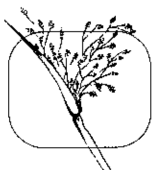
An Overview of Wetland Identification and Delineation Techniques, With Recommendations for Improvement

—Ralph W. Tiner[1]



INTRODUCTION

While there is a long history of interest in the classification, ecology, and natural history of wetlands, the topic of wetland delineation is a recent subject. Delineation is the process of identifying the presence of a wetland and marking its upper (landward) boundary. Prior to the passage of laws to protect or conserve wetlands, there was little need to delineate a wetland-upland boundary. The necessity for wetland delineation arose in the 1960s and 1970s when certain state governments and the federal government began to regulate certain uses of wetland on private property. Massachusetts was the first state to pass wetland laws in the mid-1960s. Today, most eastern and some midwestern states have wetland regulations as do California, Washington, and Oregon. The federal government increased the geographic scope of its regulation under the Clean Water Act in the 1970s and later in 1989.

Locating the jurisdictional limits of wetlands subject to various laws in a consistent and accurate manner requires standardized procedures and a trained workforce to implement them. The former must be written in a manner that produces consistent, repeatable results under most circumstances, yet allows for limited use of professional judgment for extenuating circumstances. The latter requires that both regulators and representatives of the regulated community (namely, environmental consultants) receive training and develop competency in recognizing wetland indicators and applying the procedures to insure proper delineation of jurisdictional limits.

Over the past 37 years, various wetland delineation procedures have been developed. During this period, our knowledge of wetlands has greatly expanded in many subject areas including many pertinent to wetland identification and delineation. For example, the concept of a hydrophyte or hydrophytic vegetation has been refined (Reed 1988; see Tiner 1991 for summary) and a few versions of a national list of potential hydrophytes have been published (e.g., Reed 1988, 1996). In addition, a new concept - hydric soils - has been developed and continues to be improved, with lists of hydric soil series and field indicators of hydric soils published (e.g., U.S.D.A. Soil Conservation Service 1991; Hurt and others 1998). These and other developments (e.g., wetland mapping) have improved our knowledge of how to recognize and delineate wetlands. The National Research Council's book "Wetlands: Characteristics and Boundaries" (1995) and "Wetland Indicators: A Guide to Wetland Identification, Delineation, Classification, and Mapping" (Tiner 1999) provide excellent treatises on the topic of wetland delineation. At the 1999 annual meeting of the Society of Wetland Scientists in Norfolk, Virginia, I presented an overview of wetland identification and delineation techniques and discussed some advances in the 1990s. This paper provides a summary of this presentation. Details on each method can be found in the pertinent manuals, while a comprehensive review of various wetland indicators can be found in Tiner (1999).

THREE BASIC APPROACHES

There are three main approaches to wetland identification and delineation: 1) single indicator methods, 2) multiple indicator methods, and 3) tiered methods. Single indicator methods attempt to use either vegetation or soils alone or a set of individual features unique to wetlands for identification and delineation. Multiple indicator methods typically require the presence of two or more indicators to verify the existence of a wetland. Tiered methods follow a stepwise procedure, first identifying easily recognized wetlands by some obvious wetland indicator and then using a set of indicators for more difficult-to-identify wetlands (e.g., drier-end wetlands).

SINGLE INDICATOR METHODS

At the outset of wetland regulations, the traditional method for wetland identification and delineation required only examination of the vegetation. Northeastern coastal states (e.g., Massachusetts, Rhode Island, Connecticut, New York, and New Jersey) used these procedures to identify tidal wetlands, while some states (e.g., Massachusetts and New York) also used this approach for freshwater wetlands. Wetlands were identified by a "wetland plant community" - where more than 50% of the plant community was represented by "wetland species" (e.g., listed in a specific law or similar types in terms of their frequency of occurrence in wetlands). Unfortunately, there was no explicit guidance in how to determine the 50% threshold. For example, was it based on a list of all species, or only dominant species? Were dominants from all strata to be considered? And if so, was the 50% applied to each stratum to see if the stratum indicated wetland, or was it to be applied to all dominants (treating them as equals re-

[1]The opinions expressed in this paper are those of the author and do not necessarily reflect those of his employer.

gardless of actual cover values)? Different approaches to the 50% rule could lead to varied interpretations, hence the need for clearly articulated procedures. Moreover, no state produced a comprehensive listing of "wetland species." Some states subsequently referred to a regional wetland plant list produced by the federal government (e.g., Reed 1988).

