USDA Natural Resources Conservation Service

Ecological site R103XY013MN
Calcareous Fens

Last updated: 10/04/2023
Accessed: 05/05/2024

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): 103X–Central Iowa and Minnesota Till Prairies

MLRA 103 is in Minnesota (56 percent) and Iowa (44 percent) and consists of approximately 18 million acres. It is in the Western Lake Section of the Central Lowland Province of the Interior Plains in an area known as the "Des Moines Lobe" of the Wisconsin-age ice sheet. The MLRA is mostly on a young, nearly level to gently rolling, glaciated till plain that has moraines and glacial lake plains in some areas. The plain is covered with glacial till, outwash, and glacial lake deposits. Recent alluvium consisting of clay, silt, sand, and gravel fill the bottoms of most of the major river valleys. Paleozoic bedrock sediments, primarily shale and limestone, underlie the glacial deposits in most of the area.

The annual precipitation increases from northwest to southeast. Most of the rainfall occurs as high-intensity, convective thunderstorms during the summer. Two-thirds or more of the precipitation falls during the freeze-free period. Snowfall is common in winter. Ground water supplies are adequate for the domestic, livestock, municipal, and industrial needs. Nearly all of this area is farmland, and about four-fifths is cropland.

Classification relationships

Major Land Resource Area (MLRA): Central Iowa and Minnesota Till Prairies (103) (USDA Handbook 296, 2006)

USFS Subregions: North Central Glaciated Plains Section (251B) and Upper Minnesota River-Des Moines Lobe (251BA) Subsections (Cleland et al. 2007)

Relationship to Other Established Classifications:
The reference state shares similarities to Minnesota Department of Natural Resources OPp93 Prairie Extremely Rich Fen

Ecological site concept

With natural hydrology intact, the Calcareous Fens ecological site is ponded and has a high-water table (i.e. endosaturated). Ponding can be frequent and long term. Hydrologic interaction with adjacent ground classifies this site as a discharge wetland. Soils are rich in organic matter, very poorly drained, and have high calcium carbonate levels.

Associated sites

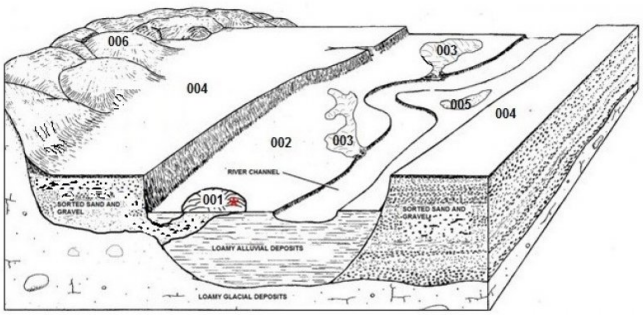
F103XY032MN	**Loamy Floodplains** The Loamy Floodplains ecological site is located on medium textured alluvium throughout MRLA 103. Soils textures include loam, silt loam, sandy loam and fine sandy loam. Some areas within this ecological site will incur long-term flooding (7-30 days).

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Carex prairea* (2) *Rhynchospora capillacea*

Physiographic features

The Calcareous Fens ecological site occurs infrequently in MLRA 103. Counties with mapped fens include Kandiyohi, Stearns, Redwood, Scott, Emmet, Webster, Dickinson, and Clay. This site can be quite convex in shape and highly sloping (>20%) for an organic/hydric soil.



Code	Ecological Site Name	Representative Soil Series
001	Calcareous Fens	Klossner, Houghton, Aquolls
002	Loamy Floodplains	Spillville, Minneiska
003	Organic Floodplain Marsh	Muskego, Klossner
004	Sandy Upland Prairie	Estherville, Dickinson
005	Floodplain Marsh	Nishna ,Oshawa
006	Loamy Upland Prairie	Clarion, Nicollet

Figure 1. Block diagrams of the representative Calcareous Fens and associated ecological sites.

