

# Vermont

## Wetland Resources

**R**ecent estimates of the area covered by wetlands in Vermont range from 4 to 6 percent of the State's total area. Many of the State's wetlands are small; about 80 percent are less than 10 acres (Parsons, 1988a). The largest wetlands are in the broad valleys of north-eastern Vermont and in the flood plains and deltas of rivers that discharge into Lake Champlain (fig. 1).

Despite their small collective area, wetlands are an integral part of Vermont's natural resources. They provide essential habitat for certain types of wildlife and vegetation, including rare and endangered species. Wetlands provide timber and opportunities for hunting and fishing; education and research; and bird, wildlife, and plant observation that all boost the tourist industry and economy. Beneficial wetland functions include flood control, bank- and shoreline-erosion control, sediment retention, water filtration, and nutrient uptake. In recognition of the importance of wetlands, many government and private organizations have worked to preserve wetlands and educate the public about wetland values. For example, wetlands in the delta of the Missisquoi River contain one of the largest great blue heron colonies in the Northeastern United States (Wanner, 1979) and are protected as part of the Missisquoi National Wildlife Refuge.

### TYPES AND DISTRIBUTION

Wetlands are lands transitional between terrestrial and deep-water habitats where the water table usually is at or near the land surface or the land is covered by shallow water (Cowardin and others, 1979). The distribution of wetlands and deepwater habitats in Vermont is shown in figure 2A; only wetlands are discussed herein.

Wetlands can be vegetated or nonvegetated and are classified on the basis of their hydrology, vegetation, and substrate. In this summary, wetlands are classified according to the system proposed by Cowardin and others (1979), which is used by the U.S. Fish and Wildlife Service (FWS) to map and inventory the Nation's wetlands. At the most general level of the classification system, wetlands are grouped into five ecological systems: Palustrine, Lacustrine, Riverine, Estuarine, and Marine. The Palustrine System includes only wetlands, whereas the other systems comprise wetlands and deepwater habitats. Wetlands of the systems that occur in Vermont are described below.

<b>System</b>	<b>Wetland description</b>
Palustrine .....	Wetlands in which vegetation is predominantly trees (forested wetlands); shrubs (scrub-shrub wetlands); persistent or nonpersistent emergent, erect, rooted, herbaceous plants (persistent- and nonpersistent-emergent wetlands); or submersed and (or) floating plants (aquatic beds). Also, intermittently to permanently flooded open-water bodies of less than 20 acres in which water is less than 6.6 feet deep.
Lacustrine .....	Wetlands within an intermittently to permanently flooded lake or reservoir. Vegetation, when present, is predominantly nonpersistent emergent plants (nonpersistent-emergent wetlands), or submersed and (or) floating plants (aquatic beds), or both.
Riverine .....	Wetlands within a channel. Vegetation, when present, is same as in the Lacustrine System.

The FWS National Wetlands Inventory estimated that Vermont contains approximately 243,000 acres of wetlands, including 218,600 acres of palustrine wetland, 800 acres of lacustrine wetland (exclusive of Lake Champlain), and less than 200 acres of riverine wetland, as well as 23,400 acres of lacustrine wetlands in Lake Champlain (Tiner, 1987). The 243,000-acre total represents about 4 percent of the State's area. The Wetlands Office in the Water Quality Division of the Vermont Agency of Natural Resources' Department of Environmental Conservation, considers the State's actual wetland acreage to be as much as 50 percent higher (George Springston, Vermont Agency of Natural Resources, written commun., 1993).

The distribution of wetlands in Vermont is influenced by physiography (fig. 2B). About one-half of the State's wetlands are in the Lake Champlain Valley (Tiner, 1987), either in river flood plains and low-lying areas in valleys, or in deltas, bayheads, and other areas of shallow water in Lake Champlain. Wetlands are sparse in the mountains and southern parts of the New England Upland, where they have formed primarily in river valleys. Several large wetlands are present in the Otter Creek Valley between the Taconic and Green Mountains. About one-third of the State's wetlands are in northeastern Vermont (Tiner, 1987), where they have formed in broad valleys over thick glacial deposits, such as in Victory Basin along the Moose River. Except in the headwaters and a few areas where dams have created backwater conditions along tributaries, wetlands are sparse in the lowlands of the Connecticut River Valley.

Palustrine forested wetlands constitute about 55 percent of Vermont's wetlands (Tiner, 1987). Forested wetlands that have mineral soils rich in organic material are commonly referred to as swamps, whereas wetlands that have organic soils over mineral soils are called peatlands. Forested wetlands in southern Vermont and in the Connecticut River and Lake Champlain Valleys contain hardwood communities similar to those in southern New England wetlands. For example, silver maple and swamp white oak predominate in swamps along Lake Champlain, silver maple and black ash



**Figure 1.** Fall foliage in a cattail marsh along East Creek, southwest of Middleburg. About two-thirds of the wetland has been protected by the Vermont chapter of The Nature Conservancy. (Photograph courtesy of John Roe, The Nature Conservancy.)

