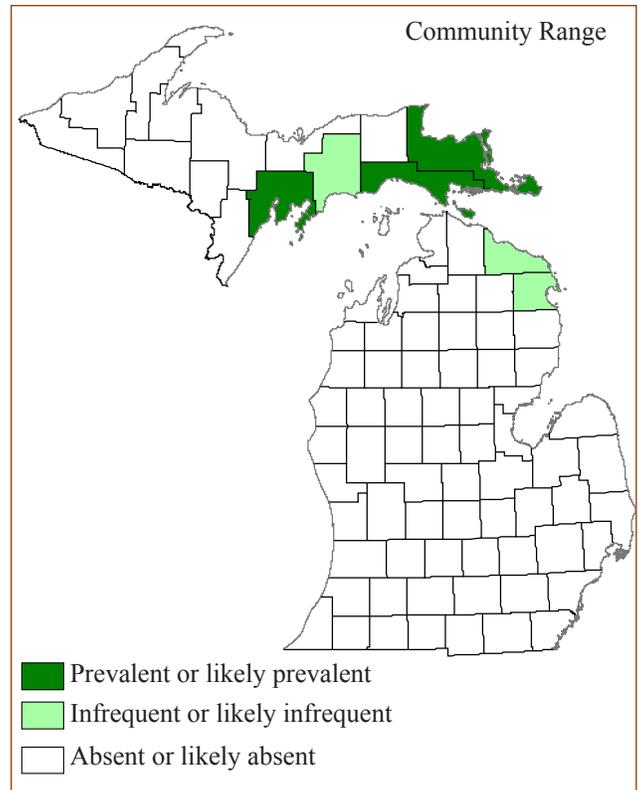




Photo by Joshua G. Cohen



Global and state rank: G3/S2

Rank justification: This community has a restricted distribution but the status and ranking of sparsely and unvegetated communities has not been entirely resolved.

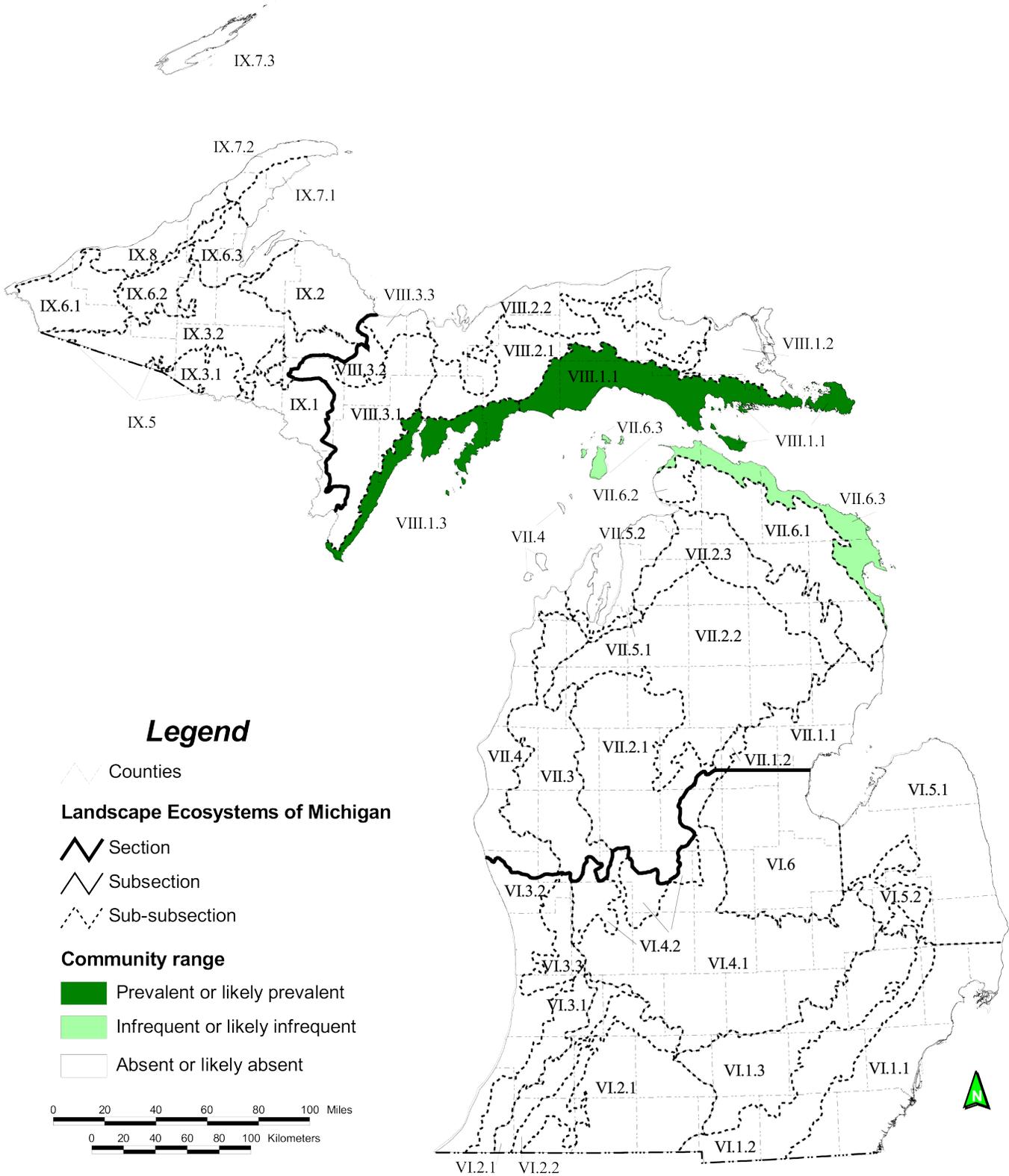
Range: Limestone bedrock lakeshores are found along the Great Lakes shorelines of Wisconsin, Michigan, Ontario, and New York. Fifteen occurrences are known from Michigan along the northern Lake Michigan and Lake Huron shorelines. Similar communities are found along Lake Champlain and on lakeshores throughout the Adirondack region.

