TECHNICAL NOTE

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MANAGING BLACK GREASEWOOD SITES

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This Technical Note provides a general description of black greasewood, its range, habitat, distribution and uses. It provides a discussion of soil chemistry including salinity and sodicity and how these conditions effect plant communities and influence management practices. Tables provide information on species commonly found in association with black greasewood habitats as well as species recommendations for seeding into existing or controlled black greasewood communities.

Mature Black Greasewood Plant on Utah Rangeland

Introduction

Black greasewood plant communities make up thousands of acres of western rangelands. These sites have long been disregarded by many as unproductive wastelands; however this native shrub is an integral part of many western arid to semi-arid ecosystems. These large shrubs provide cover for several species of wildlife including pronghorn antelope, badger, jack rabbits, coyotes and song birds.

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Sites occupied by black greasewood are often high in salinity or sodicity, and the presence of black greasewood may indicate a perched water table or wet to semi-wet saline conditions. Black greasewood plants can also be found in saline upland habitats including Wyoming and basin big sagebrush communities. Black greasewood is not only an indicator of saline or sodic soils but may also be an indicator of poor rangeland management practices.

Staminate or male flower "cones".

Plant description

Developing fruit (above), and mature fruit (left).

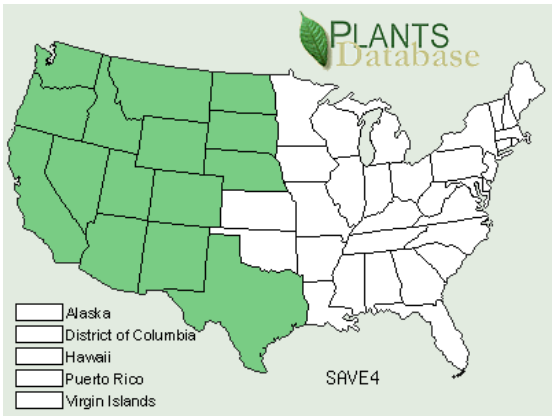
Black greasewood has traditionally been placed in the goosefoot family (Chenopodiaceae), but new evidence is leading systematists to place the genus in a distinct family, Sarobataceae. Black greasewood is a rapidly growing, tall (3 to 10 ft), erect spiny deciduous to semi-evergreen shrub (it is more deciduous in northern reaches and less so in the southern reaches of its range). Black greasewood has a long lifespan with very good seedling vigor. Leaves are bright green to light olive green in color, round, narrow and fleshy.

Black greasewood plants are generally monoecious (having separate male and female flowers on the same plant) but can also be dioecious (having separate male and female plants) [Hickman 1993]. The male (staminate) flowers are small and clustered in pine cone shaped spikes that are 1/2 to 1 inch long. Male flowers lack both sepals and petals. Flowers are found at the ends of the top most branches on the plant. The female (pistillate) flowers are green, small in size (about 3/16 in), very inconspicuous with a wing-like membrane that becomes enlarged as the fruit matures. The fruit is approximately 1/2 inch in size at maturity. Fruit are green while growing, turning reddish when nearing the end of development, and then tan when fully mature. Black greasewood plants flower in May through July with the fruit maturing in July through September. Both male flowers and female flowers can be found on plants from May through July. The male flowers persist on the plant through the end of the growing season, while the female flowers are found on the plant from mid July through November.

Bark is white on young plants and new growth, but turns gray to black on old growth. Spines are found along the branches and at the tips of the branches (spines are not considered to be true spines, but the ends of branches which grow out at about a 90 degree angle). These serve as mechanical protection from grazing.

Black greasewood stems showing spines.

Distribution:
Black greasewood can be found in saline wet to semi-wet seeps as well as dry upland communities in arid and semi-arid habitats from Alberta to Mexico, and in all western states east to Texas and North Dakota.



Distribution map for black greasewood. Courtesy of PLANTS Database, UDSA-NRCS.

