USDA Natural Resources Conservation Service

Ecological site R028AY107NV SALINE FLOODPLAIN

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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.

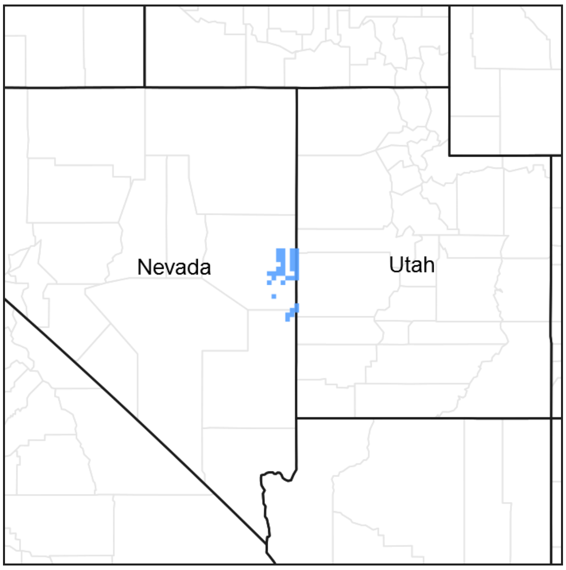

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 028A–Ancient Lake Bonneville

MLRA 28A occurs in Utah (82%), Nevada (16%), and Idaho (2%). It makes up about 36,775 square miles. A large area west and southwest of Great Salt Lake is a salty playa. This area is the farthest eastern extent of the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. It is an area of nearly level basins between widely separated mountain ranges trending north to south. The basins are bordered by long, gently sloping alluvial fans. The mountains are uplifted fault blocks with steep side slopes. They are not well dissected because of low rainfall in the MLRA. Most of the valleys are closed basins containing sinks or playa lakes. Elevation ranges from 3,950 to 6,560 ft. in the basins and from 6,560 to 11,150 ft. in the mountains. Most of this area has alluvial valley fill and playa lakebed deposits at the surface. Great Salt Lake is all that remains of glacial Lake Bonneville. A level line on some mountain slopes indicates the former extent of this glacial lake. Most of the mountains in the interior of this area consist of tilted blocks of marine sediments from Cambrian to Mississippian age. Scattered outcrops of Tertiary continental sediments and volcanic rocks are throughout the area. The average annual precipitation is 5 to 12 ins. in the valleys and is as much as 49 ins. in the mountains. Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The driest period is from midsummer to early autumn. Precipitation in winter typically occurs as snow. The average annual temperature is 39 to 53 °F. The freeze-free period averages 165 days and ranges from 110 to 215 days, decreasing in length with elevation. The dominant soil orders in this MLRA are Aridisols, Entisols, and Mollisols. The soils in the area dominantly have a mesic or frigid soil temperature regime, an aridic or xeric soil moisture regime, and mixed mineralogy. They generally are well drained, loamy or loamy-skeletal, and very deep.

Ecological site concept

This site occurs on alluvial flats. Slope gradients of 0 to 2 percent are typical. Elevations are 5400 to about 5600 feet.
The climate associated with this site is semiarid, characterized by cool, moist winters and warm, dry summers. Average annual precipitation is (6)8 to about 10 inches. Mean annual air temperature is 45 to 50 degrees F. The average growing season is about 100 to 140 days.
The soils associated with this site are very deep and well drained. The soils have formed in alluvium derived from of mixed rock sources. These soils are highly calcareous with moderate to high accumulation of salts throughout the soil profile. Runoff is low to medium and ponding may occur for brief periods in the spring. Water intake rates are slow and the available water capacity is very low to moderate.
The reference state is dominated by fourwing saltbush and basin wildrye. Black greasewood and alkali sacaton are other important species associated with this plant community. Production ranges from 900 to 1700 pounds per acre.

Associated sites

R028AY008NV	**SODIC TERRACE 8-10 P. Z.**
R028AY024NV	**SODIC TERRACE 5-8 P.Z.**
R028AY037NV	**VALLEY WASH**

Similar sites

R028AY025NV	**DRY FLOODPLAIN** ATCA2 minor shrub, if present; ARTR2 dominant shrub
R028AY037NV	**VALLEY WASH** occurs within defined channels; not a stable plant community
R028BY005NV	**SANDY 8-10 P.Z.** ATCA2 minor shrub, if present

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Atriplex canescens*
Herbaceous	(1) *Leymus cinereus*

Physiographic features

This site occurs on alluvial flats. Slope gradients of 0 to 2 percent are typical. Elevations are 5400 to about 5600 feet.

