USDA Natural Resources Conservation Service

Ecological site F139XY001OH
Coastal Dune Complex

Last updated: 10/03/2019
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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): 139X–Lake Erie Glaciated Plateau

This area is mostly the northwest portion of the Allegheny Plateau, which is a gently to strongly rolling, and dissected glaciated highland. Along the north escarpment is narrow band of flat plains along Lake Erie. Stream valleys are narrow and are not deeply incised, but the valley walls are typically steep. In some areas the interfluves are broad and nearly level. Elevation ranges from 174 m on Lake Erie to 663 m (570 to 2175 ft) increasing from north to south. Local topographic relief averages 20 m and ranges up to 267 m (65 to 875 ft).

Most of the rivers in this MLRA flow north to Lake Erie. Other rivers flowing south are part the Ohio River system, including headwaters of the Ohio River, in the northeast corner of this area, in Pennsylvania. The headwaters of the Muskingum River are in the central part of the area, in Ohio. The Grand River is designated as National Wild and Scenic River in northeastern Ohio. Geology The bedrock in this area consists mostly of alternating beds of sandstone, siltstone, and shale of upper Devonian, Mississippian, and Pennsylvanian age. Shale units are dominant closer to the surface along Lake Erie and the western edge of the area. The surface is mantled with glacial till, outwash of unconsolidated sand and gravel, glacial lake sediments, and stratified drift deposits (kames and eskers). The outwash, lake sediments, and stratified drift deposits that fill valleys are important sources of ground water. Younger stream deposits cover the glacial deposits in some of the river valleys.

The dominant soil order in this MLRA is Alfisols. The soils in the area dominantly have a mesic soil temperature

regime, an aquic or udic soil moisture regime, and mixed or illitic mineralogy. They are very deep, well drained to poorly drained, and loamy or clayey. The calcareous till on the northwestern lowland till plains have generally higher clay content and are dominated by Epiaqualfs (Mahoning series). Hapludalfs formed in outwash deposits on outwash plains, terraces, kames, and beach ridges (Chili series) and in till on till plains (Ellsworth series). In contrast, the southeastern plateau has till capped with loess which is lower in carbonates and lower in clay relative to silt. Here fragipans commonly develop into Fragiudalfs (Canfield, Rittman, and Wooster series) and Fragiaqualfs (Frenchtown, Platea, Ravenna, Sheffield, Venango, and Wadsworth series) formed in till.

This low carbonate/low clay trend combined with increased slope results in otherwise loamy soils with less clay film development, Dysdrudepts (Allard), becoming more common eastward. The southeast edge of the region was not glaciated during the most recent (Wisconsin) glaciation. Accordingly, the till deposits are more highly weathered and depleted of their bases as Fragiaquults (Alvira) and Fragiudults (Hanover). Due to the shallow nature of the glacial drift (plus any residuum and colluvium) towards the southeastern extreme of the MLRA, some of the soil series have bedrock within 50 cm and are thereby classified in Lithic subgroups, which are otherwise rare. The southern MLRA boundary is marked by unglaciated colluvium and residuum (mostly Dysdrudepts and Hapludults).

This area supports a matrix North-Central Interior Beech-Maple Forest on the west across a wide range of upland substrates and drainage classes, but mostly on flat to rolling, somewhat poorly drained fine tills. The matrix forest type transitions to Appalachian (Hemlock) Northern Hardwood Forest to the east (a function of increased precipitation and elevations, and decreasing calcium in the till). The transition to northern hardwoods may be geographically approximated with a separate ecological inference area starting near the Pennsylvania state line, eastward. The extensive flat interfluve areas of fragipans and episaturated poorly drained tills may have patches of North-Central Interior Wet Flatwoods, whereas wetlands on loamy outwash lowlands are Central Interior and Appalachian Swamp Systems. Larger streams and river floodplains host Central Interior and Appalachian Floodplain Systems, but smaller creek margin may be more consistent with Central Interior and Appalachian Riparian Systems. In more rugged topography, concave slopes, particularly in older till areas is convergent with the concept of South-Central Interior Mesophytic Forest of unglaciated areas to the south. Northeastern Interior Dry-Mesic Oak Forest feathers into the area near Native American village sites due to local fire use, but also on convex slopes, coarser parent material, and older, more weathered till and residuum. Some outliers of Allegheny-Cumberland Dry Oak Forest and Woodland and Central Appalachian Dry Oak-Pine Forest may occur along sandstone outcrops and convex slopes on thin drift toward the southeastern edge of the area.