Habitat:
Black greasewood plants inhabit a wide range of plant communities in the lowlands of the western deserts. Plants are typically found growing in saline soils that can be quite moist (wet to semi-wet saline) to dry uplands. Black greasewood is often the dominant species in the plant community, but plants are also found associated with seepweed, saltbush species, saltgrass, shadscale, basin big sagebrush and Wyoming big sagebrush communities. Some ecological sites may naturally only support a minor component of black greasewood, but black greasewood will often increase to become dominant under poor management circumstances giving the impression that it is a "greasewood site".

Adaptation
Black greasewood tolerates mildly to strongly sodic soil as well as non-saline to strongly saline soils. It is normally found on soils that are primarily fine-textured and saline and/or sodic, but this plant will grow on a wide variety of soils from very heavy clays to cobbly loams. It has very high tolerance to sodic to saline affected soils. Plants are highly drought tolerant but can also tolerate high water tables and can survive prolonged flooding (up to approximately 40 days). Black greasewood plants can have an extremely long root system (reported from 1.5 meters (5 ft) to 6.1 meters (20 ft) long) with lateral roots 0.9 meters (3 ft) to 3.7 meters (12 ft) in length. Adventitious buds are found all along the lateral root system which initiate sprouting when the above ground plant or the root system is damaged. It also has the ability to crown sprout whenever the crown is damaged.

Uses of black greasewood
Wildlife habitat/forage: Although often considered poor browse, black greasewood provides important cover habitat for wildlife and livestock, especially during the winter. Livestock utilize greasewood for winter cover and early spring browse. Some wildlife species, such as jackrabbits, pronghorn antelope or prairie dogs, forage on the plant. The plants provide burrowing or resting sites for small mammals and birds. Plants are low to low fair in protein levels depending on soil and growing conditions.

***Caution*:** Black greasewood plants contain sodium and potassium oxalates and are toxic to livestock. Browsing black greasewood can be fatal if even low to moderate quantities are consumed without large quantities of other forage in the diet. Black greasewood is poisonous year round, but plants can be consumed safely in light to very moderate amounts in the spring while the leaves are growing, as long as there is a substantial amount of other preferable forage available. As the season progresses, toxins accumulate and the plant becomes the most toxic in the fall. Animals can also be poisoned in fall and winter by eating the leaves from the ground. Signs of poisoning develop 4 to 6 hours after an animal has eaten a toxic amount, approximately 2 pounds for sheep and 3 pounds for cattle (James et al 1980; Weathers 1998). However, grazing black greasewood properly, and with a great deal of caution, can be beneficial to the grazing animal (James et al 1988).

Ethnobotanical: The tough wood from black greasewood was used by Native American Indians for tools and firewood (Welsh et al 2003).

Salinity and Sodicity
Soil chemistry plays a very important role in choosing proper management practices, especially in black greasewood sites. In order to properly manage a site, one must first understand the underlying principles of the soils. These may be high in salinity or sodicity or both. Additionally, the soil hydrology is also

closely related to its chemistry and will have a strong influence in management decisions. Most of the following material on salinity and sodicity comes from Ogle and others (2004).

Salt-affected soils may contain excess soluble salts (saline soils), excess exchangeable sodium (sodic soils), or both (saline-sodic soils). Salt affected soils commonly contain a mixture of cations of sodium, calcium, magnesium and potassium and anions of chloride, sulfate, bicarbonate, carbonate and sometimes borate and nitrate. When the total salt, individual salt or combination of salts in the soil is high enough to retard plant growth, injure plant tissue, and/or decrease yields, the soil is referred to as salt affected. Western states have mostly saline soils with some saline-sodic soils and only isolated occurrences of sodic soils.

The original source of all salts in the soil is weathered bedrock and ancient saline sea-bottoms, although it is rare for sufficient salts to have accumulated in place from these sources. The major factor responsible for the formation of salt-affected soils is the redistribution of salts within the soil, with water as the primary carrier. Where rainfall is high, most salts are leached out of the soil. In arid regions, the salt levels accumulated in soils can be very high because of limited rainfall and reduced leaching. However, not all soils in arid regions are salt-affected because the soil parent materials are not contributing sources of salts. Indirect sources of salts include irrigation water coming from saline sources or saline water from groundwater wells.

