4.4.8 Miscellaneous Community Group

4.4.8.1 Overview

This group captures those natural communities that have few common themes that would allow them to fall into one of the other existing broad natural community groupings. Some provisional subgroupings, however, have been developed to foster cohesiveness, including "Bedrock Communities," "Great Lakes Shoreline," and "Wetland" (see below). Many of the communities within the Miscellaneous group contain highly specialized flora and fauna reflective of the unique environment that they are dependent upon. Table 4.4.8.1 provides the number of SGCNs estimated to have a high or moderate association with this community group. Seeps, ice, wave action, water level fluctuation and bedrock-shaped, these communities support many rare, sometimes regionally endemic species. Included are the more common dry cliff and Great Lakes beach, the ecologically diverse forested ridge and swale, and the extremely rare, highly specialized algific talus slope. Several other often obscure, lesser known natural communities are also included within the Miscellaneous Group.

The Miscellaneous Group includes the following 16 community types:

<u>Bedrock Communities</u>
- Algific Talus Slope
- Alvar
- Bedrock Glade
- Caves and Subterranean Openings
- Dry Cliff
- Glaciere Talus (Felsenmeer)
- Moist Cliff

<u>Great Lakes Shoreline</u>
- Bedrock Shore
- Great Lakes Alkaline Rockshore
- Great Lakes Beach
- Great Lakes Dune
- Great Lakes Ridge and Swale

<u>Wetlands</u>
- Inland Beach
- Lacustrine Mud Flat
- Clay Seepage Bluff

<u>Other Community Types</u>
- Transportation and Utility Corridors

Descriptions for these community types can be found online except for caves and transportation, which are described in Appendix 4.4.[1]

[1] http://dnr.wi.gov/topic/EndangeredResources/Communities.asp?mode=group&Type=Misc (Search Terms: Aquatic Communities of Wisconsin DNR)

We will continue to struggle with how to assess and recognize, let alone name, biological communities that are not just influenced by, but created and sustained almost entirely by anthropogenic activities. For the present this sub-group, "Other Community Types" includes only Transportation and Utility Corridors. This community type was added to the WWAP because of its prevalence in all landscapes and community types throughout the state as well as its role, albeit variable, in providing habitat elements for *some* SGCN in *some* locations. Issues and conservation actions for this community type were cited sparingly. It is however, included in the summary tables 4.4.8.1 and 4.4.8.2 at the end of this Section.[2]

Table 4.4.8.2 at the end of this Section provides the Natural Community – Ecological Landscape (NC-EL) Opportunity scores for the Miscellaneous Community Group. The key to these scores is provided below.

Key to NC-EL Opportunity Scores

Level of Opportunity	Score	Description
High	3	A major opportunity for sustaining the natural community in the Ecological Landscape exists, either because many significant occurrences of the natural community have been recorded in the landscape or restoration activities in areas of historical occurrence are likely to be successful maintaining the community's composition, structure, and ecological function over a long period of time.
Moderate	2	Although the natural community does not occur extensively or commonly in the Ecological Landscape, one to several significant occurrences do occur and are important in sustaining the community in the state. In some cases, important opportunities may exist because the natural community may be restricted to just one or a few Ecological Landscapes within the state and should be considered for management there because of limited geographic distribution and a lack of better opportunities elsewhere.
Low	1	The natural community occurs in the Ecological Landscape, but better management opportunities appear to exist in other parts of the state.
None	0	The natural community is not known to occur in this Ecological Landscape.

4.4.8.2 Issues and Associated Conservation Actions for the Miscellaneous Group – Bedrock Communities

The dominant substrate for bedrock communities is bedrock. This can range from porous sandstone (Moist Cliff) to limestone or dolomite (Moist Cliff, Dry Cliff, Alvar, Algific Talus Slope, Cave) to metamorphic (Felsenmeer, Bedrock Glade). Associated

[2] Other anthropogenically influenced communities like "Subterranean Openings" (bedrock community sub-group above), surrogate grasslands (grassland group) and riverine impoundment (aquatic group) retain relatively more of the habitat characteristics of their native/natural counterparts for their associated SGCN such that for now they remain within those natural community groups. Other types may be added or split off and shifted over to this sub-group in the future.

vegetation is strongly influenced by a site's microclimate (cool and moist versus hot and dry), as well as by available moisture. Due to the typically thin substrates and exposed conditions, habitat specialists are often associated with these community types.