About three-fourths of this area is in farms. Feed grains (corn, soybeans, winter wheat, and oats) and forage (grass-legume hay, tall fescue pasture, and alfalfa hay) for dairy cattle are the main crops in the western part of the area. Similar crops are grown in the eastern part, where there are many part-time farms and many rural residences. The area has some cow-calf operations. Some areas are used for potatoes or small fruit crops. A large amount of the milk produced in the area is converted to cheese. The areas of hardwood forest in the MLRA are mainly in farm woodlots. Sawlogs for rough construction, firewood, and some high-quality sawlogs for specialty uses are harvested from the numerous farm woodlots. Some large holdings are used for watershed protection. Cuyahoga Valley National Park, Pymatuning State Park (Pennsylvania), Presque Isle State Park (Pennsylvania), and Erie National Wildlife Refuge are among the more notable conservation lands.

Summary of existing land use:
Upland Forest (39%)
Hardwood (33%)
Conifer (3%)
Conifer-Hardwood (3%)
Agricultural (30%)
Developed (24%)
Swamps and Marshes (5%)

Classification relationships

The USFS ecoregion classification for the majority of MLRA 139 is the Humid Temperate Domain, Hot Continental Division, Eastern Broadleaf Forest Province 222, Western Glaciated Allegheny Plateau Section 221F. The

ecoregion subsection composition is 221Fa (Allegheny Plateau), 221Fb (Grand River-Pymatuning Lowlands), and 221Fc (Akron Kames). Along Lake Erie the land is classified as Midwest Broadleaf Forest Province, Erie and Ontario Lake Plain Section 222I. This narrow strip is subsection 222Ia (Lake Erie Plain). The southeast extreme or MLRA 139 that is of older glacial till and into the adjacent unglaciated MLRAs is classified as Warm Continental Division, Northeastern Mixed Forest Province 211, Northern Unglaciated Allegheny Plateau Section 211G. This small area is subsection 211Ga.

A majority of MLRA 139 is occupied by the EPA ecoregion 61c (Low Lime Drift Plain) with inclusions of 61b (Mosquito Creek/Pymatuning Lowlands), 61d (Erie Gorges), and 61e (Summit Interlobate Area). The northern strip along Lake Erie is 83a (Erie/Ontario Lake Plain). The EPA ecoregions 62d (Unglaciated High Allegheny Plateau) and 70c (Pittsburgh Low Plateau) overlap the older till southern fringe of MLRA 139.

Ecological site concept

The central concept of Coastal Dune Complex is sand dunes and beaches adjacent to open Great Lakes (large fetches) subject to frequent strong winds and large surf. Vegetation is usually sparse, consisting of species tolerant of drought and sand abrasion.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Ammophila breviligulata* (2) *Cakile edentula*

Physiographic features

Site is beaches and alternating series of dunes and swales adjacent to an active exposed shoreline.

Table 2. Representative physiographic features

Landforms	(1) Beach (2) Dune

Climatic features

Mean July temperatures range from 18.6 to 23.4 °C (65 to 74 °F). Mean January temperatures range from -6 to -1.8 °C (21 to 29 °F). Average 0 °C (32 °F) frost-free season ranges from 113 to 192 days. Average -2 °C (28 °F) freeze-free season is 142 to 213 days. Mean annual extreme minimum temperatures range from -28.5 to -18.5 °C (-19 to -1 °F), or hardiness zones 5a to 6b. The warmest summer and winter temperatures, longer growing seasons, and less extreme highs and lows occur in the lowlands adjacent to Lake Erie. Temperatures inland decrease with elevation. Mean annual precipitation ranges from 838 to 1312 mm (33 to 52 in). Rainfall occurs as high-intensity, convective thunderstorms during the summer. Mean annual snowfall ranges from 0.4 to 5.6 m (15 to 220 in). Maximum snowfall occurs on the higher hills at the northern edge of the Allegheny Plateau adjacent to Lake Erie, where air moistened by the lake is uplifted and cooled into narrow intense bands of lake effect snow. The higher elevations of the eastern plateau with its generally cooler summers and much higher precipitation to potential evapotranspiration ratios (>2.0, perhumid), warrants consideration as a separate ecological inference area.