Table 2. Representative physiographic features

Landforms	(1) Alluvial flat
Flooding duration	Brief (2 to 7 days)
Flooding frequency	Occasional
Ponding duration	Brief (2 to 7 days)
Ponding frequency	Occasional
Elevation	1,646–1,707 m
Slope	0–2%
Ponding depth	8 cm
Aspect	Aspect is not a significant factor

Climatic features

Nevada’s climate is predominantly arid, with large daily ranges of temperature, infrequent severe storms, heavy snowfall in the higher mountains, and great location variations with elevation. Three basic geographical factors largely influence Nevada’s climate: continentality, latitude, and elevation. Continentality is the most important factor. The strong continental effect is expressed in the form of both dryness and large temperature variations. Nevada lies on the eastern, lee side of the Sierra Nevada Range, a massive mountain barrier that markedly influences the climate of the State. The prevailing winds are from the west, and as the warm moist air from the Pacific Ocean ascend the western slopes of the Sierra Range, the air cools, condensation occurs and most of the moisture falls as precipitation. As the air descends the eastern slope, it is warmed by compression, and very little precipitation occurs. The effects of this mountain barrier are felt not only in the West but throughout the state, with the result that the lowlands of Nevada are largely desert or steppes. The temperature regime is also affected by the blocking of the inland-moving maritime air. Nevada sheltered from maritime winds, has a continental climate with well-developed seasons and the terrain responds quickly to changes in solar heating.
Nevada lies within the mid-latitude belt of prevailing westerly winds which occur most of the year. These winds bring frequent changes in weather during the late fall, winter and spring months, when most of the precipitation occurs. To the south of the mid-latitude westerlies, lies a zone of high pressure in subtropical latitudes, with a center over the Pacific Ocean. In the summer, this high-pressure belt shifts northward over the latitudes of Nevada, blocking storms from the ocean. The resulting weather is mostly clear and dry during the summer and early fall, with scattered thundershowers. The eastern portion of the state receives significant summer thunderstorms generated from monsoonal moisture pushed up from the Gulf of California, known as the North American monsoon. The monsoon system peaks in August and by October the monsoon high over the Western U.S. begins to weaken and the precipitation retreats southward towards the tropics (NOAA 2004).
The climate associated with this site is semiarid, characterized by cool, moist winters and warm, dry summers. Average annual precipitation is (7)8 to about 10 inches. Mean annual air temperature is 45 to 50 degrees F. The average growing season is about 100 to 140 days.

Mean annual precipitaion at the LUND, NEVADA climate station (264745) is 10.04 inches.

January 0.78; February 0.85; March 1; April 0.98:
May 0.95; June 0.82; July 0.69; August 0.87;
September 0.77; October 0.92; November 0.69;
December 0.73.

Table 3. Representative climatic features

Frost-free period (average)	0 days
Freeze-free period (average)	120 days
Precipitation total (average)	229 mm

Influencing water features

This site receives run-in moisture from adjacent landscapes.

Soil features

The soils associated with this site are very deep and well drained. The soils have formed in alluvium derived from of mixed rock sources. These soils are highly calcareous with moderate to high accumulation of salts throughout the soil profile. Runoff is low to medium and flooding and ponding may occur for brief periods in the spring. Water intake rates are slow and the available water capacity is very low to moderate. The soil series associated with this site include: Slaw and Threedogs.

The representative soil series is Threedogs, a Fine-silty, mixed, superactive, mesic Typic Calciargids. Diagnostic horizons include an Ochric epipedon from the soil surface to 12 inches, an argillic horizon from 12 to 35 inches, and a calcic horizon from 35 to 71 inches. Clay content in the particle control section averages 27 to 35 percent. Rock fragments range from 0 to 5 percent. Reaction is moderately to very strongly alkaline. Effervescence is violently effervescent. Lithology consists of limestone and welded tuff.

Table 4. Representative soil features

Parent material	(1) Alluvium–limestone
Surface texture	(1) Loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate to slow
Soil depth	165–178 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	8.38–18.29 cm
Calcium carbonate equivalent (0-101.6cm)	20–35%
Electrical conductivity (0-101.6cm)	8–30 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	4–400
Soil reaction (1:1 water) (0-101.6cm)	8.9–9.9
Subsurface fragment volume <=3" (Depth not specified)	0–5%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

An ecological site is the product of all the environmental factors responsible for its development and it has a set of key characteristics that influence a site's resilience to disturbance and resistance to invasives. Key characteristics include 1) climate (precipitation, temperature), 2) topography (aspect, slope, elevation, and landform), 3) hydrology (infiltration, runoff), 4) soils (depth, texture, structure, organic matter), 5) plant communities (functional groups, productivity), and 6) natural disturbance regime (fire, herbivory, etc.) (Caudle et al 2013). Biotic factors that influence resilience include site productivity, species composition and structure, and population regulation and regeneration (Chambers et al. 2013).

The Great Basin salt desert communities have high spatial and temporal variability in precipitation both among years and within growing seasons. Nutrient availability is typically low but increases with elevation and closely follows moisture availability. The moisture resource supporting the greatest amount of plant growth is usually the water stored in the soil profile during the winter. The invasibility of plant communities is often linked to resource availability. Disturbance can decrease resource uptake due to damage or mortality of the native species and depressed competition or can increase resource pools by the decomposition of dead plant material following disturbance. The invasion of cheatgrass has been linked to disturbances (fire, abusive grazing) that have resulted in fluctuations in resources (Chambers et al 2007).

This ecological site is dominated by deep-rooted cool season, perennial bunchgrasses such as basin wildrye and long-lived shrubs such as fourwing saltbush and black greasewood. These shrubs have high root to shoot ratios. Black greasewood is classified as a phreatophyte (Eddleman 2002), and its distribution is well correlated with the distribution of groundwater (Mozingo 1987). Meinzer (1927) discovered that the taproots of black greasewood could penetrate from 20 to 57 feet below the surface. Romo (1984) found water tables ranging from 3.5-15 m under black greasewood dominated communities in Oregon. Black greasewood stands develop best where moisture is readily available, either from surface or subsurface runoff (Brown 1965). It is commonly found on floodplains that are either subject to periodic flooding, have a high water table at least part of the year, or have a water table less than 34 feet deep (Harr and Price 1972, Blauer et al. 1976, Branson et al. 1976, Blaisdell and Holmgren 1984, Eddleman 2002).

