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Abstract: Wetlands of Minnesota and Wisconsin are categorized into 15 plant communities. Each community is described and illustrated by color photographs along with descriptions, color photographs and ink drawings of 317 representative plant species. Descriptions include taxonomic characteristics, habitat and notes on wildlife use and economic values.

AUTHORS

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Acknowledgments

This pictorial guide to wetland plants is not an original idea. Pictorial guides covering other groups of plants have also been used as models for this guide, such as *Wildflowers of the Northern Great Plains* by Vance *et al.* (1984). Furthermore, we have borrowed extensively from the authoritative botanical references by Gleason and Cronquist (1991), Swink and Wilhelm (1994), Voss (1972, 1985, 1996), Chadde (2002, 2011), Smith (2003, 2008) and others. We acknowledge this fact by citing these references throughout the guide.

We are indebted to Charles J. Newling (formerly with the U.S. Army Corps of Engineers, Waterways Experiment Station-Vicksburg) and Dr. James H. Zimmerman who were instrumental in formulating the guide. We are also grateful to Dr. Daniel E. Wujek (Central Michigan University), Welby R. Smith (Minnesota Natural Heritage Program) and John M. Kittelson (formerly with the St. Paul District-Corps) for their review and comments on the draft manuscript. Other individuals on the staffs of the St. Paul District-Corps and Southeastern Wisconsin Regional Planning Commission who assisted in preparation of the guide are too numerous to list, but are gratefully acknowledged.

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Foreword

Wetlands are very much in the news today, as their many functions and values are becoming recognized. The belated interest in this neglected natural resource has led to a flurry of efforts to protect, maintain, and restore wetlands in the face of insufficient basic knowledge and educational materials. While these deficiencies are being remedied, many questions are being raised by attempts to regulate uses and to minimize abuses and further losses of this resource. Much of the confusion over the values of wetlands and how to maintain these values arises from the great diversity of systems-hydrological and biological-that is included in the term "wetlands."

Questions that need quick, accurate answers include: How does one recognize a wetland and know what kind of wetland it is? Where does the wetland stop and the upland begin? What particular values does this wetland have -- for the owner and for the public? Which human impacts will affect these values? How might lost values be replaced? In creating or restoring a wetland, what type and/or functions should be stressed, among those that are practical? All these questions share an important principle, that of site specificity. Since each place on Earth is unique, we need "ground truth" to make wise decisions about natural resource husbandry. Thus, the decision-maker must be knowledgeable in the field.

For a start, we certainly need a detailed field guide to wetlands. Plenty of guide books exist for identifying species of plants or animals in the field. However, guides to ecosystems are rare and often too technical and specialized for general use. One reason is that a guide covering a continent or part of one would span too many geographic areas and climates to cover the same species throughout. The complexity of such a guide would thereby be unmanageable.

Here, however, we have a relatively small geographic area -- two states which share just two floristic provinces: the Great Lakes or northern conifer-hardwood forest region and the prairie-hardwood forest transition region. These provinces are separated by a comparatively narrow or steep gradient of climate and vegetation -- the "tension zone" of John Curtis. It is true that similar hydrologic systems and geologic origins may lead to different vegetation in the two zones. For example, a pothole (glacial kettle) may have marsh in the prairie and prairie-oak regions, and swamp forest in the more humid north and east regions where tree seeds can grow on downed logs and water levels fluctuate less drastically.

Nevertheless, the variation in wetlands within Wisconsin and Minnesota is small enough to be manageable, and this guide begins with a simple and workable outline-key for recognizing the main wetland types, which number only fifteen. Vegetation is the handle by which wetland types can be most easily recognized. Of course, vegetation is by no means the only element in wetlands. However, plant life is visible to the unaided eye at all seasons; it reflects the water regime and water quality faithfully; and it influences the wetland type and function. Vegetation also reflects historical factors such as climate, fires, and use/abuse intensity by animals and man. An example of human abuse is the introduction of alien pest species such as carp and purple loosestrife.

To this end, this guide provides relevant information on vegetation and does so in the best way -- by stressing groups of plant species which together characterize each wetland type. The three advantages of using floras -- that is, groups of plant species -- as indicators of wetlands, wetland types, and wetland values are:

1. An individual species used alone might be misidentified and confused with a similar upland plant or one belonging in a different kind of wetland.

2. Individual species have individual limits on their distribution that do not exactly coincide with those of any other, whereas a given wetland is sure to have several, if not all, of the characteristic species present.

3. Since one type of wetland may grade into another, so that several types may occur in a single valley or basin, the locations of groups of species will help describe the actual situation, by mapping for the eye the gradients in environmental conditions that cause the wetland and its functions to vary from place to place. (For example, a peatland may grade from fen to bog, telling you that groundwater discharges at the former end while the latter is rainfed.)