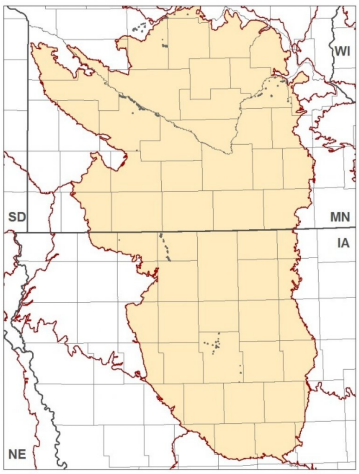


Figure 2. Distribution of the Calcareous Fens ecological site within MLRA 103. In many cases, the data set is not spatially consistent across political boundaries due to the method by which soils were mapped; e.g. due to county subsets.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Backslope (3) Shoulder
Landforms	(1) River valley (2) Moraine (3) Lake plain (4) Outwash plain (5) Till plain

Runoff class	Negligible to medium
Ponding duration	Long (7 to 30 days)
Ponding frequency	None to frequent
Elevation	689–1,837 ft
Slope	0–25%
Water table depth	0–50 in
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

The soil temperature regime of MLRA 103 is classified as “mesic” (i.e., mean annual soil temperature between 46 and 59°F). The average freeze-free period of this site is 152 days, while the frost-free period is 122 days. The average mean annual precipitation is 32 inches, which includes rainfall plus the water equivalent from snowfall.

Table 3. Representative climatic features

Frost-free period (characteristic range)	122 days
Freeze-free period (characteristic range)	152 days
Precipitation total (characteristic range)	32 in
Frost-free period (actual range)	122 days
Freeze-free period (actual range)	152 days
Precipitation total (actual range)	32 in
Frost-free period (average)	122 days
Freeze-free period (average)	152 days
Precipitation total (average)	32 in

