Ecological site F097XA002MI
Backdune

Last updated: 1/16/2024
Accessed: 04/26/2024

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.

MLRA notes

Major Land Resource Area (MLRA): 097X–Southwestern Michigan Fruit and Vegetable Crop Belt

Physiography consists of sandy lake plains and dunes along the western side adjacent to Lake Michigan, and moderately sloping fine-loamy moraine from the Lake Michigan lobe of the Wisconsin Ice Sheet.

Vegetation is mostly mesophytic forests of central and northern hardwood and conifer species with prairie and oak savanna to the south. Compared to inland locations, cold sensitive hardwood species extend further north due to milder winters, and conifers extend further south due to cooler summers, heavier snowfall, and sandier soils. Lake effect snow and delayed spring warm up dampen the fire frequency relative to similar inland sites, except along the south side of Lake Michigan. The northern extent is defined by a major floristic boundary where several central hardwoods species drop out. The southern boundary is defined by fine-loamy moraines with predominantly prairie vegetation.

The ecological site inference area for MLRA 97 is subdivided along a floristic/climatic break roughly from New Buffalo, Michigan to Portage, Indiana. This corresponds to the heaviest lake effect snow belt (>160 cm) south and east of this line and is associated lower historic fire frequencies. The snow belt portion “A”, has more frequent conifer and beech, while the less snowy portion “B” has more prairie and savanna elements. Although differing in precise boundary location, both USFS and EPA ecoregions support a climatic/floristic break at the next higher rank in their respective hierarchies.

Classification relationships

Among the USFS ecoregional framework (Cleland et al., 2007), most of MLRA 97 is represented by the Humid Temperate Domain (200), Hot Continental Division (220), Midwest Broadleaf Forest Province (222), South Central Great Lakes Section (222J), subsections 222Ja and 222Jb. MLRA 97 was recently extended northward to be more consistent with the limits of the USFS ecoregions subsections 222Ja and 222Jb, because it is more consistent with vegetation patterns and species distributions. A former portion of MLRA 97 that extended westward from the southern end of Lake Michigan (including most of the city of Chicago) was recently removed from the MLRA due to its predominantly non-sandy deposits and reduced lake effect climate, and would have overlapped USFS ecoregion 222K.

Among the EPA ecoregional framework (Omernik and Griffith, 2014), most of MLRA 97 falls within Eastern Temperate Forests (Level I: 8), Mixed Wood Plains (Level II: 8.1), Southern Michigan/Northern Indiana Drift Plains (Level III: 56), and Level IV: 56d and 56f. Ecoregion 56f continues north beyond MLRA 97. Former portions of MLRA 97 that encompassed the city of Chicago included Level III ecoregion 54, Central Corn Belt Plains, before the last revision of MRLA boundaries.

Ecological site concept

The central concept of the Backdune is old parabolic dunes that formed during higher lake levels thousands of

years ago and have since become stabilized with forest vegetation. The vegetation tends to have a mix of mesophytic species like beech, maple, basswood, and hemlock due to the lack of fire, presence of fog, and possible calcium enrichment from lake spray. The forest margin on the windward side generally has a more xerophytic composition of pine and oak due to younger, more nitrogen impoverished soils, and exposure to more sunlight and sand abrasion. On occasion, some dunes become unstable and begin to migrate inland, uprooting trees and creating open sand dune vegetation on the windward side and burying trees on the lee/inland side.

Associated sites

R097XA001MI	**Beach And Foredune**

Similar sites

F097XA010MI	**Sandy Slopes**
F097XB003IN	**Chicago Backdune**
R097XA001MI	**Beach And Foredune**

Table 1. Dominant plant species

Tree	(1) *Fagus grandifolia* (2) *Tsuga canadensis*
Shrub	Not specified
Herbaceous	(1) *Maianthemum canadense* (2) *Dryopteris marginalis*

Physiographic features

Old stabilized dunes along a Great Lakes.

Table 2. Representative physiographic features

Landforms	(1) Dune
Runoff class	Very low to low
Elevation	581–820 ft
Slope	0–100%
Water table depth	39 in
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

The southeastern Lake Michigan lake plain and adjacent lake influenced moraines have a humid warm continental climate with cold winters and warm summers.