The authors — biologists respectively for the U.S. Army Corps of Engineers, St. Paul District and the Southeastern Wisconsin Regional Planning Commission, Waukesha — represent wide experience in real life situations of wetland identification and natural resource planning. In other words, they know what information is pertinent and what questions to address. In this still experimental area (in both ecology and law), we can trust the direction they give us to understanding the wetland resource.

This work will be invaluable in enabling citizens, organizations, and agency personnel to interpret and apply regulations for land use to specific sites, and to prioritize acquisition and other protection strategies. It is the perfect companion to such publications as Paulson's *Wetlands and Water Quality: A Citizen's Handbook on How to Review Section 404 Permits*. We hope this work will stimulate generation of similar guides to wetlands in other regions.

James Hall Zimmerman
November 12, 1986

Dr. James H. Zimmerman passed away on September 28, 1992. Whether in the classroom or the field, his expertise and insight had a profound influence on many ecologists and botanists, including the authors. We would like to dedicate this wetland guide to his memory.

SDE, DMR

SECTION 1

Introduction

Introduction

PURPOSE

The primary purpose of this guide is to assist U.S. Army Corps of Engineers (Corps) personnel working with the regulatory program under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. It provides an easy-to-use, pictorial guide to wetlands primarily for individuals who are not botanists, although botanists may also find it useful. A secondary purpose is to provide a guide for individuals working with other agencies and programs dealing with wetlands. Finally, this guide serves to enhance public awareness of wetlands by illustrating their diversity and values.

APPLICABILITY

The guide specifically addresses wetland plants and plant communities of Minnesota and Wisconsin (Figures 1 and 2), but is applicable in general to wetlands of the entire Great Lakes Region. Note that the 317 plant species included in the guide do not represent, nor are they intended to represent, a listing of all plant species found in wetlands of Minnesota and Wisconsin. For a complete listing of these species, refer to the botanical references listed in the bibliography.

ORGANIZATION

This guide is organized by wetland plant community. In general, the wetland plant communities are organized according to water permanence, depth and degree of soil saturation. Thus, the guide progresses from deepwater wetlands (I. Shallow, Open Water Communities) to temporary water-holding wetlands (VIII. Seasonally Flooded Basins). Photographs and descriptions are provided for each of the 15 wetland plant communities along with representative plant species of each. A particular plant species can occur not only in the wetland plant community under which it is listed, but in other wetland communities, and in some cases, upland communities. The other communities in which an individual plant species may frequently occur are provided under ECOLOGICAL NOTES. Note that upland plants occasionally occur in wetlands and, conversely, wetland plants occasionally occur in upland habitats. This is especially true in transitional areas between wetlands and uplands.

WETLAND DEFINITION

The definition of wetlands used by the Corps in its regulatory program is:

> Wetlands are those areas inundated or saturated by surface or ground-water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (33 CFR 328).

