Science Delivery

Many concepts of peatland ecology, hydrology, and biogeochemistry are derived from research at the MEF. Research on the cycling of water, carbon, nutrients, and trace metals in peatlands was groundbreaking. Information from studies shows why peatlands are important landscape features in northern ecosystems, allowed the development of ecosystem models, guided best management practices in peatland ecosystems, and formed a template for the development of other national and international research programs. With a network of sensors that are deployed across uplands and peatlands to measure meteorology, hydrology, trace gas emissions, and water quality, the Marcell Experimental Forest is well poised for studies of the effects of climate change on northern peatlands and other emerging issues in the ecosystems sciences.

The Marcell Experimental Forest research is the subject of a book:

Kolka, R.K., S.S. Sebestyen, E.S. Verry, and K.N. Brooks, eds. 2011. *Peatland Biogeochemistry and Watershed Hydrology at the Marcell Experimental Forest.* CRC Press, Boca Raton, FL, 488 pp.

This book is a compilation and synthesis of 50 years of research.

Facilities

The Marcell Research Center has a heated shop, laboratory, conference facility and living quarters for up to eight visiting researchers and graduate students.

Measuring snow depth and the amount of water contained in snow helps us predict snow melt in the spring and provides a long-term record of changes in snowpack over the past 50 years. Photo by Art Elling, U.S. Forest Service.

U.S. Forest Service Experimental Forest and Range Network

Forest Service Research and Development (R&D) works at the forefront of science to improve the health and use of our nation's forests and grasslands. Research has been part of the Forest Service mission since the agency's inception. Today, Forest Service researchers work in a range of biological, physical, and social science fields; their research covers all 50 states, U.S. territories, and commonwealths. The Northern Research Station is one of six in R&D, and includes 20 states in the north-central and northeastern U.S., comprising both the most densely populated and most heavily forested portions of the country.

The Experimental Forest and Range (EFR) network contributes importantly to R&D's research infrastructure and is increasingly viewed as one of its most valued assets. There are currently 22 official experimental forests in the Northern Research Station, and 80 EFRs nationwide. Taken together, these sites provide a record of forests and forest change that dates back more than 100 years. Though initially focused on local and regional topics, EFRs are becoming increasingly networked to address issues of national and international concern such as climate change, carbon sequestration, air and water quality, and invasive plants and animals.

For more information about Marcell Experimental Forest

Websites:

http://ors.fs.fed.us/ef/marcell/

http://www.fs.fed.us/research/efr/

http://nrs.fs.fed.us/ef/

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Cover photo: Experimental bog at the Marcell Experimental Forest. Note the carnivorous pitcher plants in the foreground, a good indicator of a very nutrient-poor ecosystem. Photo by Art Elling, U.S. Forest Service.