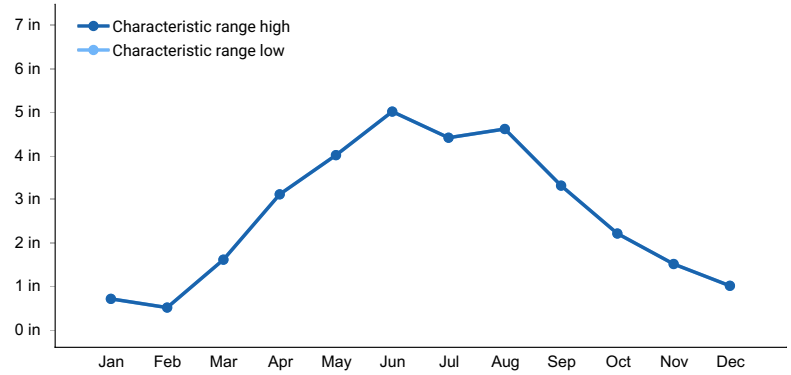


Figure 3. Monthly precipitation range

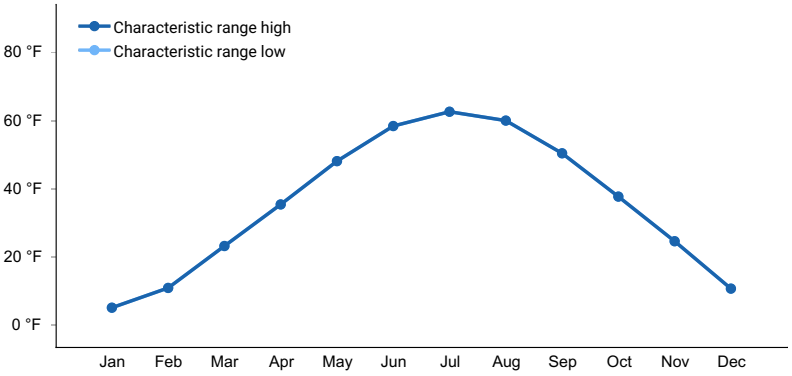


Figure 4. Monthly minimum temperature range

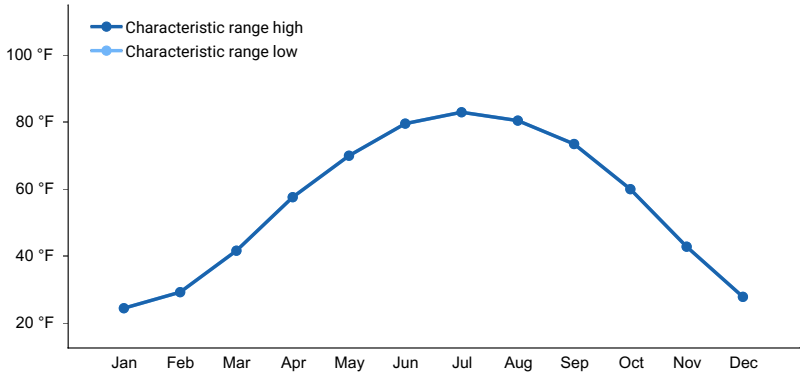


Figure 5. Monthly maximum temperature range

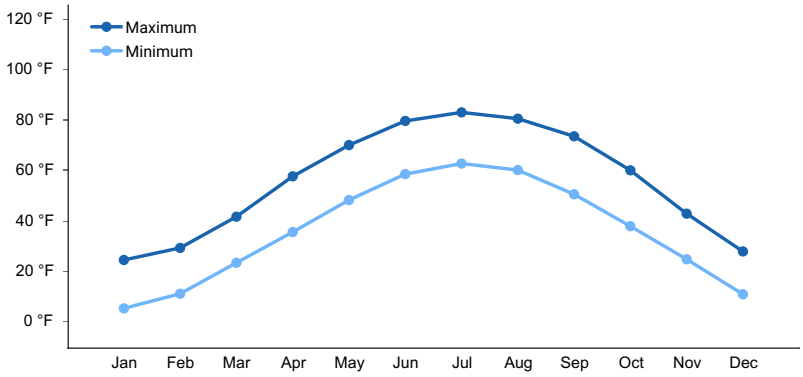


Figure 6. Monthly average minimum and maximum temperature

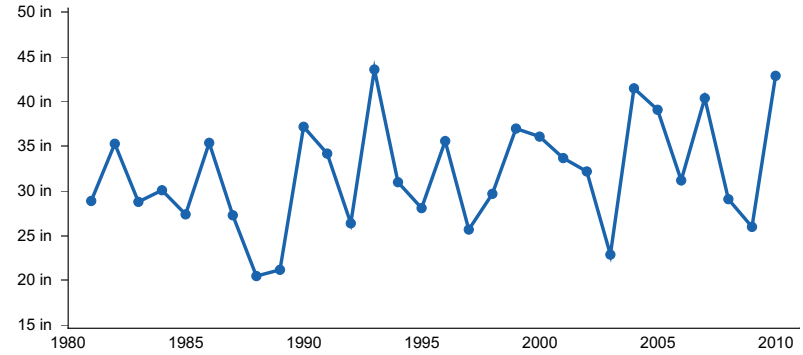


Figure 7. Annual precipitation pattern

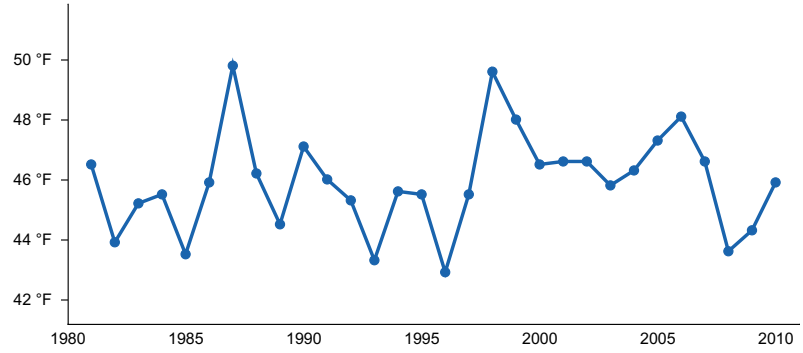


Figure 8. Annual average temperature pattern

Climate stations used

- (1) WELLS [USC00218808], Wells, MN
- (2) LITCHFIELD [USC00214778], Litchfield, MN
- (3) WORTHINGTON 2 NNE [USC00219170], Worthington, MN

- (4) PERRY [USC00136566], Perry, IA
- (5) ALBERT LEA 3 SE [USC00210075], Albert Lea, MN
- (6) NEW ULM 2 SE [USC00215887], New Ulm, MN

Influencing water features

The Calcareous Fens ecological site receives water primarily through discharge from adjacent higher elevation landforms via subsurface groundwater flow. The discharge often occurs through veins of relatively coarser material. During the spring or during intense rainfall, these soils are ponded.

Soils are classified as endosaturated and the water table is typically above the soil surface (ponded) during the spring months. During dry periods, the water table may drop as low as 3-4 feet below the surface. This site is highly calcareous due to carbonate-rich groundwater being discharged to the surface. Draining of this site is rarely feasible because of the continual subsurface discharge of water. Frequent long-term flooding can occur.

This site has a Saturated Cowardin Hydrologic classification of Palustrine, Emergent Wetland Persistent, Seasonally Saturated. It also has a United States Army Corps of Engineers Wetland Plant Community of F; Calcareous Fens.