Some of these communities are exceptionally rare and unique. Algific Talus Slope, for example, occurs on steep north- or east-facing slopes with a substrate of fractured limestone (dolomite) bedrock that retains ice and emits cold air throughout the growing season. The community is dependent on water entering gaps in the dolomite, freezing in winter, and then slowly melting during the summer months and producing a steady outflow of cold air. Cold microhabitats support and enable the persistence of disjunct northern plant species, and "periglacial relicts" such as northern monkshood and globally rare terrestrial snails. Alvar, in contrast, has a thin, discontinuous soil overlying horizontal beds of limestone or dolomite in the vicinity of Great Lakes shorelines that supports an unusual blend of boreal and prairie species, including the lakeside daisy, which occurs nowhere else in the world except on Great Lakes alvars and several isolated places in Illinois.

The Bedrock communities subgroup includes the following community types:

- Algific Talus Slope
- Alvar
- Bedrock Glade
- Caves and Subterranean Openings
- Dry Cliff
- Glaciere Talus (Felsenmeer)
- Moist Cliff

This section describes issues and conservation actions that are common to all or most of the community types in this group. As much as possible, the threat or source of the threat is described as well as the stresses or effects that occur directly or indirectly as a result of the threat. Stresses are generally thought of as loss, conversion and/or degradation of the natural community.

Issue. Three bedrock community types, Moist Cliff, Algific Talus Slope, and Felsenmeer, require cool and moist microclimates to maintain their community structure and function. Intrinsic factors such as topography, slope and aspect play an important role in this microclimate. A forested matrix surrounding these communities is also important for maintaining a cool microclimate. Outliers of northern plant species occur in southern Wisconsin due to unusually cool, moist microclimates created by cold air vents (Algific Talus Slope, Felsenmeer) and by steep topography, north-facing aspects, and/or regular provision of a water source. With climate change, temperatures may increase to the point of exceeding a physiological threshold for these northern species, e.g., eastern hemlock and yellow birch, causing a reduction in their extent or extirpation from existing sites. Lichens, an important substrate stabilizer in many of these communities (especially Dry Cliff and Bedrock Glade), are sensitive to warming and drying, and could also be compromised by a changing climate.

Conservation Actions. Depending on your overall objectives, the following voluntary conservation actions can address changes in microclimate to some bedrock communities:

- Consider a landscape-scale approach to reserve design and management, where complementary natural communities and habitat types are interwoven in a mosaic, and occupy different positions along soil, topography, and moisture gradients. In the Western Coulees and Ridges Ecological Landscape, restore and manage sandstone-influenced sites with a mosaic of dry oak savanna, oak woodland and sand prairie communities, along with smaller patches containing oak forest, pine relicts, dry prairie, open shrubby barrens, and rock outcrops.
- Maintain sufficient canopy cover surrounding Moist Cliffs to confer resistance to extreme heat and drought. Let shading be the guide as to the amount and extent of canopy trees.
- Maintain a landscape matrix of mid-successional to mature upland forest around Algific Talus Slope. The intent is to buffer this exceptionally rare and sensitive resource from external threats, as well as confer resistance to changing environmental conditions by maintaining cool soil temperatures and by providing a buffer for northern outlier species. The extent of this buffer is currently at the land manager's judgment; the need for research on buffer extent is expressed in a separate action.
- Conduct research on extent of mature upland forest buffer needed to protect Algific Talus Slope sites from external threats and changing environmental conditions.

