Red Lake Peatlands

One of the most unusual landscapes in the United States is found in the glacial lake beds of northern Minnesota. Over the past several thousand years, extensive and highly patterned peatland ecosystems have developed across this level, poorly drained region. Although this region is relatively flat topographically, there is sufficient slope for the slow movement of water across the landscape. The quantity of moving water and its chemistry, particularly mineral content and pH, varies throughout these peatlands. The complex landform patterns are a result of the interplay of plant communities that have developed in response to these subtle gradients in water chemistry and water movements. The landforms can be classified into two general types: Acid Peatlands and Rich Peatlands.

Acid Peatlands

Acid peatlands or bogs are convex landforms that have a well-develped sphagnum moss substrate that elevates the rooting zone of surface vegetation above the influence of mineral-rich groundwater. With rainfall being the only source for nutrients and minerals, bogs are very acidic and extremely poor in nutrients and minerals. The most highly developed bogs form crests or domes that are sufficiently above the water table to allow aeration of roots. These elevated areas are occupied by black spruce. The bog slopes, which are lower in elevation and therefore wetter, are dominated by acid-loving shrubs, herbs and sedges. Acid peatland formations include raised or crested bogs and ovoid bog islands.

Rich Peatlands

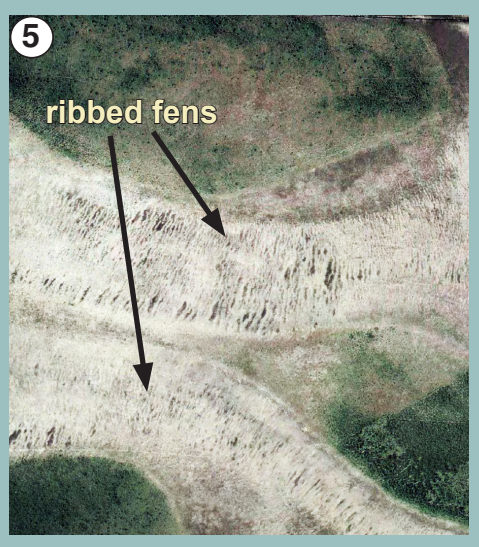
Rich peatlands are concave to level landforms fed by groundwater that has flowed though mineral soil and is discharged into and across the peatlands. These mineral-rich water-fed peatlands can be either open or forested. The wetter of these areas develop into treeless water tracks called fens that are dominated by sedges and other grass-like plants. Slightly drier environments or localized areas with slightly elevated hummocks are dominated by tamarack swamps. Rich peatland landforms include water tracks, tear drop islands, and ribbed fens.

◀ **Western Water Track** – This vast sedge fen is ~2.5 miles wide and 16 miles in length. The mineral-rich water of this “river of grass” flows from west to east (left to right) and splits into north and south-flowing branches that define the western edge of the central bog island complex. The wettest areas show up as black in this photo.

◀ **Tear Drop Islands** – Scattered throughout the sedge fen are tear drop-shaped islands of tamarack. These stream-lined islands are slightly elevated above the surrounding sedge fen and typically have an upstream head of tamarack and a trailing tail of brush.

◀ **Ovoid Bog Islands** – These black spruce–sphagnum moss dominated islands have rounded heads oriented upslope (southward) towards the crested raised bog and tails pointed down-stream (northward). The outer edges of the ovoid islands are slightly raised allowing for the growth of black spruce whereas the interior portions of the islands are wet and dominated by sphagnum.

◀ **Crested Bog** – This crested bog is an east-west oriented ridge of sphagnum peat that rises above the influence of mineral rich water. It is recognizable by the radiating pattern formed by black spruce (dark green) that grows tallest on the crest and becomes increasingly stunted and sparser along the slopes and finally grades into a tree-less sphagnum lawn (light color). The crest forms the hydrological divide between waters flowing north to the Rapid River and water flowing south to Red Lake.



◀ **Ribbed Fen** – The ribbed fen pattern is a feature within a water track that is characterized by the formation of alternating shrub-dominated sphagnum ridges and sedge-dominated pools of water that are oriented perpendicular to the flow of water. Well-developed pools provide habitat for several rare plant species including the linear-leaved sundew.

