominant. Associated species include shagbark hickory (*Carya ovata*), black cherry (*Prunus serotina*), aspen (*Populus* spp.), and paper birch (*Betula papyrifera*).

b. Dry Northern Hardwoods: This community type corresponds to the scrub oak cover type. Refer to scrub oak type description below.

c. Dry-Mesic Southern Hardwoods: Includes upland sites where red oak (*Q. rubra*) or white oak dominate. Associated species may include basswood (*Tilia americana*), shagbark hickory, black cherry, red maple (*Acer rubrum*), and black walnut (*Juglans nigra*).

d. Dry-Mesic Northern Hardwoods: Includes upland sites with sandy loam to silt loam soils where red oak, white pine (*Pinus strobus*), aspen, paper birch, and red maple dominate. White oak and many of the northern hardwood species (basswood, ash, sugar maple, etc.) are also found on these sites.

e. Mesic Southern Hardwoods: Includes moist upland sites where sugar maple (*A. saccharum*) and basswood are dominant. Associated species include red oak, black cherry, ironwood (*Ostrya virginiana*), white ash (*Fraxinus americana*), and red maple.

f. Mesic Northern Hardwoods: Includes upland sites with loamy sands to silt loams where red oak and most northern hardwood species, especially sugar maple, dominate. White oak, American elm (*Ulmus americana*), American beech (*Fagus grandifolia*), and hemlock (*Tsuga canadensis*) are also common on many of these sites.

Scrub oak

a. Stand Composition: More than 50 percent of the stand consists of black oak (*Quercus velutina*), white oak (*Q. alba*), northern pin oak (*Q. ellipsoidalis*), or bur oak (*Q. macrocarpa*). Site index is 30-50.

b. Associated Species:

(1) Southern Wisconsin: Shagbark hickory (*Carya ovata*), red maple (*Acer rubrum*), paper birch (*Betula papyrifera*), aspen (*Populus* spp.), or black cherry (*Prunus serotina*).

(2) Northern Wisconsin: Aspen, red maple, paper birch, jack pine (*Pinus banksiana*), red pine (*P. resinosa*), or white pine (*P. strobus*).

Aspen

a. Stand Composition: Principal species of this type are quaking aspen (*Populus tremuloides*) and bigtooth aspen (*P. grandidentata*). The type occurs on the full range of site conditions from clays to sands and from moist to dry. Bigtooth aspen is similar to quaking aspen, but it does better on sandier soils and in warmer climates. The two species will be considered together when speaking of aspen unless otherwise specified. Aspen is intolerant and generally grows in even-aged stands. Most stands originate from seed or suckers on burned-over and cutover areas. Two-aged stands are the result of suckering after partial cutting or partial loss from fire, wind, hail, insects, or disease.

b. Associated Species: Aspen regenerates only through clearcutting or following a natural disturbance. Under these conditions it often outgrows all other species and forms pure stands, but because it is intolerant and short-lived, it is quickly replaced by other species. Under favorable conditions, however, many other intolerant and mid-tolerant species, e.g., paper birch (*Betula papyrifera*), white pine (*Pinus strobus*), red oak (*Quercus rubra*), and red maple (*Acer rubrum*), may become established at the same time resulting in mixed stands. Consequently aspen also occurs in Aspen-Pine, Aspen-Paper Birch, and Aspen-Red Oak cover types.

Paper/White birch

a. Stand Composition: Paper birch (*Betula papyrifera*; also called white birch) comprising more than 50 percent of the basal area in sawtimber and pole timber stands, or more than 50 percent of the stems in sapling and seedling stands. Mainly found where the climate has short, cool summers and long cold winters and where one-third to one-half of total precipitation falls as snow.

b. Associated Species: Large pure stands are uncommon. Most commonly found in association with aspen (*Populus* spp.), balsam fir (*Abies balsamea*), jack pine (*Pinus banksiana*), red oak (*Quercus rubra*), sugar maple (*Acer saccharum*), white spruce (*Picea glauca*), yellow birch (*B. allegheniensis*), and American beech (*Fagus grandifolia*).

Black walnut

a. Stand Composition: The black walnut type is defined as having stand composition of 50 percent black walnut (*Juglans nigra*). However, it is present in southern Wisconsin to a very limited extent and is seldom abundant. Black walnut grows in many mixed mesophytic forests or less commonly forms pure stands along the forest edge.

b. Associated Species: Eastern red cedar (*Juniperus virginiana*), white oak (*Quercus alba*), red oak (*Q. rubra*), shagbark hickory (*Carya ovata*), American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), white ash (*Fraxinus americana*), black cherry (*Prunus serotina*), basswood (*Tilia americana*), American elm (*Ulmus americana*), hackberry (*Celtis occidentalis*), boxelder (*A. negundo*), and green ash (*F. pennsylvanica*). In general where white ash or red oak grows well, black walnut also thrives.

Swamp hardwood

a. Stand Composition: The major components of this type include black ash (*Fraxinus nigra*), American elm (*Ulmus americana*), and red maple (*Acer rubrum*).
b. Sites are typically wet and subject to fluctuations in water table. Swamp hardwood species can tolerate semi-stagnant drainage conditions, but for best growth it is important that the water be moving so that the soil is aerated even if saturated.

Bottomland hardwoods

a. Stand Composition: The bottomland hardwood type is associated with flood plains and stream/river bottoms, primarily in the southern two-thirds of Wisconsin. When the bottomland hardwood community is found further north, it can be regionally significant and may provide important habitat for uncommon or rare species.

b. The major commercial tree species are eastern cottonwood (*Populus deltoides*), green ash (*Fraxinus pennsylvanica*), river birch (*Betula nigra*), swamp white oak (*Quercus bicolor*), and silver maple (*Acer saccharinum*). Unfortunately, Dutch elm disease has precluded management of American elm (*Ulmus americana*).

c. Cottonwood is commonly found along streams and bottomlands in the southern two-thirds of Wisconsin. An excellent pioneer of recently disturbed sites, cottonwood requires a continuous supply of moisture throughout the growing season. Cottonwood grows best on medium textured soils with good internal drainage; growth is poor on excessively wet sites and areas of impeded drainage.

d. Green ash is usually confined to bottomland sites. However, it will grow well when planted on moist upland sites. In Wisconsin, it is most commonly found on wet, rich alluvial soils in the southern half of the state.

e. River birch occurs at the northern edge of its range in southwestern Wisconsin. It extends north along the Wisconsin River to Stevens Point and the Mississippi River to Lake Pepin. It prefers deep rich alluvial soils that are sometimes flooded for weeks at a time.

f. Swamp white oak commonly occurs on wet sites characterized by hardpan or areas subject to flooding. In Wisconsin, it is most commonly found as a component of bottomland hardwoods.

g. Silver maple is characteristically a bottomland species, common within alluvial flood plains. It occurs on all major soil types, but is more common on medium to fine textured soils.

h. American elm was an important component of bottomland forests, but Dutch elm disease has killed most large elm. Elm seedlings and saplings may be locally abundant but are not generally favored by foresters due to continuing disease problems.

i. Associated Species: Other tree species that commonly occur with bottomland hardwoods include: hackberry (*Celtis occidentals*), bur oak (*Quercus macrocarpa*), black willow (*Salix nigra*), basswood (*Tilia americana*), black ash (*Fraxinus nigra*), red maple (*Acer rubrum*), and red oak (*Quercus rubra*).

Red maple

a. Stand Composition: Red Maple (*Acer rubrum*) comprising more than 50 percent of the basal area in pole timber and sawtimber stands or more than 50 percent of the stems in seedling and sapling stands.

b. Associated Species: Pure stands of red maple are uncommon. The most commonly found species associated with red maple are paper birch (*Betula papyrifera*), northern red *oak (Quercus rubra*), northern pin oak (*Quercus palustris*), quaking aspen (*Populus tremuloides*), large tooth aspen (*Populus gradidentata*), black oak (*Quarcus velutina*), black cherry (*Prunus*

serotina), bitternut hickory (*Carya cordiformis*), shagbark hickory (*Carya ovata*), white pine (*Pinus strobus*), eastern hemlock (*Tsuga canadensis*), and white spruce (*Picea glauca*). Red maple can be found as a minor component within most Wisconsin cover types due to its adaptive root system and tolerance of varied moisture regimes.

