Ecological site R010XA023OR Juniper Shrubby Lava Blisters 10-12 PZ

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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.

MLRA notes

Major Land Resource Area (MLRA): 010X–Central Rocky and Blue Mountain Foothills

This MLRA is characterized by gently rolling to steep hills, plateaus, and low mountains at the foothills of the Blue Mountains in Oregon and the Central Rocky Mountains in Idaho. The geology of this area is highly varied and ranges from Holocene volcanics to Cretaceous sedimentary rocks. Mollisols are the dominant soil order and the soil climate is typified by mesic or frigid soil temperature regimes, and xeric or aridic soil moisture regimes. Elevation ranges from 1,300 to 6,600 feet (395 to 2,010 meters), increasing from west to east. The climate is characterized by dry summers and snow dominated winters with precipitation averaging 8 to 16 inches (205 to 405 millimeters) and increasing from west to east. These factors support plant communities with shrub-grass associations with considerable acreage of sagebrush grassland. Big sagebrush, bluebunch wheatgrass, and Idaho fescue are the dominant species. Stiff sagebrush, low sagebrush, and Sandberg bluegrass are often dominant on sites with shallow restrictive layers. Western juniper is one of the few common tree species and since European settlement has greatly expanded its extent in Oregon. Nearly half of the MLRA is federally owned and managed by the Bureau of Land Management. Most of the area is used for livestock grazing with areas accessible by irrigation often used for irrigated agriculture.

Ecological site concept

This ecological site occurs on exposed lava flows and lava blisters or small knolls dispersed across nearly level basalt lava plains, overlain by eolian pumice sands. Elevations range from 2,500 to 4,000 feet (750 to 1,200 meters) and slopes range from 0 to 10 percent but is typically less 3 percent. The soils associated with this site are shallow to very shallow to bedrock, and commonly interspersed with rock outcrop. The soil climate is mesic (soil temperature regime) and aridic (soil moisture regime). The reference plant community is characterized by an overstory of old growth western juniper, which are over 150 years old and express old growth morphological and structural characteristics. Spacing of trees is variable based on the amount of soil and rock. The understory is sparse. It is dominated by mountain big sagebrush, antelope bitterbrush, and bluebunch wheatgrass, with widely varying amounts of other grasses such as Sandberg bluegrass, Thurber's needlegrass and Idaho fescue. Idaho fescue commonly dominates under the trees and within influence of the tree crowns. Pockets of deeper soils with coarser surface textures also provide a niche for needlegrasses and Indian ricegrass.

Associated sites

R010XA009OR	**Juniper Shrubby Pumice Flat 10-12 PZ** Occurs in complex with this site on adjacent lava plains. Pumice sand mantle is moderately deep to deep to bedrock.

Similar sites

R010XA022OR	**Juniper Lava Blisters 8-10 PZ** Lower precipitation and production. Understory dominated by big sagebrush, bluebunch wheatgrass, and Sandberg bluegrass.

Table 1. Dominant plant species

Tree	(1) *Juniperus occidentalis*
Shrub	(1) *Artemisia tridentata ssp. vaseyana* (2) *Purshia tridentata*
Herbaceous	(1) *Pseudoroegneria spicata ssp. spicata*

Physiographic features

This site occurs on exposed lava flows and lava blisters or small knolls dispersed across lava plains. Slopes range from 0 to 10 percent. Elevations range from 2,500 to 4,000 feet.

Table 2. Representative physiographic features

Landforms	(1) Lava plain > Lava plateau
Flooding frequency	None
Ponding frequency	None
Elevation	760 – 1,220 m
Slope	0 – 10 %
Aspect	Aspect is not a significant factor

Climatic features

The annual precipitation ranges from 10 to 12 inches which occurs mainly between the months of October and June, mostly in the form of rain and snow. The average annual air temperature is 48 degrees F. with extreme temperatures ranging from -27 to 105 degrees F. The frost free period is 40 to 90 days. The optimum period for plant growth is from late March through June.