Ganskopp (1986) reported that water tables within 9.8 to 11.8 inches of the surface had no effect on black greasewood in Oregon. Differences in root depth distribution between grasses and shrubs result in resource partitioning in this system. Fourwing saltbush has a long taproot of depths of 5 to 15 meters and many small lateral roots (Barrow 1997, Van Dersal 1938). Wallace et al. (1974) found that the roots compose 40 percent of the total mass of adult plants. Fourwing saltbush is classified as a phreatophyte and has been documented at water tables occuring from 8 to 62 feet in New Mexico (Meinzer 1927). Atriplex species are considered medium to short-lived shrubs and possess a number of morphological and physiological traits that enable them to cope with drought. Some of these traits include: a) photosynthesis through the C4 carboxylation pathway; b) production of leaf trichomes and accumulation of salt crystals on the leaf surface to increase reflectance; c) accumulation and synthesis of inorganic and organic solutes to maintain turgor; and 4) root association with endomycorrhizae that allows absorption of soil moisture at very low water potentials (Cibils, et al. 1998, Dobrowolski 1990, Newton and Goodin 1989).

The perennial bunchgrasses generally have somewhat shallower root systems than the shrubs, but root densities are often as high as or higher than those of shrubs in the upper 0.5 m but taper off more rapidly than shrubs. However, basin wildrye is weakly rhizomatous and has been found to root to depths of up to 2 meters and to exhibit greater lateral root spread than many other grass species (Abbott et al. 1991, Reynolds and Fraley 1989).

Basin wildrye is a large, cool-season perennial bunchgrass with an extensive deep coarse fibrous root system (Reynolds and Fraley 1989). Clumps may reach up to six feet in height (Ogle et al 2012a). Basin wildrye does not tolerate long periods of inundation; it prefers cycles of wet winters and dry summers and is most commonly found in deep soils with high water holding capacities or seasonally high water tables (Ogle et al 2012a, Perryman and Skinner 2007).

Seasonally high water tables have been found to be necessary for maintenance of site productivity and reestablishment of basin wildrye stands following disturbances such as fire, drought or excessive herbivory (Eckert et al. 1973). The sensitivity of basin wildrye seedling establishment to reduced soil water availability is increased as soil pH increases (Stuart et al. 1971). Lowering of the water table through extended drought, channel incision or water pumping will decrease basin wildrye production and establishment, while sagebrush, black greasewood, rabbitbrush, and invasive weeds increase. Farming and abandonment may facilitate the creation of surface vesicular crust, increased surface ponding, and decreased infiltration; which leads to dominance by sprouting shrubs and an annual understory.

This ecological site has moderate resilience to disturbance and resistance to invasion. A primary disturbance on these ecological sites is drought, fire, flooding, Aroga infestation (Aroga websteri), and channel incision or other disturbance leading to a lowered seasonal water table. This facilitates an increase in shrubs and a decrease in basin wildrye. The introduction of annual weedy species, like cheatgrass (*Bromus tectorum*), may cause an increase in fire frequency and eventually lead to an annual state or a state dominated by rabbitbrush. Other troublesome non-native weeds such as broadleaved pepperweed or tall whitetop (*Lepidium latifolium*) and hoary cress or whitetop (*Cardaria draba*) are potential invaders on this site. Four possible alternative stable states have been identified for this site.

Fire Ecology:

Fire is a rare disturbance in the salt-desert shrub communities likely occurring in years with above average precipitation and corresponding biomass. Historically, salt-desert shrub communities had sparse understories and bare soil in intershrub spaces, making these communities somewhat resistant to fire (Young 1983, Paysen et al. 2000). They may burn only during high fire hazard conditions; for example, years with high precipitation can result in almost continuous fine fuels, increasing fire hazard (West et al. 1994, Paysen et al. 2000).

Fourwing saltbush is the most widely distributed shrubby saltbush in North America (Meyer 2003). It is highly variable across landscapes and even within populations (McArthur et al. 1983, Petersen et al. 1987). Its ability to sprout following fire may depend on the population and fire severity. A study by Parmenter (2008) showed 58% mortality rate of fourwing saltbush following fire in New Mexico, the surviving shrubs produced sprouts shortly after fire. Fourwing saltbush readily reestablished is from seed (Howard 2003).

Black greasewood, a sub-dominant shrub on these sites, can occur in almost pure stands. It is a salt tolerant shrub usually found on saline soils. Black greasewood may be killed by severe fires but usually sprouts vigorously after low to moderate severity fire (Young 1983, Rickard and McShane 1984, West 1994). Bentz et al. (2008) reported that following a Nevada wildfire, black greasewood sprouts reached approximately 2.5 feet within 3 years. In a study by Rickard and McShane (1983) black greasewood sprouted following wildfire and canopy cover was at 47 percent of preburn levels 2 years following fire. They also counted 185 shrubs before wildfire and 210 shrubs 2 years following fire.