Central hardwoods

a. Stand Composition: Contains more than 50% upland hardwood species or type; no specie or type constitutes over 50% of the stand. This forest type would primarily be found south of Wisconsin's Vegetative Tension Zone (Curtis, 1959); see map 52.1. However, it also occurs on dry mesic sites in the north. Predominant species include those of moderate to high shade tolerance: basswood (*Tilia americana*), red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), white ash (*Fraxinus americana*), shagbark hickory (*Carya ovata*), bitternut hickory (*Carya cordiformis*) and elm (*Ulmus sp*); and other species of low to moderate tolerance - Black walnut (*Juglans nigra*), butternut (*Juglans cinera*) , oaks (*Quercus sp*.) and white pine (*Pinus strobus*).

b. In the past most of these stands have been burned, grazed and harvested in various ways. Generally, harvesting removed the most valuable species and the highest quality stems, especially oak. This has produced many low density, low quality stands with high density shrub layers. Species present include the early successional species. Stands often have low productivity even on the better sites. These stands are often called "degraded central hardwoods".

c. Associated Species:
   (1) Intolerant: Aspen (*Populus sp*.), black cherry (*Prunus serotina*), box elder (*Acer negundo*), white birch (*Betula papyrifera*) and eastern red cedar (*Juniperus virginiana*).

   (2) Moderate to tolerant: Hackberry (*Celtis occidentalis*) and ironwood (*Ostrya virginiana*).

FIA and DNR Forestry forest type class comparisons.

FIA (Schmidt, 1997)	**DNR Forestry** (WDNR HB24505.50)
Jack pine	Jack pine
Red pine	Red pine
Eastern white pine	White pine
Balsam fir	Fir-spruce, Swamp conifer
White spruce	Fir-spruce, White spruce
Black spruce	Black spruce
Northern white-cedar	Cedar
Tamarack	Tamarack
Oak-hickory	Oak
Oak-hickory	Scrub oak
Elm-ash-soft maple	Bottomland hardwoods
Elm-ash-soft maple	Swamp hardwood
Elm-ash-soft maple or Maple-basswood	Central hardwoods, locust
Elm-ash-soft maple or Maple-basswood	Red maple
Elm-ash-soft maple or Maple-basswood	Walnut
Maple-basswood	Northern hardwood
Maple-basswood	Hemlock hardwood
Aspen	Aspen
Balsam poplar	Aspen
Paper birch	White birch

FOREST HABITAT TYPES

1) DNR-supported system of site classification that uses the floristic composition of a forest community (understory herbs and shrubs, as well as trees) as an integrated indicator of those environmental factors that affect species reproduction, growth, competition, and, therefore, community development.

2) The habitat type system serves the following basic functions:
   a. Communication - It provides managers and researchers with a common language for describing forest communities and sites.
   b. Research - It provides a framework for systematic gathering and interpretation of research data and empirical knowledge.
   c. Management interpretation - It allows resource managers to develop long-term management objectives and specific prescriptions for manipulating vegetation, based on ecological potential of the land.

3) Forest habitats can also be classified using the system presented by Kotar et al. (1988) and Kotar and Burger (1996).

Plant Communities

There are several classification systems in use in Wisconsin that relate to plant communities. The primary system is the Wisconsin Natural Heritage Inventory Community Classification. This system is built on the work of The Nature Conservancy, Curtis (1971), and the DNR Biodiversity report (WDNR, 1995). Wetland classification can follow one of several systems including the above, Eggers and Reed (1997), the Wisconsin Wetland Inventory (a modification of Cowardin et al., 1979), and the US Fish and Wildlife Service Circular 39 (Shaw and Fredine, 1971). Forest habitat types can also be classified using Kotar et al. (1988) and Kotar and Burger (1996).

Plant Community Classifications

(From the Wisconsin Natural Heritage Inventory 1999 Community classification after the Biodiversity Report. Prepared by Elizabeth Spencer and Eric Epstein.)

Northern Forest	Black Spruce Swamp[1,*]	**Grassland** (cont.)	Northern Sedge Meadow[*]
	Boreal Forest		Sand Barrens
	Forested Seep (also in Driftless Area)		Sand Prairie (or Dry Sand Prairie)
	(Northern) Hardwood Swamp[1,*]		Southern Sedge Meadow[*]
	Mesic Cedar Forest		Wet Prairie[*]
	Mesic Floodplain Terrace		Wet-Mesic Prairie
	Northern Dry Forest		
	Northern Dry-Mesic Forest	**Aquatic**	Emergent Aquatic
	Northern Mesic Forest		Emergent Aquatic-Wild Rice[1]
	Northern Wet Forest[1,*]		Submergent Aquatic
	Northern Wet-Mesic Forest[1,*]		Submergent Aquatic-Oligotrophic[1]
	Tamarack Swamp[1,*]		
Southern Forest	Central Sands Pine - Oak Forest	**Wetland**	Alder Thicket
	Floodplain Forest[1]		Black Spruce Swamp[1]
	Hemlock Relict		Bog Relict
	Pine Relict		Boreal Rich Fen
	Southern Dry Forest		Calcareous Fen
	Southern Dry-Mesic Forest		Coastal Fen
	Southern Hardwood Swamp[1,*]		Coastal Plain Marsh
	Southern Mesic Forest		Ephemeral Pond
	Tamarack Fen[1,*]		Interdunal Wetland
	White Pine - Red Maple Swamp[*]		(Northern) Hardwood Swamp[1]
			Muskeg

Oak Savanna	Cedar Glade Oak Opening Oak Woodland	Northern Sedge Meadow Northern Wet Forest[1] Northern Wet-Mesic Forest[1] Open Bog
Oak/Pine Barrens	Great Lakes Barrens Oak Barrens Pine Barrens	Patterned Peatland Poor Fen Shrub Carr Southern Hardwood Swamp[1]
Grassland	Boreal Rich Fen* Bracken Grassland Calcareous Fen* Coastal Fen* Coastal Plain Marsh* Dry Prairie Dry-Mesic Prairie Mesic Prairie	Southern Sedge Meadow Tamarack Fen[1] Tamarack Swamp[1] Wet Prairie White-Pine Red Maple Swamp
Minor Miscellaneous and Primary Communities	Algific Talus Slope Alkaline Clay Bluff Alvar Bedrock Glade Bedrock Shore Dry Cliff (Curtis' Exposed Cliff)[1] Forested Ridge and Swale	Great Lakes Alkaline Rockshore Great Lakes Beach Inland Beach Lake Dune Moist Cliff (Curtis' Shaded Cliff)[1] Talus Forest (Description in prep)

[1] Communities split (or revised) from Curtis by NHI.
* Communities also listed as wetlands.

Plant Community Descriptions

(From The Wisconsin Natural Heritage Inventory's recognized Natural Communities – Working Document [December 15, 1999 Revision] Prepared by Eric Epstein, Emmet Judziewicz and Elizabeth Spencer)

Alder Thicket

These wetlands are dominated by thick growths of tall shrubs, especially speckled alder (Alnus incana). Among the common herbaceous species are Canada bluejoint grass (Calamagrostis canadensis), orange jewelweed (Impatiens capensis), several asters (Aster lanceolatus, A. puniceus, and A. umbellatus), boneset (Eupatorium perfoliatum), rough bedstraw (Galium asprellum), marsh fern (Thelypteris palustris), arrow-leaved tearthumb (Polygonum sagittatum), and sensitive fern (Onoclea sensibilis). This type is common and widespread in northern and central Wisconsin, but also occurs in the southern part of the state.

Algific Talus Slope

This rare community of southwestern Wisconsin's Driftless Area consists of steep slopes of fractured limestone (dolomite) rock that retains ice and emits cold air throughout the growing season. The cold microhabitats enable the persistence of northern species and "periglacial relicts" such as northern

monkshood (Aconitum noveboracense) and rare terrestrial snails. The woody overstory is often sparse, with scattered small black ash (Fraxinus nigra) and white birch (Betula papyrifera). Mountain maple (Acer spicatum), a northern shrub, may be frequent and extensive beds of bulblet fern (Cystopteris bulbifera) and mosses are characteristic.

Alkaline Clay Bluff

Steep, clay bluffs occur along some stretches of the Great Lakes shorelines and less commonly inland on streams draining into Lake Superior and Lake Michigan. Vegetative cover ranges from forested with pines (Pinus resinosa and P. strobus), white cedar (Thuja occidentalis) and white birch (Betula papyrifera), to bare clay with only a few herbs present. Buffaloberry (Sheperdia canadensis) is a characteristic shrub, but more typically, alders (Alnus incana and A. crispa), as well as herbs such as Canada goldenrod (Solidago canadensis) and pearly everlasting (Anaphalis margaritacea) are dominant. Both native and exotic pioneers such as fireweed (Epilobium angustifolium) and Canada thistle (Cirsium arvense) are common, especially on unstable sites. But it is the semi-stabilized "weeping" bluffs that are of the greatest biological interest. Golden sedge (Carex aurea), orchids and calciphilic fen species may colonize such sites, which can be local repositories of rare or otherwise noteworthy species.