Connecticut took a different approach than adjacent states for identifying freshwater wetlands. By 1972, the U.S.D.A. Soil Conservation Service had completed statewide mapping of soils. The availability of soil maps plus recognition that many freshwater wetland plant species also were common on uplands (e.g., red maple; Acer rubrum) led the state to focus on soil types for inland (nontidal) wetland identification. The state adopted procedures using the presence of poorly drained, very poorly drained, alluvial, and floodplain soils as indicators of regulated inland wetlands. The latter two types also contain soils that do not qualify as ecological wetlands (e.g., soils on the 100-year floodplain). These soils represent soils flooded briefly (less than 1 week) or at infrequent intervals (less often than 50 years out of 100 years). They are places where development would be at risk of flooding if constructed thereon, so the lawmakers included them as regulated areas (wetlands). Identification of regulated inland wetlands in Connecticut requires soil classification to the series level and reference to a list of applicable soils based on the National Cooperative Soils Survey.

In the 1990s, a new approach using indicators unique to wetlands was presented for use in wetland identification and delineation - the Primary Indicators Method (PRIMET; Tiner 1993). This approach was based on procedures used to identify wetlands during wetland mapping projects for the U.S. Fish and Wildlife Service's National Wetlands Inventory. As knowledge of wetland indicators progressed, the NWI Project used a host of indicators to verify the presence of wetlands during its field reviews. At the beginning of the NWI (late 1970s), vegetation and landscape position tended to be emphasized. As knowledge of hydric soils and their indicators was developed, the NWI also began to use hydric soil indicators for wetland recognition (in areas not extensively drained) where necessary. PRIMET simply articulated the procedures employed by the NWI in the 1980s and 1990s. This method utilized a list of vegetation and soil indicators that were unique to wetlands for their identification and delineation, such as the presence of OBL (obligate) hydrophytes or hydric soil properties (see examples listed in Table 1). The use of this technique is restricted to areas without significant hydrologic modification since most reliable wetland indicators are not useful for wetland determinations in significantly drained areas. Kraus (1993) noted that this is the approach that most experienced wetland delineators already used to help identify the wetland boundary for regulatory purposes, and simply complete the necessary data forms for adjacent plant communities(wetland and nonwetland).

The strengths of single indicator methods

Table 1. Some examples of primary indicators used in PRIMET (adapted from Tiner 1993).

Vegetation Indicators	Soil Indicators
OBL[1] species comprise >50% of the abundent species (i.e., a species with >20%cover)	Organic soil (except Folists)
OBL and FACW species comprise >50% of the abundent species	Histic epipedon
OBL perennial species represent at least 10% areal cover and are not restricted to depressional microsites.	Sulfic material within 12 inches (30cm) of the surface
One abundent species has certain morphological adaptations associated with wetlands (e.g., pneumatophores, hypertrophied lenticels, hypertrophied stems, and floating leaves).	Gleyed horizon immeidately below the A-horizon
Algea or peat mosses are materially present	Low chroma matrix with either iron/manganese concretions, oxidized rhizoshperes, or low chroma mottles within 12 inches (30cm) of the surface
	Sandy hydric soil indicators (e.g., thin layer of peat or muck, or vertical streaking or blotchiness, organic concretions, or orstein within 12 inches (30cm))
	Remains of aquatic invertebrates within 12 inches in pothole-like depressions
	Other regional applicable, field-verifiable hydric soil properties (e.g., Hurt et al. 1998)

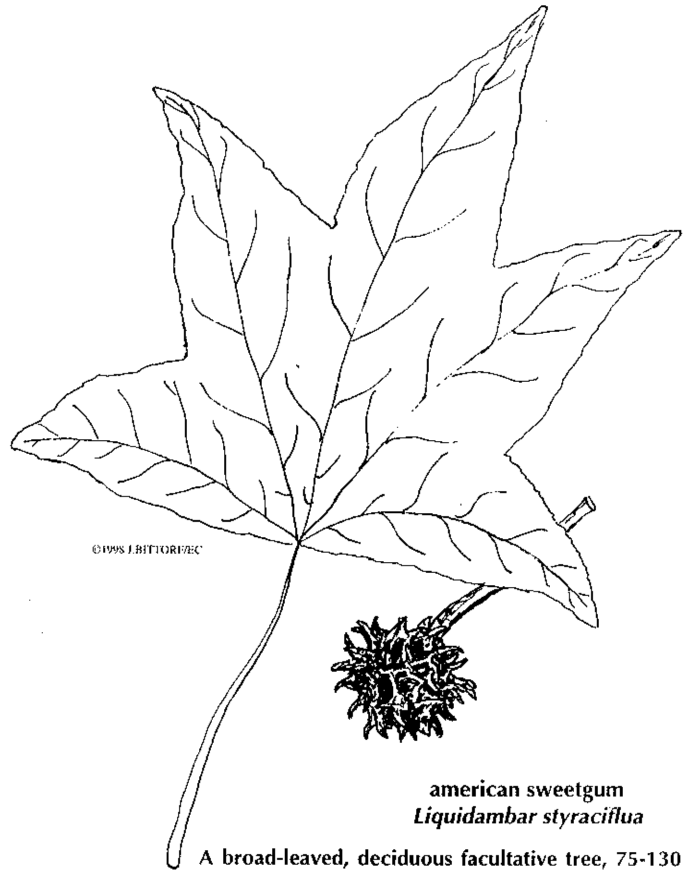
[1]OBL (obligate) species have an estimated probability of occurance in wetlands >99% of the time; FACW (facultative wetland) species have an estimated probability of occurance in wetlands between 67-83% of the time.