Just over half of the precipitation is distributed during the warmer half of the year with a significant portion of the precipitation occurring as heavy downpours during thunderstorms. Thunderstorm activity is enhanced inland by lake breeze fronts, while it is diminished near the lakeshore by the stabilizing effect of the cooler lake waters. Occasionally, thunderstorm microbursts cause localized high winds which open single tree gaps in forest canopies, or more rarely, tornados and derechos (severe straight-line winds) open larger gaps. Fall storms bring more frequent strong winds, but with impacts moderated by the lack of leaves (wind resistance) in the canopy. During July, average precipitation lags potential evapotranspiration, resulting in droughty conditions in the upper soil horizons of upland sites. During dry years, this droughty period is extended into August and September, resulting in dry fuels and potential for wildfire over oak and pine dominated areas.

Winter precipitation is enhanced by lake effect snows, with 1.6 to 2.4 m (40-95 inches) falling annually within the

snow belt. Peak snowfall occurs at intermediate distances from the lake where topography enhances uplift. The combination of heavier winter snowfall, lake-delayed spring warm up, and frequent wetlands all contribute to relatively lower fire frequencies relative to inland locations with similarly droughty soils.

The area falls within USDA Hardiness zones 6a and 6b and has delayed spring warm up until after the last killing frosts, allowing for a wide range of fruit crops to be grown.

Table 3. Representative climatic features

Frost-free period (characteristic range)	120-137 days
Freeze-free period (characteristic range)	153-173 days
Precipitation total (characteristic range)	33-37 in
Frost-free period (actual range)	117-143 days
Freeze-free period (actual range)	150-189 days
Precipitation total (actual range)	33-37 in
Frost-free period (average)	129 days
Freeze-free period (average)	165 days
Precipitation total (average)	35 in