Alvar

This rare community consists of areas of thin discontinuous soil overlying horizontal beds of limestone or dolomite in the vicinity of Great Lakes shorelines. They are characterized by relatively low tree cover and a distinctive biota which includes elements of rock pavement, prairie, savanna and boreal forest communities. Among these are regional endemics, some very rare. This community type is much more common and better-developed in Michigan and Ontario than in Wisconsin. Small coniferous and deciduous trees (cedar, fir, pine, oak, aspen, birch) are scattered among an assemblage of species that can include big bluestem (Andropogon gerardii), little bluestem (Schizachyrium scoparium), Indian-grass (Sorghastrum nutans), and wood lily (Lilium philadelphicum), as well as shoreline plants such as silverweed (Potentilla anserina) and dwarf lake iris (Iris lacustris).

Bedrock Glade

These are xeric, sparsely vegetated non-vertical bedrock exposures with very thin, often discontinous soils. The rock types vary from quartzite (Baraboo Hills, McCaslin Mountain), to basalt (lower St. Croix River valley), to granite (northeastern Wisconsin). The flora can include prairie, savanna, or barrens components, some at their northern range limits. Trees and shrubs are sparse and may include pines, oaks, and cherries. Xerophytic pteridophytes such as rusty woodsia (Woodsia ilvensis) and rock spikemoss (Selaginella rupestris) are characteristic, as are lichens and mosses.

Bedrock Shore

Wave-splashed bedrock shoreline ledges are best developed on sandstone in the Apostle Islands of Lake Superior. Stunted trees of white cedar (Thuja occidentalis), white birch (Betula papyrifera), showy mountain-ash (Sorbus decora) and green alder (Alnus crispa) are often present in crevices. Common herbs are ticklegrass (Agrostis hyemalis), fireweed (Epilobium angustifolium), and Canada goldenrod (Solidago canadensis), but the flora often includes unusual plants such as bird's-eye primrose (Primula mistassinica), brook lobelia (Lobelia kalmii), and three-toothed cinquefoil (Potentilla tridentata).

Black Spruce Swamp (A split from Curtis' Northern Wet Forest)

An acidic conifer swamp forest characterized by a relatively closed canopy of black spruce (Picea mariana) and an open understory in which Labrador-tea (Ledum groenlandicum) and sphagnum mosses (Sphagnum spp.) are often prominent, along with three-leaved false Solomon's-seal (Smilacina trifolia), creeping snowberry (Gaultheria procumbens), and three-seeded sedge (Carex trisperma). The herbaceous understory is otherwise relatively depauperate. This community is closely related to Open Bogs and Muskegs, and sometimes referred to as Forested Bogs outside of Wisconsin.

Bog Relict

These boggy, acidic, weakly minerotrophic peatlands occur south of the Tension Zone within a matrix of "southern" vegetation. Bog relicts are isolated from the more extensive, better-developed and much more widespread stands of this community found in the northern part of the state. Acidophiles present can include sphagnum mosses (Sphagnum spp), sedges (e.g., few seeded sedge, Carex oligosperma), ericaceous shrubs, and insectivorous herbs. Tamarack (Larix laricina) is usually the most common tree and poison-sumac (Toxicodendron vernix) is often formidably abundant in the understory, especially in the moat (or "lagg") at the upland/wetland interface. Examples in southeastern Wisconsin are all somewhat alkaline and may resemble "shrub-fen" communities described in other states.

Boreal Forest

In Wisconsin, mature stands of this forest community are dominated by white spruce (Picea glauca) and balsam-fir (Abies balsamea), often mixed with white birch (Betula papyrifera), white cedar (Thuja occidentalis), white pine (Pinus strobus), balsam-poplar (Populus balsamifera) and quaking aspen (Populus tremuloides). Mountain-ash (Sorbus spp.) may also be present. Common understory herbs are large-leaved aster (Aster macrophyllus), bluebead lily (Clintonia borealis), Canada mayflower (Maianthemum canadense), wild sarsaparilla (Aralia nudicaulis), and bunchberry (Cornus canadensis). Most Wisconsin stands are associated with the Great Lakes, especially the clay plain of Lake Superior, and the eastern side of the northern Door Peninsula on Lake Michigan. Of potential interest from the perspectives of vegetation classification and restoration, white pine had the highest importance value of any tree in the Lake Superior region, as recorded during the original land survey of the mid-1800's.

Boreal Rich Fen

Neutral to alkaline cold open peatlands of northern Wisconsin through which carbonate-rich groundwater percolates. Sphagnum mosses are absent or of relatively minor importance, as calciphilic species (especially the "brown" mosses) predominate. Dominant/characteristic plants include woolly sedge (Carex lasiocarpa), twig rush (Cladium mariscoides), beaked bladderwort (Utricularia cornuta), rushes (Juncus spp.), and Hudson Bay cotton-grass (Scirpus hudsonianus). Shrubby phases also occur, with bog birch (Betula pumila), sage willow (Salix candida), and speckled alder (Alnus incana) present in significant amounts.

Bracken Grassland

These are open upland areas, in northern Wisconsin on sandy soils, dominated by bracken fern (Pteridium aquilinium), Penn sedge (Carex penyslvanica), Kalm's bromegrass (Bromus kalmii), and Canada bluegrass (Poa compressa). There may be a high cover of low shrubs such as blueberries (Vaccinium angustifolium and V. myrtilloides), sweet fern (Comptonia peregrina), prairie willow (Salix humilis), and hazelnuts (Corylus spp.). Other common herbs include poverty oat-grass (Danthonia spicata), Lindley's aster (Aster ciliolatus), gray goldenrod (Solidago nemoralis), and common strawberry (Fragaria virginiana). Exotics are often frequent. There is disagreement on whether bracken grassland should be considered a "natural community" in Wisconsin and elsewhere in the Upper Great Lakes region.

Calcareous Fen

An open wetland found in southern Wisconsin, often underlain by a calcareous substrate, through which carbonate-rich groundwater percolates. The flora is typically diverse, with many calciphiles. Common species are several sedges (Carex sterilis and C. lanuginosa), marsh fern (Thelypteris palustris), shrubby cinquefoil (Potentilla fruticosa), shrubby St. John's-wort (Hypericum kalmianum), Ohio goldenrod (Solidago ohioensis), grass-of-parnassus (Parnassia glauca), twig-rush (Cladium mariscoides), brook lobelia (Lobelia kalmii), boneset (Eupatorium perfoliatum), swamp thistle (Cirsium muticum), and asters (Aster spp.). Some fens have significant prairie or sedge meadow components, and intergrade with those communities.

Cedar Glade

Dry sandstone, quartzite or dolomite exposures vegetated with dense thickets of red cedar (Juniperus virginiana). Red maple (Acer rubrum), Paper birch (Betula papyrifera) and black and bur oaks (Quercus velutina and Q. macrocarpa) may also be present. This community is usually if not always the result of fire

suppression on dry prairies, and in pre-settlement times it may have occurred only where extensive cliffs served as firebreaks. Common herbs include bluestem and grama grasses (Andropogon spp. and Bouteloua spp.), prickly-pear cactus (Opuntia compressa), flowering spurge (Euphorbia corollata), stiff sandwort (Arenaria stricta) and gray goldenrod (Solidago nemoralis).

Central Sands Pine-Oak Forest

This forest community is associated with the Central Sands ecoregion on dry to dry-mesic sites with acid sandy soils. The dominants are white and red pines (Pinus strobus and P. resinosa), oaks (Quercus alba, Q. rubra, and Q. velutina), and on dry-mesic sites, red maple (Acer rubrum). The understory is typically depauperate consisting primarily of huckleberry (Gaylussacia baccata), early blueberry (Vaccinium angustifolium), bracken fern (Pteridium aquilinium), wood anemone (Anemone quinquefolia) and Penn sedge (Carex pensylvanica). Jack pine (Pinus banksiana) is sometimes co-dominant on the driest sites (jack pine – black / Hills oak dominated stands maybe split out in the future).

Coastal Fen

This open peatland community occurs primarily along Great Lakes shorelines, especially near the mouths of estuarine streams. Along Lake Superior most stands are separated from the lake waters by a sand spit. The floating sedge mat is composed mostly of woolly sedge (Carex lasiocarpa); co-dominants are sweet gale (Myrica gale) and bogbean (Menyanthes trifoliata). The following herbs are common in this diverse, circumneutral, nutrient-rich community: twigrush (Cladium mariscoides), marsh horsetail (Equisetum fluviatile), a spikerush (Eleocharis elliptica), intermediate bladderwort (Utricularia intermedia), marsh bellflower (Campanula aparinoides), narrow-leaved willow-herb (Epilobium leptophyllum), water-parsnip (Sium suave), and bog willow (Salix pedicellaris). Coastal fens are distinguished from open bogs and poor fens (which may adjoin them in the same wetland complex) by the lack of Sphagnum spp. mosses, higher pH, and direct hydrologic connection to the Great Lakes. They are distinguished from rich fens by the absence of indicator species such as linear-leaved sundew (Drosera linearis), grass-of-parnassus (Parnassia glauca), false asphodel (Tofiedia glutinosa) and a spikerush (Eleocharis rostellata).