USDA United States Department of Agriculture

Forest Service

Marcell Experimental Forest

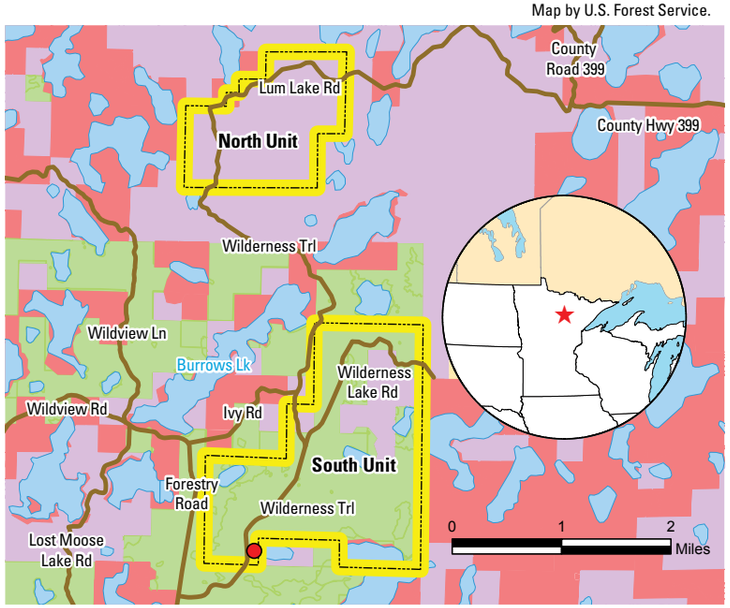
NORTHERN RESEARCH STATION
EXPERIMENTAL FOREST NETWORK

NRS-INF-30-13

Marcell Experimental Forest

The Marcell Experimental Forest (MEF) is a long-term ecosystem research site operated by the Northern Research Station of the U.S. Forest Service. The MEF, located 40 km north of Grand Rapids, Minnesota, is an 1,141 ha (2,819 ac) tract of land that was formally established in 1962 to study the ecology and hydrology of peatland watersheds. The MEF includes uplands, lakes, and peatlands on two separate land areas, the North and South Units. The Forest is situated in the Marcell Hills moraine of north-central Minnesota on lands of the Chippewa National Forest, the Minnesota Department of Natural Resources, Itasca County, and a private landowner.

Map by U.S. Forest Service.



Marcell Research Center
Marcell Experimental Forest
Chippewa National Forest
State
Private
County
Water

Left: State-of-the-art Marcell Research Center opened in 2006 to provide conference, laboratory, and sleeping space for Forest Service researchers and collaborators. Photo by Steve Sebestyen, U.S. Forest Service.

Above: An aerial view of S6 Watershed that had the deciduous upland harvested in 1980 and converted to conifers as part of an experiment to understand the influence of conifer restoration on water and nutrient cycles. Photo by Sandy Verry, U.S. Forest Service.

Features

About 30 percent of the forest landscape at the MEF is peatlands or lakes. The peatlands include fens that receive groundwater from the regional groundwater aquifer and bogs that only have inputs of water from precipitation. Either type of peatland may be treeless or have tree cover that ranges from relatively open to a closed canopy. Forested bogs contain black spruce and tamarack. Both forested and open bogs are dominated by *Sphagnum* and ericaceous shrubs. Forested fens contain similar species as the bogs but also include northern white cedar and black ash. Open, poor fens are dominated by sedges, mosses, and *Sphagnum*.

- **The climate is subhumid continental, with wide diurnal and seasonal temperature fluctuations. Mean annual air temperature is 38.1 °F, with extremes of -50.8 °F and 100.4 °F. The average temperature at Marcell has risen about 0.72 °F per decade since the 1960s.**
- **Mean annual precipitation is 30.4 inches with 75 percent occurring in the snow-free period. The pH of waters draining the bogs ranges from about 3.5 to 4.5 with the fens having a pH of near neutral.**
- **There are six research watersheds and other intensive research locations.**
- **Sandy loam tills in the uplands have aspen, birch, and northern hardwood stands. Sandy outwash soils have stands of red and jack pine along with mixed aspen, white birch, balsam fir, and white spruce.**

Research

Hydrological and meteorological measurements started on the MEF during 1961. Previous and ongoing research at the MEF addresses the ecology, hydrology, and biogeochemistry of peatlands; effects of atmospheric pollutants on forests; the storage and transport of chemicals in the environment; climate change; trace gas emissions from peatlands and upland soils; and forest management. The MEF was a pilot site in the Long-term Soil Productivity (LTSP) Study, is the longest running National Atmospheric Deposition Program (NADP) site in the nation, and was one of three pilot sites in the NADP Mercury Deposition Network. In early 2000, cooperative efforts led to online hydrological (HydroDB) and climate (ClimDB) databases. The MEF is also participating in an online water-chemistry database (tentatively named StreamChemDB) that is under development.

The MEF is host to a new exciting climate change manipulation experiment. The Spruce-Peatland Responses Under Climatic and Environmental Change (SPRUCE) experiment, is the next large scale DOE sponsored experiment that is a collaboration between the USFS Northern Research Station and Oak Ridge National Laboratory. The experiment is using large chambers to test the effect of elevated soil/air temperature and carbon dioxide on peatland (bog) vegetation and carbon processes. Over the course of this 10+ year experiment, total funding is expected to exceed $50 million and involve 100+ scientists from across the globe.

Overhead of SPRUCE: An aerial view of the development of the Spruce and Peatland Responses Under Climatic and Environmental Change (SPRUCE) experiment. SPRUCE will assess how warming and elevated carbon dioxide influence biological, chemical and physical processes in a northern bog. Photo by Oak Ridge National Lab.