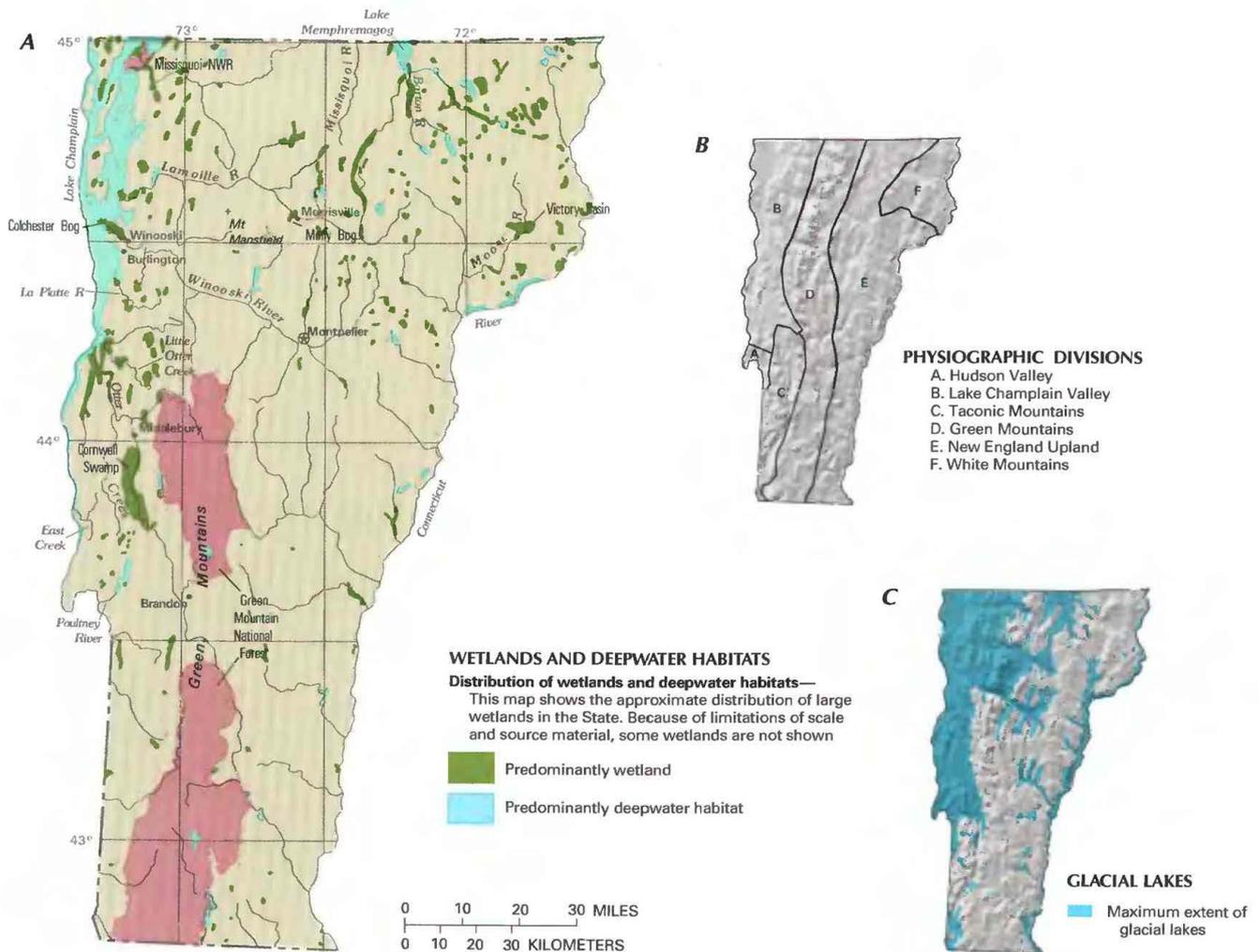
are common in flood plains of major rivers, and red maple-black ash swamps typically are present in poorly drained basins and along small streams (Thompson, 1989). Some red maple swamps, such as Cornwall Swamp near Middlebury, were northern white cedar swamps before they were logged. The distribution of northern white cedar in Vermont corresponds well to the distribution of calcareous soils (Meeks, 1986), which exist where the underlying bedrock is limestone, marble, or other rock that contains calcium carbonate. A few wetlands in extreme southwestern Vermont and in the Lake Champlain Valley contain black gum, a species at the northern extent of its range. Forested wetlands in northeastern Vermont and at higher altitudes elsewhere in the State are similar to those in Canadian wetlands. For example, swamps containing red spruce, balsam fir, and larch are most common in poorly drained basins and along streams, whereas black spruce, larch, and northern white cedar predominate in evergreen forested peatlands (Thompson, 1989):

