Wet Shores

Wet shores may be our most dynamic and changeable group of natural communities. These wetland communities that occur along lake and river shores are subject to several forms of natural disturbance and environmental stress that keep them in an open, non-forested condition and affect species composition.

Primary among the stressors is flooding. All wet shore communities are subject to flooding, but they vary in the frequency and duration of inundation. The shoreline communities along Lake Champlain flood annually in the spring and inundation may last until early summer. River flows respond quickly to rainfall. Consequently, wet shore communities along rivers have relatively short duration spring flooding but also may have flooding at any other time during the year. Generally, the lower in the river floodplain, the more frequent the flooding. Long duration or frequent flooding during the growing season prevents most woody plants from becoming established or growing to maturity.

Ice scouring is another major stressor of wet shores. As ice forms along lake margins, it may be forced up onto the shoreline, where it can injure or remove establishing woody vegetation. Similarly, ice floating down rivers with early spring high water can shear off young woody vegetation established in the river channel. In years with extreme ice scouring, even well-established trees at the edge of the lake or river floodplain forest might be scarred or killed.

A final significant stressor and natural disturbance in wet shores is the erosive force of moving water, which greatly affects the stability and type of substrate. It is difficult for most plants to colonize a substrate that shifts annually. Waves break on the shorelines of lakes, eroding and re-depositing substrates and uprooting some plants. High flows in rivers may move boulders and cobbles in the most dynamic portions of the channels and erode finer materials in one area only to re-deposit them elsewhere where water velocities are slower. The outsides of river bends receive the brunt of the river's power and typically have eroded, undercut banks. Point bars develop on the downstream portion of inside bends, where slow-water eddies result in sediment deposition. Over time, these point bars may continue to grow and may eventually become part of the vegetated floodplain.

The biological and ecological integrity of wet shore communities is very closely related to the integrity of the lakes or rivers themselves. Extensive land clearing in the 1800s dramatically changed runoff characteristics from the land and sediment deposition rates in shoreline areas. There was a peak in sediment deposition about 100 years ago. Alteration of natural flooding regimes by dams can dramatically alter the species composition and the location of wet shore communities, or even eliminate them entirely. Changes in water quality also may affect species composition. The substrate of many river shore communities is repeatedly left exposed, as scouring and flooding either erode or deposit alluvium. Similar substrate exposure occurs on many lake shore communities. This exposed substrate is an ideal site for colonization by invasive, exotic plant species, which are a particular threat to these communities.

How to Identify

Wet Shore Natural Communities

Read the short descriptions that follow and choose the community that fits best. Then go to the page indicated and read the full community profile to confirm your decision.

Outwash Plain Pondshore: This is a rare community found only in southeastern Vermont on the sloping, seasonally exposed shorelines of ponds with substantial annual water level fluctuations. Herbaceous plants may include three-way sedge, olive spikerush, pipewort, meadow beauty, golden pert, and marsh fern. Go to page 356.

River Mud Shore: This is a common community found along slow-moving rivers. Mud shores are exposed during low flow periods of summer and are sparsely vegetated with plants such as false pimpernel and species of spikerush, cyperus, and bulrush. Go to page 358.

River Sand or Gravel Shore: This common shoreline community is found along moderate gradient rivers. The shifting sand and gravel substrate is sparsely vegetated with species such as sandbar willow, Indian hemp, big bluestem, little bluestem, fringed loosestrife, and other grasses. Go to page 360.

River Cobble Shore: This common shoreline community occurs along high energy rivers and streams. The cobble substrate is unstable and is sparsely vegetated with twisted sedge, Indian hemp, grass-leaved goldenrod, Joe-pye weed, reed canary grass, bluejoint grass, and willows. Go to page 363.

Calcareous Riverside Seep: This rare type occurs on exposed bedrock along rivers and streams where there is seepage of calcareous groundwater. They are kept open by flooding and ice scouring. Characteristic herbs include grass of Parnassus, capillary beak-rush, pumpkin sedge, and Kalm's lobelia. Bryophytes are abundant. Go to page 366.

Rivershore Grassland: A community found on sheltered shorelines of moderate to high gradient rivers. Substrate is a mix of cobble, gravel, and fines. Common species are reed canary grass, bluejoint grass, big bluestem, and thimbleweed. Go to page 369.

Lakeshore Grassland: These grasslands occur on the gently sloping shorelines of gravel, cobble, and shale of Lake Champlain. They are kept open by wave and ice scouring and annual flooding. Characteristic plants are freshwater cordgrass, greenish sedge, and silverweed. Go to page 372.

Outwash Plain Pondshore

Distribution/Abundance

Only one example of this community is found in southeastern Vermont. Closely related communities occur in coastal areas from Nova Scotia south to New York.

Ecology and Physical Setting

Outwash Plain Pondshore is a rare community in Vermont, with only one site currently known in the southeastern part of the state. This community is similar to the coastal plain pondshores of the Atlantic coast. Like these coastal communities, our Vermont example is located in an area of glacial outwash. These deep sand and gravel deposits left by the retreating glaciers are very porous, and consequently, the groundwater table can drop substantially over the summer. For ponds located in glacial outwash plains, the result is a significant lowering of the pond water level over the course of the summer and exposure of wide, muddy to sandy shores. These seasonally exposed shores are the location of the Outwash Plain Pondshore community. The relatively warm climate of southeastern Vermont contributes to the similarity of our Outwash Plain Pondshore with the classic coastal plain pondshores farther south.

Water levels do not fluctuate regularly in ponds of this type. In years of drought, water levels may drop significantly, exposing a wide shoreline. In especially wet years, however, pond water levels may stay nearly constant with little shoreline substrate exposed. Additional study is needed to better understand the hydrology of our Vermont example and its similarity to coastal plain pondshores.

Vegetation

The vegetation in Outwash Plain Pondshores is adapted to the irregularly fluctuating water levels that are characteristic of these ponds. Many of the plants present are annuals whose seeds remain dormant in the muddy substrate until they are exposed in years when water levels recede. There is distinct zonation of vegetation within this community that is defined by substrate elevation relative to water levels.

Some characteristic plants of the exposed shoreline include three-way sedge, olive spikerush, pipewort, slender-branched rush, meadow beauty, golden pert, toothed cyperus, and autumn fimbristylus. Many of these plants are rare in Vermont. At the upper edges of the exposed muddy substrate, marsh fern may be common. Highbush blueberry and occasional black gum trees occur at the upper edge of the wetland but are not really part of the Outwash Plain Pondshore community. Buttonbush occurs in patches at the deeper end of the exposed shoreline, along with pickerelweed. There is a sharp transition to upland forest above the shoreline, and a gradual transition to floating-leaved aquatic communities and open water below the shoreline.