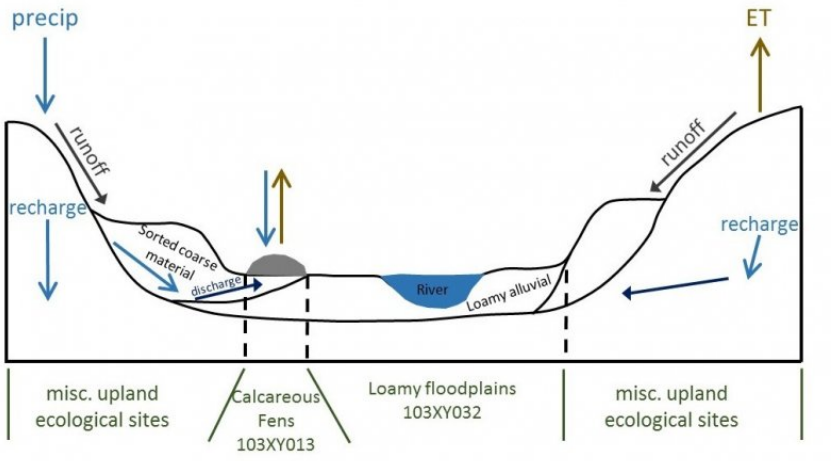


Figure 9. Representation of hydrological factors in a typical area of the Calcareous Fens and associated ecological sites on the Des Moines Lobe (MLRA 103).

Soil features

The Calcareous Fens ecological site is located on soils which are rich in organic matter and were developed under hydrophytic vegetation and ponded conditions. Organic soils by definition have thick, dark histic horizons composed mainly of organic matter, mostly the remains of plants.

Terric, Limnic, and Typic Histosols are central concepts for this site. Terric Histosols have a mineral substratum within the range of 16-51 in and Typic/Limnic Histosols have a mineral substratum below 51-in. Soil drainage class is very poorly drained. The surface texture is muck, and organic horizons above the mineral soil substratum have around 65 percent organic matter. The subsurface textural group, when present within the series control section, is classified primarily as fine-loamy (with 18 to 35 percent clay) but also includes coarse loamy (with less than 18 percent clay) and sandy (less than 15 percent clay and 30 percent silt). The soil series Palms (more likely Klossner) is the most extensive Terric Histosol in this site, while Houghton and Muskego are the more extensive deeper Histosols. Houghton is a Typic Haplosaprist, and Muskego is a Limnic Haplosaprists. Organic soils, such as Blue Earth which has limnic material, most often form in conditions that were ponded for long periods of time, such as in shallow lakes or ponds, but can also form on fens. These soils were formed under saturated conditions that produced anaerobic conditions during much of the year. The anaerobic conditions inhibit the decomposition of the organic matter which accumulates to form organic soils.

The A and/or 2C horizon, when present in soils like Klossner, typically does not represent the modal glacial till in MLRA 103, but is more representative of glaciofluvial, alluvial or slope wash materials derived from original Des

Moines lobe materials. Since this site formed at discharge areas downslope from higher elevations, and near rivers and streams, a certain amount of sediment accumulated before the organic material started to accumulate or was present previously because of their position on a floodplain. The soil series associated with this ecological site are Blue Earth, Klossner/Palms, and Houghton.

Table 4. Representative soil features

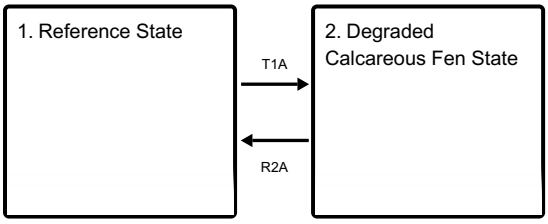
Parent material	(1) Organic material–slate (2) Slope alluvium (3) Alluvium
Surface texture	(1) Muck
Drainage class	Very poorly drained
Permeability class	Moderately slow to rapid
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-60in)	9–24 in
Calcium carbonate equivalent (0-40in)	0–40%
Soil reaction (1:1 water) (0-40in)	7–8.4
Subsurface fragment volume <=3" (0-40in)	0–23%
Subsurface fragment volume >3" (0-40in)	0–5%

Ecological dynamics

The Calcareous Fens ecological site is characterized by two states: the Reference State and the Degraded Fen State. Drought and fire are natural disturbance triggers. Human disturbances, such as absence of a natural fire regime, cattle grazing, and invasive plant species, will transition the site to a degraded condition (State 2). Plant species adapted to this site are hydrophytic (adapted to grow in water). The ecology of the site is influenced by soils that are very poorly drained, frequently ponded, and have a high calcium carbonate level due to the continual groundwater discharge. Cancerous Fens are habitat for state-listed rare plants species such as the white lady's slipper (*Cypripedium candidum*).