Issue. Non-native invasive plants are prolific reproducers in the absence of their homeland's natural checks and balances, and outcompete native plants by monopolizing light, water and nutrient resources. The most common non-native invasive plants of bedrock communities include herbs such as garlic mustard (*Alliaria petiolata*) and shrubs such as common buckthorn (*Rhamnus cathartica*) and Eurasian bush honeysuckles (*Lonicera* spp.). White-tailed deer are a problematic native species that can be devastating to forests in terms of limiting regeneration and growth of trees and ground layer plants, especially as their populations are allowed/encouraged to reach extremely high levels. Climate change scientists suggest that non-native invasive species may increase in productivity with increasing CO_2, warmer temperatures, earlier springs, and reduced snowpack, and may invade new areas during extreme flood events; white-tailed deer may also benefit from milder winters, with increased access to vegetation and reduced winter mortality. Lastly, as trees become stressed with extreme climatic conditions, they may become more vulnerable to pests and diseases.

Conservation Actions. Depending on your overall objectives, the following conservation actions can address non-native invasives and other problematic species as well as the effects that they have on bedrock communities:

- At the site level, employ an eight-part approach to non-native invasive species: 1) careful planning; 2) prevention; 3) early detection and rapid response; 4) control; 5) slowing the spread; 6) reducing impacts; 7) monitoring; 8) restoration.

- Develop a plan by conducting surveys for invasives and creating maps showing their locations and densities. Set reasonable management objectives based on this information. Consider designating management zones based on degree of infestation and available resources (zero tolerance, acceptable threshold, slow the spread).
- Prevent invasions of non-native plants by limiting human vectors (e.g., install boot brushes at trail heads, clean out seeds from maintenance equipment), minimizing soil disturbance, maintaining healthy and diverse natural communities, conducting periodic inspections of high-risk areas (e.g., trails), and revegetating disturbed sites with native plants.
- Implement an Early Detection-Rapid Response approach by finding new populations of non-native invasives as early as possible when eradication and control are still feasible and less costly.
- Control non-native invasive species and problematic woody species by manual, mechanical, and/or chemical means.
- In areas where eradication and control are not feasible, slow the spread of non-native invasives into adjoining areas by restricting activities during certain seasons, minimizing travel through areas, and inspecting clothing and equipment.
- If eradication, control, and containment methods fail to manage an infestation of non-native invasives, reduce their impact on elements of the natural community by focusing control efforts to allow for specific functions to occur (e.g., tree regeneration), translocating sensitive species, or accommodating unavoidable changes (e.g., underplanting swamp white oaks to replace ash trees that will die due to emerald ash borer or installing deer exclosures to protect tree seedlings and saplings).
- Conduct regular monitoring of sites to detect new invasions and to evaluate the success of pest management plans and control measures.
- Restore sites to confer resistance to infestation by non-native invasives, pests and diseases. This may involve restoring system functions (e.g., fire), restoring natural community structure (canopy, mid-story, shrub layer), and ameliorating ground layer species.
- At a landscape or statewide level, enforce and strengthen regulatory mechanisms and voluntary BMPs that address the introduction and spread of non-native invasives.
- For more details, see "Wisconsin's Forestry BMPs for Invasive Species" (dnr.wi.gov, search words "Wisconsin dnr invasive bmp").

Issue. Development, mining and quarrying can pose a direct threat to most bedrock communities, especially Dry and Moist Cliff, Algific Talus Slope, and Felsenmeer. Livestock are known to plug cold air vents, the climatic lifeline for Algific Talus Slope, and they can trample vegetation and compact soils in other bedrock settings that are accessible to them. Vandalism (mostly pertains to Dry Cliff), hiking, and rock climbing can also cause damage to fragile vegetation and substrates.

Conservation Actions. Depending on your overall objectives, the following conservation actions can address direct damage to substrates and ground layer vegetation and the effects that they have on bedrock communities:

- In the Niagara Escarpment and Driftless Area COAs, encourage public and private landowners to maintain natural forest cover, protect areas where surface waters drain into natural fissures, minimize pesticide use, and maintain partially open sinkholes that serve as bat hibernacula and host SGCN snails.
- Create and provide written materials to landowners in the areas where Algific Talus Slopes are confirmed or probable, with information on these unique and important habitats that encourages protection of this critical resource for Wisconsin.
- Limit or avoid rock climbing and other disruptive recreational activities on Dry Cliff sites with high conservation value by: 1) conducting educational outreach with rock climbing clubs to inform members of important sites and help them know how to recognize SGCN/quality habitat; 2) blocking access to high value sites; and 3) identifying lower value sites where rock climbing will have little to no impact.
- Avoid routing recreational trails through sensitive resource areas when possible. When that can't be avoided, monitor periodically for evidence of erosion, browse damage, and infestation by invasive plants.