FIGURE 1 - **Counties of Minnesota**

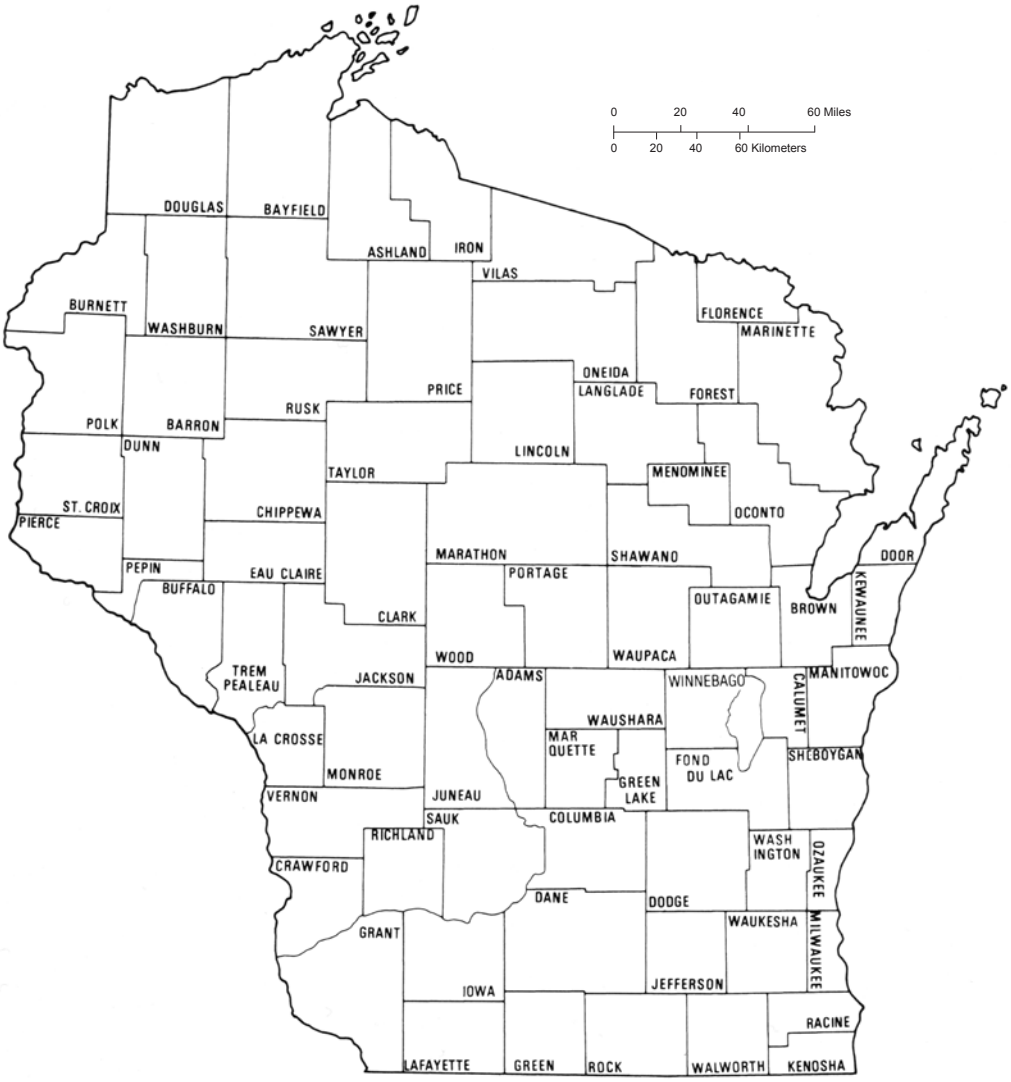

FIGURE 2 - **Counties of Wisconsin**

Refer to the current Corps of Engineers Wetlands Delineation Manual, and applicable regional supplement, for a methodology to apply this definition in the field.

CONCEPT OF A HYDROPHYTE

Wetland plants are hydrophytes (hydro = water, phyte = plant)[1]. These are plants growing in water or on a substrate that at least periodically is deficient in oxygen due to excessive water content. Hydrophytes have morphological, physiological and reproductive adaptations that allow them to thrive in inundated or saturated soils where non-hydrophytes (upland plants) cannot. Communities dominated by hydrophytes are referred to as hydrophytic plant communities.

CLASSIFICATION OF WETLANDS

A number of wetland classification schemes have been developed. Table 1 compares the 15 plant communities of this guide to classification systems developed by Shaw and Fredine (1971), Cowardin *et al.* (1979), Curtis (1971), and the Wisconsin Wetland Inventory. As shown in Table 1, the 15 plant communities of this guide correspond most closely to the wetland plant communities described by Curtis (1971) in *The Vegetation of Wisconsin*.

VEGETATION TENSION ZONE

Throughout the guide are references to a vegetation tension zone. The flora of Minnesota and Wisconsin is arranged in two major floristic provinces. A floristic province is a large area with a relatively uniform flora, delineated by a tension zone in which many species reach a common range boundary (Curtis 1971).

The vegetation tension zone then is a band between two floristic provinces marked by the intermingling of species from both (Curtis 1971). The two floristic provinces in Minnesota and Wisconsin are the "northern forest floristic province" and the "prairie-forest floristic province," located to the north and south of the vegetation tension zone, respectively. The vegetation tension zone and the floristic provinces are illustrated on page 8. The vegetation tension zone through Wisconsin is shown according to Curtis (1971). A tentative vegetation tension zone through Minnesota is extrapolated from the original vegetation map of Minnesota compiled by Marschner (1930).

[1] See Tiner (1991).