The total concentration of ions in the soil water usually has more influence in affecting plants than the precise composition of the solution. Salinity is expressed in a number of ways: equivalents per liter (mol/l), milligrams per liter (mg/l) which equates to parts per million (ppm), electrical conductivity (EC) which is measured in decisiemens per meter (dS/m) or millimhos per centimeter (mmhos/cm) and total dissolved solids (TDS) (%). Soil surveys generally determine salinity by measuring the electrical conductivity (EC) of the soil solution and are expressed in millimhos/cm (mmhos/cm).

Saline soils are often referred to as “white alkali” because of the white salt crust that forms on the soil surface. Saline soils are characterized by the following: EC > 4, Exchangeable Sodium Percentage (ESP) < 15, and pH < 8.5. Saline soils can be easily reclaimed by application of sufficient water to promote leaching of salts beyond the root zone.

Sodic soils are often referred to as “black alkali” or “slick spots” because of the dissolved organic matter in the soil solution. Sodic soils are characterized by the following: EC < 4, ESP > 15, and pH > 8.5. The exchangeable sodium causes soil particles to disperse, resulting in decreased pore space within the soil and increased soil crusting. The loss of permeability due to less pore space can severely restrict water movement into the root zone resulting in plant stress from lack of water. Crusting can severely affect seedling emergence. Reclamation of sodic soils involves the application of gypsum or sulfur, leaching of salts, special tillage operations or a combination of these measures.

Saline-sodic soils having properties of both saline and sodic conditions are characterized by the following: EC > 4, ESP > 15, and pH < 8.5. Properties of saline-sodic soils are generally similar to those of saline soils; however, “black alkali” sodic conditions can be a problem if excess soluble salts are leached without addressing the excess sodium. Reclamation of saline-sodic soils is the same as sodic soils to ensure that excess salts and sodium are removed.

The soil salinity level can best be determined by taking soil samples in the upper 6 inches of the soils profile and measuring the electrical conductivity. Plants growing on the site can also provide an indication of the severity of salinization. The following table lists some of the commonly found plants that can be expected in saline and sodic soils of western rangelands (table 1).

Table 1. Plants Associated with Black Greasewood Communities

Common Name	Scientific Name	Salinity/sodicity tolerance
Black greasewood	*Sarcobatus vermiculatus*	very high
Inland saltgrass	*Distichlis spicata*	
Nuttall's alkaligrass	*Puccinellia airoides*	
Beardless wildrye	*Leymus triticioides*	
Shore arrowgrass	*Triglochin maritima*	
Glasswort	*Salicornia rubra*	
Seepweed	*Suaeda* spp.	
Pickleweed	*Salicornia* spp.	
Alkali cordgrass	*Spartina gracilis*	High
Slender wheatgrass	*Elymus trachycaulus*	
Spear saltbush	*Atriplex patula* var. *hastata*	
Alkali bluegrass	*Poa juncifolia*	
Alkali sacaton	*Sporobolus airoides*	
Foxtail barley	*Hordeum jubatum*	
Cinquefoil	*Potentilla* spp.	
Curley dock	*Rumex crispus*	Moderate
Poverty weed	*Iva axillaries*	
Kochia	*Kochia scoparia*	
Forage kochia	*Kochia prostrate*	
Plains bluegrass	*Poa arida*	
Western wheatgrass	*Pascopyrum smithii*	
Thickspike wheatgrass	*Elymus lanceolatus*	

Management

Although black greasewood is not considered to be a weedy species, sites containing the plant are often in poor ecological condition due to the combination of past management and the harsh environment in which the plant normally occurs. Recovering the health of sites that are in poor condition can be very challenging and may take years to achieve.

Characteristics of greasewood, such as adventitious buds and crown sprouting, make it relatively difficult to manage. Unlike black greasewood, big sagebrush species do not tolerate high levels of salinity or sodicity. In general, the more big sagebrush that is found on the site the better the chance of being able to successfully treat the site. Where there is very little to no big sagebrush, the treatment of the site will most likely fail or be a very poor investment of capital. Other criteria that should be considered are climate, available water holding capacity of the soil, depth of soil, soil surface texture, surface rock fragments and slope.