Issue. Water is vital for three of our bedrock communities: Moist Cliff, Algific Talus Slope, and Bedrock Glade. Water enters cracks or pools at the base of rocky slopes, creating permanent ice blocks that maintain a cool microclimate for our two 'climate relicts,' Algific Talus Slope and Felsenmeer. Moist Cliff is kept moist by a variety of factors that can include an internal water source, permeable or fractured bedrock substrate (sandstone or limestone), or wave splash/spray. Road building and quarrying can interrupt internal water flow as well as movement of water through sandstone or limestone, diminishing the vital source of moisture. Furthermore, extreme heat and drought associated with climate change (along with milder winters) may compromise ice formation in the two climate relict communities.

Conservation Actions. Depending on your overall objectives, the following conservation actions can address soil disturbance and hydrologic alteration and the effects that they can have on bedrock communities:

- Conduct research on mechanics behind cold air sources for Algific Talus Slope and Felsenmeer, and identify warming thresholds that may cause loss of community identity.

Issue: Projections for vulnerability of bedrock communities to climate change range from low to high (Climate Change Vulnerability Assessment Workshops 2014). Negative impacts relate to milder winters, drought, extreme summer heat, and changes in winter precipitation. Milder winters and drought may compromise ice formation in the two climate relict communities (Algific Talus Slope, Felsenmeer), which is the lifeblood of these community types where northern outlier species rely on a microclimate that is exceptionally cooler than the surrounding landscape. These northern species may be further stressed, or even pushed beyond a physiological threshold, by extreme summer heat and drought. Lichens, an important substrate stabilizer in many of these communities (especially Dry Cliff and Bedrock Glade), are sensitive to warming and drying, and could also be compromised by a changing climate. In Alvar, community composition may shift to favor prairie species over boreal species. Less snowpack in winter may render tree roots vulnerable to frost damage, while ice storms may severely

damage trees, especially conifers. Climate change scientists suggest that non-native invasive species may increase in productivity with increasing CO_2, warmer temperatures, earlier springs, and reduced snowpack, and may invade new areas during extreme flood events; white-tailed deer may also benefit from milder winters, with increased access to vegetation and reduced winter mortality. Lastly, as trees become stressed with extreme climatic conditions, they may become more vulnerable to pests and diseases. Resistance to climate change is projected for species that are already adapted to hot and dry climates and thin, nutrient-poor substrates. Species that have high dispersal capabilities and ample alternate habitat available in the vicinity also show resilience to climate change (e.g., lichens).

Moist Cliff, Felsenmeer, Algific Talus Slope and Alvar are considered to have the highest vulnerability to climate change due to the amplified threats of non-native invasive species, milder winters, modification of water sources, and extreme summer heat/drought. The extreme rarity of Algific Talus Slope, Felsenmeer, and Alvar, in addition to the small size and isolation of remnants, further contribute to the vulnerability of these community types. Dry Cliff may fare the best due to the fact that associated species are already adapted to a hot, dry, harsh environment.

Conservation Actions: Depending on your overall objectives, the following conservation actions can address climate change and the effects that it can have on bedrock communities:

- Consider a landscape-scale approach to reserve design and management, where complementary natural communities and habitat types are interwoven in a mosaic, and occupy different positions along soil, topography, and moisture gradients.
- Maintain sufficient canopy cover surrounding Moist Cliff, Algific Talus Slope, and Felsenmeer sites to confer resistance to changing environmental conditions. Let shading be the guide as to the amount and extent of canopy trees.
- At the site level, employ an eight-part approach to non-native invasive species: 1) careful planning; 2) prevention; 3) early detection and rapid response; 4) control; 5) slowing the spread; 6) reducing impacts; 7) monitoring; 8) restoration.

