USDA Natural Resources Conservation Service

Ecological site F043CY502WA
Cool-Frigid, Dry-Xeric, Loamy Mountains (Douglas-fir Cool Dry Grass)

Last updated: 9/08/2023
Accessed: 05/19/2024

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): 043C–Blue and Seven Devils Mountains

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Description of MLRAs can be found in: United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

Available electronically at: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053624#handbook

LRU notes

Major land resource area (MLRA): 043C-Blue and Seven Devils Mountains
Modal LRU – 43C04 Dissected Basalt Highlands

This LRU is composed predominantly of mid-elevation slopes of foothills, mountains, and canyon walls. The soils tend to be loamy Argixerolls and Haploxerolls with minor ash influence in the surface layer.
Also found in LRU 43C01 - Cold, Moist Volcanic Highlands

Classification relationships

This ES group fits into the National Vegetation Standard's Central Rocky Mountains Douglas-fir - Ponderosa Pine / Herb WoodlandAlliance and Washington State's Natural Heritage Program's Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest.

Ecological site concept

Ecological Site Concept:
This ES is characterized by widely spaced, older mature Ponderosa pine (*Pinus ponderosa*) dominating the upper canopy layer, with both mature Douglas-fir (Pseutotsuga menziesii) and western larch (*Larix occidentalis*) in the mid-to upper layer(s) of the forest. Pinegrass (Calamagrosis rubescens) dominates the understory vegetation layer along with limited numbers of low growing shrub species. It is found on mid to high elevation mountain slopes, valley walls and ridges. Soils have loamy textures and are developed on material weathered from basalt with an admixture of loess and volcanic ash in the surface layer. The soils are generally moderately deep to hard basalt bedrock and are well drained.

Associated sites

F043CY503WA	**Frigid, Moist-Xeric Loamy, Canyons and Mountains (Grand fir/Moist Shrub)** frigid, moist-xeric, ashy surface, basalt/andesite geology.
F043CY504WA	**Warm-Frigid, Xeric, Loamy, Basalt Mountains and Plateaus (Douglas-fir/warm dry shrub)** warm-frigid, xeric, mixed ash surface, basalt geology.

Similar sites

F043CY508WA	**Frigid, Xeric, Loamy, Mountains and Plateaus, Mixed Ash Surface Grand fir/pinegrass** Mixed ash surface, xeric soil moisture regmie
F043CY509WA	**Frigid, Xeric, Loamy Mountains and Plateaus, Ashy Surface Grand fir/pinegrass** Ashy surface, xeric soil moisture regime
F043CY503WA	**Frigid, Moist-Xeric Loamy, Canyons and Mountains (Grand fir/Moist Shrub)** Moist-xeric soil moisture regime

Table 1. Dominant plant species

Tree	(1) *Pseudotsuga menziesii var. glauca* (2) *Pinus ponderosa*
Shrub	(1) *Spiraea betulifolia* (2) *Cercocarpus ledifolius*
Herbaceous	(1) *Calamagrostis rubescens* (2) *Carex geyeri*

Physiographic features

Physiographic Features
This ecological site occurs mainly on forested backslopes of mountains, ridges and steep valley walls. Parent materials are residuum and colluvium derived from basalt thinly mantled by mixed volcanic ash and loess.

Landscapes: Mountains,
Landforms: Mountain slope, Ridge, Valley Wall

Elevation:
Total range = 950 to 1910 m
(3,115 to 7,260 feet)
Central tendency = 1330 to 1910 m
(4,360 to 7,260 feet)

Slope (percent):
Total range = 0 to 100 percent
Central tendency = 35 to 60 percent

Water Table Depth:
>200 cm
(>80 inches)

Flooding:
Frequency: None
Duration: None

Ponding:
Frequency: None
Duration: None

Aspect:
Total range = 45-155-310

Central tendency = 90-155-210

Table 2. Representative physiographic features

Landforms	(1) Mountains > Mountain slope (2) Mountains > Ridge (3) Mountains > Valley side
Flooding frequency	None
Ponding frequency	None
Elevation	1,329–2,213 m
Slope	35–60%
Water table depth	0 cm
Aspect	E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	949–2,213 m
Slope	0–100%
Water table depth	0 cm