TABLE 1

COMPARISON OF WETLAND CLASSIFICATION SYSTEMS

Wetland Plant Community Types of this Guide	Vegetation of Wisconsin (Curtis 1971)	Wisconsin Wetland Inventory	Classification of Wetlands and Deep Water Habitats of the United States (Cowardin et al. 1979)	Fish and Wildlife Service Circular 39 (Shaw and Fredine 1971)
Shallow, Open Water	Submergent aquatic community	Aquatic bed, submergent and floating	Palustrine or lacustrine, littoral; aquatic bed; submergent, floating, and floating-leaved	Type 5: Inland open fresh water
Deep Marsh	Emergent and submergent aquatic community	Aquatic bed,sub-mergent, and floating; and persistent emergent, and nonpersistent	Palustrine or lacustrine, littoral; aquatic bed; submergent, floating, and floating-leaved; and emergent; persistent and nonpersistent	Type 4: Inland deep fresh marsh
Shallow Marsh	Emergent aquatic community	Persistent and nonpersistent, emergent	Palustrine; emergent; persistent and nonpersistent	Type 3: Inland shallow fresh marsh
Sedge Meadow	Northern and southern sedge meadow	Narrow-leaved persistent, emergent/ wet meadow	Palustrine; emergent; narrow-leaved persistent	Type 2: Inland fresh meadow
Fresh (Wet) Meadow		Broad- and narrow-leaved persistent, emergent/wet meadow	Palustrine; emergent; broad- and narrow-leaved persistent	Type 1: Seasonally flooded basin or flat; Type 2: Inland fresh meadow
Wet to Wet-Mesic Prairie	Low (wet to wet-mesic) prairie	Broad- and narrow-leaved persistent, emergent/wet meadow	Palustrine; emergent; broad- and narrow-leaved persistent	Type 1: Seasonally flooded basin or flat; Type 2: Inland fresh meadow
Calcareous Fen	Fen	Narrow-leaved, per-sistent, emergent/wet meadow; and broad-leaved deciduous, scrub/shrub	Palustrine; emergent; narrow-leaved persistent; and scrub/shrub; broad-leaved deciduous	Type 2: Inland fresh meadow
Open Bog	Open bog	Moss; and broad-leaved evergreen, scrub/shrub	Palustrine; moss/lichen; and scrub/shrub; broad-leaved evergreen	Type 8: Bog
Coniferous Bog	Northern wet forest	Needle-leaved evergreen and deciduous, forested	Palustrine; forested: needle-leaved evergreen and deciduous	Type 8: Bog

TABLE 1

COMPARISON OF WETLAND CLASSIFICATION SYSTEMS *(cont.)*

Wetland Plant Community Types of this Guide	Vegetation of Wisconsin (Curtis 1971)	Wisconsin Wetland Inventory	Classification of Wetlands and Deep Water Habitats of the United States (Cowardin et al. 1979)	Fish and Wildlife Service Circular 39 (Shaw and Fredine 1971)
Shrub-Carr	Shrub-carr	Broad-leaved deciduous, scrub/ shrub	Palustrine; scrub/shrub; broad-leaved deciduous	Type 6: Shrub swamp
Alder Thicket	Alder thicket	Broad-leaved deciduous, scrub/ shrub	Palustrine; scrub/ shrub; broad-leaved deciduous	Type 6: Shrub swamp
Hardwood Swamp	Northern wet-mesic forest and southern wet to wet-mesic forest	Broad-leaved deciduous, forested	Palustrine; forested; broad-leaved deciduous	Type 7: Wooded swamp
Coniferous Swamp	Northern wet-mesic forest	Needle-leaved deciduous and evergreen, forested	Palustrine; forested; needle-leaved deciduous and evergreen	Type 7: Wooded swamp
Floodplain Forest	Northern and southern wet-mesic forest	Broad-leaved deciduous, forested	Palustrine; forested; broad-leaved deciduous	Type 1: Seasonally flooded basin or flat
Seasonally Flooded Basin		Flats/unvegetated wet soil; and persistent and non-persistent, emergent /wet meadow	Palustrine; flat; emergent; persistent and non - persistent	Type 1: Seasonally flooded basin or flat