ANIMALS

Little is known about the specific animals that use this narrowly defined wetland natural community. It is expected that great blue heron and spotted sandpipers use the exposed shoreline for feeding. Green frogs and bullfrogs are also likely to be present.

VARIANTS

None recognized at this time.

RELATED COMMUNITIES

Kettle Basin Shrub Swamp variant of ***Buttonbush Swamp:*** The Kettle Basin Shrub Swamp also occurs primarily in outwash plains of southeastern Vermont and has high spring water levels that slowly recede during the growing season. Kettle Basin Shrub Swamps occur in small isolated basins, generally lack permanent standing water, and are dominated by buttonbush and other shrubs.

CONSERVATION STATUS AND MANAGEMENT CONSIDERATIONS

The one known Vermont example of this community is on privately owned land. Long-term protection of the pond and its associated shoreline wetland communities and rare plants will require careful planning by the owners and the town. Particular threats to this community include alteration of the natural water regimes that could result from changing flows in the outlet stream, additional shoreline development, and use of off-road vehicles on the exposed muddy shores. Additional inventory of pondshores in appropriate landscape settings may reveal other examples of this community type in Vermont.

CHARACTERISTIC PLANTS

SHRUBS

Occasional to Locally Abundant Species

Buttonbush – *Cephalanthus occidentalis*

HERBS

Abundant Species

Three-way sedge – *Dulichium arundinaceum*
Olive spikerush – *Eleocharis flavescens* var. *olivacea*
Pipewort – *Eriocaulon aquaticum*

Occasional to Locally Abundant Species

Slender-branched rush – *Juncus pelocarpus*
Meadow beauty – *Rhexia virginica*
Golden pert – *Gratiola aurea*
Toothed cyperus – *Cyperus dentatus*
Autumn fimbristylus – *Fimbristylus autumnalis*
Three-square bulrush – *Scirpus americanus*
Marsh fern – *Thelypteris palustris*
Pickerelweed – *Pontederia cordata*

INVASIVE EXOTIC PLANTS

Purple loosestrife – *Lythrum salicaria*

RARE AND UNCOMMON PLANTS

Meadow beauty – *Rhexia virginica*
Autumn fimbristylus – *Fimbristylus autumnalis*
Olive spikerush – *Eleocharis flavescens* var. *olivacea*
Orange-grass St. John's-wort – *Hypericum gentianoides*
Lance-leaved violet – *Viola lanceolata*
Marsh mermaid-weed – *Proserpinaca palustris*

River Mud Shore

Distribution/ Abundance

River Mud Shores are found throughout Vermont on slow-moving sections of rivers. Similar communities occur across much of eastern North America.

Ecology and Physical Setting

River Mud Shores are common along many of Vermont's rivers but are typically very small. They occur primarily along the margins of our larger rivers where currents are slow, but they may also be found in sheltered coves, eddies, and backwaters of more high-energy rivers. The substrate is a muddy mix of fine mineral and organic deposits that are exposed only when river levels go down in the summer. Some of this fine, organic-rich substrate may be washed downstream during storms, but new deposits are laid down annually as water levels recede. In some years, River Mud Shores may be flooded intermittently throughout the growing season.

River Mud Shores commonly occur below Riverside Grasslands and may also occur in sheltered areas of shoreline associated with River Sand or Gravel Shores. Similar communities may also occur along some lakeshores.

Vegetation

River Mud Shores may be inundated until early summer. When the shoreline is exposed, the bare, sun-warmed mud is an ideal habitat for germination of seeds that have over-wintered or have been recently deposited in the sediments. These conditions favor the life cycle of annual plants, which tend to dominate this very sparsely vegetated community. Typical plants include species of spikerush, cyperus, and bulrush, false pimpernel, rice cutgrass, and common monkey-flower. Quillworts may be present in permanent water areas. Invasive exotic species may be common.

Animals

Raccoon tracks are commonly found in the soft mud of this shoreline community. Great blue herons and spotted sandpipers are frequently seen feeding in these areas. Green frogs may be common.

Variants

None recognized at this time.

Related Communities

River Sand or Gravel Shore: This community occurs along river shores with faster moving water and has a sand or gravel substrate. It is also sparsely vegetated with graminoids and forbs.

Conservation Status and Management Considerations

River Mud Shores can be greatly affected by the operation of dams, which alter natural river flow regimes and sediment deposition. The rich, muddy, exposed substrate of this natural community is an ideal habitat for invasion by non-native plants.

Places to Visit

South Bay Wildlife Management Area, Coventry, Vermont Department of Fish and Wildlife

Ethan Allen Homestead, Burlington, Winooski Valley Park District

Richmond Corridor, Richmond, Richmond Land Trust

Connecticut River, numerous areas are accessible by canoe

Lower sections of the Missisquoi, Lamoille, and Winooski Rivers, accessible by canoe

Characteristic Plants

Herbs

Occasional to Locally Abundant Species

Slender beakrush – *Eleocharis tenuis*
Needle spikerush – *Eleocharis acicularis*
Thin cyperus – *Cyperus strigosus*
False pimpernel – *Lindernia dubia*
Rice cutgrass – *Leersia oryzoides*
Common monkey-flower – *Mimulus ringens*
Pennsylvania bittercress – *Cardamine pensylvanica*
Cardinal flower – *Lobelia cardinalis*
Common water plantain – *Alisma plantago-aquatica*
Woolgrass – *Scirpus cyperinus*
Black-green bulrush – *Scirpus atrovirens*
Nodding bur marigold – *Bidens cernua*
Water purslane – *Ludwigia palustris*
Giant bur-reed – *Sparganium eurycarpum*
Broad-leaved arrowhead – *Sagittaria latifolia*
Water parsnip – *Sium suave*
Yellow nutsedge – *Cyperus esculentus*
Quillworts – *Isoetes* spp.