Climatic features

Climatic Features
During the spring and summer, a circulation of air around a high-pressure center brings a prevailing westerly and northwesterly flow of comparatively dry, cool and stable air into the region. As the air moves inland, it becomes warmer and drier which results in a dry season beginning in the late spring and reaching a peak in mid-summer. In the fall and winter, a circulation of air around two pressure centers over the ocean brings a prevailing southwesterly and westerly flow of air into the Pacific Northwest. This air from over the ocean is moist and near the temperature of the water. Condensation occurs as the air moves inland over the cooler land and rises along the windward slopes of the mountains or highlands. This results in a wet season beginning in October, reaching a peak in winter, then gradually decreasing in the spring.
The elevation within the LRU varies from approximately 1,500 feet in the lower river valleys to over 5,600 feet in the higher terrain. The annual precipitation increases from 14 inches in the valleys to over 60 inches over the higher mountains. Winter season snowfall varies from 30 to 50 inches. Both rainfall and snowfall increase in the higher elevations. Snow can be expected after the first of November and to remain on the ground from the first of December until March or April.
In January, the average maximum temperature is near 31° F and the minimum temperature is 18° F. Minimum temperatures from -10° to -20°F are recorded almost every winter and temperatures ranging to -30° F have been recorded. In July, the average maximum temperature is 85° to 90° and the minimum temperature 45° to 50° F. Maximum temperatures reach 100° F on a few afternoons each summer and temperatures between 105° to 110° F have been recorded. Temperatures in the mountains decrease three to five degrees Fahrenheit with each 1,000 feet increase in elevation. The average date of the last freezing temperatures can be expected by mid-May and before mid-October in the warmer areas.
(Compiled from WRCC: Climate of Washington and available station data)

Frost-free period (days):
Total range = 65 to 105 days
Central tendency = 70 to 105 days

Mean annual precipitation:
Total range = 425 to 1560 mm
(17 to 61 inches)

Central tendency = 850 to 1265 mm
(33 to 50 inches)
MAAT (C)
Total range = 4.4 to 9.3
(40 to 49 F)
Central tendency = 6.0 to 7.3
(43 to 45 F)
Climate stations: none

Table 4. Representative climatic features

Frost-free period (characteristic range)	70-105 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	838-1,270 mm
Frost-free period (actual range)	65-105 days
Freeze-free period (actual range)	
Precipitation total (actual range)	432-1,549 mm
Frost-free period (average)	90 days
Freeze-free period (average)	
Precipitation total (average)	1,067 mm

Influencing water features

Water Table Depth:
>200 cm
(>80 inches)

Flooding:
Frequency: None
Duration: None

Ponding:
Frequency: None
Duration: None

Soil features

Representative Soil Features
This ecological site is associated with the Larabee and Bolobin series. These soils are Vitrandic Argixerolls. They have loamy textures and are developed on material weathered from basalt with an admixture of loess and volcanic ash in the surface layer. The soils are generally moderately deep to hard basalt bedrock and are well drained.
Parent Materials:
Kind: Tephra (volcanic ash)
Origin: mixed
Kind: residuum, colluvium
Origin: basalt
Surface Texture: (<2mm fraction)
(1) Ashy Silt Loam
(2) Ashy Clay Loam

Table 5. Representative soil features

Parent material	(1) Volcanic ash (2) Residuum–basalt (3) Colluvium–basalt
Surface texture	(1) Ashy silt loam (2) Ashy clay loam
Drainage class	Well drained
Permeability class	Moderate
Depth to restrictive layer	56–109 cm
Soil depth	56–109 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	14.99 cm
Calcium carbonate equivalent (0-152.4cm)	0%
Electrical conductivity (0-152.4cm)	0 mmhos/cm
Sodium adsorption ratio (0-152.4cm)	0
Soil reaction (1:1 water) (0-152.4cm)	6.6
Subsurface fragment volume <=3" (25.4-152.4cm)	10%
Subsurface fragment volume >3" (25.4-152.4cm)	12%

Table 6. Representative soil features (actual values)

