USDA Natural Resources
Conservation Service

Ecological site R236XY131AK
Subarctic Tussock-Scrub Frozen Plains

Last updated: 2/13/2024
Accessed: 04/29/2024

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): 236X–Bristol Bay-Northern Alaska Peninsula Lowlands

The Bristol Bay-Northern Alaska Peninsula Lowland Major Land Resource Area (MLRA 236) is located in Western Alaska. This MLRA covers approximately 19,500 square miles and is defined by an expanse of nearly level to rolling lowlands, uplands and low to moderate hills bordered by long, mountain footslopes. Major rivers include the Egegik, Mulchatna, Naknek, Nushagak, and Wood River. MLRA 236 is in the zone of discontinuous permafrost. It is primarily in areas with finer textured soils on terraces, rolling uplands and footslopes. This MLRA was glaciated during the early to middle Pleistocene. Moraine and glaciofluvial deposits cover around sixty percent of the MLRA. Alluvium and coastal deposits make up a large portion of the remaining area (Kautz et al., 2012; USDA, 2006).

Climate patterns across this MLRA shift as one moves away from the coast. A maritime climate is prominent along the coast, while continental weather, commonly associated with Interior Alaska, is more influential inland. Across the MLRA, summers are general short and warm while winters are long and cold. Mean annual precipitation is 13 to 50 inches, with increased precipitation at higher elevations and areas away from the coast. Mean annual temperatures is between 30 and 36 degrees F (USDA, 2006).

The Bristol Bay-Northern Alaska Peninsula MLRA is principally undeveloped wilderness. Federally managed land includes parts of the Katmai and Aniakchak National Parks, and the Alaska Peninsula, Becharof, Togiak and Alaska Maritime National Wildlife Refuges. The MLRA is sparsely populated. Principal communities include Dillingham, Naknek, and King Salmon. Commercial fishing in Bristol Bay and the Bering Sea comprises a major part of economic activity in the MLRA. Other land uses include subsistence activities (fishing, hunting, and gathering) and sport hunting and fishing (USDA, 2006).

Classification relationships

Alaska Vegetation Classification:
Mesic graminoid herbaceous (III.A.2 - level III) / Tussock tundra (III.A.2.d - level IV)
(Viereck et al., 1992)

LandFire BioPhysical Settings Model
Alaska Arctic Scrub Birch-Ericaceous Shrubland – Infrequent Fire- 7616821 (LandFire BpS, 2009)

Ecological site concept

This ecological site is on concave plain slopes with cold, organic, permafrost-supporting soils. Site elevation is between 10 and 960 feet above sea level. Slopes are nearly level to strongly sloped (1 – 12 percent). Soil hydrology, soil temperature, and frost heave shape the vegetation on this landform. Water perches atop the permafrost during the growing season, restricting vegetation. Frost heave creates peat mounds that do not pond throughout the growing season, allowing a different community to develop.

The reference state supports two communities. The reference plant community is a tussock tundra (Viereck et al., 1992). It is composed of a tussock cottongrasses, ericaceous shrubs, and thick moss. Ponding in the concave depressions support primarily facultative to obligate wetland species in the reference plant community, while shrubs dominate community 1.2, which is restricted to raised areas on top of frost-heaved peat mounds.

Associated sites

R236XY109AK	**Subarctic Low Scrub Peat Drainages** Both sites are in concave plain slopes. R236XY109AK is not associated with permafrost and does not support the peat mounds that define R236XY131AK. This site contains more tussock graminoids and less shrubs that R236XY109AK.
R236XY130AK	**Subarctic Scrub Scrub Tundra Loamy Plains and Hills** Both sites are on plain landforms. R236XY130AK is an ericaceous scrubland site on linear plain slopes. R236XY131AK is a tussock tundra associated with permafrost and the microtopography created by frost heave and collapse.
R236XY132AK	**Subarctic Dwarf Scrub Dry Loamy Slopes** Both sites are on plain landforms. R236XY132AK is an ericaceous scrubland site on convex plain slopes. R236XY131AK is a tussock tundra, differentiated by the presence of permafrost and the microtopography created by frost heave and collapse.
R236XY140AK	**Subarctic Tussock Tundra Wet Loamy Plains** Both sites support tussock graminoids. R236XY140AK describes the tussock scrublands on non-permafrost eolian plain talfs. R236XY131AK describes mounded features with permafrost on these talfs and is identifiable by the microtopography created by frost mound heave and collapse.