Coastal Plain Marsh

Sandy to peaty-mucky lakeshores, pondshores, depressions, and ditches in and around the bed of extinct glacial Lake Wisconsin may harbor assemblages of wetland species including some which are significantly disjunct from their main ranges on the Atlantic Coastal Plain. There is often a well-developed concentric zonation of vegetation. Frequent members of this community are sedges in the genera Cyperus, Eleocharis, Fimbristylis, Hemicarpha, Rhynchospora and Scirpus; rushes (Juncus spp.); milkworts (Polygala cruciata and P. sanguinea), toothcup (Rotala ramosior), meadow-beauty (Rhexia virginica), grass-leaved goldenrod (Euthamia graminifolia), hardhack (Spiraea tomentosa), lance-leaved violet (Viola lanceolata), and yellow-eyed grass (Xyris torta).

Dry Cliff (Exposed Cliff of Curtis' community classification)

These dry vertical bedrock exposures occur on many different rock types, which may influence species composition. Scattered pines, oaks, or shrubs often occur. However, the most characteristic plants are often the ferns, common polypody (Polypodium vulgare) and rusty woodsia (Woodsia ilvensis), along with herbs such as columbine (Aquilegia canadensis), harebell (Campanula rotundifolia), pale corydalis (Corydalis sempervirens), juneberry (Amelanchier spp.), bush-honeysuckle (Diervilla lonicera), and rock spikemoss (Selaginella rupestris).

Dry Prairie

This grassland community occurs on dry, often loess-derived soils, usually on steep south or west facing slopes or at the summits of river bluffs with sandstone or dolomite near the surface. Short to medium-sized prairie grasses: little bluestem (Schizachyrium scoparium), side-oats grama (Bouteloua curtipendula), hairy grama (B. hirsuta), and prairie dropseed (Sporobolus heterolepis), are the dominants in this community. Common shrubs and forbs include lead plant (Amorpha canescens), silky aster (Aster sericeus), flowering spurge (Euphorbia corollata), purple prairie-clover (Petalostemum purpureum), cylindrical blazing-star

(Liatris cylindracea), and gray goldenrod (Solidago nemoralis). Stands on gravelly knolls in the Kettle Moraine region of southeastern Wisconsin and along the St. Croix River on the Minnesota – Wisconsin border may warrant recognition, at least at the subtype level.

Dry-Mesic Prairie

This grassland community occurs on slightly less droughty sites than Dry Prairie and has many of the same grasses, but taller species such as big bluestem (Andropogon gerardii) and Indian-grass (Sorghastrum nutans) dominate. Needle grass (Stipa spartea) may also be present. The herb component is more diverse than in Dry Prairies, including many species that occur in both Dry and Mesic Prairies.

Emergent Aquatic

These open, marsh, lake, riverine and estuarine communities with permanent standing water are dominated by robust emergent macrophytes, in pure stands of single species or in various mixtures. Dominants include cat-tails (Typha spp.), bulrushes (particularly Scirpus acutus, S. fluviatilis, and S. validus), bur-reeds (Sparganium spp.), giant reed (Phragmites australis), pickerel-weed (Pontederia cordata), water-plantains (Alisma spp.), arrowheads (Sagittaria spp.), and the larger species of spikerush such as (Eleocharis smallii).

Emergent Aquatic - Wild Rice

This open community is an emergent macrophyte type, with wild rice (Zizania aquatica) as the dominant species. The substrate usually consists of poorly-consolidated, semi-organic sediments. Water fertility is low to moderate, and a slow current is present. Wild rice beds have great cultural significance to native peoples, and are important wildlife habitats.

Ephemeral Pond

These ponds are depressions with impeded drainage (usually in forest landscapes), that hold water for a period of time following snowmelt but typically dry out by mid-summer. Common aquatic plants of these habitats include yellow water crowfoot (Ranunculus flabellaris), mermaid weed (Proserpinaca palustris), Canada bluejoint grass (Calamagrostis canadensis), floating manna grass (Glyceria septentrionalis), spotted cowbane (Cicuta maculata), smartweeds (Polygonum spp.), orange jewelweed (Impatiens capensis), and sedges. Ephemeral ponds provide critical breeding habitat for certain invertebrates, as well as for many amphibians such as frogs and salamanders.

Floodplain Forest (replaces in part the Southern Wet and Southern Wet-Mesic Forests of Curtis)

This is a lowland hardwood forest community that occurs along large rivers, usually stream order 3 or higher, that flood periodically. The best-development occurs along large rivers in southern Wisconsin, but this community is also found in the north. Canopy dominants may include silver maple (Acer saccharinum), river birch (Betula nigra), green ash (Fraxinus pennsylvanica), hackberry (Celtis occidentalis), swamp white oak (Quercus bicolor), and cottonwood (Populus deltoides). Northern stands are often species poor, but balsam-poplar (Populus balsamifera), bur oak (Quercus macrocarpa), and box elder (Acer negundo) may replace some of the missing "southern" trees. Buttonbush (Cephalanthus occidentalis) is a locally dominant shrub and may form dense thickets on the margins of oxbow lakes, sloughs and ponds within the forest. Nettles (Laportea canadensis and Urtica dioica), sedges, ostrich fern (Matteuccia struthiopteris) and gray-headed coneflower (Rudbeckia laciniata) are important understory herbs, and lianas such as Virginia creepers (Parthenocissus spp.), grapes (Vitis spp.), Canada moonseed (Menispermum canadense), and poison-ivy (Toxicodendron radicans) are often common. Among the striking and characteristic herbs of this community are cardinal flower (Lobelia cardinalis) and green dragon (Arisaema dracontium).

Forested Ridge and Swale

This is a complex of semi- to fully-stabilized, often forested beach / dune ridges alternating with wet open to forested swales, found on the shores of the Great Lakes but best-developed along Lake Michigan. Both parallel the coast and offer exceptionally complex and diverse habitats for wetland, upland, and Great Lakes shoreline plants. Ridges may support assemblages similar to boreal, northern mesic, or northern dry-mesic forests. Water depth is a controlling factor in the swales, and the vegetation may run the gamut from open

(emergent marsh, fen, or sedge meadow), shrub (bog birch, alder), or forested wetlands (often white cedar, black ash are prominent in these).

Forested Seep

These are shaded seepage areas with active spring discharges in (usually) hardwood forests that may host a number of uncommon to rare species. The overstory dominant is frequently black ash (Fraxinus nigra), but yellow birch (Betula allegheniensis), American elm (Ulmus americana) and many other tree species may be present including conifers such as hemlock (Tsuga canadensis) or white pine (Pinus strobus). Understory species include skunk cabbage (Symplocarpus foetidus), water-pennywort (Hydrocotyle americana), marsh blue violet (Viola cucullata), swamp saxifrage (Saxifraga pennsylvanica), golden saxifrage (Chysosplenium americanum), golden ragwort (Senecio aureus), silvery spleenwort (Athyrium thelypterioides) and the rare sedges (Carex scabrata and C. prasina). Most documented occurrences are in the Driftless Area, or locally along major rivers flanked by steep bluffs.

Great Lakes Alkaline Rockshore

These are creviced, wave-splashed, nearly horizontal dolomite ledges along Lake Michigan on the Door Peninsula. Depending on lake levels, large expanses of this habitat may be either inundated or exposed during a given year. Common members of this community are the shrubs ninebark (Physocarpus opulifolius), shrubby cinquefoil (Potentilla fruticosa), and the herbs silverweed (Potentilla anserina), goldenrods (especially Solidago hispida), brook lobelia (Lobelia kalmii), gentians (Gentiana spp.), grasses-of Parnassus (Parnassia spp.), Indian paint-brush (Castilleja coccinea), low calamint (Calamintha arkansana) and many other calciphiles. Plants endemic to the Great Lakes shores are significant components of some stands.

Great Lakes Barrens

In Wisconsin, this variant of pine savanna is known from only one sandy site on Lake Superior. The dominant trees in this open stand are wind- and fire-deformed trees, red pines (Pinus resinosa) with white pine (P. strobus) also present. The understory consists of dense growths of lichens with scattered thickets of common juniper (Juniperus communis), early blueberry (Vaccinium angustifolium) and huckleberry (Gaylussacia baccata). Other common plants are hairgrass (Deschampsia flexuosa), ticklegrass (Agrostis hyemalis), false-heather (Hudsonia tomentosa), and bearberry (Arctostaphylos uva–ursi).

Great Lakes Beach

This beach community usually occurs in association with active dune systems. The beaches of the Great Lakes are extremely dynamic features, strongly influenced by water level changes and storm events. They support a suite of very specialized organisms, although unprotected shorelines may be entirely unvegetated. The plant species found in this community include (along Lake Michigan) seaside spurge (Euphorbia polygonifolia) and American sea-rocket (Cakile edentula).