Table 3. Representative climatic features

Frost-free period (characteristic range)	153-164 days
Freeze-free period (characteristic range)	187-202 days
Precipitation total (characteristic range)	940-1,067 mm
Frost-free period (actual range)	153-173 days
Freeze-free period (actual range)	184-204 days

Precipitation total (actual range)	864-1,067 mm
Frost-free period (average)	160 days
Freeze-free period (average)	194 days
Precipitation total (average)	991 mm

Climate stations used

- (1) ASHTABULA [USC00330264], Ashtabula, OH
- (2) CLEVELAND [USW00014820], Cleveland, OH
- (3) SANDUSKY [USW00014846], Sandusky, OH
- (4) ERIE INTL AP [USW00014860], Erie, PA

Influencing water features

Surface waters of the Great Lakes have the greatest influence on this site, though groundwater seeps may occur inland. See ecological dynamics for details on water level variability.

Soil features

Soils are excessively drained to somewhat poorly drained sand. They are not commonly classified and are commonly mapped as Lake beach or Beaches components.

Ecological dynamics

Coastal Dune Complex shares the same ecological dynamics as Natureserve/Landfire systems, Great Lakes Dune or Great Lakes Dune or Swale. Due to discontinuous fuels, stand replacing fires rarely occurred, while light to moderate intensity fires occurred every 250-1050 years. During the calm periods, the storm beach may provide habitat for water dispersed annual sea rocket (Cakile endentula). The width of the storm beach is determined by exposure to wave action and gradient (5-10% slope) of the beach. Seas are calm for most of the late spring and summer periods along even the most exposed shoreline with waves less than 0.5 m (periods of around 3.6 s). Calm periods are regularly interrupted by storms with waves of 1-2 m (periods 5-6 s). From fall through early spring, exposed shorelines are subject to wave action for a majority of the time, with average wave heights greater than 1 m (period >5 s), except during late winter ice packs. Peak storm waves in fall through early spring are typically 2-3 m (periods 6-7 s) are limited by the shallow depths and limited fetch of Lake Erie. On top of this, storm surge may add another 0.25 m to the water level, but can exceed 1 m in shallow Lake Erie. As a result, berms of the storm beach can lie 0.5-2 m above lake level and 5-20 m from the waterline. During high water years, the beach becomes steeper and erodes inland. During low water years, more beach is exposed, and sand tends to accrete. Inland from the storm beach, dune grasses like *Ammophila breviligulata* may allow windblown sand to accumulate. Subsequent erosion of sand may create depressions which may reach the water table, allowing for marsh vegetation. The height of the water table is largely controlled by average lake levels. Water levels rise and fall on annual cycles of about a 30 cm, peaking in summer. Average water levels vary more than 1 m over periods of 20 years or more due to trends in basin wide precipitation and evaporation. Maximum range within the last century has been about 2 m.