- See other conservation actions under the following issue sections above:
    - Changes in microclimate
    - Non-native invasive plants and aggressive native plants
    - Hydrologic alteration

Estimated Vulnerability of miscellaneous bedrock communities to climate change under low and high change scenarios.

Community type	Vulnerability under Low degree of climate change	Vulnerability under High degree of climate change
Algific Talus Slope	Moderate	High
Alvar	Moderately Low	Moderately High
Bedrock Glade	Moderate	Moderate
Caves and Subterranean Openings*	NA	NA
Dry Cliff	Low	Moderately Low
Glaciere Talus (Felsenmeer)	Moderate	Moderately High
Moist Cliff	Moderately High	High

Source: WDNR Climate Change Vulnerability Assessment Workshops 2014.
*Caves were not evaluated during the 2014 workshops.

4.4.8.3 Issues and Associated Conservation Actions for the Miscellaneous Group – Great Lakes Shore Communities

Great Lakes shore communities are among the most unique in Wisconsin. Found only along the world's largest freshwater lake system, these communities on Wisconsin's Lakes Michigan and Superior shoreline are of high conservation significance. They support endemic animals and plants such as the beach dune tiger beetle and Pitcher's thistle. Great Lakes shore communities depend on a suite of shared ecological processes, such as wind and wave action, sand movement, and ice scouring. Perhaps more so than any other community group, Great Lakes shores are also highly used for recreation and development.

Sand-based shore communities (Great Lakes beach, dunes, and barrens) develop as the longshore currents and rivers emptying into the Great Lakes deposit sand in embayments. Waves wash sand ashore to form beaches, and in the right conditions, wind deposits the sand at higher elevations to form dunes. On Lake Michigan, dunes are much more common on the eastern shore of the lake in Michigan and parts of Indiana due to prevailing westerly winds. Occasionally, dunes become stabilized by red pine and low-growing shrubs to form Great Lakes barrens. In special circumstances, dunes can also form in a series of low parallel ridges with wet swales in between, a community complex known as Great Lakes ridge and swale. In all cases, protecting sand movement in rivers and along the lake shore is critical for sustaining sand-based shore communities. At the same time, these communities are very vulnerable to erosion due to the unstable nature of the sandy soils, and ORVs, development, and even excess foot traffic can damage habitats and the species they support.

Rock-based shore communities (Great Lakes Alkaline Rockshore and Bedrock Shore) are usually of limestone, dolomite, or sandstone origin in Wisconsin; although in

Minnesota and Michigan, igneous rock shores are also common. While extremely erosion-resistant, plant life has a tenuous hold in rockshores and is found only in cracks and cervices where it is vulnerable to trampling from recreation. Historically, some rockshores were quarried, particularly for dolomite. Wave splash and ice-push ridges are important processes that maintain rockshores.
Natural fluctuations in Great Lakes water levels are a unique characteristic that drastically affects shoreline communities. Lake Michigan has historically fluctuated about 6 feet from high water to low water on a near-decadal scale, while Lake Superior exhibits a lower natural fluctuation (3.5 feet) due to a dam on the St. Mary's River at Sault Ste. Marie. Water level has a tremendous impact on shoreline communities, with high water eroding beaches and dunes, but also maintaining wet swales, and preventing woody encroachment on rockshores. Conversely, low water creates wider beaches, but can cause drying of swales and woody invasion of rockshores and wetlands.

The Great Lakes shore subgroup included the following community types:

- Bedrock Shore
- Great Lakes Alkaline Rockshore
- Great Lakes Barrens
- Great Lakes Beach
- Great Lakes Dune
- Great Lakes Ridge and Swale

Other wetland community types commonly found along the Great Lakes such as Interdunal Wetland and Shore Fen can be found in the "Wetland" Community Group.

This Section describes issues and conservation actions that are common to all or most of the community types in this group. As much as possible, the threat or source of the threat is described as well as the stresses or effects that occur directly or indirectly as a result of the threat. Stresses are generally thought of as loss, conversion and/or degradation of the natural community.