Control of black greasewood is not easily accomplished. 2, 4-D and 2, 4-D + dicamba (Banvel®) are the most common control methods, but these rarely work with a single application. Normally two applications on subsequent years are needed. Occasionally three applications are required to gain acceptable control. Picloram (Tordon®) works fairly well. Metsulfuron (Ally®, Cimmaron®, or Escort®) have produced mixed results. Metsulfuron, when it works, will work very well, but apparently there are some environmental factors that contribute to its effectiveness. These factors do not appear to be clearly defined at this time. Other mixes that have been successfully applied are 2, 4-D + Tordon and 2, 4-D + Metsulfuron. Adding the surfactant Quest® to any chemical application seems to improve the success of the control project. Spraying should be completed in the spring when plants are actively growing and the new leaves are about 1/2 to 3/4 in long. Be sure to read and follow pesticide label instructions.

Deep plowing to a depth of 10 inches or deeper and plowing in two directions is often the most effective treatment where soil conditions are favorable. After the first plowing, wait until the plants start growing again and then make the second pass at a 45 degree angle to the previous pass. Regrowth normally occurs in the next growing season but can happen in the year of the first plowing.

Where the site is not conducive to brush removal, but improving the understory is needed, broadcast seeding around the existing plants without disturbing them is an option. The likelihood of success for this type of seeding would be low; however, some of the seed should grow and improve the opportunity for livestock and wildlife use.

One way of seeding areas where a drill can not be used, due to soils being too fluffy or where there are shrubs or plant stumps in the way, is to broadcast or aerially apply seed and then put a large number of animals in the area for a short period of time to work the seed into the soil surface. Seed trampling works best where the soil surface is too soft to be drilled at the right depth, or where you are trying to seed around and/or through an existing stand of black greasewood.

Saline areas with a high water table can not be entered with heavy equipment during much of the year. It is very important that weed control and seedbed preparation are performed. Weed competition and heavy trash are the biggest obstacles in seeding and establishing plant materials on wet to semi-wet saline sites. It is also very important to take advantage of organic matter (plant litter), particularly if salinity/sodicity is associated with a high water table. The growing plants act as a biological pump, keeping the water table far enough below the surface to decrease evaporation and salt deposition on the soil surface. The roots and stems of plants that have been controlled chemically (herbicides), assist with soil structure, infiltration and percolation of moisture through the soil profile. Mechanical tillage can destroy organic matter and soil structure, retard infiltration and may cause salt accumulation on the soil surface. An ATV four-wheeler equipped with spray equipment can enter wet sites earlier in the spring than heavy equipment and may be the best alternative to control weed competition and maintain soil structure.

The optimum period to complete seedings for forage and cover type species in wet-saline soils is late fall and winter (November through February) when soils are frozen and during snow-free periods. The seed should be in the ground before the growing season so that it can take advantage of the diluting effect of early spring moisture on salt concentrations. Under irrigated situations, germination and seedling emergence can be improved with light – frequent irrigations during initial establishment.

Seedbed preparation is critical. With low to moderate salinity, a tilled, firm, weed-free seedbed is recommended. With high to very high salinity levels, particularly when a high water table is involved, tillage may not provide the best seedbed. Under these conditions, vegetation and weeds should be controlled chemically. The soil structure will remain intact and the decomposing stems and roots improve conditions for moisture infiltration into the soil, reduce evaporation from the soil surface, and protect emerging seedlings.

Planting depth for most species should be about 1/4 to 1/2 inch (see table 2 for additional information).

An alternate method of establishing rhizomatous grasses in saline-sodic soils is sprigging. Sprigging involves the planting of rhizomes over an area at a 3 to 4 inch depth. Specialized equipment for digging and planting sprigs is commercially available. Sprigs can also be planted with a tree planter. Plants can be established by sprigging at slightly higher salinity levels than by seeding because the rhizomes are more salt tolerant than seed and seedlings and are placed below the highest concentration of salts that form near the soil surface. Once established, rhizomatous grasses will spread and fill in vacant spaces. The availability of a source of sprigs in close proximity of the planting site, transportation costs, and equipment availability are the greatest limitations to this establishment method.