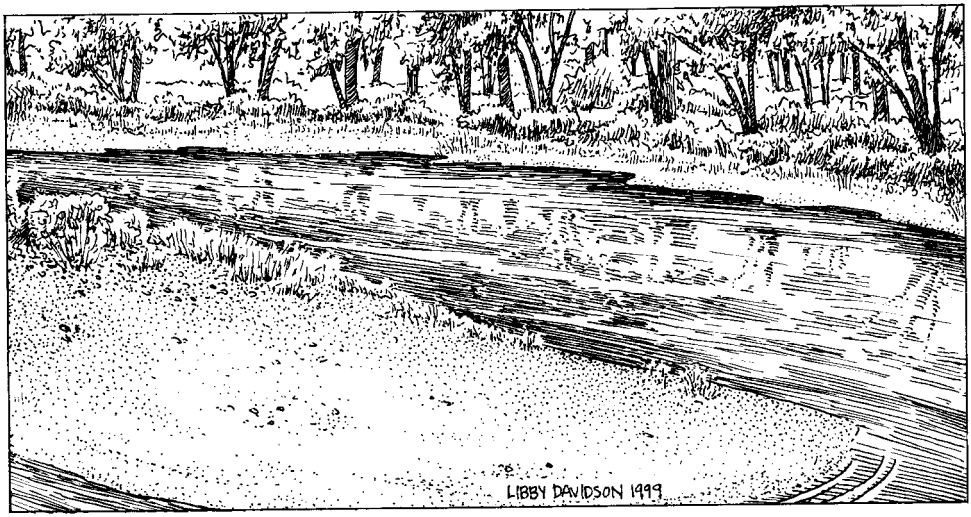
Non-native and Invasive Plants

Common barnyard grass – *Echinochloa crusgalli*
Common forget-me-not – *Myosotis scorpioides*
Purple loosestrife – *Lythrum salicaria*
Flowering rush – *Butomus umbellatus*

Rare and Uncommon Plants

Matted spikerush – *Eleocharis intermedia*
Creeping lovegrass – *Eragrostis hypnoides*
Shore quillwort – *Isoetes riparia*

River Sand or Gravel Shore



Distribution/Abundance

River Sand or Gravel Shores occur on rivers throughout Vermont. Similar communities occur across eastern North America.

Ecology and Physical Setting

This community occurs on the sparsely vegetated sand and gravel deposits of point bars and islands typical of many Vermont rivers with fast-moving water. River Sand or Gravel Shores occur along all of our rivers that flow through watersheds that supply sand and gravel and have sufficient energy to transport this sand and gravel downstream.

River Sand or Gravel Shores are flooded during spring flows and rain storms throughout the year. They typically occur in depositional sections of rivers, such as the downstream portions of inside bends and islands in river channels. The dominant sand and gravel substrates typically make this community very well drained and consequently quite dry during periods of low river flow. However, in some locations, there are more fine-textured soils mixed with the sand and gravel and the substrate may remain moist. Ice scouring is an important factor in maintaining the sparsely vegetated character. River Sand or Gravel Shores typically form part of the zonation of communities along rivers that may include River Cobble Shores, River Mud Shores, Alluvial Shrub Swamps, and floodplain forests.

Vegetation

Portions of River Sand and Gravel Shores closest to the summer river level may be completely devoid of vegetation or harbor a few herbaceous plants, primarily annuals. Perennials and woody plants are more abundant in upper zones of the shoreline that are less frequently flooded. Overall, vegetation cover is commonly less than 10 percent. Plant cover is especially well developed on rivers and streams where the channel is wide enough to create breaks in the overstory tree canopy and allow light to reach the sand bars.

Typical woody plants in the upper zones of this community include sandbar willow, cottonwood, and in the southern portion of the state, sycamore. Typical herbaceous plants are Indian hemp, grass-leaved goldenrod, big bluestem, little bluestem, fringed loosestrife, blue vervain, and several species of grasses and sedges. The bryophyte component of this community is poorly developed, likely resulting from the dry, well-drained summer conditions and the unstable, shifting nature of the fine-textured substrate. Additional study of this community's vegetation is needed.

ANIMALS

Little is known about the animals that use this relatively narrowly defined natural community. However, several species of tiger beetles are associated with River Sand or Gravel Shores. Common shore tiger beetle is a common and characteristic species of sandy river shores. Its brownish and white markings make it well camouflaged in sand. The very rare boulder-beach tiger beetle and the cobblestone tiger beetle may also be found in this community. Spotted sandpipers use these shores for foraging habitat and nesting areas.

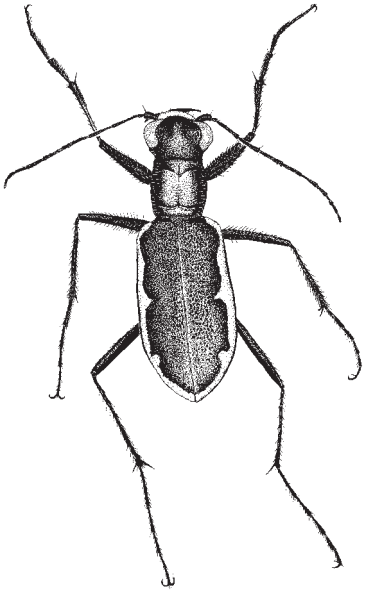


ILLUSTRATION BY JONATHAN LEONARD

The cobblestone tiger beetle is a rare species restricted to sandy and cobbly river shores.

VARIANTS

None recognized at this time.

RELATED COMMUNITIES

River Cobble Shore: This community has much in common with River Sand or Gravel Shore. The primary difference is the texture of the substrate, which varies across a continuum from boulders and cobbles to fine sands. The effects of differences in substrate texture on vegetation need further investigation.

Rivershore Grassland: This community typically occurs at slightly higher elevations in the channel or lower floodplain than the River Sand or Gravel Shore. The substrate is more stable and the grassland is more densely vegetated with grasses and forbs.

CONSERVATION STATUS AND MANAGEMENT CONSIDERATIONS

Flood control and power generation dams alter the natural river flooding regime. The impoundments upstream of these dams act as large settling basins, trapping sediments that would naturally be transported downstream and deposited on point bars or floodplains. These two alterations of natural river processes likely affect the stability and species composition of River Sand or Gravel Shores and other riverside communities. Invasive exotic plants are a particular threat to rivershore communities due to the abundance of exposed mineral substrate.

