USDA Natural Resources Conservation Service

Ecological site F094DY007WI
Sand Barrens

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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 094D–Northern Highland Sandy Pitted Outwash

MLRA 94D, the Northern Highland Sandy Drift, comprises 1.346 million acres of outwash plains, sandy moraines, wetlands and numerous water bodies (large lakes, small ponds, large rivers, small streams and flowages of all sizes). Sand Barrens lie at driest end of the soil-landscape moisture gradient and they comprise about 50,000 acres in this MLRA.

Classification relationships

The Sand Barrens ecological site correlates to a PQE habitat type developed by Kotar et al (2002); this habitat types is named after Pinus strobus (white pine)-Quercus rubra (red oak)/Epigea repens (trailing arbutus). These species have a very high constancy value relative to this site, i.e. they are present on a higher percentage of these sites than other species. This ecological site has a very dry moisture regime and is poor in nutrients. The Sand Barrens ecological site has analogs in every ecological classification system. Probably because very dry sites, like wetlands, have a unique plant community and a long list of management concerns: drought-prone soils, fire-prone vegetation, rare species, and generally low productivity all present a host of issues to be resolved.

Ecological site concept

ATTENTION: This ecological site meets the NESH 2014 requirements for PROVISIONAL. A provisional ecological

site is established after broad ecological site concepts are identified and an initial state-and-transition model is drafted. Following quality control and quality assurance reviews of the ecological site concepts, an identification number and name for the provisional ecological site are entered into ESIS. A provisional ecological site may include literature reviews, land use history information, some soils data, legacy data, ocular estimates for canopy and/or species composition by weight, and even some line-point intercept information. A provisional ecological site does not meet the NESH 2014 standards for an Approved ESD, but does provide the conceptual framework of soil-site correlation for the development of the ESD. For more information about this ecological site, please contact your local NRCS office.

Sand Barrens ecological sites are driest (most xeric) of the ecological sites in this MLRA. As such, they have been very prone to disturbance, now and in the past. In European pre-settlement times, low-level fires were common and kept many areas open and the fuel load low. Under the current conditions of effective and mostly necessary fire suppression many areas have an increasing fuel load, and coincidentally became dominated by fewer species. Jack pine and northern pin oak (which is often hybridized with black oak in this region) were once the dominant trees, with openings between that resembled prairie or savanna. At present the savanna-like nature of the vegetation has been drastically altered to a patchwork of thick, stunted, jack pine stands, marginally productive red pine plantations, and weedy open areas dominated by bracken fern or exotic invasive species such as spotted knapweed (Centaurea stoebe)and Canada bluegrass (Poa compressa). Small patches of the pyrophilic savanna vegetation still exist on the driest, most nutrient-poor sites. Otherwise, on slightly richer sites, woody plants overtop and eliminate the prairie plants, all because of the absence of frequent low-intensity fires.

Associated sites

F094DY006WI	**Steep Sandy Ridges** Steep Sandy Ridges occur frequently on sand plains that are predominantly either Sand Barrens or Sandy Uplands. The steeper areas are more affected by aspect than the lower slope areas.

Table 1. Dominant plant species

Tree	(1) *Pinus banksiana* (2) *Quercus ellipsoidalis*
Shrub	(1) *Vaccinium angustifolium* (2) *Comptonia peregrina*
Herbaceous	(1) *Gaultheria procumbens* (2) *Pteridium aquilinum*

Physiographic features

Sand Barrens ecological sites are found on low relief, gently undulating plains formed in sand deposited by glacial meltwater. The glacial rivers that laid down these sediments were massive, these ancient river beds became outwash plains, fans and terraces. At times, wind erosion reshaped some of these sediments into dune landforms. These deposits have lowest amount of silt and clay in the region. In some areas, giant blocks of glacial ice were buried by these sediments, which left deep depressions after the ice melted; this is the pitted outwash landscape.

Table 2. Representative physiographic features

Landforms	(1) Outwash plain (2) Pitted outwash plain (3) Outwash terrace
Elevation	408–549 m
Slope	0–15%
Aspect	Aspect is not a significant factor

Climatic features

The climate is humid continental with very cold winters and warm summers. As is common across northern Wisconsin, two-thirds of the precipitation falls as rain during the relatively short growing season of late May to early

September. Most of the rainfall is transpired by plants. Snow cover is likely in the months of November through April. Snow cover prevents deep frost penetration which promotes groundwater recharge.

Table 3. Representative climatic features

Frost-free period (average)	109 days
Freeze-free period (average)	130 days
Precipitation total (average)	838 mm

Climate stations used

- (1) RHINELANDER [USC00477113], Rhinelander, WI
- (2) EAGLE RIVER [USC00472314], Eagle River, WI
- (3) MINOCQUA [USC00475516], Minocqua, WI
- (4) REST LAKE [USC00477092], Manitowish Waters, WI

Influencing water features

This ecological site is well removed from surface water features. Water moves through this site rapidly and the groundwater is deep.

Soil features

Sandy soils in this MLRA have a moderate to high amount of chemically inert quartz relative to weatherable minerals, which supply plant nutrients. Under these nutrient poor conditions, small differences in the clay content of these soils can produce a vegetation response. Thus a significant resource gradient exists within sandy soils; every inch of loamy sand, which was deposited by the glacial melt-waters over the nearly pure sand below, takes the site that much further away from the Sand Barrens ecological site and toward the Sandy Uplands ecological site. Rubicon sand in the main soil component on this site. This may also occur on very thin loamy sand phases of Vilas and Sayner.