Landscape context: In Michigan, these plant communities are commonly found along northern Great Lakes shores where flat bedrock pavement associated with the Niagaran Escarpment is exposed. The bedrock of the Niagaran Series is Silurian-age limestone and dolostone formed from marine reefs that were common in shallow portions of the Michigan Basin (Ehlers 1973). Ordovician-age limestone and dolostone also support these plant communities on northern Drummond Island. Being formed from marine organisms, these rocks are rich in calcium carbonates. Resistance to erosion is variable; limestone and dolostone are readily dissolved by rain water, producing solution cracks that often connect to the underlying groundwater system. In contrast, limestone rich in sand, silt, or clay sized particles originating from terrestrial sources (argillaceous limestone) is much more resistant to solution and typically contains few broad cracks. These lakeshores are located within sub-

subsections VII.6.3, VIII.1.1, and VIII.1.3 of the Regional Landscape Ecosystems as delineated by Albert (1995). The proximity of the Great Lakes results in moderated climate and high precipitation in these sub-subsections, relative to adjacent portions of the upper Great Lakes region. The pavement of this community forms a gentle slope (averaging 1%) dipping into the lake. Immediately inland of the exposed pavement is often a ridge of limestone or dolostone cobble (typically 1-2 m high) deposited from ice scours and major storm events in years when lake levels were higher. From this point inland, more continuous soil development is common. Typically, beginning with the cobble ridge, there are dense forests of northern-white cedar (*Thuja occidentalis*), white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), and paper birch (*Betula papyrifera*). Given their location along Great Lakes shorelines, these forests tend to experience frequent windthrow, but typically have 80% forest canopy. Occasionally, the exposed pavement is bordered along the inland edge by open northern-white cedar glades, dense herbaceous and shrub vegetation.

Natural processes: Composition and diversity of plant species is largely determined by distance from the waters edge and the width of bedrock cracks. Soil accumulation begins in the cracks forming the first sites for vegetative colonization. A distinctive vegetative zonation results from the ice scrape and wave wash dynamics of the lakeshore. The lower zone of this community, averaging 10 m wide, is continually washed by waves and is very sparsely vegetated. Ice buildup and wave wash from severe storm events





Ecoregional map of Michigan (Albert 1995) depicting distribution of limestone bedrock lakeshore (Albert et al. 2008)



may also scour the pavement surface, depositing cobbles in a narrow ridge. This zonation varies with fluctuations in Great Lakes water levels. Pools of water typically occupy about 10% of the surface of this zone. Above the wave wash/scrape zone, a more densely vegetated zone extends to the inland forest edge. The width of this zone in Michigan varies from 5-70 m wide, averaging 23 m. Pools of water typically occupy about 1% of the surface of this zone. The soils and substrate are neutral to slightly alkaline (pH 6.7-8.0). All communities along these shorelines experience frequent high winds and storm events.

Vegetation description: Limestone bedrock lakeshores are sparsely vegetated communities. The wave-washed and ice-scoured zone immediately adjacent to the lake on average contains 2% vegetative cover, with *Juncus balticus* (rush), *Potentilla anserina* (silverweed), and *Populus balsamifera* (Balm-of-Gilead) being most frequent. Mosses typically occupy 1% of the surface of this zone. The more densely vegetated zone, with patches of herbs, and occasional shrubs, typically has about 20% vegetative cover. Characteristic plant species include *Calamintha arkansana* (Arkansas mint), *Potentilla fruticosa* (shrubby cinquefoil), *P. anserina*, *Panicum lindheimeri* (panic grass), *Thuja occidentalis* (Northern white cedar), and *Deschampsia cespitosa* (hair grass). Mosses in this zone comprise 5% areal coverage. Occasionally, a glade zone occurs in the upper portion of the shoreline, dominated by stunted conifers, low evergreen shrubs, and dense herbaceous plants and mosses. These areas have, on average, 23% coverage of shrubs, 78% coverage of herbaceous plants, and 10% coverage of mosses. Characteristic plant species include: *Thuja occidentalis*, *Potentilla fruticosa*, *Arctostaphylos uva-ursi* (bearberry), *Deschampsia cespitosa*, *Senecio pauperculus* (ragwort), *Juniperus communis* (common juniper), and *Picea glauca* (white spruce) (Kost et al. 2007).