are: 1) their rapid assessment capability, 2) efficiency and cost-effectiveness, and 3) their emphasis on what is perceived to be the most important distinguishing feature between wetland and nonwetland.

The disadvantages of single indicator methods vary with the actual approach. Vegetation-based methods have not been developed to sufficiently identify all wetlands. Some may require a time-consuming examination of vegetation when, in fact, vegetation characteristics alone can not adequately identify all wetlands. Some of the procedures were poorly articulated, leaving much room for interpretation including lack of a comprehensive "wetland plant indicator" list and direction on vegetation sampling and analysis. Depending on the rules for using vegetation, the delineation may be too liberal (including nonwetlands), or too conservative (omitting some wetland types), or may produce inconsistent results. Soil-based approaches have similar limitations.

Single indicator methods are popular because they can be applied quickly, economically, and by using the obvious distinguishing feature between wetland and upland.

They also require analysis of soil where unnecessary (e.g., obvious wetlands like marshes, bogs, many swamps, and pocosins). If requiring series classification rather than hydric soil indicator recognition, the wetland identification/delineation method is more time-consuming than necessary and therefore inefficient and costly. PRIMET is the most efficient and cost-effective of the single indicator approaches. It is important to recognize that its placement under the single indicator approaches is debatable as the method was intended to be used in a tiered fashion by applying the most readily observed "primary indicators" first (namely vegetation) and then using the more labor-intensive investigation of soil properties when necessary (e.g., drier-end wetlands and to define the limits of wetlands in low-gradient areas). PRIMET was included here because it recognizes that a single indicator (a unique vegetation or soil characteristic) can be used to identify and delineate wetlands. Although efficient, PRIMET like all single indicator methods fails to gather and evaluate more complete data on wetland vegetation, soils, and signs of hydrology. This is the price of efficiency (i.e., collect only the minimum data needed to make an accurate decision). Further documentation of other features is not prohibited from the single indicator methods, it is simply that other features are not essential to making a wetland determination. Also, none of the single indicator methods can be used for areas subject to significant artificial drainage. They all lack specific procedures for determining what is significant drainage (left up to the user). In fact, none of the other methods developed to-date (multiple indicator or tiered methods) provides explicit evaluation procedures on how to determine when an "wetland area" is effectively drained. The bottomline in these cases is either measure the hydrology and compare to the wetland hydrology threshold (criterion) or use hydrologic models to evaluate the effect of drainage on the wetland.



american sweetgum
Liquidambar styraciflua

A broad-leaved, deciduous facultative tree, 75-130 ft. (23-40m) high, from southern Connecticut to southern Illinois and Oklahoma, south to Florida and Mexico and Central America, fall leaf colors range from yellow to red, as one goes from dry to wet sites, found in woody mesic sites as well as in wet or swampy woodlands, occasionally on sites where water stands almost continuously. (References 2 and 5 on page 38)

The disadvantages of single indicator methods vary with the approach used.