Places to Visit

Hartland Rivershore Natural Area, Hartland, The Nature Conservancy
Lower sections of the Missisquoi and Lamoille Rivers, accessible by canoe.
Ethan Allen Homestead, Burlington, Winooski Valley Park District
Richmond Rivershore, Richmond, Richmond Land Trust

Characteristic Plants

Shrubs and Saplings

Abundant Species
Sandbar willow – *Salix exigua*
Silky willow – *Salix sericea*
Woolly-headed willow – *Salix eriocephala*
Occasional to Locally Abundant Species
Cottonwood – *Populus deltoides*
Sycamore – *Platanus occidentalis*

Herbs

Occasional to Locally Abundant Species
Indian hemp – *Apocynum cannabinum*
Grass-leaved goldenrod – *Euthamia graminifolia*
Big bluestem – *Andropogon gerardii*
Little bluestem – *Schizachyrium scoparium*
Fringed loosestrife – *Lysimachia ciliata*
Blue vervain – *Verbena hastata*
Twisted sedge – *Carex torta*
Hidden panic grass – *Panicum clandestinum*
Witchgrass – *Panicum capillare*
Northern panic grass – *Panicum boreale*
Creeping lovegrass – *Eragrostis hypnoides*
Two-parted cyperus – *Cyperus bipartitus*

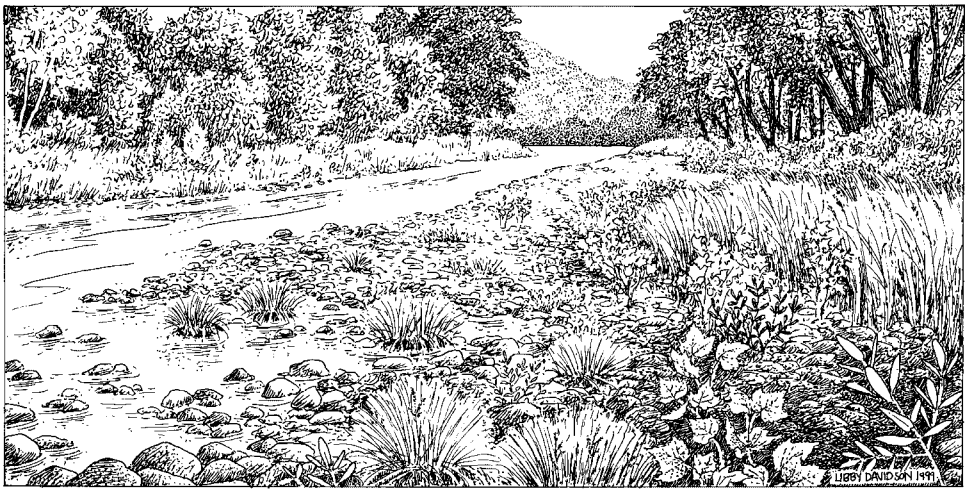
Invasive and Non-native Plants

Purple loosestrife – *Lythrum salicaria*
Japanese knotweed – *Polygonum cuspidatum*
Pigweed – *Chenopodium album*

Rare and Uncommon Plants

Hare figwort – *Scrophularia lanceolata*
Obedience – *Physostegia virginiana*
Frank's lovegrass – *Eragrostis frankii*
Creeping lovegrass – *Eragrostis hypnoides*
Canada Burnet – *Sanguisorba canadensis*
Great St. John's-wort – *Hypericum pyramidatum*
Musk flower – *Mimulus moschatus*

River Cobble Shore



Distribution/Abundance

River Cobble Shores occur on high-energy rivers throughout Vermont and eastern North America.

Ecology and Physical Setting

Flowing rivers contain an incredible amount of energy. River Cobble Shores, Vermont's most dynamic natural community type, are products of this energy. You can actually see and hear them being formed and altered. Standing in a safe location next to one of our high-gradient, high-energy rivers like the White or the West Rivers during high flood conditions, you can hear large cobbles and boulders clunking and tumbling down the river. When the flood waters recede, you will see a new or altered cobble bar.

River Cobble Shores are a type of point bar formed along high-energy stretches of rivers. As with point bars composed of finer-textured deposits, cobble shores or bars typically occur on the inside of river bends and at the downstream end of river islands. It is in these locations that flood waters slow down and water-borne sediments are deposited. In addition to the shifting of substrate during high water conditions, River Cobble Shores are also subject to regular flooding and ice scour. Gravel, sand, silt, and even fine organic material all accumulate in the spaces between the cobbles, and on the more stable cobble shores, these materials form a moist environment where some tolerant plants become established. River Cobble Shores grade into Rivershore Grasslands and River Sand or Gravel Shores, both of which occur in more sheltered portions of the river channel.

Vegetation

River Cobble Shores are very sparsely vegetated, but the pattern of vegetation typically varies with the distance from the summer low water levels. Cobble shores closest to the summer low water levels are most frequently flooded and less stable and therefore sparsely vegetated. Cobble shores highest above the summer low water levels are less

frequently flooded and more stable and also have more accumulated fine materials. Consequently, they are vegetated with more herbaceous and woody species. Vegetation patterns in this community are also greatly affected by the shifting of river channels over time. A cobble shore adjacent to an abandoned channel will go through many stages of succession that may include dominance by trees.

Obedience is a rare plant of calcareous shorelines.

Although River Cobble Shores are sparsely vegetated, the number of species per unit area tends to be relatively high. Twisted sedge is among the herbaceous plants that may be found in a typical River Cobble Shore. This tenaciously rooted sedge has a densely cespitose (clumped) growth form, and its small seeds are water dispersed in inflated sacs called perigynia. These characteristics are excellent adaptations for the fast-water shore environment in which it is found. Other species include Indian hemp, grass-leaved goldenrod, Joe-pye weed, dock-leaved smartweed, reed canary grass, and bluejoint grass. Typical shrubs include silky willow and woolly-headed willow. Saplings of cottonwood and sycamore may be common at some sites. Sycamore appears to be especially well suited for colonization of cobble shores and can tolerate extensive scouring by moving rock and ice. Bryophytes may be common in the spaces between cobbles and include species of the moss genus *Bryum*. Additional study of the bryophyte component of this community is needed. Invasive and non-native species may be abundant on some shores.

Animals

Spotted sandpipers nest and feed in this and other shoreline communities. Two-lined salamanders and green frogs are often found in wetter portions of this community as well as River Sand or Gravel Shore. The rare cobblestone tiger beetle and White Mountain tiger beetle both occur here.

Variants

None recognized at this time.

Related Communities

River Sand or Gravel Shore: This is a closely related community occurring on more sheltered shores of high-energy rivers and on the typical sandy point bars of our larger rivers. They are sparsely vegetated with species similar to those found on River Cobble Shores, but they typically lack bryophytes.

Rivershore Grassland: This community typically occurs at slightly higher elevations than the River Cobble Shore. The substrate is more stable and the grassland is more densely vegetated with grasses and forbs.