State and transition model

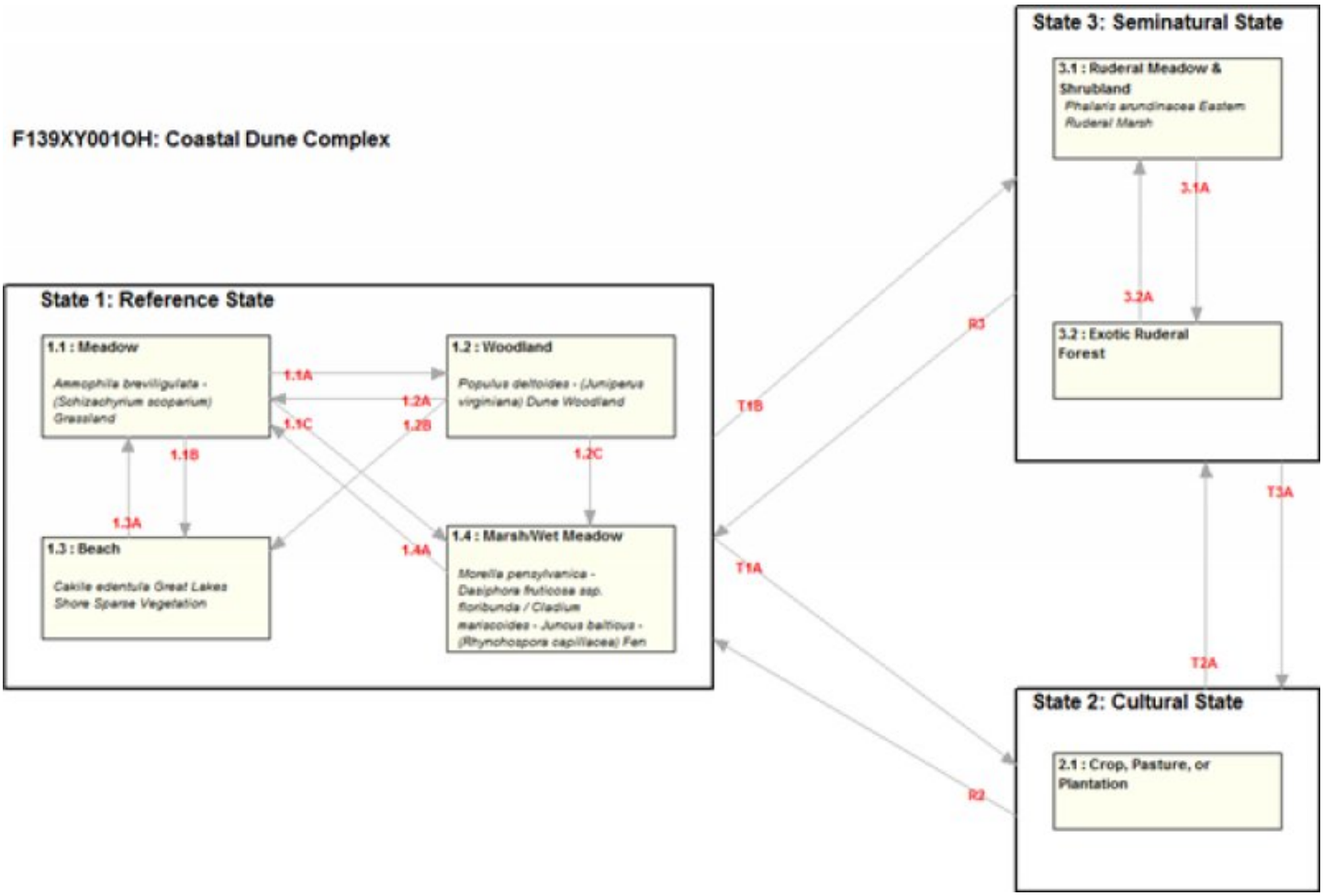

Figure 6. stm

Legend

T1A	Clear vegetation; cultivate domesticated species
T1B	Clear vegetation, invasive species introduced
1.1A	Succession
1.1B	Beach erosion/lake level increase
1.1C	Blowout below water table
1.2A	Fire/erosion/burial
1.2B	Beach erosion/lake level increase