MULTIPLE INDICATORS METHODS

Multiple indicator approaches require the presence of two or more indicators to verify the occurrence of a wetland. Both the U.S. Army Corps of Engineers manual (Environmental Laboratory 1987) and the federal interagency manual (Federal Interagency Committee for Wetland Delineation 1989) use this approach. The former requires positive indicators of three "parameters" - hydrophytic vegetation, hydric soils, and wetland hydrology - except in limited cases. The interagency manual has similar requirements for most situations (verification of three "criteria"), while allowing for the use of two indicators (hydrophytic vegetation and hydric soil) in cases where there is no apparent drainage. Also, the two manuals tend to follow similar procedures, but acceptable indicators are defined somewhat differently. For example, the Corps manual does not consider FAC- (facultative minus) species[2] to be indicators of hydrophytic vegetation, while the interagency manual includes these in its basic indicator for such. Also, the Corps manual does not openly acknowledge the existence of FACU-dominated wetlands, while the interagency manual does. There are also differences in the use of hydrology indicators to verify the presence of wetland hydrology. The Corps methods separate these indicators into two groups - primary and secondary wetland hydrology indicators (Table 2). The presence of one primary indicator is sufficient to verify wetland hydrology, while two secondary indicators are required. The former are simply those indicators listed in the Corps manual, while the latter were later added through Corps guidance memoranda (e.g., Williams 1992). Some of the latter are actually more reliable indicators of the duration and frequency of wetness than the former (e.g., oxidized rhizospheres and water-stained leaves vs. drift lines and sediment deposits) as they require a week or more to develop rather than being capable of being produced by a single short-duration event (e.g., 1 day flood event). See Tiner (1999) for other differences between these two manuals.

The strengths of multiple indicator methods are based on the fact that they force investigators to evaluate vegetation, soils, and hydrology before making a decision and that these methods have been used for over 10 years by federal regulators and the regulated community. Some people feel that having two or more indicators of certain parameters/criteria provides more assurance that the area in question is truly a wetland than if less than two or three parameters/criteria were used. This, however, is not necessarily true, for certain indicators are unique to wetlands and by themselves provide strong evidence of the likely presence of wetland (e.g., plant community dominated by OBL hydrophytes, or an area possessing peaty or mucky organic soils). The National Research Council (1995) recognized that if the hydrology has not been altered, the presence of wetland hydrology (hence, wetland) can be evaluated from substrate characteristics (e.g., hydric soil), plant composition (unequivocal hydrophytic vegetation), or other indicators reflective of frequent, prolonged soil saturation near the surface.

Multiple indicator methods are attractive because they require the use of vegetation, soils, and hydrology to validate the decision regarding wetland or upland.

The weaknesses of multiple indicator methods are: 1) they are not as rapid as other approaches for identifying "obvious" wetlands, 2) they require collecting more data on plant communities than really necessary to evaluate whether the community is hydrophytic or not (inefficient), and 3) depending on the acceptability of certain indicators, the methods can be very conservative (not consistent with ecological wetlands) or in the view of some, too liberal (including all ecological wetlands).

Multiple indicator methods suffer because they are time consuming and unnecessarily tedious, and often provide results that are considered overly conservative or overly liberal.

TIERED METHODS

Tiered approaches to wetland delineation identify wetlands using a varied set of indicators depending on their strength or fidelity to wetlands. Obvious wetlands are readily detected by rapid assessment procedures using vegetation alone (in the simplest cases), while more difficult-to-identify wetlands require more analysis and multiple indicators (or combination of indicators).

Tiered methods use a set of indicators that vary depending upon their accuracy to wetlands.

Several states have adopted these methods including Massachusetts, Rhode Island, New York, and Florida. In addition, the primary indicators method (PRIMET) summarized above (under Single Indicator Methods) was intended to be used in a stepwise (tiered) fashion, using readily observed indicators first (e.g., certain vegetation) for simple wetlands, and requiring examination of soils for more difficult situations where the presence of obvious hydrophytic vegetation was lacking.

Summarized below are four state approaches to demonstrate varied methods. For most, vegetation is the first feature considered. It is used to identify typical, easy-to-identify wetlands. For wetlands lacking the more wetland-specific plants, examination of soils and other signs of wetland hydrology are usually required. The strengths of a tiered approach are that more effort or increased validation is required for more questionable sites and that many, if not most, wetlands can be rapidly identified by rather simple assessments of vegetation. These methods therefore are more efficient and cost-effective than the others. Their main weakness is similar to all procedures/methods: hydrologically disturbed sites require separate analysis and little guidance is given in that regard. Also, tiered approaches like the single indicator methods do not require collection of considerable information on the site's vegetation, soils, and hydrology as the multiple indicators methods do.

