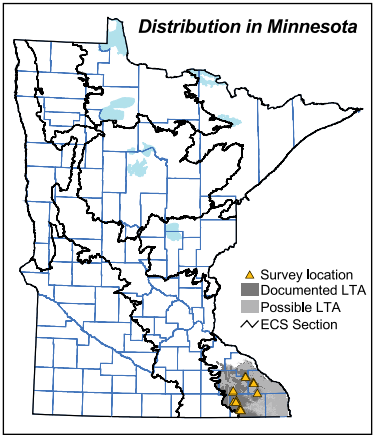
Southern Maderate Cliff

Cool, moist, moss-dominated plant communities on shaded northwest- to northeast-facing cliffs in karst landscapes of southeastern Minnesota. Characterized by cold microclimate maintained by cold air and groundwater emanating from subterranean ice. Community supports northern plants uncommon in southern Minnesota and Pleistocene land snails.

Vegetation Structure & Composition

Description is based on summary of plant species lists and field notes from 22 cliffs



- **Lichen** and **bryophyte** cover is high. Exposed bedrock on cliff face is dominated by mosses, liverworts, and algae, which form thick mats, especially around areas of groundwater seepage. Lichens are common on exposed bedrock, especially in drier areas, but are usually less abundant than mosses and liverworts. Rare bryophyte species may be present as very small clones, including the mosses *Grimmia teretinervis*, *Mnium marginatum*, *Myurella sibirica*, *Plagiopus oederiana*, *Platydictya* spp., *Pseudoleskeella tectorum*, *Seligeria calcarea*, and *S. pusilla*. More common bryophyte species such as the liverwort *Conocephalum conicum*, and the mosses *Gymnostomum aeruginosum*, *Plagiomnium cuspidatum*, *Thuidium delicatulum*, and the ubiquitous *Brachythecium acuminatum* may form abundant cover on boulders or rock edges near cold-air vents.
- **Herbaceous plant** cover is sparse to patchy. Typical species include Arabian whitlow grass *(Draba arabisans),* slender cliff brake *(Cryptogramma stelleri)*, fragile fern *(Cystopteris fragilis)*, and bulblet fern *(C. bulbifera).* The rare Leedy's roseroot *(Sedum rosea* var. *integrifolium)* is restricted to this community in Minnesota. Herbaceous plants from Southern Mesic Hardwood Forest communities are also frequent on cliff face.
- **Tree** and **shrub** cover on cliff face ranges from absent to fairly dense but most often is sparse to patchy (5–50%), with canopy, subcanopy, and shrub layer poorly differentiated when present. White pine, Canada yew *(Taxus canadensis),* mountain maple *(Acer spicatum),* and red-berried elder *(Sambucus racemosa)* are often present, though often restricted to top or base of cliff. Yellow birch and balsam fir are associated with some maderate cliffs.

Landscape Setting & Soils

- **Steep stream-dissected bedrock bluffs**—Rare. Present in dissected bedrock terrain where little of the original plateau remains as interfluves between stream valleys. Most common on steep slopes with north-facing aspects, typically in middle and upper portions of small to medium stream valleys. Rock types include limestone and dolomite, sometimes with inclusions of shale or sandstone. Cliff faces may be composed of multiple rock layers, and seepage often emerges at contacts between different layers. True soil development is limited, with soil mostly confined to ledges and crevices and consisting of thin organic deposits from decomposing plant and animal remains. Local areas such as slides and chutes generally have somewhat greater soil accumulation. (Blufflands in PPL)

Natural History

Maderate cliffs are rare, with worldwide distribution limited to the Paleozoic Plateau of Minnesota, Wisconsin, Iowa, and Illinois. They occur in specialized settings on steep slopes in deep, narrow, often tightly meandering forested valleys. The cold air and water that create the cold microclimate in the community are maintained by a unique system

involving ridgetop sinkholes and subterranean ice caves; this system also provides cold air for Algific Talus Slopes (CTs46). Maderate cliffs have cold microclimates throughout the summer, even on the warmest days. On the coldest cliffs, ice may be present into summer beneath moss mats. The deep valleys where the community occurs are generally cooler and moister than the surrounding landscape, especially in areas with intact forest canopies, and maderate cliffs are rarely affected by direct sunlight. Cool air settles in these valleys in the evening, further enhancing their cool microclimate and minimizing desiccation.