Areas of black greasewood that are burned, crowned, brush beat, or shallow plowed and/or shallow disked will often result in a much higher density of black greasewood. Over-grazing of the understory vegetation also gives greasewood the chance to increase on the site to the point of site domination.

Not all of the ecological sites where black greasewood is found are suitable for manipulation. Thus, extreme caution should be exercised when selecting which sites have the best potential to be improved.

The following points should be kept in mind when managing black greasewood sites:

- Proper grazing management of understory vegetation is critical to maintaining healthy greasewood sites.
- If proper grazing practices are not followed after improvements are made, the site will quickly revert back to their former state.
- Conditions such as low precipitation, high sodicity and high salinity can reduce the success of improvements.
- Black greasewood is a sprouting plant and will come back vigorously if only the plant crown is disturbed and the root system is not destroyed.

Species Selection

A salinity-sodicity soil assessment must be made prior to selection of site treatment alternatives. It is impractical to recommend a universal mixture covering all variables at potential planting sites. Species not only vary in their salinity tolerance, but also their ability to withstand a high water table or more droughty conditions. Table 2 provides a list of some plant species and releases which may be suitable for use in black greasewood sites.

Most species can be seeded by themselves or in combination with additional adapted species. Species compatibility needs to be considered when developing a seed mixture. Some species have very good seeding vigor; develop rapidly, often at the expense of other species in the seed mixture. It is recommended that tall wheatgrass be planted by itself, as it will completely dominate a planting after 4 to 5 years. Slender wheatgrass also develops rapidly, often developing seed-heads the establishment year. Although slender wheatgrass establishes quickly, providing cover and stability to the site, this species begins to decline after 2 to 5 years relinquishing itself to longer lived species in the mix. Slender wheatgrass should be included in seeding mixtures at a rate of about 1- 2 pounds per acre to avoid competitiveness with other species in the mixture. Both Russian wildrye and tall fescue are slow to develop and are not aggressive seedlings, but commonly dominate a site once established. If these species are desired, they should generally be planted by themselves or in alternate row plantings.

If gradients of soil salinity and/or soil moisture (water tables) are present, mixtures can be designed so each species will dominate in its most favored condition. A mixture of creeping foxtail, western wheatgrass, and beardless wildrye will sort along a wet saline gradient with creeping foxtail on mildly saline, wet end of gradient and beardless wildrye on the most saline, drier end of the gradient. A mixture of Altai wildrye and beardless wildrye will sort along a moisture gradient where Altai wildrye will be on the drier locations. If a site is too wet to traverse with equipment and salinity is low to moderate, creeping foxtail is recommended. An ATV four-wheeler equipped with seeding equipment can enter wet sites better than heavy equipment and may be the best alternative for seeding wet to very wet sites. The optimum period to complete seedings for forage and cover type species in wet to very wet soils is late fall and winter (November through February) when soils are frozen and during snow-free periods.

Beardless wildrye, tall wheatgrass, Russian wildrye, and 'Newhy' hybrid wheatgrass are the most salt-tolerant species on moderate to well drained areas. Beardless wildrye, tall wheatgrass, tall fescue and western wheatgrass are the most salt-tolerant species on wet areas (sites where the water table stays within three feet of the surface the entire growing season). Creeping foxtail is moderately salt tolerant and an excellent forage on wet areas when it can be utilized. Russian wildrye, tall wheatgrass and Altai wildrye are quite drought-tolerant and perform well on drier saline areas (sites where the water table drops below three feet of the surface during the growing season, or where no water table is present). Crested wheatgrass, Siberian wheatgrass, Russian wildrye, intermediate wheatgrass and pubescent wheatgrass are very drought tolerant and will perform very well in drier low to moderately saline areas.