Massachusetts Approach

Wetland identification is a two-step

[2]FAC- species have an estimated probability of occurance in wetlands between 34-50% of the time.

process (Jackson 1995). Step 1 considers vegetation alone. Wetlands are recognized where all the dominants are FACW- (facultative wetland minus) and wetter species and the slope is abrupt or distinct between wetland and upland. Such vegetation may also be used to identify wetlands in situations where all proposed work is clearly limited to the buffer zone. Step 2 is for all other situations. In these cases, both vegetation and hydrology indicators are required. Wetland vegetation indicators are those species listed in the state's freshwater wetlands act plus FAC (facultative) or wetter species and plants with certain morphological and physiological adaptations for life in wetlands. The indicators for wetland hydrology include hydric soil properties, direct or indirect evidence of surface water or saturated soils, and plant morphology (i.e., shallow or adventitious roots, buttressed or fluted trunks, hypertrophied lenticels, polymorphic leaves, or aerenchyma). The Massachusetts manual does acknowledge that FAC- and FACU (facultative upland) species are not uncommon in the state's wetlands and that disturbed areas require special considerations in making a wetland determination.

Rhode Island Approach

Wetlands in this state have been traditionally identified by vegetation. In 1994, the State published new procedures in an attempt to identify hydrophytes consistent with the state of the science (Rhode Island Department of Environmental Management 1994). Today, hydrophytic vegetation can be identified by the 50% rule (more than half of the plant community is composed of hydrophytic species) in three ways: 1) plants listed in the state's freshwater wetlands act, 2) plants with an indicator status of OBL on the federal list (Reed 1988), and 3) FACW, FAC, and/or FACU species where such plants or their habitats have "clear" hydrologic indicators of wetlands. The latter indicators include either one from a group of prime indicators or two from a group of lesser indicators. The indicators have been adapted from the Corps manual and PRIMET. The first group includes hydric soil morphological properties, observed saturation or sulfidic materials within 12 inches (30cm), and patches of peat moss (*Sphagnum spp.*). The second group includes distinct water marks, mound and pool topography, soil evidence of recent/periodic flooding, visual observation of surface water, dark or water-stained leaves on the ground, drift or wrack lines, wetland drainage features, morphological plant adaptations, and distinct or prominent pore linings (oxidized rhizospheres) along living roots within 12 inches (30cm). For boundary determinations, vegetation is recommended for areas with abrupt changes in slope, whereas for flat or gently sloping areas, the limits of hydrologic indicators (e.g., hydric soil properties or two of the lesser indicators) are used.

New York Approach

Wetland identification is potentially a three-step process (Browne and others 1996) in this state. Step 1 considers vegetation alone for identifying wet-

Table 2. Wetland hydrology indicators used to identify wetlands regulated by the U.S. Army Corps of Engineers (Environmental Laboratory 1987; Williams 1992).

Primary Indicators	Secondary Indicators
Recorded data (proving wetland hydrology)	Oxidized rhizospheres along living roots within 1 foot (30 cm) of the surface
Visual observation of inumdation during the growing season	Water-stained leaves
Visual observation of soil saturation within 1 foot (30cm) during the growing season	Local soil survey data (verification of wetland hydrology from soil-water features table)
Water marks	FAC neutral test (e.g., more OBL and FACW species than FACU and UPL species)[1]
Drift lines	Others (unspecified)[2]
Water-borne sediment deposits	
Drainage patterns in wetlands	

[1]FACU (facultative upland) species have estimated probability of occurance in wetlands between 1-33% of the time; UPL (upland) species have an estimated probability of occurance in wetlands <1% of the time.

[2]Potentially the following could be included as secondary indicators of wetland hydrology: algal encrustations/mats (aufwuchs), peat moss, moss-lichen lines, remains of aquatic invertebrates, surface scouring (bare areas due to extended flooding), iron precipitates on vegetation or the soil surface, certain plant morphological adaptations (e.g., hypertrophied lenticels and water roots), and crayfish chimneys.

lands. Hydrophytic vegetation and wetlands are definitely present when: 1) more than 50% of the plant community's dominants are FACW or wetter and no FACU or UPL species are dominant, or 2) OBL perennial species collectively represent at least 10% areal cover and are evenly distributed throughout the community (not restricted to depressional microsites), or 3) one or more of the dominant species possesses certain morphological adaptations indicative of prolonged flooding and saturation, or 4) unbroken expanses of peat mosses and other regionally applicable bryophytes are present over persistently saturated soil. Note that most of these indicators are adapted from PRIMET (Table 1). Step 2 requires certain vegetation and hydrology indicators to verify wetlands: FAC or wetter species predominate and either one primary or two secondary hydrology indicators are present (using Corps list; Table 2). Step 3 would be used for areas not satisfying requirements of Step 1 or Step 2. This final step requires the presence of both vegetation and soil indicators: vegetation same as in Step 2 (FAC or wetter species predominate) with hydric soil indicators (adapted from PRIMET including regional hydric soil indicators). Like the Corps and federal interagency manuals, the New York manual also discusses how to handle disturbed sites and problem wetlands.