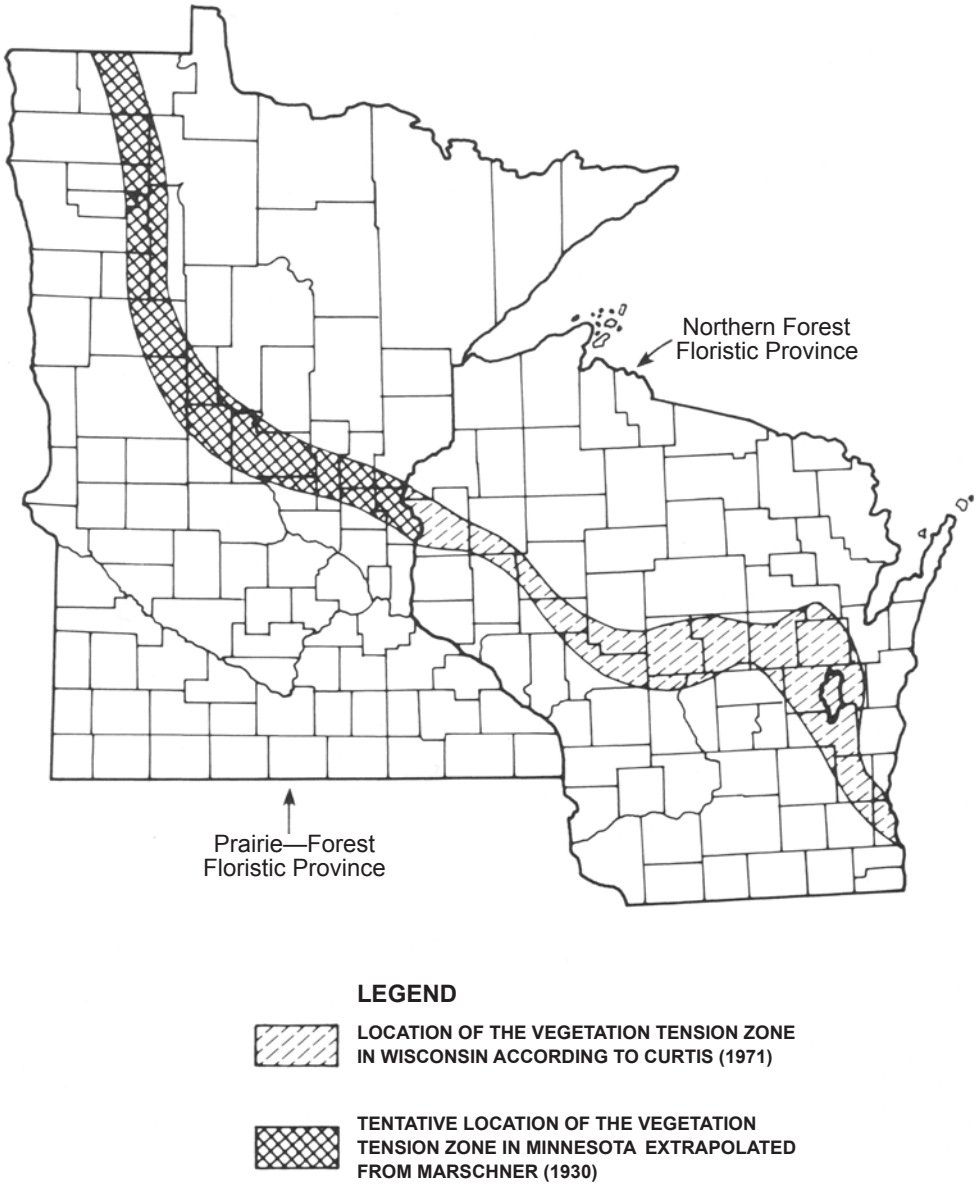

FIGURE 3

(The Wisconsin portion of this figure is adapted from an illustration copyrighted by the University of Wisconsin Press. It is used here by permission.)

PRAIRIE POTHOLES

A portion of the "prairie-forest floristic province" in southern and western Minnesota deserves special mention. It is part of the Prairie Pothole Region (Figure 4). Prairie potholes are shallow, water-holding depressions of glacial origin found in the prairies of north-central United States and south-central Canada (Sloan 1972). These wetlands have great variability in size, depth, water permanence, and water chemistry (Sloan 1972; Stewart and Kantrud 1972). For example, prairie potholes range in size from less than one quarter acre to several thousand acres. In terms of water permanence and depth, prairie potholes range from seasonally flooded basins that hold water for only a few weeks each year, to wet prairies, to shallow and deep marshes, to permanent open water. Water chemistry ranges from fresh, mixosaline, saline, to hypersaline. Multiple year wet and drought cycles are typical in the Prairie Pothole Region.

FIGURE 4
Generalized Original Limits of the Prairie Pothole Region of the U.S. and Prairie Provinces of Canada (adapted from Sanders 1982).

Prairie potholes are extremely important for North American waterfowl production. Although prairie potholes comprise only 10 percent of potential waterfowl breeding habitat in North America, it is estimated that 50 percent of waterfowl production occurs in these wetlands, with an even higher percentage occurring in wet years (Sloan 1972). Agricultural practices continue to degrade or destroy these important wetlands. However, there are federal, state and private programs and participants working to restore prairie potholes and the important functions and values they provide.

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The above photograph illustrates a deep marsh prairie pothole dominated by river bulrush (*Schoenoplectus fluviatilis*) and hardstem bulrush (*Schoenoplectus acutus*) located within the Victory Wildlife Management Area in Big Stone County, Minnesota.

Corps of Engineers

An oblique aerial photograph illustrating a landscape view of the diversity in size and shape, as well as density, of prairie potholes.

PATTERNED PEATLANDS

North of the vegetation tension zone is another group of wetlands deserving special mention. These are the patterned peatlands of northern Minnesota. A notable example is the Red Lake Peatlands, which covers nearly 500 square miles making it one of the largest continuous tracts of peatlands in the conterminous United States (Glaser *et al.* 1981). "Patterned" refers to the distinct and frequently striking landforms that compose these peatlands. Flarks, strings, ovoid islands, teardrop islands, raised bogs and fens are examples of names applied to these patterned landforms. Some of the plant associations of the patterned peatlands correspond to the communities described herein. However, other associations of patterned peatlands are not specifically described. Discussion of these specialized plant associations goes beyond the scope of this generalized guide. For a detailed description of the patterned peatland communities, refer to Glaser *et al.* (1981), Wright *et al.* (1992) and Minnesota Department of Natural Resources (2003).