Groundwater seepage on maderate cliffs varies from barely detectable to localized flows emanating from crevices to water visibly dripping or cascading over much of the rock face. Dense, thick mats of mosses and liverworts form around seepage areas. The rate of seepage flow tends to be stable but may be affected by annual precipitation levels. Maderate and wet cliffs are somewhat more buffered from the extremes of temperature, moisture, and wind prevalent on mesic and dry cliffs. Limited nutrient availability, however, and stresses on plants growing outward from vertical surfaces are still important influences on the composition and structure of vegetation. Fracture of large pieces of rock from cliff faces is a major, although rare, event that can disrupt cliff communities and set back succession. In general, the coldest and most extensive maderate cliffs occur in limestone formations, especially the Galena group; maderate cliffs on dolomite are typically not as cold and tend to have fewer northern plants.

Similar Native Plant Community Classes

- **CTs53 Southern Wet Cliff**

CTs53 occurs in settings similar to CTs43 and is also characterized by groundwater seepage flow over cliff faces but does not have the cold microclimate that supports northern plant species such as Leedy's roseroot and Arabian whitlow grass or populations of remnant Pleistocene land snails. CTs53 may occur on sandstone bedrock cliff faces in addition to limestone or dolomite and is much more likely than CTs43 to have reniform sullivantia *(Sullivantia renifolia)*.

- **CTs33 Southern Mesic Cliff**

CTs33 often grades into CTs43, especially on maderate cliffs with very limited groundwater seepage. Distinguishing between the two is most difficult on large cliffs with only small wet areas that may or may not be cold. When cold microclimate conditions are present, even on just a small portion of the cliff, the cliff is classified as CTs43. In general, in CTs33 lichens are either dominant or co-dominant with mosses, and thick bryophyte mats are uncommon, with vascular plants mostly limited to crevices and ledges. CTs33 is more likely to have smooth cliff brake *(Pellaea glabella)*, jeweled shooting star *(Dodecatheon radicatum),* ebony sedge *(Carex eburnea)*, and northern bedstraw *(Galium boreale)*. In CTs43, mosses and algae are dominant on rock surfaces, often forming thick mats. Vascular plants are present on moss mats in addition to crevices and ledges, and CTs43 is much more likely to have slender cliff brake.

- **CTs46 Southern Algific Talus**

CTs46 and CTs43 both support northern species, are cooled by the same subterranean ice systems, and may be present in close proximity. CTs46 occurs on steep bluff slopes and is characterized by a substrate of moist, rich silt and talus blocks, with occasional moist bedrock outcrops. CTs46 is much more likely to have naked miterwort *(Mitella nuda),* Iowa golden saxifrage *(Chrysosplenium iowense),* nodding wild onion *(Allium cernuum),* swamp saxifrage *(Saxifraga pennsylvanica),* northern oak fern *(Gymnocarpium robertianum),* dwarf alder *(Rhamnus alnifolia),* and northern black currant *(Ribes hudsonianum)*. CTs43 occurs on vertical bedrock substrates at least 10ft (3m) tall and generally much taller. CTs43 is much more likely to have fragile fern, Arabian whitlow grass, and Leedy's roseroot.

Native Plant Community Types in Class

Plant species composition has not been systematically sampled across the range of CTs43, and only one community type is recognized in the class at present.

- **CTs43a Maderate Cliff**

Mesic to wet limestone or dolomite cliffs with cold microclimates. CTs43a is divided into two subtypes based on type of bedrock, which appears to influence degree of coldness and species composition. In general, limestone formations are colder than dolomite formations because they are more extensively fractured and dissolved and store larger quantities of subterranean ice.

  - *CTs43a1 Limestone Subtype*
  - *CTs43a2 Dolomite Subtype*

photo by F.S. Harris MN DNR

Olmsted County, MN