Issue. Beaches and dunes are built in part by longshore currents which run parallel to the shoreline, which, depending on shoreline features and local currents both bring in and erode the sand that forms the foundation of these communities. The construction of artificial structures such as jetties, breakwalls, riprap, and sea walls can disrupt the longshore current and alter sand transport, leading to the deposition of sand behind these structures and erosion of beaches elsewhere. Loss of a sand source is among the major functional threats to beach and dune ecosystems along the Great Lakes, especially near large urban centers and ports. Minimizing the construction of the new structures will help preserve beaches and dunes.

Conservation Actions: Depending on your overall objectives, the following voluntary conservation actions can address disruption of natural shoreline processes and the effects that it has on Great Lakes shoreline natural communities:

- Implement practices to reduce shoreland and bluff erosion on Great Lake shorelines that maintain natural long-shore sand movement and minimize new artificial shoreline structures (permanent piers, breakwalls, seawalls, rip-rap, jetties, etc.).

Issue. Heavy recreational use, residential and occasional commercial development have adversely impacted many dune and beach complexes. Some municipalities and parks groom the beaches and the adjacent dunes, removing all plant life and introducing high levels of frequent physical disturbance to these communities. Recreational uses such as off-road vehicles and horseback riding are incompatible with dune protection and maintenance, as they destroy the fragile dune vegetation, damage or eliminate rare plant and animal populations, create and enlarge blowouts, and facilitate the spread of invasive plants. For bedrock-based communities, excessive trampling can damage already sparse vegetation, including exceptionally rare plants adapted to unique lakeshore bedrock exposures.

Conservation Actions. Depending on your overall objectives, the following conservation actions can be considered to address erosion and the effects that it has on Great Lakes shoreline natural communities:

- Educate landowners on the uniqueness of the dune and shoreline plant community to minimize trails, erosion, and beach grooming.
- Avoid routing recreational trails through sensitive resource areas when possible. When that can't be avoided, monitor periodically for evidence of erosion, browse damage, and infestation by invasive plants.
- Promote dune vegetation re-establishment by protecting sensitive or eroded areas from recreation.

Issue. Great Lakes shorelines are dynamic and soil disturbance is common. Native and non-native weed species are able to take advantage of this disturbance, and are sometimes common along shorelines. Some of these weeds are highly invasive, including such problematic species as spotted knapweed (*Centaurea biebersteinii*), Lyme grass (*Leymus arenarius*), sweetclovers (*Melilotus* spp.), Canada bluegrass (*Poa compressa*), Kentucky bluegrass (*P. pratensis*), black locust (*Robinia pseudoacacia*), and poison ivy (*Toxicodendron radicans*). Non-native Phragmites (*P. australis* var. *australis*) is also extremely problematic along shorelines, particularly in the Green Bay area. In forested areas, such as Great Lakes Ridge and Swale systems, glossy buckthorn (*Rhamnus frangula*) can gain a foothold and alter habitat used by dozens of rare species. Invasive species tend to increase where management and recreation causes soil disturbance. Non-native invasive species may increase under climate change as well due to their productivity with increasing CO_2, warmer temperatures, earlier springs, and reduced snowpack, and may invade new areas following extreme storms that cause erosion and transport seeds and vegetative propagules.

Conservation Actions. Depending on your overall objectives, the following voluntary conservation actions can address invasive species and the effects that it has on Great Lakes shoreline natural communities:

- At the site level, employ an eight-part approach to non-native invasive species: 1) careful planning; 2) prevention; 3) early detection and rapid response; 4) control; 5) slowing the spread; 6) reducing impacts; 7) monitoring; 8) restoration.
- Develop a plan by conducting surveys for invasives and creating maps showing their locations and densities. Set reasonable management objectives based on this information. Consider designating management zones based on degree of infestation and available resources.
- Prevent invasions of non-native plants by limiting human vectors (e.g., install boot brushes at trail heads, clean out seeds from maintenance equipment), minimizing soil disturbance, maintaining healthy and diverse natural communities, conducting periodic inspections of high-risk areas (e.g., trails), and revegetating disturbed sites with native plants.
- Implement an Early Detection-Rapid Response approach by finding new populations of non-native invasives as early as possible when eradication and control are still feasible and less costly.
- Control non-native invasive species and problematic woody species by manual, mechanical, and/or chemical means.
- In areas where eradication and control are not feasible, slow the spread of non-native invasives into adjoining areas by restricting activities during certain seasons, minimizing travel through areas, and inspecting clothing and equipment.
- If eradication, control, and containment methods fail to manage an infestation of non-native invasives, reduce their impact by limiting their dominance.
- Conduct regular monitoring of sites to detect new invasions and to evaluate the success of pest management plans and control measures.
- Restore sites to confer resistance to infestation by non-native invasives.