The following page is a color infrared aerial photograph showing a portion (approximately 16 square miles) of the Red Lake Peatlands in Beltrami County, Minnesota. Visible peat landforms and vegetation patterns include the following (numbers correspond to those on the photograph):

1. Water tract where runoff is channeled across the peat surface; includes strings (peat ridges) and flarks (pools) arranged perpendicular to the direction of water flow. Dominant vegetation includes sedges (*Carex*).

2. Streamlined tree islands (mostly tamarack with some black spruce) tapered in the direction of water movement.

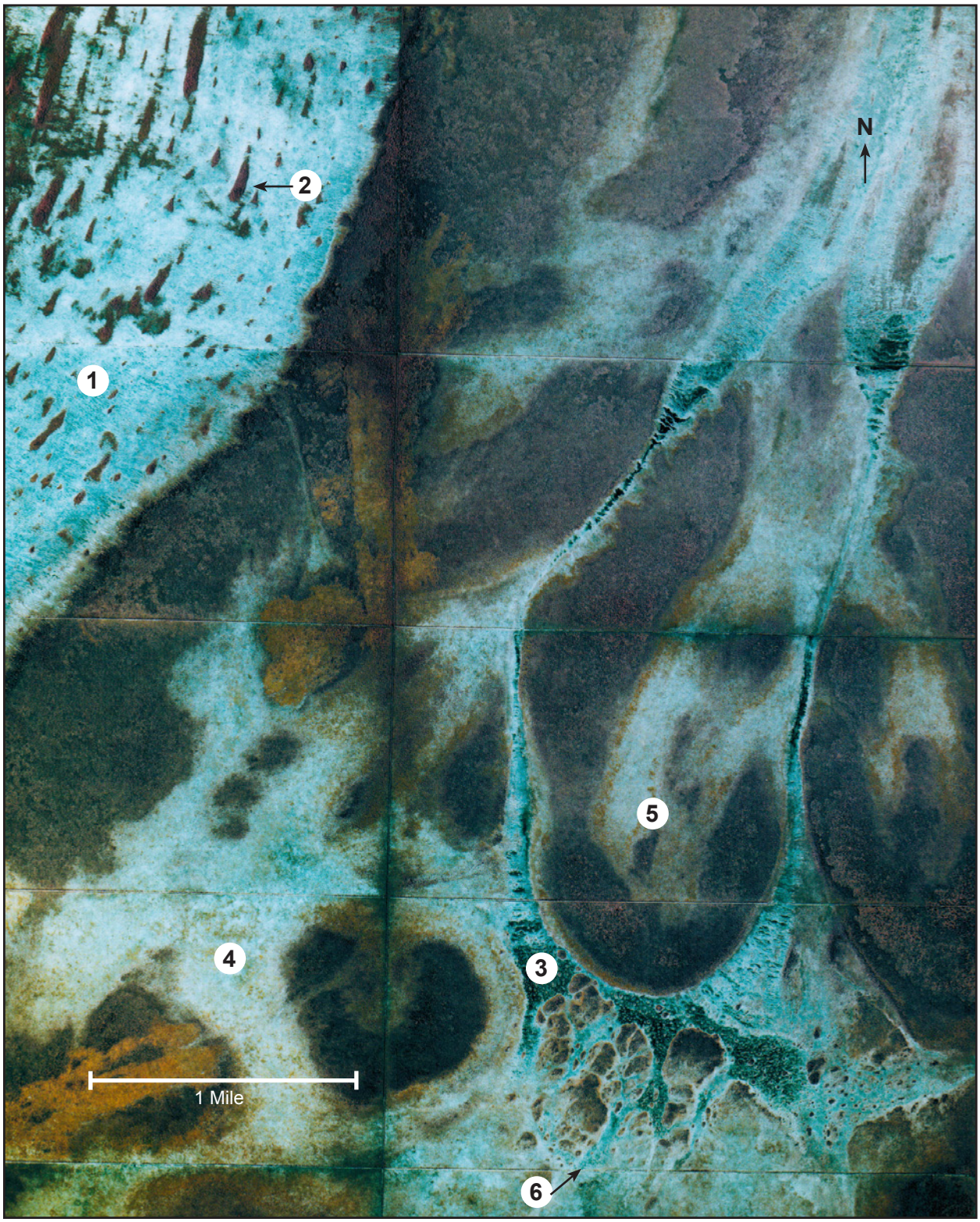
3. A smaller internal water tract.