The effect of fire on bunchgrasses relates to culm density, culm-leaf morphology, and the size of the plant. The

initial condition of bunchgrasses within the site along with seasonality and intensity of the fire all factor into the individual species response. For most forbs and grasses the growing points are located at or below the soil surface providing relative protection from disturbances which decrease above ground biomass, such as grazing or fire. Thus, fire mortality is more correlated to duration and intensity of heat which is related to culm density, culm-leaf morphology, size of plant and abundance of old growth (Wright 1971, Young 1983). Season and severity of the fire will influence plant response as will. post-fire soil moisture availability.
Basin wildrye is relatively resistant to fire, particularly dormant season fire, as plants sprout from surviving root crowns and rhizomes (Zschaechner 1985). Fire maintained the grass dominance of these ecosystems, therefore increases in the fire return interval favors increases in the shrub component of the plant community. The reduction of grasses potentially facilitates increases in bare ground, inland salt grass, and invasive weeds. Lack of fire combined with excessive herbivory converts these sites to sagebrush, black greasewood, and rabbitbrush dominance.
Depending on fire severity, rabbitbrush may increase after fire. Rubber rabbitbrush is top-killed by fire, but can resprout after fire and can also establish from seed (Young 1983).

State and transition model

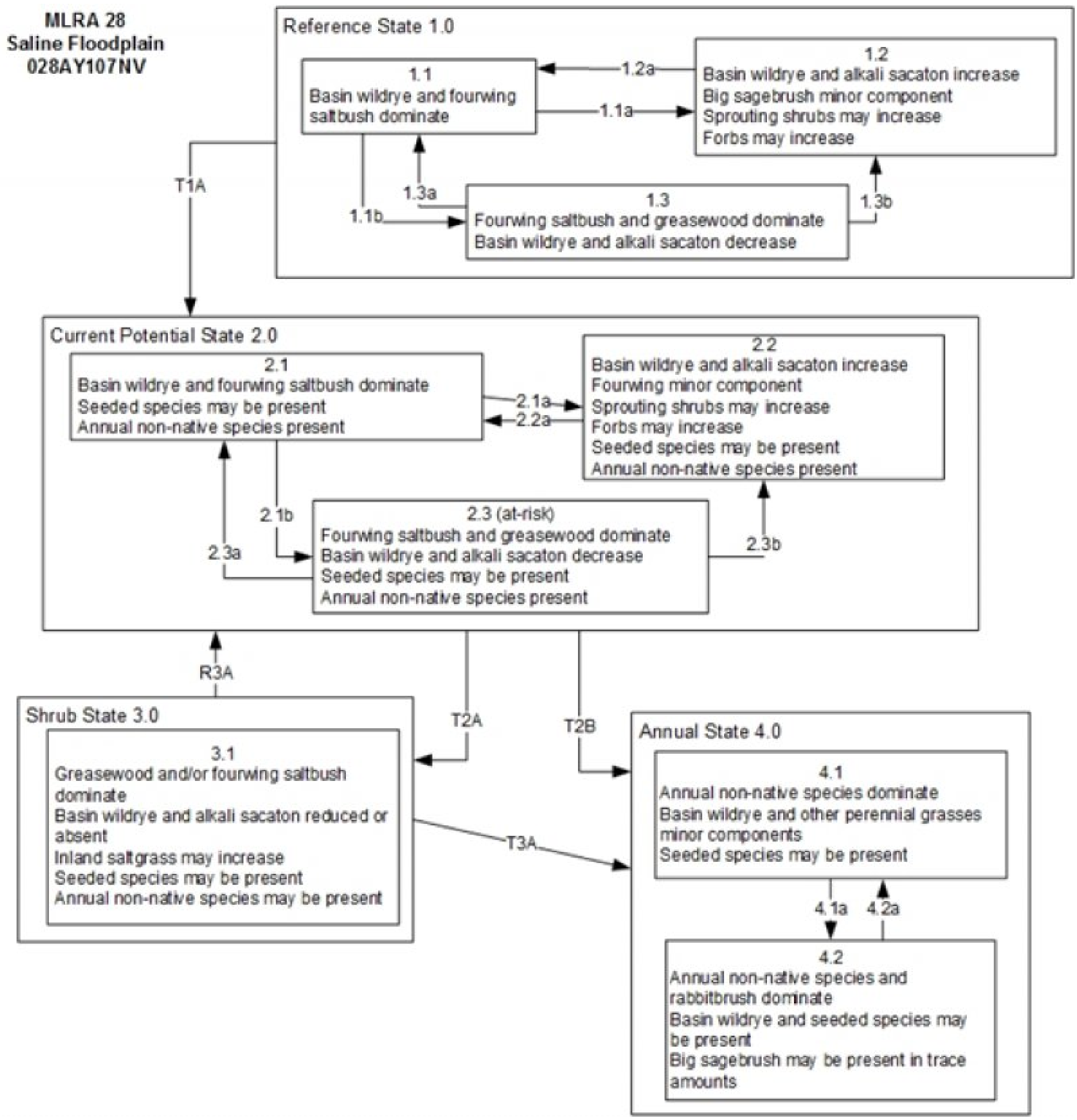

Figure 5. Stringham 2/2015

Legend
MLRA 28
Saline Floodplain
028AY107NV

Reference State 1.0 Community Phase Pathways
1.1a: Low severity fire creates grass/sagebrush mosaic; high severity fire significantly reduces sagebrush cover and leads to early/mid-seral community dominated by grasses and forbs.
1.1b: Time and lack of disturbance such as fire or drought. Excessive herbivory may also decrease perennial understory.
1.2a: Time and lack of disturbance allows for shrub regeneration.
1.3a: A low severity fire, Aroga moth, or combinations will reduce some of the sagebrush overstory and allow grass species to increase.
1.3b: High severity fire significantly reduces sagebrush cover and allows grass species to dominate.