Issue. Great Lakes shoreline communities are projected to have moderate to high vulnerability to climate change (Climate Change Vulnerability Assessment Workshops 2014). The greatest impacts are expected to be from extreme storms and less ice cover in winter, both of which can increase shoreline erosion through wave action (especially due to winter storms). In addition, high winds may exacerbate dune blowouts and sand loss in general. Less winter ice cover will likely result in less scouring of bedrock shorelines, an important process that maintains an open condition. Wetlands associated with the Great Lakes, including Great Lakes Ridge and Swales are anticipated to be highly vulnerable to small changes in hydrology, as well as direct impacts from higher temperatures on trees that require cool, moist conditions like eastern white-cedar. However, Great Lakes shorelines may be buffered from extreme temperatures by proximity to the large, generally cool waters of the Great Lakes. Invasive species may increase under climate change as well due to increased productivity with increasing CO_2, warmer temperatures, earlier springs, and reduced snowpack, and ability to invade new areas following extreme storms that cause erosion and transport seeds and vegetative propagules.
Finally, changes to Great Lakes water levels driven by climate will also have a major impact on all shoreline communities. Projections on future water levels are still uncertain, however, and average water levels may be slightly higher or somewhat lower compared to contemporary levels. In either case, year to year variability and cyclical fluctuations will likely still occur, and management that plans for variability will help increase resiliency of communities.

Conservation Actions. Depending on your overall objectives, the following conservation actions can be considered to encourage climate change adaptation for Great Lakes shoreline natural communities:

- Implement practices to reduce shoreland and bluff erosion on Great Lake shorelines that maintain natural long-shore sand movement and minimize new artificial shoreline structures (permanent piers, breakwalls, seawalls, rip-rap, jetties, etc.).
- Revegetate disturbed or eroded areas by installing boardwalks, manually reseeding or replanting, or allowing sensitive areas to naturally revegetate.
- Minimize land use conflicts and improve wetland conservation at the local level by implementing recommendations in Wisconsin Wetlands Association's "Land Use and Wetlands: Zoning Opportunities to Improve Wetland Protection."
- Educate shoreline landowners and restore natural shoreline habitat.
- Employ an eight-part approach to non-native invasive species: 1) careful planning; 2) prevention; 3) early detection and rapid response; 4) control; 5) slowing the spread; 6) reducing impacts; 7) monitoring; 8) restoration.

Estimated Vulnerability of Great Lakes Shoreline Communities to Climate Change Under Low and High Change Scenarios

Community type	Vulnerability under Low degree of climate change	Vulnerability under High degree of climate change
Great Lakes Ridge and Swale	High	High
Great Lakes Barrens	Moderate	Moderately high
Great Lakes Dune	Moderate	Moderately high
Great Lakes Alkaline Rockshore	Moderately high	Moderately high
Bedrock Shore	Moderately high	Moderately high

Source: WDNR Climate Change Vulnerability Assessment Workshops 2014.

4.4.8.4 Issues and Associated Conservation Actions for the Miscellaneous Group – Wetlands

Three communities originally placed in the "Miscellaneous" group are closely related to wetlands, and are faced with similar threats and will benefit from similar conservation actions to those described in the Non-forested Wetlands group. For the following communities, please refer to the wetlands group in Section 4.4.7 for a summary of threats and conservation actions.