Table 2. Suggested Plants and Seeding Rates for Planting Black Greasewood Sites

	Origin	Release(s)	*Scientific Name*	Salinity/sodicity tolerance	Full PLS rate/ac [a]	Seeding depth (in)
Wet sites						
Beardless wildrye	Native	Shoshone	*Leymus triticoides*	very high	10*	0-1/4 [a]
Tall wheatgrass	Introduced	Alkar; Largo; Jose	*Thinopyrum ponticum*	very high	15	1/4-3/4
Hybrid wheatgrass	Introduced	Newhy	*Elymus hoffmannii*	very high	12	1/4-1/2
Slender wheatgrass	Native	Pryor; San Luis; Revenue	*Elymus trachycaulus*	very high	12**	1/2-3/4
Altai wildrye	Introduced	Prairieland; Pearle; Eejay	*Leymus angustus*	very high	15	1/4-1/2
Tall fescue	Introduced	Kenmont; Fawn; Alta	*Schedonorus phoenix*	high	8	1/4-1/2
Western wheatgrass	Native	Rosana; Rodan; Arriba	*Pascopyrum smithii*	high	9	1/4-1/2
Strawberry Clover	Introduced	Salina	*Trifolium fragiferum*	high	6	1/8-1/4
Creeping foxtail	Introduced	Garrison	*Alopecurus arundinaceus*	moderate	5	1/8-1/4
Dryland Sites						
Russian wildrye	Introduced	Bozoisky II; Mankota; Swift	*Psathyrostachys juncea*	very high	9	1/4-1/2
Tall wheatgrass	Introduced	Alkar; Largo; Jose	*Thinopyrum ponticum*	very high	15	1/4-3/4
Slender wheatgrass	Native	Pryor; San Luis; Revenue	*Elymus trachycaulus*	very high	12	1/2-3/4
Crested wheatgrass	Introduced	Ephraim; Douglas; Hycrest II	*Agropyron cristatum*	high	8	1/4-1/2
Standard crested wheatgrass	Introduced	Nordan; Summit	*Agropyron desertorum*	high	8	1/4-1/2
Siberian wheatgrass	Introduced	P-27; Vavilov; Vavilov II	*Agropyron fragile*	high	9	1/4-1/2
Western wheatgrass	Native	Rosana; Rodan; Arriba	*Pascopyrum smithii*	high	9	1/4-1/2
Nuttall's alkaligrass	Native	Quill	*Puccinellia nuttalliana*	very high	4	1/8-1/4
Alkali sacaton	Native	Salado	*Sporobolus airoides*	high	3	1/8-1/2
Alkali cordgrass	Native		*Spartina gracilis*	high	4	1/8-1/4
Alkali bluegrass	Native		*Poa secunda–juncifolia*	high	3	0-1/4
Yellow sweetclover	Introduced	Madrid	*Melilotus officinalis*	moderate	6**	1/8-1/2

[a] Seeding information from Ogle and others (2006) and are the recommended critical area planting rates of 1.5 times the normal drill seeding rate.

Double these rates if seed is broadcast planted.

* Beardless wildrye requires over-wintering in soil for seed stratification and must be dormant fall planted

** Recommended in mixtures with no more than 2 lb/ac slender wheatgrass and 1 lb/ac sweetclover

The species listed for drier sites perform best in the 12 to 18 inch annual precipitation areas, but some may be adequate in lower rainfall areas as well. For sites with higher rainfall, wet site or irrigated species are recommended.

Slender wheatgrass performs well on both wet and dry sites, but is relatively short-lived (2 to 5 years). Yellow sweetclover performs well in moderate to low levels of salinity on drier sites, but is short-lived. These species could be included in mixtures for quick establishment and cover, but they will not persist over the long term. Both species could be considered as interim hay crops while soil amendments are being used or as green manure crops to improve soil tilth and organic matter, thus enabling the establishment of longer-lived species.

There are no commercially available legumes that will establish in very high saline soils. Strawberry clover is the most salt tolerant legume and it can be used only in wet to saturated conditions. The upper limit for establishment of other saline tolerant legumes is about 10 EC (mmhos/cm) or less.

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