Hemlock Relict

These are isolated hemlock (Tsuga canadensis) stands occuring in deep, moist ravines or on cool, north or east facing slopes in southwestern Wisconsin. Associated trees include white pine (Pinus strobus), and yellow birch (Betula allegheniensis). The groundlayer includes herbaceous species with northern affinities such as shining clubmoss (Lycopodium lucidulum), bluebead lily (Clintonia borealis), canada mayflower (Maianthemum canadense), and woodferns (Dryopteris spp). Cambrian sandstone cliffs are usually nearby and often prominent.

Interdunal Wetland

Wind-created hollows that intersect the water table within active dune fields along the Great Lakes. These maybe colonized by wetland plants, including habitat specialists that are of high conservation significance. Common members of this wetland community on Lake Superior are twig-rush (Cladium mariscoides), species of rushes (especially Juncus balticus), pipewort (Eriocaulon septangulare), the sedge (Carex viridula), ladies-tress orchids (Spiranthes sp.) and bladderworts (Utricularia cornuta and U. resupinata).

Inland Beach

The beaches of inland lakes that experience enough water level fluctuation to prevent the development of a stable shoreline forest or other community may, instead support a specialized biota adapted to sandy or gravelly littoral habitats. The shorelines of such lakes (usually seepage lakes) may be subject to fluctuations of as much as several meters over a few years or decades. The alternation of high and low periods maintains populations of the beach specialists over time, including some rare species of unusual geographic affinity such as the Atlantic Coastal Plain of the eastern United States.

Lake Dune

The dominant plant in these semi-stabilized, open dunes along Great Lakes shorelines, is usually the sand-binding marram grass (Ammophila breviligulata). Frequent associates are common juniper (Juniperus communis), Canada wild-rye (Elymus canadensis), false-heather (Hudsonia tomentosa), beach-pea (Lathyrus japonicus), beach wormwood (Artemisia campestris), sand cherry (Prunus pumila), and various willows (Salix spp.). Two plants endemic to the Great Lakes region, pitcher's thistle (Cirsium pitcheri) and Lake Huron tansy (Tanacetum huronense; possibly now extirpated in Wisconsin), occur in this community along Lake Michigan.

Mesic Cedar Forest

This is a rare upland forest community of mesic sites in northern Wisconsin, characterized by white cedar (Thuja occidentalis) and various associates including hemlock (Tsuga canadensis), white spruce (Abies balsamea), yellow birch (Betula alleghanensis), and white pine (Pinus strobus). The herb layer may contain canada mayflower (Maianthemum canadense), twinflower (Linnaea borealis), clubmosses (Lycopodium spp.), and others. More information is needed on this community type.

Mesic Floodplain Terrace

These are deciduous forests developed on alluvial terraces along rich, infrequently flooding (or flooding only for a very short period) rivers draining into Lake Superior. The dominant trees are usually sugar maple (Acer saccharum), basswood (Tilia americana), and sometimes ashes (Fraxinus spp.). There is a diverse spring ephemeral flora (which in Wisconsin includes many southern species at their northern range limits), but by late spring, these may be overtopped by dense stands of ostrich fern (Matteuccia struthiopteris) and wood-nettle (Laportea canadensis).

Mesic Prairie

This grassland community occurs on rich, moist, well-drained sites. The dominant plant is the tall grass, big bluestem (Andropogon gerardii). The grasses little bluestem (Andropogon scoparius), indian grass (Sorghastrum nutans), porcupine grass (Stipa spartea), prairie dropseed (Sporobolus heterolepis), and tall switchgrass (Panicum virgatum) are also frequent. The forb layer is diverse in the number, size, and physiognomy of the species. Common taxa include the prairie docks (Silphium spp.), lead plant (Amorpha canescens), heath and smooth asters (Aster ericoides and A. laevis), sand coreopsis (Coreopsis palmata), prairie sunflower (Helianthus laetiflorus), rattlesnake-master (Eryngium yuccifolium), flowering spurge (Euphorbia corollata), beebalm (Monarda fistulosa), prairie coneflower (Ratibida pinnata), and spiderwort (Tradescantia ohioensis).

Moist Cliff (Shaded Cliff of the Curtis community classification)

This "micro-community" occurs on shaded (by trees or the cliff itself because of aspect), moist to seeping mossy, vertical exposures of various rock types, most commonly sandstone and dolomite. Common species are columbine (Aquilegia canadensis), the fragile ferns (Cystopteris bulbifera and C. fragilis), wood ferns (Dryopteris spp.), rattlesnake-root (Prenanthes alba), and wild sarsaparilla (Aralia nudicaulis). The rare flora of these cliffs vary markedly in different parts of the state; Driftless Area cliffs might have northern monkshood (Aconitum noveboracense), those on Lake Superior, butterwort (Pinguicula vulgaris), or those in Door County, green spleenwort (Asplenium viride).

Muskeg

Muskegs are cold, acidic, sparsely wooded northern peatlands with composition similar to the Open Bogs (Sphagnum spp. mosses, Carex spp., and ericaceous shrubs), but with scattered stunted trees of black spruce (Picea mariana) and tamarack (Larix laricina). Plant diversity is typically low, but the community is important for a number of boreal bird and butterfly species, some of which are quite specialized and not found in other communities.

Northern Dry Forest

This forest community occurs on nutrient-poor sites with excessively drained sandy or rocky soils. The primary historic disturbance regime was catastrophic fire at intervals of decades to approximately a century. Dominant trees of mature stands include jack and red pines (Pinus banksiana and P. resinosa) and/or Hill's oak (Quercus ellipsoidalis). Large acreages of this forest type were cut and burned during the catastrophic logging of the late 19th and early 20th century. Much of this land was then colonized by white birch (Betula papyrifera) and/or quaking aspen (Populus tremuloides), or converted to pine plantations starting in the 1920s. Common understory shrubs are hazelnuts (Corylus spp.), early blueberry (Vaccinium angustifolium) and brambles (Rubus spp.); common herbs include bracken fern (Pteridium aquilinium), starflower (Trientalis borealis), barren-strawberry (Waldsteinia fragarioides), cow-wheat (Melampyrum lineare), trailing arbutus (Epigaea repens), and members of the shinleaf family (Chimaphila umbellata, Pyrola spp.). Vast acreages of open "barrens" were also planted to pine, or naturally succeeded to densely stocked “dry” forests.

Northern Dry-Mesic Forest

In this forest community, mature stands are dominated by white and red pines (Pinus strobus and P. resinosa), sometimes mixed with red oak (Quercus rubra) and red maple (Acer rubrum). Common understory shrubs are hazelnuts (Corylus spp.), blueberries (Vaccinium angustifolium and V. myrtilloides), wintergreen (Gaultheria procumbens), partridge-berry (Mitchella repens); among the dominant herbs are wild sarsaparilla (Aralia nudicaulis), Canada mayflower (Maianthemum canadense), and cow-wheat (Melampyrum lineare). Stands usually occur on sandy loams, sands or sometimes rocky soils.

Northern Hardwood Swamp (split from Curtis’ Northern Wet-Mesic Forest)

These are northern deciduous forested wetlands that occur along lakes or streams, or in insular basins in poorly drained morainal landscapes. The dominant tree species is black ash (Fraxinus nigra), but in some stands red maple (Acer rubrum), yellow birch (Betula allegheniensis), and (formerly) American elm (Ulmus americana) are also important. The tall shrub speckled alder (Alnus incana) may be locally common. The herbaceous flora is often diverse and may include many of the same species found in Alder Thickets. Typical species are marsh-marigold (Caltha palustris), swamp raspberry (Rubus pubescens), skullcap (Scutellaria galericulata), orange jewelweed (Impatiens capensis), and many sedges (Carex spp.). Soils may be mucks or mucky sands.

Northern Mesic Forest

This forest complex covered the largest acreage of any Wisconsin vegetation type prior to European settlement. Sugar maple (Acer saccharum) is dominant or co-dominant in most stands, while hemlock (Tsuga canadensis) was the second most important species, sometimes occurring in nearly pure stands with white pine (Pinus strobus). Beech (Fagus grandifolia) can be a co-dominant with sugar maple in the counties near Lake Michigan. Other important tree species were yellow birch (Betula allegheniensis), basswood (Tilia americana), and white ash (Fraxinus americana). The groundlayer varies from sparse and species poor (especially in hemlock stands) with woodferns (especially Dryopteris intermedia), bluebead lily (Clintonia borealis), clubmosses (Lycopodium spp.), and Canada mayflower (Maianthemum canadense) prevalent, to lush and species-rich with fine spring ephemeral displays. After old-growth stands were cut, trees such as quaking and bigtoothed aspens (Populus tremuloides and P. grandidentata), white birch (Betula papyrifera), and red maple (Acer rubrum) became and still are important in many second-growth Northern Mesic Forests. Several distinct associations within this complex warrant recognition as communities, and draft abstracts of these are currently undergoing review.