Similar sites

R236XY130AK	**Subarctic Scrub Scrub Tundra Loamy Plains and Hills** Both sites support a mix of facultative to obligate wetland shrubs and graminoids. These sites are dominated by ericaceous shrubs on acidic soils. R236XY131AK is distinguished by the frost heave mound topography created by permafrost, which is not found in R236Xy130AK.
R236XY140AK	**Subarctic Tussock Tundra Wet Loamy Plains** Both sites support tussock cottongrasses. R236XY131AK is underlain with permafrost and experiences frost heave and collapse. R236XY140AK supports multiple communities based on a ponding regime not recorded in this site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Ledum palustre subsp. decumbens* (2) *Betula nana*
Herbaceous	(1) *Eriophorum vaginatum* (2) *Eriophorum russeolum*

Physiographic features

This site is in plain organic depressions and associated peat mounds. Elevation ranges from 10 to 960 feet above sea level. Slopes are nearly level to strongly sloped (1 – 12 percent). Ponding is a frequent, very long occurrence in concave areas, but is not observed on convex peat mounds. There is no flooding. This site is found at all aspects

Table 2. Representative physiographic features

Geomorphic position, flats	(1) Talf (2) Dip
Landforms	(1) Plains > Plain > Mound (2) Plains > Depression
Runoff class	Low to high

Flooding frequency	None
Ponding duration	Very long (more than 30 days)
Ponding frequency	None to frequent
Elevation	10–960 ft
Slope	1–12%
Water table depth	28–50 in
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Low to high
Flooding frequency	None
Ponding duration	Very long (more than 30 days)
Ponding frequency	None to frequent
Elevation	0–1,450 ft
Slope	1–12%
Water table depth	0–50 in

Climatic features

The climate of this site reflects that of the MLRA, which is described as maritime polar (EPA, 2013). Temperatures are moderated by the nearby Bristol Bay and norther Pacific bodies of water. Annual precipitation ranges from 21 – 34 inches with approximately 40 percent occurring during the June-September growing season (PRISM, 2018).

Table 4. Representative climatic features

Frost-free period (characteristic range)	75-100 days
Freeze-free period (characteristic range)	65-90 days
Precipitation total (characteristic range)	21-34 in
Frost-free period (actual range)	75-100 days
Freeze-free period (actual range)	65-90 days
Precipitation total (actual range)	15-41 in
Frost-free period (average)	90 days
Freeze-free period (average)	75 days
Precipitation total (average)	29 in