Table 4. Representative soil features

Parent material	(1) Outwash–metavolcanics
Surface texture	(1) Sand
Family particle size	(1) Sandy
Drainage class	Excessively drained
Permeability class	Very rapid
Soil depth	203 cm
Surface fragment cover <=3"	0–20%
Surface fragment cover >3"	0–20%
Available water capacity (0-101.6cm)	7.62–15.24 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	5–6

Subsurface fragment volume <=3" (Depth not specified)	2–40%
Subsurface fragment volume >3" (Depth not specified)	2–20%

Ecological dynamics

Sand Barrens were a fire maintained ecological site. In the absence of fire, they no longer have the open dry prairie plant community. In some cases the canopy has closed with stunted jack pine or aspen. In other cases, they remain open but the prairie plants have been replaced by native, drought-tolerant pioneer species or very hardy weeds. Fire has not been completely eliminated, the risk remains high, especially before green-up in spring and during dry weather periods. But fire suppression has been effective and property needs to be protected, so unfortunately dry fuel continues to accumulate in most areas of this site. This sets the stage for potentially very large fires in the future.

State and transition model

Ecosystem states

1. Reference State

2. Cutover State

3. Disturbed/Invaded State

4. Converted State

State 1 submodel, plant communities

1.1. Jack Pine Savanna Phase

1.2. Jack Pine-Pin Oak Phase

State 2 submodel, plant communities

2.1. Jack Pine-Aspen Phase

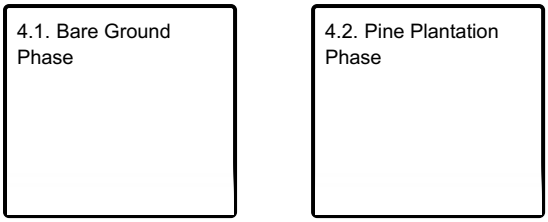
2.2. Blueberry-Bracken Phase

State 3 submodel, plant communities

3.1. Invasive Weeds Phase

3.2. Bracken-Aspen Phase

State 4 submodel, plant communities



State 1
Reference State

The Reference State for Sand Barrens ecological has two main phases that were created by a variable fire frequency. Frequent low intensity fires favor prairie vegetation (grasses and forbs) over woody vegetation; whereas a lower fire frequency would permit for more trees and shrubs on these sites. Modern fire suppression has made prairies and Sand Barrens a threatened ecosystem. Prescribed burning is often used to restore these plant communities.

Community 1.1
Jack Pine Savanna Phase

This phase occurred in the past on the most fire-prone areas of the ecological site. Grasses and forbs were dominant vegetation. Jack pine was often killed by fire, but readily re-seeded itself back onto the site. Pin oak was often present in this phase and it was seldom killed by fire. It was burned down to the ground and then re-sprouted. The frequent fires prevented most pin oaks from becoming tree-sized, they persisted on the site as shrub-sized plants.

Community 1.2
Jack Pine-Pin Oak Phase

Parts of the site that were protected from fire had a more developed forest canopy. Prairie plants occurred in the openings. Once the pin oak attained tree-size it was relatively safe from the occasional fires.

State 2
Cutover State

Logging occurred on this site even though these species were not the main target. Tall jack pines were used mainly for poles, and there were a lot of poles needed for the new telegraph networks. Pin oak was used mainly for firewood during the cold northern winters. The vast cutover lands were often sold to settlers who wanted to farm. With fewer large stumps, clearing these sites for agriculture was easier. Ironically, agriculture failed sooner on these sites due to the infertile soils. Abandonment left these sites to naturally re-vegetate. Natural re-forestation often failed and these sites were left open until the conservation movement started in the 1930’s, pine plantations then became the dominant land use on these sites.

Community 2.1
Jack Pine-Aspen Phase

Jack pine regenerates after fires, and aspen will colonize bare mineral soils such as old fields. These species rarely formed mixed stands, presence of one or another indicates site history. Relatively pure stands of aspen and jack pine may be interspersed on a given site.

Community 2.2
Blueberry-Bracken Phase

If catastrophic fire occurred after a logging operation or if the site cleared for agriculture and subsequently abandoned then reforestation was slow and the site became dominated by native drought-tolerant plants.

State 3

Disturbed/Invaded State

This state is very problematic because the weeds that occupy the site are so tough that they are difficult to eradicate and the site conditions can be so harsh as to preclude restoration.

Community 3.1
Invasive Weeds Phase

This phase is the least desirable of all, it is dominated by noxious weeds. For example, spotted knapweed is one most serious problem invasive species, it spreads rapidly and each plant lives up to nine years. It has strong allelopathic properties which are toxic to other species and it has a taproot that depletes the soil of moisture. Eradication is difficult and expensive, but if left alone the problem multiplies.

Community 3.2
Bracken-Aspen Phase

This phase started as weed patch but is now dominated by native plants which gradually crowded out the weeds. Bracken fern is the most common plant, aspen can colonize more protected sites.

State 4
Converted State

The Converted State is very recognizable on this site. The soil is nearly pure sand and becomes so dry and hot that plants have a difficult time establishing on it, leading to the Bare Ground Phase. Some of these sites have been planted to red or jack pine in an attempt to reclaim their productivity.

Community 4.1
Bare Ground Phase

This phase is at the edges of vegetated areas, large areas do not stay bare ground for a long time. Only the driest and hottest sites stay completely bare. Eventually hardy plants will colonize the site, but these plants are seldom very productive.

Community 4.2
Pine Plantation Phase

These are slow growing, high risk plantations, but they were considered a worthwhile attempt to reclaim the productivity of the land.

Additional community tables

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Contributors

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

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6. **Extent of wind scoured, blowouts and/or depositional areas:**

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7. **Amount of litter movement (describe size and distance expected to travel):**

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if**

their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:

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17. **Perennial plant reproductive capability:**