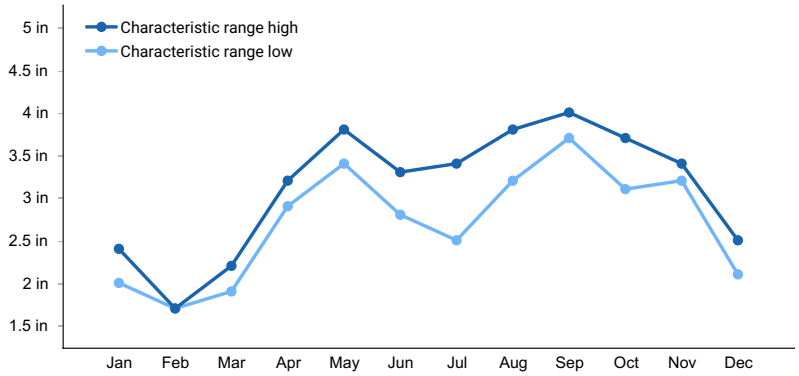


Figure 1. Monthly precipitation range

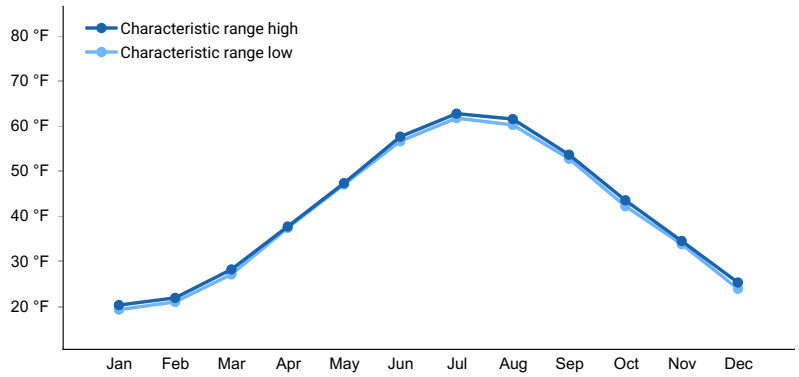


Figure 2. Monthly minimum temperature range

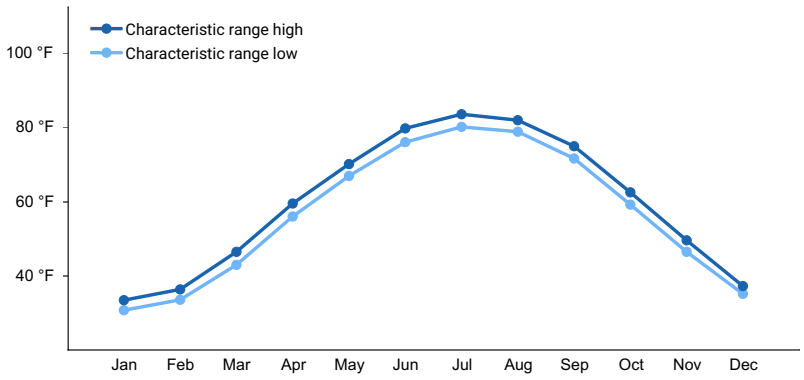


Figure 3. Monthly maximum temperature range

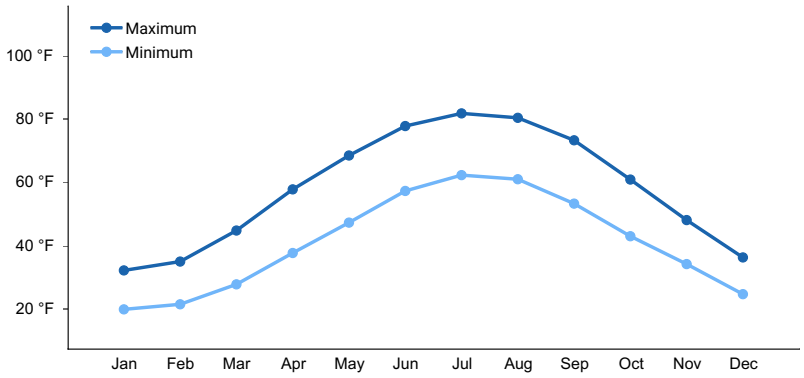


Figure 4. Monthly average minimum and maximum temperature

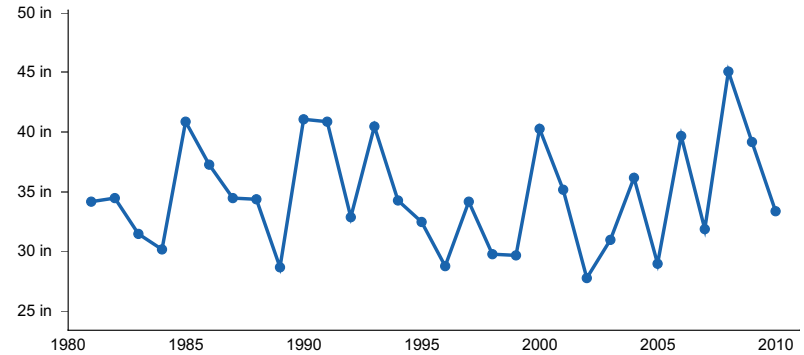


Figure 5. Annual precipitation pattern

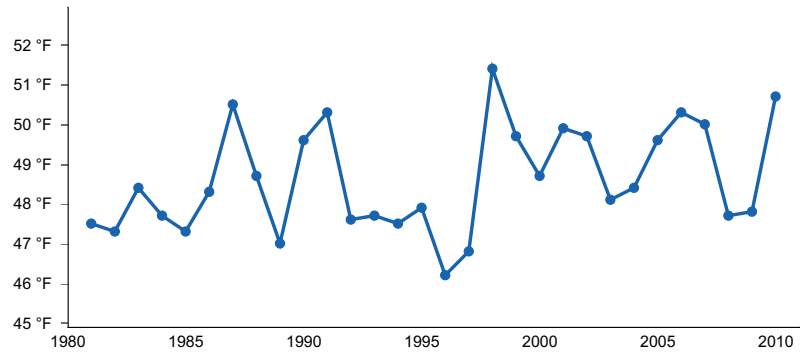


Figure 6. Annual average temperature pattern

Climate stations used

- (1) HOLLAND WTP [USC00203858], Holland, MI
- (2) MUSKEGON CO AP [USW00014840], Muskegon, MI
- (3) BENTON HARBOR AP [USW00094871], Benton Harbor, MI

- (4) GRAND HAVEN FIRE DEPT [USC00203290], Grand Haven, MI

Influencing water features

Not wet, but adjacent to Great Lakes.

Soil features

Soils are excessively drained to moderately well drained sands on >15% slopes. They are commonly classified as Typic Udipsamments, and commonly mapped as Plainfield and Oakville series.