Transition T1A: Introduction of annual non-native species.

Current Potential State 2.0 Community Phase Pathways
2.1a: Low severity fire creates grass/sagebrush mosaic; high severity fire significantly reduces sagebrush cover and leads to early/mid-seral community dominated by grasses and forbs. Non-native annual species present.
2.1b: Time and lack of disturbance such as fire or drought. Inappropriate grazing management may also reduce perennial understory.
2.2a: Time and lack of disturbance allows for regeneration of sagebrush.
2.3a: A low severity fire, Aroga moth, or combinations will reduce some of the sagebrush overstory and allow grass species to increase. May also be caused by brush management with minimal soil disturbance or late-fall/winter grazing that causes mechanical damage to sagebrush.
2.3b: High severity fire significantly reduces sagebrush cover and allows grass species to dominate.

Transition T2A: Time and lack of disturbance, may be coupled with grazing management and/or hydrologic changes that favor shrubs over perennial grasses.
Transition T2B: Severe fire.

Shrub State 3.0 Community Phase Pathways
None.

Transition T3A: Severe fire.
Restoration Pathway R3A: Mechanical/chemical brush treatment coupled with herbicide. Seeding of perennial bunchgrasses may be necessary.

Annual State 4.0 Community Phase Pathways
4.1a: Time and lack of disturbance
4.2a: Fire

Figure 6. Legend

State 1
Reference State

The Reference State 1.0 is a representative of the natural range of variability under pristine conditions. The Reference State has three general community phases: a shrub-grass dominant phase, a perennial grass dominant phase and a shrub dominant phase. State dynamics are maintained by interactions between climatic patterns and disturbance regimes. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These include the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Plant community phase changes are primarily driven by fire, periodic drought and/or insect or disease attack.

Community 1.1
Community Phase

This plant community is dominated by fourwing saltbush and basin wildrye. Black greasewood and alkali sacaton are other important species associated with this plant community. Potential vegetative composition is about 70% grasses, 5% forbs and 25% shrubs. Approximate ground cover (basal and crown) is 30 to 45 percent.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	706	942	1334
Shrub/Vine	252	336	476
Forb	50	67	95
Total	**1008**	**1345**	**1905**

Community 1.2
Community Phase

This community phase is characteristic of a post-disturbance, early-seral community. Basin wildrye and other perennial bunchgrasses dominate. Depending on fire severity, rubber rabbitbrush and black greasewood may be sprouting.

Community 1.3
Community Phase

Fourwing saltbush and black greasewood increase in the absence of disturbance. The deep-rooted perennial grasses in the understory are reduced either from competition with shrubs and/or from herbivory.

Pathway a
Community 1.1 to 1.2

Fire will decrease or eliminate the overstory and allow for the perennial bunchgrasses to dominate the site. Fires will typically be low severity, resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring may be more severe and reduce shrub cover to trace amounts.

Pathway b
Community 1.1 to 1.3

Time and lack of disturbance such as fire allows for shrubs to increase and become decadent. Chronic drought, herbivory, or combinations of these will cause a decline in perennial bunchgrasses and fine fuels, leading to a reduced fire frequency and allowing shrubs to dominate the site.

Pathway a
Community 1.2 to 1.1

Time and lack of disturbance will allow shrubs to increase.

Pathway a
Community 1.3 to 1.1

A low severity fire, Aroga moth, prolonged flooding or combinations will reduce some of the overstory and allow grass species to increase.

Pathway b
Community 1.3 to 1.2

Fire will decrease or eliminate the overstory and allow for the perennial bunchgrasses to dominate the site. Fires will typically be low severity resulting in a mosaic pattern due to low fine fuel loads. A fire following an unusually wet spring or a change in management favoring an increase in fine fuels may be more severe and reduce shrub cover to trace amounts.

State 2

Current Potential State

This state is similar to the Reference State 1.0 with three similar community phases. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. Non-natives may increase in abundance but will not become dominant within this State. These non-natives can be highly flammable and can promote fire where historically fire had been infrequent. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These feedbacks include the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Positive feedbacks decrease ecosystem resilience and stability of the state. These include the non-natives' high seed output, persistent seed bank, rapid growth rate, ability to cross pollinate, and adaptations for seed dispersal. A site may be considered to be in the Current Potential State if the non-native seeded species crested wheatgrass is present.

Community 2.1
Community Phase

This community phase is similar to the Reference State Community Phase 1.1, but non-native species are present in trace amounts. Basin wildrye and fourwing saltbush dominate the site. Seeded species such as crested wheatgrass may be present and/or dominate the understory. Forbs and other shrubs and grasses make up smaller components of this site.

Community 2.2
Community Phase

This community phase is characteristic of a post-disturbance, early seral community where annual non-native species are present. Perennial bunchgrasses dominate the site. Depending on fire severity or intensity of Aroga moth infestations, patches of intact sagebrush may remain. Rabbitbrush and black greasewood may be sprouting. Seeded species such as crested wheatgrass may be present and/or dominate the understory. Perennial forbs may be a significant component after fire for several years. Annual non-native species are stable or increasing within the community.