Peatlands are present throughout Vermont but are less common in the southeastern part of the State. The terms “bog” and “fen” have been used to differentiate peatlands in some classification systems (Damman and French, 1987). Bogs (palustrine forested and

scrub-shrub wetlands) are acidic, nutrient-poor peatlands that have a low species diversity; whereas fens (palustrine forested, scrub-shrub, and persistent-emergent wetlands) are less acidic and have higher nutrient levels and plant-species diversity. The herbaceous-plant community in bogs is generally dominated by sphagnum moss, whereas in fens it typically is dominated by sedges and mosses.

Palustrine scrub-shrub wetlands constitute about 29 percent of Vermont’s wetlands (Tiner, 1987). Scrub-shrub vegetation grows in most wetlands, generally either as a transitional community between emergent wetlands and forested wetlands or upland, or between open water and forested wetlands or upland. Broad-leaved deciduous shrubs such as willow and alder typically predominate in shrub swamps (Thompson, 1989); stunted black spruce and larch and broad-leaved evergreen shrubs such as leatherleaf and labrador tea are characteristic of scrub-shrub communities in bogs; and broad-leaved evergreen shrubs, broad-leaved deciduous shrubs, and northern white cedar commonly grow in fens.

Palustrine emergent wetlands, commonly referred to as marshes, constitute about 11 percent of Vermont’s wetlands (Tiner, 1987). Most of the State’s largest marshes are in the Lake Champlain Valley in deltas and flood plains of rivers that flow into the lake. For



**Figure 2.** Wetland distribution and physical features that determine wetland distribution in Vermont. **A.** Distribution of wetlands and deepwater habitats. **B.** Physiography. **C.** Maximum extent of glacial lakes. (Sources: A, T.E. Dahl, U.S. Fish and Wildlife Service, unpub. data, 1991. B, Physiographic divisions modified from Fenneman, 1946; landforms from EROS Data Center. C, Modified from Meeks, 1986; and Doll, 1970.)

example, extensive marshes have formed near the mouths of the Missisquoi, Lamoille, and Winooski Rivers and also along several smaller rivers and creeks such as the La Platte and Poultney Rivers, and Otter, Little Otter, and East Creeks. A large marsh is in a similar setting at the mouth of the Barton River where it discharges into Lake Memphremagog. Several marshes line creeks and fringe bayheads in the islands and peninsulas of northern Lake Champlain. Elsewhere in Vermont, marshes are generally small and are associated with lacustrine and riverine wetlands. Marsh vegetation is largely determined by the wetland's hydrologic setting or soil type. Cattails and bulrushes are characteristic of semipermanently or permanently flooded marshes; grasses predominate in areas that have permanently saturated mineral soils, such as swales; and sedges are typical of permanently saturated or seasonally flooded peatlands or areas that have muck soils (Thompson, 1989).

Lacustrine wetlands in Vermont include about 600 acres of open water, 200 acres of aquatic-bed wetlands, less than 50 acres of emergent wetlands, and 23,400 acres of unclassified near-shore wetlands in Lake Champlain (Tiner, 1987). Riverine emergent wetlands cover about 174 acres. Many of the shores and bottoms of shallow lakes and rivers are unconsolidated gravel, sand, or rock. Although largely unvegetated, these habitats are classified as wetlands. Most of Vermont's lakes and rivers have areas of shallow water or slow reaches where aquatic-bed and nonpersistent-emergent vegetation is established. These wetlands and associated riparian wetlands are very important to the biological productivity of lakes and rivers.

As a result of recent increases in beaver populations, many riverine and riparian wetlands in smaller streams and rivers have been flooded behind beaver dams. Over time, this flooding promotes a cyclical change from shrub swamps to small ponds and marshes to wet meadows and then back to shrub swamps (George Springston, Vermont Wetlands Office, written commun., 1993). This flooding can be detrimental to existing wetlands but also can create wetlands that have high value to some wildlife, such as waterfowl.

## HYDROLOGIC SETTING

Wetlands are hydrologic features that occur wherever climate and physiography favor the retention of water (Winter, 1992). Wetlands are found along rivers and lakes where flooding is likely to occur, in isolated depressions where surface water collects, and on slopes and surface drainageways where ground water discharges to the land surface in spring or seepage areas (Federal Interagency Committee for Wetland Delineation, 1989). Soil saturation favors the growth of wetland plants and the development of hydric soils. Water either can be present on the surface of wetlands or it can keep underlying soils saturated near the surface with no surface water present (Tiner, 1991).