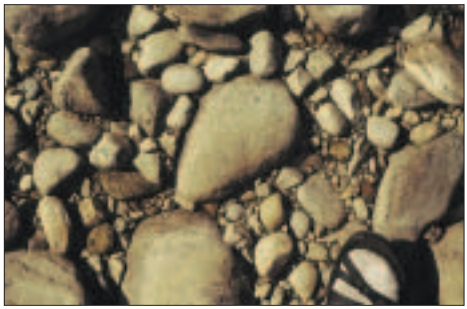
Conservation Status and Management Considerations

As with other natural communities associated with rivers, the condition and naturalness of River Cobble Shores are closely tied to the condition of the river along which they occur. Long-term conservation of these communities must include watershed-scale planning, as well as consideration of the dynamic nature of rivers within their floodplains. Power generation and flood control dams both alter natural river flows and can result in changes in the long-term stability and species composition of River Cobble Shores. Invasive exotic plants are a particularly significant threat to rivershore communities with naturally abundant exposed substrate. Japanese knotweed may dominate some rivershore communities and require concentrated effort to control.

River Cobble Shore

Places to Visit

Hartland Rivershore Natural Area, Hartland, The Nature Conservancy (TNC)
White River Ledges Natural Area, Sharon and Pomfret, TNC
West River, Townshend, dam flood control project, U.S. Army Corps of Engineers (ACOE)
West River, Jamaica, flood control project, Ball Mountain Dam, ACOE
Jamaica State Park, Jamaica, Vermont Department of Forests, Parks, and Recreation



The substrate of a River Cobble Shore.

Characteristic Plants

Shrubs

Abundant Species
Silky willow – *Salix sericea*
Woolly-headed willow – *Salix eriocephala*
Occasional to Locally Abundant Species
Cottonwood – *Populus deltoides*
Sycamore – *Platanus occidentalis*

Herbs

Abundant Species
Twisted sedge – *Carex torta*
Indian hemp – *Apocynum cannabinum*
Occasional to Locally Abundant Species
Grass-leaved goldenrod – *Euthamia graminifolia*
Joe-pye weed – *Eupatorium maculatum*
Dock-leaved smartweed – *Polygonum lapathifolium*
Reed canary grass – *Phalaris arundinacea*
Bluejoint grass – *Calamagrostis canadensis*
Big bluestem – *Andropogon gerardii*
Little bluestem – *Schizachyrium scoparium*
Blue vervain – *Verbena hastata*
Thin cyperus – *Cyperus strigosus*
Monkey flower – *Mimulus ringens*
Common St. John's-wort – *Hypericum perforatum*
Nodding bur marigold – *Bidens cernua*
Virgin's bower – *Clematis virginiana*
Riverbank wild-rye – *Elymus riparius*
Frondose muhlenbergia – *Muhlenbergia frondosa*

Invasive and Non-native Plants

Japanese knotweed – *Polygonum cuspidatum*
Lady's thumb – *Polygonum persicaria*
Coltsfoot – *Tussilago farfara*
Common barnyard grass – *Echinochloa crusgalli*
White sweet clover – *Melilotus alba*

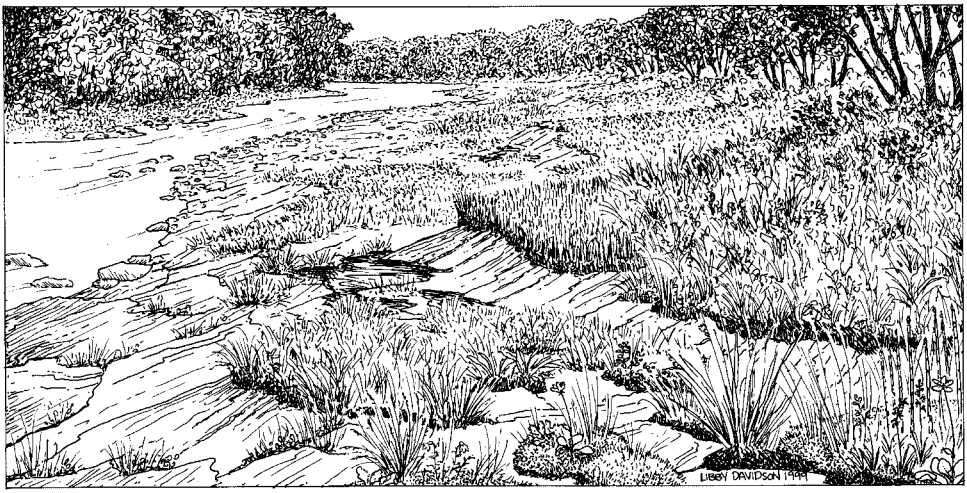
Bryophytes

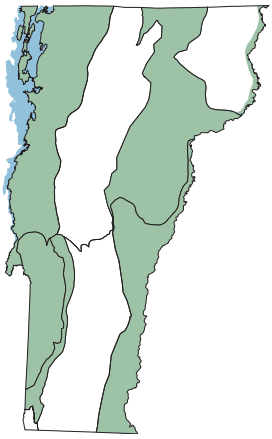
Occasional to Locally Abundant Species
Bryum spp.

Rare and Uncommon Plants

Tubercled orchid – *Habenaria flava*
Obedience – *Physostegia virginiana*
Sand cherry – *Prunus pumila*
Shore sedge – *Carex lenticularis*
Canada Burnet – *Sanguisorba canadensis*

Calcareous Riverside Seep





Distribution/Abundance

This extremely rare Vermont community is found only on the Winooski, Passumpsic, White, and Connecticut Rivers. It is rare throughout its range, with scattered locations in areas of calcareous bedrock in New York, Connecticut, Maine, New Hampshire, Pennsylvania, and West Virginia.

Ecology and Physical Setting

Calcareous Riverside Seeps are botanical treasures. This very rare community occurs along the shorelines of several of Vermont's larger rivers. Like many other shoreline communities, Calcareous Riverside Seeps are maintained in an open condition by annual flooding and ice-scouring. What gives this community its distinct character, however, is the presence of calcium-rich groundwater that seeps out of the river bank and flows over and through the shoreline substrate throughout the year. This community occurs in areas of the state with calcareous bedrock. Here, the groundwater is enriched with dissolved minerals as it flows through gaps in the bedrock and associated glacial till.

Calcareous Riverside Seeps are typically associated with exposed bedrock, although alluvial deposits of sand, gravel, and cobble may also be present. The finest textured alluvial deposits accumulate in the bedrock fissures and in the gaps between cobbles and large gravel. The calcium-rich water seeping through these crevices provides an ideal habitat for many grasses, sedges, forbs, and bryophytes. Annual decomposition of this vegetation adds organic matter to the fine-textured alluvium. These peaty accumulations are prevented from growing in depth or from spreading across the exposed bedrock by annual flooding and scouring.