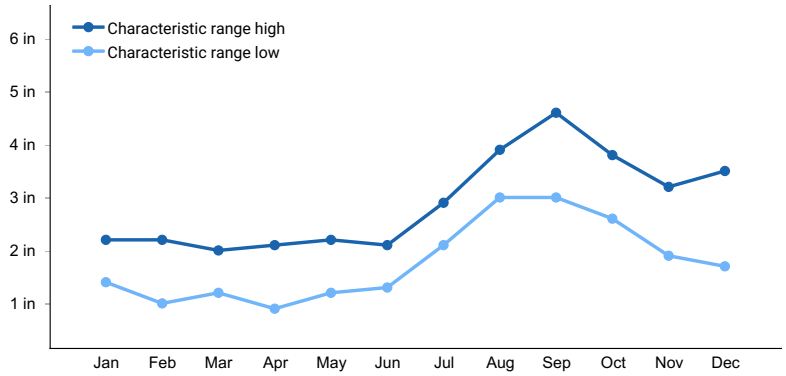


Figure 1. Monthly precipitation range

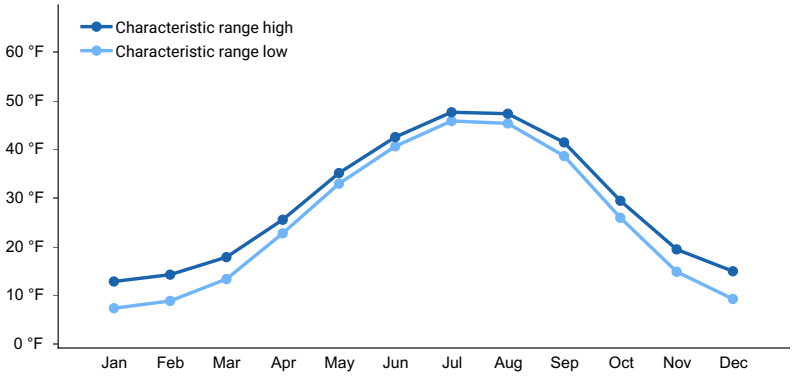


Figure 2. Monthly minimum temperature range

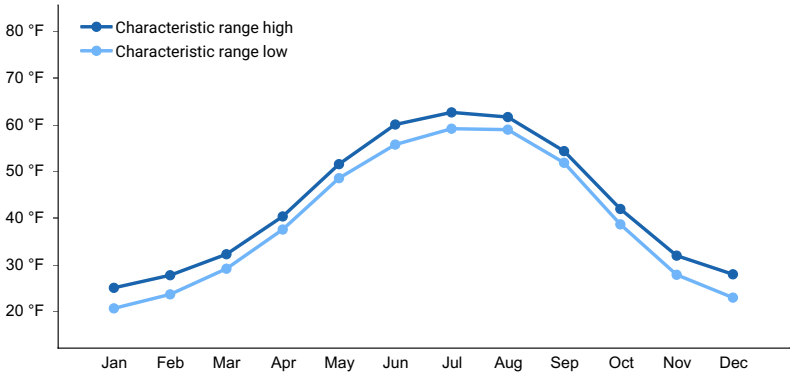


Figure 3. Monthly maximum temperature range

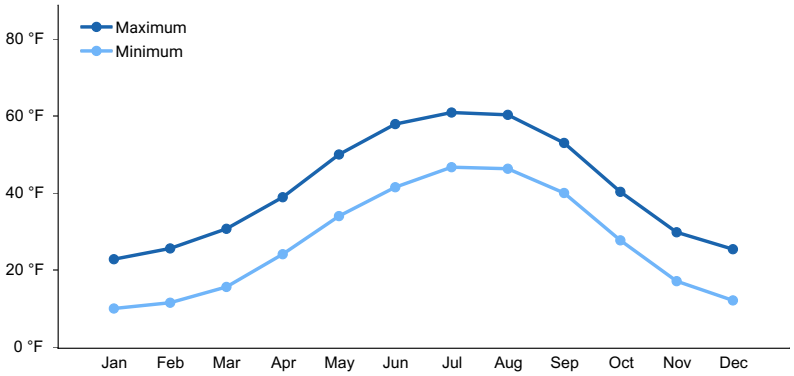


Figure 4. Monthly average minimum and maximum temperature

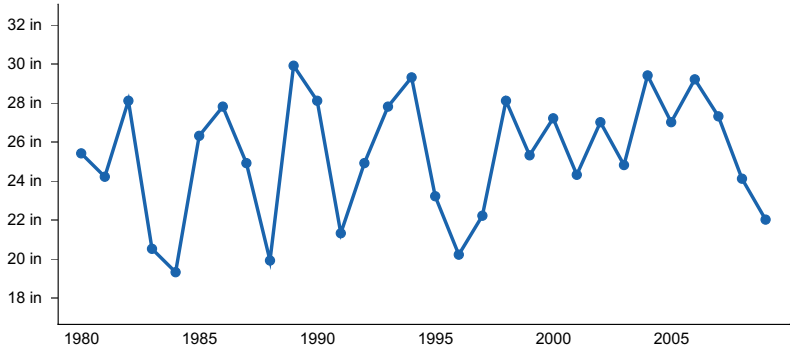


Figure 5. Annual precipitation pattern

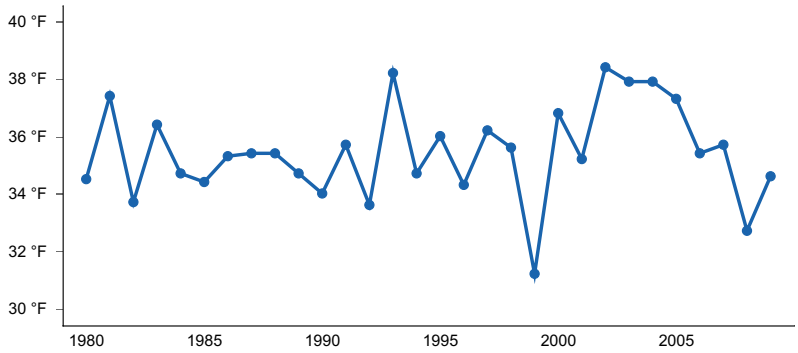


Figure 6. Annual average temperature pattern

Influencing water features

Ponding occurs in these concave plain depressions. Vegetation is primarily facultative to obligate wetland species in low areas. Peat mounds support less cover of wetland species. Water sources include precipitation, water flow in, snow melt, and seasonal ice melt. A water table is present throughout the year, perched above the impermeable permafrost layer.

Soil features

All soils are very cold, organic Gelisols with slow weathering processes (Soil Survey Staff, 2013). Soils are very deep and support a permafrost with a perched water table throughout the year. They support a gelic temperature regime. Parent material is organic material over coarse-silty loess.

Soils differ between concave, ponded areas and on frost-heaved peat mounds. Concave areas support a water table at the soil surface and aquic conditions above the permafrost. The slow breakdown of organic matter results in layered hemic materials above sapric soil materials. Vegetation is restricted by cold soil temperatures, aquic conditions, and relatively low nutrient availability.

Peat mounds also support permafrost, but at a relative lower depth. Cryoturbation is present in peat mounds. Vegetation on peat mounds is less restricted by soil hydrology than in ponded areas.

Correlated soil components in MLRA 236:
D36-Western maritime scrub organic peat mounds
D36-Western maritime tussock scrub organic depressions
Kumla
E36-Maritime scrub-sedge-gravelly frozen slopes
E36-Maritime tussock-scrub-ashy frozen slopes
E36-Maritime tussock-gravelly frozen till slopes
E36-Maritime tussock/scrub-silty frozen slopes