Table 3 Representative climatic features

Frost-free period (characteristic range)	50 days
Freeze-free period (characteristic range)	100 days
Precipitation total (characteristic range)	250-310 mm
Frost-free period (actual range)	50 days
Freeze-free period (actual range)	100 days

Precipitation total (actual range)	250-310 mm
Frost-free period (average)	50 days
Freeze-free period (average)	100 days
Precipitation total (average)	280 mm

- (1) BEND 7 NE [USC00350699], Bend, OR

Influencing water features

This site is not associated with riparian or wetland features.

Soil features

The soils of this site are shallow or very shallow to basalt bedrock and are commonly associated with rock outcrops. They are formed from eolian deposited pumice ash, primarily derived from Mt. Mazama. They are typically well drained and have an ashy sandy loam texture throughout the profile. They are generally found on lava flows which have created a very uneven land surface. Volcanic ash soil fills rock fractures and pockets on the lava in which plants take root. Herbaceous vegetation primarily occupies the areas with soil. Juniper trees and some shrubs are able to penetrate cracks in the bedrock, allowing trees to also occupy the associated rock outcrops. Permeability is moderately rapid to rapid and the available water holding capacity is 1.5 to 3 inches for the profile. The potential for wind erosion is high. Soil temperature regime is mesic. Soil moisture regime is aridic.

Table 4. Representative soil features

Parent material	(1) Volcanic ash (2) Residuum – basalt
Surface texture	(1) Stony, ashy sandy loam (2) Ashy sandy loam (3) Cobbly, ashy loamy sand
Family particle size	(1) Loamy (2) Ashy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately rapid to rapid
Soil depth	30 – 50 cm

Surface fragment cover <=3"	0 – 20 %
Surface fragment cover >3"	10 – 50 %
Available water capacity (0-50.8cm)	3.81 – 7.62 cm
Calcium carbonate equivalent (Depth not specified)	Not specified
Electrical conductivity (0-50.8cm)	Not specified
Sodium adsorption ratio (0-50.8cm)	Not specified
Soil reaction (1:1 water) (0-50.8cm)	6.6 – 7.8
Subsurface fragment volume <=3" (0-50.8cm)	0 – 10 %
Subsurface fragment volume >3" (0-50.8cm)	0 – 20 %

Ecological dynamics

This site occurs on exposed lava flows and lava blisters or small knolls dispersed across nearly level basalt lava plains, overlain by eolian pumice sands and supports a juniper woodland plant community. These woodlands are characterized by old growth western juniper, which are over 150 years old and express old growth morphological and structural characteristics. The understory is sparse. It is dominated by mountain big sagebrush, antelope bitterbrush, and bluebunch wheatgrass, with widely varying amounts of other grasses such as Sandberg bluegrass, Thurber's needlegrass and Idaho fescue. Idaho fescue commonly dominates under the trees and within influence of the tree crowns. Pockets of deeper soils with coarser surface textures also provide a niche for needlegrasses and Indian ricegrass.

Woodland ecological sites existing on these eolian-volcanic sands collectively represent the most extensive old growth western juniper woodlands within the range of the species (Waichler et al. 2001). Trees in this region have been aged at over 1,600 years old and standing snags have been dated back to 100 BC. When compared to younger trees, old growth trees have a more rounded canopy shape with limited leader growth, deep vertical furrows in their bark, rot pockets, cavities, abundant arboreal lichen cover, and changing branch structure, including large basal branches. These woodlands have evolved over centuries and are relatively stable, resulting in the accumulation of dead wood in the form of snags, dead branches in live trees, logs, and weathered stumps (RMRS-GTR-403, pg 57). It also predominately stays aloft throughout the decay process, deteriorating more through abiotic weathering than biotic decomposition; greatly limiting contributions to soil organic matter and nitrogen pools (Waichler et al. 2001).