Calcareous Riverside Seeps are commonly associated with other river shore communities, including River Sand or Gravel Shores, Rivershore Grasslands, and the upland Riverside Outcrop. Calcareous Riverside Seeps are the wettest of these related communities.

VEGETATION

The vegetation of Calcareous Riverside Seeps resembles both Riverside Outcrops and Rich Fens. In areas with less seepage and more exposed bedrock, vegetation can be quite sparse and conditions may be relatively dry. In contrast, in areas with consistent groundwater seepage and some shelter from annual scouring, vegetation can be dense.

Characteristic herbs include grass of Parnassus, capitate beak-rush, pumpkin sedge, Kalm's lobelia, and Loesel's tway-blade. Several rare or uncommon plants are also closely associated with this community, among them are Garber's sedge, sticky false asphodel, fringed gentian, and shining lady's-tresses. Other common herbs found in this community include variegated scouring-rush and yellow sedge. Scattered shrubs of woolly-headed willow may be present.

Often there is a well-developed moss component, and many species characteristic of fens are found in Calcareous Riverside Seeps as well. Typical species include starry campylium, *Bryum pseudotriquetrum*, *Philinotis fontana*, and *Drepanocladus* spp.

ANIMALS

Little is known about the animals that may use this very rare wetland type.

VARIANTS

None recognized at this time.

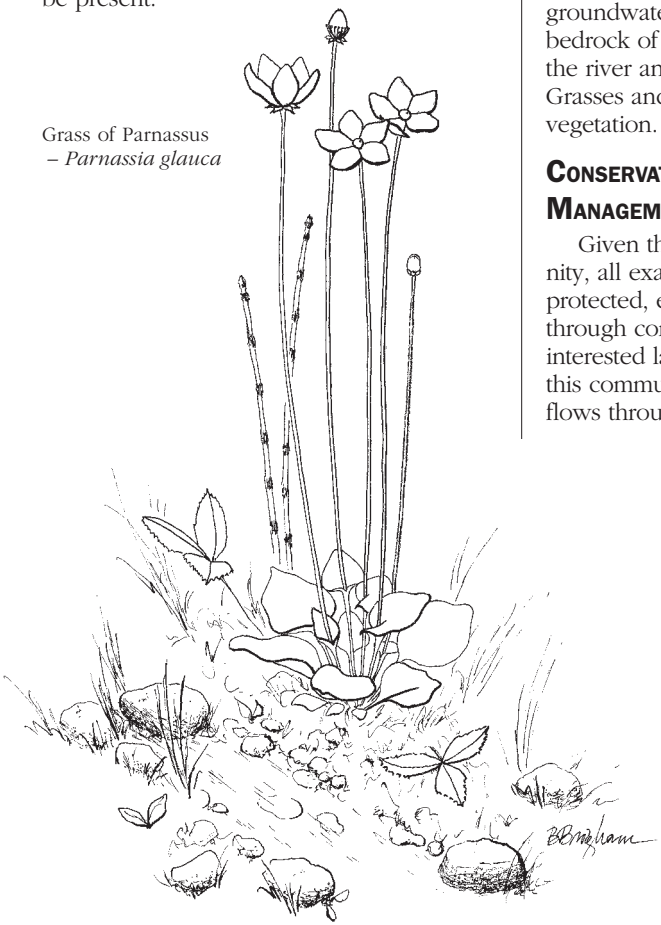
RELATED COMMUNITIES

Rich Fen: This community is associated with calcareous groundwater seepage and typically occurs on shallow peat. Sedges and mosses dominate this peatland.

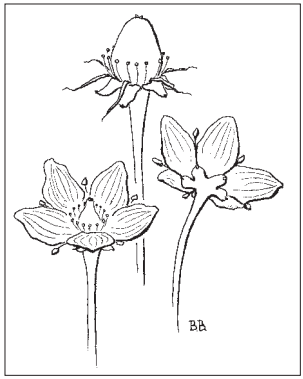
Riverside Outcrop: This community often occurs in association with Calcareous Riverside Seeps in areas where there is no groundwater discharge. The exposed bedrock of this community is scoured by the river annually but is otherwise dry. Grasses and low forbs dominate the sparse vegetation.

CONSERVATION STATUS AND MANAGEMENT CONSIDERATIONS

Given the extreme rarity of this community, all examples in Vermont should be protected, either by public ownership or through conservation easements with interested landowners. Potential threats to this community include alteration of river flows through operation of dams, grazing



Grass of Parnassus – *Parnassia glauca*



by livestock, and spread of invasive exotic plants. As with other wetland types that are closely associated with calcareous groundwater seepage, long-term protection of Calcareous Riverside Seeps will require study and conservation efforts in the immediate watershed of the seep as well as in the larger groundwater recharge area that feeds the seep. A very high quality example of this community is protected at the White River Ledges Natural Area, owned and managed by The Nature Conservancy.

Places to Visit

White River Ledges Natural Area, Sharon and Pomfret, The Nature Conservancy

Selected References and Further Reading

Thompson, E. and R. Popp. 1995. Calcareous open fens and riverside seeps of Vermont: some sites of ecological importance. Vermont Nongame and Natural Heritage Program.

Characteristic Plants

Shrubs

Occasional to Locally Abundant Species

Woolly-headed willow – *Salix eriocephala*

Herbs

Abundant Species

Grass of Parnassus – *Parnassia glauca*
Capillary beak-rush – *Rhynchospora capillacea*
Pumpkin sedge – *Carex aurea*
Yellow sedge – *Carex flava*
Porcupine sedge – *Carex hystericina*

Occasional to Locally Abundant Species

Kalm's lobelia – *Lobelia kalmii*
Loesel's twayblade – *Liparis loeselii*
Variegated scouring-rush – *Equisetum variegatum*
Garber's sedge – *Carex garberi*
Sticky false asphodel – *Tofieldia glutinosa*

Invasive Exotic Plants

Coltsfoot – *Tussilago farfara*
Purple loosestrife – *Lythrum salicaria*

Bryophytes

Abundant Species

Starry campylium – *Campylium stellatum*
Moss – *Bryum pseudotriquetrum*

Occasional to Locally Abundant Species

Moss – *Philinotis fontana*
Moss – *Drepanocladus* spp.