- Clay Seepage Bluff
- Inland Beech
- Lacustrine Mud Flat

Table 4.4.8.1 Number of Species of Greatest Conservation Need Highly or Moderately Associated with Miscellaneous Communities

SGCN Species Group	Miscellaneous Community Group
Birds	12
Fish	
Herps	15
Mammals	7
Insects - Aquatic	1
Insects - Terrestrial	18
Invertebrates - Crustacea	
Invertebrates - Mussels	
Invertebrates - Terrestrial Snails	12
Total SGCN (High/Moderate Association)	**65**

Table 4.4.8.2 Natural Community – Ecological Landscape Opportunity Scores for the Miscellaneous Community Group

Community	Central Lake Michigan Coastal	Central Sand Hills	Central Sand Plains	Forest Transition	North Central Forest	Northeast Sands	Northern Highland	Northern Lake Michigan Coastal	Northwest Lowlands	Northwest Sands	Southeast Glacial Plains	Southern Lake Michigan Coastal	Southwest Savanna	Superior Coastal Plain	Western Coulee and Ridges	Western Prairie
Algific Talus Slope															H	
Alvar	H							M								
Bedrock Glade	M	M	L	M	H	M	L	L	L						H	M
Bedrock Shore														M		
Caves and Subterranean Cultural	M		H		M			M			H		M		H	M
Clay Seepage Bluff	M							M				M		M		
Dry Cliff	H	L	H	M	H	M		H	L		H	L	M	H	H	M
Glaciere Talus (Felsenmeer)				M	H	M									M	
Great Lakes Alkaline Rockshore								H								
Great Lakes Beach	H							H				L		H		
Great Lakes Dune	H							H				M		H		
Great Lakes Ridge and Swale	H							H						L		
Inland Beach		M			L	L	M			H						
Lacustrine Mud Flat	H	H	L	M	L	H	M	H	H	M	M	H	H	H	H	H
Moist Cliff	M	M	M	M	H	M		M	L		M	L	M	H	H	M
Transportation-Utility Corridor																

Appendix 4.4
Miscellaneous Community Descriptions New to the WWAP and Currently Not Presented Online

Caves and Subterranean Openings
Transportation and Utility Corridors

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Appendix 4.4
Miscellaneous Community Descriptions New to the WWAP and Currently Not Presented Online

Caves and Subterranean Openings
Transportation and Utility Corridors

A4.4.1 Caves and Subterranean Openings

This includes naturally occurring caves beneath the earth's surface as well as subterraneous voids such as mines and tunnels that are created, maintained or modified by human activity. These features often have an opening to the surface, but are characterized by little or no light. Structure, geology and hydrology are other dominant ecological influences. Caves form from the dissolution of several rock types including limestone, dolomite, and gypsum, which differ in their chemical composition and rates of erosion, and influence cave size and structure. The distinctive biodiversity and geologic formations in caves and artificial subterranean openings depend on unique and specific environmental conditions. Bats, raccoons, salamanders as well as many invertebrates, including a number of global endemic springtails, are known to inhabit these systems. Caves, mines, tunnels, and similar underground structures provide summer roosting and winter hibernating sites for significant numbers of bats.

A4.4.2 Transportation and Utility Corridors

Transportation and utility corridors are tracts of real estate marked by their linear form and their continuous extension across all types of terrestrial and aquatic land cover: natural or constructed; rural, suburban, or urban. While transportation and utility corridors are not independently sustainable biological communities, we feel it is necessary to distinguish them because of their ubiquity throughout Wisconsin and the important influence they have on the flora and fauna of our state, their habitats and the ecological processes they depend upon. Corridors can vary greatly in width, length and depth of disturbance, as well as the portion occupied by structures like transmission poles, the area of impermeable features like road surfaces and the intensity of vegetation management. Although there is considerable variation in how they are constructed, managed and maintained, transportation and utility corridors are all subject to practices that control vegetation through mechanical or chemical means; altered soil conditions; altered surface and subsurface hydrology; and controlled and repeated access and disturbance. Depending upon their location and applied management practices, these corridors offer opportunities for dispersal of native or invasive species; for sustaining open habitat types like grasslands and savannah or loss and fragmentation of forested, shrub and wetland communities. They may also create open corridor or edge that improves habitat resource diversity in otherwise continuous habitat no longer subject to natural processes that control succession and gap formation or serve to break up continuous habitat into smaller patches and diminish habitat quality through increased predation and exposure.