The timing and duration of the presence of water affects water chemistry, soil development, and plant communities in wetlands. Although degree of wetness is important in the determination of wetland type, many ecological functions of wetlands also depend upon wetland size, position of the wetland in a drainage network, and sources of water (Brinson, 1993). Differences in climate, physiography, and geology influence the hydrology and water quality of wetlands. The complex interactions of these factors with biology, in combination with site history, determine the type of wetland that develops in any particular setting.

Although Vermont is the driest of the New England States, adequate moisture exists to support the development and maintenance of wetlands. Many climatic and hydrologic variables in Vermont are influenced by altitude and mirror the State's topography when mapped. For instance, from the lowlands of the Lake Champlain and Connecticut River Valleys to higher altitudes of the Taconic and Green Mountains, the average summer temperature and

length of the growing season decrease, and the average annual precipitation and runoff increase (Meeks, 1986; Hammond and Cotton, 1986). The structure of plant communities in Vermont's wetlands is influenced by these climatic differences.

The distribution of wetlands in Vermont is partly determined by physiography, glacial history, and characteristics of the underlying bedrock. Areas of steep topography do not retain water long enough for wetlands to form. However, given favorable hydrologic conditions, wetlands form on drainage divides and near mountain tops. For example, a small alpine bog lies near the summit of Mount Mansfield, the highest mountain in the State. Most of Vermont's wetlands, however, are in lowlands, valleys, and depressions that have more favorable hydrologic conditions for wetlands.

Many of the low-lying areas of Vermont are covered by stratified sand, gravel, clay, and silt deposited by glacial meltwater and by modern streams in the time since glaciation. Stratified deposits in the lowlands of the Lake Champlain Valley include marine clay deposited during glaciation when the land was depressed by the weight of glacial ice, allowing an arm of the Atlantic Ocean to occupy the valley (Meeks, 1986). Most mountains and uplands in Vermont are composed of bedrock mantled by glacial till, an unstratified mixture of clay, silt, sand, gravel, and boulders. Both till and fine-grained sediments can restrict drainage and retain surface water. Thus, wetlands occur over till in northeastern Vermont and at higher altitudes elsewhere, over fine-grained glacial-lake and marine deposits in the lowlands of the Lake Champlain Valley, over fine-grained glacial-lake deposits in the lowlands around Lake Memphremagog, and over fine-grained glacial-lake deposits in parts of the Missisquoi, Lamoille, Winooski, and Connecticut River Valleys (fig. 2C). A lack of clay exposures accounts in part for the scarcity of wetlands in parts of the Connecticut River Valley (Fred Larson, Norwich University, oral commun., 1993). In parts of northeastern Vermont, thick sand and till deposits (moraines) contain many poorly drained depressions favorable for wetlands. In a few areas, depressions called kettle holes formed when ice blocks buried by glacial outwash melted. These kettles either filled with water or passed through several successional stages of infilling to become kettle bogs. Molly Bog, near Morrisville, likely developed in this manner (Johnson, 1985). Most Vermont bogs are in small depressions, although some are in basins that also include open water, such as around the margins of small ponds or in lake-level basins cut off from the influence of lake water. The absence of extensive peatlands in northern Vermont is due to the mountainous terrain and the limited extent of glacial outwash and glacially derived surface features in Vermont (Johnson, 1985).

Differences in the interactions of hydrology and vegetation in different wetland types can be illustrated by peatlands and lakeside wetlands. In peatlands, vegetation patterns are determined largely by water chemistry and movement (Damman and French, 1987). For instance, bogs receive little input from runoff or ground water and rely on precipitation (including fog) and wind-blown dust as sources for water, nutrients, and minerals. Vegetation in bogs commonly grows in a concentric pattern because of the scarcity of nutrients and minerals in the center of the bog and the increased availability of nutrients and minerals along bog margins. In contrast, fens rely principally on ground-water discharge and runoff for inputs of water, minerals, and nutrients. Flooding is the major hydrologic influence in lakeside wetlands. The water level in Lake Champlain is unregulated and fluctuates by an average of 6 feet annually, but the range can be as much as 9 feet (Downer, 1971; Meeks, 1986). In response to these fluctuations, vegetation communities in lakeside wetlands grow in zones; wetlands nearest lake level have more flood-tolerant species. Furthermore, changes in lake level change the sediment and nutrient dynamics in lakeside wetlands. High water levels in spring can dilute nutrient and sediment concentrations (Clausen and Johnson, 1990). For example, wetlands at the mouth of the Lamoille

River and in nearby Colchester Bog receive floodwaters from Lake Champlain. However, Lamoille River wetlands support a large variety of vegetation largely owing to nutrient inputs from the river, whereas Colchester Bog, which receives no river input, remains nutrient poor and has low plant-species diversity.