Rare and Uncommon Plants

Capillary beak-rush – *Rhynchospora capillacea*
Garber's sedge – *Carex garberi*
Sticky false asphodel – *Tofieldia glutinosa*
Few-flowered spikerush – *Eleocharis pauciflora*
Fringed gentian – *Gentianopsis crinita*
Shining lady's-tresses – *Spiranthes lucida*
Greenish sedge – *Carex viridula*
Atlantic sedge – *Carex atlantica*
Musk flower – *Mimulus moschatus*

Rivershore Grassland

Distribution/Abundance

Occurs throughout Vermont, but large, well-developed examples are restricted to the Connecticut, West, White, and Winooski Rivers. Similar communities are described for all of eastern North America.

Ecology and Physical Setting

Rivershore Grasslands are open wetland communities on relatively stable substrates along high-energy and high-gradient stretches of our larger rivers. Rivershore Grasslands typically occur in the zone that includes the upper portion of the active river channel, and they are bordered above by a sharp rise in topography to the flat river floodplain. Rivershore Grasslands commonly grade into River Cobble Shore or River Sand and Gravel communities closer to the river. Rivershore Grasslands are more common on the inside of river meanders, where there is less erosion and more deposition of alluvial material. This alluvium includes both fine textured mineral soils and organic matter, which accumulates in the spaces between the substrate of primarily cobble and gravel. Exposed bedrock may be present at some sites.

Rivershore Grasslands are maintained as open communities for many years by flooding from spring flows and summer storms, both of which may inundate the community. Ice scouring during winter and early spring also restricts the establishment of woody plants in this community. Over a period of many years, as the river channel continues to migrate laterally and as alluvium is deposited, Rivershore Grasslands tend to develop into floodplain forests. Rivers are very dynamic systems, however, and a single large storm can change the channel location significantly and reverse this trend in community succession.

VEGETATION

Tall grasses and forbs dominate the vegetation of Rivershore Grasslands, with occasional woody and herbaceous vines. Woody plants typically do not survive on the lower, wetter portions of the grassland but are more common on the upper margins where flooding and ice scouring is less severe. The organic-rich interstices between cobbles are commonly vegetated by bryophytes. Overall, Rivershore Grasslands are more than 50 percent vegetated, but the distribution of species and abundance of plants may vary dramatically as the distance from the river increases.

The striking cardinal flower grows in Rivershore Grasslands.

Common species in the Rivershore Grassland community are reed canary grass, bluejoint grass, big bluestem, woolly panic grass, Indian hemp, and Joe-pye weed. Typical shrubs and vines include speckled alder, bush-honeysuckle, and riverbank grape. The bryophyte component of this community needs further investigation.

ANIMALS

Rivershore Grasslands provide habitat for leopard frogs and green frogs. Wood turtles may use this community when foraging for food. Otter and mink use Rivershore Grasslands as part of their travel corridors along rivers. Meadow voles may be common.

VARIANTS

None recognized at this time.

RELATED COMMUNITIES

River Sand or Gravel Shore: This community is a sparsely vegetated sand or gravel shore on moderate-gradient segments of rivers and may grade into more densely vegetated Rivershore Grassland community above.

River Cobble Shore: Sparsely vegetated cobble shore on high-gradient, high-energy river segments. May also grade into more densely vegetated Rivershore Grassland community.

Lakeshore Grassland: This community occurs along the shores of Lake Champlain and has longer periods of flooding and more stable substrate than Rivershore Grasslands.

CONSERVATION STATUS AND MANAGEMENT CONSIDERATIONS

The ecological integrity of Rivershore Grasslands and other riverside communities is inseparable from the integrity of the river itself. Alteration of flow regimes through dam operation, river channelization, rip-rapping, and loss of forested buffers and floodplains are all factors that can alter natural river dynamics and, in turn, affect shoreline and floodplain communities. Like most rivershore communities with exposed mineral soils, Rivershore Grasslands are threatened by the spread of invasive exotic plants.

PLACES TO VISIT

Hartland Rivershore Natural Area, Hartland, The Nature Conservancy (TNC)

White River Ledges Natural Area, Sharon and Pomfret, TNC

West River, Townshend, flood control project, U.S. Army Corps of Engineers

CHARACTERISTIC PLANTS

SHRUBS AND VINES

Occasional to Locally Abundant Species

Speckled alder – *Alnus incana*
Bush-honeysuckle – *Diervilla lonicera*
Riverbank grape – *Vitis riparia*
Meadow-sweet – *Spiraea alba* var. *latifolia*
Purple-flowering raspberry – *Rubus odoratus*

HERBS

Abundant Species

Reed canary grass – *Phalaris arundinacea*
Bluejoint grass – *Calamagrostis canadensis*
Big bluestem – *Andropogon gerardii*

Occasional to Locally Abundant Species

Woolly panic grass – *Panicum lanuginosum*
Indian hemp – *Apocynum cannabinum*
Little bluestem – *Schizachyrium scoparium*
Twisted sedge – *Carex torta*
Joe-pye weed – *Eupatorium maculatum*
Common St. John's-wort – *Hypericum perforatum*
Groundnut – *Apios americana*
Cardinal flower – *Lobelia cardinalis*
Common monkey-flower – *Mimulus ringens*
Starry false Solomon's seal – *Smilacina stellata*
Woolly-fruited sedge – *Carex lanuginosa*
Hop sedge – *Carex lupulina*

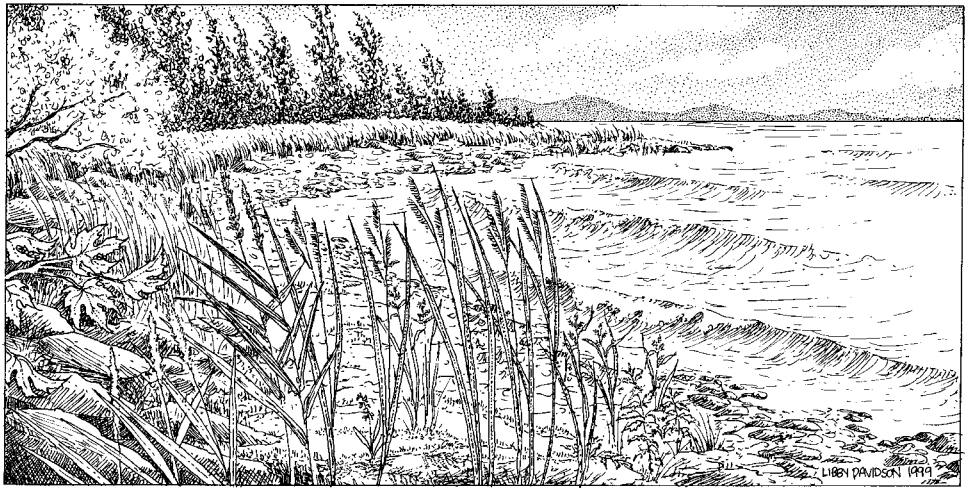
INVASIVE AND NON-NATIVE PLANTS

White sweet clover – *Melilotus alba*
Purple loosestrife – *Lythrum salicaria*
Japanese knotweed – *Polygonum cuspidatum*

RARE AND UNCOMMON PLANTS

Obedience – *Physostegia virginiana*
Great St. John's-wort – *Hypericum pyramidatum*
Canada burnet – *Sanguisorba canadensis*
Wild chives – *Allium schoenoprasum* var. *sibiricum*

Lakeshore Grassland



Distribution/Abundance

A rare community type found on the shores of Lake Champlain and Lake Memphremagog. Similar lakeshore grassland communities are found throughout the Great Lakes and in some larger lakes of New England.