E36-Maritime tussock/scrub-silty frozen slopes
E36-Maritime scrub/sedge-organic frozen slopes

Table 5. Representative soil features

Parent material	(1) Mossy organic material (2) Loess
Surface texture	(1) Silt (2) Peat
Drainage class	Very poorly drained to moderately well drained
Permeability class	Very slow to moderate
Depth to restrictive layer	28–50 in
Soil depth	60 in

Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-10in)	1.8–2.2 in
Soil reaction (1:1 water) (0-10in)	5–5.5
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Table 6. Representative soil features (actual values)

Drainage class	Very poorly drained to moderately well drained
Permeability class	Very slow to moderate
Depth to restrictive layer	24–56 in
Soil depth	60 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-10in)	1.8–5.9 in
Soil reaction (1:1 water) (0-10in)	4–5.5
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

This site is on concave plain slopes. Soils are cold and organic Gelisols with permafrost between 28 and 50 inches, depending on location and community phase. Local site factors, including soil hydrology, soil temperature, and frost heave create two co-occurring vegetative communities.

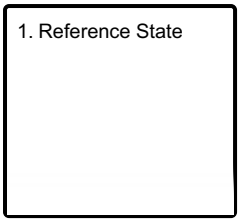
The reference plant community is a tussock tundra community. Low soil temperature supports permafrost with a perched water table at the soil surface throughout the growing season. Vegetation is restricted to primarily facultative wet to obligate wetland species. Frost heave raises the affected area, lowering the relative permafrost and water table. Hydrophytic vegetation is no longer favored and the community shifts to one comprised primarily of hardy, low shrubs. Cryoturbation is common in frost heave areas and can restrict deep-rooting plants.

Fire may occur on this site, though the natural fire interval is expected to be much longer (greater than 500 years) than the human management timescale. A post-fire community may be comprised of more herbaceous and graminoid species, but will likely return to the reference plant community within 25 years (Landfire, 2009).