4. A *Sphagnum* lawn.

5. Ovoid island with a horseshoe-shaped black spruce forest and a non-forested interior.

6. Straight lines are drainage ditches, the result of a failed attempt to drain the peatlands during 1905-1929.

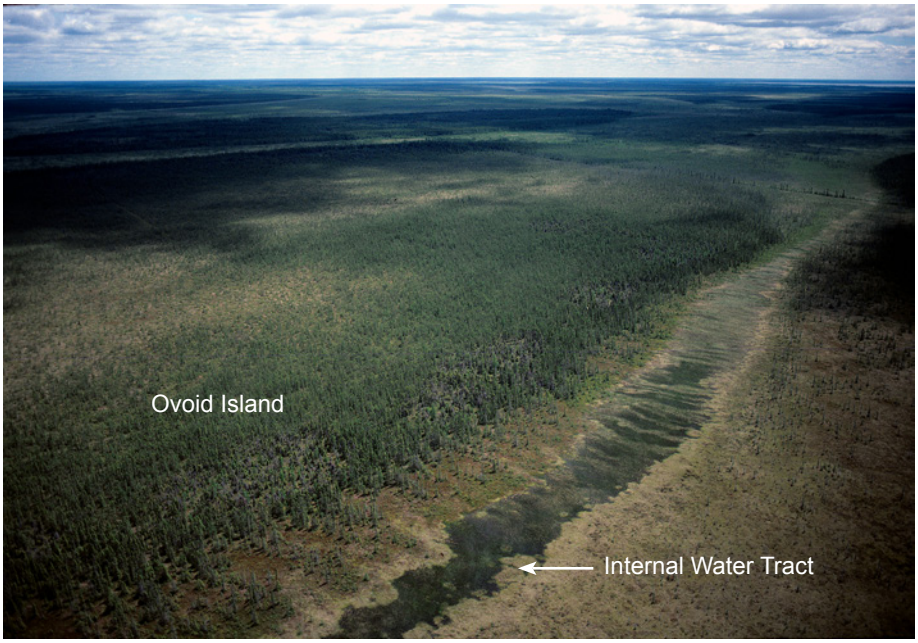
Interpretation of aerial photography is from Wright *et al.* (1992).



Minnesota DNR

Red Lake Peatlands

The above is a color infrared aerial photograph illustrating an example of the striking landforms within the Red Lake Peatlands.



The above are oblique aerial photographs illustrating examples of the landforms within the Red Lake Peatlands.

FARMED WETLANDS

Millions of acres of wetlands in Minnesota and Wisconsin have been effectively drained and converted to non-wetland during the past 150 years, primarily for agricultural use. Millions of additional acres of existing wetlands are: (1) partially drained and cropped; or, (2) cropped under natural conditions (e.g., during dry periods). Partially drained refers to cases where wetland hydrology has been altered by ditching and/or tiling, but the area still retains sufficient hydrology to meet wetland criteria. An example is a deep marsh plant community that was ditched and converted to a fresh (wet) meadow community.

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A wetland within a cropped field in Kenosha County, Wisconsin.

The example of a farmed wetland shown by the photograph below is a shallow marsh prairie pothole basin that had been plowed and planted to corn (*Zea mays*), an upland species, at the start of the growing season. By midsummer, ponding and saturated soil conditions had resulted in drown out and crop stress (yellowed, stunted corn). The dark green vegetation in the far background of the basin is softstem bulrush (*Schoenoplectus tabernaemontani*), an obligate wetland plant recolonizing the basin in spite of plowing earlier in the growing season.

A farmed wetland in Ottertail County, Minnesota.

NATIONAL WETLAND PLANT LIST

As part of the National Wetland Inventory undertaken by the U.S. Fish and Wildlife Service (Service), a wetland plant list was developed by the Service in cooperation with federal interagency review panels (Reed 1988, 1996). Responsibility for the *National Wetland Plant List* was transferred to the Corps in 2006. As of October 2011, Reed (1988) remains the official list used by the Corps for wetland delineations; therefore, the indicator statuses shown herein use this reference. One change is that the (+) and (-) modifiers for the facultative categories have been dropped. The *National Wetland Plant List* is currently in the process of revision and an updated version is expected to be finalized in 2012. Changes in the indicator status of at least a few species included in this Third Edition are expected.

This list ranks individual plant species according to their probability of occurrence in wetlands as shown below:

INDICATOR CATEGORIES:

Wetland Indicator Status	**Description** (Lichvar and Gillrich 2011)	**Estimated Frequency of Occurrence in Wetlands**
Obligate (OBL)	Require standing water or seasonally saturated soils near the surface to assure adequate growth, development, and reproduction and to maintain healthy populations.	>99%
Facultative wetland (FACW)	Depend on and predominately occur with hydric soils, standing water, or seasonally high water tables in wet habitats for assuring optimal growth, development, and reproduction and for maintaining healthy populations. These plants often grow in geomorphic locations where water saturates soils or floods the soil surface at least seasonally.	67-99%
Facultative (FAC)	These plants can occur in wetlands or nonwetlands. They can grow in hydric, mesic, or xeric habitats.	34-66%
Facultative upland (FACU)	These plants are not wetland dependent. They can grow on hydric and seasonally saturated soils, but they develop optimal growth and healthy populations on predominately drier or more mesic sites.	1-33%
Upland (UPL)	These plants occupy mesic to xeric nonwetland habitats. They almost never occur in standing water or saturated soils.	<1%

A wetland indicator status that is in brackets [ ] reflects the opinion of the authors as to the occurrence in wetlands of that particular species.

