photo by M.D. Lee MN DNR

Stearns County, MN

General Description

Rock Outcrop (RO) communities are open or shrub-dominated plant communities on horizontal or sloping bedrock exposures. They occur in landscapes with thin soils over bedrock. Crustose and foliose lichens typically cover exposed rock surfaces, with fruticose lichens also often present. Vascular plant cover is sparse to patchy, depending on the amount of fracturing of bedrock surfaces and accumulation of soil in cracks, crevices, and shallow depressions. RO communities are uncommon over most of the Eastern Broadleaf Forest (EBF) Province because exposed bedrock is rare, except in the Blufflands Subsection in the PPL where depth to bedrock is generally less than 50 feet (15 meters) and often much shallower. Outside of the PPL, bedrock is mostly buried beneath glacial sediments generally greater than 50 feet deep.

In the central MIM, RO communities occur locally in the Anoka Sand Plain and Hardwood Hills subsections near the Mississippi and Sauk rivers in the vicinity of St. Cloud, and very locally in the Big Woods Subsection along the Minnesota River between Mankato and Shakopee. Here, the bedrock is mostly granitic and occasionally gabbro and gneiss; all are Precambrian in origin. These outcrops are present in level to gently rolling outwash and glacial till landscapes. Most RO communities in the central MIM date from the most recent glaciation, when the bedrock was exposed by the scouring action of ice and meltwater. Over the past 10,000 years, further erosion has exposed some additional bedrock, especially along streams.

In the southern MIM and in the PPL, the bedrock is sedimentary and of Cambrian and Ordovician (Paleozoic) origin. Bedrock exposures are abundant in the rugged, stream-dissected bedrock terrain of the Blufflands Subsection. Here, exposures typically occur on steep slopes and ridgetops and along streams. There are also sporadic exposures of Paleozoic rocks in the Rochester Plateau, Oak Savanna, St. Paul–Baldwin Plains and Moraines, and Big Woods subsections. These outcrops are largely restricted to major river valleys including the lower Minnesota River downstream from Mankato, the lower St. Croix River downstream from Taylors Falls, the Mississippi River in and south of the Twin Cities metropolitan area, and the Cannon River downstream from Owatonna. Exposures from multiple bedrock formations are represented in both the PPL and the

southern MIM. These are predominantly layers of sandstone, limestone, and dolomite of various thicknesses. Even with the amount of exposed bedrock in the PPL and parts of the southern MIM, the conditions suitable for development of bedrock outcrop plant communities are limited. Many bedrock exposures are cliffs rather than horizontal or sloping bedrock. Many others have no (or few) diagnostic outcrop plants, especially smaller exposures, which are best treated as inclusions in the larger forest, woodland, savanna, or prairie communities in which they are typically embedded.

Vegetation Structure and Composition

The vegetation of RO communities is variable, although they are usually sparsely vegetated because of scarcity of soil. RO communities can be dominated by lichens, graminoids, or shrubs. In this classification, RO communities are classified by bedrock type and geography, which are major determinants of plant community composition.

Lichens are the dominant life forms on most outcrops. Crustose and foliose lichens cover exposed rock surfaces. Fruticose species are also common, especially in undisturbed sites. Mosses can be codominant with lichens along crevices and on bedrock margins. Vascular plant cover is sparse to patchy, limited mostly by the amount of soil present. On many outcrops, the amount of soil is closely tied to bedrock fragmentation, with soil accumulating in cracks and crevices and providing rooting areas for plants. Shrub-dominated outcrops often have greater soil buildup than open outcrops but less than surrounding forested communities. With fire suppression since Euro-American settlement, woody plant cover is increasing in many RO communities.

RO communities are perhaps more accurately treated as heterogeneous assemblages of different plant communities rather than as a single vegetation type. A typical example may include a bare rock community mostly composed of lichens, a crevice and thin soil community with specialized vascular plants, a deeper soil community with prairie or woodland species, and a shallow pool community supporting aquatic plants.