Table 4. Representative soil features

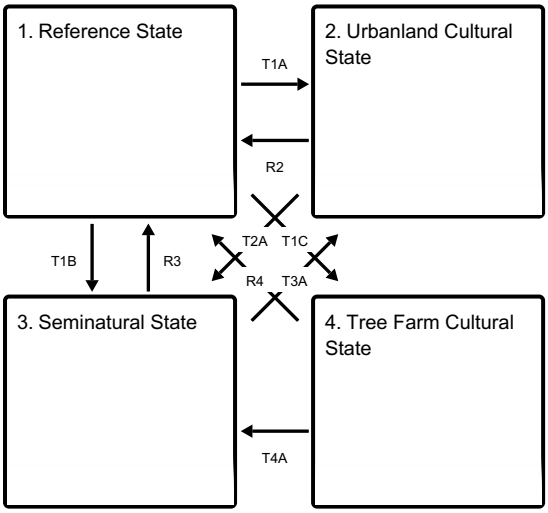
Parent material	(1) Eolian sands
Surface texture	(1) Sand
Drainage class	Somewhat poorly drained to well drained
Permeability class	Moderately rapid to rapid
Soil depth	79 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-39.4in)	1.57–3.94 in
Soil reaction (1:1 water) (0-19.7in)	4.5–6
Subsurface fragment volume <=3" (0-59.1in)	0%
Subsurface fragment volume >3" (0-59.1in)	0%

Ecological dynamics

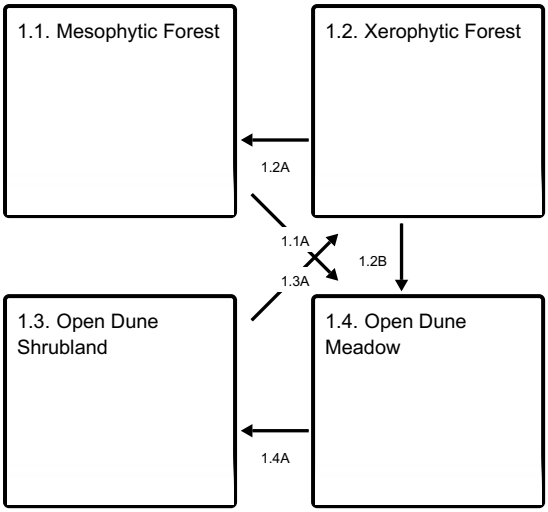
Fire was infrequent due to irregular topography, patchy initial vegetation, and high humidity, allowing succession to fire sensitive species. Shifting sand may bury or uproot existing forest. Low fertility favors oak and pine, but lack of fire and establishment of maple species gradually improves soil fertility, allowing for the establishment of a wider array of mesophytic species, especially in lower slope positions.

State and transition model

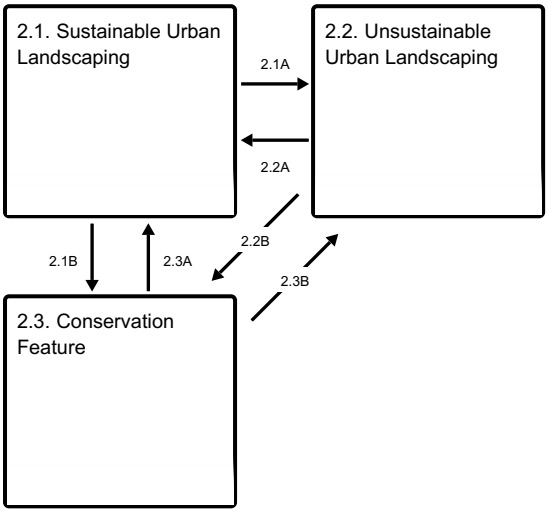
Ecosystem states



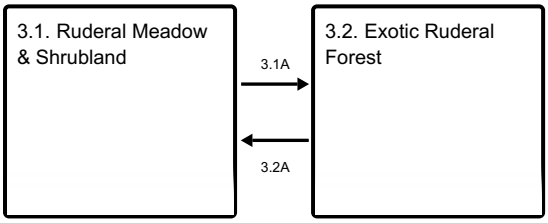
State 1 submodel, plant communities



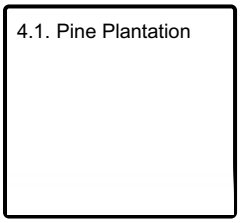
State 2 submodel, plant communities



State 3 submodel, plant communities



State 4 submodel, plant communities



State 1
Reference State

The Reference State consists of forest and open shrubland.

Dominant plant species

- American beech (*Fagus grandifolia*), tree
- eastern hemlock (*Tsuga canadensis*), tree
- Canada mayflower (*Maianthemum canadense*), other herbaceous

- marginal woodfern (*Dryopteris marginalis*), other herbaceous

Community 1.1
Mesophytic Forest

Community 1.2
Xerophytic Forest

Community 1.3
Open Dune Shrubland

Community 1.4
Open Dune Meadow

Pathway 1.1A
Community 1.1 to 1.4

Blowout or severe fire.