COEFFICIENT OF CONSERVATISM (C of C)

The C of C is a numerical rating of 0 to 10 that expresses an individual species' relative fidelity, or conservatism, to specific natural habitats. High values indicate that the species is restricted to a very narrow range of habitats. For example, the white lady's-slipper (*Cypripedium candidum*) is found only in intact calcareous fens and wet prairies and has a C of C of 10 in Minnesota and Wisconsin. Conversely, low values indicate low conservatism to specific natural habitats. Species with low values tend to be more ubiquitous in their distributions, tolerating a broader range of environmental conditions including human impacts. Box elder (*Acer negundo*), which has a C of C of 1 in Minnesota and 0 in Wisconsin, is a natural component of floodplain forests; however, box elder has little fidelity to this habitat and can be found in other habitats, including disturbed lands, throughout the region.

Species that are not native to either state have not had specific C of C values assigned but are typically treated as having a C of C of 0.

The C of C is the central component of a vegetation based assessment technique called the Floristic Quality Assessment (FQA). FQA consists of a class of metrics that are derived from vegetation data and the C of C values, such as the mean C of C and the Floristic Quality Index. These metrics have been repeatedly found to be effective wetland condition indicators (Mack and Kentula 2010). FQA could be used to assess the floristic quality of wetlands within a particular planning area or project site. It could also be used to determine compensatory mitigation requirements as well as set performance standards for compensatory mitigation. It is essential that comparisons using FQA be made on an "apples to apples" basis. In other words, FQA is only used to compare plant communities of the same type, e.g., the FQA of a sedge meadow within a project area is only compared to the FQA of other sedge meadows. As discussed by Milburn *et al.* (2007), FQA metric values and expected ranges can vary considerably between the wetland plant communities described herein. For example, the highest FQA metric values for deep marsh communities were found to be considerably lower than those for alder thicket and coniferous swamp communities. This does not mean that deep marshes have a low condition value; rather, it means that the floristic composition of deep marshes is *different* compared to other wetland plant communities and those differences are reflected in the metric scores.

Both Minnesota and Wisconsin have published C of C values for their respective wetland floras (Milburn *et al.* 2007; Bernthal 2003). The text herein will note whether each species is native or introduced as well as list its C of C. For example: **C of C:** Native (5). In some instances, different C of C values were assigned by each state. Both values are shown in those cases.

FACU DOMINATED WETLANDS

FACU species can, in some cases, be dominant species in wetlands. Examples include white pine (*Pinus strobus*) and jack pine (*Pinus banksiana*) swamps. The photograph on the opposing page shows a swamp dominated by white pine in Monroe County, Wisconsin. Soils are Dawson peat, a very poorly-drained organic soil. Hydrology is primarily groundwater seepages. No hydrologic modifications (e.g., ditching, tiling, groundwater extraction) have occurred. Other plant species present are OBL or FACW species such as speckled alder (*Alnus incana* ssp. *rugosa*), skunk cabbage (*Symplocarpus foetidus*) and cinnamon fern (*Osmunda cinnamomea*). Mature white pines have formed raised hummocks caused by shallow rooting, apparently a response to saturated soil conditions.

Another case where FACU species may dominate are seasonally flooded basins and vernal pools that are ponded early in the growing season, but are dry for much of the remainder of the growing season. In addition, FACU species can become established and even dominate wetland basins during periods of drought, such as the multiple year drought cycles experienced in the Prairie Pothole Region.

A white pine swamp.

NOMENCLATURE

Nomenclature generally follows that of the Biota of North America Program (Kartesz 1994), which is used for the *National List of Wetland Plants*. Common names were selected at the discretion of the authors.

MEASUREMENTS

Occasionally, the following format is used for listing measurements of a given character: (2)3-5(6) mm. This means the character is typically 3 to 5 mm. in size, but can range from a minimum of 2 mm. to a maximum of 6 mm.

ABBREVIATIONS

The following abbreviations are used in the text.
mm. -- millimeter(s)
cm. -- centimeter(s)
dm. -- decimeters)
m. -- meter(s)
sp. and spp. -- species (singular) and species (plural)
ssp. -- subspecies
var. -- variety
dbh -- diameter at breast height

PHOTOGRAPHY CREDITS

Photography is by Steve D. Eggers except for the following:
Gary B. Walton: Swamp red currant, dark-scale cottongrass, bristle-berry, clustered bur-reed, alder-leaved buckthorn and rough bedstraw.
Chris Bowman: *Sphagnum capillifolium, S. teres, S. fuscum* and *S. wolfii*.
Minnesota Department of Natural Resources: high altitude aerial photograph of the Red Lake Peatlands.