**TRENDS**

Flood-plain forests and wetlands once were extensive in Vermont. In the 1800's and early 1900's, timber harvesting and clearing and draining of wetlands for crops and grazing resulted in the degradation or loss of many wetlands (Bulmer, 1988), particularly in the Connecticut River Valley. As much as 35 percent of Vermont's wetland resources have been lost since settlement by Europeans; much of the loss has been emergent and scrub-shrub wetlands (Parsons, 1988a). Although Federal and State regulations focus on minimizing wetland losses, many wetlands remain threatened. Before the adoption of the Vermont Wetland Rules in 1990, annual wetland losses were estimated to be 200 acres (Parsons, 1988a). Present losses are as much as 30 to 40 acres per year (George Springston, Vermont Wetlands Office, written commun., 1993). These losses commonly are in areas where pressure from population growth has resulted in development in and adjacent to wetlands, such as in the Lake Champlain Valley and in other seasonal residential and recreation areas (Parsons, 1988a). Other factors that can destroy wetlands or affect wetland functions include road building, reservoir construction, agricultural activities, peat harvesting, timber harvesting, hydropower releases, inadequate bridge and culvert sizing, navigation, and air or water pollution. The cumulative effect of loss or alteration of wetlands in Vermont is yet to be determined but is likely to be an important issue in the future.

**CONSERVATION**

Many government agencies and private organizations participate in wetland conservation in Vermont. The most active agencies and organizations and some of their activities are listed in table 1.

*Federal wetland activities.*—Development activities in Vermont wetlands are regulated by several Federal statutory prohibitions and incentives that are intended to slow wetland losses. Some of the more important of these are contained in the 1899 Rivers and Harbors Act; the 1972 Clean Water Act and amendments; the 1985 Food Security Act; the 1990 Food, Agriculture, Conservation, and Trade Act; and the 1986 Emergency Wetlands Resources Act.

Section 10 of the Rivers and Harbors Act gives the U.S. Army Corps of Engineers (Corps) authority to regulate certain activities in navigable waters. Regulated activities include diking, deepening, filling, excavating, and placing of structures. The related section 404 of the Clean Water Act is the most often-used Federal legislation protecting wetlands. Under section 404 provisions, the Corps issues permits regulating the discharge of dredged or fill material into wetlands. Permits are subject to review and possible veto by the U.S. Environmental Protection Agency (EPA), and the FWS has review and advisory roles. Section 401 of the Clean Water Act grants to States and eligible Indian Tribes the authority to approve, apply conditions to, or deny section 404 permit applications on the basis of a proposed activity's probable effects on the water quality of a wetland.

Most farming, ranching, and silviculture activities are not subject to section 404 regulation. However, the "Swampbuster" provision of the 1985 Food Security Act and amendments in the 1990 Food, Agriculture, Conservation, and Trade Act discourage (through financial disincentives) the draining, filling, or other alteration of wetlands for agricultural use. The law allows exemptions from penalties in some cases, especially if the farmer agrees to restore the altered wetland or other wetlands that have been converted to agricultural use. The Wetlands Reserve Program of the 1990 Food,

**Table 1.** Selected wetland-related activities of government agencies and private organizations in Vermont, 1993

[Source: Classification of activities is generalized from information provided by agencies and organizations. ●, agency or organization participates in wetland-related activity; ..., agency or organization does not participate in wetland-related activity. MAN, management; REG, regulation; R&C, restoration and creation; LAN, land acquisition; R&D, research and data collection; D&I, delineation and inventory]