State and transition model

Ecosystem states



T1A - Disturbances alter plant community composition and structure

R2A - Restoration inputs

State 1 submodel, plant communities

1.1. Calcareous Fen Community

State 2 submodel, plant communities

2.1. Degraded Fen Community

State 1
Reference State

The Calcareous Fen reference state is dependent upon ponding and groundwater discharge, which makes the soil water very basic in pH. The most common month for ponding is April. This site tends to stay ponded for a much longer duration than other wetlands in MLRA 103. Most woody species and upland grasses are kept from proliferating mainly by saturated conditions. The natural plant community is composed of hydrophytic species including prairie sedge (*Carex prairea*), needle beaksedge (*Rhynchospora capillacea*), muhly grass (Muhlenbergia spp.) and includes various state-listed species such as the white lady’s slipper (*Cypripedium candidum*). Fire, drought, and grazing were the historic, natural disturbances.

Dominant plant species

- prairie sedge (*Carex prairea*), grass
- needle beaksedge (*Rhynchospora capillacea*), grass
- muhly (*Muhlenbergia*), grass

Community 1.1
Calcareous Fen Community

This community is unique within MLRA 103 and is characterized by native hydrophytic vegetation, frequent ponding, and mucky, calcareous soils. The Calcareous Fen ecological site is dominated by hydrophytic species. Numerous state-listed species such as white lady's slipper (*Cypripedium candidum*) and wild sweet William (*Phlox maculata*) may be found on these rare sites.

Dominant plant species

- prairie sedge (*Carex prairea*), grass
- needle beaksedge (*Rhynchospora capillacea*), grass
- muhly (*Muhlenbergia*), grass

State 2
Degraded Calcareous Fen State

Through a variety of disturbances, invasive woody plants and non-native grasses can become established on this site. These plant spread quickly thereby changing the composition and structure of the plant community. Common invasives include narrowleaf cattail (*Typha angustifolia* L.), hybrid cattail (Typha xglauca Godr. (pro sp.) [angustifolia or domingensis x latifolia]), and common reed (*Phragmites australis* (Cav.) Trin. ex Steud.), reed canarygrass (*Phalaris arundinacea* L.). Historically, these sites burned which reduced woody vegetation and maintained the dominance of grasses and sedges. Without fire, these sites often exhibit an increase in woody species such as redosier dogwood (*Cornus sericea*) and willows (Salix spp.).

Dominant plant species

- willow (*Salix*), shrub
- redosier dogwood (*Cornus sericea*), shrub
- reed canarygrass (*Phalaris arundinacea*), grass
- hybrid cattail (*Typha ×glauca*), grass
- common reed (*Phragmites australis*), grass
- narrowleaf cattail (*Typha angustifolia*), grass

Community 2.1
Degraded Fen Community

This plant community can show variation in composition and structure depending on the type and severity of disturbances. Common triggers of plant community change include the presence of non-native plant species, cattle grazing, hydrological modifications, and the absence of a natural fire regime.

Dominant plant species

- willow (*Salix*), shrub
- redosier dogwood (*Cornus sericea*), shrub
- reed canarygrass (*Phalaris arundinacea*), grass
- hybrid cattail (*Typha ×glauca*), grass
- common reed (*Phragmites australis*), grass
- narrowleaf cattail (*Typha angustifolia*), grass

Transition T1A
State 1 to 2

Disturbances trigger plant community changes. Common disturbances include grazing, hydrological alterations, an absence of a natural fire regime, and invasive species.

Restoration pathway R2A
State 2 to 1

Restoration inputs include invasive species control and removal of anthropogenic disturbances such as cattle grazing. Restoration to a reference community would require a natural hydrological function.

Additional community tables

Other references

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Cowardin, L. M., V. Carter, F. C. Golet, and E.T. LaRoe. 1979 (revised 2013). Classification of Wetlands and Deepwater Habitats of the United States. FWS/OBS-79/31, U.S. Department of Interior-Fish and Wildlife Service, Washington, D.C.

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Approval

Suzanne Mayne-Kinney, 10/04/2023

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	05/05/2024
Approved by	Suzanne Mayne-Kinney
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):**

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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:**