Northern Sedge Meadow

This open wetland community is dominated by sedges and grasses. There are several common subtypes: Tussock meadows, dominated by tussock sedge (Carex stricta) and Canada bluejoint grass (Calamagrostis canadensis); Broad-leaved sedge meadows, dominated by the robust sedges (Carex lacustris and/or C. utriculata); and Wire-leaved sedge meadows, dominated by such species as woolly sedge (Carex lasiocarpa) and few-seeded sedge (C. oligosperma). Frequent associates include marsh bluegrass (Poa palustris), manna grasses (Glyceria spp.), panicled aster (Aster lanceolatus), joy-pye-weed (Eupatorium maculatum), and the bulrushes (Scirpus atrovirens and S. cyperinus).

Northern Wet Forest (revised from Curtis, with Black Spruce and Tamarack Swamps split out)

These weakly minerotrophic conifer swamps, located in the North, are dominated by black spruce (Picea mariana) and tamarack (Larix laricina). Jack pine (Pinus banksiana) may be a significant canopy component in certain parts of the range of this community complex. Understories are composed mostly of sphagnum (Sphagnum spp.) mosses and ericaceous shrubs such as leatherleaf (Chamaedaphne calyculata), Labrador-tea (Ledum groenlandicum), and small cranberry (Vaccinium oxycoccos) and sedges such as (Carex trisperma and C paupercula). The Natural Heritage Inventory has split out two entities, identified (but not strictly defined) by the two dominant species (see Black Spruce Swamp and Tamarack Swamp).

Northern Wet-Mesic Forest (revised from Curtis, with Northern Hardwood Swamp split out)

This forested minerotrophic wetland is dominated by white cedar (Thuja occidentalis), and occurs on rich, neutral to alkaline substrates. Balsam fir (Abies balsamea), black ash (Fraxinus nigra), and spruces (Picea glauca and P. mariana) are among the many potential canopy associates. The understory is rich in sedges (such as Carex disperma and C. trisperma), orchids (e.g., Platanthera obtusata and Listera cordata), and wildflowers such as goldthread (Coptis trifolia), fringed polygala (Polygala pauciflora), and naked miterwort (Mitella nuda), and trailing sub-shrubs such as twinflower (Linnaea borealis) and creeping snowberry (Gaultheria hispidula). A number of rare plants occur more frequently in the cedar swamps than in any other habitat.

Oak Barrens

Black oak (Quercus velutina) is the dominant tree in this fire-adapted savanna community of xeric sites, but other oaks may also be present. Common understory species are lead plant (Amorpha canescens), black-eyed susan (Rudbeckia hirta), round-headed bush clover (Lespedeza capitata), goat's rue (Tephrosia virginiana), june grass (Koeleria cristata), little bluestem (Schizachyrium scoparium), flowering spurge (Euphorbia corollata), frostweed (Helianthemum canadense), false Solomon's-seals (Smilacina racemosa and S. stellata), spiderwort (Tradescantia ohioensis), and lupine (Lupinus perennis). Distribution of this community is mostly in southwestern, central and west central Wisconsin.

Oak Opening

As defined by Curtis, this is an oak-dominated savanna community in which there is less than 50% tree canopy. Historically, oak openings occurred on wet-mesic to dry sites. The few extant remnants are mostly on drier sites, with the mesic and wet-mesic openings almost totally destroyed by conversion to agricultural or residential uses, and by the encroachment of other woody plants due to fire suppression. Bur, white, and black oaks (Quercus macrocarpa, Q. alba and Q. velutina) are dominant in mature stands as large, open-grown trees with distinctive limb architecture. Shagbark hickory (Carya ovata) is sometimes present. American hazelnut (Corylus americana) is a common shrub, and while the herblayer is similar to those found in oak forests and prairies, with many of the same grasses and forbs present, there are some plants and animals that reach their optimal abundance in the "openings".

Oak Woodland

This "forest" community is structurally intermediate between Oak Openings and Southern Dry Forest. The tree canopy cover is high, but frequent low-intensity fires and possibly (in pre-settlement times) browsing by herbivores such as elk, bison, and deer kept the understory relatively free of shrubs and saplings. Much

additional information is needed but it appears that at least some plants (certain legumes, grasses, and composites among them) reached their highest abundance here.

Open Bog

These non-forested bogs are acidic, low nutrient, northern Wisconsin peatlands dominated by Sphagnum spp. mosses that occur in deep layers, often with pronounced hummocks and hollows. Also present are a few narrow-leaved sedge species such as (Carex oligosperma and C. pauciflora), cotton-grasses (Eriophorum spp.), and ericaceous shrubs, especially bog laurel (Kalmia polifolia), leatherleaf (Chamaedaphne calyculata), and small cranberry (Vaccinium oxycoccus). Plant diversity is very low but includes characteristic and distinctive specialists. Trees are absent or achieve very low cover values as this community is closely related to and intergrades with Muskeg. When this community occurs in southern Wisconsin, it is often referred to as a Bog Relict.

Patterned Peatland

Very rare in Wisconsin, this wetland type can be characterized as a herb- and shrub-dominated minerotrophic peatland with alternating moss and sedge-dominated peat ridges (strings) and saturated and inundated hollows (flarks). These are oriented parallel to the contours of a slope and perpendicular to the flow of groundwater. Within a patterned peatland the peat "landforms" differ significantly in nutrient availability and pH. The flora may be quite diverse and includes many sedges of bogs and fens, along with ericads, sundews, orchids, arrow-grasses (Triglochin spp.), and calciphilic shrubs such as bog birch (Betula pumila) and shrubby cinquefoil (Potentilla fruticosa).

Pine Barrens

This savanna community is characterized by scattered jack pines (Pinus banksiana), or less commonly red pines (P. resinosa), sometimes mixed with scrubby Hill's and bur oaks (Quercus ellipsoidalis and Q. macrocarpa), interspersed with openings in which shrubs such as hazelnuts, (Corylus spp.) and prairie willow (Salix humilis) and herbs dominate. The flora often contains species characteristic of "heaths" such as blueberries (Vaccinium angustifolium and V. myrtilloides), bearberry (Arctostaphylos uva-ursi), American hazelnut (Corylus americana), sweet fern (Comptonia peregrina), and sand cherry (Prunus pensylvanica). Also present are dry sand prairie species such as june grass (Koeleria macrantha), little bluestem (Schizachyrium scoparium), silky and sky-blue asters (Aster sericeus and A. azureus), lupine (Lupinus perennis), blazing-stars (Liatris aspera and L. cylindracea), and western sunflower (Helianthus occidentalis). Pines may be infrequent, even absent, in some stands in northern Wisconsin and elsewhere because of past logging, altered fire regimes, and an absence of seed source.

Pine Relict

These isolated stands of white pine (Pinus strobus) and red pine (P. resinosa) or, less commonly, jack pine (P.banksiana), that occur on sandstone outcrops or in thin soils over sandstone in the Driftless Area of southwestern Wisconsin, have historically been referred to as relicts. The understories often contain species with northern affinities such as blueberries (Vaccinium spp.), huckleberry (Gaylussacia baccata), wintergreen (Gaultheria procumbens), pipsissewa (Chimaphila umbellata), and partridge-berry (Mitchella repens), sometimes mixed with herbs typically found in southern Wisconsin's oak forests and prairies.

Poor Fen

This acidic, weakly minerotrophic peatland type is similar to the Open Bog, but can be differentiated by higher pH, nutrient availability, and floristics. Sphagnum (Sphagnum spp.) mosses are common but don't typically occur in deep layers with pronounced hummocks. Floristic diversity is higher than in the Open Bog and may include white beak-rush (Rhynchospora alba), pitcher-plant (Sarracenia purpurea), sundews (Drosera spp.), pod grass (Scheuchzeria palustris), and the pink-flowered orchids (Calopogon tuberosus, Pogonia ophioglossoides and Arethusa bulbosa). Common sedges are (Carex oligosperma, C. limosa, C. lasiocarpa, C. chordorrhiza), and cotton-grasses (Eriphorum spp.).

Sand Barrens

Sand Barrens are herbaceous upland communities that develop on unstable or semi-stabilized alluvial sands along major rivers such the Mississippi and Wisconsin. They are partly or perhaps wholly anthropogenic in origin, occurring on sites historically disturbed by plowing or very heavy grazing. Unvegetated "blow-outs" are characteristic features. Barrens, Dry Prairie and Sand Prairie species such as false-heather (Hudsonia tomentosa), bearberry (Arctostaphylos uva-ursi), sedges (Cyperus filiculmis and C. schweinitzii), sand cress (Arabis lyrata), three-awn grasses (Aristida spp.), rock spikemoss (Selaginella rupestris), and the earthstar fungi (Geaster spp.) are present in this community. Many exotics are present, and rare disturbance dependent species such as fameflower (Talinum rugospermum) occur in some stands.