DEPARTMENT OF NATURAL RESOURCES

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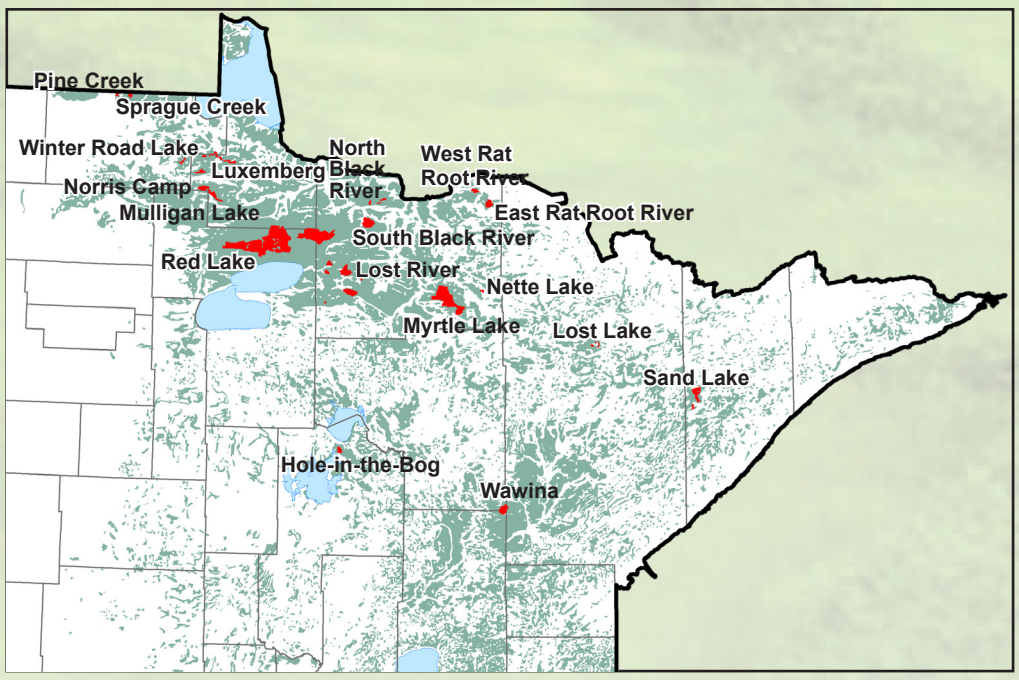
Patterned Peatlands

Importance of Minnesota's Peatlands

Peatlands are one of Minnesota's most extensive ecosystems, covering over six million acres or more than 10% of the state. Unlike some of Minnesota's other large ecosystems such as prairies and eastern broadleaf forests, most of Minnesota's peatlands have not been cleared or fragmented by development. The large, mostly unaltered patterned peatlands of the Lake Agassiz Lowlands are recognized internationally for their significance and present a rare opportunity in Minnesota for landscape-scale conservation as well as for research on how peatlands develop. The southerly position of the Red Lake Peatland, just 50 miles from the prairie-forest border, makes it a bellwether for the impact of climate change on the world's boreal peatlands. One of the most pressing concerns is that climate change will dry peat surfaces, causing rapid decomposition of peat and the release of large quantities of carbon dioxide and methane into the atmosphere. Undisturbed complex peatlands are essential as study areas for understanding these processes and developing approaches to mitigate them. In addition to their ecosystem-level importance, Minnesota's peatlands provide habitat for over two dozen rare plant species—including linear-leaved sundew, English sundew, coastal sedge, twig-rush, bog rush, sooty-colored beak-rush, and montane yellow-eyed grass—and for rare animals such as the northern bog lemming, short-eared owl, yellow rail, and Wilson's phalarope.