Ecology and Physical Setting

Lakeshore Grassland is a rare community type in Vermont, with known occurrences only along the shore of Lake Champlain, and to a lesser extent, Lake Memphremagog. This community occurs on gently sloping shorelines of gravel, cobble, and shale. These grasslands are generally only 25 to 50 feet wide but may extend for several thousand feet along the shoreline. This community likely occurs along the shores of other lakes in Vermont, but these examples are probably very narrow as the width of the community is tied to seasonal lake level fluctuations.

Ice scouring during the winter and spring, flooding that may last into the early summer in wet years, and breaking waves during storms are all factors responsible for maintaining this community as an open grassland. On their upper margins, Lakeshore Grasslands may be bordered by Lakeside Floodplain Forests or upland forest communities, depending on the topographic change and the levels of flooding. Summer lake levels are generally below the grassland, although breaking waves typically keep the substrate of the grassland moist throughout most of the growing season. Groundwater seepage may provide a constant source of moisture to this community at some sites. Fine mineral soils and organic matter accumulate in the gaps between cobbles and shale blocks, providing a substrate for vascular plants and bryophytes.

Lakeshore Grasslands may intergrade with Lakeshore Dry Shale Cobble, an upland community. The ecological differences between these two communities needs further investigation, but substrate type, elevation above the lake level, and the amount of groundwater seepage may all be important factors.

VEGETATION

This open community is dominated by grasses, sedges, and forbs that typically cover at least 50 percent of the ground and grow in the finer substrate between the cobble and shale. Characteristic plants are freshwater cordgrass, greenish sedge, silverweed, fringed loosestrife, shining lady's-tresses, and wild mint. Reed canary grass may be common at some sites, as may the invasive exotic, purple loosestrife. Although seldom abundant, the presence of variegated scouring-rush in some lakeshore grasslands is an indication of a calcium-rich substrate.

Mosses are common on the organic substrate between cobbles and shale pieces. *Hypnum lindbergii* and *Bryum pseudotriquetrum* are two common mosses associated with lakeshore grasslands, both of which generally occur in base-rich habitats. Additional inventory work is needed to characterize the bryophyte component of this community.

Silverweed is a characteristic plant of Lakeshore Grasslands.

Woody vegetation is very sparse in the grassland community. It consists of scattered shrubs of willow and red-osier dogwood, with seedlings and saplings of silver maple, green ash, and cottonwood. Trees of the latter three species are common on the shoreline above the grassland community.

ANIMALS

Leopard frogs are common in this community and may be hunted by great blue heron. Painted turtles may nest in this community. Spotted sandpipers typically nest in this and other shoreline communities. Meadow voles are often quite common. Native and exotic snails can be common on the algae-covered cobble within the spray of breaking waves.

VARIANTS

None recognized at this time.

RELATED COMMUNITIES

Lakeshore Dry Shale Cobble: This upland community is subject to flooding and ice scouring like the Lakeshore Grassland Community, but the substrate is predominantly shale, which becomes hot and dry by summer. Showy tick trefoil and Canada anemone are common plants in this sparsely vegetated community.

Rivershore Grassland: This rivershore community is also kept open by ice scour and flooding, although the duration of spring flooding is typically shorter than in lakeside grasslands. The substrate is less stable than in lakeshore grasslands and may shift in years with high river flow. Grasses and forbs dominate.

CONSERVATION STATUS AND MANAGEMENT CONSIDERATIONS

The present locations of lakeshore grasslands and other shoreline communities along Lake Champlain have been determined by the elevation of lake levels regulated at the dam on the Richelieu River in Québec. Alterations in Lake Champlain water regimes would have a significant impact on this and other shoreline communities. Purple loosestrife is common in many lakeshore grasslands and poses a significant threat to the biological integrity of this natural community.

PLACES TO VISIT

Campmeeting Point, Knight Point State Park, North Hero, Vermont Department of Forests, Parks, and Recreation

CHARACTERISTIC PLANTS

SHRUBS AND SAPLINGS

Occasional to Locally Abundant Species

Shining willow – *Salix lucida*
Slender willow – *Salix petiolaris*
Red-osier dogwood – *Cornus sericea*
Silver maple – *Acer saccharinum*
Green ash – *Fraxinus pennsylvanica*
Cottonwood – *Populus deltoides*

HERBS

Abundant Species

Freshwater cordgrass – *Spartina pectinata*
Greenish sedge – *Carex viridula*

Occasional to Locally Abundant Species

Silverweed – *Potentilla anserina*
Fringed loosestrife – *Lysimachia ciliata*
Clammyweed – *Polanisia dodecandra*
Wild mint – *Mentha arvensis*
Common water-horehound – *Lycopus uniflorus*
Variegated scouring-rush – *Equisetum variegatum*
Reed canary grass – *Phalaris arundinacea*
Bluejoint grass – *Calamagrostis canadensis*
Tall meadow rue – *Thalictrum pubescens*
Rushes – *Juncus* spp.
Shining lady's tresses – *Spiranthes lucida*

INVASIVE EXOTIC PLANTS

Purple loosestrife – *Lythrum salicaria*

BRYOPHYTES

Occasional to Locally Abundant Species

Moss – *Hypnum lindbergii*
Moss – *Bryum pseudotriquetrum*

RARE AND UNCOMMON PLANTS

Greenish sedge – *Carex viridula*
Alpine rush – *Juncus alpinoarticulatus*
Obedience – *Physostegia virginiana*
Beach wormwood – *Artemisia campestris* ssp. *caudata*
Northern meadow rue – *Thalictrum venulosum*
Small skullcap – *Scutellaria parvula*
Shining lady's-tresses – *Spiranthes lucida*