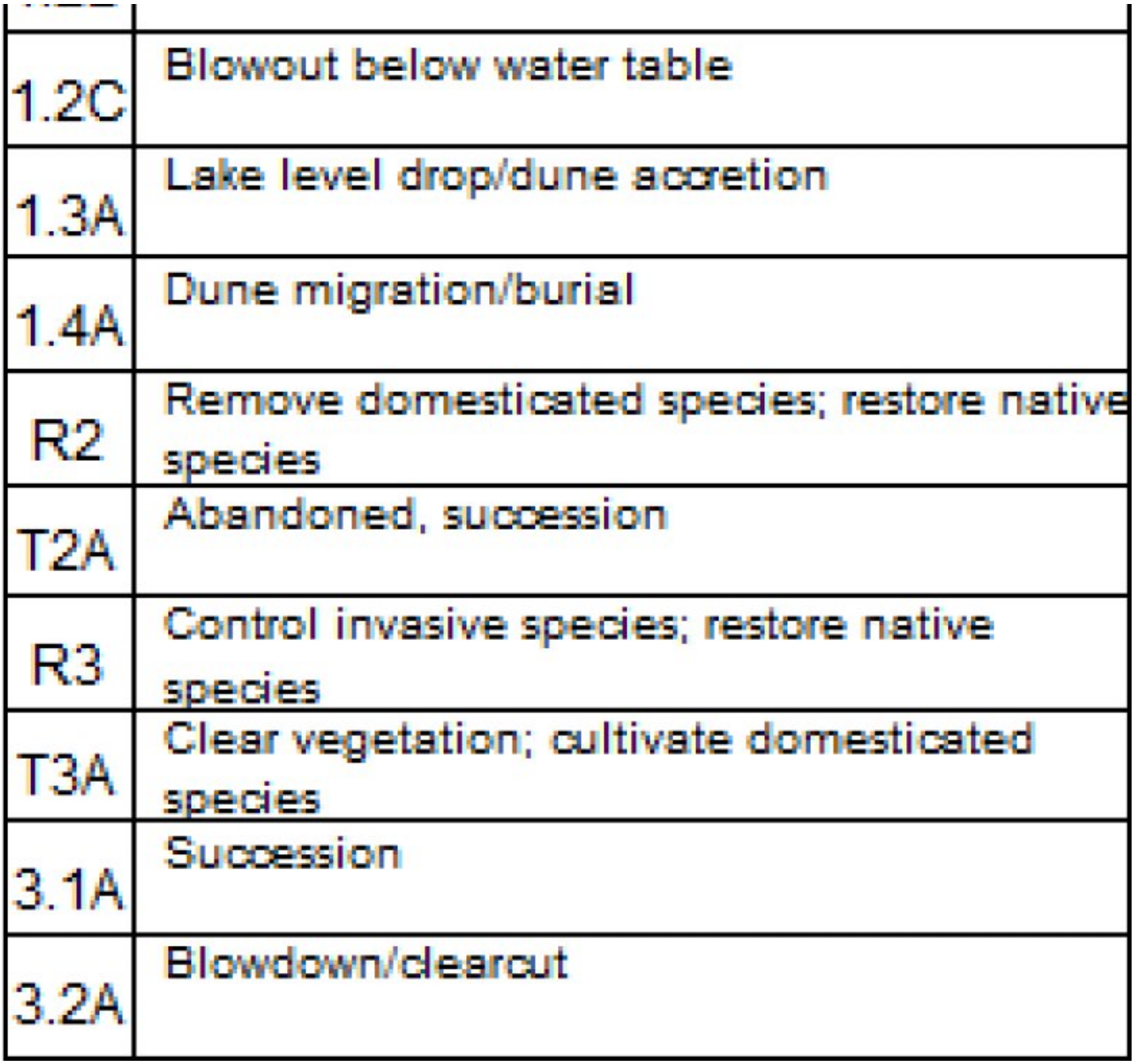

Figure 7. legend

State 1
Reference State

Community 1.1
Meadow: Ammophila breviligulata - (Schizachyrium scoparium) Grassland

Dominant plant species

- American beachgrass (*Ammophila breviligulata*), grass
- little bluestem (*Schizachyrium scoparium*), grass

Community 1.2
Woodland: Populus deltoides - (Juniperus virginiana) Dune Woodland

Dominant plant species

- eastern cottonwood (*Populus deltoides*), tree
- eastern redcedar (*Juniperus virginiana*), tree

Community 1.3
Beach: Cakile edentula Great Lakes Shore Sparse Vegetation

Dominant plant species

- American searocket (*Cakile edentula*), grass

Community 1.4
Marsh/Wet Meadow: Morella pensylvanica - Dasiphora fruticosa ssp. floribunda / Cladium mariscoides - Juncus balticus - (Rhynchospora capillacea) Fen

Dominant plant species

- northern bayberry (*Morella pensylvanica*), shrub
- shrubby cinquefoil (*Dasiphora fruticosa ssp. floribunda*), shrub
- smooth sawgrass (*Cladium mariscoides*), grass
- mountain rush (*Juncus arcticus ssp. littoralis*), grass
- needle beaksedge (*Rhynchospora capillacea*), grass

Pathway 1.1A
Community 1.1 to 1.2

Succession.

Pathway 1.1B
Community 1.1 to 1.3

Beach erosion/lake level increase.

Pathway 1.1C
Community 1.1 to 1.4

Blowout below water table.