Drainage class	Well drained
Permeability class	Moderate
Depth to restrictive layer	51–152 cm
Soil depth	51–152 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	14.22–15.75 cm
Calcium carbonate equivalent (0-152.4cm)	0%
Electrical conductivity (0-152.4cm)	0 mmhos/cm
Sodium adsorption ratio (0-152.4cm)	0
Soil reaction (1:1 water) (0-152.4cm)	5.6–7.3
Subsurface fragment volume <=3" (25.4-152.4cm)	0–50%
Subsurface fragment volume >3" (25.4-152.4cm)	0–20%

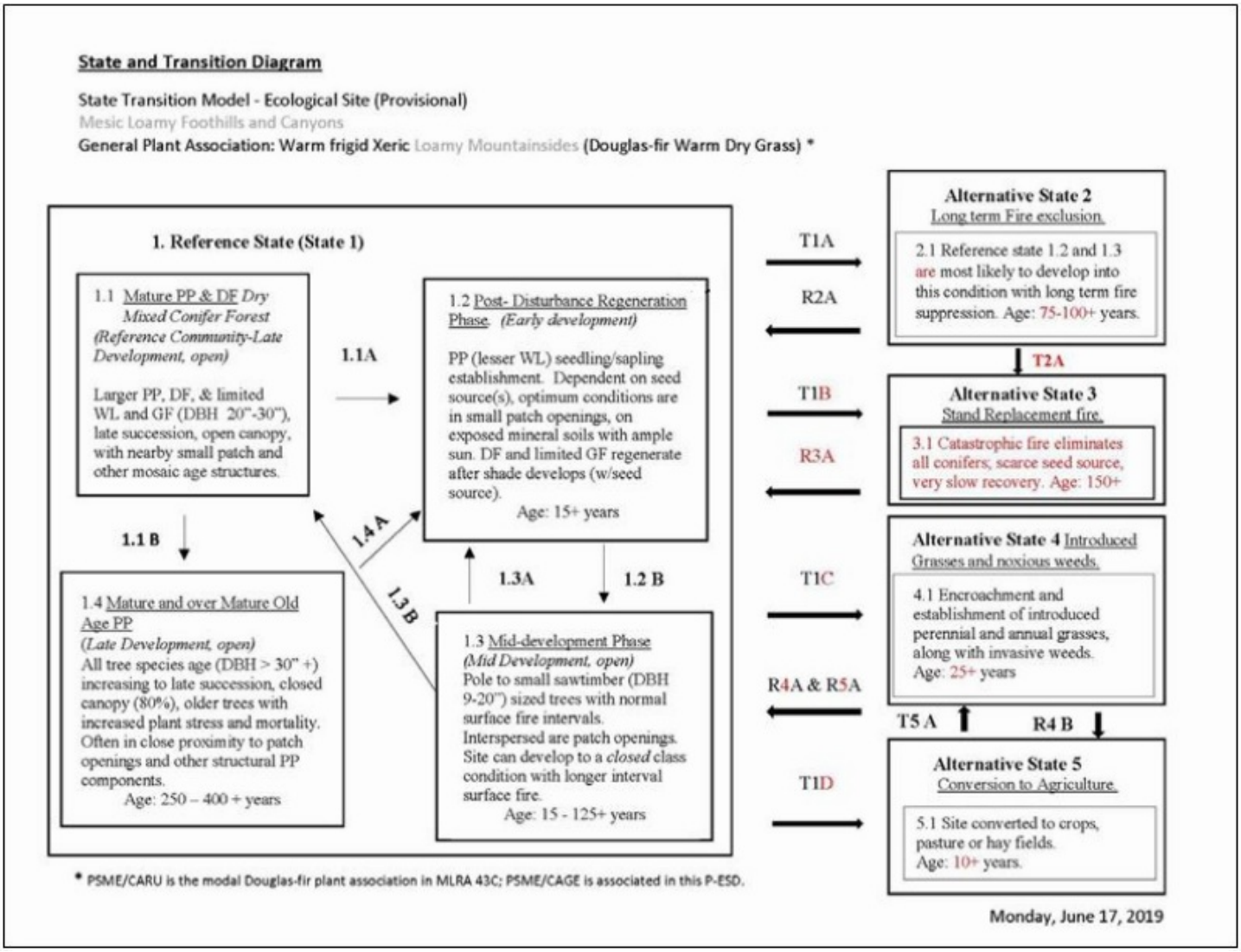
Ecological dynamics

ECOLOGICAL DYNAMICS OF THE SITE
An open stand structure characterized the late seral development state, which was the most extensive expression of this ecological site. In this representative stage, widely spaced, older mature1 Ponderosa pine (*Pinus ponderosa*) dominated the upper canopy layer, with both mature Douglas-fir (Pseutotsuga menziesii) and limited western larch (*Larix occidentalis*) in the mid-and upper layer(s) of the forest. Low severity ground fires were frequent, occurring at typical intervals of 2-35 years, which maintained these mature forests in a “park-like” appearance. Pinegrass (Calamagrosis rubescens) dominated the understory vegetation layer along with limited levels of low growing shrub species, kept in check from the impacts of the repetitive surface fires.
Some grand fir (*Abies grandis*) could be found reproducing and growing in shaded pockets on the moister sites, especially where ground fire had been absent for a longer period of time, but it was historically limited in expression over most of this ESD due to climatic limitations and long- term vulnerability to mortality from fire.
The Douglas-fir potential vegetation “series” (a series is named for the dominant fine scale climax tree species2) occupy positions which are transitional from the warmer, dryer Ponderosa pine (*Pinus ponderosa*) series, progressing to the moister and cooler grand-fir (Abis grandis) series. At this scale, vegetative transitions are often gradual in the absence of abrupt changes in soil types, aspect, or other features that exert strong influence on the expression of the potential natural plant community (PNC).
This ecological site encompasses two potential vegetation types (PVTs) of the series; the Douglas-fir/pinegrass (PSME/CARU) plant association which is the modal representation of the ESD, and the less extensive Douglas-fir/elk sedge (PSME/CAGE) plant association. These group of plant association(s) are collectively part of the extensive and broad “Dry Mixed Conifer Forest” group of the northwestern United States (this group also includes the warmer and drier Grand fir plant associations(s) with similar understory PVT identifiers).
This ecological site was characteristically maintained in an early to mid-seral condition by the influence of relatively frequent surface fires. Mixed and stand replacement fires are less frequent than surface fires, but they both occurred under natural historic conditions in this ecological site.