Other plant species commonly associated with limestone bedrock lakeshores in Michigan include: *Deschampsia flexuosa* (hair grass), *Hypericum kalmianum* (Kalm's St. John's-wort), *Aster laevis* (smooth aster), *Solidago ohioensis* (Ohio goldenrod), *Campanula rotundifolia* (harebell), *Lycopus americanus* (water horehound), *Viola nephrophylla* (bog violet), *Euthamia graminifolia* (grass-leaved goldenrod), *Eleocharis elliptica* (spikerush), *Primula mistassinica* (bird's eye primrose), *Carex viridula* (sedge), *C. eburnea* (ebony sedge), and *Zigadenus glaucus* (white camas). Rare plants may include such species as *Carex richardsonii* (Richardson's sedge), *C. concinna* (beauty sedge), and *C. scirpoidea* (bulrush sedge). A total of 147 vascular plant species have been recorded along limestone bedrock lakeshores in Michigan. On any given stretch of bedrock lakeshore one would, on average, encounter 24 vascular plant species.

Strata

Tree canopy

Short shrub

Herbaceous

Most abundant

Thuja occidentalis

Potentilla fruticosa, *Populus balsamifera*,
Thuja occidentalis

Calamintha arkansana, *Potentilla anserina*, *Juncus balticus*, *Deschampsia cespitosa*, *Panicum lindheimeri*



Photo by Joshua G. Cohen

The sparse vegetation is restricted to cracks and fissures in the limestone bedrock.

Michigan indicator species: *Primula mistassinica*, *Carex richardsonii*.

Other noteworthy species: Rare plants that can occur within limestone bedrock lakeshore include *Solidago houghtonii* (Houghton's goldenrod, state threatened), *Carex richardsonii* (Richardson's sedge, state special concern), *C. scirpoidea* (bulrush sedge, state threatened), *Iris lacustris* (dwarf lake iris, state threatened), and *Cirsium hillii* (Hill's thistle, state special concern).

Special animals: Special animal species that associate with the limestone bedrock lakeshores in Michigan include several land snails and one uncommon butterfly. *Vertigo hubrichti* (state endangered) is a periglacial relict snail known from less than 30 sites worldwide and from two sites in Michigan. One of these is from a shaded, damp to dry low ledge in the shrub zone of limestone bedrock lakeshore.

A number of butterflies have been recorded from the limestone lakeshores including the tawny crescent-spot (*Phyciodes batesii*, state special concern). In addition to lakeshore pavements, this species can be found in alvar glades and wet meadows of northern Michigan where its larvae feed on a variety of aster species.

The shorelines also provide stopover and feeding corridors important to neotropical migratory birds including many warbler species.





Limestone bedrock lakeshore occurs along the shorelines of northern Lake Michigan and Lake Huron on broad, flat, horizontally bedded expanses of limestone or dolomite bedrock that support sparse vegetation concentrated in cracks and depressions in the bedrock. Photos by Joshua G. Cohen.



Conservation/management: Principal threats to these areas are related to trampling of vegetation and the introduction of invasive, non-native plant species. Residential subdivision of adjacent uplands frequently causes degradation to this community through trampling, off-road vehicle use, water pollution, and non-native plant introduction. Protection of adjacent vegetation and limited shoreline access are needed surrounding each lakeshore occurrence.

Research needs: Range-wide perspective of the relative rarity and biological variation of these systems is needed to further clarify conservation priorities. Additional characterization of non-vascular plants and insects in Michigan shorelines is needed as well as research into the effects of residential development on the function of these communities.

Similar communities: alvar, limestone bedrock glade, limestone cobble shore, limestone cliff, limestone lakeshore cliff, boreal forest.

Other classifications:

Michigan Natural Features Inventory (MNFI) Presettlement Vegetation (MNFI): 74, exposed bedrock.

Michigan Department of Natural Resources (MDNR):
K, rock

Michigan Resource Information Systems (MIRIS):
74, exposed rock.

National Wetland Inventory (NWI): none.

The Nature Conservancy National Vegetation Classification:

ALLIANCE: Sparsely vegetated pavement.
ASSOCIATION: Great Lakes alkaline rock shore.

Related abstracts: Dwarf lake iris, Houghton's goldenrod, Hill's thistle, prairie smoke, alvar, limestone bedrock glade, limestone cobble shore, boreal forest

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Abstract citation:

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Photo by Joshua G. Cohen

Limestone bedrock lakeshore, Delta County, Michigan.

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