Agency or organization	MAN	REG	R&C	LAN	R&D	D&I
<b>FEDERAL</b>						
<b>Department of Agriculture</b>						
Consolidated Farm Service Agency .....	...	●	...	...	...	...
Forest Service .....	●	...	●	●	●	●
Natural Resources Conservation Service .....	...	●	●	...	●	●
<b>Department of Commerce</b>						
<b>National Oceanic and Atmospheric Administration</b>						
Administration .....	...	●	...	...	●	...
<b>Department of Defense</b>						
Army Corps of Engineers .....	●	●	●	●	●	●
Military reservations .....	●	...	...	...	...	...
<b>Department of the Interior</b>						
Fish and Wildlife Service .....	●	...	●	●	●	●
Geological Survey .....	...	...	...	...	●	●
National Biological Service .....	...	...	...	...	●	...
National Park Service .....	●	...	...	●	...	...
Environmental Protection Agency .....	...	●	...	...	●	●
<b>STATE</b>						
<b>Agency of Natural Resources</b>						
Department of Environmental Conservation .....	●	●	●	...	●	●
Department of Fish and Wildlife .....	●	●	●	●	●	●
Department of Forests, Parks, and Recreation .....	●	●	...	...	...	...
Vermont Geological Survey .....	...	...	...	...	●	●
Vermont Housing and Conservation Board .....	...	...	...	●	...	...
State universities .....	...	...	...	...	●	●
<b>COUNTY AND LOCAL</b>						
District environmental commissions .....	...	●	...	...	...	...
Soil and water conservation districts .....	...	...	●	...	...	●
Some county, town, and city governments .....	●	●	●	●	...	...
Winooski Valley Park District .....	●	●	●	●	...	...
<b>PRIVATE ORGANIZATIONS</b>						
Ducks Unlimited .....	...	...	...	●	...	...
Private colleges and universities .....	...	...	...	...	●	●
The Nature Conservancy .....	●	...	...	●	...	...
Vermont Land Trust .....	...	...	...	●	...	...

Agriculture, Conservation, and Trade Act authorizes the Federal Government to purchase conservation easements from landowners who agree to protect or restore wetlands. The Consolidated Farm Service Agency (formerly the Agricultural Stabilization and Conservation Service) administers the Swampbuster provisions and Wetlands Reserve Program. The Natural Resources Conservation Service (formerly the Soil Conservation Service) determines compliance with Swampbuster provisions and assists farmers in the identification of wetlands and in the development of wetland protection, restoration, or creation plans.

The 1986 Emergency Wetlands Resources Act encourages wetland protection through funding incentives. The act requires States to address wetland protection in their Statewide Comprehensive Outdoor Recreation Plans to qualify for Federal funding for State recreational land; the National Park Service (NPS) provides guidance to States in developing the wetland component of their plans.

Federal agencies manage many wetlands in Vermont. The FWS manages wetlands in waterfowl protection areas, National Fish Hatcheries, and National Wildlife Refuges. For example, the FWS is responsible for about 5,800 acres of wetlands in the Missisquoi National Wildlife Refuge. Also, the FWS administers wetland-acquisition programs such as the Partners for Wildlife Program, which helps restore wetlands on private lands, and the North American

Waterfowl Management Plan, a cooperative program that provides funding for purchasing wetlands and contiguous uplands. In addition, the FWS has funded research on peatland ecology (Damman and French, 1987). The NPS has designated 11 sites in Vermont as National Natural Landmarks, 5 of which contain significant wetlands. Some of these are protected voluntarily by individual landowners. The U.S. Forest Service manages about 3,750 acres of wetlands in the Green Mountain National Forest. The Corps owns and manages several impoundments that have an undetermined amount of wetland acreage (Parsons, 1988a). The EPA has funded several wetland studies in Vermont, including the study of wetlands of outstanding ecological significance in Chittenden County (which contains Burlington, Vermont's largest city) and Grand Isle County (Vermont Department of Fish and Wildlife, 1992), the study of threats to wetlands in the Lake Champlain region (Borre, 1989), and the study of calcareous fens. The EPA has provided partial funding to the Lake Champlain Basin Program, which has included wetland-acquisition study (Jon Binhammer, The Nature Conservancy, written commun., 1993).

*State wetland activities.*— Vermont protects wetlands primarily through the Vermont Wetland Rules and Act 250 (Vermont's Land Use and Development Law) permit process and review. The Vermont Wetland Rules are administered by the Wetlands Office of the Vermont Agency of Natural Resources' Department of Environmental Conservation. The Vermont Wetland Rules establish three classes of wetlands (Vermont Department of Environmental Conservation, 1990a). Class One wetlands are those determined to provide an exceptional and irreplaceable contribution to Vermont's natural heritage in addition to providing other functions and have the highest level of protection. Class Two wetlands provide valuable ecologic, hydrologic, water-quality, cultural, or economic functions. Class Two wetlands include most wetlands shown on the National Wetland Inventory maps for Vermont and wetland areas contiguous to those wetlands but do not include seven categories of riverine and lacustrine open-water, beach, or bar wetlands. Class One and Two wetlands are protected by 100-foot and 50-foot buffer zones, respectively, unless otherwise ruled by the Water Resources Board. Under certain guidelines, activities such as logging and agriculture are allowed in Class One and Two wetlands. Class Three wetlands are those wetlands not designated as Class One or Two wetlands but which may still be protected under other Federal, State, or local regulations (Vermont Department of Environmental Conservation, 1990).