Ponderosa pine is the predominant early seral forested conifer species of the ecological site under pre-European historic conditions. Ponderosa pine, a long-lived species (averaging 300 and up to a 750-year life span), occurs in the early and mid-seral successional stage, and typically persists in the overstory into the climax ecological phase. Western larch is similar Ponderosa pine in terms of fire adaptation, longevity and seral status; however, it would occur less often in this ecological site due to moisture limitations. Historically grand fir would have been a minor component as it is susceptible to fire mortality throughout much of its growth stages, and it requires more favorable moisture/temperature conditions to flourish. However, the limited grand fir trees that were able to persist into older age and size would gain resistance to surface fire as their root systems grew deeper into the soil, and as their bark thickened, especially near the surface of the forest floor.
The increase in moisture for this ecological site (compared to the dryer Ponderosa pine series) allows Douglas-fir to establish under partial shade given an adequate seed source, with the natural progression in age and size classes under favorable conditions. In the late pole size class, typically around 40 years of age, Douglas-fir trees begin to acquire fire resistance similar to that of Ponderosa pine, due to the thick, corky bark that protects individual Douglas-fir trees from low intensity surface fires. Western larch has similar bark protection, and with open growing (i.e. low foliage crown volumes) that is less vulnerable to crown fire damage.
In addition to direct impacts of wildfire, abiotic disturbance factors that impacted all trees included injury from lightning strikes, wind events and, weather extremes (e.g. snow, ice and drought damage). Ponderosa pine suffers from injury or mortality from bark beetles, pine engraver, mistletoe, and other adapted insects and diseases. Douglas-fir is often killed or weakened by Douglas-fir beetle, wood borers, tussock moth and western spruce budworm.
These agents often cause “secondary effect” post-fire mortality when fire stresses, but does not outright kill, individual mature Douglas-fir. Endemic bark beetle produce patch mortality, whereas epidemic outbreaks typically cause larger scale mortality. Root disease, age, overstocking, and other biotic and abiotic stressors will also impact the health and wellbeing of individual Douglas-fir trees, often leading to mortality. Western larch is susceptible to damage from dwarf mistletoe, needlecast and various fungi. Larch casebearer, sawfly, spruce budworm and tussock moth are common defoliators.