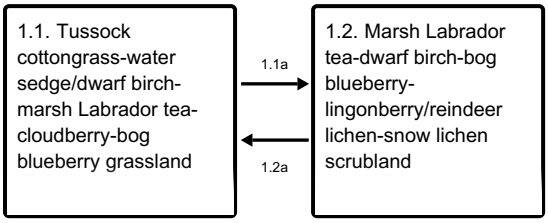
The information in this Ecological Dynamics section, including the state-and-transition model (STM), was developed based on current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

State and transition model

Ecosystem states



State 1 submodel, plant communities



1.1a - Frost heave.

1.2a - Frost heave collapse.

State 1
Reference State

The reference state supports two community phases, which are grouped by the structure and dominance of the vegetation (e.g., graminoids, shrubs, and lichens) and by their ecological function and stability. The reference community phase is represented by tussock grassland consisting of hydrophilic graminoids, low and dwarf shrubs, and mosses. The presence of these community phases is dictated temporally and spatially by frost heave and collapse of frost heaved areas. No alternate states have been observed.

Dominant plant species

- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- dwarf birch (*Betula nana*), shrub
- cloudberry (*Rubus chamaemorus*), shrub
- tussock cottongrass (*Eriophorum vaginatum*), grass
- red cottongrass (*Eriophorum russeolum*), grass
- water sedge (*Carex aquatilis*), grass

Community 1.1
Tussock cottongrass-water sedge/dwarf birch-marsh Labrador tea-cloudberry-bog blueberry grassland

Figure 7. Typical area of community 1.1.

Community Phase Canopy Cover

(Vegetation data in the table are provided as constancy (percent) and average canopy cover (percent) of the most dominant and ecologically relevant species for this community phase.)

Plant group	Common name	Scientific name	USDA plant code	Constancy (percent)	Average canopy cover (percent)
S	Dwarf birch	*Betula nana*	BENA	100	10
S	Marsh Labrador tea	*Ledum palustre* ssp. *decumbens*	LEPAD	98	15
S	Cloudberry	*Rubus chamaemorus*	RUCH	89	6
S	Bog blueberry	*Vaccinium uliginosum*	VAUL	85	8
S	Bog rosemary	*Andromeda polifolia*	ANPO	77	2
S	Bog cranberry	*Vaccinium oxycoccos*	VAOX	57	Trace
G	Tussock cottongrass	*Eriophorum vaginatum*	ERVA4	85	30
G	Water sedge	*Carex aquatilis*	CAAQ	55	5
G	Red cottongrass	*Eriophorum russeolum*	ERRU2	38	20
F	Roundleaf sundew	*Drosera rotundifolia*	DRRO	34	Trace
M	Sphagnum moss	*Sphagnum spp.*	SPHAG2^	53	40

^ Sphagnum mosses are identified to the genus level.

Figure 8. Constancy and canopy cover of plants in community 1.1.

The reference community phase is characterized by grassland consisting of hydrophilic graminoids and a rich mix of shrubs. Typically, this community consists of tussock cottongrass (*Eriophorum vaginatum*), water sedge (*Carex aquatilis*), red cottongrass (*Eriophorum russeolum*), and shrubs, including dwarf birch (*Betula nana*), marsh Labrador tea (*Ledum palustre* ssp. decumbens), cloudberry (*Rubus chamaemorus*), and bog blueberry (*Vaccinium uliginosum*). Other facultative or obligate wetland species include bog rosemary (*Andromeda polifolia*), bog cranberry (*Vaccinium oxycoccos*), and roundleaf sundew (*Drosera rotundifolia*). Sporadic, rare individual regenerative or medium white spruce (*Picea glauca*) trees are present. Mosses, mainly sphagnum mosses (Sphagnum spp.) are prevalent in the ground cover (about 35 percent total mean cover). The ground cover may also include lichens (about 25 percent cover), herbaceous litter (about 55 percent) and woody litter (about 1 percent). About 1 percent of the surface is covered with water. About 1 percent is bare soil.

Community 1.2
Marsh Labrador tea-dwarf birch-bog blueberry-lingonberry/reindeer lichen-snow lichen scrubland

Figure 9. Typical area of community 1.2.

Community Phase Canopy Cover

(Vegetation data in the table are provided as constancy (percent) and average canopy cover (percent) of the most dominant and ecologically relevant species for this community phase.)