Western juniper is highly susceptible to fire, so old growth juniper woodlands are often isolated in fire resistant locations such as “rock outcrops, knolls, ridges, and/or soils that are shallow, coarse, rocky, and often high in clay or sand” (RMRS-GTR-403, pg 57). This site occurs on pressure ridges of basalt lava flows overlain with shallow to very shallow pumice ash, primarily derived from Mt. Mazama. Soils on this site are commonly intermixed with rock outcrops. The juniper can penetrate the fractures in the lava bedrock allowing it to occupy both these shallow soils and the associated rock outcrops. The soils on this site are geologically young; less than 7,000 years old, and primarily course pumice sands with limited pedogenic development. The amount of rock exposure and low productivity in the understory makes this site very fire resistant, so any fire events are typically contained to one or several trees. Stand replacement fires and mixed-severity fires were historically rare (return intervals measured in centuries) (Tech Bulletin 152, 2005, pg 21 and RMRS-GTR-403, pg 112); meaning climatic conditions, such as severe drought, are the primary influence on tree mortality and establishment and understory dynamics.

While soils are shallow and soil textures are coarse, the soil particles themselves are porous and can hold water in addition to the capillary water of the profile. Some of this water is plant available, greatly increasing the available water capacity (AWC) of the soil compared to non-pumice soils with similar textures. (Ecological Provinces, SR 990, pg 89). These pumice soils also have high albedo. The light color on the surface absorbs less sunlight and thus keeps the soil cooler than soils with darker A horizons. The porous nature of these soils also makes them very insulating, moderating subsurface temperatures, and keeping them cooler longer into the growing season. These unique characteristics result in a diverse species composition in the understory community that is typically more common on cooler, wetter, higher production sites. Spatial distribution of these understory species is further influenced by the size of the pumice sands. Redistribution of the pumice ash by wind resulted in varying surface textures across the site. The courser sands favor the needlegrasses, while the finer sands favor other species like bluebunch wheatgrass and Idaho fescue.

Paleobotany and Climate:
Western juniper first arrived in its current geographical range in Central Oregon between 4,800 to 6,600 years ago, during the mid Holocene era. Cool and moist conditions 4,000 to 3,000 years ago favored tree growth, cone production and seedling establishment, resulting in rapid expansion; Western juniper reached its prehistoric maximum across most of its present-day range during this period. A subsequent warm period 2,500 to 3,000 years ago caused severe droughts, major fires, and regional declines in western juniper stands. With the onset of the Little Ice Age conditions again became cooler and wetter and pollen records indicate juniper again began to gradually increase to its current range. (RMRS-GTR-403, pg 102, 103). Under a natural disturbance regime, climate is the primary driver of juniper distribution and persistence, particularly in juniper woodlands. It directly influences seed production, seedling establishment, and plant mortality while also influencing other disturbances such as fire, competition, insects, and disease. (RMRS-GTR-403, pg 123)

Cool, moist conditions favor juniper expansion, while severe or extended drought and warmer conditions cause tree stress and mortality (RMRS-GTR-403, pg 102). Some mortality is the direct result of drought stress, while some trees succumb to secondary disturbances due to reduced vigor. Old trees are susceptible to heart-rots, which target the heartwood of the trunk and large limbs. Heart-rots rarely kill the tree but can structurally weaken them. Stressed trees are also more susceptible to mistletoe infestations and insects. In spite of vulnerabilities, western juniper is very resistant to many pressures. Overall, tree mortality in old growth juniper woodlands is typically low (RMRS-GTR-403, pg 42 to 48); estimated at less than one percent per century (RMRS-GTR-403, pg 111).

Western Juniper Woodland Infill:
While old growth juniper woodlands are relatively stable, they are not static. They have historically experienced cycles of infill and mortality in response to climatic conditions. With the end of the Little Ice Age in the 1850s, evidence suggests these woodlands were slowly expanding and infilling. Rate of infill throughout the Great Basin greatly accelerated in the late 1800s, peaking in the early 1900s. Infill rates slowed with the onset of widespread severe droughts starting in the 1920s. This acceleration coincides with a significant rise in settlement throughout the Intermountain West and is attributed to a combination of factors including climate, grazing, altered fire regimes, and increased CO2 levels (RMRS-GTR-403, pg 83, 104).