Community 2.3
Community Phase

This community is at risk of crossing a threshold to another state. Fourwing saltbush and black greasewood dominate the overstory and perennial bunchgrasses in the understory are reduced, either from competition with shrubs or from inappropriate grazing, or from both. Rabbitbrush may be a significant component. Inland saltgrass may increase and become co-dominant with deep rooted bunchgrasses. Annual non-natives species may be stable or increasing due to lack of competition with perennial bunchgrasses. Seeded species such as crested wheatgrass (*Agropyron cristatum*) may be present. This site is susceptible to further degradation from grazing, drought, and fire.

Pathway a
Community 2.1 to 2.2

Fire reduces the shrub overstory and allows for perennial bunchgrasses to dominate the site. Fires are typically low severity resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring or a change in management favoring an increase in fine fuels may be more severe and reduce shrub cover to trace amounts. Annual non-native species are likely to increase after fire.

Pathway b
Community 2.1 to 2.3

Time and lack of disturbance allows for shrubs to increase and become decadent. Chronic drought reduces fine fuels and leads to a reduced fire frequency, allowing shrubs to dominate the site. Inappropriate grazing management reduces the perennial bunchgrasses and fourwing saltbush.

Pathway a
Community 2.2 to 2.1

Time and lack of disturbance and/or grazing management that favors the establishment and growth of shrubs allows the shrub component to recover.

Pathway a
Community 2.3 to 2.1

Heavy late-fall or winter grazing may cause a reduction in fourwing saltbush. Brush treatments with minimal soil disturbance will also decrease shrubs and release the perennial understory. Annual non-native species are present and may increase in the community.

Conservation practices

Brush Management

Pathway b
Community 2.3 to 2.2

Fire will reduce the shrub overstory and allow for the understory perennial grasses to increase. Fires will typically be low severity resulting in a mosaic pattern due to low fine fuel loads. A fire that follows an unusually wet spring or change in management favoring an increase in fine fuels may be more severe and reduce the shrub component to trace amounts. Annual non-native species respond well to fire and may increase post-burn.

State 3
Shrub State

This state is a product of many years of heavy grazing during time periods harmful to perennial grasses. Sites with high water tables may transition to a shrub state if the hydrology of the area is affected. In both cases, basin wildrye is significantly reduced and other perennial grasses such as inland saltgrass will increase. Fourwing saltbush, black greasewood, rabbitbrush and big sagebrush dominate the overstory. The shrub overstory and shallower rooted grasses dominate site resources such that soil water, nutrient capture, nutrient cycling and soil organic matter are temporally and spatially redistributed.

Community 3.1
Community Phase

Fourwing saltbush and black greasewood dominate the overstory. Rabbitbrush and sagebrush may be significant components. Deep-rooted perennial bunchgrasses may be present in trace amounts or absent from the community. Annual non-native species increase. Crested wheatgrass may be a significant component in this phase if the site has a history of seeding treatments. Bare ground is significant.

State 4
Annual State

This state has two community phases. One community phase is characterized by the dominance of annual non-native species such as cheatgrass and annual mustards in the understory. The other community phase is dominated by rabbitbrush and black greasewood with an understory of cheatgrass and mustards.

Community 4.1
Community Phase

Annual non-native plants such as mustards and cheatgrass dominate this site. Crested wheatgrass may be a significant component in this phase if the site has a history of seeding treatments.

Community 4.2
Community Phase

Annual non-native plants such as mustards and cheatgrass dominate the understory while sprouting shrubs such as rabbitbrush and black greasewood. dominate the overstory. Crested wheatgrass may be a significant component in this phase if the site has a history of seeding treatments.

Pathway a
Community 4.1 to 4.2

Time and lack of disturbance allow sprouting shrubs to recover and mature.

Pathway a
Community 4.2 to 4.1

Fire.

Transition A
State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual plants, such as cheatgrass and mustards. Slow variables: Over time the annual non-native species will increase within the community. Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

Transition A
State 2 to 3

Trigger: To Community Phase 3.1: Repeated, heavy, growing season grazing will decrease or eliminate basin wildrye and favor shrub growth and establishment. To Community Phase 3.2: Severe fire in the depleted state 2.3 will remove shrub overstory and allow basin wildrye to dominate the understory. Grazing and/or fire may couple with hydrologic changes and accelerate the transition to state 3.0. Slow variables: Long term decrease in basin wildrye density due to grazing or lowering water table. Threshold: Loss of the large, deep-rooted basin wildrye changes nutrient cycling, nutrient redistribution, and reduces soil organic matter.

Transition B
State 2 to 4

Trigger: Severe fire. Slow variables: Increased production and cover of non-native annual species. Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs truncates, spatially and temporally, nutrient capture and cycling within the community. Increased, continuous fine fuels from annual non-native plants modify the fire regime by changing intensity, size and spatial variability of fires.

Restoration pathway A
State 3 to 2

Restoration of this state would require mechanical or chemical brush treatment and control of annual invasive weed species. Seeding of grasses may be necessary if basin wildrye is severely reduced or no longer present in the community. Prescribed burning is not recommended if there is a significant component of cheatgrass or other non-native weeds in the understory. If channel incision has lowered the water table or altered spring soil moisture the probability of establishment of a basin wildrye seeding will be significantly reduced.