Plant Adaptations

Species in RO communities are subjected to greater environmental extremes than species in surrounding terrestrial communities. Many plants that grow on bedrock outcrops have adaptations to withstand frequent desiccation resulting from full exposure to direct sun and to wind, combined with limited moisture reserves in thin pockets of soil. Fleshy water-storing tissues are present in such vascular plant outcrop specialists as prickly pear cactuses *(Opuntia* spp.) and small-seeded fameflower *(Talinum parviflorum)*. During periods of drought some species, such as rusty woodsia *(Woodsia ilvensis),* die back to their roots and then resprout when rains return. Plants must also withstand rapid fluctuations in substrate temperatures, which are significantly colder at night than in surrounding forests and much warmer during midafternoon on sunny days. Limited nutrient availability also influences community composition by preventing more nutrient-demanding species characteristic of other systems from competitively excluding characteristic RO species. Species in RO communities commonly reproduce by vegetative structures such as rhizomes, runners, or stolons and tend to persist from year to year once established at a site; species that disperse and reproduce by seed alone are much less common. The annual species present in RO communities germinate only if ample moisture is available; they mature rapidly to produce seeds before moisture is depleted and the seeds remain dormant until the next wet period. Some of the long-lived species flower and produce seeds only during periods of above-average rainfall. Because of similarity in several environmental conditions, RO communities often share a number of plants with communities in the CT system.

Landscape Setting and Disturbance Regime

In the broader landscape, RO communities are small features, rarely covering more than 10 acres (4ha) and most often less than 5 acres (2ha). Exposed rock often makes up

just a portion of a typical community occurrence, with individual exposures rarely larger than 2 acres (1ha) and usually much smaller (often ¼ acre or less) and embedded in a matrix of prairie, woodland, or forest vegetation. In the EBF Province, RO communities occur most often in wooded, fire-prone landscapes dominated by communities of the Fire-Dependent Forest/Woodland (FD) System, and less often in landscapes dominated by Upland Prairie (UP) or Mesic Hardwood (MH) Forest communities. Because of their small size, RO communities are often mapped as complexes with or inclusions within prairie, savanna, woodland, forest, or, occasionally, cliff and talus communities. Complexes of RO communities with prairie, savanna, woodland, or forest communities can be larger than 10 acres but are rarely more than 25 acres (10ha).

Because of their small size, RO communities are frequently affected by disturbances in surrounding woodlands, prairies, and forests. Removal of adjacent forest canopies by fire or windstorm results in warmer and drier local microclimates on adjacent outcrops, which further favors drought-tolerant RO species. Fires, as evidenced by the presence of charcoal on some rock outcrops, also can burn through RO communities, reducing woody cover and removing organic matter from the soil. Severe fires can effectively remove most vascular plants from an outcrop. The patchy distribution of fuels on outcrops, however, typically causes great spatial variability in fire intensity. As a result, the specialized plants characteristic of outcrops—which are typically present on microsites with very low levels of fuel within the community—often escape combustion. Major fires may result in expansion of RO communities into adjacent forests and can create new outcrop openings in woodlands with shallow soils over bedrock. In general, under a regime of periodic natural disturbance such as fire, RO communities are resistant to successional change because of limited habitat for root establishment and prevalence of species that persist from year to year. In the absence of fire and other succession-suppressing disturbances, RO communities will succeed over centuries to woodland or forest.

Floristic Regions

Communities in the RO System are divided into two floristic regions based on geographic variation in climate and plant species composition (Fig. RO-1). One of these regions, the Southern Floristic (ROs) Region, is present in both the EBF and Prairie Parkland provinces. The other, the Northern Floristic (ROn) Region, is present to the north in the Laurentian Mixed Forest Province. Vascular plants with high fidelity for RO communities in the ROs Region include brittle prickly pear *(Opuntia fragilis)*, small-seeded fameflower, rusty woodsia, false pennyroyal *(Isanthus brachiatus),* pale corydalis *(Corydalis sempervirens),* bulbostylis *(Bulbostylis capillaris),* slender knotweed *(Polygonum tenue),* bearberry *(Arctostaphylos uva-ursi),* Carolina foxtail *(Alopecurus carolinianus)*, disk hyssop *(Gratiola neglecta)*, mousetail *(Myosurus minimus),* common ragweed *(Ambrosia artemisiifolia),* rock spikemoss *(Selaginella rupestris),* and rock sandwort *(Arenaria stricta).* Only one native plant community class is recognized in the ROs Region; additional sampling, especially of lichens and mosses, may result in changes in the classification of ROs communities.

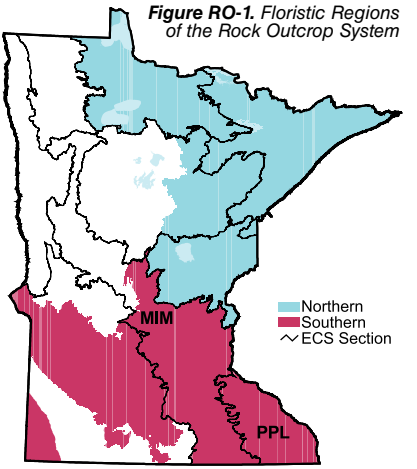

Figure RO-1. *Floristic Regions of the Rock Outcrop System*