Sand Prairie (or Dry Sand Prairie)

This dry grassland community is composed of little bluestem (Schizachyrium scoparium), junegrass (Koeleria macrantha), panic grass (Panicum spp.), and crab grass (Digitaria cognata). Common herbaceous species are western ragweed (Ambrosia psilostachya), the sedges (Carex muhlenbergii and C. pensylvanica), poverty-oat grass (Danthonia spicata), flowering spurge (Euphorbia corollata), frostweed (Helianthemum canadense), common bush-clover (Lespedeza capitata), false-heather (Hudsonia tomentosa), long-bearded hawkweed (Hieracium longipilum), stiff goldenrod (Solidago rigida), horsebalm (Monarda punctata), and spiderwort (Tradescantia ohioensis). At least some stands are Barrens remnants now lacking appreciable woody cover, though extensive stands may have occurred historically on broad level terraces along the Mississippi, Wisconsin, Black, and Chippewa Rivers.

Shrub-Carr

This wetland community is dominated by tall shrubs such as red-osier dogwood (Cornus stolonifera), meadow-sweet (Spiraea alba), and various willows (Salix discolor, S. bebbiana, and S. gracilis). Canada bluejoint grass (Calamagrostis canadensis) is often very common. Associates are similar to those found in Alder Thickets and tussock-type Sedge Meadows. This type is common and widespread in southern Wisconsin but also occurs in the north.

Southern Dry Forest

Oaks are the dominant species in this upland forest community of dry sites. White oak (Quercus alba) and black oak (Quercus velutina) are dominant, often with admixtures of red and bur oaks (Q. rubra and Q. macrocarpa) and black cherry (Prunus serotina). In the well developed shrub layer, brambles (Rubus spp.), gray dogwood (Cornus racemosa), and American hazelnut (Corylus americana) are common. Frequent herbaceous species are wild geranium (Geranium maculatum), false Solomon's-seal (Smilacina racemosa), hog-peanut (Amphicarpaea bracteata), and woodland sunflower (Helianthus strumosus).

Southern Dry-Mesic Forest

Red oak (Quercus rubra) is a common dominant tree of this upland forest community type. White oak (Q. alba), basswood (Tilia americana), sugar and red maples (Acer saccharum and A. rubrum), and white ash (Fraxinus americana) are also important. The herbaceous understory flora is diverse and includes many species listed under Southern Dry Forest plus jack-in-the-pulpit (Arisaema triphyllum), enchanter's-nightshade (Circaea lutetiana), large-flowered bellwort (Uvularia grandiflora), interrupted fern (Osmunda claytoniana), Lady Fern (Athyrium Filix-femina), tick-trefoils (Desmodium glutinosum and D. nudiflorum), and hog peanut (Amphicarpa bracteata) . To the detriment of the oaks, mesophytic tree species are becoming increasingly important under current management practices and fire suppression policies.

Southern Hardwood Swamp (A split from Curtis' Southern Wet-Mesic Forest)

This is a deciduous forested wetland community type found in insular basins with seasonally high water tables. It is best developed in glaciated southeastern Wisconsin. The dominant trees are red maple (Acer rubrum), green ash (Fraxinus pennsylvanica), and formerly, American elm (Ulmus americana). The exotic reed canary grass (Phalaris arundinacea) is often dominant in the understory. This Natural Heritage Inventory community partly includes the Southern Wet-Mesic Forest of the Curtis classification.

Southern Mesic Forest

This upland forest community occurs on rich, well-drained soils. The dominant tree species is sugar maple (Acer saccharum), but basswood (Tilia americana) and (near Lake Michigan) beech (Fagus grandifolia) may be co-dominant. Many other trees are found in these forests, including those of the walnut family (Juglandaceae). The understory is typically open (sometimes brushy with species of gooseberry (Ribes) if there is a past history of grazing) and supports fine spring ephemeral displays. Characteristic herbs are spring-beauty (Claytonia virginica), trout-lilies (Erythronium spp.), trilliums (Trillium spp.), violets (Viola spp.), bloodroot (Sanguinaria canadensis), blue cohosh (Caulophyllum thalictroides), mayapple (Podophyllum peltatum), and Virginia waterleaf (Hydrophyllum virginianum).

Southern Sedge Meadow

Widespread in southern Wisconsin, this open wetland community is most typically dominated by tussock sedge (Carex stricta) and Canada bluejoint grass (Calamagrostis canadensis). Common associates are water-horehound (Lycopus uniflorus), panicled aster (Aster simplex), blue flag (Iris virginica), Canada goldenrod (Solidago canadensis), spotted joe-pye-weed (Eupatorium maculatum), broad-leaved cat-tail (Typha latifolia), and swamp milkweed (Asclepias incarnata). Reed canary grass (Phalaris arundinacea) may be dominant in grazed and/or ditched stands. Ditched stands can succeed quickly to Shrub-Carr.

Submergent Aquatic

This herbaceous community of aquatic macrophytes occurs in lakes, ponds, and rivers. Submergent macrophytes often occur in deeper water than emergents, but there is considerable overlap. Dominants include various species of pondweeds (Potamogeton spp.) along with waterweed (Elodea canadensis), slender naiad (Najas flexilis), eel-grass (Vallisneria americana), and species of water-milfoil (Myriophyllum) and bladderworts (Utricularia).

Submergent Aquatic – Oligotrophic

This herbaceous community of distinctive highly specialized submersed, rosette-forming aquatic macrophytes occurs in clear, deep soft-water lakes in northern Wisconsin. The plants grow at depths ranging from the beach line to several meters. Species in this community include American shore-grass (Littorella americana), pipewort (Eriocaulon septangulare), yellow hedge-hyssop (Gratiola aurea), aquatic lobelia (Lobelia dortmanna), a milfoil (Myriophyllum tenellum), brown-fruit rush (Juncus pelocarpus), and quillworts (Isoetes spp.).

Talus Forest (Description in preparation)

Tamarack Fen

This forested wetland community type is a variant of the Tamarack Swamp, but occurs south of the Tension Zone within a matrix of "southern" vegetation types. Poison-sumac (Toxicodendron vernix) is often a dominant understory shrub. Successional stages and processes are not well understood but fire, windthrow, water level fluctuations, and periodic infestations of larch sawfly are among the important dynamic forces influencing this community. Groundwater seepage influences the composition of most if not all stands. Where the substrate is especially springy, skunk cabbage (Symplocarpus foetidus), marsh marigold Caltha palustris), sedges, and a variety of mosses may carpet the forest floor. Drier, more acid stands may support an ericad and sphagnum dominated groundlayer.

Tamarack Swamp (A split from Curtis' Northern Wet Forest)

These weakly to moderately minerotrophic conifer swamps are dominated by a broken to closed canopy of tamarack (Larix laricina) and a frequently dense understory of speckled alder (Alnus incana). The understory is more diverse than in Black Spruce Swamps and may include more nutrient-demanding species such as winterberry holly (Ilex verticillata) and black ash (Fraxinus nigra). The bryophytes include many genera other than Sphagnum. Stands with spring seepage sometimes have marsh-marigold (Caltha palustris) and skunk-cabbage (Symplocarpus foetidus) as common understory inhabitats. These seepage stands have been separated out as a distinct type or subtype in some nearby states and provinces.

Wet Prairie

This is a rather heterogeneous tall grassland community that shares characteristics of prairies, Southern Sedge Meadow, Calcareous Fen and even Emergent Aquatic communities. The Wet Prairie's more wetland-like character can mean that sometimes very few true prairie species are present. Many of the stands assigned to this type by Curtis are currently classified as Wet-Mesic Prairies. The dominant graminoids are Canada bluejoint grass (Calamagrostis canadensis), cordgrass (Spartina pectinata), and prairie muhly (Muhlenbergia glomerata), plus several sedge (Carex) species including lake sedge (C. lacustris), water sedge (C. aquatilis), and woolly sedge (C. lanuginosa). Many of the herb species are shared with Wet-Mesic Prairies, but the following species are often prevalent: New England aster (Aster novae-angliae), swamp thistle (Cirsium muticum), northern bedstraw (Galium boreale), yellow stargrass (Hypoxis hirsuta), cowbane (Oxypolis rigidior), tall meadow-rue (Thalictrum dasycarpum), golden alexander (Zizea aurea), and mountain-mint (Pycnanthemum virginianum).

Wet-Mesic Prairie

This herbaceous grassland community is dominated by tall grasses including big bluestem (Andropogon gerardii), Canada bluejoint grass (Calamagrostis canadensis), cordgrass (Spartina pectinata), and Canada wild-rye (Elymus canadensis). The forb component is diverse and includes azure aster (Aster oolentangiensis), shooting-star (Dodecatheon meadia), sawtooth sunflower (Helianthus grosseseratus), prairie blazing-star (Liatris pycnostachya), prairie phlox (Phlox pilosa), prairie coneflower (Ratibida pinnata), prairie docks (Silphium integrifolium and S. terebinthinaceum), late and stiff goldenrods (Solidago gigantea and S. rigida), and culver's-root (Veronicastrum virginicum).