Conservation practices

Brush Management
Range Planting

Transition A
State 3 to 4

Trigger: Severe fire. Slow variables: Increased production and cover of non-native annual species. Threshold: Increased, continuous fine fuels modify the fire regime by changing intensity, size and spatial variability of fires. Changes in plant community composition and spatial variability of vegetation due to the loss of perennial bunchgrasses and shrubs truncate energy capture spatially and temporally thus impacting nutrient cycling and distribution.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			740–1042	
	basin wildrye	LECI4	*Leymus cinereus*	673–874	–
	alkali sacaton	SPAI	*Sporobolus airoides*	67–168	–
2	**Secondary Perennial Grasses**			67–135	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	7–40	–
	saltgrass	DISP	*Distichlis spicata*	7–40	–
	squirreltail	ELEL5	*Elymus elymoides*	7–40	–
	western wheatgrass	PASM	*Pascopyrum smithii*	7–40	–
Forb					
3	**Perennial**			34–168	
	milkvetch	ASTRA	*Astragalus*	7–67	–
	povertyweed	IVAX	*Iva axillaris*	7–67	–
Shrub/Vine					
4	**Primary Shrubs**			229–444	
	fourwing saltbush	ATCA2	*Atriplex canescens*	202–336	–
	greasewood	SAVE4	*Sarcobatus vermiculatus*	27–108	–
5	**Secondary Shrubs**			27–67	
	big sagebrush	ARTR2	*Artemisia tridentata*	13–27	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	13–27	–
	spiny hopsage	GRSP	*Grayia spinosa*	13–27	–

Animal community

Livestock Interpretations:
This site is suited to livestock grazing. Grazing management considerations include timing, intensity, frequency, and duration of grazing. During settlement, many of the cattle in the Great Basin were wintered on extensive basin wildrye stands, however due to sensitivity to spring use many stands were decimated by early in the 20th century (Young et al. 1976). Less palatable species such as black greasewood, rabbitbrush and inland salt grass (Distichlis spicata) increased in dominance along with invasive non-native species such as Russian thistle (Salsola tragus), mustards, and cheatgrass (Roundy 1985). Spring defoliation of basin wildrye and/or consistent, heavy grazing during the growing season has been found to significantly reduce basin wildrye production and density (Krall et al. 1971). Thus, inadequate rest and recovery from defoliation can cause a decrease in basin wildrye and an increase in rabbitbrush, black greasewood, inland saltgrass, and non-native weeds (Young et al. 1976, Roundy 1985). Additionally, native basin wildrye seed viability has been found to be low and seedlings lack vigor (Young and Evans 1981). Roundy (1985) found that although basin wildrye is adapted to seasonally dry saline soils, high and frequent spring precipitation is necessary to establish it from seed. This suggests that establishment of native basin wildrye seedlings occurs only during years of unusually high precipitation. Therefore, reestablishment of a stand that has been decimated by grazing may be episodic.
Basin wildrye is valuable forage for livestock (Ganskopp et al. 2007) and wildlife, but is intolerant of heavy,

repeated, or spring grazing (Krall et al. 1971). The early growth and abundant production of basin wildrye make it a valuable source of forage for livestock. It is important forage for cattle and is readily grazed by cattle and horses in early spring and fall. Basin wildrye is used often as a winter feed for livestock and wildlife; not only providing roughage above the snow but also cover in the early spring months (Majerus 1992). Inadequate rest and recovery from defoliation causes a decrease in basin wildrye and an increase in black greasewood, basin big sagebrush and rubber rabbitbrush along with western wheatgrass (Pascopyrum smithii). Further deterioration of the sites promotes shrub dominance, increased bare ground and the invasion of annual weeds, primarily cheatgrass and Russian thistle.
Alkali sacaton is a valuable forage species in arid and semiarid regions. Plants are tolerant to moderate grazing and can produce abundant herbage utilized by livestock. Fourwing saltbush is one of the most palatable shrubs in the West. Its protein, fat, and carbohydrate levels are comparable to alfalfa. It provides nutritious forage for all classes of livestock. Palatability is rated as good for domestic sheep and domestic goats; fair for cattle; fair to good for horses in winter, poor for horses in other seasons. Black greasewood is an important winter browse plant for domestic sheep and cattle. It also receives light to moderate use by domestic sheep and cattle during spring and summer months. Black greasewood contains soluble sodium and potassium oxalates that may cause poisoning and death in domestic sheep and cattle if large amounts are consumed in a short time.
Stocking rates vary over time depending upon season of use, climate variations, site, and previous and current management goals. A safe starting stocking rate is an estimated stocking rate that is fine tuned by the client by adaptive management through the year and from year to year.