Pathway 1.2A
Community 1.2 to 1.1

Fire/erosion/burial.

Conservation practices

Prescribed Burning

Pathway 1.2B
Community 1.2 to 1.3

Beach erosion/lake level increase.

Pathway 1.2C
Community 1.2 to 1.4

Blowout below water table.

Pathway 1.3A
Community 1.3 to 1.1

Lake level drop/dune accretion.

Pathway 1.4A
Community 1.4 to 1.1

Dune migration/burial.

State 2
Cultural State

Community 2.1
Crop, Pasture, or Plantation

State 3
Seminatural State

Community 3.1
Ruderal Meadow & Shrubland: Phalaris arundinacea Eastern Ruderal Marsh

Dominant plant species

- reed canarygrass (*Phalaris arundinacea*), grass

Community 3.2
Exotic Ruderal Forest

Pathway 3.1A
Community 3.1 to 3.2

Succession

Pathway 3.2A
Community 3.2 to 3.1

Blowdown/clearcut

Transition T1A
State 1 to 2

Clear vegetation; cultivate domesticated species

Transition T1B
State 1 to 3

Clear vegetation, invasive species introduced

Restoration pathway R2
State 2 to 1

Remove domesticated species; restore native species

Conservation practices

Tree/Shrub Establishment
Restoration and Management of Rare and Declining Habitats
Dune Stabilization
Restoration and Management of Natural Ecosystems

Invasive Plant Species Control

Transition T2A
State 2 to 3

Abandoned, succession.

Transition R3
State 3 to 1

Control invasive species; restore native species.

Conservation practices

Tree/Shrub Establishment
Restoration and Management of Rare and Declining Habitats
Upland Wildlife Habitat Management
Herbaceous Weed Control

Restoration pathway T3A
State 3 to 2

Clear vegetation; cultivate domesticated species

Additional community tables

Other references

A PROVISIONAL ECOLOGICAL SITE is a conceptual grouping of soil map unit components within a major land resource area (MLRA) based on the similarities in response to management. A provisional ecological site is a first approximation based on a cursory literature review, personal experience, and limited field reconnaissance. As more adequate literature review, expert opinion, and intensive plot data are collected, the site concept is subject to shifting, broadening, narrowing, subdivision, or re-aggregation in definition. Likewise, the community dynamics will be more elaborate in content, and may also change in structure, upon reaching approved status.

Future work, as described in a project plan, to validate the information in this provisional ecological site description is needed. This will include field activities to collect low and medium intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document. Annual reviews of the project plan are to be conducted by the Ecological Site Technical Team.

References consulted for MLRA 139 PES:
Faison, E.K. and Foster, D.R., 2014. Did American Chestnut Really Dominate the Eastern Forest?. Arnoldia 72(2):18-32.

GHCN, 2016. Global Historical Climatology Network Monthly Versions 2 and 3 (temperature and precipitation data). NOAA. https://www.ncdc.noaa.gov/ghcnm/

Landfire, 2017. Landfire Biophysical Settings Review Site. Accessed May, 2017 http://www.landfirereview.org/descriptions.html.

PRISM Climate Group. 2013. Gridded 30 Year Normals, 1981-2010. Oregon State University, http://prism.oregonstate.edu

Sampson, H.C., 1930. The mixed mesophytic forest community of northeastern Ohio.The Ohio Journal of Science 30:358-367.

U.S. Department of the Interior, Geological Survey, 2011. LANDFIRE: LANDFIRE 1.1.0 Existing Vegetation Type layer. http://landfire.cr.usgs.gov/viewer/

Wang, Y.C., 2007. Spatial patterns and vegetation–site relationships of the presettlement forests in western New York, USA. Journal of Biogeography, 34(3):500-513.

Whitney, G.G. and DeCant, J.P., 2003. Physical and historical determinants of the pre-and post-settlement forests of northwestern Pennsylvania. Canadian Journal of Forest Research, 33(9):1683-1697.

Whitney, G.G., 1982. Vegetation-site relationships in the presettlement forests of northeastern Ohio. Botanical Gazette, 143(2):225-237.

Contributors

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Approval

Nels Barrett, 10/03/2019

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):**

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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):**

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:**

17. **Perennial plant reproductive capability:**