Woodland infill, precipitated by the end of the Little Ice Age, coincided with a time of rapid settlement and introduction of livestock grazing in the Great Basin, altering understory dynamics and fire behavior. Wetter periods, as were experienced during this timeframe, typically result in the accumulation of fine fuels (RMRS-GTR-403, pg 83). In addition to effects increased understory vegetation has on fire cycles, paleobotany literature suggests competition with herbaceous vegetation may limit tree seedling establishment and/or result in thinning. This indicates a robust understory can provide some competition to juniper establishment, limiting infill (RMRS-GTR-403, pg 112). Large numbers of domestic livestock grazing during this period prevented fine fuel accumulation and areas of heavy grazing would have resulted in understory plant stress. Without fire or competition, young juniper trees were able to rapidly establish.

Carbon dioxide (CO2) levels have also increased since the end of the Little Ice Age. Increased CO2 can increase water use efficiency in conifers relative to herbaceous species, resulting in faster tree growth and denser canopies (RMRS-GTR-403, pg 119). As climate conditions became warmer and drier in the early 1900s, expansion and infill slowed but still exceeded historic rates under similar conditions. This suggests CO2 concentrations and reduced competition from perennial grasses could be playing a significant role in current woodland expansion (RMRS-GTR-403, pg 121 and 123). These factors have resulted in altered stand structure in many persistent woodlands.

Infill trees compete with understory vegetation for water and other resources. Shrubs decline as trees increase in dominance, with sagebrush being highly sensitive to tree competition. Bitterbrush and Idaho fescue will persist longer as infill progresses, in part due to their superior shade tolerance relative to other species but will also eventually be removed from the site. (RMRS-GTR-403, pg 52; Miller et al., 2000). Herbaceous species are more resistant to tree competition, but also decline with increased tree dominance. Microclimate conditions under old growth trees shelter Idaho fescue, so interspace species are the first to decline. Understory decline is accelerated when plants are stressed by other disturbances such as drought, heavy grazing, or recreational use (RMRS-GTR-403, pg 48 to 55).

Rate of infill on this site is slower than adjacent sites with deeper soils due to limited site resources, and density of infill trees is highly variable based on resource availability associated with soil depth and number of rock outcrops. However, with time, trees have the potential to dominate site resources and deplete understory species.

Non-Native Species:
If the native plant understory experiences stress and mortality, there is greater opportunity for establishment of non-native species and native increasers. This site is susceptible to cheatgrass, an invasive annual grass, and introduced annual forbs like pale madwort (Alyssum alyssoides). Medusahead and Ventenata dubia are not a concern on this site, as they typically do not establish in these coarse textured pumaceous soils. With repeated disturbance, sprouting shrubs (e.g. rabbitbrush species) and forbs (e.g. granite prickly phlox, Linanthus pungens and tansymustard Descurainia sp.) also increase and fill open spaces in the understory.

Over time, this can create fuel continuity that is atypical of old growth woodlands, making this site more prone to fire. Fires become more frequent and widespread. Higher tree densities from juniper infill also creates ladder fuels, making old trees more susceptible to fire, leading to more stand-replacing fires. (RMRS-GTR-403, pg 115). Recurring fires favor re-establishment of annual and sprouting species over native perennial grasses and shrubs, thereby perpetuating the fire cycle.

Resilience Management:
Within the natural range of variability under a normal distribution regime this site is resistant to disturbance, but has low resilience when disturbance occurs. Physiographic characteristics including proximity to rock outcrops, shallow soils, and low fine fuel loads make this site very fire resistant. The site is also capable of withstanding extended drought with limited plant mortality. Disturbances outside of shifts in climate are not common, resulting in a very stable site.

When disturbance occurs outside the normal range of variability the plant community shifts quickly and is very susceptible to invasion by non-native annual species. This low resilience is a result of the site’s limited resources (arid soil moisture regime and sandy soils) and warmer climate (mesic soil temperature regime). Changes in disturbance regimes of surrounding sites also jeopardize this site. The adjacent sites are highly susceptible to infill and encroachment of juniper. Infill across sites creates fuel continuity at a landscape scale and increases the probability of large scale fires that carry through previously fire resistant sites.