Florida Approach

The Florida manual involves two steps for wetland identification, with the second step being comprised of multiple steps (Florida Department of Environmental Protection and others 1995). Step 1 allows for identification of wetlands simply on the basis of the state's wetland definition. This permits obvious wetlands with abrupt boundaries to be identified (e.g., marsh, swamp, bayhead, bog, cypress dome, cypress strand, slough, wet prairie, and mangrove swamp). Step 2 requires technical evaluation of various properties and involves four "tests". Test A: The area is wetland where OBL species > UPL species and where hydric soil indicators, riverwash, or hydrologic indicators are present. Test B: The area is wetland where OBL and FACW species have ≥80% coverage and where hydric soil indicators, riverwash, or hydrologic indicators are present. Test C: Wetland is present when one of the following conditions are met: 1) field verification of Argiaquolls, Hydraquents, Humaquepts, Sulfaquents, Umbraqualfs, and Umbraquults, 2) saline sands in the high marsh (coastal marshes), or 3) frequently flooded and depressional map units on soil survey maps, with boundaries verified in the field. Test C cannot be used in pine flatwoods.[3] Test D: Wetland is verified by the presence of hydric soil and one or more hydrologic indicators (vegetation may be used considering reasonable scientific judgment). For disturbed sites, the procedures ask several pertinent questions.

NEEDS FOR IMPROVED TECHNICAL GUIDANCE

The following are recommendations to improve wetland delineation in the future, based largely on the findings of the National Research Council (1995):

1. **Need to develop standardized procedures for evaluating the hydrology of significantly drained wetlands to be able to determine when they are effectively drained (National Research Council 1995).** (Note: This also requires an explicit statement on the minimum wetness threshold for wetland. The National Research Council (1995) defines this as: "saturation within 1 ft of the soil surface for 2 weeks or more during the growing season in most years (about every other year on average)." Is this reference standard adopted by federal and state regulators? If not, the best science is not being used for wetland identification, delineation, and regulation.)

2. **Need more research on the minimum wetness threshold for establishing wetland.** The significant time period for wetland hydrology should be based on considerations of wetland function and values as well as the effect on plant growth (see Tiner 1999 for rationale). Serious consideration should be given to abandoning emphasis on the "growing season."

3. **Need better guidance on how to identify and evaluate problem wetlands and conditions.** This should include development of a fairly comprehensive regionally-based listing of these wetlands and situations.

4. **Need to produce a more up-to-date wetland plant list.** The current list is 11 years old (Reed 1988) and much has been learned about wetland plant distribution in the intervening period. The defined regions are rather broad geographic units, thereby resulting in one indicator status for widely distributed species in a region. The proposed 1996 list (Reed 1996) based on input from numerous field investigators contains more up-to-date classifications and, in some regions, subregional breakdowns. The latter recognizes intraregional differences in plant species fidelity to wetlands and offers a better interpretation of the significance of a plant's occurrence for determining the presence of hydrophytic vegetation than the 1988 list. The 1996 list should be adopted for wetland delineation purposes as it is the most technically accurate listing to date.

5. **Expand the list of hydric soil field indicators.** This is in-progress. Perhaps the creation of regional hydric soil committees as recommended by the National Research Council (1995) would facilitate this effort.

6. **Recognize the existence of aerobic wetlands and provide guidance on their identification.** Such wetlands exist in coldwater mountain streambeds (e.g., willows on cobble-gravel substrates).