White Pine - Red Maple Swamp

This swamp community is restricted to the margins of the bed of extinct glacial Lake Wisconsin in the central part of the state. It often occurs along headwaters streams and seepages in gently sloping areas. White pine (Pinus strobus) and red maple (Acer rubrum) are the dominant trees, with other species, including yellow birch (Betula alleghiensis), present in lesser amounts. Common understory shrubs are speckled alder (Alnus incana), winterberry holly (Ilex verticillata), and swamp dewberry (Rubus pubescens); characteristic herbs include skunk cabbage (Symplocarpus foetidus), cinnamon fern (Osmunda cinnamomea), gold thread (Coptis trifolia), and two disjuncts from the eastern United States, bog fern (Thelypteris simulata) and long sedge (Carex folliculata). Sphagnum and other mosses are common.

Wetland Community "Cross-walks"

The following table provides a crosswalk of the different wetland community classifications used in Wisconsin. Eggers and Reed (1997) describe a system for classifying the wetland communities in Wisconsin and Minnesota. That book provides a crosswalk to the terminology in Curtis (1971), the Wisconsin Wetland Inventory (WWI), Cowardin (1979) and the US Fish and Wildlife Service Circular 39 (Shaw and Fredine 1956).

Since WWI is a regional simplification of the Cowardin system, only the WWI nomenclature is referenced in the crosswalk provided below. Cowardin (1979) is the basis for the National Wetland Inventory (NWI) system. In Wisconsin, WWI is used instead of the NWI.

WWI mapping of the state provides wetland/upland boundaries based on aerial photograph interpretation for wetlands greater than 5 acres in size (in some counties it is down to 2 acres), and wetlands less than 5 acres are shown as a point symbol. WWI uses an alpha-numeric system to represent class, subclass, and hydrology. The vegetative classes/subclasses are: **A**quatic/ 1 = submergent, 2 = floating, 3 = rooted floating, 4 = free floating; **E**mergent/ 1 = persistent, 2 = narrow-leaved persistent, 3 = broad-leaved persistent, 4 = non-persistent, 5 = narrow-leaved nonpersistent, 6 = broad-leaved nonpersistent; **M**oss; Forested (**T**)/ 1 = deciduous, 2 = needle-leaved deciduous, 3 = broad-leaved deciduous, 5 = needle-leaved evergreen, 7 = dead, 8 = needle-leaved; **S**crub-shrub/ 1 = deciduous, 2 = needle-leaved deciduous, 3 = broad-leaved deciduous, 4 = evergreen, 5 = needle-leaved evergreen, 6 = broad-leaved evergreen, 7 = dead, 8 = needle-leaved, 9 = broad-leaved; and Open **W**ater. The hydrologic modifier is either: **L**acustrine (lakes or standing water); **R**iverine (rivers or flowing water); and wetlands not associated with lakes or rivers which are also called palustrine wetlands broken into two classes-- **H** for standing water or **K** for wet soil or saturated soil conditions.

Biodiversity Report	**Wisconsin NHI** (*revised or split from Curtis, 1971)	**Eggers and Reed** (1997)	**Wisconsin Wetland Inventory**	**FWS Circular 39**
Wetland	Alder Thicket	Alder Thicket	Broad-leaved deciduous scrub/shrub	Type 6: Shrub swamp
	Black Spruce Swamp*	Coniferous Swamp	Needle-leaved deciduous and evergreen forested	Type 7: Wooded swamp
	Bog Relict	Coniferous Bog	Needle leaved evergreen and deciduous, forested	Type 8: Bog
	Boreal Rich Fen	Open Bog	Moss; and broad-leaved evergreen, scrub/shrub	Type 8: Bog

Biodiversity Report	**Wisconsin NHI** (*revised or split from Curtis, 1971)	**Eggers and Reed** (1997)	**Wisconsin Wetland Inventory**	**FWS Circular 39**
Wetland (cont.)	Calcareous Fen	Calcareous Fen	Narrow-leaved persistent; emergent/wet meadow; and broad-leaved deciduous, scrub/shrub	Type 2: Inland fresh meadow
	Coastal Fen	Sedge Meadow	Narrow-leaved persistent, emergent/wet meadow	Type 2: Inland fresh meadow
	Coastal Plain Marsh	Shallow Marsh	Persistent and non-persistent, emergent	Type 3: Inland shallow fresh marsh
	Ephemeral Pond	Shallow Open Water	Aquatic bed, submergent and floating	Type 5: Inland open fresh water
	Floodplain Forest*	Floodplain Forest	Broad-leaved deciduous forest	Type 1: Seasonally flooded basin or flat
	Interdunal Wetland	Not Covered		
	Muskeg	Open Bog	Moss; and broad-leaved evergreen, scrub/shrub	Type 8: Bog
	Northern Hardwood Swamp*	Hardwood Swamp	Broad-leaved deciduous forest	Type 7: Wooded swamp
	Northern Sedge Meadow	Sedge Meadow	Narrow-leaved persistent, emergent/wet meadow	Type 2: Inland fresh meadow
	Northern Wet Forest*	Coniferous Bog	Needle leaved evergreen and deciduous, forested	Type 8: Bog
	Northern Wet-Mesic Forest*	Hardwood Swamp	Broad-leaved deciduous forest	Type 7: Wooded swamp
	Open Bog	Open Bog	Moss; and broad-leaved evergreen, scrub/shrub	Type 8: Bog
	Patterned Peatland	Not Covered		
	Poor Fen	Open Bog	Moss; and broad-leaved evergreen, scrub/shrub	Type 8: Bog
	Shrub Carr	Shrub Carr	Broad-leaved deciduous scrub/shrub	Type 6: Shrub swamp

Biodiversity Report	Wisconsin NHI (*revised or split from Curtis, 1971)	Eggers and Reed (1997)	Wisconsin Wetland Inventory	FWS Circular 39
Wetland (cont.)	Southern Hardwood Swamp*	Hardwood Swamp	Broad-leaved deciduous forest	Type 7: Wooded swamp
	Southern Sedge Meadow	Sedge Meadow	Narrow-leaved persistent, emergent/wet meadow	Type 2: Inland fresh meadow
	Tamarack Fen*	Coniferous Swamp	Needle-leaved deciduous and evergreen forested	Type 7: Wooded swamp
	Tamarack Swamp*	Coniferous Swamp	Needle-leaved deciduous and evergreen forested	Type 7: Wooded swamp
	Wet Prairie	Wet to Wet-Mesic Prairie	Broad and narrow-leaved, persistent, emergent/wet meadow	Type 1: Seasonally flooded basin or flat Type 2: Inland fresh meadow
	White Pine-Red Maple Swamp	Coniferous Swamp	Needle-leaved evergreen forested	Type 7: Wooded swamp
Aquatic	Emergent Aquatic	Shallow Marsh	Persistent and non-persistent, emergent	Type 3: Inland shallow fresh marsh
	Emergent Aquatic-Wild Rice*	Shallow Marsh	Persistent and non-persistent, emergent	Type 3: Inland shallow fresh marsh
	Submergent Aquatic	Deep Marsh	Aquatic bed, submergent and floating; and persistent and nonpersistent, emergent	Type 4: Inland deep fresh marsh
	Submergent Aquatic-Oligotrophic*	Deep Marsh	Aquatic bed, submergent and floating; and persistent and nonpersistent, emergent	Type 4: Inland deep fresh marsh

DATA STRUCTURE

Common Elements

REQUIRED

- ***Date***
  Month/Day/Year that sampling took place. If data was collected for over a range of time, specify the start and end date in the metadata.

- ***Location***
  Consistent with locational data standard policy.

- ***Community / Habitat / Forest Type***
  The database must contain at least one consistently applied community or habitat classification system specified in the "Plant Communities" subsection or a forest type classification identified under "Taxonomy" within the "Forest Types and Trees" subsection.

- ***Land Ownership Type***
  Data from discrete sites must include the appropriate ownership category for that site.
  Domain: federal, state, county, tribal, private

CONDITIONAL

If database contains species information:

- Genus
- Species
- Common Name
- Taxonomic Number
  Utilizing ITIS, NHI or Forest Service taxonomic ID numbering system.

If multiple methodologies are used:

- Method Code or Abbreviation
  Methodologies must be specified under the Lineage section of the metadata and referenced to a method code or abbreviation included for each record in the database.

Quality Control

No requirements other than those outlined in the ATRI metadata standard.

Taxonomic Format

Both common and scientific name if available. Method of abbreviation should be included in metadata. If a commonly recognized system for abbreviation is not

employed or ITIS, NHI or Forest Service taxonomic IDs are not included, a lookup table must be provided.

Source Codes

Acceptable taxonomic ID numbering systems: ITIS, NHI, US Forest Service. (include link or citation to systems.)

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