Plant group	Common name	Scientific name	USDA plant code	Constancy (percent)	Average canopy cover (percent)
S	Marsh Labrador tea	*Ledum palustre* ssp. *decumbens*	LEPAD	100	15
S	Dwarf birch	*Betula nana*	BENA	100	10
S	Bog blueberry	*Vaccinium uliginosum*	VAUL	82	6
S	Lingonberry	*Vaccinium vitis-idaea*	VAVI	79	3
S	Cloudberry	*Rubus chamaemorus*	RUCH	75	7
S	Black crowberry	*Empetrum nigrum*	EMNI	64	8
G	Tussock cottongrass	*Eriophorum vaginatum*	ERVA4	68	20
L	Reindeer lichens	*Cladina spp.*	CLADI3^	61	35
L	Cup lichens	*Cladonia spp.*	CLADO3*	36	10

^ This does not include reindeer lichens (*Cladina spp.*) that were identified to the species level, including *Cladina arbuscula, Cladina rangiferina, Cladina stellaris,* and *Cladina stygia*.

* This does not include cup lichens (*Cladonia spp.*) that were identified to the species level, including *Cladonia uncialis* and *Cladonia alaskana*.

Figure 10. Constancy and canopy cover of plants in community 1.2.

This frost heave community phase is characterized by scrubland consisting of low and dwarf shrubs with lichens interspersed throughout. Overall productivity is hypothesized to be lower in this phase than in the reference community phase due to reduced richness and abundance of graminoids. Typically, this community consists of marsh Labrador tea (*Ledum palustre* ssp. decumbens), dwarf birch (*Betula nana*), bog blueberry (*Vaccinium uliginosum*), and tussock cottongrass (*Eriophorum vaginatum*). Other extant species include lingonberry (*Vaccinium vitis-idaea*), cloudberry (*Rubus chamaemorus*), bog rosemary (*Andromeda polifolia*), and red cottongrass (*Eriophorum russeolum*). Lichens are common in the ground cover (about 40 percent total mean cover). Reindeer lichens (Cladina spp.) and cup lichens (Cladonia spp.) typically are most abundant. Other ground cover commonly includes mosses (about 20 percent cover), herbaceous litter (about 35 percent), and woody litter (about 1 percent). About 1 percent is bare soil.

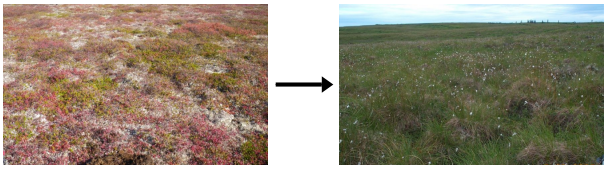
Pathway 1.1a
Community 1.1 to 1.2

Tussock cottongrass-water sedge/dwarf birch-marsh Labrador tea-cloudberry-bog blueberry grassland

Marsh Labrador tea-dwarf birch-bog blueberry-lingonberry/reindeer lichen-snow lichen scrubland

Frost heave raises the soil surface and lowers the relative water table. The influence of soil hydrology on vegetation lessens as depth to permafrost increases and the drainage class shifts from very poorly to moderately well drained. Total cover of hydrophytic herbaceous species lessens and canopy cover of low and dwarf ericaceous shrubs increases.

Pathway 1.2a
Community 1.2 to 1.1



Marsh Labrador tea-dwarf birch-bog blueberry-lingonberry/reindeer lichen-snow lichen scrubland

Tussock cottongrass-water sedge/dwarf birch-marsh Labrador tea-cloudberry-bog blueberry grassland

Frost heave collapse decreases depth to permafrost, increasing the water table to the soil surface. Soil hydrology becomes the major influencing factor on the vegetation and the plant community shifts to one comprised of facultative wet to obligate wetland species.

Additional community tables

Inventory data references

Modal points for Community 1.1
07CS00102
07CS01306
07DM00802
10SS13504

Modal points for Community 1.2
07SS04902
08AO06303
08LL06101
10TD09402
11SS02304

References

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Approval

Kirt Walstad, 2/13/2024

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	04/21/2016
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Foliar Cover

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:**