Act 250 requires a permit for every major land development and subdivision in Vermont. Administrative support for Act 250 is provided by nine District Environmental Commissions and an Environmental Board. Each Act 250 permit must comply with Vermont Wetland Rules, and all permit applications are reviewed by the Wetlands Office (Vermont Department of Environmental Conservation, 1990b). Some Class Three wetlands not protected under Vermont Wetland Rules may be protected under several criteria of Act 250.

The Department of Environmental Conservation administers sections 305(b) and 401 of the Federal Clean Water Act. Section 305(b) requires States to submit biennial water-quality-assessment reports to Congress and the EPA, a part of which specifically addresses water quality in wetlands. Section 401 requires State water-quality certification before a section 404 permit may be issued. A number of other programs, acts, and laws protect Vermont's wetlands. For example, a lake- and pond-management law protects wetlands below the average water level of lakes and ponds. A stream-alteration law protects wetlands within and along streambanks. Act 200, Vermont's growth bill, encourages local, regional, and State agency planning and has established broad goals for quality of wetlands and other resources. Through a grant from the EPA, the Department of Environmental Conservation is undertaking the Vermont Wetlands Conservation Strategy, a comprehensive review of

wetland conservation programs that will analyze the strengths and weaknesses of wetland conservation at the Federal, State, municipal, and private levels and recommend and rank actions to improve wetland conservation in Vermont (George Springston, Vermont Wetlands Office, written commun., 1993).

Several other State agencies own wetlands or have jurisdiction in wetland protection. The Vermont Department of Fish and Wildlife comments on projects that arise during Act 250 permit process and review (Parsons, 1988a). The Department has compiled a list of wetland-acquisition priorities (Parsons, 1988b) and has purchased wetlands and surrounding uplands for waterfowl habitat through administration of a duck-stamp program and through implementation of the Matching Aid to Restore States' Habitat program in cooperation with the Vermont chapter of Ducks Unlimited. The Department protects over 9,000 acres of wetlands within its waterfowl and wildlife management areas. The Vermont Department of Forests, Parks, and Recreation has established and enforces acceptable timber-management practices near surface waters and wetlands. The Vermont Nongame and Natural Heritage Program has inventoried natural wetland communities and rare and endangered species of wetlands and their habitats. This program also helps administer the Fragile Areas Registry and, along with the Department of Forests, Parks, and Recreation, administers State Natural Areas. There are more than 30 designated Natural Areas in Vermont, comprising more than 14,000 acres, some of which include wetlands. Designation as a Fragile Area does not provide direct protection but encourages landowners to conserve sensitive areas. The Department of Forests, Parks, and Recreation also is responsible for producing the wetlands component of the Vermont Statewide Comprehensive Outdoor Recreation Plan (Parsons, 1988a), which is the primary document guiding wetland acquisition with some Federal funding. The Vermont Housing and Conservation Board administers the Housing and Conservation Trust Fund. Approximately \$10 million is appropriated annually to this fund by the State legislature. Part of these funds is granted to State agencies and nonprofit organizations for the purchase of easements and fee title acquisition of conservation lands, including wetlands, and of farm and forest lands, which sometimes include wetlands. For instance, the Vermont office of The Nature Conservancy has received grants to acquire wetland and upland buffers along East Creek, a tributary to Lake Champlain (fig. 1).

*County and local wetland activities.*— More than 20 towns in the State have adopted zoning bylaws to provide additional protection to wetlands (George Springston, Vermont Wetlands Office, written commun., 1993). Several intermunicipal districts in Vermont protect wetland areas. For example, the Winooski Valley Park District, a consortium of several towns in Chittenden County near Burlington, owns and manages several hundred acres of wetlands along the lower Winooski River (Parsons, 1988a). Vermont statutes authorize municipalities to acquire conservation easements as a land-protection tool, but few wetlands have been protected this way.

*Private wetland activities.*— Private organizations provide complementary functions that cannot readily be accomplished in governmental agencies. Private organizations, such as The Nature Conservancy, can provide rapid action in the purchase of property. The Nature Conservancy manages nine sites in Vermont that include significant wetlands and has assisted in the protection or purchase and transfer of nine additional sites. In 1993, The Nature Conservancy received a \$600,000 grant from the FWS North American Wetlands Conservation Council for easements and fee title acquisition of approximately 1,500 acres of Lake Champlain wetlands. The Vermont chapter of Ducks Unlimited has worked in cooperation with the Department of Fish and Wildlife to purchase about 430 acres of waterfowl habitat, much of which is wetland. The Vermont Land Trust is a private organization that negotiates conservation easements with landowners to protect productive agricultural and

forest lands. The Trust's holdings include several properties that have wetlands. Other organizations involved in wetland protection include the National Audubon Society, the New England Wildflower Society, the Izaak Walton League, the Sierra Club, the Appalachian Mountain Club, and others. Individuals, timber companies, towns, and other private landowners own most of Vermont's wetlands, and many actively pursue wetland conservation.