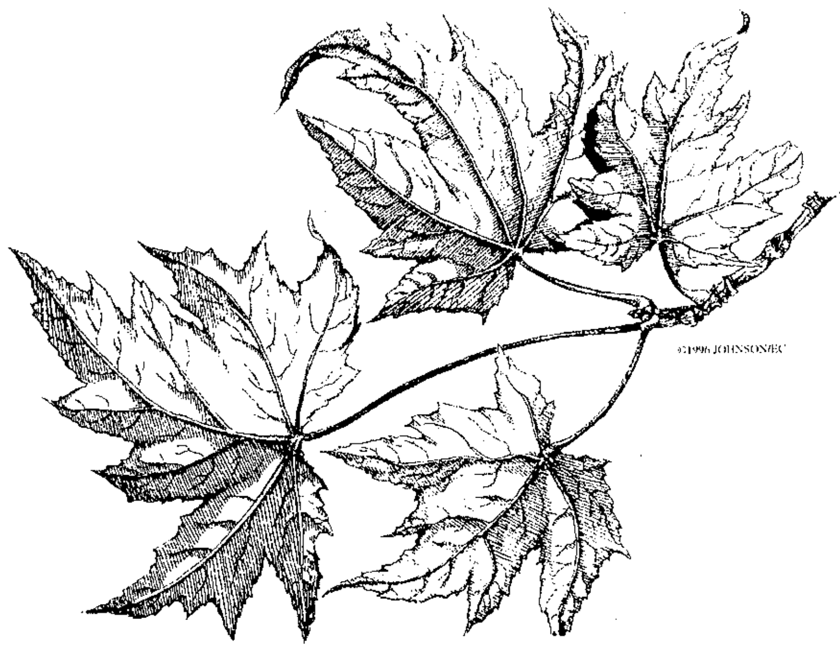
7. **Initiate studies of the more transitional, drier-end wetlands particularly in regions of low, flat relief, such as the coastal plain, major floodplains, and glaciolacustrine plains.** Such work should include benchmark hydrologic studies coupled with an examination of the effect of anaerobiosis on plants and assessments of wetland functions, especially microbial activity important for water quality renovation (denitrification). Do

[3] The regulatory definition of Florida wetlands purposefully excludes longleaf or slash pine flatwoods with an understory dominated by saw palmetto (Florida Department of Environmental Protection et al. 1995).

their hydrology and their effect on plant growth, and performance of nutrient cycling and other wetland functions warrant their inclusion as regulated wetlands? Reference wetlands should be established on federal and state lands for conducting long-term studies of such systems (National Research Council 1995).

8. **Create a quality assurance step that helps insure consistent wetland determinations within and between various regulatory agencies.** Develop regional interagency teams of wetland specialists to aid in reviewing wetland boundary determinations, especially for projects with major impacts. In spite of the Corps' attempt to achieve consistency in wetland delineation, there is still inconsistency among regulators and the regulated community due to varied interpretations of the Corps manual. More standardized procedures rather than general guidelines are required as they provide for more consistent, repeatable results and make it easier for regulators and environmental consultants to make more accurate and technically defensible wetland determinations. Periodic review by a technical team would help improve consistency while providing technical direction and training where needed.

9. **Develop a manual that utilizes our current level of scientific understanding of wetlands following recommendations listed by the National Research Council (1995) and others (e.g., Tiner 1999).** The new wetland delineation manual should adopt a tiered approach to wetland delineation (perhaps using PRIMET as a foundation) as suggested by the National Research Council (1995). The Council recommended abandoning the three-parameter approach by recognizing that if hydrologic data are not available and if the hydrology has not been altered, the presence of wetland hydrology can be evaluated from information on substrate (e.g., hydric soils) or from vegetation (when hydrophytic vegetation is unequivocal), or from other indicators strongly tied to wetland hydrology. At a minimum, update the Corps manual by incorporating additional clarification and procedures published in various regulatory guidance memoranda on the topic of wetland delineation. This would put all applicable references into a single document. In the process, if possible, attempt to make the Corps manual more of a technical standard than a guidance document to improve consistency and repeatability of results.



red maple
Acer Rubrum

Ranging from extreme southeastern Manitoba east to Newfoundland, south to southern Florida and west to east Texas, this tree species has the largest north to south distribution of any tree species along the east coast. This tree is found in many different habitats ranging from swamps and wet stream banks to dry ridges. With local variations, this tree exhibits the following characteristics: red flowers, red fruit, red leafstalks, and red autumn foliage making it an attractive tree throughout the year. (References 2 and 4 on page 38).

10. **Institute a wetland certification program to help guarantee that wetland delineators have the proper knowledge and skills to perform wetland delineations in accordance with various techniques.** The key here is to insure that such individuals are able to identify plants common to wetlands and their boundaries, to interpret relevant soil properties (e.g., separate hydric soils from nonhydric soils), and to apply wetland delineation techniques in the field. Testing of both general knowledge of wetland ecology (written test) and field skills (field test) is essential. The Corps tested a pilot certification program like this in a few districts several years ago (I felt it was a fair test). Unfortunately, the Corps has not implemented the program nationwide. Requiring certification facilitates necessary staff training in both the public and private sectors.