Depending on the disturbance type and frequency, a landscape level mixture of open stands of fire-resistant trees was intermixed with various stand mosaics across the broader landscape (which would result in “patchy” and “clumpy” features). Progression to the late seral edaphic climax would be rare within the parameters of the pre-European fire regime. (In this ecological site Douglas-fir is considered as the climax species of the site).
Fire exclusion within the past 100 years (the Post-European period) has drastically changed the structural

expression of the present forest in this ecological site, resulting in an increase in the proportion of mid to late serial tree species, and corresponding in increases in crown density and continuity. Fuel loads have increased at all levels of present day stands.

State and transition model



Plant Community, Transition(s) and Restoration Pathways

Reference State:

(Refer again to Appendix 1 for tree-size classes)

1.1A – Small scale patch openings are created by biotic and abiotic disturbances which reduce or eliminate many of the structural overstory components and change the nature of the forest at this scale.
1.1B – Stand continues to progress in age and diameter size of the overstory dominant trees. Forest plant competition increases in the over-mature overstory.

Ground fire eliminates many of the newly established seedlings; this can occur multiple times within a short interval of successional development, maintaining Community Phase 1.2.
1.2B – Seedlings and saplings grow and develop to pole and small saw timer size class(s). 1.3A – Sapling and pole size young stand is killed by wildfire event.
1.3B – Stand grows to the mature/large sawtimber phase (> 20" DBH).
1.4A – Mixed severity fire or other significant scale disturbance event (i.e. biotic/abiotic injury induced mortality) occurs in the mature and over-mature overstory canopy.

Transitions:

T1A – Long term fire exclusion (50-100+) years (resulting in Alternative State 2).
T1B –A widespread catastrophic (also referred to as "stand replacing") fire event occurs as a natural (but relatively rare) event in any phase of the reference state. Approximately ¾ or more of the cone producing age conifer species are virtually eliminated across all age/size classes, potentially leading to a long-term deficiency of seed source(s) necessary for the re-establishment of the early seral Ponderosa pine and mid and late seral species (resulting in Alternative State 3).
T1C – Introduced cool season grasses invading sites near homesteads, pastureland, and other converted land. This includes cheatgrass invasion of overgrazed sites, as well as other excessive disturbance(s) of the native vegetation (resulting in Alternative State 4).
T1D – Site converted to annual cropland or pasture/hay land (leading to Alternative State 5).
T2A – Wide spread catastrophic fire occurs, similar to that of T1B, but the likelihood, intensity and impact of the wildfire event is much greater in scope due to the unnatural buildup of fuels in Alternative State 2 (this occurrence also results in the development of Alternative State 3).
T5A – Poor management or abandonment leads to weed invasion, often with noxious species (resulting in Alternative State 4).

Restoration Pathways:

R2A – Treatment practices commonly used to rehabilitate forest lands and reduce fuels is applied.
R3A – Afforestation (planting Ponderosa pine and Douglas-fir) is applied. Native fire adapted understory species rebound naturally.

References

Powell, D.C., C.G. Johnson, E.A. Crowe, A. Wells, and D.K. Swanson. 2007. Potential vegetation hierarchy for the Blue Mountains section of northeastern Oregon, southeastern Washington, and west-central Idaho. Gen. Tech.

Rep. PNW-GTR-709.. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station., Portland, OR.

Other references

USNVC [United States National Vegetation Classification]. 2020. United States National Vegetation Classification Database, V2.03. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC. USNVC: http://usnvc.org/

Contributors

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Approval

Kirt Walstad, 9/08/2023

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	05/19/2024
Approved by	Kirt Walstad
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:

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17. **Perennial plant reproductive capability:**