Pathway 1.2A
Community 1.2 to 1.1

Succession.

Pathway 1.2B
Community 1.2 to 1.4

Blowout or severe fire.

Pathway 1.3A
Community 1.3 to 1.2

Succession.

Pathway 1.4A
Community 1.4 to 1.3

Succession.

State 2
Urbanland Cultural State

[Alternative States to be developed; refer to component communities.]

Community 2.1
Sustainable Urban Landscaping

Community 2.2
Unsustainable Urban Landscaping

Community 2.3
Conservation Feature

Can be a conservation reserve, a small patch pollinator garden, or other land taken out of its primary cultural production to mitigate or reduce impacts of adjacent land use, and is not by itself a permanent restoration of a complete native biological community and associated ecosystem services.

Pathway 2.1A
Community 2.1 to 2.2

Revert to unsustainable cultural practices (i.e. maintain non-native lawn, apply fertilizers, grow invasive ornamentals).

Pathway 2.1B
Community 2.1 to 2.3

Establish conservation feature (i.g. native pollinator garden).

Conservation practices

Brush Management
Tree/Shrub Establishment
Restoration and Management of Rare and Declining Habitats
Herbaceous Weed Control

Pathway 2.2A
Community 2.2 to 2.1

Implement sustainable cultural practices (i.e. establish native dunegrass, stop applying fertilizer, eliminate invasive ornamentals).

Conservation practices

Brush Management
Conservation Cover
Tree/Shrub Establishment
Herbaceous Weed Control

Pathway 2.2B
Community 2.2 to 2.3

Establish conservation feature (i.g. native pollinator garden).

Conservation practices

Brush Management
Tree/Shrub Establishment
Restoration and Management of Rare and Declining Habitats
Herbaceous Weed Control

Pathway 2.3A
Community 2.3 to 2.1

Implement sustainable cultural practices (i.e. establish native dunegrass, stop applying fertilizer, eliminate invasive ornamentals).

Conservation practices

Brush Management
Conservation Cover

Tree/Shrub Establishment
Herbaceous Weed Control

Pathway 2.3B
Community 2.3 to 2.2

Revert to unsustainable cultural practices (i.e. maintain non-native lawn, apply fertilizers, grow invasive ornamentals).

State 3
Seminatural State

[Alternative States to be developed; refer to component communities.]

Community 3.1
Ruderal Meadow & Shrubland

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.

State 4
Tree Farm Cultural State

[Alternative States to be developed; refer to component communities.]

Community 4.1
Pine Plantation

Transition T1A
State 1 to 2

Clear vegetation; cultivate domesticated species

Transition T1B
State 1 to 3

Clear vegetation, invasive species introduced

Transition T1C
State 1 to 4

Clearcut natural forest if present; recontour landscape; plant tree monoculture in rows.

Restoration pathway R2

State 2 to 1

Remove domesticated species; restore native species.

Conservation practices

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

Transition T2A
State 2 to 3

Abandoned, succession.

Restoration pathway R3
State 3 to 1

Control invasive species; restore native species

Conservation practices

Brush Management
Tree/Shrub Site Preparation
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

Restoration pathway R4
State 4 to 1

Clearcut or thin plantation if native trees; remove non-native species; restore native species.

Conservation practices

Brush Management
Tree/Shrub Site Preparation
Tree/Shrub Establishment
Restoration and Management of Rare and Declining Habitats
Upland Wildlife Habitat Management
Forest Stand Improvement
Herbaceous Weed Control

Restoration pathway T4A
State 4 to 3

Clearcut without restoration.

Additional community tables

Inventory data references

Site Development and Testing Plan
Future work is needed, as described in a future project plan, to validate the information presented in this provisional ecological site description. Future work includes field sampling, data collection and analysis by qualified vegetation ecologists and soil scientists. As warranted, annual reviews of the project plan can be conducted by the Ecological Site Technical Team. A final field review, peer review, quality control, and quality assurance reviews of the ESD are necessary to approve a final document.

Other references

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

Contributors

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Approval

Nels Barrett, 1/16/2024

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	04/26/2024
Approved by	Nels Barrett
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:**

   _____

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

   _____

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

   _____

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

   _____

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

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

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

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:

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

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

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:**