Wildlife Interpretations:
Fourwing saltbush provides valuable habitat and year-round browse for wildlife. Fourwing saltbush also provides browse and shelter for small mammals. Additionally, the browse provides a source of water for black-tailed jackrabbits in arid environments. Granivorous birds consume the fruits. Wild ungulates, rodent and lagomorphs readily consume all aboveground portions of the plant. Palatability is rated good for deer, elk, pronghorn and bighorn sheep. Black greasewood is an important winter browse plant for big game animals and a food source for many other wildlife species. It also receives light to moderate use by mule deer and pronghorn during spring and summer months. Basin wildrye provides winter forage for mule deer, though use is often low compared to other native grasses. Basin wildrye provides summer forage for black-tailed jackrabbits. Because basin wildrye remains green throughout early summer, it remains available for small mammal forage for longer time than other grasses. The western salt desert shrub and grassland communities where alkali sacaton is common support an abundance of mule deer, pronghorn, carnivores, small mammals, birds, amphibians, and reptiles.
Changes in plant community composition caused by, human activity, invasive weeds, fire frequency associated with this ecological site could affect the distribution and presence of wildlife species.

Hydrological functions

Permeability is slow. Runoff is low to medium. This site is essentially level and rills are not expected. Water flow patterns are rare to common dependent on site location relative to major inflow areas. Water flow patterns are typically short, ending in depressional areas where water ponds. Moderately fine to fine surface textures and physical crusts result in limited infiltration rates. The surface layer will normally crust and bake upon drying, inhibiting water infiltration and seedling emergence. Ponding occurs in late winter/early spring in many areas. Ponding may also occur after heavy summer convection storms. A few pedestals may occur along flow paths. There are no terracettes. This site is typically ponded for short periods in the late winter/early spring and runoff is not significant. In areas, with herbaceous cover (sparse) of deep-rooted perennial herbaceous bunchgrasses (alkali sacaton) and/or rhizomatous grasses (basin wildrye, western wheatgrass), these plants can increase infiltration.

Recreational uses

Aesthetic value is derived from the diverse floral and faunal composition. This site has potential for upland and big game hunting.

Other products

Fourwing saltbush is traditionally important to Native Americans. They ground the seeds for flour. The leaves, placed on coals, impart a salty flavor to corn and other roasted food. Top-growth produces a yellow dye. Young leaves and shoots were used to dye wool and other materials. The roots and flowers were ground to soothe insect bites. The leaves, seeds and stems of black greasewood are edible.

Other information

Fourwing saltbush is widely used in rangeland and riparian improvement and reclamation projects, including burned area recovery. It is probably the most widely used shrub for restoration of winter ranges and mined land reclamation. Black greasewood is useful for stabilizing soil on wind-blown areas. It successfully revegetates processed oil shale and is commonly found on eroded areas and sites too saline for most plant species.

Type locality

Location 1: White Pine County, NV	
Township/Range/Section	T9N R70E S35
Latitude	38° 40′ 59″
Longitude	114° 5′ 35″
General legal description	SE¼NE¼ Section 35, R70E. T9½N. MDBM. Big Spring Wash area, Hamlin Valley, White Pine County, Nevada.

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Contributors

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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)	P NOVAK-ECHENIQUE
Contact for lead author	STATE RANGELAND MANAGEMENT SPECIALIST
Date	11/03/2015
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** This site is essentially level and rills are not expected.

2. **Presence of water flow patterns:** Water flow patterns are rare to common dependent on site location relative to major inflow areas. Water flow patterns are typically short, ending in depressional areas where water ponds. Moderately fine to fine surface textures and physical crusts result in limited infiltration rates. The surface layer will normally crust and bake upon drying, inhibiting water infiltration and seedling emergence. Ponding occurs in late winter/early spring in many areas. Ponding may also occur after heavy summer convection storms.

3. **Number and height of erosional pedestals or terracettes:** A few pedestals may occur along flow paths. There are no terracettes.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground 20-30%

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

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

7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter (foliage of grasses and annual & perennial forbs) expected to move distance of slope length during periods of intense summer convection storms or run in of early spring snow melt flows. Persistent litter (large woody material) will remain in place except during unusual flooding (ponding) events.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values will range from 2 to 4. (To be field tested.)

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Structure of soil surface will be thick to thin platy. Soil surface colors are pale browns and soils are typified by an ochric epipedon. Organic matter is typically less than 1 percent.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** This site is typically ponded for short periods in the late winter/early spring and runoff is not significant. In areas, with herbaceous cover (sparse) of deep-rooted perennial herbaceous bunchgrasses (alkali sacaton) and/or rhizomatous grasses (basin wildrye, western wheatgrass), these plants can increase infiltration.

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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):** Compacted layers are none. Subsurface argillic or calcic horizons are normal for this site and are not to be interpreted as compaction.

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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: Reference State: Tall-statured, deep-rooted, cool season, perennial grasses (basin wildrye, alkali sacaton>

    Sub-dominant: salt-desert shrubs > rhizomatous grasses > deep-rooted perennial forbs > deep-rooted cool season bunchgrasses = rhizomatous grasses > associated grass-like plants

    Other: annual forbs, microbiotic crusts

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs common and standing dead shrub canopy material may be as much as 35% of total woody canopy

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14. **Average percent litter cover (%) and depth (in):** Between plant interspaces (20-30%) and depth (<¼ in.)

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** For normal or average growing season (thru June) ± 1200 lbs/ac; Favorable years ± 1700 lbs/ac and unfavorable years ± 900 lbs/ac.

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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:** Potential invaders include annual mustards, perennial pepperweed, white top, annual kochia, Russian thistle, halogeton, and cheatgrass.

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17. **Perennial plant reproductive capability:** All functional groups should reproduce in average (or normal) and above average growing season years. Reduced growth and reproduction occurs during extended or extreme drought conditions.