CONCLUDING REMARKS

If regulators are interested in using the best science in wetland identification and delineation, they must be receptive to periodic changes in procedures. While the resistance to change is understandable (e.g., too frequent changes may confuse the regulated community), changes are commonplace in the regulatory environment and changes in wetland identification procedures should pose no more confusion than the frequent changes in regulatory guidance regarding what activity is and what is not regulated (e.g., nationwide permits). Moreover, changes in procedures based on the science are not likely to be as frequent as changes due to policy considerations. If the federal government accepts the leadership role and implements a science-based wetland delineation procedure, it is highly likely that most states and local governments will adopt it and the nation's wetland resource will receive more consideration regarding impacts from proposed developments. A tiered approach would likely be the most acceptable method, as it is efficient and cost-effective. It is also a practical approach that recognizes that many wetlands can be readily identified by a rather simple set of indicators and that more labor-intensive investigation (e.g., examination of soil properties) is needed for more difficult situations. Finally, the tiered approach is one that several states have already embraced. Having a universally acceptable set of procedures for identifying wetlands should be a goal of the federal government.

A tiered method will most likely be adopted because of its effeciency, low cost, practicality, and present use by several states.

Moreover, a science-based approach is more likely to be adopted by all levels of government than one burdened with federal policy decisions. Concurrent to developing a unifying concept, research into the functions of the drier-end wetlands should be undertaken to aid policymakers in making the best decisions regarding their inclusion in the universe of regulated areas. ❀

REFERENCES

Browne, S., S. Crocoll, D. Goetke, N. Heaslip. T. Kerpex, K. Koget, S. Sanford, and D. Spada. 1996. Freshwater Wetlands Delineation Manual. New York State Department of Environmental Conservation, Division of Fish and Wildlife, Albany, NY.

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Tech. Rpt. Y-87-1. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Federal Interagency Committee for Wetland Delineation. 1989. Federal Manual for Identifying and Delineating Jurisdictional Wetlands. Cooperative technical publication. U.S. Army Corps of Engineers, U.S Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S.D.A. Soil Conservation Service, Washington, DC.

Florida Department of Environmental Protection, South Florida Water Management District, St. John's River Water Management District, Suwannee River Water Management District, Southwest Florida Water Management District, and Northwest Florida Water Management District. 1995. The Florida Wetlands Delineation Manual. Florida Department of Environmental Protection, Wetland Evaluation and Delineation Section, Tallahassee, FL.

Hurt, G.W., P.M. Whited, and R.F. Pringle (editors). 1998. Field Indicators of Hydric Soils in the United States, ver. 4.0. U.S.D.A. Natural Resources Conservation Service, Fort Worth, TX.

Jackson, S. 1995. Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act. Massachusetts Department of Environmental Protection, Division of Wetlands and Waterways, Boston, MA.

Kraus, M. 1993. Wetland identification and delineation manuals: where are we? Environmental Concern, Inc., St. Michaels, MD. Wetland J. 5: 8, 13.

National Research Council. 1995. Wetlands Characteristics and Boundaries. National Academy Press, Washington, DC.

Reed, P.B., Jr. 1988. National List of Plant Species that Occur in Wetlands: 1988 National Summary. Biol. Rpt. 88(24). U.S. Fish and Wildlife Service, Washington, DC.

Reed, P.B., Jr. (compiler). 1996. Revision of the National List of Plant Species that Occur in Wetlands. In cooperation with the National and Regional Interagency Review Panels. U.S. Fish and Wildlife Service, Washington, DC.

Rhode Island Department of Environmental Management. 1994. Rules and Regulations Governing the Administration and Enforcement of the Freshwater Wetlands Act. Providence, RI.

Tiner, R.W. 1991. The concept of a hydrophyte for wetland identification. BioScience 41: 236-247.

Tiner, R.W. 1993. The primary indicators method - a practical approach to wetland recognition and delineation in the United States. Wetlands 13: 50-64.

Tiner, R.W. 1999. Wetland Indicators: A Guide to Wetland Identification, Delineation, Classification, and Mapping. Lewis Publishers, CRC Press, Boca Raton, FL.

U.S.D.A. Soil Conservation Service. 1991. Hydric Soils of the United States. In cooperation with the National Technical Committee for Hydric Soils. Washington, DC.

Williams, MG A.E. 1992. U.S. Army Corps of Engineers memorandum on clarification and interpretation of the 1987 manual. March 6, 1992.

ABOUT THE AUTHOR

Ralph W. Tiner

Ralph Tiner is the Regional Coordinator for the U.S. Fish and Wildlife Service's National Wetland's Inventory in the Northeastern United States.

U.S. Fish & Wildlife Service
Region 5
300 Westgate Center Drive
Hadley, MA 01035
ph: (413) 253-8658
fax: (413) 253-8482