## References Cited

- Borre, M.A., 1989, Threats to wetlands in the Lake Champlain region of Vermont—Boundary determination for the EPA's proposed advance identification: New Haven, Conn., Yale University, School of Forestry and Environmental Studies, 51 p.
- Brinson, M.M., 1993, Changes in the functioning of wetlands along environmental gradients: *Wetlands*, v. 13, no. 2, p. 65–74.
- Bulmer, S.K., 1988, 1988 Vermont recreation plan: Waterbury, Vt., Agency of Natural Resources, Department of Forests, Parks, and Recreation, 128 p.
- Clausen, J.C., and Johnson, G.D., 1990, Lake level influences on sediment and nutrient retention in a lakeside wetland: *Journal of Environmental Quality*, v. 19, no. 1, p. 83–88.
- Cowardin, L.M., Carter, Virginia, Golet, F.C., and LaRoe, E.T., 1979, Classification of wetlands and deepwater habitats of the United States: U.S. Fish and Wildlife Service Report FWS/OBS–79/31, 131 p.
- Damman, A.W.H., and French, T.W., 1987, The ecology of peat bogs of the glaciated northeastern United States—A community profile: U.S. Fish and Wildlife Service Biological Report 85(7.16), 114 p.
- Doll, C.G., comp., 1970, Surficial geologic map of Vermont: Waterbury, Vermont Geological Survey Division, scale 1:250,000.
- Downer, R.N., 1971, Extreme mean daily annual water levels of Lake Champlain: University of Vermont, Vermont Water Resources Research Report 3, 18 p.
- Federal Interagency Committee for Wetland Delineation, 1989, Federal manual for identifying and delineating jurisdictional wetlands: Washington, D.C., U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S. Department of Agriculture Soil Conservation Service Cooperative Technical Publication, 76 p.
- Fenneman, N.M., 1946, Physical divisions of the United States: Washington D.C., U.S. Geological Survey special map, scale 1:7,000,000.
- Hammond, R.E., and Cotton, J.E., 1986, Vermont surface-water resources, in U.S. Geological Survey, National water summary 1985—Hydrologic events and surface-water resources: U.S. Geological Survey Water-Supply Paper 2300, p. 461–466.
- Johnson, C.W., 1985, Bogs of the northeast: Hanover, N.H., The University Press of New England, 269 p.
- Meeks, H.A., 1986, Vermont's land and resources: Shelburne, Vt., The New England Press, 332 p.
- Parsons, Jeffrey, 1988a, Wetlands component, 1988 Vermont recreation plan: Waterbury, Vermont Department of Forests, Parks, and Recreation, Recreation Division, 43 p.
- \_\_\_\_\_, 1988b, A characterization of Vermont's more important wetlands: Waterbury, Vermont Department of Forests, Parks, and Recreation, 23 p.
- Thompson, Liz, 1989, Natural communities of Vermont: Waterbury, Vermont Department of Fish and Wildlife, Nongame and Heritage Program, 12 p.
- Tiner, R.W., 1987, Preliminary National Wetlands Inventory report on Vermont's wetland acreage: Newton Corner, Mass., U.S. Fish and Wildlife Service, 5 p.
- \_\_\_\_\_, 1991, Maine wetlands and their boundaries—A guide for code enforcement officers: Augusta, Maine Department of Economic and Community Development, Office of Comprehensive Planning, 72 p.
- Vermont Department of Environmental Conservation, 1990a, Wetland fact sheet number 4, wetland rules summary: Waterbury, Vermont Department of Environmental Conservation, Water Quality Division, Wetlands Office, 2 p.
- \_\_\_\_\_, 1990b, Wetland fact sheet number 1, Act 250 review guidelines: Waterbury, Vermont Department of Environmental Conservation, Water Quality Division, Wetlands Office, 2 p.
- Vermont Department of Fish and Wildlife, 1992, Wetlands of outstanding ecological significance in Chittenden County, Vermont: Waterbury, Vermont Department of Fish and Wildlife, Nongame and Natural Heritage Program, 122 p.
- Wanner, R., 1979, Wetlands in Vermont, their identification and protection: Montpelier, Vermont Natural Resources Council, 71 p.
- Winter, T.C., 1992, A physiographic and climatic framework for hydrologic studies of wetlands, in Robarts, R.D., and Bothwell, M.L., eds., Aquatic ecosystems in semi-arid regions—Implications for resource management, 1992: National Hydrologic Research Institute Symposium Series 7, Environment Canada, Saskatoon, p. 127–148.

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