State and transition model

Figure 7. Photo courtesy of Dr. Richard Miller

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Bunchgrasses**			336-628	
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	196-275	–
	Idaho fescue	FEID	*Festuca idahoensis*	39-118	–
	Sandberg bluegrass	POSE	*Poa secunda*	39-118	–
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	39-78	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	11-22	–
	western needlegrass	ACOC3	*Achnatherum occidentale*	11-17	–
2	**Other Perennial Grasses/Grasslikes**			0-78	
	prairie Junegrass	KOMA	*Koeleria macrantha*	0-17	–
	needle and thread	HECO26	*Hesperostipa comata*	0-17	–
	squirreltail	ELEL5	*Elymus elymoides*	0-17	–
	Ross' sedge	CARO5	*Carex rossii*	0-17	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0-17	–
Forb					
3	**Perennial Forbs**			28-56	
	slender buckwheat	ERMI4	*Eriogonum microthecum*	17-39	–

	spiny phlox	PHHO	*Phlox hoodii*	11-17	–
4	**Other Perennial Forbs**			0-56	
	lecidea lichen	LEPU11	*Lecidea pumicicola*	0-17	–
	buckwheat	ERIOG	*Eriogonum*	0-11	–
	fleabane	ERIGE2	*Erigeron*	0-11	–
	common yarrow	ACMI2	*Achillea millefolium*	0-11	–
	pussytoes	ANTEN	*Antennaria*	0-11	–
	milkvetch	ASTRA	*Astragalus*	0-11	–
Shrub/Vine					
5	**Shrubs**			78-157	
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	39-78	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	39-78	–
6	**Other Shrubs**			0-17	
	wax currant	RICE	*Ribes cereum*	0-8	–
	desert gooseberry	RIVE	*Ribes velutinum*	0-8	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0-8	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0-8	–
Tree					
7	**Tree**			39-78	
	western juniper	JUOC	*Juniperus occidentalis*	39-78	–

Table 6. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 7. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 8. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 9. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 10. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 11. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 12. Community 4.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 13. Community 4.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Animal community

The unique morphological structure of old growth western juniper trees including hollows and cavities provide habitat for cavity nesting birds. A study in Central Oregon found cavity nesting birds were 2.7 times more abundant in old growth juniper woodlands than post settlement stands (Waichler et al. 2001).

Hydrological functions

The soils of this site have high infiltration rates and low runoff potential.

Inventory data references

Prineville District BLM Ecological Site Inventory NASIS component and pedon data Range Site Descriptions Field knowledge of range-trained personnel

Other references

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Miller, Richard F.; Chambers, Jeanne C.; Evers, Louisa; Williams, C. Jason; Snyder, Keirith A.; Roundy, Bruce A.; Pierson, Fred B. 2019. The ecology, history, ecohydrology, and management of pinyon and juniper woodlands in the Great Basin and Northern Colorado Plateau of the western United States. Gen. Tech. Rep. RMRS-GTR-403. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 284 p.

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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)	Jeff Repp and Bruce Franssen
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Date	04/24/2003

Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** **None to some.**

2. **Presence of water flow patterns:** **None to some.**

3. **Number and height of erosional pedestals or terracettes:** **None.**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** **10 - 20%**

5. **Number of gullies and erosion associated with gullies:** **None.**

6. **Extent of wind scoured, blowouts and/or depositional areas:** **None to some.**

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

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** **Moderately to slightly resistant to erosion: aggregate stability = 2-4.**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** **Shallow and very shallow, well drained, sandy loams and stony loamy sands dominated by volcanic ash: Weak thin and medium platy to single grain structure, dry color value of 5, 3-4 inches thick; Low OM (1-2%).**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** **Moderate ground cover (40-50%) and slight to severe slopes (0-15% with some as high as 60% on sides of**

blisters) moderately limit rainfall impact and overland flow.

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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): None.**

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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: Perennail, deep-rooted bunch-grasses

    Sub-dominant: Evergreen shrubs = deciduous shrubs

    Other: Evergreen trees = perennial forbs > other shrubs

    Additional:

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

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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): Favorable: 900, Normal: 700, Unfavorable: 500 lbs/acre/year.**

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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: Cheatgrass and Medusahead invade sites that have lost deep rooted perennial grass functional groups.**

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17. **Perennial plant reproductive capability: All species should be capable of reproducing annually.**