Peatland History

- Peatlands began to form in the Lake Agassiz Lowlands following the onset of cooler and wetter climate about 5,000 years ago.
- The first detailed description of Minnesota's northern peatlands was published by Warren Upham in 1895 in his account of Glacial Lake Agassiz.
- A large-scale effort was begun around 1905 to drain Minnesota's northern peatlands for agriculture. The effort failed and was mostly abandoned by 1929, leaving several bankrupt counties in its aftermath.
- In the 1940s the Soil Conservation and Stabilization Service produced the first comprehensive set of aerial photos of the distinctive patterns visible in Minnesota's northern peatlands. Naval Reserve pilots flying over the Agassiz Lowlands during training flights for World War II also observed and photographed the peatland patterns, prompting an investigative trip to the peatlands by University of Minnesota researchers after the war.
- The first substantial research on the large Lake Agassiz peatlands was begun in 1955 by Miron Heinselman, then a graduate student at the University of Minnesota; Heinselman published a detailed interpretation of the peatland patterns in his pioneering work on the Glacial Lake Agassiz peatlands in 1963.
- In 1974 the National Park Service designated the Red Lake Peatland as a National Natural Landmark.
- In 1975, during the energy crisis, Minnegasco proposed mining peat for energy on 300,000 acres in the Red Lake Peatland. This proposal spawned the origin of the DNR's Minnesota Peat Program in 1977, which funded research on the ecology, hydrology, and economic uses of peat, and generated new interest in Minnesota's peatlands.
- The DNR's Peat Program published *Preliminary Report: Protection of Ecologically Significant Peatlands in Minnesota* in 1984, which summarized ecological and conservation information for the most significant peatlands in Minnesota over 3,000 acres in size.
- Minnesota's Wetland Conservation Act of 1991 established protection for 18 ecologically significant peatlands in Minnesota—including the Red Lake Peatland—as Scientific and Natural Areas (2007 Minnesota Statute 84.036, Peatland Scientific and Natural Area Designation).
- *The Patterned Peatlands of Minnesota* was published by the University of Minnesota Press in 1992, summarizing the findings of several decades of research on Minnesota's peatlands.
- Scientists at the University of Minnesota have continued research on peatland formation, hydrology, and ecology since the late 1970s, with recent studies examining the impact of climate change on peatlands.



Minnesota's Peatland Scientific and Natural Areas are shown in red. Areas in green represent the original extent of peatlands (open muskeg/conifer bogs and swamps as recorded at the time of the Public Land Survey: 1847-1908*). The Wetland Conservation Act of 1991 protected the core areas of 18 of Minnesota's ecologically significant peatlands as Scientific and Natural Areas.

*Adapted from Marschner, F.J. 1974. *The original vegetation of Minnesota, compiled from U.S. General Land Office Survey notes* [map]. 1:500,000. Redrafted from the 1930 original by P.J. Burwell and S.J. Haas under the direction of M.L. Heinselman. St. Paul: North Central Forest Experiment Station, United States Department of Agriculture.

Peatland Facts

- Minnesota has over 6 million acres of peatlands, more than any state except Alaska.
- The large patterned peatlands of northern Minnesota are internationally recognized for their ecological significance.
- The Red Lake Peatland is the largest, most highly developed, and most diversely patterned peatland in the United States.
- Peat forms in poorly drained settings under a balance of precipitation, groundwater inputs, and evaporation.
- Peat accumulates very slowly; in Minnesota, it has been measured at a rate of just 1.5 to 3 inches per century.
- The continuously saturated and often mineral-poor conditions of peatlands support a narrowly adapted set of peatland plants and animals.
- The sphagnum mosses that carpet peatland bogs are extremely effective at holding water.
- Peatlands are sensitive to small changes in water level and chemistry. Drainage ditches and roads can cause changes in water levels and flow that have lasting impact on peatlands.
- Trails used by caribou during migration to calving grounds in Canada are still visible in the Red Lake Peatland, even though the last migration took place in the 1930s.
- Peatlands filter large amounts of carbon dioxide from the atmosphere. Globally they are estimated to store about 20%-30 of terrestrial carbon, an amount equivavent to roughly half of the earth's atmospheric carbon. Peatlands also store large quantities of methane gas, one of the most potent greenhouse gases.
- The Red Lake Peatland is the southernmost of the boreal peatlands in North America. Its southerly position, at the edge of climatic conditions favorable for development of boreal peatlands, makes it a bellwether for the impacts of climate change on the earth's northern peatlands.